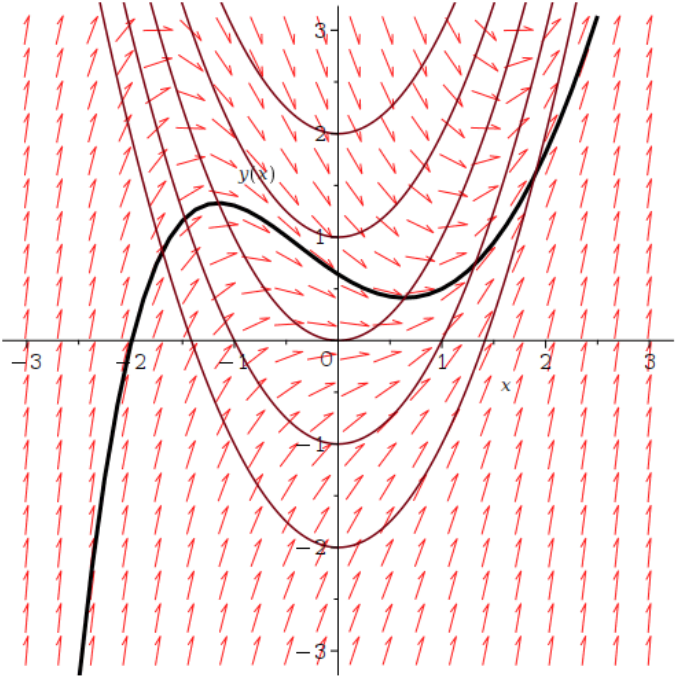> `#TASK1with(DETools)` :

> $de := diff(y(x), x) = x^2 - y(x)$

$$de := \frac{d}{dx} y(x) = x^2 - y(x) \tag{1}$$

> $de\_plot := DEplot\left(de, y(x), x = -3..3, y = -3..3, \left[y(1) = \frac{1}{2} \right], linecolor = black\right)$:

> $plot\_1 := plot(x^2, x = -3..3, y = -3..3)$:

> $plot\_2 := plot(x^2 - 1, x = -3..3, y = -3..3)$:

> $plot\_3 := plot(x^2 + 1, x = -3..3, y = -3..3)$:

> $plot\_4 := plot(x^2 - 2, x = -3..3, y = -3..3)$:

> $plot\_5 := plot(x^2 + 2, x = -3..3, y = -3..3)$:

> $plots[display](de\_plot, plot\_1, plot\_2, plot\_3, plot\_4, plot\_5)$

> `restart#TASK2.1`

>

> $a := 13$

$$a := 13 \tag{2}$$

> $de := diff(y(x), x) = \frac{x}{\sqrt{a^2 - x^2}}$

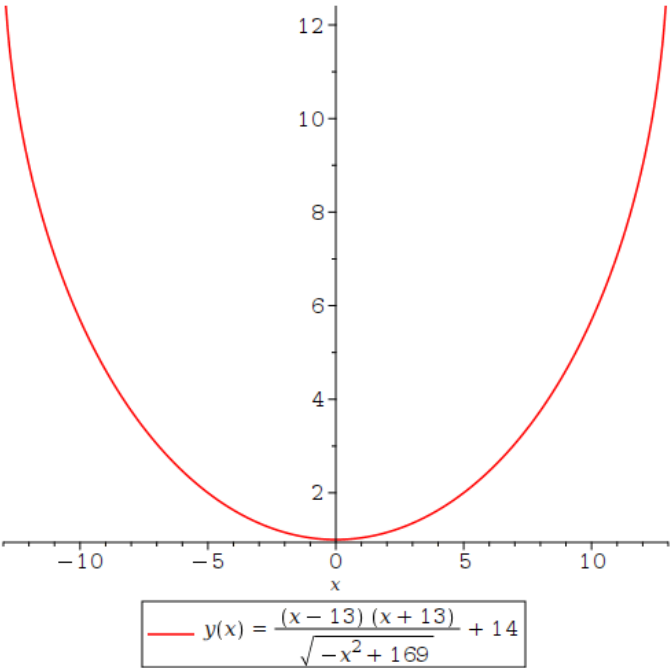$$de := \frac{d}{dx} y(x) = \frac{x}{\sqrt{-x^2 + 169}} \tag{3}$$

> $dsolve(de, y(x))$

$$y(x) = \frac{(x - 13)(x + 13)}{\sqrt{-x^2 + 169}} + \_C1 \tag{4}$$

> $dsolve(\{de, y(5) = 2\}, y(x))$

$$y(x) = \frac{(x-13)\,(x+13)}{\sqrt{-x^2+169}} + 14 \tag{5}$$

> $plot(rhs(\%), color = red, legend = (\%))$

$$\text{—} \quad y(x) = \frac{(x-13)\,(x+13)}{\sqrt{-x^2+169}} + 14$$

> $restart\#TASK2.2$

> $restart$

> $a := 4$

$$a := 4 \tag{6}$$

> $x1 := 4:$

> $y1 := \frac{1}{e^2}:$

> $de := diff(y(x), x) = -\frac{x \cdot y(x)}{a}$

$$de := \frac{d}{dx}\,y(x) = -\frac{x\,y(x)}{4} \tag{7}$$

> $dsolve(de, y(x))$

$$y(x) = \mathit{C1}\,e^{-\frac{x^2}{8}} \tag{8}$$

> $y1 := dsolve\left(\left\{de, y(4) = \frac{1}{e^2}\right\}, y(x)\right)$

$$y1 := y(x) = e^{-\frac{x^2}{8}} \tag{9}$$

> $plot\left(e^{-\frac{x^2}{8}}, legend = \left[e^{-\frac{x^2}{8}}\right], color = red\right)$

$$e^{-\frac{1}{8}x^2}$$

```
>
```
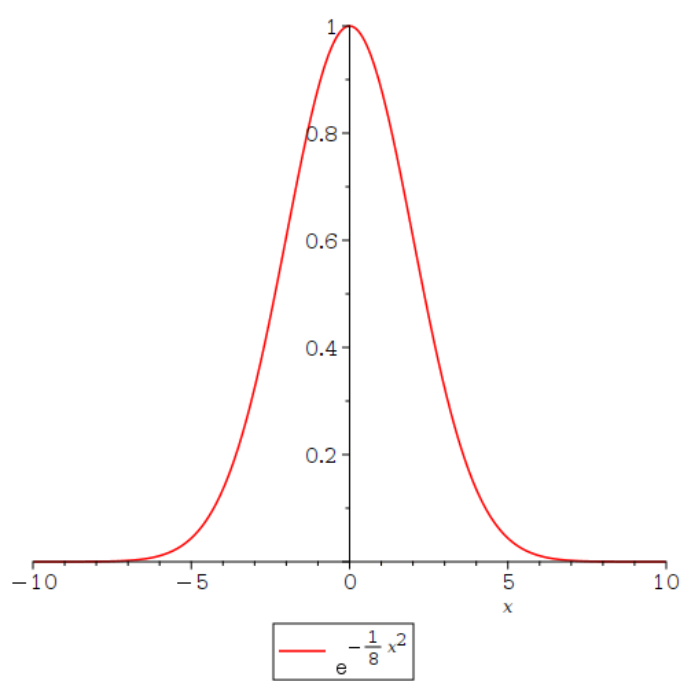
```
> restart#TASK3
```

```
> with(DETools) :
```

```
> de := diff(y(x), x) = (20·x + 77·y(x) − 97) / (76·x + y(x) − 77)
```

$$de := \frac{d}{dx}\, y(x) = \frac{20\,x + 77\,y(x) - 97}{76\,x + y(x) - 77} \tag{10}$$

```
> field := dfieldplot(de, y(x), x = 0..1.2 , y = 0..1.2) :
```
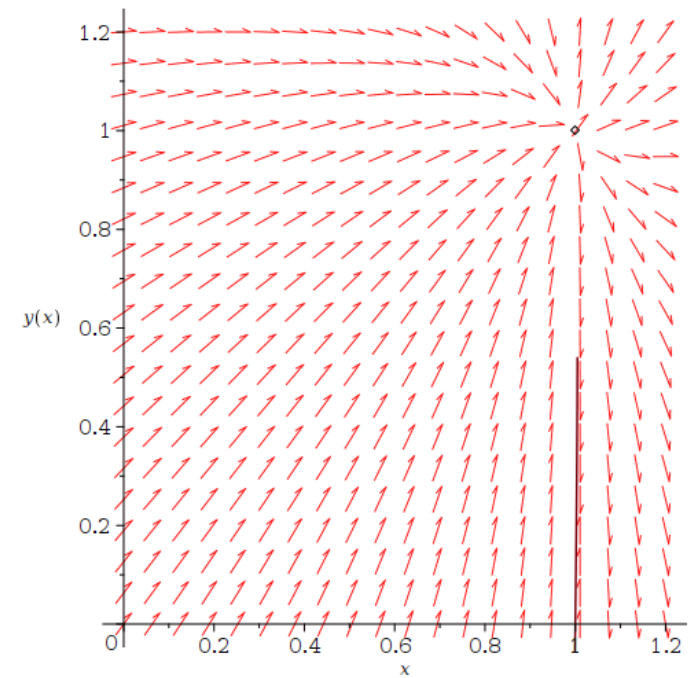
```
> p := plots[pointplot]([1, 1], color = black) :
```

```
> deSolve := rhs(dsolve({de, y(1) = 0}, y(x)))
```

$$deSolve := RootOf\left(8\ln\left(-\frac{Z - 5 + 4x}{x - 1}\right) - 9\ln\left(-\frac{Z + 4 - 5x}{x - 1}\right) - \ln(x - 1)\right) \tag{11}$$

```
> sol := plot(deSolve, x = 0..1.2, y = 0..1.2) :
```

```
> plots[display](field, p, sol)
```



```
> A := Matrix([[76 − t, 1], [20, 77 − t]])
```

$$A := \begin{bmatrix} 76 - t & 1 \\ 20 & 77 - t \end{bmatrix} \tag{12}$$

```
> det a := linalg[det](A)
```

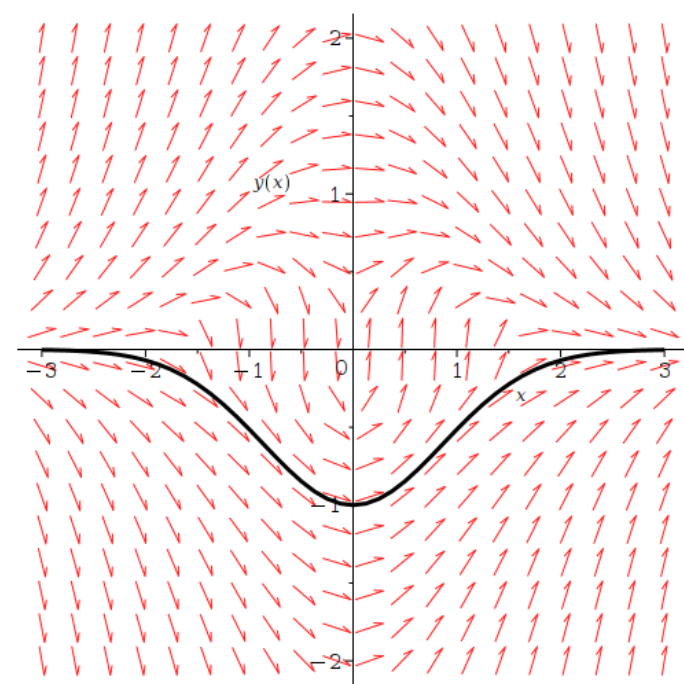$$det\ a := t^2 - 153\,t + 5832 \tag{13}$$

> `solve(det a = 0)`

$$81, 72 \tag{14}$$

> `restart`

> `#TASK4`

> `with(DETools):`

> $de := 3 \cdot diff(y(x), x) = -2 \cdot x \cdot y(x) + \dfrac{2 \cdot x}{y(x)^2 \cdot e^{2\,x^2}}$

$$de := 3\,\frac{d}{dx}\,y(x) = -2\,x\,y(x) + \frac{2\,x}{y(x)^2\,e^{2\,x^2}} \tag{15}$$

> `gen_sol := dsolve(de)`

$$gen\_sol := y(x) = \frac{\left(\left(\_C1\,e^{x^2} - 1\right) e^{x^2}\right)^{1/3}}{e^{x^2}},\ y(x) = -\frac{\left(\left(\_C1\,e^{x^2} - 1\right) e^{x^2}\right)^{1/3}}{2\,e^{x^2}} - \frac{I\sqrt{3}\left(\left(\_C1\,e^{x^2} - 1\right) e^{x^2}\right)^{1/3}}{2\,e^{x^2}},\ y(x) =$$
$$-\frac{\left(\left(\_C1\,e^{x^2} - 1\right) e^{x^2}\right)^{1/3}}{2\,e^{x^2}} + \frac{I\sqrt{3}\left(\left(\_C1\,e^{x^2} - 1\right) e^{x^2}\right)^{1/3}}{2\,e^{x^2}} \tag{16}$$

> `spec_sol := dsolve({de, y(0) = -1})`

$$spec\_sol := y(x) = \frac{\left(-e^{x^2}\right)^{1/3}\left(I\sqrt{3} - 1\right) e^{-x^2}}{2} \tag{17}$$

> `DEplot(de, y(x), x = -3..3, y = -2..2, [y(0) = -1], linecolor = black)`

> `restart`

> `#TASK5`

> $de := x = (diff(y(x), x) - 1) e^{diff(y(x), x)}$

$$de := x = \left(\frac{d}{dx}\,y(x) - 1\right) e^{\frac{d}{dx}\,y(x)} \tag{18}$$

> `de := subs(diff(y(x), x) = t, de)`

$$de := x = (t - 1)\,e^t \tag{19}$$

> `xt := rhs(de)`

$$xt := (t - 1)\,e^t \tag{20}$$

> `yt = int(t·diff(xt, t), t)`

$$yt = \left(t^2 - 2\,t + 2\right) e^t \tag{21}$$
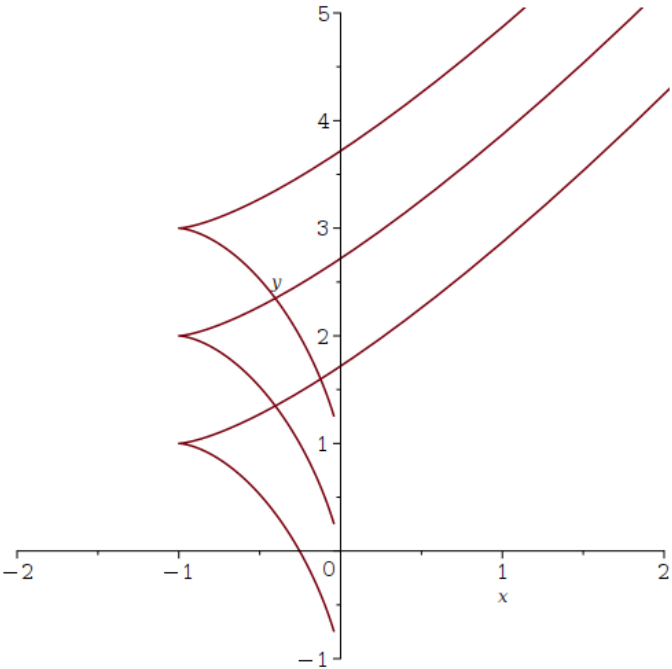
> $xt := xt$

$$xt := (t - 1) e^t \qquad (22)$$

#Построим интегральные кривые.

> $p1 := plot([(t - 1) e^t, (t^2 - 2t + 2) e^t - 1, t = -5..5], x = -2..2, y = -1..5):$

> $p2 := plot([(t - 1) e^t, (t^2 - 2t + 2) e^t, t = -5..5], x = -2..2, y = -1..5):$

> $p3 := plot([(t - 1) e^t, (t^2 - 2t + 2) e^t + 1, t = -5..5], x = -2..2, y = -1..5):$

> $plots[display](p1, p2, p3)$

> $restart \; \#TASK5.2$

> $de := y = \ln(|\sin(diff(y(x), x))|) - diff(y(x), x) \cdot \cot(diff(y(x), x)) - 1$

$$de := y = \ln\left(\left|\sin\left(\frac{d}{dx} y(x)\right)\right|\right) - \left(\frac{d}{dx} y(x)\right) \cot\left(\frac{d}{dx} y(x)\right) - 1 \qquad (23)$$

> $de := subs(diff(y(x), x) = t, de)$

$$de := y = \ln(|\sin(t)|) - t\cot(t) - 1 \qquad (24)$$

> $yt := rhs(de)$

$$yt := \ln(|\sin(t)|) - t\cot(t) - 1 \qquad (25)$$

> $xt := int\left(\frac{diff(yt, t)}{t}, t\right)$
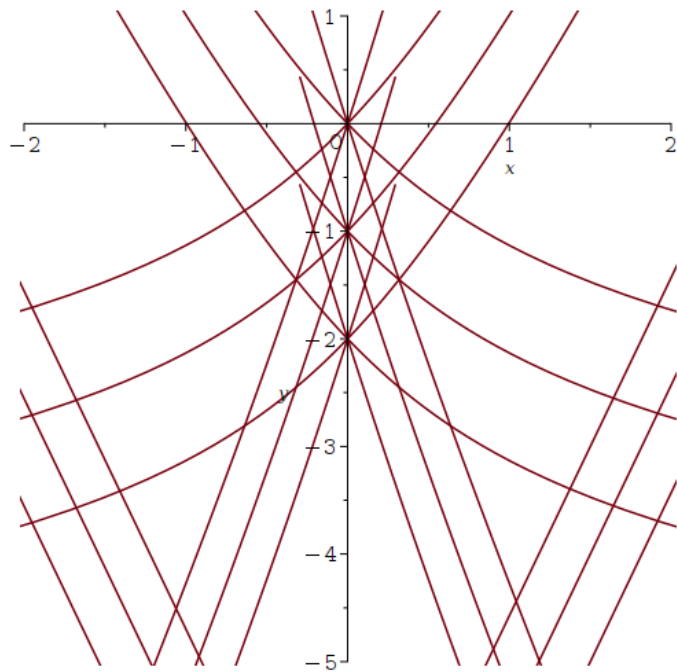
$$xt := -\cot(t) \qquad (26)$$

>

> $p1 := plot([-\cot(t), \ln(|\sin(t)|) - t\cot(t) - 2, t = -5..5], x = -2..2, y = -5..1):$

> $p2 := plot([-\cot(t), \ln(|\sin(t)|) - t\cot(t) - 1, t = -5..5], x = -2..2, y = -5..1):$

> $p3 := plot([-\cot(t), \ln(|\sin(t)|) - t\cot(t), t = -5..5], x = -2..2, y = -5..1):$

> $plots[display](p1, p2, p3)$
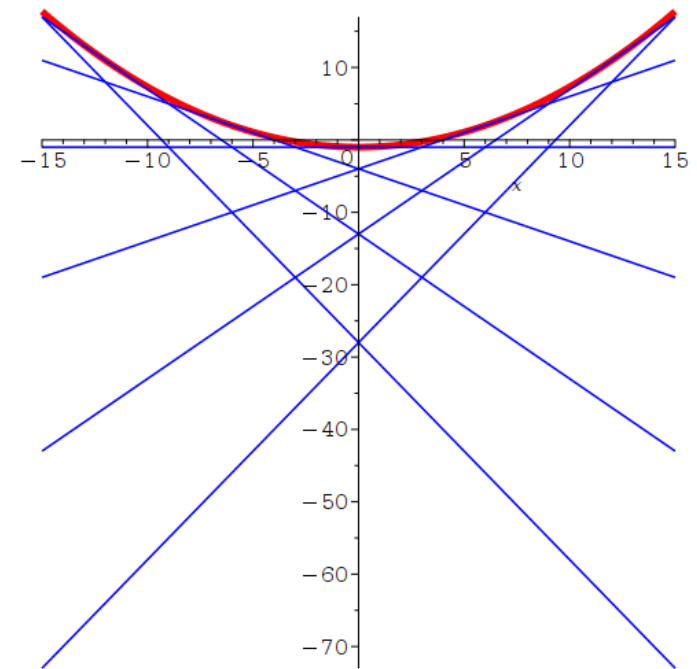
$$spec\_sol := \frac{x^2}{12} - 1 \tag{30}$$

> $curves := seq(subs(\_C1 = i, gen\_sol), i = -3..3)$

$$curves := -3x - 28, -2x - 13, -x - 4, -1, x - 4, 2x - 13, 3x - 28 \tag{31}$$

> $p\_spec := plot(spec\_sol, color = red, thickness = 5):$

> $p\_curves := plot([curves], color = blue):$

> $plots[display](p\_spec, p\_curves)$

>

>

> restart

> #TASK6

> $de := y(x) = x \cdot diff(y(x), x) - 3\, diff(y(x), x)^2 - 1$

$$de := y(x) = x\left(\frac{d}{dx}\, y(x)\right) - 3\left(\frac{d}{dx}\, y(x)\right)^2 - 1 \tag{27}$$

> $res := dsolve(de)$

$$res := y(x) = \frac{x^2}{12} - 1,\ y(x) = -3\_C1^2 + x\_C1 - 1 \tag{28}$$

> $gen\_sol := rhs(res[2])$

$$gen\_sol := -3\_C1^2 + x\_C1 - 1 \tag{29}$$

> $spec\_sol := rhs(res[1])$