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> #Lab 3.1, Yarmak Veronika, variant 29
> #Task 1
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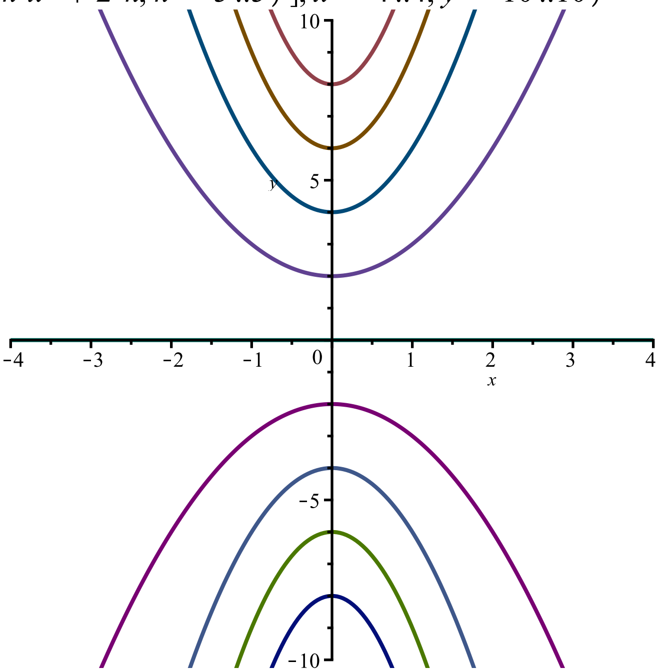
\> $restart : ode := diff(y(x), x) = \frac{y(x)}{(x^2+2)};$

$$ode := \frac{d}{dx}\, y(x) = \frac{y(x)}{x^2+2} \quad (1)$$

\> $with(DETools) :$

\> $isocl := plot\left(\left[seq\left(k \cdot x^2 + 2 \cdot k,\, k = -5 .. 5\right) \right], x = -4 .. 4, y = -10 .. 10 \right)$



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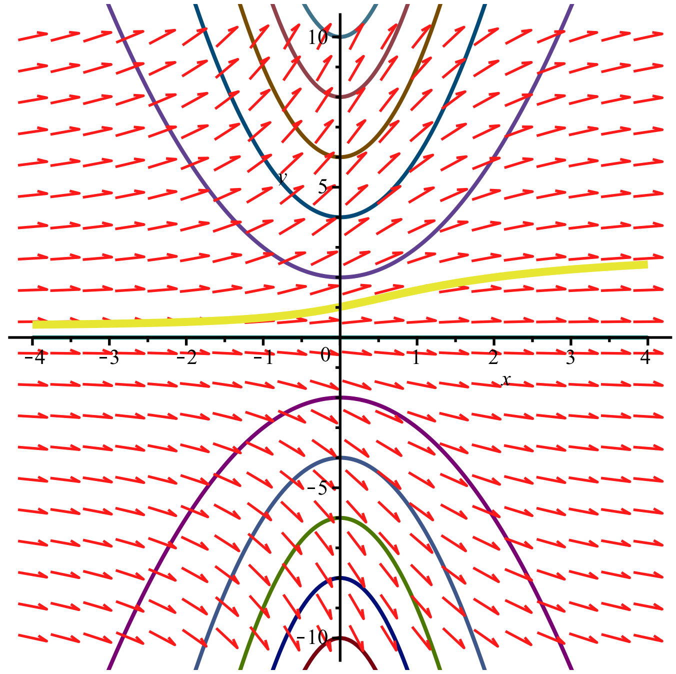
\> $dplot := DEplot(ode, y(x), x = -4 .. 4, y = -10 .. 10, [y(2) = 2]) :$

\> $plots[display](isocl, dplot)$



> #Task 2 part 1
> restart;

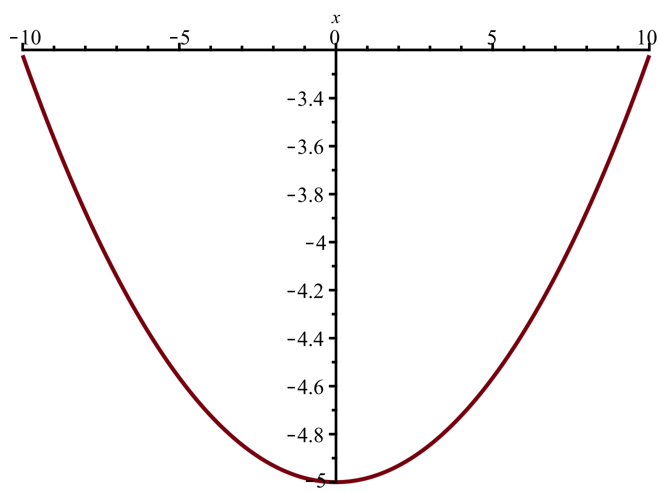
> $line := dsolve\left(\left\{diff(y(x), x) = \frac{x}{\mathrm{sqrt}(29^2 - x^2)}, y(20) = 3\right\}\right)$

$$line := y(x) = \frac{(x-29)\ (x+29)}{\sqrt{-x^2+841}} + 24 \quad \textbf{(2)}$$

> $simplify(line);$

$$y(x) = \frac{x^2 + 24\sqrt{-x^2+841} - 841}{\sqrt{-x^2+841}} \quad \textbf{(3)}$$

> $plot(rhs(line))$



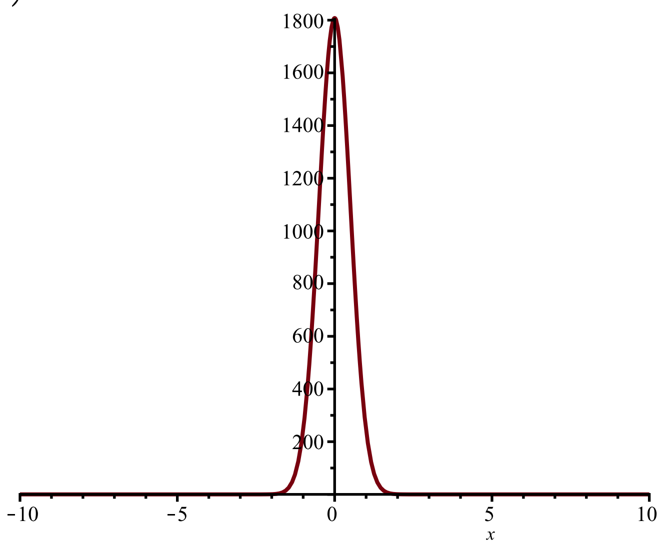
> #part 2
> restart;

> $a := \frac{1}{4}$:

> $line := simplify\left(dsolve\left(\left\{diff(y(x), x) = -\frac{y(x) \cdot x}{a}, y(2) = \frac{1}{\sqrt{e}}\right\}\right)\right)$

$$line := y(x) = e^{\frac{15}{2} - 2x^2} \quad \textbf{(4)}$$

> $plot\left(e^{\left(\frac{15}{2} - 2 \cdot x^2\right)}\right)$



> #Task 3

> restart;

> $dy := diff(y(x), x) = \frac{7 \cdot x + 57 \cdot y(x) + 64}{63 \cdot x + y(x) + 64}$;

$$dy := \frac{d}{dx} y(x) = \frac{7x + 57 y(x) + 64}{63x + y(x) + 64} \quad \textbf{(5)}$$

> $dy\_solve := dsolve(dy, y(x))$

$$dy\_solve := 7 \ln\left(-\frac{y(x) + 8 + 7x}{x + 1}\right) - 8 \ln\left(\frac{-y(x) + x}{x + 1}\right) - \ln(x + 1) - \_C1 = 0 \quad \textbf{(6)}$$

> $A := Matrix([[7, 57], [63, 1]])$

$$A := \begin{bmatrix} 7 & 57 \\ 63 & 1 \end{bmatrix} \quad \textbf{(7)}$$

> $linalg[det](A)$

$$-3584 \quad \textbf{(8)}$$

> #сводится к однородному

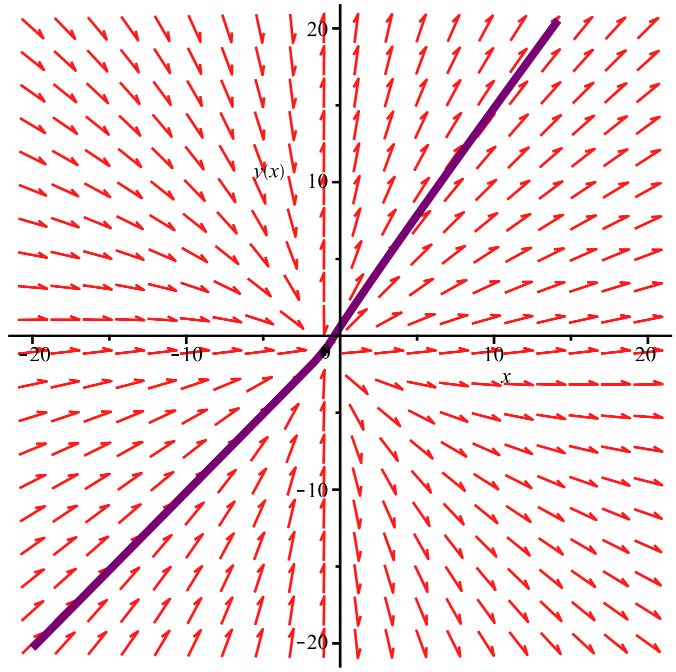
> $solve(\{7 \cdot x + 57 \cdot y + 64 = 0, 63 \cdot x + y + 64 = 0\})$

$$\{x = -1, y = -1\} \quad \textbf{(9)}$$

> $dplot := DETools[DEplot](dy, y(x), x = -20..20, y = -20..20, [y(3) = 5], linecolor = purple)$:

> $ppoint := plot([[-1, -1]], style = point, color = black)$:

> $plots[display](dplot, ppoint)$;



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> $A := Matrix([[7 - x, 57], [63, 1 - x]])$

$$A := \begin{bmatrix} 7 - x & 57 \\ 63 & 1 - x \end{bmatrix} \qquad \textbf{(10)}$$

> $solve(LinearAlgebra[Determinant](A) = 0)$

$$64, -56 \qquad \textbf{(11)}$$

> #ВЫВОД О ТОЧКЕ

> #Task 4

> restart;

> $dy\_4 := x \cdot diff(y(x), x) = (y(x))^2 \cdot \ln(x) - y(x)$

$$dy\_4 := x \left(\frac{d}{dx} y(x)\right) = y(x)^2 \ln(x) - y(x) \qquad \textbf{(12)}$$

> $dy\_44 := diff(y(x), x) = \frac{(y(x))^2 \cdot \ln(x) - y(x)}{x}$

$$dy\_44 := \frac{d}{dx} y(x) = \frac{y(x)^2 \ln(x) - y(x)}{x} \qquad \textbf{(13)}$$

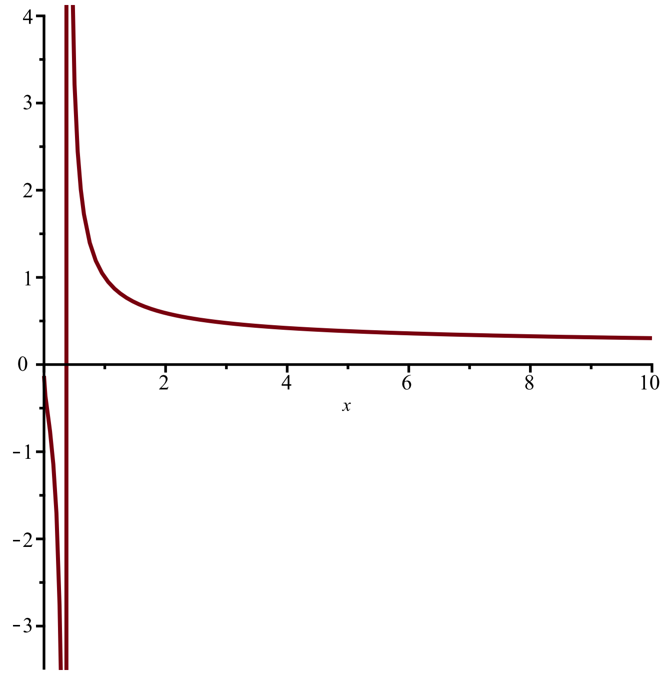
> $dy\_44\_solve := dsolve(dy\_44, y(x))$

$$dy\_44\_solve := y(x) = \frac{1}{1 + \_C1\, x + \ln(x)} \qquad \textbf{(14)}$$

> $dy\_4\_solve := dsolve(\{dy\_4, y(1) = 1\})$

$$dy\_4\_solve := y(x) = \frac{1}{\ln(x) + 1} \qquad \textbf{(15)}$$

> $plot\left(\frac{1}{\ln(x) + 1}\right)$



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> #Task 5
> #part 1
> restart;
> dy_5 := x = diff(y(x), x)·sinh(diff(y(x), x)) − cosh(diff(y(x), x));
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$$dy\_5 := x = \left(\frac{d}{dx} y(x)\right) \sinh\left(\frac{d}{dx} y(x)\right) - \cosh\left(\frac{d}{dx} y(x)\right) \quad \textbf{(16)}$$

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> dy_p := diff(y(t), t) = t^2·cosh(t)
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$$dy\_p := \frac{d}{dt} y(t) = t^2 \cosh(t) \quad \textbf{(17)}$$

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> dy_5_solve := dsolve(dy_p)
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$$dy\_5\_solve := y(t) = t^2 \sinh(t) - 2\,t \cosh(t) + 2 \sinh(t) + \_C1 \quad \textbf{(18)}$$

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> deplot := DETools[DEplot](dy_p, y(t), t=-10..10, y=-10..10, thickness=5) :
> dpl := plot([seq(t^2 ·sinh(t) − 2 ·t ·cosh(t) + 2 ·sinh(t) + C, C=-1..1)], t=-10..10, y=-10
   ..10) :
> plots[display](dpl, deplot);
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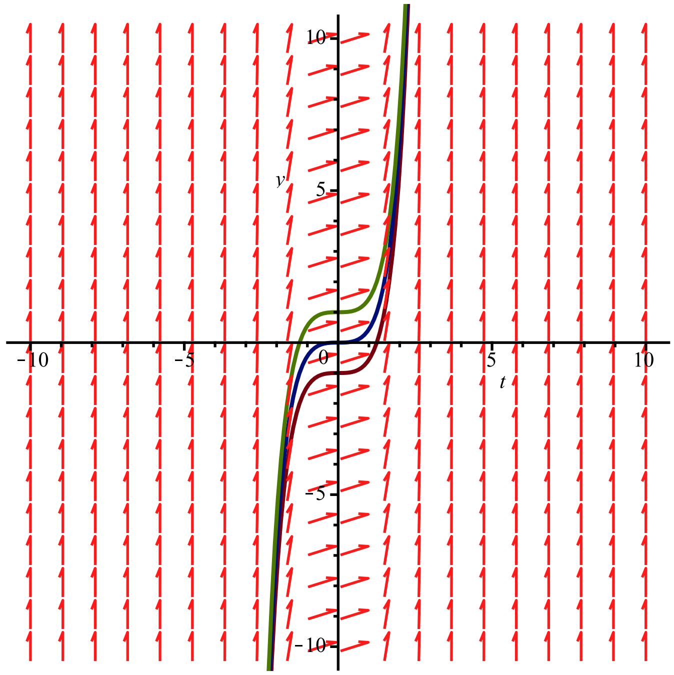


> #Part 2

> restart;

> $dy := y(x) = \frac{1}{9} \cdot diff(y(x), x)^3 \left(3 \cdot \ln\left(diff(y(x), x)\right) - 1\right);$

$$dy := y(x) = \frac{\left(\frac{d}{dx}\, y(x)\right)\left(3\,\ln\left(\frac{d}{dx}\, y(x)\right) - 1\right)^3}{9} \tag{19}$$

> $dy\_x := diff\,(x(p), p) = p \cdot \ln(p);$

$$dy\_x := \frac{d}{dp}\, x(p) = p\,\ln(p) \tag{20}$$

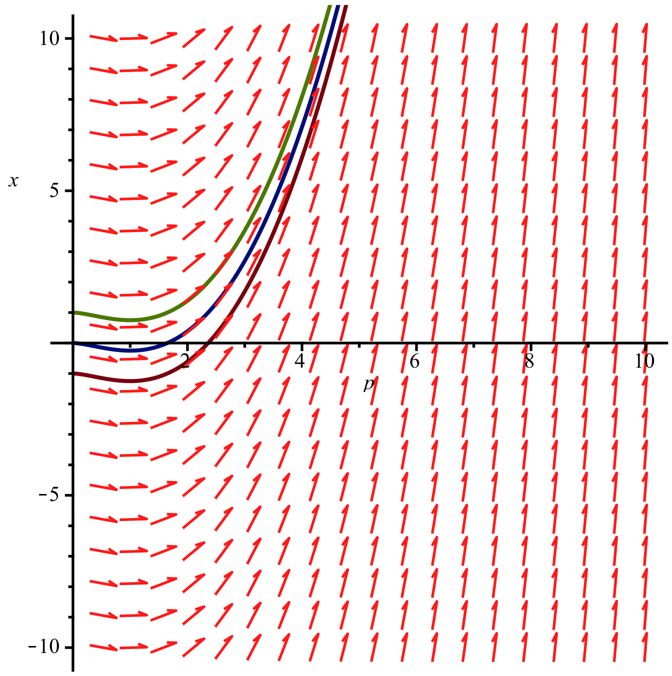
> $dsolve(dy\_x);$

$$x(p) = \frac{p^2\,\ln(p)}{2} - \frac{p^2}{4} + \_C1 \tag{21}$$

> $dplot := plot\left(\left[seq\left(\frac{1}{2}\,p^2\,\ln(p) - \frac{1}{4}\,p^2 + C, C = -1\,..1\right)\right], p = 0\,..10, x = -10\,..10\right):$

> $deplot := DETools[DEplot](dy\_x, x(p), p = 0\,..10, x = -10\,..10):$

> $plots[display](dplot, deplot)$



> #Task 6

> restart;

> $dy := y(x) = x \cdot \frac{d}{dx}(y(x)) + 2 \cdot \left(\frac{d}{dx}(y(x))\right)^2 - 3;$

$$dy := y(x) = x \left(\frac{d}{dx} y(x)\right) + 2 \left(\frac{d}{dx} y(x)\right)^2 - 3 \quad \textbf{(22)}$$

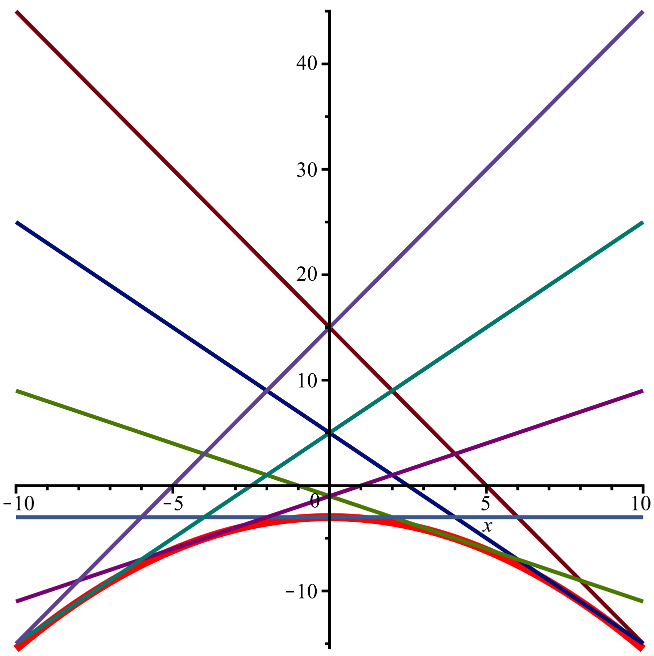
> $dy\_solve := dsolve(dy);$

$$dy\_solve := y(x) = -\frac{x^2}{8} - 3, y(x) = 2\_C1^2 + x\_C1 - 3 \quad \textbf{(23)}$$

> $sq := seq(2 \cdot C^2 + x \cdot C - 3, C = -3..3):$
$cc := plot([sq]):$

> $pplot := plot\left(-\frac{x^2}{8} - 3, color = red, thickness = 3\right):$

> $plots[display](pplot, cc);$



40
30
20
10
−10
−5
0
5
10
x
−10

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