Practical -1

Plotting of First Order Differential Equations

Question 1: Solve first order differential equation

dy/dx +y=0

Solution:

Null
```
DSolve [y '[x] + y[x] == 0, y[x], x]
```

Out[2]= $\{\{y[x] \to e^{-x}\, c_1\}\}$

Question 2: Solve first order differential equation

dy/dx + 12y =0

Solution:

```
DSolve[y '[x] + 12 y[x] == 0, y[x], x ]
```

Out[3]= $\{\{y[x] \to e^{-12\,x}\, c_1\}\}$

Question 3: Solve first order differential equation

dy/dx =0

Solution:

In[4]:=
```
DSolve [y '[x] == 0, y[x] , x]
```

Out[4]= $\{\{y[x] \to c_1\}\}$

Question 4: Solve first order differential equation

dy/dx + 10y =x^2

Solution:

In[6]:=
```
DSolve [y '[x] + 10 y[x] == x ^ 2 , y[x] , x]
```

Out[6]= $\left\{\left\{y[x] \to \frac{1}{500} \times \left(1 - 10\,x + 50\,x^2\right) + e^{-10\,x}\, c_1\right\}\right\}$

Question 5: Solve first order differential equation

dy/dx + 24y =e^x

Solution:

In[7]:=
```
DSolve [y '[x] + 24 y[x] == e ^ x, y[x], x]
```

Out[7]=
$$\left\{\left\{y[x] \to e^{-24\,x}\,c_1 + \frac{e^{-24\,x + x\,(24 + Log[e])}}{24 + Log[e]}\right\}\right\}$$

Question 6 : Solve first order differential equations

dy/dt +y =0,

dx/dt + 12x=0

Solution:

In[8]:=
```
DSolve[{y '[t] + y[t] == 0 , x '[t] + 12 x[t] == 0}, {y[t], x[t]}, t]
```

Out[8]=
$$\{\{y[t] \to e^{-t}\,c_1,\ x[t] \to e^{-12\,t}\,c_2\}\}$$

Question 7: Solve first order differential equations

dy/dt =0,

dx/dt +10x =t^2,

dz/dt+24z =e^t

In[10]:=
```
DSolve[{y '[t] == 0, x '[t] + 10 x[t] == t ^ 2, z '[t] + 24 z[t] == e ^ t}, {y[t], x[t], z[t]} , t]
```

Out[10]=
$$\left\{\left\{y[t] \to c_1,\ x[t] \to \frac{1}{500} \times \left(1 - 10\,t + 50\,t^2\right) + e^{-10\,t}\,c_2,\ z[t] \to e^{-24\,t}\,c_3 + \frac{e^{-24\,t + t\,(24 + Log[e])}}{24 + Log[e]}\right\}\right\}$$

Question 8: Solve first order differential equation

dy/dx + $\sqrt{}$(1-y^2)/1-x^2=0

Solution:

In[11]:=
```
DSolve[y '[x] + Sqrt[(1 - y[x] ^ 2) / (1 - x ^ 2)] == 0, y[x], x]
```

Out[11]=
$$\left\{\left\{y[x] \to \frac{-1 - Tanh\left[\frac{1}{2} \times \left(-2\,ArcTanh\left[\frac{\sqrt{-1+x}}{\sqrt{1+x}}\right] + c_1\right)\right]^2}{-1 + Tanh\left[\frac{1}{2} \times \left(-2\,ArcTanh\left[\frac{\sqrt{-1+x}}{\sqrt{1+x}}\right] + c_1\right)\right]^2}\right\}\right\}$$

Question 9: Solve first order differential equation

(y-xdy/dx) = (y^2+dy/dx)

Solution:

In[1]:=
```
DSolve[(y[x] - x y '[x]) == ((y[x]) ^ 2 + y '[x]), y[x], x]
```

Out[1]=
$$\left\{\left\{y[x] \to \frac{1 + x}{1 + e^{c_1} + x}\right\}\right\}$$

Question 10: Solve first order differential equation

(y^2)dx +(xy +x^2)dy/dx =0

Solution:

In[19]:= `DSolve[y'[x] == (y[x]^2 / -(xy[x] + x^2)), y[x], x]`

Out[19]=
$$\left\{\left\{y[x] \to \frac{1}{-c_1 - \int_1^x \frac{1}{-K[1]^2 - xy[K[1]]}\, dK[1]}\right\}\right\}$$

Question 11: Solve first order differential equation

(dy/dx)^2 - x^3 =0

Solution:

In[21]:= `DSolve[y'[x]^2 == x^3 , y[x], x]`

Out[21]=
$$\left\{\left\{y[x] \to -\frac{2\, x^{5/2}}{5} + c_1\right\}, \left\{y[x] \to \frac{2\, x^{5/2}}{5} + c_1\right\}\right\}$$

Question 12: Solve first order differential equation

x = y +(dy/dx)^2

Solution:

In[23]:= `DSolve[x[y] == y + (1 / x'[y])^2, x[y], y]`

Out[23]=
$$\left\{\text{Solve}\left[2\,\text{Log}\left[1 + \sqrt{-y + x[y]}\right] + x[y] - 2\sqrt{-y + x[y]} == c_1,\ x[y]\right],\right.$$
$$\left.\text{Solve}\left[-x[y] - 2\left(\text{Log}\left[1 - \sqrt{-y + x[y]}\right] + \sqrt{-y + x[y]}\right) == c_1,\ x[y]\right]\right\}$$

Question 13: Solve first order differential equation

y=2p+3p^2

In[1]:= `DSolve [ y[x] == 2 y'[x] + 3 (y'[x])^2 , y[x], x]`

Solve : Inverse functions are being used by Solve , so some solutions may not be found ; use Reduce for complete solution information .

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Out[1]=
$$\left\{\left\{y[x] \to \frac{1}{3}\,\text{ProductLog}\left[-e^{-1+\frac{x}{2}-\frac{3 c_1}{2}}\right]\left(2 + \text{ProductLog}\left[-e^{-1+\frac{x}{2}-\frac{3 c_1}{2}}\right]\right)\right\},\right.$$
$$\left.\left\{y[x] \to \frac{1}{3}\,\text{ProductLog}\left[-e^{-1+\frac{x}{2}+\frac{3 c_1}{2}}\right]\left(2 + \text{ProductLog}\left[-e^{-1+\frac{x}{2}+\frac{3 c_1}{2}}\right]\right)\right\}\right\}$$

Question 14: Solve first order differential equation

(dy/dx)^2 + xydy/dx - x^2 (dy/dx)^2 =0

In[2]:= `DSolve [y[x]^2 + x y[x] × y'[x] - x^2 (y'[x])^2 == 0, y[x], x]`

Out[2]=
$$\left\{\left\{y[x] \to x^{\frac{1}{2}\times(1-\sqrt{5})}\, c_1\right\}, \left\{y[x] \to x^{\frac{1}{2}\times(1+\sqrt{5})}\, c_1\right\}\right\}$$

Question 15: Solve first order differential equation

y=(1+dy/dx)x + p^2

In[2]:= `DSolve[y[x] == (1 + y'[x]) x + (y'[x])^2, y[x], x]`

Solve : Inverse functions are being used by Solve , so some solutions may not be found ; use Reduce for complete solution information .

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Out[2]= {{y[x] → 1}}

Question 16: Solve first order differential equation x^2(y-xdy/dx) = y(dy/dx)^2

In[3]:= `DSolve [x^2 (y[x] - x y'[x]) == y[x] × (y'[x])^2, y[x], x]`

Out[3]=
$$\left\{\text{Solve}\left[\frac{1}{2}\,\text{Log}[y[x]] - \frac{\text{ArcTanh}\left[\frac{x^2}{\sqrt{x^4+4\,y[x]^2}}\right]\sqrt{x^6+4\,x^2\,y[x]^2}}{2\,x\,\sqrt{x^4+4\,y[x]^2}} == c_1,\ y[x]\right],\right.$$
$$\left.\text{Solve}\left[\frac{1}{2}\,\text{Log}[y[x]] + \frac{\text{ArcTanh}\left[\frac{x^2}{\sqrt{x^4+4\,y[x]^2}}\right]\sqrt{x^6+4\,x^2\,y[x]^2}}{2\,x\,\sqrt{x^4+4\,y[x]^2}} == c_1,\ y[x]\right]\right\}$$