In[58]:= `DSolve[m y''[x] + k y[x] == 0, y[x], x]`

Out[58]= $\left\{\left\{y[x] \to C[1] \, \mathrm{Cos}\left[\frac{\sqrt{k}\ x}{\sqrt{m}}\right] + C[2] \, \mathrm{Sin}\left[\frac{\sqrt{k}\ x}{\sqrt{m}}\right]\right\}\right\}$

In[59]:= `DSolve[y'[x]^2 + y[x]^2 == e, y[x], x]`

Out[59]= $\left\{\left\{y[x] \to -\left(\left(\sqrt{e}\ \mathrm{Tan}[x - C[1]]\right) \Big/ \left(\sqrt{\left(1 + \mathrm{Tan}[x - C[1]]^2\right)}\right)\right)\right\},\right.$
$\left\{y[x] \to \left(\sqrt{e}\ \mathrm{Tan}[x - C[1]]\right) \Big/ \left(\sqrt{\left(1 + \mathrm{Tan}[x - C[1]]^2\right)}\right)\right\},$
$\left\{y[x] \to -\left(\left(\sqrt{e}\ \mathrm{Tan}[x + C[1]]\right) \Big/ \left(\sqrt{\left(1 + \mathrm{Tan}[x + C[1]]^2\right)}\right)\right)\right\},$
$\left.\left\{y[x] \to \left(\sqrt{e}\ \mathrm{Tan}[x + C[1]]\right) \Big/ \left(\sqrt{\left(1 + \mathrm{Tan}[x + C[1]]^2\right)}\right)\right\}\right\}$

In[60]:= `DSolve[y'[x] + y[x]^2 == 0, y[x], x]`

Out[60]= $\left\{\left\{y[x] \to \frac{1}{x - C[1]}\right\}\right\}$

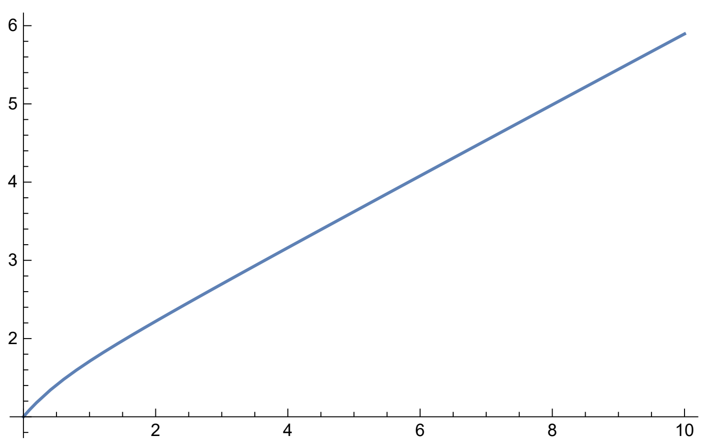
In[61]:= `DSolve[(x^3 + 1) y''[x] + y[x] y'[x]^3 == 0, y[x], x]`

Out[61]= $\mathrm{DSolve}\left[y[x]\, y'[x]^3 + \left(1 + x^3\right) y''[x] == 0,\ y[x],\ x\right]$

In[62]:= `NDSolve[{(x^3 + 1) y''[x] + y[x] y'[x]^3 == 0, y[0] == 1, y'[0] == 1}, y[x], {x, 0, 10}]`

Out[62]= {{y[x] → InterpolatingFunction[Domain: {{0., 10.}} Output: scalar][x]}}

In[63]:= `Plot[y[x] /. %[[1]], {x, 0, 10}]`

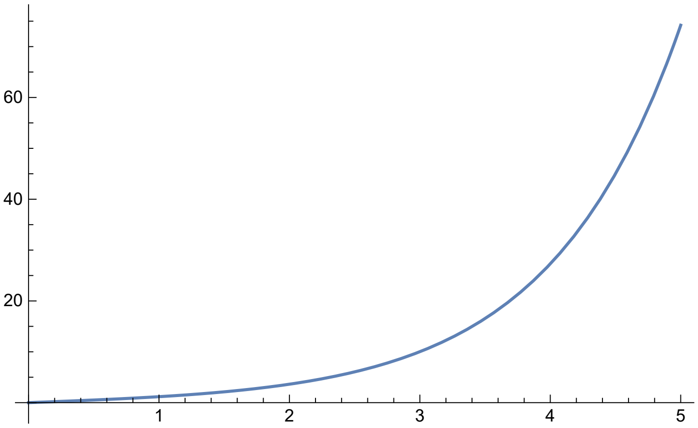
Out[63]=


In[64]:= `NDSolve[{y''[x] == y[x], y[0] == 0, y'[0] == 1}, y[x], {x, 0, 5}]`

Out[64]= {{y[x] → InterpolatingFunction[Domain: {{0., 5.}} Output: scalar][x]}}

In[65]:=
```
Plot[y[x] /. %[[1]], {x, 0, 5}]
```

Out[65]=

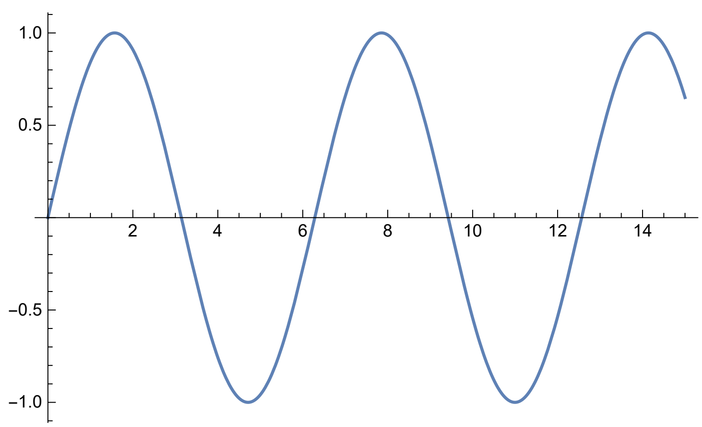


In[66]:=
```
NDSolve[{y''[x] == -y[x], y[0] == 0, y'[0] == 1}, y[x], {x, 0, 15}]
```

Out[66]=
```
{{y[x] → InterpolatingFunction[ Domain: {{0., 15.}} Output: scalar ][x]}}
```

In[67]:=
```
Plot[y[x] /. %[[1]], {x, 0, 15}]
```

Out[67]=



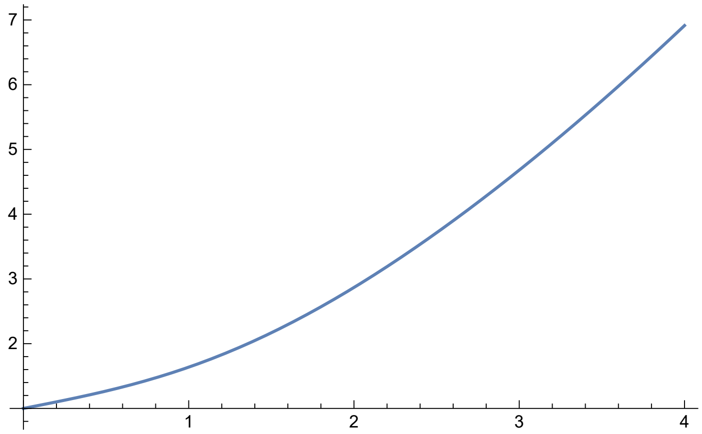
In[68]:=
```
NDSolve[{y''[x] == -y[x], y'[0] == 1}, y[x], {x, 0, 15}]
```

Out[68]=
```
NDSolve[{y′′[x] == -y[x], y′[0] == 1}, y[x], {x, 0, 15}]
```

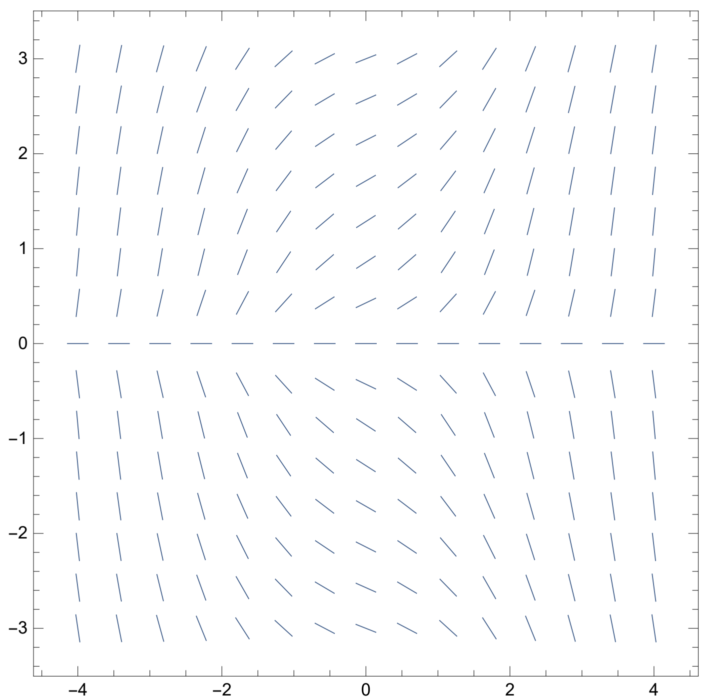
In[69]:= $\text{NDSolve}\left[\left\{y'[x] == \dfrac{1+x^2}{1+y[x]^2}\, y[x],\ y[0] == 1\right\},\ y[x],\ \{x, 0, 4\}\right]$

Out[69]=
```
{{y[x] → InterpolatingFunction[ Domain: {{0., 4.}} Output: scalar ][x]}}
```

In[70]:= `Plot[y[x] /. %[[1]], {x, 0, 4}]`

Out[70]=


In[71]:= $\texttt{VectorPlot}\left[\left\{1, \frac{1+x^2}{1+y^2}\,y\right\}\Big/\left(\sqrt{\left(1+\frac{(1+x^2)^2}{(1+y^2)^2}\,y^2\right)}\right), \{x, -4, 4\}, \{y, -3, 3\}, \texttt{VectorStyle} \to \texttt{Arrowheads}[0], \texttt{VectorScale} \to 0.03\right]$

Out[71]=


In[72]:=
```
u = Sum[a[k] x^k, {k, 0, 5}]
D[u, x] + u^2 + u
CoefficientList[Series[%, {x, 0, 4}], x]
NSolve[{a[0] == 1, % == {0, 0, 0, 0, 0}}]
u /. %[[1]]
Plot[%, {x, -3, 3}]
```

$$u = \sum_{k=0}^{5} a[k]\, x^k$$

Out[72]= $a[0] + x\, a[1] + x^2\, a[2] + x^3\, a[3] + x^4\, a[4] + x^5\, a[5]$

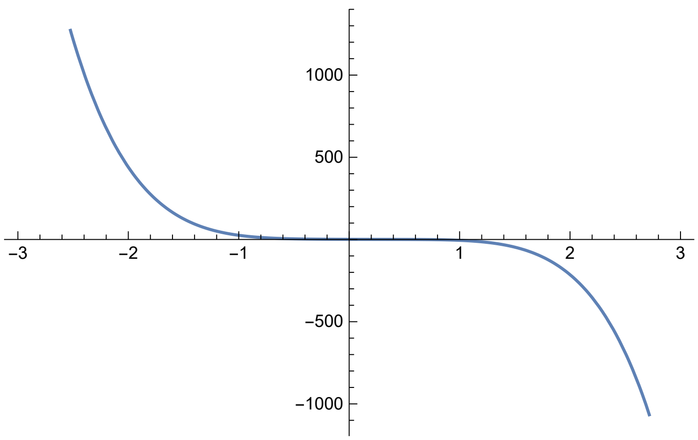
Out[73]= $a[0] + a[1] + x\, a[1] + 2\, x\, a[2] + x^2\, a[2] + 3\, x^2\, a[3] + x^3\, a[3] + 4\, x^3\, a[4] + x^4\, a[4] + 5\, x^4\, a[5] + x^5\, a[5] + \left(a[0] + x\, a[1] + x^2\, a[2] + x^3\, a[3] + x^4\, a[4] + x^5\, a[5]\right)^2$

Out[74]= $\{a[0] + a[0]^2 + a[1],\ a[1] + 2\, a[0]\, a[1] + 2\, a[2],\ a[1]^2 + a[2] + 2\, a[0]\, a[2] + 3\, a[3],\ 2\, a[1]\, a[2] + a[3] + 2\, a[0]\, a[3] + 4\, a[4],\ a[2]^2 + 2\, a[1]\, a[3] + a[4] + 2\, a[0]\, a[4] + 5\, a[5]\}$

Out[75]= $\{\{a[0] \to 1.,\ a[1] \to -2.,\ a[2] \to 3.,\ a[3] \to -4.33333,\ a[4] \to 6.25,\ a[5] \to -9.01667\}\}$

Out[76]= $1. - 2.\, x + 3.\, x^2 - 4.33333\, x^3 + 6.25\, x^4 - 9.01667\, x^5$

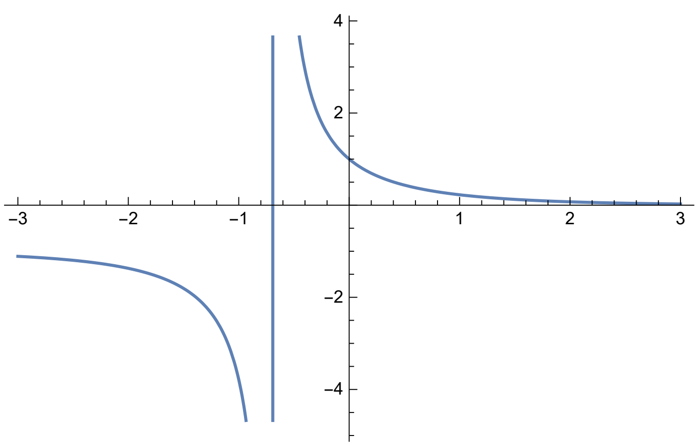
Out[77]=



In[78]:=
```
DSolve[{uu'[x] + uu[x]^2 + uu[x] == 0, uu[0] == 1}, uu[x], x]
Plot[uu[x] /. %[[1]], {x, -3, 3}]
```

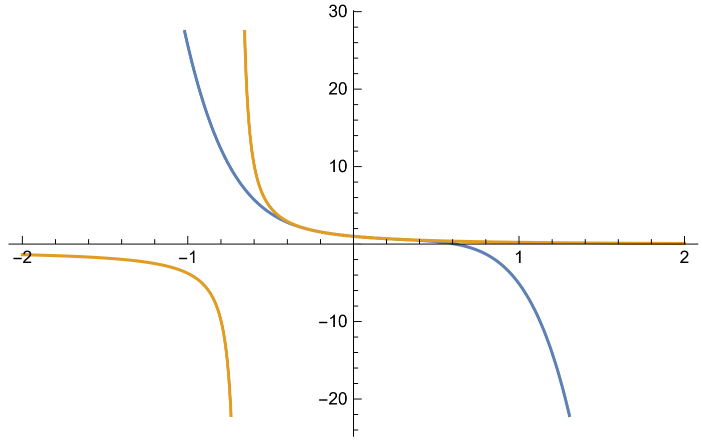
Out[78]= $\left\{\left\{uu[x] \to \frac{1}{-1 + 2\, e^x}\right\}\right\}$

Out[79]=



In[80]:=
```
Plot[{1.` - 2.` x + 3.` x^2 - 4.333333333333333` x^3 + 6.25` x^4 - 9.016666666666666` x^5, 1/(-1 + 2 E^x)},
 {x, -2, 2}]
```

Out[80]=



In[81]:=
```
NDSolve[{x'[t] == -3 (x[t] - y[t]), y'[t] == -x[t] z[t] + 26.5 x[t] - y[t],
  z'[t] == x[t] y[t] - z[t], x[0] == z[0] == 0, y[0] == 1},
 {x, y, z}, {t, 0, 200}, MaxSteps → Infinity]
```

Out[81]=
```
{{x → InterpolatingFunction[ Domain: {{0., 200.}} Output: scalar ],
  y → InterpolatingFunction[ Domain: {{0., 200.}} Output: scalar ],
  z → InterpolatingFunction[ Domain: {{0., 200.}} Output: scalar ]}}
```

In[82]:=
```
ParametricPlot3D[Evaluate[{x[t], y[t], z[t]} /. %], {t, 0, 200},
  PlotPoints → 10000, ColorFunction → (ColorData["Rainbow"][#4] &)]
```

Out[82]=