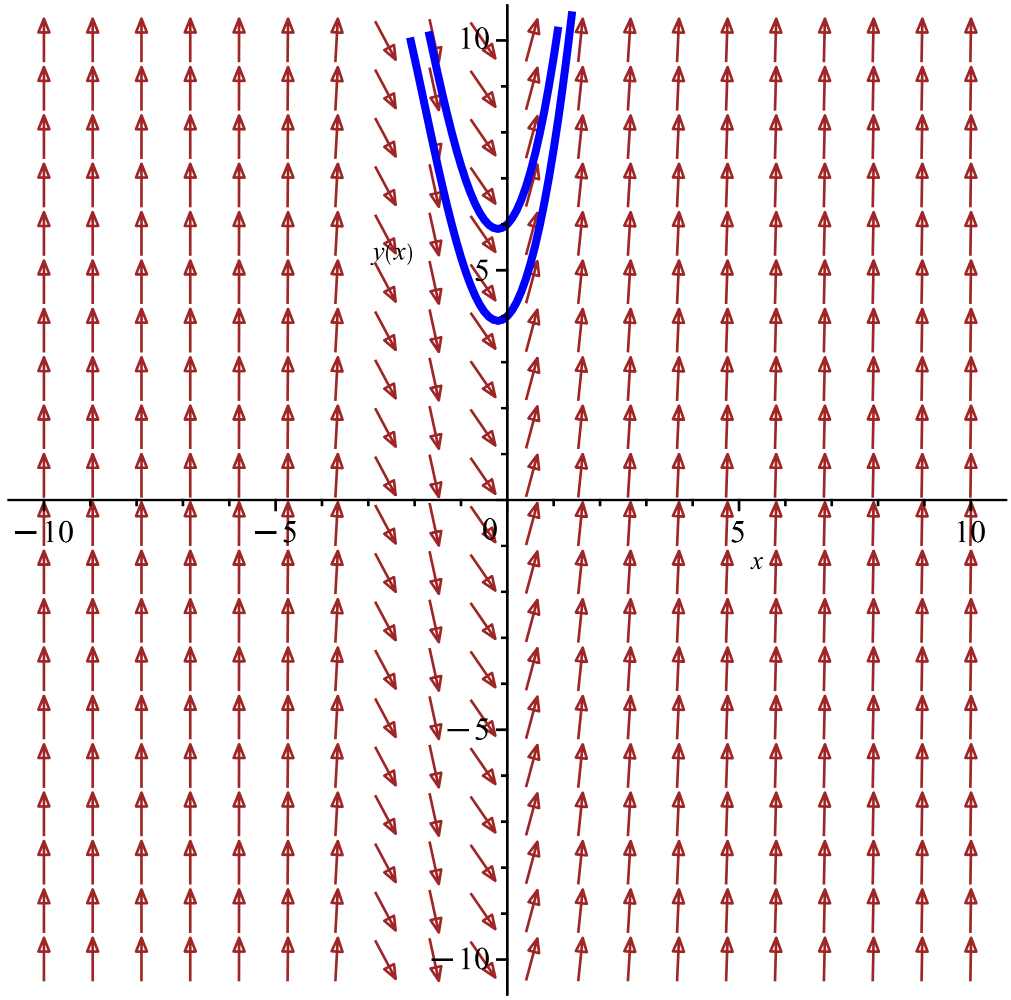
```
> #ex1:
> ec1:=diff(y(x),x)-6*x-exp(-x)=0
```

$$ec1 := \frac{d}{dx}\, y(x) - 6\,x - e^{-x} = 0 \quad (1)$$

```
> sol__1a:=dsolve(ec1,y(x))
```

$$sol_{1a} := y(x) = 3\,x^2 - e^{-x} + c_1 \quad (2)$$

```
> with(DEtools):
> DEplot(ec1,y(x),x=-10..10,y=-10..10,[[y(0)=4],[y(0)=6]],arrows=medium, linecolor=blue, stepsize=0.1)
```




```
> cond_in:=y(-1)=1-exp(1)
```

$$cond\_in := y(-1) = 1 - e \quad (3)$$

```
> sol__1b:=dsolve({ec1,cond_in},y(x))
```

$$sol_{1b} := y(x) = 3\,x^2 - e^{-x} - 2 \quad (4)$$

```
> #ex2:
> ec2:=diff(y(x),x$2)-7*diff(y(x),x)+10*y(x)-30*x-19=0
```

$$ec2 := \frac{d^2}{dx^2}\, y(x) - 7\,\frac{d}{dx}\, y(x) + 10\,y(x) - 30\,x - 19 = 0 \quad (5)$$

```
> sol__2a:=dsolve(ec2,y(x))
```

$$sol_{2a} := y(x) = e^{2\,x}\, c_2 + e^{5\,x}\, c_1 + 3\,x + 4 \quad (6)$$

```
> cond_in2:=y(0)=6,D(y)(0)=10
```

$$cond\_in2 := y(0) = 6, D(y)(0) = 10 \quad (7)$$

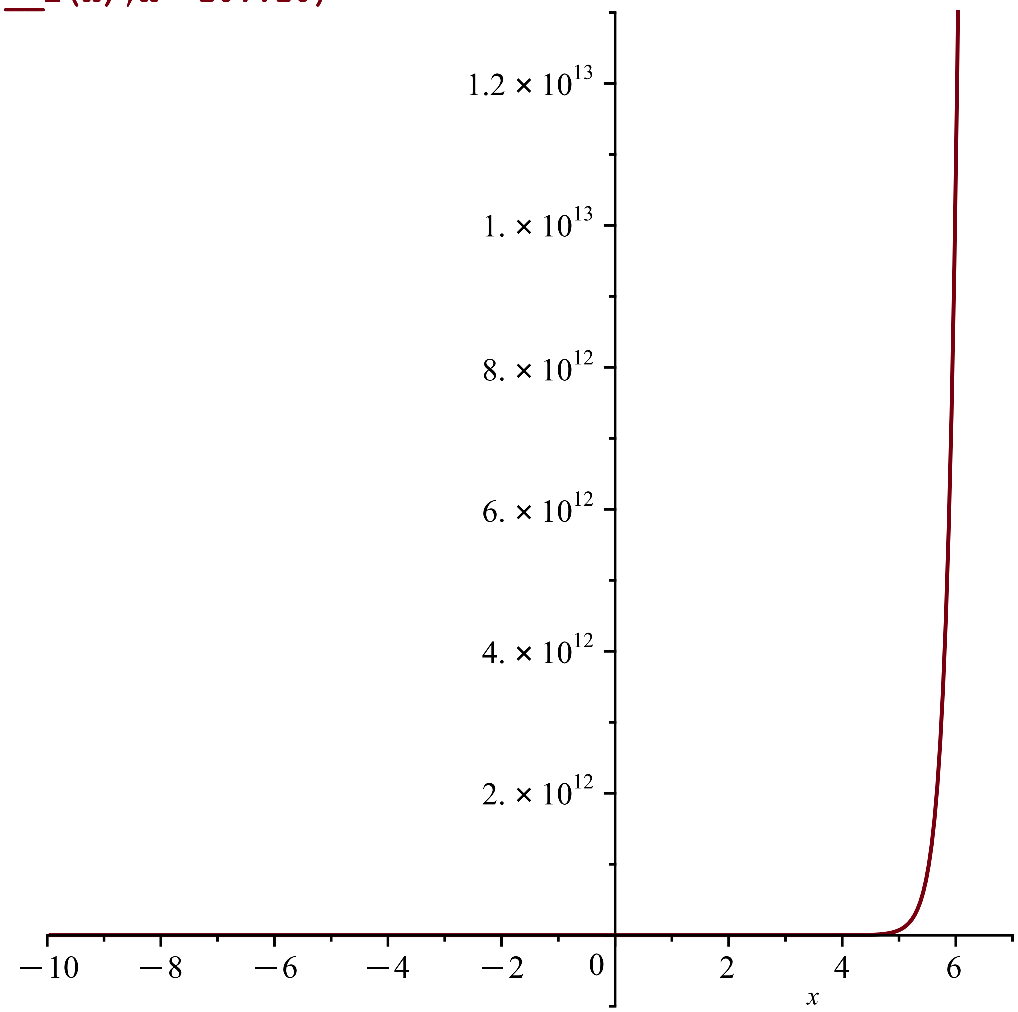
```
> sol__2b:=dsolve({ec2,cond_in2},y(x))
```

$$sol_{2b} := y(x) = e^{2x} + e^{5x} + 3x + 4 \quad (8)$$

```
> y__2:=unapply(rhs(sol__2b),x)
```

$$y_2 := x \mapsto e^{2 \cdot x} + e^{5 \cdot x} + 3 \cdot x + 4 \quad (9)$$

```
> with(plots):
> plot(y__2(x),x=-10..10)
```




```
> restart: with(DEtools):
> #ex3:
> ec1:=diff(x(t),t)=x(t)+5*y(t)
```

$$ec1 := \frac{d}{dt} x(t) = x(t) + 5\, y(t) \quad (10)$$

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

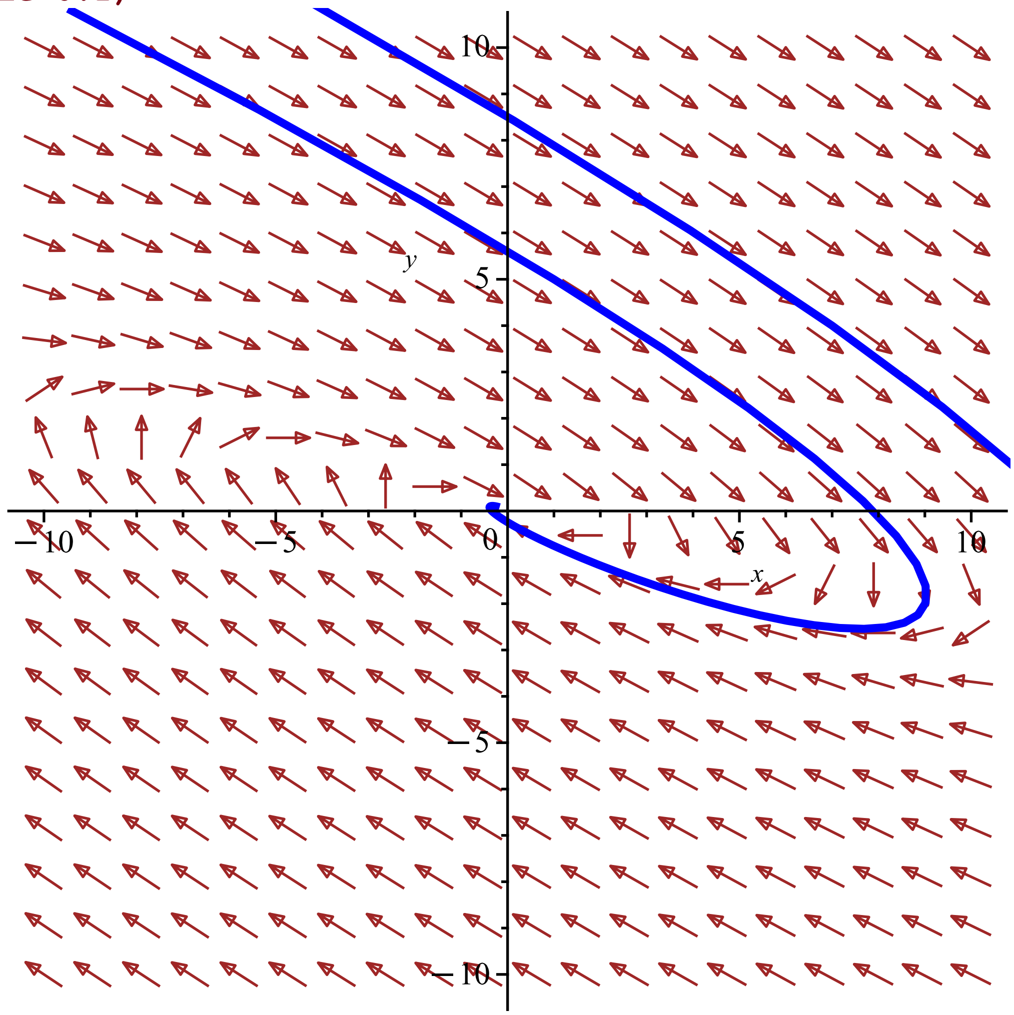
$$ec2 := \frac{d}{dt} y(t) = -x(t) - 3\, y(t) \quad (11)$$

```
> sol__a:=dsolve({ec1,ec2},{x(t),y(t)})
```

$$sol_a := \Big\{ x(t) = e^{-t} \left(\sin(t)\, c_1 + \cos(t)\, c_2\right), y(t) = \quad (12)$$

$$-\frac{e^{-t}\left(2\sin(t)\, c_1 + \sin(t)\, c_2 - \cos(t)\, c_1 + 2\cos(t)\, c_2\right)}{5}\}$$

```
> DEplot([ec1,ec2],[x(t),y(t)],t=-5..5,x=-10..10,y=-10..10,[[x(0)=1,y(0)=5],[x(0)=7,y(0)=4]],arrows=medium, linecolor=blue, stepsize=0.1)
```




```
> #se observa din directia campului de directii ca ambele limite tind la 0 => lim(x(t))=lim(y(t)), cand t -> infinnit
```

```
> cond_in__d:=x(0)=1,y(0)=4
```

$$cond\_in_d := x(0) = 1, y(0) = 4 \tag{13}$$

```
> sol__d:=dsolve({ec1,ec2,cond_in__d},{x(t),y(t)})
```

$$sol_d := \left\{x(t) = e^{-t}\left(22\sin(t) + \cos(t)\right), y(t) = -\frac{e^{-t}\left(45\sin(t) - 20\cos(t)\right)}{5}\right\} \tag{14}$$

```
> restart
> ec1:=diff(x(t),t)=-k*x(t)
```

$$ec1 := \frac{d}{dt}\, x(t) = -k\, x(t) \tag{15}$$

```
> cond_in:=x(0)=x__0
```

$$cond\_in := x(0) = x_0 \tag{16}$$

```
> sol__a:=dsolve({ec1,cond_in},x(t))
```

$$sol_a := x(t) = x_0\, e^{-k t} \tag{17}$$

```
> xx:=unapply(rhs(sol__a),t,x__0,k)
```

$$xx := (t, x_0, k) \mapsto x_0 \cdot e^{-k \cdot t} \tag{18}$$

```
> ec__d:=xx(6,100,k)=30
```

$$ec_d := 100\, e^{-6 k} = 30 \tag{19}$$

```
> k__d:=solve(ec__d,k)
```

$$k_d := -\frac{\ln\left(\frac{3}{10}\right)}{6} \tag{20}$$

```
> restart: with(DEtools): with(linalg):
> #ex5:
> f__1:=(x,y)->x*y
```

$$f_1 := (x, y) \mapsto x \cdot y \tag{21}$$

```
> f__2:=(x,y)->x-y^2+1
```

$$f_2 := (x, y) \mapsto x - y^2 + 1 \tag{22}$$

```
> ec1:=diff(x(t),t)=f__1(x(t),y(t))
```

$$ec1 := \frac{d}{dt}\, x(t) = x(t)\, y(t) \tag{23}$$

```
> ec2:=diff(y(t),t)=f__2(x(t),y(t))
```

$$ec2 := \frac{d}{dt}\, y(t) = x(t) - y(t)^2 + 1 \tag{24}$$

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

$$sist := \frac{d}{dt}\, x(t) = x(t)\, y(t),\ \frac{d}{dt}\, y(t) = x(t) - y(t)^2 + 1 \tag{25}$$

```
> PctEch:=solve({f__1(x,y)=0,f__2(x,y)=0},{x,y})
```

$$PctEch := \{x = -1, y = 0\},\ \{x = 0, y = 1\},\ \{x = 0, y = -1\} \tag{26}$$

```
> J:=jacobian([f__1(x,y),f__2(x,y)],[x,y])
```

$$J := \begin{bmatrix} y & x \\ 1 & -2\, y \end{bmatrix} \tag{27}$$

```
> A:=subs(PctEch[1,1],PctEch[1,2],eval(J))
```

$$A := \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \tag{28}$$

```
> eigenvals(A)
```

$$I,\ -I \tag{29}$$

```
> #instabil, de tip centru
> B:=subs(PctEch[2,1],PctEch[2,2],eval(J))
```

$$B := \begin{bmatrix} 1 & 0 \\ 1 & -2 \end{bmatrix} \tag{30}$$

```
> eigenvals(B)
```

$$1, -2 \tag{31}$$

```
> #instabil, de tip sa
> C:=subs(PctEch[3,1],PctEch[3,2],eval(J))
```

$$C := \begin{bmatrix} -1 & 0 \\ 1 & 2 \end{bmatrix} \tag{32}$$

```
> eigenvals(C)
```

$$-1, 2 \tag{33}$$

```
> #instabil, de tip sa
> DEplot([sist],[x(t),y(t)],t=-5..5,x=-3..3,y=-3..3,[[x(0)=-1,y(0)=
  1],[x(0)=-1/2,y(0)=1],[x(0)=1,y(0)=1],[x(0)=1,y(0)=2],[x(0)=2,y
  (0)=1/2],[x(0)=-1,y(0)=-1]])
```