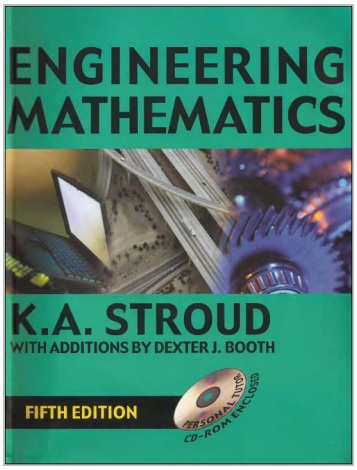
A Solution Manual For

# Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001

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# Contents

# 1 Program 24. First order differential equations. Test excercise 24. page 1067

## 1.1 problem 1

Internal problem ID [4566]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 1.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_quadrature]`

$$\boxed{y'x - x^2 - 2x + 3 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 18

```
dsolve(x*diff(y(x),x)=x^2+2*x-3,y(x), singsol=all)
```

$$y(x) = \frac{x^2}{2} + 2x - 3\ln(x) + c_1$$

✓ Solution by Mathematica

Time used: 0.003 (sec). Leaf size: 20

```
DSolve[x*y'[x]==x^2+2*x-3,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{2}x(x+4) - 3\log(x) + c_1$$

## 1.2 problem 2

Internal problem ID [4567]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 2.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{(x+1)^2 y' - 1 - y^2 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 17

```
dsolve((1+x)^2*diff(y(x),x)=1+y(x)^2,y(x), singsol=all)
```

$$y(x) = \tan\left(\frac{c_1 x + c_1 - 1}{x+1}\right)$$

✓ Solution by Mathematica

Time used: 0.28 (sec). Leaf size: 32

```
DSolve[(1+x)^2*y'[x]==1+y[x]^2,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\tan\left(\frac{1}{x+1} - c_1\right)$$
$$y(x) \to -i$$
$$y(x) \to i$$

## 1.3 problem 3

Internal problem ID [4568]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 3.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_linear, 'class A']]`

$$\boxed{y' + 2y - \mathrm{e}^{3x} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 17

```
dsolve(diff(y(x),x)+2*y(x)=exp(3*x),y(x), singsol=all)
```

$$y(x) = \left(\frac{\mathrm{e}^{5x}}{5} + c_1\right) \mathrm{e}^{-2x}$$

✓ Solution by Mathematica

Time used: 0.042 (sec). Leaf size: 23

```
DSolve[y'[x]+2*y[x]==Exp[3*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{e^{3x}}{5} + c_1 e^{-2x}$$

## 1.4 problem 4

Internal problem ID [4569]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 4.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{-y + y'x - x^2 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 9

```
dsolve(x*diff(y(x),x)-y(x)=x^2,y(x), singsol=all)
```

$$y(x) = (x + c_1)\, x$$

✓ Solution by Mathematica

Time used: 0.025 (sec). Leaf size: 11

```
DSolve[x*y'[x]-y[x]==x^2,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to x(x + c_1)$$

## 1.5 problem 5

Internal problem ID [4570]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 5.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_quadrature]`

$$\boxed{x^2 y' - x^3 \sin(3x) - 4 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 24

```
dsolve(x^2*diff(y(x),x)=x^3*sin(3*x)+4,y(x), singsol=all)
```

$$y(x) = \frac{\sin(3x)}{9} - \frac{x\cos(3x)}{3} - \frac{4}{x} + c_1$$

✓ Solution by Mathematica

Time used: 0.011 (sec). Leaf size: 30

```
DSolve[x^2*y'[x]==x^3*Sin[3*x]+4,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{4}{x} + \frac{1}{9}\sin(3x) - \frac{1}{3}x\cos(3x) + c_1$$

## 1.6 problem 6

Internal problem ID [4571]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 6.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{x \cos(y) y' - \sin(y) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 8

```
dsolve(x*cos(y(x))*diff(y(x),x)-sin(y(x))=0,y(x), singsol=all)
```

$$y(x) = \arcsin(c_1 x)$$

✓ Solution by Mathematica

Time used: 6.183 (sec). Leaf size: 17

```
DSolve[x*Cos[y[x]]*y'[x]-Sin[y[x]]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \arcsin(e^{c_1} x)$$
$$y(x) \to 0$$

## 1.7 problem 7

Internal problem ID [4572]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 7.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class A'], _rational, _dAlembert]`

$$\boxed{\left(x^3+xy^2\right)y'-2y^3=0}$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 47

```
dsolve((x^3+x*y(x)^2)*diff(y(x),x)=2*y(x)^3,y(x), singsol=all)
```

$$y(x)=\left(\frac{c_1x}{2}-\frac{\sqrt{c_1^2x^2+4}}{2}\right)x$$
$$y(x)=\left(\frac{c_1x}{2}+\frac{\sqrt{c_1^2x^2+4}}{2}\right)x$$

✓ Solution by Mathematica

Time used: 1.238 (sec). Leaf size: 83

```
DSolve[(x^3+x*y[x]^2)*y'[x]==2*y[x]^3,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)\to -\frac{1}{2}x\left(\sqrt{4+e^{2c_1}x^2}+e^{c_1}x\right)$$
$$y(x)\to \frac{1}{2}x\left(\sqrt{4+e^{2c_1}x^2}-e^{c_1}x\right)$$
$$y(x)\to 0$$
$$y(x)\to -x$$
$$y(x)\to x$$

## 1.8 problem 8

Internal problem ID [4573]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 8.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{\left(x^2-1\right)y'+2xy-x=0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 22

```
dsolve((x^2-1)*diff(y(x),x)+2*x*y(x)=x,y(x), singsol=all)
```

$$y(x)=\frac{\frac{x^2}{2}+c_1}{(x-1)(x+1)}$$

✓ Solution by Mathematica

Time used: 0.029 (sec). Leaf size: 31

```
DSolve[(x^2-1)*y'[x]+2*x*y[x]==x,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)\to\frac{x^2+2c_1}{2\left(x^2-1\right)}$$
$$y(x)\to\frac{1}{2}$$

## 1.9 problem 9

Internal problem ID [4574]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 9.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' + y\tanh(x) - 2\sinh(x) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 17

```
dsolve(diff(y(x),x)+y(x)*tanh(x)=2*sinh(x),y(x), singsol=all)
```

$$y(x) = \frac{\frac{\cosh(2x)}{2} + c_1}{\cosh(x)}$$

✓ Solution by Mathematica

Time used: 0.097 (sec). Leaf size: 20

```
DSolve[y'[x]+y[x]*Tanh[x]==2*Sinh[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{2}\operatorname{sech}(x)(\cosh(2x) + 2c_1)$$

## 1.10 problem 10

Internal problem ID [4575]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 10.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y'x - 2y - \cos(x)\, x^3 = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 12

```
dsolve(x*diff(y(x),x)-2*y(x)=x^3*cos(x),y(x), singsol=all)
```

$$y(x) = (\sin(x) + c_1)\, x^2$$

✓ Solution by Mathematica

Time used: 0.037 (sec). Leaf size: 14

```
DSolve[x*y'[x]-2*y[x]==x^3*Cos[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to x^2(\sin(x) + c_1)$$

## 1.11 problem 11

Internal problem ID [4576]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 11.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class G'], _rational, _Bernoulli]`

$$\boxed{y' + \frac{y}{x} - y^3 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 31

```
dsolve(diff(y(x),x)+y(x)/x=y(x)^3,y(x), singsol=all)
```

$$y(x) = \frac{1}{\sqrt{c_1 x^2 + 2x}}$$
$$y(x) = -\frac{1}{\sqrt{c_1 x^2 + 2x}}$$

✓ Solution by Mathematica

Time used: 0.38 (sec). Leaf size: 40

```
DSolve[y'[x]+y[x]/x==y[x]^3,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{1}{\sqrt{x(2 + c_1 x)}}$$
$$y(x) \to \frac{1}{\sqrt{x(2 + c_1 x)}}$$
$$y(x) \to 0$$

## 1.12 problem 12

Internal problem ID [4577]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Test excercise 24. page 1067
**Problem number**: 12.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class G'], _rational, _Bernoulli]`

$$\boxed{y'x + 3y - x^2y^2 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 15

```
dsolve(x*diff(y(x),x)+3*y(x)=x^2*y(x)^2,y(x), singsol=all)
```

$$y(x) = \frac{1}{x^2\left(c_1 x + 1\right)}$$

✓ Solution by Mathematica

Time used: 0.141 (sec). Leaf size: 22

```
DSolve[x*y'[x]+3*y[x]==x^2*y[x]^2,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{x^2 + c_1 x^3}$$
$$y(x) \to 0$$

# 2 Program 24. First order differential equations. Further problems 24. page 1068

## 2.1 problem 1

Internal problem ID [4578]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 1.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{x(y-3)\,y'-4y=0}$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 25

```
dsolve(x*(y(x)-3)*diff(y(x),x)=4*y(x),y(x), singsol=all)
```

$$y(x)=\mathrm{e}^{-\operatorname{LambertW}\left(-\frac{\mathrm{e}^{-\frac{4c_1}{3}}}{3x^{\frac{4}{3}}}\right)-\frac{4\ln(x)}{3}-\frac{4c_1}{3}}$$

✓ Solution by Mathematica

Time used: 15.382 (sec). Leaf size: 94

```
DSolve[x*(y[x]-3)*y'[x]==4*y[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)\to -3W\left(\frac{1}{3}\sqrt[3]{-\frac{e^{-c_1}}{x^4}}\right)$$
$$y(x)\to -3W\left(-\frac{1}{3}\sqrt[3]{-1}\sqrt[3]{-\frac{e^{-c_1}}{x^4}}\right)$$
$$y(x)\to -3W\left(\frac{1}{3}(-1)^{2/3}\sqrt[3]{-\frac{e^{-c_1}}{x^4}}\right)$$
$$y(x)\to 0$$

## 2.2 problem 2

Internal problem ID [4579]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 2.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{\left(x^3+1\right)y' - x^2 y = 0}$$

With initial conditions

$$[y(1) = 2]$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 15

```
dsolve([(1+x^3)*diff(y(x),x)=x^2*y(x),y(1) = 2],y(x), singsol=all)
```

$$y(x) = 2^{\frac{2}{3}}\left(x^3+1\right)^{\frac{1}{3}}$$

✓ Solution by Mathematica

Time used: 0.033 (sec). Leaf size: 20

```
DSolve[{(1+x^3)*y'[x]==x^2*y[x],{y[1]==2}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to 2^{2/3}\sqrt[3]{x^3+1}$$

## 2.3 problem 3

Internal problem ID [4580]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 3.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{x^3 + (1+y)^2 y' = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 89

```
dsolve(x^3+(y(x)+1)^2*diff(y(x),x)=0,y(x), singsol=all)
```

$$y(x) = \frac{(-6x^4 - 24c_1)^{\frac{1}{3}}}{2} - 1$$
$$y(x) = -\frac{(-6x^4 - 24c_1)^{\frac{1}{3}}}{4} - \frac{i\sqrt{3}\,(-6x^4 - 24c_1)^{\frac{1}{3}}}{4} - 1$$
$$y(x) = -\frac{(-6x^4 - 24c_1)^{\frac{1}{3}}}{4} + \frac{i\sqrt{3}\,(-6x^4 - 24c_1)^{\frac{1}{3}}}{4} - 1$$

✓ Solution by Mathematica

Time used: 0.493 (sec). Leaf size: 89

```
DSolve[x^3+(y[x]+1)^2*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -1 + \frac{\sqrt[3]{-3x^4 + 4 + 12c_1}}{2^{2/3}}$$
$$y(x) \to -1 + \left(-\frac{1}{2}\right)^{2/3} \sqrt[3]{-3x^4 + 4 + 12c_1}$$
$$y(x) \to \frac{1}{2}\left(-2 - \sqrt[3]{-2}\sqrt[3]{-3x^4 + 4 + 12c_1}\right)$$

## 2.4 problem 4

Internal problem ID [4581]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 4.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{\cos(y) + \left(\mathrm{e}^{-x} + 1\right) \sin(y)\, y' = 0}$$

With initial conditions

$$\left[y(0) = \frac{\pi}{4}\right]$$

✓ Solution by Maple

Time used: 0.156 (sec). Leaf size: 14

```
dsolve([cos(y(x))+(1+exp(-x))*sin(y(x))*diff(y(x),x)=0,y(0) = 1/4*Pi],y(x), singsol=all)
```

$$y(x) = \arccos\left(\frac{\sqrt{2}\,(\mathrm{e}^{x} + 1)}{4}\right)$$

✓ Solution by Mathematica

Time used: 49.806 (sec). Leaf size: 20

```
DSolve[{Cos[y[x]]+(1+Exp[-x])*Sin[y[x]]*y'[x]==0,{y[0]==Pi/4}},y[x],x,IncludeSingularSolution
```

$$y(x) \to \arccos\left(\frac{e^{x} + 1}{2\sqrt{2}}\right)$$

## 2.5 problem 5

Internal problem ID [4582]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 5.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{x^2(1+y)+y^2(x-1)\,y'=0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 30

```
dsolve(x^2*(y(x)+1)+y(x)^2*(x-1)*diff(y(x),x)=0,y(x), singsol=all)
```

$$\frac{x^2}{2}+x+\ln(x-1)+\frac{y(x)^2}{2}-y(x)+\ln(y(x)+1)+c_1=0$$

✓ Solution by Mathematica

Time used: 0.427 (sec). Leaf size: 54

```
DSolve[x^2*(y[x]+1)+y[x]^2*(x-1)*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)\to \text{InverseFunction}\left[\frac{1}{2}(\#1+1)^2-2(\#1+1)+\log(\#1+1)\&\right]\left[-\frac{1}{2}x(x+2)-\log(x-1)+\frac{3}{2}+c_1\right]$$

$$y(x)\to -1$$

## 2.6 problem 6

Internal problem ID [4583]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 6.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class A'], _exact, _rational, [_Abel, '2nd typ`

$$\boxed{(2y-x)\,y'-y-2x=0}$$

✓ Solution by Maple

Time used: 0.031 (sec). Leaf size: 53

```
dsolve((2*y(x)-x)*diff(y(x),x)=2*x+y(x),y(x), singsol=all)
```

$$y(x)=\frac{\frac{c_1 x}{2}-\frac{\sqrt{5c_1^2x^2+4}}{2}}{c_1}$$
$$y(x)=\frac{\frac{c_1 x}{2}+\frac{\sqrt{5c_1^2x^2+4}}{2}}{c_1}$$

✓ Solution by Mathematica

Time used: 0.458 (sec). Leaf size: 102

```
DSolve[(2*y[x]-x)*y'[x]==2*x+y[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)\to\frac{1}{2}\left(x-\sqrt{5x^2-4e^{c_1}}\right)$$
$$y(x)\to\frac{1}{2}\left(x+\sqrt{5x^2-4e^{c_1}}\right)$$
$$y(x)\to\frac{1}{2}\left(x-\sqrt{5}\sqrt{x^2}\right)$$
$$y(x)\to\frac{1}{2}\left(\sqrt{5}\sqrt{x^2}+x\right)$$

## 2.7 problem 7

Internal problem ID [4584]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 7.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, ‘class A‘], _rational, [_Abel, ‘2nd type‘, ‘cla`

$$\boxed{xy + y^2 + \left(x^2 - xy\right) y' = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 25

```
dsolve((x*y(x)+y(x)^2)+(x^2-x*y(x))*diff(y(x),x)=0,y(x), singsol=all)
```

$$y(x) = \frac{\mathrm{e}^{-\operatorname{LambertW}\left(-\frac{\mathrm{e}^{-2c_1}}{x^2}\right)-2c_1}}{x}$$

✓ Solution by Mathematica

Time used: 3.251 (sec). Leaf size: 25

```
DSolve[(x*y[x]+y[x]^2)+(x^2-x*y[x])*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -xW\left(-\frac{e^{-c_1}}{x^2}\right)$$
$$y(x) \to 0$$

## 2.8 problem 8

Internal problem ID [4585]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 8.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class A'], _rational, _Bernoulli]`

$$\boxed{y^3 + x^3 - 3xy^2y' = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 90

```
dsolve((x^3+y(x)^3)=3*x*y(x)^2*diff(y(x),x),y(x), singsol=all)
```

$$y(x) = \frac{(4x^3 + 8c_1x)^{\frac{1}{3}}}{2}$$
$$y(x) = -\frac{(4x^3 + 8c_1x)^{\frac{1}{3}}}{4} - \frac{i\sqrt{3}\,(4x^3 + 8c_1x)^{\frac{1}{3}}}{4}$$
$$y(x) = -\frac{(4x^3 + 8c_1x)^{\frac{1}{3}}}{4} + \frac{i\sqrt{3}\,(4x^3 + 8c_1x)^{\frac{1}{3}}}{4}$$

✓ Solution by Mathematica

Time used: 0.21 (sec). Leaf size: 90

```
DSolve[(x^3+y[x]^3)==3*x*y[x]^2*y'[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\sqrt[3]{-\frac{1}{2}}\sqrt[3]{x}\sqrt[3]{x^2 + 2c_1}$$
$$y(x) \to \frac{\sqrt[3]{x}\sqrt[3]{x^2 + 2c_1}}{\sqrt[3]{2}}$$
$$y(x) \to \frac{(-1)^{2/3}\sqrt[3]{x}\sqrt[3]{x^2 + 2c_1}}{\sqrt[3]{2}}$$

## 2.9 problem 9

Internal problem ID [4586]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 9.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, ‘class A‘], _rational, [_Abel, ‘2nd type‘, ‘cla`

$$\boxed{y - 3x + (4y + 3x)\,y' = 0}$$

✓ Solution by Maple

Time used: 0.25 (sec). Leaf size: 278

```
dsolve(y(x)-3*x+(4*y(x)+3*x)*diff(y(x),x)=0,y(x), singsol=all)
```

$$y(x) = -\frac{3x^8 c_1 \operatorname{RootOf}\left(\_Z^{64} c_1 x^8 + 12\_Z^{56} c_1 x^8 + 48\_Z^{48} c_1 x^8 + 64\_Z^{40} c_1 x^8 - 1\right)^{56} + 24x^8 c_1 \operatorname{RootOf}\left(\_Z^{64} c_1 x^{\phantom{8}}\right.}{2c_1 x^7 \operatorname{RootOf}\left(\_Z^{64} c_1 x^8 + 12\_Z^{56} c_1 x^8 + 48\_Z^{48} c_1 x^8 + 64\_Z^{40} c_1 x^8 - 1\right)^{40} \left(\operatorname{RootOf}\left(\_Z^{64} c_1 x^8 -\right.}$$

✓ Solution by Mathematica

Time used: 5.306 (sec). Leaf size: 673

```
DSolve[y[x]-3*x+(4*y[x]+3*x)*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,1\right]$$

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,2\right]$$

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,3\right]$$

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,4\right]$$

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,5\right]$$

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,6\right]$$

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,7\right]$$

$$y(x) \to \text{Root}\left[256\#1^8+512\#1^7x-512\#1^6x^2-896\#1^5x^3+800\#1^4x^4+352\#1^3x^5 -576\#1^2x^6+216\#1x^7-27x^8+e^{8c_1}\&,8\right]$$

## 2.10 problem 10

Internal problem ID [4587]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 10.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class A'], _rational, _dAlembert]`

$$\boxed{\left(x^3+3xy^2\right)y'-y^3-3x^2y=0}$$

✓ Solution by Maple

Time used: 0.063 (sec). Leaf size: 23

```
dsolve((x^3+3*x*y(x)^2)*diff(y(x),x)=y(x)^3+3*x^2*y(x),y(x), singsol=all)
```

$$y(x)=\text{RootOf}\left(\_Z^4c_1x-c_1x-\_Z\right)^2x$$

✓ Solution by Mathematica

Time used: 60.145 (sec). Leaf size: 1659

```
DSolve[(x^3+3*x*y[x]^2)*y'[x]==y[x]^3+3*x^2*y[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)$$

$$\to \frac{1}{6}\left(-\sqrt{3}\sqrt{4x^2+\frac{16\sqrt[3]{2}x^4}{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+81e^{4c_1}x^4}}}+\frac{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+}}}{\sqrt[3]{2}}}\right.$$

$$\left.-3\sqrt{\frac{8x^2}{3}-\frac{16\sqrt[3]{2}x^4}{3\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+81e^{4c_1}x^4}}}-\frac{}{\sqrt{4x^2+\frac{16\sqrt[3]{2}x^4}{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c}}}}}}}\right)$$

$$y(x)$$

$$\to \frac{1}{6}\left(3\sqrt{\frac{8x^2}{3}-\frac{16\sqrt[3]{2}x^4}{3\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+81e^{4c_1}x^4}}}-\frac{}{\sqrt{4x^2+\frac{16\sqrt[3]{2}x^4}{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e}}}}}}\right.$$

$$\left.-\sqrt{3}\sqrt{4x^2+\frac{16\sqrt[3]{2}x^4}{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+81e^{4c_1}x^4}}}+\frac{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+81}}}{\sqrt[3]{2}}}\right)$$

$$y(x)$$

$$\to \frac{1}{6}\left(\sqrt{3}\sqrt{4x^2+\frac{16\sqrt[3]{2}x^4}{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+81e^{4c_1}x^4}}}+\frac{\sqrt[3]{128x^6+27e^{2c_1}x^2+3\sqrt{768e^{2c_1}x^8+8}}}{\sqrt[3]{2}}}\right.$$

## 2.11 problem 11

Internal problem ID [4588]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 11.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{-y + y'x - x^3 - 3x^2 + 2x = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 20

```
dsolve(x*diff(y(x),x)-y(x)=x^3+3*x^2-2*x,y(x), singsol=all)
```

$$y(x) = \left(\frac{x^2}{2} + 3x - 2\ln(x) + c_1\right) x$$

✓ Solution by Mathematica

Time used: 0.028 (sec). Leaf size: 22

```
DSolve[x*y'[x]-y[x]==x^3+3*x^2-2*x,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to x\left(\frac{1}{2}x(x+6) - 2\log(x) + c_1\right)$$

## 2.12 problem 12

Internal problem ID [4589]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 12.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' + y\tan(x) - \sin(x) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 14

```
dsolve(diff(y(x),x)+y(x)*tan(x)=sin(x),y(x), singsol=all)
```

$$y(x) = (-\ln(\cos(x)) + c_1)\cos(x)$$

✓ Solution by Mathematica

Time used: 0.059 (sec). Leaf size: 16

```
DSolve[y'[x]+y[x]*Tan[x]==Sin[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \cos(x)(-\log(\cos(x)) + c_1)$$

## 2.13 problem 13

Internal problem ID [4590]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 13.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{-y + y'x - \cos(x)\, x^3 = 0}$$

With initial conditions

$$[y(\pi) = 0]$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 14

```
dsolve([x*diff(y(x),x)-y(x)=x^3*cos(x),y(Pi) = 0],y(x), singsol=all)
```

$$y(x) = (\cos(x) + \sin(x)\, x + 1)\, x$$

✓ Solution by Mathematica

Time used: 0.043 (sec). Leaf size: 15

```
DSolve[{x*y'[x]-y[x]==x^3*Cos[x],{y[Pi]==0}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to x(x\sin(x) + \cos(x) + 1)$$

## 2.14 problem 14

Internal problem ID [4591]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 14.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{\left(x^2+1\right)y' + 3xy - 5x = 0}$$

With initial conditions

$$[y(1) = 2]$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 18

```
dsolve([(1+x^2)*diff(y(x),x)+3*x*y(x)=5*x,y(1) = 2],y(x), singsol=all)
```

$$y(x) = \frac{5}{3} + \frac{2\sqrt{2}}{3\left(x^2+1\right)^{\frac{3}{2}}}$$

✓ Solution by Mathematica

Time used: 0.039 (sec). Leaf size: 27

```
DSolve[{(1+x^2)*y'[x]+3*x*y[x]==5*x,{y[1]==2}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{2\sqrt{2}}{3\left(x^2+1\right)^{3/2}} + \frac{5}{3}$$

## 2.15 problem 15

Internal problem ID [4592]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 15.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' + y\cot(x) - 5\,\mathrm{e}^{\cos(x)} = 0}$$

With initial conditions

$$\left[y\left(\frac{\pi}{2}\right) = -4\right]$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 14

```
dsolve([diff(y(x),x)+y(x)*cot(x)=5*exp(cos(x)),y(1/2*Pi) = -4],y(x), singsol=all)
```

$$y(x) = -5\,\mathrm{e}^{\cos(x)}\csc(x) + \csc(x)$$

✓ Solution by Mathematica

Time used: 0.103 (sec). Leaf size: 16

```
DSolve[{y'[x]+y[x]*Cot[x]==5*Exp[Cos[x]],{y[Pi/2]==-4}},y[x],x,IncludeSingularSolutions -> Tr
```

$$y(x) \to \left(1 - 5e^{\cos(x)}\right)\csc(x)$$

## 2.16 problem 16

Internal problem ID [4593]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 16.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, ‘class C‘], _rational, [_Abel, ‘2nd type‘, ‘cla`

$$\boxed{(3x+3y-4)\,y'+x+y=0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 29

```
dsolve((3*x+3*y(x)-4)*diff(y(x),x)=-(x+y(x)),y(x), singsol=all)
```

$$y(x)=\mathrm{e}^{-\operatorname{LambertW}\left(\frac{3\mathrm{e}^{x}\mathrm{e}^{-3}\mathrm{e}^{-c_1}}{2}\right)+x-3-c_1}+2-x$$

✓ Solution by Mathematica

Time used: 3.767 (sec). Leaf size: 33

```
DSolve[(3*x+3*y[x]-4)*y'[x]==-(x+y[x]),y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)\to \frac{2}{3}W\left(-e^{x-1+c_1}\right)-x+2$$
$$y(x)\to 2-x$$

## 2.17 problem 17

Internal problem ID [4594]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 17.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_rational, [_1st_order, '_with_symmetry_[F(x)*G(y),0]'], [_Abe`

$$\boxed{x - xy^2 - \left(x + x^2 y\right) y' = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 56

```
dsolve((x-x*y(x)^2)=(x+x^2*y(x))*diff(y(x),x),y(x), singsol=all)
```

$$x + \frac{\sqrt{\left(y\left(x\right) - 1\right)\left(y\left(x\right) + 1\right)}\,\ln\left(y(x) + \sqrt{y\left(x\right)^2 - 1}\right)}{\left(y\left(x\right) - 1\right)\left(y\left(x\right) + 1\right)} - \frac{c_1}{\sqrt{y\left(x\right) - 1}\,\sqrt{y\left(x\right) + 1}} = 0$$

✓ Solution by Mathematica

Time used: 0.132 (sec). Leaf size: 55

```
DSolve[(x-x*y[x]^2)==(x+x^2*y[x])*y'[x],y[x],x,IncludeSingularSolutions -> True]
```

$$\text{Solve}\left[x = -\frac{2\arctan\left(\frac{\sqrt{1-y(x)^2}}{y(x)+1}\right)}{\sqrt{1-y(x)^2}} + \frac{c_1}{\sqrt{1-y(x)^2}}, y(x)\right]$$

## 2.18 problem 18

Internal problem ID [4595]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 18.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class C'], _rational, [_Abel, '2nd type', 'cla`

$$\boxed{x - y - 1 + (4y + x - 1)\, y' = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 29

```
dsolve((x-y(x)-1)+(4*y(x)+x-1)*diff(y(x),x)=0,y(x), singsol=all)
```

$$y(x) = -\frac{\tan\left(\text{RootOf}\left(\ln\left(\frac{1}{\cos(\_Z)^2}\right) - \_Z + 2\ln(x-1) + 2c_1\right)\right)(x-1)}{2}$$

✓ Solution by Mathematica

Time used: 0.062 (sec). Leaf size: 58

```
DSolve[(x-y[x]-1)+(4*y[x]+x-1)*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$\text{Solve}\left[2\arctan\left(\frac{2y(x)-2x+2}{4y(x)+x-1}\right) + 2\log\left(\frac{4}{5}\left(\frac{4y(x)^2}{(x-1)^2}+1\right)\right) + 4\log(x-1) + 5c_1 = 0, y(x)\right]$$

## 2.19 problem 19

Internal problem ID [4596]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 19.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, ‘class C‘], _rational, [_Abel, ‘2nd type‘, ‘cla`

$$\boxed{3y - 7x + 7 + (7y - 3x + 3)\,y' = 0}$$

✓ Solution by Maple

Time used: 0.187 (sec). Leaf size: 706

```
dsolve((3*y(x)-7*x+7)+(7*y(x)-3*x+3)*diff(y(x),x)=0,y(x), singsol=all)
```

Expression too large to display

✓ Solution by Mathematica

Time used: 60.692 (sec). Leaf size: 7785

```
DSolve[(3*y[x]-7*x+7)+(7*y[x]-3*x+3)*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

Too large to display

## 2.20 problem 20

Internal problem ID [4597]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 20.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class G'], _rational]`

$$\boxed{y(xy+1)+x\left(1+xy+x^2y^2\right)y'=0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 38

```
dsolve(y(x)*(x*y(x)+1)+x*(1+x*y(x)+x^2*y(x)^2)*diff(y(x),x)=0,y(x), singsol=all)
```

$$y(x)=\frac{\mathrm{e}^{\mathrm{RootOf}\left(-2\ln(x)\mathrm{e}^{2\_Z}+2c_1\mathrm{e}^{2\_Z}+2\_Z\mathrm{e}^{2\_Z}-2\mathrm{e}^{\_Z}-1\right)}}{x}$$

✓ Solution by Mathematica

Time used: 0.112 (sec). Leaf size: 30

```
DSolve[y[x]*(x*y[x]+1)+x*(1+x*y[x]+x^2*y[x]^2)*y'[x]==0,y[x],x,IncludeSingularSolutions -> Tr
```

$$\text{Solve}\left[\frac{-\frac{1}{2x^2}-\frac{y(x)}{x}}{y(x)^2}+\log(y(x))=c_1,y(x)\right]$$

## 2.21 problem 21

Internal problem ID [4598]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 21.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_Bernoulli]`

$$\boxed{y' + y - y^3 x = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 39

```
dsolve(diff(y(x),x)+y(x)=x*y(x)^3,y(x), singsol=all)
```

$$y(x) = -\frac{2}{\sqrt{2 + 4\,\mathrm{e}^{2x} c_1 + 4x}}$$
$$y(x) = \frac{2}{\sqrt{2 + 4\,\mathrm{e}^{2x} c_1 + 4x}}$$

✓ Solution by Mathematica

Time used: 3.015 (sec). Leaf size: 50

```
DSolve[y'[x]+y[x]==x*y[x]^3,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{1}{\sqrt{x + c_1 e^{2x} + \frac{1}{2}}}$$
$$y(x) \to \frac{1}{\sqrt{x + c_1 e^{2x} + \frac{1}{2}}}$$
$$y(x) \to 0$$

## 2.22 problem 22

Internal problem ID [4599]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 22.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_1st_order, _with_linear_symmetries], _Bernoulli]`

$$\boxed{y' + y - y^4 \mathrm{e}^x = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 194

```
dsolve(diff(y(x),x)+y(x)=y(x)^4*exp(x),y(x), singsol=all)
```

$$y(x) = \frac{2^{\frac{1}{3}} \left( \left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)^2 \right)^{\frac{1}{3}}}{2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x}$$

$$y(x) = -\frac{2^{\frac{1}{3}} \left( \left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)^2 \right)^{\frac{1}{3}}}{2\left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)} - \frac{i\sqrt{3}\, 2^{\frac{1}{3}} \left( \left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)^2 \right)^{\frac{1}{3}}}{2\left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)}$$

$$y(x) = -\frac{2^{\frac{1}{3}} \left( \left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)^2 \right)^{\frac{1}{3}}}{2\left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)} + \frac{i\sqrt{3}\, 2^{\frac{1}{3}} \left( \left( 2c_1 \mathrm{e}^{3x} + 3\,\mathrm{e}^x \right)^2 \right)^{\frac{1}{3}}}{4c_1 \mathrm{e}^{3x} + 6\,\mathrm{e}^x}$$

✓ Solution by Mathematica

Time used: 4.724 (sec). Leaf size: 90

```
DSolve[y'[x]+y[x]==y[x]^4*Exp[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{\sqrt[3]{-2}}{\sqrt[3]{e^x\left(3+2c_1e^{2x}\right)}}$$

$$y(x) \to \frac{1}{\sqrt[3]{\frac{3e^x}{2}+c_1e^{3x}}}$$

$$y(x) \to \frac{(-1)^{2/3}}{\sqrt[3]{\frac{3e^x}{2}+c_1e^{3x}}}$$

$$y(x) \to 0$$

## 2.23 problem 23

Internal problem ID [4600]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 23.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_Bernoulli]`

$$\boxed{2y' + y - y^3(x-1) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 25

```
dsolve(2*diff(y(x),x)+y(x)=y(x)^3*(x-1),y(x), singsol=all)
```

$$y(x) = \frac{1}{\sqrt{\mathrm{e}^x c_1 + x}}$$
$$y(x) = -\frac{1}{\sqrt{\mathrm{e}^x c_1 + x}}$$

✓ Solution by Mathematica

Time used: 2.971 (sec). Leaf size: 40

```
DSolve[2*y'[x]+y[x]==y[x]^3*(x-1),y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{1}{\sqrt{x + c_1 e^x}}$$
$$y(x) \to \frac{1}{\sqrt{x + c_1 e^x}}$$
$$y(x) \to 0$$

## 2.24 problem 24

Internal problem ID [4601]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 24.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_Bernoulli]`

$$\boxed{y' - 2y\tan(x) - y^2\tan(x)^2 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 20

```
dsolve(diff(y(x),x)-2*y(x)*tan(x)=y(x)^2*tan(x)^2,y(x), singsol=all)
```

$$y(x) = -\frac{3}{\cos(x)^2\left(\tan(x)^3 - 3c_1\right)}$$

✓ Solution by Mathematica

Time used: 0.517 (sec). Leaf size: 30

```
DSolve[y'[x]-2*y[x]*Tan[x]==y[x]^2*Tan[x]^2,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{-\frac{1}{3}\sin^2(x)\tan(x) + c_1\cos^2(x)}$$
$$y(x) \to 0$$

## 2.25 problem 25

Internal problem ID [4602]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 25.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_Bernoulli]`

$$\boxed{y' + y\tan(x) - y^3\sec(x)^4 = 0}$$

✓ Solution by Maple

Time used: 0.032 (sec). Leaf size: 92

```
dsolve(diff(y(x),x)+y(x)*tan(x)=y(x)^3*sec(x)^4,y(x), singsol=all)
```

$$y(x) = \frac{\sqrt{\cos(x)\left(c_1\cos(x) - 2\sin(x)\right)\left(\sin(x)^4 + 2\cos(x)^2 - 1\right)}}{\cos(x)\left(c_1\cos(x) - 2\sin(x)\right)}$$

$$y(x) = -\frac{\sqrt{\cos(x)\left(c_1\cos(x) - 2\sin(x)\right)\left(\sin(x)^4 + 2\cos(x)^2 - 1\right)}}{\cos(x)\left(c_1\cos(x) - 2\sin(x)\right)}$$

✓ Solution by Mathematica

Time used: 4.06 (sec). Leaf size: 48

```
DSolve[y'[x]+y[x]*Tan[x]==y[x]^3*Sec[x]^4,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{1}{\sqrt{\sec^2(x)(-2\tan(x) + c_1)}}$$

$$y(x) \to \frac{1}{\sqrt{\sec^2(x)(-2\tan(x) + c_1)}}$$

$$y(x) \to 0$$

## 2.26 problem 26

Internal problem ID [4603]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 26.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{\left(-x^2+1\right)y' - xy - 1 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 48

```
dsolve((1-x^2)*diff(y(x),x)=1+x*y(x),y(x), singsol=all)
```

$$y(x) = -\frac{\sqrt{(x-1)(x+1)}\,\ln\left(x+\sqrt{x^2-1}\right)}{(x-1)(x+1)} + \frac{c_1}{\sqrt{x-1}\sqrt{x+1}}$$

✓ Solution by Mathematica

Time used: 0.031 (sec). Leaf size: 32

```
DSolve[(1-x^2)*y'[x]==1+x*y[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{-\operatorname{arctanh}\left(\frac{x}{\sqrt{x^2-1}}\right) + c_1}{\sqrt{x^2-1}}$$

## 2.27 problem 27

Internal problem ID [4604]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 27.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{xyy' - (x+1)\sqrt{y-1} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 20

```
dsolve(x*y(x)*diff(y(x),x)-(1+x)*sqrt(y(x)-1)=0,y(x), singsol=all)
```

$$x + \ln(x) - \frac{2\sqrt{y(x)-1}\,(y(x)+2)}{3} + c_1 = 0$$

✓ Solution by Mathematica

Time used: 5.484 (sec). Leaf size: 475

```
DSolve[x*y[x]*y'[x]-(1+x)*Sqrt[y[x]-1]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)$$

$$\to \frac{1}{2}\sqrt[3]{9(x+c_1)^2+9\log(x)(\log(x)+2(x+c_1))+3\sqrt{(x+\log(x)+c_1)^2\left(9(x+c_1)^2+9\log(x)(\log(x)+2(}$$

$$+\frac{2}{\sqrt[3]{9(x+c_1)^2+9\log(x)(\log(x)+2(x+c_1))+3\sqrt{(x+\log(x)+c_1)^2\left(9(x+c_1)^2+9\log(x)(\log(x)+2(}}$$

$$-1$$

$$y(x)\to \frac{1}{4}i\Big(\sqrt{3}$$

$$+i\Big)\sqrt[3]{9(x+c_1)^2+9\log(x)(\log(x)+2(x+c_1))+3\sqrt{(x+\log(x)+c_1)^2\left(9(x+c_1)^2+9\log(x)(\log(x)+}$$

$$+\frac{-1-i\sqrt{3}}{\sqrt[3]{9(x+c_1)^2+9\log(x)(\log(x)+2(x+c_1))+3\sqrt{(x+\log(x)+c_1)^2\left(9(x+c_1)^2+9\log(x)(\log(x)+2(}}$$

$$-1$$

$$y(x)\to -\frac{1}{4}i\Big(\sqrt{3}$$

$$-i\Big)\sqrt[3]{9(x+c_1)^2+9\log(x)(\log(x)+2(x+c_1))+3\sqrt{(x+\log(x)+c_1)^2\left(9(x+c_1)^2+9\log(x)(\log(x)+}$$

$$+\frac{i\left(\sqrt{3}+i\right)}{\sqrt[3]{9(x+c_1)^2+9\log(x)(\log(x)+2(x+c_1))+3\sqrt{(x+\log(x)+c_1)^2\left(9(x+c_1)^2+9\log(x)(\log(x)+2(}}$$

$$-1$$

$$y(x)\to 1$$

## 2.28 problem 28

Internal problem ID [4605]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 28.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class A'], _rational, _dAlembert]`

$$\boxed{x^2 - 2xy + 5y^2 - \left(y^2 + 2xy + x^2\right) y' = 0}$$

✓ Solution by Maple

Time used: 0.031 (sec). Leaf size: 35

```
dsolve((x^2-2*x*y(x)+5*y(x)^2)=(x^2+2*x*y(x)+y(x)^2)*diff(y(x),x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{\mathrm{RootOf}\left(\ln(x)\mathrm{e}^{2\_Z} + c_1 \mathrm{e}^{2\_Z} + \_Z \mathrm{e}^{2\_Z} - 4\,\mathrm{e}^{\_Z} - 2\right)} x + x$$

✓ Solution by Mathematica

Time used: 0.346 (sec). Leaf size: 41

```
DSolve[(x^2-2*x*y[x]+5*y[x]^2)==(x^2+2*x*y[x]+y[x]^2)*y'[x],y[x],x,IncludeSingularSolutions -
```

$$\text{Solve}\left[\frac{2 - \frac{4y(x)}{x}}{\left(\frac{y(x)}{x} - 1\right)^2} + \log\left(\frac{y(x)}{x} - 1\right) = -\log(x) + c_1, y(x)\right]$$

## 2.29 problem 29

Internal problem ID [4606]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 29.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_Bernoulli]`

$$\boxed{y' - y\cot(x) - y^2\sec(x)^2 = 0}$$

With initial conditions

$$\left[y\left(\frac{\pi}{4}\right) = -1\right]$$

✓ Solution by Maple

Time used: 0.469 (sec). Leaf size: 18

```
dsolve([diff(y(x),x)-y(x)*cot(x)=y(x)^2*sec(x)^2,y(1/4*Pi) = -1],y(x), singsol=all)
```

$$y(x) = \frac{2\sin(x)}{\sqrt{2} - 2\sec(x)}$$

✗ Solution by Mathematica

Time used: 0.0 (sec). Leaf size: 0

```
DSolve[{y'[x]-y[x]*Cot[x]==y[x]^2*Sec[x]^2,{y[Pi/2]==-1}},y[x],x,IncludeSingularSolutions ->
```

{}

## 2.30 problem 30

Internal problem ID [4607]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 30.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{y + (x^2 - 4x)\, y' = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 14

```
dsolve(y(x)+(x^2-4*x)*diff(y(x),x)=0,y(x), singsol=all)
```

$$y(x) = \frac{c_1 x^{\frac{1}{4}}}{(x-4)^{\frac{1}{4}}}$$

✓ Solution by Mathematica

Time used: 0.035 (sec). Leaf size: 27

```
DSolve[y[x]+(x^2-4*x)*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{c_1 \sqrt[4]{x}}{\sqrt[4]{4-x}}$$
$$y(x) \to 0$$

## 2.31 problem 31

Internal problem ID [4608]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 31.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' - y\tan(x) - \cos(x) + 2\sin(x)\,x = 0}$$

With initial conditions

$$\left[y\left(\frac{\pi}{6}\right) = 0\right]$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 22

```
dsolve([diff(y(x),x)-y(x)*tan(x)=cos(x)-2*x*sin(x),y(1/6*Pi) = 0],y(x), singsol=all)
```

$$y(x) = \frac{(4x\cos(2x) - \pi + 4x)\sec(x)}{8}$$

✓ Solution by Mathematica

Time used: 0.073 (sec). Leaf size: 17

```
DSolve[{y'[x]-y[x]*Tan[x]==Cos[x]-2*x*Sin[x],{y[Pi/6]==0}},y[x],x,IncludeSingularSolutions ->
```

$$y(x) \to x\cos(x) - \frac{1}{8}\pi\sec(x)$$

## 2.32 problem 32

Internal problem ID [4609]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 32.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, ‘class A‘], _rational, [_Abel, ‘2nd type‘, ‘cla`

$$\boxed{y' - \frac{2xy + y^2}{x^2 + 2xy} = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 380

```
dsolve(diff(y(x),x)=(2*x*y(x)+y(x)^2)/(x^2+2*x*y(x)),y(x), singsol=all)
```

$$y(x) = \frac{12^{\frac{1}{3}}\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}{6c_1} + \frac{x12^{\frac{2}{3}}}{6\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}} + x$$

$$y(x) = -\frac{12^{\frac{1}{3}}\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}{12c_1} - \frac{x12^{\frac{2}{3}}}{12\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}$$
$$+ x - \frac{i\sqrt{3}\left(\frac{12^{\frac{1}{3}}\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}{6c_1} - \frac{x12^{\frac{2}{3}}}{6\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}\right)}{2}$$

$$y(x) = -\frac{12^{\frac{1}{3}}\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}{12c_1} - \frac{x12^{\frac{2}{3}}}{12\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}$$
$$+ x + \frac{i\sqrt{3}\left(\frac{12^{\frac{1}{3}}\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}{6c_1} - \frac{x12^{\frac{2}{3}}}{6\left(x\left(\sqrt{3}\sqrt{\frac{x(27c_1x-4)}{c_1}}+9x\right)c_1^2\right)^{\frac{1}{3}}}\right)}{2}$$

✓ Solution by Mathematica

Time used: 44.505 (sec). Leaf size: 404

```
DSolve[y'[x]==(2*x*y[x]+y[x]^2)/(x^2+2*x*y[x]),y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{\sqrt[3]{\frac{2}{3}}e^{c_1}x}{\sqrt[3]{\sqrt{3}\sqrt{e^{2c_1}x^3\left(27x+4e^{c_1}\right)}-9e^{c_1}x^2}}+\frac{\sqrt[3]{\sqrt{3}\sqrt{e^{2c_1}x^3\left(27x+4e^{c_1}\right)}-9e^{c_1}x^2}}{\sqrt[3]{2}3^{2/3}}+x$$

$$y(x) \to \frac{\left(1+i\sqrt{3}\right)e^{c_1}x}{2^{2/3}\sqrt[3]{3\sqrt{3}\sqrt{e^{2c_1}x^3\left(27x+4e^{c_1}\right)}-27e^{c_1}x^2}}+\frac{i\left(\sqrt{3}+i\right)\sqrt[3]{\sqrt{3}\sqrt{e^{2c_1}x^3\left(27x+4e^{c_1}\right)}-9e^{c_1}x^2}}{2\sqrt[3]{2}3^{2/3}}+x$$

$$y(x) \to \frac{\left(1-i\sqrt{3}\right)e^{c_1}x}{2^{2/3}\sqrt[3]{3\sqrt{3}\sqrt{e^{2c_1}x^3\left(27x+4e^{c_1}\right)}-27e^{c_1}x^2}}-\frac{\left(1+i\sqrt{3}\right)\sqrt[3]{\sqrt{3}\sqrt{e^{2c_1}x^3\left(27x+4e^{c_1}\right)}-9e^{c_1}x^2}}{2\sqrt[3]{2}3^{2/3}}+x$$

## 2.33 problem 33

Internal problem ID [4610]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 33.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{\left(x^2+1\right)y' - x(1+y) = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 15

```
dsolve((1+x^2)*diff(y(x),x)=x*(1+y(x)),y(x), singsol=all)
```

$$y(x) = c_1\sqrt{x^2+1} - 1$$

✓ Solution by Mathematica

Time used: 0.036 (sec). Leaf size: 24

```
DSolve[(1+x^2)*y'[x]==x*(1+y[x]),y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -1 + c_1\sqrt{x^2+1}$$
$$y(x) \to -1$$

## 2.34 problem 34

Internal problem ID [4611]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 34.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y'x + 2y - 3x + 1 = 0}$$

With initial conditions

$$[y(2) = 1]$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 12

```
dsolve([x*diff(y(x),x)+2*y(x)=3*x-1,y(2) = 1],y(x), singsol=all)
```

$$y(x) = x - \frac{1}{2} - \frac{2}{x^2}$$

✓ Solution by Mathematica

Time used: 0.025 (sec). Leaf size: 15

```
DSolve[{x*y'[x]+2*y[x]==3*x-1,{y[2]==1}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{2}{x^2} + x - \frac{1}{2}$$

## 2.35 problem 35

Internal problem ID [4612]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 35.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, ‘class A‘], _rational, [_Abel, ‘2nd type‘, ‘cla`

$$\boxed{x^2y' - y^2 + xyy' = 0}$$

With initial conditions

$$[y(1) = 1]$$

✓ Solution by Maple

Time used: 0.187 (sec). Leaf size: 13

```
dsolve([x^2*diff(y(x),x)=y(x)^2-x*y(x)*diff(y(x),x),y(1) = 1],y(x), singsol=all)
```

$$y(x) = \text{LambertW}\left(\frac{\mathrm{e}}{x}\right) x$$

✓ Solution by Mathematica

Time used: 2.205 (sec). Leaf size: 13

```
DSolve[{x^2*y'[x]==y[x]^2-x*y[x]*y'[x],{y[1]==1}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to xW\left(\frac{e}{x}\right)$$

## 2.36 problem 36

Internal problem ID [4613]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 36.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{y' - \mathrm{e}^{3x-2y} = 0}$$

With initial conditions

$$[y(0) = 0]$$

✓ Solution by Maple

Time used: 0.031 (sec). Leaf size: 15

```
dsolve([diff(y(x),x)=exp(3*x-2*y(x)),y(0) = 0],y(x), singsol=all)
```

$$y(x) = -\frac{\ln(3)}{2} + \frac{\ln(1 + 2\,\mathrm{e}^{3x})}{2}$$

✓ Solution by Mathematica

Time used: 0.845 (sec). Leaf size: 23

```
DSolve[{y'[x]==Exp[3*x-2*y[x]],{y[0]==0}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{2}\log\left(\frac{1}{3}\left(2e^{3x} + 1\right)\right)$$

## 2.37 problem 37

Internal problem ID [4614]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 37.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' + \frac{y}{x} - \sin(2x) = 0}$$

With initial conditions

$$\left[y\left(\frac{\pi}{4}\right) = 2\right]$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 25

```
dsolve([diff(y(x),x)+1/x*y(x)=sin(2*x),y(1/4*Pi) = 2],y(x), singsol=all)
```

$$y(x) = \frac{-2x\cos(2x) + 2\pi + \sin(2x) - 1}{4x}$$

✓ Solution by Mathematica

Time used: 0.091 (sec). Leaf size: 28

```
DSolve[{y'[x]+1/x*y[x]==Sin[2*x],{y[Pi/4]==2}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{\sin(2x) - 2x\cos(2x) + 2\pi - 1}{4x}$$

## 2.38 problem 38

Internal problem ID [4615]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 38.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class A'], _rational, [_Abel, '2nd type', 'cla`

$$\boxed{y^2 + x^2 y' - xyy' = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 21

```
dsolve(y(x)^2+x^2*diff(y(x),x)=x*y(x)*diff(y(x),x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{-\operatorname{LambertW}\left(-\frac{\mathrm{e}^{-c_1}}{x}\right)-c_1}$$

✓ Solution by Mathematica

Time used: 1.993 (sec). Leaf size: 25

```
DSolve[y[x]^2+x^2*y'[x]==x*y[x]*y'[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -xW\left(-\frac{e^{-c_1}}{x}\right)$$
$$y(x) \to 0$$

## 2.39 problem 39

Internal problem ID [4616]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 39.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class A'], _exact, _rational, _Bernoulli]`

$$\boxed{2xyy' - x^2 + y^2 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 45

```
dsolve(2*x*y(x)*diff(y(x),x)=x^2-y(x)^2,y(x), singsol=all)
```

$$y(x) = -\frac{\sqrt{3}\sqrt{x\left(x^3+3c_1\right)}}{3x}$$
$$y(x) = \frac{\sqrt{3}\sqrt{x\left(x^3+3c_1\right)}}{3x}$$

✓ Solution by Mathematica

Time used: 0.188 (sec). Leaf size: 56

```
DSolve[2*x*y[x]*y'[x]==x^2-y[x]^2,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{\sqrt{x^3+3c_1}}{\sqrt{3}\sqrt{x}}$$
$$y(x) \to \frac{\sqrt{x^3+3c_1}}{\sqrt{3}\sqrt{x}}$$

## 2.40 problem 40

Internal problem ID [4617]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 40.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class C'], _rational, [_Abel, '2nd type', 'cla`

$$\boxed{y' - \frac{-2y + x + 1}{2x - 4y} = 0}$$

With initial conditions

$$[y(1) = 1]$$

✓ Solution by Maple

Time used: 0.109 (sec). Leaf size: 17

```
dsolve([diff(y(x),x)=(x-2*y(x)+1)/(2*x-4*y(x)),y(1) = 1],y(x), singsol=all)
```

$$y(x) = \frac{x}{2} + \frac{\sqrt{-2x+3}}{2}$$

✓ Solution by Mathematica

Time used: 0.109 (sec). Leaf size: 24

```
DSolve[{y'[x]==(x-2*y[x]+1)/(2*x-4*y[x]),{y[1]==1}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{2}\left(x - i\sqrt{2x-3}\right)$$

## 2.41 problem 41

Internal problem ID [4618]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 41.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{\left(-x^3+1\right)y' + x^2 y - x^2\left(-x^3+1\right) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 20

```
dsolve((1-x^3)*diff(y(x),x)+x^2*y(x)=x^2*(1-x^3),y(x), singsol=all)
```

$$y(x) = \frac{x^3}{2} - \frac{1}{2} + \left(x^3-1\right)^{\frac{1}{3}} c_1$$

✓ Solution by Mathematica

Time used: 0.049 (sec). Leaf size: 27

```
DSolve[(1-x^3)*y'[x]+x^2*y[x]==x^2*(1-x^3),y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{2}\left(x^3 + 2c_1\sqrt[3]{x^3-1} - 1\right)$$

## 2.42 problem 42

Internal problem ID [4619]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 42.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' + \frac{y}{x} - \sin(x) = 0}$$

With initial conditions

$$\left[y\left(\frac{\pi}{2}\right) = 0\right]$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 17

```
dsolve([diff(y(x),x)+y(x)/x=sin(x),y(1/2*Pi) = 0],y(x), singsol=all)
```

$$y(x) = \frac{\sin(x) - \cos(x)\, x - 1}{x}$$

✓ Solution by Mathematica

Time used: 0.048 (sec). Leaf size: 18

```
DSolve[{y'[x]+y[x]/x==Sin[x],{y[Pi/2]==0}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{\sin(x) - x\cos(x) - 1}{x}$$

## 2.43 problem 43

Internal problem ID [4620]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 43.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{y' + x + xy^2 = 0}$$

With initial conditions

$$[y(1) = 0]$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 14

```
dsolve([diff(y(x),x)+x+x*y(x)^2=0,y(1) = 0],y(x), singsol=all)
```

$$y(x) = -\tan\left(\frac{x^2}{2} - \frac{1}{2}\right)$$

✓ Solution by Mathematica

Time used: 0.209 (sec). Leaf size: 17

```
DSolve[{y'[x]+x+x*y[x]^2==0,{y[1]==0}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \tan\left(\frac{1}{2}(1 - x^2)\right)$$

## 2.44 problem 44

Internal problem ID [4621]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 44.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' + \left(\frac{1}{x} - \frac{2x}{-x^2+1}\right) y - \frac{1}{-x^2+1} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 22

```
dsolve(diff(y(x),x)+(1/x-(2*x)/(1-x^2))*y(x)=1/(1-x^2),y(x), singsol=all)
```

$$y(x) = \frac{-\frac{x^2}{2} + c_1}{x\left(x^2-1\right)}$$

✓ Solution by Mathematica

Time used: 0.036 (sec). Leaf size: 25

```
DSolve[y'[x]+(1/x-(2*x)/(1-x^2))*y[x]==1/(1-x^2),y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{x^2 + 2c_1}{2x - 2x^3}$$

## 2.45 problem 45

Internal problem ID [4622]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 45.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{\left(x^2+1\right)y' + xy - \left(x^2+1\right)^{\frac{3}{2}} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 20

```
dsolve((1+x^2)*diff(y(x),x)+x*y(x)=(1+x^2)^(3/2),y(x), singsol=all)
```

$$y(x) = \frac{\frac{1}{3}x^3 + x + c_1}{\sqrt{x^2+1}}$$

✓ Solution by Mathematica

Time used: 0.06 (sec). Leaf size: 29

```
DSolve[(1+x^2)*y'[x]+x*y[x]==(1+x^2)^(3/2),y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{x^3 + 3x + 3c_1}{3\sqrt{x^2+1}}$$

## 2.46 problem 46

Internal problem ID [4623]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 46.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{x(1+y^2)-y(x^2+1)\,y'=0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 29

```
dsolve(x*(1+y(x)^2)-y(x)*(1+x^2)*diff(y(x),x)=0,y(x), singsol=all)
```

$$y(x)=\sqrt{c_1x^2+c_1-1}$$
$$y(x)=-\sqrt{c_1x^2+c_1-1}$$

✓ Solution by Mathematica

Time used: 0.472 (sec). Leaf size: 61

```
DSolve[x*(1+y[x]^2)-y[x]*(1+x^2)*y'[x]==0,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x)\to -\sqrt{-1+e^{2c_1}\left(x^2+1\right)}$$
$$y(x)\to \sqrt{-1+e^{2c_1}\left(x^2+1\right)}$$
$$y(x)\to -i$$
$$y(x)\to i$$

## 2.47 problem 47

Internal problem ID [4624]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 47.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_separable]`

$$\boxed{\frac{r \tan(\theta) r'}{a^2 - r^2} - 1 = 0}$$

With initial conditions

$$\left[r\left(\frac{\pi}{4}\right) = 0\right]$$

✓ Solution by Maple

Time used: 0.079 (sec). Leaf size: 37

```
dsolve([r(theta)*tan(theta)/(a^2-r(theta)^2)*diff(r(theta),theta)=1,r(1/4*Pi) = 0],r(theta),
```

$$r(\theta) = -\frac{a\sqrt{-4\cos(\theta)^2 + 2}\,\csc(\theta)}{2}$$

$$r(\theta) = \frac{a\sqrt{-4\cos(\theta)^2 + 2}\,\csc(\theta)}{2}$$

✓ Solution by Mathematica

Time used: 0.153 (sec). Leaf size: 51

```
DSolve[{r[\[Theta]]*Tan[\[Theta]]/(a^2-r[\[Theta]]^2)*r'[\[Theta]]==1,{r[Pi/4]==0}},r[\[Theta
```

$$r(\theta) \to -\sqrt{\frac{a^2\cos(2\theta)}{\cos(2\theta) - 1}}$$

$$r(\theta) \to \sqrt{\frac{a^2\cos(2\theta)}{\cos(2\theta) - 1}}$$

## 2.48 problem 48

Internal problem ID [4625]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 48.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[_linear]`

$$\boxed{y' + y\cot(x) - \cos(x) = 0}$$

With initial conditions

$$[y(0) = 0]$$

✓ Solution by Maple

Time used: 0.094 (sec). Leaf size: 8

```
dsolve([diff(y(x),x)+y(x)*cot(x)=cos(x),y(0) = 0],y(x), singsol=all)
```

$$y(x) = \frac{\sin(x)}{2}$$

✓ Solution by Mathematica

Time used: 0.125 (sec). Leaf size: 11

```
DSolve[{y'[x]+y[x]*Cot[x]==Cos[x],{y[0]==0}},y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{\sin(x)}{2}$$

## 2.49 problem 49

Internal problem ID [4626]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 24. First order differential equations. Further problems 24. page 1068
**Problem number**: 49.
**ODE order**: 1.
**ODE degree**: 1.

CAS Maple gives this as type `[[_homogeneous, 'class G'], _rational, _Bernoulli]`

$$\boxed{y' + \frac{y}{x} - xy^2 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 15

```
dsolve(diff(y(x),x)+y(x)/x=x*y(x)^2,y(x), singsol=all)
```

$$y(x) = \frac{1}{(-x + c_1)\, x}$$

✓ Solution by Mathematica

Time used: 0.122 (sec). Leaf size: 22

```
DSolve[y'[x]+y[x]/x==x*y[x]^2,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{x(-x + c_1)}$$
$$y(x) \to 0$$

# 3 Program 25. Second order differential equations. Test Excercise 25. page 1093

## 3.1 problem 1

Internal problem ID [4627]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 1.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _missing_x]]`

$$\boxed{y'' - y' - 2y - 8 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 18

```
dsolve(diff(y(x),x$2)-diff(y(x),x)-2*y(x)=8,y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{2x} c_2 + \mathrm{e}^{-x} c_1 - 4$$

✓ Solution by Mathematica

Time used: 0.009 (sec). Leaf size: 23

```
DSolve[y''[x]-y'[x]-2*y[x]==8,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to c_1 e^{-x} + c_2 e^{2x} - 4$$

## 3.2 problem 2

Internal problem ID [4628]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 2.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' - 4y - 10\,\mathrm{e}^{3x} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 23

```
dsolve(diff(y(x),x$2)-4*y(x)=10*exp(3*x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{2x} c_2 + \mathrm{e}^{-2x} c_1 + 2\,\mathrm{e}^{3x}$$

✓ Solution by Mathematica

Time used: 0.004 (sec). Leaf size: 28

```
DSolve[y''[x]-4*y[x]==10*Exp[3*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to e^{-2x}\left(e^{4x}(2e^{x} + c_1) + c_2\right)$$

## 3.3 problem 3

Internal problem ID [4629]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 3.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' + 2y' + y - \mathrm{e}^{-2x} = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 22

```
dsolve(diff(y(x),x$2)+2*diff(y(x),x)+y(x)=exp(-2*x),y(x), singsol=all)
```

$$y(x) = c_2\mathrm{e}^{-x} + \mathrm{e}^{-x}xc_1 + \mathrm{e}^{-2x}$$

✓ Solution by Mathematica

Time used: 0.028 (sec). Leaf size: 24

```
DSolve[y''[x]+2*y'[x]+y[x]==Exp[-2*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to e^{-2x}(1 + e^x(c_2x + c_1))$$

## 3.4 problem 4

Internal problem ID [4630]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 4.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' + 25y - 5x^2 - x = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 26

```
dsolve(diff(y(x),x$2)+25*y(x)=5*x^2+x,y(x), singsol=all)
```

$$y(x) = \sin(5x)\, c_2 + \cos(5x)\, c_1 + \frac{x^2}{5} + \frac{x}{25} - \frac{2}{125}$$

✓ Solution by Mathematica

Time used: 0.003 (sec). Leaf size: 34

```
DSolve[y''[x]+25*y[x]==5*x^2+x,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{125}(5x-1)(5x+2) + c_1 \cos(5x) + c_2 \sin(5x)$$

## 3.5 problem 5

Internal problem ID [4631]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 5.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' - 2y' + y - 4\sin(x) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 18

```
dsolve(diff(y(x),x$2)-2*diff(y(x),x)+y(x)=4*sin(x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{x} c_2 + \mathrm{e}^{x} x c_1 + 2\cos(x)$$

✓ Solution by Mathematica

Time used: 0.005 (sec). Leaf size: 21

```
DSolve[y''[x]-2*y'[x]+y[x]==4*Sin[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to 2\cos(x) + e^{x}(c_2 x + c_1)$$

## 3.6 problem 6

Internal problem ID [4632]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 6.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' + 4y' + 5y - 2\,\mathrm{e}^{-2x} = 0}$$

With initial conditions

$$[y(0) = 1, y'(0) = -2]$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 14

```
dsolve([diff(y(x),x$2)+4*diff(y(x),x)+5*y(x)=2*exp(-2*x),y(0) = 1, D(y)(0) = -2],y(x), singso
```

$$y(x) = -\mathrm{e}^{-2x}(\cos(x) - 2)$$

✓ Solution by Mathematica

Time used: 0.012 (sec). Leaf size: 16

```
DSolve[{y''[x]+4*y'[x]+5*y[x]==2*Exp[-2*x],{y[0]==1,y'[0]==-2}},y[x],x,IncludeSingularSolutio
```

$$y(x) \to -e^{-2x}(\cos(x) - 2)$$

## 3.7 problem 7

Internal problem ID [4633]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 7.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{3y'' - 2y' - y - 2x + 3 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 19

```
dsolve(3*diff(y(x),x$2)-2*diff(y(x),x)-y(x)=2*x-3,y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{-\frac{x}{3}} c_2 + \mathrm{e}^{x} c_1 - 2x + 7$$

✓ Solution by Mathematica

Time used: 0.003 (sec). Leaf size: 26

```
DSolve[3*y''[x]-2*y'[x]-y[x]==2*x-3,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -2x + c_1 e^{-x/3} + c_2 e^{x} + 7$$

## 3.8 problem 8

Internal problem ID [4634]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Test Excercise 25. page 1093
**Problem number**: 8.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' - 6y' + 8y - 8\,\mathrm{e}^{4x} = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 23

```
dsolve(diff(y(x),x$2)-6*diff(y(x),x)+8*y(x)=8*exp(4*x),y(x), singsol=all)
```

$$y(x) = \left(\frac{\mathrm{e}^{2x}(8x + c_1 - 4)}{2} + c_2\right)\mathrm{e}^{2x}$$

✓ Solution by Mathematica

Time used: 0.013 (sec). Leaf size: 27

```
DSolve[y''[x]-6*y'[x]+8*y[x]==8*Exp[4*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to c_1 e^{2x} + e^{4x}(4x - 2 + c_2)$$

# 4 Program 25. Second order differential equations. Further problems 25. page 1094

## 4.1 problem 1

Internal problem ID [4635]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 1.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{2y'' - 7y' - 4y - \mathrm{e}^{3x} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 23

```
dsolve(2*diff(y(x),x$2)-7*diff(y(x),x)-4*y(x)=exp(3*x),y(x), singsol=all)
```

$$y(x) = c_2 \mathrm{e}^{4x} + \mathrm{e}^{-\frac{x}{2}} c_1 - \frac{\mathrm{e}^{3x}}{7}$$

✓ Solution by Mathematica

Time used: 0.004 (sec). Leaf size: 33

```
DSolve[2*y''[x]-7*y'[x]-4*y[x]==Exp[3*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{e^{3x}}{7} + c_1 e^{-x/2} + c_2 e^{4x}$$

## 4.2 problem 2

Internal problem ID [4636]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 2.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' - 6y' + 9y - 54x - 18 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 22

```
dsolve(diff(y(x),x$2)-6*diff(y(x),x)+9*y(x)=54*x+18,y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{3x} c_2 + \mathrm{e}^{3x} x c_1 + 6x + 6$$

✓ Solution by Mathematica

Time used: 0.003 (sec). Leaf size: 24

```
DSolve[y''[x]-6*y'[x]+9*y[x]==54*x+18,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to 6(x+1) + e^{3x}(c_2 x + c_1)$$

## 4.3 problem 3

Internal problem ID [4637]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 3.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' - 5y' + 6y - 100\sin(4x) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 29

```
dsolve(diff(y(x),x$2)-5*diff(y(x),x)+6*y(x)=100*sin(4*x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{2x}c_2 + c_1\mathrm{e}^{3x} - 2\sin(4x) + 4\cos(4x)$$

✓ Solution by Mathematica

Time used: 0.007 (sec). Leaf size: 33

```
DSolve[y''[x]-5*y'[x]+6*y[x]==100*Sin[4*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -2\sin(4x) + 4\cos(4x) + e^{2x}(c_2e^x + c_1)$$

## 4.4 problem 4

Internal problem ID [4638]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 4.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' + 2y' + y - 4\sinh(x) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 38

```
dsolve(diff(y(x),x$2)+2*diff(y(x),x)+y(x)=4*sinh(x),y(x), singsol=all)
```

$$y(x) = c_2 \mathrm{e}^{-x} + \mathrm{e}^{-x} x c_1 + \frac{(-2x^2 + 2x + 1)\,\mathrm{e}^{-x}}{2} + \frac{\mathrm{e}^{x}}{2}$$

✓ Solution by Mathematica

Time used: 0.024 (sec). Leaf size: 30

```
DSolve[y''[x]+2*y'[x]+y[x]==4*Sinh[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{e^x}{2} + e^{-x}(x(-x + c_2) + c_1)$$

## 4.5 problem 5

Internal problem ID [4639]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 5.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' + y' - 2y - 2\cosh(2x) = 0}$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 32

```
dsolve(diff(y(x),x$2)+diff(y(x),x)-2*y(x)=2*cosh(2*x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{x} c_2 + \mathrm{e}^{-2x} c_1 + \frac{(-12x - 7)\,\mathrm{e}^{-2x}}{36} + \frac{\mathrm{e}^{2x}}{4}$$

✓ Solution by Mathematica

Time used: 0.022 (sec). Leaf size: 38

```
DSolve[y''[x]+y'[x]-2*y[x]==2*Cosh[2*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{e^{2x}}{4} + e^{-2x}\left(-\frac{x}{3} - \frac{1}{9} + c_1\right) + c_2 e^{x}$$

## 4.6 problem 6

Internal problem ID [4640]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 6.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' - y' + 10y - 20 + \mathrm{e}^{2x} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 38

```
dsolve(diff(y(x),x$2)-diff(y(x),x)+10*y(x)=20-exp(2*x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{\frac{x}{2}} \sin\left(\frac{\sqrt{39}\,x}{2}\right) c_2 + \mathrm{e}^{\frac{x}{2}} \cos\left(\frac{\sqrt{39}\,x}{2}\right) c_1 + 2 - \frac{\mathrm{e}^{2x}}{12}$$

✓ Solution by Mathematica

Time used: 0.486 (sec). Leaf size: 53

```
DSolve[y''[x]-y'[x]+10*y[x]==20-Exp[2*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{e^{2x}}{12} + e^{x/2}\left(c_2 \cos\left(\frac{\sqrt{39}x}{2}\right) + c_1 \sin\left(\frac{\sqrt{39}x}{2}\right)\right) + 2$$

## 4.7 problem 7

Internal problem ID [4641]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 7.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' + 4y' + 4y - 2\cos(x)^2 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 25

```
dsolve(diff(y(x),x$2)+4*diff(y(x),x)+4*y(x)=2*cos(x)^2,y(x), singsol=all)
```

$$y(x) = c_2 \mathrm{e}^{-2x} + \mathrm{e}^{-2x} x c_1 + \frac{1}{4} + \frac{\sin(2x)}{8}$$

✓ Solution by Mathematica

Time used: 0.058 (sec). Leaf size: 29

```
DSolve[y''[x]+4*y'[x]+4*y[x]==2*Cos[x]^2,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{8}\left(\sin(2x) + 8e^{-2x}(c_2 x + c_1) + 2\right)$$

## 4.8 problem 8

Internal problem ID [4642]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 8.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' - 4y' + 3y - x - \mathrm{e}^{2x} = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 25

```
dsolve(diff(y(x),x$2)-4*diff(y(x),x)+3*y(x)=x+exp(2*x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{x} c_2 + c_1 \mathrm{e}^{3x} - \mathrm{e}^{2x} + \frac{x}{3} + \frac{4}{9}$$

✓ Solution by Mathematica

Time used: 0.056 (sec). Leaf size: 34

```
DSolve[y''[x]-4*y'[x]+3*y[x]==x+Exp[2*x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{9}(3x+4) + e^{x}(e^{x}(-1 + c_2 e^{x}) + c_1)$$

## 4.9 problem 9

Internal problem ID [4643]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 9.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' - 2y' + 3y - x^2 + 1 = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 34

```
dsolve(diff(y(x),x$2)-2*diff(y(x),x)+3*y(x)=x^2-1,y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{x} \sin\left(\sqrt{2}\, x\right) c_2 + \mathrm{e}^{x} \cos\left(\sqrt{2}\, x\right) c_1 + \frac{x^2}{3} + \frac{4x}{9} - \frac{7}{27}$$

✓ Solution by Mathematica

Time used: 0.004 (sec). Leaf size: 46

```
DSolve[y''[x]-2*y'[x]+3*y[x]==x^2-1,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to \frac{1}{9}x(3x+4) + e^{x}\left(c_2 \cos\left(\sqrt{2}x\right) + c_1 \sin\left(\sqrt{2}x\right)\right) - \frac{7}{27}$$

## 4.10 problem 10

Internal problem ID [4644]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 10.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' - 9y - \mathrm{e}^{3x} - \sin(x) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 32

```
dsolve(diff(y(x),x$2)-9*y(x)=exp(3*x)+sin(x),y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{-3x} c_2 + c_1 \mathrm{e}^{3x} + \frac{(-1+6x)\,\mathrm{e}^{3x}}{36} - \frac{\sin(x)}{10}$$

✓ Solution by Mathematica

Time used: 0.058 (sec). Leaf size: 37

```
DSolve[y''[x]-9*y[x]==Exp[3*x]+Sin[x],y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to -\frac{\sin(x)}{10} + e^{3x}\left(\frac{x}{6} - \frac{1}{36} + c_1\right) + c_2 e^{-3x}$$

## 4.11 problem 12

Internal problem ID [4645]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 12.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{x'' + 4x' + 3x - \mathrm{e}^{-3t} = 0}$$

With initial conditions

$$\left[x(0) = \frac{1}{2}, x'(0) = -2\right]$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 13

```
dsolve([diff(x(t),t$2)+4*diff(x(t),t)+3*x(t)=exp(-3*t),x(0) = 1/2, D(x)(0) = -2],x(t), singso
```

$$x(t) = -\frac{\mathrm{e}^{-3t}(t-1)}{2}$$

✓ Solution by Mathematica

Time used: 0.017 (sec). Leaf size: 17

```
DSolve[{x''[t]+4*x'[t]+3*x[t]==Exp[-3*t],{x[0]==1/2,x'[0]==-2}},x[t],t,IncludeSingularSolutio
```

$$x(t) \to -\frac{1}{2}e^{-3t}(t-1)$$

## 4.12 problem 13

Internal problem ID [4646]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 13.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' + 4y' + 5y - 6\sin(t) = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 29

```
dsolve(diff(y(t),t$2)+4*diff(y(t),t)+5*y(t)=6*sin(t),y(t), singsol=all)
```

$$y(t) = \mathrm{e}^{-2t}\sin(t)\,c_2 + \mathrm{e}^{-2t}\cos(t)\,c_1 - \frac{3\cos(t)}{4} + \frac{3\sin(t)}{4}$$

✓ Solution by Mathematica

Time used: 0.006 (sec). Leaf size: 34

```
DSolve[y''[t]+4*y'[t]+5*y[t]==6*Sin[t],y[t],t,IncludeSingularSolutions -> True]
```

$$y(t) \to -\frac{3}{4}(\cos(t) - \sin(t)) + e^{-2t}(c_2\cos(t) + c_1\sin(t))$$

## 4.13 problem 14

Internal problem ID [4647]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 14.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{x'' - 3x' + 2x - \sin(t) = 0}$$

With initial conditions

$$[x(0) = 0, x'(0) = 0]$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 23

```
dsolve([diff(x(t),t$2)-3*diff(x(t),t)+2*x(t)=sin(t),x(0) = 0, D(x)(0) = 0],x(t), singsol=all)
```

$$x(t) = \frac{e^{2t}}{5} + \frac{3\cos(t)}{10} + \frac{\sin(t)}{10} - \frac{e^{t}}{2}$$

✓ Solution by Mathematica

Time used: 0.028 (sec). Leaf size: 27

```
DSolve[{x''[t]-3*x'[t]+2*x[t]==Sin[t],{x[0]==0,x'[0]==0}},x[t],t,IncludeSingularSolutions ->
```

$$x(t) \to \frac{1}{10}\left(e^{t}\left(2e^{t} - 5\right) + \sin(t) + 3\cos(t)\right)$$

## 4.14 problem 15

Internal problem ID [4648]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 15.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' + 3y' + 2y - 3\sin(x) = 0}$$

With initial conditions

$$\left[y(0) = -\frac{9}{10}, y'(0) = -\frac{7}{10}\right]$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 23

```
dsolve([diff(y(x),x$2)+3*diff(y(x),x)+2*y(x)=3*sin(x),y(0) = -9/10, D(y)(0) = -7/10],y(x), si
```

$$y(x) = \mathrm{e}^{-2x} - \frac{9\cos(x)}{10} + \frac{3\sin(x)}{10} - \mathrm{e}^{-x}$$

✓ Solution by Mathematica

Time used: 0.007 (sec). Leaf size: 29

```
DSolve[{y''[x]+3*y'[x]+2*y[x]==3*Sin[x],{y[0]==-9/10,y'[0]==-7/10}},y[x],x,IncludeSingularSol
```

$$y(x) \to e^{-2x} + \frac{3\sin(x)}{10} - \frac{9\cos(x)}{10} + \sinh(x) - \cosh(x)$$

## 4.15 problem 16

Internal problem ID [4649]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 16.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _with_linear_symmetries]]`

$$\boxed{y'' + 6y' + 10y - 50x = 0}$$

✓ Solution by Maple

Time used: 0.0 (sec). Leaf size: 25

```
dsolve(diff(y(x),x$2)+6*diff(y(x),x)+10*y(x)=50*x,y(x), singsol=all)
```

$$y(x) = \mathrm{e}^{-3x} \sin(x)\, c_2 + \mathrm{e}^{-3x} \cos(x)\, c_1 + 5x - 3$$

✓ Solution by Mathematica

Time used: 0.003 (sec). Leaf size: 27

```
DSolve[y''[x]+6*y'[x]+10*y[x]==50*x,y[x],x,IncludeSingularSolutions -> True]
```

$$y(x) \to 5x + e^{-3x}(c_2 \cos(x) + c_1 \sin(x)) - 3$$

## 4.16 problem 17

Internal problem ID [4650]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 17.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{x'' + 2x' + 2x - 85\sin(3t) = 0}$$

With initial conditions

$$[x(0) = 0, x'(0) = -20]$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 33

```
dsolve([diff(x(t),t$2)+2*diff(x(t),t)+2*x(t)=85*sin(3*t),x(0) = 0, D(x)(0) = -20],x(t), sings
```

$$x(t) = (7\sin(t) + 6\cos(t))\,\mathrm{e}^{-t} - 6\cos(3t) - 7\sin(3t)$$

✓ Solution by Mathematica

Time used: 0.007 (sec). Leaf size: 33

```
DSolve[{x''[t]+2*x'[t]+2*x[t]==85*Sin[3*t],{x[0]==0,x'[0]==-20}},x[t],t,IncludeSingularSoluti
```

$$x(t) \to -7\sin(3t) - 6\cos(3t) + e^{-t}(7\sin(t) + 6\cos(t))$$

## 4.17 problem 18

Internal problem ID [4651]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 18.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{y'' - 3\sin(x) + 4y = 0}$$

With initial conditions

$$\left[y(0) = 0, y'\left(\frac{\pi}{2}\right) = 1\right]$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 13

```
dsolve([diff(y(x),x$2)=3*sin(x)-4*y(x),y(0) = 0, D(y)(1/2*Pi) = 1],y(x), singsol=all)
```

$$y(x) = -\frac{\sin(2x)}{2} + \sin(x)$$

✓ Solution by Mathematica

Time used: 0.006 (sec). Leaf size: 13

```
DSolve[{y''[x]==3*Sin[x]-4*y[x],{y[0]==0,y'[Pi/2]==1}},y[x],x,IncludeSingularSolutions -> Tru
```

$$y(x) \to -(\sin(x)(\cos(x) - 1))$$

## 4.18 problem 19

Internal problem ID [4652]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 19.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _missing_x]]`

$$\boxed{\frac{x''}{2} + 48x = 0}$$

With initial conditions

$$\left[x(0) = \frac{1}{6}, x'(0) = 0\right]$$

✓ Solution by Maple

Time used: 0.016 (sec). Leaf size: 13

```
dsolve([1/2*diff(x(t),t$2)=-48*x(t),x(0) = 1/6, D(x)(0) = 0],x(t), singsol=all)
```

$$x(t) = \frac{\cos\left(4\sqrt{6}\,t\right)}{6}$$

✓ Solution by Mathematica

Time used: 0.003 (sec). Leaf size: 18

```
DSolve[{1/2*x''[t]==-48*x[t],{x[0]==1/6,x'[0]==0}},x[t],t,IncludeSingularSolutions -> True]
```

$$x(t) \to \frac{1}{6}\cos\left(4\sqrt{6}t\right)$$

## 4.19 problem 20

Internal problem ID [4653]

**Book**: Engineering Mathematics. By K. A. Stroud. 5th edition. Industrial press Inc. NY. 2001
**Section**: Program 25. Second order differential equations. Further problems 25. page 1094
**Problem number**: 20.
**ODE order**: 2.
**ODE degree**: 1.

CAS Maple gives this as type `[[_2nd_order, _linear, _nonhomogeneous]]`

$$\boxed{x'' + 5x' + 6x - \cos(t) = 0}$$

With initial conditions

$$\left[x(0) = \frac{1}{10}, x'(0) = 0\right]$$

✓ Solution by Maple

Time used: 0.015 (sec). Leaf size: 25

```
dsolve([diff(x(t),t$2)+5*diff(x(t),t)+6*x(t)=cos(t),x(0) = 1/10, D(x)(0) = 0],x(t), singsol=a
```

$$x(t) = \frac{\mathrm{e}^{-3t}}{10} - \frac{\mathrm{e}^{-2t}}{10} + \frac{\cos(t)}{10} + \frac{\sin(t)}{10}$$

✓ Solution by Mathematica

Time used: 0.027 (sec). Leaf size: 26

```
DSolve[{x''[t]+5*x'[t]+6*x[t]==Cos[t],{x[0]==1/10,x'[0]==0}},x[t],t,IncludeSingularSolutions
```

$$x(t) \to \frac{1}{10}\left(e^{-3t} - e^{-2t} + \sin(t) + \cos(t)\right)$$