Practical 2

* Solve and Plot the following Differential Equations

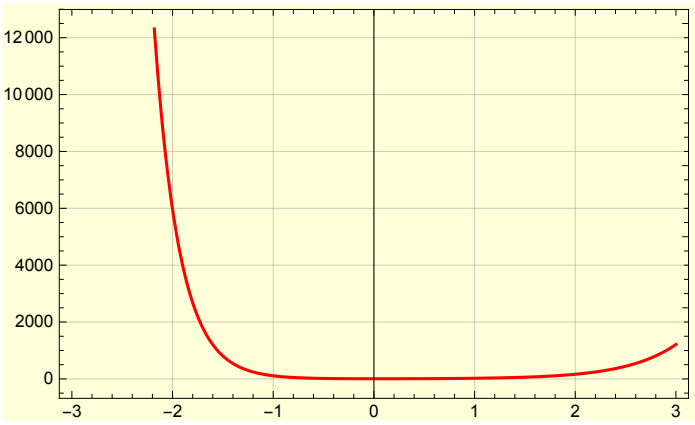
Q1. y'' + 2 y' – 8 y = 0

```
In[]:= sol1 = DSolve[y''[x] + 2 * y'[x] - 8 * y[x] == 0, y[x], x]
Out[]= {{y[x] → e^(-4 x) C[1] + e^(2 x) C[2]}}

In[]:= sol = y[x] /. sol1[[1]] /. {C[1] → 2, C[2] → 3}
Out[]= 2 e^(-4 x) + 3 e^(2 x)

In[]:= Plot[{sol3}, {x, -3, 3}, PlotStyle → Red,
  Frame → True, AxesOrigin → {0, 0}, GridLines → Automatic]
```

Out[]=

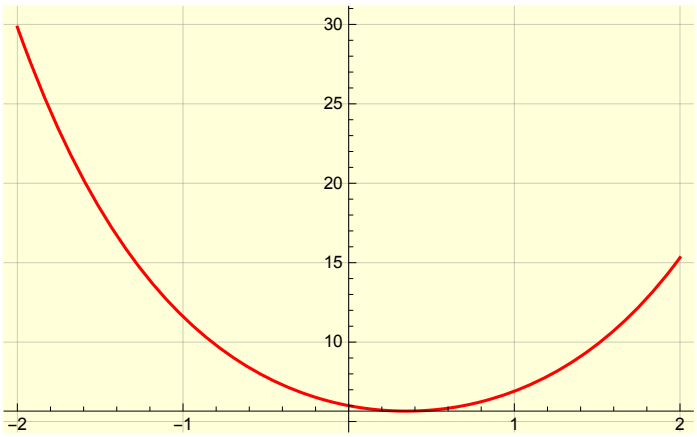


Q2. y”-y=0,y(0)=6,y’(0)=-2

```
In[]:= sol2 = DSolve[{y''[x] - y[x] == 0, y[0] == 6, y'[0] == -2}, y[x], x]
Out[]= {{y[x] → 2 e^(-x) (2 + e^(2 x))}}

In[]:= Plot[y[x] /. sol2, {x, -2, 2}, PlotStyle → {Red}, GridLines → Automatic]
```

Out[ ]=



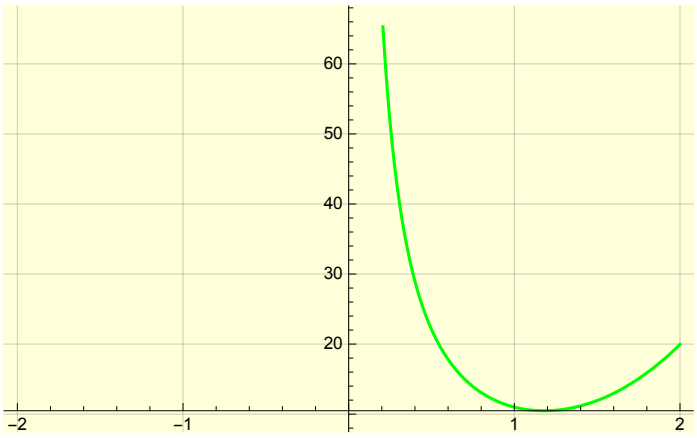
Q3.x^2 y'' + x * y' − 4 * y = 0, y (1) = 11, y' (1) = −6

In[ ]:=
```
q = DSolve[{x^2 * y''[x] - x * y'[x] - 4 * y[x] == 0, y[1] == 11, y'[1] == -6}, y[x], x]
```

Out[ ]=
$$\left\{\left\{y[x] \to -\frac{1}{10} x^{1-\sqrt{5}} \left(-55 - 17\sqrt{5} - 55\, x^{2\sqrt{5}} + 17\sqrt{5}\, x^{2\sqrt{5}}\right)\right\}\right\}$$

In[ ]:=
```
Plot[y[x] /. q, {x, -2, 2}, PlotStyle → {Green}, GridLines → Automatic]
```

Out[ ]=



Q4.y'' + y' − 2 y = x^2

In[ ]:=
```
r = DSolve[y''[x] + y'[x] - 2 * y[x] == x^2, y[x], x]
```

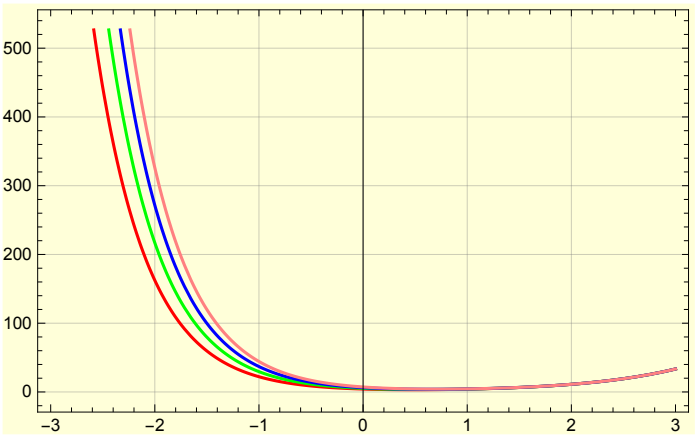
Out[ ]=
$$\left\{\left\{y[x] \to \frac{1}{4}\left(-3 - 2x - 2x^2\right) + e^{-2x} C[1] + e^{x} C[2]\right\}\right\}$$

In[ ]:=
```
r1 = Table[y[x] /. r /. {C[1] → k, C[2] → 2}, {k, 3, 6}]
```

Out[ ]=
$$\left\{\left\{3\, e^{-2x} + 2\, e^{x} + \frac{1}{4}\left(-3 - 2x - 2x^2\right)\right\}, \left\{4\, e^{-2x} + 2\, e^{x} + \frac{1}{4}\left(-3 - 2x - 2x^2\right)\right\},\right.$$
$$\left.\left\{5\, e^{-2x} + 2\, e^{x} + \frac{1}{4}\left(-3 - 2x - 2x^2\right)\right\}, \left\{6\, e^{-2x} + 2\, e^{x} + \frac{1}{4}\left(-3 - 2x - 2x^2\right)\right\}\right\}$$

In[ ]:=
```
Plot[{r1}, {x, -3, 3}, PlotStyle → {Red, Green, Blue, Pink},
 GridLines → Automatic, Frame → True, AxesOrigin → {0, 0}]
```

Out[ ]=



Q5.y'' − 5 y' + 6 y = 4 * e^2 x

In[ ]:=
```
sol5 = DSolve[y''[x] - 5 * y'[x] + 6 * y[x] == 4 * (e^2 x), y[x], x]
```

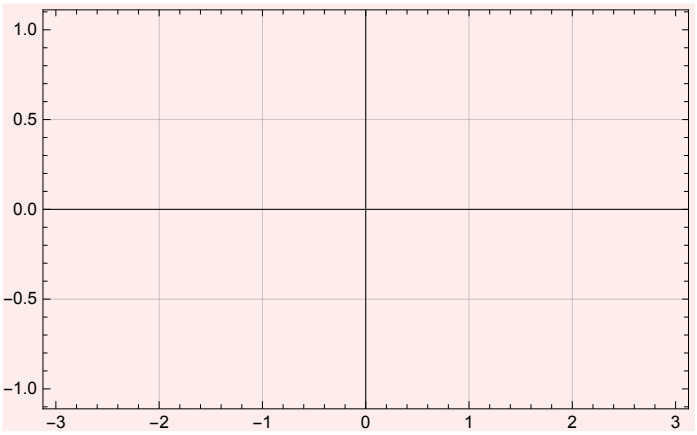
Out[ ]=
$$\left\{\left\{y[x] \to \frac{1}{9}\left(5\,e^2 + 6\,e^2\,x\right) + e^{2x}\,C[1] + e^{3x}\,C[2]\right\}\right\}$$

In[ ]:=
```
SOL5 = Table[y[x] /. sol5 /. {C[1] → k, C[2] → 2}, {k, 3, 6}]
```

Out[ ]=
$$\left\{\left\{3\,e^{2x} + 2\,e^{3x} + \frac{1}{9}\left(5\,e^2 + 6\,e^2\,x\right)\right\}, \left\{4\,e^{2x} + 2\,e^{3x} + \frac{1}{9}\left(5\,e^2 + 6\,e^2\,x\right)\right\},\right.$$
$$\left.\left\{5\,e^{2x} + 2\,e^{3x} + \frac{1}{9}\left(5\,e^2 + 6\,e^2\,x\right)\right\}, \left\{6\,e^{2x} + 2\,e^{3x} + \frac{1}{9}\left(5\,e^2 + 6\,e^2\,x\right)\right\}\right\}$$

In[ ]:=
```
Plot[{SOL5}, {x, -3, 3}, PlotStyle → {Red, Green, Blue, Pink},
 GridLines → Automatic, Frame → True, AxesOrigin → {0, 0}]
```

Out[ ]=



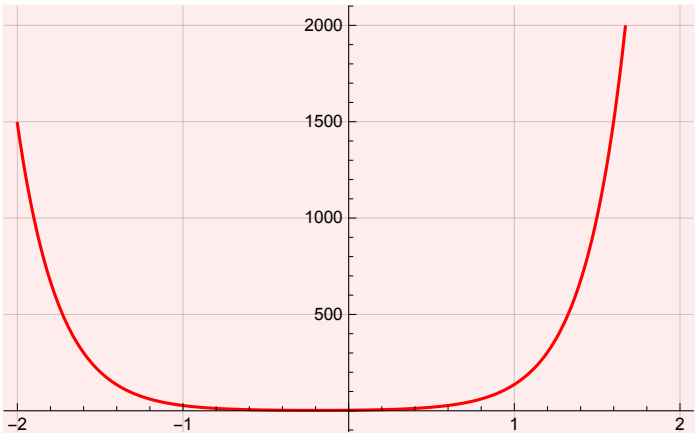
Q6.y'' − 16 y = 0, y (0) = 3, y' (0) = 8

In[•]:=
```
p = DSolve[{y''[x] - 16 * y[x] == 0, y[0] == 3, y'[0] == 8}, y[x], x]
```

Out[•]=
$$\left\{\left\{y[x] \to \frac{1}{2} e^{-4x}\left(1 + 5 e^{8x}\right)\right\}\right\}$$

In[•]:=
```
Plot[y[x] /. p, {x, -2, 2}, PlotStyle → Red, GridLines → Automatic]
```

Out[•]=



Q7 .10 y'' − 7 y' + 1.2 y = 0

In[•]:=
```
sol7 = DSolve[10 * y''[x] - 7 * y'[x] + 1.2 * y[x] == 0, y[x], x]
```

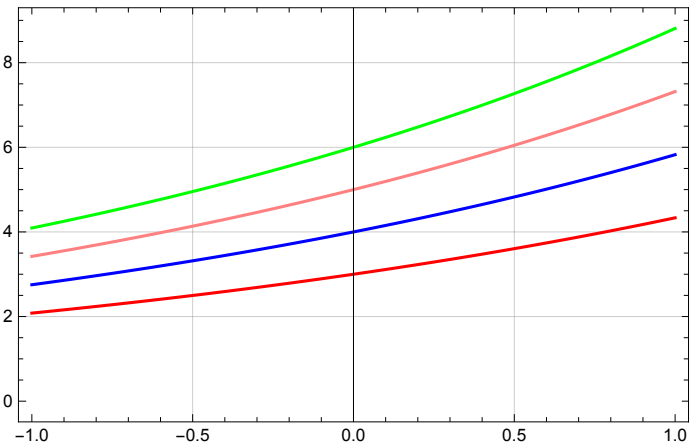
Out[•]=
$$\left\{\left\{y[x] \to e^{0.3x} C[1] + e^{0.4x} C[2]\right\}\right\}$$

In[•]:=
```
Sol = Table[y[x] /. sol7 /. {C[1] → 1, C[2] → k}, {k, 2, 5}]
```

Out[•]=
$$\left\{\left\{e^{0.3x} + 2 e^{0.4x}\right\}, \left\{e^{0.3x} + 3 e^{0.4x}\right\}, \left\{e^{0.3x} + 4 e^{0.4x}\right\}, \left\{e^{0.3x} + 5 e^{0.4x}\right\}\right\}$$

In[•]:=
```
Plot[{Sol}, {x, -1, 1}, PlotStyle → {Red, Blue, Pink, Green},
 GridLines → Automatic, Frame → True, AxesOrigin → {0, 0}, ImageSize → Medium]
```

Out[•]=



Q8.x^2 y'' + 2 xy' − 6 y = 0

```
In[•]:= Sol8 = DSolve[x^2 * y''[x] + 2 * x * y'[x] - 6 * y[x] == 0, y[x], x]
```

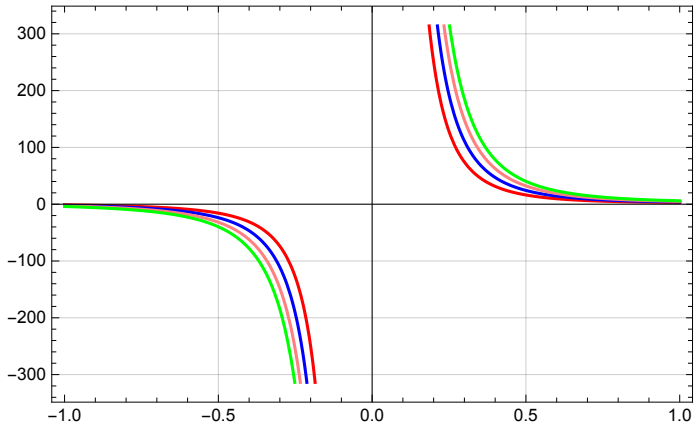
$$\text{Out[•]= } \left\{\left\{y[x] \to x^2\, C[1] + \frac{C[2]}{x^3}\right\}\right\}$$

```
In[•]:= SOL = Table[y[x] /. Sol8 /. {C[1] → 1, C[2] → k}, {k, 2, 5}]
```

$$\text{Out[•]= } \left\{\left\{\frac{2}{x^3} + x^2\right\}, \left\{\frac{3}{x^3} + x^2\right\}, \left\{\frac{4}{x^3} + x^2\right\}, \left\{\frac{5}{x^3} + x^2\right\}\right\}$$

```
In[•]:= Plot[{SOL}, {x, -1, 1}, PlotStyle → {Red, Blue, Pink, Green},
 GridLines → Automatic, Frame → True, AxesOrigin → {0, 0}, ImageSize → Medium]
```

Out[•]=



Q9.x^2 y'' + xy' + 4 y = 0

```
In[•]:= Sol9 = DSolve[x^2 * y''[x] + x * y'[x] + 4 * y[x] == 0, y[x], x]
```

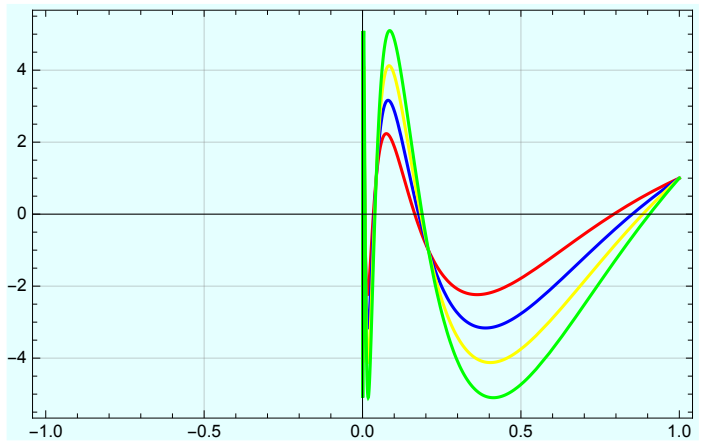
```
Out[•]= {{y[x] → C[1] Cos[2 Log[x]] + C[2] Sin[2 Log[x]]}}
```

```
In[•]:= SOL = Table[y[x] /. Sol9 /. {C[1] → 1, C[2] → k}, {k, 2, 5}]
```

```
Out[•]= {{Cos[2 Log[x]] + 2 Sin[2 Log[x]]}, {Cos[2 Log[x]] + 3 Sin[2 Log[x]]},
 {Cos[2 Log[x]] + 4 Sin[2 Log[x]]}, {Cos[2 Log[x]] + 5 Sin[2 Log[x]]}}
```

```
In[•]:= Plot[{SOL}, {x, -1, 1}, PlotStyle → {Red, Blue, Yellow, Green},
 GridLines → Automatic, Frame → True, AxesOrigin → {0, 0}]
```

Out[•]=



Q10.x^2 y'' – 0.75 y = 0

```
In[•]:= Sol10 = DSolve[x^2 * y''[x] - 0.75 * y[x] == 0, y[x], x]
```

$$\text{Out}[\bullet]= \left\{\left\{y[x] \to x^{-0.5+0.\,i}\, C[1] + x^{1.5+0.\,i}\, C[2]\right\}\right\}$$

```
In[•]:= SOL = Table[y[x] /. Sol10 /. {C[1] → 1, C[2] → k}, {k, 2, 5}]
```

$$\text{Out}[\bullet]= \left\{\left\{x^{-0.5+0.\,i} + 2\, x^{1.5+0.\,i}\right\}, \left\{x^{-0.5+0.\,i} + 3\, x^{1.5+0.\,i}\right\}, \left\{x^{-0.5+0.\,i} + 4\, x^{1.5+0.\,i}\right\}, \left\{x^{-0.5+0.\,i} + 5\, x^{1.5+0.\,i}\right\}\right\}$$

```
In[•]:= Plot[{SOL}, {x, -3, 3}, PlotStyle → {Blue, Red, Green, Yellow},
  Frame → True, AxesOrigin → {0, 0}, GridLines → Automatic, ImageSize → 600]
```

Out[•]=