```
> ec1:=diff(x(t),t) = x(t)+4*y(t);
```

$$ec1 := \frac{d}{dt}x(t) = x(t) + 4\,y(t) \tag{1}$$

```
> ec2:=diff(y(t),t) = x(t)+y(t);
```

$$ec2 := \frac{d}{dt}y(t) = x(t) + y(t) \tag{2}$$

```
> sist:=ec1,ec2;
```

$$sist := \frac{d}{dt}x(t) = x(t) + 4\,y(t),\ \frac{d}{dt}y(t) = x(t) + y(t) \tag{3}$$

```
> with(DEtools):with(plots):
  dsolve({sist},{x(t),y(t)});
```

$$\left\{x(t) = c_1\,e^{-t} + c_2\,e^{3\,t},\ y(t) = -\frac{c_1\,e^{-t}}{2} + \frac{c_2\,e^{3\,t}}{2}\right\} \tag{4}$$

```
> ec1:=diff(x(t),t) = 2*x(t)-y(t);
```

$$ec1 := \frac{d}{dt}x(t) = 2\,x(t) - y(t) \tag{5}$$

```
> ec2:=diff(y(t),t)=x(t)+2*y(t);
```

$$ec2 := \frac{d}{dt}y(t) = x(t) + 2\,y(t) \tag{6}$$

```
> sist:=ec1,ec2;
```

$$sist := \frac{d}{dt}x(t) = 2\,x(t) - y(t),\ \frac{d}{dt}y(t) = x(t) + 2\,y(t) \tag{7}$$

```
> with(DEtools):with(plots):
  dsolve({sist},{x(t),y(t)});
```

$$\{x(t) = e^{2\,t}\,(c_2\cos(t) + c_1\sin(t)),\ y(t) = -e^{2\,t}\,(\cos(t)\,c_1 - \sin(t)\,c_2)\} \tag{8}$$

```
> ec1:=diff(x(t),t) = x(t)-y(t)+z(t);
```

$$ec1 := \frac{d}{dt}x(t) = x(t) - y(t) + z(t) \tag{9}$$

```
> ec2:=diff(y(t),t) = x(t)+y(t)-z(t);
```

$$ec2 := \frac{d}{dt}y(t) = x(t) + y(t) - z(t) \tag{10}$$

```
> ec3:=diff(z(t),t) = -y(t)+2*z(t);
```

$$ec3 := \frac{d}{dt}z(t) = -y(t) + 2\,z(t) \tag{11}$$

```
> sist:=ec1,ec2,ec3;
```

$$sist := \frac{d}{dt}x(t) = x(t) - y(t) + z(t),\ \frac{d}{dt}y(t) = x(t) + y(t) - z(t),\ \frac{d}{dt}z(t) = -y(t) + 2\,z(t) \tag{12}$$

```
> with(DEtools):with(plots):
  dsolve({sist},{x(t),y(t),z(t)});
```

$$\{x(t) = c_1\,e^{2\,t} + c_2\,e^{t} + c_3\,e^{t}\,t + c_3\,e^{t},\ y(t) = e^{t}\,(c_3\,t + c_2 - c_3),\ z(t) = c_1\,e^{2\,t} + c_2\,e^{t}\} \tag{13}$$

$$+ c_3 e^t t\}$$

```
> ec1:=diff(x(t),t)=x(t)-y(t)+t-1;
```

$$ec1 := \frac{d}{dt} x(t) = x(t) - y(t) + t - 1 \quad (14)$$

```
> ec2:=diff(y(t),t)=(-2)*x(t)+4*y(t)+cos(t);
```

$$ec2 := \frac{d}{dt} y(t) = -2\,x(t) + 4\,y(t) + \cos(t) \quad (15)$$

```
> sist:=ec1,ec2;
```

$$sist := \frac{d}{dt} x(t) = x(t) - y(t) + t - 1,\ \frac{d}{dt} y(t) = -2\,x(t) + 4\,y(t) + \cos(t) \quad (16)$$

```
> cond_in1:= x(0)=0;
```

$$cond\_in1 := x(0) = 0 \quad (17)$$

```
> cond_in2:= y(0)=1;
```

$$cond\_in2 := y(0) = 1 \quad (18)$$

```
> sol:=dsolve({sist,cond_in1,cond_in2},{x(t),y(t)});
```

$$sol := \left\{ x(t) = e^{\frac{(5+\sqrt{17})\,t}{2}} \left(\frac{33}{26} - \frac{5\sqrt{17}}{13} \right) + e^{-\frac{(-5+\sqrt{17})\,t}{2}} \left(\frac{33}{26} + \frac{5\sqrt{17}}{13} \right) \right. \quad (19)$$

$$+ \frac{5\sin(t)}{26} - \frac{\cos(t)}{26} - 2\,t - \frac{5}{2},\ y(t) = -\frac{e^{\frac{(5+\sqrt{17})\,t}{2}} \left(\frac{33}{26} - \frac{5\sqrt{17}}{13} \right) \sqrt{17}}{2}$$

$$+ \frac{e^{-\frac{(-5+\sqrt{17})\,t}{2}} \left(\frac{33}{26} + \frac{5\sqrt{17}}{13} \right) \sqrt{17}}{2} - \frac{3\,e^{\frac{(5+\sqrt{17})\,t}{2}} \left(\frac{33}{26} - \frac{5\sqrt{17}}{13} \right)}{2}$$

$$\left. - \frac{3\,e^{-\frac{(-5+\sqrt{17})\,t}{2}} \left(\frac{33}{26} + \frac{5\sqrt{17}}{13} \right)}{2} + \frac{2\sin(t)}{13} - \frac{3\cos(t)}{13} - t - \frac{3}{2} \right\}$$

```
> xx:=unapply(rhs(sol[1]),t);
```

$$xx := t \mapsto e^{\frac{(5+\sqrt{17})\cdot t}{2}} \cdot \left(\frac{33}{26} - \frac{5\cdot\sqrt{17}}{13} \right) + e^{-\frac{(-5+\sqrt{17})\cdot t}{2}} \cdot \left(\frac{33}{26} + \frac{5\cdot\sqrt{17}}{13} \right) \quad (20)$$

$$+ \frac{5\cdot\sin(t)}{26} - \frac{\cos(t)}{26} - 2\cdot t - \frac{5}{2}$$

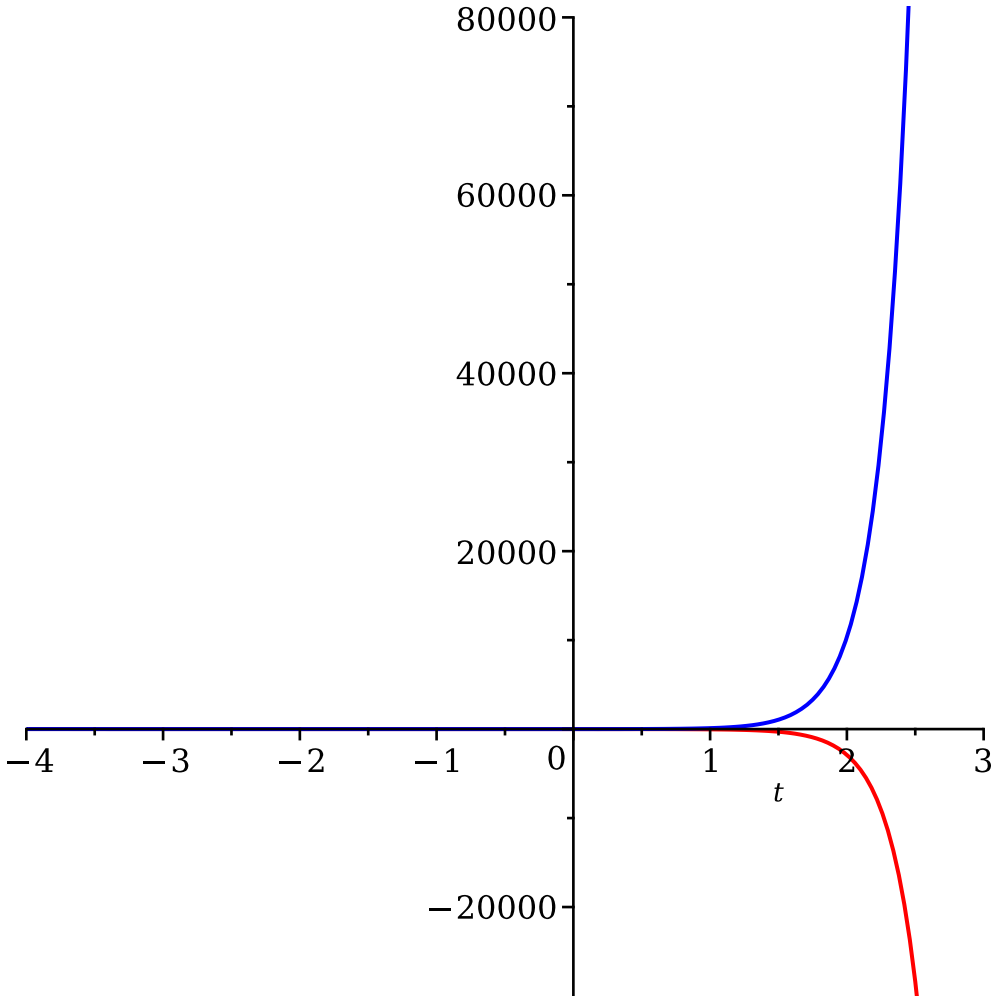
```
> yy:=unapply(rhs(sol[2]),t);
```

$$yy := t \mapsto -\frac{e^{\frac{(5+\sqrt{17})\cdot t}{2}} \cdot \left(\frac{33}{26} - \frac{5\cdot\sqrt{17}}{13} \right) \cdot \sqrt{17}}{2} \quad (21)$$

$$+\frac{e^{-\frac{(-5+\sqrt{17})\cdot t}{2}}\cdot\left(\frac{33}{26}+\frac{5\cdot\sqrt{17}}{13}\right)\cdot\sqrt{17}}{2}-\frac{3\cdot e^{\frac{(5+\sqrt{17})\cdot t}{2}}\cdot\left(\frac{33}{26}-\frac{5\cdot\sqrt{17}}{13}\right)}{2}$$

$$-\frac{3\cdot e^{-\frac{(-5+\sqrt{17})\cdot t}{2}}\cdot\left(\frac{33}{26}+\frac{5\cdot\sqrt{17}}{13}\right)}{2}+\frac{2\cdot\sin(t)}{13}-\frac{3\cdot\cos(t)}{13}-t-\frac{3}{2}$$

```
> plot([xx(t),yy(t)],t=-4..4,color=[red,blue]);
```




```
> ec1:=diff(x(t),t)=x(t)+2*y(t)+exp(-t);
```

$$ec1 := \frac{d}{dt}x(t) = x(t) + 2\,y(t) + e^{-t} \qquad (22)$$

```
> ec2:=diff(y(t),t)=(-2)*x(t)+y(t)+1;
```

$$ec2 := \frac{d}{dt}y(t) = -2\,x(t) + y(t) + 1 \qquad (23)$$

```
> sist:=ec1,ec2;
```

$$sist := \frac{d}{dt}x(t) = x(t) + 2\,y(t) + e^{-t},\ \frac{d}{dt}y(t) = -2\,x(t) + y(t) + 1 \qquad (24)$$

```
> cond_in1:=x(0)=0;
```

(25)

$$cond\_in1 := x(0) = 0 \quad (25)$$

```
> cond_in2:= y(0)=1;
```

$$cond\_in2 := y(0) = 1 \quad (26)$$

```
> sol:=dsolve({sist,cond_in1,cond_in2},{x(t),y(t)});
```

$$sol := \left\{x(t) = -\frac{3\,e^{t}\cos(2\,t)}{20} + \frac{29\,e^{t}\sin(2\,t)}{20} - \frac{e^{-t}}{4} + \frac{2}{5}, y(t) = \frac{3\,e^{t}\sin(2\,t)}{20} + \frac{29\,e^{t}\cos(2\,t)}{20} - \frac{1}{5} - \frac{e^{-t}}{4}\right\} \quad (27)$$

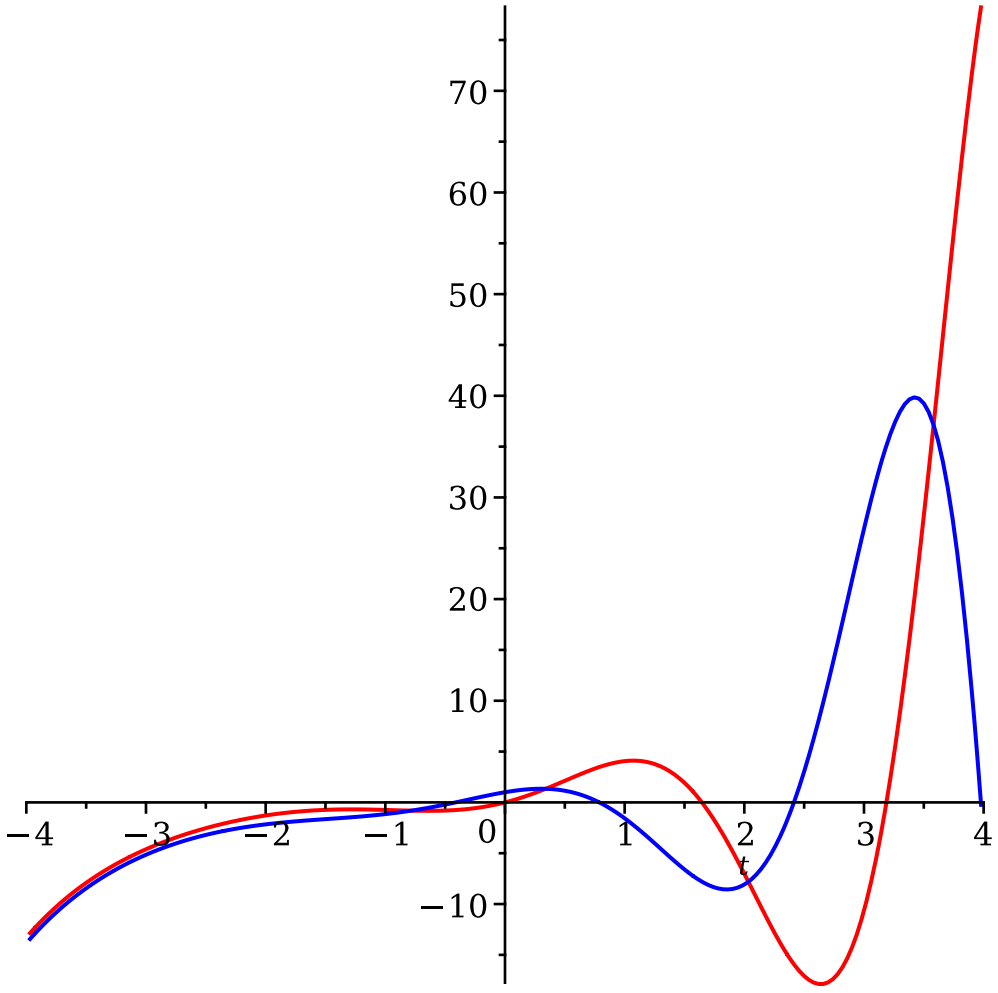
```
> xx:=unapply(rhs(sol[1]),t);
```

$$xx := t \mapsto -\frac{3\cdot e^{t}\cdot\cos(2\cdot t)}{20} + \frac{29\cdot e^{t}\cdot\sin(2\cdot t)}{20} - \frac{e^{-t}}{4} + \frac{2}{5} \quad (28)$$

```
> yy:=unapply(rhs(sol[2]),t);
```

$$yy := t \mapsto \frac{3\cdot e^{t}\cdot\sin(2\cdot t)}{20} + \frac{29\cdot e^{t}\cdot\cos(2\cdot t)}{20} - \frac{1}{5} - \frac{e^{-t}}{4} \quad (29)$$

```
> plot([xx(t),yy(t)],t=-4..4,color=[red,blue]);
```




```
> ec1:=diff(x(t),t)=-x(t)+3*y(t)+3*z(t)+27*t^2;
```

$$ec1 := \frac{d}{dt}x(t) = -x(t) + 3\,y(t) + 3\,z(t) + 27\,t^{2} \quad (30)$$

```
> ec2:=diff(y(t),t)=2*x(t)-2*y(t)-5*z(t)+3*t;
```

$$ec2 := \frac{d}{dt} y(t) = 2\,x(t) - 2\,y(t) - 5\,z(t) + 3\,t \quad (31)$$

```
> ec3:=diff(z(t),t)=(-2)*x(t)+3*y(t)+6*z(t)+3;
```

$$ec3 := \frac{d}{dt} z(t) = -2\,x(t) + 3\,y(t) + 6\,z(t) + 3 \quad (32)$$

```
> cond_in1:=x(0)=50;
```

$$cond\_in1 := x(0) = 50 \quad (33)$$

```
> cond_in2:=y(0)=-30;
```

$$cond\_in2 := y(0) = -30 \quad (34)$$

```
> cond_in3:=z(0)=26;
```

$$cond\_in3 := z(0) = 26 \quad (35)$$

```
> sist:=ec1,ec2,ec3;
```

$$sist := \frac{d}{dt} x(t) = -x(t) + 3\,y(t) + 3\,z(t) + 27\,t^2, \frac{d}{dt} y(t) = 2\,x(t) - 2\,y(t) \quad (36)$$
$$- 5\,z(t) + 3\,t, \frac{d}{dt} z(t) = -2\,x(t) + 3\,y(t) + 6\,z(t) + 3$$

```
> sol:=dsolve({sist,cond_in1,cond_in2,cond_in3},{x(t),y(t),z(t)});
```

$$sol := \{x(t) = 2\,e^{-t} + 3\,e^{t} + 27\,t^2 - 63\,t + 45, y(t) = e^{3\,t} + 2\,e^{t} - 18\,t^2 + 24\,t - 32 \quad (37)$$
$$- e^{-t}, z(t) = -e^{3\,t} - 27\,t + 26 + 18\,t^2 + e^{-t}\}$$

```
> xx:=unapply(rhs(sol[1]),t);
```

$$xx := t \mapsto 2\cdot e^{-t} + 3\cdot e^{t} + 27\cdot t^2 - 63\cdot t + 45 \quad (38)$$

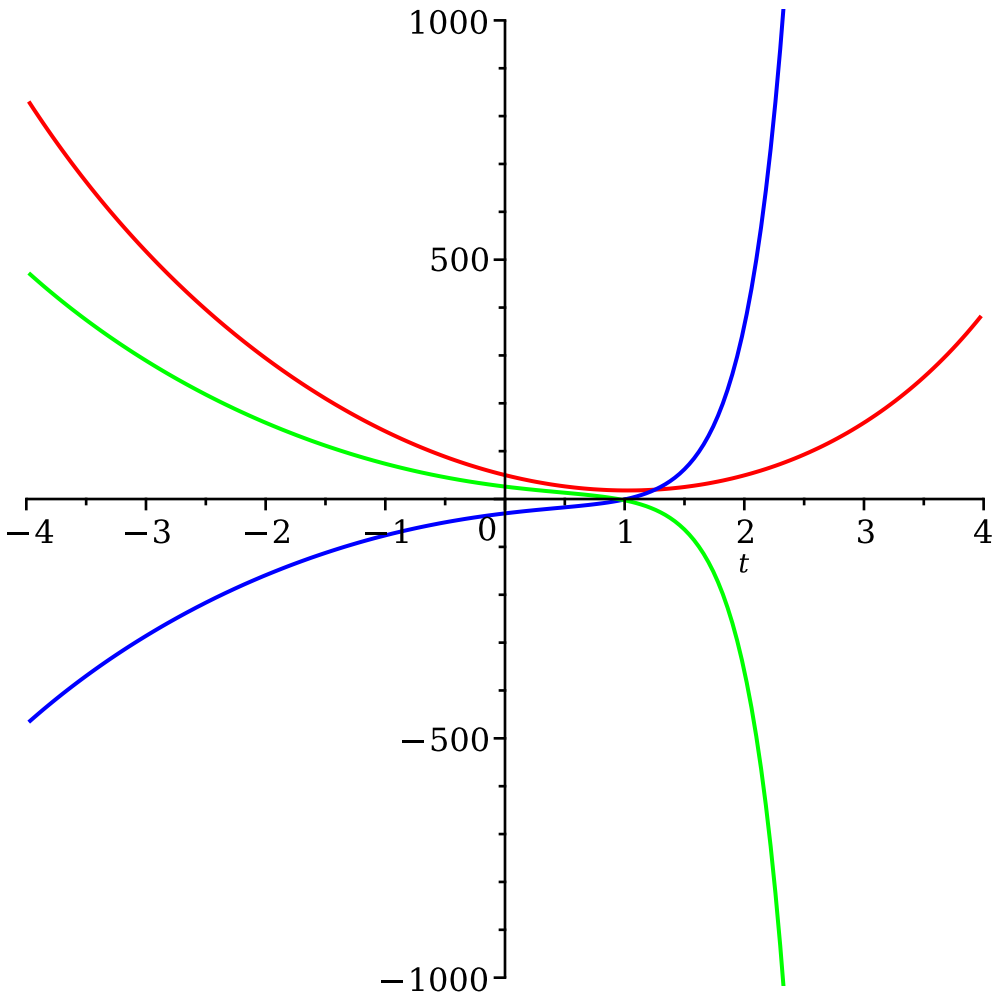
```
> yy:=unapply(rhs(sol[2]),t);
```

$$yy := t \mapsto e^{3\cdot t} + 2\cdot e^{t} - 18\cdot t^2 + 24\cdot t - 32 - e^{-t} \quad (39)$$

```
> zz:=unapply(rhs(sol[3]),t);
```

$$zz := t \mapsto -e^{3\cdot t} - 27\cdot t + 26 + 18\cdot t^2 + e^{-t} \quad (40)$$

```
> plot([xx(t),yy(t),zz(t)],t=-4..4,color=[red,blue,green]);
```




```
> restart
> with(DETools):
> with(plots):
> ec1 := diff(x(t), t) = x(t) + y(t);
```

$$ec1 := \frac{d}{dt}\,x(t) = x(t) + y(t) \qquad (41)$$

```
> ec2 := diff(y(t), t) = -2 * x(t) + 4 * y(t)
```

$$ec2 := \frac{d}{dt}\,y(t) = -2\,x(t) + 4\,y(t) \qquad (42)$$

```
> sist := ec1, ec2
```

$$sist := \frac{d}{dt}\,x(t) = x(t) + y(t),\ \frac{d}{dt}\,y(t) = -2\,x(t) + 4\,y(t) \qquad (43)$$

```
> cond_in_1 := x(0) = 3, y(0) = 0;
```

$$cond\_in\_1 := x(0) = 3,\ y(0) = 0 \qquad (44)$$

```
> cond_in_2 := x(0) = 0, y(0) = 3;
```

$$cond\_in\_2 := x(0) = 0,\ y(0) = 3 \qquad (45)$$

```
> cond_in_3 := x(0) = -3, y(0) = 0;
```

$$cond\_in\_3 := x(0) = -3,\ y(0) = 0 \qquad (46)$$

```
> cond_in_4 := x(0) = 0, y(0) = -3;
```

$$cond\_in\_4 := x(0) = 0, y(0) = -3 \quad (47)$$

```
> sol1 := dsolve({sist, cond_in_1}, {x(t), y(t)});
```

$$sol1 := \{x(t) = 6\,e^{2t} - 3\,e^{3t}, y(t) = 6\,e^{2t} - 6\,e^{3t}\} \quad (48)$$

```
> sol2 := dsolve({sist, cond_in_2}, {x(t), y(t)});
```

$$sol2 := \{x(t) = -3\,e^{2t} + 3\,e^{3t}, y(t) = -3\,e^{2t} + 6\,e^{3t}\} \quad (49)$$

```
> sol3 := dsolve({sist, cond_in_3}, {x(t), y(t)});
```

$$sol3 := \{x(t) = -6\,e^{2t} + 3\,e^{3t}, y(t) = -6\,e^{2t} + 6\,e^{3t}\} \quad (50)$$

```
> sol4 := dsolve({sist, cond_in_4}, {x(t), y(t)});
```

$$sol4 := \{x(t) = 3\,e^{2t} - 3\,e^{3t}, y(t) = 3\,e^{2t} - 6\,e^{3t}\} \quad (51)$$

```
> xx1 := unapply(rhs(sol1[1]), t);
```

$$xx1 := t \mapsto 6 \cdot e^{2 \cdot t} - 3 \cdot e^{3 \cdot t} \quad (52)$$

```
> xx2 := unapply(rhs(sol1[2]), t);
```

$$xx2 := t \mapsto 6 \cdot e^{2 \cdot t} - 6 \cdot e^{3 \cdot t} \quad (53)$$

```
> xx3 := unapply(rhs(sol2[1]), t);
```

$$xx3 := t \mapsto -3 \cdot e^{2 \cdot t} + 3 \cdot e^{3 \cdot t} \quad (54)$$

```
> xx4 := unapply(rhs(sol2[2]), t);
```

$$xx4 := t \mapsto -3 \cdot e^{2 \cdot t} + 6 \cdot e^{3 \cdot t} \quad (55)$$

```
> xx5 := unapply(rhs(sol3[1]), t);
  xx6 := unapply(rhs(sol3[2]), t);
  xx7 := unapply(rhs(sol4[1]), t);
  xx8 := unapply(rhs(sol4[2]), t);
```

$$xx5 := t \mapsto -6 \cdot e^{2 \cdot t} + 3 \cdot e^{3 \cdot t}$$

$$xx6 := t \mapsto -6 \cdot e^{2 \cdot t} + 6 \cdot e^{3 \cdot t}$$

$$xx7 := t \mapsto 3 \cdot e^{2 \cdot t} - 3 \cdot e^{3 \cdot t}$$

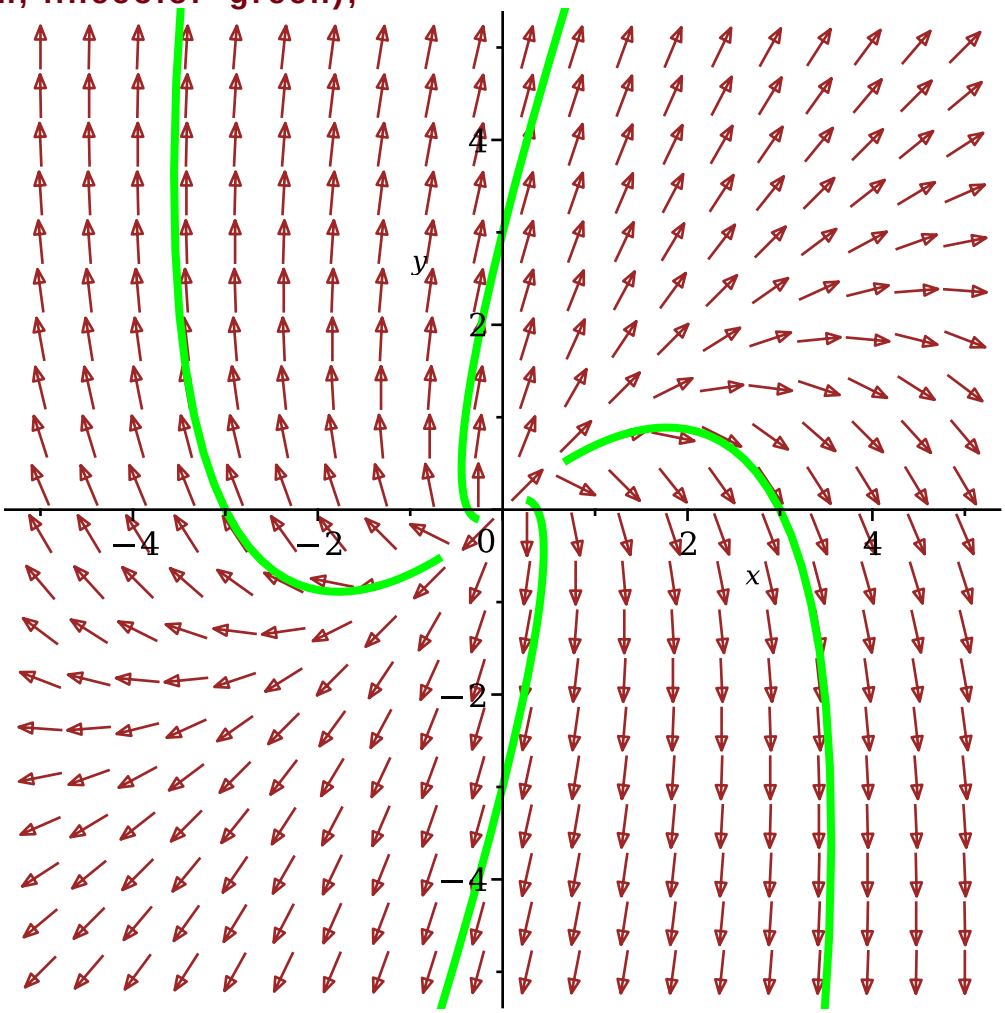
$$xx8 := t \mapsto 3 \cdot e^{2 \cdot t} - 6 \cdot e^{3 \cdot t} \quad (56)$$

```
> limit(xx1(t), t = infinity);
  limit(xx2(t), t = infinity);
  limit(xx3(t), t = infinity);
  limit(xx4(t), t = infinity);
  limit(xx5(t), t = infinity);
  limit(xx6(t), t = infinity);
  limit(xx7(t), t = infinity);
  limit(xx8(t), t = infinity);
```

$$-\infty$$
$$-\infty$$
$$\infty$$
$$\infty$$
$$\infty$$
$$\infty$$

$$-\infty$$
$$-\infty \qquad (57)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
  [cond_in_1], [cond_in_2], [cond_in_3], [cond_in_4]], arrows=
  medium, linecolor=green);
```




```
> restart;
  with(plots):
  with(DEtools):
```

```
> ec1 := diff(x(t), t) = y(t)
```

$$ec1 := \frac{d}{dt}x(t) = y(t) \qquad (58)$$

```
> ec2 := diff(y(t), t) = - x(t) - 2 * y(t)
```

$$ec2 := \frac{d}{dt}y(t) = -x(t) - 2\,y(t) \qquad (59)$$

```
> sist := ec1, ec2
```

$$sist := \frac{d}{dt}x(t) = y(t),\ \frac{d}{dt}y(t) = -x(t) - 2\,y(t) \qquad (60)$$

```
> sol := dsolve({sist}, {x(t), y(t)});
```

$$sol := \{x(t) = e^{-t}(c_2\,t + c_1),\ y(t) = -e^{-t}(c_2\,t + c_1 - c_2)\} \qquad (61)$$

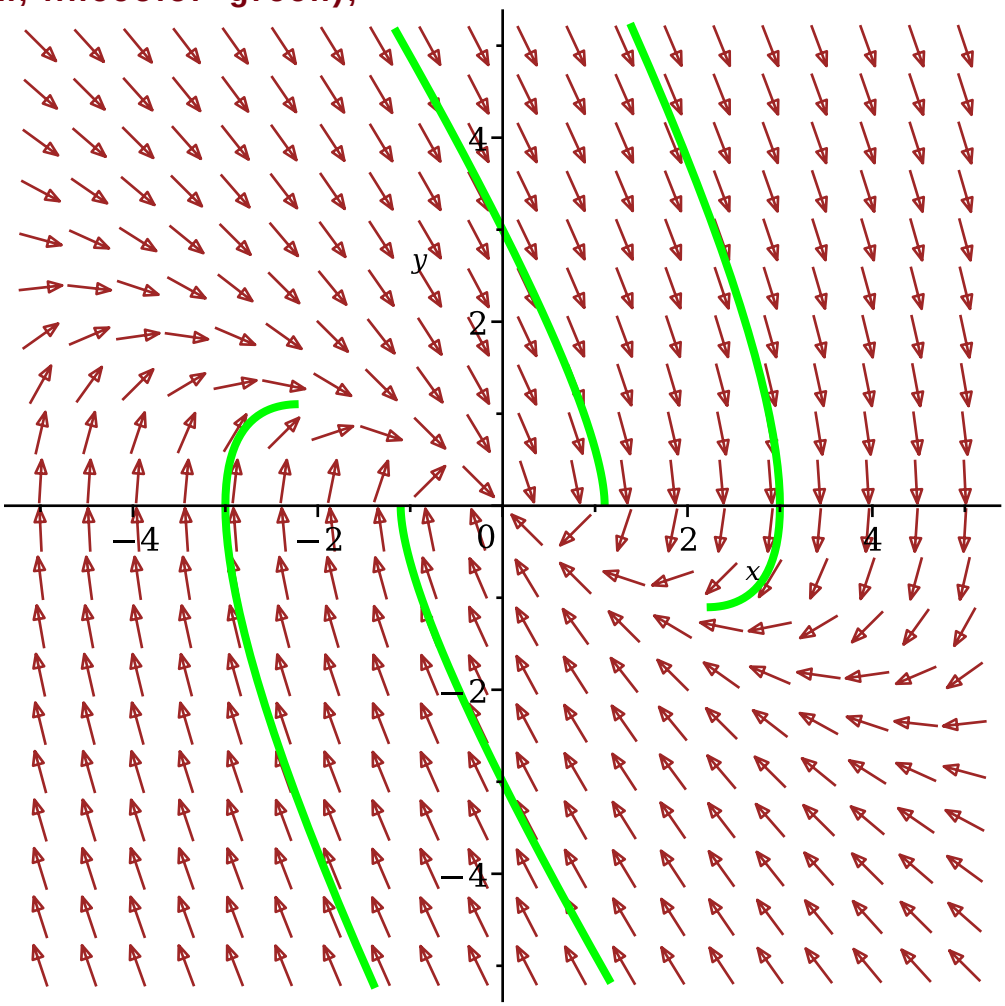
```
> limit(sol[1], t = infinity);
```

$$\lim_{t \to \infty} x(t) = 0 \qquad (62)$$

```
> limit(sol[2], t = infinity);
```

$$\lim_{t \to \infty} y(t) = 0 \qquad (63)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
  [x(0)=3,y(0)=0], [x(0)=0,y(0)=3], [x(0)=-3,y(0)=0], [x(0)=0,y(0)=
  -3]], arrows=
  medium, linecolor=green);
```




```
> restart
> with(DETools):
> with(plots):
> ec1 := diff(x(t), t) = 2 * x(t) + y(t)
```

$$ec1 := \frac{d}{dt} x(t) = 2\,x(t) + y(t) \qquad (64)$$

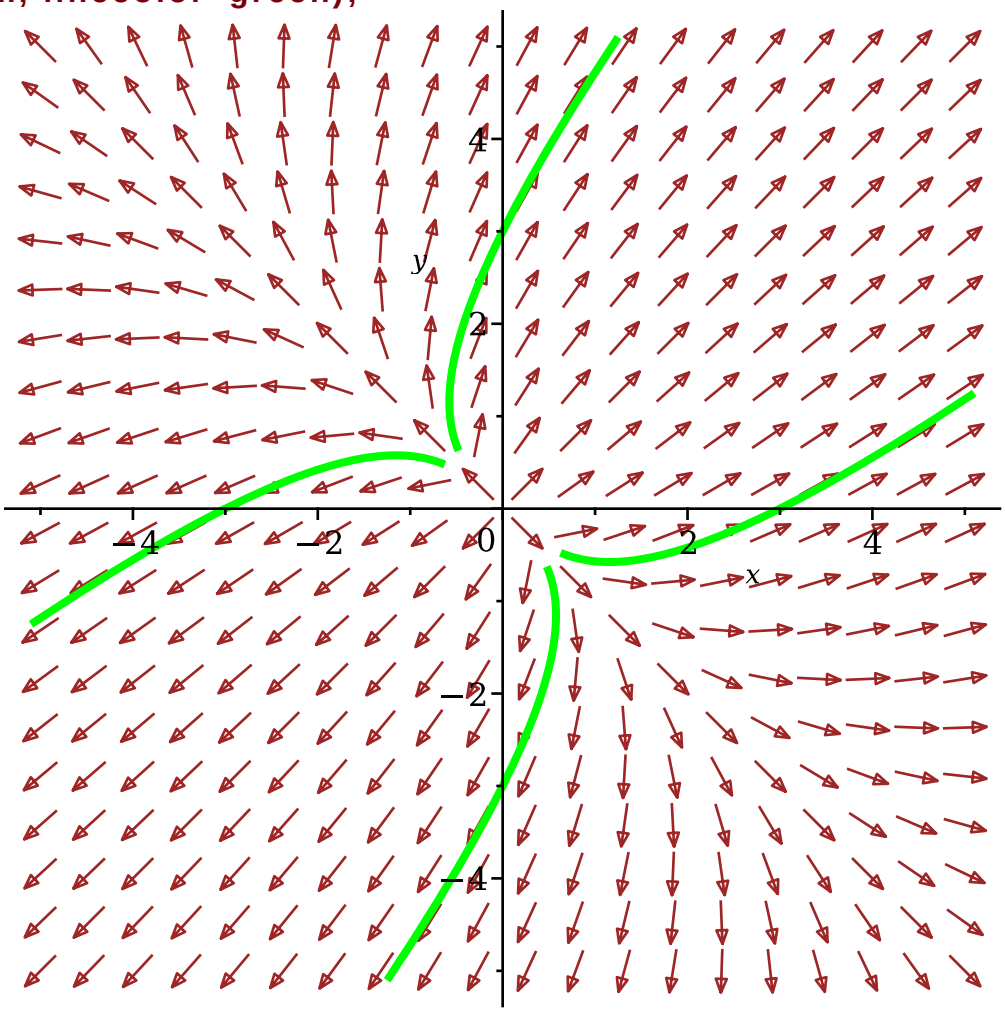
```
> ec2 := diff(y(t), t) = x(t) + 2 * y(t);
```

$$ec2 := \frac{d}{dt} y(t) = x(t) + 2\,y(t) \qquad (65)$$

```
> sist := ec1, ec2
```

$$sist := \frac{d}{dt}x(t) = 2x(t) + y(t),\ \frac{d}{dt}y(t) = x(t) + 2y(t) \quad (66)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
  [x(0)=3,y(0)=0], [x(0)=0,y(0)=3], [x(0)=-3,y(0)=0], [x(0)=0,y(0)=
  -3]], arrows=
  medium, linecolor=green);
```




```
> # nu are limita 0
> restart
> with(DETools):
> with(plots):
> ec1 := diff(x(t), t) = -x(t) - y(t)
```

$$ec1 := \frac{d}{dt}x(t) = -x(t) - y(t) \quad (67)$$

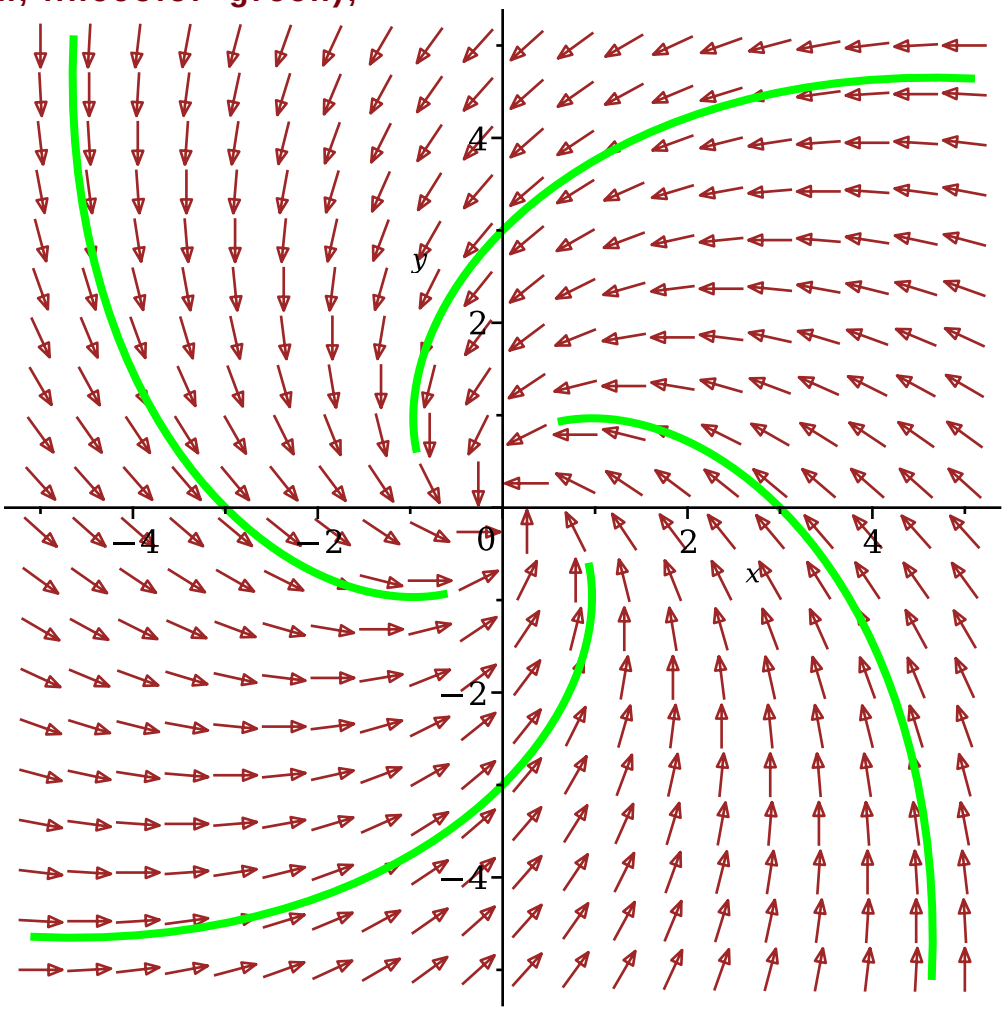
```
> ec2 := diff(y(t), t) = x(t) - y(t);
```

$$ec2 := \frac{d}{dt}y(t) = x(t) - y(t) \quad (68)$$

```
> sist := ec1, ec2
```

$$sist := \frac{d}{dt}x(t) = -x(t) - y(t),\ \frac{d}{dt}y(t) = x(t) - y(t) \quad (69)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
  [x(0)=3,y(0)=0], [x(0)=0,y(0)=3], [x(0)=-3,y(0)=0], [x(0)=0,y(0)=
  -3]], arrows=
  medium, linecolor=green);
```




```
> # are limita 0
> restart
> with(DETools):
> with(plots):
> ec1 := diff(x(t), t) = y(t);
```

$$ec1 := \frac{d}{dt}\,x(t) = y(t) \qquad (70)$$

```
> ec2 := diff(y(t), t) = -x(t);
```

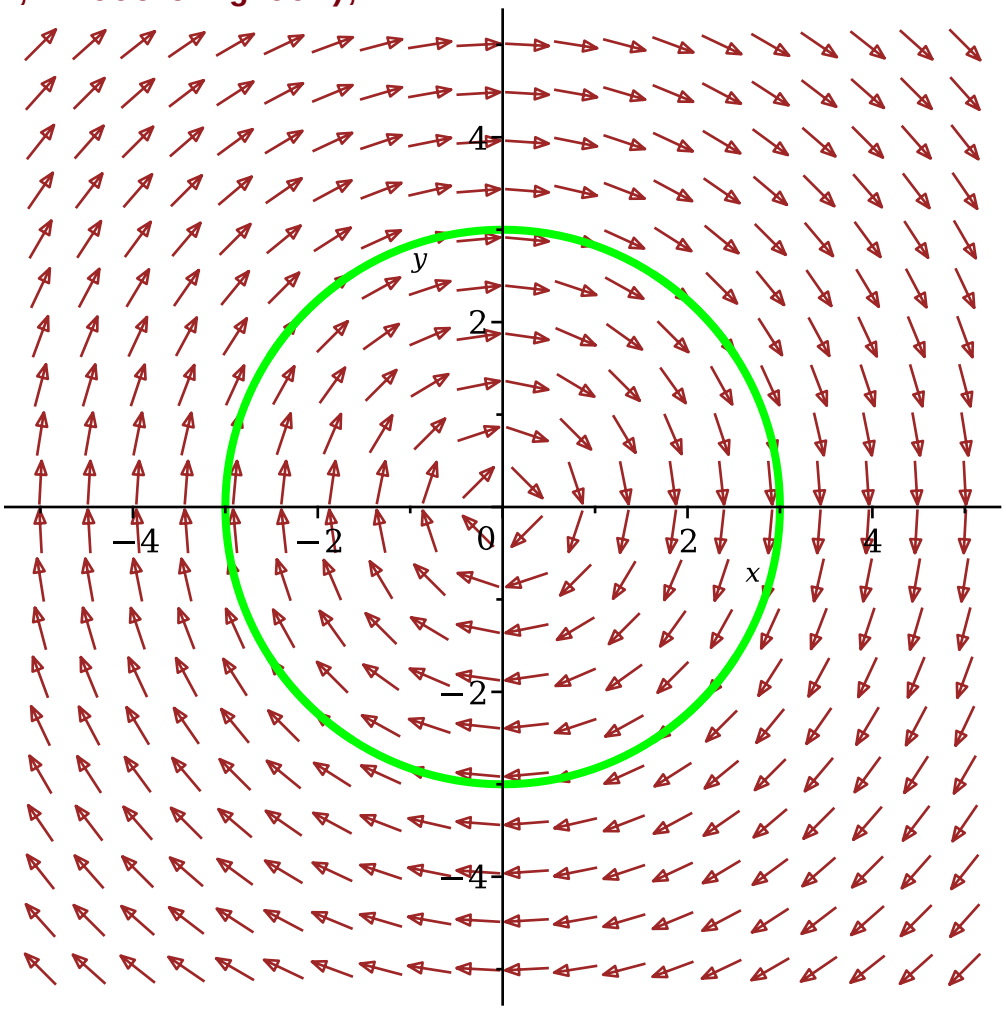
$$ec2 := \frac{d}{dt}\,y(t) = -x(t) \qquad (71)$$

```
> sist := ec1, ec2;
```

$$sist := \frac{d}{dt}\,x(t) = y(t),\ \frac{d}{dt}\,y(t) = -x(t) \qquad (72)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
  [x(0)=3,y(0)=0], [x(0)=0,y(0)=3], [x(0)=-3,y(0)=0], [x(0)=0,y(0)=
```

```
-3]], arrows=
medium, linecolor=green);
```




```
> # nu are limita 0
> restart
> with(DETools):
> with(plots):
> ec1 := diff(x(t), t) = -2 * x(t);
```

$$ec1 := \frac{d}{dt}x(t) = -2\,x(t) \qquad (73)$$

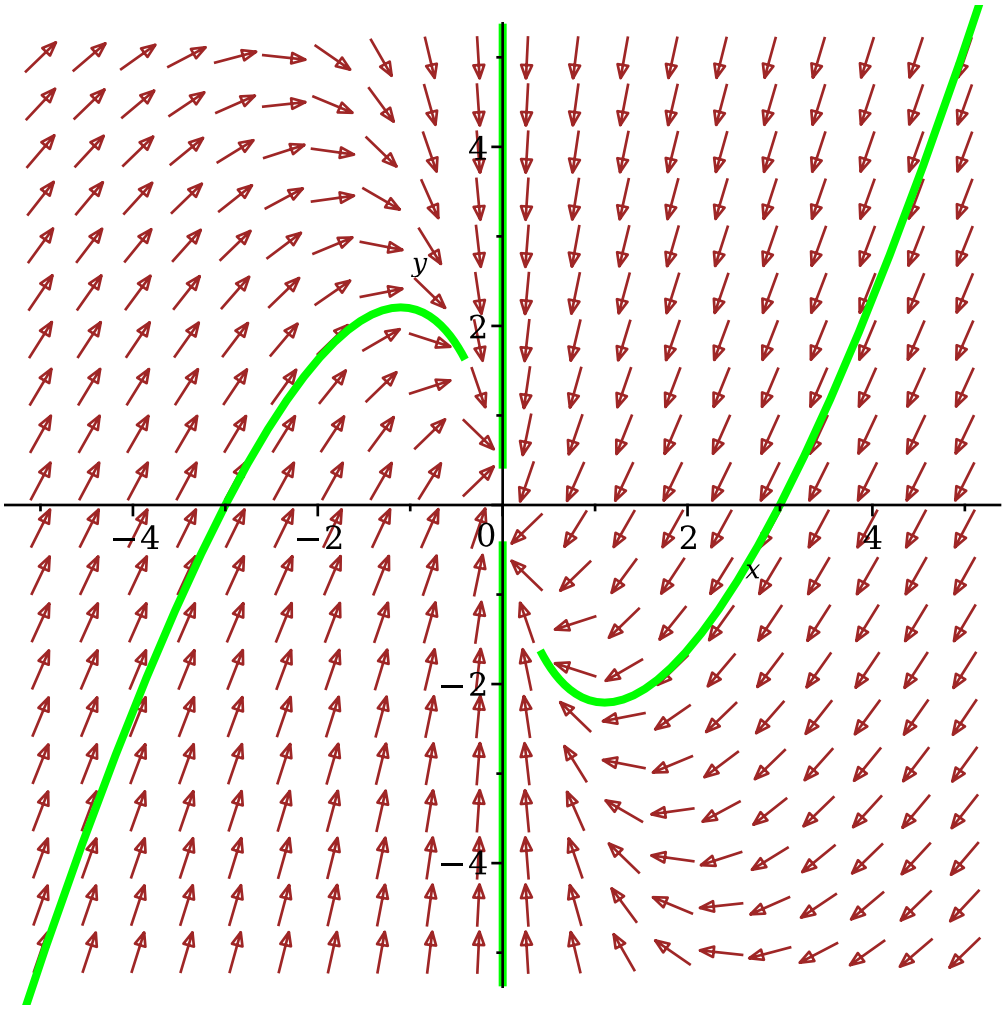
```
> ec2 := diff(y(t), t) = - 4 * x(t) - 2 * y(t)
```

$$ec2 := \frac{d}{dt}y(t) = -4\,x(t) - 2\,y(t) \qquad (74)$$

```
> sist := ec1, ec2;
```

$$sist := \frac{d}{dt}x(t) = -2\,x(t),\ \frac{d}{dt}y(t) = -4\,x(t) - 2\,y(t) \qquad (75)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
[x(0)=3,y(0)=0], [x(0)=0,y(0)=3], [x(0)=-3,y(0)=0], [x(0)=0,y(0)=
-3]], arrows=
medium, linecolor=green);
```




```
> # are limita 0
> restart
> with(DETools):
> with(plots):
> ec1 := diff(x(t), t) = x(t) - 4 * y(t);
```

$$ec1 := \frac{d}{dt}x(t) = x(t) - 4\,y(t) \qquad (76)$$

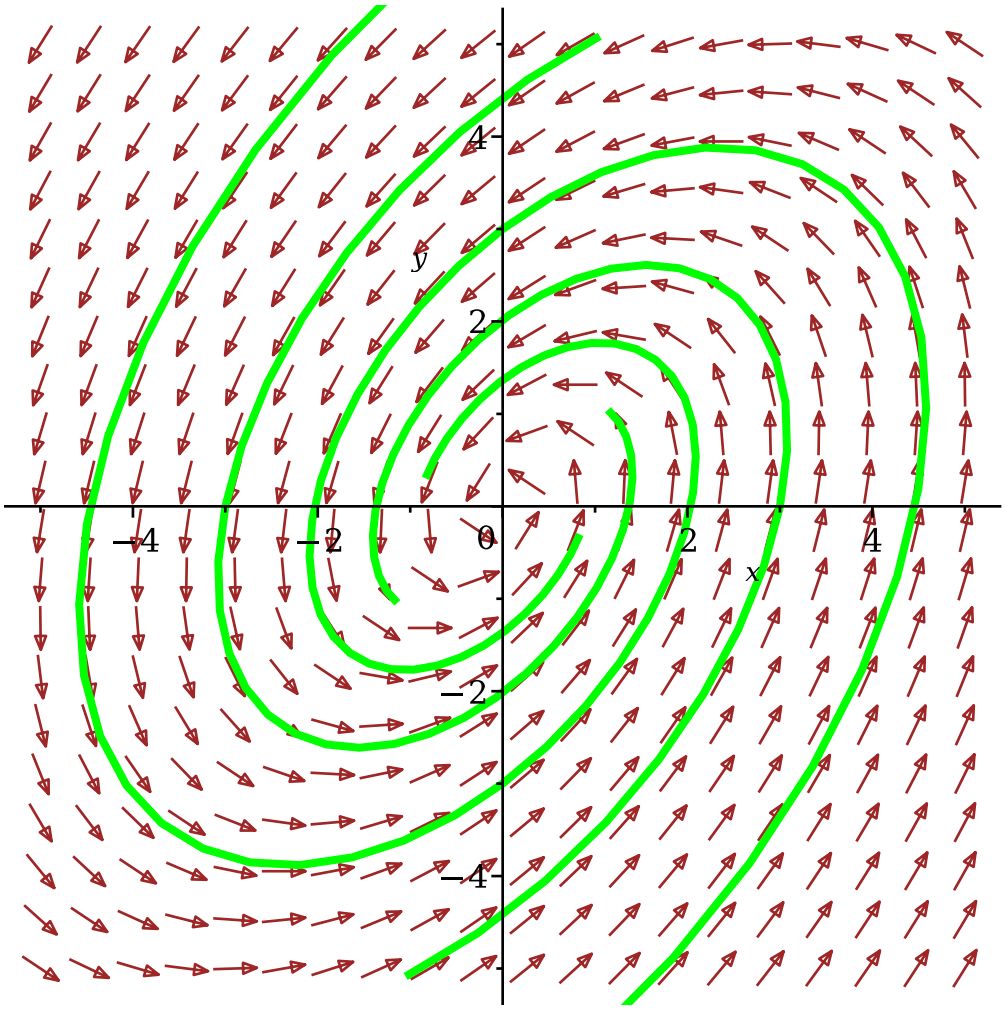
```
> ec2 := diff(y(t), t) = 5 * x(t) - 3 * y(t);
```

$$ec2 := \frac{d}{dt}y(t) = 5\,x(t) - 3\,y(t) \qquad (77)$$

```
> sist := ec1, ec2;
```

$$sist := \frac{d}{dt}x(t) = x(t) - 4\,y(t),\ \frac{d}{dt}y(t) = 5\,x(t) - 3\,y(t) \qquad (78)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
  [x(0)=3,y(0)=0], [x(0)=0,y(0)=3], [x(0)=-3,y(0)=0], [x(0)=0,y(0)=
  -3]], arrows=
  medium, linecolor=green);
```




```
> # are limita 0
> restart
> with(DETools):
> with(plots):
> ec1 := diff(x(t), t) = 3 * x(t) - y(t)
```

$$ec1 := \frac{d}{dt}\,x(t) = 3\,x(t) - y(t) \qquad (79)$$

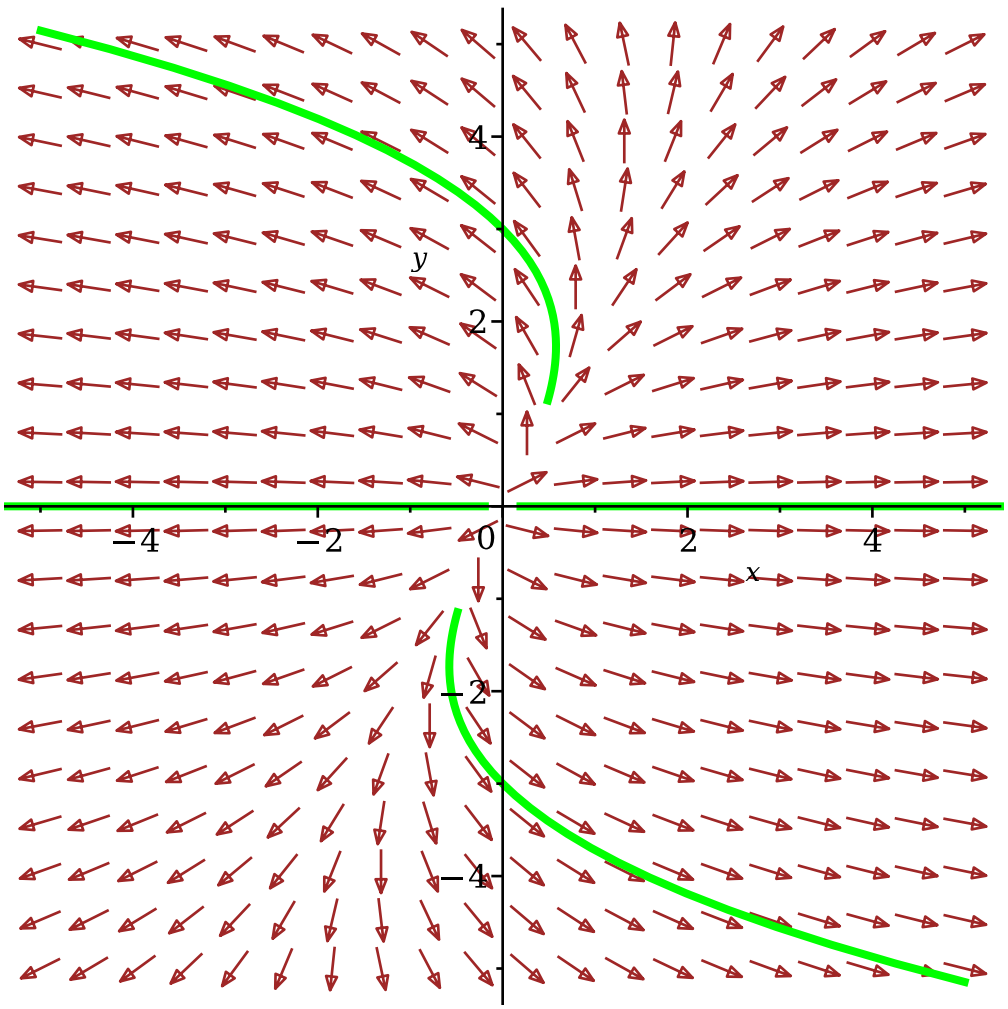
```
> ec2 := diff(y(t), t) = y(t);
```

$$ec2 := \frac{d}{dt}\,y(t) = y(t) \qquad (80)$$

```
> sist := ec1, ec2;
```

$$sist := \frac{d}{dt}\,x(t) = 3\,x(t) - y(t),\ \frac{d}{dt}\,y(t) = y(t) \qquad (81)$$

```
> DEplot([sist], [x(t), y(t)], t = -1..1, x = -5..5, y = -5..5, [
  [x(0)=3,y(0)=0], [x(0)=0,y(0)=3], [x(0)=-3,y(0)=0], [x(0)=0,y(0)=
  -3]], arrows=
  medium, linecolor=green);
```




```
> # nu are limita 0
```