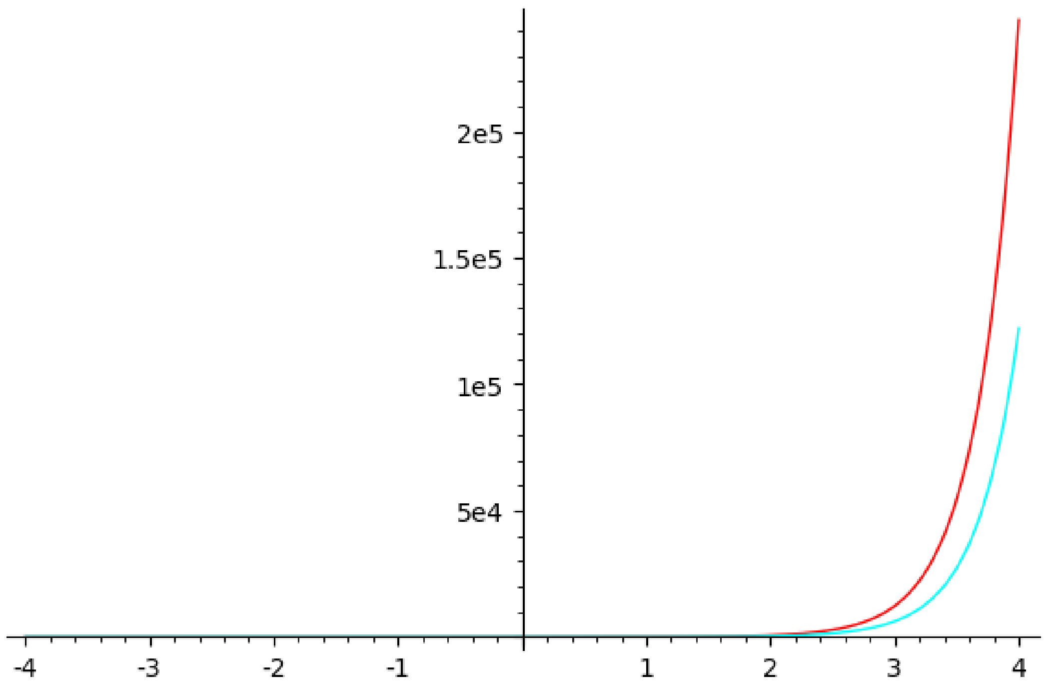
In [19]:

```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==x+4*y
eq2=diff(y,t)==x+y
syst=[eq1, eq2]
C1,C2=var('C1,C2')
sol=desolve_system(syst, [x, y], [0, C1, C2])
show(sol)
sol_x(t,C1,C2)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t, 1, 1), t, -4, 4, color='red')
sol_y(t,C1,C2)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t, 1, 1), t, -4, 4, color='cyan')
show(reprx+repry)
```

$$\left[x\left(t\right) = \frac{1}{2}\left(C_1 + 2\,C_2\right)e^{\left(3\,t\right)} + \frac{1}{2}\left(C_1 - 2\,C_2\right)e^{\left(-t\right)}, y\left(t\right) = \frac{1}{4}\left(C_1 + 2\,C_2\right)e^{\left(3\,t\right)} - \frac{1}{4}\left(C_1 - 2\,C_2\right)e^{\left(-t\right)}\right]$$

$$\left(t, C_1, C_2\right) \mapsto$$

$$\left(t, C_1, C_2\right) \mapsto$$



In [48]:

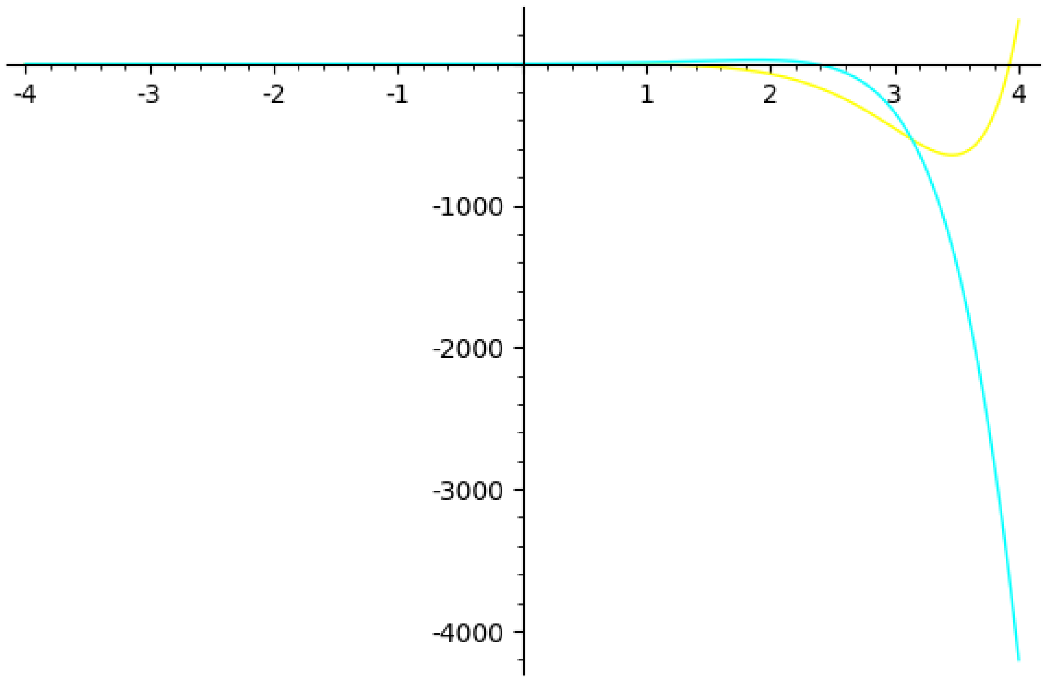
```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==2*x-y
eq2=diff(y,t)==x+2*y
syst=[eq1, eq2]
C1,C2=var('C1,C2')
sol=desolve_system(syst, [x, y], [0, C1, C2])
show(sol)
sol_x(t,C1,C2)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t, 1, 1), t, -4, 4, color='yellow')
```

```
sol_y(t,C1,C2)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t, 1, 1), t, -4, 4, color='cyan')
show(reprx+repry)
```

$$\left[x\left(t\right) = \left(C_1 \cos\left(t\right) - C_2 \sin\left(t\right)\right) e^{\left(2\,t\right)}, y\left(t\right) = \left(C_2 \cos\left(t\right) + C_1 \sin\left(t\right)\right) e^{\left(2\,t\right)}\right]$$

$\left(t, C_1, C_2\right) \mapsto$

$\left(t, C_1, C_2\right) \mapsto$



In [40]:

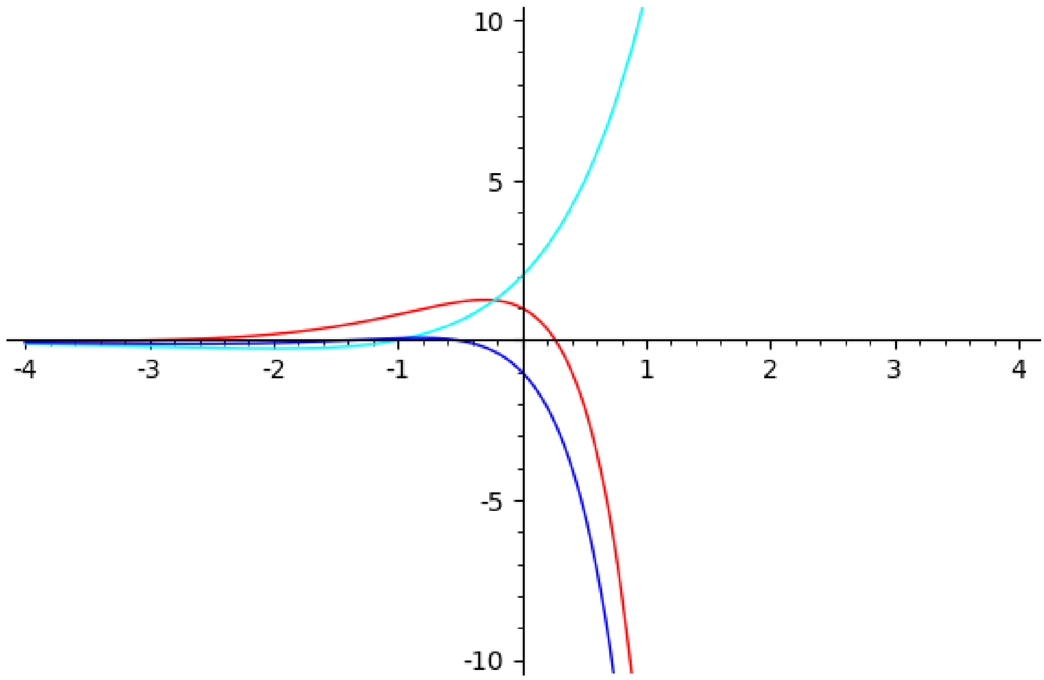
```
t=var('t')
x=function('x')(t)
y=function('y')(t)
z=function('z')(t)
eq1=diff(x,t)==x-y+z
eq2=diff(y,t)==x+y-z
eq3=diff(z,t)==-y+2*z
syst=[eq1, eq2, eq3]
C1,C2,C3=var('C1,C2,C3')
sol=desolve_system(syst, [x, y, z], [0, C1, C2, C3])
show(sol)
sol_x(t,C1,C2,C3)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t, 1, 2, -1), t, -4, 4, color='red',ymin=-10,ymax=10)
sol_y(t,C1,C2,C3)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t, 1, 2, -1), t, -4, 4, color='cyan',ymin=-10,ymax=10)
sol_z(t,C1,C2,C3)=sol[2].rhs()
show(sol_z)
reprz=plot(sol_z(t, 1, 2, -1), t, -4, 4, color='blue',ymin=-10,ymax=10)
show(reprx+repry+reprz)
```

$$\left[x\left(t\right) = C_1 t e^{t} - C_3 t e^{t} - \left(C_1 + C_2 - 2\,C_3\right) e^{\left(2\,t\right)} + \left(2\,C_1 + C_2 - 2\,C_3\right) e^{t}, y\left(t\right) = C_1 t e^{t} - C_3 t e^{t} + C_2 e^{t}, z\left(t\right)$$

$\left(t, C_1, C_2, C_3\right) \mapsto$

$\left(t, C_1, C_2, C_3\right) \mapsto$

(t, C_1, C_2, C_3) $\mapsto$



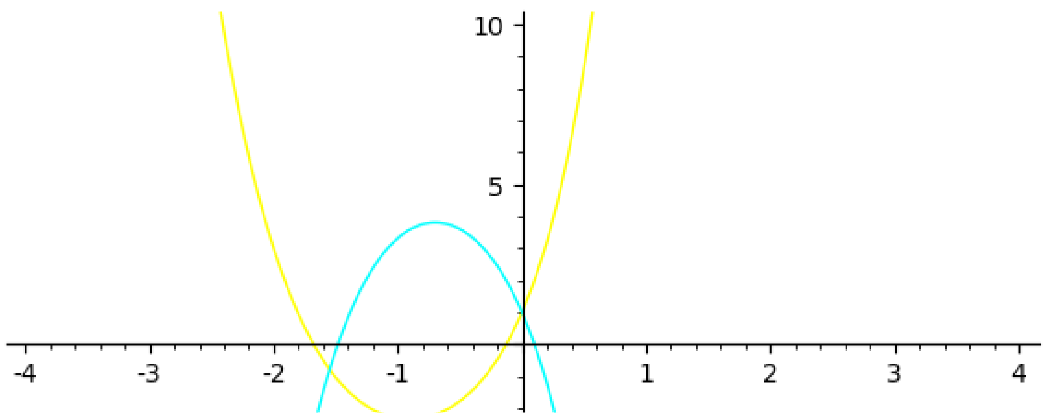
In [49]:

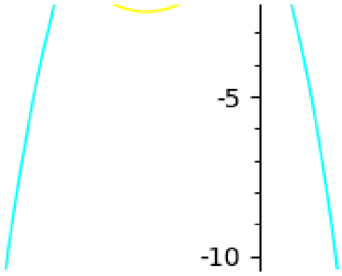
```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==5*x+3*y+1
eq2=diff(y,t)==-6*x-4*y+e^(-t)
syst=[eq1, eq2]
C1,C2=var('C1,C2')
sol=desolve_system(syst, [x, y], [0, C1, C2])
show(sol)
sol_x(t,C1,C2)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t, 1, 1), t, -4, 4, color='yellow',ymin=-10,ymax=10)
sol_y(t,C1,C2)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t, 1, 1), t, -4, 4, color='cyan',ymin=-10,ymax=10)
show(reprx+repry)
```

$$\left[x(t) = \frac{1}{3}\left(6C_1 + 3C_2 + 4\right) e^{(2t)} - \frac{1}{3}\left(3C_1 + 3C_2 - 2\right) e^{(-t)} - te^{(-t)} - 2, y(t) = -\frac{1}{3}\left(6C_1 + 3C_2 + 4\right) e^{(2t)}\right.$$

(t, C_1, C_2) $\mapsto$

(t, C_1, C_2) $\mapsto$





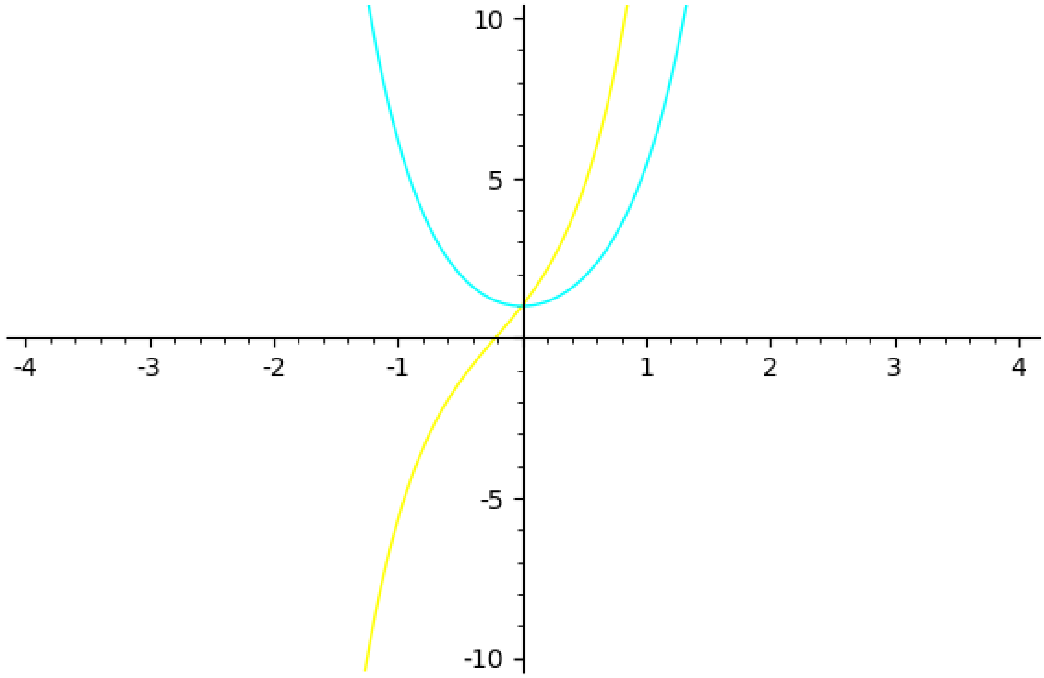
In [47]:

```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==x+3*y+cos(t)
eq2=diff(y,t)==x-y+2*t
syst=[eq1, eq2]
C1,C2=var('C1,C2')
sol=desolve_system(syst, [x, y], [0, C1, C2])
show(sol)
sol_x(t,C1,C2)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t, 1, 1), t, -4, 4, color='yellow',ymin=-10,ymax=10)
sol_y(t,C1,C2)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t, 1, 1), t, -4, 4, color='cyan',ymin=-10,ymax=10)
show(reprx+repry)
```

$$\left[x(t) = \frac{3}{40}\left(10\,C_1 + 10\,C_2 + 9\right)\,e^{(2\,t)} + \frac{1}{40}\left(10\,C_1 - 30\,C_2 - 19\right)\,e^{(-2\,t)} - \frac{3}{2}t - \frac{1}{5}\cos(t) + \frac{1}{5}\sin(t), y(t) = -\frac{\;}{4}\right.$$

$(t, C_1, C_2) \qquad \mapsto$

$(t, C_1, C_2) \qquad \mapsto$



In [46]:

```
t=var('t')
x=function('x')(t)
y=function('y')(t)
z=function('z')(t)
```

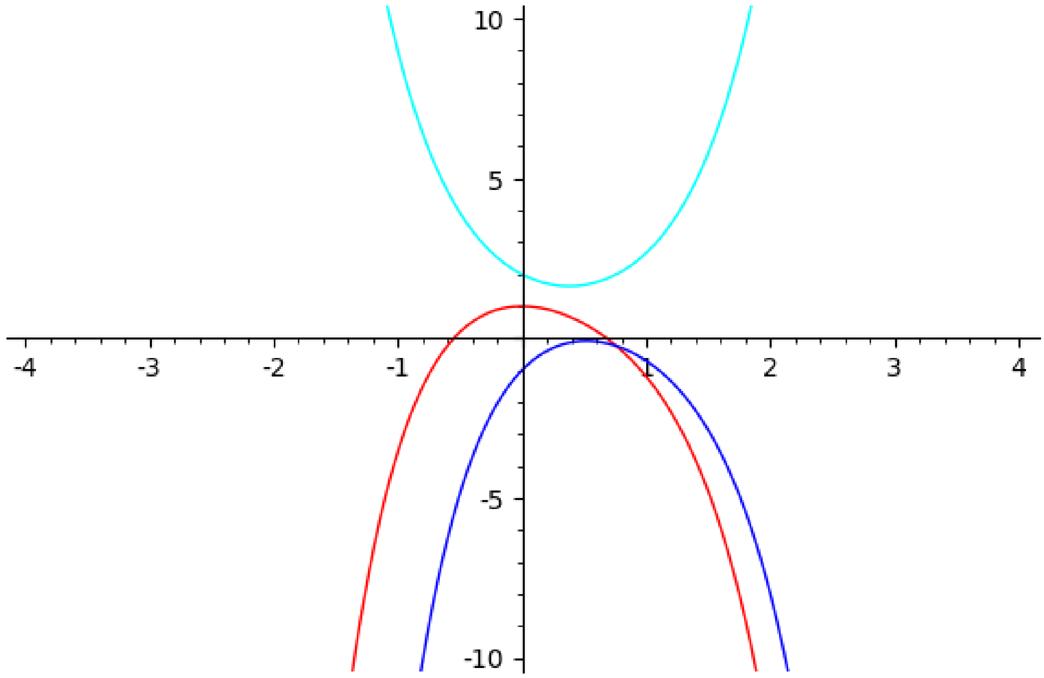
```
eq1=diff(x,t)==x-2*y-2*z+e^(-t)
eq2=diff(y,t)==-2*x+y+2*z
eq3=diff(z,t)==2*x-y-3*z+e^(-t)
syst=[eq1, eq2, eq3]
C1,C2,C3=var('C1,C2,C3')
sol=desolve_system(syst, [x, y, z], [0, C1, C2, C3])
show(sol)
sol_x(t,C1,C2,C3)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t, 1, 2, -1), t, -4, 4, color='red',ymin=-10,ymax=10)
sol_y(t,C1,C2,C3)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t, 1, 2, -1), t, -4, 4, color='cyan',ymin=-10,ymax=10)
sol_z(t,C1,C2,C3)=sol[2].rhs()
show(sol_z)
reprz=plot(sol_z(t, 1, 2, -1), t, -4, 4, color='blue',ymin=-10,ymax=10)
show(reprx+repry+reprz)
```

$$\left[x(t) = \frac{1}{3}\sqrt{3}(2C_1 - C_2 - 2C_3)\ \sinh(\sqrt{3}t) - C_2\cosh(\sqrt{3}t) + (C_1 + C_2)e^{(-t)} + te^{(-t)}, y(t) = -\frac{1}{3}\sqrt{3}(2C_1\right.$$

$$(t, C_1, C_2, C_3) \quad \mapsto$$

$$(t, C_1, C_2, C_3) \quad \mapsto$$

$$(t, C_1, C_2, C_3) \quad \mapsto$$



In [55]:

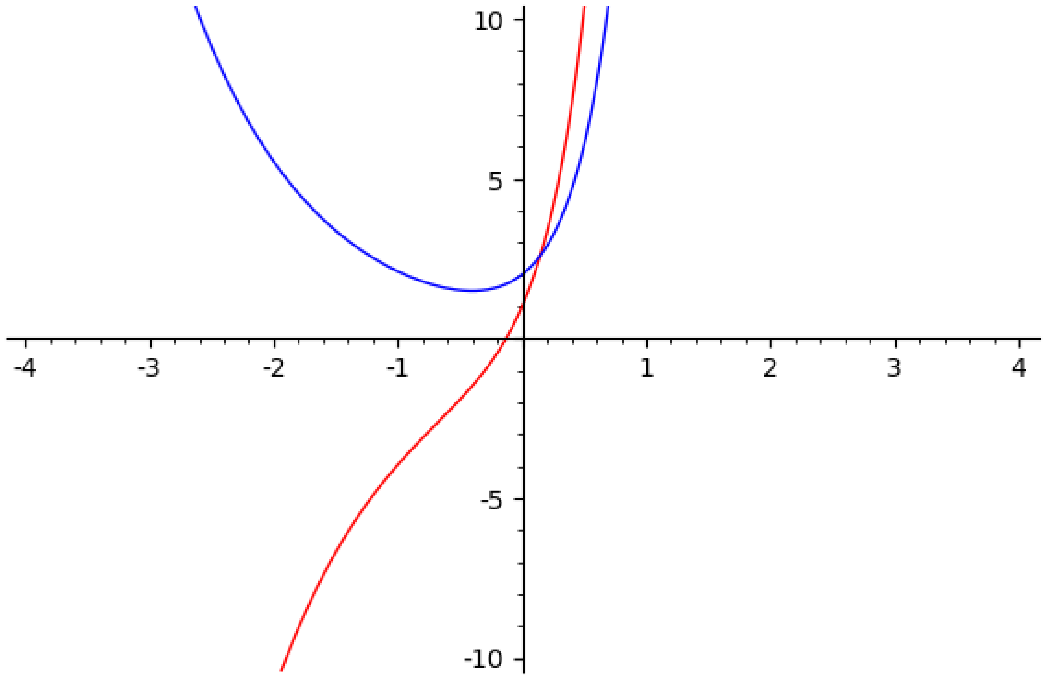
```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==x+4*y
eq2=diff(y,t)==x+y
syst=[eq1, eq2]
sol=desolve_system(syst, [x, y], [0, 1, 2])
show(sol)
sol_x(t)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t), t, -4, 4, color='red',ymin=-10,ymax=10)
sol_y(t)=sol[1].rhs()
```

```
show(sol_y)
repry=plot(sol_y(t), t, -4, 4, color='blue',ymin=-10,ymax=10)
show(reprx+repry)
```

$$\left[x\left(t\right) = \frac{5}{2} e^{\left(3 \, t\right)} - \frac{3}{2} e^{\left(-t\right)}, y\left(t\right) = \frac{5}{4} e^{\left(3 \, t\right)} + \frac{3}{4} e^{\left(-t\right)}\right]$$

$t \mapsto$

$t \mapsto$



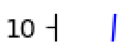
In [57]:

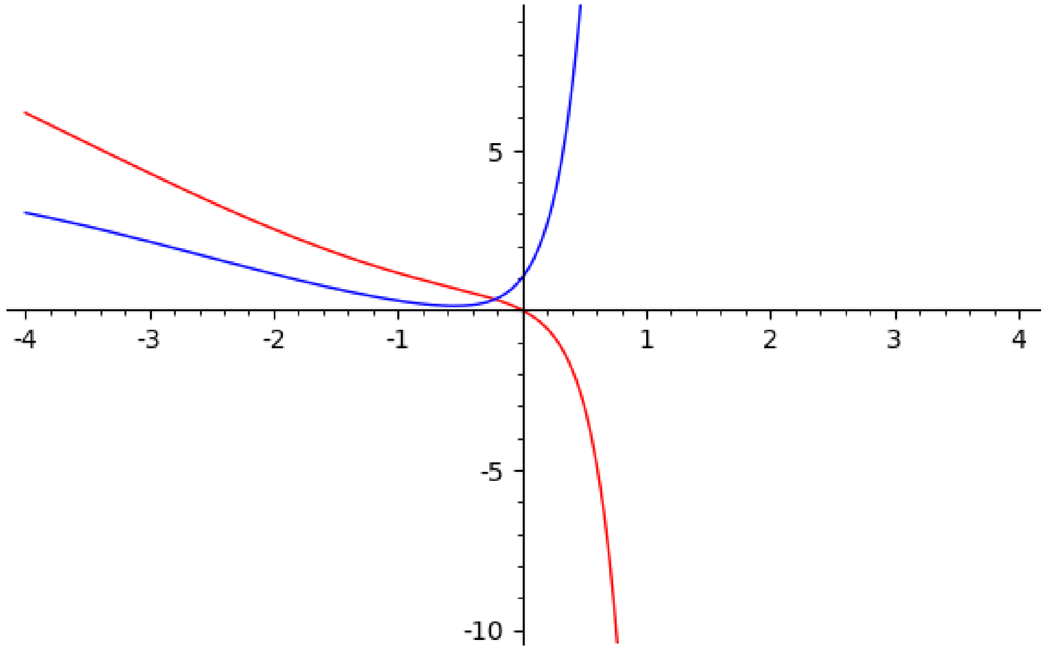
```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==x-y+t-1
eq2=diff(y,t)==-2*x+4*y+cos(t)
syst=[eq1, eq2]
sol=desolve_system(syst, [x, y], [0, 0, 1])
show(sol)
sol_x(t)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t), t, -4, 4, color='red',ymin=-10,ymax=10)
sol_y(t)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t), t, -4, 4, color='blue',ymin=-10,ymax=10)
show(reprx+repry)
```

$$\left[x\left(t\right) = -\frac{1}{13} \left(10 \sqrt{17} \sinh\left(\frac{1}{2} \sqrt{17} t\right) - 33 \cosh\left(\frac{1}{2} \sqrt{17} t\right)\right) e^{\left(\frac{5}{2} \, t\right)} - 2 \, t - \frac{1}{26} \cos\left(t\right) + \frac{5}{26} \sin\left(t\right) - \frac{5}{2}, y\left(\right.$$

$t \mapsto$

$t \mapsto$





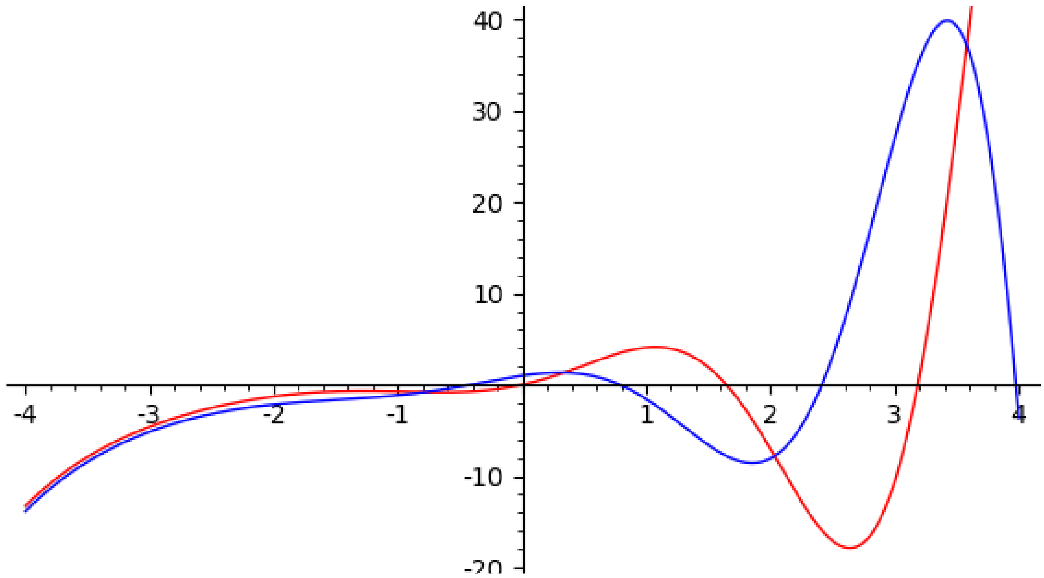
In [64]:

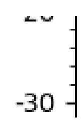
```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==x+2*y+e^(-t)
eq2=diff(y,t)==-2*x+y+1
syst=[eq1, eq2]
sol=desolve_system(syst, [x, y], [0, 0, 1])
show(sol)
sol_x(t)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t), t, -4, 4, color='red',ymin=-30,ymax=30)
sol_y(t)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t), t, -4, 4, color='blue',ymin=-30,ymax=40)
show(reprx+repry)
```

$$\left[x\left(t\right) = -\frac{1}{20} \left(3 \cos(2t) - 29 \sin(2t)\right) e^{t} - \frac{1}{4} e^{(-t)} + \frac{2}{5}, y\left(t\right) = \frac{1}{20} \left(29 \cos(2t) + 3 \sin(2t)\right) e^{t} - \frac{1}{4} e^{(-t)} - \frac{1}{5}\right.$$

$t \qquad \mapsto$

$t \qquad \mapsto$





In [1]:

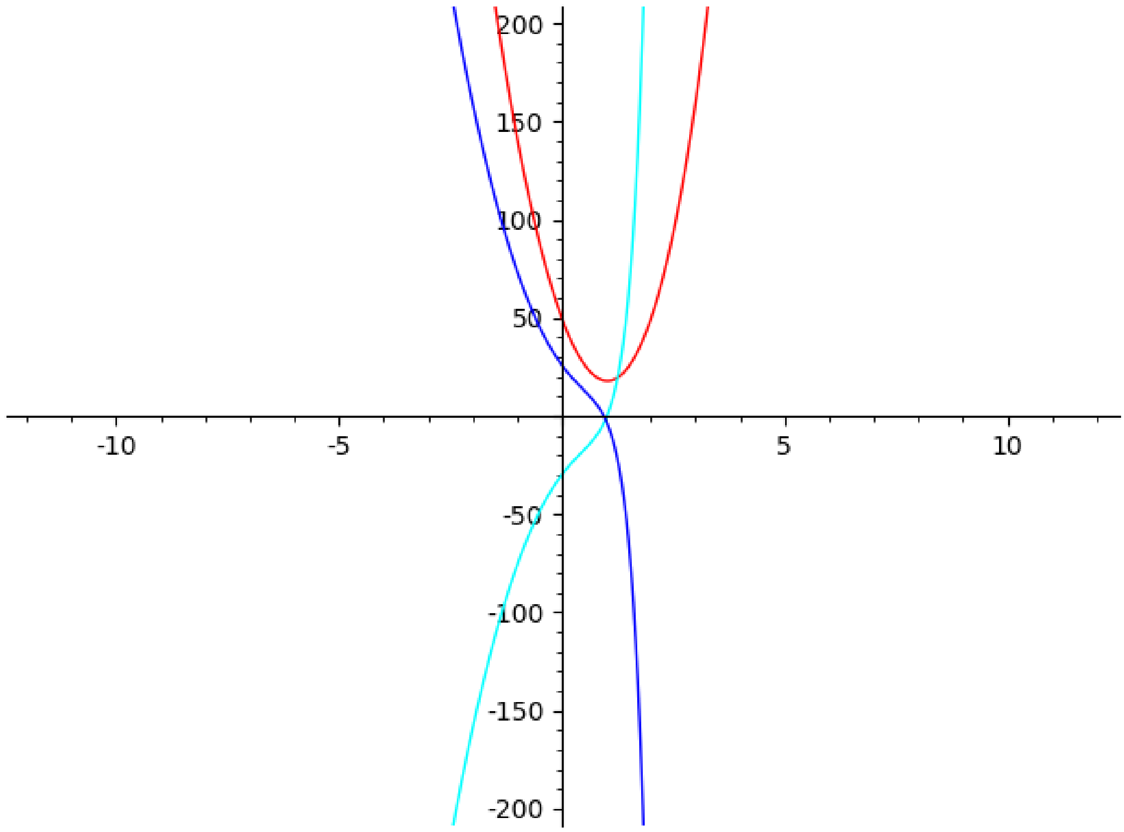
```
t=var('t')
x=function('x')(t)
y=function('y')(t)
z=function('z')(t)
eq1=diff(x,t)==-x+3*y+3*z+27*t^2
eq2=diff(y,t)==2*x-2*y-5*z+3*t
eq3=diff(z,t)==-2*x+3*y+6*z+3
syst=[eq1, eq2, eq3]
sol=desolve_system(syst, [x, y, z], [0, 50, -30, 26])
show(sol)
sol_x(t)=sol[0].rhs()
show(sol_x)
reprx=plot(sol_x(t), t, -12, 12, color='red',ymin=-200,ymax=200)
sol_y(t)=sol[1].rhs()
show(sol_y)
repry=plot(sol_y(t), t, -12, 12, color='cyan',ymin=-200,ymax=200)
sol_z(t)=sol[2].rhs()
show(sol_z)
reprz=plot(sol_z(t), t, -12, 12, color='blue',ymin=-200,ymax=200)
show(reprx+repry+reprz)
```

$$\left[x\left(t\right) = 27\,t^{2} - 63\,t + 2\,e^{\left(-t\right)} + 3\,e^{t} + 45, y\left(t\right) = -18\,t^{2} + 24\,t + e^{\left(3\,t\right)} - e^{\left(-t\right)} + 2\,e^{t} - 32, z\left(t\right) = 18\,t^{2} - 27\,t -\right.$$

$t \mapsto$

$t \mapsto$

$t \mapsto$



In [12]:

```
t=var('t')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==x+y
eq2=diff(y,t)==-2*x+4*y
sol1=desolve_system([eq1, eq2], [x,y], [0,3,0])
show(sol1)
show(limit(sol1[0].rhs(),t=infinity), limit(sol1[1].rhs(),t=infinity))
sol2=desolve_system([eq1, eq2], [x,y], [0,0,3])
show(sol2)
show(limit(sol2[0].rhs(),t=infinity), limit(sol2[1].rhs(),t=infinity))
sol3=desolve_system([eq1, eq2], [x,y], [0,-3,0])
show(sol3)
show(limit(sol3[0].rhs(),t=infinity), limit(sol3[1].rhs(),t=infinity))
sol4=desolve_system([eq1, eq2], [x,y], [0,0,-3])
show(sol4)
show(limit(sol4[0].rhs(),t=infinity), limit(sol4[1].rhs(),t=infinity))
```

$$\left[x\left(t\right) = -3\,e^{\left(3\,t\right)} + 6\,e^{\left(2\,t\right)}, y\left(t\right) = -6\,e^{\left(3\,t\right)} + 6\,e^{\left(2\,t\right)}\right]$$

$$-\infty - \infty$$

$$\left[x\left(t\right) = 3\,e^{\left(3\,t\right)} - 3\,e^{\left(2\,t\right)}, y\left(t\right) = 6\,e^{\left(3\,t\right)} - 3\,e^{\left(2\,t\right)}\right]$$

$$+\infty + \infty$$

$$\left[x\left(t\right) = 3\,e^{\left(3\,t\right)} - 6\,e^{\left(2\,t\right)}, y\left(t\right) = 6\,e^{\left(3\,t\right)} - 6\,e^{\left(2\,t\right)}\right]$$

$$+\infty + \infty$$

$$\left[x\left(t\right) = -3\,e^{\left(3\,t\right)} + 3\,e^{\left(2\,t\right)}, y\left(t\right) = -6\,e^{\left(3\,t\right)} + 3\,e^{\left(2\,t\right)}\right]$$

$$-\infty - \infty$$

In [17]:

```
t,C1,C2=var('t,C1,C2')
x=function('x')(t)
y=function('y')(t)
eq1=diff(x,t)==y
eq2=diff(y,t)==-x-2*y
sol=desolve_system([eq1, eq2], [x,y],[0,C1,C2])
show(sol)
show(limit(sol[0].rhs(),t=infinity))
show(limit(sol[1].rhs(),t=infinity))
```

$$\left[x\left(t\right) = C_1 t e^{\left(-t\right)} + C_2 t e^{\left(-t\right)} + C_1 e^{\left(-t\right)}, y\left(t\right) = -C_1 t e^{\left(-t\right)} - C_2 t e^{\left(-t\right)} + C_2 e^{\left(-t\right)}\right]$$

$$0$$

$$0$$