In[1]:=
```
Clear["Global'*"]
```

In[2]:=
```
Factor[s^3 + 7 s^2 + 14 s + 8]
```

Out[2]=
$$(1 + s)\ (2 + s)\ (4 + s)$$

In[3]:=
```
Factor[s^3 + s^2 - 2 s - 5]
```

Out[3]=
$$-5 - 2\ s + s^2 + s^3$$

In[4]:=
```
FullSimplify[(s^3 + s^2 - 2 s - 5)/(s^3 + 7 s^2 + 14 s + 8)]
```

Out[4]=
$$\frac{-5 + s\ \left(-2 + s + s^2\right)}{(1 + s)\ (2 + s)\ (4 + s)}$$

In[5]:=
```
Factor[2 s^2 + 7 s + 7]
```

Out[5]=
$$7 + 7\ s + 2\ s^2$$

In[32]:=
```
A = ({{-1, 0, 0}, {0, -2, 0}, {0, 0, -4}});
B = ({{1}, {1}, {1}});
c1 = ({-1, 5/2, -15/2});
D1 = ({1});
y0 = ({{1}, {0}, {0}});
u0 = ({{1}, {0}, {0}});
EA[t_] := {{e^-t, 0, 0}, {0, e^-2 t, 0}, {0, 0, e^-4 t}}
t21 = c1.B;
t31 = c1.A.B;
s21 = c1.A;
s31 = c1.A^2;
```

In[16]:=
$$x0 = \text{Inverse}\left[\begin{pmatrix} c1[[1,1]] & c1[[1,2]] & c1[[1,3]] \\ s21[[1,1]] & s21[[1,2]] & s21[[1,3]] \\ s31[[1,1]] & s31[[1,2]] & s31[[1,3]] \end{pmatrix}\right] \cdot \left(y0 - \left(\begin{pmatrix} D1[[1,1]] & 0 & 0 \\ t21[[1,1]] & D1[[1,1]] & 0 \\ t31[[1,1]] & t21[[1,1]] & D1[[1,1]] \end{pmatrix} \cdot u0\right)\right)$$

Out[16]=
$$\left\{\left\{-\frac{10}{3}\right\}, \left\{-\frac{4}{5}\right\}, \left\{\frac{8}{45}\right\}\right\}$$

In[43]:=
```
ψ1 = c1.EA[t].x0;
ψ2 = Integrate[c1.EA[t - τ].B, {τ, 0, t}];
```

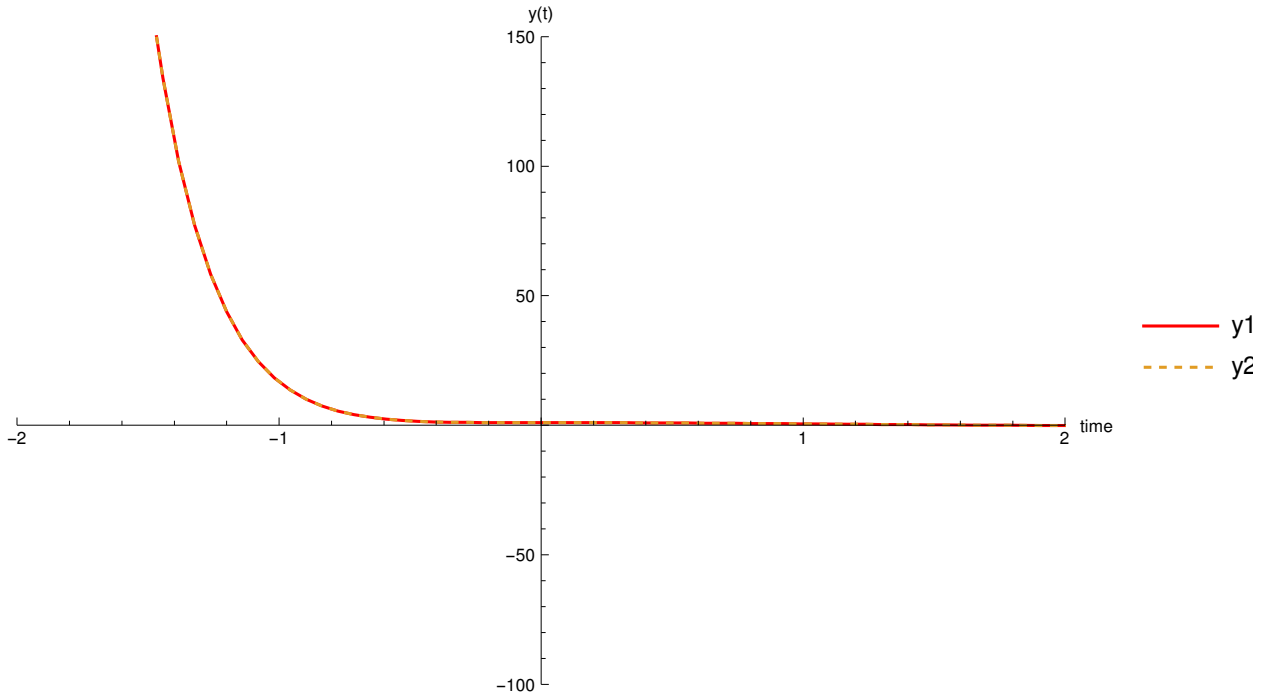
In[54]:=
```
y1[t_] = FullSimplify[((ψ1 + ψ2 + D1[[1, All]])[[1, All]])[[1, All]]]
y2[t_] =
 FullSimplify[InverseLaplaceTransform[(s^3 + s^2 - 2 s - 5)/(s (s^3 + 7 s^2 + 14 s + 8)) + (6 s + 16)/(s^3 + 7 s^2 + 14 s + 8), s, t]]
```

Out[54]=
$$\frac{1}{24}\left(-15 + 13\, e^{-4t}\left(1 - 6\, e^{2t} + 8\, e^{3t}\right)\right)$$

Out[55]=
$$\frac{1}{24}\left(-15 + 13\, e^{-4t}\left(1 - 6\, e^{2t} + 8\, e^{3t}\right)\right)$$

In[53]:=
```
Plot[{y1[t], y2[t]}, {t, -100, 100}, PlotRange → {{-2, 2}, {-100, 1.5 * 100}},
 PlotStyle → {Red, Dashed}, AxesLabel → {"time", "y(t)"},
 AxesOrigin → {0, 0}, ImageSize → Large, PlotLegends → {"y1", "y2"}]
```

Out[53]=



In[22]:=
```
Apart[(s^3 + s^2 - 2 s - 5)/(s^3 + 7 s^2 + 14 s + 8), s]
```
Out[22]= $1 - \frac{1}{1+s} + \frac{5}{2\,(2+s)} - \frac{15}{2\,(4+s)}$

In[23]:=
```
Apart[(6 s^2 + 16 s + 13)/(s^3 + 7 s^2 + 14 s + 8), s]
```
Out[23]= $\frac{1}{1+s} - \frac{5}{2\,(2+s)} + \frac{15}{2\,(4+s)}$

In[24]:=
```
Apart[(s^3 + s^2 - 2 s - 5)/(s * (s^3 + 7 s^2 + 14 s + 8)), s]
```
Out[24]= $-\frac{5}{8\,s} + \frac{1}{1+s} - \frac{5}{4\,(2+s)} + \frac{15}{8\,(4+s)}$

In[25]:=
```
InverseLaplaceTransform[-5/(8 s) + 1/(1 + s) - 5/(4 (2 + s)) + 15/(8 (4 + s)), s, t]
```
Out[25]= $-\frac{5}{8} + \frac{15\,e^{-4t}}{8} - \frac{5\,e^{-2t}}{4} + e^{-t}$

In[26]:=
```
Apart[(6 s + 16)/(s^3 + 7 s^2 + 14 s + 8), s]
```
Out[26]= $\frac{10}{3\,(1+s)} - \frac{2}{2+s} - \frac{4}{3\,(4+s)}$

In[27]:=
```
Exp[A * t]
```
Out[27]= $\{\{e^{-t}, 1, 1\}, \{1, e^{-2t}, 1\}, \{1, 1, e^{-4t}\}\}$

```
EA := {{e^-t, 0, 0}, {0, e^-2t, 0}, {0, 0, e^-4t}}
```