Computer Algebra
Independent Integration Tests

Summer 2024

4-Trig-functions/4.2-Cosine/198-4.2.1.1

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May 17, 2024 Compiled on May 17, 2024 at 11:26pm

Contents

CHAPTER 1

Introduction

This report gives the result of running the computer algebra independent integration test.The download section in on the main webpage contains links to download the problems in plain text format used for all CAS systems. The number of integrals in this report is [**62**]. This is test number [198].

1.1 Listing of CAS systems tested

The following are the CAS systems tested:

1. Mathematica 14 (January 9, 2024) on windows 10 pro.
2. Rubi 4.17.3 (Sept 25, 2023) on Mathematica 14 on windows 10m pro.
3. Maple 2024 (March 1, 2024) on windows 10 pro.
4. Maxima 5.47 (June 1, 2023) using Lisp SBCL 2.4.0 on Linux Manjaro 23.1.2 KDE via sagemath 10.3.
5. FriCAS 1.3.10 built with sbcl 2.3.11 (January 10, 2024) on Linux Manjaro 23.1.2 KDE via sagemath 10.3.
6. Giac/Xcas 1.9.0-99 on Linux via sagemath 10.3.
7. Sympy 1.12 using Python 3.11.6 (Nov 14 2023, 09:36:21) [GCC 13.2.1 20230801] on Linux Manjaro 23.1.2 KDE.
8. Mupad using Matlab 2021a with Symbolic Math Toolbox Version 8.7 on windows 10.
9. Reduce CSL rev 6687 (January 9, 2024) on Linux Manjaro 23.1.2 KDE.

Maxima and Fricas and Giac are called using Sagemath. This was done using Sagemath `integrate` command by changing the name of the algorithm to use the different CAS systems.

Sympy was run directly in Python not via sagemath.

Reduce was called directly.

1.2 Results

Important note: A number of problems in this test suite have no antiderivative in closed form. This means the antiderivative of these integrals can not be expressed in terms of elementary, special functions or `Hypergeometric2F1` functions. `RootSum` and `RootOf` are not allowed. If a CAS returns the above integral unevaluated within the time limit, then the result is counted as passed and assigned an A grade.

However, if CAS times out, then it is assigned an F grade even if the integral is not integrable, as this implies CAS could not determine that the integral is not integrable in the time limit.

If a CAS returns an antiderivative to such an integral, it is assigned an A grade automatically and this special result is listed in the introduction section of each individual test report to make it easy to identify as this can be important result to investigate.

The results given in in the table below reflects the above.

System	% solved	% Failed
Rubi	100.00 (62)	0.00 (0)
Mathematica	100.00 (62)	0.00 (0)
Maple	72.58 (45)	27.42 (17)
Fricas	72.58 (45)	27.42 (17)
Giac	62.90 (39)	37.10 (23)
Maxima	62.90 (39)	37.10 (23)
Mupad	56.45 (35)	43.55 (27)
Reduce	51.61 (32)	48.39 (30)
Sympy	51.61 (32)	48.39 (30)

Table 1.1: Percentage solved for each CAS

The table below gives additional break down of the grading of quality of the antiderivatives generated by each CAS. The grading is given using the letters A,B,C and F with A being the best quality. The grading is accomplished by comparing the antiderivative generated with the optimal antiderivatives included in the test suite. The following table describes the meaning of these grades.

grade	description
A	Integral was solved and antiderivative is optimal in quality and leaf size.
B	Integral was solved and antiderivative is optimal in quality but leaf size is larger than twice the optimal antiderivatives leaf size.
C	Integral was solved and antiderivative is non-optimal in quality. This can be due to one or more of the following reasons 1. antiderivative contains a hypergeometric function and the optimal antiderivative does not. 2. antiderivative contains a special function and the optimal antiderivative does not. 3. antiderivative contains the imaginary unit and the optimal antiderivative does not.
F	Integral was not solved. Either the integral was returned unevaluated within the time limit, or it timed out, or CAS hanged or crashed or an exception was raised.

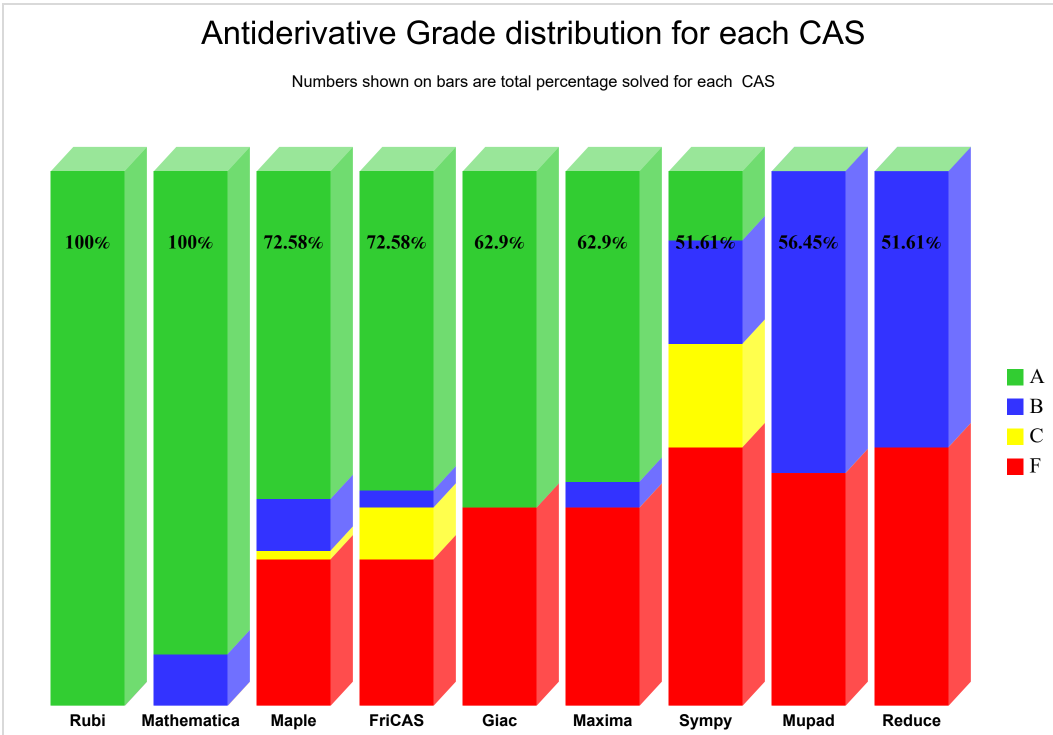
Table 1.2: Description of grading applied to integration result

Grading is implemented for all CAS systems. Based on the above, the following table summarizes the grading for this test suite.

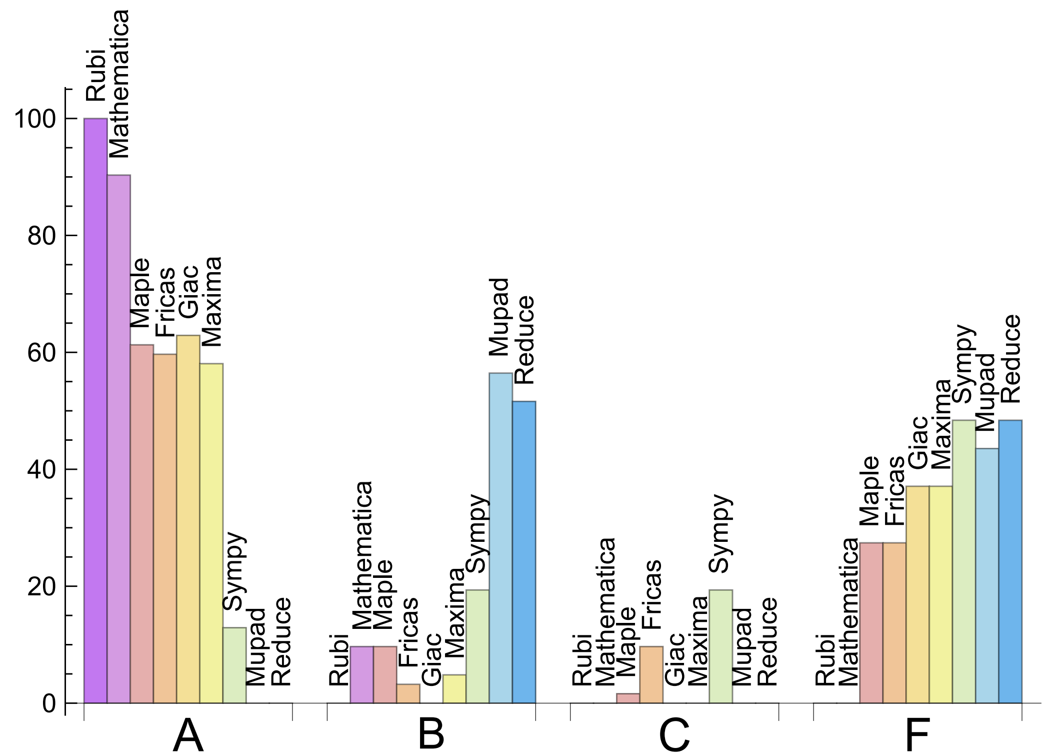
System	% A grade	% B grade	% C grade	% F grade
Rubi	100.000	0.000	0.000	0.000
Mathematica	90.323	9.677	0.000	0.000
Giac	62.903	0.000	0.000	37.097
Maple	61.290	9.677	1.613	27.419
Fricas	59.677	3.226	9.677	27.419
Maxima	58.065	4.839	0.000	37.097
Sympy	12.903	19.355	19.355	48.387
Mupad	0.000	56.452	0.000	43.548
Reduce	0.000	51.613	0.000	48.387

Table 1.3: Antiderivative Grade distribution of each CAS

The following is a Bar chart illustration of the data in the above table.



The figure below compares the grades of the CAS systems.



The following table shows the distribution of the different types of failures for each CAS. There are 3 types failures. The first is when CAS returns the input within the time limit, which means it could not solve it. This is the typical failure and given as **F**.

The second failure is due to time out. CAS could not solve the integral within the 3 minutes time limit which is assigned. This is assigned **F(-1)**.

The third is due to an exception generated, indicated as **F(-2)**. This most likely indicates an interface problem between sagemath and the CAS (applicable only to FriCAS, Maxima and Giac) or it could be an indication of an internal error in the CAS itself. This type of error requires more investigation to determine the cause.

System	Number failed	Percentage normal failure	Percentage timeout failure	Percentage exception failure
Rubi	0	0.00	0.00	0.00
Mathematica	0	0.00	0.00	0.00
Fricas	17	100.00	0.00	0.00
Maple	17	100.00	0.00	0.00
Giac	23	100.00	0.00	0.00
Maxima	23	100.00	0.00	0.00
Mupad	27	0.00	100.00	0.00
Reduce	30	100.00	0.00	0.00
Sympy	30	96.67	3.33	0.00

Table 1.4: Failure statistics for each CAS

1.3 Time and leaf size Performance

The table below summarizes the performance of each CAS system in terms of time used and leaf size of results.

Mean size is the average leaf size produced by the CAS (before any normalization). The Normalized mean is relative to the mean size of the optimal anti-derivative given in the input files.

For example, if CAS has **Normalized mean** of 3, then the mean size of its leaf size is 3 times as large as the mean size of the optimal leaf size.

Median size is value of leaf size where half the values are larger than this and half are smaller (before any normalization). i.e. The Middle value.

Similarly the **Normalized median** is relative to the median leaf size of the optimal.

For example, if a CAS has Normalized median of 1.2, then its median is 1.2 as large as the median leaf size of the optimal.

System	Mean time (sec)
Fricas	0.09
Giac	0.12
Reduce	0.18
Mathematica	0.28
Rubi	0.34
Maxima	0.46
Maple	1.20
Sympy	1.22
Mupad	30.40

Table 1.5: Time performance for each CAS

System	Mean size	Normalized mean	Median size	Normalized median
Mupad	65.26	0.85	67.00	0.90
Giac	69.08	0.86	75.00	0.83
Rubi	80.58	0.92	75.50	1.00
Maple	103.27	1.02	71.00	0.77
Mathematica	104.81	1.12	69.00	1.00
Reduce	117.12	1.21	108.00	1.29
Fricas	135.02	1.41	90.00	1.11
Sympy	346.69	3.51	299.50	3.76
Maxima	2655.69	26.49	94.00	1.19

Table 1.6: Leaf size performance for each CAS

1.4 Performance based on number of rules Rubi used

This section shows how each CAS performed based on the number of rules Rubi needed to solve the same integral. One diagram is given for each CAS.

On the y axis is the percentage solved which Rubi itself needed the number of rules given the x axis. These plots show that as more rules are needed then most CAS system percentage of solving decreases which indicates the integral is becoming more complicated to solve.

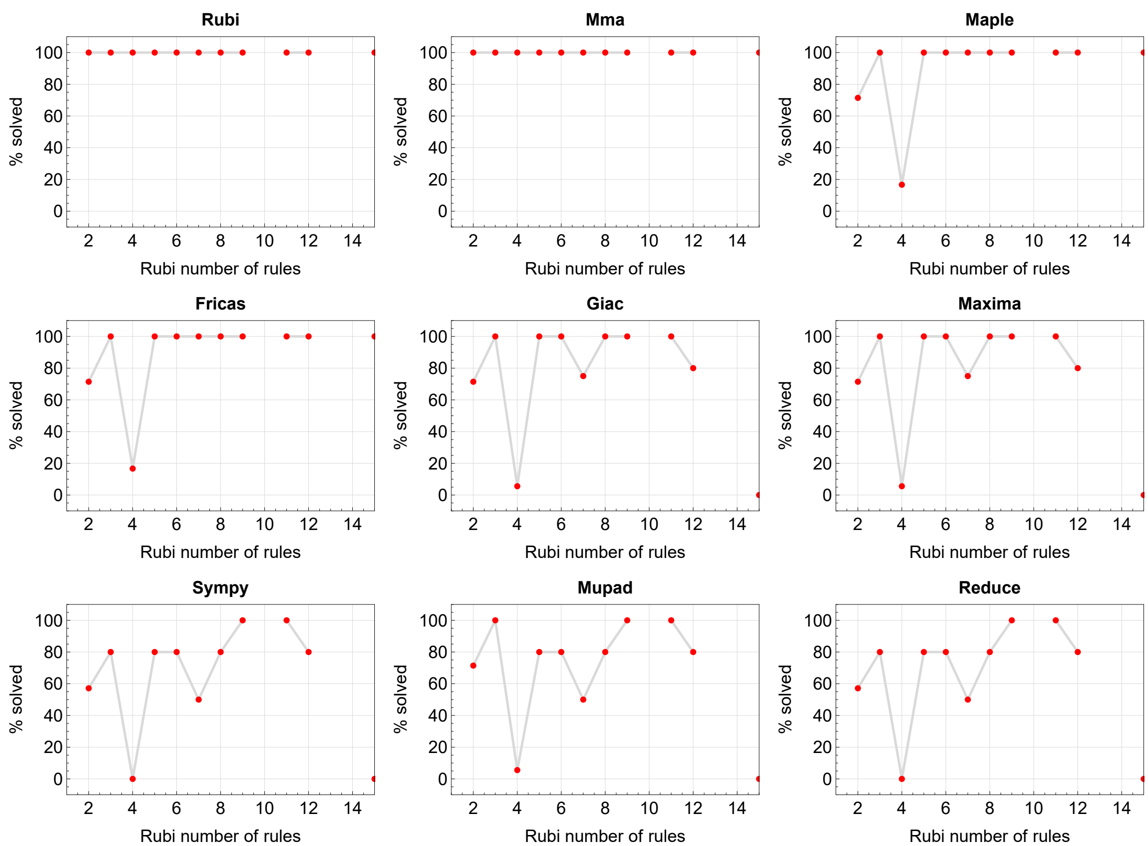


Figure 1.1: Solving statistics per number of Rubi rules used

1.5 Performance based on number of steps Rubi used

This section shows how each CAS performed based on the number of steps Rubi needed to solve the same integral. Note that the number of steps Rubi needed can be much higher than the number of rules, as the same rule could be used more than once.

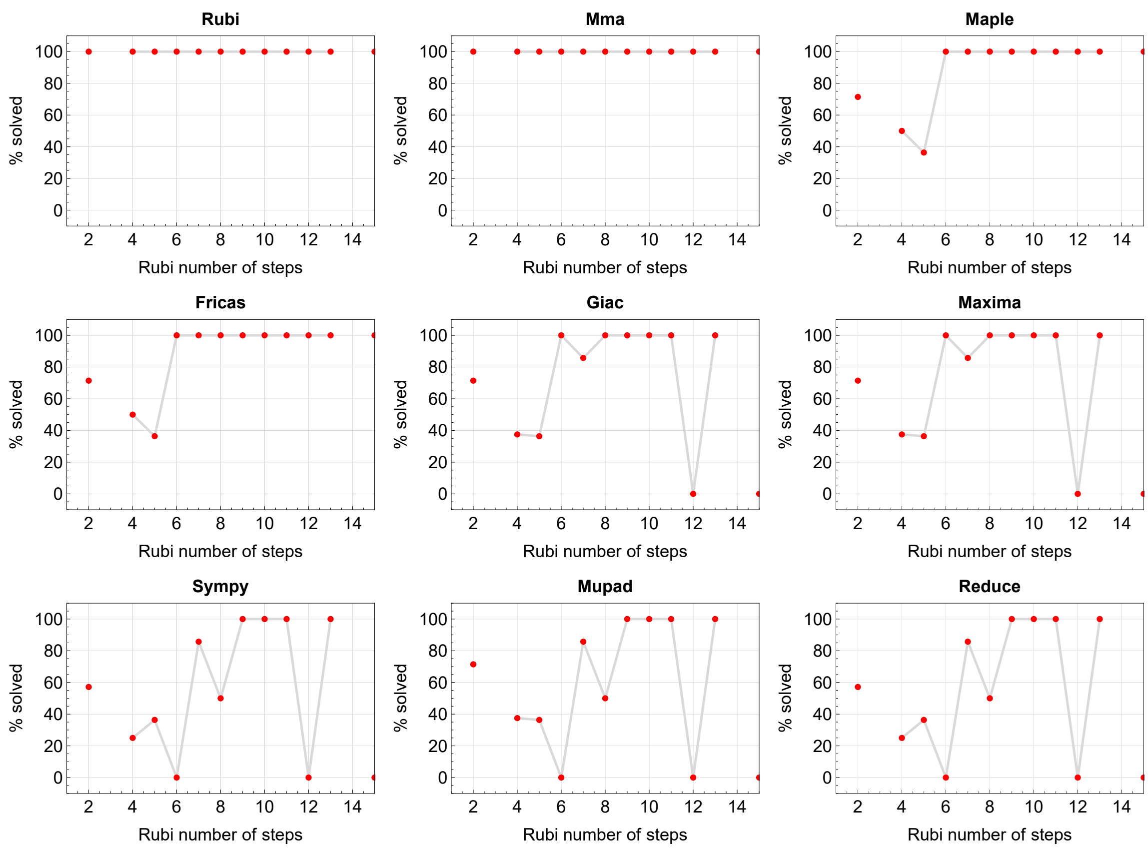


Figure 1.2: Solving statistics per number of Rubi steps used

The above diagram show that the precentage of solved intergals decreases for most CAS systems as the number of steps increases. As expected, for integrals that required less steps by Rubi, CAS systems had more success which indicates the integral was not as hard to solve. As Rubi needed more steps to solve the integral, the solved percentage decreased for most CAS systems which indicates the integral is becoming harder to solve.

1.6 Solved integrals histogram based on leaf size of result

The following shows the distribution of solved integrals for each CAS system based on leaf size of the antiderivatives produced by each CAS. It shows that most integrals solved produced leaf size less than about 100 to 150. The bin size used is 40.

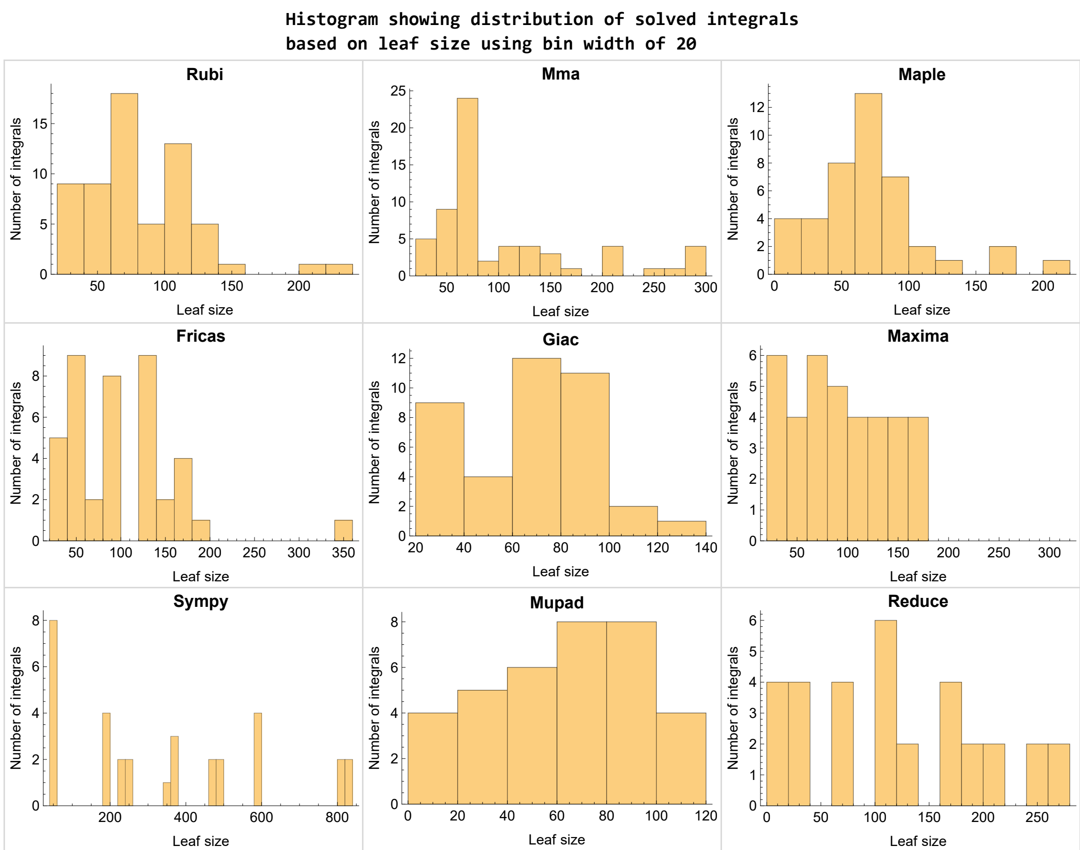


Figure 1.3: Solved integrals based on leaf size distribution

1.7 Solved integrals histogram based on CPU time used

The following shows the distribution of solved integrals for each CAS system based on CPU time used in seconds. The bin size used is 0.1 second.

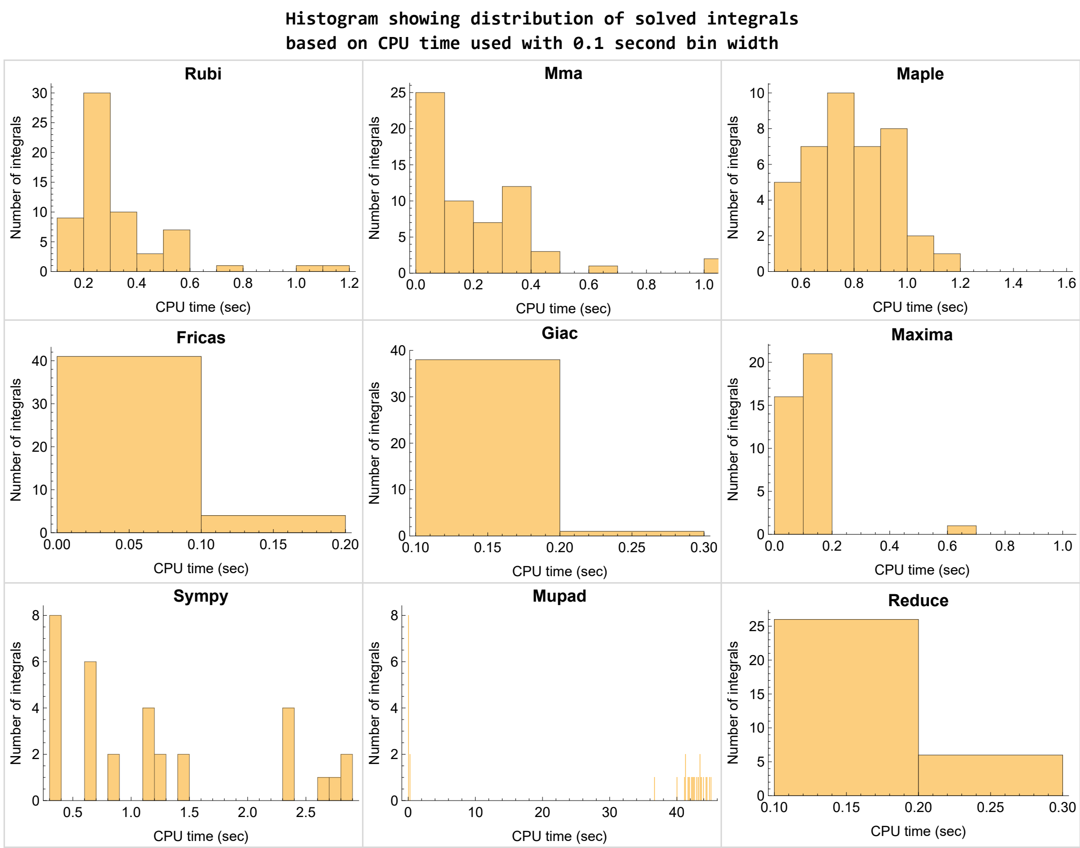


Figure 1.4: Solved integrals histogram based on CPU time used

1.8 Leaf size vs. CPU time used

The following shows the relation between the CPU time used to solve an integral and the leaf size of the antiderivative.

The result for Fricas, Maxima and Giac is shifted more to the right than the other CAS system due to the use of sagemath to call them, which causes an initial slight delay in the timing to start the integration due to overhead of starting a new process each time. This should also be taken into account when looking at the timing of these three CAS systems. Direct calls not using sagemath would result in faster timings, but current implementation uses sagemath as this makes testing much easier to do.

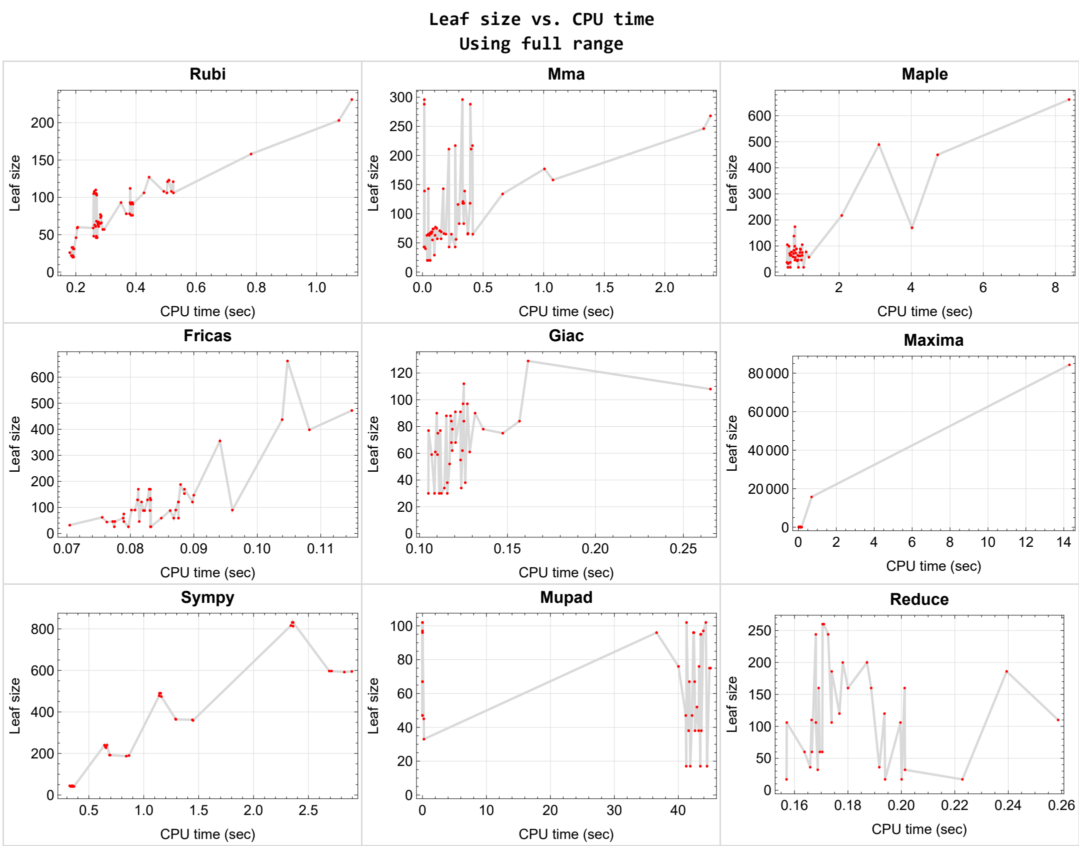


Figure 1.5: Leaf size vs. CPU time. Full range

1.9 list of integrals with no known antiderivative

{}

1.10 List of integrals solved by CAS but has no known antiderivative

Rubi {}

Mathematica {}

Maple {}

Maxima {}

Fricas {}

Sympy {}

Giac {}

Reduce {}

Mupad {}

1.11 list of integrals solved by CAS but failed verification

The following are integrals solved by CAS but the verification phase failed to verify the anti-derivative produced is correct. This does not necessarily mean that the anti-derivative is wrong as additional methods of verification might be needed, or more time is needed (3 minutes time limit was used). These integrals are listed here to make it possible to do further investigation to determine why the result could not be verified.

Rubi {}

Mathematica $\{56, 57, 58, 59, 60, 61, 62\}$

Maple $\{5, 55\}$

Maxima Verification phase not currently implemented.

Fricas Verification phase not currently implemented.

Sympy Verification phase not currently implemented.

Giac Verification phase not currently implemented.

Reduce Verification phase not currently implemented.

Mupad Verification phase not currently implemented.

1.12 Timing

The command `AbsoluteTiming[]` was used in Mathematica to obtain the elapsed time for each integrate call. In Maple, the command `Usage` was used as in the following example

```
cpu_time := Usage(assign ('result_of_int',int(expr,x)),output='realtime'
```

For all other CAS systems, the elapsed time to complete each integral was found by taking the difference between the time after the call completed from the time before the call was made. This was done using Python's `time.time()` call.

All elapsed times shown are in seconds. A time limit of 3 CPU minutes was used for each integral. If the integrate command did not complete within this time limit, the integral was aborted and considered to have failed and assigned an F grade. The time used by failed integrals due to time out was not counted in the final statistics.

1.13 Verification

A verification phase was applied on the result of integration for `Rubi` and `Mathematica`.

Future version of this report will implement verification for the other CAS systems. For the integrals whose result was not run through a verification phase, it is assumed that the antiderivative was correct.

Verification phase also had 3 minutes time out. An integral whose result was not verified could still be correct, but further investigation is needed on those integrals. These integrals were marked in the summary table below and also in each integral separate section so they are easy to identify and locate.

1.14 Important notes about some of the results

Important note about Maxima results

Since tests were run in a batch mode, and using an automated script, then any integral where Maxima needed an interactive response from the user to answer a question during the evaluation of the integral will fail.

The exception raised is `ValueError`. Therefore Maxima results is lower than what would result if Maxima was run directly and each question was answered correctly.

The percentage of such failures were not counted for each test file, but for an example, for the `Timofeev` test file, there were about 14 such integrals out of total 705, or about 2 percent. This percentage can be higher or lower depending on the specific input test file.

Such integrals can be identified by looking at the output of the integration in each section for Maxima. The exception message will indicate the cause of error.

Maxima integrate was run using SageMath with the following settings set by default

```
'besselexpand : true'
'display2d : false'
'domain : complex'
'keepfloat : true'
'load(to_poly_solve)'
'load(simplify_sum)'
'load(abs_integrate)' 'load(diag)'
```

SageMath automatic loading of Maxima `abs_integrate` was found to cause some problems. So the following code was added to disable this effect.

```
from sage.interfaces.maxima_lib import maxima_lib
maxima_lib.set('extra_definite_integration_methods', '[]')
maxima_lib.set('extra_integration_methods', '[]')
```

See `https://ask.sagemath.org/question/43088/integrate-results-that-are-different-from-using-maxima/` for reference.

Important note about FriCAS result

There were few integrals which failed due to SageMath interface and not because FriCAS system could not do the integration.

These will fail With error `Exception raised: NotImplementedError`.

The number of such cases seems to be very small. About 1 or 2 percent of all integrals. These can be identified by looking at the exception message given in the result.

Important note about finding leaf size of antiderivative

For Mathematica, Rubi, and Maple, the builtin system function `LeafSize` was used to find the leaf size of each antiderivative.

The other CAS systems (SageMath and Sympy) do not have special builtin function for this purpose at this time. Therefore the leaf size for Fricas and Sympy antiderivative was determined using the following function, thanks to user `slelievre` at `https://ask.sagemath.org/question/57123/could-we-have-a-leaf_count-function-in-base-sagemath/`

```
def tree_size(expr):
    r"""
    Return the tree size of this expression.
    """
    if expr not in SR:
        # deal with lists, tuples, vectors
        return 1 + sum(tree_size(a) for a in expr)
    expr = SR(expr)
    x, aa = expr.operator(), expr.operands()
    if x is None:
        return 1
    else:
        return 1 + sum(tree_size(a) for a in aa)
```

For Sympy, which was called directly from Python, the following code was used to obtain the leafsize of its result

```
try:
  # 1.7 is a fudge factor since it is low side from actual leaf count
  leafCount = round(1.7*count_ops(anti))

  except Exception as ee:
        leafCount =1
```

Important note about Mupad results

Matlab's symbolic toolbox does not have a leaf count function to measure the size of the antiderivative. Maple was used to determine the leaf size of Mupad output by post processing Mupad result.

Currently no grading of the antiderivative for Mupad is implemented. If it can integrate the problem, it was assigned a B grade automatically as a placeholder. In the future, when grading function is implemented for Mupad, the tests will be rerun again.

The following is an example of using Matlab's symbolic toolbox (Mupad) to solve an integral

```
integrand = evalin(symengine,'cos(x)*sin(x)')
the_variable = evalin(symengine,'x')
anti = int(integrand,the_variable)
```

Which gives `sin(x)^2/2`

1.15 Current tree layout of integration tests

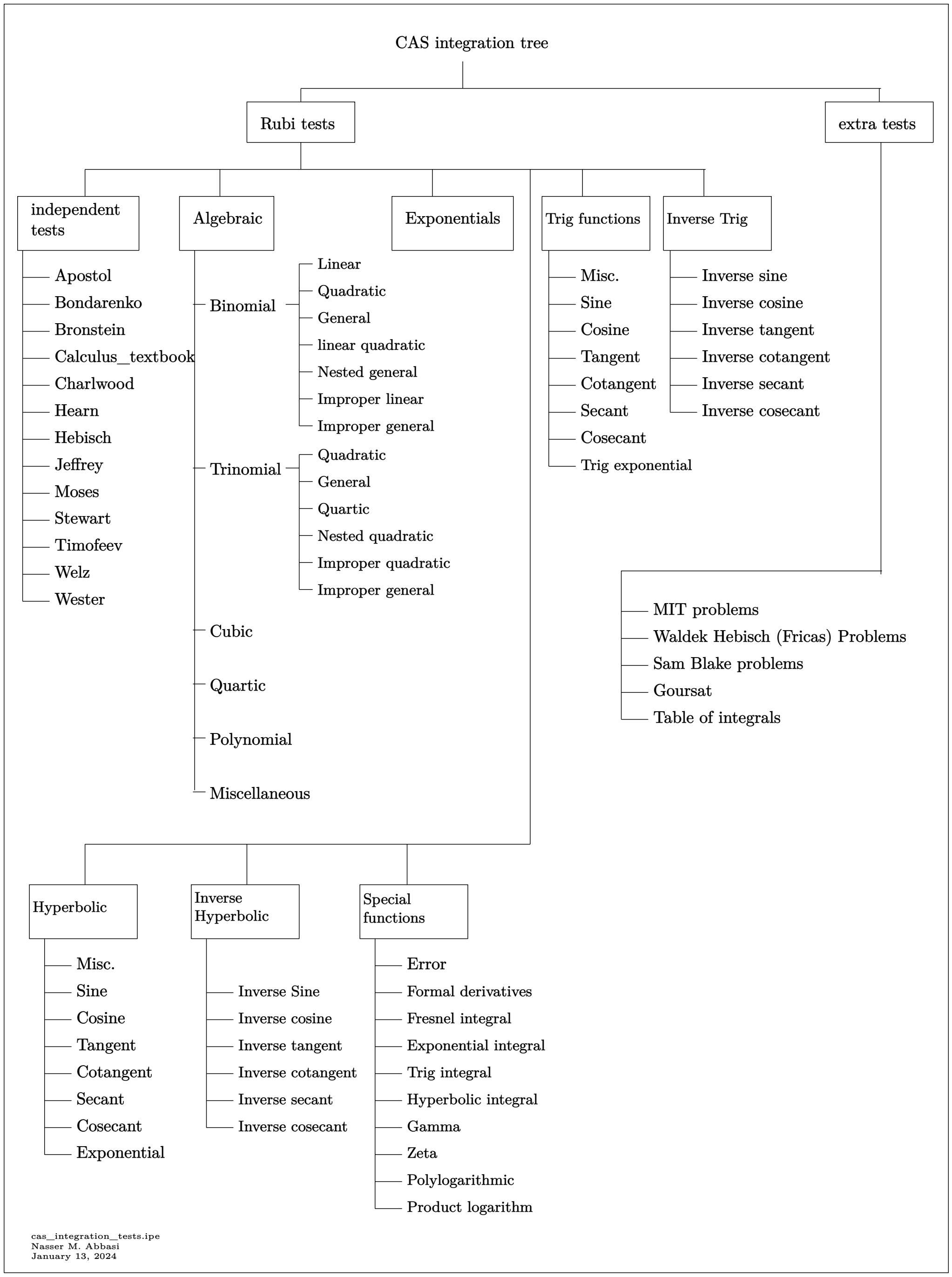
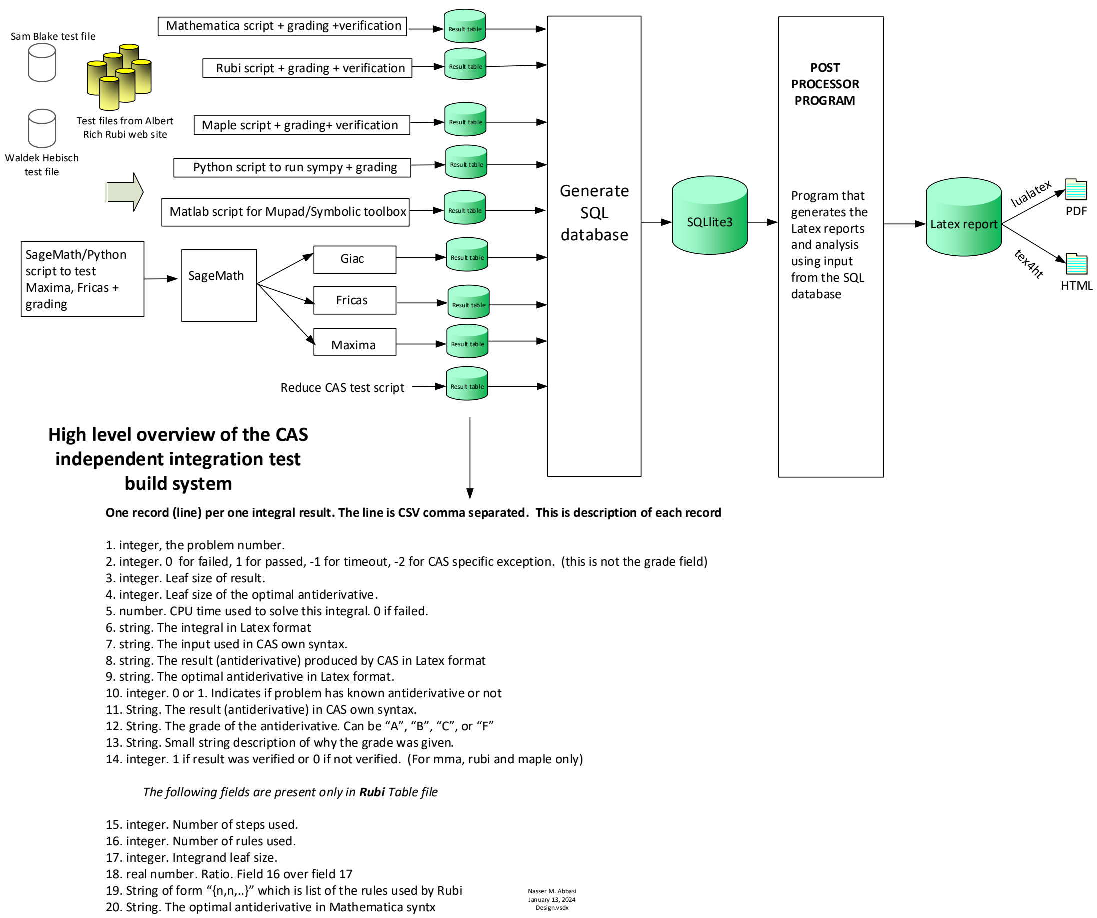


Figure 1.6: CAS integration tests tree

1.16 Design of the test system

The following diagram gives a high level view of the current test build system.



CHAPTER 2

DETAILED SUMMARY TABLES OF RESULTS

2.1 List of integrals sorted by grade for each CAS

Rubi

A grade { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62 }

B grade { }

C grade { }

F normal fail { }

F(-1) timedout fail { }

F(-2) exception fail { }

Mma

A grade { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40, 42, 43, 44, 46, 47, 48, 50, 51, 52, 53, 54, 55, 57, 58, 59, 60, 62 }

B grade { 37, 41, 45, 49, 56, 61 }

C grade { }

F normal fail { }

F(-1) timedout fail { }

F(-2) exception fail { }

Maple

A grade { 1, 2, 3, 4, 7, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 53 }

B grade { 6, 50, 51, 52, 54, 55 }

C grade { 5 }

F normal fail { 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 56, 57, 58, 59, 60, 61, 62 }

F(-1) timedout fail { }

F(-2) exception fail { }

Fricas

A grade { 1, 2, 3, 4, 5, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 }

B grade { 6, 7 }

C grade { 50, 51, 52, 53, 54, 55 }

F normal fail { 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 56, 57, 58, 59, 60, 61, 62 }

F(-1) timedout fail { }

F(-2) exception fail { }

Maxima

A grade { 1, 2, 3, 4, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 }

B grade { 5, 6, 7 }

C grade { }

F normal fail { 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62 }

F(-1) timedout fail { }

F(-2) exception fail { }

Giac

A grade { 1, 2, 3, 4, 5, 6, 7, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 }

B grade { }

C grade { }

F normal fail { 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62 }

F(-1) timedout fail { }

F(-2) exception fail { }

Mupad

A grade { }

B grade { 4, 5, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 53 }

C grade { }

F normal fail { }

F(-1) timedout fail { 1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 50, 51, 52, 54, 55, 56, 57, 58, 59, 60, 61, 62 }

F(-2) exception fail { }

Sympy

A grade { 18, 22, 26, 30, 34, 38, 42, 46 }

B grade { 35, 36, 37, 39, 40, 41, 43, 44, 45, 47, 48, 49 }

C grade { 19, 20, 21, 23, 24, 25, 27, 28, 29, 31, 32, 33 }

F normal fail { 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62 }

F(-1) timedout fail { 1 }

F(-2) exception fail { }

Reduce

A grade { }

B grade { 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 }

C grade { }

F normal fail { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62 }

F(-1) timedout fail { }

F(-2) exception fail { }

2.2 Detailed conclusion table per each integral for all CAS systems

Detailed conclusion table per each integral is given by the table below. The elapsed time is in seconds. For failed result it is given as **F(-1)** if the failure was due to timeout. It is given as **F(-2)** if the failure was due to an exception being raised, which could indicate a bug in the system. If the failure was due to integral not being evaluated within the time limit, then it is given as **F**.

In this table, the column `N.S.` means **normalized size** and is defined as $\frac{\text{antiderivative leaf size}}{\text{optimal antiderivative leaf size}}$. To make the table fit the page, the name `Mathematica` was abbreviated to `MMA`.

Problem 1	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	F(-1)	A	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	119	127	83	86	77	75	0	108	80	0
N.S.	1	1.07	0.70	0.72	0.65	0.63	0.00	0.91	0.67	0.00
time (sec)	N/A	0.443	0.340	0.934	0.153	0.079	0.000	0.265	0.227	0.000

Problem 2	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	F	A	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	89	93	71	73	60	62	0	84	58	0
N.S.	1	1.04	0.80	0.82	0.67	0.70	0.00	0.94	0.65	0.00
time (sec)	N/A	0.350	0.142	0.797	0.166	0.076	0.000	0.157	0.186	0.000

Problem 3	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	F	A	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	59	59	55	58	38	44	0	55	34	0
N.S.	1	1.00	0.93	0.98	0.64	0.75	0.00	0.93	0.58	0.00
time (sec)	N/A	0.258	0.082	0.728	0.165	0.076	0.000	0.123	0.189	0.000

Problem 4	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	F	A	F	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	26	26	29	43	20	32	0	30	14	33
N.S.	1	1.00	1.12	1.65	0.77	1.23	0.00	1.15	0.54	1.27
time (sec)	N/A	0.180	0.098	0.836	0.165	0.070	0.000	0.116	0.170	0.225

Problem 5	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	C	B	A	F	A	F	B
verified	N/A	Yes	Yes	No	TBD	TBD	TBD	TBD	TBD	TBD
size	46	46	40	56	90	135	0	52	28	45
N.S.	1	1.00	0.87	1.22	1.96	2.93	0.00	1.13	0.61	0.98
time (sec)	N/A	0.201	0.025	0.785	0.168	0.083	0.000	0.117	0.172	0.202

Problem 6	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	B	B	B	F	A	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	77	77	63	138	15721	153	0	112	38	0
N.S.	1	1.00	0.82	1.79	204.17	1.99	0.00	1.45	0.49	0.00
time (sec)	N/A	0.282	0.104	0.750	0.698	0.089	0.000	0.125	0.188	0.000

Problem 7	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	B	B	F	A	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	107	112	65	174	84332	188	0	129	48	0
N.S.	1	1.05	0.61	1.63	788.15	1.76	0.00	1.21	0.45	0.00
time (sec)	N/A	0.380	0.239	0.777	14.297	0.088	0.000	0.162	0.196	0.000

Problem 8	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	67	67	69	0	0	0	0	0	36	0
N.S.	1	1.00	1.03	0.00	0.00	0.00	0.00	0.00	0.54	0.00
time (sec)	N/A	0.275	0.155	0.000	0.000	0.000	0.000	0.000	0.180	0.000

Problem 9	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	66	66	69	0	0	0	0	0	16	0
N.S.	1	1.00	1.05	0.00	0.00	0.00	0.00	0.00	0.24	0.00
time (sec)	N/A	0.285	0.079	0.000	0.000	0.000	0.000	0.000	0.183	0.000

Problem 10	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	65	65	69	0	0	0	0	0	16	0
N.S.	1	1.00	1.06	0.00	0.00	0.00	0.00	0.00	0.25	0.00
time (sec)	N/A	0.273	0.074	0.000	0.000	0.000	0.000	0.000	0.174	0.000

Problem 11	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	65	65	67	0	0	0	0	0	16	0
N.S.	1	1.00	1.03	0.00	0.00	0.00	0.00	0.00	0.25	0.00
time (sec)	N/A	0.282	0.065	0.000	0.000	0.000	0.000	0.000	0.166	0.000

Problem 12	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	65	65	67	0	0	0	0	0	16	0
N.S.	1	1.00	1.03	0.00	0.00	0.00	0.00	0.00	0.25	0.00
time (sec)	N/A	0.275	0.065	0.000	0.000	0.000	0.000	0.000	0.185	0.000

Problem 13	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	68	68	69	0	0	0	0	0	36	0
N.S.	1	1.00	1.01	0.00	0.00	0.00	0.00	0.00	0.53	0.00
time (sec)	N/A	0.269	0.076	0.000	0.000	0.000	0.000	0.000	0.203	0.000

Problem 14	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	73	73	74	0	0	0	0	0	14	0
N.S.	1	1.00	1.01	0.00	0.00	0.00	0.00	0.00	0.19	0.00
time (sec)	N/A	0.283	0.086	0.000	0.000	0.000	0.000	0.000	0.189	0.000

Problem 15	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	75	75	75	0	0	0	0	0	15	0
N.S.	1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
time (sec)	N/A	0.284	0.117	0.000	0.000	0.000	0.000	0.000	0.179	0.000

Problem 16	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	59	59	77	0	0	0	0	0	14	0
N.S.	1	1.00	1.31	0.00	0.00	0.00	0.00	0.00	0.24	0.00
time (sec)	N/A	0.205	0.107	0.000	0.000	0.000	0.000	0.000	0.242	0.000

Problem 17	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	Yes	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	60	60	74	0	0	0	0	0	14	0
N.S.	1	1.00	1.23	0.00	0.00	0.00	0.00	0.00	0.23	0.00
time (sec)	N/A	0.206	0.091	0.000	0.000	0.000	0.000	0.000	0.259	0.000

Problem 18	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	31	31	20	18	24	26	41	30	17	38
N.S.	1	1.00	0.65	0.58	0.77	0.84	1.32	0.97	0.55	1.23
time (sec)	N/A	0.194	0.064	0.873	0.107	0.083	0.350	0.112	0.223	43.606

Problem 19	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	56	61	43	46	68	59	187	59	60	67
N.S.	1	1.09	0.77	0.82	1.21	1.05	3.34	1.05	1.07	1.20
time (sec)	N/A	0.266	0.270	0.829	0.111	0.079	0.841	0.110	0.164	41.731

Problem 20	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	81	91	56	62	111	90	359	75	106	96
N.S.	1	1.12	0.69	0.77	1.37	1.11	4.43	0.93	1.31	1.19
time (sec)	N/A	0.382	0.277	0.920	0.109	0.081	1.449	0.147	0.157	36.604

Problem 21	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	106	121	66	75	151	121	592	88	160	96
N.S.	1	1.14	0.62	0.71	1.42	1.14	5.58	0.83	1.51	0.91
time (sec)	N/A	0.523	0.374	0.979	0.109	0.088	2.827	0.118	0.189	42.359

Problem 22	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	33	33	20	18	24	26	41	30	17	38
N.S.	1	1.00	0.61	0.55	0.73	0.79	1.24	0.91	0.52	1.15
time (sec)	N/A	0.187	0.058	1.017	0.107	0.077	0.364	0.111	0.194	43.177

Problem 23	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	58	63	43	46	69	59	192	61	60	67
N.S.	1	1.09	0.74	0.79	1.19	1.02	3.31	1.05	1.03	1.16
time (sec)	N/A	0.274	0.219	0.956	0.109	0.088	0.688	0.129	0.167	42.561

Problem 24	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	83	93	65	64	112	90	364	77	106	95
N.S.	1	1.12	0.78	0.77	1.35	1.08	4.39	0.93	1.28	1.14
time (sec)	N/A	0.388	0.415	0.978	0.115	0.087	1.292	0.105	0.174	43.538

Problem 25	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	108	123	66	77	152	121	597	90	160	97
N.S.	1	1.14	0.61	0.71	1.41	1.12	5.53	0.83	1.48	0.90
time (sec)	N/A	0.509	0.375	1.086	0.114	0.088	2.690	0.110	0.201	43.911

Problem 26	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	33	33	20	18	24	26	42	30	17	38
N.S.	1	1.00	0.61	0.55	0.73	0.79	1.27	0.91	0.52	1.15
time (sec)	N/A	0.190	0.040	0.582	0.106	0.080	0.351	0.109	0.200	42.609

Problem 27	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	58	63	43	46	69	59	192	61	60	67
N.S.	1	1.09	0.74	0.79	1.19	1.02	3.31	1.05	1.03	1.16
time (sec)	N/A	0.263	0.013	0.776	0.110	0.087	0.693	0.109	0.170	0.003

Problem 28	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	83	93	65	64	112	90	366	77	106	96
N.S.	1	1.12	0.78	0.77	1.35	1.08	4.41	0.93	1.28	1.16
time (sec)	N/A	0.380	0.192	0.855	0.117	0.096	1.290	0.112	0.168	42.441

Problem 29	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	108	123	66	77	152	121	597	90	160	97
N.S.	1	1.14	0.61	0.71	1.41	1.12	5.53	0.83	1.48	0.90
time (sec)	N/A	0.510	0.073	0.681	0.112	0.082	2.711	0.132	0.169	0.003

Problem 30	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	31	31	20	18	24	26	44	30	17	38
N.S.	1	1.00	0.65	0.58	0.77	0.84	1.42	0.97	0.55	1.23
time (sec)	N/A	0.192	0.050	0.648	0.107	0.083	0.343	0.105	0.157	41.620

Problem 31	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	56	61	43	46	68	59	190	59	60	67
N.S.	1	1.09	0.77	0.82	1.21	1.05	3.39	1.05	1.07	1.20
time (sec)	N/A	0.276	0.017	0.862	0.112	0.085	0.866	0.107	0.170	0.002

Problem 32	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	81	91	65	62	111	90	362	75	106	95
N.S.	1	1.12	0.80	0.77	1.37	1.11	4.47	0.93	1.31	1.17
time (sec)	N/A	0.390	0.374	0.880	0.116	0.080	1.443	0.110	0.200	43.485

Problem 33	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	C	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	106	121	66	75	151	121	595	88	160	96
N.S.	1	1.14	0.62	0.71	1.42	1.14	5.61	0.83	1.51	0.91
time (sec)	N/A	0.505	0.177	0.914	0.112	0.090	2.895	0.115	0.180	0.003

Problem 34	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	65	22	65	33	48	46	41	34	32	17
N.S.	1	0.34	1.00	0.51	0.74	0.71	0.63	0.52	0.49	0.26
time (sec)	N/A	0.190	0.056	0.593	0.027	0.078	0.335	0.114	0.201	41.871

Problem 35	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	90	48	143	64	91	88	228	62	110	47
N.S.	1	0.53	1.59	0.71	1.01	0.98	2.53	0.69	1.22	0.52
time (sec)	N/A	0.269	0.172	0.673	0.035	0.082	0.655	0.119	0.259	41.166

Problem 36	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	115	78	217	83	135	129	474	78	186	76
N.S.	1	0.68	1.89	0.72	1.17	1.12	4.12	0.68	1.62	0.66
time (sec)	N/A	0.379	0.271	0.745	0.033	0.083	1.160	0.136	0.239	40.028

Problem 37	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	B	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	140	108	296	99	174	170	813	91	244	102
N.S.	1	0.77	2.11	0.71	1.24	1.21	5.81	0.65	1.74	0.73
time (sec)	N/A	0.518	0.330	0.770	0.037	0.081	2.360	0.120	0.173	41.286

Problem 38	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	63	20	63	37	50	46	44	38	36	17
N.S.	1	0.32	1.00	0.59	0.79	0.73	0.70	0.60	0.57	0.27
time (sec)	N/A	0.189	0.057	0.645	0.027	0.079	0.354	0.126	0.166	41.236

Problem 39	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	88	46	139	71	94	88	240	68	120	47
N.S.	1	0.52	1.58	0.81	1.07	1.00	2.73	0.77	1.36	0.53
time (sec)	N/A	0.271	0.348	0.740	0.036	0.086	0.665	0.118	0.194	42.150

Problem 40	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	113	76	211	89	137	129	490	84	200	76
N.S.	1	0.67	1.87	0.79	1.21	1.14	4.34	0.74	1.77	0.67
time (sec)	N/A	0.388	0.402	0.925	0.037	0.081	1.154	0.125	0.178	43.246

Problem 41	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	B	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	138	106	288	105	177	170	831	97	260	102
N.S.	1	0.77	2.09	0.76	1.28	1.23	6.02	0.70	1.88	0.74
time (sec)	N/A	0.524	0.395	0.978	0.037	0.089	2.361	0.127	0.171	44.310

Problem 42	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	63	20	63	37	50	46	44	38	36	17
N.S.	1	0.32	1.00	0.59	0.79	0.73	0.70	0.60	0.57	0.27
time (sec)	N/A	0.193	0.037	0.556	0.043	0.077	0.326	0.116	0.192	43.444

Problem 43	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	88	46	139	71	94	88	240	68	120	47
N.S.	1	0.52	1.58	0.81	1.07	1.00	2.73	0.77	1.36	0.53
time (sec)	N/A	0.268	0.017	0.632	0.036	0.083	0.642	0.120	0.177	0.002

Problem 44	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	113	76	211	89	137	129	490	84	200	75
N.S.	1	0.67	1.87	0.79	1.21	1.14	4.34	0.74	1.77	0.66
time (sec)	N/A	0.383	0.218	0.819	0.031	0.083	1.143	0.118	0.187	44.875

Problem 45	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	B	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	138	106	288	105	177	170	831	97	260	102
N.S.	1	0.77	2.09	0.76	1.28	1.23	6.02	0.70	1.88	0.74
time (sec)	N/A	0.503	0.015	0.566	0.038	0.083	2.352	0.125	0.171	0.002

Problem 46	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	A	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	65	22	65	33	48	46	42	34	32	17
N.S.	1	0.34	1.00	0.51	0.74	0.71	0.65	0.52	0.49	0.26
time (sec)	N/A	0.185	0.048	0.579	0.030	0.081	0.337	0.124	0.169	44.490

Problem 47	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	90	48	143	64	91	88	231	62	110	47
N.S.	1	0.53	1.59	0.71	1.01	0.98	2.57	0.69	1.22	0.52
time (sec)	N/A	0.260	0.048	0.645	0.028	0.082	0.652	0.124	0.166	0.003

Problem 48	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	115	78	217	83	135	129	478	78	186	75
N.S.	1	0.68	1.89	0.72	1.17	1.12	4.16	0.68	1.62	0.65
time (sec)	N/A	0.368	0.413	0.762	0.034	0.081	1.141	0.119	0.174	45.028

Problem 49	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	B	A	A	A	B	A	B	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	140	108	296	99	174	170	816	91	244	102
N.S.	1	0.77	2.11	0.71	1.24	1.21	5.83	0.65	1.74	0.73
time (sec)	N/A	0.492	0.015	0.613	0.039	0.083	2.340	0.123	0.168	0.002

Problem 50	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	B	F	C	F	F	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	197	203	177	662	0	437	0	0	68	0
N.S.	1	1.03	0.90	3.36	0.00	2.22	0.00	0.00	0.35	0.00
time (sec)	N/A	1.074	1.007	8.378	0.000	0.104	0.000	0.000	0.202	0.000

Problem 51	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	B	F	C	F	F	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	157	158	134	450	0	398	0	0	38	0
N.S.	1	1.01	0.85	2.87	0.00	2.54	0.00	0.00	0.24	0.00
time (sec)	N/A	0.782	0.661	4.733	0.000	0.108	0.000	0.000	0.177	0.000

Problem 52	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	B	F	C	F	F	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	57	57	57	170	0	355	0	0	13	0
N.S.	1	1.00	1.00	2.98	0.00	6.23	0.00	0.00	0.23	0.00
time (sec)	N/A	0.290	0.154	4.022	0.000	0.094	0.000	0.000	0.160	0.000

Problem 53	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	A	F	C	F	F	F	B
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	57	57	57	57	0	147	0	0	26	52
N.S.	1	1.00	1.00	1.00	0.00	2.58	0.00	0.00	0.46	0.91
time (sec)	N/A	0.294	0.123	1.164	0.000	0.090	0.000	0.000	0.239	42.912

Problem 54	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	B	F	C	F	F	F	F(-1)
verified	N/A	Yes	Yes	Yes	TBD	TBD	TBD	TBD	TBD	TBD
size	106	106	83	217	0	472	0	0	42	0
N.S.	1	1.00	0.78	2.05	0.00	4.45	0.00	0.00	0.40	0.00
time (sec)	N/A	0.426	0.303	2.074	0.000	0.115	0.000	0.000	0.246	0.000

Problem 55	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	B	F	C	F	F	F	F(-1)
verified	N/A	Yes	Yes	No	TBD	TBD	TBD	TBD	TBD	TBD
size	221	231	158	489	0	662	0	0	58	0
N.S.	1	1.05	0.71	2.21	0.00	3.00	0.00	0.00	0.26	0.00
time (sec)	N/A	1.117	1.077	3.105	0.000	0.105	0.000	0.000	0.289	0.000

Problem 56	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	B	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	No	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	105	108	246	0	0	0	0	0	40	0
N.S.	1	1.03	2.34	0.00	0.00	0.00	0.00	0.00	0.38	0.00
time (sec)	N/A	0.261	2.321	0.000	0.000	0.000	0.000	0.000	0.175	0.000

Problem 57	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	No	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	105	105	118	0	0	0	0	0	14	0
N.S.	1	1.00	1.12	0.00	0.00	0.00	0.00	0.00	0.13	0.00
time (sec)	N/A	0.267	0.340	0.000	0.000	0.000	0.000	0.000	0.182	0.000

Problem 58	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	No	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	105	105	118	0	0	0	0	0	14	0
N.S.	1	1.00	1.12	0.00	0.00	0.00	0.00	0.00	0.13	0.00
time (sec)	N/A	0.268	0.332	0.000	0.000	0.000	0.000	0.000	0.185	0.000

Problem 59	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	No	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	105	105	118	0	0	0	0	0	14	0
N.S.	1	1.00	1.12	0.00	0.00	0.00	0.00	0.00	0.13	0.00
time (sec)	N/A	0.266	0.392	0.000	0.000	0.000	0.000	0.000	0.165	0.000

Problem 60	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	No	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	105	105	116	0	0	0	0	0	14	0
N.S.	1	1.00	1.10	0.00	0.00	0.00	0.00	0.00	0.13	0.00
time (sec)	N/A	0.259	0.293	0.000	0.000	0.000	0.000	0.000	0.176	0.000

Problem 61	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	B	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	No	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	105	110	268	0	0	0	0	0	39	0
N.S.	1	1.05	2.55	0.00	0.00	0.00	0.00	0.00	0.37	0.00
time (sec)	N/A	0.266	2.376	0.000	0.000	0.000	0.000	0.000	0.170	0.000

Problem 62	Optimal	Rubi	MMA	Maple	Maxima	Fricas	Sympy	Giac	Reduce	Mupad
grade	N/A	A	A	F	F	F	F	F	F	F(-1)
verified	N/A	Yes	No	N/A	TBD	TBD	TBD	TBD	TBD	TBD
size	103	103	121	0	0	0	0	0	14	0
N.S.	1	1.00	1.17	0.00	0.00	0.00	0.00	0.00	0.14	0.00
time (sec)	N/A	0.269	0.334	0.000	0.000	0.000	0.000	0.000	0.188	0.000

2.3 Detailed conclusion table specific for Rubi results

The following table is specific to Rubi only. It gives additional statistics for each integral. the column **steps** is the number of steps used by Rubi to obtain the antiderivative. The **rules** column is the number of unique rules used. The **integrand size** column is the leaf size of the integrand. Finally the ratio $\frac{\text{number of rules}}{\text{integrand size}}$ is also given. The larger this ratio is, the harder the integral is to solve. In this test file, problem number [50] had the largest ratio of [1.07143000000000010]

Table 2.1: Rubi specific breakdown of results for each integral

#	grade	number of steps used	number of unique rules	normalized antiderivative leaf size	integrand leaf size	$\frac{\text{number of rules}}{\text{integrand leaf size}}$
1	A	8	8	1.07	14	0.571
2	A	6	6	1.04	14	0.429
3	A	4	4	1.00	14	0.286
4	A	2	2	1.00	14	0.143
5	A	4	3	1.00	14	0.214
6	A	6	5	1.00	14	0.357
7	A	8	7	1.05	14	0.500
8	A	4	4	1.00	14	0.286
9	A	4	4	1.00	14	0.286
10	A	4	4	1.00	14	0.286
11	A	4	4	1.00	14	0.286
12	A	4	4	1.00	14	0.286
13	A	4	4	1.00	14	0.286
14	A	4	4	1.00	12	0.333
15	A	4	4	1.00	13	0.308
16	A	2	2	1.00	12	0.167
17	A	2	2	1.00	12	0.167
18	A	2	2	1.00	12	0.167
19	A	5	5	1.09	12	0.417
20	A	8	8	1.12	12	0.667
21	A	11	11	1.14	12	0.917

Continued on next page

Table 2.1 – continued from previous page

#	grade	number of steps used	number of unique rules	normalized antiderivative leaf size	integrand leaf size	$\frac{\text{number of rules}}{\text{integrand leaf size}}$
22	A	2	2	1.00	12	0.167
23	A	5	5	1.09	12	0.417
24	A	8	8	1.12	12	0.667
25	A	11	11	1.14	12	0.917
26	A	2	2	1.00	12	0.167
27	A	5	5	1.09	12	0.417
28	A	7	7	1.12	12	0.583
29	A	11	11	1.14	12	0.917
30	A	2	2	1.00	12	0.167
31	A	5	5	1.09	12	0.417
32	A	7	7	1.12	12	0.583
33	A	11	11	1.14	12	0.917
34	A	4	3	0.34	12	0.250
35	A	7	6	0.53	12	0.500
36	A	10	9	0.68	12	0.750
37	A	13	12	0.77	12	1.000
38	A	4	3	0.32	12	0.250
39	A	7	6	0.52	12	0.500
40	A	10	9	0.67	12	0.750
41	A	13	12	0.77	12	1.000
42	A	4	3	0.32	12	0.250
43	A	7	6	0.52	12	0.500
44	A	9	8	0.67	12	0.667
45	A	13	12	0.77	12	1.000
46	A	4	3	0.34	12	0.250
47	A	7	6	0.53	12	0.500
48	A	9	8	0.68	12	0.667
49	A	13	12	0.77	12	1.000
50	A	15	15	1.03	14	1.071
51	A	12	12	1.01	14	0.857
52	A	4	4	1.00	14	0.286
53	A	4	4	1.00	14	0.286

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Table 2.1 – continued from previous page

#	grade	number of steps used	number of unique rules	normalized antiderivative leaf size	integrand leaf size	$\frac{\text{number of rules}}{\text{integrand leaf size}}$
54	A	7	7	1.00	14	0.500
55	A	15	15	1.05	14	1.071
56	A	5	4	1.03	14	0.286
57	A	5	4	1.00	14	0.286
58	A	5	4	1.00	14	0.286
59	A	5	4	1.00	14	0.286
60	A	5	4	1.00	14	0.286
61	A	5	4	1.05	14	0.286
62	A	5	4	1.00	12	0.333

CHAPTER 3

Listing of integrals

3.1 $\int (a+a\cos(c+dx))^{7/2}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 119

$$\int (a+a\cos(c+dx))^{7/2}\,dx=\frac{256a^4\sin(c+dx)}{35d\sqrt{a+a\cos(c+dx)}}+\frac{64a^3\sqrt{a+a\cos(c+dx)}\sin(c+dx)}{35d}+\frac{24a^2(a+a\cos(c+dx))^{3/2}\sin(c+dx)}{35d}+\frac{2a(a+a\cos(c+dx))^{5/2}\sin(c+dx)}{7d}$$

output
```
256/35*a^4*sin(d*x+c)/d/(a+a*cos(d*x+c))^(1/2)+64/35*a^3*(a+a*cos(d*x+c))^
(1/2)*sin(d*x+c)/d+24/35*a^2*(a+a*cos(d*x+c))^(3/2)*sin(d*x+c)/d+2/7*a*(a+
a*cos(d*x+c))^(5/2)*sin(d*x+c)/d
```

Mathematica [A] (verified)

Time = 0.34 (sec) , antiderivative size = 83, normalized size of antiderivative = 0.70

$$\int (a+a\cos(c+dx))^{7/2}\,dx=\frac{a^3\sqrt{a(1+\cos(c+dx))}\sec\left(\frac{1}{2}(c+dx)\right)\left(1225\sin\left(\frac{1}{2}(c+dx)\right)+245\sin\left(\frac{3}{2}(c+dx)\right)+49\sin\right.}{140d}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(7/2),x]
```

output
```
(a^3*Sqrt[a*(1 + Cos[c + d*x])]*Sec[(c + d*x)/2]*(1225*Sin[(c + d*x)/2] +
245*Sin[(3*(c + d*x))/2] + 49*Sin[(5*(c + d*x))/2] + 5*Sin[(7*(c + d*x))/2
]))/(140*d)
```

Rubi [A] (verified)

Time = 0.44 (sec) , antiderivative size = 127, normalized size of antiderivative = 1.07, number of steps used = 8, number of rules used = 8, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.571, Rules used = {3042, 3126, 3042, 3126, 3042, 3126, 3042, 3125}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a\cos(c+dx)+a)^{7/2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{7/2}dx$$

$$\Big\downarrow \text{3126}$$

$$\frac{12}{7}a\int (\cos(c+dx)a+a)^{5/2}dx+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{5/2}}{7d}$$

$$\Big\downarrow \text{3042}$$

$$\frac{12}{7}a\int \left(\sin\left(c+dx+\frac{\pi}{2}\right)a+a\right)^{5/2}dx+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{5/2}}{7d}$$

$$\Big\downarrow \text{3126}$$

$$\frac{12}{7}a\left(\frac{8}{5}a\int (\cos(c+dx)a+a)^{3/2}dx+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{5/2}}{7d}$$

$$\Big\downarrow \text{3042}$$

$$\frac{12}{7}a\left(\frac{8}{5}a\int \left(\sin\left(c+dx+\frac{\pi}{2}\right)a+a\right)^{3/2}dx+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{5/2}}{7d}$$

$\downarrow$ 3126

$$\frac{12}{7}a\left(\frac{8}{5}a\left(\frac{4}{3}a\int \sqrt{\cos(c+dx)a+a}dx+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{5/2}}{7d}$$

$\downarrow$ 3042

$$\frac{12}{7}a\left(\frac{8}{5}a\left(\frac{4}{3}a\int \sqrt{\sin\left(c+dx+\frac{\pi}{2}\right)a+a}dx+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{5/2}}{7d}$$

$\downarrow$ 3125

$$\frac{12}{7}a\left(\frac{8}{5}a\left(\frac{8a^2\sin(c+dx)}{3d\sqrt{a\cos(c+dx)+a}}+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{5/2}}{7d}$$

input
```
Int[(a + a*Cos[c + d*x])^(7/2),x]
```

output
```
(2*a*(a + a*Cos[c + d*x])^(5/2)*Sin[c + d*x])/(7*d) + (12*a*((2*a*(a + a*C
os[c + d*x])^(3/2)*Sin[c + d*x])/(5*d) + (8*a*((8*a^2*Sin[c + d*x])/(3*d*S
qrt[a + a*Cos[c + d*x]]) + (2*a*Sqrt[a + a*Cos[c + d*x]]*Sin[c + d*x])/(3*
d)))/5))/7
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3125
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[-2*b*(Cos
[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]])), x] /; FreeQ[{a, b, c, d}, x] && Eq
Q[a^2 - b^2, 0]
```

rule 3126
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n - 1)/(d*n)), x] + Simp[a*((2*n - 1)/n)
 Int[(a + b*Sin[c + d*x])^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && EqQ[
a^2 - b^2, 0] && IGtQ[n - 1/2, 0]
```

Maple [A] (verified)

Time = 0.93 (sec) , antiderivative size = 86, normalized size of antiderivative = 0.72

method	result	size
default	$\frac{16a^4\cos\left(\frac{dx}{2}+\frac{c}{2}\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)\left(5\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^6+6\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^4+8\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2+16\right)\sqrt{2}}{35\sqrt{a\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2}\,d}$	86

input
```
int((a+a*cos(d*x+c))^(7/2),x,method=_RETURNVERBOSE)
```

output
```
16/35*a^4*cos(1/2*d*x+1/2*c)*sin(1/2*d*x+1/2*c)*(5*cos(1/2*d*x+1/2*c)^6+6*
cos(1/2*d*x+1/2*c)^4+8*cos(1/2*d*x+1/2*c)^2+16)*2^(1/2)/(a*cos(1/2*d*x+1/2
*c)^2)^(1/2)/d
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 75, normalized size of antiderivative = 0.63

$$\int (a + a\cos(c + dx))^{7/2}\,dx = \frac{2\left(5\,a^3\cos\left(dx + c\right)^3 + 27\,a^3\cos\left(dx + c\right)^2 + 71\,a^3\cos\left(dx + c\right) + 177\,a^3\right)\sqrt{a\cos\left(dx + c\right) + a}}{35\left(d\cos\left(dx + c\right) + d\right)}$$

input
```
integrate((a+a*cos(d*x+c))^(7/2),x, algorithm="fricas")
```

output
```
2/35*(5*a^3*cos(d*x + c)^3 + 27*a^3*cos(d*x + c)^2 + 71*a^3*cos(d*x + c) +
 177*a^3)*sqrt(a*cos(d*x + c) + a)*sin(d*x + c)/(d*cos(d*x + c) + d)
```

Sympy [F(-1)]

Timed out.

$$\int (a + a\cos(c + dx))^{7/2}\,dx = \text{Timed out}$$

input
```
integrate((a+a*cos(d*x+c))**(7/2),x)
```

output
```
Timed out
```

Maxima [A] (verification not implemented)

Time = 0.15 (sec) , antiderivative size = 77, normalized size of antiderivative = 0.65

$$\int (a + a\cos(c + dx))^{7/2}\,dx = \frac{\left(5\sqrt{2}a^3\sin\left(\frac{7}{2}\,dx + \frac{7}{2}\,c\right) + 49\sqrt{2}a^3\sin\left(\frac{5}{2}\,dx + \frac{5}{2}\,c\right) + 245\sqrt{2}a^3\sin\left(\frac{3}{2}\,dx + \frac{3}{2}\,c\right) + 1225\sqrt{2}a^3}{140\,d}$$

input
```
integrate((a+a*cos(d*x+c))^(7/2),x, algorithm="maxima")
```

output
```
1/140*(5*sqrt(2)*a^3*sin(7/2*d*x + 7/2*c) + 49*sqrt(2)*a^3*sin(5/2*d*x + 5
/2*c) + 245*sqrt(2)*a^3*sin(3/2*d*x + 3/2*c) + 1225*sqrt(2)*a^3*sin(1/2*d*
x + 1/2*c))*sqrt(a)/d
```

Giac [A] (verification not implemented)

Time = 0.27 (sec) , antiderivative size = 108, normalized size of antiderivative = 0.91

$$\int (a + a\cos(c + dx))^{7/2}\,dx = \frac{\sqrt{2}\left(5\,a^3\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx + \frac{1}{2}\,c\right)\right)\sin\left(\frac{7}{2}\,dx + \frac{7}{2}\,c\right) + 49\,a^3\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx + \frac{1}{2}\,c\right)\right)\sin\left(\frac{5}{2}\,dx + \frac{5}{2}\,c\right) \cdots}{\cdots}$$

input
```
integrate((a+a*cos(d*x+c))^(7/2),x, algorithm="giac")
```

output
```
1/140*sqrt(2)*(5*a^3*sgn(cos(1/2*d*x + 1/2*c))*sin(7/2*d*x + 7/2*c) + 49*a
^3*sgn(cos(1/2*d*x + 1/2*c))*sin(5/2*d*x + 5/2*c) + 245*a^3*sgn(cos(1/2*d*
x + 1/2*c))*sin(3/2*d*x + 3/2*c) + 1225*a^3*sgn(cos(1/2*d*x + 1/2*c))*sin(
1/2*d*x + 1/2*c))*sqrt(a)/d
```

Mupad [F(-1)]

Timed out.

$$\int (a + a\cos(c + dx))^{7/2}\,dx = \int (a + a\,\cos(c + d\,x))^{7/2}\,dx$$

input
```
int((a + a*cos(c + d*x))^(7/2),x)
```

output
```
int((a + a*cos(c + d*x))^(7/2), x)
```

Reduce [F]

$$\int (a + a\cos(c + dx))^{7/2}\, dx = \sqrt{a}\, a^3 \left(\int \sqrt{\cos(dx + c) + 1} dx + 3 \left(\int \sqrt{\cos(dx + c) + 1}\, \cos(dx + c)\, dx \right) + \int \sqrt{\cos(dx + c) + 1}\, \cos(dx + c)^3\, dx + 3 \left(\int \sqrt{\cos(dx + c) + 1}\, \cos(dx + c)^2\, dx \right) \right)$$

input
```
int((a+a*cos(d*x+c))^(7/2),x)
```

output
```
sqrt(a)*a**3*(int(sqrt(cos(c + d*x) + 1),x) + 3*int(sqrt(cos(c + d*x) + 1)
*cos(c + d*x),x) + int(sqrt(cos(c + d*x) + 1)*cos(c + d*x)**3,x) + 3*int(s
qrt(cos(c + d*x) + 1)*cos(c + d*x)**2,x))
```

3.2 $\int (a + a\cos(c + dx))^{5/2} \, dx$

Optimal result

Integrand size = 14, antiderivative size = 89

$$\int (a + a\cos(c + dx))^{5/2} \, dx = \frac{64a^3\sin(c + dx)}{15d\sqrt{a + a\cos(c + dx)}} + \frac{16a^2\sqrt{a + a\cos(c + dx)}\sin(c + dx)}{15d} + \frac{2a(a + a\cos(c + dx))^{3/2}\sin(c + dx)}{5d}$$

output
```
64/15*a^3*sin(d*x+c)/d/(a+a*cos(d*x+c))^(1/2)+16/15*a^2*(a+a*cos(d*x+c))^(
1/2)*sin(d*x+c)/d+2/5*a*(a+a*cos(d*x+c))^(3/2)*sin(d*x+c)/d
```

Mathematica [A] (verified)

Time = 0.14 (sec) , antiderivative size = 71, normalized size of antiderivative = 0.80

$$\int (a + a\cos(c + dx))^{5/2} \, dx = \frac{a^2\sqrt{a(1 + \cos(c + dx))}\sec\left(\frac{1}{2}(c + dx)\right)\left(150\sin\left(\frac{1}{2}(c + dx)\right) + 25\sin\left(\frac{3}{2}(c + dx)\right) + 3\sin\left(\frac{5}{2}(\right.\right.}{30d}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(5/2),x]
```

output
```
(a^2*Sqrt[a*(1 + Cos[c + d*x])]*Sec[(c + d*x)/2]*(150*Sin[(c + d*x)/2] + 2
5*Sin[(3*(c + d*x))/2] + 3*Sin[(5*(c + d*x))/2]))/(30*d)
```

Rubi [A] (verified)

Time = 0.35 (sec) , antiderivative size = 93, normalized size of antiderivative = 1.04, number of steps used = 6, number of rules used = 6, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.429, Rules used = {3042, 3126, 3042, 3126, 3042, 3125}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a\cos(c+dx)+a)^{5/2}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{5/2}dx$$

$$\Big\downarrow \text{3126}$$

$$\frac{8}{5}a\int (\cos(c+dx)a+a)^{3/2}dx+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}$$

$$\Big\downarrow \text{3042}$$

$$\frac{8}{5}a\int \left(\sin\left(c+dx+\frac{\pi}{2}\right)a+a\right)^{3/2}dx+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}$$

$$\Big\downarrow \text{3126}$$

$$\frac{8}{5}a\left(\frac{4}{3}a\int \sqrt{\cos(c+dx)a+a}dx+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}$$

$$\Big\downarrow \text{3042}$$

$$\frac{8}{5}a\left(\frac{4}{3}a\int \sqrt{\sin\left(c+dx+\frac{\pi}{2}\right)a+a}dx+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}$$

$$\Big\downarrow \text{3125}$$

$$\frac{8}{5}a\left(\frac{8a^2\sin(c+dx)}{3d\sqrt{a\cos(c+dx)+a}}+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}\right)+\frac{2a\sin(c+dx)(a\cos(c+dx)+a)^{3/2}}{5d}$$

input
```
Int[(a + a*Cos[c + d*x])^(5/2),x]
```

output
```
(2*a*(a + a*Cos[c + d*x])^(3/2)*Sin[c + d*x])/(5*d) + (8*a*((8*a^2*Sin[c +
 d*x])/(3*d*Sqrt[a + a*Cos[c + d*x]]) + (2*a*Sqrt[a + a*Cos[c + d*x]]*Sin[
c + d*x])/(3*d)))/5
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3125
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[-2*b*(Cos
[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]])), x] /; FreeQ[{a, b, c, d}, x] && Eq
Q[a^2 - b^2, 0]
```

rule 3126
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n - 1)/(d*n)), x] + Simp[a*((2*n - 1)/n)
 Int[(a + b*Sin[c + d*x])^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && EqQ[
a^2 - b^2, 0] && IGtQ[n - 1/2, 0]
```

Maple [A] (verified)

Time = 0.80 (sec) , antiderivative size = 73, normalized size of antiderivative = 0.82

method	result	size
default	$\frac{8a^3\cos\left(\frac{dx}{2}+\frac{c}{2}\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)\left(3\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^4+4\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2+8\right)\sqrt{2}}{15\sqrt{a\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2}\,d}$	73

input
```
int((a+a*cos(d*x+c))^(5/2),x,method=_RETURNVERBOSE)
```

output
```
8/15*a^3*cos(1/2*d*x+1/2*c)*sin(1/2*d*x+1/2*c)*(3*cos(1/2*d*x+1/2*c)^4+4*c
os(1/2*d*x+1/2*c)^2+8)*2^(1/2)/(a*cos(1/2*d*x+1/2*c)^2)^(1/2)/d
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 62, normalized size of antiderivative = 0.70

$$\int (a+a\cos(c+dx))^{5/2}\,dx = \frac{2\left(3\,a^2\cos\left(dx+c\right)^2+14\,a^2\cos\left(dx+c\right)+43\,a^2\right)\sqrt{a\cos\left(dx+c\right)+a}\sin\left(dx+c\right)}{15\left(d\cos\left(dx+c\right)+d\right)}$$

input
```
integrate((a+a*cos(d*x+c))^(5/2),x, algorithm="fricas")
```

output
```
2/15*(3*a^2*cos(d*x + c)^2 + 14*a^2*cos(d*x + c) + 43*a^2)*sqrt(a*cos(d*x
+ c) + a)*sin(d*x + c)/(d*cos(d*x + c) + d)
```

Sympy [F]

$$\int (a+a\cos(c+dx))^{5/2}\,dx = \int \left(a\cos\left(c+dx\right)+a\right)^{\frac{5}{2}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))**(5/2),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(5/2), x)
```

Maxima [A] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 60, normalized size of antiderivative = 0.67

$$\int (a+a\cos(c+dx))^{5/2}\,dx = \frac{\left(3\sqrt{2}a^2\sin\left(\frac{5}{2}\,dx+\frac{5}{2}\,c\right)+25\sqrt{2}a^2\sin\left(\frac{3}{2}\,dx+\frac{3}{2}\,c\right)+150\sqrt{2}a^2\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)\sqrt{a}}{30\,d}$$

input
```
integrate((a+a*cos(d*x+c))^(5/2),x, algorithm="maxima")
```

output
```
1/30*(3*sqrt(2)*a^2*sin(5/2*d*x + 5/2*c) + 25*sqrt(2)*a^2*sin(3/2*d*x + 3/
2*c) + 150*sqrt(2)*a^2*sin(1/2*d*x + 1/2*c))*sqrt(a)/d
```

Giac [A] (verification not implemented)

Time = 0.16 (sec) , antiderivative size = 84, normalized size of antiderivative = 0.94

$$\int (a+a\cos(c+dx))^{5/2}\,dx = \frac{\sqrt{2}\left(3\,a^2\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)\sin\left(\frac{5}{2}\,dx+\frac{5}{2}\,c\right)+25\,a^2\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)\sin\left(\frac{3}{2}\,dx+\frac{3}{2}\,c\right)+\right.}{30\,d}$$

input
```
integrate((a+a*cos(d*x+c))^(5/2),x, algorithm="giac")
```

output
```
1/30*sqrt(2)*(3*a^2*sgn(cos(1/2*d*x + 1/2*c))*sin(5/2*d*x + 5/2*c) + 25*a^
2*sgn(cos(1/2*d*x + 1/2*c))*sin(3/2*d*x + 3/2*c) + 150*a^2*sgn(cos(1/2*d*x
 + 1/2*c))*sin(1/2*d*x + 1/2*c))*sqrt(a)/d
```

Mupad [F(-1)]

Timed out.

$$\int (a + a\cos(c + dx))^{5/2}\,dx = \int (a + a\,\cos(c + d\,x))^{5/2}\,dx$$

input
```
int((a + a*cos(c + d*x))^(5/2),x)
```

output
```
int((a + a*cos(c + d*x))^(5/2), x)
```

Reduce [F]

$$\int (a + a\cos(c + dx))^{5/2}\,dx = \sqrt{a}\,a^2\left(\int \sqrt{\cos(dx + c) + 1}dx + 2\left(\int \sqrt{\cos(dx + c) + 1}\,\cos(dx+c)\,dx\right) + \int \sqrt{\cos(dx + c) + 1}\,\cos(dx+c)^2\,dx\right)$$

input
```
int((a+a*cos(d*x+c))^(5/2),x)
```

output
```
sqrt(a)*a**2*(int(sqrt(cos(c + d*x) + 1),x) + 2*int(sqrt(cos(c + d*x) + 1)
*cos(c + d*x),x) + int(sqrt(cos(c + d*x) + 1)*cos(c + d*x)**2,x))
```

3.3 $\int (a + a\cos(c+dx))^{3/2}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 59

$$\int (a+a\cos(c+dx))^{3/2}\,dx = \frac{8a^2\sin(c+dx)}{3d\sqrt{a+a\cos(c+dx)}} + \frac{2a\sqrt{a+a\cos(c+dx)}\sin(c+dx)}{3d}$$

output
```
8/3*a^2*sin(d*x+c)/d/(a+a*cos(d*x+c))^(1/2)+2/3*a*(a+a*cos(d*x+c))^(1/2)*s
in(d*x+c)/d
```

Mathematica [A] (verified)

Time = 0.08 (sec) , antiderivative size = 55, normalized size of antiderivative = 0.93

$$\int (a+a\cos(c+dx))^{3/2}\,dx = \frac{a\sqrt{a(1+\cos(c+dx))}\sec\left(\frac{1}{2}(c+dx)\right)\left(9\sin\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{3}{2}(c+dx)\right)\right)}{3d}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(3/2),x]
```

output
```
(a*Sqrt[a*(1 + Cos[c + d*x])]*Sec[(c + d*x)/2]*(9*Sin[(c + d*x)/2] + Sin[(
3*(c + d*x))/2]))/(3*d)
```

Rubi [A] (verified)

Time = 0.26 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.286, Rules used = {3042, 3126, 3042, 3125}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a\cos(c+dx)+a)^{3/2}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{3/2}dx$$

$$\Big\downarrow \text{ 3126}$$

$$\frac{4}{3}a\int \sqrt{\cos(c+dx)a+a}dx+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{4}{3}a\int \sqrt{\sin\left(c+dx+\frac{\pi}{2}\right)a+a}dx+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}$$

$$\Big\downarrow \text{ 3125}$$

$$\frac{8a^2\sin(c+dx)}{3d\sqrt{a\cos(c+dx)+a}}+\frac{2a\sin(c+dx)\sqrt{a\cos(c+dx)+a}}{3d}$$

input
```
Int[(a + a*Cos[c + d*x])^(3/2),x]
```

output
```
(8*a^2*Sin[c + d*x])/(3*d*Sqrt[a + a*Cos[c + d*x]]) + (2*a*Sqrt[a + a*Cos[
c + d*x]]*Sin[c + d*x])/(3*d)
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3125
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[-2*b*(Cos
[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]])), x] /; FreeQ[{a, b, c, d}, x] && Eq
Q[a^2 - b^2, 0]
```

rule 3126
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n - 1)/(d*n)), x] + Simp[a*((2*n - 1)/n)
 Int[(a + b*Sin[c + d*x])^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && EqQ[
a^2 - b^2, 0] && IGtQ[n - 1/2, 0]
```

Maple [A] (verified)

Time = 0.73 (sec) , antiderivative size = 58, normalized size of antiderivative = 0.98

method	result	size
default	$\frac{4a^2 \cos\left(\frac{dx}{2}+\frac{c}{2}\right) \sin\left(\frac{dx}{2}+\frac{c}{2}\right) \left(\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2+2\right) \sqrt{2}}{3\sqrt{a \cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2}\, d}$	58

input
```
int((a+a*cos(d*x+c))^(3/2),x,method=_RETURNVERBOSE)
```

output
```
4/3*a^2*cos(1/2*d*x+1/2*c)*sin(1/2*d*x+1/2*c)*(cos(1/2*d*x+1/2*c)^2+2)*2^(
1/2)/(a*cos(1/2*d*x+1/2*c)^2)^(1/2)/d
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 44, normalized size of antiderivative = 0.75

$$\int (a + a\cos(c + dx))^{3/2}\,dx = \frac{2\,(a\cos{(dx + c)} + 5\,a)\sqrt{a\cos{(dx + c)} + a}\sin{(dx + c)}}{3\,(d\cos{(dx + c)} + d)}$$

input
```
integrate((a+a*cos(d*x+c))^(3/2),x, algorithm="fricas")
```

output
```
2/3*(a*cos(d*x + c) + 5*a)*sqrt(a*cos(d*x + c) + a)*sin(d*x + c)/(d*cos(d*
x + c) + d)
```

Sympy [F]

$$\int (a + a\cos(c + dx))^{3/2}\,dx = \int (a\cos{(c + dx)} + a)^{\frac{3}{2}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))**(3/2),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(3/2), x)
```

Maxima [A] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 38, normalized size of antiderivative = 0.64

$$\int (a + a\cos(c + dx))^{3/2}\,dx = \frac{\left(\sqrt{2}a\sin\left(\frac{3}{2}\,dx + \frac{3}{2}\,c\right) + 9\,\sqrt{2}a\sin\left(\frac{1}{2}\,dx + \frac{1}{2}\,c\right)\right)\sqrt{a}}{3\,d}$$

input
```
integrate((a+a*cos(d*x+c))^(3/2),x, algorithm="maxima")
```

output
```
1/3*(sqrt(2)*a*sin(3/2*d*x + 3/2*c) + 9*sqrt(2)*a*sin(1/2*d*x + 1/2*c))*sq
rt(a)/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 55, normalized size of antiderivative = 0.93

$$\int (a + a\cos(c + dx))^{3/2}\,dx = \frac{\sqrt{2}\left(a\operatorname{sgn}\left(\cos\left(\frac{1}{2}\,dx + \frac{1}{2}\,c\right)\right)\sin\left(\frac{3}{2}\,dx + \frac{3}{2}\,c\right) + 9\,a\operatorname{sgn}\left(\cos\left(\frac{1}{2}\,dx + \frac{1}{2}\,c\right)\right)\sin\left(\frac{1}{2}\,dx + \frac{1}{2}\,c\right)\right)\sqrt{a}}{3\,d}$$

input
```
integrate((a+a*cos(d*x+c))^(3/2),x, algorithm="giac")
```

output
```
1/3*sqrt(2)*(a*sgn(cos(1/2*d*x + 1/2*c))*sin(3/2*d*x + 3/2*c) + 9*a*sgn(co
s(1/2*d*x + 1/2*c))*sin(1/2*d*x + 1/2*c))*sqrt(a)/d
```

Mupad [F(-1)]

Timed out.

$$\int (a + a\cos(c + dx))^{3/2}\,dx = \int (a + a\,\cos(c + d\,x))^{3/2}\,dx$$

input
```
int((a + a*cos(c + d*x))^(3/2),x)
```

output
```
int((a + a*cos(c + d*x))^(3/2), x)
```

Reduce [F]

$$\int (a + a\cos(c + dx))^{3/2}\,dx = \sqrt{a}\,a\left(\int \sqrt{\cos(dx + c) + 1}dx + \int \sqrt{\cos(dx + c) + 1}\,\cos(dx + c)\,dx\right)$$

input
```
int((a+a*cos(d*x+c))^(3/2),x)
```

output
```
sqrt(a)*a*(int(sqrt(cos(c + d*x) + 1),x) + int(sqrt(cos(c + d*x) + 1)*cos(
c + d*x),x))
```

3.4 $\int \sqrt{a+a\cos(c+dx)}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 26

$$\int \sqrt{a+a\cos(c+dx)}\,dx = \frac{2a\sin(c+dx)}{d\sqrt{a+a\cos(c+dx)}}$$

output
```
2*a*sin(d*x+c)/d/(a+a*cos(d*x+c))^(1/2)
```

Mathematica [A] (verified)

Time = 0.10 (sec) , antiderivative size = 29, normalized size of antiderivative = 1.12

$$\int \sqrt{a+a\cos(c+dx)}\,dx = \frac{2\sqrt{a(1+\cos(c+dx))}\tan\left(\frac{1}{2}(c+dx)\right)}{d}$$

input
```
Integrate[Sqrt[a + a*Cos[c + d*x]],x]
```

output
```
(2*Sqrt[a*(1 + Cos[c + d*x])]*Tan[(c + d*x)/2])/d
```

Rubi [A] (verified)

Time = 0.18 (sec) , antiderivative size = 26, normalized size of antiderivative = 1.00, number of steps used = 2, number of rules used = 2, $\frac{\text{number of rules}}{\text{integrand size}} = 0.143$, Rules used = {3042, 3125}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \sqrt{a\cos(c+dx)+a}\,dx$$

$$\Big\downarrow \ 3042$$

$$\int \sqrt{a\sin\left(c+dx+\frac{\pi}{2}\right)+a}dx$$

$$\Big\downarrow \ 3125$$

$$\frac{2a\sin(c+dx)}{d\sqrt{a\cos(c+dx)+a}}$$

input
```
Int[Sqrt[a + a*Cos[c + d*x]],x]
```

output
```
(2*a*Sin[c + d*x])/(d*Sqrt[a + a*Cos[c + d*x]])
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3125
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[-2*b*(Cos
[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]])), x] /; FreeQ[{a, b, c, d}, x] && Eq
Q[a^2 - b^2, 0]
```

Maple [A] (verified)

Time = 0.84 (sec) , antiderivative size = 43, normalized size of antiderivative = 1.65

method	result	size
default	$\frac{2a\cos\left(\frac{dx}{2}+\frac{c}{2}\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)\sqrt{2}}{\sqrt{a\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\, d}$	43
risch	$-\frac{i\sqrt{2}\,\sqrt{a\left(e^{i(dx+c)}+1\right)^{2}e^{-i(dx+c)}}\,\left(e^{i(dx+c)}-1\right)}{\left(e^{i(dx+c)}+1\right)d}$	60

input
```
int((a+a*cos(d*x+c))^(1/2),x,method=_RETURNVERBOSE)
```

output
```
2*a*cos(1/2*d*x+1/2*c)*sin(1/2*d*x+1/2*c)*2^(1/2)/(a*cos(1/2*d*x+1/2*c)^2)
^(1/2)/d
```

Fricas [A] (verification not implemented)

Time = 0.07 (sec) , antiderivative size = 32, normalized size of antiderivative = 1.23

$$\int \sqrt{a+a\cos(c+dx)}\,dx = \frac{2\,\sqrt{a\cos\left(dx+c\right)+a}\sin\left(dx+c\right)}{d\cos\left(dx+c\right)+d}$$

input
```
integrate((a+a*cos(d*x+c))^(1/2),x, algorithm="fricas")
```

output
```
2*sqrt(a*cos(d*x + c) + a)*sin(d*x + c)/(d*cos(d*x + c) + d)
```

Sympy [F]

$$\int \sqrt{a+a\cos(c+dx)}\,dx = \int \sqrt{a\cos\left(c+dx\right)+a}\,dx$$

input
```
integrate((a+a*cos(d*x+c))**(1/2),x)
```

output
```
Integral(sqrt(a*cos(c + d*x) + a), x)
```

Maxima [A] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 20, normalized size of antiderivative = 0.77

$$\int \sqrt{a+a\cos(c+dx)}\,dx=\frac{2\sqrt{2}\sqrt{a}\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{d}$$

input
```
integrate((a+a*cos(d*x+c))^(1/2),x, algorithm="maxima")
```

output
```
2*sqrt(2)*sqrt(a)*sin(1/2*d*x + 1/2*c)/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 30, normalized size of antiderivative = 1.15

$$\int \sqrt{a+a\cos(c+dx)}\,dx=\frac{2\sqrt{2}\sqrt{a}\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{d}$$

input
```
integrate((a+a*cos(d*x+c))^(1/2),x, algorithm="giac")
```

output
```
2*sqrt(2)*sqrt(a)*sgn(cos(1/2*d*x + 1/2*c))*sin(1/2*d*x + 1/2*c)/d
```

Mupad [B] (verification not implemented)

Time = 0.22 (sec) , antiderivative size = 33, normalized size of antiderivative = 1.27

$$\int \sqrt{a+a\cos(c+dx)}\,dx=\frac{2\,\sin\left(c+d\,x\right)\,\sqrt{a\,\left(\cos\left(c+d\,x\right)+1\right)}}{d\,\left(\cos\left(c+d\,x\right)+1\right)}$$

input
```
int((a + a*cos(c + d*x))^(1/2),x)
```

output
```
(2*sin(c + d*x)*(a*(cos(c + d*x) + 1))^(1/2))/(d*(cos(c + d*x) + 1))
```

Reduce [F]

$$\int \sqrt{a + a\cos(c + dx)}\,dx = \sqrt{a}\left(\int \sqrt{\cos(dx + c) + 1}dx\right)$$

input
```
int((a+a*cos(d*x+c))^(1/2),x)
```

output
```
sqrt(a)*int(sqrt(cos(c + d*x) + 1),x)
```

3.5 $\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 46

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx = \frac{\sqrt{2}\text{arctanh}\left(\frac{\sqrt{a}\sin(c+dx)}{\sqrt{2}\sqrt{a+a\cos(c+dx)}}\right)}{\sqrt{a}d}$$

output
```
2^(1/2)*arctanh(1/2*a^(1/2)*sin(d*x+c)*2^(1/2)/(a+a*cos(d*x+c))^(1/2))/a^(
1/2)/d
```

Mathematica [A] (verified)

Time = 0.02 (sec) , antiderivative size = 40, normalized size of antiderivative = 0.87

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx = \frac{2\coth^{-1}\left(\sin\left(\frac{1}{2}(c+dx)\right)\right)\cos\left(\frac{1}{2}(c+dx)\right)}{d\sqrt{a(1+\cos(c+dx))}}$$

input
```
Integrate[1/Sqrt[a + a*Cos[c + d*x]],x]
```

output
```
(2*ArcCoth[Sin[(c + d*x)/2]]*Cos[(c + d*x)/2])/(d*Sqrt[a*(1 + Cos[c + d*x]
)])
```

Rubi [A] (verified)

Time = 0.20 (sec) , antiderivative size = 46, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 3, $\frac{\text{number of rules}}{\text{integrand size}} = 0.214$, Rules used = {3042, 3128, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{\sqrt{a\cos(c+dx)+a}}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\sqrt{a\sin\left(c+dx+\frac{\pi}{2}\right)+a}}dx$$

$$\Big\downarrow \text{3128}$$

$$-\frac{2\int \frac{1}{2a-\frac{a^2\sin^2(c+dx)}{\cos(c+dx)a+a}}d\left(-\frac{a\sin(c+dx)}{\sqrt{\cos(c+dx)a+a}}\right)}{d}$$

$$\Big\downarrow \text{219}$$

$$\frac{\sqrt{2}\text{arctanh}\left(\frac{\sqrt{a}\sin(c+dx)}{\sqrt{2}\sqrt{a\cos(c+dx)+a}}\right)}{\sqrt{a}d}$$

input
```
Int[1/Sqrt[a + a*Cos[c + d*x]],x]
```

output
```
(Sqrt[2]*ArcTanh[(Sqrt[a]*Sin[c + d*x])/(Sqrt[2]*Sqrt[a + a*Cos[c + d*x]])
])/(Sqrt[a]*d)
```

Defintions of rubi rules used

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3128
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[-2/d
Subst[Int[1/(2*a - x^2), x], x, b*(Cos[c + d*x]/Sqrt[a + b*Sin[c + d*x]])],
 x] /; FreeQ[{a, b, c, d}, x] && EqQ[a^2 - b^2, 0]
```

Maple [C] (warning: unable to verify)

Result contains higher order function than in optimal. Order 9 vs. order 3.

Time = 0.78 (sec) , antiderivative size = 56, normalized size of antiderivative = 1.22

method	result	size
default	$\frac{\sqrt{2}\,\mathrm{InverseJacobiAM}\left(\frac{dx}{2}+\frac{c}{2},1\right)}{d\sec\left(\frac{dx}{2}+\frac{c}{2}\right)\sqrt{a\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\,\mathrm{csgn}\left(\cos\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}$	56

input
```
int(1/(a+a*cos(d*x+c))^(1/2),x,method=_RETURNVERBOSE)
```

output
```
1/d*2^(1/2)/sec(1/2*d*x+1/2*c)/(a*cos(1/2*d*x+1/2*c)^2)^(1/2)/csgn(cos(1/2
*d*x+1/2*c))*InverseJacobiAM(1/2*d*x+1/2*c,1)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 135, normalized size of antiderivative = 2.93

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx = \left[\frac{\sqrt{2}\log\left(-\frac{\cos(dx+c)^2-\frac{2\sqrt{2}\sqrt{a\cos(dx+c)+a}\sin(dx+c)}{\sqrt{a}}-2\cos(dx+c)-3}{\cos(dx+c)^2+2\cos(dx+c)+1}\right)}{2\sqrt{a}d}, -\frac{\sqrt{2}\sqrt{-\frac{1}{a}}\arctan\left(\frac{\sqrt{2}\sqrt{a\cos(dx+c)+a}\sqrt{-\frac{1}{a}}\sin(dx+c)}{2(\cos(dx+c)+1)}\right)}{d}\right]$$

input
```
integrate(1/(a+a*cos(d*x+c))^(1/2),x, algorithm="fricas")
```

output
```
[1/2*sqrt(2)*log(-(cos(d*x + c)^2 - 2*sqrt(2)*sqrt(a*cos(d*x + c) + a)*sin
(d*x + c)/sqrt(a) - 2*cos(d*x + c) - 3)/(cos(d*x + c)^2 + 2*cos(d*x + c) +
 1))/(sqrt(a)*d), -sqrt(2)*sqrt(-1/a)*arctan(1/2*sqrt(2)*sqrt(a*cos(d*x +
c) + a)*sqrt(-1/a)*sin(d*x + c)/(cos(d*x + c) + 1))/d]
```

Sympy [F]

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx = \int \frac{1}{\sqrt{a\cos(c+dx)+a}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))**(1/2),x)
```

output
```
Integral(1/sqrt(a*cos(c + d*x) + a), x)
```

Maxima [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 90 vs. $2(37) = 74$.

Time = 0.17 (sec) , antiderivative size = 90, normalized size of antiderivative = 1.96

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx = \frac{\sqrt{2}\log\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+2\,\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right)-\sqrt{2}\log\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+\sin\right.}{2\,\sqrt{a}d}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(1/2),x, algorithm="maxima")
```

output
```
1/2*(sqrt(2)*log(cos(1/2*d*x + 1/2*c)^2 + sin(1/2*d*x + 1/2*c)^2 + 2*sin(1
/2*d*x + 1/2*c) + 1) - sqrt(2)*log(cos(1/2*d*x + 1/2*c)^2 + sin(1/2*d*x +
1/2*c)^2 - 2*sin(1/2*d*x + 1/2*c) + 1))/(sqrt(a)*d)
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 52, normalized size of antiderivative = 1.13

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx = \frac{\sqrt{2}\left(\log\left(\left|\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right|\right)-\log\left(\left|\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-1\right|\right)\right)}{2\,\sqrt{a}d\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(1/2),x, algorithm="giac")
```

output
```
1/2*sqrt(2)*(log(abs(sin(1/2*d*x + 1/2*c) + 1)) - log(abs(sin(1/2*d*x + 1/
2*c) - 1)))/(sqrt(a)*d*sgn(cos(1/2*d*x + 1/2*c)))
```

Mupad [B] (verification not implemented)

Time = 0.20 (sec) , antiderivative size = 45, normalized size of antiderivative = 0.98

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx=\frac{\mathrm{F}\left(\frac{c}{2}+\frac{d\,x}{2}\middle|1\right)\,\sqrt{\frac{2\,(a+a\,\cos(c+d\,x))}{a}}}{d\,\sqrt{a+a\,\cos\left(c+d\,x\right)}}$$

input
```
int(1/(a + a*cos(c + d*x))^(1/2),x)
```

output
```
(ellipticF(c/2 + (d*x)/2, 1)*((2*(a + a*cos(c + d*x)))/a)^(1/2))/(d*(a + a
*cos(c + d*x))^(1/2))
```

Reduce [F]

$$\int \frac{1}{\sqrt{a+a\cos(c+dx)}}\,dx=\frac{\sqrt{a}\left(\int \frac{\sqrt{\cos(dx+c)+1}}{\cos(dx+c)+1}dx\right)}{a}$$

input
```
int(1/(a+a*cos(d*x+c))^(1/2),x)
```

output
```
(sqrt(a)*int(sqrt(cos(c + d*x) + 1)/(cos(c + d*x) + 1),x))/a
```

3.6 $\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 77

$$\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx=\frac{\operatorname{arctanh}\left(\frac{\sqrt{a}\sin(c+dx)}{\sqrt{2}\sqrt{a+a\cos(c+dx)}}\right)}{2\sqrt{2}a^{3/2}d}+\frac{\sin(c+dx)}{2d(a+a\cos(c+dx))^{3/2}}$$

output
```
1/4*arctanh(1/2*a^(1/2)*sin(d*x+c)*2^(1/2)/(a+a*cos(d*x+c))^(1/2))*2^(1/2)
/a^(3/2)/d+1/2*sin(d*x+c)/d/(a+a*cos(d*x+c))^(3/2)
```

Mathematica [A] (verified)

Time = 0.10 (sec) , antiderivative size = 63, normalized size of antiderivative = 0.82

$$\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx=\frac{\cos^2\left(\frac{1}{2}(c+dx)\right)\left(\operatorname{arctanh}\left(\sin\left(\frac{1}{2}(c+dx)\right)\right)\cos\left(\frac{1}{2}(c+dx)\right)+\tan\left(\frac{1}{2}(c+dx\right.\right.}{d(a(1+\cos(c+dx)))^{3/2}}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(-3/2),x]
```

output
```
(Cos[(c + d*x)/2]^2*(ArcTanh[Sin[(c + d*x)/2]]*Cos[(c + d*x)/2] + Tan[(c +
 d*x)/2]))/(d*(a*(1 + Cos[c + d*x]))^(3/2))
```

Rubi [A] (verified)

Time = 0.28 (sec) , antiderivative size = 77, normalized size of antiderivative = 1.00, number of steps used = 6, number of rules used = 5, $\frac{\text{number of rules}}{\text{integrand size}} = 0.357$, Rules used = {3042, 3129, 3042, 3128, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a\cos(c+dx)+a)^{3/2}}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{3/2}}dx$$

$$\Big\downarrow \text{3129}$$

$$\frac{\int \frac{1}{\sqrt{\cos(c+dx)a+a}}dx}{4a}+\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{\int \frac{1}{\sqrt{\sin\left(c+dx+\frac{\pi}{2}\right)a+a}}dx}{4a}+\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}$$

$$\Big\downarrow \text{3128}$$

$$\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}-\frac{\int \frac{1}{2a-\frac{a^2\sin^2(c+dx)}{\cos(c+dx)a+a}}d\left(-\frac{a\sin(c+dx)}{\sqrt{\cos(c+dx)a+a}}\right)}{2ad}$$

$$\Big\downarrow \text{219}$$

$$\frac{\text{arctanh}\left(\frac{\sqrt{a}\sin(c+dx)}{\sqrt{2}\sqrt{a\cos(c+dx)+a}}\right)}{2\sqrt{2}a^{3/2}d}+\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}$$

input
```
Int[(a + a*Cos[c + d*x])^(-3/2),x]
```

output
```
ArcTanh[(Sqrt[a]*Sin[c + d*x])/(Sqrt[2]*Sqrt[a + a*Cos[c + d*x]])]/(2*Sqrt
[2]*a^(3/2)*d) + Sin[c + d*x]/(2*d*(a + a*Cos[c + d*x])^(3/2))
```

Defintions of rubi rules used

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3128
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[-2/d
Subst[Int[1/(2*a - x^2), x], x, b*(Cos[c + d*x]/Sqrt[a + b*Sin[c + d*x]])],
 x] /; FreeQ[{a, b, c, d}, x] && EqQ[a^2 - b^2, 0]
```

rule 3129
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[b*Cos[c
+ d*x]*((a + b*Sin[c + d*x])^n/(a*d*(2*n + 1))), x] + Simp[(n + 1)/(a*(2*n
+ 1))   Int[(a + b*Sin[c + d*x])^(n + 1), x], x] /; FreeQ[{a, b, c, d}, x]
&& EqQ[a^2 - b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [B] (verified)

Leaf count of result is larger than twice the leaf count of optimal. 137 vs. $2(62) = 124$.

Time = 0.75 (sec) , antiderivative size = 138, normalized size of antiderivative = 1.79

method	result	size
default	$\frac{\sqrt{a\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\,\left(\sqrt{2}\,\ln\left(\frac{4\sqrt{a}\,\sqrt{a\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}+4a}{\cos\left(\frac{dx}{2}+\frac{c}{2}\right)}\right)\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}a+\sqrt{2}\,\sqrt{a\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\,\sqrt{a}\right)}{4a^{\frac{5}{2}}\cos\left(\frac{dx}{2}+\frac{c}{2}\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)\sqrt{a\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\,d}$	138

input
```
int(1/(a+a*cos(d*x+c))^(3/2),x,method=_RETURNVERBOSE)
```

output
```
1/4/a^(5/2)/cos(1/2*d*x+1/2*c)*(a*sin(1/2*d*x+1/2*c)^2)^(1/2)*(2^(1/2)*ln(
2*(2*a^(1/2)*(a*sin(1/2*d*x+1/2*c)^2)^(1/2)+2*a)/cos(1/2*d*x+1/2*c))*cos(1
/2*d*x+1/2*c)^2*a+2^(1/2)*(a*sin(1/2*d*x+1/2*c)^2)^(1/2)*a^(1/2))/sin(1/2*
d*x+1/2*c)/(a*cos(1/2*d*x+1/2*c)^2)^(1/2)/d
```

Fricas [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 153 vs. $2(62) = 124$.

Time = 0.09 (sec) , antiderivative size = 153, normalized size of antiderivative = 1.99

$$\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx = \frac{\sqrt{2}\left(\cos(dx+c)^2+2\cos(dx+c)+1\right)\sqrt{a}\log\left(-\frac{a\cos(dx+c)^2-2\sqrt{2}\sqrt{a\cos(dx+c)-}}{\cos(dx+c)^2+2}\right.}{8\left(a^2d\cos(dx+c)^2+2a^2d\,c\right.}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(3/2),x, algorithm="fricas")
```

output
```
1/8*(sqrt(2)*(cos(d*x + c)^2 + 2*cos(d*x + c) + 1)*sqrt(a)*log(-(a*cos(d*x
 + c)^2 - 2*sqrt(2)*sqrt(a*cos(d*x + c) + a)*sqrt(a)*sin(d*x + c) - 2*a*co
s(d*x + c) - 3*a)/(cos(d*x + c)^2 + 2*cos(d*x + c) + 1)) + 4*sqrt(a*cos(d*
x + c) + a)*sin(d*x + c))/(a^2*d*cos(d*x + c)^2 + 2*a^2*d*cos(d*x + c) + a
^2*d)
```

Sympy [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx = \int \frac{1}{(a\cos(c+dx)+a)^{\frac{3}{2}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))**(3/2),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(-3/2), x)
```

Maxima [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 15721 vs. $2(62) = 124$.

Time = 0.70 (sec) , antiderivative size = 15721, normalized size of antiderivative = 204.17

$$\int \frac{1}{(a + a\cos(c + dx))^{3/2}}\,dx = \text{Too large to display}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(3/2),x, algorithm="maxima")
```

output
```
1/4*(32*(cos(3/2*d*x + 3/2*c)*sin(2*d*x + 2*c) + cos(2*d*x + 2*c)*sin(3/2*
d*x + 3/2*c) + cos(d*x + c)*sin(3/2*d*x + 3/2*c) + cos(3/2*d*x + 3/2*c)*si
n(d*x + c))*cos(3*d*x + 3*c)^2 + 96*(cos(3/2*d*x + 3/2*c)*sin(3*d*x + 3*c)
 + 3*cos(3/2*d*x + 3/2*c)*sin(2*d*x + 2*c) - (3*cos(d*x + c) + 1)*sin(3/2*
d*x + 3/2*c) - cos(3*d*x + 3*c)*sin(3/2*d*x + 3/2*c) - 3*cos(2*d*x + 2*c)*
sin(3/2*d*x + 3/2*c) + 3*cos(3/2*d*x + 3/2*c)*sin(d*x + c))*cos(4/3*arctan
2(sin(3/2*d*x + 3/2*c), cos(3/2*d*x + 3/2*c)))^2 + 96*(cos(3/2*d*x + 3/2*c
)*sin(3*d*x + 3*c) + 3*cos(3/2*d*x + 3/2*c)*sin(2*d*x + 2*c) - (3*cos(d*x
+ c) + 1)*sin(3/2*d*x + 3/2*c) - cos(3*d*x + 3*c)*sin(3/2*d*x + 3/2*c) - 3
*cos(2*d*x + 2*c)*sin(3/2*d*x + 3/2*c) + 3*cos(3/2*d*x + 3/2*c)*sin(d*x +
c))*cos(2/3*arctan2(sin(3/2*d*x + 3/2*c), cos(3/2*d*x + 3/2*c)))^2 - 32*(c
os(3/2*d*x + 3/2*c)*sin(2*d*x + 2*c) + cos(2*d*x + 2*c)*sin(3/2*d*x + 3/2*
c) + cos(d*x + c)*sin(3/2*d*x + 3/2*c) + cos(3/2*d*x + 3/2*c)*sin(d*x + c)
)*sin(3*d*x + 3*c)^2 + 32*(6*cos(d*x + c) + 1)*cos(2*d*x + 2*c)*sin(3/2*d*
x + 3/2*c) + 96*cos(2*d*x + 2*c)^2*sin(3/2*d*x + 3/2*c) + 96*sin(2*d*x + 2
*c)^2*sin(3/2*d*x + 3/2*c) + 96*(cos(3/2*d*x + 3/2*c)*sin(3*d*x + 3*c) + 3
*cos(3/2*d*x + 3/2*c)*sin(2*d*x + 2*c) - (3*cos(d*x + c) + 1)*sin(3/2*d*x
+ 3/2*c) - cos(3*d*x + 3*c)*sin(3/2*d*x + 3/2*c) - 3*cos(2*d*x + 2*c)*sin(
3/2*d*x + 3/2*c) + 3*cos(3/2*d*x + 3/2*c)*sin(d*x + c))*sin(4/3*arctan2(si
n(3/2*d*x + 3/2*c), cos(3/2*d*x + 3/2*c)))^2 + 96*(cos(3/2*d*x + 3/2*c)...
```

Giac [A] (verification not implemented)

Time = 0.13 (sec) , antiderivative size = 112, normalized size of antiderivative = 1.45

$$\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx = \frac{\sqrt{2}\left(\frac{\log\left(\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right)}{a\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)} - \frac{\log\left(-\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right)}{a\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)} - \frac{2\,\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{\left(\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-1\right)a\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\right.\right.}\right.}{8\,\sqrt{a}d}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(3/2),x, algorithm="giac")
```

output
```
1/8*sqrt(2)*(log(sin(1/2*d*x + 1/2*c) + 1)/(a*sgn(cos(1/2*d*x + 1/2*c))) -
 log(-sin(1/2*d*x + 1/2*c) + 1)/(a*sgn(cos(1/2*d*x + 1/2*c))) - 2*sin(1/2*
d*x + 1/2*c)/((sin(1/2*d*x + 1/2*c)^2 - 1)*a*sgn(cos(1/2*d*x + 1/2*c))))/(
sqrt(a)*d)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx = \int \frac{1}{\left(a+a\,\cos\left(c+d\,x\right)\right)^{3/2}}\,dx$$

input
```
int(1/(a + a*cos(c + d*x))^(3/2),x)
```

output
```
int(1/(a + a*cos(c + d*x))^(3/2), x)
```

Reduce [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{3/2}}\,dx = \frac{\sqrt{a}\left(\int \frac{\sqrt{\cos(dx+c)+1}}{\cos(dx+c)^2+2\cos(dx+c)+1}dx\right)}{a^2}$$

input
```
int(1/(a+a*cos(d*x+c))^(3/2),x)
```

output
```
(sqrt(a)*int(sqrt(cos(c + d*x) + 1)/(cos(c + d*x)**2 + 2*cos(c + d*x) + 1)
,x))/a**2
```

3.7 $\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 107

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \frac{3\operatorname{arctanh}\left(\frac{\sqrt{a}\sin(c+dx)}{\sqrt{2}\sqrt{a+a\cos(c+dx)}}\right)}{16\sqrt{2}a^{5/2}d} + \frac{\sin(c+dx)}{4d(a+a\cos(c+dx))^{5/2}} + \frac{3\sin(c+dx)}{16ad(a+a\cos(c+dx))^{3/2}}$$

output
```
3/32*arctanh(1/2*a^(1/2)*sin(d*x+c)*2^(1/2)/(a+a*cos(d*x+c))^(1/2))*2^(1/2
)/a^(5/2)/d+1/4*sin(d*x+c)/d/(a+a*cos(d*x+c))^(5/2)+3/16*sin(d*x+c)/a/d/(a
+a*cos(d*x+c))^(3/2)
```

Mathematica [A] (verified)

Time = 0.24 (sec) , antiderivative size = 65, normalized size of antiderivative = 0.61

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \frac{24\operatorname{arctanh}\left(\sin\left(\frac{1}{2}(c+dx)\right)\right)\cos^5\left(\frac{1}{2}(c+dx)\right) + 14\sin(c+dx) + 3\sin(2(c+}{32d(a(1+\cos(c+dx)))^{5/2}}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(-5/2),x]
```

output
```
(24*ArcTanh[Sin[(c + d*x)/2]]*Cos[(c + d*x)/2]^5 + 14*Sin[c + d*x] + 3*Sin
[2*(c + d*x)])/(32*d*(a*(1 + Cos[c + d*x]))^(5/2))
```

Rubi [A] (verified)

Time = 0.38 (sec) , antiderivative size = 112, normalized size of antiderivative = 1.05, number of steps used = 8, number of rules used = 7, $\frac{\text{number of rules}}{\text{integrand size}} = 0.500$, Rules used = {3042, 3129, 3042, 3129, 3042, 3128, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a\cos(c+dx)+a)^{5/2}}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{5/2}}dx$$

$$\Big\downarrow \text{3129}$$

$$\frac{3\int \frac{1}{(\cos(c+dx)a+a)^{3/2}}dx}{8a}+\frac{\sin(c+dx)}{4d(a\cos(c+dx)+a)^{5/2}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{3\int \frac{1}{\left(\sin\left(c+dx+\frac{\pi}{2}\right)a+a\right)^{3/2}}dx}{8a}+\frac{\sin(c+dx)}{4d(a\cos(c+dx)+a)^{5/2}}$$

$$\Big\downarrow \text{3129}$$

$$\frac{3\left(\frac{\int \frac{1}{\sqrt{\cos(c+dx)a+a}}dx}{4a}+\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}\right)}{8a}+\frac{\sin(c+dx)}{4d(a\cos(c+dx)+a)^{5/2}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{3\left(\frac{\int \frac{1}{\sqrt{\sin\left(c+dx+\frac{\pi}{2}\right)a+a}}dx}{4a}+\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}\right)}{8a}+\frac{\sin(c+dx)}{4d(a\cos(c+dx)+a)^{5/2}}$$

$$\Big\downarrow \text{3128}$$

$$\frac{3\left(\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}-\frac{\int \frac{1}{2a-\frac{a^2\sin^2(c+dx)}{\cos(c+dx)a+a}}d\left(-\frac{a\sin(c+dx)}{\sqrt{\cos(c+dx)a+a}}\right)}{2ad}\right)}{8a}+\frac{\sin(c+dx)}{4d(a\cos(c+dx)+a)^{5/2}}$$

$$\Big\downarrow \text{219}$$

$$\frac{3\left(\frac{\operatorname{arctanh}\left(\frac{\sqrt{a}\sin(c+dx)}{\sqrt{2}\sqrt{a\cos(c+dx)+a}}\right)}{2\sqrt{2}a^{3/2}d}+\frac{\sin(c+dx)}{2d(a\cos(c+dx)+a)^{3/2}}\right)}{8a}+\frac{\sin(c+dx)}{4d(a\cos(c+dx)+a)^{5/2}}$$

input
```
Int[(a + a*Cos[c + d*x])^(-5/2),x]
```

output
```
Sin[c + d*x]/(4*d*(a + a*Cos[c + d*x])^(5/2)) + (3*(ArcTanh[(Sqrt[a]*Sin[c
 + d*x])/(Sqrt[2]*Sqrt[a + a*Cos[c + d*x]])]/(2*Sqrt[2]*a^(3/2)*d) + Sin[c
 + d*x]/(2*d*(a + a*Cos[c + d*x])^(3/2))))/(8*a)
```

Defintions of rubi rules used

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3128
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[-2/d
Subst[Int[1/(2*a - x^2), x], x, b*(Cos[c + d*x]/Sqrt[a + b*Sin[c + d*x]])],
 x] /; FreeQ[{a, b, c, d}, x] && EqQ[a^2 - b^2, 0]
```

rule 3129
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[b*Cos[c
+ d*x]*((a + b*Sin[c + d*x])^n/(a*d*(2*n + 1))), x] + Simp[(n + 1)/(a*(2*n
+ 1))   Int[(a + b*Sin[c + d*x])^(n + 1), x], x] /; FreeQ[{a, b, c, d}, x]
&& EqQ[a^2 - b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.78 (sec) , antiderivative size = 174, normalized size of antiderivative = 1.63

method	result
default	$\frac{\sqrt{a \sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\,\left(3\sqrt{2}\,\ln\left(\frac{4\sqrt{a}\,\sqrt{a \sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}+4a}{\cos\left(\frac{dx}{2}+\frac{c}{2}\right)}\right) a \cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{4}+3\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}\sqrt{2}\,\sqrt{a}\,\sqrt{a \sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}+2\sqrt{2}\,\sqrt{a \sin\left(\frac{dx}{2}-\right.}\right.}{32 a^{\frac{7}{2}} \cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{3} \sin\left(\frac{dx}{2}+\frac{c}{2}\right) \sqrt{a \cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\, d}$

input
```
int(1/(a+a*cos(d*x+c))^(5/2),x,method=_RETURNVERBOSE)
```

output
```
1/32/a^(7/2)/cos(1/2*d*x+1/2*c)^3*(a*sin(1/2*d*x+1/2*c)^2)^(1/2)*(3*2^(1/2
)*ln(2*(2*a^(1/2)*(a*sin(1/2*d*x+1/2*c)^2)^(1/2)+2*a)/cos(1/2*d*x+1/2*c))*
a*cos(1/2*d*x+1/2*c)^4+3*cos(1/2*d*x+1/2*c)^2*2^(1/2)*a^(1/2)*(a*sin(1/2*d
*x+1/2*c)^2)^(1/2)+2*2^(1/2)*(a*sin(1/2*d*x+1/2*c)^2)^(1/2)*a^(1/2))/sin(1
/2*d*x+1/2*c)/(a*cos(1/2*d*x+1/2*c)^2)^(1/2)/d
```

Fricas [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 188 vs. $2(88) = 176$.

Time = 0.09 (sec) , antiderivative size = 188, normalized size of antiderivative = 1.76

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \frac{3\sqrt{2}\left(\cos\left(dx+c\right)^{3}+3\cos\left(dx+c\right)^{2}+3\cos\left(dx+c\right)+1\right)\sqrt{a}\log\left(-\frac{a\cos(dx}{}\right.}{64\left(a^{3}d\cos\left(dx+c\right)^{3}\right.}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(5/2),x, algorithm="fricas")
```

output
```
1/64*(3*sqrt(2)*(cos(d*x + c)^3 + 3*cos(d*x + c)^2 + 3*cos(d*x + c) + 1)*s
qrt(a)*log(-(a*cos(d*x + c)^2 - 2*sqrt(2)*sqrt(a*cos(d*x + c) + a)*sqrt(a)
*sin(d*x + c) - 2*a*cos(d*x + c) - 3*a)/(cos(d*x + c)^2 + 2*cos(d*x + c) +
 1)) + 4*sqrt(a*cos(d*x + c) + a)*(3*cos(d*x + c) + 7)*sin(d*x + c))/(a^3*
d*cos(d*x + c)^3 + 3*a^3*d*cos(d*x + c)^2 + 3*a^3*d*cos(d*x + c) + a^3*d)
```

Sympy [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \int \frac{1}{(a\cos{(c+dx)}+a)^{\frac{5}{2}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))**(5/2),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(-5/2), x)
```

Maxima [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 84332 vs. 2(88) = 176.

Time = 14.30 (sec) , antiderivative size = 84332, normalized size of antiderivative = 788.15

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \text{Too large to display}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(5/2),x, algorithm="maxima")
```

output
```
1/32*(512*((2*sin(2*d*x + 2*c) + sin(d*x + c))*cos(5/2*d*x + 5/2*c) + cos(
5/2*d*x + 5/2*c)*sin(4*d*x + 4*c) + 2*cos(5/2*d*x + 5/2*c)*sin(3*d*x + 3*c
) + (2*cos(2*d*x + 2*c) + cos(d*x + c))*sin(5/2*d*x + 5/2*c) + cos(4*d*x +
 4*c)*sin(5/2*d*x + 5/2*c) + 2*cos(3*d*x + 3*c)*sin(5/2*d*x + 5/2*c))*cos(
5*d*x + 5*c)^2 + 2560*(5*(2*sin(2*d*x + 2*c) + sin(d*x + c))*cos(5/2*d*x +
 5/2*c) + cos(5/2*d*x + 5/2*c)*sin(5*d*x + 5*c) + 5*cos(5/2*d*x + 5/2*c)*s
in(4*d*x + 4*c) + 10*cos(5/2*d*x + 5/2*c)*sin(3*d*x + 3*c) - (10*cos(2*d*x
 + 2*c) + 5*cos(d*x + c) + 1)*sin(5/2*d*x + 5/2*c) - cos(5*d*x + 5*c)*sin(
5/2*d*x + 5/2*c) - 5*cos(4*d*x + 4*c)*sin(5/2*d*x + 5/2*c) - 10*cos(3*d*x
+ 3*c)*sin(5/2*d*x + 5/2*c))*cos(8/5*arctan2(sin(5/2*d*x + 5/2*c), cos(5/2
*d*x + 5/2*c)))^2 + 10240*(5*(2*sin(2*d*x + 2*c) + sin(d*x + c))*cos(5/2*d
*x + 5/2*c) + cos(5/2*d*x + 5/2*c)*sin(5*d*x + 5*c) + 5*cos(5/2*d*x + 5/2*
c)*sin(4*d*x + 4*c) + 10*cos(5/2*d*x + 5/2*c)*sin(3*d*x + 3*c) - (10*cos(2
*d*x + 2*c) + 5*cos(d*x + c) + 1)*sin(5/2*d*x + 5/2*c) - cos(5*d*x + 5*c)*
sin(5/2*d*x + 5/2*c) - 5*cos(4*d*x + 4*c)*sin(5/2*d*x + 5/2*c) - 10*cos(3*
d*x + 3*c)*sin(5/2*d*x + 5/2*c))*cos(6/5*arctan2(sin(5/2*d*x + 5/2*c), cos
(5/2*d*x + 5/2*c)))^2 + 10240*(5*(2*sin(2*d*x + 2*c) + sin(d*x + c))*cos(5
/2*d*x + 5/2*c) + cos(5/2*d*x + 5/2*c)*sin(5*d*x + 5*c) + 5*cos(5/2*d*x +
5/2*c)*sin(4*d*x + 4*c) + 10*cos(5/2*d*x + 5/2*c)*sin(3*d*x + 3*c) - (10*c
os(2*d*x + 2*c) + 5*cos(d*x + c) + 1)*sin(5/2*d*x + 5/2*c) - cos(5*d*x ...
```

Giac [A] (verification not implemented)

Time = 0.16 (sec) , antiderivative size = 129, normalized size of antiderivative = 1.21

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \frac{\sqrt{2}\left(\frac{3\log\left(\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right)}{a^2\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)} - \frac{3\log\left(-\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right)}{a^2\mathrm{sgn}\left(\cos\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)} - \frac{2\left(3\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3-5\sin\left(\frac{1}{2}\,dx\right.\right.}{\left(\sin\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-1\right)^2a^2\mathrm{sgn}\left(\cos\left(\frac{1}{2}\right.\right.}\right.}{64\sqrt{a}d}$$

input
```
integrate(1/(a+a*cos(d*x+c))^(5/2),x, algorithm="giac")
```

output
```
1/64*sqrt(2)*(3*log(sin(1/2*d*x + 1/2*c) + 1)/(a^2*sgn(cos(1/2*d*x + 1/2*c
))) - 3*log(-sin(1/2*d*x + 1/2*c) + 1)/(a^2*sgn(cos(1/2*d*x + 1/2*c))) - 2
*(3*sin(1/2*d*x + 1/2*c)^3 - 5*sin(1/2*d*x + 1/2*c))/((sin(1/2*d*x + 1/2*c
)^2 - 1)^2*a^2*sgn(cos(1/2*d*x + 1/2*c))))/(sqrt(a)*d)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \int \frac{1}{(a+a\,\cos\left(c+d\,x\right))^{5/2}}\,dx$$

input
```
int(1/(a + a*cos(c + d*x))^(5/2),x)
```

output
```
int(1/(a + a*cos(c + d*x))^(5/2), x)
```

Reduce [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{5/2}}\,dx = \frac{\sqrt{a}\left(\int \frac{\sqrt{\cos(dx+c)+1}}{\cos(dx+c)^3+3\cos(dx+c)^2+3\cos(dx+c)+1}dx\right)}{a^3}$$

input
```
int(1/(a+a*cos(d*x+c))^(5/2),x)
```

output
```
(sqrt(a)*int(sqrt(cos(c + d*x) + 1)/(cos(c + d*x)**3 + 3*cos(c + d*x)**2 +
 3*cos(c + d*x) + 1),x))/a**3
```

3.8 $\int (a+a\cos(c+dx))^{4/3}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 67

$$\int (a+a\cos(c+dx))^{4/3}\,dx=\frac{2\,2^{5/6}a\sqrt[3]{a+a\cos(c+dx)}\,\text{Hypergeometric2F1}\left(-\frac{5}{6},\frac{1}{2},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)\sin(c+dx)}{d(1+\cos(c+dx))^{5/6}}$$

output
```
2*2^(5/6)*a*(a+a*cos(d*x+c))^(1/3)*hypergeom([-5/6, 1/2],[3/2],1/2-1/2*cos
(d*x+c))*sin(d*x+c)/d/(1+cos(d*x+c))^(5/6)
```

Mathematica [A] (verified)

Time = 0.15 (sec) , antiderivative size = 69, normalized size of antiderivative = 1.03

$$\int (a+a\cos(c+dx))^{4/3}\,dx = -\frac{6(a(1+\cos(c+dx)))^{4/3}\cot\left(\frac{1}{2}(c+dx)\right)\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{11}{6},\frac{17}{6},\cos^2\left(\frac{1}{2}(c+dx)\right)\right)\sqrt{\sin^2\left(\frac{1}{2}(c+a\right.}}{11d}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(4/3),x]
```

output
```
(-6*(a*(1 + Cos[c + d*x]))^(4/3)*Cot[(c + d*x)/2]*Hypergeometric2F1[1/2, 1
1/6, 17/6, Cos[(c + d*x)/2]^2]*Sqrt[Sin[(c + d*x)/2]^2])/(11*d)
```

Rubi [A] (verified)

Time = 0.28 (sec) , antiderivative size = 67, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a\cos(c+dx)+a)^{4/3}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{4/3}dx$$

$$\Big\downarrow \text{3131}$$

$$\frac{a\sqrt[3]{a\cos(c+dx)+a}\int (\cos(c+dx)+1)^{4/3}dx}{\sqrt[3]{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{a\sqrt[3]{a\cos(c+dx)+a}\int \left(\sin\left(c+dx+\frac{\pi}{2}\right)+1\right)^{4/3}dx}{\sqrt[3]{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{3130}$$

$$\frac{2\ 2^{5/6}a\sin(c+dx)\sqrt[3]{a\cos(c+dx)+a}\,\text{Hypergeometric2F1}\left(-\frac{5}{6},\frac{1}{2},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{d(\cos(c+dx)+1)^{5/6}}$$

input
```
Int[(a + a*Cos[c + d*x])^(4/3),x]
```

output
```
(2*2^(5/6)*a*(a + a*Cos[c + d*x])^(1/3)*Hypergeometric2F1[-5/6, 1/2, 3/2,
(1 - Cos[c + d*x])/2]*Sin[c + d*x])/(d*(1 + Cos[c + d*x])^(5/6))
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] &&  !GtQ[a, 0]
```

Maple [F]

$$\int (a+a\cos(dx+c))^{\frac{4}{3}}\,dx$$

input
```
int((a+a*cos(d*x+c))^(4/3),x)
```

output
```
int((a+a*cos(d*x+c))^(4/3),x)
```

Fricas [F]

$$\int (a+a\cos(c+dx))^{4/3}\,dx=\int (a\cos(dx+c)+a)^{\frac{4}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(4/3),x, algorithm="fricas")
```

output
```
integral((a*cos(d*x + c) + a)^(4/3), x)
```

Sympy [F]

$$\int (a+a\cos(c+dx))^{4/3}\,dx=\int (a\cos{(c+dx)}+a)^{\frac{4}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))**(4/3),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(4/3), x)
```

Maxima [F]

$$\int (a+a\cos(c+dx))^{4/3}\,dx=\int (a\cos{(dx+c)}+a)^{\frac{4}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(4/3),x, algorithm="maxima")
```

output
```
integrate((a*cos(d*x + c) + a)^(4/3), x)
```

Giac [F]

$$\int (a+a\cos(c+dx))^{4/3}\,dx=\int (a\cos{(dx+c)}+a)^{\frac{4}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(4/3),x, algorithm="giac")
```

output
```
integrate((a*cos(d*x + c) + a)^(4/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+a\cos(c+dx))^{4/3}\,dx = \int (a+a\ \cos(c+d\,x))^{4/3}\,dx$$

input
```
int((a + a*cos(c + d*x))^(4/3),x)
```

output
```
int((a + a*cos(c + d*x))^(4/3), x)
```

Reduce [F]

$$\int (a+a\cos(c+dx))^{4/3}\,dx = a^{\frac{4}{3}}\left(\int (\cos(dx+c)+1)^{\frac{1}{3}}\,dx + \int (\cos(dx+c)+1)^{\frac{1}{3}}\cos(dx+c)\,dx\right)$$

input
```
int((a+a*cos(d*x+c))^(4/3),x)
```

output
```
a**(1/3)*a*(int((cos(c + d*x) + 1)**(1/3),x) + int((cos(c + d*x) + 1)**(1/
3)*cos(c + d*x),x))
```

3.9 $\int (a+a\cos(c+dx))^{2/3}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 66

$$\int (a+a\cos(c+dx))^{2/3}\,dx=\frac{2\sqrt[6]{2}(a+a\cos(c+dx))^{2/3}\,\text{Hypergeometric2F1}\left(-\frac{1}{6},\frac{1}{2},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)\sin(c+dx)}{d(1+\cos(c+dx))^{7/6}}$$

output
```
2*2^(1/6)*(a+a*cos(d*x+c))^(2/3)*hypergeom([-1/6, 1/2],[3/2],1/2-1/2*cos(d
*x+c))*sin(d*x+c)/d/(1+cos(d*x+c))^(7/6)
```

Mathematica [A] (verified)

Time = 0.08 (sec) , antiderivative size = 69, normalized size of antiderivative = 1.05

$$\int (a+a\cos(c+dx))^{2/3}\,dx = -\frac{6(a(1+\cos(c+dx)))^{2/3}\cot\left(\frac{1}{2}(c+dx)\right)\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{7}{6},\frac{13}{6},\cos^2\left(\frac{1}{2}(c+dx)\right)\right)\sqrt{\sin^2\left(\frac{1}{2}(c+dx\right.}}{7d}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(2/3),x]
```

output
```
(-6*(a*(1 + Cos[c + d*x]))^(2/3)*Cot[(c + d*x)/2]*Hypergeometric2F1[1/2, 7
/6, 13/6, Cos[(c + d*x)/2]^2]*Sqrt[Sin[(c + d*x)/2]^2])/(7*d)
```

Rubi [A] (verified)

Time = 0.28 (sec) , antiderivative size = 66, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a\cos(c+dx)+a)^{2/3}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{2/3}dx$$

$$\Big\downarrow \text{3131}$$

$$\frac{(a\cos(c+dx)+a)^{2/3}\int (\cos(c+dx)+1)^{2/3}dx}{(\cos(c+dx)+1)^{2/3}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{(a\cos(c+dx)+a)^{2/3}\int \left(\sin\left(c+dx+\frac{\pi}{2}\right)+1\right)^{2/3}dx}{(\cos(c+dx)+1)^{2/3}}$$

$$\Big\downarrow \text{3130}$$

$$\frac{2\sqrt[6]{2}\sin(c+dx)(a\cos(c+dx)+a)^{2/3}\,\text{Hypergeometric2F1}\left(-\frac{1}{6},\frac{1}{2},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{d(\cos(c+dx)+1)^{7/6}}$$

input
```
Int[(a + a*Cos[c + d*x])^(2/3),x]
```

output
```
(2*2^(1/6)*(a + a*Cos[c + d*x])^(2/3)*Hypergeometric2F1[-1/6, 1/2, 3/2, (1
 - Cos[c + d*x])/2]*Sin[c + d*x])/(d*(1 + Cos[c + d*x])^(7/6))
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] &&  !GtQ[a, 0]
```

Maple [F]

$$\int (a+a\cos(dx+c))^{\frac{2}{3}}\,dx$$

input
```
int((a+a*cos(d*x+c))^(2/3),x)
```

output
```
int((a+a*cos(d*x+c))^(2/3),x)
```

Fricas [F]

$$\int (a+a\cos(c+dx))^{2/3}\,dx=\int (a\cos(dx+c)+a)^{\frac{2}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(2/3),x, algorithm="fricas")
```

output
```
integral((a*cos(d*x + c) + a)^(2/3), x)
```

Sympy [F]

$$\int (a+a\cos(c+dx))^{2/3}\,dx=\int (a\cos{(c+dx)}+a)^{\frac{2}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))**(2/3),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(2/3), x)
```

Maxima [F]

$$\int (a+a\cos(c+dx))^{2/3}\,dx=\int (a\cos{(dx+c)}+a)^{\frac{2}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(2/3),x, algorithm="maxima")
```

output
```
integrate((a*cos(d*x + c) + a)^(2/3), x)
```

Giac [F]

$$\int (a+a\cos(c+dx))^{2/3}\,dx=\int (a\cos{(dx+c)}+a)^{\frac{2}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(2/3),x, algorithm="giac")
```

output
```
integrate((a*cos(d*x + c) + a)^(2/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+a\cos(c+dx))^{2/3}\,dx=\int (a+a\,\cos\left(c+d\,x\right))^{2/3}\,dx$$

input
```
int((a + a*cos(c + d*x))^(2/3),x)
```

output
```
int((a + a*cos(c + d*x))^(2/3), x)
```

Reduce [F]

$$\int (a+a\cos(c+dx))^{2/3}\,dx=a^{\frac{2}{3}}\left(\int \left(\cos\left(dx+c\right)+1\right)^{\frac{2}{3}}dx\right)$$

input
```
int((a+a*cos(d*x+c))^(2/3),x)
```

output
```
a**(2/3)*int((cos(c + d*x) + 1)**(2/3),x)
```

3.10 $\int \sqrt[3]{a+a\cos(c+dx)}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 65

$$\int \sqrt[3]{a+a\cos(c+dx)}\,dx = \frac{2^{5/6}\sqrt[3]{a+a\cos(c+dx)}\,\text{Hypergeometric2F1}\left(\frac{1}{6},\frac{1}{2},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)\sin(c+dx)}{d(1+\cos(c+dx))^{5/6}}$$

output
```
2^(5/6)*(a+a*cos(d*x+c))^(1/3)*hypergeom([1/6, 1/2],[3/2],1/2-1/2*cos(d*x+
c))*sin(d*x+c)/d/(1+cos(d*x+c))^(5/6)
```

Mathematica [A] (verified)

Time = 0.07 (sec) , antiderivative size = 69, normalized size of antiderivative = 1.06

$$\int \sqrt[3]{a+a\cos(c+dx)}\,dx = -\frac{6\sqrt[3]{a(1+\cos(c+dx))}\cot\left(\frac{1}{2}(c+dx)\right)\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{5}{6},\frac{11}{6},\cos^2\left(\frac{1}{2}(c+dx)\right)\right)\sqrt{\sin^2\left(\frac{1}{2}(c+d\right.}}{5d}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(1/3),x]
```

output
```
(-6*(a*(1 + Cos[c + d*x]))^(1/3)*Cot[(c + d*x)/2]*Hypergeometric2F1[1/2, 5
/6, 11/6, Cos[(c + d*x)/2]^2]*Sqrt[Sin[(c + d*x)/2]^2])/(5*d)
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 65, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \sqrt[3]{a\cos(c+dx)+a}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \sqrt[3]{a\sin\left(c+dx+\frac{\pi}{2}\right)+a}dx$$

$$\Big\downarrow \text{3131}$$

$$\frac{\sqrt[3]{a\cos(c+dx)+a}\int \sqrt[3]{\cos(c+dx)+1}dx}{\sqrt[3]{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{\sqrt[3]{a\cos(c+dx)+a}\int \sqrt[3]{\sin\left(c+dx+\frac{\pi}{2}\right)+1}dx}{\sqrt[3]{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{3130}$$

$$\frac{2^{5/6}\sin(c+dx)\sqrt[3]{a\cos(c+dx)+a}\,\text{Hypergeometric2F1}\left(\frac{1}{6},\frac{1}{2},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{d(\cos(c+dx)+1)^{5/6}}$$

input
```
Int[(a + a*Cos[c + d*x])^(1/3),x]
```

output
```
(2^(5/6)*(a + a*Cos[c + d*x])^(1/3)*Hypergeometric2F1[1/6, 1/2, 3/2, (1 -
Cos[c + d*x])/2]*Sin[c + d*x])/(d*(1 + Cos[c + d*x])^(5/6))
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] &&  !GtQ[a, 0]
```

Maple [F]

$$\int (a + a\cos(dx + c))^{\frac{1}{3}}\, dx$$

input
```
int((a+a*cos(d*x+c))^(1/3),x)
```

output
```
int((a+a*cos(d*x+c))^(1/3),x)
```

Fricas [F]

$$\int \sqrt[3]{a + a\cos(c + dx)}\, dx = \int (a\cos(dx + c) + a)^{\frac{1}{3}}\, dx$$

input
```
integrate((a+a*cos(d*x+c))^(1/3),x, algorithm="fricas")
```

output
```
integral((a*cos(d*x + c) + a)^(1/3), x)
```

Sympy [F]

$$\int \sqrt[3]{a+a\cos(c+dx)}\,dx=\int \sqrt[3]{a\cos{(c+dx)}+a}\,dx$$

input
```
integrate((a+a*cos(d*x+c))**(1/3),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(1/3), x)
```

Maxima [F]

$$\int \sqrt[3]{a+a\cos(c+dx)}\,dx=\int (a\cos{(dx+c)}+a)^{\frac{1}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(1/3),x, algorithm="maxima")
```

output
```
integrate((a*cos(d*x + c) + a)^(1/3), x)
```

Giac [F]

$$\int \sqrt[3]{a+a\cos(c+dx)}\,dx=\int (a\cos{(dx+c)}+a)^{\frac{1}{3}}\,dx$$

input
```
integrate((a+a*cos(d*x+c))^(1/3),x, algorithm="giac")
```

output
```
integrate((a*cos(d*x + c) + a)^(1/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \sqrt[3]{a+a\cos(c+dx)}\,dx = \int (a+a\,\cos(c+d\,x))^{1/3}\,dx$$

input
```
int((a + a*cos(c + d*x))^(1/3),x)
```

output
```
int((a + a*cos(c + d*x))^(1/3), x)
```

Reduce [F]

$$\int \sqrt[3]{a+a\cos(c+dx)}\,dx = a^{\frac{1}{3}}\left(\int (\cos(dx+c)+1)^{\frac{1}{3}}\,dx\right)$$

input
```
int((a+a*cos(d*x+c))^(1/3),x)
```

output
```
a**(1/3)*int((cos(c + d*x) + 1)**(1/3),x)
```

3.11 $\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 65

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx = \frac{\sqrt[6]{2}\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{5}{6},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)\sin(c+dx)}{d\sqrt[6]{1+\cos(c+dx)}\sqrt[3]{a+a\cos(c+dx)}}$$

output
```
2^(1/6)*hypergeom([1/2, 5/6],[3/2],1/2-1/2*cos(d*x+c))*sin(d*x+c)/d/(1+cos
(d*x+c))^(1/6)/(a+a*cos(d*x+c))^(1/3)
```

Mathematica [A] (verified)

Time = 0.06 (sec) , antiderivative size = 67, normalized size of antiderivative = 1.03

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx = -\frac{6\cot\left(\frac{1}{2}(c+dx)\right)\text{Hypergeometric2F1}\left(\frac{1}{6},\frac{1}{2},\frac{7}{6},\cos^2\left(\frac{1}{2}(c+dx)\right)\right)\sqrt{\sin^2\left(\frac{1}{2}(c+dx)\right)}}{d\sqrt[3]{a(1+\cos(c+dx))}}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(-1/3),x]
```

output
```
(-6*Cot[(c + d*x)/2]*Hypergeometric2F1[1/6, 1/2, 7/6, Cos[(c + d*x)/2]^2]*
Sqrt[Sin[(c + d*x)/2]^2])/(d*(a*(1 + Cos[c + d*x]))^(1/3))
```

Rubi [A] (verified)

Time = 0.28 (sec) , antiderivative size = 65, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{\sqrt[3]{a\cos(c+dx)+a}}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\sqrt[3]{a\sin\left(c+dx+\frac{\pi}{2}\right)+a}}dx$$

$$\Big\downarrow \text{3131}$$

$$\frac{\sqrt[3]{\cos(c+dx)+1}\int \frac{1}{\sqrt[3]{\cos(c+dx)+1}}dx}{\sqrt[3]{a\cos(c+dx)+a}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{\sqrt[3]{\cos(c+dx)+1}\int \frac{1}{\sqrt[3]{\sin\left(c+dx+\frac{\pi}{2}\right)+1}}dx}{\sqrt[3]{a\cos(c+dx)+a}}$$

$$\Big\downarrow \text{3130}$$

$$\frac{\sqrt[6]{2}\sin(c+dx)\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{5}{6},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{d\sqrt[6]{\cos(c+dx)+1}\sqrt[3]{a\cos(c+dx)+a}}$$

input
```
Int[(a + a*Cos[c + d*x])^(-1/3),x]
```

output
```
(2^(1/6)*Hypergeometric2F1[1/2, 5/6, 3/2, (1 - Cos[c + d*x])/2]*Sin[c + d*
x])/(d*(1 + Cos[c + d*x])^(1/6)*(a + a*Cos[c + d*x])^(1/3))
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] && !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] && !IntegerQ[2*n] && !GtQ[a, 0]
```

Maple [F]

$$\int \frac{1}{(a + a\cos(dx + c))^{\frac{1}{3}}} dx$$

input
```
int(1/(a+a*cos(d*x+c))^(1/3),x)
```

output
```
int(1/(a+a*cos(d*x+c))^(1/3),x)
```

Fricas [F]

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx = \int \frac{1}{(a\cos(dx+c)+a)^{\frac{1}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(1/3),x, algorithm="fricas")
```

output
```
integral((a*cos(d*x + c) + a)^(-1/3), x)
```

Sympy [F]

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx = \int \frac{1}{\sqrt[3]{a\cos(c+dx)+a}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))**(1/3),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(-1/3), x)
```

Maxima [F]

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx = \int \frac{1}{(a\cos(dx+c)+a)^{\frac{1}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(1/3),x, algorithm="maxima")
```

output
```
integrate((a*cos(d*x + c) + a)^(-1/3), x)
```

Giac [F]

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx=\int \frac{1}{\left(a\cos\left(dx+c\right)+a\right)^{\frac{1}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(1/3),x, algorithm="giac")
```

output
```
integrate((a*cos(d*x + c) + a)^(-1/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx=\int \frac{1}{{\left(a+a\,\cos\left(c+d\,x\right)\right)}^{1/3}}\,dx$$

input
```
int(1/(a + a*cos(c + d*x))^(1/3),x)
```

output
```
int(1/(a + a*cos(c + d*x))^(1/3), x)
```

Reduce [F]

$$\int \frac{1}{\sqrt[3]{a+a\cos(c+dx)}}\,dx=\frac{\int \frac{1}{(\cos(dx+c)+1)^{\frac{1}{3}}}dx}{a^{\frac{1}{3}}}$$

input
```
int(1/(a+a*cos(d*x+c))^(1/3),x)
```

output
```
int(1/(cos(c + d*x) + 1)**(1/3),x)/a**(1/3)
```

3.12 $\int \frac{1}{(a+a\cos(c+dx))^{2/3}} \, dx$

Optimal result

Integrand size = 14, antiderivative size = 65

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}} \, dx = \frac{\sqrt[6]{1+\cos(c+dx)}\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{7}{6},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)\sin(c+}{\sqrt[6]{2}d(a+a\cos(c+dx))^{2/3}}$$

output
```
1/2*(1+cos(d*x+c))^(1/6)*hypergeom([1/2, 7/6],[3/2],1/2-1/2*cos(d*x+c))*si
n(d*x+c)*2^(5/6)/d/(a+a*cos(d*x+c))^(2/3)
```

Mathematica [A] (verified)

Time = 0.06 (sec) , antiderivative size = 67, normalized size of antiderivative = 1.03

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}} \, dx = \frac{6\cot\left(\frac{1}{2}(c+dx)\right)\text{Hypergeometric2F1}\left(-\frac{1}{6},\frac{1}{2},\frac{5}{6},\cos^2\left(\frac{1}{2}(c+dx)\right)\right)\sqrt{\sin^2\left(\frac{1}{2}\right.}}{d(a(1+\cos(c+dx)))^{2/3}}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(-2/3),x]
```

output
```
(6*Cot[(c + d*x)/2]*Hypergeometric2F1[-1/6, 1/2, 5/6, Cos[(c + d*x)/2]^2]*
Sqrt[Sin[(c + d*x)/2]^2])/(d*(a*(1 + Cos[c + d*x]))^(2/3))
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 65, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a\cos(c+dx)+a)^{2/3}}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \frac{1}{\left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{2/3}}dx$$

$$\Big\downarrow \text{ 3131}$$

$$\frac{(\cos(c+dx)+1)^{2/3}\int \frac{1}{(\cos(c+dx)+1)^{2/3}}dx}{(a\cos(c+dx)+a)^{2/3}}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{(\cos(c+dx)+1)^{2/3}\int \frac{1}{\left(\sin\left(c+dx+\frac{\pi}{2}\right)+1\right)^{2/3}}dx}{(a\cos(c+dx)+a)^{2/3}}$$

$$\Big\downarrow \text{ 3130}$$

$$\frac{\sin(c+dx)\sqrt[6]{\cos(c+dx)+1}\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{7}{6},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{\sqrt[6]{2}d(a\cos(c+dx)+a)^{2/3}}$$

input
```
Int[(a + a*Cos[c + d*x])^(-2/3),x]
```

output
```
((1 + Cos[c + d*x])^(1/6)*Hypergeometric2F1[1/2, 7/6, 3/2, (1 - Cos[c + d*
x])/2]*Sin[c + d*x])/(2^(1/6)*d*(a + a*Cos[c + d*x])^(2/3))
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] &&  !GtQ[a, 0]
```

Maple [F]

$$\int \frac{1}{(a+a\cos(dx+c))^{\frac{2}{3}}}dx$$

input
```
int(1/(a+a*cos(d*x+c))^(2/3),x)
```

output
```
int(1/(a+a*cos(d*x+c))^(2/3),x)
```

Fricas [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}}\,dx=\int \frac{1}{(a\cos(dx+c)+a)^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(2/3),x, algorithm="fricas")
```

output
```
integral((a*cos(d*x + c) + a)^(-2/3), x)
```

Sympy [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(a\cos{(c+dx)}+a)^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))**(2/3),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(-2/3), x)
```

Maxima [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(a\cos{(dx+c)}+a)^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(2/3),x, algorithm="maxima")
```

output
```
integrate((a*cos(d*x + c) + a)^(-2/3), x)
```

Giac [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(a\cos{(dx+c)}+a)^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(2/3),x, algorithm="giac")
```

output
```
integrate((a*cos(d*x + c) + a)^(-2/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{{\left(a+a\,\cos\left(c+d\,x\right)\right)}^{2/3}} \,d x$$

input
```
int(1/(a + a*cos(c + d*x))^(2/3),x)
```

output
```
int(1/(a + a*cos(c + d*x))^(2/3), x)
```

Reduce [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{2/3}}\,dx = \frac{\int \frac{1}{(\cos(dx+c)+1)^{\frac{2}{3}}}dx}{a^{\frac{2}{3}}}$$

input
```
int(1/(a+a*cos(d*x+c))^(2/3),x)
```

output
```
int(1/(cos(c + d*x) + 1)**(2/3),x)/a**(2/3)
```

3.13 $\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 68

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx = \frac{\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{11}{6},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)\sin(c+dx)}{2^{5/6}ad\sqrt[6]{1+\cos(c+dx)}\sqrt[3]{a+a\cos(c+dx)}}$$

output
```
1/2*hypergeom([1/2, 11/6],[3/2],1/2-1/2*cos(d*x+c))*sin(d*x+c)*2^(1/6)/a/d
/(1+cos(d*x+c))^(1/6)/(a+a*cos(d*x+c))^(1/3)
```

Mathematica [A] (verified)

Time = 0.08 (sec) , antiderivative size = 69, normalized size of antiderivative = 1.01

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx = \frac{6\cot\left(\frac{1}{2}(c+dx)\right)\text{Hypergeometric2F1}\left(-\frac{5}{6},\frac{1}{2},\frac{1}{6},\cos^2\left(\frac{1}{2}(c+dx)\right)\right)\sqrt{\sin^2\left(\frac{1}{2}\right.}}{5d(a(1+\cos(c+dx)))^{4/3}}$$

input
```
Integrate[(a + a*Cos[c + d*x])^(-4/3),x]
```

output
```
(6*Cot[(c + d*x)/2]*Hypergeometric2F1[-5/6, 1/2, 1/6, Cos[(c + d*x)/2]^2]*
Sqrt[Sin[(c + d*x)/2]^2])/(5*d*(a*(1 + Cos[c + d*x]))^(4/3))
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 68, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a\cos(c+dx)+a)^{4/3}}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^{4/3}}dx$$

$$\Big\downarrow \text{3131}$$

$$\frac{\sqrt[3]{\cos(c+dx)+1}\int \frac{1}{(\cos(c+dx)+1)^{4/3}}dx}{a\sqrt[3]{a\cos(c+dx)+a}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{\sqrt[3]{\cos(c+dx)+1}\int \frac{1}{\left(\sin\left(c+dx+\frac{\pi}{2}\right)+1\right)^{4/3}}dx}{a\sqrt[3]{a\cos(c+dx)+a}}$$

$$\Big\downarrow \text{3130}$$

$$\frac{\sin(c+dx)\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{11}{6},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{2^{5/6}ad\sqrt[6]{\cos(c+dx)+1}\sqrt[3]{a\cos(c+dx)+a}}$$

input
```
Int[(a + a*Cos[c + d*x])^(-4/3),x]
```

output
```
(Hypergeometric2F1[1/2, 11/6, 3/2, (1 - Cos[c + d*x])/2]*Sin[c + d*x])/(2^
(5/6)*a*d*(1 + Cos[c + d*x])^(1/6)*(a + a*Cos[c + d*x])^(1/3))
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] &&  !GtQ[a, 0]
```

Maple [F]

$$\int \frac{1}{(a+a\cos(dx+c))^{\frac{4}{3}}}dx$$

input
```
int(1/(a+a*cos(d*x+c))^(4/3),x)
```

output
```
int(1/(a+a*cos(d*x+c))^(4/3),x)
```

Fricas [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(a\cos(dx+c)+a)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(4/3),x, algorithm="fricas")
```

output
```
integral((a*cos(d*x + c) + a)^(2/3)/(a^2*cos(d*x + c)^2 + 2*a^2*cos(d*x +
c) + a^2), x)
```

Sympy [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(a\cos(c+dx)+a)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))**(4/3),x)
```

output
```
Integral((a*cos(c + d*x) + a)**(-4/3), x)
```

Maxima [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(a\cos(dx+c)+a)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(4/3),x, algorithm="maxima")
```

output
```
integrate((a*cos(d*x + c) + a)^(-4/3), x)
```

Giac [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(a\cos(dx+c)+a)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+a*cos(d*x+c))^(4/3),x, algorithm="giac")
```

output
```
integrate((a*cos(d*x + c) + a)^(-4/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx=\int \frac{1}{\left(a+a\,\cos\left(c+d\,x\right)\right)^{4/3}}\,dx$$

input
```
int(1/(a + a*cos(c + d*x))^(4/3),x)
```

output
```
int(1/(a + a*cos(c + d*x))^(4/3), x)
```

Reduce [F]

$$\int \frac{1}{(a+a\cos(c+dx))^{4/3}}\,dx=\frac{\int \frac{1}{(\cos(dx+c)+1)^{\frac{1}{3}}\cos(dx+c)+(\cos(dx+c)+1)^{\frac{1}{3}}}dx}{a^{\frac{4}{3}}}$$

input
```
int(1/(a+a*cos(d*x+c))^(4/3),x)
```

output
```
int(1/((cos(c + d*x) + 1)**(1/3)*cos(c + d*x) + (cos(c + d*x) + 1)**(1/3))
,x)/(a**(1/3)*a)
```

3.14 $\int (a + a\cos(c + dx))^n \, dx$

Optimal result

Integrand size = 12, antiderivative size = 73

$$\int (a + a\cos(c + dx))^n \, dx$$
$$= \frac{2^{\frac{1}{2}+n}(1 + \cos(c + dx))^{-\frac{1}{2}-n}(a + a\cos(c + dx))^n \, \text{Hypergeometric2F1}\left(\frac{1}{2}, \frac{1}{2} - n, \frac{3}{2}, \frac{1}{2}(1 - \cos(c + dx))\right) \mathrm{si}}{d}$$

output
```
2^(1/2+n)*(1+cos(d*x+c))^(-1/2-n)*(a+a*cos(d*x+c))^n*hypergeom([1/2, 1/2-n
],[3/2],1/2-1/2*cos(d*x+c))*sin(d*x+c)/d
```

Mathematica [A] (verified)

Time = 0.09 (sec) , antiderivative size = 74, normalized size of antiderivative = 1.01

$$\int (a + a\cos(c + dx))^n \, dx =$$
$$-\frac{2(a(1 + \cos(c + dx)))^n \cot\left(\frac{1}{2}(c + dx)\right) \text{Hypergeometric2F1}\left(\frac{1}{2}, \frac{1}{2} + n, \frac{3}{2} + n, \cos^2\left(\frac{1}{2}(c + dx)\right)\right) \sqrt{\sin^2}}{d + 2dn}$$

input
```
Integrate[(a + a*Cos[c + d*x])^n,x]
```

output
```
(-2*(a*(1 + Cos[c + d*x]))^n*Cot[(c + d*x)/2]*Hypergeometric2F1[1/2, 1/2 +
 n, 3/2 + n, Cos[(c + d*x)/2]^2]*Sqrt[Sin[(c + d*x)/2]^2])/(d + 2*d*n)
```

Rubi [A] (verified)

Time = 0.28 (sec) , antiderivative size = 73, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a\cos(c+dx)+a)^n\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a\sin\left(c+dx+\frac{\pi}{2}\right)+a\right)^n dx$$

$$\Big\downarrow \text{3131}$$

$$(\cos(c+dx)+1)^{-n}(a\cos(c+dx)+a)^n\int (\cos(c+dx)+1)^n dx$$

$$\Big\downarrow \text{3042}$$

$$(\cos(c+dx)+1)^{-n}(a\cos(c+dx)+a)^n\int \left(\sin\left(c+dx+\frac{\pi}{2}\right)+1\right)^n dx$$

$$\Big\downarrow \text{3130}$$

$$\frac{2^{n+\frac{1}{2}}\sin(c+dx)(\cos(c+dx)+1)^{-n-\frac{1}{2}}(a\cos(c+dx)+a)^n\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}-n,\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{d}$$

input
```
Int[(a + a*Cos[c + d*x])^n,x]
```

output
```
(2^(1/2 + n)*(1 + Cos[c + d*x])^(-1/2 - n)*(a + a*Cos[c + d*x])^n*Hypergeo
metric2F1[1/2, 1/2 - n, 3/2, (1 - Cos[c + d*x])/2]*Sin[c + d*x])/d
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] &&  !GtQ[a, 0]
```

Maple [F]

$$\int (a + a\cos(dx + c))^n \, dx$$

input
```
int((a+a*cos(d*x+c))^n,x)
```

output
```
int((a+a*cos(d*x+c))^n,x)
```

Fricas [F]

$$\int (a + a\cos(c + dx))^n \, dx = \int (a\cos(dx + c) + a)^n \, dx$$

input
```
integrate((a+a*cos(d*x+c))^n,x, algorithm="fricas")
```

output
```
integral((a*cos(d*x + c) + a)^n, x)
```

Sympy [F]

$$\int (a+a\cos(c+dx))^n\,dx = \int (a\cos(c+dx)+a)^n\,dx$$

input
```
integrate((a+a*cos(d*x+c))**n,x)
```

output
```
Integral((a*cos(c + d*x) + a)**n, x)
```

Maxima [F]

$$\int (a+a\cos(c+dx))^n\,dx = \int (a\cos(dx+c)+a)^n\,dx$$

input
```
integrate((a+a*cos(d*x+c))^n,x, algorithm="maxima")
```

output
```
integrate((a*cos(d*x + c) + a)^n, x)
```

Giac [F]

$$\int (a+a\cos(c+dx))^n\,dx = \int (a\cos(dx+c)+a)^n\,dx$$

input
```
integrate((a+a*cos(d*x+c))^n,x, algorithm="giac")
```

output
```
integrate((a*cos(d*x + c) + a)^n, x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+a\cos(c+dx))^n\,dx=\int \left(a+a\,\cos\left(c+d\,x\right)\right)^n\,dx$$

input
```
int((a + a*cos(c + d*x))^n,x)
```

output
```
int((a + a*cos(c + d*x))^n, x)
```

Reduce [F]

$$\int (a+a\cos(c+dx))^n\,dx=\int \left(\cos\left(dx+c\right)a+a\right)^n dx$$

input
```
int((a+a*cos(d*x+c))^n,x)
```

output
```
int((cos(c + d*x)*a + a)**n,x)
```

3.15 $\int (a-a\cos(c+dx))^n\,dx$

Optimal result

Integrand size = 13, antiderivative size = 75

$$\int (a-a\cos(c+dx))^n\,dx = -\frac{2^{\frac{1}{2}+n}(1-\cos(c+dx))^{-\frac{1}{2}-n}(a-a\cos(c+dx))^n \operatorname{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}-n,\frac{3}{2},\frac{1}{2}(1+\cos(c+dx))\right)}{d}$$

output
```
-2^(1/2+n)*(1-cos(d*x+c))^(-1/2-n)*(a-a*cos(d*x+c))^n*hypergeom([1/2, 1/2-
n],[3/2],1/2+1/2*cos(d*x+c))*sin(d*x+c)/d
```

Mathematica [A] (verified)

Time = 0.12 (sec) , antiderivative size = 75, normalized size of antiderivative = 1.00

$$\int (a-a\cos(c+dx))^n\,dx = \frac{\sqrt{2}\sqrt{1+\cos(c+dx)}(a-a\cos(c+dx))^n \operatorname{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}+n,\frac{3}{2}+n,\sin^2\left(\frac{1}{2}(c+dx)\right)\right)\tan\left(\frac{1}{2}\right.}{d+2dn}$$

input
```
Integrate[(a - a*Cos[c + d*x])^n,x]
```

output
```
(Sqrt[2]*Sqrt[1 + Cos[c + d*x]]*(a - a*Cos[c + d*x])^n*Hypergeometric2F1[1
/2, 1/2 + n, 3/2 + n, Sin[(c + d*x)/2]^2]*Tan[(c + d*x)/2])/(d + 2*d*n)
```

Rubi [A] (verified)

Time = 0.28 (sec) , antiderivative size = 75, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.308$, Rules used = {3042, 3131, 3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a-a\cos(c+dx))^n\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a-a\sin\left(c+dx+\frac{\pi}{2}\right)\right)^n dx$$

$$\Big\downarrow \text{3131}$$

$$(1-\cos(c+dx))^{-n}(a-a\cos(c+dx))^n\int (1-\cos(c+dx))^n dx$$

$$\Big\downarrow \text{3042}$$

$$(1-\cos(c+dx))^{-n}(a-a\cos(c+dx))^n\int \left(1-\sin\left(c+dx+\frac{\pi}{2}\right)\right)^n dx$$

$$\Big\downarrow \text{3130}$$

$$-\frac{2^{n+\frac{1}{2}}\sin(c+dx)(1-\cos(c+dx))^{-n-\frac{1}{2}}(a-a\cos(c+dx))^n\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}-n,\frac{3}{2},\frac{1}{2}(\cos(c+dx)+\right.}{d}$$

input
```
Int[(a - a*Cos[c + d*x])^n,x]
```

output
```
-((2^(1/2 + n)*(1 - Cos[c + d*x])^(-1/2 - n)*(a - a*Cos[c + d*x])^n*Hyperg
eometric2F1[1/2, 1/2 - n, 3/2, (1 + Cos[c + d*x])/2]*Sin[c + d*x])/d)
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

rule 3131
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[a^IntPar
t[n]*((a + b*Sin[c + d*x])^FracPart[n]/(1 + (b/a)*Sin[c + d*x])^FracPart[n]
)   Int[(1 + (b/a)*Sin[c + d*x])^n, x], x] /; FreeQ[{a, b, c, d, n}, x] &&
EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] &&  !GtQ[a, 0]
```

Maple [F]

$$\int (a - a\cos(dx + c))^n \, dx$$

input
```
int((a-a*cos(d*x+c))^n,x)
```

output
```
int((a-a*cos(d*x+c))^n,x)
```

Fricas [F]

$$\int (a - a\cos(c + dx))^n \, dx = \int (-a\cos(dx + c) + a)^n \, dx$$

input
```
integrate((a-a*cos(d*x+c))^n,x, algorithm="fricas")
```

output
```
integral((-a*cos(d*x + c) + a)^n, x)
```

Sympy [F]

$$\int (a-a\cos(c+dx))^n\,dx=\int\left(-a\cos\left(c+dx\right)+a\right)^n\,dx$$

input
```
integrate((a-a*cos(d*x+c))**n,x)
```

output
```
Integral((-a*cos(c + d*x) + a)**n, x)
```

Maxima [F]

$$\int (a-a\cos(c+dx))^n\,dx=\int\left(-a\cos\left(dx+c\right)+a\right)^n\,dx$$

input
```
integrate((a-a*cos(d*x+c))^n,x, algorithm="maxima")
```

output
```
integrate((-a*cos(d*x + c) + a)^n, x)
```

Giac [F]

$$\int (a-a\cos(c+dx))^n\,dx=\int\left(-a\cos\left(dx+c\right)+a\right)^n\,dx$$

input
```
integrate((a-a*cos(d*x+c))^n,x, algorithm="giac")
```

output
```
integrate((-a*cos(d*x + c) + a)^n, x)
```

Mupad [F(-1)]

Timed out.

$$\int (a-a\cos(c+dx))^n\,dx=\int \left(a-a\,\cos\left(c+d\,x\right)\right)^n\,dx$$

input
```
int((a - a*cos(c + d*x))^n,x)
```

output
```
int((a - a*cos(c + d*x))^n, x)
```

Reduce [F]

$$\int (a-a\cos(c+dx))^n\,dx=\int \left(-\cos\left(dx+c\right)a+a\right)^n dx$$

input
```
int((a-a*cos(d*x+c))^n,x)
```

output
```
int(( - cos(c + d*x)*a + a)**n,x)
```

3.16 $\int (2+2\cos(c+dx))^n\,dx$

Optimal result

Integrand size = 12, antiderivative size = 59

$$\int (2+2\cos(c+dx))^n\,dx = \frac{2^{\frac{1}{2}+2n}\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}-n,\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)\sin(c+dx)}{d\sqrt{1+\cos(c+dx)}}$$

output
```
2^(1/2+2*n)*hypergeom([1/2, 1/2-n],[3/2],1/2-1/2*cos(d*x+c))*sin(d*x+c)/d/
(1+cos(d*x+c))^(1/2)
```

Mathematica [A] (verified)

Time = 0.11 (sec) , antiderivative size = 77, normalized size of antiderivative = 1.31

$$\int (2+2\cos(c+dx))^n\,dx = -\frac{2^{1+n}(1+\cos(c+dx))^n\cot\left(\frac{1}{2}(c+dx)\right)\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}+n,\frac{3}{2}+n,\cos^2\left(\frac{1}{2}(c+dx)\right)\right)\sqrt{\sin^2}}{d+2dn}$$

input
```
Integrate[(2 + 2*Cos[c + d*x])^n,x]
```

output
```
-((2^(1 + n)*(1 + Cos[c + d*x])^n*Cot[(c + d*x)/2]*Hypergeometric2F1[1/2,
1/2 + n, 3/2 + n, Cos[(c + d*x)/2]^2]*Sqrt[Sin[(c + d*x)/2]^2])/(d + 2*d*n
))
```

Rubi [A] (verified)

Time = 0.20 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.00, number of steps used = 2, number of rules used = 2, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.167, Rules used = {3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (2\cos(c+dx)+2)^n\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(2\sin\left(c+dx+\frac{\pi}{2}\right)+2\right)^n dx$$

$$\Big\downarrow \text{3130}$$

$$\frac{2^{2n+\frac{1}{2}}\sin(c+dx)\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}-n,\frac{3}{2},\frac{1}{2}(1-\cos(c+dx))\right)}{d\sqrt{\cos(c+dx)+1}}$$

input
```
Int[(2 + 2*Cos[c + d*x])^n,x]
```

output
```
(2^(1/2 + 2*n)*Hypergeometric2F1[1/2, 1/2 - n, 3/2, (1 - Cos[c + d*x])/2]*
Sin[c + d*x])/(d*Sqrt[1 + Cos[c + d*x]])
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] &&  !IntegerQ[2*n] && GtQ[a, 0]
```

Maple [F]

$$\int (2+2\cos (dx+c))^n\,dx$$

input
```
int((2+2*cos(d*x+c))^n,x)
```

output
```
int((2+2*cos(d*x+c))^n,x)
```

Fricas [F]

$$\int (2+2\cos(c+dx))^n\,dx=\int (2\,\cos (dx+c)+2)^n\,dx$$

input
```
integrate((2+2*cos(d*x+c))^n,x, algorithm="fricas")
```

output
```
integral((2*cos(d*x + c) + 2)^n, x)
```

Sympy [F]

$$\int (2+2\cos(c+dx))^n\,dx = 2^n\int (\cos(c+dx)+1)^n\,dx$$

input
```
integrate((2+2*cos(d*x+c))**n,x)
```

output
```
2**n*Integral((cos(c + d*x) + 1)**n, x)
```

Maxima [F]

$$\int (2+2\cos(c+dx))^n\,dx = \int (2\cos(dx+c)+2)^n\,dx$$

input
```
integrate((2+2*cos(d*x+c))^n,x, algorithm="maxima")
```

output
```
integrate((2*cos(d*x + c) + 2)^n, x)
```

Giac [F]

$$\int (2+2\cos(c+dx))^n\,dx = \int (2\cos(dx+c)+2)^n\,dx$$

input
```
integrate((2+2*cos(d*x+c))^n,x, algorithm="giac")
```

output
```
integrate((2*cos(d*x + c) + 2)^n, x)
```

Mupad [F(-1)]

Timed out.

$$\int (2+2\cos(c+dx))^n\,dx = \int \left(4\cos\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2\right)^n\,dx$$

input
```
int((2*cos(c + d*x) + 2)^n,x)
```

output
```
int((4*cos(c/2 + (d*x)/2)^2)^n, x)
```

Reduce [F]

$$\int (2+2\cos(c+dx))^n\,dx = \int (2\cos(dx+c)+2)^n\,dx$$

input
```
int((2+2*cos(d*x+c))^n,x)
```

output
```
int((2*cos(c + d*x) + 2)**n,x)
```

3.17 $\int (2-2\cos(c+dx))^n\,dx$

Optimal result

Integrand size = 12, antiderivative size = 60

$$\int (2-2\cos(c+dx))^n\,dx = -\frac{2^{\frac{1}{2}+2n}\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}-n,\frac{3}{2},\frac{1}{2}(1+\cos(c+dx))\right)\sin(c+dx)}{d\sqrt{1-\cos(c+dx)}}$$

output
```
-2^(1/2+2*n)*hypergeom([1/2, 1/2-n],[3/2],1/2+1/2*cos(d*x+c))*sin(d*x+c)/d
/(1-cos(d*x+c))^(1/2)
```

Mathematica [A] (verified)

Time = 0.09 (sec) , antiderivative size = 74, normalized size of antiderivative = 1.23

$$\int (2-2\cos(c+dx))^n\,dx = \frac{\sqrt{2}(2-2\cos(c+dx))^n\sqrt{1+\cos(c+dx)}\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}+n,\frac{3}{2}+n,\sin^2\left(\frac{1}{2}(c+dx)\right)\right)\tan\left(\frac{1}{2}(\right.}{d+2dn}$$

input
```
Integrate[(2 - 2*Cos[c + d*x])^n,x]
```

output
```
(Sqrt[2]*(2 - 2*Cos[c + d*x])^n*Sqrt[1 + Cos[c + d*x]]*Hypergeometric2F1[1
/2, 1/2 + n, 3/2 + n, Sin[(c + d*x)/2]^2]*Tan[(c + d*x)/2])/(d + 2*d*n)
```

Rubi [A] (verified)

Time = 0.21 (sec) , antiderivative size = 60, normalized size of antiderivative = 1.00, number of steps used = 2, number of rules used = 2, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.167, Rules used = {3042, 3130}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (2-2\cos(c+dx))^n\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(2-2\sin\left(c+dx+\frac{\pi}{2}\right)\right)^n dx$$

$$\Big\downarrow \text{3130}$$

$$-\frac{2^{2n+\frac{1}{2}}\sin(c+dx)\,\text{Hypergeometric2F1}\left(\frac{1}{2},\frac{1}{2}-n,\frac{3}{2},\frac{1}{2}(\cos(c+dx)+1)\right)}{d\sqrt{1-\cos(c+dx)}}$$

input
```
Int[(2 - 2*Cos[c + d*x])^n,x]
```

output
```
-((2^(1/2 + 2*n)*Hypergeometric2F1[1/2, 1/2 - n, 3/2, (1 + Cos[c + d*x])/2
]*Sin[c + d*x])/(d*Sqrt[1 - Cos[c + d*x]]))
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3130
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-2^(n +
 1/2))*a^(n - 1/2)*b*(Cos[c + d*x]/(d*Sqrt[a + b*Sin[c + d*x]]))*Hypergeome
tric2F1[1/2, 1/2 - n, 3/2, (1/2)*(1 - b*(Sin[c + d*x]/a))], x] /; FreeQ[{a,
 b, c, d, n}, x] && EqQ[a^2 - b^2, 0] && !IntegerQ[2*n] && GtQ[a, 0]
```

Maple [F]

$$\int (2-2\cos(dx+c))^n\,dx$$

input
```
int((2-2*cos(d*x+c))^n,x)
```

output
```
int((2-2*cos(d*x+c))^n,x)
```

Fricas [F]

$$\int (2-2\cos(c+dx))^n\,dx = \int (-2\,\cos(dx+c)+2)^n\,dx$$

input
```
integrate((2-2*cos(d*x+c))^n,x, algorithm="fricas")
```

output
```
integral((-2*cos(d*x + c) + 2)^n, x)
```

Sympy [F]

$$\int (2-2\cos(c+dx))^n\,dx=\int \left(2-2\cos\left(c+dx\right)\right)^n\,dx$$

input
```
integrate((2-2*cos(d*x+c))**n,x)
```

output
```
Integral((2 - 2*cos(c + d*x))**n, x)
```

Maxima [F]

$$\int (2-2\cos(c+dx))^n\,dx=\int (-2\,\cos\left(dx+c\right)+2)^n\,dx$$

input
```
integrate((2-2*cos(d*x+c))^n,x, algorithm="maxima")
```

output
```
integrate((-2*cos(d*x + c) + 2)^n, x)
```

Giac [F]

$$\int (2-2\cos(c+dx))^n\,dx=\int (-2\,\cos\left(dx+c\right)+2)^n\,dx$$

input
```
integrate((2-2*cos(d*x+c))^n,x, algorithm="giac")
```

output
```
integrate((-2*cos(d*x + c) + 2)^n, x)
```

Mupad [F(-1)]

Timed out.

$$\int (2-2\cos(c+dx))^n\,dx = \int \left(4\sin\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2\right)^n\,dx$$

input
```
int((2 - 2*cos(c + d*x))^n,x)
```

output
```
int((4*sin(c/2 + (d*x)/2)^2)^n, x)
```

Reduce [F]

$$\int (2-2\cos(c+dx))^n\,dx = \int (-2\cos(dx+c)+2)^n\,dx$$

input
```
int((2-2*cos(d*x+c))^n,x)
```

output
```
int(( - 2*cos(c + d*x) + 2)**n,x)
```

3.18 $\int \frac{1}{5+3\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 31

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = \frac{x}{4} - \frac{\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{2d}$$

output
```
1/4*x-1/2*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d
```

Mathematica [A] (verified)

Time = 0.06 (sec) , antiderivative size = 20, normalized size of antiderivative = 0.65

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = -\frac{\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Integrate[(5 + 3*Cos[c + d*x])^(-1),x]
```

output
```
-1/2*ArcTan[2*Cot[(c + d*x)/2]]/d
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 31, normalized size of antiderivative = 1.00, number of steps used = 2, number of rules used = 2, $\frac{\text{number of rules}}{\text{integrand size}} = 0.167$, Rules used = $\{3042, 3136\}$

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{3\cos(c+dx)+5}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)+5}dx$$

$$\Big\downarrow \text{3136}$$

$$\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}$$

input
```
Int[(5 + 3*Cos[c + d*x])^(-1),x]
```

output
```
x/4 - ArcTan[Sin[c + d*x]/(3 + Cos[c + d*x])]/(2*d)
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

Maple [A] (verified)

Time = 0.87 (sec) , antiderivative size = 18, normalized size of antiderivative = 0.58

method	result	size
derivativedivides	$\frac{\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{2d}$	18
default	$\frac{\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{2d}$	18
parallelrisch	$-\frac{i\left(\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)-\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2i\right)\right)}{4d}$	36
risch	$-\frac{i\ln\left(e^{i(dx+c)}+\frac{1}{3}\right)}{4d}+\frac{i\ln\left(e^{i(dx+c)}+3\right)}{4d}$	38

input
```
int(1/(5+3*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
1/2/d*arctan(1/2*tan(1/2*d*x+1/2*c))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 26, normalized size of antiderivative = 0.84

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = -\frac{\arctan\left(\frac{5\cos(dx+c)+3}{4\sin(dx+c)}\right)}{4\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c)),x, algorithm="fricas")
```

output
```
-1/4*arctan(1/4*(5*cos(d*x + c) + 3)/sin(d*x + c))/d
```

Sympy [A] (verification not implemented)

Time = 0.35 (sec) , antiderivative size = 41, normalized size of antiderivative = 1.32

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = \begin{cases} \frac{\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor}{2d} & \text{for } d\neq 0 \\ \frac{x}{3\cos(c)+5} & \text{otherwise} \end{cases}$$

input
```
integrate(1/(5+3*cos(d*x+c)),x)
```

output
```
Piecewise(((atan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/
(2*d), Ne(d, 0)), (x/(3*cos(c) + 5), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 24, normalized size of antiderivative = 0.77

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = \frac{\arctan\left(\frac{\sin(dx+c)}{2(\cos(dx+c)+1)}\right)}{2\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c)),x, algorithm="maxima")
```

output
```
1/2*arctan(1/2*sin(d*x + c)/(cos(d*x + c) + 1))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 30, normalized size of antiderivative = 0.97

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = \frac{dx+c-2\,\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{4\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c)),x, algorithm="giac")
```

output
```
1/4*(d*x + c - 2*arctan(sin(d*x + c)/(cos(d*x + c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 43.61 (sec) , antiderivative size = 38, normalized size of antiderivative = 1.23

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = \frac{\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{2\,d} - \frac{\operatorname{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}}{2\,d}$$

input
```
int(1/(3*cos(c + d*x) + 5),x)
```

output
```
atan(tan(c/2 + (d*x)/2)/2)/(2*d) - (atan(tan(c/2 + (d*x)/2)) - (d*x)/2)/(2
*d)
```

Reduce [B] (verification not implemented)

Time = 0.22 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.55

$$\int \frac{1}{5+3\cos(c+dx)}\,dx = \frac{atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{2d}$$

input
```
int(1/(5+3*cos(d*x+c)),x)
```

output
```
atan(tan((c + d*x)/2)/2)/(2*d)
```

3.19 $\int \frac{1}{(5+3\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 56

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx=\frac{5x}{64}-\frac{5\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{32d}-\frac{3\sin(c+dx)}{16d(5+3\cos(c+dx))}$$

output
```
5/64*x-5/32*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d-3/16*sin(d*x+c)/d/(5+3*cos
(d*x+c))
```

Mathematica [A] (verified)

Time = 0.27 (sec) , antiderivative size = 43, normalized size of antiderivative = 0.77

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx=-\frac{5\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right)+\frac{6\sin(c+dx)}{5+3\cos(c+dx)}}{32d}$$

input
```
Integrate[(5 + 3*Cos[c + d*x])^(-2),x]
```

output
```
-1/32*(5*ArcTan[2*Cot[(c + d*x)/2]] + (6*Sin[c + d*x])/(5 + 3*Cos[c + d*x]
))/d
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 61, normalized size of antiderivative = 1.09, number of steps used = 5, number of rules used = 5, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.417, Rules used = {3042, 3143, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3\cos(c+dx)+5)^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^2}dx$$

$$\Big\downarrow \text{3143}$$

$$-\frac{1}{16}\int -\frac{5}{3\cos(c+dx)+5}dx-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

$$\Big\downarrow \text{27}$$

$$\frac{5}{16}\int \frac{1}{3\cos(c+dx)+5}dx-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

$$\Big\downarrow \text{3042}$$

$$\frac{5}{16}\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)+5}dx-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

$$\Big\downarrow \text{3136}$$

$$\frac{5}{16}\left(\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}\right)-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

input
```
Int[(5 + 3*Cos[c + d*x])^(-2),x]
```

output
```
(5*(x/4 - ArcTan[Sin[c + d*x]/(3 + Cos[c + d*x])]/(2*d)))/16 - (3*Sin[c +
d*x])/(16*d*(5 + 3*Cos[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.83 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.82

method	result	size
derivativedivides	$\frac{-\frac{3\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+4\right)}+\frac{5\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{32}}{d}$	46
default	$\frac{-\frac{3\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+4\right)}+\frac{5\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{32}}{d}$	46
parallelrisch	$\frac{(-15i\cos(dx+c)-25i)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)+(15i\cos(dx+c)+25i)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2i\right)-12\sin(dx+c)}{192d\cos(dx+c)+320d}$	78
risch	$-\frac{i\left(5\,e^{i(dx+c)}+3\right)}{8d\left(3\,e^{2i(dx+c)}+10\,e^{i(dx+c)}+3\right)}-\frac{5i\ln\left(e^{i(dx+c)}+\frac{1}{3}\right)}{64d}+\frac{5i\ln\left(e^{i(dx+c)}+3\right)}{64d}$	83

input
```
int(1/(5+3*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
1/d*(-3/16*tan(1/2*d*x+1/2*c)/(tan(1/2*d*x+1/2*c)^2+4)+5/32*arctan(1/2*tan
(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.05

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx = -\frac{5\,(3\,\cos\left(dx+c\right)+5)\arctan\left(\frac{5\,\cos(dx+c)+3}{4\,\sin(dx+c)}\right)+12\,\sin\left(dx+c\right)}{64\,(3\,d\cos\left(dx+c\right)+5\,d)}$$

input
```
integrate(1/(5+3*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
-1/64*(5*(3*cos(d*x + c) + 5)*arctan(1/4*(5*cos(d*x + c) + 3)/sin(d*x + c)
) + 12*sin(d*x + c))/(3*d*cos(d*x + c) + 5*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.84 (sec) , antiderivative size = 187, normalized size of antiderivative = 3.34

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx = \begin{cases} \frac{x}{(5+3\cosh(2\operatorname{atanh}(2)))^2} & \text{fo} \\ \frac{x}{(3\cos(c)+5)^2} & \text{fo} \\ \frac{5\left(\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{32d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+128d}+\frac{20\left(\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)}{32d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+128d}-\frac{6\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{32d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+128d} & \text{o} \end{cases}$$

input
```
integrate(1/(5+3*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(5 + 3*cosh(2*atanh(2)))**2, Eq(c, -d*x - 2*I*atanh(2)) | Eq(
c, -d*x + 2*I*atanh(2))), (x/(3*cos(c) + 5)**2, Eq(d, 0)), (5*(atan(tan(c/
2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**2/(32
*d*tan(c/2 + d*x/2)**2 + 128*d) + 20*(atan(tan(c/2 + d*x/2)/2) + pi*floor(
(c/2 + d*x/2 - pi/2)/pi))/(32*d*tan(c/2 + d*x/2)**2 + 128*d) - 6*tan(c/2 +
 d*x/2)/(32*d*tan(c/2 + d*x/2)**2 + 128*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 68, normalized size of antiderivative = 1.21

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx = -\frac{\frac{6\,\sin(dx+c)}{\left(\frac{\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+4\right)(\cos(dx+c)+1)} - 5\,\arctan\left(\frac{\sin(dx+c)}{2\,(\cos(dx+c)+1)}\right)}{32\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
-1/32*(6*sin(d*x + c)/((sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + 4)*(cos(d*x
+ c) + 1)) - 5*arctan(1/2*sin(d*x + c)/(cos(d*x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.05

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx = \frac{5\,dx + 5\,c - \frac{12\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+4} - 10\,\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{64\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
1/64*(5*d*x + 5*c - 12*tan(1/2*d*x + 1/2*c)/(tan(1/2*d*x + 1/2*c)^2 + 4) -
 10*arctan(sin(d*x + c)/(cos(d*x + c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 41.73 (sec) , antiderivative size = 67, normalized size of antiderivative = 1.20

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx = \frac{5\,\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{32\,d} - \frac{5\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{32\,d} - \frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{16\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+4\right)}$$

input
```
int(1/(3*cos(c + d*x) + 5)^2,x)
```

output
```
(5*atan(tan(c/2 + (d*x)/2)/2))/(32*d) - (5*(atan(tan(c/2 + (d*x)/2)) - (d*
x)/2))/(32*d) - (3*tan(c/2 + (d*x)/2))/(16*d*(tan(c/2 + (d*x)/2)^2 + 4))
```

Reduce [B] (verification not implemented)

Time = 0.16 (sec) , antiderivative size = 60, normalized size of antiderivative = 1.07

$$\int \frac{1}{(5+3\cos(c+dx))^2}\,dx = \frac{15atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos(dx+c)+25atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)-6\sin(dx+c)}{32d\,(3\cos(dx+c)+5)}$$

input
```
int(1/(5+3*cos(d*x+c))^2,x)
```

output
```
(15*atan(tan((c + d*x)/2)/2)*cos(c + d*x) + 25*atan(tan((c + d*x)/2)/2) -
6*sin(c + d*x))/(32*d*(3*cos(c + d*x) + 5))
```

3.20 $\int \frac{1}{(5+3\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 81

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = \frac{59x}{2048}-\frac{59\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{1024d}-\frac{3\sin(c+dx)}{32d(5+3\cos(c+dx))^2}-\frac{45\sin(c+dx)}{512d(5+3\cos(c+dx))}$$

output
```
59/2048*x-59/1024*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d-3/32*sin(d*x+c)/d/(5
+3*cos(d*x+c))^2-45/512*sin(d*x+c)/d/(5+3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.28 (sec) , antiderivative size = 56, normalized size of antiderivative = 0.69

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = -\frac{59\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right)+\frac{3(182\sin(c+dx)+45\sin(2(c+dx)))}{(5+3\cos(c+dx))^2}}{1024d}$$

input
```
Integrate[(5 + 3*Cos[c + d*x])^(-3),x]
```

output
```
-1/1024*(59*ArcTan[2*Cot[(c + d*x)/2]] + (3*(182*Sin[c + d*x] + 45*Sin[2*(
c + d*x)]))/(5 + 3*Cos[c + d*x])^2)/d
```

Rubi [A] (verified)

Time = 0.38 (sec) , antiderivative size = 91, normalized size of antiderivative = 1.12, number of steps used = 8, number of rules used = 8, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.667, Rules used = {3042, 3143, 25, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3\cos(c+dx)+5)^3}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^3}dx$$

$$\Big\downarrow \text{3143}$$

$$-\frac{1}{32}\int -\frac{10-3\cos(c+dx)}{(3\cos(c+dx)+5)^2}dx-\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{32}\int \frac{10-3\cos(c+dx)}{(3\cos(c+dx)+5)^2}dx-\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\int \frac{10-3\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^2}dx-\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{32}\left(-\frac{1}{16}\int -\frac{59}{3\cos(c+dx)+5}dx-\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{32}\left(\frac{59}{16}\int \frac{1}{3\cos(c+dx)+5}dx-\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\left(\frac{59}{16}\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)+5}dx-\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{3136}$$

$$\frac{1}{32}\left(\frac{59}{16}\left(\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}\right)-\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

input
```
Int[(5 + 3*Cos[c + d*x])^(-3),x]
```

output
```
(-3*Sin[c + d*x])/(32*d*(5 + 3*Cos[c + d*x])^2) + ((59*(x/4 - ArcTan[Sin[c
 + d*x]/(3 + Cos[c + d*x])]/(2*d)))/16 - (45*Sin[c + d*x])/(16*d*(5 + 3*Co
s[c + d*x])))/32
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.92 (sec) , antiderivative size = 62, normalized size of antiderivative = 0.77

method	result
derivativedivides	$\frac{\frac{-\frac{69 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{128}-\frac{51 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{32}}{4\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+4\right)^2}+\frac{59 \arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{1024}}{d}$
default	$\frac{\frac{-\frac{69 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{128}-\frac{51 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{32}}{4\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+4\right)^2}+\frac{59 \arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{1024}}{d}$
risch	$-\frac{3i\left(59\,\mathrm{e}^{3i(dx+c)}+295\,\mathrm{e}^{2i(dx+c)}+241\,\mathrm{e}^{i(dx+c)}+45\right)}{256d\left(3\,\mathrm{e}^{2i(dx+c)}+10\,\mathrm{e}^{i(dx+c)}+3\right)^2}-\frac{59i\ln\left(\mathrm{e}^{i(dx+c)}+\frac{1}{3}\right)}{2048d}+\frac{59i\ln\left(\mathrm{e}^{i(dx+c)}+3\right)}{2048d}$
parallelrisch	$\frac{59i(-9\cos(2dx+2c)-59-60\cos(dx+c))\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)+59i(9\cos(2dx+2c)+59+60\cos(dx+c))\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right.\right.}{2048d(9\cos(2dx+2c)+59+60\cos(dx+c))}$

input
```
int(1/(5+3*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
1/d*(1/4*(-69/128*tan(1/2*d*x+1/2*c)^3-51/32*tan(1/2*d*x+1/2*c))/(tan(1/2*
d*x+1/2*c)^2+4)^2+59/1024*arctan(1/2*tan(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 90, normalized size of antiderivative = 1.11

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = -\frac{59\left(9\cos(dx+c)^2+30\cos(dx+c)+25\right)\arctan\left(\frac{5\cos(dx+c)+3}{4\sin(dx+c)}\right)+12\left(45\cos(dx+c)+91\right)\sin(dx+c)}{2048\left(9\,d\cos(dx+c)^2+30\,d\cos(dx+c)+25\,d\right)}$$

input
```
integrate(1/(5+3*cos(d*x+c))^3,x, algorithm="fricas")
```

output
```
-1/2048*(59*(9*cos(d*x + c)^2 + 30*cos(d*x + c) + 25)*arctan(1/4*(5*cos(d*
x + c) + 3)/sin(d*x + c)) + 12*(45*cos(d*x + c) + 91)*sin(d*x + c))/(9*d*c
os(d*x + c)^2 + 30*d*cos(d*x + c) + 25*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 1.45 (sec) , antiderivative size = 359, normalized size of antiderivative = 4.43

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = \begin{cases} \frac{x}{(5+3\cosh(2\operatorname{atanh}(2)))^3} \\ \frac{x}{(3\cos(c)+5)^3} \\ \frac{59\left(\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)}{1024d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+16384d} + \frac{472\left(\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{1024d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+16384d} + \frac{944\left(\operatorname{atan}\right.}{1024d\tan^4\left(\right.} \end{cases}$$

input
```
integrate(1/(5+3*cos(d*x+c))**3,x)
```

output
```
Piecewise((x/(5 + 3*cosh(2*atanh(2)))**3, Eq(c, -d*x - 2*I*atanh(2)) | Eq(
c, -d*x + 2*I*atanh(2))), (x/(3*cos(c) + 5)**3, Eq(d, 0)), (59*(atan(tan(c
/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**4/(1
024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 16384*d) + 472*(a
tan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x
/2)**2/(1024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 16384*d)
 + 944*(atan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/(102
4*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 16384*d) - 138*tan(
c/2 + d*x/2)**3/(1024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 +
 16384*d) - 408*tan(c/2 + d*x/2)/(1024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(
c/2 + d*x/2)**2 + 16384*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 111, normalized size of antiderivative = 1.37

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = -\frac{\frac{6\left(\frac{68\,\sin(dx+c)}{\cos(dx+c)+1}+\frac{23\,\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\,\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+16} - 59\,\arctan\left(\frac{\sin(dx+c)}{2\,(\cos(dx+c)+1)}\right)}{1024\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
-1/1024*(6*(68*sin(d*x + c)/(cos(d*x + c) + 1) + 23*sin(d*x + c)^3/(cos(d*
x + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + sin(d*x + c)^4/(co
s(d*x + c) + 1)^4 + 16) - 59*arctan(1/2*sin(d*x + c)/(cos(d*x + c) + 1)))/
d
```

Giac [A] (verification not implemented)

Time = 0.15 (sec) , antiderivative size = 75, normalized size of antiderivative = 0.93

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = \frac{59\,dx + 59\,c - \frac{12\left(23\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3+68\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+4\right)^2} - 118\,\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{2048\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
1/2048*(59*d*x + 59*c - 12*(23*tan(1/2*d*x + 1/2*c)^3 + 68*tan(1/2*d*x + 1
/2*c))/(tan(1/2*d*x + 1/2*c)^2 + 4)^2 - 118*arctan(sin(d*x + c)/(cos(d*x +
 c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 36.60 (sec) , antiderivative size = 96, normalized size of antiderivative = 1.19

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = \frac{59\,\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{1024\,d} - \frac{59\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{1024\,d} - \frac{\frac{69\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{512}+\frac{51\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{128}}{d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4+8\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+16\right)}$$

input
```
int(1/(3*cos(c + d*x) + 5)^3,x)
```

output
```
(59*atan(tan(c/2 + (d*x)/2)/2))/(1024*d) - (59*(atan(tan(c/2 + (d*x)/2)) -
 (d*x)/2))/(1024*d) - ((51*tan(c/2 + (d*x)/2))/128 + (69*tan(c/2 + (d*x)/2
)^3)/512)/(d*(8*tan(c/2 + (d*x)/2)^2 + tan(c/2 + (d*x)/2)^4 + 16))
```

Reduce [B] (verification not implemented)

Time = 0.16 (sec) , antiderivative size = 106, normalized size of antiderivative = 1.31

$$\int \frac{1}{(5+3\cos(c+dx))^3}\,dx = \frac{1770 atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos(dx+c) - 531 atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\sin(dx+c)^2 + 2006 atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right) - 270}{1024d\left(30\cos(dx+c) - 9\sin(dx+c)^2 + 34\right)}$$

input
```
int(1/(5+3*cos(d*x+c))^3,x)
```

output
```
(1770*atan(tan((c + d*x)/2)/2)*cos(c + d*x) - 531*atan(tan((c + d*x)/2)/2)
*sin(c + d*x)**2 + 2006*atan(tan((c + d*x)/2)/2) - 270*cos(c + d*x)*sin(c
+ d*x) - 546*sin(c + d*x))/(1024*d*(30*cos(c + d*x) - 9*sin(c + d*x)**2 +
34))
```

3.21 $\int \frac{1}{(5+3\cos(c+dx))^4} dx$

Optimal result

Integrand size = 12, antiderivative size = 106

$$\int \frac{1}{(5+3\cos(c+dx))^4} dx = \frac{385x}{32768} - \frac{385\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{16384d} - \frac{\sin(c+dx)}{16d(5+3\cos(c+dx))^3} - \frac{25\sin(c+dx)}{512d(5+3\cos(c+dx))^2} - \frac{311\sin(c+dx)}{8192d(5+3\cos(c+dx))}$$

output
```
385/32768*x-385/16384*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d-1/16*sin(d*x+c)/
d/(5+3*cos(d*x+c))^3-25/512*sin(d*x+c)/d/(5+3*cos(d*x+c))^2-311/8192*sin(d
*x+c)/d/(5+3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.37 (sec) , antiderivative size = 66, normalized size of antiderivative = 0.62

$$\int \frac{1}{(5+3\cos(c+dx))^4} dx = -\frac{770\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right) + \frac{9(4883\sin(c+dx)+2340\sin(2(c+dx))+311\sin(3(c+dx)))}{(5+3\cos(c+dx))^3}}{32768d}$$

input
```
Integrate[(5 + 3*Cos[c + d*x])^(-4),x]
```

output
```
-1/32768*(770*ArcTan[2*Cot[(c + d*x)/2]] + (9*(4883*Sin[c + d*x] + 2340*Si
n[2*(c + d*x)] + 311*Sin[3*(c + d*x)]))/(5 + 3*Cos[c + d*x])^3)/d
```

Rubi [A] (verified)

Time = 0.52 (sec) , antiderivative size = 121, normalized size of antiderivative = 1.14, number of steps used = 11, number of rules used = 11, $\frac{\text{number of rules}}{\text{integrand size}} = 0.917$, Rules used = {3042, 3143, 27, 3042, 3233, 25, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3\cos(c+dx)+5)^4}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^4}dx$$

$$\Big\downarrow \text{3143}$$

$$-\frac{1}{48}\int -\frac{3(5-2\cos(c+dx))}{(3\cos(c+dx)+5)^3}dx-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{16}\int \frac{5-2\cos(c+dx)}{(3\cos(c+dx)+5)^3}dx-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\int \frac{5-2\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^3}dx-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{16}\left(-\frac{1}{32}\int -\frac{62-25\cos(c+dx)}{(3\cos(c+dx)+5)^2}dx-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{62-25\cos(c+dx)}{(3\cos(c+dx)+5)^2}dx-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{62-25\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^2}dx-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \; 3233$$

$$\frac{1}{16}\left(\frac{1}{32}\left(-\frac{1}{16}\int -\frac{385}{3\cos(c+dx)+5}dx-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \; 27$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{3\cos(c+dx)+5}dx-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \; 3042$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)+5}dx-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \; 3136$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\left(\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}\right)-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

input

```
Int[(5 + 3*Cos[c + d*x])^(-4),x]
```

output

```
-1/16*Sin[c + d*x]/(d*(5 + 3*Cos[c + d*x])^3) + ((-25*Sin[c + d*x])/(32*d*
(5 + 3*Cos[c + d*x])^2) + ((385*(x/4 - ArcTan[Sin[c + d*x]/(3 + Cos[c + d*
x])]/(2*d)))/16 - (311*Sin[c + d*x])/(16*d*(5 + 3*Cos[c + d*x])))/32)/16
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.98 (sec) , antiderivative size = 75, normalized size of antiderivative = 0.71

method	result
derivativedivides	$\frac{\frac{-\frac{639\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}}{1024}-\frac{117\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{32}-\frac{369\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64}}{8\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)^{3}}+\frac{385\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{16384}}{d}$
default	$\frac{\frac{-\frac{639\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}}{1024}-\frac{117\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{32}-\frac{369\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64}}{8\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)^{3}}+\frac{385\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{16384}}{d}$
risch	$-\frac{i\left(10395\,\mathrm{e}^{5i(dx+c)}+86625\,\mathrm{e}^{4i(dx+c)}+239470\,\mathrm{e}^{3i(dx+c)}+218466\,\mathrm{e}^{2i(dx+c)}+73575\,\mathrm{e}^{i(dx+c)}+8397\right)}{12288d\left(3\,\mathrm{e}^{2i(dx+c)}+10\,\mathrm{e}^{i(dx+c)}+3\right)^{3}}-\frac{385i\ln(\mathrm{e}^{i(dx+}}{32768d}$
parallelrisch	$\frac{385i(-27\cos(3dx+3c)-981\cos(dx+c)-270\cos(2dx+2c)-770)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)+385i(27\cos(3dx+3c)+981\cos(}{32768d(27\cos(3dx+3c)+981\cos(}$

input
```
int(1/(5+3*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
1/d*(1/8*(-639/1024*tan(1/2*d*x+1/2*c)^5-117/32*tan(1/2*d*x+1/2*c)^3-369/6
4*tan(1/2*d*x+1/2*c))/(tan(1/2*d*x+1/2*c)^2+4)^3+385/16384*arctan(1/2*tan(
1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 121, normalized size of antiderivative = 1.14

$$\int \frac{1}{(5+3\cos(c+dx))^4}\,dx =$$
$$-\frac{385\left(27\cos(dx+c)^{3}+135\cos(dx+c)^{2}+225\cos(dx+c)+125\right)\arctan\left(\frac{5\cos(dx+c)+3}{4\sin(dx+c)}\right)+36\,(311\,}{32768\left(27\,d\cos(dx+c)^{3}+135\,d\cos(dx+c)^{2}+225\,d\cos(dx}$$

input
```
integrate(1/(5+3*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
-1/32768*(385*(27*cos(d*x + c)^3 + 135*cos(d*x + c)^2 + 225*cos(d*x + c) +
 125)*arctan(1/4*(5*cos(d*x + c) + 3)/sin(d*x + c)) + 36*(311*cos(d*x + c)
^2 + 1170*cos(d*x + c) + 1143)*sin(d*x + c))/(27*d*cos(d*x + c)^3 + 135*d*
cos(d*x + c)^2 + 225*d*cos(d*x + c) + 125*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 2.83 (sec) , antiderivative size = 592, normalized size of antiderivative = 5.58

$$\int \frac{1}{(5+3\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(5+3*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(5 + 3*cosh(2*atanh(2)))**4, Eq(c, -d*x - 2*I*atanh(2)) | Eq(
c, -d*x + 2*I*atanh(2))), (x/(3*cos(c) + 5)**4, Eq(d, 0)), (385*(atan(tan(
c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**6/(
16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*tan(
c/2 + d*x/2)**2 + 1048576*d) + 4620*(atan(tan(c/2 + d*x/2)/2) + pi*floor((
c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**4/(16384*d*tan(c/2 + d*x/2)**6
+ 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*d)
 + 18480*(atan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*ta
n(c/2 + d*x/2)**2/(16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/2)
**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*d) + 24640*(atan(tan(c/2 + d*
x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/(16384*d*tan(c/2 + d*x/2)**6
+ 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*d)
 - 1278*tan(c/2 + d*x/2)**5/(16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/
2 + d*x/2)**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*d) - 7488*tan(c/2 +
 d*x/2)**3/(16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/2)**4 + 7
86432*d*tan(c/2 + d*x/2)**2 + 1048576*d) - 11808*tan(c/2 + d*x/2)/(16384*d
*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*tan(c/2 + d
*x/2)**2 + 1048576*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 151, normalized size of antiderivative = 1.42

$$\int \frac{1}{(5+3\cos(c+dx))^4}\,dx = -\frac{\frac{18\left(\frac{656\,\sin(dx+c)}{\cos(dx+c)+1}+\frac{416\,\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{71\,\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{48\,\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{12\,\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{\sin(dx+c)^6}{(\cos(dx+c)+1)^6}+64}-385\,\arctan\left(\frac{\sin(dx+c)}{2\,(\cos(dx+c)+1)}\right)}{16384\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
-1/16384*(18*(656*sin(d*x + c)/(cos(d*x + c) + 1) + 416*sin(d*x + c)^3/(co
s(d*x + c) + 1)^3 + 71*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(48*sin(d*x +
c)^2/(cos(d*x + c) + 1)^2 + 12*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + sin(d
*x + c)^6/(cos(d*x + c) + 1)^6 + 64) - 385*arctan(1/2*sin(d*x + c)/(cos(d*
x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 88, normalized size of antiderivative = 0.83

$$\int \frac{1}{(5+3\cos(c+dx))^4}\,dx = \frac{385\,dx+385\,c-\frac{36\left(71\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^5+416\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3+656\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+4\right)^3}-770\,\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{32768\,d}$$

input
```
integrate(1/(5+3*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
1/32768*(385*d*x + 385*c - 36*(71*tan(1/2*d*x + 1/2*c)^5 + 416*tan(1/2*d*x
 + 1/2*c)^3 + 656*tan(1/2*d*x + 1/2*c))/(tan(1/2*d*x + 1/2*c)^2 + 4)^3 - 7
70*arctan(sin(d*x + c)/(cos(d*x + c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 42.36 (sec) , antiderivative size = 96, normalized size of antiderivative = 0.91

$$\int \frac{1}{(5+3\cos(c+dx))^4}\,dx = \frac{385\,\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{16384\,d} - \frac{385\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{16384\,d} - \frac{\frac{639\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^5}{8192}+\frac{117\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{256}+\frac{369\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{512}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+4\right)^3}$$

input
```
int(1/(3*cos(c + d*x) + 5)^4,x)
```

output
```
(385*atan(tan(c/2 + (d*x)/2)/2))/(16384*d) - (385*(atan(tan(c/2 + (d*x)/2)
) - (d*x)/2))/(16384*d) - ((369*tan(c/2 + (d*x)/2))/512 + (117*tan(c/2 + (
d*x)/2)^3)/256 + (639*tan(c/2 + (d*x)/2)^5)/8192)/(d*(tan(c/2 + (d*x)/2)^2
 + 4)^3)
```

Reduce [B] (verification not implemented)

Time = 0.19 (sec) , antiderivative size = 160, normalized size of antiderivative = 1.51

$$\int \frac{1}{(5+3\cos(c+dx))^4}\,dx = \frac{10395atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos(dx+c)\sin(dx+c)^2 - 97020atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos(dx+c) + 51975atan\Bigg(}{16384d\,(27\cos(dx+c)\sin(d}$$

input
```
int(1/(5+3*cos(d*x+c))^4,x)
```

output
```
(10395*atan(tan((c + d*x)/2)/2)*cos(c + d*x)*sin(c + d*x)**2 - 97020*atan(
tan((c + d*x)/2)/2)*cos(c + d*x) + 51975*atan(tan((c + d*x)/2)/2)*sin(c +
d*x)**2 - 100100*atan(tan((c + d*x)/2)/2) + 21060*cos(c + d*x)*sin(c + d*x
) - 5598*sin(c + d*x)**3 + 26172*sin(c + d*x))/(16384*d*(27*cos(c + d*x)*s
in(c + d*x)**2 - 252*cos(c + d*x) + 135*sin(c + d*x)**2 - 260))
```

3.22 $\int \frac{1}{5-3\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 33

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = \frac{x}{4}+\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}$$

output
```
1/4*x+1/2*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d
```

Mathematica [A] (verified)

Time = 0.06 (sec) , antiderivative size = 20, normalized size of antiderivative = 0.61

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = \frac{\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Integrate[(5 - 3*Cos[c + d*x])^(-1),x]
```

output
```
ArcTan[2*Tan[(c + d*x)/2]]/(2*d)
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 33, normalized size of antiderivative = 1.00, number of steps used = 2, number of rules used = 2, $\frac{\text{number of rules}}{\text{integrand size}} = 0.167$, Rules used = {3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{5-3\cos(c+dx)}dx$$
$$\Big\downarrow \text{ 3042}$$
$$\int \frac{1}{5-3\sin\left(c+dx+\frac{\pi}{2}\right)}dx$$
$$\Big\downarrow \text{ 3136}$$
$$\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}+\frac{x}{4}$$

input
```
Int[(5 - 3*Cos[c + d*x])^(-1),x]
```

output
```
x/4 + ArcTan[Sin[c + d*x]/(3 - Cos[c + d*x])]/(2*d)
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

Maple [A] (verified)

Time = 1.02 (sec) , antiderivative size = 18, normalized size of antiderivative = 0.55

method	result	size
derivativedivides	$\frac{\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{2d}$	18
default	$\frac{\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{2d}$	18
risch	$\frac{i\ln\left(e^{i(dx+c)}-3\right)}{4d}-\frac{i\ln\left(e^{i(dx+c)}-\frac{1}{3}\right)}{4d}$	38
parallelrisch	$-\frac{i\left(\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)-\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+i\right)\right)}{4d}$	40

input
```
int(1/(5-3*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
1/2/d*arctan(2*tan(1/2*d*x+1/2*c))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 26, normalized size of antiderivative = 0.79

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = -\frac{\arctan\left(\frac{5\cos(dx+c)-3}{4\sin(dx+c)}\right)}{4\,d}$$

input
```
integrate(1/(5-3*cos(d*x+c)),x, algorithm="fricas")
```

output
```
-1/4*arctan(1/4*(5*cos(d*x + c) - 3)/sin(d*x + c))/d
```

Sympy [A] (verification not implemented)

Time = 0.36 (sec) , antiderivative size = 41, normalized size of antiderivative = 1.24

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = \begin{cases} \frac{\operatorname{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor}{2d} & \text{for } d\neq 0 \\ \frac{x}{5-3\cos(c)} & \text{otherwise} \end{cases}$$

input
```
integrate(1/(5-3*cos(d*x+c)),x)
```

output
```
Piecewise(((atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/
(2*d), Ne(d, 0)), (x/(5 - 3*cos(c)), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 24, normalized size of antiderivative = 0.73

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = \frac{\arctan\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}\right)}{2d}$$

input
```
integrate(1/(5-3*cos(d*x+c)),x, algorithm="maxima")
```

output
```
1/2*arctan(2*sin(d*x + c)/(cos(d*x + c) + 1))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 30, normalized size of antiderivative = 0.91

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = \frac{dx+c-2\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{4d}$$

input
```
integrate(1/(5-3*cos(d*x+c)),x, algorithm="giac")
```

output
```
1/4*(d*x + c - 2*arctan(sin(d*x + c)/(cos(d*x + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 43.18 (sec) , antiderivative size = 38, normalized size of antiderivative = 1.15

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = \frac{\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)}{2\,d} - \frac{\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)-\frac{dx}{2}}{2\,d}$$

input
```
int(-1/(3*cos(c + d*x) - 5),x)
```

output
```
atan(2*tan(c/2 + (d*x)/2))/(2*d) - (atan(tan(c/2 + (d*x)/2)) - (d*x)/2)/(2
*d)
```

Reduce [B] (verification not implemented)

Time = 0.19 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.52

$$\int \frac{1}{5-3\cos(c+dx)}\,dx = \frac{atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{2d}$$

input
```
int(1/(5-3*cos(d*x+c)),x)
```

output
```
atan(2*tan((c + d*x)/2))/(2*d)
```

3.23 $\int \frac{1}{(5-3\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 58

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx=\frac{5x}{64}+\frac{5\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{32d}+\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

output
```
5/64*x+5/32*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d+3/16*sin(d*x+c)/d/(5-3*cos
(d*x+c))
```

Mathematica [A] (verified)

Time = 0.22 (sec) , antiderivative size = 43, normalized size of antiderivative = 0.74

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx=\frac{5\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)-\frac{6\sin(c+dx)}{-5+3\cos(c+dx)}}{32d}$$

input
```
Integrate[(5 - 3*Cos[c + d*x])^(-2),x]
```

output
```
(5*ArcTan[2*Tan[(c + d*x)/2]] - (6*Sin[c + d*x])/(-5 + 3*Cos[c + d*x]))/(3
2*d)
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 63, normalized size of antiderivative = 1.09, number of steps used = 5, number of rules used = 5, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.417, Rules used = {3042, 3143, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5-3\cos(c+dx))^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}-\frac{1}{16}\int -\frac{5}{5-3\cos(c+dx)}dx$$

$$\Big\downarrow \text{27}$$

$$\frac{5}{16}\int \frac{1}{5-3\cos(c+dx)}dx+\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

$$\Big\downarrow \text{3042}$$

$$\frac{5}{16}\int \frac{1}{5-3\sin\left(c+dx+\frac{\pi}{2}\right)}dx+\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

$$\Big\downarrow \text{3136}$$

$$\frac{5}{16}\left(\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}+\frac{x}{4}\right)+\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

input
```
Int[(5 - 3*Cos[c + d*x])^(-2),x]
```

output
```
(5*(x/4 + ArcTan[Sin[c + d*x]/(3 - Cos[c + d*x])]/(2*d)))/16 + (3*Sin[c +
d*x])/(16*d*(5 - 3*Cos[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.96 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.79

method	result	size
derivativedivides	$\frac{\frac{3 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+\frac{1}{4}\right)}+\frac{5 \arctan\left(2 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{32}}{d}$	46
default	$\frac{\frac{3 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+\frac{1}{4}\right)}+\frac{5 \arctan\left(2 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{32}}{d}$	46
parallelrisch	$\frac{(-15i\cos(dx+c)+25i)\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)+(15i\cos(dx+c)-25i)\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+i\right)-12\sin(dx+c)}{192d\cos(dx+c)-320d}$	82
risch	$\frac{i\left(5\,e^{i(dx+c)}-3\right)}{8d\left(3\,e^{2i(dx+c)}-10\,e^{i(dx+c)}+3\right)}-\frac{5i\ln\left(e^{i(dx+c)}-\frac{1}{3}\right)}{64d}+\frac{5i\ln\left(e^{i(dx+c)}-3\right)}{64d}$	83

input
```
int(1/(5-3*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
1/d*(3/64*tan(1/2*d*x+1/2*c)/(tan(1/2*d*x+1/2*c)^2+1/4)+5/32*arctan(2*tan(
1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.02

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx = -\frac{5\,(3\,\cos(dx+c)-5)\arctan\left(\frac{5\,\cos(dx+c)-3}{4\,\sin(dx+c)}\right)+12\,\sin(dx+c)}{64\,(3\,d\cos(dx+c)-5\,d)}$$

input
```
integrate(1/(5-3*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
-1/64*(5*(3*cos(d*x + c) - 5)*arctan(1/4*(5*cos(d*x + c) - 3)/sin(d*x + c)
) + 12*sin(d*x + c))/(3*d*cos(d*x + c) - 5*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.69 (sec) , antiderivative size = 192, normalized size of antiderivative = 3.31

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx = \begin{cases} \frac{x}{\left(5-3\cosh\left(2\operatorname{atanh}\left(\frac{1}{2}\right)\right)\right)^2} \\ \frac{x}{(5-3\cos(c))^2} \\ \frac{20\left(\operatorname{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{128d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+32d}+\frac{5\left(\operatorname{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)}{128d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+32d}+\frac{6\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{128d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+32d} \end{cases}$$

input
```
integrate(1/(5-3*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(5 - 3*cosh(2*atanh(1/2)))**2, Eq(c, -d*x - 2*I*atanh(1/2)) |
 Eq(c, -d*x + 2*I*atanh(1/2))), (x/(5 - 3*cos(c))**2, Eq(d, 0)), (20*(atan
(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)
**2/(128*d*tan(c/2 + d*x/2)**2 + 32*d) + 5*(atan(2*tan(c/2 + d*x/2)) + pi*
floor((c/2 + d*x/2 - pi/2)/pi))/(128*d*tan(c/2 + d*x/2)**2 + 32*d) + 6*tan
(c/2 + d*x/2)/(128*d*tan(c/2 + d*x/2)**2 + 32*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 69, normalized size of antiderivative = 1.19

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx = \frac{\frac{6\sin(dx+c)}{\left(\frac{4\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+1\right)(\cos(dx+c)+1)} + 5\arctan\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}\right)}{32\,d}$$

input
```
integrate(1/(5-3*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
1/32*(6*sin(d*x + c)/((4*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + 1)*(cos(d*x
 + c) + 1)) + 5*arctan(2*sin(d*x + c)/(cos(d*x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.13 (sec) , antiderivative size = 61, normalized size of antiderivative = 1.05

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx = \frac{5\,dx + 5\,c + \frac{12\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{4\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+1} - 10\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{64\,d}$$

input
```
integrate(1/(5-3*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
1/64*(5*d*x + 5*c + 12*tan(1/2*d*x + 1/2*c)/(4*tan(1/2*d*x + 1/2*c)^2 + 1)
 - 10*arctan(sin(d*x + c)/(cos(d*x + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 42.56 (sec) , antiderivative size = 67, normalized size of antiderivative = 1.16

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx = \frac{5\,\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{32\,d} - \frac{5\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{32\,d} + \frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{64\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+\frac{1}{4}\right)}$$

input
```
int(1/(3*cos(c + d*x) - 5)^2,x)
```

output
```
(5*atan(2*tan(c/2 + (d*x)/2)))/(32*d) - (5*(atan(tan(c/2 + (d*x)/2)) - (d*
x)/2))/(32*d) + (3*tan(c/2 + (d*x)/2))/(64*d*(tan(c/2 + (d*x)/2)^2 + 1/4))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 60, normalized size of antiderivative = 1.03

$$\int \frac{1}{(5-3\cos(c+dx))^2}\,dx = \frac{15atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos(dx+c)-25atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)-6\sin(dx+c)}{32d\,(3\cos(dx+c)-5)}$$

input
```
int(1/(5-3*cos(d*x+c))^2,x)
```

output
```
(15*atan(2*tan((c + d*x)/2))*cos(c + d*x) - 25*atan(2*tan((c + d*x)/2)) -
6*sin(c + d*x))/(32*d*(3*cos(c + d*x) - 5))
```

3.24 $\int \frac{1}{(5-3\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 83

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx=\frac{59x}{2048}+\frac{59\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{1024d}+\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}+\frac{45\sin(c+dx)}{512d(5-3\cos(c+dx))}$$

output
```
59/2048*x+59/1024*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d+3/32*sin(d*x+c)/d/(5
-3*cos(d*x+c))^2+45/512*sin(d*x+c)/d/(5-3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.42 (sec) , antiderivative size = 65, normalized size of antiderivative = 0.78

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx=\frac{59\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)(5-3\cos(c+dx))^2+546\sin(c+dx)-135\sin(2(c+dx))}{1024d(5-3\cos(c+dx))^2}$$

input
```
Integrate[(5 - 3*Cos[c + d*x])^(-3),x]
```

output
```
(59*ArcTan[2*Tan[(c + d*x)/2]]*(5 - 3*Cos[c + d*x])^2 + 546*Sin[c + d*x] -
 135*Sin[2*(c + d*x)])/(1024*d*(5 - 3*Cos[c + d*x])^2)
```

Rubi [A] (verified)

Time = 0.39 (sec) , antiderivative size = 93, normalized size of antiderivative = 1.12, number of steps used = 8, number of rules used = 8, $\frac{\text{number of rules}}{\text{integrand size}} = 0.667$, Rules used = {3042, 3143, 25, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^3}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}-\frac{1}{32}\int -\frac{3\cos(c+dx)+10}{(5-3\cos(c+dx))^2}dx$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{32}\int \frac{3\cos(c+dx)+10}{(5-3\cos(c+dx))^2}dx+\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\int \frac{3\sin\left(c+dx+\frac{\pi}{2}\right)+10}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx+\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}-\frac{1}{16}\int -\frac{59}{5-3\cos(c+dx)}dx\right)+\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{32}\left(\frac{59}{16}\int \frac{1}{5-3\cos(c+dx)}dx+\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\left(\frac{59}{16}\int \frac{1}{5-3\sin\left(c+dx+\frac{\pi}{2}\right)}dx+\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3136}$$

$$\frac{1}{32}\left(\frac{59}{16}\left(\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}+\frac{x}{4}\right)+\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

input
```
Int[(5 - 3*Cos[c + d*x])^(-3),x]
```

output
```
(3*Sin[c + d*x])/(32*d*(5 - 3*Cos[c + d*x])^2) + ((59*(x/4 + ArcTan[Sin[c
+ d*x]/(3 - Cos[c + d*x])]/(2*d)))/16 + (45*Sin[c + d*x])/(16*d*(5 - 3*Cos
[c + d*x])))/32
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.98 (sec) , antiderivative size = 64, normalized size of antiderivative = 0.77

method	result
derivativedivides	$\frac{\frac{\frac{51\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{128}+\frac{69\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{512}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+1\right)^2}+\frac{59\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{1024}}{d}$
default	$\frac{\frac{\frac{51\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{128}+\frac{69\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{512}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+1\right)^2}+\frac{59\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{1024}}{d}$
risch	$\frac{3i\left(59\,\mathrm{e}^{3i(dx+c)}-295\,\mathrm{e}^{2i(dx+c)}+241\,\mathrm{e}^{i(dx+c)}-45\right)}{256d\left(3\,\mathrm{e}^{2i(dx+c)}-10\,\mathrm{e}^{i(dx+c)}+3\right)^2}-\frac{59i\ln\left(\mathrm{e}^{i(dx+c)}-\frac{1}{3}\right)}{2048d}+\frac{59i\ln\left(\mathrm{e}^{i(dx+c)}-3\right)}{2048d}$
parallelrisch	$\frac{59i(59+9\cos(2dx+2c)-60\cos(dx+c))\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)+59i(-9\cos(2dx+2c)-59+60\cos(dx+c))\ln\left(2\tan\left(\frac{dx}{2}+\right.\right.}{2048d(-9\cos(2dx+2c)-59+60\cos(dx+c))}$

input
```
int(1/(5-3*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
1/d*(4*(51/512*tan(1/2*d*x+1/2*c)^3+69/2048*tan(1/2*d*x+1/2*c))/(4*tan(1/2
*d*x+1/2*c)^2+1)^2+59/1024*arctan(2*tan(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 90, normalized size of antiderivative = 1.08

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx = -\frac{59\left(9\cos\left(dx+c\right)^2-30\cos\left(dx+c\right)+25\right)\arctan\left(\frac{5\cos(dx+c)-3}{4\sin(dx+c)}\right)+12\left(45\cos\left(dx+c\right)-91\right)\sin\left(dx+\right.}{2048\left(9\,d\cos\left(dx+c\right)^2-30\,d\cos\left(dx+c\right)+25\,d\right)}$$

input
```
integrate(1/(5-3*cos(d*x+c))^3,x, algorithm="fricas")
```

output
```
-1/2048*(59*(9*cos(d*x + c)^2 - 30*cos(d*x + c) + 25)*arctan(1/4*(5*cos(d*
x + c) - 3)/sin(d*x + c)) + 12*(45*cos(d*x + c) - 91)*sin(d*x + c))/(9*d*c
os(d*x + c)^2 - 30*d*cos(d*x + c) + 25*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 1.29 (sec) , antiderivative size = 364, normalized size of antiderivative = 4.39

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx = \begin{cases} \frac{x}{\left(5-3\cosh\left(2\,\mathrm{atanh}\left(\frac{1}{2}\right)\right)\right)^3} \\ \frac{x}{\left(5-3\cos\left(c\right)\right)^3} \\ \frac{944\left(\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)}{16384d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+1024d}+\frac{472\left(\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{16384d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+1024d}+\frac{59\left(\mathrm{at}\right.}{16384d\,\mathrm{tar}} \end{cases}$$

input
```
integrate(1/(5-3*cos(d*x+c))**3,x)
```

output
```
Piecewise((x/(5 - 3*cosh(2*atanh(1/2)))**3, Eq(c, -d*x - 2*I*atanh(1/2)) |
 Eq(c, -d*x + 2*I*atanh(1/2))), (x/(5 - 3*cos(c))**3, Eq(d, 0)), (944*(ata
n(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2
)**4/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 1024*d) +
 472*(atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/
2 + d*x/2)**2/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 +
1024*d) + 59*(atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi)
)/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 1024*d) + 40
8*tan(c/2 + d*x/2)**3/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/
2)**2 + 1024*d) + 138*tan(c/2 + d*x/2)/(16384*d*tan(c/2 + d*x/2)**4 + 8192
*d*tan(c/2 + d*x/2)**2 + 1024*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 112, normalized size of antiderivative = 1.35

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx = \frac{\frac{6\left(\frac{23\sin(dx+c)}{\cos(dx+c)+1}+\frac{68\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{16\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+1}+59\arctan\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}\right)}{1024\,d}$$

input
```
integrate(1/(5-3*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
1/1024*(6*(23*sin(d*x + c)/(cos(d*x + c) + 1) + 68*sin(d*x + c)^3/(cos(d*x
 + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + 16*sin(d*x + c)^4/(
cos(d*x + c) + 1)^4 + 1) + 59*arctan(2*sin(d*x + c)/(cos(d*x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 77, normalized size of antiderivative = 0.93

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx = \frac{59\,dx+59\,c+\frac{12\left(68\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3+23\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(4\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+1\right)^2}-118\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{2048\,d}$$

input
```
integrate(1/(5-3*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
1/2048*(59*d*x + 59*c + 12*(68*tan(1/2*d*x + 1/2*c)^3 + 23*tan(1/2*d*x + 1
/2*c))/(4*tan(1/2*d*x + 1/2*c)^2 + 1)^2 - 118*arctan(sin(d*x + c)/(cos(d*x
 + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 43.54 (sec) , antiderivative size = 95, normalized size of antiderivative = 1.14

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx = \frac{59\,\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{1024\,d} - \frac{59\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{1024\,d} + \frac{\frac{51\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{2048}+\frac{69\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{8192}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4+\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2}{2}+\frac{1}{16}\right)}$$

input
```
int(-1/(3*cos(c + d*x) - 5)^3,x)
```

output
```
(59*atan(2*tan(c/2 + (d*x)/2)))/(1024*d) - (59*(atan(tan(c/2 + (d*x)/2)) -
 (d*x)/2))/(1024*d) + ((69*tan(c/2 + (d*x)/2))/8192 + (51*tan(c/2 + (d*x)/
2)^3)/2048)/(d*(tan(c/2 + (d*x)/2)^2/2 + tan(c/2 + (d*x)/2)^4 + 1/16))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 106, normalized size of antiderivative = 1.28

$$\int \frac{1}{(5-3\cos(c+dx))^3}\,dx = \frac{1770\,atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos(dx+c)+531\,atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\sin(dx+c)^2-2006\,atan\left(2\tan\left(\frac{dx}{2}+\right.\right.}{1024d\left(30\cos(dx+c)+9\sin(dx+c)^2-34\right)}$$

input
```
int(1/(5-3*cos(d*x+c))^3,x)
```

output
```
(1770*atan(2*tan((c + d*x)/2))*cos(c + d*x) + 531*atan(2*tan((c + d*x)/2))
*sin(c + d*x)**2 - 2006*atan(2*tan((c + d*x)/2)) + 270*cos(c + d*x)*sin(c
+ d*x) - 546*sin(c + d*x))/(1024*d*(30*cos(c + d*x) + 9*sin(c + d*x)**2 -
34))
```

3.25 $\int \frac{1}{(5-3\cos(c+dx))^4}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 108

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx = \frac{385x}{32768}+\frac{385\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{16384d}+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}+\frac{25\sin(c+dx)}{512d(5-3\cos(c+dx))^2}+\frac{311\sin(c+dx)}{8192d(5-3\cos(c+dx))}$$

output
```
385/32768*x+385/16384*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d+1/16*sin(d*x+c)/
d/(5-3*cos(d*x+c))^3+25/512*sin(d*x+c)/d/(5-3*cos(d*x+c))^2+311/8192*sin(d
*x+c)/d/(5-3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.37 (sec) , antiderivative size = 66, normalized size of antiderivative = 0.61

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx = \frac{770\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)-\frac{9(4883\sin(c+dx)-2340\sin(2(c+dx))+311\sin(3(c+dx)))}{(-5+3\cos(c+dx))^3}}{32768d}$$

input
```
Integrate[(5 - 3*Cos[c + d*x])^(-4),x]
```

output
```
(770*ArcTan[2*Tan[(c + d*x)/2]] - (9*(4883*Sin[c + d*x] - 2340*Sin[2*(c +
d*x)] + 311*Sin[3*(c + d*x)]))/(-5 + 3*Cos[c + d*x])^3)/(32768*d)
```

Rubi [A] (verified)

Time = 0.51 (sec) , antiderivative size = 123, normalized size of antiderivative = 1.14, number of steps used = 11, number of rules used = 11, $\frac{\text{number of rules}}{\text{integrand size}} = 0.917$, Rules used = {3042, 3143, 27, 3042, 3233, 25, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5-3\cos(c+dx))^4}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^4}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}-\frac{1}{48}\int -\frac{3(2\cos(c+dx)+5)}{(5-3\cos(c+dx))^3}dx$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{16}\int \frac{2\cos(c+dx)+5}{(5-3\cos(c+dx))^3}dx+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\int \frac{2\sin\left(c+dx+\frac{\pi}{2}\right)+5}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^3}dx+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{16}\left(\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}-\frac{1}{32}\int -\frac{25\cos(c+dx)+62}{(5-3\cos(c+dx))^2}dx\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{25\cos(c+dx)+62}{(5-3\cos(c+dx))^2}dx+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{25\sin\left(c+dx+\frac{\pi}{2}\right)+62}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}-\frac{1}{16}\int -\frac{385}{5-3\cos(c+dx)}dx\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{5-3\cos(c+dx)}dx+\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{5-3\sin\left(c+dx+\frac{\pi}{2}\right)}dx+\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3136}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\left(\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}+\frac{x}{4}\right)+\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

input

```
Int[(5 - 3*Cos[c + d*x])^(-4),x]
```

output

```
Sin[c + d*x]/(16*d*(5 - 3*Cos[c + d*x])^3) + ((25*Sin[c + d*x])/(32*d*(5 -
 3*Cos[c + d*x])^2) + ((385*(x/4 + ArcTan[Sin[c + d*x]/(3 - Cos[c + d*x])]
/(2*d)))/16 + (311*Sin[c + d*x])/(16*d*(5 - 3*Cos[c + d*x])))/32)/16
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 1.09 (sec) , antiderivative size = 77, normalized size of antiderivative = 0.71

method	result
derivativedivides	$\frac{\frac{\frac{369\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^5}{512}+\frac{117\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{256}+\frac{639\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{8192}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+1\right)^3}+\frac{385\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{16384}}{d}$
default	$\frac{\frac{\frac{369\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^5}{512}+\frac{117\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{256}+\frac{639\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{8192}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+1\right)^3}+\frac{385\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{16384}}{d}$
risch	$\frac{i\left(10395\,\mathrm{e}^{5i(dx+c)}-86625\,\mathrm{e}^{4i(dx+c)}+239470\,\mathrm{e}^{3i(dx+c)}-218466\,\mathrm{e}^{2i(dx+c)}+73575\,\mathrm{e}^{i(dx+c)}-8397\right)}{12288d\left(3\,\mathrm{e}^{2i(dx+c)}-10\,\mathrm{e}^{i(dx+c)}+3\right)^3}+\frac{385i\ln\left(\mathrm{e}^{i(dx+c)}\right.}{32768d}$
parallelrisch	$\frac{385i(770-27\cos(3dx+3c)-981\cos(dx+c)+270\cos(2dx+2c))\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)+385i(27\cos(3dx+3c)+981\cos(d}{32768d(27\cos(3dx+3c)+981\cos(d}$

input
```
int(1/(5-3*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
1/d*(8*(369/4096*tan(1/2*d*x+1/2*c)^5+117/2048*tan(1/2*d*x+1/2*c)^3+639/65
536*tan(1/2*d*x+1/2*c))/(4*tan(1/2*d*x+1/2*c)^2+1)^3+385/16384*arctan(2*ta
n(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 121, normalized size of antiderivative = 1.12

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx =$$
$$-\frac{385\left(27\cos\left(dx+c\right)^3-135\cos\left(dx+c\right)^2+225\cos\left(dx+c\right)-125\right)\arctan\left(\frac{5\cos(dx+c)-3}{4\sin(dx+c)}\right)+36\,(311\ldots}{32768\left(27\,d\cos\left(dx+c\right)^3-135\,d\cos\left(dx+c\right)^2+225\,d\cos\left(dx\ldots\right.\right.}$$

input
```
integrate(1/(5-3*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
-1/32768*(385*(27*cos(d*x + c)^3 - 135*cos(d*x + c)^2 + 225*cos(d*x + c) -
 125)*arctan(1/4*(5*cos(d*x + c) - 3)/sin(d*x + c)) + 36*(311*cos(d*x + c)
^2 - 1170*cos(d*x + c) + 1143)*sin(d*x + c))/(27*d*cos(d*x + c)^3 - 135*d*
cos(d*x + c)^2 + 225*d*cos(d*x + c) - 125*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 2.69 (sec) , antiderivative size = 597, normalized size of antiderivative = 5.53

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(5-3*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(5 - 3*cosh(2*atanh(1/2)))**4, Eq(c, -d*x - 2*I*atanh(1/2)) |
 Eq(c, -d*x + 2*I*atanh(1/2))), (x/(5 - 3*cos(c))**4, Eq(d, 0)), (24640*(a
tan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x
/2)**6/(1048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 196
608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 18480*(atan(2*tan(c/2 + d*x/2)) + p
i*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**4/(1048576*d*tan(c/2 +
 d*x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 +
 16384*d) + 4620*(atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)
/pi))*tan(c/2 + d*x/2)**2/(1048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c/
2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 385*(atan(2*tan(
c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/(1048576*d*tan(c/2 + d*
x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 16
384*d) + 11808*tan(c/2 + d*x/2)**5/(1048576*d*tan(c/2 + d*x/2)**6 + 786432
*d*tan(c/2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 7488*ta
n(c/2 + d*x/2)**3/(1048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c/2 + d*x/
2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 1278*tan(c/2 + d*x/2)/(1
048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 196608*d*tan
(c/2 + d*x/2)**2 + 16384*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 152, normalized size of antiderivative = 1.41

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx = \frac{\frac{18\left(\frac{71\sin(dx+c)}{\cos(dx+c)+1}+\frac{416\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{656\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{12\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{48\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{64\sin(dx+c)^6}{(\cos(dx+c)+1)^6}+1}+385\arctan\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}\right)}{16384\,d}$$

input
```
integrate(1/(5-3*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
1/16384*(18*(71*sin(d*x + c)/(cos(d*x + c) + 1) + 416*sin(d*x + c)^3/(cos(
d*x + c) + 1)^3 + 656*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(12*sin(d*x + c
)^2/(cos(d*x + c) + 1)^2 + 48*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + 64*sin
(d*x + c)^6/(cos(d*x + c) + 1)^6 + 1) + 385*arctan(2*sin(d*x + c)/(cos(d*x
 + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 90, normalized size of antiderivative = 0.83

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx = \frac{385\,dx+385\,c+\frac{36\left(656\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^5+416\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3+71\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(4\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2+1\right)^3}-770\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{32768\,d}$$

input
```
integrate(1/(5-3*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
1/32768*(385*d*x + 385*c + 36*(656*tan(1/2*d*x + 1/2*c)^5 + 416*tan(1/2*d*
x + 1/2*c)^3 + 71*tan(1/2*d*x + 1/2*c))/(4*tan(1/2*d*x + 1/2*c)^2 + 1)^3 -
 770*arctan(sin(d*x + c)/(cos(d*x + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 43.91 (sec) , antiderivative size = 97, normalized size of antiderivative = 0.90

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx = \frac{385\,\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{16384\,d} - \frac{385\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{16384\,d} + \frac{\frac{369\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^5}{512}+\frac{117\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{256}+\frac{639\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{8192}}{d\,\left(4\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+1\right)^3}$$

input
```
int(1/(3*cos(c + d*x) - 5)^4,x)
```

output
```
(385*atan(2*tan(c/2 + (d*x)/2)))/(16384*d) - (385*(atan(tan(c/2 + (d*x)/2)
) - (d*x)/2))/(16384*d) + ((639*tan(c/2 + (d*x)/2))/8192 + (117*tan(c/2 +
(d*x)/2)^3)/256 + (369*tan(c/2 + (d*x)/2)^5)/512)/(d*(4*tan(c/2 + (d*x)/2)
^2 + 1)^3)
```

Reduce [B] (verification not implemented)

Time = 0.20 (sec) , antiderivative size = 160, normalized size of antiderivative = 1.48

$$\int \frac{1}{(5-3\cos(c+dx))^4}\,dx = \frac{10395atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos(dx+c)\sin(dx+c)^2 - 97020atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos(dx+c) - 51975}{16384d\left(27\cos(dx+c)\right.}$$

input
```
int(1/(5-3*cos(d*x+c))^4,x)
```

output
```
(10395*atan(2*tan((c + d*x)/2))*cos(c + d*x)*sin(c + d*x)**2 - 97020*atan(
2*tan((c + d*x)/2))*cos(c + d*x) - 51975*atan(2*tan((c + d*x)/2))*sin(c +
d*x)**2 + 100100*atan(2*tan((c + d*x)/2)) - 21060*cos(c + d*x)*sin(c + d*x
) - 5598*sin(c + d*x)**3 + 26172*sin(c + d*x))/(16384*d*(27*cos(c + d*x)*s
in(c + d*x)**2 - 252*cos(c + d*x) - 135*sin(c + d*x)**2 + 260))
```

3.26 $\int \frac{1}{-5+3\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 33

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx = -\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}$$

output
```
-1/4*x-1/2*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d
```

Mathematica [A] (verified)

Time = 0.04 (sec) , antiderivative size = 20, normalized size of antiderivative = 0.61

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx = -\frac{\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Integrate[(-5 + 3*Cos[c + d*x])^(-1),x]
```

output
```
-1/2*ArcTan[2*Tan[(c + d*x)/2]]/d
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 33, normalized size of antiderivative = 1.00, number of steps used = 2, number of rules used = 2, $\frac{\text{number of rules}}{\text{integrand size}} = 0.167$, Rules used = {3042, 3137}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{3\cos(c+dx)-5}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)-5}dx$$

$$\Big\downarrow \text{3137}$$

$$-\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}-\frac{x}{4}$$

input
```
Int[(-5 + 3*Cos[c + d*x])^(-1),x]
```

output
```
-1/4*x - ArcTan[Sin[c + d*x]/(3 - Cos[c + d*x])]/(2*d)
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3137
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[-x/q, x] - Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a -
q + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &
& NegQ[a]
```

Maple [A] (verified)

Time = 0.58 (sec) , antiderivative size = 18, normalized size of antiderivative = 0.55

method	result	size
derivativedivides	$-\frac{\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{2d}$	18
default	$-\frac{\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{2d}$	18
risch	$\frac{i\ln\left(e^{i(dx+c)}-\frac{1}{3}\right)}{4d}-\frac{i\ln\left(e^{i(dx+c)}-3\right)}{4d}$	38
parallelrisch	$\frac{i\left(\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)-\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+i\right)\right)}{4d}$	40

input
```
int(1/(-5+3*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
-1/2/d*arctan(2*tan(1/2*d*x+1/2*c))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 26, normalized size of antiderivative = 0.79

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx=\frac{\arctan\left(\frac{5\cos(dx+c)-3}{4\sin(dx+c)}\right)}{4\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c)),x, algorithm="fricas")
```

output
```
1/4*arctan(1/4*(5*cos(d*x + c) - 3)/sin(d*x + c))/d
```

Sympy [A] (verification not implemented)

Time = 0.35 (sec) , antiderivative size = 42, normalized size of antiderivative = 1.27

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx = \begin{cases} -\frac{\operatorname{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor}{2d} & \text{for } d\neq 0 \\ \frac{x}{3\cos(c)-5} & \text{otherwise} \end{cases}$$

input
```
integrate(1/(-5+3*cos(d*x+c)),x)
```

output
```
Piecewise((-(atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))
/(2*d), Ne(d, 0)), (x/(3*cos(c) - 5), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 24, normalized size of antiderivative = 0.73

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx = -\frac{\arctan\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}\right)}{2\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c)),x, algorithm="maxima")
```

output
```
-1/2*arctan(2*sin(d*x + c)/(cos(d*x + c) + 1))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 30, normalized size of antiderivative = 0.91

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx = -\frac{dx+c-2\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{4\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c)),x, algorithm="giac")
```

output
```
-1/4*(d*x + c - 2*arctan(sin(d*x + c)/(cos(d*x + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 42.61 (sec) , antiderivative size = 38, normalized size of antiderivative = 1.15

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx = \frac{\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}}{2\,d} - \frac{\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{2\,d}$$

input
```
int(1/(3*cos(c + d*x) - 5),x)
```

output
```
(atan(tan(c/2 + (d*x)/2)) - (d*x)/2)/(2*d) - atan(2*tan(c/2 + (d*x)/2))/(2
*d)
```

Reduce [B] (verification not implemented)

Time = 0.20 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.52

$$\int \frac{1}{-5+3\cos(c+dx)}\,dx = -\frac{atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{2d}$$

input
```
int(1/(-5+3*cos(d*x+c)),x)
```

output
```
( - atan(2*tan((c + d*x)/2)))/(2*d)
```

3.27 $\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 58

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = \frac{5x}{64} + \frac{5\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{32d} + \frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

output
```
5/64*x+5/32*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d+3/16*sin(d*x+c)/d/(5-3*cos
(d*x+c))
```

Mathematica [A] (verified)

Time = 0.01 (sec) , antiderivative size = 43, normalized size of antiderivative = 0.74

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = \frac{5\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right) - \frac{6\sin(c+dx)}{-5+3\cos(c+dx)}}{32d}$$

input
```
Integrate[(-5 + 3*Cos[c + d*x])^(-2),x]
```

output
```
(5*ArcTan[2*Tan[(c + d*x)/2]] - (6*Sin[c + d*x])/(-5 + 3*Cos[c + d*x]))/(3
2*d)
```

Rubi [A] (verified)

Time = 0.26 (sec) , antiderivative size = 63, normalized size of antiderivative = 1.09, number of steps used = 5, number of rules used = 5, $\frac{\text{number of rules}}{\text{integrand size}} = 0.417$, Rules used = {3042, 3143, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3\cos(c+dx)-5)^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)-5\right)^2}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}-\frac{1}{16}\int -\frac{5}{5-3\cos(c+dx)}dx$$

$$\Big\downarrow \text{27}$$

$$\frac{5}{16}\int \frac{1}{5-3\cos(c+dx)}dx+\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

$$\Big\downarrow \text{3042}$$

$$\frac{5}{16}\int \frac{1}{5-3\sin\left(c+dx+\frac{\pi}{2}\right)}dx+\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

$$\Big\downarrow \text{3136}$$

$$\frac{5}{16}\left(\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}+\frac{x}{4}\right)+\frac{3\sin(c+dx)}{16d(5-3\cos(c+dx))}$$

input
```
Int[(-5 + 3*Cos[c + d*x])^(-2),x]
```

output
```
(5*(x/4 + ArcTan[Sin[c + d*x]/(3 - Cos[c + d*x])]/(2*d)))/16 + (3*Sin[c +
d*x])/(16*d*(5 - 3*Cos[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.78 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.79

method	result	size
derivativedivides	$\frac{\frac{3\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+\frac{1}{4}\right)}+\frac{5\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{32}}{d}$	46
default	$\frac{\frac{3\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+\frac{1}{4}\right)}+\frac{5\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{32}}{d}$	46
parallelrisch	$\frac{(-15i\cos(dx+c)+25i)\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)+(15i\cos(dx+c)-25i)\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+i\right)-12\sin(dx+c)}{192d\cos(dx+c)-320d}$	82
risch	$\frac{i\left(5\,\mathrm{e}^{i(dx+c)}-3\right)}{8d\left(3\,\mathrm{e}^{2i(dx+c)}-10\,\mathrm{e}^{i(dx+c)}+3\right)}-\frac{5i\ln\left(\mathrm{e}^{i(dx+c)}-\frac{1}{3}\right)}{64d}+\frac{5i\ln\left(\mathrm{e}^{i(dx+c)}-3\right)}{64d}$	83

input
```
int(1/(-5+3*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
1/d*(3/64*tan(1/2*d*x+1/2*c)/(tan(1/2*d*x+1/2*c)^2+1/4)+5/32*arctan(2*tan(
1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.02

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = -\frac{5\,(3\,\cos\left(dx+c\right)-5)\arctan\left(\frac{5\,\cos(dx+c)-3}{4\,\sin(dx+c)}\right)+12\,\sin\left(dx+c\right)}{64\,(3\,d\cos\left(dx+c\right)-5\,d)}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
-1/64*(5*(3*cos(d*x + c) - 5)*arctan(1/4*(5*cos(d*x + c) - 3)/sin(d*x + c)
) + 12*sin(d*x + c))/(3*d*cos(d*x + c) - 5*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.69 (sec) , antiderivative size = 192, normalized size of antiderivative = 3.31

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = \begin{cases} \frac{x}{\left(-5+3\cosh\left(2\,\mathrm{atanh}\left(\frac{1}{2}\right)\right)\right)^2} \\ \frac{x}{\left(3\cos\left(c\right)-5\right)^2} \\ \frac{20\left(\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{128d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+32d} + \frac{5\left(\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)}{128d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+32d} + \frac{6\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{128d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+32d} \end{cases}$$

input
```
integrate(1/(-5+3*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(-5 + 3*cosh(2*atanh(1/2)))**2, Eq(c, -d*x - 2*I*atanh(1/2))
| Eq(c, -d*x + 2*I*atanh(1/2))), (x/(3*cos(c) - 5)**2, Eq(d, 0)), (20*(ata
n(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2
)**2/(128*d*tan(c/2 + d*x/2)**2 + 32*d) + 5*(atan(2*tan(c/2 + d*x/2)) + pi
*floor((c/2 + d*x/2 - pi/2)/pi))/(128*d*tan(c/2 + d*x/2)**2 + 32*d) + 6*ta
n(c/2 + d*x/2)/(128*d*tan(c/2 + d*x/2)**2 + 32*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 69, normalized size of antiderivative = 1.19

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = \frac{\frac{6\sin(dx+c)}{\left(\frac{4\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+1\right)(\cos(dx+c)+1)} + 5\arctan\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}\right)}{32\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
1/32*(6*sin(d*x + c)/((4*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + 1)*(cos(d*x
 + c) + 1)) + 5*arctan(2*sin(d*x + c)/(cos(d*x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 61, normalized size of antiderivative = 1.05

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = \frac{5\,dx + 5\,c + \frac{12\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{4\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+1} - 10\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{64\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
1/64*(5*d*x + 5*c + 12*tan(1/2*d*x + 1/2*c)/(4*tan(1/2*d*x + 1/2*c)^2 + 1)
 - 10*arctan(sin(d*x + c)/(cos(d*x + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 67, normalized size of antiderivative = 1.16

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = \frac{5\,\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{32\,d} - \frac{5\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{32\,d} + \frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{64\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+\frac{1}{4}\right)}$$

input
```
int(1/(3*cos(c + d*x) - 5)^2,x)
```

output
```
(5*atan(2*tan(c/2 + (d*x)/2)))/(32*d) - (5*(atan(tan(c/2 + (d*x)/2)) - (d*
x)/2))/(32*d) + (3*tan(c/2 + (d*x)/2))/(64*d*(tan(c/2 + (d*x)/2)^2 + 1/4))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 60, normalized size of antiderivative = 1.03

$$\int \frac{1}{(-5+3\cos(c+dx))^2}\,dx = \frac{15atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos\left(dx+c\right)-25atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)-6\sin\left(dx+c\right)}{32d\left(3\cos\left(dx+c\right)-5\right)}$$

input
```
int(1/(-5+3*cos(d*x+c))^2,x)
```

output
```
(15*atan(2*tan((c + d*x)/2))*cos(c + d*x) - 25*atan(2*tan((c + d*x)/2)) -
6*sin(c + d*x))/(32*d*(3*cos(c + d*x) - 5))
```

3.28 $\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 83

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = -\frac{59x}{2048} - \frac{59\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{1024d} - \frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2} - \frac{45\sin(c+dx)}{512d(5-3\cos(c+dx))}$$

output
```
-59/2048*x-59/1024*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d-3/32*sin(d*x+c)/d/(
5-3*cos(d*x+c))^2-45/512*sin(d*x+c)/d/(5-3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.19 (sec) , antiderivative size = 65, normalized size of antiderivative = 0.78

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = \frac{-59\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)(5-3\cos(c+dx))^2 - 546\sin(c+dx) + 135\sin(2(c+dx))}{1024d(5-3\cos(c+dx))^2}$$

input
```
Integrate[(-5 + 3*Cos[c + d*x])^(-3),x]
```

output
```
(-59*ArcTan[2*Tan[(c + d*x)/2]]*(5 - 3*Cos[c + d*x])^2 - 546*Sin[c + d*x]
+ 135*Sin[2*(c + d*x)])/(1024*d*(5 - 3*Cos[c + d*x])^2)
```

Rubi [A] (verified)

Time = 0.38 (sec) , antiderivative size = 93, normalized size of antiderivative = 1.12, number of steps used = 7, number of rules used = 7, $\frac{\text{number of rules}}{\text{integrand size}} = 0.583$, Rules used = {3042, 3143, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3\cos(c+dx)-5)^3}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)-5\right)^3}dx$$

$$\Big\downarrow \text{3143}$$

$$-\frac{1}{32}\int \frac{3\cos(c+dx)+10}{(5-3\cos(c+dx))^2}dx-\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3042}$$

$$-\frac{1}{32}\int \frac{3\sin\left(c+dx+\frac{\pi}{2}\right)+10}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx-\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{32}\left(\frac{1}{16}\int -\frac{59}{5-3\cos(c+dx)}dx-\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)-\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{32}\left(-\frac{59}{16}\int \frac{1}{5-3\cos(c+dx)}dx-\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)-\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\left(-\frac{59}{16}\int \frac{1}{5-3\sin\left(c+dx+\frac{\pi}{2}\right)}dx-\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)-\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

$$\Big\downarrow \text{3136}$$

$$\frac{1}{32}\left(-\frac{59}{16}\left(\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}+\frac{x}{4}\right)-\frac{45\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)-\frac{3\sin(c+dx)}{32d(5-3\cos(c+dx))^2}$$

input
```
Int[(-5 + 3*Cos[c + d*x])^(-3),x]
```

output
```
(-3*Sin[c + d*x])/(32*d*(5 - 3*Cos[c + d*x])^2) + ((-59*(x/4 + ArcTan[Sin[
c + d*x]/(3 - Cos[c + d*x])]/(2*d)))/16 - (45*Sin[c + d*x])/(16*d*(5 - 3*C
os[c + d*x])))/32
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.86 (sec) , antiderivative size = 64, normalized size of antiderivative = 0.77

method	result
derivativedivides	$\frac{-\frac{4\left(\frac{51\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{512}+\frac{69\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2048}\right)}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+1\right)^{2}}-\frac{59\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{1024}}{d}$
default	$\frac{-\frac{4\left(\frac{51\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{512}+\frac{69\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2048}\right)}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+1\right)^{2}}-\frac{59\arctan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{1024}}{d}$
risch	$-\frac{3i\left(59\,\mathrm{e}^{3i(dx+c)}-295\,\mathrm{e}^{2i(dx+c)}+241\,\mathrm{e}^{i(dx+c)}-45\right)}{256d\left(3\,\mathrm{e}^{2i(dx+c)}-10\,\mathrm{e}^{i(dx+c)}+3\right)^{2}}+\frac{59i\ln\left(\mathrm{e}^{i(dx+c)}-\frac{1}{3}\right)}{2048d}-\frac{59i\ln\left(\mathrm{e}^{i(dx+c)}-3\right)}{2048d}$
parallelrisch	$\frac{59i(-9\cos(2dx+2c)-59+60\cos(dx+c))\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)+59i(59+9\cos(2dx+2c)-60\cos(dx+c))\ln\left(2\tan\left(\frac{dx}{2}+\right.\right.}{2048d(-9\cos(2dx+2c)-59+60\cos(dx+c))}$

input
```
int(1/(-5+3*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
1/d*(-4*(51/512*tan(1/2*d*x+1/2*c)^3+69/2048*tan(1/2*d*x+1/2*c))/(4*tan(1/
2*d*x+1/2*c)^2+1)^2-59/1024*arctan(2*tan(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.10 (sec) , antiderivative size = 90, normalized size of antiderivative = 1.08

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = \frac{59\left(9\cos(dx+c)^2-30\cos(dx+c)+25\right)\arctan\left(\frac{5\cos(dx+c)-3}{4\sin(dx+c)}\right)+12\left(45\cos(dx+c)-91\right)\sin(dx+c}{2048\left(9d\cos(dx+c)^2-30d\cos(dx+c)+25d\right)}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^3,x, algorithm="fricas")
```

output
```
1/2048*(59*(9*cos(d*x + c)^2 - 30*cos(d*x + c) + 25)*arctan(1/4*(5*cos(d*x
 + c) - 3)/sin(d*x + c)) + 12*(45*cos(d*x + c) - 91)*sin(d*x + c))/(9*d*co
s(d*x + c)^2 - 30*d*cos(d*x + c) + 25*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 1.29 (sec) , antiderivative size = 366, normalized size of antiderivative = 4.41

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = \begin{cases} \frac{x}{\left(-5+3\cosh\left(2\operatorname{atanh}\left(\frac{1}{2}\right)\right)\right)^3} \\ \frac{x}{(3\cos(c)-5)^3} \\ -\frac{944\left(\operatorname{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)}{16384d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+1024d} - \frac{472\left(\operatorname{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{16384d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+1024d} - \frac{59(}{16384d} \end{cases}$$

input
```
integrate(1/(-5+3*cos(d*x+c))**3,x)
```

output
```
Piecewise((x/(-5 + 3*cosh(2*atanh(1/2)))**3, Eq(c, -d*x - 2*I*atanh(1/2))
| Eq(c, -d*x + 2*I*atanh(1/2))), (x/(3*cos(c) - 5)**3, Eq(d, 0)), (-944*(a
tan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x
/2)**4/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 1024*d)
 - 472*(atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(
c/2 + d*x/2)**2/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2
+ 1024*d) - 59*(atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/p
i))/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 1024*d) -
408*tan(c/2 + d*x/2)**3/(16384*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*
x/2)**2 + 1024*d) - 138*tan(c/2 + d*x/2)/(16384*d*tan(c/2 + d*x/2)**4 + 81
92*d*tan(c/2 + d*x/2)**2 + 1024*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 112, normalized size of antiderivative = 1.35

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = -\frac{\frac{6\left(\frac{23\,\sin(dx+c)}{\cos(dx+c)+1}+\frac{68\,\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\,\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{16\,\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+1}+59\,\arctan\left(\frac{2\,\sin(dx+c)}{\cos(dx+c)+1}\right)}{1024\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
-1/1024*(6*(23*sin(d*x + c)/(cos(d*x + c) + 1) + 68*sin(d*x + c)^3/(cos(d*
x + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + 16*sin(d*x + c)^4/
(cos(d*x + c) + 1)^4 + 1) + 59*arctan(2*sin(d*x + c)/(cos(d*x + c) + 1)))/
d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 77, normalized size of antiderivative = 0.93

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = -\frac{59\,dx+59\,c+\frac{12\left(68\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3+23\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(4\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+1\right)^2}-118\,\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{2048\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
-1/2048*(59*d*x + 59*c + 12*(68*tan(1/2*d*x + 1/2*c)^3 + 23*tan(1/2*d*x +
1/2*c))/(4*tan(1/2*d*x + 1/2*c)^2 + 1)^2 - 118*arctan(sin(d*x + c)/(cos(d*
x + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 42.44 (sec) , antiderivative size = 96, normalized size of antiderivative = 1.16

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = \frac{59\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)-\frac{dx}{2}\right)}{1024\,d}-\frac{59\,\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)}{1024\,d}-\frac{\frac{51\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^3}{2048}+\frac{69\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{8192}}{d\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^4+\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^2}{2}+\frac{1}{16}\right)}$$

input
```
int(1/(3*cos(c + d*x) - 5)^3,x)
```

output
```
(59*(atan(tan(c/2 + (d*x)/2)) - (d*x)/2))/(1024*d) - (59*atan(2*tan(c/2 +
(d*x)/2)))/(1024*d) - ((69*tan(c/2 + (d*x)/2))/8192 + (51*tan(c/2 + (d*x)/
2)^3)/2048)/(d*(tan(c/2 + (d*x)/2)^2/2 + tan(c/2 + (d*x)/2)^4 + 1/16))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 106, normalized size of antiderivative = 1.28

$$\int \frac{1}{(-5+3\cos(c+dx))^3}\,dx = \frac{-1770atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos(dx+c)-531atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\sin(dx+c)^2+2006atan\left(2\tan\left(\frac{dx}{2}\right.\right.}{1024d\left(30\cos(dx+c)+9\sin(dx+c)^2-34\right)}$$

input
```
int(1/(-5+3*cos(d*x+c))^3,x)
```

output
```
( - 1770*atan(2*tan((c + d*x)/2))*cos(c + d*x) - 531*atan(2*tan((c + d*x)/
2))*sin(c + d*x)**2 + 2006*atan(2*tan((c + d*x)/2)) - 270*cos(c + d*x)*sin
(c + d*x) + 546*sin(c + d*x))/(1024*d*(30*cos(c + d*x) + 9*sin(c + d*x)**2
 - 34))
```

3.29 $\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 108

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx = \frac{385x}{32768} + \frac{385\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{16384d} + \frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3} + \frac{25\sin(c+dx)}{512d(5-3\cos(c+dx))^2} + \frac{311\sin(c+dx)}{8192d(5-3\cos(c+dx))}$$

output
```
385/32768*x+385/16384*arctan(sin(d*x+c)/(3-cos(d*x+c)))/d+1/16*sin(d*x+c)/
d/(5-3*cos(d*x+c))^3+25/512*sin(d*x+c)/d/(5-3*cos(d*x+c))^2+311/8192*sin(d
*x+c)/d/(5-3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.07 (sec) , antiderivative size = 66, normalized size of antiderivative = 0.61

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx = \frac{770\arctan\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right) - \frac{9(4883\sin(c+dx)-2340\sin(2(c+dx))+311\sin(3(c+dx)))}{(-5+3\cos(c+dx))^3}}{32768d}$$

input
```
Integrate[(-5 + 3*Cos[c + d*x])^(-4),x]
```

output
```
(770*ArcTan[2*Tan[(c + d*x)/2]] - (9*(4883*Sin[c + d*x] - 2340*Sin[2*(c +
d*x)] + 311*Sin[3*(c + d*x)]))/(-5 + 3*Cos[c + d*x])^3)/(32768*d)
```

Rubi [A] (verified)

Time = 0.51 (sec) , antiderivative size = 123, normalized size of antiderivative = 1.14, number of steps used = 11, number of rules used = 11, $\frac{\text{number of rules}}{\text{integrand size}} = 0.917$, Rules used = {3042, 3143, 27, 3042, 3233, 25, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3\cos(c+dx)-5)^4}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)-5\right)^4}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}-\frac{1}{48}\int -\frac{3(2\cos(c+dx)+5)}{(5-3\cos(c+dx))^3}dx$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{16}\int \frac{2\cos(c+dx)+5}{(5-3\cos(c+dx))^3}dx+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\int \frac{2\sin\left(c+dx+\frac{\pi}{2}\right)+5}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^3}dx+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{16}\left(\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}-\frac{1}{32}\int -\frac{25\cos(c+dx)+62}{(5-3\cos(c+dx))^2}dx\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{25\cos(c+dx)+62}{(5-3\cos(c+dx))^2}dx+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \textbf{3042}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{25\sin\left(c+dx+\frac{\pi}{2}\right)+62}{\left(5-3\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \textbf{3233}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}-\frac{1}{16}\int -\frac{385}{5-3\cos(c+dx)}dx\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \textbf{27}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{5-3\cos(c+dx)}dx+\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \textbf{3042}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{5-3\sin\left(c+dx+\frac{\pi}{2}\right)}dx+\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

$$\Big\downarrow \textbf{3136}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\left(\frac{\arctan\left(\frac{\sin(c+dx)}{3-\cos(c+dx)}\right)}{2d}+\frac{x}{4}\right)+\frac{311\sin(c+dx)}{16d(5-3\cos(c+dx))}\right)+\frac{25\sin(c+dx)}{32d(5-3\cos(c+dx))^2}\right)+\frac{\sin(c+dx)}{16d(5-3\cos(c+dx))^3}$$

input
```
Int[(-5 + 3*Cos[c + d*x])^(-4),x]
```

output
```
Sin[c + d*x]/(16*d*(5 - 3*Cos[c + d*x])^3) + ((25*Sin[c + d*x])/(32*d*(5 -
 3*Cos[c + d*x])^2) + ((385*(x/4 + ArcTan[Sin[c + d*x]/(3 - Cos[c + d*x])]
/(2*d)))/16 + (311*Sin[c + d*x])/(16*d*(5 - 3*Cos[c + d*x])))/32)/16
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.68 (sec) , antiderivative size = 77, normalized size of antiderivative = 0.71

method	result
derivativedivides	$\frac{\frac{\frac{369 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^5}{512}+\frac{117 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{256}+\frac{639 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{8192}}{\left(4 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+1\right)^3}+\frac{385 \arctan\left(2 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{16384}}{d}$
default	$\frac{\frac{\frac{369 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^5}{512}+\frac{117 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{256}+\frac{639 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{8192}}{\left(4 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+1\right)^3}+\frac{385 \arctan\left(2 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)}{16384}}{d}$
risch	$\frac{i(10395\,\mathrm{e}^{5i(dx+c)}-86625\,\mathrm{e}^{4i(dx+c)}+239470\,\mathrm{e}^{3i(dx+c)}-218466\,\mathrm{e}^{2i(dx+c)}+73575\,\mathrm{e}^{i(dx+c)}-8397)}{12288d(3\,\mathrm{e}^{2i(dx+c)}-10\,\mathrm{e}^{i(dx+c)}+3)^3}+\frac{385i\ln(\mathrm{e}^{i(dx+c)}}{32768d}$
parallelrisch	$\frac{385i(770-27\cos(3dx+3c)-981\cos(dx+c)+270\cos(2dx+2c))\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-i\right)+385i(27\cos(3dx+3c)+981\cos(d}{32768d(27\cos(3dx+3c)+981\cos(d}$

input
```
int(1/(-5+3*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
1/d*(8*(369/4096*tan(1/2*d*x+1/2*c)^5+117/2048*tan(1/2*d*x+1/2*c)^3+639/65
536*tan(1/2*d*x+1/2*c))/(4*tan(1/2*d*x+1/2*c)^2+1)^3+385/16384*arctan(2*ta
n(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 121, normalized size of antiderivative = 1.12

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx =$$
$$-\frac{385\left(27\cos(dx+c)^3-135\cos(dx+c)^2+225\cos(dx+c)-125\right)\arctan\left(\frac{5\cos(dx+c)-3}{4\sin(dx+c)}\right)+36\,(311}{32768\left(27\,d\cos(dx+c)^3-135\,d\cos(dx+c)^2+225\,d\cos(dx\right.}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
-1/32768*(385*(27*cos(d*x + c)^3 - 135*cos(d*x + c)^2 + 225*cos(d*x + c) -
 125)*arctan(1/4*(5*cos(d*x + c) - 3)/sin(d*x + c)) + 36*(311*cos(d*x + c)
^2 - 1170*cos(d*x + c) + 1143)*sin(d*x + c))/(27*d*cos(d*x + c)^3 - 135*d*
cos(d*x + c)^2 + 225*d*cos(d*x + c) - 125*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 2.71 (sec) , antiderivative size = 597, normalized size of antiderivative = 5.53

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(-5+3*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(-5 + 3*cosh(2*atanh(1/2)))**4, Eq(c, -d*x - 2*I*atanh(1/2))
| Eq(c, -d*x + 2*I*atanh(1/2))), (x/(3*cos(c) - 5)**4, Eq(d, 0)), (24640*(
atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*
x/2)**6/(1048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 19
6608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 18480*(atan(2*tan(c/2 + d*x/2)) +
pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**4/(1048576*d*tan(c/2
+ d*x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2
+ 16384*d) + 4620*(atan(2*tan(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2
)/pi))*tan(c/2 + d*x/2)**2/(1048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c
/2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 385*(atan(2*tan
(c/2 + d*x/2)) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/(1048576*d*tan(c/2 + d
*x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 1
6384*d) + 11808*tan(c/2 + d*x/2)**5/(1048576*d*tan(c/2 + d*x/2)**6 + 78643
2*d*tan(c/2 + d*x/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 7488*t
an(c/2 + d*x/2)**3/(1048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c/2 + d*x
/2)**4 + 196608*d*tan(c/2 + d*x/2)**2 + 16384*d) + 1278*tan(c/2 + d*x/2)/(
1048576*d*tan(c/2 + d*x/2)**6 + 786432*d*tan(c/2 + d*x/2)**4 + 196608*d*ta
n(c/2 + d*x/2)**2 + 16384*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 152, normalized size of antiderivative = 1.41

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx = \frac{\frac{18\left(\frac{71\sin(dx+c)}{\cos(dx+c)+1}+\frac{416\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{656\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{12\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{48\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{64\sin(dx+c)^6}{(\cos(dx+c)+1)^6}+1}+385\arctan\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}\right)}{16384\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
1/16384*(18*(71*sin(d*x + c)/(cos(d*x + c) + 1) + 416*sin(d*x + c)^3/(cos(
d*x + c) + 1)^3 + 656*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(12*sin(d*x + c
)^2/(cos(d*x + c) + 1)^2 + 48*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + 64*sin
(d*x + c)^6/(cos(d*x + c) + 1)^6 + 1) + 385*arctan(2*sin(d*x + c)/(cos(d*x
 + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.13 (sec) , antiderivative size = 90, normalized size of antiderivative = 0.83

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx = \frac{385\,dx+385\,c+\frac{36\left(656\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^5+416\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3+71\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(4\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2+1\right)^3}-770\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)-3}\right)}{32768\,d}$$

input
```
integrate(1/(-5+3*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
1/32768*(385*d*x + 385*c + 36*(656*tan(1/2*d*x + 1/2*c)^5 + 416*tan(1/2*d*
x + 1/2*c)^3 + 71*tan(1/2*d*x + 1/2*c))/(4*tan(1/2*d*x + 1/2*c)^2 + 1)^3 -
 770*arctan(sin(d*x + c)/(cos(d*x + c) - 3)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 97, normalized size of antiderivative = 0.90

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx = \frac{385\,\mathrm{atan}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{16384\,d} - \frac{385\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{16384\,d} + \frac{\frac{369\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^5}{512}+\frac{117\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{256}+\frac{639\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{8192}}{d\,\left(4\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+1\right)^3}$$

input
```
int(1/(3*cos(c + d*x) - 5)^4,x)
```

output
```
(385*atan(2*tan(c/2 + (d*x)/2)))/(16384*d) - (385*(atan(tan(c/2 + (d*x)/2)
) - (d*x)/2))/(16384*d) + ((639*tan(c/2 + (d*x)/2))/8192 + (117*tan(c/2 +
(d*x)/2)^3)/256 + (369*tan(c/2 + (d*x)/2)^5)/512)/(d*(4*tan(c/2 + (d*x)/2)
^2 + 1)^3)
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 160, normalized size of antiderivative = 1.48

$$\int \frac{1}{(-5+3\cos(c+dx))^4}\,dx = \frac{10395atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos(dx+c)\sin(dx+c)^2 - 97020atan\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)\right)\cos(dx+c) - 51975 \cdots}{16384d\,(27\cos(dx+c) \cdots}$$

input
```
int(1/(-5+3*cos(d*x+c))^4,x)
```

output
```
(10395*atan(2*tan((c + d*x)/2))*cos(c + d*x)*sin(c + d*x)**2 - 97020*atan(
2*tan((c + d*x)/2))*cos(c + d*x) - 51975*atan(2*tan((c + d*x)/2))*sin(c +
d*x)**2 + 100100*atan(2*tan((c + d*x)/2)) - 21060*cos(c + d*x)*sin(c + d*x
) - 5598*sin(c + d*x)**3 + 26172*sin(c + d*x))/(16384*d*(27*cos(c + d*x)*s
in(c + d*x)**2 - 252*cos(c + d*x) - 135*sin(c + d*x)**2 + 260))
```

3.30 $\int \frac{1}{-5-3\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 31

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx = -\frac{x}{4}+\frac{\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{2d}$$

output
```
-1/4*x+1/2*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d
```

Mathematica [A] (verified)

Time = 0.05 (sec) , antiderivative size = 20, normalized size of antiderivative = 0.65

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx = \frac{\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Integrate[(-5 - 3*Cos[c + d*x])^(-1),x]
```

output
```
ArcTan[2*Cot[(c + d*x)/2]]/(2*d)
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 31, normalized size of antiderivative = 1.00, number of steps used = 2, number of rules used = 2, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.167, Rules used = {3042, 3137}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{-3\cos(c+dx)-5}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{-3\sin\left(c+dx+\frac{\pi}{2}\right)-5}dx$$

$$\Big\downarrow \text{3137}$$

$$\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}-\frac{x}{4}$$

input
```
Int[(-5 - 3*Cos[c + d*x])^(-1),x]
```

output
```
-1/4*x + ArcTan[Sin[c + d*x]/(3 + Cos[c + d*x])]/(2*d)
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3137
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[-x/q, x] - Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a -
q + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &
& NegQ[a]
```

Maple [A] (verified)

Time = 0.65 (sec) , antiderivative size = 18, normalized size of antiderivative = 0.58

method	result	size
derivativedivides	$-\frac{\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{2d}$	18
default	$-\frac{\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{2d}$	18
parallelrisch	$\frac{i\left(\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)-\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2i\right)\right)}{4d}$	36
risch	$\frac{i\ln\left(e^{i(dx+c)}+\frac{1}{3}\right)}{4d}-\frac{i\ln\left(e^{i(dx+c)}+3\right)}{4d}$	38

input
```
int(1/(-5-3*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
-1/2/d*arctan(1/2*tan(1/2*d*x+1/2*c))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 26, normalized size of antiderivative = 0.84

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx=\frac{\arctan\left(\frac{5\cos(dx+c)+3}{4\sin(dx+c)}\right)}{4\,d}$$

input
```
integrate(1/(-5-3*cos(d*x+c)),x, algorithm="fricas")
```

output
```
1/4*arctan(1/4*(5*cos(d*x + c) + 3)/sin(d*x + c))/d
```

Sympy [A] (verification not implemented)

Time = 0.34 (sec) , antiderivative size = 44, normalized size of antiderivative = 1.42

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx = \begin{cases} -\frac{\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor}{2d} & \text{for } d\neq 0 \\ \frac{x}{-3\cos(c)-5} & \text{otherwise} \end{cases}$$

input
```
integrate(1/(-5-3*cos(d*x+c)),x)
```

output
```
Piecewise((-(atan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))
/(2*d), Ne(d, 0)), (x/(-3*cos(c) - 5), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 24, normalized size of antiderivative = 0.77

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx = -\frac{\arctan\left(\frac{\sin(dx+c)}{2(\cos(dx+c)+1)}\right)}{2d}$$

input
```
integrate(1/(-5-3*cos(d*x+c)),x, algorithm="maxima")
```

output
```
-1/2*arctan(1/2*sin(d*x + c)/(cos(d*x + c) + 1))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 30, normalized size of antiderivative = 0.97

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx = -\frac{dx+c-2\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{4d}$$

input
```
integrate(1/(-5-3*cos(d*x+c)),x, algorithm="giac")
```

output
```
-1/4*(d*x + c - 2*arctan(sin(d*x + c)/(cos(d*x + c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 41.62 (sec) , antiderivative size = 38, normalized size of antiderivative = 1.23

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx = \frac{\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}}{2\,d} - \frac{\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{2\,d}$$

input
```
int(-1/(3*cos(c + d*x) + 5),x)
```

output
```
(atan(tan(c/2 + (d*x)/2)) - (d*x)/2)/(2*d) - atan(tan(c/2 + (d*x)/2)/2)/(2
*d)
```

Reduce [B] (verification not implemented)

Time = 0.16 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.55

$$\int \frac{1}{-5-3\cos(c+dx)}\,dx = -\frac{atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{2d}$$

input
```
int(1/(-5-3*cos(d*x+c)),x)
```

output
```
( - atan(tan((c + d*x)/2)/2))/(2*d)
```

3.31 $\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 56

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = \frac{5x}{64} - \frac{5\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{32d} - \frac{3\sin(c+dx)}{16d(5+3\cos(c+dx))}$$

output
```
5/64*x-5/32*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d-3/16*sin(d*x+c)/d/(5+3*cos
(d*x+c))
```

Mathematica [A] (verified)

Time = 0.02 (sec) , antiderivative size = 43, normalized size of antiderivative = 0.77

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = -\frac{5\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right) + \frac{6\sin(c+dx)}{5+3\cos(c+dx)}}{32d}$$

input
```
Integrate[(-5 - 3*Cos[c + d*x])^(-2),x]
```

output
```
-1/32*(5*ArcTan[2*Cot[(c + d*x)/2]] + (6*Sin[c + d*x])/(5 + 3*Cos[c + d*x]
))/d
```

Rubi [A] (verified)

Time = 0.28 (sec) , antiderivative size = 61, normalized size of antiderivative = 1.09, number of steps used = 5, number of rules used = 5, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.417, Rules used = {3042, 3143, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(-3\cos(c+dx)-5)^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(-3\sin\left(c+dx+\frac{\pi}{2}\right)-5\right)^2}dx$$

$$\Big\downarrow \text{3143}$$

$$-\frac{1}{16}\int -\frac{5}{3\cos(c+dx)+5}dx-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

$$\Big\downarrow \text{27}$$

$$\frac{5}{16}\int \frac{1}{3\cos(c+dx)+5}dx-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

$$\Big\downarrow \text{3042}$$

$$\frac{5}{16}\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)+5}dx-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

$$\Big\downarrow \text{3136}$$

$$\frac{5}{16}\left(\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}\right)-\frac{3\sin(c+dx)}{16d(3\cos(c+dx)+5)}$$

input
```
Int[(-5 - 3*Cos[c + d*x])^(-2),x]
```

output
```
(5*(x/4 - ArcTan[Sin[c + d*x]/(3 + Cos[c + d*x])]/(2*d)))/16 - (3*Sin[c +
d*x])/(16*d*(5 + 3*Cos[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.86 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.82

method	result	size
derivativedivides	$\frac{-\frac{3\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)}+\frac{5\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{32}}{d}$	46
default	$\frac{-\frac{3\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)}+\frac{5\arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{32}}{d}$	46
parallelrisch	$\frac{(-15i\cos(dx+c)-25i)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)+(15i\cos(dx+c)+25i)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2i\right)-12\sin(dx+c)}{192d\cos(dx+c)+320d}$	78
risch	$-\frac{i\left(5\,\mathrm{e}^{i(dx+c)}+3\right)}{8d\left(3\,\mathrm{e}^{2i(dx+c)}+10\,\mathrm{e}^{i(dx+c)}+3\right)}-\frac{5i\ln\left(\mathrm{e}^{i(dx+c)}+\frac{1}{3}\right)}{64d}+\frac{5i\ln\left(\mathrm{e}^{i(dx+c)}+3\right)}{64d}$	83

input
```
int(1/(-5-3*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
1/d*(-3/16*tan(1/2*d*x+1/2*c)/(tan(1/2*d*x+1/2*c)^2+4)+5/32*arctan(1/2*tan
(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.05

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = -\frac{5\,(3\,\cos\left(dx+c\right)+5)\arctan\left(\frac{5\,\cos(dx+c)+3}{4\,\sin(dx+c)}\right)+12\,\sin\left(dx+c\right)}{64\,(3\,d\cos\left(dx+c\right)+5\,d)}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
-1/64*(5*(3*cos(d*x + c) + 5)*arctan(1/4*(5*cos(d*x + c) + 3)/sin(d*x + c)
) + 12*sin(d*x + c))/(3*d*cos(d*x + c) + 5*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.87 (sec) , antiderivative size = 190, normalized size of antiderivative = 3.39

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = \begin{cases} \frac{x}{(-5-3\cosh(2\operatorname{atanh}(2)))^2} & \text{fo} \\ \frac{x}{(-3\cos(c)-5)^2} & \text{fo} \\ \frac{5\left(\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{32d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+128d}+\frac{20\left(\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)}{32d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+128d}-\frac{6\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{32d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+128d} & \text{o} \end{cases}$$

input
```
integrate(1/(-5-3*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(-5 - 3*cosh(2*atanh(2)))**2, Eq(c, -d*x - 2*I*atanh(2)) | Eq
(c, -d*x + 2*I*atanh(2))), (x/(-3*cos(c) - 5)**2, Eq(d, 0)), (5*(atan(tan(
c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**2/(
32*d*tan(c/2 + d*x/2)**2 + 128*d) + 20*(atan(tan(c/2 + d*x/2)/2) + pi*floo
r((c/2 + d*x/2 - pi/2)/pi))/(32*d*tan(c/2 + d*x/2)**2 + 128*d) - 6*tan(c/2
 + d*x/2)/(32*d*tan(c/2 + d*x/2)**2 + 128*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 68, normalized size of antiderivative = 1.21

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = -\frac{\frac{6\,\sin(dx+c)}{\left(\frac{\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+4\right)(\cos(dx+c)+1)} - 5\,\arctan\left(\frac{\sin(dx+c)}{2\,(\cos(dx+c)+1)}\right)}{32\,d}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
-1/32*(6*sin(d*x + c)/((sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + 4)*(cos(d*x
+ c) + 1)) - 5*arctan(1/2*sin(d*x + c)/(cos(d*x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 59, normalized size of antiderivative = 1.05

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = \frac{5\,dx + 5\,c - \frac{12\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+4} - 10\,\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{64\,d}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
1/64*(5*d*x + 5*c - 12*tan(1/2*d*x + 1/2*c)/(tan(1/2*d*x + 1/2*c)^2 + 4) -
 10*arctan(sin(d*x + c)/(cos(d*x + c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 67, normalized size of antiderivative = 1.20

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = \frac{5\,\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{32\,d} - \frac{5\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{32\,d} - \frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{16\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+4\right)}$$

input
```
int(1/(3*cos(c + d*x) + 5)^2,x)
```

output
```
(5*atan(tan(c/2 + (d*x)/2)/2))/(32*d) - (5*(atan(tan(c/2 + (d*x)/2)) - (d*
x)/2))/(32*d) - (3*tan(c/2 + (d*x)/2))/(16*d*(tan(c/2 + (d*x)/2)^2 + 4))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 60, normalized size of antiderivative = 1.07

$$\int \frac{1}{(-5-3\cos(c+dx))^2}\,dx = \frac{15 atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos(dx+c)+25 atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)-6\sin(dx+c)}{32d\,(3\cos(dx+c)+5)}$$

input
```
int(1/(-5-3*cos(d*x+c))^2,x)
```

output
```
(15*atan(tan((c + d*x)/2)/2)*cos(c + d*x) + 25*atan(tan((c + d*x)/2)/2) -
6*sin(c + d*x))/(32*d*(3*cos(c + d*x) + 5))
```

3.32 $\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 81

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx=-\frac{59x}{2048}+\frac{59\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{1024d}+\frac{3\sin(c+dx)}{32d(5+3\cos(c+dx))^2}+\frac{45\sin(c+dx)}{512d(5+3\cos(c+dx))}$$

output
```
-59/2048*x+59/1024*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d+3/32*sin(d*x+c)/d/(
5+3*cos(d*x+c))^2+45/512*sin(d*x+c)/d/(5+3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.37 (sec) , antiderivative size = 65, normalized size of antiderivative = 0.80

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx=\frac{59\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right)(5+3\cos(c+dx))^2+546\sin(c+dx)+135\sin(2(c+dx))}{1024d(5+3\cos(c+dx))^2}$$

input
```
Integrate[(-5 - 3*Cos[c + d*x])^(-3),x]
```

output
```
(59*ArcTan[2*Cot[(c + d*x)/2]]*(5 + 3*Cos[c + d*x])^2 + 546*Sin[c + d*x] +
 135*Sin[2*(c + d*x)])/(1024*d*(5 + 3*Cos[c + d*x])^2)
```

Rubi [A] (verified)

Time = 0.39 (sec) , antiderivative size = 91, normalized size of antiderivative = 1.12, number of steps used = 7, number of rules used = 7, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.583, Rules used = {3042, 3143, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(-3\cos(c+dx)-5)^3}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(-3\sin\left(c+dx+\frac{\pi}{2}\right)-5\right)^3}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}-\frac{1}{32}\int \frac{10-3\cos(c+dx)}{(3\cos(c+dx)+5)^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}-\frac{1}{32}\int \frac{10-3\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^2}dx$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{32}\left(\frac{1}{16}\int -\frac{59}{3\cos(c+dx)+5}dx+\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)+\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}-\frac{59}{16}\int \frac{1}{3\cos(c+dx)+5}dx\right)+\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}-\frac{59}{16}\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)+5}dx\right)+\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

$$\Big\downarrow \text{3136}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(3\cos(c+dx)+5)}-\frac{59}{16}\left(\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}\right)\right)+\frac{3\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}$$

input
```
Int[(-5 - 3*Cos[c + d*x])^(-3),x]
```

output
```
(3*Sin[c + d*x])/(32*d*(5 + 3*Cos[c + d*x])^2) + ((-59*(x/4 - ArcTan[Sin[c
 + d*x]/(3 + Cos[c + d*x])]/(2*d)))/16 + (45*Sin[c + d*x])/(16*d*(5 + 3*Co
s[c + d*x])))/32
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.88 (sec) , antiderivative size = 62, normalized size of antiderivative = 0.77

method	result
derivativedivides	$\frac{-\frac{-\frac{69 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{128}-\frac{51 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{32}}{4\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)^{2}}-\frac{59 \arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{1024}}{d}$
default	$\frac{-\frac{-\frac{69 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{128}-\frac{51 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{32}}{4\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)^{2}}-\frac{59 \arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{1024}}{d}$
risch	$\frac{3i\left(59\,{\mathrm e}^{3i(dx+c)}+295\,{\mathrm e}^{2i(dx+c)}+241\,{\mathrm e}^{i(dx+c)}+45\right)}{256d\left(3\,{\mathrm e}^{2i(dx+c)}+10\,{\mathrm e}^{i(dx+c)}+3\right)^{2}}+\frac{59i\ln\left({\mathrm e}^{i(dx+c)}+\frac{1}{3}\right)}{2048d}-\frac{59i\ln\left({\mathrm e}^{i(dx+c)}+3\right)}{2048d}$
parallelrisch	$\frac{59i(9\cos(2dx+2c)+59+60\cos(dx+c))\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)+59i(-9\cos(2dx+2c)-59-60\cos(dx+c))\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right.\right.}{2048d(9\cos(2dx+2c)+59+60\cos(dx+c))}$

input
```
int(1/(-5-3*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
1/d*(-1/4*(-69/128*tan(1/2*d*x+1/2*c)^3-51/32*tan(1/2*d*x+1/2*c))/(tan(1/2
*d*x+1/2*c)^2+4)^2-59/1024*arctan(1/2*tan(1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 90, normalized size of antiderivative = 1.11

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx = \frac{59\left(9\,\cos\left(dx+c\right)^2+30\,\cos\left(dx+c\right)+25\right)\arctan\left(\frac{5\,\cos(dx+c)+3}{4\,\sin(dx+c)}\right)+12\left(45\,\cos\left(dx+c\right)+91\right)\sin\left(dx+c\right)}{2048\left(9\,d\cos\left(dx+c\right)^2+30\,d\cos\left(dx+c\right)+25\,d\right)}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^3,x, algorithm="fricas")
```

output
```
1/2048*(59*(9*cos(d*x + c)^2 + 30*cos(d*x + c) + 25)*arctan(1/4*(5*cos(d*x
 + c) + 3)/sin(d*x + c)) + 12*(45*cos(d*x + c) + 91)*sin(d*x + c))/(9*d*co
s(d*x + c)^2 + 30*d*cos(d*x + c) + 25*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 1.44 (sec) , antiderivative size = 362, normalized size of antiderivative = 4.47

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx = \begin{cases} \frac{x}{\left(-5-3\cosh\left(2\,\mathrm{atanh}\left(2\right)\right)\right)^3} \\ \frac{x}{\left(-3\cos\left(c\right)-5\right)^3} \\ -\frac{59\left(\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)}{1024d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+16384d} - \frac{472\left(\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)+\pi\left\lfloor\frac{\frac{c}{2}+\frac{dx}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{1024d\tan^4\left(\frac{c}{2}+\frac{dx}{2}\right)+8192d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)+16384d} - \frac{944\left(\mathrm{at}\right.}{1024d\tan^4} \end{cases}$$

input
```
integrate(1/(-5-3*cos(d*x+c))**3,x)
```

output
```
Piecewise((x/(-5 - 3*cosh(2*atanh(2)))**3, Eq(c, -d*x - 2*I*atanh(2)) | Eq
(c, -d*x + 2*I*atanh(2))), (x/(-3*cos(c) - 5)**3, Eq(d, 0)), (-59*(atan(ta
n(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**4
/(1024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 16384*d) - 472
*(atan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 +
d*x/2)**2/(1024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 16384
*d) - 944*(atan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/(
1024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**2 + 16384*d) + 138*t
an(c/2 + d*x/2)**3/(1024*d*tan(c/2 + d*x/2)**4 + 8192*d*tan(c/2 + d*x/2)**
2 + 16384*d) + 408*tan(c/2 + d*x/2)/(1024*d*tan(c/2 + d*x/2)**4 + 8192*d*t
an(c/2 + d*x/2)**2 + 16384*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 111, normalized size of antiderivative = 1.37

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx = \frac{\frac{6\left(\frac{68\,\sin(dx+c)}{\cos(dx+c)+1}+\frac{23\,\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\,\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+16} - 59\,\arctan\left(\frac{\sin(dx+c)}{2\,(\cos(dx+c)+1)}\right)}{1024\,d}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
1/1024*(6*(68*sin(d*x + c)/(cos(d*x + c) + 1) + 23*sin(d*x + c)^3/(cos(d*x
 + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 + sin(d*x + c)^4/(cos
(d*x + c) + 1)^4 + 16) - 59*arctan(1/2*sin(d*x + c)/(cos(d*x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 75, normalized size of antiderivative = 0.93

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx = -\frac{59\,dx + 59\,c - \frac{12\left(23\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3+68\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+4\right)^2} - 118\,\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{2048\,d}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
-1/2048*(59*d*x + 59*c - 12*(23*tan(1/2*d*x + 1/2*c)^3 + 68*tan(1/2*d*x +
1/2*c))/(tan(1/2*d*x + 1/2*c)^2 + 4)^2 - 118*arctan(sin(d*x + c)/(cos(d*x
+ c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 43.49 (sec) , antiderivative size = 95, normalized size of antiderivative = 1.17

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx = \frac{59\left(\operatorname{atan}\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)-\frac{dx}{2}\right)}{1024\,d}-\frac{59\operatorname{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)}{1024\,d}+\frac{\frac{69\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^3}{512}+\frac{51\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{128}}{d\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^4+8\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^2+16\right)}$$

input
```
int(-1/(3*cos(c + d*x) + 5)^3,x)
```

output
```
(59*(atan(tan(c/2 + (d*x)/2)) - (d*x)/2))/(1024*d) - (59*atan(tan(c/2 + (d
*x)/2)/2))/(1024*d) + ((51*tan(c/2 + (d*x)/2))/128 + (69*tan(c/2 + (d*x)/2
)^3)/512)/(d*(8*tan(c/2 + (d*x)/2)^2 + tan(c/2 + (d*x)/2)^4 + 16))
```

Reduce [B] (verification not implemented)

Time = 0.20 (sec) , antiderivative size = 106, normalized size of antiderivative = 1.31

$$\int \frac{1}{(-5-3\cos(c+dx))^3}\,dx = \frac{-1770atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos\left(dx+c\right)+531atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\sin\left(dx+c\right)^2-2006atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)+2}{1024d\left(30\cos\left(dx+c\right)-9\sin\left(dx+c\right)^2+34\right)}$$

input
```
int(1/(-5-3*cos(d*x+c))^3,x)
```

output

```
( - 1770*atan(tan((c + d*x)/2)/2)*cos(c + d*x) + 531*atan(tan((c + d*x)/2)
/2)*sin(c + d*x)**2 - 2006*atan(tan((c + d*x)/2)/2) + 270*cos(c + d*x)*sin
(c + d*x) + 546*sin(c + d*x))/(1024*d*(30*cos(c + d*x) - 9*sin(c + d*x)**2
 + 34))
```

3.33 $\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 106

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx = \frac{385x}{32768} - \frac{385\arctan\left(\frac{\sin(c+dx)}{3+\cos(c+dx)}\right)}{16384d} - \frac{\sin(c+dx)}{16d(5+3\cos(c+dx))^3} - \frac{25\sin(c+dx)}{512d(5+3\cos(c+dx))^2} - \frac{311\sin(c+dx)}{8192d(5+3\cos(c+dx))}$$

output
```
385/32768*x-385/16384*arctan(sin(d*x+c)/(3+cos(d*x+c)))/d-1/16*sin(d*x+c)/
d/(5+3*cos(d*x+c))^3-25/512*sin(d*x+c)/d/(5+3*cos(d*x+c))^2-311/8192*sin(d
*x+c)/d/(5+3*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.18 (sec) , antiderivative size = 66, normalized size of antiderivative = 0.62

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx = -\frac{770\arctan\left(2\cot\left(\frac{1}{2}(c+dx)\right)\right) + \frac{9(4883\sin(c+dx)+2340\sin(2(c+dx))+311\sin(3(c+dx)))}{(5+3\cos(c+dx))^3}}{32768d}$$

input
```
Integrate[(-5 - 3*Cos[c + d*x])^(-4),x]
```

output
```
-1/32768*(770*ArcTan[2*Cot[(c + d*x)/2]] + (9*(4883*Sin[c + d*x] + 2340*Si
n[2*(c + d*x)] + 311*Sin[3*(c + d*x)]))/(5 + 3*Cos[c + d*x])^3)/d
```

Rubi [A] (verified)

Time = 0.50 (sec) , antiderivative size = 121, normalized size of antiderivative = 1.14, number of steps used = 11, number of rules used = 11, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.917, Rules used = {3042, 3143, 27, 3042, 3233, 25, 3042, 3233, 27, 3042, 3136}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(-3\cos(c+dx)-5)^4}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(-3\sin\left(c+dx+\frac{\pi}{2}\right)-5\right)^4}dx$$

$$\Big\downarrow \text{3143}$$

$$-\frac{1}{48}\int -\frac{3(5-2\cos(c+dx))}{(3\cos(c+dx)+5)^3}dx-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{16}\int \frac{5-2\cos(c+dx)}{(3\cos(c+dx)+5)^3}dx-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\int \frac{5-2\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^3}dx-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{16}\left(-\frac{1}{32}\int -\frac{62-25\cos(c+dx)}{(3\cos(c+dx)+5)^2}dx-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{62-25\cos(c+dx)}{(3\cos(c+dx)+5)^2}dx-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\left(\frac{1}{32}\int \frac{62-25\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(3\sin\left(c+dx+\frac{\pi}{2}\right)+5\right)^2}dx-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(-\frac{1}{16}\int -\frac{385}{3\cos(c+dx)+5}dx-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{3\cos(c+dx)+5}dx-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\int \frac{1}{3\sin\left(c+dx+\frac{\pi}{2}\right)+5}dx-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

$$\Big\downarrow \text{3136}$$

$$\frac{1}{16}\left(\frac{1}{32}\left(\frac{385}{16}\left(\frac{x}{4}-\frac{\arctan\left(\frac{\sin(c+dx)}{\cos(c+dx)+3}\right)}{2d}\right)-\frac{311\sin(c+dx)}{16d(3\cos(c+dx)+5)}\right)-\frac{25\sin(c+dx)}{32d(3\cos(c+dx)+5)^2}\right)-\frac{\sin(c+dx)}{16d(3\cos(c+dx)+5)^3}$$

input
```
Int[(-5 - 3*Cos[c + d*x])^(-4),x]
```

output
```
-1/16*Sin[c + d*x]/(d*(5 + 3*Cos[c + d*x])^3) + ((-25*Sin[c + d*x])/(32*d*
(5 + 3*Cos[c + d*x])^2) + ((385*(x/4 - ArcTan[Sin[c + d*x]/(3 + Cos[c + d*
x])]/(2*d)))/16 - (311*Sin[c + d*x])/(16*d*(5 + 3*Cos[c + d*x])))/32)/16
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3136
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{q = Rt[
a^2 - b^2, 2]}, Simp[x/q, x] + Simp[(2/(d*q))*ArcTan[b*(Cos[c + d*x]/(a + q
 + b*Sin[c + d*x]))], x]] /; FreeQ[{a, b, c, d}, x] && GtQ[a^2 - b^2, 0] &&
 PosQ[a]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.91 (sec) , antiderivative size = 75, normalized size of antiderivative = 0.71

method	result
derivativedivides	$\frac{\frac{-\frac{639 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}}{1024}-\frac{117 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{32}-\frac{369 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64}}{8\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)^{3}}+\frac{385 \arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{16384}}{d}$
default	$\frac{\frac{-\frac{639 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}}{1024}-\frac{117 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{32}-\frac{369 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{64}}{8\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+4\right)^{3}}+\frac{385 \arctan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)}{16384}}{d}$
risch	$-\frac{i\left(10395\,e^{5i(dx+c)}+86625\,e^{4i(dx+c)}+239470\,e^{3i(dx+c)}+218466\,e^{2i(dx+c)}+73575\,e^{i(dx+c)}+8397\right)}{12288d\left(3\,e^{2i(dx+c)}+10\,e^{i(dx+c)}+3\right)^{3}}-\frac{385i\ln\left(e^{i(dx+}\right.}{32768d}$
parallelrisch	$\frac{385i(-27\cos(3dx+3c)-981\cos(dx+c)-270\cos(2dx+2c)-770)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2i\right)+385i(27\cos(3dx+3c)+981\cos(}{32768d(27\cos(3dx+3c)+981\cos(}$

input
```
int(1/(-5-3*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
1/d*(1/8*(-639/1024*tan(1/2*d*x+1/2*c)^5-117/32*tan(1/2*d*x+1/2*c)^3-369/6
4*tan(1/2*d*x+1/2*c))/(tan(1/2*d*x+1/2*c)^2+4)^3+385/16384*arctan(1/2*tan(
1/2*d*x+1/2*c)))
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 121, normalized size of antiderivative = 1.14

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx =$$
$$-\frac{385\left(27\cos\left(dx+c\right)^{3}+135\cos\left(dx+c\right)^{2}+225\cos\left(dx+c\right)+125\right)\arctan\left(\frac{5\cos(dx+c)+3}{4\sin(dx+c)}\right)+36\,(311\,}{32768\left(27\,d\cos\left(dx+c\right)^{3}+135\,d\cos\left(dx+c\right)^{2}+225\,d\cos\left(dx\right.\right.}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
-1/32768*(385*(27*cos(d*x + c)^3 + 135*cos(d*x + c)^2 + 225*cos(d*x + c) +
 125)*arctan(1/4*(5*cos(d*x + c) + 3)/sin(d*x + c)) + 36*(311*cos(d*x + c)
^2 + 1170*cos(d*x + c) + 1143)*sin(d*x + c))/(27*d*cos(d*x + c)^3 + 135*d*
cos(d*x + c)^2 + 225*d*cos(d*x + c) + 125*d)
```

Sympy [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 2.90 (sec) , antiderivative size = 595, normalized size of antiderivative = 5.61

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(-5-3*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(-5 - 3*cosh(2*atanh(2)))**4, Eq(c, -d*x - 2*I*atanh(2)) | Eq
(c, -d*x + 2*I*atanh(2))), (x/(-3*cos(c) - 5)**4, Eq(d, 0)), (385*(atan(ta
n(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**6
/(16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*ta
n(c/2 + d*x/2)**2 + 1048576*d) + 4620*(atan(tan(c/2 + d*x/2)/2) + pi*floor
((c/2 + d*x/2 - pi/2)/pi))*tan(c/2 + d*x/2)**4/(16384*d*tan(c/2 + d*x/2)**
6 + 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*
d) + 18480*(atan(tan(c/2 + d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))*
tan(c/2 + d*x/2)**2/(16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/
2)**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*d) + 24640*(atan(tan(c/2 +
d*x/2)/2) + pi*floor((c/2 + d*x/2 - pi/2)/pi))/(16384*d*tan(c/2 + d*x/2)**
6 + 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*
d) - 1278*tan(c/2 + d*x/2)**5/(16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(
c/2 + d*x/2)**4 + 786432*d*tan(c/2 + d*x/2)**2 + 1048576*d) - 7488*tan(c/2
 + d*x/2)**3/(16384*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/2)**4 +
 786432*d*tan(c/2 + d*x/2)**2 + 1048576*d) - 11808*tan(c/2 + d*x/2)/(16384
*d*tan(c/2 + d*x/2)**6 + 196608*d*tan(c/2 + d*x/2)**4 + 786432*d*tan(c/2 +
 d*x/2)**2 + 1048576*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 151, normalized size of antiderivative = 1.42

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx = -\frac{\frac{18\left(\frac{656\sin(dx+c)}{\cos(dx+c)+1}+\frac{416\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{71\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{48\sin(dx+c)^2}{(\cos(dx+c)+1)^2}+\frac{12\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{\sin(dx+c)^6}{(\cos(dx+c)+1)^6}+64}-385\arctan\left(\frac{\sin(dx+c)}{2(\cos(dx+c)+1)}\right)}{16384\,d}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
-1/16384*(18*(656*sin(d*x + c)/(cos(d*x + c) + 1) + 416*sin(d*x + c)^3/(co
s(d*x + c) + 1)^3 + 71*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(48*sin(d*x +
c)^2/(cos(d*x + c) + 1)^2 + 12*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + sin(d
*x + c)^6/(cos(d*x + c) + 1)^6 + 64) - 385*arctan(1/2*sin(d*x + c)/(cos(d*
x + c) + 1)))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 88, normalized size of antiderivative = 0.83

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx = \frac{385\,dx+385\,c-\frac{36\left(71\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^5+416\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3+656\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2+4\right)^3}-770\arctan\left(\frac{\sin(dx+c)}{\cos(dx+c)+3}\right)}{32768\,d}$$

input
```
integrate(1/(-5-3*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
1/32768*(385*d*x + 385*c - 36*(71*tan(1/2*d*x + 1/2*c)^5 + 416*tan(1/2*d*x
 + 1/2*c)^3 + 656*tan(1/2*d*x + 1/2*c))/(tan(1/2*d*x + 1/2*c)^2 + 4)^3 - 7
70*arctan(sin(d*x + c)/(cos(d*x + c) + 3)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 96, normalized size of antiderivative = 0.91

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx = \frac{385\,\mathrm{atan}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{16384\,d} - \frac{385\,\left(\mathrm{atan}\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)-\frac{d\,x}{2}\right)}{16384\,d} - \frac{\frac{639\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^5}{8192}+\frac{117\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{256}+\frac{369\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{512}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+4\right)^3}$$

input
```
int(1/(3*cos(c + d*x) + 5)^4,x)
```

output
```
(385*atan(tan(c/2 + (d*x)/2)/2))/(16384*d) - (385*(atan(tan(c/2 + (d*x)/2)
) - (d*x)/2))/(16384*d) - ((369*tan(c/2 + (d*x)/2))/512 + (117*tan(c/2 + (
d*x)/2)^3)/256 + (639*tan(c/2 + (d*x)/2)^5)/8192)/(d*(tan(c/2 + (d*x)/2)^2
 + 4)^3)
```

Reduce [B] (verification not implemented)

Time = 0.18 (sec) , antiderivative size = 160, normalized size of antiderivative = 1.51

$$\int \frac{1}{(-5-3\cos(c+dx))^4}\,dx = \frac{10395 atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos(dx+c)\sin(dx+c)^2 - 97020 atan\left(\frac{\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{2}\right)\cos(dx+c) + 51975 atan\left(\right.}{16384d\left(27\cos(dx+c)\sin(d\right.}$$

input
```
int(1/(-5-3*cos(d*x+c))^4,x)
```

output
```
(10395*atan(tan((c + d*x)/2)/2)*cos(c + d*x)*sin(c + d*x)**2 - 97020*atan(
tan((c + d*x)/2)/2)*cos(c + d*x) + 51975*atan(tan((c + d*x)/2)/2)*sin(c +
d*x)**2 - 100100*atan(tan((c + d*x)/2)/2) + 21060*cos(c + d*x)*sin(c + d*x
) - 5598*sin(c + d*x)**3 + 26172*sin(c + d*x))/(16384*d*(27*cos(c + d*x)*s
in(c + d*x)**2 - 252*cos(c + d*x) + 135*sin(c + d*x)**2 - 260))
```

3.34 $\int \frac{1}{3+5\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 65

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = -\frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} + \frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

output
```
-1/4*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d+1/4*ln(2*cos(1/2*d*x+1/
2*c)+sin(1/2*d*x+1/2*c))/d
```

Mathematica [A] (verified)

Time = 0.06 (sec) , antiderivative size = 65, normalized size of antiderivative = 1.00

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = -\frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} + \frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

input
```
Integrate[(3 + 5*Cos[c + d*x])^(-1),x]
```

output
```
-1/4*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]]/d + Log[2*Cos[(c + d*x)/2]
 + Sin[(c + d*x)/2]]/(4*d)
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 22, normalized size of antiderivative = 0.34, number of steps used = 4, number of rules used = 3, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.250, Rules used = {3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{5\cos(c+dx)+3}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)+3}dx$$

$$\Big\downarrow \text{ 3138}$$

$$\frac{2\int \frac{1}{8-2\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{d}$$

$$\Big\downarrow \text{ 219}$$

$$\frac{\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Int[(3 + 5*Cos[c + d*x])^(-1),x]
```

output
```
ArcTanh[Tan[(c + d*x)/2]/2]/(2*d)
```

Defintions of rubi rules used

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

Maple [A] (verified)

Time = 0.59 (sec) , antiderivative size = 33, normalized size of antiderivative = 0.51

method	result	size
parallelrisch	$\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)-\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{4d}$	33
derivativedivides	$\frac{\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4}-\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{4}}{d}$	34
default	$\frac{\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4}-\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{4}}{d}$	34
norman	$-\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{4d}+\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4d}$	36
risch	$-\frac{\ln\left(e^{i(dx+c)}+\frac{3}{5}-\frac{4i}{5}\right)}{4d}+\frac{\ln\left(e^{i(dx+c)}+\frac{3}{5}+\frac{4i}{5}\right)}{4d}$	40

input
```
int(1/(3+5*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
1/4*(ln(tan(1/2*d*x+1/2*c)+2)-ln(tan(1/2*d*x+1/2*c)-2))/d
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.71

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = \frac{\log\left(\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-\log\left(\frac{3}{2}\cos\left(dx+c\right)-2\sin\left(dx+c\right)+\frac{5}{2}\right)}{8\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c)),x, algorithm="fricas")
```

output
```
1/8*(log(3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - log(3/2*cos(d*x + c) -
 2*sin(d*x + c) + 5/2))/d
```

Sympy [A] (verification not implemented)

Time = 0.33 (sec) , antiderivative size = 41, normalized size of antiderivative = 0.63

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = \begin{cases} -\frac{\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-2\right)}{4d}+\frac{\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+2\right)}{4d} & \text{for}\ d\neq 0\\ \frac{x}{5\cos\left(c\right)+3} & \text{otherwise}\end{cases}$$

input
```
integrate(1/(3+5*cos(d*x+c)),x)
```

output
```
Piecewise((-log(tan(c/2 + d*x/2) - 2)/(4*d) + log(tan(c/2 + d*x/2) + 2)/(4
*d), Ne(d, 0)), (x/(5*cos(c) + 3), True))
```

Maxima [A] (verification not implemented)

Time = 0.03 (sec) , antiderivative size = 48, normalized size of antiderivative = 0.74

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = \frac{\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right)-\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{4\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c)),x, algorithm="maxima")
```

output
```
1/4*(log(sin(d*x + c)/(cos(d*x + c) + 1) + 2) - log(sin(d*x + c)/(cos(d*x
+ c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.11 (sec) , antiderivative size = 34, normalized size of antiderivative = 0.52

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = \frac{\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+2\right|\right)-\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-2\right|\right)}{4\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c)),x, algorithm="giac")
```

output
```
1/4*(log(abs(tan(1/2*d*x + 1/2*c) + 2)) - log(abs(tan(1/2*d*x + 1/2*c) - 2
)))/d
```

Mupad [B] (verification not implemented)

Time = 41.87 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.26

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = \frac{\mathrm{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{2\,d}$$

input
```
int(1/(5*cos(c + d*x) + 3),x)
```

output
```
atanh(tan(c/2 + (d*x)/2)/2)/(2*d)
```

Reduce [B] (verification not implemented)

Time = 0.20 (sec) , antiderivative size = 32, normalized size of antiderivative = 0.49

$$\int \frac{1}{3+5\cos(c+dx)}\,dx = \frac{-\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)+\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4d}$$

input
```
int(1/(3+5*cos(d*x+c)),x)
```

output
```
( - log(tan((c + d*x)/2) - 2) + log(tan((c + d*x)/2) + 2))/(4*d)
```

3.35 $\int \frac{1}{(3+5\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 90

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx = \frac{3\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} - \frac{3\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} + \frac{5\sin(c+dx)}{16d(3+5\cos(c+dx))}$$

output
```
3/64*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d-3/64*ln(2*cos(1/2*d*x+1
/2*c)+sin(1/2*d*x+1/2*c))/d+5/16*sin(d*x+c)/d/(3+5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.17 (sec) , antiderivative size = 143, normalized size of antiderivative = 1.59

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx = \frac{9\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)+15\cos(c+dx)\left(\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)-\right.}{64d(3+5}$$

input
```
Integrate[(3 + 5*Cos[c + d*x])^(-2),x]
```

output
```
(9*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] + 15*Cos[c + d*x]*(Log[2*Cos
[(c + d*x)/2] - Sin[(c + d*x)/2]] - Log[2*Cos[(c + d*x)/2] + Sin[(c + d*x)
/2]]) - 9*Log[2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2]] + 20*Sin[c + d*x])/(6
4*d*(3 + 5*Cos[c + d*x]))
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 48, normalized size of antiderivative = 0.53, number of steps used = 7, number of rules used = 6, $\frac{\text{number of rules}}{\text{integrand size}} = 0.500$, Rules used = {3042, 3143, 27, 3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5\cos(c+dx)+3)^2}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \frac{1}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^2}dx$$

$$\Big\downarrow \text{ 3143}$$

$$\frac{1}{16}\int -\frac{3}{5\cos(c+dx)+3}dx+\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}$$

$$\Big\downarrow \text{ 27}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{3}{16}\int \frac{1}{5\cos(c+dx)+3}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{3}{16}\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)+3}dx$$

$$\Big\downarrow \text{ 3138}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{3\int \frac{1}{8-2\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}$$

$$\Big\downarrow \text{ 219}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)} - \frac{3\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}$$

input
```
Int[(3 + 5*Cos[c + d*x])^(-2),x]
```

output
```
(-3*ArcTanh[Tan[(c + d*x)/2]/2])/(32*d) + (5*Sin[c + d*x])/(16*d*(3 + 5*Co
s[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.67 (sec) , antiderivative size = 64, normalized size of antiderivative = 0.71

method	result
derivativedivides	$\frac{-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{64}-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}+\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{64}}{d}$
default	$\frac{-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{64}-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}+\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{64}}{d}$
norman	$-\frac{5\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16d\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-4\right)}+\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{64d}-\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{64d}$
risch	$\frac{i\left(3\,\mathrm{e}^{i(dx+c)}+5\right)}{8d\left(5\,\mathrm{e}^{2i(dx+c)}+6\,\mathrm{e}^{i(dx+c)}+5\right)}-\frac{3\ln\left(\mathrm{e}^{i(dx+c)}+\frac{3}{5}+\frac{4i}{5}\right)}{64d}+\frac{3\ln\left(\mathrm{e}^{i(dx+c)}+\frac{3}{5}-\frac{4i}{5}\right)}{64d}$
parallelrisch	$\frac{9\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-9\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)+15\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\cos(dx+c)-15\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)\cos(dx+c}{64d(3+5\cos(dx+c))}$

input
```
int(1/(3+5*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
1/d*(-5/32/(tan(1/2*d*x+1/2*c)+2)-3/64*ln(tan(1/2*d*x+1/2*c)+2)-5/32/(tan(
1/2*d*x+1/2*c)-2)+3/64*ln(tan(1/2*d*x+1/2*c)-2))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 88, normalized size of antiderivative = 0.98

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx = -\frac{3\,(5\,\cos(dx+c)+3)\log\left(\frac{3}{2}\,\cos(dx+c)+2\,\sin(dx+c)+\frac{5}{2}\right)-3\,(5\,\cos(dx+c)+3)\log\left(\frac{3}{2}\,\cos(dx\right.}{128\,(5\,d\cos(dx+c)+3\,d)}$$

input
```
integrate(1/(3+5*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
-1/128*(3*(5*cos(d*x + c) + 3)*log(3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2
) - 3*(5*cos(d*x + c) + 3)*log(3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) -
40*sin(d*x + c))/(5*d*cos(d*x + c) + 3*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 228 vs. $2(78) = 156$.

Time = 0.66 (sec) , antiderivative size = 228, normalized size of antiderivative = 2.53

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx = \begin{cases} \frac{x}{(5\cos(2\operatorname{atan}(2))+3)^2} \\ \frac{x}{(5\cos(c)+3)^2} \\ \frac{3\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-2\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} - \frac{12\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-2\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} - \frac{3\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+2\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} + \frac{12\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+2\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} \end{cases}$$

input
```
integrate(1/(3+5*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(5*cos(2*atan(2)) + 3)**2, Eq(c, -d*x - 2*atan(2)) | Eq(c, -d
*x + 2*atan(2))), (x/(5*cos(c) + 3)**2, Eq(d, 0)), (3*log(tan(c/2 + d*x/2)
 - 2)*tan(c/2 + d*x/2)**2/(64*d*tan(c/2 + d*x/2)**2 - 256*d) - 12*log(tan(
c/2 + d*x/2) - 2)/(64*d*tan(c/2 + d*x/2)**2 - 256*d) - 3*log(tan(c/2 + d*x
/2) + 2)*tan(c/2 + d*x/2)**2/(64*d*tan(c/2 + d*x/2)**2 - 256*d) + 12*log(t
an(c/2 + d*x/2) + 2)/(64*d*tan(c/2 + d*x/2)**2 - 256*d) - 20*tan(c/2 + d*x
/2)/(64*d*tan(c/2 + d*x/2)**2 - 256*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 91, normalized size of antiderivative = 1.01

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx = -\frac{\frac{20\sin(dx+c)}{\left(\frac{\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-4\right)(\cos(dx+c)+1)} + 3\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right) - 3\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{64\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
-1/64*(20*sin(d*x + c)/((sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - 4)*(cos(d*x
 + c) + 1)) + 3*log(sin(d*x + c)/(cos(d*x + c) + 1) + 2) - 3*log(sin(d*x +
 c)/(cos(d*x + c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 62, normalized size of antiderivative = 0.69

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx = -\frac{\frac{20\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-4} + 3\,\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+2\right|\right) - 3\,\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-2\right|\right)}{64\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
-1/64*(20*tan(1/2*d*x + 1/2*c)/(tan(1/2*d*x + 1/2*c)^2 - 4) + 3*log(abs(ta
n(1/2*d*x + 1/2*c) + 2)) - 3*log(abs(tan(1/2*d*x + 1/2*c) - 2)))/d
```

Mupad [B] (verification not implemented)

Time = 41.17 (sec) , antiderivative size = 47, normalized size of antiderivative = 0.52

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx = -\frac{3\,\mathrm{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{32\,d} - \frac{5\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{16\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2-4\right)}$$

input
```
int(1/(5*cos(c + d*x) + 3)^2,x)
```

output
```
- (3*atanh(tan(c/2 + (d*x)/2)/2))/(32*d) - (5*tan(c/2 + (d*x)/2))/(16*d*(t
an(c/2 + (d*x)/2)^2 - 4))
```

Reduce [B] (verification not implemented)

Time = 0.26 (sec) , antiderivative size = 110, normalized size of antiderivative = 1.22

$$\int \frac{1}{(3+5\cos(c+dx))^2}\,dx$$
$$= \frac{3\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-12\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-3\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right.}{64d\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-4\right)}$$

input
```
int(1/(3+5*cos(d*x+c))^2,x)
```

output
```
(3*log(tan((c + d*x)/2) - 2)*tan((c + d*x)/2)**2 - 12*log(tan((c + d*x)/2)
 - 2) - 3*log(tan((c + d*x)/2) + 2)*tan((c + d*x)/2)**2 + 12*log(tan((c +
d*x)/2) + 2) - 20*tan((c + d*x)/2))/(64*d*(tan((c + d*x)/2)**2 - 4))
```

3.36 $\int \frac{1}{(3+5\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 115

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx = -\frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{5\sin(c+dx)}{32d(3+5\cos(c+dx))^2} - \frac{45\sin(c+dx)}{512d(3+5\cos(c+dx))}$$

output
```
-43/2048*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d+43/2048*ln(2*cos(1/
2*d*x+1/2*c)+sin(1/2*d*x+1/2*c))/d+5/32*sin(d*x+c)/d/(3+5*cos(d*x+c))^2-45
/512*sin(d*x+c)/d/(3+5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.27 (sec) , antiderivative size = 217, normalized size of antiderivative = 1.89

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx = -\frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{5}{512d\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} - \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{2048d\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)} - \frac{5}{512d\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} - \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{2048d\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}$$

input
```
Integrate[(3 + 5*Cos[c + d*x])^(-3),x]
```

output
```
(-43*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]])/(2048*d) + (43*Log[2*Cos[
(c + d*x)/2] + Sin[(c + d*x)/2]])/(2048*d) + 5/(512*d*(2*Cos[(c + d*x)/2]
- Sin[(c + d*x)/2])^2) - (45*Sin[(c + d*x)/2])/(2048*d*(2*Cos[(c + d*x)/2]
 - Sin[(c + d*x)/2])) - 5/(512*d*(2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2])^2
) - (45*Sin[(c + d*x)/2])/(2048*d*(2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2]))
```

Rubi [A] (verified)

Time = 0.38 (sec) , antiderivative size = 78, normalized size of antiderivative = 0.68, number of steps used = 10, number of rules used = 9, $\frac{\text{number of rules}}{\text{integrand size}} = 0.750$, Rules used = {3042, 3143, 25, 3042, 3233, 27, 3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5\cos(c+dx)+3)^3}\,dx$$

$$\Big\downarrow \ 3042$$

$$\int \frac{1}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^3}dx$$

$$\Big\downarrow \ 3143$$

$$\frac{1}{32}\int -\frac{6-5\cos(c+dx)}{(5\cos(c+dx)+3)^2}dx+\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \ 25$$

$$\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}-\frac{1}{32}\int \frac{6-5\cos(c+dx)}{(5\cos(c+dx)+3)^2}dx$$

$$\Big\downarrow \ 3042$$

$$\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}-\frac{1}{32}\int \frac{6-5\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^2}dx$$

$$\Big\downarrow \ 3233$$

$$\frac{1}{32}\left(-\frac{1}{16}\int -\frac{43}{5\cos(c+dx)+3}dx-\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)+\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \ 27$$

$$\frac{1}{32}\left(\frac{43}{16}\int \frac{1}{5\cos(c+dx)+3}dx-\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)+\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \ 3042$$

$$\frac{1}{32}\left(\frac{43}{16}\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)+3}dx-\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)+\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \ 3138$$

$$\frac{1}{32}\left(\frac{43\int \frac{1}{8-2\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}-\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)+\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \ 219$$

$$\frac{1}{32}\left(\frac{43\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}-\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)+\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

input
```
Int[(3 + 5*Cos[c + d*x])^(-3),x]
```

output
```
(5*Sin[c + d*x])/(32*d*(3 + 5*Cos[c + d*x])^2) + ((43*ArcTanh[Tan[(c + d*x
)/2]/2])/(32*d) - (45*Sin[c + d*x])/(16*d*(3 + 5*Cos[c + d*x])))/32
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.74 (sec) , antiderivative size = 83, normalized size of antiderivative = 0.72

method	result
norman	$\frac{-\frac{35\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{128d}+\frac{85\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{512d}}{\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-4\right)^{2}}-\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{2048d}+\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{2048d}$
derivativedivides	$\frac{\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)^{2}}+\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}-\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{2048}-\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{2}}+\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}+\frac{43}{}}{d}$
default	$\frac{\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)^{2}}+\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}-\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{2048}-\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{2}}+\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}+\frac{43}{}}{d}$
risch	$-\frac{i\left(215\,e^{3i(dx+c)}+387\,e^{2i(dx+c)}+325\,e^{i(dx+c)}+225\right)}{256d\left(5\,e^{2i(dx+c)}+6\,e^{i(dx+c)}+5\right)^{2}}-\frac{43\ln\left(e^{i(dx+c)}+\frac{3}{5}-\frac{4i}{5}\right)}{2048d}+\frac{43\ln\left(e^{i(dx+c)}+\frac{3}{5}+\frac{4i}{5}\right)}{2048d}$
parallelrisch	$\frac{(-2580\cos(dx+c)-1075\cos(2dx+2c)-1849)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)+(2580\cos(dx+c)+1075\cos(2dx+2c)+1849)\ln\left(\mathrm{ta}\right.}{2048d(43+25\cos(2dx+2c)+60\cos(dx+c))}$

input
```
int(1/(3+5*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
(-35/128/d*tan(1/2*d*x+1/2*c)+85/512/d*tan(1/2*d*x+1/2*c)^3)/(tan(1/2*d*x+
1/2*c)^2-4)^2-43/2048/d*ln(tan(1/2*d*x+1/2*c)-2)+43/2048/d*ln(tan(1/2*d*x+
1/2*c)+2)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 129, normalized size of antiderivative = 1.12

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx$$
$$= \frac{43\left(25\cos\left(dx+c\right)^2+30\cos\left(dx+c\right)+9\right)\log\left(\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-43\left(25\cos\left(dx+\cdots\right.\right.}{4096\left(25\,d\cos\left(dx+c\right)^2\cdots\right.}$$

input
```
integrate(1/(3+5*cos(d*x+c))^3,x, algorithm="fricas")
```

output
```
1/4096*(43*(25*cos(d*x + c)^2 + 30*cos(d*x + c) + 9)*log(3/2*cos(d*x + c)
+ 2*sin(d*x + c) + 5/2) - 43*(25*cos(d*x + c)^2 + 30*cos(d*x + c) + 9)*log
(3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) - 40*(45*cos(d*x + c) + 11)*sin(
d*x + c))/(25*d*cos(d*x + c)^2 + 30*d*cos(d*x + c) + 9*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 474 vs. 2(102) = 204.

Time = 1.16 (sec) , antiderivative size = 474, normalized size of antiderivative = 4.12

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx = \text{Too large to display}$$

input
```
integrate(1/(3+5*cos(d*x+c))**3,x)
```

output
```
Piecewise((x/(5*cos(2*atan(2)) + 3)**3, Eq(c, -d*x - 2*atan(2)) | Eq(c, -d
*x + 2*atan(2))), (x/(5*cos(c) + 3)**3, Eq(d, 0)), (-43*log(tan(c/2 + d*x/
2) - 2)*tan(c/2 + d*x/2)**4/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2
+ d*x/2)**2 + 32768*d) + 344*log(tan(c/2 + d*x/2) - 2)*tan(c/2 + d*x/2)**2
/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) - 68
8*log(tan(c/2 + d*x/2) - 2)/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2
+ d*x/2)**2 + 32768*d) + 43*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**4/
(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) - 344
*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**2/(2048*d*tan(c/2 + d*x/2)**4
 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) + 688*log(tan(c/2 + d*x/2) + 2)/
(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) + 340
*tan(c/2 + d*x/2)**3/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2
)**2 + 32768*d) - 560*tan(c/2 + d*x/2)/(2048*d*tan(c/2 + d*x/2)**4 - 16384
*d*tan(c/2 + d*x/2)**2 + 32768*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.03 (sec) , antiderivative size = 135, normalized size of antiderivative = 1.17

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx = \frac{\frac{20\left(\frac{28\sin(dx+c)}{\cos(dx+c)+1}-\frac{17\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{\sin(dx+c)^4}{(\cos(dx+c)+1)^4}-16}+43\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right)-43\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{2048\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
1/2048*(20*(28*sin(d*x + c)/(cos(d*x + c) + 1) - 17*sin(d*x + c)^3/(cos(d*
x + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - sin(d*x + c)^4/(co
s(d*x + c) + 1)^4 - 16) + 43*log(sin(d*x + c)/(cos(d*x + c) + 1) + 2) - 43
*log(sin(d*x + c)/(cos(d*x + c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.14 (sec) , antiderivative size = 78, normalized size of antiderivative = 0.68

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx = \frac{\frac{20\left(17\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3-28\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2-4\right)^2}+43\log\left(\left|\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)+2\right|\right)-43\log\left(\left|\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)-2\right|\right)}{2048\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
1/2048*(20*(17*tan(1/2*d*x + 1/2*c)^3 - 28*tan(1/2*d*x + 1/2*c))/(tan(1/2*
d*x + 1/2*c)^2 - 4)^2 + 43*log(abs(tan(1/2*d*x + 1/2*c) + 2)) - 43*log(abs
(tan(1/2*d*x + 1/2*c) - 2)))/d
```

Mupad [B] (verification not implemented)

Time = 40.03 (sec) , antiderivative size = 76, normalized size of antiderivative = 0.66

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx = \frac{43\,\mathrm{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{1024\,d} - \frac{\frac{35\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{128}-\frac{85\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{512}}{d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4-8\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+16\right)}$$

input
```
int(1/(5*cos(c + d*x) + 3)^3,x)
```

output
```
(43*atanh(tan(c/2 + (d*x)/2)/2))/(1024*d) - ((35*tan(c/2 + (d*x)/2))/128 -
 (85*tan(c/2 + (d*x)/2)^3)/512)/(d*(tan(c/2 + (d*x)/2)^4 - 8*tan(c/2 + (d*
x)/2)^2 + 16))
```

Reduce [B] (verification not implemented)

Time = 0.24 (sec) , antiderivative size = 186, normalized size of antiderivative = 1.62

$$\int \frac{1}{(3+5\cos(c+dx))^3}\,dx$$
$$= \frac{-43\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^4+344\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-688\log\left(\tan\left(\frac{dx}{2}+\right.\right.}{}$$

input
```
int(1/(3+5*cos(d*x+c))^3,x)
```

output
```
( - 43*log(tan((c + d*x)/2) - 2)*tan((c + d*x)/2)**4 + 344*log(tan((c + d*
x)/2) - 2)*tan((c + d*x)/2)**2 - 688*log(tan((c + d*x)/2) - 2) + 43*log(ta
n((c + d*x)/2) + 2)*tan((c + d*x)/2)**4 - 344*log(tan((c + d*x)/2) + 2)*ta
n((c + d*x)/2)**2 + 688*log(tan((c + d*x)/2) + 2) + 340*tan((c + d*x)/2)**
3 - 560*tan((c + d*x)/2))/(2048*d*(tan((c + d*x)/2)**4 - 8*tan((c + d*x)/2
)**2 + 16))
```

3.37 $\int \frac{1}{(3+5\cos(c+dx))^4}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 140

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx = \frac{279\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} - \frac{279\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} + \frac{5\sin(c+dx)}{48d(3+5\cos(c+dx))^3} - \frac{25\sin(c+dx)}{512d(3+5\cos(c+dx))^2} + \frac{995\sin(c+dx)}{24576d(3+5\cos(c+dx))}$$

output
```
279/32768*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d-279/32768*ln(2*cos
(1/2*d*x+1/2*c)+sin(1/2*d*x+1/2*c))/d+5/48*sin(d*x+c)/d/(3+5*cos(d*x+c))^3
-25/512*sin(d*x+c)/d/(3+5*cos(d*x+c))^2+995/24576*sin(d*x+c)/d/(3+5*cos(d*
x+c))
```

Mathematica [B] (verified)

Leaf count is larger than twice the leaf count of optimal. 296 vs. $2(140) = 280$.

Time = 0.33 (sec) , antiderivative size = 296, normalized size of antiderivative = 2.11

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx$$
$$= \frac{467046\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)+104625\cos(3(c+dx))\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}\right.\right.}{}$$

input
```
Integrate[(3 + 5*Cos[c + d*x])^(-4),x]
```

output
```
(467046*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] + 104625*Cos[3*(c + d*x
)]*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] + 765855*Cos[c + d*x]*(Log[2
*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] - Log[2*Cos[(c + d*x)/2] + Sin[(c +
d*x)/2]]) + 376650*Cos[2*(c + d*x)]*(Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x
)/2]] - Log[2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2]]) - 467046*Log[2*Cos[(c
+ d*x)/2] + Sin[(c + d*x)/2]] - 104625*Cos[3*(c + d*x)]*Log[2*Cos[(c + d*x
)/2] + Sin[(c + d*x)/2]] + 226140*Sin[c + d*x] + 190800*Sin[2*(c + d*x)] +
 99500*Sin[3*(c + d*x)])/(393216*d*(3 + 5*Cos[c + d*x])^3)
```

Rubi [A] (verified)

Time = 0.52 (sec) , antiderivative size = 108, normalized size of antiderivative = 0.77, number of steps used = 13, number of rules used = 12, $\frac{\text{number of rules}}{\text{integrand size}} = 1.000$, Rules used = {3042, 3143, 25, 3042, 3233, 25, 3042, 3233, 27, 3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5\cos(c+dx)+3)^4}dx$$
$$\Big\downarrow \text{3042}$$
$$\int \frac{1}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^4}dx$$
$$\Big\downarrow \text{3143}$$

$$\frac{1}{48}\int -\frac{9-10\cos(c+dx)}{(5\cos(c+dx)+3)^3}dx+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{ 25}$$

$$\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}-\frac{1}{48}\int \frac{9-10\cos(c+dx)}{(5\cos(c+dx)+3)^3}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}-\frac{1}{48}\int \frac{9-10\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^3}dx$$

$$\Big\downarrow \text{ 3233}$$

$$\frac{1}{48}\left(-\frac{1}{32}\int -\frac{154-75\cos(c+dx)}{(5\cos(c+dx)+3)^2}dx-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{ 25}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{154-75\cos(c+dx)}{(5\cos(c+dx)+3)^2}dx-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{154-75\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^2}dx-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{ 3233}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{1}{16}\int -\frac{837}{5\cos(c+dx)+3}dx+\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{ 27}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837}{16}\int \frac{1}{5\cos(c+dx)+3}dx\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837}{16}\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)+3}dx\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{3138}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837\int\frac{1}{8-2\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{219}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

input
```
Int[(3 + 5*Cos[c + d*x])^(-4),x]
```

output
```
(5*Sin[c + d*x])/(48*d*(3 + 5*Cos[c + d*x])^3) + ((-75*Sin[c + d*x])/(32*d
*(3 + 5*Cos[c + d*x])^2) + ((-837*ArcTanh[Tan[(c + d*x)/2]/2])/(32*d) + (9
95*Sin[c + d*x])/(16*d*(3 + 5*Cos[c + d*x])))/32)/48
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.77 (sec) , antiderivative size = 99, normalized size of antiderivative = 0.71

method	result
norman	$\frac{-\frac{295\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{512d}+\frac{265\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{768d}-\frac{745\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}}{8192d}}{\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-4\right)^{3}}+\frac{279\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{32768d}-\frac{279\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{32768d}$
derivativedivides	$\frac{-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{3}}+\frac{175}{4096\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{2}}-\frac{745}{16384\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{279\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{32768}-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right.}}{d}$
default	$\frac{-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{3}}+\frac{175}{4096\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{2}}-\frac{745}{16384\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{279\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{32768}-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right.}}{d}$
risch	$\frac{i\left(20925\,e^{5i(dx+c)}+62775\,e^{4i(dx+c)}+111042\,e^{3i(dx+c)}+119310\,e^{2i(dx+c)}+68625\,e^{i(dx+c)}+24875\right)}{12288d\left(5\,e^{2i(dx+c)}+6\,e^{i(dx+c)}+5\right)^{3}}-\frac{279\ln\left(e^{i(dx+c)}\right.}{32768d}$
parallelrisch	$\frac{\left(765855\cos(dx+c)+376650\cos(2dx+2c)+104625\cos(3dx+3c)+467046\right)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)+\left(-765855\cos(dx+c)-\right.}{98304d\left(558+125\cos(3d\right.}$

input
```
int(1/(3+5*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
(-295/512/d*tan(1/2*d*x+1/2*c)+265/768/d*tan(1/2*d*x+1/2*c)^3-745/8192/d*t
an(1/2*d*x+1/2*c)^5)/(tan(1/2*d*x+1/2*c)^2-4)^3+279/32768/d*ln(tan(1/2*d*x
+1/2*c)-2)-279/32768/d*ln(tan(1/2*d*x+1/2*c)+2)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 170, normalized size of antiderivative = 1.21

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx = -\frac{837\left(125\cos(dx+c)^3+225\cos(dx+c)^2+135\cos(dx+c)+27\right)\log\left(\frac{3}{2}\cos(dx+c)+2\sin(dx+\right.}{}$$

input
```
integrate(1/(3+5*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
-1/196608*(837*(125*cos(d*x + c)^3 + 225*cos(d*x + c)^2 + 135*cos(d*x + c)
 + 27)*log(3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - 837*(125*cos(d*x + c
)^3 + 225*cos(d*x + c)^2 + 135*cos(d*x + c) + 27)*log(3/2*cos(d*x + c) - 2
*sin(d*x + c) + 5/2) - 40*(4975*cos(d*x + c)^2 + 4770*cos(d*x + c) + 1583)
*sin(d*x + c))/(125*d*cos(d*x + c)^3 + 225*d*cos(d*x + c)^2 + 135*d*cos(d*
x + c) + 27*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 813 vs. 2(126) = 252.

Time = 2.36 (sec) , antiderivative size = 813, normalized size of antiderivative = 5.81

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(3+5*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(5*cos(2*atan(2)) + 3)**4, Eq(c, -d*x - 2*atan(2)) | Eq(c, -d
*x + 2*atan(2))), (x/(5*cos(c) + 3)**4, Eq(d, 0)), (837*log(tan(c/2 + d*x/
2) - 2)*tan(c/2 + d*x/2)**6/(98304*d*tan(c/2 + d*x/2)**6 - 1179648*d*tan(c
/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 - 6291456*d) - 10044*log(ta
n(c/2 + d*x/2) - 2)*tan(c/2 + d*x/2)**4/(98304*d*tan(c/2 + d*x/2)**6 - 117
9648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 - 6291456*d) +
40176*log(tan(c/2 + d*x/2) - 2)*tan(c/2 + d*x/2)**2/(98304*d*tan(c/2 + d*x
/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 - 6
291456*d) - 53568*log(tan(c/2 + d*x/2) - 2)/(98304*d*tan(c/2 + d*x/2)**6 -
 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 - 6291456*d
) - 837*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**6/(98304*d*tan(c/2 + d
*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 -
 6291456*d) + 10044*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**4/(98304*d
*tan(c/2 + d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 +
 d*x/2)**2 - 6291456*d) - 40176*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)
**2/(98304*d*tan(c/2 + d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592
*d*tan(c/2 + d*x/2)**2 - 6291456*d) + 53568*log(tan(c/2 + d*x/2) + 2)/(983
04*d*tan(c/2 + d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c
/2 + d*x/2)**2 - 6291456*d) - 8940*tan(c/2 + d*x/2)**5/(98304*d*tan(c/2 +
d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)*...
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 174, normalized size of antiderivative = 1.24

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(\frac{2832\,\sin(dx+c)}{\cos(dx+c)+1}-\frac{1696\,\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{447\,\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{48\,\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{12\,\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{\sin(dx+c)^6}{(\cos(dx+c)+1)^6}-64}+837\,\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right)-837\,\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{98304\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
-1/98304*(20*(2832*sin(d*x + c)/(cos(d*x + c) + 1) - 1696*sin(d*x + c)^3/(
cos(d*x + c) + 1)^3 + 447*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(48*sin(d*x
 + c)^2/(cos(d*x + c) + 1)^2 - 12*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + si
n(d*x + c)^6/(cos(d*x + c) + 1)^6 - 64) + 837*log(sin(d*x + c)/(cos(d*x +
c) + 1) + 2) - 837*log(sin(d*x + c)/(cos(d*x + c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 91, normalized size of antiderivative = 0.65

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(447\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^5-1696\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3+2832\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2-4\right)^3}+837\log\left(\left|\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)+2\right|\right)-837\log\left(\left|\mathrm{t}\right.\right.}{98304\,d}$$

input
```
integrate(1/(3+5*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
-1/98304*(20*(447*tan(1/2*d*x + 1/2*c)^5 - 1696*tan(1/2*d*x + 1/2*c)^3 + 2
832*tan(1/2*d*x + 1/2*c))/(tan(1/2*d*x + 1/2*c)^2 - 4)^3 + 837*log(abs(tan
(1/2*d*x + 1/2*c) + 2)) - 837*log(abs(tan(1/2*d*x + 1/2*c) - 2)))/d
```

Mupad [B] (verification not implemented)

Time = 41.29 (sec) , antiderivative size = 102, normalized size of antiderivative = 0.73

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx = -\frac{279\,\mathrm{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{16384\,d} - \frac{\frac{745\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^5}{8192}-\frac{265\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{768}+\frac{295\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{512}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^6-12\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4+48\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2-64\right)}$$

input
```
int(1/(5*cos(c + d*x) + 3)^4,x)
```

output
```
- (279*atanh(tan(c/2 + (d*x)/2)/2))/(16384*d) - ((295*tan(c/2 + (d*x)/2))/
512 - (265*tan(c/2 + (d*x)/2)^3)/768 + (745*tan(c/2 + (d*x)/2)^5)/8192)/(d
*(48*tan(c/2 + (d*x)/2)^2 - 12*tan(c/2 + (d*x)/2)^4 + tan(c/2 + (d*x)/2)^6
 - 64))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 244, normalized size of antiderivative = 1.74

$$\int \frac{1}{(3+5\cos(c+dx))^4}\,dx$$
$$= \frac{104625\cos(dx+c)\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\sin(dx+c)^2-217620\cos(dx+c)\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-1}{}$$

input
```
int(1/(3+5*cos(d*x+c))^4,x)
```

output
```
(104625*cos(c + d*x)*log(tan((c + d*x)/2) - 2)*sin(c + d*x)**2 - 217620*co
s(c + d*x)*log(tan((c + d*x)/2) - 2) - 104625*cos(c + d*x)*log(tan((c + d*
x)/2) + 2)*sin(c + d*x)**2 + 217620*cos(c + d*x)*log(tan((c + d*x)/2) + 2)
 - 95400*cos(c + d*x)*sin(c + d*x) + 188325*log(tan((c + d*x)/2) - 2)*sin(
c + d*x)**2 - 210924*log(tan((c + d*x)/2) - 2) - 188325*log(tan((c + d*x)/
2) + 2)*sin(c + d*x)**2 + 210924*log(tan((c + d*x)/2) + 2) + 99500*sin(c +
 d*x)**3 - 131160*sin(c + d*x))/(98304*d*(125*cos(c + d*x)*sin(c + d*x)**2
 - 260*cos(c + d*x) + 225*sin(c + d*x)**2 - 252))
```

3.38 $\int \frac{1}{3-5\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 63

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = \frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} - \frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

output
```
1/4*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d-1/4*ln(cos(1/2*d*x+1/2*c
)+2*sin(1/2*d*x+1/2*c))/d
```

Mathematica [A] (verified)

Time = 0.06 (sec) , antiderivative size = 63, normalized size of antiderivative = 1.00

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = \frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} - \frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

input
```
Integrate[(3 - 5*Cos[c + d*x])^(-1),x]
```

output
```
Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]]/(4*d) - Log[Cos[(c + d*x)/2] +
2*Sin[(c + d*x)/2]]/(4*d)
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 20, normalized size of antiderivative = 0.32, number of steps used = 4, number of rules used = 3, $\frac{\text{number of rules}}{\text{integrand size}} = 0.250$, Rules used = {3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{3-5\cos(c+dx)}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{3-5\sin\left(c+dx+\frac{\pi}{2}\right)}dx$$

$$\Big\downarrow \text{3138}$$

$$\frac{2\int \frac{1}{8\tan^2\left(\frac{1}{2}(c+dx)\right)-2}d\tan\left(\frac{1}{2}(c+dx)\right)}{d}$$

$$\Big\downarrow \text{220}$$

$$-\frac{\text{arctanh}\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Int[(3 - 5*Cos[c + d*x])^(-1),x]
```

output
```
-1/2*ArcTanh[2*Tan[(c + d*x)/2]]/d
```

Defintions of rubi rules used

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

Maple [A] (verified)

Time = 0.64 (sec) , antiderivative size = 37, normalized size of antiderivative = 0.59

method	result	size
parallelrisch	$\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)-\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4d}$	37
derivativedivides	$\frac{\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{4}-\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4}}{d}$	38
default	$\frac{\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{4}-\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4}}{d}$	38
norman	$\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{4d}-\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4d}$	40
risch	$\frac{\ln\left(e^{i(dx+c)}-\frac{3}{5}-\frac{4i}{5}\right)}{4d}-\frac{\ln\left(e^{i(dx+c)}-\frac{3}{5}+\frac{4i}{5}\right)}{4d}$	40

input
```
int(1/(3-5*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
1/4*(ln(2*tan(1/2*d*x+1/2*c)-1)-ln(2*tan(1/2*d*x+1/2*c)+1))/d
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.73

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = -\frac{\log\left(-\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-\log\left(-\frac{3}{2}\cos\left(dx+c\right)-2\sin\left(dx+c\right)+\frac{5}{2}\right)}{8\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c)),x, algorithm="fricas")
```

output
```
-1/8*(log(-3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - log(-3/2*cos(d*x + c
) - 2*sin(d*x + c) + 5/2))/d
```

Sympy [A] (verification not implemented)

Time = 0.35 (sec) , antiderivative size = 44, normalized size of antiderivative = 0.70

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = \begin{cases} \frac{\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-1\right)}{4d}-\frac{\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+1\right)}{4d} & \text{for } d\neq 0 \\ \frac{x}{3-5\cos\left(c\right)} & \text{otherwise} \end{cases}$$

input
```
integrate(1/(3-5*cos(d*x+c)),x)
```

output
```
Piecewise((log(2*tan(c/2 + d*x/2) - 1)/(4*d) - log(2*tan(c/2 + d*x/2) + 1)
/(4*d), Ne(d, 0)), (x/(3 - 5*cos(c)), True))
```

Maxima [A] (verification not implemented)

Time = 0.03 (sec) , antiderivative size = 50, normalized size of antiderivative = 0.79

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = -\frac{\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}+1\right)-\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{4\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c)),x, algorithm="maxima")
```

output
```
-1/4*(log(2*sin(d*x + c)/(cos(d*x + c) + 1) + 1) - log(2*sin(d*x + c)/(cos
(d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.13 (sec) , antiderivative size = 38, normalized size of antiderivative = 0.60

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = -\frac{\log\left(\left|2\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right|\right)-\log\left(\left|2\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-1\right|\right)}{4\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c)),x, algorithm="giac")
```

output
```
-1/4*(log(abs(2*tan(1/2*d*x + 1/2*c) + 1)) - log(abs(2*tan(1/2*d*x + 1/2*c
) - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 41.24 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.27

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = -\frac{\operatorname{atanh}\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)\right)}{2\,d}$$

input
```
int(-1/(5*cos(c + d*x) - 3),x)
```

output
```
-atanh(2*tan(c/2 + (d*x)/2))/(2*d)
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 36, normalized size of antiderivative = 0.57

$$\int \frac{1}{3-5\cos(c+dx)}\,dx = \frac{\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)-\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4d}$$

input
```
int(1/(3-5*cos(d*x+c)),x)
```

output
```
(log(2*tan((c + d*x)/2) - 1) - log(2*tan((c + d*x)/2) + 1))/(4*d)
```

3.39 $\int \frac{1}{(3-5\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 88

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx = -\frac{3\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} + \frac{3\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} - \frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

output
```
-3/64*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d+3/64*ln(cos(1/2*d*x+1/
2*c)+2*sin(1/2*d*x+1/2*c))/d-5/16*sin(d*x+c)/d/(3-5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.35 (sec) , antiderivative size = 139, normalized size of antiderivative = 1.58

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx = \frac{9\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)-15\cos(c+dx)\left(\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)-\right.}{64d(-3+5}$$

input
```
Integrate[(3 - 5*Cos[c + d*x])^(-2),x]
```

output
```
(9*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - 15*Cos[c + d*x]*(Log[Cos[(
c + d*x)/2] - 2*Sin[(c + d*x)/2]] - Log[Cos[(c + d*x)/2] + 2*Sin[(c + d*x)
/2]]) - 9*Log[Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2]] + 20*Sin[c + d*x])/(6
4*d*(-3 + 5*Cos[c + d*x]))
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.52, number of steps used = 7, number of rules used = 6, $\frac{\text{number of rules}}{\text{integrand size}} = 0.500$, Rules used = {3042, 3143, 27, 3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3-5\cos(c+dx))^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3-5\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{1}{16}\int -\frac{3}{3-5\cos(c+dx)}dx-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{27}$$

$$-\frac{3}{16}\int \frac{1}{3-5\cos(c+dx)}dx-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{3042}$$

$$-\frac{3}{16}\int \frac{1}{3-5\sin\left(c+dx+\frac{\pi}{2}\right)}dx-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{3138}$$

$$-\frac{3\int \frac{1}{8\tan^2\left(\frac{1}{2}(c+dx)\right)-2}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{220}$$

$$\frac{3\text{arctanh}\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

input
```
Int[(3 - 5*Cos[c + d*x])^(-2),x]
```

output
```
(3*ArcTanh[2*Tan[(c + d*x)/2]])/(32*d) - (5*Sin[c + d*x])/(16*d*(3 - 5*Cos
[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.74 (sec) , antiderivative size = 71, normalized size of antiderivative = 0.81

method	result
norman	$-\frac{5\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16d\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-1\right)}-\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{64d}+\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{64d}$
derivativedivides	$\frac{-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{64}-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}+\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{64}}{d}$
default	$\frac{-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{64}-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}+\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{64}}{d}$
risch	$-\frac{i\left(3\,e^{i(dx+c)}-5\right)}{8d\left(5\,e^{2i(dx+c)}-6\,e^{i(dx+c)}+5\right)}+\frac{3\ln\left(e^{i(dx+c)}-\frac{3}{5}+\frac{4i}{5}\right)}{64d}-\frac{3\ln\left(e^{i(dx+c)}-\frac{3}{5}-\frac{4i}{5}\right)}{64d}$
parallelrisch	$\frac{-15\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\cos(dx+c)+15\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)\cos(dx+c)+20\sin(dx+c)+9\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)-9}{64d(-3+5\cos(dx+c))}$

input
```
int(1/(3-5*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
-5/16/d*tan(1/2*d*x+1/2*c)/(4*tan(1/2*d*x+1/2*c)^2-1)-3/64/d*ln(2*tan(1/2*
d*x+1/2*c)-1)+3/64/d*ln(2*tan(1/2*d*x+1/2*c)+1)
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 88, normalized size of antiderivative = 1.00

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx = \frac{3\left(5\cos\left(dx+c\right)-3\right)\log\left(-\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-3\left(5\cos\left(dx+c\right)-3\right)\log\left(-\frac{3}{2}\cos\left(dx\right.\right.}{128\left(5\,d\cos\left(dx+c\right)-3\,d\right)}$$

input
```
integrate(1/(3-5*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
1/128*(3*(5*cos(d*x + c) - 3)*log(-3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2
) - 3*(5*cos(d*x + c) - 3)*log(-3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) +
 40*sin(d*x + c))/(5*d*cos(d*x + c) - 3*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 240 vs. $2(78) = 156$.

Time = 0.66 (sec) , antiderivative size = 240, normalized size of antiderivative = 2.73

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx$$
$$= \begin{cases} \frac{x}{\left(3-5\cos\left(2\operatorname{atan}\left(\frac{1}{2}\right)\right)\right)^2} \\ \frac{x}{(3-5\cos(c))^2} \\ -\frac{12\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-1\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{256d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-64d} + \frac{3\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-1\right)}{256d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-64d} + \frac{12\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+1\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{256d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-64d} - \frac{3\log\left(2\tan\left(\frac{c}{2}\right.\right.}{256d\tan^2\left(\frac{c}{2}+\right.} \end{cases}$$

input
```
integrate(1/(3-5*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(3 - 5*cos(2*atan(1/2)))**2, Eq(c, -d*x - 2*atan(1/2)) | Eq(c
, -d*x + 2*atan(1/2))), (x/(3 - 5*cos(c))**2, Eq(d, 0)), (-12*log(2*tan(c/
2 + d*x/2) - 1)*tan(c/2 + d*x/2)**2/(256*d*tan(c/2 + d*x/2)**2 - 64*d) + 3
*log(2*tan(c/2 + d*x/2) - 1)/(256*d*tan(c/2 + d*x/2)**2 - 64*d) + 12*log(2
*tan(c/2 + d*x/2) + 1)*tan(c/2 + d*x/2)**2/(256*d*tan(c/2 + d*x/2)**2 - 64
*d) - 3*log(2*tan(c/2 + d*x/2) + 1)/(256*d*tan(c/2 + d*x/2)**2 - 64*d) - 2
0*tan(c/2 + d*x/2)/(256*d*tan(c/2 + d*x/2)**2 - 64*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 94, normalized size of antiderivative = 1.07

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx$$
$$= -\frac{\frac{20\sin(dx+c)}{\left(\frac{4\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-1\right)(\cos(dx+c)+1)} - 3\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}+1\right) + 3\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{64\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
-1/64*(20*sin(d*x + c)/((4*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - 1)*(cos(d
*x + c) + 1)) - 3*log(2*sin(d*x + c)/(cos(d*x + c) + 1) + 1) + 3*log(2*sin
(d*x + c)/(cos(d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 68, normalized size of antiderivative = 0.77

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx = -\frac{\frac{20\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{4\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-1} - 3\,\log\left(\left|2\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right|\right) + 3\,\log\left(\left|2\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-1\right|\right)}{64\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
-1/64*(20*tan(1/2*d*x + 1/2*c)/(4*tan(1/2*d*x + 1/2*c)^2 - 1) - 3*log(abs(
2*tan(1/2*d*x + 1/2*c) + 1)) + 3*log(abs(2*tan(1/2*d*x + 1/2*c) - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 42.15 (sec) , antiderivative size = 47, normalized size of antiderivative = 0.53

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx = \frac{3\,\mathrm{atanh}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{32\,d} - \frac{5\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{64\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2-\frac{1}{4}\right)}$$

input
```
int(1/(5*cos(c + d*x) - 3)^2,x)
```

output
```
(3*atanh(2*tan(c/2 + (d*x)/2)))/(32*d) - (5*tan(c/2 + (d*x)/2))/(64*d*(tan
(c/2 + (d*x)/2)^2 - 1/4))
```

Reduce [B] (verification not implemented)

Time = 0.19 (sec) , antiderivative size = 120, normalized size of antiderivative = 1.36

$$\int \frac{1}{(3-5\cos(c+dx))^2}\,dx$$
$$= \frac{-12\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+3\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)+12\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)\tan}{64d\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-1\right)}$$

input
```
int(1/(3-5*cos(d*x+c))^2,x)
```

output
```
( - 12*log(2*tan((c + d*x)/2) - 1)*tan((c + d*x)/2)**2 + 3*log(2*tan((c +
d*x)/2) - 1) + 12*log(2*tan((c + d*x)/2) + 1)*tan((c + d*x)/2)**2 - 3*log(
2*tan((c + d*x)/2) + 1) - 20*tan((c + d*x)/2))/(64*d*(4*tan((c + d*x)/2)**
2 - 1))
```

3.40 $\int \frac{1}{(3-5\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 113

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx = \frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2} + \frac{45\sin(c+dx)}{512d(3-5\cos(c+dx))}$$

output
```
43/2048*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d-43/2048*ln(cos(1/2*d
*x+1/2*c)+2*sin(1/2*d*x+1/2*c))/d-5/32*sin(d*x+c)/d/(3-5*cos(d*x+c))^2+45/
512*sin(d*x+c)/d/(3-5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.40 (sec) , antiderivative size = 211, normalized size of antiderivative = 1.87

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx = \frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{5}{512d\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} - \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{1024d\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)} + \frac{5}{512d\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} - \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{1024d\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}$$

input
```
Integrate[(3 - 5*Cos[c + d*x])^(-3),x]
```

output
```
(43*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]])/(2048*d) - (43*Log[Cos[(c
+ d*x)/2] + 2*Sin[(c + d*x)/2]])/(2048*d) - 5/(512*d*(Cos[(c + d*x)/2] - 2
*Sin[(c + d*x)/2])^2) - (45*Sin[(c + d*x)/2])/(1024*d*(Cos[(c + d*x)/2] -
2*Sin[(c + d*x)/2])) + 5/(512*d*(Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2])^2)
 - (45*Sin[(c + d*x)/2])/(1024*d*(Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2]))
```

Rubi [A] (verified)

Time = 0.39 (sec) , antiderivative size = 76, normalized size of antiderivative = 0.67, number of steps used = 10, number of rules used = 9, $\frac{\text{number of rules}}{\text{integrand size}} = 0.750$, Rules used = {3042, 3143, 25, 3042, 3233, 27, 3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(3-5 \sin \left(c+dx+\frac{\pi}{2}\right)\right)^3}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{1}{32} \int -\frac{5 \cos (c+dx)+6}{(3-5 \cos (c+dx))^2}dx-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

$$\Big\downarrow \text{25}$$

$$-\frac{1}{32} \int \frac{5 \cos (c+dx)+6}{(3-5 \cos (c+dx))^2}dx-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

$$\Big\downarrow \text{3042}$$

$$-\frac{1}{32} \int \frac{5 \sin \left(c+dx+\frac{\pi}{2}\right)+6}{\left(3-5 \sin \left(c+dx+\frac{\pi}{2}\right)\right)^2}dx-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{32} \left(\frac{45 \sin (c+dx)}{16 d (3-5 \cos (c+dx))}-\frac{1}{16} \int -\frac{43}{3-5 \cos (c+dx)}dx\right)-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{32} \left(\frac{43}{16} \int \frac{1}{3-5 \cos (c+dx)}dx+\frac{45 \sin (c+dx)}{16 d (3-5 \cos (c+dx))}\right)-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32} \left(\frac{43}{16} \int \frac{1}{3-5 \sin \left(c+dx+\frac{\pi}{2}\right)}dx+\frac{45 \sin (c+dx)}{16 d (3-5 \cos (c+dx))}\right)-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

$$\Big\downarrow \text{3138}$$

$$\frac{1}{32} \left(\frac{43 \int \frac{1}{8 \tan ^2\left(\frac{1}{2} (c+dx)\right)-2}d\tan \left(\frac{1}{2} (c+dx)\right)}{8 d}+\frac{45 \sin (c+dx)}{16 d (3-5 \cos (c+dx))}\right)-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

$$\Big\downarrow \text{220}$$

$$\frac{1}{32} \left(\frac{45 \sin (c+dx)}{16 d (3-5 \cos (c+dx))}-\frac{43 \text{arctanh}\left(2 \tan \left(\frac{1}{2} (c+dx)\right)\right)}{32 d}\right)-\frac{5 \sin (c+dx)}{32 d (3-5 \cos (c+dx))^2}$$

input
```
Int[(3 - 5*Cos[c + d*x])^(-3),x]
```

output
```
(-5*Sin[c + d*x])/(32*d*(3 - 5*Cos[c + d*x])^2) + ((-43*ArcTanh[2*Tan[(c +
 d*x)/2]])/(32*d) + (45*Sin[c + d*x])/(16*d*(3 - 5*Cos[c + d*x])))/32
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.92 (sec) , antiderivative size = 89, normalized size of antiderivative = 0.79

method	result
norman	$\frac{-\frac{85\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{512d}+\frac{35\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{128d}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-1\right)^2}+\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{2048d}-\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{2048d}$
derivativedivides	$\frac{-\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^2}+\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}+\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{2048}+\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)^2}+\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\right.\right.}}{d}$
default	$\frac{-\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^2}+\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}+\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{2048}+\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)^2}+\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\right.\right.}}{d}$
risch	$\frac{i\left(215\,e^{3i(dx+c)}-387\,e^{2i(dx+c)}+325\,e^{i(dx+c)}-225\right)}{256d\left(5\,e^{2i(dx+c)}-6\,e^{i(dx+c)}+5\right)^2}+\frac{43\ln\left(e^{i(dx+c)}-\frac{3}{5}-\frac{4i}{5}\right)}{2048d}-\frac{43\ln\left(e^{i(dx+c)}-\frac{3}{5}+\frac{4i}{5}\right)}{2048d}$
parallelrisch	$\frac{(2580\cos(dx+c)-1075\cos(2dx+2c)-1849)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-\frac{1}{2}\right)+(-2580\cos(dx+c)+1075\cos(2dx+2c)+1849)\ln\left(\mathrm{ta}\right.}{2048d(-43-25\cos(2dx+2c)+60\cos(dx+c))}$

input
```
int(1/(3-5*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
(-85/512/d*tan(1/2*d*x+1/2*c)+35/128/d*tan(1/2*d*x+1/2*c)^3)/(4*tan(1/2*d*
x+1/2*c)^2-1)^2+43/2048/d*ln(2*tan(1/2*d*x+1/2*c)-1)-43/2048/d*ln(2*tan(1/
2*d*x+1/2*c)+1)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 129, normalized size of antiderivative = 1.14

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx =$$
$$-\frac{43\left(25\cos\left(dx+c\right)^2-30\cos\left(dx+c\right)+9\right)\log\left(-\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-43\left(25\cos\left(d\right.\right.}{4096\left(25\,d\cos\left(dx\right.\right.}$$

input
```
integrate(1/(3-5*cos(d*x+c))^3,x, algorithm="fricas")
```

output
```
-1/4096*(43*(25*cos(d*x + c)^2 - 30*cos(d*x + c) + 9)*log(-3/2*cos(d*x + c
) + 2*sin(d*x + c) + 5/2) - 43*(25*cos(d*x + c)^2 - 30*cos(d*x + c) + 9)*l
og(-3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) + 40*(45*cos(d*x + c) - 11)*s
in(d*x + c))/(25*d*cos(d*x + c)^2 - 30*d*cos(d*x + c) + 9*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 490 vs. 2(102) = 204.

Time = 1.15 (sec) , antiderivative size = 490, normalized size of antiderivative = 4.34

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx = \text{Too large to display}$$

input
```
integrate(1/(3-5*cos(d*x+c))**3,x)
```

output
```
Piecewise((x/(3 - 5*cos(2*atan(1/2)))**3, Eq(c, -d*x - 2*atan(1/2)) | Eq(c
, -d*x + 2*atan(1/2))), (x/(3 - 5*cos(c))**3, Eq(d, 0)), (688*log(2*tan(c/
2 + d*x/2) - 1)*tan(c/2 + d*x/2)**4/(32768*d*tan(c/2 + d*x/2)**4 - 16384*d
*tan(c/2 + d*x/2)**2 + 2048*d) - 344*log(2*tan(c/2 + d*x/2) - 1)*tan(c/2 +
 d*x/2)**2/(32768*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 20
48*d) + 43*log(2*tan(c/2 + d*x/2) - 1)/(32768*d*tan(c/2 + d*x/2)**4 - 1638
4*d*tan(c/2 + d*x/2)**2 + 2048*d) - 688*log(2*tan(c/2 + d*x/2) + 1)*tan(c/
2 + d*x/2)**4/(32768*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 +
 2048*d) + 344*log(2*tan(c/2 + d*x/2) + 1)*tan(c/2 + d*x/2)**2/(32768*d*ta
n(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 2048*d) - 43*log(2*tan(c
/2 + d*x/2) + 1)/(32768*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**
2 + 2048*d) + 560*tan(c/2 + d*x/2)**3/(32768*d*tan(c/2 + d*x/2)**4 - 16384
*d*tan(c/2 + d*x/2)**2 + 2048*d) - 340*tan(c/2 + d*x/2)/(32768*d*tan(c/2 +
 d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 2048*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 137, normalized size of antiderivative = 1.21

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx = \frac{\frac{20\left(\frac{17\sin(dx+c)}{\cos(dx+c)+1}-\frac{28\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{16\sin(dx+c)^4}{(\cos(dx+c)+1)^4}-1}-43\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}+1\right)+43\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{2048\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
1/2048*(20*(17*sin(d*x + c)/(cos(d*x + c) + 1) - 28*sin(d*x + c)^3/(cos(d*
x + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - 16*sin(d*x + c)^4/
(cos(d*x + c) + 1)^4 - 1) - 43*log(2*sin(d*x + c)/(cos(d*x + c) + 1) + 1)
+ 43*log(2*sin(d*x + c)/(cos(d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.13 (sec) , antiderivative size = 84, normalized size of antiderivative = 0.74

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx = \frac{\frac{20\left(28\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3-17\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(4\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-1\right)^2} - 43\log\left(\left|2\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right|\right) + 43\log\left(\left|2\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-1\right|\right)}{2048\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
1/2048*(20*(28*tan(1/2*d*x + 1/2*c)^3 - 17*tan(1/2*d*x + 1/2*c))/(4*tan(1/
2*d*x + 1/2*c)^2 - 1)^2 - 43*log(abs(2*tan(1/2*d*x + 1/2*c) + 1)) + 43*log
(abs(2*tan(1/2*d*x + 1/2*c) - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 43.25 (sec) , antiderivative size = 76, normalized size of antiderivative = 0.67

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx = -\frac{43\,\mathrm{atanh}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{1024\,d} - \frac{\frac{85\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{8192}-\frac{35\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{2048}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4-\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2}{2}+\frac{1}{16}\right)}$$

input
```
int(-1/(5*cos(c + d*x) - 3)^3,x)
```

output
```
- (43*atanh(2*tan(c/2 + (d*x)/2)))/(1024*d) - ((85*tan(c/2 + (d*x)/2))/819
2 - (35*tan(c/2 + (d*x)/2)^3)/2048)/(d*(tan(c/2 + (d*x)/2)^4 - tan(c/2 + (
d*x)/2)^2/2 + 1/16))
```

Reduce [B] (verification not implemented)

Time = 0.18 (sec) , antiderivative size = 200, normalized size of antiderivative = 1.77

$$\int \frac{1}{(3-5\cos(c+dx))^3}\,dx$$
$$= \frac{688\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^4-344\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+43\log\left(2\tan\left(\frac{d}{}\right.\right.}{}$$

input
```
int(1/(3-5*cos(d*x+c))^3,x)
```

output
```
(688*log(2*tan((c + d*x)/2) - 1)*tan((c + d*x)/2)**4 - 344*log(2*tan((c +
d*x)/2) - 1)*tan((c + d*x)/2)**2 + 43*log(2*tan((c + d*x)/2) - 1) - 688*lo
g(2*tan((c + d*x)/2) + 1)*tan((c + d*x)/2)**4 + 344*log(2*tan((c + d*x)/2)
 + 1)*tan((c + d*x)/2)**2 - 43*log(2*tan((c + d*x)/2) + 1) + 560*tan((c +
d*x)/2)**3 - 340*tan((c + d*x)/2))/(2048*d*(16*tan((c + d*x)/2)**4 - 8*tan
((c + d*x)/2)**2 + 1))
```

3.41 $\int \frac{1}{(3-5\cos(c+dx))^4}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 138

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx = -\frac{279\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} + \frac{279\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} - \frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3} + \frac{25\sin(c+dx)}{512d(3-5\cos(c+dx))^2} - \frac{995\sin(c+dx)}{24576d(3-5\cos(c+dx))}$$

output
```
-279/32768*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d+279/32768*ln(cos(
1/2*d*x+1/2*c)+2*sin(1/2*d*x+1/2*c))/d-5/48*sin(d*x+c)/d/(3-5*cos(d*x+c))^
3+25/512*sin(d*x+c)/d/(3-5*cos(d*x+c))^2-995/24576*sin(d*x+c)/d/(3-5*cos(d
*x+c))
```

Mathematica [B] (verified)

Leaf count is larger than twice the leaf count of optimal. 288 vs. $2(138) = 276$.

Time = 0.39 (sec) , antiderivative size = 288, normalized size of antiderivative = 2.09

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx$$
$$= \frac{467046\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)-104625\cos(3(c+dx))\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}\right.\right.}{}$$

input
```
Integrate[(3 - 5*Cos[c + d*x])^(-4),x]
```

output
```
(467046*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - 104625*Cos[3*(c + d*x
)]*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - 765855*Cos[c + d*x]*(Log[C
os[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - Log[Cos[(c + d*x)/2] + 2*Sin[(c +
d*x)/2]]) + 376650*Cos[2*(c + d*x)]*(Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x
)/2]] - Log[Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2]]) - 467046*Log[Cos[(c +
d*x)/2] + 2*Sin[(c + d*x)/2]] + 104625*Cos[3*(c + d*x)]*Log[Cos[(c + d*x)/
2] + 2*Sin[(c + d*x)/2]] + 226140*Sin[c + d*x] - 190800*Sin[2*(c + d*x)] +
 99500*Sin[3*(c + d*x)])/(393216*d*(-3 + 5*Cos[c + d*x])^3)
```

Rubi [A] (verified)

Time = 0.52 (sec) , antiderivative size = 106, normalized size of antiderivative = 0.77, number of steps used = 13, number of rules used = 12, $\frac{\text{number of rules}}{\text{integrand size}} = 1.000$, Rules used = {3042, 3143, 25, 3042, 3233, 25, 3042, 3233, 27, 3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx$$
$$\Big\downarrow \text{3042}$$
$$\int \frac{1}{\left(3-5\sin\left(c+dx+\frac{\pi}{2}\right)\right)^4}dx$$
$$\Big\downarrow \text{3143}$$

$$\frac{1}{48}\int -\frac{10\cos(c+dx)+9}{(3-5\cos(c+dx))^3}dx-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{25}$$

$$-\frac{1}{48}\int \frac{10\cos(c+dx)+9}{(3-5\cos(c+dx))^3}dx-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{3042}$$

$$-\frac{1}{48}\int \frac{10\sin\left(c+dx+\frac{\pi}{2}\right)+9}{\left(3-5\sin\left(c+dx+\frac{\pi}{2}\right)\right)^3}dx-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{48}\left(\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}-\frac{1}{32}\int -\frac{75\cos(c+dx)+154}{(3-5\cos(c+dx))^2}dx\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{75\cos(c+dx)+154}{(3-5\cos(c+dx))^2}dx+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{75\sin\left(c+dx+\frac{\pi}{2}\right)+154}{\left(3-5\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{1}{16}\int -\frac{837}{3-5\cos(c+dx)}dx-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(-\frac{837}{16}\int \frac{1}{3-5\cos(c+dx)}dx-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(-\frac{837}{16}\int \frac{1}{3-5\sin\left(c+dx+\frac{\pi}{2}\right)}dx-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$\Big\downarrow$ 3138

$$\frac{1}{48}\left(\frac{1}{32}\left(-\frac{837\int \frac{1}{8\tan^2\left(\frac{1}{2}(c+dx)\right)-2}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$\Big\downarrow$ 220

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{837\text{arctanh}\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

input
```
Int[(3 - 5*Cos[c + d*x])^(-4),x]
```

output
```
(-5*Sin[c + d*x])/(48*d*(3 - 5*Cos[c + d*x])^3) + ((75*Sin[c + d*x])/(32*d
*(3 - 5*Cos[c + d*x])^2) + ((837*ArcTanh[2*Tan[(c + d*x)/2]])/(32*d) - (99
5*Sin[c + d*x])/(16*d*(3 - 5*Cos[c + d*x])))/32)/48
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.98 (sec) , antiderivative size = 105, normalized size of antiderivative = 0.76

method	result
norman	$\frac{-\frac{745\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{8192d}+\frac{265\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{768d}-\frac{295\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}}{512d}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-1\right)^{3}}-\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{32768d}+\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{32768d}$
risch	$-\frac{i\left(20925\,e^{5i(dx+c)}-62775\,e^{4i(dx+c)}+111042\,e^{3i(dx+c)}-119310\,e^{2i(dx+c)}+68625\,e^{i(dx+c)}-24875\right)}{12288d\left(5\,e^{2i(dx+c)}-6\,e^{i(dx+c)}+5\right)^{3}}-\frac{279\ln(e^{i(dx+}}{327}$
derivativedivides	$\frac{-\frac{125}{49152\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{3}}+\frac{25}{8192\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{2}}-\frac{295}{32768\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{32768}-\frac{12}{49152\left(2\tan\left(\right.\right.}}{d}$
default	$\frac{-\frac{125}{49152\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{3}}+\frac{25}{8192\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{2}}-\frac{295}{32768\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{32768}-\frac{12}{49152\left(2\tan\left(\right.\right.}}{d}$
parallelrisch	$\frac{(-765855\cos(dx+c)+376650\cos(2dx+2c)-104625\cos(3dx+3c)+467046)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-\frac{1}{2}\right)+(765855\cos(dx+c)-}{98304d(-558+125\cos(3}$

input
```
int(1/(3-5*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
(-745/8192/d*tan(1/2*d*x+1/2*c)+265/768/d*tan(1/2*d*x+1/2*c)^3-295/512/d*t
an(1/2*d*x+1/2*c)^5)/(4*tan(1/2*d*x+1/2*c)^2-1)^3-279/32768/d*ln(2*tan(1/2
*d*x+1/2*c)-1)+279/32768/d*ln(2*tan(1/2*d*x+1/2*c)+1)
```

Fricas [A] (verification not implemented)

Time = 0.09 (sec) , antiderivative size = 170, normalized size of antiderivative = 1.23

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx$$
$$= \frac{837\left(125\,\cos\left(dx+c\right)^{3}-225\,\cos\left(dx+c\right)^{2}+135\,\cos\left(dx+c\right)-27\right)\log\left(-\frac{3}{2}\,\cos\left(dx+c\right)+2\,\sin\left(dx+\right.\right.}{}$$

input
```
integrate(1/(3-5*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
1/196608*(837*(125*cos(d*x + c)^3 - 225*cos(d*x + c)^2 + 135*cos(d*x + c)
- 27)*log(-3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - 837*(125*cos(d*x + c
)^3 - 225*cos(d*x + c)^2 + 135*cos(d*x + c) - 27)*log(-3/2*cos(d*x + c) -
2*sin(d*x + c) + 5/2) + 40*(4975*cos(d*x + c)^2 - 4770*cos(d*x + c) + 1583
)*sin(d*x + c))/(125*d*cos(d*x + c)^3 - 225*d*cos(d*x + c)^2 + 135*d*cos(d
*x + c) - 27*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 831 vs. $2(126) = 252$.

Time = 2.36 (sec) , antiderivative size = 831, normalized size of antiderivative = 6.02

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(3-5*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(3 - 5*cos(2*atan(1/2)))**4, Eq(c, -d*x - 2*atan(1/2)) | Eq(c
, -d*x + 2*atan(1/2))), (x/(3 - 5*cos(c))**4, Eq(d, 0)), (-53568*log(2*tan
(c/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**6/(6291456*d*tan(c/2 + d*x/2)**6 - 47
18592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) + 4
0176*log(2*tan(c/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**4/(6291456*d*tan(c/2 +
d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2
- 98304*d) - 10044*log(2*tan(c/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**2/(629145
6*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c/
2 + d*x/2)**2 - 98304*d) + 837*log(2*tan(c/2 + d*x/2) - 1)/(6291456*d*tan(
c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x/
2)**2 - 98304*d) + 53568*log(2*tan(c/2 + d*x/2) + 1)*tan(c/2 + d*x/2)**6/(
6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*
tan(c/2 + d*x/2)**2 - 98304*d) - 40176*log(2*tan(c/2 + d*x/2) + 1)*tan(c/2
 + d*x/2)**4/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**
4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) + 10044*log(2*tan(c/2 + d*x/2
) + 1)*tan(c/2 + d*x/2)**2/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(
c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) - 837*log(2*tan
(c/2 + d*x/2) + 1)/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*
x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) - 56640*tan(c/2 + d*x/2
)**5/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1...
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 177, normalized size of antiderivative = 1.28

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(\frac{447\sin(dx+c)}{\cos(dx+c)+1}-\frac{1696\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{2832\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{12\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{48\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{64\sin(dx+c)^6}{(\cos(dx+c)+1)^6}-1}-837\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}+1\right)+837\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{98304\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
-1/98304*(20*(447*sin(d*x + c)/(cos(d*x + c) + 1) - 1696*sin(d*x + c)^3/(c
os(d*x + c) + 1)^3 + 2832*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(12*sin(d*x
 + c)^2/(cos(d*x + c) + 1)^2 - 48*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + 64
*sin(d*x + c)^6/(cos(d*x + c) + 1)^6 - 1) - 837*log(2*sin(d*x + c)/(cos(d*
x + c) + 1) + 1) + 837*log(2*sin(d*x + c)/(cos(d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.13 (sec) , antiderivative size = 97, normalized size of antiderivative = 0.70

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(2832\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^5-1696\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3+447\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(4\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2-1\right)^3}-837\log\left(\left|2\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)+1\right|\right)+837\log\left(\right.}{98304\,d}$$

input
```
integrate(1/(3-5*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
-1/98304*(20*(2832*tan(1/2*d*x + 1/2*c)^5 - 1696*tan(1/2*d*x + 1/2*c)^3 +
447*tan(1/2*d*x + 1/2*c))/(4*tan(1/2*d*x + 1/2*c)^2 - 1)^3 - 837*log(abs(2
*tan(1/2*d*x + 1/2*c) + 1)) + 837*log(abs(2*tan(1/2*d*x + 1/2*c) - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 44.31 (sec) , antiderivative size = 102, normalized size of antiderivative = 0.74

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx = \frac{279\,\mathrm{atanh}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{16384\,d} - \frac{\frac{295\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^5}{32768}-\frac{265\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{49152}+\frac{745\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{524288}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^6-\frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4}{4}+\frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2}{16}-\frac{1}{64}\right)}$$

input
```
int(1/(5*cos(c + d*x) - 3)^4,x)
```

output
```
(279*atanh(2*tan(c/2 + (d*x)/2)))/(16384*d) - ((745*tan(c/2 + (d*x)/2))/52
4288 - (265*tan(c/2 + (d*x)/2)^3)/49152 + (295*tan(c/2 + (d*x)/2)^5)/32768
)/(d*((3*tan(c/2 + (d*x)/2)^2)/16 - (3*tan(c/2 + (d*x)/2)^4)/4 + tan(c/2 +
 (d*x)/2)^6 - 1/64))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 260, normalized size of antiderivative = 1.88

$$\int \frac{1}{(3-5\cos(c+dx))^4}\,dx = \frac{-104625\cos(dx+c)\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\sin(dx+c)^2+217620\cos(dx+c)\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right.}{}$$

input
```
int(1/(3-5*cos(d*x+c))^4,x)
```

output
```
( - 104625*cos(c + d*x)*log(2*tan((c + d*x)/2) - 1)*sin(c + d*x)**2 + 2176
20*cos(c + d*x)*log(2*tan((c + d*x)/2) - 1) + 104625*cos(c + d*x)*log(2*ta
n((c + d*x)/2) + 1)*sin(c + d*x)**2 - 217620*cos(c + d*x)*log(2*tan((c + d
*x)/2) + 1) + 95400*cos(c + d*x)*sin(c + d*x) + 188325*log(2*tan((c + d*x)
/2) - 1)*sin(c + d*x)**2 - 210924*log(2*tan((c + d*x)/2) - 1) - 188325*log
(2*tan((c + d*x)/2) + 1)*sin(c + d*x)**2 + 210924*log(2*tan((c + d*x)/2) +
 1) + 99500*sin(c + d*x)**3 - 131160*sin(c + d*x))/(98304*d*(125*cos(c + d
*x)*sin(c + d*x)**2 - 260*cos(c + d*x) - 225*sin(c + d*x)**2 + 252))
```

3.42 $\int \frac{1}{-3+5\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 63

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = -\frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} + \frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

output
```
-1/4*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d+1/4*ln(cos(1/2*d*x+1/2*
c)+2*sin(1/2*d*x+1/2*c))/d
```

Mathematica [A] (verified)

Time = 0.04 (sec) , antiderivative size = 63, normalized size of antiderivative = 1.00

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = -\frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} + \frac{\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

input
```
Integrate[(-3 + 5*Cos[c + d*x])^(-1),x]
```

output
```
-1/4*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]]/d + Log[Cos[(c + d*x)/2] +
 2*Sin[(c + d*x)/2]]/(4*d)
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 20, normalized size of antiderivative = 0.32, number of steps used = 4, number of rules used = 3, $\frac{\text{number of rules}}{\text{integrand size}} = 0.250$, Rules used = {3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{5\cos(c+dx)-3}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)-3}dx$$

$$\Big\downarrow \text{3138}$$

$$\frac{2\int \frac{1}{2-8\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{d}$$

$$\Big\downarrow \text{219}$$

$$\frac{\text{arctanh}\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Int[(-3 + 5*Cos[c + d*x])^(-1),x]
```

output
```
ArcTanh[2*Tan[(c + d*x)/2]]/(2*d)
```

Defintions of rubi rules used

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

Maple [A] (verified)

Time = 0.56 (sec) , antiderivative size = 37, normalized size of antiderivative = 0.59

method	result	size
parallelrisch	$\frac{-\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)+\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4d}$	37
derivativedivides	$\frac{-\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{4}+\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4}}{d}$	38
default	$\frac{-\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{4}+\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4}}{d}$	38
norman	$-\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{4d}+\frac{\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4d}$	40
risch	$-\frac{\ln\left(e^{i(dx+c)}-\frac{3}{5}-\frac{4i}{5}\right)}{4d}+\frac{\ln\left(e^{i(dx+c)}-\frac{3}{5}+\frac{4i}{5}\right)}{4d}$	40

input
```
int(1/(-3+5*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
1/4*(-ln(2*tan(1/2*d*x+1/2*c)-1)+ln(2*tan(1/2*d*x+1/2*c)+1))/d
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.73

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = \frac{\log\left(-\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-\log\left(-\frac{3}{2}\cos\left(dx+c\right)-2\sin\left(dx+c\right)+\frac{5}{2}\right)}{8\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c)),x, algorithm="fricas")
```

output
```
1/8*(log(-3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - log(-3/2*cos(d*x + c)
 - 2*sin(d*x + c) + 5/2))/d
```

Sympy [A] (verification not implemented)

Time = 0.33 (sec) , antiderivative size = 44, normalized size of antiderivative = 0.70

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = \begin{cases} -\frac{\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-1\right)}{4d}+\frac{\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+1\right)}{4d} & \text{for}\ d\neq 0 \\ \frac{x}{5\cos\left(c\right)-3} & \text{otherwise} \end{cases}$$

input
```
integrate(1/(-3+5*cos(d*x+c)),x)
```

output
```
Piecewise((-log(2*tan(c/2 + d*x/2) - 1)/(4*d) + log(2*tan(c/2 + d*x/2) + 1
)/(4*d), Ne(d, 0)), (x/(5*cos(c) - 3), True))
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 50, normalized size of antiderivative = 0.79

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = \frac{\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}+1\right)-\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{4\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c)),x, algorithm="maxima")
```

output
```
1/4*(log(2*sin(d*x + c)/(cos(d*x + c) + 1) + 1) - log(2*sin(d*x + c)/(cos(
d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 38, normalized size of antiderivative = 0.60

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = \frac{\log\left(\left|2\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right|\right)-\log\left(\left|2\,\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-1\right|\right)}{4\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c)),x, algorithm="giac")
```

output
```
1/4*(log(abs(2*tan(1/2*d*x + 1/2*c) + 1)) - log(abs(2*tan(1/2*d*x + 1/2*c)
 - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 43.44 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.27

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = \frac{\mathrm{atanh}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{2\,d}$$

input
```
int(1/(5*cos(c + d*x) - 3),x)
```

output
```
atanh(2*tan(c/2 + (d*x)/2))/(2*d)
```

Reduce [B] (verification not implemented)

Time = 0.19 (sec) , antiderivative size = 36, normalized size of antiderivative = 0.57

$$\int \frac{1}{-3+5\cos(c+dx)}\,dx = \frac{-\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)+\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{4d}$$

input
```
int(1/(-3+5*cos(d*x+c)),x)
```

output
```
( - log(2*tan((c + d*x)/2) - 1) + log(2*tan((c + d*x)/2) + 1))/(4*d)
```

3.43 $\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 88

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx = -\frac{3\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} + \frac{3\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} - \frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

output
```
-3/64*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d+3/64*ln(cos(1/2*d*x+1/
2*c)+2*sin(1/2*d*x+1/2*c))/d-5/16*sin(d*x+c)/d/(3-5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.02 (sec) , antiderivative size = 139, normalized size of antiderivative = 1.58

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx = \frac{9\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)-15\cos(c+dx)\left(\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)-\right.}{64d(-3+5}$$

input
```
Integrate[(-3 + 5*Cos[c + d*x])^(-2),x]
```

output
```
(9*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - 15*Cos[c + d*x]*(Log[Cos[(
c + d*x)/2] - 2*Sin[(c + d*x)/2]] - Log[Cos[(c + d*x)/2] + 2*Sin[(c + d*x)
/2]]) - 9*Log[Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2]] + 20*Sin[c + d*x])/(6
4*d*(-3 + 5*Cos[c + d*x]))
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.52, number of steps used = 7, number of rules used = 6, $\frac{\text{number of rules}}{\text{integrand size}} = 0.500$, Rules used = {3042, 3143, 27, 3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5\cos(c+dx)-3)^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)-3\right)^2}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{1}{16}\int -\frac{3}{3-5\cos(c+dx)}dx-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{27}$$

$$-\frac{3}{16}\int \frac{1}{3-5\cos(c+dx)}dx-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{3042}$$

$$-\frac{3}{16}\int \frac{1}{3-5\sin\left(c+dx+\frac{\pi}{2}\right)}dx-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{3138}$$

$$-\frac{3\int \frac{1}{8\tan^2\left(\frac{1}{2}(c+dx)\right)-2}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

$$\Big\downarrow \text{220}$$

$$\frac{3\text{arctanh}\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}-\frac{5\sin(c+dx)}{16d(3-5\cos(c+dx))}$$

input
```
Int[(-3 + 5*Cos[c + d*x])^(-2),x]
```

output
```
(3*ArcTanh[2*Tan[(c + d*x)/2]])/(32*d) - (5*Sin[c + d*x])/(16*d*(3 - 5*Cos
[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.63 (sec) , antiderivative size = 71, normalized size of antiderivative = 0.81

method	result
norman	$-\frac{5\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16d\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-1\right)}-\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{64d}+\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{64d}$
derivativedivides	$\frac{-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{64}-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}+\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{64}}{d}$
default	$\frac{-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{64}-\frac{5}{64\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}+\frac{3\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{64}}{d}$
risch	$-\frac{i\left(3\,\mathrm{e}^{i(dx+c)}-5\right)}{8d\left(5\,\mathrm{e}^{2i(dx+c)}-6\,\mathrm{e}^{i(dx+c)}+5\right)}+\frac{3\ln\left(\mathrm{e}^{i(dx+c)}-\frac{3}{5}+\frac{4i}{5}\right)}{64d}-\frac{3\ln\left(\mathrm{e}^{i(dx+c)}-\frac{3}{5}-\frac{4i}{5}\right)}{64d}$
parallelrisch	$\frac{-15\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\cos(dx+c)+15\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)\cos(dx+c)+20\sin(dx+c)+9\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)-9}{64d(-3+5\cos(dx+c))}$

input
```
int(1/(-3+5*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
-5/16/d*tan(1/2*d*x+1/2*c)/(4*tan(1/2*d*x+1/2*c)^2-1)-3/64/d*ln(2*tan(1/2*
d*x+1/2*c)-1)+3/64/d*ln(2*tan(1/2*d*x+1/2*c)+1)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 88, normalized size of antiderivative = 1.00

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx$$
$$=\frac{3\left(5\cos\left(dx+c\right)-3\right)\log\left(-\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-3\left(5\cos\left(dx+c\right)-3\right)\log\left(-\frac{3}{2}\cos\left(dx\right.\right.}{128\left(5\,d\cos\left(dx+c\right)-3\,d\right)}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
1/128*(3*(5*cos(d*x + c) - 3)*log(-3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2
) - 3*(5*cos(d*x + c) - 3)*log(-3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) +
 40*sin(d*x + c))/(5*d*cos(d*x + c) - 3*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 240 vs. $2(78) = 156$.

Time = 0.64 (sec) , antiderivative size = 240, normalized size of antiderivative = 2.73

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx = \begin{cases} \frac{x}{\left(-3+5\cos\left(2\operatorname{atan}\left(\frac{1}{2}\right)\right)\right)^2} \\ \frac{x}{(5\cos(c)-3)^2} \\ -\frac{12\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-1\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{256d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-64d} + \frac{3\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-1\right)}{256d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-64d} + \frac{12\log\left(2\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+1\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{256d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-64d} - \frac{3\log\left(2\tan\left(\frac{c}{2}\right.\right.}{256d\tan^2\left(\frac{c}{2}+\right.} \end{cases}$$

input
```
integrate(1/(-3+5*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(-3 + 5*cos(2*atan(1/2)))**2, Eq(c, -d*x - 2*atan(1/2)) | Eq(
c, -d*x + 2*atan(1/2))), (x/(5*cos(c) - 3)**2, Eq(d, 0)), (-12*log(2*tan(c
/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**2/(256*d*tan(c/2 + d*x/2)**2 - 64*d) +
3*log(2*tan(c/2 + d*x/2) - 1)/(256*d*tan(c/2 + d*x/2)**2 - 64*d) + 12*log(
2*tan(c/2 + d*x/2) + 1)*tan(c/2 + d*x/2)**2/(256*d*tan(c/2 + d*x/2)**2 - 6
4*d) - 3*log(2*tan(c/2 + d*x/2) + 1)/(256*d*tan(c/2 + d*x/2)**2 - 64*d) -
20*tan(c/2 + d*x/2)/(256*d*tan(c/2 + d*x/2)**2 - 64*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 94, normalized size of antiderivative = 1.07

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx = -\frac{\frac{20\,\sin(dx+c)}{\left(\frac{4\,\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-1\right)(\cos(dx+c)+1)} - 3\,\log\left(\frac{2\,\sin(dx+c)}{\cos(dx+c)+1}+1\right) + 3\,\log\left(\frac{2\,\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{64\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
-1/64*(20*sin(d*x + c)/((4*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - 1)*(cos(d
*x + c) + 1)) - 3*log(2*sin(d*x + c)/(cos(d*x + c) + 1) + 1) + 3*log(2*sin
(d*x + c)/(cos(d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 68, normalized size of antiderivative = 0.77

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx = -\frac{\frac{20\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{4\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-1} - 3\log\left(\left|2\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+1\right|\right) + 3\log\left(\left|2\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-1\right|\right)}{64\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
-1/64*(20*tan(1/2*d*x + 1/2*c)/(4*tan(1/2*d*x + 1/2*c)^2 - 1) - 3*log(abs(
2*tan(1/2*d*x + 1/2*c) + 1)) + 3*log(abs(2*tan(1/2*d*x + 1/2*c) - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 47, normalized size of antiderivative = 0.53

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx = \frac{3\,\mathrm{atanh}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{32\,d} - \frac{5\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{64\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2-\frac{1}{4}\right)}$$

input
```
int(1/(5*cos(c + d*x) - 3)^2,x)
```

output
```
(3*atanh(2*tan(c/2 + (d*x)/2)))/(32*d) - (5*tan(c/2 + (d*x)/2))/(64*d*(tan
(c/2 + (d*x)/2)^2 - 1/4))
```

Reduce [B] (verification not implemented)

Time = 0.18 (sec) , antiderivative size = 120, normalized size of antiderivative = 1.36

$$\int \frac{1}{(-3+5\cos(c+dx))^2}\,dx$$
$$= \frac{-12\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+3\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)+12\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)\tan}{64d\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-1\right)}$$

input
```
int(1/(-3+5*cos(d*x+c))^2,x)
```

output
```
( - 12*log(2*tan((c + d*x)/2) - 1)*tan((c + d*x)/2)**2 + 3*log(2*tan((c +
d*x)/2) - 1) + 12*log(2*tan((c + d*x)/2) + 1)*tan((c + d*x)/2)**2 - 3*log(
2*tan((c + d*x)/2) + 1) - 20*tan((c + d*x)/2))/(64*d*(4*tan((c + d*x)/2)**
2 - 1))
```

3.44 $\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 113

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx = -\frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2} - \frac{45\sin(c+dx)}{512d(3-5\cos(c+dx))}$$

output
```
-43/2048*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d+43/2048*ln(cos(1/2*
d*x+1/2*c)+2*sin(1/2*d*x+1/2*c))/d+5/32*sin(d*x+c)/d/(3-5*cos(d*x+c))^2-45
/512*sin(d*x+c)/d/(3-5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.22 (sec) , antiderivative size = 211, normalized size of antiderivative = 1.87

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx = -\frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{43\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} + \frac{5}{512d\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} + \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{1024d\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)} - \frac{5}{512d\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} + \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{1024d\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}$$

input
```
Integrate[(-3 + 5*Cos[c + d*x])^(-3),x]
```

output
```
(-43*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]])/(2048*d) + (43*Log[Cos[(c
 + d*x)/2] + 2*Sin[(c + d*x)/2]])/(2048*d) + 5/(512*d*(Cos[(c + d*x)/2] -
2*Sin[(c + d*x)/2])^2) + (45*Sin[(c + d*x)/2])/(1024*d*(Cos[(c + d*x)/2] -
 2*Sin[(c + d*x)/2])) - 5/(512*d*(Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2])^2
) + (45*Sin[(c + d*x)/2])/(1024*d*(Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2]))
```

Rubi [A] (verified)

Time = 0.38 (sec) , antiderivative size = 76, normalized size of antiderivative = 0.67, number of steps used = 9, number of rules used = 8, $\frac{\text{number of rules}}{\text{integrand size}} = 0.667$, Rules used = {3042, 3143, 3042, 3233, 27, 3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5\cos(c+dx)-3)^3}\,dx$$

$$\Big\downarrow \; 3042$$

$$\int \frac{1}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)-3\right)^3}dx$$

$$\Big\downarrow \; 3143$$

$$\frac{1}{32}\int \frac{5\cos(c+dx)+6}{(3-5\cos(c+dx))^2}dx+\frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2}$$

$$\Big\downarrow \; 3042$$

$$\frac{1}{32}\int \frac{5\sin\left(c+dx+\frac{\pi}{2}\right)+6}{\left(3-5\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx+\frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2}$$

$$\Big\downarrow \; 3233$$

$$\frac{1}{32}\left(\frac{1}{16}\int -\frac{43}{3-5\cos(c+dx)}dx-\frac{45\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2}$$

$$\Big\downarrow \; 27$$

$$\frac{1}{32}\left(-\frac{43}{16}\int \frac{1}{3-5\cos(c+dx)}dx-\frac{45\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2}$$

$$\Big\downarrow \; 3042$$

$$\frac{1}{32}\left(-\frac{43}{16}\int \frac{1}{3-5\sin\left(c+dx+\frac{\pi}{2}\right)}dx-\frac{45\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2}$$

$$\Big\downarrow \; 3138$$

$$\frac{1}{32}\left(-\frac{43\int \frac{1}{8\tan^2\left(\frac{1}{2}(c+dx)\right)-2}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}-\frac{45\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2}$$

$$\Big\downarrow \; 220$$

$$\frac{1}{32}\left(\frac{43\text{arctanh}\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}-\frac{45\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{5\sin(c+dx)}{32d(3-5\cos(c+dx))^2}$$

input
```
Int[(-3 + 5*Cos[c + d*x])^(-3),x]
```

output
```
(5*Sin[c + d*x])/(32*d*(3 - 5*Cos[c + d*x])^2) + ((43*ArcTanh[2*Tan[(c + d
*x)/2]])/(32*d) - (45*Sin[c + d*x])/(16*d*(3 - 5*Cos[c + d*x])))/32
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.82 (sec) , antiderivative size = 89, normalized size of antiderivative = 0.79

method	result
norman	$\frac{\frac{85\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{512d}-\frac{35\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{128d}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-1\right)^2}-\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{2048d}+\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{2048d}$
derivativedivides	$-\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)^2}-\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}+\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{2048}+\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^2}-\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\right.\right.}$ ... over d
default	$-\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)^2}-\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}+\frac{43\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{2048}+\frac{25}{2048\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^2}-\frac{35}{2048\left(2\tan\left(\frac{dx}{2}+\right.\right.}$ ... over d
risch	$-\frac{i\left(215\,e^{3i(dx+c)}-387\,e^{2i(dx+c)}+325\,e^{i(dx+c)}-225\right)}{256d\left(5\,e^{2i(dx+c)}-6\,e^{i(dx+c)}+5\right)^2}-\frac{43\ln\left(e^{i(dx+c)}-\frac{3}{5}-\frac{4i}{5}\right)}{2048d}+\frac{43\ln\left(e^{i(dx+c)}-\frac{3}{5}+\frac{4i}{5}\right)}{2048d}$
parallelrisch	$\frac{(-2580\cos(dx+c)+1075\cos(2dx+2c)+1849)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-\frac{1}{2}\right)+(2580\cos(dx+c)-1075\cos(2dx+2c)-1849)\ln\left(\mathrm{ta}\right.}{2048d(-43-25\cos(2dx+2c)+60\cos(dx+c))}$

input
```
int(1/(-3+5*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
(85/512/d*tan(1/2*d*x+1/2*c)-35/128/d*tan(1/2*d*x+1/2*c)^3)/(4*tan(1/2*d*x
+1/2*c)^2-1)^2-43/2048/d*ln(2*tan(1/2*d*x+1/2*c)-1)+43/2048/d*ln(2*tan(1/2
*d*x+1/2*c)+1)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 129, normalized size of antiderivative = 1.14

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx$$
$$=\frac{43\left(25\cos\left(dx+c\right)^2-30\cos\left(dx+c\right)+9\right)\log\left(-\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-43\left(25\cos\left(dx\right.\right.}{4096\left(25\,d\cos\left(dx+c\right.\right.}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^3,x, algorithm="fricas")
```

output

```
1/4096*(43*(25*cos(d*x + c)^2 - 30*cos(d*x + c) + 9)*log(-3/2*cos(d*x + c)
 + 2*sin(d*x + c) + 5/2) - 43*(25*cos(d*x + c)^2 - 30*cos(d*x + c) + 9)*lo
g(-3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) + 40*(45*cos(d*x + c) - 11)*si
n(d*x + c))/(25*d*cos(d*x + c)^2 - 30*d*cos(d*x + c) + 9*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 490 vs. $2(102) = 204$.

Time = 1.14 (sec) , antiderivative size = 490, normalized size of antiderivative = 4.34

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx = \text{Too large to display}$$

input

```
integrate(1/(-3+5*cos(d*x+c))**3,x)
```

output

```
Piecewise((x/(-3 + 5*cos(2*atan(1/2)))**3, Eq(c, -d*x - 2*atan(1/2)) | Eq(
c, -d*x + 2*atan(1/2))), (x/(5*cos(c) - 3)**3, Eq(d, 0)), (-688*log(2*tan(
c/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**4/(32768*d*tan(c/2 + d*x/2)**4 - 16384
*d*tan(c/2 + d*x/2)**2 + 2048*d) + 344*log(2*tan(c/2 + d*x/2) - 1)*tan(c/2
 + d*x/2)**2/(32768*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 +
2048*d) - 43*log(2*tan(c/2 + d*x/2) - 1)/(32768*d*tan(c/2 + d*x/2)**4 - 16
384*d*tan(c/2 + d*x/2)**2 + 2048*d) + 688*log(2*tan(c/2 + d*x/2) + 1)*tan(
c/2 + d*x/2)**4/(32768*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2
 + 2048*d) - 344*log(2*tan(c/2 + d*x/2) + 1)*tan(c/2 + d*x/2)**2/(32768*d*
tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 2048*d) + 43*log(2*tan
(c/2 + d*x/2) + 1)/(32768*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)
**2 + 2048*d) - 560*tan(c/2 + d*x/2)**3/(32768*d*tan(c/2 + d*x/2)**4 - 163
84*d*tan(c/2 + d*x/2)**2 + 2048*d) + 340*tan(c/2 + d*x/2)/(32768*d*tan(c/2
 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 2048*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.03 (sec) , antiderivative size = 137, normalized size of antiderivative = 1.21

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx = -\frac{\frac{20\left(\frac{17\sin(dx+c)}{\cos(dx+c)+1}-\frac{28\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{16\sin(dx+c)^4}{(\cos(dx+c)+1)^4}-1}-43\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}+1\right)+43\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{2048\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
-1/2048*(20*(17*sin(d*x + c)/(cos(d*x + c) + 1) - 28*sin(d*x + c)^3/(cos(d
*x + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - 16*sin(d*x + c)^4
/(cos(d*x + c) + 1)^4 - 1) - 43*log(2*sin(d*x + c)/(cos(d*x + c) + 1) + 1)
 + 43*log(2*sin(d*x + c)/(cos(d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 84, normalized size of antiderivative = 0.74

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx = -\frac{\frac{20\left(28\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3-17\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(4\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2-1\right)^2}-43\log\left(\left|2\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)+1\right|\right)+43\log\left(\left|2\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)-\right.\right.}{2048\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
-1/2048*(20*(28*tan(1/2*d*x + 1/2*c)^3 - 17*tan(1/2*d*x + 1/2*c))/(4*tan(1
/2*d*x + 1/2*c)^2 - 1)^2 - 43*log(abs(2*tan(1/2*d*x + 1/2*c) + 1)) + 43*lo
g(abs(2*tan(1/2*d*x + 1/2*c) - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 44.88 (sec) , antiderivative size = 75, normalized size of antiderivative = 0.66

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx = \frac{43\,\mathrm{atanh}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{1024\,d} + \frac{\frac{85\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{8192}-\frac{35\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{2048}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4-\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2}{2}+\frac{1}{16}\right)}$$

input
```
int(1/(5*cos(c + d*x) - 3)^3,x)
```

output
```
(43*atanh(2*tan(c/2 + (d*x)/2)))/(1024*d) + ((85*tan(c/2 + (d*x)/2))/8192
- (35*tan(c/2 + (d*x)/2)^3)/2048)/(d*(tan(c/2 + (d*x)/2)^4 - tan(c/2 + (d*
x)/2)^2/2 + 1/16))
```

Reduce [B] (verification not implemented)

Time = 0.19 (sec) , antiderivative size = 200, normalized size of antiderivative = 1.77

$$\int \frac{1}{(-3+5\cos(c+dx))^3}\,dx = \frac{-688\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^4+344\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-43\log\left(2\tan\left(\right.\right.}{}$$

input
```
int(1/(-3+5*cos(d*x+c))^3,x)
```

output
```
( - 688*log(2*tan((c + d*x)/2) - 1)*tan((c + d*x)/2)**4 + 344*log(2*tan((c
 + d*x)/2) - 1)*tan((c + d*x)/2)**2 - 43*log(2*tan((c + d*x)/2) - 1) + 688
*log(2*tan((c + d*x)/2) + 1)*tan((c + d*x)/2)**4 - 344*log(2*tan((c + d*x)
/2) + 1)*tan((c + d*x)/2)**2 + 43*log(2*tan((c + d*x)/2) + 1) - 560*tan((c
 + d*x)/2)**3 + 340*tan((c + d*x)/2))/(2048*d*(16*tan((c + d*x)/2)**4 - 8*
tan((c + d*x)/2)**2 + 1))
```

3.45 $\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 138

$$\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx = -\frac{279\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} + \frac{279\log\left(\cos\left(\frac{1}{2}(c+dx)\right)+2\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} - \frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3} + \frac{25\sin(c+dx)}{512d(3-5\cos(c+dx))^2} - \frac{995\sin(c+dx)}{24576d(3-5\cos(c+dx))}$$

output
```
-279/32768*ln(cos(1/2*d*x+1/2*c)-2*sin(1/2*d*x+1/2*c))/d+279/32768*ln(cos(
1/2*d*x+1/2*c)+2*sin(1/2*d*x+1/2*c))/d-5/48*sin(d*x+c)/d/(3-5*cos(d*x+c))^
3+25/512*sin(d*x+c)/d/(3-5*cos(d*x+c))^2-995/24576*sin(d*x+c)/d/(3-5*cos(d
*x+c))
```

Mathematica [B] (verified)

Leaf count is larger than twice the leaf count of optimal. 288 vs. 2(138) = 276.

Time = 0.01 (sec) , antiderivative size = 288, normalized size of antiderivative = 2.09

$$\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx$$
$$= \frac{467046\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}(c+dx)\right)\right)-104625\cos(3(c+dx))\log\left(\cos\left(\frac{1}{2}(c+dx)\right)-2\sin\left(\frac{1}{2}\right.\right.}{}$$

input
```
Integrate[(-3 + 5*Cos[c + d*x])^(-4),x]
```

output
```
(467046*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - 104625*Cos[3*(c + d*x
)]*Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - 765855*Cos[c + d*x]*(Log[C
os[(c + d*x)/2] - 2*Sin[(c + d*x)/2]] - Log[Cos[(c + d*x)/2] + 2*Sin[(c +
d*x)/2]]) + 376650*Cos[2*(c + d*x)]*(Log[Cos[(c + d*x)/2] - 2*Sin[(c + d*x
)/2]] - Log[Cos[(c + d*x)/2] + 2*Sin[(c + d*x)/2]]) - 467046*Log[Cos[(c +
d*x)/2] + 2*Sin[(c + d*x)/2]] + 104625*Cos[3*(c + d*x)]*Log[Cos[(c + d*x)/
2] + 2*Sin[(c + d*x)/2]] + 226140*Sin[c + d*x] - 190800*Sin[2*(c + d*x)] +
 99500*Sin[3*(c + d*x)])/(393216*d*(-3 + 5*Cos[c + d*x])^3)
```

Rubi [A] (verified)

Time = 0.50 (sec) , antiderivative size = 106, normalized size of antiderivative = 0.77, number of steps used = 13, number of rules used = 12, $\frac{\text{number of rules}}{\text{integrand size}} = 1.000$, Rules used = {3042, 3143, 25, 3042, 3233, 25, 3042, 3233, 27, 3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(5\cos(c+dx)-3)^4}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)-3\right)^4}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{1}{48}\int -\frac{10\cos(c+dx)+9}{(3-5\cos(c+dx))^3}dx-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 25}$$

$$-\frac{1}{48}\int \frac{10\cos(c+dx)+9}{(3-5\cos(c+dx))^3}dx-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 3042}$$

$$-\frac{1}{48}\int \frac{10\sin\left(c+dx+\frac{\pi}{2}\right)+9}{\left(3-5\sin\left(c+dx+\frac{\pi}{2}\right)\right)^3}dx-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 3233}$$

$$\frac{1}{48}\left(\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}-\frac{1}{32}\int -\frac{75\cos(c+dx)+154}{(3-5\cos(c+dx))^2}dx\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 25}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{75\cos(c+dx)+154}{(3-5\cos(c+dx))^2}dx+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{75\sin\left(c+dx+\frac{\pi}{2}\right)+154}{\left(3-5\sin\left(c+dx+\frac{\pi}{2}\right)\right)^2}dx+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 3233}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{1}{16}\int -\frac{837}{3-5\cos(c+dx)}dx-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 27}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(-\frac{837}{16}\int \frac{1}{3-5\cos(c+dx)}dx-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(-\frac{837}{16}\int \frac{1}{3-5\sin\left(c+dx+\frac{\pi}{2}\right)}dx-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{3138}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(-\frac{837\int \frac{1}{8\tan^2\left(\frac{1}{2}(c+dx)\right)-2}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

$$\Big\downarrow \text{220}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{837\text{arctanh}\left(2\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}-\frac{995\sin(c+dx)}{16d(3-5\cos(c+dx))}\right)+\frac{75\sin(c+dx)}{32d(3-5\cos(c+dx))^2}\right)-\frac{5\sin(c+dx)}{48d(3-5\cos(c+dx))^3}$$

input
```
Int[(-3 + 5*Cos[c + d*x])^(-4),x]
```

output
```
(-5*Sin[c + d*x])/(48*d*(3 - 5*Cos[c + d*x])^3) + ((75*Sin[c + d*x])/(32*d
*(3 - 5*Cos[c + d*x])^2) + ((837*ArcTanh[2*Tan[(c + d*x)/2]])/(32*d) - (99
5*Sin[c + d*x])/(16*d*(3 - 5*Cos[c + d*x])))/32)/48
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.57 (sec) , antiderivative size = 105, normalized size of antiderivative = 0.76

method	result
norman	$\frac{-\frac{745\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{8192d}+\frac{265\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{768d}-\frac{295\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}}{512d}}{\left(4\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-1\right)^{3}}-\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{32768d}+\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+1\right)}{32768d}$
risch	$-\frac{i\left(20925\,\mathrm{e}^{5i(dx+c)}-62775\,\mathrm{e}^{4i(dx+c)}+111042\,\mathrm{e}^{3i(dx+c)}-119310\,\mathrm{e}^{2i(dx+c)}+68625\,\mathrm{e}^{i(dx+c)}-24875\right)}{12288d\left(5\,\mathrm{e}^{2i(dx+c)}-6\,\mathrm{e}^{i(dx+c)}+5\right)^{3}}-\frac{279\ln(\mathrm{e}^{i(dx+}}{327\mathrm{6}}$
derivativedivides	$\frac{-\frac{125}{49152\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{3}}+\frac{25}{8192\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{2}}-\frac{295}{32768\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{32768}-\frac{12}{49152\left(2\tan\left(\right.\right.}}{d}$
default	$\frac{-\frac{125}{49152\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{3}}+\frac{25}{8192\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)^{2}}-\frac{295}{32768\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}-\frac{279\ln\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)}{32768}-\frac{12}{49152\left(2\tan\left(\right.\right.}}{d}$
parallelrisch	$\frac{(-765855\cos(dx+c)+376650\cos(2dx+2c)-104625\cos(3dx+3c)+467046)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-\frac{1}{2}\right)+(765855\cos(dx+c)-}{98304d(-558+125\cos(3}$

input
```
int(1/(-3+5*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
(-745/8192/d*tan(1/2*d*x+1/2*c)+265/768/d*tan(1/2*d*x+1/2*c)^3-295/512/d*t
an(1/2*d*x+1/2*c)^5)/(4*tan(1/2*d*x+1/2*c)^2-1)^3-279/32768/d*ln(2*tan(1/2
*d*x+1/2*c)-1)+279/32768/d*ln(2*tan(1/2*d*x+1/2*c)+1)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 170, normalized size of antiderivative = 1.23

$$\int\frac{1}{(-3+5\cos(c+dx))^4}\,dx$$
$$=\frac{837\left(125\cos\left(dx+c\right)^3-225\cos\left(dx+c\right)^2+135\cos\left(dx+c\right)-27\right)\log\left(-\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+\right.\right.}{}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
1/196608*(837*(125*cos(d*x + c)^3 - 225*cos(d*x + c)^2 + 135*cos(d*x + c)
- 27)*log(-3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - 837*(125*cos(d*x + c
)^3 - 225*cos(d*x + c)^2 + 135*cos(d*x + c) - 27)*log(-3/2*cos(d*x + c) -
2*sin(d*x + c) + 5/2) + 40*(4975*cos(d*x + c)^2 - 4770*cos(d*x + c) + 1583
)*sin(d*x + c))/(125*d*cos(d*x + c)^3 - 225*d*cos(d*x + c)^2 + 135*d*cos(d
*x + c) - 27*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 831 vs. $2(126) = 252$.

Time = 2.35 (sec) , antiderivative size = 831, normalized size of antiderivative = 6.02

$$\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(-3+5*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(-3 + 5*cos(2*atan(1/2)))**4, Eq(c, -d*x - 2*atan(1/2)) | Eq(
c, -d*x + 2*atan(1/2))), (x/(5*cos(c) - 3)**4, Eq(d, 0)), (-53568*log(2*ta
n(c/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**6/(6291456*d*tan(c/2 + d*x/2)**6 - 4
718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) +
40176*log(2*tan(c/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**4/(6291456*d*tan(c/2 +
 d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2
 - 98304*d) - 10044*log(2*tan(c/2 + d*x/2) - 1)*tan(c/2 + d*x/2)**2/(62914
56*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c
/2 + d*x/2)**2 - 98304*d) + 837*log(2*tan(c/2 + d*x/2) - 1)/(6291456*d*tan
(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x
/2)**2 - 98304*d) + 53568*log(2*tan(c/2 + d*x/2) + 1)*tan(c/2 + d*x/2)**6/
(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + 1179648*d
*tan(c/2 + d*x/2)**2 - 98304*d) - 40176*log(2*tan(c/2 + d*x/2) + 1)*tan(c/
2 + d*x/2)**4/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)*
*4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) + 10044*log(2*tan(c/2 + d*x/
2) + 1)*tan(c/2 + d*x/2)**2/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan
(c/2 + d*x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) - 837*log(2*ta
n(c/2 + d*x/2) + 1)/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d
*x/2)**4 + 1179648*d*tan(c/2 + d*x/2)**2 - 98304*d) - 56640*tan(c/2 + d*x/
2)**5/(6291456*d*tan(c/2 + d*x/2)**6 - 4718592*d*tan(c/2 + d*x/2)**4 + ...
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 177, normalized size of antiderivative = 1.28

$$\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(\frac{447\sin(dx+c)}{\cos(dx+c)+1}-\frac{1696\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{2832\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{12\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{48\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{64\sin(dx+c)^6}{(\cos(dx+c)+1)^6}-1}-837\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}+1\right)+837\log\left(\frac{2\sin(dx+c)}{\cos(dx+c)+1}-1\right)}{98304\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
-1/98304*(20*(447*sin(d*x + c)/(cos(d*x + c) + 1) - 1696*sin(d*x + c)^3/(c
os(d*x + c) + 1)^3 + 2832*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(12*sin(d*x
 + c)^2/(cos(d*x + c) + 1)^2 - 48*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + 64
*sin(d*x + c)^6/(cos(d*x + c) + 1)^6 - 1) - 837*log(2*sin(d*x + c)/(cos(d*
x + c) + 1) + 1) + 837*log(2*sin(d*x + c)/(cos(d*x + c) + 1) - 1))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 97, normalized size of antiderivative = 0.70

$$\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(2832\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^5-1696\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3+447\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(4\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2-1\right)^3}-837\log\left(\left|2\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)+1\right|\right)+837\log\left(\right.}{98304\,d}$$

input
```
integrate(1/(-3+5*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
-1/98304*(20*(2832*tan(1/2*d*x + 1/2*c)^5 - 1696*tan(1/2*d*x + 1/2*c)^3 +
447*tan(1/2*d*x + 1/2*c))/(4*tan(1/2*d*x + 1/2*c)^2 - 1)^3 - 837*log(abs(2
*tan(1/2*d*x + 1/2*c) + 1)) + 837*log(abs(2*tan(1/2*d*x + 1/2*c) - 1)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 102, normalized size of antiderivative = 0.74

$$\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx = \frac{279\,\mathrm{atanh}\left(2\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)\right)}{16384\,d} - \frac{\frac{295\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^5}{32768} - \frac{265\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{49152} + \frac{745\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{524288}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^6 - \frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4}{4} + \frac{3\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2}{16} - \frac{1}{64}\right)}$$

input
```
int(1/(5*cos(c + d*x) - 3)^4,x)
```

output
```
(279*atanh(2*tan(c/2 + (d*x)/2)))/(16384*d) - ((745*tan(c/2 + (d*x)/2))/52
4288 - (265*tan(c/2 + (d*x)/2)^3)/49152 + (295*tan(c/2 + (d*x)/2)^5)/32768
)/(d*((3*tan(c/2 + (d*x)/2)^2)/16 - (3*tan(c/2 + (d*x)/2)^4)/4 + tan(c/2 +
 (d*x)/2)^6 - 1/64))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 260, normalized size of antiderivative = 1.88

$$\int \frac{1}{(-3+5\cos(c+dx))^4}\,dx = \frac{-104625\cos(dx+c)\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right)\sin(dx+c)^2 + 217620\cos(dx+c)\log\left(2\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-1\right.}{}$$

input
```
int(1/(-3+5*cos(d*x+c))^4,x)
```

output
```
( - 104625*cos(c + d*x)*log(2*tan((c + d*x)/2) - 1)*sin(c + d*x)**2 + 2176
20*cos(c + d*x)*log(2*tan((c + d*x)/2) - 1) + 104625*cos(c + d*x)*log(2*ta
n((c + d*x)/2) + 1)*sin(c + d*x)**2 - 217620*cos(c + d*x)*log(2*tan((c + d
*x)/2) + 1) + 95400*cos(c + d*x)*sin(c + d*x) + 188325*log(2*tan((c + d*x)
/2) - 1)*sin(c + d*x)**2 - 210924*log(2*tan((c + d*x)/2) - 1) - 188325*log
(2*tan((c + d*x)/2) + 1)*sin(c + d*x)**2 + 210924*log(2*tan((c + d*x)/2) +
 1) + 99500*sin(c + d*x)**3 - 131160*sin(c + d*x))/(98304*d*(125*cos(c + d
*x)*sin(c + d*x)**2 - 260*cos(c + d*x) - 225*sin(c + d*x)**2 + 252))
```

3.46 $\int \frac{1}{-3-5\cos(c+dx)}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 65

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = \frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} - \frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

output
```
1/4*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d-1/4*ln(2*cos(1/2*d*x+1/2
*c)+sin(1/2*d*x+1/2*c))/d
```

Mathematica [A] (verified)

Time = 0.05 (sec) , antiderivative size = 65, normalized size of antiderivative = 1.00

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = \frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d} - \frac{\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{4d}$$

input
```
Integrate[(-3 - 5*Cos[c + d*x])^(-1),x]
```

output
```
Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]]/(4*d) - Log[2*Cos[(c + d*x)/2]
+ Sin[(c + d*x)/2]]/(4*d)
```

Rubi [A] (verified)

Time = 0.19 (sec) , antiderivative size = 22, normalized size of antiderivative = 0.34, number of steps used = 4, number of rules used = 3, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.250, Rules used = {3042, 3138, 220}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{-5\cos(c+dx)-3}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \frac{1}{-5\sin\left(c+dx+\frac{\pi}{2}\right)-3}dx$$

$$\Big\downarrow \text{ 3138}$$

$$\frac{2\int \frac{1}{2\tan^2\left(\frac{1}{2}(c+dx)\right)-8}d\tan\left(\frac{1}{2}(c+dx)\right)}{d}$$

$$\Big\downarrow \text{ 220}$$

$$-\frac{\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{2d}$$

input
```
Int[(-3 - 5*Cos[c + d*x])^(-1),x]
```

output
```
-1/2*ArcTanh[Tan[(c + d*x)/2]/2]/d
```

Defintions of rubi rules used

rule 220
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(-(Rt[-a, 2]*Rt[b, 2])^(-
1))*ArcTanh[Rt[b, 2]*(x/Rt[-a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] &&
 (LtQ[a, 0] || GtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

Maple [A] (verified)

Time = 0.58 (sec) , antiderivative size = 33, normalized size of antiderivative = 0.51

method	result	size
parallelrisch	$\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4d}$	33
derivativedivides	$\frac{\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{4}-\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4}}{d}$	34
default	$\frac{\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{4}-\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4}}{d}$	34
norman	$\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{4d}-\frac{\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4d}$	36
risch	$-\frac{\ln\left(e^{i(dx+c)}+\frac{3}{5}+\frac{4i}{5}\right)}{4d}+\frac{\ln\left(e^{i(dx+c)}+\frac{3}{5}-\frac{4i}{5}\right)}{4d}$	40

input
```
int(1/(-3-5*cos(d*x+c)),x,method=_RETURNVERBOSE)
```

output
```
1/4*(ln(tan(1/2*d*x+1/2*c)-2)-ln(tan(1/2*d*x+1/2*c)+2))/d
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 46, normalized size of antiderivative = 0.71

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = -\frac{\log\left(\frac{3}{2}\,\cos\left(dx+c\right)+2\,\sin\left(dx+c\right)+\frac{5}{2}\right)-\log\left(\frac{3}{2}\,\cos\left(dx+c\right)-2\,\sin\left(dx+c\right)+\frac{5}{2}\right)}{8\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c)),x, algorithm="fricas")
```

output
```
-1/8*(log(3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - log(3/2*cos(d*x + c)
- 2*sin(d*x + c) + 5/2))/d
```

Sympy [A] (verification not implemented)

Time = 0.34 (sec) , antiderivative size = 42, normalized size of antiderivative = 0.65

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = \begin{cases} \frac{\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-2\right)}{4d} - \frac{\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+2\right)}{4d} & \text{for}\ d \neq 0 \\ \frac{x}{-5\cos\left(c\right)-3} & \text{otherwise} \end{cases}$$

input
```
integrate(1/(-3-5*cos(d*x+c)),x)
```

output
```
Piecewise((log(tan(c/2 + d*x/2) - 2)/(4*d) - log(tan(c/2 + d*x/2) + 2)/(4*
d), Ne(d, 0)), (x/(-5*cos(c) - 3), True))
```

Maxima [A] (verification not implemented)

Time = 0.03 (sec) , antiderivative size = 48, normalized size of antiderivative = 0.74

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = -\frac{\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right)-\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{4\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c)),x, algorithm="maxima")
```

output
```
-1/4*(log(sin(d*x + c)/(cos(d*x + c) + 1) + 2) - log(sin(d*x + c)/(cos(d*x
 + c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 34, normalized size of antiderivative = 0.52

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = -\frac{\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+2\right|\right)-\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-2\right|\right)}{4\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c)),x, algorithm="giac")
```

output
```
-1/4*(log(abs(tan(1/2*d*x + 1/2*c) + 2)) - log(abs(tan(1/2*d*x + 1/2*c) -
2)))/d
```

Mupad [B] (verification not implemented)

Time = 44.49 (sec) , antiderivative size = 17, normalized size of antiderivative = 0.26

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = -\frac{\operatorname{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{2\,d}$$

input
```
int(-1/(5*cos(c + d*x) + 3),x)
```

output
```
-atanh(tan(c/2 + (d*x)/2)/2)/(2*d)
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 32, normalized size of antiderivative = 0.49

$$\int \frac{1}{-3-5\cos(c+dx)}\,dx = \frac{\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{4d}$$

input
```
int(1/(-3-5*cos(d*x+c)),x)
```

output
```
(log(tan((c + d*x)/2) - 2) - log(tan((c + d*x)/2) + 2))/(4*d)
```

3.47 $\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 90

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx = \frac{3\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} - \frac{3\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{64d} + \frac{5\sin(c+dx)}{16d(3+5\cos(c+dx))}$$

output
```
3/64*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d-3/64*ln(2*cos(1/2*d*x+1
/2*c)+sin(1/2*d*x+1/2*c))/d+5/16*sin(d*x+c)/d/(3+5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.05 (sec) , antiderivative size = 143, normalized size of antiderivative = 1.59

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx = \frac{9\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)+15\cos(c+dx)\left(\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)-\right.}{64d(3+5}$$

input
```
Integrate[(-3 - 5*Cos[c + d*x])^(-2),x]
```

output
```
(9*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] + 15*Cos[c + d*x]*(Log[2*Cos
[(c + d*x)/2] - Sin[(c + d*x)/2]] - Log[2*Cos[(c + d*x)/2] + Sin[(c + d*x)
/2]]) - 9*Log[2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2]] + 20*Sin[c + d*x])/(6
4*d*(3 + 5*Cos[c + d*x]))
```

Rubi [A] (verified)

Time = 0.26 (sec) , antiderivative size = 48, normalized size of antiderivative = 0.53, number of steps used = 7, number of rules used = 6, $\frac{\text{number of rules}}{\text{integrand size}} = 0.500$, Rules used = {3042, 3143, 27, 3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(-5\cos(c+dx)-3)^2}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(-5\sin\left(c+dx+\frac{\pi}{2}\right)-3\right)^2}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{1}{16}\int -\frac{3}{5\cos(c+dx)+3}dx+\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}$$

$$\Big\downarrow \text{27}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{3}{16}\int \frac{1}{5\cos(c+dx)+3}dx$$

$$\Big\downarrow \text{3042}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{3}{16}\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)+3}dx$$

$$\Big\downarrow \text{3138}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{3\int \frac{1}{8-2\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}$$

$$\Big\downarrow \text{219}$$

$$\frac{5\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{3\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}$$

input
```
Int[(-3 - 5*Cos[c + d*x])^(-2),x]
```

output
```
(-3*ArcTanh[Tan[(c + d*x)/2]/2])/(32*d) + (5*Sin[c + d*x])/(16*d*(3 + 5*Co
s[c + d*x]))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [A] (verified)

Time = 0.64 (sec) , antiderivative size = 64, normalized size of antiderivative = 0.71

method	result
derivativedivides	$\frac{-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{64}-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}+\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{64}}{d}$
default	$\frac{-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{64}-\frac{5}{32\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}+\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{64}}{d}$
norman	$-\frac{5\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{16d\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-4\right)}+\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{64d}-\frac{3\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{64d}$
risch	$\frac{i\left(3\,\mathrm{e}^{i(dx+c)}+5\right)}{8d\left(5\,\mathrm{e}^{2i(dx+c)}+6\,\mathrm{e}^{i(dx+c)}+5\right)}-\frac{3\ln\left(\mathrm{e}^{i(dx+c)}+\frac{3}{5}+\frac{4i}{5}\right)}{64d}+\frac{3\ln\left(\mathrm{e}^{i(dx+c)}+\frac{3}{5}-\frac{4i}{5}\right)}{64d}$
parallelrisch	$\frac{9\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-9\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)+15\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\cos(dx+c)-15\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)\cos(dx+c)}{64d(3+5\cos(dx+c))}$

input
```
int(1/(-3-5*cos(d*x+c))^2,x,method=_RETURNVERBOSE)
```

output
```
1/d*(-5/32/(tan(1/2*d*x+1/2*c)+2)-3/64*ln(tan(1/2*d*x+1/2*c)+2)-5/32/(tan(
1/2*d*x+1/2*c)-2)+3/64*ln(tan(1/2*d*x+1/2*c)-2))
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 88, normalized size of antiderivative = 0.98

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx = -\frac{3\,(5\,\cos(dx+c)+3)\log\left(\frac{3}{2}\,\cos(dx+c)+2\,\sin(dx+c)+\frac{5}{2}\right)-3\,(5\,\cos(dx+c)+3)\log\left(\frac{3}{2}\,\cos(dx\right.}{128\,(5\,d\cos(dx+c)+3\,d)}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^2,x, algorithm="fricas")
```

output
```
-1/128*(3*(5*cos(d*x + c) + 3)*log(3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2
) - 3*(5*cos(d*x + c) + 3)*log(3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) -
40*sin(d*x + c))/(5*d*cos(d*x + c) + 3*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 231 vs. 2(78) = 156.

Time = 0.65 (sec) , antiderivative size = 231, normalized size of antiderivative = 2.57

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx$$
$$= \begin{cases} \frac{x}{(-3-5\cos(2\operatorname{atan}(2)))^2} \\ \frac{x}{(-5\cos(c)-3)^2} \\ \frac{3\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-2\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} - \frac{12\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)-2\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} - \frac{3\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+2\right)\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} + \frac{12\log\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)+2\right)}{64d\tan^2\left(\frac{c}{2}+\frac{dx}{2}\right)-256d} \end{cases}$$

input
```
integrate(1/(-3-5*cos(d*x+c))**2,x)
```

output
```
Piecewise((x/(-3 - 5*cos(2*atan(2)))**2, Eq(c, -d*x - 2*atan(2)) | Eq(c, -
d*x + 2*atan(2))), (x/(-5*cos(c) - 3)**2, Eq(d, 0)), (3*log(tan(c/2 + d*x/
2) - 2)*tan(c/2 + d*x/2)**2/(64*d*tan(c/2 + d*x/2)**2 - 256*d) - 12*log(ta
n(c/2 + d*x/2) - 2)/(64*d*tan(c/2 + d*x/2)**2 - 256*d) - 3*log(tan(c/2 + d
*x/2) + 2)*tan(c/2 + d*x/2)**2/(64*d*tan(c/2 + d*x/2)**2 - 256*d) + 12*log
(tan(c/2 + d*x/2) + 2)/(64*d*tan(c/2 + d*x/2)**2 - 256*d) - 20*tan(c/2 + d
*x/2)/(64*d*tan(c/2 + d*x/2)**2 - 256*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.03 (sec) , antiderivative size = 91, normalized size of antiderivative = 1.01

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx$$
$$= -\frac{\frac{20\sin(dx+c)}{\left(\frac{\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-4\right)(\cos(dx+c)+1)} + 3\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right) - 3\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{64\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^2,x, algorithm="maxima")
```

output
```
-1/64*(20*sin(d*x + c)/((sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - 4)*(cos(d*x
 + c) + 1)) + 3*log(sin(d*x + c)/(cos(d*x + c) + 1) + 2) - 3*log(sin(d*x +
 c)/(cos(d*x + c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 62, normalized size of antiderivative = 0.69

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx = -\frac{\frac{20\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)}{\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-4}+3\,\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+2\right|\right)-3\,\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-2\right|\right)}{64\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^2,x, algorithm="giac")
```

output
```
-1/64*(20*tan(1/2*d*x + 1/2*c)/(tan(1/2*d*x + 1/2*c)^2 - 4) + 3*log(abs(ta
n(1/2*d*x + 1/2*c) + 2)) - 3*log(abs(tan(1/2*d*x + 1/2*c) - 2)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 47, normalized size of antiderivative = 0.52

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx = -\frac{3\,\mathrm{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{32\,d}-\frac{5\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{16\,d\,\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2-4\right)}$$

input
```
int(1/(5*cos(c + d*x) + 3)^2,x)
```

output
```
- (3*atanh(tan(c/2 + (d*x)/2)/2))/(32*d) - (5*tan(c/2 + (d*x)/2))/(16*d*(t
an(c/2 + (d*x)/2)^2 - 4))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 110, normalized size of antiderivative = 1.22

$$\int \frac{1}{(-3-5\cos(c+dx))^2}\,dx$$
$$= \frac{3\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-12\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-3\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right.}{64d\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-4\right)}$$

input

```
int(1/(-3-5*cos(d*x+c))^2,x)
```

output

```
(3*log(tan((c + d*x)/2) - 2)*tan((c + d*x)/2)**2 - 12*log(tan((c + d*x)/2)
 - 2) - 3*log(tan((c + d*x)/2) + 2)*tan((c + d*x)/2)**2 + 12*log(tan((c +
d*x)/2) + 2) - 20*tan((c + d*x)/2))/(64*d*(tan((c + d*x)/2)**2 - 4))
```

3.48 $\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 115

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = \frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{5\sin(c+dx)}{32d(3+5\cos(c+dx))^2} + \frac{45\sin(c+dx)}{512d(3+5\cos(c+dx))}$$

output

```
43/2048*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d-43/2048*ln(2*cos(1/2
*d*x+1/2*c)+sin(1/2*d*x+1/2*c))/d-5/32*sin(d*x+c)/d/(3+5*cos(d*x+c))^2+45/
512*sin(d*x+c)/d/(3+5*cos(d*x+c))
```

Mathematica [A] (verified)

Time = 0.41 (sec) , antiderivative size = 217, normalized size of antiderivative = 1.89

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = \frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{43\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{2048d} - \frac{5}{512d\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} + \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{2048d\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)} + \frac{5}{512d\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)^2} + \frac{45\sin\left(\frac{1}{2}(c+dx)\right)}{2048d\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}$$

input
```
Integrate[(-3 - 5*Cos[c + d*x])^(-3),x]
```

output
```
(43*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]])/(2048*d) - (43*Log[2*Cos[(
c + d*x)/2] + Sin[(c + d*x)/2]])/(2048*d) - 5/(512*d*(2*Cos[(c + d*x)/2] -
 Sin[(c + d*x)/2])^2) + (45*Sin[(c + d*x)/2])/(2048*d*(2*Cos[(c + d*x)/2]
- Sin[(c + d*x)/2])) + 5/(512*d*(2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2])^2)
 + (45*Sin[(c + d*x)/2])/(2048*d*(2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2]))
```

Rubi [A] (verified)

Time = 0.37 (sec) , antiderivative size = 78, normalized size of antiderivative = 0.68, number of steps used = 9, number of rules used = 8, $\frac{\text{number of rules}}{\text{integrand size}} = 0.667$, Rules used = {3042, 3143, 3042, 3233, 27, 3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(-5\cos(c+dx)-3)^3}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(-5\sin\left(c+dx+\frac{\pi}{2}\right)-3\right)^3}dx$$

$$\Big\downarrow \text{3143}$$

$$\frac{1}{32}\int \frac{6-5\cos(c+dx)}{(5\cos(c+dx)+3)^2}dx-\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\int \frac{6-5\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^2}dx-\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{32}\left(\frac{1}{16}\int -\frac{43}{5\cos(c+dx)+3}dx+\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)-\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{43}{16}\int \frac{1}{5\cos(c+dx)+3}dx\right)-\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{43}{16}\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)+3}dx\right)-\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \text{3138}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{43\int \frac{1}{8-2\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}\right)-\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

$$\Big\downarrow \text{219}$$

$$\frac{1}{32}\left(\frac{45\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{43\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}\right)-\frac{5\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}$$

input
```
Int[(-3 - 5*Cos[c + d*x])^(-3),x]
```

output
```
(-5*Sin[c + d*x])/(32*d*(3 + 5*Cos[c + d*x])^2) + ((-43*ArcTanh[Tan[(c + d
*x)/2]/2])/(32*d) + (45*Sin[c + d*x])/(16*d*(3 + 5*Cos[c + d*x])))/32
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.76 (sec) , antiderivative size = 83, normalized size of antiderivative = 0.72

method	result
norman	$\frac{\frac{35\tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{128d}-\frac{85\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}}{512d}}{\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-4\right)^{2}}+\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{2048d}-\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{2048d}$
derivativedivides	$\frac{-\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)^{2}}-\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}+\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{2048}+\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{2}}-\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-}{d}$
default	$\frac{-\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)^{2}}-\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}+\frac{43\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{2048}+\frac{25}{512\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^{2}}-\frac{85}{1024\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-}{d}$
risch	$\frac{i\left(215\,{\mathrm e}^{3i(dx+c)}+387\,{\mathrm e}^{2i(dx+c)}+325\,{\mathrm e}^{i(dx+c)}+225\right)}{256d\left(5\,{\mathrm e}^{2i(dx+c)}+6\,{\mathrm e}^{i(dx+c)}+5\right)^{2}}-\frac{43\ln\left({\mathrm e}^{i(dx+c)}+\frac{3}{5}+\frac{4i}{5}\right)}{2048d}+\frac{43\ln\left({\mathrm e}^{i(dx+c)}+\frac{3}{5}-\frac{4i}{5}\right)}{2048d}$
parallelrisch	$\frac{(2580\cos(dx+c)+1075\cos(2dx+2c)+1849)\ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)+(-2580\cos(dx+c)-1075\cos(2dx+2c)-1849)\ln\left(\mathrm{ta}\right.}{2048d(43+25\cos(2dx+2c)+60\cos(dx+c))}$

input
```
int(1/(-3-5*cos(d*x+c))^3,x,method=_RETURNVERBOSE)
```

output
```
(35/128/d*tan(1/2*d*x+1/2*c)-85/512/d*tan(1/2*d*x+1/2*c)^3)/(tan(1/2*d*x+1
/2*c)^2-4)^2+43/2048/d*ln(tan(1/2*d*x+1/2*c)-2)-43/2048/d*ln(tan(1/2*d*x+1
/2*c)+2)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 129, normalized size of antiderivative = 1.12

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = -\frac{43\left(25\cos\left(dx+c\right)^{2}+30\cos\left(dx+c\right)+9\right)\log\left(\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+c\right)+\frac{5}{2}\right)-43\left(25\cos\left(dx\right.\right.}{4096\left(25\,d\cos\left(dx+\right.\right.}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^3,x, algorithm="fricas")
```

output
```
-1/4096*(43*(25*cos(d*x + c)^2 + 30*cos(d*x + c) + 9)*log(3/2*cos(d*x + c)
 + 2*sin(d*x + c) + 5/2) - 43*(25*cos(d*x + c)^2 + 30*cos(d*x + c) + 9)*lo
g(3/2*cos(d*x + c) - 2*sin(d*x + c) + 5/2) - 40*(45*cos(d*x + c) + 11)*sin
(d*x + c))/(25*d*cos(d*x + c)^2 + 30*d*cos(d*x + c) + 9*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 478 vs. $2(102) = 204$.

Time = 1.14 (sec) , antiderivative size = 478, normalized size of antiderivative = 4.16

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = \text{Too large to display}$$

input
```
integrate(1/(-3-5*cos(d*x+c))**3,x)
```

output
```
Piecewise((x/(-3 - 5*cos(2*atan(2)))**3, Eq(c, -d*x - 2*atan(2)) | Eq(c, -
d*x + 2*atan(2))), (x/(-5*cos(c) - 3)**3, Eq(d, 0)), (43*log(tan(c/2 + d*x
/2) - 2)*tan(c/2 + d*x/2)**4/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2
 + d*x/2)**2 + 32768*d) - 344*log(tan(c/2 + d*x/2) - 2)*tan(c/2 + d*x/2)**
2/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) + 6
88*log(tan(c/2 + d*x/2) - 2)/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2
 + d*x/2)**2 + 32768*d) - 43*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**4
/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) + 34
4*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**2/(2048*d*tan(c/2 + d*x/2)**
4 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) - 688*log(tan(c/2 + d*x/2) + 2)
/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/2)**2 + 32768*d) - 34
0*tan(c/2 + d*x/2)**3/(2048*d*tan(c/2 + d*x/2)**4 - 16384*d*tan(c/2 + d*x/
2)**2 + 32768*d) + 560*tan(c/2 + d*x/2)/(2048*d*tan(c/2 + d*x/2)**4 - 1638
4*d*tan(c/2 + d*x/2)**2 + 32768*d), True))
```

Maxima [A] (verification not implemented)

Time = 0.03 (sec) , antiderivative size = 135, normalized size of antiderivative = 1.17

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = -\frac{\frac{20\left(\frac{28\sin(dx+c)}{\cos(dx+c)+1}-\frac{17\sin(dx+c)^3}{(\cos(dx+c)+1)^3}\right)}{\frac{8\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{\sin(dx+c)^4}{(\cos(dx+c)+1)^4}-16}+43\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right)-43\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{2048\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^3,x, algorithm="maxima")
```

output
```
-1/2048*(20*(28*sin(d*x + c)/(cos(d*x + c) + 1) - 17*sin(d*x + c)^3/(cos(d
*x + c) + 1)^3)/(8*sin(d*x + c)^2/(cos(d*x + c) + 1)^2 - sin(d*x + c)^4/(c
os(d*x + c) + 1)^4 - 16) + 43*log(sin(d*x + c)/(cos(d*x + c) + 1) + 2) - 4
3*log(sin(d*x + c)/(cos(d*x + c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 78, normalized size of antiderivative = 0.68

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = -\frac{\frac{20\left(17\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^3-28\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)\right)}{\left(\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)^2-4\right)^2}+43\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)+2\right|\right)-43\log\left(\left|\tan\left(\frac{1}{2}\,dx+\frac{1}{2}\,c\right)-2\right|\right)}{2048\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^3,x, algorithm="giac")
```

output
```
-1/2048*(20*(17*tan(1/2*d*x + 1/2*c)^3 - 28*tan(1/2*d*x + 1/2*c))/(tan(1/2
*d*x + 1/2*c)^2 - 4)^2 + 43*log(abs(tan(1/2*d*x + 1/2*c) + 2)) - 43*log(ab
s(tan(1/2*d*x + 1/2*c) - 2)))/d
```

Mupad [B] (verification not implemented)

Time = 45.03 (sec) , antiderivative size = 75, normalized size of antiderivative = 0.65

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = \frac{\frac{35\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{128}-\frac{85\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^3}{512}}{d\left(\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^4-8\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)^2+16\right)} - \frac{43\,\mathrm{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{d\,x}{2}\right)}{2}\right)}{1024\,d}$$

input
```
int(-1/(5*cos(c + d*x) + 3)^3,x)
```

output
```
((35*tan(c/2 + (d*x)/2))/128 - (85*tan(c/2 + (d*x)/2)^3)/512)/(d*(tan(c/2
+ (d*x)/2)^4 - 8*tan(c/2 + (d*x)/2)^2 + 16)) - (43*atanh(tan(c/2 + (d*x)/2
)/2))/(1024*d)
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 186, normalized size of antiderivative = 1.62

$$\int \frac{1}{(-3-5\cos(c+dx))^3}\,dx = \frac{43\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^4-344\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2+688\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right.\right.}{}$$

input
```
int(1/(-3-5*cos(d*x+c))^3,x)
```

output
```
(43*log(tan((c + d*x)/2) - 2)*tan((c + d*x)/2)**4 - 344*log(tan((c + d*x)/
2) - 2)*tan((c + d*x)/2)**2 + 688*log(tan((c + d*x)/2) - 2) - 43*log(tan((
c + d*x)/2) + 2)*tan((c + d*x)/2)**4 + 344*log(tan((c + d*x)/2) + 2)*tan((
c + d*x)/2)**2 - 688*log(tan((c + d*x)/2) + 2) - 340*tan((c + d*x)/2)**3 +
 560*tan((c + d*x)/2))/(2048*d*(tan((c + d*x)/2)**4 - 8*tan((c + d*x)/2)**
2 + 16))
```

3.49 $\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx$

Optimal result

Integrand size = 12, antiderivative size = 140

$$\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx = \frac{279\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} - \frac{279\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)+\sin\left(\frac{1}{2}(c+dx)\right)\right)}{32768d} + \frac{5\sin(c+dx)}{48d(3+5\cos(c+dx))^3} - \frac{25\sin(c+dx)}{512d(3+5\cos(c+dx))^2} + \frac{995\sin(c+dx)}{24576d(3+5\cos(c+dx))}$$

output

```
279/32768*ln(2*cos(1/2*d*x+1/2*c)-sin(1/2*d*x+1/2*c))/d-279/32768*ln(2*cos
(1/2*d*x+1/2*c)+sin(1/2*d*x+1/2*c))/d+5/48*sin(d*x+c)/d/(3+5*cos(d*x+c))^3
-25/512*sin(d*x+c)/d/(3+5*cos(d*x+c))^2+995/24576*sin(d*x+c)/d/(3+5*cos(d*
x+c))
```

Mathematica [B] (verified)

Leaf count is larger than twice the leaf count of optimal. 296 vs. 2(140) = 280.

Time = 0.02 (sec) , antiderivative size = 296, normalized size of antiderivative = 2.11

$$\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx = \frac{467046\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}(c+dx)\right)\right)+104625\cos(3(c+dx))\log\left(2\cos\left(\frac{1}{2}(c+dx)\right)-\sin\left(\frac{1}{2}\right.\right.}{}$$

input
```
Integrate[(-3 - 5*Cos[c + d*x])^(-4),x]
```

output
```
(467046*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] + 104625*Cos[3*(c + d*x
)]*Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] + 765855*Cos[c + d*x]*(Log[2
*Cos[(c + d*x)/2] - Sin[(c + d*x)/2]] - Log[2*Cos[(c + d*x)/2] + Sin[(c +
d*x)/2]]) + 376650*Cos[2*(c + d*x)]*(Log[2*Cos[(c + d*x)/2] - Sin[(c + d*x
)/2]] - Log[2*Cos[(c + d*x)/2] + Sin[(c + d*x)/2]]) - 467046*Log[2*Cos[(c
+ d*x)/2] + Sin[(c + d*x)/2]] - 104625*Cos[3*(c + d*x)]*Log[2*Cos[(c + d*x
)/2] + Sin[(c + d*x)/2]] + 226140*Sin[c + d*x] + 190800*Sin[2*(c + d*x)] +
 99500*Sin[3*(c + d*x)])/(393216*d*(3 + 5*Cos[c + d*x])^3)
```

Rubi [A] (verified)

Time = 0.49 (sec) , antiderivative size = 108, normalized size of antiderivative = 0.77, number of steps used = 13, number of rules used = 12, $\frac{\text{number of rules}}{\text{integrand size}} = 1.000$, Rules used = {3042, 3143, 25, 3042, 3233, 25, 3042, 3233, 27, 3042, 3138, 219}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(-5\cos(c+dx)-3)^4}\,dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \frac{1}{\left(-5\sin\left(c+dx+\frac{\pi}{2}\right)-3\right)^4}dx$$

$$\Big\downarrow \text{ 3143}$$

$$\frac{1}{48}\int -\frac{9-10\cos(c+dx)}{(5\cos(c+dx)+3)^3}dx+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{25}$$

$$\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}-\frac{1}{48}\int \frac{9-10\cos(c+dx)}{(5\cos(c+dx)+3)^3}dx$$

$$\Big\downarrow \text{3042}$$

$$\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}-\frac{1}{48}\int \frac{9-10\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^3}dx$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{48}\left(-\frac{1}{32}\int -\frac{154-75\cos(c+dx)}{(5\cos(c+dx)+3)^2}dx-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{25}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{154-75\cos(c+dx)}{(5\cos(c+dx)+3)^2}dx-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\int \frac{154-75\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(5\sin\left(c+dx+\frac{\pi}{2}\right)+3\right)^2}dx-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{3233}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{1}{16}\int -\frac{837}{5\cos(c+dx)+3}dx+\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837}{16}\int \frac{1}{5\cos(c+dx)+3}dx\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837}{16}\int \frac{1}{5\sin\left(c+dx+\frac{\pi}{2}\right)+3}dx\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{3138}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837\int\frac{1}{8-2\tan^2\left(\frac{1}{2}(c+dx)\right)}d\tan\left(\frac{1}{2}(c+dx)\right)}{8d}\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

$$\Big\downarrow \text{219}$$

$$\frac{1}{48}\left(\frac{1}{32}\left(\frac{995\sin(c+dx)}{16d(5\cos(c+dx)+3)}-\frac{837\text{arctanh}\left(\frac{1}{2}\tan\left(\frac{1}{2}(c+dx)\right)\right)}{32d}\right)-\frac{75\sin(c+dx)}{32d(5\cos(c+dx)+3)^2}\right)+\frac{5\sin(c+dx)}{48d(5\cos(c+dx)+3)^3}$$

input
```
Int[(-3 - 5*Cos[c + d*x])^(-4),x]
```

output
```
(5*Sin[c + d*x])/(48*d*(3 + 5*Cos[c + d*x])^3) + ((-75*Sin[c + d*x])/(32*d
*(3 + 5*Cos[c + d*x])^2) + ((-837*ArcTanh[Tan[(c + d*x)/2]/2])/(32*d) + (9
95*Sin[c + d*x])/(16*d*(3 + 5*Cos[c + d*x])))/32)/48
```

Defintions of rubi rules used

rule 25
```
Int[-(Fx_), x_Symbol] :> Simp[Identity[-1]   Int[Fx, x], x]
```

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 219
```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1/(Rt[a, 2]*Rt[-b, 2]))*
ArcTanh[Rt[-b, 2]*(x/Rt[a, 2])], x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt
Q[a, 0] || LtQ[b, 0])
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3138
```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] :> With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Simp[2*(e/d)   Subst[Int[1/(a + b +
(a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
 && NeQ[a^2 - b^2, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [A] (verified)

Time = 0.61 (sec) , antiderivative size = 99, normalized size of antiderivative = 0.71

method	result
norman	$\frac{-\frac{295 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)}{512d}+\frac{265 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^3}{768d}-\frac{745 \tan\left(\frac{dx}{2}+\frac{c}{2}\right)^5}{8192d}}{\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)^2-4\right)^3}+\frac{279 \ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)}{32768d}-\frac{279 \ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{32768d}$
derivativedivides	$\frac{-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^3}+\frac{175}{4096\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^2}-\frac{745}{16384\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{279 \ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{32768}-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right.}}{d}$
default	$\frac{-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^3}+\frac{175}{4096\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)^2}-\frac{745}{16384\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}-\frac{279 \ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)+2\right)}{32768}-\frac{125}{6144\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right.}}{d}$
risch	$\frac{i\left(20925 e^{5i(dx+c)}+62775 e^{4i(dx+c)}+111042 e^{3i(dx+c)}+119310 e^{2i(dx+c)}+68625 e^{i(dx+c)}+24875\right)}{12288d\left(5 e^{2i(dx+c)}+6 e^{i(dx+c)}+5\right)^3}-\frac{279 \ln\left(e^{i(dx+c)}\right.}{32768d}$
parallelrisch	$\frac{(765855 \cos(dx+c)+376650 \cos(2dx+2c)+104625 \cos(3dx+3c)+467046) \ln\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)+(-765855 \cos(dx+c)-}{98304d(558+125 \cos(3d}$

input
```
int(1/(-3-5*cos(d*x+c))^4,x,method=_RETURNVERBOSE)
```

output
```
(-295/512/d*tan(1/2*d*x+1/2*c)+265/768/d*tan(1/2*d*x+1/2*c)^3-745/8192/d*t
an(1/2*d*x+1/2*c)^5)/(tan(1/2*d*x+1/2*c)^2-4)^3+279/32768/d*ln(tan(1/2*d*x
+1/2*c)-2)-279/32768/d*ln(tan(1/2*d*x+1/2*c)+2)
```

Fricas [A] (verification not implemented)

Time = 0.08 (sec) , antiderivative size = 170, normalized size of antiderivative = 1.21

$$\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx = -\frac{837\left(125\cos\left(dx+c\right)^3+225\cos\left(dx+c\right)^2+135\cos\left(dx+c\right)+27\right)\log\left(\frac{3}{2}\cos\left(dx+c\right)+2\sin\left(dx+\right.\right.}{}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^4,x, algorithm="fricas")
```

output
```
-1/196608*(837*(125*cos(d*x + c)^3 + 225*cos(d*x + c)^2 + 135*cos(d*x + c)
 + 27)*log(3/2*cos(d*x + c) + 2*sin(d*x + c) + 5/2) - 837*(125*cos(d*x + c
)^3 + 225*cos(d*x + c)^2 + 135*cos(d*x + c) + 27)*log(3/2*cos(d*x + c) - 2
*sin(d*x + c) + 5/2) - 40*(4975*cos(d*x + c)^2 + 4770*cos(d*x + c) + 1583)
*sin(d*x + c))/(125*d*cos(d*x + c)^3 + 225*d*cos(d*x + c)^2 + 135*d*cos(d*
x + c) + 27*d)
```

Sympy [B] (verification not implemented)

Leaf count of result is larger than twice the leaf count of optimal. 816 vs. 2(126) = 252.

Time = 2.34 (sec) , antiderivative size = 816, normalized size of antiderivative = 5.83

$$\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx = \text{Too large to display}$$

input
```
integrate(1/(-3-5*cos(d*x+c))**4,x)
```

output
```
Piecewise((x/(-3 - 5*cos(2*atan(2)))**4, Eq(c, -d*x - 2*atan(2)) | Eq(c, -
d*x + 2*atan(2))), (x/(-5*cos(c) - 3)**4, Eq(d, 0)), (837*log(tan(c/2 + d*
x/2) - 2)*tan(c/2 + d*x/2)**6/(98304*d*tan(c/2 + d*x/2)**6 - 1179648*d*tan
(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 - 6291456*d) - 10044*log(
tan(c/2 + d*x/2) - 2)*tan(c/2 + d*x/2)**4/(98304*d*tan(c/2 + d*x/2)**6 - 1
179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 - 6291456*d)
+ 40176*log(tan(c/2 + d*x/2) - 2)*tan(c/2 + d*x/2)**2/(98304*d*tan(c/2 + d
*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 -
 6291456*d) - 53568*log(tan(c/2 + d*x/2) - 2)/(98304*d*tan(c/2 + d*x/2)**6
 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2 - 6291456
*d) - 837*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**6/(98304*d*tan(c/2 +
 d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2)**2
 - 6291456*d) + 10044*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/2)**4/(98304
*d*tan(c/2 + d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2
 + d*x/2)**2 - 6291456*d) - 40176*log(tan(c/2 + d*x/2) + 2)*tan(c/2 + d*x/
2)**2/(98304*d*tan(c/2 + d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 47185
92*d*tan(c/2 + d*x/2)**2 - 6291456*d) + 53568*log(tan(c/2 + d*x/2) + 2)/(9
8304*d*tan(c/2 + d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan
(c/2 + d*x/2)**2 - 6291456*d) - 8940*tan(c/2 + d*x/2)**5/(98304*d*tan(c/2
+ d*x/2)**6 - 1179648*d*tan(c/2 + d*x/2)**4 + 4718592*d*tan(c/2 + d*x/2...
```

Maxima [A] (verification not implemented)

Time = 0.04 (sec) , antiderivative size = 174, normalized size of antiderivative = 1.24

$$\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(\frac{2832\sin(dx+c)}{\cos(dx+c)+1}-\frac{1696\sin(dx+c)^3}{(\cos(dx+c)+1)^3}+\frac{447\sin(dx+c)^5}{(\cos(dx+c)+1)^5}\right)}{\frac{48\sin(dx+c)^2}{(\cos(dx+c)+1)^2}-\frac{12\sin(dx+c)^4}{(\cos(dx+c)+1)^4}+\frac{\sin(dx+c)^6}{(\cos(dx+c)+1)^6}-64}+837\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}+2\right)-837\log\left(\frac{\sin(dx+c)}{\cos(dx+c)+1}-2\right)}{98304\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^4,x, algorithm="maxima")
```

output
```
-1/98304*(20*(2832*sin(d*x + c)/(cos(d*x + c) + 1) - 1696*sin(d*x + c)^3/(
cos(d*x + c) + 1)^3 + 447*sin(d*x + c)^5/(cos(d*x + c) + 1)^5)/(48*sin(d*x
 + c)^2/(cos(d*x + c) + 1)^2 - 12*sin(d*x + c)^4/(cos(d*x + c) + 1)^4 + si
n(d*x + c)^6/(cos(d*x + c) + 1)^6 - 64) + 837*log(sin(d*x + c)/(cos(d*x +
c) + 1) + 2) - 837*log(sin(d*x + c)/(cos(d*x + c) + 1) - 2))/d
```

Giac [A] (verification not implemented)

Time = 0.12 (sec) , antiderivative size = 91, normalized size of antiderivative = 0.65

$$\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx = -\frac{\frac{20\left(447\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^5-1696\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^3+2832\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)\right)}{\left(\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)^2-4\right)^3}+837\log\left(\left|\tan\left(\frac{1}{2}dx+\frac{1}{2}c\right)+2\right|\right)-837\log\left(\left|\mathrm{t}\right.\right.}{98304\,d}$$

input
```
integrate(1/(-3-5*cos(d*x+c))^4,x, algorithm="giac")
```

output
```
-1/98304*(20*(447*tan(1/2*d*x + 1/2*c)^5 - 1696*tan(1/2*d*x + 1/2*c)^3 + 2
832*tan(1/2*d*x + 1/2*c))/(tan(1/2*d*x + 1/2*c)^2 - 4)^3 + 837*log(abs(tan
(1/2*d*x + 1/2*c) + 2)) - 837*log(abs(tan(1/2*d*x + 1/2*c) - 2)))/d
```

Mupad [B] (verification not implemented)

Time = 0.00 (sec) , antiderivative size = 102, normalized size of antiderivative = 0.73

$$\begin{aligned}\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx &= -\frac{279\,\mathrm{atanh}\left(\frac{\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{2}\right)}{16384\,d} \\ &\quad -\frac{\frac{745\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^5}{8192}-\frac{265\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^3}{768}+\frac{295\tan\left(\frac{c}{2}+\frac{dx}{2}\right)}{512}}{d\left(\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^6-12\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^4+48\tan\left(\frac{c}{2}+\frac{dx}{2}\right)^2-64\right)}\end{aligned}$$

input
```
int(1/(5*cos(c + d*x) + 3)^4,x)
```

output
```
- (279*atanh(tan(c/2 + (d*x)/2)/2))/(16384*d) - ((295*tan(c/2 + (d*x)/2))/
512 - (265*tan(c/2 + (d*x)/2)^3)/768 + (745*tan(c/2 + (d*x)/2)^5)/8192)/(d
*(48*tan(c/2 + (d*x)/2)^2 - 12*tan(c/2 + (d*x)/2)^4 + tan(c/2 + (d*x)/2)^6
 - 64))
```

Reduce [B] (verification not implemented)

Time = 0.17 (sec) , antiderivative size = 244, normalized size of antiderivative = 1.74

$$\int \frac{1}{(-3-5\cos(c+dx))^4}\,dx = \frac{104625\cos(dx+c)\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)\sin(dx+c)^2-217620\cos(dx+c)\log\left(\tan\left(\frac{dx}{2}+\frac{c}{2}\right)-2\right)-1}{}$$

input
```
int(1/(-3-5*cos(d*x+c))^4,x)
```

output
```
(104625*cos(c + d*x)*log(tan((c + d*x)/2) - 2)*sin(c + d*x)**2 - 217620*co
s(c + d*x)*log(tan((c + d*x)/2) - 2) - 104625*cos(c + d*x)*log(tan((c + d*
x)/2) + 2)*sin(c + d*x)**2 + 217620*cos(c + d*x)*log(tan((c + d*x)/2) + 2)
 - 95400*cos(c + d*x)*sin(c + d*x) + 188325*log(tan((c + d*x)/2) - 2)*sin(
c + d*x)**2 - 210924*log(tan((c + d*x)/2) - 2) - 188325*log(tan((c + d*x)/
2) + 2)*sin(c + d*x)**2 + 210924*log(tan((c + d*x)/2) + 2) + 99500*sin(c +
 d*x)**3 - 131160*sin(c + d*x))/(98304*d*(125*cos(c + d*x)*sin(c + d*x)**2
 - 260*cos(c + d*x) + 225*sin(c + d*x)**2 - 252))
```

3.50 $\int (a+b\cos(c+dx))^{5/2}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 197

$$\int (a+b\cos(c+dx))^{5/2}\,dx = \frac{2(23a^2+9b^2)\sqrt{a+b\cos(c+dx)}\,E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{15d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}} - \frac{16a(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{15d\sqrt{a+b\cos(c+dx)}} + \frac{16ab\sqrt{a+b\cos(c+dx)}\sin(c+dx)}{15d} + \frac{2b(a+b\cos(c+dx))^{3/2}\sin(c+dx)}{5d}$$

output
```
2/15*(23*a^2+9*b^2)*(a+b*cos(d*x+c))^(1/2)*EllipticE(sin(1/2*d*x+1/2*c),2^
(1/2)*(b/(a+b))^(1/2))/d/((a+b*cos(d*x+c))/(a+b))^(1/2)-16/15*a*(a^2-b^2)*
((a+b*cos(d*x+c))/(a+b))^(1/2)*InverseJacobiAM(1/2*d*x+1/2*c,2^(1/2)*(b/(a
+b))^(1/2))/d/(a+b*cos(d*x+c))^(1/2)+16/15*a*b*(a+b*cos(d*x+c))^(1/2)*sin(
d*x+c)/d+2/5*b*(a+b*cos(d*x+c))^(3/2)*sin(d*x+c)/d
```

Mathematica [A] (verified)

Time = 1.01 (sec) , antiderivative size = 177, normalized size of antiderivative = 0.90

$$\int (a+b\cos(c+dx))^{5/2}\,dx = \frac{2(23a^3+23a^2b+9ab^2+9b^3)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)-16a(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\mathrm{I}}{15d\sqrt{a+l}}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(5/2),x]
```

output
```
(2*(23*a^3 + 23*a^2*b + 9*a*b^2 + 9*b^3)*Sqrt[(a + b*Cos[c + d*x])/(a + b)
]*EllipticE[(c + d*x)/2, (2*b)/(a + b)] - 16*a*(a^2 - b^2)*Sqrt[(a + b*Cos
[c + d*x])/(a + b)]*EllipticF[(c + d*x)/2, (2*b)/(a + b)] + b*(22*a^2 + 3*
b^2 + 28*a*b*Cos[c + d*x] + 3*b^2*Cos[2*(c + d*x)])*Sin[c + d*x])/(15*d*Sq
rt[a + b*Cos[c + d*x]])
```

Rubi [A] (verified)

Time = 1.07 (sec) , antiderivative size = 203, normalized size of antiderivative = 1.03, number of steps used = 15, number of rules used = 15, $\frac{\text{number of rules}}{\text{integrand size}} = 1.071$, Rules used = {3042, 3135, 27, 3042, 3232, 27, 3042, 3231, 3042, 3134, 3042, 3132, 3142, 3042, 3140}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a+b\cos(c+dx))^{5/2}\,dx$$

$$\Big\downarrow \; 3042$$

$$\int \left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{5/2}dx$$

$$\Big\downarrow \; 3135$$

$$\frac{2}{5}\int \frac{1}{2}\sqrt{a+b\cos(c+dx)}\left(5a^2+8b\cos(c+dx)a+3b^2\right)dx+\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{5}\int \sqrt{a+b\cos(c+dx)}\left(5a^2+8b\cos(c+dx)a+3b^2\right)dx+\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{5}\int \sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}\left(5a^2+8b\sin\left(c+dx+\frac{\pi}{2}\right)a+3b^2\right)dx+\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$$\Big\downarrow \text{3232}$$

$$\frac{1}{5}\left(\frac{2}{3}\int \frac{a\left(15a^2+17b^2\right)+b\left(23a^2+9b^2\right)\cos(c+dx)}{2\sqrt{a+b\cos(c+dx)}}dx+\frac{16ab\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}\right)+\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{5}\left(\frac{1}{3}\int \frac{a\left(15a^2+17b^2\right)+b\left(23a^2+9b^2\right)\cos(c+dx)}{\sqrt{a+b\cos(c+dx)}}dx+\frac{16ab\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}\right)+\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{5}\left(\frac{1}{3}\int \frac{a\left(15a^2+17b^2\right)+b\left(23a^2+9b^2\right)\sin\left(c+dx+\frac{\pi}{2}\right)}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx+\frac{16ab\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}\right)+\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$$\Big\downarrow \text{3231}$$

$$\frac{1}{5}\left(\frac{1}{3}\left(\left(23a^2+9b^2\right)\int \sqrt{a+b\cos(c+dx)}dx-8a\left(a^2-b^2\right)\int \frac{1}{\sqrt{a+b\cos(c+dx)}}dx\right)+\frac{16ab\sin(c+dx)\sqrt{a+}}{3d}\right.$$
$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$\downarrow$ 3042

$$\frac{1}{5}\left(\frac{1}{3}\left(\left(23a^2+9b^2\right)\int\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}dx-8a\left(a^2-b^2\right)\int\frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right)+\frac{16ab\sin(c$$
$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$\downarrow$ 3134

$$\frac{1}{5}\left(\frac{1}{3}\left(\frac{\left(23a^2+9b^2\right)\sqrt{a+b\cos(c+dx)}\int\sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-8a\left(a^2-b^2\right)\int\frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right)\right.$$
$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$\downarrow$ 3042

$$\frac{1}{5}\left(\frac{1}{3}\left(\frac{\left(23a^2+9b^2\right)\sqrt{a+b\cos(c+dx)}\int\sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-8a\left(a^2-b^2\right)\int\frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right.\right.$$
$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$\downarrow$ 3132

$$\frac{1}{5}\left(\frac{1}{3}\left(\frac{2\left(23a^2+9b^2\right)\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-8a\left(a^2-b^2\right)\int\frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right)+\frac{1}{}\right.$$
$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$\downarrow$ 3142

$$\frac{1}{5}\left(\frac{1}{3}\left(\frac{2\left(23a^2+9b^2\right)\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{8a\left(a^2-b^2\right)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int\frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}}dx}{\sqrt{a+b\cos(c+dx)}}\right)\right.$$
$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$\downarrow$ 3042

$$\frac{1}{5}\left(\frac{1}{3}\left(\frac{2(23a^2+9b^2)\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{8a(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int\frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}}d}{\sqrt{a+b\cos(c+dx)}}\right.\right.$$

$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

$$\Big\downarrow \text{3140}$$

$$\frac{1}{5}\left(\frac{1}{3}\left(\frac{2(23a^2+9b^2)\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{16a(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\text{EllipticF}\left(\frac{1}{2}(c+dx)\right.}{d\sqrt{a+b\cos(c+dx)}}\right.\right.$$

$$\frac{2b\sin(c+dx)(a+b\cos(c+dx))^{3/2}}{5d}$$

input
```
Int[(a + b*Cos[c + d*x])^(5/2),x]
```

output
```
(2*b*(a + b*Cos[c + d*x])^(3/2)*Sin[c + d*x])/(5*d) + (((2*(23*a^2 + 9*b^2
)*Sqrt[a + b*Cos[c + d*x]]*EllipticE[(c + d*x)/2, (2*b)/(a + b)])/(d*Sqrt[
(a + b*Cos[c + d*x])/(a + b)]) - (16*a*(a^2 - b^2)*Sqrt[(a + b*Cos[c + d*x
])/(a + b)]*EllipticF[(c + d*x)/2, (2*b)/(a + b)])/(d*Sqrt[a + b*Cos[c + d
*x]]))/3 + (16*a*b*Sqrt[a + b*Cos[c + d*x]]*Sin[c + d*x])/(3*d))/5
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3132
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[2*(Sqrt[a
 + b]/d)*EllipticE[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[{a,
b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3134
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[a +
b*Sin[c + d*x]]/Sqrt[(a + b*Sin[c + d*x])/(a + b)]   Int[Sqrt[a/(a + b) + (
b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2
, 0] &&  !GtQ[a + b, 0]
```

rule 3135
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n - 1)/(d*n)), x] + Simp[1/n   Int[(a + b*
Sin[c + d*x])^(n - 2)*Simp[a^2*n + b^2*(n - 1) + a*b*(2*n - 1)*Sin[c + d*x]
, x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[n, 1] &&
 IntegerQ[2*n]
```

rule 3140
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[(2/(d*S
qrt[a + b]))*EllipticF[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[
{a, b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3142
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[(a
 + b*Sin[c + d*x])/(a + b)]/Sqrt[a + b*Sin[c + d*x]]   Int[1/Sqrt[a/(a + b)
 + (b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] &&  !GtQ[a + b, 0]
```

rule 3231
```
Int[((c_.) + (d_.)*sin[(e_.) + (f_.)*(x_)])/Sqrt[(a_) + (b_.)*sin[(e_.) + (
f_.)*(x_)]], x_Symbol] :> Simp[(b*c - a*d)/b   Int[1/Sqrt[a + b*Sin[e + f*x
]], x], x] + Simp[d/b   Int[Sqrt[a + b*Sin[e + f*x]], x], x] /; FreeQ[{a, b
, c, d, e, f}, x] && NeQ[b*c - a*d, 0] && NeQ[a^2 - b^2, 0]
```

rule 3232
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-d)*Cos[e + f*x]*((a + b*Sin[e + f*x])^m/(
f*(m + 1))), x] + Simp[1/(m + 1)   Int[(a + b*Sin[e + f*x])^(m - 1)*Simp[b*
d*m + a*c*(m + 1) + (a*d*m + b*c*(m + 1))*Sin[e + f*x], x], x], x] /; FreeQ
[{a, b, c, d, e, f}, x] && NeQ[b*c - a*d, 0] && NeQ[a^2 - b^2, 0] && GtQ[m,
 0] && IntegerQ[2*m]
```

Maple [B] (verified)

Leaf count of result is larger than twice the leaf count of optimal. 661 vs. $2(186) = 372$.

Time = 8.38 (sec) , antiderivative size = 662, normalized size of antiderivative = 3.36

method	result
default	$-\frac{2\sqrt{\left(2b\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+a-b\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\,\left(24\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{7}b^{3}+56\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}a\,b^{2}-48\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{5}b^{3}+22\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{3}a^{2}b\right.}{}$

input
```
int((a+cos(d*x+c)*b)^(5/2),x,method=_RETURNVERBOSE)
```

output
```
-2/15*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)*sin(1/2*d*x+1/2*c)^2)^(1/2)*(24*cos(
1/2*d*x+1/2*c)^7*b^3+56*cos(1/2*d*x+1/2*c)^5*a*b^2-48*cos(1/2*d*x+1/2*c)^5
*b^3+22*cos(1/2*d*x+1/2*c)^3*a^2*b-84*cos(1/2*d*x+1/2*c)^3*a*b^2+30*cos(1/
2*d*x+1/2*c)^3*b^3-8*a^3*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/
2*c)^2+a-b)/(a-b))^(1/2)*EllipticF(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))+
8*b^2*a*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b)
)^(1/2)*EllipticF(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))+23*(sin(1/2*d*x+1
/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b))^(1/2)*EllipticE(cos(
1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))*a^3-23*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2
*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b))^(1/2)*EllipticE(cos(1/2*d*x+1/2*c),(-2
*b/(a-b))^(1/2))*a^2*b+9*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/
2*c)^2+a-b)/(a-b))^(1/2)*EllipticE(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))*
a*b^2-9*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b)
)^(1/2)*EllipticE(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))*b^3-22*cos(1/2*d*
x+1/2*c)*a^2*b+28*cos(1/2*d*x+1/2*c)*a*b^2-6*cos(1/2*d*x+1/2*c)*b^3)/(-2*b
*sin(1/2*d*x+1/2*c)^4+(a+b)*sin(1/2*d*x+1/2*c)^2)^(1/2)/sin(1/2*d*x+1/2*c)
/(-2*sin(1/2*d*x+1/2*c)^2*b+a+b)^(1/2)/d
```

Fricas [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.10 (sec) , antiderivative size = 437, normalized size of antiderivative = 2.22

$$\int (a+b\cos(c+dx))^{5/2}\,dx =$$

$$-\frac{2\left(\sqrt{\frac{1}{2}}(-i\,a^3+33i\,ab^2)\sqrt{b}\text{weierstrassPInverse}\left(\frac{4\,(4\,a^2-3\,b^2)}{3\,b^2},-\frac{8\,(8\,a^3-9\,ab^2)}{27\,b^3},\frac{3\,b\cos(dx+c)+3i\,b\sin(dx+c)+2\,a}{3\,b}\right)+\sqrt{\ldots}\right.}{}$$

input
```
integrate((a+b*cos(d*x+c))^(5/2),x, algorithm="fricas")
```

output
```
-2/45*(sqrt(1/2)*(-I*a^3 + 33*I*a*b^2)*sqrt(b)*weierstrassPInverse(4/3*(4*
a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I
*b*sin(d*x + c) + 2*a)/b) + sqrt(1/2)*(I*a^3 - 33*I*a*b^2)*sqrt(b)*weierst
rassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*
b*cos(d*x + c) - 3*I*b*sin(d*x + c) + 2*a)/b) + 3*sqrt(1/2)*(-23*I*a^2*b -
 9*I*b^3)*sqrt(b)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 -
9*a*b^2)/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 -
9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) + 2*a)/b)) + 3*sq
rt(1/2)*(23*I*a^2*b + 9*I*b^3)*sqrt(b)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)
/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)
/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d*x +
 c) + 2*a)/b)) - 3*(3*b^3*cos(d*x + c) + 11*a*b^2)*sqrt(b*cos(d*x + c) + a
)*sin(d*x + c))/(b*d)
```

Sympy [F]

$$\int (a+b\cos(c+dx))^{5/2}\,dx = \int (a+b\cos{(c+dx)})^{\frac{5}{2}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))**(5/2),x)
```

output
```
Integral((a + b*cos(c + d*x))**(5/2), x)
```

Maxima [F]

$$\int (a+b\cos(c+dx))^{5/2}\,dx = \int (b\cos(dx+c)+a)^{\frac{5}{2}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(5/2),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(5/2), x)
```

Giac [F]

$$\int (a+b\cos(c+dx))^{5/2}\,dx = \int (b\cos(dx+c)+a)^{\frac{5}{2}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(5/2),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(5/2), x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+b\cos(c+dx))^{5/2}\,dx = \int (a+b\,\cos(c+d\,x))^{5/2}\,dx$$

input
```
int((a + b*cos(c + d*x))^(5/2),x)
```

output
```
int((a + b*cos(c + d*x))^(5/2), x)
```

Reduce [F]

$$
\int (a+b\cos(c+dx))^{5/2}\,dx = \left(\int \sqrt{\cos(dx+c)\,b+a}dx\right)a^2 + 2\left(\int \sqrt{\cos(dx+c)\,b+a}\,\cos(dx+c)\,dx\right)ab + \left(\int \sqrt{\cos(dx+c)\,b+a}\,\cos(dx+c)^2\,dx\right)b^2
$$

input

```
int((a+b*cos(d*x+c))^(5/2),x)
```

output

```
int(sqrt(cos(c + d*x)*b + a),x)*a**2 + 2*int(sqrt(cos(c + d*x)*b + a)*cos(
c + d*x),x)*a*b + int(sqrt(cos(c + d*x)*b + a)*cos(c + d*x)**2,x)*b**2
```

3.51 $\int (a+b\cos(c+dx))^{3/2}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 157

$$\int (a+b\cos(c+dx))^{3/2}\,dx = \frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{3d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}} - \frac{2(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{3d\sqrt{a+b\cos(c+dx)}} + \frac{2b\sqrt{a+b\cos(c+dx)}\sin(c+dx)}{3d}$$

output
```
8/3*a*(a+b*cos(d*x+c))^(1/2)*EllipticE(sin(1/2*d*x+1/2*c),2^(1/2)*(b/(a+b)
)^(1/2))/d/((a+b*cos(d*x+c))/(a+b))^(1/2)-2/3*(a^2-b^2)*((a+b*cos(d*x+c))/
(a+b))^(1/2)*InverseJacobiAM(1/2*d*x+1/2*c,2^(1/2)*(b/(a+b))^(1/2))/d/(a+b
*cos(d*x+c))^(1/2)+2/3*b*(a+b*cos(d*x+c))^(1/2)*sin(d*x+c)/d
```

Mathematica [A] (verified)

Time = 0.66 (sec) , antiderivative size = 134, normalized size of antiderivative = 0.85

$$\int (a+b\cos(c+dx))^{3/2}\,dx = \frac{8a(a+b)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)-2(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2}{a+}\right.}{3d\sqrt{a+b\cos(c+dx)}}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(3/2),x]
```

output
```
(8*a*(a + b)*Sqrt[(a + b*Cos[c + d*x])/(a + b)]*EllipticE[(c + d*x)/2, (2*
b)/(a + b)] - 2*(a^2 - b^2)*Sqrt[(a + b*Cos[c + d*x])/(a + b)]*EllipticF[(
c + d*x)/2, (2*b)/(a + b)] + 2*b*(a + b*Cos[c + d*x])*Sin[c + d*x])/(3*d*S
qrt[a + b*Cos[c + d*x]])
```

Rubi [A] (verified)

Time = 0.78 (sec) , antiderivative size = 158, normalized size of antiderivative = 1.01, number of steps used = 12, number of rules used = 12, $\frac{\text{number of rules}}{\text{integrand size}} = 0.857$, Rules used = {3042, 3135, 27, 3042, 3231, 3042, 3134, 3042, 3132, 3142, 3042, 3140}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a+b\cos(c+dx))^{3/2}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{3/2}dx$$

$$\Big\downarrow \text{3135}$$

$$\frac{2}{3}\int \frac{3a^2+4b\cos(c+dx)a+b^2}{2\sqrt{a+b\cos(c+dx)}}dx+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \text{27}$$

$$\frac{1}{3}\int \frac{3a^2+4b\cos(c+dx)a+b^2}{\sqrt{a+b\cos(c+dx)}}dx+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \ \textbf{3042}$$

$$\frac{1}{3}\int \frac{3a^2+4b\sin\left(c+dx+\frac{\pi}{2}\right)a+b^2}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \ \textbf{3231}$$

$$\frac{1}{3}\left(4a\int \sqrt{a+b\cos(c+dx)}dx-\left(a^2-b^2\right)\int \frac{1}{\sqrt{a+b\cos(c+dx)}}dx\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \ \textbf{3042}$$

$$\frac{1}{3}\left(4a\int \sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}dx-\left(a^2-b^2\right)\int \frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \ \textbf{3134}$$

$$\frac{1}{3}\left(\frac{4a\sqrt{a+b\cos(c+dx)}\int \sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\left(a^2-b^2\right)\int \frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \ \textbf{3042}$$

$$\frac{1}{3}\left(\frac{4a\sqrt{a+b\cos(c+dx)}\int \sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\left(a^2-b^2\right)\int \frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \ \textbf{3132}$$

$$\frac{1}{3}\left(\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\left(a^2-b^2\right)\int \frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \text{3142}$$

$$\frac{1}{3}\left(\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int\frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}}dx}{\sqrt{a+b\cos(c+dx)}}\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \text{3042}$$

$$\frac{1}{3}\left(\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int\frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}}dx}{\sqrt{a+b\cos(c+dx)}}\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

$$\Big\downarrow \text{3140}$$

$$\frac{1}{3}\left(\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{2(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{d\sqrt{a+b\cos(c+dx)}}\right)+\frac{2b\sin(c+dx)\sqrt{a+b\cos(c+dx)}}{3d}$$

input
```
Int[(a + b*Cos[c + d*x])^(3/2),x]
```

output
```
((8*a*Sqrt[a + b*Cos[c + d*x]]*EllipticE[(c + d*x)/2, (2*b)/(a + b)])/(d*S
qrt[(a + b*Cos[c + d*x])/(a + b)]) - (2*(a^2 - b^2)*Sqrt[(a + b*Cos[c + d*
x])/(a + b)]*EllipticF[(c + d*x)/2, (2*b)/(a + b)])/(d*Sqrt[a + b*Cos[c +
d*x]]))/3 + (2*b*Sqrt[a + b*Cos[c + d*x]]*Sin[c + d*x])/(3*d)
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3132
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[2*(Sqrt[a
 + b]/d)*EllipticE[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[{a,
b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3134
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[a +
b*Sin[c + d*x]]/Sqrt[(a + b*Sin[c + d*x])/(a + b)]   Int[Sqrt[a/(a + b) + (
b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2
, 0] &&  !GtQ[a + b, 0]
```

rule 3135
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n - 1)/(d*n)), x] + Simp[1/n   Int[(a + b*
Sin[c + d*x])^(n - 2)*Simp[a^2*n + b^2*(n - 1) + a*b*(2*n - 1)*Sin[c + d*x]
, x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[n, 1] &&
 IntegerQ[2*n]
```

rule 3140
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[(2/(d*S
qrt[a + b]))*EllipticF[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[
{a, b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3142
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[(a
 + b*Sin[c + d*x])/(a + b)]/Sqrt[a + b*Sin[c + d*x]]   Int[1/Sqrt[a/(a + b)
 + (b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] &&  !GtQ[a + b, 0]
```

rule 3231
```
Int[((c_.) + (d_.)*sin[(e_.) + (f_.)*(x_)])/Sqrt[(a_) + (b_.)*sin[(e_.) + (
f_.)*(x_)]], x_Symbol] :> Simp[(b*c - a*d)/b   Int[1/Sqrt[a + b*Sin[e + f*x
]], x], x] + Simp[d/b   Int[Sqrt[a + b*Sin[e + f*x]], x], x] /; FreeQ[{a, b
, c, d, e, f}, x] && NeQ[b*c - a*d, 0] && NeQ[a^2 - b^2, 0]
```

Maple [B] (verified)

Leaf count of result is larger than twice the leaf count of optimal. 449 vs. $2(150) = 300$.

Time = 4.73 (sec) , antiderivative size = 450, normalized size of antiderivative = 2.87

method	result
default	$-\frac{2\sqrt{\left(2b\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2+a-b\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^2}\left(4\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^5b^2+2\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^3ab-6\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^3b^2-a^2\sqrt{\frac{1}{2}-\frac{\cos(dx+c)}{2}}\sqrt{\frac{2b\cos \cdots}{}}\right.}{}$

input
```
int((a+cos(d*x+c)*b)^(3/2),x,method=_RETURNVERBOSE)
```

output
```
-2/3*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)*sin(1/2*d*x+1/2*c)^2)^(1/2)*(4*cos(1/
2*d*x+1/2*c)^5*b^2+2*cos(1/2*d*x+1/2*c)^3*a*b-6*cos(1/2*d*x+1/2*c)^3*b^2-a
^2*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b))^(1/
2)*EllipticF(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))+b^2*(sin(1/2*d*x+1/2*c
)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b))^(1/2)*EllipticF(cos(1/2*
d*x+1/2*c),(-2*b/(a-b))^(1/2))+4*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/
2*d*x+1/2*c)^2+a-b)/(a-b))^(1/2)*EllipticE(cos(1/2*d*x+1/2*c),(-2*b/(a-b))
^(1/2))*a^2-4*(sin(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)
/(a-b))^(1/2)*EllipticE(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))*a*b-2*cos(1
/2*d*x+1/2*c)*a*b+2*cos(1/2*d*x+1/2*c)*b^2)/(-2*b*sin(1/2*d*x+1/2*c)^4+(a+
b)*sin(1/2*d*x+1/2*c)^2)^(1/2)/sin(1/2*d*x+1/2*c)/(-2*sin(1/2*d*x+1/2*c)^2
*b+a+b)^(1/2)/d
```

Fricas [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.11 (sec) , antiderivative size = 398, normalized size of antiderivative = 2.54

$$\int (a + b\cos(c + dx))^{3/2}\, dx =$$

$$-\frac{2\left(-12i\sqrt{\frac{1}{2}}ab^{\frac{3}{2}}\text{weierstrassZeta}\left(\frac{4\,(4\,a^2-3\,b^2)}{3\,b^2}, -\frac{8\,(8\,a^3-9\,ab^2)}{27\,b^3}, \text{weierstrassPInverse}\left(\frac{4\,(4\,a^2-3\,b^2)}{3\,b^2}, -\frac{8\,(8\,a^3-9\,ab^2)}{27\,b^3}, \right.\right.\right.}{}$$

input
```
integrate((a+b*cos(d*x+c))^(3/2),x, algorithm="fricas")
```

output
```
-2/9*(-12*I*sqrt(1/2)*a*b^(3/2)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)/b^2, -
8/27*(8*a^3 - 9*a*b^2)/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -
8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) + 2
*a)/b)) + 12*I*sqrt(1/2)*a*b^(3/2)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)/b^2
, -8/27*(8*a^3 - 9*a*b^2)/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2
, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d*x + c)
+ 2*a)/b)) - 3*sqrt(b*cos(d*x + c) + a)*b^2*sin(d*x + c) + sqrt(1/2)*(I*a^
2 + 3*I*b^2)*sqrt(b)*weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8
*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) + 2*a)/b)
+ sqrt(1/2)*(-I*a^2 - 3*I*b^2)*sqrt(b)*weierstrassPInverse(4/3*(4*a^2 - 3*
b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d
*x + c) + 2*a)/b))/(b*d)
```

Sympy [F]

$$\int (a + b\cos(c + dx))^{3/2}\, dx = \int (a + b\cos(c + dx))^{\frac{3}{2}}\, dx$$

input
```
integrate((a+b*cos(d*x+c))**(3/2),x)
```

output
```
Integral((a + b*cos(c + d*x))**(3/2), x)
```

Maxima [F]

$$\int (a+b\cos(c+dx))^{3/2}\,dx = \int (b\cos(dx+c)+a)^{\frac{3}{2}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(3/2),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(3/2), x)
```

Giac [F]

$$\int (a+b\cos(c+dx))^{3/2}\,dx = \int (b\cos(dx+c)+a)^{\frac{3}{2}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(3/2),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(3/2), x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+b\cos(c+dx))^{3/2}\,dx = \int (a+b\,\cos(c+d\,x))^{3/2}\,dx$$

input
```
int((a + b*cos(c + d*x))^(3/2),x)
```

output
```
int((a + b*cos(c + d*x))^(3/2), x)
```

Reduce [F]

$$\int (a+b\cos(c+dx))^{3/2}\,dx = \left(\int \sqrt{\cos(dx+c)\,b+a}dx\right)a + \left(\int \sqrt{\cos(dx+c)\,b+a}\,\cos(dx+c)\,dx\right)b$$

input
```
int((a+b*cos(d*x+c))^(3/2),x)
```

output
```
int(sqrt(cos(c + d*x)*b + a),x)*a + int(sqrt(cos(c + d*x)*b + a)*cos(c + d
*x),x)*b
```

3.52 $\int \sqrt{a+b\cos(c+dx)}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 57

$$\int \sqrt{a+b\cos(c+dx)}\,dx=\frac{2\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}$$

output
```
2*(a+b*cos(d*x+c))^(1/2)*EllipticE(sin(1/2*d*x+1/2*c),2^(1/2)*(b/(a+b))^(1
/2))/d/((a+b*cos(d*x+c))/(a+b))^(1/2)
```

Mathematica [A] (verified)

Time = 0.15 (sec) , antiderivative size = 57, normalized size of antiderivative = 1.00

$$\int \sqrt{a+b\cos(c+dx)}\,dx=\frac{2\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}$$

input
```
Integrate[Sqrt[a + b*Cos[c + d*x]],x]
```

output
```
(2*Sqrt[a + b*Cos[c + d*x]]*EllipticE[(c + d*x)/2, (2*b)/(a + b)])/(d*Sqrt
[(a + b*Cos[c + d*x])/(a + b)])
```

Rubi [A] (verified)

Time = 0.29 (sec) , antiderivative size = 57, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}}$ = 0.286, Rules used = {3042, 3134, 3042, 3132}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \sqrt{a+b\cos(c+dx)}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}dx$$

$$\Big\downarrow \text{3134}$$

$$\frac{\sqrt{a+b\cos(c+dx)}\int \sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{\sqrt{a+b\cos(c+dx)}\int \sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}$$

$$\Big\downarrow \text{3132}$$

$$\frac{2\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}$$

input
```
Int[Sqrt[a + b*Cos[c + d*x]],x]
```

output
```
(2*Sqrt[a + b*Cos[c + d*x]]*EllipticE[(c + d*x)/2, (2*b)/(a + b)])/(d*Sqrt
[(a + b*Cos[c + d*x])/(a + b)])
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3132
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[2*(Sqrt[a
 + b]/d)*EllipticE[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[{a,
b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3134
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[a +
b*Sin[c + d*x]]/Sqrt[(a + b*Sin[c + d*x])/(a + b)]   Int[Sqrt[a/(a + b) + (
b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2
, 0] &&  !GtQ[a + b, 0]
```

Maple [B] (verified)

Leaf count of result is larger than twice the leaf count of optimal. 169 vs. $2(58) = 116$.

Time = 4.02 (sec) , antiderivative size = 170, normalized size of antiderivative = 2.98

method	result	si
default	$-\frac{2\sqrt{\left(2b\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2+a-b\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^2}\,\sqrt{\frac{1}{2}-\frac{\cos(dx+c)}{2}}\,\sqrt{\frac{2b\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^2+a-b}{a-b}}\,\text{EllipticE}\left(\cos\left(\frac{dx}{2}+\frac{c}{2}\right),\sqrt{-\frac{2b}{a-b}}\right)(a-b)}{\sqrt{-2b\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^4+(a+b)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^2}\,\sin\left(\frac{dx}{2}+\frac{c}{2}\right)\sqrt{-2\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^2 b+a+b}\,d}$	1
risch	Expression too large to display	1

input
```
int((a+cos(d*x+c)*b)^(1/2),x,method=_RETURNVERBOSE)
```

output
```
-2*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)*sin(1/2*d*x+1/2*c)^2)^(1/2)*(sin(1/2*d*
x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b))^(1/2)*EllipticE(c
os(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))*(a-b)/(-2*b*sin(1/2*d*x+1/2*c)^4+(a+
b)*sin(1/2*d*x+1/2*c)^2)^(1/2)/sin(1/2*d*x+1/2*c)/(-2*sin(1/2*d*x+1/2*c)^2
*b+a+b)^(1/2)/d
```

Fricas [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.09 (sec) , antiderivative size = 355, normalized size of antiderivative = 6.23

$$\int \sqrt{a+b\cos(c+dx)}\,dx =$$
$$-\frac{2\left(i\sqrt{\frac{1}{2}}a\sqrt{b}\text{weierstrassPInverse}\left(\frac{4\,(4\,a^2-3\,b^2)}{3\,b^2},-\frac{8\,(8\,a^3-9\,ab^2)}{27\,b^3},\frac{3\,b\cos(dx+c)+3i\,b\sin(dx+c)+2\,a}{3\,b}\right)-i\sqrt{\frac{1}{2}}a\sqrt{b}\text{weie}\right.}{}$$

input
```
integrate((a+b*cos(d*x+c))^(1/2),x, algorithm="fricas")
```

output
```
-2/3*(I*sqrt(1/2)*a*sqrt(b)*weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -
8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) + 2
*a)/b) - I*sqrt(1/2)*a*sqrt(b)*weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2
, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d*x + c)
+ 2*a)/b) - 3*I*sqrt(1/2)*b^(3/2)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)/b^2,
 -8/27*(8*a^3 - 9*a*b^2)/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2,
 -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) +
 2*a)/b)) + 3*I*sqrt(1/2)*b^(3/2)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)/b^2,
 -8/27*(8*a^3 - 9*a*b^2)/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2,
 -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d*x + c) +
 2*a)/b)))/(b*d)
```

Sympy [F]

$$\int \sqrt{a+b\cos(c+dx)}\,dx = \int \sqrt{a+b\cos{(c+dx)}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))**(1/2),x)
```

output
```
Integral(sqrt(a + b*cos(c + d*x)), x)
```

Maxima [F]

$$\int \sqrt{a+b\cos(c+dx)}\,dx=\int \sqrt{b\cos(dx+c)+a}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(1/2),x, algorithm="maxima")
```

output
```
integrate(sqrt(b*cos(d*x + c) + a), x)
```

Giac [F]

$$\int \sqrt{a+b\cos(c+dx)}\,dx=\int \sqrt{b\cos(dx+c)+a}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(1/2),x, algorithm="giac")
```

output
```
integrate(sqrt(b*cos(d*x + c) + a), x)
```

Mupad [F(-1)]

Timed out.

$$\int \sqrt{a+b\cos(c+dx)}\,dx=\int \sqrt{a+b\,\cos(c+d\,x)}\,dx$$

input
```
int((a + b*cos(c + d*x))^(1/2),x)
```

output
```
int((a + b*cos(c + d*x))^(1/2), x)
```

Reduce [F]

$$\int \sqrt{a+b\cos(c+dx)}\,dx = \int \sqrt{\cos(dx+c)\,b+a}dx$$

input
```
int((a+b*cos(d*x+c))^(1/2),x)
```

output
```
int(sqrt(cos(c + d*x)*b + a),x)
```

3.53 $\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 57

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = \frac{2\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{d\sqrt{a+b\cos(c+dx)}}$$

output
```
2*((a+b*cos(d*x+c))/(a+b))^(1/2)*InverseJacobiAM(1/2*d*x+1/2*c,2^(1/2)*(b/
(a+b))^(1/2))/d/(a+b*cos(d*x+c))^(1/2)
```

Mathematica [A] (verified)

Time = 0.12 (sec) , antiderivative size = 57, normalized size of antiderivative = 1.00

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = \frac{2\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{d\sqrt{a+b\cos(c+dx)}}$$

input
```
Integrate[1/Sqrt[a + b*Cos[c + d*x]],x]
```

output
```
(2*Sqrt[(a + b*Cos[c + d*x])/(a + b)]*EllipticF[(c + d*x)/2, (2*b)/(a + b)
])/(d*Sqrt[a + b*Cos[c + d*x]])
```

Rubi [A] (verified)

Time = 0.29 (sec) , antiderivative size = 57, normalized size of antiderivative = 1.00, number of steps used = 4, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3142, 3042, 3140}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx$$

$$\Big\downarrow \text{3142}$$

$$\frac{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int \frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}}dx}{\sqrt{a+b\cos(c+dx)}}$$

$$\Big\downarrow \text{3042}$$

$$\frac{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int \frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}}dx}{\sqrt{a+b\cos(c+dx)}}$$

$$\Big\downarrow \text{3140}$$

$$\frac{2\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{d\sqrt{a+b\cos(c+dx)}}$$

input
```
Int[1/Sqrt[a + b*Cos[c + d*x]],x]
```

output
```
(2*Sqrt[(a + b*Cos[c + d*x])/(a + b)]*EllipticF[(c + d*x)/2, (2*b)/(a + b)
])/(d*Sqrt[a + b*Cos[c + d*x]])
```

Defintions of rubi rules used

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3140
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[(2/(d*S
qrt[a + b]))*EllipticF[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[
{a, b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3142
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[(a
 + b*Sin[c + d*x])/(a + b)]/Sqrt[a + b*Sin[c + d*x]]   Int[1/Sqrt[a/(a + b)
 + (b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] &&  !GtQ[a + b, 0]
```

Maple [A] (verified)

Time = 1.16 (sec) , antiderivative size = 57, normalized size of antiderivative = 1.00

method	result	size
default	$\frac{2\sqrt{\frac{a+\cos(dx+c)b}{a+b}}\,\text{InverseJacobiAM}\left(\frac{dx}{2}+\frac{c}{2},\frac{\sqrt{2}\,\sqrt{b}}{\sqrt{a+b}}\right)}{d\sqrt{a+\cos(dx+c)b}}$	57

input
```
int(1/(a+cos(d*x+c)*b)^(1/2),x,method=_RETURNVERBOSE)
```

output
```
2/d/(a+cos(d*x+c)*b)^(1/2)*((a+cos(d*x+c)*b)/(a+b))^(1/2)*InverseJacobiAM(
1/2*d*x+1/2*c,2^(1/2)/(a+b)^(1/2)*b^(1/2))
```

Fricas [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.09 (sec) , antiderivative size = 147, normalized size of antiderivative = 2.58

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = -\frac{2\left(i\sqrt{\frac{1}{2}}\sqrt{b}\text{weierstrassPInverse}\left(\frac{4\,(4\,a^2-3\,b^2)}{3\,b^2},-\frac{8\,(8\,a^3-9\,ab^2)}{27\,b^3},\frac{3\,b\cos(dx+c)+3i\,b\sin(dx+c)+2\,a}{3\,b}\right)-i\sqrt{\frac{1}{2}}\sqrt{b}\text{weiers}\right.}{bd}$$

input
```
integrate(1/(a+b*cos(d*x+c))^(1/2),x, algorithm="fricas")
```

output
```
-2*(I*sqrt(1/2)*sqrt(b)*weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/27
*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) + 2*a)/
b) - I*sqrt(1/2)*sqrt(b)*weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/2
7*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d*x + c) + 2*a)
/b))/(b*d)
```

Sympy [F]

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = \int \frac{1}{\sqrt{a+b\cos{(c+dx)}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))**(1/2),x)
```

output
```
Integral(1/sqrt(a + b*cos(c + d*x)), x)
```

Maxima [F]

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = \int \frac{1}{\sqrt{b\cos\left(dx+c\right)+a}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(1/2),x, algorithm="maxima")
```

output
```
integrate(1/sqrt(b*cos(d*x + c) + a), x)
```

Giac [F]

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = \int \frac{1}{\sqrt{b\cos\left(dx+c\right)+a}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(1/2),x, algorithm="giac")
```

output
```
integrate(1/sqrt(b*cos(d*x + c) + a), x)
```

Mupad [B] (verification not implemented)

Time = 42.91 (sec) , antiderivative size = 52, normalized size of antiderivative = 0.91

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = \frac{2\,\mathrm{F}\left(\frac{c}{2}+\frac{d\,x}{2}\middle|\frac{2\,b}{a+b}\right)\,\sqrt{\frac{a+b\,\cos(c+d\,x)}{a+b}}}{d\,\sqrt{a+b\,\cos\left(c+d\,x\right)}}$$

input
```
int(1/(a + b*cos(c + d*x))^(1/2),x)
```

output
```
(2*ellipticF(c/2 + (d*x)/2, (2*b)/(a + b))*((a + b*cos(c + d*x))/(a + b))^
(1/2))/(d*(a + b*cos(c + d*x))^(1/2))
```

Reduce [F]

$$\int \frac{1}{\sqrt{a+b\cos(c+dx)}}\,dx = \int \frac{\sqrt{\cos(dx+c)\,b+a}}{\cos(dx+c)\,b+a}dx$$

input

```
int(1/(a+b*cos(d*x+c))^(1/2),x)
```

output

```
int(sqrt(cos(c + d*x)*b + a)/(cos(c + d*x)*b + a),x)
```

3.54 $\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 106

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx = \frac{2\sqrt{a+b\cos(c+dx)}\,E\left(\frac{1}{2}(c+dx)\middle|\frac{2b}{a+b}\right)}{(a^2-b^2)\,d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}} - \frac{2b\sin(c+dx)}{(a^2-b^2)\,d\sqrt{a+b\cos(c+dx)}}$$

output
```
2*(a+b*cos(d*x+c))^(1/2)*EllipticE(sin(1/2*d*x+1/2*c),2^(1/2)*(b/(a+b))^(1
/2))/(a^2-b^2)/d/((a+b*cos(d*x+c))/(a+b))^(1/2)-2*b*sin(d*x+c)/(a^2-b^2)/d
/(a+b*cos(d*x+c))^(1/2)
```

Mathematica [A] (verified)

Time = 0.30 (sec) , antiderivative size = 83, normalized size of antiderivative = 0.78

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx = \frac{2(a+b)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,E\left(\frac{1}{2}(c+dx)\middle|\frac{2b}{a+b}\right) - 2b\sin(c+dx)}{(a-b)(a+b)d\sqrt{a+b\cos(c+dx)}}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(-3/2),x]
```

output
```
(2*(a + b)*Sqrt[(a + b*Cos[c + d*x])/(a + b)]*EllipticE[(c + d*x)/2, (2*b)
/(a + b)] - 2*b*Sin[c + d*x])/((a - b)*(a + b)*d*Sqrt[a + b*Cos[c + d*x]])
```

Rubi [A] (verified)

Time = 0.43 (sec) , antiderivative size = 106, normalized size of antiderivative = 1.00, number of steps used = 7, number of rules used = 7, $\frac{\text{number of rules}}{\text{integrand size}} = 0.500$, Rules used = {3042, 3143, 27, 3042, 3134, 3042, 3132}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \frac{1}{\left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{3/2}}dx$$

$$\Big\downarrow \text{ 3143}$$

$$-\frac{2\int -\frac{1}{2}\sqrt{a+b\cos(c+dx)}dx}{a^2-b^2}-\frac{2b\sin(c+dx)}{d\left(a^2-b^2\right)\sqrt{a+b\cos(c+dx)}}$$

$$\Big\downarrow \text{ 27}$$

$$\frac{\int \sqrt{a+b\cos(c+dx)}dx}{a^2-b^2}-\frac{2b\sin(c+dx)}{d\left(a^2-b^2\right)\sqrt{a+b\cos(c+dx)}}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{\int \sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}dx}{a^2-b^2}-\frac{2b\sin(c+dx)}{d\left(a^2-b^2\right)\sqrt{a+b\cos(c+dx)}}$$

$$\Big\downarrow \text{ 3134}$$

$$\frac{\sqrt{a+b\cos(c+dx)}\int \sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}dx}{\left(a^2-b^2\right)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{2b\sin(c+dx)}{d\left(a^2-b^2\right)\sqrt{a+b\cos(c+dx)}}$$

$$\Big\downarrow \text{ 3042}$$

$$\frac{\sqrt{a+b\cos(c+dx)}\int\sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}dx}{(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{2b\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}$$

$$\Big\downarrow \text{3132}$$

$$\frac{2\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d(a^2-b^2)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{2b\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}$$

input
```
Int[(a + b*Cos[c + d*x])^(-3/2),x]
```

output
```
(2*Sqrt[a + b*Cos[c + d*x]]*EllipticE[(c + d*x)/2, (2*b)/(a + b)])/((a^2 -
 b^2)*d*Sqrt[(a + b*Cos[c + d*x])/(a + b)]) - (2*b*Sin[c + d*x])/((a^2 - b
^2)*d*Sqrt[a + b*Cos[c + d*x]])
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3132
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[2*(Sqrt[a
 + b]/d)*EllipticE[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[{a,
b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3134
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[a +
b*Sin[c + d*x]]/Sqrt[(a + b*Sin[c + d*x])/(a + b)]   Int[Sqrt[a/(a + b) + (
b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2
, 0] &&  !GtQ[a + b, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

Maple [B] (verified)

Leaf count of result is larger than twice the leaf count of optimal. 216 vs. $2(105) = 210$.

Time = 2.07 (sec) , antiderivative size = 217, normalized size of antiderivative = 2.05

method	result
default	$-\frac{2\left(2\cos\left(\frac{dx}{2}+\frac{c}{2}\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}b+\sqrt{\frac{1}{2}-\frac{\cos(dx+c)}{2}}\,\operatorname{EllipticE}\left(\cos\left(\frac{dx}{2}+\frac{c}{2}\right),\sqrt{-\frac{2b}{a-b}}\right)\sqrt{-\frac{2b\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}{a-b}+\frac{a+b}{a-b}}\,a-\sqrt{\frac{1}{2}-\frac{\cos(dx+c)}{2}}\right.}{(a-b)(a+b)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)\sqrt{-2\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}b+a+b}\,d}$

input
```
int(1/(a+cos(d*x+c)*b)^(3/2),x,method=_RETURNVERBOSE)
```

output
```
-2*(2*cos(1/2*d*x+1/2*c)*sin(1/2*d*x+1/2*c)^2*b+(sin(1/2*d*x+1/2*c)^2)^(1/
2)*EllipticE(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))*(-2*b/(a-b)*sin(1/2*d*
x+1/2*c)^2+(a+b)/(a-b))^(1/2)*a-(sin(1/2*d*x+1/2*c)^2)^(1/2)*EllipticE(cos
(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))*(-2*b/(a-b)*sin(1/2*d*x+1/2*c)^2+(a+b)
/(a-b))^(1/2)*b)/(a-b)/(a+b)/sin(1/2*d*x+1/2*c)/(-2*sin(1/2*d*x+1/2*c)^2*b
+a+b)^(1/2)/d
```

Fricas [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.11 (sec) , antiderivative size = 472, normalized size of antiderivative = 4.45

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx =$$

$$-\frac{2\left(3\sqrt{b\cos\left(dx+c\right)+a}b^{2}\sin\left(dx+c\right)-\sqrt{\frac{1}{2}}(-i\,ab\cos\left(dx+c\right)-i\,a^{2})\sqrt{b}\text{weierstrassPInverse}\left(\frac{4\left(4a^{2}-3b^{2}\right.}{3b^{2}}\right.\right.}{}$$

input
```
integrate(1/(a+b*cos(d*x+c))^(3/2),x, algorithm="fricas")
```

output
```
-2/3*(3*sqrt(b*cos(d*x + c) + a)*b^2*sin(d*x + c) - sqrt(1/2)*(-I*a*b*cos(
d*x + c) - I*a^2)*sqrt(b)*weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/
27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) + 2*a
)/b) - sqrt(1/2)*(I*a*b*cos(d*x + c) + I*a^2)*sqrt(b)*weierstrassPInverse(
4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c
) - 3*I*b*sin(d*x + c) + 2*a)/b) - 3*sqrt(1/2)*(I*b^2*cos(d*x + c) + I*a*b
)*sqrt(b)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)
/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)
/b^3, 1/3*(3*b*cos(d*x + c) + 3*I*b*sin(d*x + c) + 2*a)/b)) - 3*sqrt(1/2)*
(-I*b^2*cos(d*x + c) - I*a*b)*sqrt(b)*weierstrassZeta(4/3*(4*a^2 - 3*b^2)/
b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/
b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d*x +
c) + 2*a)/b)))/((a^2*b^2 - b^4)*d*cos(d*x + c) + (a^3*b - a*b^3)*d)
```

Sympy [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx = \int \frac{1}{(a+b\cos{(c+dx)})^{\frac{3}{2}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))**(3/2),x)
```

output
```
Integral((a + b*cos(c + d*x))**(-3/2), x)
```

Maxima [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx = \int \frac{1}{(b\cos{(dx+c)}+a)^{\frac{3}{2}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(3/2),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(-3/2), x)
```

Giac [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx = \int \frac{1}{\left(b\cos\left(dx+c\right)+a\right)^{\frac{3}{2}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(3/2),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(-3/2), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx = \int \frac{1}{\left(a+b\,\cos\left(c+d\,x\right)\right)^{3/2}}\,dx$$

input
```
int(1/(a + b*cos(c + d*x))^(3/2),x)
```

output
```
int(1/(a + b*cos(c + d*x))^(3/2), x)
```

Reduce [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{3/2}}\,dx = \int \frac{\sqrt{\cos\left(dx+c\right)b+a}}{\cos\left(dx+c\right)^{2}b^{2}+2\cos\left(dx+c\right)ab+a^{2}}dx$$

input
```
int(1/(a+b*cos(d*x+c))^(3/2),x)
```

output
```
int(sqrt(cos(c + d*x)*b + a)/(cos(c + d*x)**2*b**2 + 2*cos(c + d*x)*a*b +
a**2),x)
```

3.55 $\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 221

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \frac{8a\sqrt{a+b\cos(c+dx)}\,E\left(\frac{1}{2}(c+dx)\middle|\frac{2b}{a+b}\right)}{3\left(a^2-b^2\right)^2 d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}} - \frac{2\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\,\text{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{3\left(a^2-b^2\right)d\sqrt{a+b\cos(c+dx)}} - \frac{2b\sin(c+dx)}{3\left(a^2-b^2\right)d(a+b\cos(c+dx))^{3/2}} - \frac{8ab\sin(c+dx)}{3\left(a^2-b^2\right)^2 d\sqrt{a+b\cos(c+dx)}}$$

output
```
8/3*a*(a+b*cos(d*x+c))^(1/2)*EllipticE(sin(1/2*d*x+1/2*c),2^(1/2)*(b/(a+b)
)^(1/2))/(a^2-b^2)^2/d/((a+b*cos(d*x+c))/(a+b))^(1/2)-2/3*((a+b*cos(d*x+c)
)/(a+b))^(1/2)*InverseJacobiAM(1/2*d*x+1/2*c,2^(1/2)*(b/(a+b))^(1/2))/(a^2
-b^2)/d/(a+b*cos(d*x+c))^(1/2)-2/3*b*sin(d*x+c)/(a^2-b^2)/d/(a+b*cos(d*x+c
))^(3/2)-8/3*a*b*sin(d*x+c)/(a^2-b^2)^2/d/(a+b*cos(d*x+c))^(1/2)
```

Mathematica [A] (verified)

Time = 1.08 (sec) , antiderivative size = 158, normalized size of antiderivative = 0.71

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \frac{8a(a+b)^2\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{3/2}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)-2(a-b)(a+b)^2\left(\frac{a+b\cos(c+}{a+b}\right.}{3(a-b)^2(a+b)^2c}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(-5/2),x]
```

output
```
(8*a*(a + b)^2*((a + b*Cos[c + d*x])/(a + b))^(3/2)*EllipticE[(c + d*x)/2,
 (2*b)/(a + b)] - 2*(a - b)*(a + b)^2*((a + b*Cos[c + d*x])/(a + b))^(3/2)
*EllipticF[(c + d*x)/2, (2*b)/(a + b)] + 2*b*(-5*a^2 + b^2 - 4*a*b*Cos[c +
 d*x])*Sin[c + d*x])/(3*(a - b)^2*(a + b)^2*d*(a + b*Cos[c + d*x])^(3/2))
```

Rubi [A] (verified)

Time = 1.12 (sec) , antiderivative size = 231, normalized size of antiderivative = 1.05, number of steps used = 15, number of rules used = 15, $\frac{\text{number of rules}}{\text{integrand size}} = 1.071$, Rules used = {3042, 3143, 27, 3042, 3233, 27, 3042, 3231, 3042, 3134, 3042, 3132, 3142, 3042, 3140}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \frac{1}{\left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{5/2}}dx$$

$$\Big\downarrow \text{3143}$$

$$-\frac{2\int -\frac{3a-b\cos(c+dx)}{2(a+b\cos(c+dx))^{3/2}}dx}{3\left(a^2-b^2\right)}-\frac{2b\sin(c+dx)}{3d\left(a^2-b^2\right)(a+b\cos(c+dx))^{3/2}}$$

$$\Big\downarrow \text{27}$$

$$\frac{\int \frac{3a-b\cos(c+dx)}{(a+b\cos(c+dx))^{3/2}}dx}{3(a^2-b^2)}-\frac{2b\sin(c+dx)}{3d(a^2-b^2)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3042

$$\frac{\int \frac{3a-b\sin\left(c+dx+\frac{\pi}{2}\right)}{\left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{3/2}}dx}{3(a^2-b^2)}-\frac{2b\sin(c+dx)}{3d(a^2-b^2)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3233

$$\frac{-\frac{2\int -\frac{3a^2+4b\cos(c+dx)a+b^2}{2\sqrt{a+b\cos(c+dx)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3(a^2-b^2)}-\frac{2b\sin(c+dx)}{3d(a^2-b^2)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 27

$$\frac{\frac{\int \frac{3a^2+4b\cos(c+dx)a+b^2}{\sqrt{a+b\cos(c+dx)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3(a^2-b^2)}-\frac{2b\sin(c+dx)}{3d(a^2-b^2)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3042

$$\frac{\frac{\int \frac{3a^2+4b\sin\left(c+dx+\frac{\pi}{2}\right)a+b^2}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3(a^2-b^2)}-\frac{2b\sin(c+dx)}{3d(a^2-b^2)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3231

$$\frac{\frac{4a\int \sqrt{a+b\cos(c+dx)}dx-(a^2-b^2)\int \frac{1}{\sqrt{a+b\cos(c+dx)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3(a^2-b^2)}-\frac{2b\sin(c+dx)}{3d(a^2-b^2)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3042

$$\frac{\frac{4a\int \sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}dx-(a^2-b^2)\int \frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3(a^2-b^2)}-\frac{2b\sin(c+dx)}{3d(a^2-b^2)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3134

$$\frac{\frac{\frac{4a\sqrt{a+b\cos(c+dx)}\int\sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-(a^2-b^2)\int\frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3\left(a^2-b^2\right)}-\frac{2b\sin(c+dx)}{3d\left(a^2-b^2\right)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3042

$$\frac{\frac{\frac{4a\sqrt{a+b\cos(c+dx)}\int\sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}dx}{\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-(a^2-b^2)\int\frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3\left(a^2-b^2\right)}-\frac{2b\sin(c+dx)}{3d\left(a^2-b^2\right)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3132

$$\frac{\frac{\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-(a^2-b^2)\int\frac{1}{\sqrt{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3\left(a^2-b^2\right)}-\frac{2b\sin(c+dx)}{3d\left(a^2-b^2\right)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3142

$$\frac{\frac{\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{\left(a^2-b^2\right)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int\frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}}dx}{\sqrt{a+b\cos(c+dx)}}}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3\left(a^2-b^2\right)}-\frac{2b\sin(c+dx)}{3d\left(a^2-b^2\right)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3042

$$\frac{\frac{\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{\left(a^2-b^2\right)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\int\frac{1}{\sqrt{\frac{a}{a+b}+\frac{b\sin\left(c+dx+\frac{\pi}{2}\right)}{a+b}}}dx}{\sqrt{a+b\cos(c+dx)}}}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3\left(a^2-b^2\right)}-\frac{2b\sin(c+dx)}{3d\left(a^2-b^2\right)(a+b\cos(c+dx))^{3/2}}$$

$\Big\downarrow$ 3140

$$\frac{\frac{\frac{8a\sqrt{a+b\cos(c+dx)}E\left(\frac{1}{2}(c+dx)|\frac{2b}{a+b}\right)}{d\sqrt{\frac{a+b\cos(c+dx)}{a+b}}}-\frac{2\left(a^2-b^2\right)\sqrt{\frac{a+b\cos(c+dx)}{a+b}}\operatorname{EllipticF}\left(\frac{1}{2}(c+dx),\frac{2b}{a+b}\right)}{d\sqrt{a+b\cos(c+dx)}}}{a^2-b^2}-\frac{8ab\sin(c+dx)}{d(a^2-b^2)\sqrt{a+b\cos(c+dx)}}}{3\left(a^2-b^2\right)}-\frac{2b\sin(c+dx)}{3d\left(a^2-b^2\right)\left(a+b\cos(c+dx)\right)^{3/2}}$$

input
```
Int[(a + b*Cos[c + d*x])^(-5/2),x]
```

output
```
(-2*b*Sin[c + d*x])/(3*(a^2 - b^2)*d*(a + b*Cos[c + d*x])^(3/2)) + (((8*a*
Sqrt[a + b*Cos[c + d*x]]*EllipticE[(c + d*x)/2, (2*b)/(a + b)])/(d*Sqrt[(a
 + b*Cos[c + d*x])/(a + b)]) - (2*(a^2 - b^2)*Sqrt[(a + b*Cos[c + d*x])/(a
 + b)]*EllipticF[(c + d*x)/2, (2*b)/(a + b)])/(d*Sqrt[a + b*Cos[c + d*x]])
)/(a^2 - b^2) - (8*a*b*Sin[c + d*x])/((a^2 - b^2)*d*Sqrt[a + b*Cos[c + d*x
]]))/(3*(a^2 - b^2))
```

Defintions of rubi rules used

rule 27
```
Int[(a_)*(Fx_), x_Symbol] :> Simp[a   Int[Fx, x], x] /; FreeQ[a, x] &&  !Ma
tchQ[Fx, (b_)*(Gx_) /; FreeQ[b, x]]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3132
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[2*(Sqrt[a
 + b]/d)*EllipticE[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[{a,
b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3134
```
Int[Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[a +
b*Sin[c + d*x]]/Sqrt[(a + b*Sin[c + d*x])/(a + b)]   Int[Sqrt[a/(a + b) + (
b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2
, 0] &&  !GtQ[a + b, 0]
```

rule 3140
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[(2/(d*S
qrt[a + b]))*EllipticF[(1/2)*(c - Pi/2 + d*x), 2*(b/(a + b))], x] /; FreeQ[
{a, b, c, d}, x] && NeQ[a^2 - b^2, 0] && GtQ[a + b, 0]
```

rule 3142
```
Int[1/Sqrt[(a_) + (b_.)*sin[(c_.) + (d_.)*(x_)]], x_Symbol] :> Simp[Sqrt[(a
 + b*Sin[c + d*x])/(a + b)]/Sqrt[a + b*Sin[c + d*x]]   Int[1/Sqrt[a/(a + b)
 + (b/(a + b))*Sin[c + d*x]], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] &&  !GtQ[a + b, 0]
```

rule 3143
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[(-b)*Cos
[c + d*x]*((a + b*Sin[c + d*x])^(n + 1)/(d*(n + 1)*(a^2 - b^2))), x] + Simp
[1/((n + 1)*(a^2 - b^2))   Int[(a + b*Sin[c + d*x])^(n + 1)*Simp[a*(n + 1)
- b*(n + 2)*Sin[c + d*x], x], x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 -
 b^2, 0] && LtQ[n, -1] && IntegerQ[2*n]
```

rule 3231
```
Int[((c_.) + (d_.)*sin[(e_.) + (f_.)*(x_)])/Sqrt[(a_) + (b_.)*sin[(e_.) + (
f_.)*(x_)]], x_Symbol] :> Simp[(b*c - a*d)/b   Int[1/Sqrt[a + b*Sin[e + f*x
]], x], x] + Simp[d/b   Int[Sqrt[a + b*Sin[e + f*x]], x], x] /; FreeQ[{a, b
, c, d, e, f}, x] && NeQ[b*c - a*d, 0] && NeQ[a^2 - b^2, 0]
```

rule 3233
```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)])^(m_)*((c_.) + (d_.)*sin[(e_.) +
(f_.)*(x_)]), x_Symbol] :> Simp[(-(b*c - a*d))*Cos[e + f*x]*((a + b*Sin[e +
 f*x])^(m + 1)/(f*(m + 1)*(a^2 - b^2))), x] + Simp[1/((m + 1)*(a^2 - b^2))
  Int[(a + b*Sin[e + f*x])^(m + 1)*Simp[(a*c - b*d)*(m + 1) - (b*c - a*d)*(
m + 2)*Sin[e + f*x], x], x], x] /; FreeQ[{a, b, c, d, e, f}, x] && NeQ[b*c
- a*d, 0] && NeQ[a^2 - b^2, 0] && LtQ[m, -1] && IntegerQ[2*m]
```

Maple [B] (warning: unable to verify)

Leaf count of result is larger than twice the leaf count of optimal. 488 vs. $2(210) = 420$.

Time = 3.10 (sec) , antiderivative size = 489, normalized size of antiderivative = 2.21

method	result
default	$-\frac{\sqrt{-\left(-2b\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}-a+b\right)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}\left(\frac{\cos\left(\frac{dx}{2}+\frac{c}{2}\right)\sqrt{-2b\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{4}+(a+b)\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}}}{3b(a-b)(a+b)\left(\cos\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}+\frac{a-b}{2b}\right)^{2}}+\frac{16\sin\left(\frac{dx}{2}+\frac{c}{2}\right)^{2}b}{3(a-b)^{2}(a+b)^{2}\sqrt{-\left(-2b\cos\left(\frac{dx}{2}\right.\right.}}\right.}{}$

input
```
int(1/(a+cos(d*x+c)*b)^(5/2),x,method=_RETURNVERBOSE)
```

output
```
-(-(-2*b*cos(1/2*d*x+1/2*c)^2-a+b)*sin(1/2*d*x+1/2*c)^2)^(1/2)*(1/3/b/(a-b
)/(a+b)*cos(1/2*d*x+1/2*c)*(-2*b*sin(1/2*d*x+1/2*c)^4+(a+b)*sin(1/2*d*x+1/
2*c)^2)^(1/2)/(cos(1/2*d*x+1/2*c)^2+1/2/b*(a-b))^2+16/3*sin(1/2*d*x+1/2*c)
^2*b/(a-b)^2/(a+b)^2*cos(1/2*d*x+1/2*c)*a/(-(-2*b*cos(1/2*d*x+1/2*c)^2-a+b
)*sin(1/2*d*x+1/2*c)^2)^(1/2)+2*(3*a-b)/(3*a^3+3*a^2*b-3*a*b^2-3*b^3)*(sin
(1/2*d*x+1/2*c)^2)^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b))^(1/2)/(-2*
b*sin(1/2*d*x+1/2*c)^4+(a+b)*sin(1/2*d*x+1/2*c)^2)^(1/2)*EllipticF(cos(1/2
*d*x+1/2*c),(-2*b/(a-b))^(1/2))-8/3*a/(a-b)/(a+b)^2*(sin(1/2*d*x+1/2*c)^2)
^(1/2)*((2*b*cos(1/2*d*x+1/2*c)^2+a-b)/(a-b))^(1/2)/(-2*b*sin(1/2*d*x+1/2*
c)^4+(a+b)*sin(1/2*d*x+1/2*c)^2)^(1/2)*(EllipticF(cos(1/2*d*x+1/2*c),(-2*b
/(a-b))^(1/2))-EllipticE(cos(1/2*d*x+1/2*c),(-2*b/(a-b))^(1/2))))/sin(1/2*
d*x+1/2*c)/(-2*sin(1/2*d*x+1/2*c)^2*b+a+b)^(1/2)/d
```

Fricas [C] (verification not implemented)

Result contains complex when optimal does not.

Time = 0.10 (sec) , antiderivative size = 662, normalized size of antiderivative = 3.00

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \text{Too large to display}$$

input
```
integrate(1/(a+b*cos(d*x+c))^(5/2),x, algorithm="fricas")
```

output
```
-2/9*(sqrt(1/2)*(I*a^4 + 3*I*a^2*b^2 + (I*a^2*b^2 + 3*I*b^4)*cos(d*x + c)^
2 + 2*(I*a^3*b + 3*I*a*b^3)*cos(d*x + c))*sqrt(b)*weierstrassPInverse(4/3*
(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c) +
3*I*b*sin(d*x + c) + 2*a)/b) + sqrt(1/2)*(-I*a^4 - 3*I*a^2*b^2 + (-I*a^2*b
^2 - 3*I*b^4)*cos(d*x + c)^2 + 2*(-I*a^3*b - 3*I*a*b^3)*cos(d*x + c))*sqrt
(b)*weierstrassPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b
^3, 1/3*(3*b*cos(d*x + c) - 3*I*b*sin(d*x + c) + 2*a)/b) + 12*sqrt(1/2)*(-
I*a*b^3*cos(d*x + c)^2 - 2*I*a^2*b^2*cos(d*x + c) - I*a^3*b)*sqrt(b)*weier
strassZeta(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, weierstra
ssPInverse(4/3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*
cos(d*x + c) + 3*I*b*sin(d*x + c) + 2*a)/b)) + 12*sqrt(1/2)*(I*a*b^3*cos(d
*x + c)^2 + 2*I*a^2*b^2*cos(d*x + c) + I*a^3*b)*sqrt(b)*weierstrassZeta(4/
3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, weierstrassPInverse(4/
3*(4*a^2 - 3*b^2)/b^2, -8/27*(8*a^3 - 9*a*b^2)/b^3, 1/3*(3*b*cos(d*x + c)
- 3*I*b*sin(d*x + c) + 2*a)/b)) + 3*(4*a*b^3*cos(d*x + c) + 5*a^2*b^2 - b^
4)*sqrt(b*cos(d*x + c) + a)*sin(d*x + c))/((a^4*b^3 - 2*a^2*b^5 + b^7)*d*c
os(d*x + c)^2 + 2*(a^5*b^2 - 2*a^3*b^4 + a*b^6)*d*cos(d*x + c) + (a^6*b -
2*a^4*b^3 + a^2*b^5)*d)
```

Sympy [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \int \frac{1}{\left(a+b\cos\left(c+dx\right)\right)^{\frac{5}{2}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))**(5/2),x)
```

output
```
Integral((a + b*cos(c + d*x))**(-5/2), x)
```

Maxima [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{5}{2}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(5/2),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(-5/2), x)
```

Giac [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{5}{2}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(5/2),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(-5/2), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \int \frac{1}{(a+b\,\cos(c+d\,x))^{5/2}}\,dx$$

input
```
int(1/(a + b*cos(c + d*x))^(5/2),x)
```

output
```
int(1/(a + b*cos(c + d*x))^(5/2), x)
```

Reduce [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{5/2}}\,dx = \int \frac{\sqrt{\cos(dx+c)\,b+a}}{\cos(dx+c)^3\,b^3+3\cos(dx+c)^2\,a\,b^2+3\cos(dx+c)\,a^2b+a^3}dx$$

input
```
int(1/(a+b*cos(d*x+c))^(5/2),x)
```

output
```
int(sqrt(cos(c + d*x)*b + a)/(cos(c + d*x)**3*b**3 + 3*cos(c + d*x)**2*a*b
**2 + 3*cos(c + d*x)*a**2*b + a**3),x)
```

3.56 $\int (a+b\cos(c+dx))^{4/3}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 105

$$\int (a+b\cos(c+dx))^{4/3}\,dx=\frac{\sqrt{2}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-\frac{4}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)(a+b\cos(c+dx))^{4/3}\sin(c+d\ldots}{d\sqrt{1+\cos(c+dx)}\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{4/3}}$$

output
```
2^(1/2)*AppellF1(1/2,-4/3,1/2,3/2,b*(1-cos(d*x+c))/(a+b),1/2-1/2*cos(d*x+c
))*(a+b*cos(d*x+c))^(4/3)*sin(d*x+c)/d/(1+cos(d*x+c))^(1/2)/((a+b*cos(d*x+
c))/(a+b))^(4/3)
```

Mathematica [B] (warning: unable to verify)

Leaf count is larger than twice the leaf count of optimal. 246 vs. 2(105) = 210.

Time = 2.32 (sec) , antiderivative size = 246, normalized size of antiderivative = 2.34

$$\int (a+b\cos(c+dx))^{4/3}\,dx=$$

$$-\frac{3\sqrt[3]{a+b\cos(c+dx)}\csc(c+dx)\left(4(-a^2+b^2)\,\text{AppellF1}\left(\frac{1}{3},\frac{1}{2},\frac{1}{2},\frac{4}{3},\frac{a+b\cos(c+dx)}{a-b},\frac{a+b\cos(c+dx)}{a+b}\right)\sqrt{-\frac{b(-1+\ldots}{a\ldots}}\ldots}{\ldots}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(4/3),x]
```

output
```
(-3*(a + b*Cos[c + d*x])^(1/3)*Csc[c + d*x]*(4*(-a^2 + b^2)*AppellF1[1/3,
1/2, 1/2, 4/3, (a + b*Cos[c + d*x])/(a - b), (a + b*Cos[c + d*x])/(a + b)]
*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[-((b*(1 + Cos[c + d*x]))/(a
 - b))] + 5*a*AppellF1[4/3, 1/2, 1/2, 7/3, (a + b*Cos[c + d*x])/(a - b), (
a + b*Cos[c + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt
[-((b*(1 + Cos[c + d*x]))/(a - b))]*(a + b*Cos[c + d*x]) - 4*b^2*Sin[c + d
*x]^2))/(16*b*d)
```

Rubi [A] (verified)

Time = 0.26 (sec) , antiderivative size = 108, normalized size of antiderivative = 1.03, number of steps used = 5, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3144, 156, 155}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a+b\cos(c+dx))^{4/3}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{4/3}dx$$

$$\Big\downarrow \text{3144}$$

$$-\frac{\sin(c+dx)\int \frac{(a+b\cos(c+dx))^{4/3}}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{156}$$

$$-\frac{(a+b)\sin(c+dx)\sqrt[3]{a+b\cos(c+dx)}\int \frac{\left(\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}\right)^{4/3}}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}}$$

$$\Big\downarrow \text{155}$$

$$\frac{\sqrt{2}(a+b)\sin(c+dx)\sqrt[3]{a+b\cos(c+dx)}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-\frac{4}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)}{d\sqrt{\cos(c+dx)+1}\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}}$$

input
```
Int[(a + b*Cos[c + d*x])^(4/3),x]
```

output
```
(Sqrt[2]*(a + b)*AppellF1[1/2, 1/2, -4/3, 3/2, (1 - Cos[c + d*x])/2, (b*(1
 - Cos[c + d*x]))/(a + b)]*(a + b*Cos[c + d*x])^(1/3)*Sin[c + d*x])/(d*Sqr
t[1 + Cos[c + d*x]]*((a + b*Cos[c + d*x])/(a + b))^(1/3))
```

Defintions of rubi rules used

rule 155
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[((a + b*x)^(m + 1)/(b*(m + 1)*Simplify[b/(b*c - a*d)]^n*
Simplify[b/(b*e - a*f)]^p))*AppellF1[m + 1, -n, -p, m + 2, (-d)*((a + b*x)/
(b*c - a*d)), (-f)*((a + b*x)/(b*e - a*f))], x] /; FreeQ[{a, b, c, d, e, f,
 m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] && GtQ[Sim
plify[b/(b*c - a*d)], 0] && GtQ[Simplify[b/(b*e - a*f)], 0] && !(GtQ[Simpl
ify[d/(d*a - c*b)], 0] && GtQ[Simplify[d/(d*e - c*f)], 0] && SimplerQ[c + d
*x, a + b*x]) && !(GtQ[Simplify[f/(f*a - e*b)], 0] && GtQ[Simplify[f/(f*c
 - e*d)], 0] && SimplerQ[e + f*x, a + b*x])
```

rule 156
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[(e + f*x)^FracPart[p]/(Simplify[b/(b*e - a*f)]^IntPart[p
]*(b*((e + f*x)/(b*e - a*f)))^FracPart[p])   Int[(a + b*x)^m*(c + d*x)^n*Si
mp[b*(e/(b*e - a*f)) + b*f*(x/(b*e - a*f)), x]^p, x], x] /; FreeQ[{a, b, c,
 d, e, f, m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] &
& GtQ[Simplify[b/(b*c - a*d)], 0] && !GtQ[Simplify[b/(b*e - a*f)], 0]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3144
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[Cos[c +
d*x]/(d*Sqrt[1 + Sin[c + d*x]]*Sqrt[1 - Sin[c + d*x]])   Subst[Int[(a + b*x
)^n/(Sqrt[1 + x]*Sqrt[1 - x]), x], x, Sin[c + d*x]], x] /; FreeQ[{a, b, c,
d, n}, x] && NeQ[a^2 - b^2, 0] &&  !IntegerQ[2*n]
```

Maple [F]

$$\int (a + \cos(dx + c)\, b)^{\frac{4}{3}}\, dx$$

input
```
int((a+cos(d*x+c)*b)^(4/3),x)
```

output
```
int((a+cos(d*x+c)*b)^(4/3),x)
```

Fricas [F]

$$\int (a + b\cos(c + dx))^{4/3}\, dx = \int (b\cos(dx + c) + a)^{\frac{4}{3}}\, dx$$

input
```
integrate((a+b*cos(d*x+c))^(4/3),x, algorithm="fricas")
```

output
```
integral((b*cos(d*x + c) + a)^(4/3), x)
```

Sympy [F]

$$\int (a + b\cos(c + dx))^{4/3}\, dx = \int (a + b\cos(c + dx))^{\frac{4}{3}}\, dx$$

input
```
integrate((a+b*cos(d*x+c))**(4/3),x)
```

output
```
Integral((a + b*cos(c + d*x))**(4/3), x)
```

Maxima [F]

$$\int (a+b\cos(c+dx))^{4/3}\,dx = \int (b\cos(dx+c)+a)^{\frac{4}{3}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(4/3),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(4/3), x)
```

Giac [F]

$$\int (a+b\cos(c+dx))^{4/3}\,dx = \int (b\cos(dx+c)+a)^{\frac{4}{3}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(4/3),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(4/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+b\cos(c+dx))^{4/3}\,dx = \int (a+b\,\cos(c+d\,x))^{4/3}\,dx$$

input
```
int((a + b*cos(c + d*x))^(4/3),x)
```

output
```
int((a + b*cos(c + d*x))^(4/3), x)
```

Reduce [F]

$$\int (a+b\cos(c+dx))^{4/3}\,dx = \left(\int (\cos(dx+c)\,b+a)^{\frac{1}{3}}\,dx\right)a + \left(\int (\cos(dx+c)\,b+a)^{\frac{1}{3}}\cos(dx+c)\,dx\right)b$$

input
```
int((a+b*cos(d*x+c))^(4/3),x)
```

output
```
int((cos(c + d*x)*b + a)**(1/3),x)*a + int((cos(c + d*x)*b + a)**(1/3)*cos
(c + d*x),x)*b
```

3.57 $\int (a+b\cos(c+dx))^{2/3}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 105

$$\int (a+b\cos(c+dx))^{2/3}\,dx=\frac{\sqrt{2}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-\frac{2}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)(a+b\cos(c+dx))^{2/3}\sin(c+d}{d\sqrt{1+\cos(c+dx)}\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{2/3}}$$

output
```
2^(1/2)*AppellF1(1/2,-2/3,1/2,3/2,b*(1-cos(d*x+c))/(a+b),1/2-1/2*cos(d*x+c
))*(a+b*cos(d*x+c))^(2/3)*sin(d*x+c)/d/(1+cos(d*x+c))^(1/2)/((a+b*cos(d*x+
c))/(a+b))^(2/3)
```

Mathematica [A] (warning: unable to verify)

Time = 0.34 (sec) , antiderivative size = 118, normalized size of antiderivative = 1.12

$$\int (a+b\cos(c+dx))^{2/3}\,dx=-\frac{3\,\text{AppellF1}\left(\frac{5}{3},\frac{1}{2},\frac{1}{2},\frac{8}{3},\frac{a+b\cos(c+dx)}{a-b},\frac{a+b\cos(c+dx)}{a+b}\right)\sqrt{-\frac{b(-1+\cos(c+dx))}{a+b}}\sqrt{\frac{b(1+\cos(c+dx))}{-a+b}}(a+b\cos(c+dx))^{5/3}\,\mathrm{cs}}{5bd}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(2/3),x]
```

output
```
(-3*AppellF1[5/3, 1/2, 1/2, 8/3, (a + b*Cos[c + d*x])/(a - b), (a + b*Cos[
c + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[(b*(1 + C
os[c + d*x]))/(-a + b)]*(a + b*Cos[c + d*x])^(5/3)*Csc[c + d*x])/(5*b*d)
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 105, normalized size of antiderivative = 1.00, number of steps used = 5, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3144, 156, 155}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a+b\cos(c+dx))^{2/3}\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{2/3}dx$$

$$\Big\downarrow \text{3144}$$

$$-\frac{\sin(c+dx)\int \frac{(a+b\cos(c+dx))^{2/3}}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{156}$$

$$-\frac{\sin(c+dx)(a+b\cos(c+dx))^{2/3}\int \frac{\left(\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}\right)^{2/3}}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{2/3}}$$

$$\Big\downarrow \text{155}$$

$$\frac{\sqrt{2}\sin(c+dx)(a+b\cos(c+dx))^{2/3}\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-\frac{2}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)}{d\sqrt{\cos(c+dx)+1}\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{2/3}}$$

input
```
Int[(a + b*Cos[c + d*x])^(2/3),x]
```

output
```
(Sqrt[2]*AppellF1[1/2, 1/2, -2/3, 3/2, (1 - Cos[c + d*x])/2, (b*(1 - Cos[c
 + d*x]))/(a + b)]*(a + b*Cos[c + d*x])^(2/3)*Sin[c + d*x])/(d*Sqrt[1 + Co
s[c + d*x]]*((a + b*Cos[c + d*x])/(a + b))^(2/3))
```

Defintions of rubi rules used

rule 155
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[((a + b*x)^(m + 1)/(b*(m + 1)*Simplify[b/(b*c - a*d)]^n*
Simplify[b/(b*e - a*f)]^p))*AppellF1[m + 1, -n, -p, m + 2, (-d)*((a + b*x)/
(b*c - a*d)), (-f)*((a + b*x)/(b*e - a*f))], x] /; FreeQ[{a, b, c, d, e, f,
 m, n, p}, x] &&  !IntegerQ[m] &&  !IntegerQ[n] &&  !IntegerQ[p] && GtQ[Sim
plify[b/(b*c - a*d)], 0] && GtQ[Simplify[b/(b*e - a*f)], 0] &&  !(GtQ[Simpl
ify[d/(d*a - c*b)], 0] && GtQ[Simplify[d/(d*e - c*f)], 0] && SimplerQ[c + d
*x, a + b*x]) &&  !(GtQ[Simplify[f/(f*a - e*b)], 0] && GtQ[Simplify[f/(f*c
- e*d)], 0] && SimplerQ[e + f*x, a + b*x])
```

rule 156
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[(e + f*x)^FracPart[p]/(Simplify[b/(b*e - a*f)]^IntPart[p
]*(b*((e + f*x)/(b*e - a*f)))^FracPart[p])   Int[(a + b*x)^m*(c + d*x)^n*Si
mp[b*(e/(b*e - a*f)) + b*f*(x/(b*e - a*f)), x]^p, x], x] /; FreeQ[{a, b, c,
 d, e, f, m, n, p}, x] &&  !IntegerQ[m] &&  !IntegerQ[n] &&  !IntegerQ[p] &
& GtQ[Simplify[b/(b*c - a*d)], 0] &&  !GtQ[Simplify[b/(b*e - a*f)], 0]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3144
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[Cos[c +
d*x]/(d*Sqrt[1 + Sin[c + d*x]]*Sqrt[1 - Sin[c + d*x]])   Subst[Int[(a + b*x
)^n/(Sqrt[1 + x]*Sqrt[1 - x]), x], x, Sin[c + d*x]], x] /; FreeQ[{a, b, c,
d, n}, x] && NeQ[a^2 - b^2, 0] &&  !IntegerQ[2*n]
```

Maple [F]

$$\int (a+\cos (dx+c)\, b)^{\frac{2}{3}} \, dx$$

input
```
int((a+cos(d*x+c)*b)^(2/3),x)
```

output
```
int((a+cos(d*x+c)*b)^(2/3),x)
```

Fricas [F]

$$\int (a+b\cos(c+dx))^{2/3} \, dx = \int (b\cos (dx+c)+a)^{\frac{2}{3}} \, dx$$

input
```
integrate((a+b*cos(d*x+c))^(2/3),x, algorithm="fricas")
```

output
```
integral((b*cos(d*x + c) + a)^(2/3), x)
```

Sympy [F]

$$\int (a+b\cos(c+dx))^{2/3} \, dx = \int (a+b\cos (c+dx))^{\frac{2}{3}} \, dx$$

input
```
integrate((a+b*cos(d*x+c))**(2/3),x)
```

output
```
Integral((a + b*cos(c + d*x))**(2/3), x)
```

Maxima [F]

$$\int (a+b\cos(c+dx))^{2/3}\,dx=\int (b\cos(dx+c)+a)^{\frac{2}{3}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(2/3),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(2/3), x)
```

Giac [F]

$$\int (a+b\cos(c+dx))^{2/3}\,dx=\int (b\cos(dx+c)+a)^{\frac{2}{3}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(2/3),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(2/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+b\cos(c+dx))^{2/3}\,dx=\int (a+b\,\cos(c+d\,x))^{2/3}\,dx$$

input
```
int((a + b*cos(c + d*x))^(2/3),x)
```

output
```
int((a + b*cos(c + d*x))^(2/3), x)
```

Reduce [F]

$$\int (a+b\cos(c+dx))^{2/3}\,dx=\int (\cos(dx+c)\,b+a)^{\frac{2}{3}}\,dx$$

input
```
int((a+b*cos(d*x+c))^(2/3),x)
```

output
```
int((cos(c + d*x)*b + a)**(2/3),x)
```

3.58 $\int \sqrt[3]{a+b\cos(c+dx)}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 105

$$\int \sqrt[3]{a+b\cos(c+dx)}\,dx = \frac{\sqrt{2}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-\frac{1}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)\sqrt[3]{a+b\cos(c+dx)}\sin(c+dx)}{d\sqrt{1+\cos(c+dx)}\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}}$$

output
```
2^(1/2)*AppellF1(1/2,-1/3,1/2,3/2,b*(1-cos(d*x+c))/(a+b),1/2-1/2*cos(d*x+c
))*(a+b*cos(d*x+c))^(1/3)*sin(d*x+c)/d/(1+cos(d*x+c))^(1/2)/((a+b*cos(d*x+
c))/(a+b))^(1/3)
```

Mathematica [A] (warning: unable to verify)

Time = 0.33 (sec) , antiderivative size = 118, normalized size of antiderivative = 1.12

$$\int \sqrt[3]{a+b\cos(c+dx)}\,dx = -\frac{3\,\text{AppellF1}\left(\frac{4}{3},\frac{1}{2},\frac{1}{2},\frac{7}{3},\frac{a+b\cos(c+dx)}{a-b},\frac{a+b\cos(c+dx)}{a+b}\right)\sqrt{-\frac{b(-1+\cos(c+dx))}{a+b}}\sqrt{\frac{b(1+\cos(c+dx))}{-a+b}}(a+b\cos(c+dx))^{4/}}{4bd}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(1/3),x]
```

output
```
(-3*AppellF1[4/3, 1/2, 1/2, 7/3, (a + b*Cos[c + d*x])/(a - b), (a + b*Cos[
c + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[(b*(1 + C
os[c + d*x]))/(-a + b)]*(a + b*Cos[c + d*x])^(4/3)*Csc[c + d*x])/(4*b*d)
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 105, normalized size of antiderivative = 1.00, number of steps used = 5, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3144, 156, 155}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \sqrt[3]{a+b\cos(c+dx)}\,dx$$

$$\Big\downarrow \text{ 3042}$$

$$\int \sqrt[3]{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}dx$$

$$\Big\downarrow \text{ 3144}$$

$$-\frac{\sin(c+dx)\int \frac{\sqrt[3]{a+b\cos(c+dx)}}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{ 156}$$

$$-\frac{\sin(c+dx)\sqrt[3]{a+b\cos(c+dx)}\int \frac{\sqrt[3]{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}}$$

$$\Big\downarrow \text{ 155}$$

$$\frac{\sqrt{2}\sin(c+dx)\sqrt[3]{a+b\cos(c+dx)}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-\frac{1}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)}{d\sqrt{\cos(c+dx)+1}\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}}$$

input
```
Int[(a + b*Cos[c + d*x])^(1/3),x]
```

output
```
(Sqrt[2]*AppellF1[1/2, 1/2, -1/3, 3/2, (1 - Cos[c + d*x])/2, (b*(1 - Cos[c
 + d*x]))/(a + b)]*(a + b*Cos[c + d*x])^(1/3)*Sin[c + d*x])/(d*Sqrt[1 + Co
s[c + d*x]]*((a + b*Cos[c + d*x])/(a + b))^(1/3))
```

Defintions of rubi rules used

rule 155
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[((a + b*x)^(m + 1)/(b*(m + 1)*Simplify[b/(b*c - a*d)]^n*
Simplify[b/(b*e - a*f)]^p))*AppellF1[m + 1, -n, -p, m + 2, (-d)*((a + b*x)/
(b*c - a*d)), (-f)*((a + b*x)/(b*e - a*f))], x] /; FreeQ[{a, b, c, d, e, f,
 m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] && GtQ[Sim
plify[b/(b*c - a*d)], 0] && GtQ[Simplify[b/(b*e - a*f)], 0] && !(GtQ[Simpl
ify[d/(d*a - c*b)], 0] && GtQ[Simplify[d/(d*e - c*f)], 0] && SimplerQ[c + d
*x, a + b*x]) && !(GtQ[Simplify[f/(f*a - e*b)], 0] && GtQ[Simplify[f/(f*c
- e*d)], 0] && SimplerQ[e + f*x, a + b*x])
```

rule 156
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[(e + f*x)^FracPart[p]/(Simplify[b/(b*e - a*f)]^IntPart[p
]*(b*((e + f*x)/(b*e - a*f)))^FracPart[p])   Int[(a + b*x)^m*(c + d*x)^n*Si
mp[b*(e/(b*e - a*f)) + b*f*(x/(b*e - a*f)), x]^p, x], x] /; FreeQ[{a, b, c,
 d, e, f, m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] &
& GtQ[Simplify[b/(b*c - a*d)], 0] && !GtQ[Simplify[b/(b*e - a*f)], 0]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3144
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[Cos[c +
d*x]/(d*Sqrt[1 + Sin[c + d*x]]*Sqrt[1 - Sin[c + d*x]])   Subst[Int[(a + b*x
)^n/(Sqrt[1 + x]*Sqrt[1 - x]), x], x, Sin[c + d*x]], x] /; FreeQ[{a, b, c,
d, n}, x] && NeQ[a^2 - b^2, 0] && !IntegerQ[2*n]
```

Maple [F]

$$\int (a+\cos (dx+c)\, b)^{\frac{1}{3}}\, dx$$

input
```
int((a+cos(d*x+c)*b)^(1/3),x)
```

output
```
int((a+cos(d*x+c)*b)^(1/3),x)
```

Fricas [F]

$$\int \sqrt[3]{a+b\cos(c+dx)}\, dx = \int (b\cos (dx+c)+a)^{\frac{1}{3}}\, dx$$

input
```
integrate((a+b*cos(d*x+c))^(1/3),x, algorithm="fricas")
```

output
```
integral((b*cos(d*x + c) + a)^(1/3), x)
```

Sympy [F]

$$\int \sqrt[3]{a+b\cos(c+dx)}\, dx = \int \sqrt[3]{a+b\cos (c+dx)}\, dx$$

input
```
integrate((a+b*cos(d*x+c))**(1/3),x)
```

output
```
Integral((a + b*cos(c + d*x))**(1/3), x)
```

Maxima [F]

$$\int \sqrt[3]{a+b\cos(c+dx)}\,dx = \int (b\cos{(dx+c)}+a)^{\frac{1}{3}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(1/3),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(1/3), x)
```

Giac [F]

$$\int \sqrt[3]{a+b\cos(c+dx)}\,dx = \int (b\cos{(dx+c)}+a)^{\frac{1}{3}}\,dx$$

input
```
integrate((a+b*cos(d*x+c))^(1/3),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(1/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \sqrt[3]{a+b\cos(c+dx)}\,dx = \int (a+b\,\cos{(c+d\,x)})^{1/3}\,dx$$

input
```
int((a + b*cos(c + d*x))^(1/3),x)
```

output
```
int((a + b*cos(c + d*x))^(1/3), x)
```

Reduce [F]

$$\int \sqrt[3]{a+b\cos(c+dx)}\,dx=\int (\cos (dx+c)\,b+a)^{\frac{1}{3}}\,dx$$

input
```
int((a+b*cos(d*x+c))^(1/3),x)
```

output
```
int((cos(c + d*x)*b + a)**(1/3),x)
```

3.59 $\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 105

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\,dx = \frac{\sqrt{2}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},\frac{1}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}\sin(c+dx)}{d\sqrt{1+\cos(c+dx)}\sqrt[3]{a+b\cos(c+dx)}}$$

output
```
2^(1/2)*AppellF1(1/2,1/3,1/2,3/2,b*(1-cos(d*x+c))/(a+b),1/2-1/2*cos(d*x+c)
)*((a+b*cos(d*x+c))/(a+b))^(1/3)*sin(d*x+c)/d/(1+cos(d*x+c))^(1/2)/(a+b*co
s(d*x+c))^(1/3)
```

Mathematica [A] (warning: unable to verify)

Time = 0.39 (sec) , antiderivative size = 118, normalized size of antiderivative = 1.12

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\,dx = -\frac{3\,\text{AppellF1}\left(\frac{2}{3},\frac{1}{2},\frac{1}{2},\frac{5}{3},\frac{a+b\cos(c+dx)}{a-b},\frac{a+b\cos(c+dx)}{a+b}\right)\sqrt{-\frac{b(-1+\cos(c+dx))}{a+b}}\sqrt{\frac{b(1+\cos(c+dx))}{-a+b}}(a+b\cos(c+dx))^{2/}}{2bd}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(-1/3),x]
```

output
```
(-3*AppellF1[2/3, 1/2, 1/2, 5/3, (a + b*Cos[c + d*x])/(a - b), (a + b*Cos[
c + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[(b*(1 + C
os[c + d*x]))/(-a + b)]*(a + b*Cos[c + d*x])^(2/3)*Csc[c + d*x])/(2*b*d)
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 105, normalized size of antiderivative = 1.00, number of steps used = 5, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3144, 156, 155}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}dx$$
$$\Big\downarrow \text{3042}$$
$$\int \frac{1}{\sqrt[3]{a+b\sin\left(c+dx+\frac{\pi}{2}\right)}}dx$$
$$\Big\downarrow \text{3144}$$
$$-\frac{\sin(c+dx)\int \frac{1}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\sqrt[3]{a+b\cos(c+dx)}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$
$$\Big\downarrow \text{156}$$
$$-\frac{\sin(c+dx)\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}\int \frac{1}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\sqrt[3]{\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\sqrt[3]{a+b\cos(c+dx)}}$$
$$\Big\downarrow \text{155}$$
$$\frac{\sqrt{2}\sin(c+dx)\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},\frac{1}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)}{d\sqrt{\cos(c+dx)+1}\sqrt[3]{a+b\cos(c+dx)}}$$

input
```
Int[(a + b*Cos[c + d*x])^(-1/3),x]
```

output
```
(Sqrt[2]*AppellF1[1/2, 1/2, 1/3, 3/2, (1 - Cos[c + d*x])/2, (b*(1 - Cos[c
+ d*x]))/(a + b)]*((a + b*Cos[c + d*x])/(a + b))^(1/3)*Sin[c + d*x])/(d*Sq
rt[1 + Cos[c + d*x]]*(a + b*Cos[c + d*x])^(1/3))
```

Defintions of rubi rules used

rule 155
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[((a + b*x)^(m + 1)/(b*(m + 1)*Simplify[b/(b*c - a*d)]^n*
Simplify[b/(b*e - a*f)]^p))*AppellF1[m + 1, -n, -p, m + 2, (-d)*((a + b*x)/
(b*c - a*d)), (-f)*((a + b*x)/(b*e - a*f))], x] /; FreeQ[{a, b, c, d, e, f,
 m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] && GtQ[Sim
plify[b/(b*c - a*d)], 0] && GtQ[Simplify[b/(b*e - a*f)], 0] && !(GtQ[Simpl
ify[d/(d*a - c*b)], 0] && GtQ[Simplify[d/(d*e - c*f)], 0] && SimplerQ[c + d
*x, a + b*x]) && !(GtQ[Simplify[f/(f*a - e*b)], 0] && GtQ[Simplify[f/(f*c
- e*d)], 0] && SimplerQ[e + f*x, a + b*x])
```

rule 156
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[(e + f*x)^FracPart[p]/(Simplify[b/(b*e - a*f)]^IntPart[p
]*(b*((e + f*x)/(b*e - a*f)))^FracPart[p])   Int[(a + b*x)^m*(c + d*x)^n*Si
mp[b*(e/(b*e - a*f)) + b*f*(x/(b*e - a*f)), x]^p, x], x] /; FreeQ[{a, b, c,
 d, e, f, m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] &
& GtQ[Simplify[b/(b*c - a*d)], 0] && !GtQ[Simplify[b/(b*e - a*f)], 0]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3144
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[Cos[c +
d*x]/(d*Sqrt[1 + Sin[c + d*x]]*Sqrt[1 - Sin[c + d*x]])   Subst[Int[(a + b*x
)^n/(Sqrt[1 + x]*Sqrt[1 - x]), x], x, Sin[c + d*x]], x] /; FreeQ[{a, b, c,
d, n}, x] && NeQ[a^2 - b^2, 0] && !IntegerQ[2*n]
```

Maple [F]

$$\int \frac{1}{(a+\cos (dx+c)\, b)^{\frac{1}{3}}}dx$$

input
```
int(1/(a+cos(d*x+c)*b)^(1/3),x)
```

output
```
int(1/(a+cos(d*x+c)*b)^(1/3),x)
```

Fricas [F]

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\, dx = \int \frac{1}{(b\cos (dx+c)+a)^{\frac{1}{3}}}\, dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(1/3),x, algorithm="fricas")
```

output
```
integral((b*cos(d*x + c) + a)^(-1/3), x)
```

Sympy [F]

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\, dx = \int \frac{1}{\sqrt[3]{a+b\cos (c+dx)}}\, dx$$

input
```
integrate(1/(a+b*cos(d*x+c))**(1/3),x)
```

output
```
Integral((a + b*cos(c + d*x))**(-1/3), x)
```

Maxima [F]

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{1}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(1/3),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(-1/3), x)
```

Giac [F]

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{1}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(1/3),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(-1/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\,dx = \int \frac{1}{(a+b\,\cos(c+d\,x))^{1/3}}\,dx$$

input
```
int(1/(a + b*cos(c + d*x))^(1/3),x)
```

output
```
int(1/(a + b*cos(c + d*x))^(1/3), x)
```

Reduce [F]

$$\int \frac{1}{\sqrt[3]{a+b\cos(c+dx)}}\,dx = \int \frac{1}{(\cos(dx+c)\,b+a)^{\frac{1}{3}}}dx$$

input
```
int(1/(a+b*cos(d*x+c))^(1/3),x)
```

output
```
int(1/(cos(c + d*x)*b + a)**(1/3),x)
```

3.60 $\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 105

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx = \frac{\sqrt{2}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},\frac{2}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{2/3}}{d\sqrt{1+\cos(c+dx)}(a+b\cos(c+dx))^{2/3}}$$

output
```
2^(1/2)*AppellF1(1/2,2/3,1/2,3/2,b*(1-cos(d*x+c))/(a+b),1/2-1/2*cos(d*x+c)
)*((a+b*cos(d*x+c))/(a+b))^(2/3)*sin(d*x+c)/d/(1+cos(d*x+c))^(1/2)/(a+b*co
s(d*x+c))^(2/3)
```

Mathematica [A] (warning: unable to verify)

Time = 0.29 (sec) , antiderivative size = 116, normalized size of antiderivative = 1.10

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx =$$
$$-\frac{3\,\text{AppellF1}\left(\frac{1}{3},\frac{1}{2},\frac{1}{2},\frac{4}{3},\frac{a+b\cos(c+dx)}{a-b},\frac{a+b\cos(c+dx)}{a+b}\right)\sqrt{-\frac{b(-1+\cos(c+dx))}{a+b}}\sqrt{\frac{b(1+\cos(c+dx))}{-a+b}}\sqrt[3]{a+b\cos(c+dx)}\csc(}{bd}$$

input
```
Integrate[(a + b*Cos[c + d*x])^(-2/3),x]
```

output
```
(-3*AppellF1[1/3, 1/2, 1/2, 4/3, (a + b*Cos[c + d*x])/(a - b), (a + b*Cos[
c + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[(b*(1 + C
os[c + d*x]))/(-a + b)]*(a + b*Cos[c + d*x])^(1/3)*Csc[c + d*x])/(b*d)
```

Rubi [A] (verified)

Time = 0.26 (sec) , antiderivative size = 105, normalized size of antiderivative = 1.00, number of steps used = 5, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3144, 156, 155}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}dx$$

$$\Big\downarrow \; 3042$$

$$\int \frac{1}{\left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{2/3}}dx$$

$$\Big\downarrow \; 3144$$

$$-\frac{\sin(c+dx)\int \frac{1}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}(a+b\cos(c+dx))^{2/3}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$

$$\Big\downarrow \; 156$$

$$-\frac{\sin(c+dx)\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{2/3}\int \frac{1}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\left(\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}\right)^{2/3}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}(a+b\cos(c+dx))^{2/3}}$$

$$\Big\downarrow \; 155$$

$$\frac{\sqrt{2}\sin(c+dx)\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{2/3}\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},\frac{2}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)}{d\sqrt{\cos(c+dx)+1}(a+b\cos(c+dx))^{2/3}}$$

input
```
Int[(a + b*Cos[c + d*x])^(-2/3),x]
```

output
```
(Sqrt[2]*AppellF1[1/2, 1/2, 2/3, 3/2, (1 - Cos[c + d*x])/2, (b*(1 - Cos[c
+ d*x]))/(a + b)]*((a + b*Cos[c + d*x])/(a + b))^(2/3)*Sin[c + d*x])/(d*Sq
rt[1 + Cos[c + d*x]]*(a + b*Cos[c + d*x])^(2/3))
```

Defintions of rubi rules used

rule 155
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[((a + b*x)^(m + 1)/(b*(m + 1)*Simplify[b/(b*c - a*d)]^n*
Simplify[b/(b*e - a*f)]^p))*AppellF1[m + 1, -n, -p, m + 2, (-d)*((a + b*x)/
(b*c - a*d)), (-f)*((a + b*x)/(b*e - a*f))], x] /; FreeQ[{a, b, c, d, e, f,
 m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] && GtQ[Sim
plify[b/(b*c - a*d)], 0] && GtQ[Simplify[b/(b*e - a*f)], 0] && !(GtQ[Simpl
ify[d/(d*a - c*b)], 0] && GtQ[Simplify[d/(d*e - c*f)], 0] && SimplerQ[c + d
*x, a + b*x]) && !(GtQ[Simplify[f/(f*a - e*b)], 0] && GtQ[Simplify[f/(f*c
- e*d)], 0] && SimplerQ[e + f*x, a + b*x])
```

rule 156
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[(e + f*x)^FracPart[p]/(Simplify[b/(b*e - a*f)]^IntPart[p
]*(b*((e + f*x)/(b*e - a*f)))^FracPart[p])   Int[(a + b*x)^m*(c + d*x)^n*Si
mp[b*(e/(b*e - a*f)) + b*f*(x/(b*e - a*f)), x]^p, x], x] /; FreeQ[{a, b, c,
 d, e, f, m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] &
& GtQ[Simplify[b/(b*c - a*d)], 0] && !GtQ[Simplify[b/(b*e - a*f)], 0]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3144
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[Cos[c +
d*x]/(d*Sqrt[1 + Sin[c + d*x]]*Sqrt[1 - Sin[c + d*x]])   Subst[Int[(a + b*x
)^n/(Sqrt[1 + x]*Sqrt[1 - x]), x], x, Sin[c + d*x]], x] /; FreeQ[{a, b, c,
d, n}, x] && NeQ[a^2 - b^2, 0] && !IntegerQ[2*n]
```

Maple [F]

$$\int \frac{1}{(a+\cos(dx+c)\,b)^{\frac{2}{3}}}dx$$

input
```
int(1/(a+cos(d*x+c)*b)^(2/3),x)
```

output
```
int(1/(a+cos(d*x+c)*b)^(2/3),x)
```

Fricas [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(2/3),x, algorithm="fricas")
```

output
```
integral((b*cos(d*x + c) + a)^(-2/3), x)
```

Sympy [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(a+b\cos(c+dx))^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))**(2/3),x)
```

output
```
Integral((a + b*cos(c + d*x))**(-2/3), x)
```

Maxima [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(2/3),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(-2/3), x)
```

Giac [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{2}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(2/3),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(-2/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+b\cos(c+dx))^{2/3}}\,dx = \int \frac{1}{(a+b\,\cos(c+d\,x))^{2/3}}\,dx$$

input
```
int(1/(a + b*cos(c + d*x))^(2/3),x)
```

output
```
int(1/(a + b*cos(c + d*x))^(2/3), x)
```

Reduce [F]

$$\int \frac{1}{(a + b\cos(c + dx))^{2/3}} dx = \int \frac{1}{(\cos(dx + c)b + a)^{\frac{2}{3}}} dx$$

input

```
int(1/(a+b*cos(d*x+c))^(2/3),x)
```

output

```
int(1/(cos(c + d*x)*b + a)**(2/3),x)
```

3.61 $\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx$

Optimal result

Integrand size = 14, antiderivative size = 105

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \frac{\sqrt{2}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},\frac{4}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{4/3}}{d\sqrt{1+\cos(c+dx)}(a+b\cos(c+dx))^{4/3}}$$

output

```
2^(1/2)*AppellF1(1/2,4/3,1/2,3/2,b*(1-cos(d*x+c))/(a+b),1/2-1/2*cos(d*x+c)
)*((a+b*cos(d*x+c))/(a+b))^(4/3)*sin(d*x+c)/d/(1+cos(d*x+c))^(1/2)/(a+b*co
s(d*x+c))^(4/3)
```

Mathematica [B] (warning: unable to verify)

Leaf count is larger than twice the leaf count of optimal. 268 vs. 2(105) = 210.

Time = 2.38 (sec) , antiderivative size = 268, normalized size of antiderivative = 2.55

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \frac{15a\,\text{AppellF1}\left(\frac{2}{3},\frac{1}{2},\frac{1}{2},\frac{5}{3},\frac{a+b\cos(c+dx)}{a-b},\frac{a+b\cos(c+dx)}{a+b}\right)\sqrt{-\frac{b(-1+\cos(c+dx))}{a+b}}\sqrt{-\frac{b(1-}{}}}{}$$

input

```
Integrate[(a + b*Cos[c + d*x])^(-4/3),x]
```

output
```
(15*a*AppellF1[2/3, 1/2, 1/2, 5/3, (a + b*Cos[c + d*x])/(a - b), (a + b*Co
s[c + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[-((b*(1
 + Cos[c + d*x]))/(a - b))]*(a + b*Cos[c + d*x])*Csc[c + d*x] - 6*(5*b^2 +
 2*AppellF1[5/3, 1/2, 1/2, 8/3, (a + b*Cos[c + d*x])/(a - b), (a + b*Cos[c
 + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[(b*(1 + Co
s[c + d*x]))/(-a + b)]*(a + b*Cos[c + d*x])^2*Csc[c + d*x]^2)*Sin[c + d*x]
)/(10*b*(a^2 - b^2)*d*(a + b*Cos[c + d*x])^(1/3))
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 110, normalized size of antiderivative = 1.05, number of steps used = 5, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.286$, Rules used = {3042, 3144, 156, 155}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx$$

$$\Big\downarrow \ 3042$$

$$\int \frac{1}{\left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^{4/3}}dx$$

$$\Big\downarrow \ 3144$$

$$-\frac{\sin(c+dx)\int \frac{1}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}(a+b\cos(c+dx))^{4/3}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$

$$\Big\downarrow \ 156$$

$$-\frac{\sin(c+dx)\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}\int \frac{1}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\left(\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}\right)^{4/3}}d\cos(c+dx)}{d(a+b)\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}\sqrt[3]{a+b\cos(c+dx)}}$$

$$\Big\downarrow \ 155$$

$$\frac{\sqrt{2}\sin(c+dx)\sqrt[3]{\frac{a+b\cos(c+dx)}{a+b}}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},\frac{4}{3},\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)}{d(a+b)\sqrt{\cos(c+dx)+1}\sqrt[3]{a+b\cos(c+dx)}}$$

input
```
Int[(a + b*Cos[c + d*x])^(-4/3),x]
```

output
```
(Sqrt[2]*AppellF1[1/2, 1/2, 4/3, 3/2, (1 - Cos[c + d*x])/2, (b*(1 - Cos[c
+ d*x]))/(a + b)]*((a + b*Cos[c + d*x])/(a + b))^(1/3)*Sin[c + d*x])/((a +
 b)*d*Sqrt[1 + Cos[c + d*x]]*(a + b*Cos[c + d*x])^(1/3))
```

Defintions of rubi rules used

rule 155
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[((a + b*x)^(m + 1)/(b*(m + 1)*Simplify[b/(b*c - a*d)]^n*
Simplify[b/(b*e - a*f)]^p))*AppellF1[m + 1, -n, -p, m + 2, (-d)*((a + b*x)/
(b*c - a*d)), (-f)*((a + b*x)/(b*e - a*f))], x] /; FreeQ[{a, b, c, d, e, f,
 m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] && GtQ[Sim
plify[b/(b*c - a*d)], 0] && GtQ[Simplify[b/(b*e - a*f)], 0] && !(GtQ[Simpl
ify[d/(d*a - c*b)], 0] && GtQ[Simplify[d/(d*e - c*f)], 0] && SimplerQ[c + d
*x, a + b*x]) && !(GtQ[Simplify[f/(f*a - e*b)], 0] && GtQ[Simplify[f/(f*c
- e*d)], 0] && SimplerQ[e + f*x, a + b*x])
```

rule 156
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[(e + f*x)^FracPart[p]/(Simplify[b/(b*e - a*f)]^IntPart[p
]*(b*((e + f*x)/(b*e - a*f)))^FracPart[p])   Int[(a + b*x)^m*(c + d*x)^n*Si
mp[b*(e/(b*e - a*f)) + b*f*(x/(b*e - a*f)), x]^p, x], x] /; FreeQ[{a, b, c,
 d, e, f, m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] &
& GtQ[Simplify[b/(b*c - a*d)], 0] && !GtQ[Simplify[b/(b*e - a*f)], 0]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3144
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[Cos[c +
d*x]/(d*Sqrt[1 + Sin[c + d*x]]*Sqrt[1 - Sin[c + d*x]])   Subst[Int[(a + b*x
)^n/(Sqrt[1 + x]*Sqrt[1 - x]), x], x, Sin[c + d*x]], x] /; FreeQ[{a, b, c,
d, n}, x] && NeQ[a^2 - b^2, 0] && !IntegerQ[2*n]
```

Maple [F]

$$\int \frac{1}{\left(a+\cos \left(dx+c\right) b\right)^{\frac{4}{3}}}dx$$

input
```
int(1/(a+cos(d*x+c)*b)^(4/3),x)
```

output
```
int(1/(a+cos(d*x+c)*b)^(4/3),x)
```

Fricas [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{\left(b\cos\left(dx+c\right)+a\right)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(4/3),x, algorithm="fricas")
```

output
```
integral((b*cos(d*x + c) + a)^(2/3)/(b^2*cos(d*x + c)^2 + 2*a*b*cos(d*x +
c) + a^2), x)
```

Sympy [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{\left(a+b\cos\left(c+dx\right)\right)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))**(4/3),x)
```

output
```
Integral((a + b*cos(c + d*x))**(-4/3), x)
```

Maxima [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(4/3),x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^(-4/3), x)
```

Giac [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(b\cos(dx+c)+a)^{\frac{4}{3}}}\,dx$$

input
```
integrate(1/(a+b*cos(d*x+c))^(4/3),x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^(-4/3), x)
```

Mupad [F(-1)]

Timed out.

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(a+b\,\cos(c+d\,x))^{4/3}}\,dx$$

input
```
int(1/(a + b*cos(c + d*x))^(4/3),x)
```

output
```
int(1/(a + b*cos(c + d*x))^(4/3), x)
```

Reduce [F]

$$\int \frac{1}{(a+b\cos(c+dx))^{4/3}}\,dx = \int \frac{1}{(\cos(dx+c)\,b+a)^{\frac{1}{3}}\cos(dx+c)\,b+(\cos(dx+c)\,b+a)^{\frac{1}{3}}\,a}dx$$

input
```
int(1/(a+b*cos(d*x+c))^(4/3),x)
```

output
```
int(1/((cos(c + d*x)*b + a)**(1/3)*cos(c + d*x)*b + (cos(c + d*x)*b + a)**
(1/3)*a),x)
```

3.62 $\int (a+b\cos(c+dx))^n\,dx$

Optimal result

Integrand size = 12, antiderivative size = 103

$$\int (a+b\cos(c+dx))^n\,dx$$
$$= \frac{\sqrt{2}\,\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-n,\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)(a+b\cos(c+dx))^n\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{-n}\sin(c+ \ldots}{d\sqrt{1+\cos(c+dx)}}$$

output
```
2^(1/2)*AppellF1(1/2,-n,1/2,3/2,b*(1-cos(d*x+c))/(a+b),1/2-1/2*cos(d*x+c))
*(a+b*cos(d*x+c))^n*sin(d*x+c)/d/(1+cos(d*x+c))^(1/2)/(((a+b*cos(d*x+c))/(
a+b))^n)
```

Mathematica [A] (warning: unable to verify)

Time = 0.33 (sec) , antiderivative size = 121, normalized size of antiderivative = 1.17

$$\int (a+b\cos(c+dx))^n\,dx =$$
$$-\frac{\text{AppellF1}\left(1+n,\frac{1}{2},\frac{1}{2},2+n,\frac{a+b\cos(c+dx)}{a-b},\frac{a+b\cos(c+dx)}{a+b}\right)\sqrt{-\frac{b(-1+\cos(c+dx))}{a+b}}\sqrt{\frac{b(1+\cos(c+dx))}{-a+b}}(a+b\cos(c+ \ldots}{bd(1+n)}$$

input
```
Integrate[(a + b*Cos[c + d*x])^n,x]
```

output
```
-((AppellF1[1 + n, 1/2, 1/2, 2 + n, (a + b*Cos[c + d*x])/(a - b), (a + b*C
os[c + d*x])/(a + b)]*Sqrt[-((b*(-1 + Cos[c + d*x]))/(a + b))]*Sqrt[(b*(1
+ Cos[c + d*x]))/(-a + b)]*(a + b*Cos[c + d*x])^(1 + n)*Csc[c + d*x])/(b*d
*(1 + n)))
```

Rubi [A] (verified)

Time = 0.27 (sec) , antiderivative size = 103, normalized size of antiderivative = 1.00, number of steps used = 5, number of rules used = 4, $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$, Rules used = {3042, 3144, 156, 155}

Below are the steps used by Rubi to obtain the solution. The rule number used for the transformation is given above next to the arrow. The rules definitions used are listed below.

$$\int (a+b\cos(c+dx))^n\,dx$$

$$\Big\downarrow \text{3042}$$

$$\int \left(a+b\sin\left(c+dx+\frac{\pi}{2}\right)\right)^n dx$$

$$\Big\downarrow \text{3144}$$

$$-\frac{\sin(c+dx)\int \frac{(a+b\cos(c+dx))^n}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{156}$$

$$-\frac{\sin(c+dx)(a+b\cos(c+dx))^n\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{-n}\int \frac{\left(\frac{a}{a+b}+\frac{b\cos(c+dx)}{a+b}\right)^n}{\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}d\cos(c+dx)}{d\sqrt{1-\cos(c+dx)}\sqrt{\cos(c+dx)+1}}$$

$$\Big\downarrow \text{155}$$

$$\frac{\sqrt{2}\sin(c+dx)(a+b\cos(c+dx))^n\left(\frac{a+b\cos(c+dx)}{a+b}\right)^{-n}\text{AppellF1}\left(\frac{1}{2},\frac{1}{2},-n,\frac{3}{2},\frac{1}{2}(1-\cos(c+dx)),\frac{b(1-\cos(c+dx))}{a+b}\right)}{d\sqrt{\cos(c+dx)+1}}$$

input
```
Int[(a + b*Cos[c + d*x])^n,x]
```

output
```
(Sqrt[2]*AppellF1[1/2, 1/2, -n, 3/2, (1 - Cos[c + d*x])/2, (b*(1 - Cos[c +
 d*x]))/(a + b)]*(a + b*Cos[c + d*x])^n*Sin[c + d*x])/(d*Sqrt[1 + Cos[c +
d*x]]*((a + b*Cos[c + d*x])/(a + b))^n)
```

Defintions of rubi rules used

rule 155
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[((a + b*x)^(m + 1)/(b*(m + 1)*Simplify[b/(b*c - a*d)]^n*
Simplify[b/(b*e - a*f)]^p))*AppellF1[m + 1, -n, -p, m + 2, (-d)*((a + b*x)/
(b*c - a*d)), (-f)*((a + b*x)/(b*e - a*f))], x] /; FreeQ[{a, b, c, d, e, f,
 m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] && GtQ[Sim
plify[b/(b*c - a*d)], 0] && GtQ[Simplify[b/(b*e - a*f)], 0] && !(GtQ[Simpl
ify[d/(d*a - c*b)], 0] && GtQ[Simplify[d/(d*e - c*f)], 0] && SimplerQ[c + d
*x, a + b*x]) && !(GtQ[Simplify[f/(f*a - e*b)], 0] && GtQ[Simplify[f/(f*c
- e*d)], 0] && SimplerQ[e + f*x, a + b*x])
```

rule 156
```
Int[((a_) + (b_.)*(x_))^(m_)*((c_.) + (d_.)*(x_))^(n_)*((e_.) + (f_.)*(x_))
^(p_), x_] :> Simp[(e + f*x)^FracPart[p]/(Simplify[b/(b*e - a*f)]^IntPart[p
]*(b*((e + f*x)/(b*e - a*f)))^FracPart[p])   Int[(a + b*x)^m*(c + d*x)^n*Si
mp[b*(e/(b*e - a*f)) + b*f*(x/(b*e - a*f)), x]^p, x], x] /; FreeQ[{a, b, c,
 d, e, f, m, n, p}, x] && !IntegerQ[m] && !IntegerQ[n] && !IntegerQ[p] &
& GtQ[Simplify[b/(b*c - a*d)], 0] && !GtQ[Simplify[b/(b*e - a*f)], 0]
```

rule 3042
```
Int[u_, x_Symbol] :> Int[DeactivateTrig[u, x], x] /; FunctionOfTrigOfLinear
Q[u, x]
```

rule 3144
```
Int[((a_) + (b_.)*sin[(c_.) + (d_.)*(x_)])^(n_), x_Symbol] :> Simp[Cos[c +
d*x]/(d*Sqrt[1 + Sin[c + d*x]]*Sqrt[1 - Sin[c + d*x]])   Subst[Int[(a + b*x
)^n/(Sqrt[1 + x]*Sqrt[1 - x]), x], x, Sin[c + d*x]], x] /; FreeQ[{a, b, c,
d, n}, x] && NeQ[a^2 - b^2, 0] && !IntegerQ[2*n]
```

Maple [F]

$$\int (a+\cos (dx+c) b)^n\, dx$$

input
```
int((a+cos(d*x+c)*b)^n,x)
```

output
```
int((a+cos(d*x+c)*b)^n,x)
```

Fricas [F]

$$\int (a+b\cos(c+dx))^n\, dx = \int (b\cos (dx+c)+a)^n\, dx$$

input
```
integrate((a+b*cos(d*x+c))^n,x, algorithm="fricas")
```

output
```
integral((b*cos(d*x + c) + a)^n, x)
```

Sympy [F]

$$\int (a+b\cos(c+dx))^n\, dx = \int (a+b\cos (c+dx))^n\, dx$$

input
```
integrate((a+b*cos(d*x+c))**n,x)
```

output
```
Integral((a + b*cos(c + d*x))**n, x)
```

Maxima [F]

$$\int (a+b\cos(c+dx))^n\,dx = \int (b\cos(dx+c)+a)^n\,dx$$

input
```
integrate((a+b*cos(d*x+c))^n,x, algorithm="maxima")
```

output
```
integrate((b*cos(d*x + c) + a)^n, x)
```

Giac [F]

$$\int (a+b\cos(c+dx))^n\,dx = \int (b\cos(dx+c)+a)^n\,dx$$

input
```
integrate((a+b*cos(d*x+c))^n,x, algorithm="giac")
```

output
```
integrate((b*cos(d*x + c) + a)^n, x)
```

Mupad [F(-1)]

Timed out.

$$\int (a+b\cos(c+dx))^n\,dx = \int (a+b\,\cos(c+d\,x))^n\,dx$$

input
```
int((a + b*cos(c + d*x))^n,x)
```

output
```
int((a + b*cos(c + d*x))^n, x)
```

Reduce [F]

$$\int (a + b\cos(c + dx))^n \, dx = \int (\cos(dx + c)\, b + a)^n \, dx$$

input
```
int((a+b*cos(d*x+c))^n,x)
```

output
```
int((cos(c + d*x)*b + a)**n,x)
```

CHAPTER 4

Appendix

4.1 Listing of Grading functions

The following are the current version of the grading functions used for grading the quality of the antiderivative with reference to the optimal antiderivative included in the test suite.

There is a version for Maple and for Mathematica/Rubi. There is a version for grading Sympy and version for use with Sagemath.

The following are links to the current source code.

The following are the listings of source code of the grading functions.

Mathematica and Rubi grading function

```
(* Original version thanks to Albert Rich emailed on 03/21/2017 *)
(* ::Package:: *)

(* Nasser: April 7,2022. add second output which gives reason for the grade *)
(*                       Small rewrite of logic in main function to make it*)
(*                       match Maple's logic. No change in functionality otherwise*)

(* ::Subsection:: *)
(*GradeAntiderivative[result,optimal]*)
```

```
(* ::Text:: *)
(*If result and optimal are mathematical expressions, *)
(*         GradeAntiderivative[result,optimal] returns*)
(*  "F" if the result fails to integrate an expression that*)
(*      is integrable*)
(*  "C" if result involves higher level functions than necessary*)
(*  "B" if result is more than twice the size of the optimal*)
(*      antiderivative*)
(*  "A" if result can be considered optimal*)


GradeAntiderivative[result_,optimal_] := Module[{expnResult,expnOptimal,leafCountResult,leaf
    expnResult  = ExpnType[result];
    expnOptimal = ExpnType[optimal];
    leafCountResult = LeafCount[result];
    leafCountOptimal = LeafCount[optimal];

    (*Print["expnResult=",expnResult," expnOptimal=",expnOptimal];*)
    If[expnResult<=expnOptimal,
        If[Not[FreeQ[result,Complex]], (*result contains complex*)
            If[Not[FreeQ[optimal,Complex]], (*optimal contains complex*)
                If[leafCountResult<=2*leafCountOptimal,
                    finalresult={"A",""}
                    ,(*ELSE*)
                    finalresult={"B","Both result and optimal contain complex but leaf count
                   ]
            ,(*ELSE*)
                finalresult={"C","Result contains complex when optimal does not."}
            ]
        ,(*ELSE*)(*result does not contains complex*)
            If[leafCountResult<=2*leafCountOptimal,
               finalresult={"A",""}
            ,(*ELSE*)
               finalresult={"B","Leaf count is larger than twice the leaf count of optimal.
              ]
        ]
    ,(*ELSE*) (*expnResult>expnOptimal*)
        If[FreeQ[result,Integrate] && FreeQ[result,Int],
            finalresult={"C","Result contains higher order function than in optimal. Order "
            ,
```

```
            finalresult={"F","Contains unresolved integral."}
        ]
    ];

    finalresult
]

(* ::Text:: *)
(*The following summarizes the type number assigned an *)
(*expression based on the functions it involves*)
(*1 = rational function*)
(*2 = algebraic function*)
(*3 = elementary function*)
(*4 = special function*)
(*5 = hyperpergeometric function*)
(*6 = appell function*)
(*7 = rootsum function*)
(*8 = integrate function*)
(*9 = unknown function*)


ExpnType[expn_] :=
  If[AtomQ[expn],
    1,
  If[ListQ[expn],
    Max[Map[ExpnType,expn]],
  If[Head[expn]===Power,
    If[IntegerQ[expn[[2]]],
      ExpnType[expn[[1]]],
    If[Head[expn[[2]]]===Rational,
      If[IntegerQ[expn[[1]]] || Head[expn[[1]]]===Rational,
        1,
      Max[ExpnType[expn[[1]]],2]],
    Max[ExpnType[expn[[1]]],ExpnType[expn[[2]]],3]]],
  If[Head[expn]===Plus || Head[expn]===Times,
    Max[ExpnType[First[expn]],ExpnType[Rest[expn]]],
  If[ElementaryFunctionQ[Head[expn]],
    Max[3,ExpnType[expn[[1]]]],
  If[SpecialFunctionQ[Head[expn]],
    Apply[Max,Append[Map[ExpnType,Apply[List,expn]],4]],
  If[HypergeometricFunctionQ[Head[expn]],
```

```
    Apply[Max,Append[Map[ExpnType,Apply[List,expn]],5]],
  If[AppellFunctionQ[Head[expn]],
    Apply[Max,Append[Map[ExpnType,Apply[List,expn]],6]],
  If[Head[expn]===RootSum,
    Apply[Max,Append[Map[ExpnType,Apply[List,expn]],7]],
  If[Head[expn]===Integrate || Head[expn]===Int,
    Apply[Max,Append[Map[ExpnType,Apply[List,expn]],8]],
  9]]]]]]]]]]


ElementaryFunctionQ[func_] :=
  MemberQ[{
  Exp,Log,
  Sin,Cos,Tan,Cot,Sec,Csc,
  ArcSin,ArcCos,ArcTan,ArcCot,ArcSec,ArcCsc,
  Sinh,Cosh,Tanh,Coth,Sech,Csch,
  ArcSinh,ArcCosh,ArcTanh,ArcCoth,ArcSech,ArcCsch
},func]


SpecialFunctionQ[func_] :=
  MemberQ[{
  Erf, Erfc, Erfi,
  FresnelS, FresnelC,
  ExpIntegralE, ExpIntegralEi, LogIntegral,
  SinIntegral, CosIntegral, SinhIntegral, CoshIntegral,
  Gamma, LogGamma, PolyGamma,
  Zeta, PolyLog, ProductLog,
  EllipticF, EllipticE, EllipticPi
},func]


HypergeometricFunctionQ[func_] :=
  MemberQ[{Hypergeometric1F1,Hypergeometric2F1,HypergeometricPFQ},func]


AppellFunctionQ[func_] :=
  MemberQ[{AppellF1},func]
```

Maple grading function

```
# File: GradeAntiderivative.mpl
# Original version thanks to Albert Rich emailed on 03/21/2017

#Nasser 03/22/2017  Use Maple leaf count instead since buildin
#Nasser 03/23/2017  missing 'ln' for ElementaryFunctionQ added
#Nasser 03/24/2017  corrected the check for complex result
#Nasser 10/27/2017  check for leafsize and do not call ExpnType()
#                   if leaf size is "too large". Set at 500,000
#Nasser 12/22/2019  Added debug flag, added 'dilog' to special functions
#                   see problem 156, file Apostol_Problems
#Nasser 4/07/2022   add second output which gives reason for the grade

GradeAntiderivative := proc(result,optimal)
local leaf_count_result,
        leaf_count_optimal,
        ExpnType_result,
        ExpnType_optimal,
        debug:=false;

        leaf_count_result:=leafcount(result);
        #do NOT call ExpnType() if leaf size is too large. Recursion problem
        if leaf_count_result > 500000 then
            return "B","result has leaf size over 500,000. Avoiding possible recursion issue
        fi;

        leaf_count_optimal := leafcount(optimal);
        ExpnType_result  := ExpnType(result);
        ExpnType_optimal := ExpnType(optimal);

        if debug then
            print("ExpnType_result",ExpnType_result," ExpnType_optimal=",ExpnType_optimal);
        fi;

# If result and optimal are mathematical expressions,
#  GradeAntiderivative[result,optimal] returns
#   "F" if the result fails to integrate an expression that
#       is integrable
#   "C" if result involves higher level functions than necessary
#   "B" if result is more than twice the size of the optimal
```

```
#       antiderivative
#   "A" if result can be considered optimal

    #This check below actually is not needed, since I only
    #call this grading only for passed integrals. i.e. I check
    #for "F" before calling this. But no harm of keeping it here.
    #just in case.


    if not type(result,freeof('int')) then
        return "F","Result contains unresolved integral";
    fi;


    if ExpnType_result<=ExpnType_optimal then
        if debug then
             print("ExpnType_result<=ExpnType_optimal");
        fi;
        if is_contains_complex(result) then
            if is_contains_complex(optimal) then
                if debug then
                        print("both result and optimal complex");
                fi;
                if leaf_count_result<=2*leaf_count_optimal then
                     return "A"," ";
                else
                   return "B",cat("Both result and optimal contain complex but leaf count of
                                  convert(leaf_count_result,string)," vs. $2 (",
                                  convert(leaf_count_optimal,string)," ) = ",convert(2*leaf
                end if
            else #result contains complex but optimal is not
                if debug then
                        print("result contains complex but optimal is not");
                fi;
                return "C","Result contains complex when optimal does not.";
            fi;
        else # result do not contain complex
             # this assumes optimal do not as well. No check is needed here.
            if debug then
                   print("result do not contain complex, this assumes optimal do not as well
            fi;
```

```
            if leaf_count_result<=2*leaf_count_optimal then
                if debug then
                    print("leaf_count_result<=2*leaf_count_optimal");
                fi;
                return "A"," ";
            else
                if debug then
                    print("leaf_count_result>2*leaf_count_optimal");
                fi;
                return "B",cat("Leaf count of result is larger than twice the leaf count of
                                   convert(leaf_count_result,string),"$ vs. $2(",
                                   convert(leaf_count_optimal,string),")=",convert(2*leaf_co
            fi;
        fi;
    else #ExpnType(result) > ExpnType(optimal)
        if debug then
            print("ExpnType(result) > ExpnType(optimal)");
        fi;
        return "C",cat("Result contains higher order function than in optimal. Order ",
                       convert(ExpnType_result,string)," vs. order ",
                       convert(ExpnType_optimal,string),".");
    fi;

end proc:

#
# is_contains_complex(result)
# takes expressions and returns true if it contains "I" else false
#
#Nasser 032417
is_contains_complex:= proc(expression)
  return (has(expression,I));
end proc:

# The following summarizes the type number assigned an expression
# based on the functions it involves
# 1 = rational function
# 2 = algebraic function
# 3 = elementary function
# 4 = special function
# 5 = hyperpergeometric function
```

```
# 6 = appell function
# 7 = rootsum function
# 8 = integrate function
# 9 = unknown function

ExpnType := proc(expn)
  if type(expn,'atomic') then
    1
  elif type(expn,'list') then
    apply(max,map(ExpnType,expn))
  elif type(expn,'sqrt') then
    if type(op(1,expn),'rational') then
      1
    else
      max(2,ExpnType(op(1,expn)))
    end if
  elif type(expn,'`^`') then
    if type(op(2,expn),'integer') then
      ExpnType(op(1,expn))
    elif type(op(2,expn),'rational') then
      if type(op(1,expn),'rational') then
        1
      else
        max(2,ExpnType(op(1,expn)))
      end if
    else
        max(3,ExpnType(op(1,expn)),ExpnType(op(2,expn)))
    end if
  elif type(expn,'`+`') or type(expn,'`*`') then
    max(ExpnType(op(1,expn)),max(ExpnType(rest(expn))))
  elif ElementaryFunctionQ(op(0,expn)) then
    max(3,ExpnType(op(1,expn)))
  elif SpecialFunctionQ(op(0,expn)) then
    max(4,apply(max,map(ExpnType,[op(expn)])))
  elif HypergeometricFunctionQ(op(0,expn)) then
    max(5,apply(max,map(ExpnType,[op(expn)])))
  elif AppellFunctionQ(op(0,expn)) then
    max(6,apply(max,map(ExpnType,[op(expn)])))
  elif op(0,expn)='int' then
    max(8,apply(max,map(ExpnType,[op(expn)]))) else
  9
```

```
  end if
end proc:


ElementaryFunctionQ := proc(func)
  member(func,[
        exp,log,ln,
        sin,cos,tan,cot,sec,csc,
        arcsin,arccos,arctan,arccot,arcsec,arccsc,
        sinh,cosh,tanh,coth,sech,csch,
        arcsinh,arccosh,arctanh,arccoth,arcsech,arccsch])
end proc:

SpecialFunctionQ := proc(func)
  member(func,[
        erf,erfc,erfi,
        FresnelS,FresnelC,
        Ei,Ei,Li,Si,Ci,Shi,Chi,
        GAMMA,lnGAMMA,Psi,Zeta,polylog,dilog,LambertW,
        EllipticF,EllipticE,EllipticPi])
end proc:

HypergeometricFunctionQ := proc(func)
  member(func,[Hypergeometric1F1,hypergeom,HypergeometricPFQ])
end proc:

AppellFunctionQ := proc(func)
  member(func,[AppellF1])
end proc:

# u is a sum or product.  rest(u) returns all but the
# first term or factor of u.
rest := proc(u) local v;
  if nops(u)=2 then
     op(2,u)
  else
     apply(op(0,u),op(2..nops(u),u))
  end if
end proc:

#leafcount(u) returns the number of nodes in u.
```

```
#Nasser 3/23/17  Replaced by build-in leafCount from package in Maple
leafcount := proc(u)
   MmaTranslator[Mma][LeafCount](u);
end proc:
```

Sympy grading function

```
#Dec 24, 2019. Nasser M. Abbasi:
#             Port of original Maple grading function by
#             Albert Rich to use with Sympy/Python
#Dec 27, 2019  Nasser. Added `RootSum`. See problem 177, Timofeev file
#             added 'exp_polar'
from sympy import *

def leaf_count(expr):
   #sympy do not have leaf count function. This is approximation
   return round(1.7*count_ops(expr))

def is_sqrt(expr):
   if isinstance(expr,Pow):
      if expr.args[1] == Rational(1,2):
         return True
      else:
         return False
   else:
      return False

def is_elementary_function(func):
   return func in [exp,log,ln,sin,cos,tan,cot,sec,csc,
         asin,acos,atan,acot,asec,acsc,sinh,cosh,tanh,coth,sech,csch,
         asinh,acosh,atanh,acoth,asech,acsch
      ]

def is_special_function(func):
   return func in [ erf,erfc,erfi,
          fresnels,fresnelc,Ei,Ei,Li,Si,Ci,Shi,Chi,
          gamma,loggamma,digamma,zeta,polylog,LambertW,
          elliptic_f,elliptic_e,elliptic_pi,exp_polar
       ]
```

```
def is_hypergeometric_function(func):
   return func in [hyper]

def is_appell_function(func):
   return func in [appellf1]

def is_atom(expn):
   try:
      if expn.isAtom or isinstance(expn,int) or isinstance(expn,float):
        return True
      else:
        return False

   except AttributeError as error:
      return False

def expnType(expn):
   debug=False
   if debug:
      print("expn=",expn,"type(expn)=",type(expn))

   if is_atom(expn):
     return 1
   elif isinstance(expn,list):
      return max(map(expnType, expn))    #apply(max,map(ExpnType,expn))
   elif  is_sqrt(expn):
      if isinstance(expn.args[0],Rational): #type(op(1,expn),'rational')
         return 1
      else:
         return max(2,expnType(expn.args[0]))  #max(2,ExpnType(op(1,expn)))
   elif isinstance(expn,Pow):    #type(expn,'`^`')
      if isinstance(expn.args[1],Integer):  #type(op(2,expn),'integer')
         return expnType(expn.args[0])    #ExpnType(op(1,expn))
      elif isinstance(expn.args[1],Rational):  #type(op(2,expn),'rational')
         if isinstance(expn.args[0],Rational): #type(op(1,expn),'rational')
            return 1
         else:
            return max(2,expnType(expn.args[0]))  #max(2,ExpnType(op(1,expn)))
      else:
         return max(3,expnType(expn.args[0]),expnType(expn.args[1])) #max(3,ExpnType(op(1,expn)),Expn
   elif isinstance(expn,Add) or isinstance(expn,Mul): #type(expn,'`+`') or type(expn,'`*`')
```

```
        m1 = expnType(expn.args[0])
        m2 = expnType(list(expn.args[1:]))
        return max(m1,m2)  #max(ExpnType(op(1,expn)),max(ExpnType(rest(expn))))
    elif is_elementary_function(expn.func):  #ElementaryFunctionQ(op(0,expn))
        return max(3,expnType(expn.args[0]))  #max(3,ExpnType(op(1,expn)))
    elif is_special_function(expn.func): #SpecialFunctionQ(op(0,expn))
        m1 = max(map(expnType, list(expn.args)))
        return max(4,m1)   #max(4,apply(max,map(ExpnType,[op(expn)])))
    elif is_hypergeometric_function(expn.func): #HypergeometricFunctionQ(op(0,expn))
        m1 = max(map(expnType, list(expn.args)))
        return max(5,m1)   #max(5,apply(max,map(ExpnType,[op(expn)])))
    elif is_appell_function(expn.func):
        m1 = max(map(expnType, list(expn.args)))
        return max(6,m1)   #max(5,apply(max,map(ExpnType,[op(expn)])))
    elif isinstance(expn,RootSum):
        m1 = max(map(expnType, list(expn.args))) #Apply[Max,Append[Map[ExpnType,Apply[List,expn]],7]],
        return max(7,m1)
    elif str(expn).find("Integral") != -1:
        m1 = max(map(expnType, list(expn.args)))
        return max(8,m1)   #max(5,apply(max,map(ExpnType,[op(expn)])))
    else:
        return 9

#main function
def grade_antiderivative(result,optimal):

    #print ("Enter grade_antiderivative for sagemath")
    #print("Enter grade_antiderivative, result=",result," optimal=",optimal)

    leaf_count_result  = leaf_count(result)
    leaf_count_optimal = leaf_count(optimal)

    #print("leaf_count_result=",leaf_count_result)
    #print("leaf_count_optimal=",leaf_count_optimal)

    expnType_result  = expnType(result)
    expnType_optimal = expnType(optimal)

    if str(result).find("Integral") != -1:
        grade = "F"
        grade_annotation =""
```

```
else:
    if expnType_result <= expnType_optimal:
        if result.has(I):
            if optimal.has(I): #both result and optimal complex
                if leaf_count_result <= 2*leaf_count_optimal:
                    grade = "A"
                    grade_annotation =""
                else:
                    grade = "B"
                    grade_annotation ="Both result and optimal contain complex but leaf count of result is lar
            else: #result contains complex but optimal is not
                grade = "C"
                grade_annotation ="Result contains complex when optimal does not."
        else: # result do not contain complex, this assumes optimal do not as well
            if leaf_count_result <= 2*leaf_count_optimal:
                grade = "A"
                grade_annotation =""
            else:
                grade = "B"
                grade_annotation ="Leaf count of result is larger than twice the leaf count of optimal. "+str(
    else:
        grade = "C"
        grade_annotation ="Result contains higher order function than in optimal. Order "+str(ExpnType


#print("Before returning. grade=",grade, " grade_annotation=",grade_annotation)

return grade, grade_annotation
```

SageMath grading function

```
#Dec 24, 2019. Nasser: Ported original Maple grading function by
#          Albert Rich to use with Sagemath. This is used to
#          grade Fricas, Giac and Maxima results.
#Dec 24, 2019. Nasser: Added 'exp_integral_e' and 'sng', 'sin_integral'
#          'arctan2','floor','abs','log_integral'
#June 4, 2022  Made default grade_annotation "none" instead of "" due
#          issue later when reading the file.
#July 14, 2022. Added ellipticF. This is until they fix sagemath, then remove it.
```

```
from sage.all import *
from sage.symbolic.operators import add_vararg, mul_vararg

debug=False;

def tree_size(expr):
    r"""
    Return the tree size of this expression.
    """
    #print("Enter tree_size, expr is ",expr)

    if expr not in SR:
        # deal with lists, tuples, vectors
        return 1 + sum(tree_size(a) for a in expr)
    expr = SR(expr)
    x, aa = expr.operator(), expr.operands()
    if x is None:
        return 1
    else:
        return 1 + sum(tree_size(a) for a in aa)

def is_sqrt(expr):
    if expr.operator() == operator.pow:   #isinstance(expr,Pow):
        if expr.operands()[1]==1/2: #expr.args[1] == Rational(1,2):
            if debug: print ("expr is sqrt")
            return True
        else:
            return False
    else:
        return False

def is_elementary_function(func):
    #debug=False
    m = func.name() in ['exp','log','ln',
            'sin','cos','tan','cot','sec','csc',
            'arcsin','arccos','arctan','arccot','arcsec','arccsc',
            'sinh','cosh','tanh','coth','sech','csch',
            'arcsinh','arccosh','arctanh','arccoth','arcsech','arccsch','sgn',
        'arctan2','floor','abs'
        ]
    if debug:
```

```
        if m:
            print ("func ", func , " is elementary_function")
        else:
            print ("func ", func , " is NOT elementary_function")


    return m

def is_special_function(func):
    #debug=False
    if debug:
        print ("type(func)=", type(func))

    m= func.name() in ['erf','erfc','erfi','fresnel_sin','fresnel_cos','Ei',
           'Ei','Li','Si','sin_integral','Ci','cos_integral','Shi','sinh_integral'
           'Chi','cosh_integral','gamma','log_gamma','psi','zeta',
           'polylog','lambert_w','elliptic_f','elliptic_e','ellipticF',
           'elliptic_pi','exp_integral_e','log_integral',
           'weierstrassPInverse','weierstrass','weierstrassP','weierstrassZeta',
           'weierstrassPPrime','weierstrassSigma']

    if debug:
        print ("m=",m)
        if m:
            print ("func ", func ," is special_function")
        else:
            print ("func ", func ," is NOT special_function")


    return m


def is_hypergeometric_function(func):
    return func.name() in ['hypergeometric','hypergeometric_M','hypergeometric_U']

def is_appell_function(func):
    return func.name() in ['hypergeometric']   #[appellf1] can't find this in sagemath

def is_atom(expn):

    #debug=False
```

```
    if debug:
         print ("Enter is_atom, expn=",expn)

    if not hasattr(expn, 'parent'):
        return False


    #thanks to answer at https://ask.sagemath.org/question/49179/what-is-sagemath-equivalent-to-atomic
    try:
        if expn.parent() is SR:
            return expn.operator() is None
        if expn.parent() in (ZZ, QQ, AA, QQbar):
            return expn in expn.parent() # Should always return True
        if hasattr(expn.parent(),"base_ring") and hasattr(expn.parent(),"gens"):
            return expn in expn.parent().base_ring() or expn in expn.parent().gens()

        return False

    except AttributeError as error:
        print("Exception,AttributeError in  is_atom")
        print ("cought exception" , type(error).__name__ )
        return False


def expnType(expn):

    if debug:
        print (">>>>>Enter expnType, expn=", expn)
        print (">>>>>is_atom(expn)=", is_atom(expn))

    if is_atom(expn):
        return 1
    elif type(expn)==list:   #isinstance(expn,list):
        return max(map(expnType, expn))    #apply(max,map(ExpnType,expn))
    elif  is_sqrt(expn):
        if  type(expn.operands()[0])==Rational: #type(isinstance(expn.args[0],Rational):
            return 1
        else:
            return max(2,expnType(expn.operands()[0]))  #max(2,expnType(expn.args[0]))
    elif expn.operator() == operator.pow:   #isinstance(expn,Pow)
        if type(expn.operands()[1])==Integer:  #isinstance(expn.args[1],Integer)
```

```
            return expnType(expn.operands()[0])    #expnType(expn.args[0])
        elif type(expn.operands()[1])==Rational:  #isinstance(expn.args[1],Rational)
            if type(expn.operands()[0])==Rational: #isinstance(expn.args[0],Rational)
                return 1
            else:
                return max(2,expnType(expn.operands()[0]))  #max(2,expnType(expn.args[0]))
        else:
            return max(3,expnType(expn.operands()[0]),expnType(expn.operands()[1])) #max(3,expnType(expr
    elif expn.operator() == add_vararg or expn.operator() == mul_vararg: #isinstance(expn,Add) or isins
        m1 = expnType(expn.operands()[0]) #expnType(expn.args[0])
        m2 = expnType(expn.operands()[1:]) #expnType(list(expn.args[1:]))
        return max(m1,m2)  #max(ExpnType(op(1,expn)),max(ExpnType(rest(expn))))
    elif is_elementary_function(expn.operator()):  #is_elementary_function(expn.func)
        return max(3,expnType(expn.operands()[0]))
    elif is_special_function(expn.operator()): #is_special_function(expn.func)
        m1 = max(map(expnType, expn.operands()))      #max(map(expnType, list(expn.args)))
        return max(4,m1)   #max(4,m1)
    elif is_hypergeometric_function(expn.operator()): #is_hypergeometric_function(expn.func)
        m1 = max(map(expnType, expn.operands()))      #max(map(expnType, list(expn.args)))
        return max(5,m1)   #max(5,m1)
    elif is_appell_function(expn.operator()):
        m1 = max(map(expnType, expn.operands()))      #max(map(expnType, list(expn.args)))
        return max(6,m1)   #max(6,m1)
    elif str(expn).find("Integral") != -1: #this will never happen, since it
                #is checked before calling the grading function that is passed.
                #but kept it here.
        m1 = max(map(expnType, expn.operands()))      #max(map(expnType, list(expn.args)))
        return max(8,m1)   #max(5,apply(max,map(ExpnType,[op(expn)])))
    else:
        return 9

#main function
def grade_antiderivative(result,optimal):


    if debug:
        print ("Enter grade_antiderivative for sagemath")
        print("Enter grade_antiderivative, result=",result)
        print("Enter grade_antiderivative, optimal=",optimal)
        print("type(anti)=",type(result))
        print("type(optimal)=",type(optimal))
```

```
leaf_count_result  = tree_size(result) #leaf_count(result)
leaf_count_optimal = tree_size(optimal) #leaf_count(optimal)

#if debug: print ("leaf_count_result=", leaf_count_result, "leaf_count_optimal=",leaf_count_optimal)


expnType_result  = expnType(result)
expnType_optimal = expnType(optimal)

if debug: print ("expnType_result=", expnType_result, "expnType_optimal=",expnType_optimal)

if expnType_result <= expnType_optimal:
    if result.has(I):
        if optimal.has(I): #both result and optimal complex
            if leaf_count_result <= 2*leaf_count_optimal:
                grade = "A"
                grade_annotation ="none"
            else:
                grade = "B"
                grade_annotation ="Both result and optimal contain complex but leaf count of result is larger
        else: #result contains complex but optimal is not
            grade = "C"
            grade_annotation ="Result contains complex when optimal does not."
    else: # result do not contain complex, this assumes optimal do not as well
        if leaf_count_result <= 2*leaf_count_optimal:
            grade = "A"
            grade_annotation ="none"
        else:
            grade = "B"
            grade_annotation ="Leaf count of result is larger than twice the leaf count of optimal. "+str(lea
else:
    grade = "C"
    grade_annotation ="Result contains higher order function than in optimal. Order "+str(expnType_re


print("Before returning. grade=",grade, " grade_annotation=",grade_annotation)

return grade, grade_annotation
```

4.2 Links to plain text integration problems used in this report for each CAS

1. Mathematica integration problems as .m file
2. Maple integration problems as .txt file
3. Sagemath integration problems as .sage file
4. Reduce integration problems as .txt file
5. Mupad integration problems as .txt file
6. Sympy integration problems as .py file