In[•]:=
```
Eqn = y'''[x] + 3 y''[x] + 4 y'[x] + 12 y[x]
```

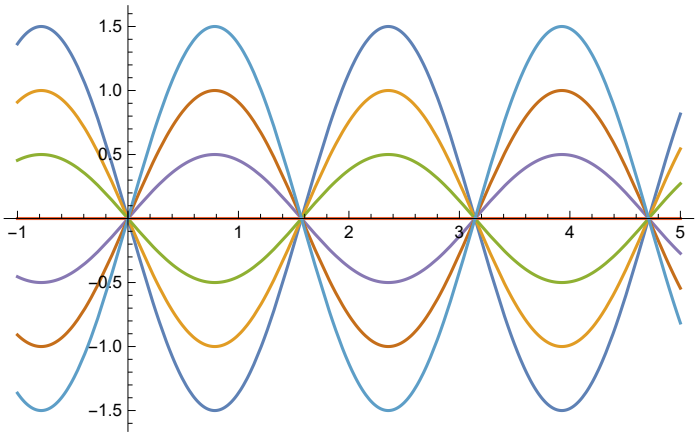
Out[•]=
$$12\,y[x] + 4\,y'[x] + 3\,y''[x] + y^{(3)}[x]$$

In[•]:=
```
Sol = DSolve[{Eqn == 0, y''[0] == 0, y'[0] == a, y[0] == 0}, y[x], x]
```

Out[•]=
$$\left\{\left\{y[x] \to \frac{1}{2}\,a\,\text{Sin}[2\,x]\right\}\right\}$$

In[•]:=
```
Plot[Evaluate[y[x] /. Sol /. a → {-3, -2, -1, 0, 1, 2, 3}], {x, -1, 5}]
```

Out[•]=

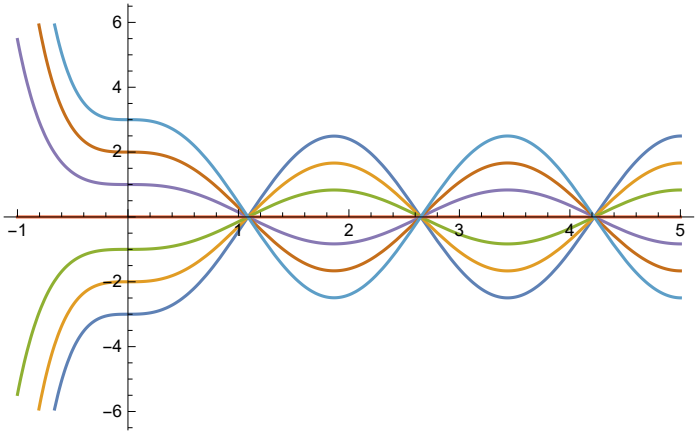


In[•]:=
```
Solution = DSolve[{Eqn == 0, y''[0] == 0, y'[0] == 0, y[0] == b}, y[x], x]
```

Out[•]=
$$\left\{\left\{y[x] \to \frac{1}{13}\,b\,e^{-3\,x}\left(4 + 9\,e^{3\,x}\,\text{Cos}[2\,x] + 6\,e^{3\,x}\,\text{Sin}[2\,x]\right)\right\}\right\}$$

In[•]:=
```
Plot[Evaluate[y[x] /. Solution /. b → {-3, -2, -1, 0, 1, 2, 3}], {x, -1, 5}]
```

Out[•]=

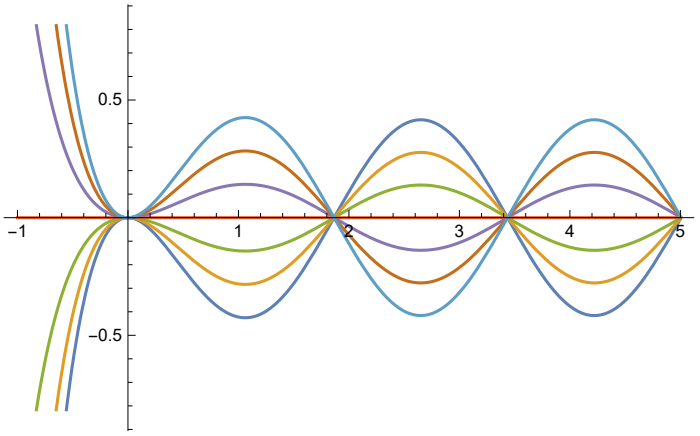


In[•]:=
```
value = DSolve[{Eqn == 0, y''[0] == a, y'[0] == 0, y[0] == 0}, y[x], x]
```

Out[•]=
$$\left\{\left\{y[x] \to -\frac{1}{26}\,a\,e^{-3\,x}\left(-2 + 2\,e^{3\,x}\,\text{Cos}[2\,x] - 3\,e^{3\,x}\,\text{Sin}[2\,x]\right)\right\}\right\}$$

In[•]:=
```
Plot[Evaluate[y[x] /. value /. a → {-3, -2, -1, 0, 1, 2, 3}], {x, -1, 5}]
```

Out[•]=



In[•]:=
```
ClearAll
```

Out[•]=
```
ClearAll
```

In[•]:=
```
first = x'[t] - n * x[t]
```

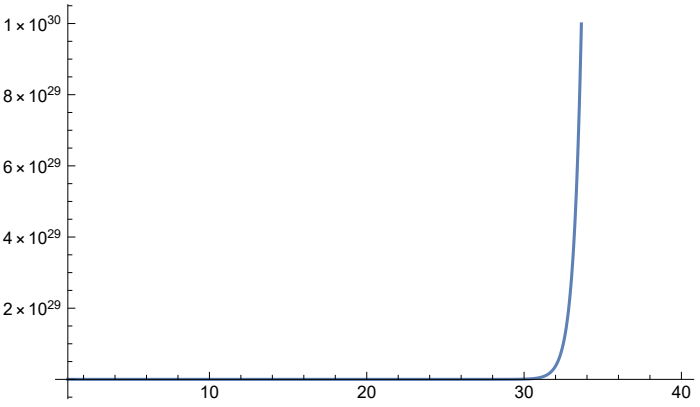
Out[•]=
```
-n x[t] + x′[t]
```

In[•]:=
```
Ans = DSolve[{first == 0, x[0] == C}, x[t], t]
```

Out[•]=
```
{{x[t] → C ℯ^(n t)}}
```

In[•]:=
```
Plot[Evaluate[x[t] /. Ans /. {n → 2, C → 6}], {t, 1, 40}]
```

Out[•]=



In[•]:=
```
Evaluate[x[t] /. Ans /. {n → 2, C → 6, t → 51}]
```

Out[•]=
```
{6 ℯ^102}
```

In[•]:=
```
first = P'[t] - n * P[t]
```

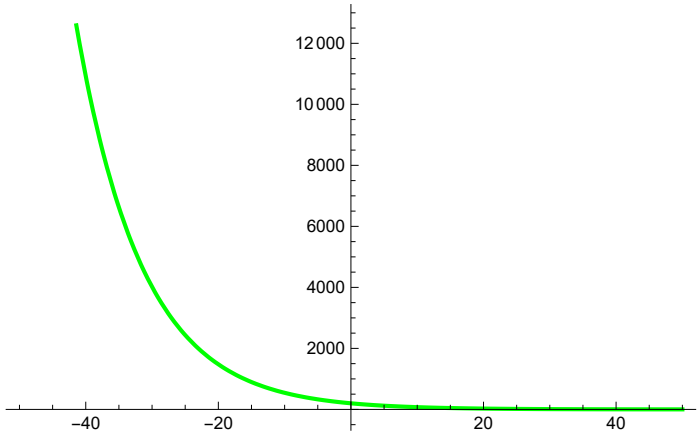
Out[•]=
```
-n P[t] + P′[t]
```

In[•]:=
```
Ans = DSolve[{first == 0, P[0] == C}, P[t], t]
```

Out[•]=
```
{{P[t] → C ℯ^(n t)}}
```

In[ ]:=
```
Plot[Evaluate[P[t] /. Ans /. {C → 200, n → -0.1}],
 {t, -50, 50}, PlotStyle → {Green, Thickness[0.006]}]
```

Out[ ]=



In[ ]:=
```
Evaluate[P[t] /. Ans /. {C → 200, n → -0.1, t → 1.5}]
```

Out[ ]=
```
{172.142}
```

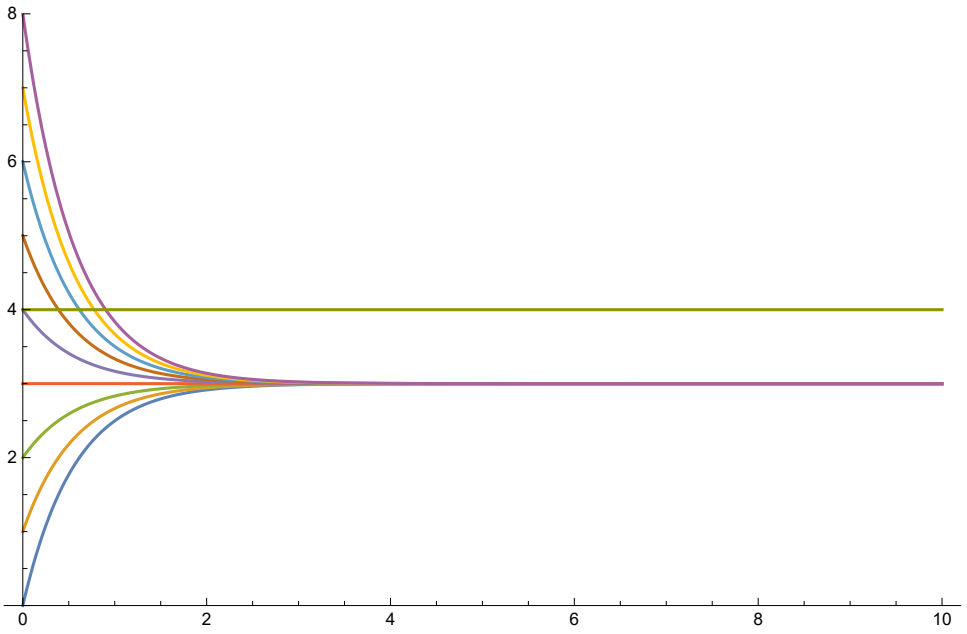
Lake pollution model with constant flow and pollution concentration

In[•]:=
```
cin = 3;
V = 28;
F = 50;
threshold = 4;
de1 = D[C[t], t] == (F / V) * (cin - C[t])
soln = DSolve[{de1, C[0] == c0}, C[t], t]
plot1 = Plot[{Evaluate[C[t] /. soln /. c0 → Range[0, 8]], threshold},
  {t, 0, 10}, PlotRange → {0, 8}]
```

Out[•]= $C'[t] == \frac{25}{14}(3 - C[t])$

Out[•]= $\left\{\left\{C[t] \to e^{-25\,t/14}\left(-3 + c0 + 3\,e^{25\,t/14}\right)\right\}\right\}$

Out[•]=



Example of lake Erie in America:

```
In[•]:= cin = 0;
V = 458 * 10^9;
F = 480 * 10^6;
de1 = D[C[t], t] == (F / V) * (cin - C[t])
soln = DSolve[{de1, C[0] == c0}, C[t], t]
C[t] /. First[soln]
sol = Solve[% == 0.05 * c0, t]
Print["Years = ", N[{t /. sol[[1]]} / 365]]
```

Out[•]= $C'[t] == -\frac{6\,C[t]}{5725}$

Out[•]= $\left\{\left\{C[t] \to c0\, e^{-6\,t/5725}\right\}\right\}$

Out[•]= $c0\, e^{-6\,t/5725}$

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

Out[•]= $\{\{t \to 2858.43\}\}$

```
Years = {7.83131}
```

Example of lake Ontario in America

```
In[•]:= cin = 0;
V = 1636 * 10^9;
F = 572 * 10^6;
de1 = D[C[t], t] == (F / V) * (cin - C[t])
soln = DSolve[{de1, C[0] == c0}, C[t], t]
C[t] /. First[soln]
sol = Solve[% == 0.05 * c0, t]
Print["Years = ", N[{t /. sol[[1]]} / 365]]
```

Out[•]= $C'[t] == -\frac{143\,C[t]}{409\,000}$

Out[•]= $\left\{\left\{C[t] \to c0\, e^{-143\,t/409\,000}\right\}\right\}$

Out[•]= $c0\, e^{-143\,t/409\,000}$

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

Out[•]= $\{\{t \to 8568.21\}\}$

```
Years = {23.4746}
```