

# PRACTICAL-01

## Solving first order Ordinary Differential Equations

Command: `Dsolve[eqn,y[x],x]`

Solve a differential equation for  $y[x]$

`Dsolve[{eqn1, eqn2, ...}, {y1[x], y2[x],.....},x]`

Solve a system of differential equations for  $y_1[x]$

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Question 1: Solve first order differential equation  
 $dy/dx+y=0$

Solution:

```
DSolve[y'[x] + y[x] == 0, y[x], x]
{{y[x] -> e^-x C[1]}}
```

Question-2 : Solve the differential equation  $dy/dx+12y=0$

Solution:

```
DSolve[y'[x] + 12 y[x] == 0, y[x], x]
{{y[x] -> e^-12 x C[1]}}
```

Question-3: Solve first order differential equation  $dz/dt=0$ .

Solution:

```
DSolve[z'[t] == 0, z[t], t]
{{z[t] -> C[1]}}
```

Question-4: Solve first order differential equation

$$dz/dt + 10z = t^2$$

Solution:

```
DSolve[z'[t] + 10 z[t] == t^2, z[t], t]
{{z[t] -> 1/500 (1 - 10 t + 50 t^2) + e^{-10 t} C[1]}}
```

Question-5: Solve the first order differential equation

$$dy/dx + 24y = e^x.$$

```
DSolve[z'[x] + 24 z[x] == e^x, z[x], x]
{{z[x] -> e^x/24}}
```

Question-6: Solve the first order differential equation

$$dy/dx + y = 0$$

$$dy/dt + 12y = 0$$

```
DSolve[{y'[t] + y[t] == 0, x'[t] + 12 x[t] == 0},
  {y[t], x[t]}, t]
{{x[t] -> E^-12 t C[1], y[t] -> 0}}
```

Question-7: Solve first order differential equations...

$$\frac{ds}{dx} = 0$$

$$\frac{dv}{dt} + 10v = t^2$$

$$\frac{dz}{dt} + 24z = e^t$$

Solution:

```
DSolve[{s'[t] == 0, v'[t] + 10 v[t] == t^2,
        w'[t] + 24 w[t] == Exp[t]}, {s[t], v[t], w[t]}, t]
{{s[t] -> C[1], v[t] -> 1/500 (1 - 10 t + 50 t^2) + e^{-10 t} C[2],
  w[t] -> e^t/25 + e^{-24 t} C[3]}}
```

Question-8: Solve first order differential equations

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

Solution :

```
DSolve[
  y'[x] + Sqrt[(1 - y[x]^2) / (1 - x^2)] ==
  0, y[x], x]
{{y[x] -> 1 + 2 Sinh[1/2 (-2 ArcSinh[
  Sqrt[-1 + x]/Sqrt[2] + C[1])]^2}}
```

□ Question-9: Solve first order differential equations.

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

Solution:

```
DSolve[(y[t] - t * y'[t]) == (y[t]^2 + y'[t]), y[t], t]
{{y[t] -> (1 + t) / (1 + e^{C[1]} + t)}}
```

Question-10: Solve first order differential equations.

$$\frac{dy}{dx} = -y^2 / (xy + x^2)$$

Solution :

$$\text{DSolve}[y'[x] == -(y[x])^2 / (x y[x] + x^2), y[x], x]$$

$$\left\{ \left\{ y[x] \rightarrow \frac{e^{2 C[1]} - \sqrt{e^{4 C[1]} + e^{2 C[1]} x^2}}{x} \right\}, \right. \\ \left. \left\{ y[x] \rightarrow \frac{e^{2 C[1]} + \sqrt{e^{4 C[1]} + e^{2 C[1]} x^2}}{x} \right\} \right\}$$

Question-11: Solve first order differential equations.

$$\left(\frac{dy}{dx}\right)^2 - x^3 = 0$$

Solution :

$$\text{DSolve}[(y'[x])^2 == x^3, y[x], x]$$

$$\left\{ \left\{ y[x] \rightarrow -\frac{2 x^{5/2}}{5} + C[1] \right\}, \left\{ y[x] \rightarrow \frac{2 x^{5/2}}{5} + C[1] \right\} \right\}$$

Question-12: Solve first order differential equations.

$$x = y + (dy/dx)^2$$

Solution:

$$\text{DSolve}[x == y[x] + (y'[x])^2, y[x], x]$$

$$\left\{ \left\{ y[x] \rightarrow -1 + x - 2 \text{ProductLog}\left[-e^{-1 - \frac{x}{2} + \frac{C[1]}{2}}\right] - \right. \right. \\ \left. \left. \text{ProductLog}\left[-e^{-1 - \frac{x}{2} + \frac{C[1]}{2}}\right]^2 \right\} \right\}$$