> **#Лабораторная работа 3**

> **#Вариант 9**

> **#Згирской Дарьи, гр. 353502**

>

> restart;

>

> **#Задание 1**

> $deq := diff(y(x), x) \cdot (x^2 + 2) = y(x)$:

> $dsolve(deq, y(x))$;

$$y(x) = \_C1\, \mathrm{e}^{\frac{\sqrt{2}\arctan\left(\frac{x\sqrt{2}}{2}\right)}{2}} \quad \textbf{(1)}$$

> $M := y(2) = 2$:
$pointM := [2, 2]$:
$plotM := plots[pointplot]([pointM], symbol = solidcircle, color = blue, symbolsize = 10, legend = \text{"M"})$:

> $plot\_dir := DEtools[DEplot](deq, y(x), x = -10..10, y = -4..4, [M])$:

>

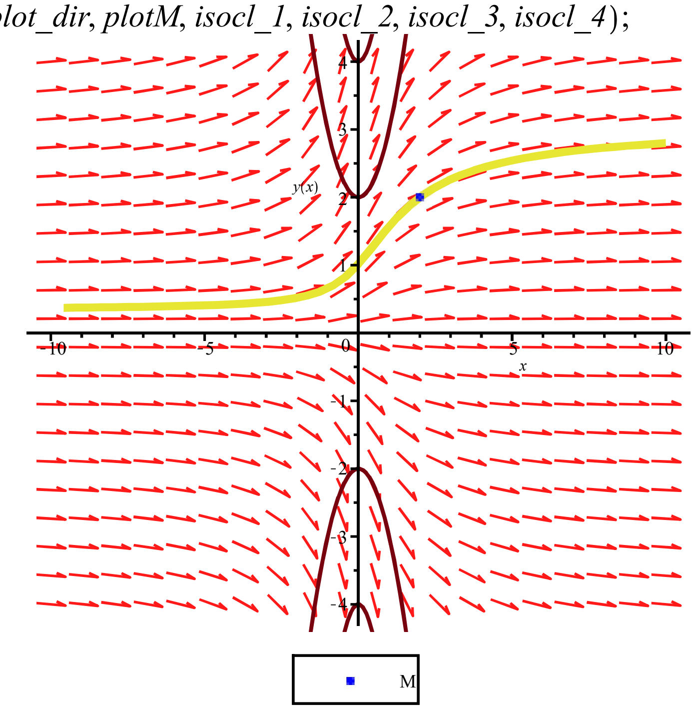
> $f := x^2 + 2$:
$isocl\_1 := plot(f, x = -10..10, y = -4..4)$:

> $isocl\_2 := plot(-x^2 - 2, x = -10..10, y = -4..4)$:

> $isocl\_3 := plot(2 \cdot (x^2 + 2), x = -10..10, y = -4..4)$:

> $isocl\_4 := plot(-2 \cdot (x^2 + 2), x = -10..10, y = -4..4)$:

> $plots[display](plot\_dir, plotM, isocl\_1, isocl\_2, isocl\_3, isocl\_4)$;



> restart;

>

> *#Задание 2*

> *#1)*

> $M0 := y(20) = 3:$

#Решение (tgβ<0)

> $a := 29:$

> $tg\alpha := diff(y(x), x):$

> $cos\beta := \frac{x}{a}:$

>

> $tg\beta := -\mathrm{sqrt}\left(\frac{1}{cos\beta^2} - 1\right):$

>

> $deq := tg\alpha = -\frac{1}{tg\beta};$

$$deq := \frac{\mathrm{d}}{\mathrm{d}x}\, y(x) = \frac{1}{\sqrt{\frac{841}{x^2} - 1}} \tag{1.1}$$

> $dsolve(deq, y(x));$

$$y(x) = \frac{(x-29)\,(x+29)}{x\sqrt{-\frac{x^2-841}{x^2}}} + \_C1 \tag{1.2}$$

> $y := -\mathrm{sqrt}((29-x)\cdot(29+x)) + C;$

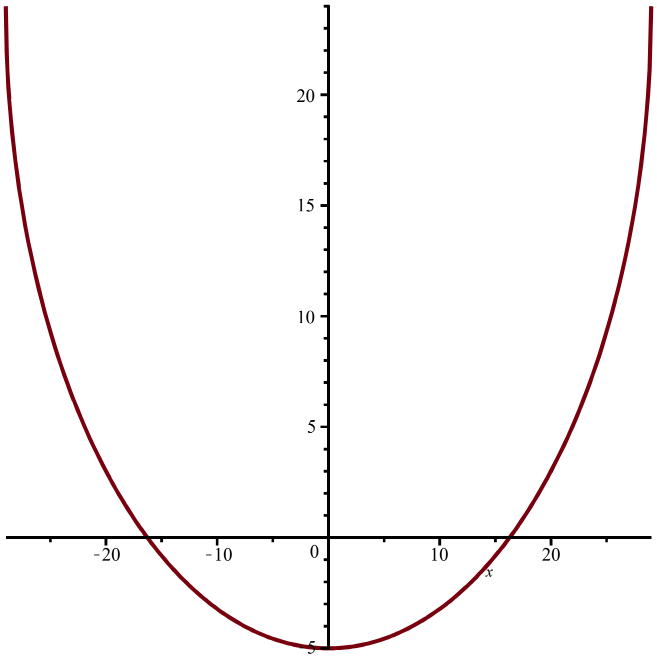
$$y := -\sqrt{(-x+29)\,(x+29)} + C \tag{1.3}$$

> $C(x, y) := y + \mathrm{sqrt}((29-x)\cdot(29+x)):$

> $C := subs(x0 = 20, y0 = 3, C(x0, y0));$

$$C := 3 + \sqrt{441} \tag{1.4}$$

> $plot(y);$



> $restart;$

#Убедимся, что tgβ>0 не является решением

> $a := 29 :$

> $tg\alpha := diff(y(x), x) :$

> $cos\beta := \frac{x}{a} :$

>

> $tg\beta := \mathrm{sqrt}\left(\frac{1}{cos\beta^2} - 1\right) :$

>

> $deq := tg\alpha = -\frac{1}{tg\beta};$

$$deq := \frac{\mathrm{d}}{\mathrm{d}x}\, y(x) = -\frac{1}{\sqrt{\frac{841}{x^2} - 1}} \tag{2.1}$$

> $dsolve(deq, y(x));$

$$y(x) = -\frac{(x-29)\,(x+29)}{x\sqrt{-\frac{x^2-841}{x^2}}} + \_C1 \tag{2.2}$$

> $y := \mathrm{sqrt}((29 - x)\cdot(29 + x)) + C;$

$$y := \sqrt{(-x+29)\,(x+29)} + C \tag{2.3}$$

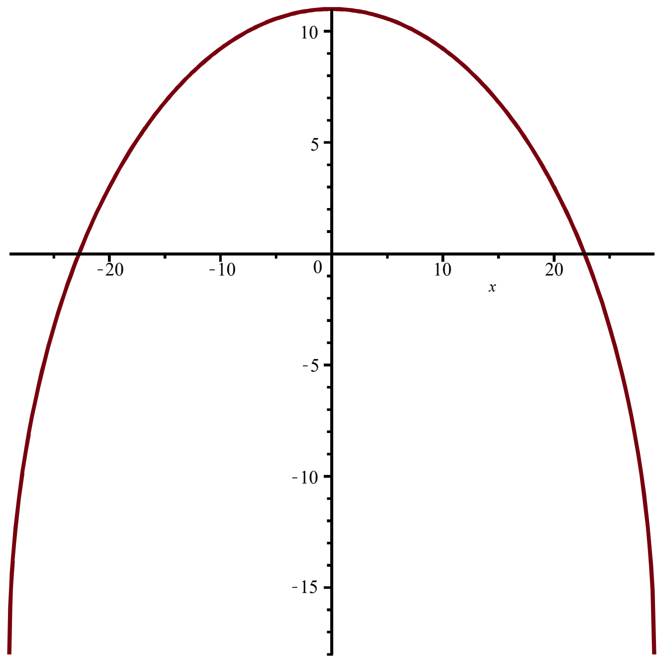
> $C(x, y) := y - \mathrm{sqrt}((29 - x)\cdot(29 + x)) :$

> $C := subs(x0 = 20, y0 = 3, C(x0, y0));$

(2.4)

$$C := 3 - \sqrt{441} \quad \textbf{(2.4)}$$

> $plot(y);$



> *#как видно по графику, вектор MN (M - точка касания, отрезок MN перпендикулярен касательной) образует тупой угол с осью Oy, что не соответствует условию задачи*

> $restart;$

>

> ***#2)***

> $M0 := y(2) = \frac{1}{\mathrm{sqrt}(\mathrm{e})}:$

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

>

> $x0 := \frac{a}{x} + x:$

> $tg\alpha := \frac{y(x)}{x - x0}:$

> $deq := diff(y(x), x) = tg\alpha;$

$$deq := \frac{\mathrm{d}}{\mathrm{d}x}\, y(x) = -4\, y(x)\, x \quad \textbf{(2)}$$

> $dsolve(deq, y(x));$

$$y(x) = \_C1\, \mathrm{e}^{-2 x^2} \quad \textbf{(3)}$$

> $y(x) := C\cdot \mathrm{e}^{-2\cdot x^2}:$

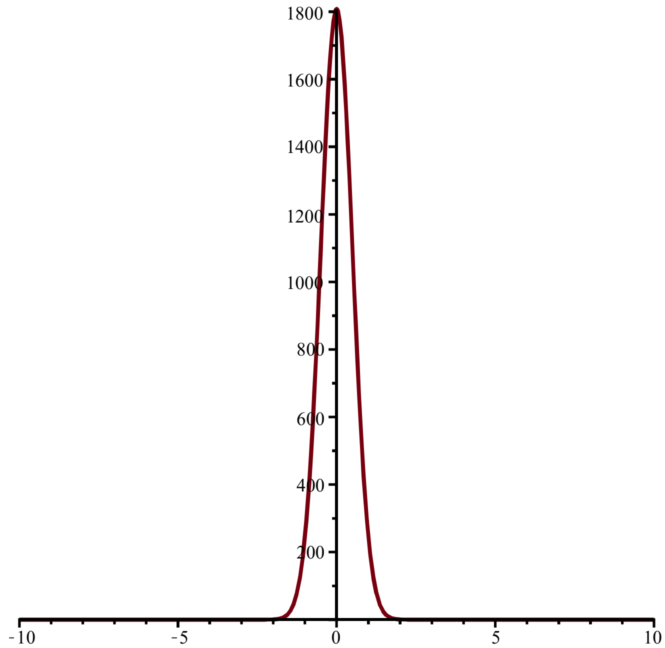
> $C(x, y) := y\cdot \mathrm{e}^{2\cdot x^2};$

$$C := (x, y) \mapsto y\cdot \mathrm{e}^{2\cdot x^2} \quad \textbf{(4)}$$

> $C := subs\left(x=2, y=\frac{1}{\mathrm{sqrt}(\mathrm{e})}, C(x,y)\right);$

$$C := \frac{\mathrm{e}^{8}}{\mathrm{e}^{\frac{1}{2}}} \tag{5}$$

> $plot(y);$



> $restart;$

>

> ***#Задание 3***

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

> $sol := dsolve(deq);$

$$sol := 7\ln\left(-\frac{8 + y(x) + 7x}{x+1}\right) - 8\ln\left(\frac{-y(x) + x}{x+1}\right) - \ln(x+1) - \_C1 = 0 \tag{6}$$

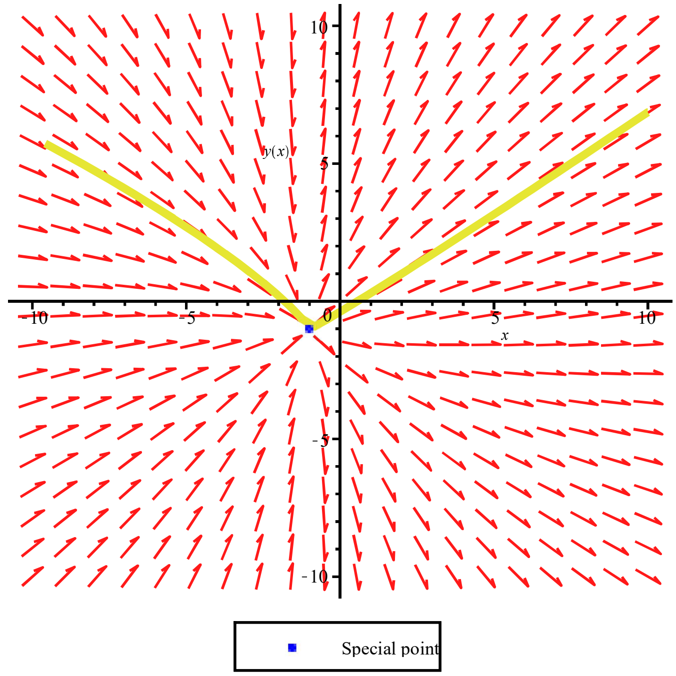
> $sol := simplify(\exp(lhs(sol))) = simplify(\exp(rhs(sol)));$

$$sol := -\frac{(8 + y(x) + 7x)^{7}\,\mathrm{e}^{-\_C1}}{(y(x) - x)^{8}} = 1 \tag{7}$$

> $isolate(sol, y(x));$

$$\frac{(8 + y(x) + 7x)^{7}}{(y(x) - x)^{8}} = -\frac{1}{\mathrm{e}^{-\_C1}} \tag{8}$$

> $plot1 := DEtools[DEplot](deq, y(x), x=-10..10, y=-10..10, [y(2)=1]):$
$plot2 := plots[pointplot]([-1,-1], symbol=solidcircle, color=blue, symbolsize=10, legend$
$="\text{Special point}"):$
$plots[display](plot1, plot2)$



> ***#Характеристическое уравнение***

> $M := Matrix([[7-\lambda, 57], [63, 1-\lambda]]);$

$$M := \begin{bmatrix} 7-\lambda & 57 \\ 63 & 1-\lambda \end{bmatrix} \quad \textbf{(9)}$$

> $solve(LinearAlgebra[Determinant](M) = 0);$

$$64, -56 \quad \textbf{(10)}$$

> *#λ_1 >0, λ_2 <0 ⇒ Точка покоя неустойчива, седло*

> *restart*;

>

> ***#Задание 4***

> $deq := diff(y(x), x) \cdot x + y(x) = y^2(x) \cdot \ln(x) :$

> $sol := dsolve(deq);$

$$sol := y(x) = \frac{1}{1 + \_C1\, x + \ln(x)} \quad \textbf{(11)}$$

> $y := rhs(sol);$

$$y := \frac{1}{1 + \_C1\, x + \ln(x)} \quad \textbf{(12)}$$

> $eq := 1 = subs(x = 1, y);$

$$eq := 1 = \frac{1}{1 + \_C1 + \ln(1)} \quad \textbf{(13)}$$

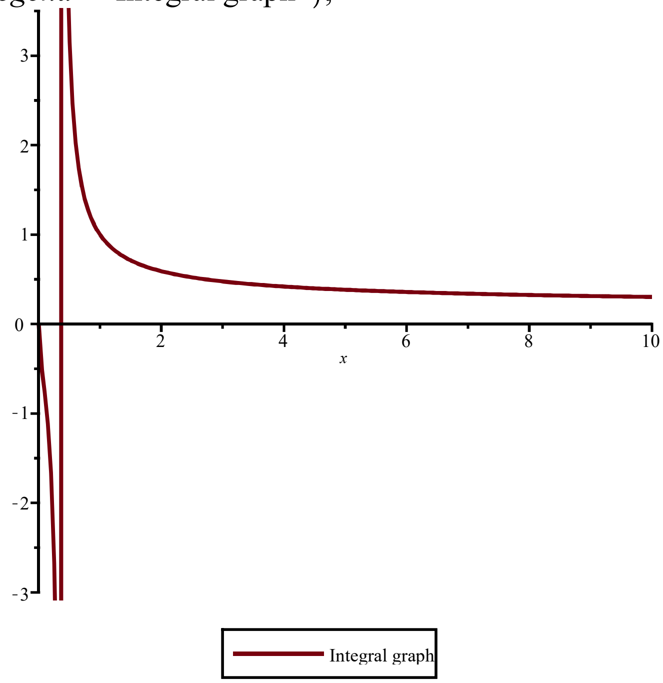
> $\_C1 := solve(eq, \_C1);$

$$\_C1 := 0 \quad \textbf{(14)}$$

> $koshi\_sol := subs(\_C1 = \_C1, y);$

$$koshi\_sol := \frac{1}{\ln(x) + 1} \quad \textbf{(15)}$$

> $plot(koshi\_sol, x, legend = \text{"Integral graph"});$



> $restart;$

>

> ***#Задание 5***

> ***#1)***

> $deq := x = diff(y(x), x)\cdot\sinh(diff(y(x), x)) - \cosh(diff(y(x), x)):$

> $sol := dsolve(deq, y(x));$

$$sol := y(x) = \int RootOf(-x + \_Z\sinh(\_Z) - \cosh(\_Z))\,\mathrm{d}x + \_C1 \quad \textbf{(16)}$$

> *#RootOf означает, что полученное выражение не имеет элементарного решения. Чтобы получить его, необходимо ввести параметр: y'=t*

> *#Тогда*

$x := t\cdot\sinh(t) - \cosh(t);$

$dx := diff(x, t)\cdot dt:$

$dy := t\cdot dx:$

$y := int(t * diff(x, t), t) + C;$

$$x := t\sinh(t) - \cosh(t)$$

$$y := t^2\sinh(t) - 2\,t\cosh(t) + 2\sinh(t) + C \quad \textbf{(17)}$$

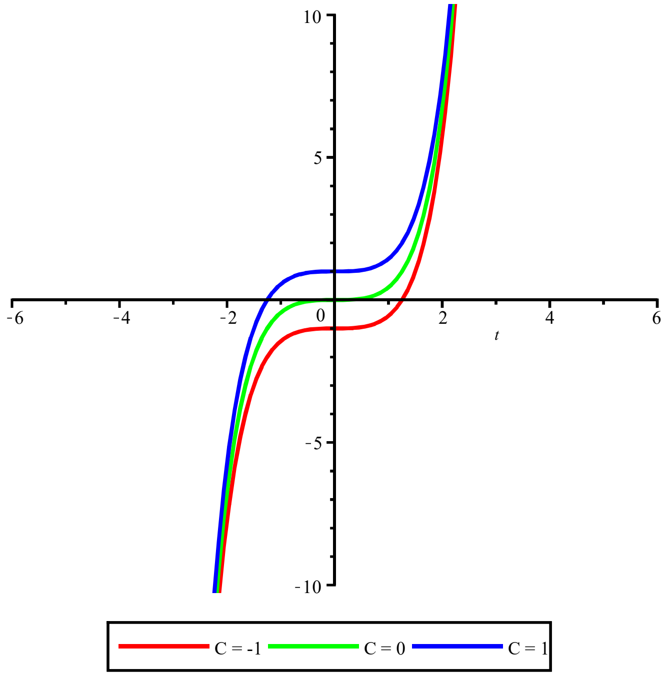
#График

> $plot\_1 := plot(subs(C = -1, y), view = [-6..6, -10..10], legend = \text{"C = -1"}, color = red):$

> $plot\_2 := plot(subs(C = 0, y), view = [-6..6, -10..10], legend = \text{"C = 0"}, color = green):$

> $plot\_3 := plot(subs(C = 1, y), view = [-6..6, -10..10], legend = \text{"C = 1"}, color = blue):$

> $plots[display](plot\_1, plot\_2, plot\_3);$



> *restart*;

>

> **#2)**

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

$sol := dsolve(deq, y(x));$

$$sol := y(x) = \frac{\left(3\,\mathrm{LambertW}\left(-\frac{4\,(\_C1 - x)}{\mathrm{e}}\right) + 1\right) \mathrm{e}^{\frac{3\,\mathrm{LambertW}\left(-\frac{4\,(\_C1 - x)}{\mathrm{e}}\right)}{2} + \frac{1}{2}}}{18} \tag{18}$$

> *#Функция LambertW(x) - это W-функция Ламберта, которая используется системой Maplesoft Maple, когда невозможно найти решение уравнения в виде уонечного числа элементарных функий. Поэтому, чтобы найти такое решение, необходимо ввести параметр: y'=t. Тогда*

> $dy := t \cdot dx:$

$y(t) := \frac{1}{9} \cdot t^3 \cdot (3 \cdot \ln(t) - 1):$

> $dy := diff(y(t), t):$

$dx := \frac{dy}{t}:$

> $x := int\left(\frac{dy}{t}, t\right) + C;$

$dx := diff(x, t):$

$y := int(t \cdot dx, t);$

$$x := \frac{t^2 \ln(t)}{2} - \frac{t^2}{4} + C \tag{19}$$

$$y := \frac{t^3 \ln(t)}{3} - \frac{t^3}{9} \qquad \textbf{(19)}$$

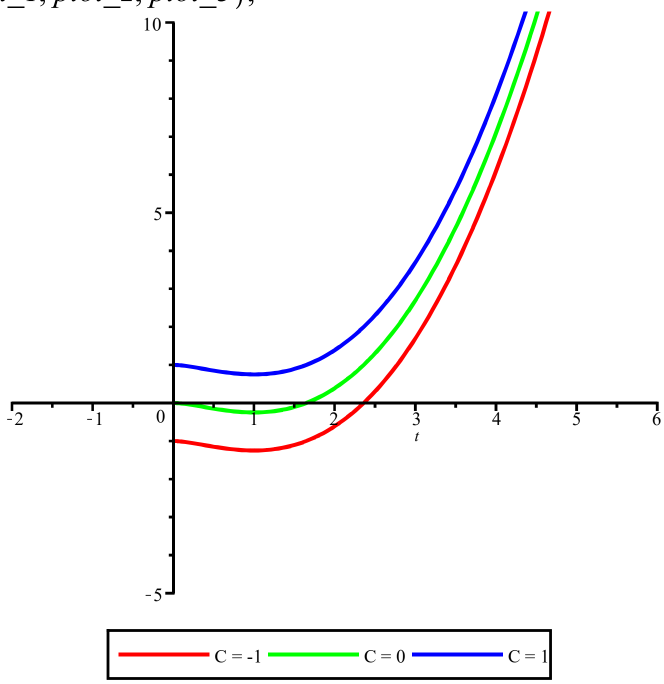
#График

> $plot\_1 := plot(subs(C=-1, x), view=[-2..6, -5..10], legend="C = -1", color=red):$

> $plot\_2 := plot(subs(C=0, x), view=[-2..6, -5..10], legend="C = 0", color=green):$

> $plot\_3 := plot(subs(C=1, x), view=[-2..6, -5..10], legend="C = 1", color=blue):$

> $plots[display](plot\_1, plot\_2, plot\_3);$



> $restart;$

>

> ***#Задание 6***

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

> $sol := dsolve(deq, y(x));$

$$sol := y(x) = -\frac{x^2}{8} - 3, y(x) = 2\_C1^2 + x\_C1 - 3 \qquad \textbf{(20)}$$

> $sol\_1 := rhs(sol[1]);$ #special

$$sol\_1 := -\frac{x^2}{8} - 3 \qquad \textbf{(21)}$$

> $sol\_2 := rhs(sol[2]);$ #common

$$sol\_2 := 2\_C1^2 + x\_C1 - 3 \qquad \textbf{(22)}$$

#График

> $\_C1 := -3:$
$plotC1\_1 := plot(sol\_2, x, legend=["\_C1 = -3"], color=red):$

> $\_C1 := -2:$

$plotC1\_2 := plot(sol\_2, x, legend = ["\_C1 = -2"], color = orange):$

> $\_C1 := -1:$
> $plotC1\_3 := plot(sol\_2, x, legend = ["\_C1 = -1"], color = yellow):$

> $\_C1 := 0:$
> $plotC1\_4 := plot(sol\_2, x, legend = ["\_C1 = 0"], color = green):$

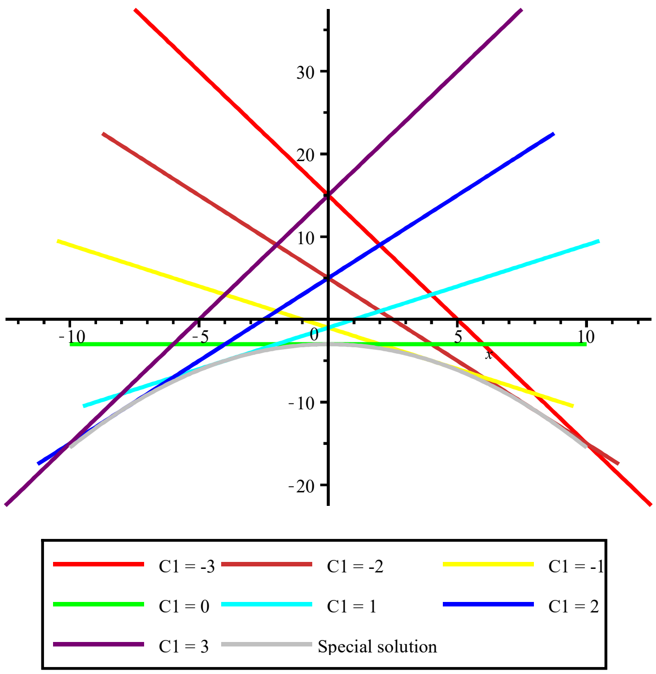
> $\_C1 := 1:$
> $plotC1\_5 := plot(sol\_2, x, legend = ["\_C1 = 1"], color = cyan):$

> $\_C1 := 2:$
> $plotC1\_6 := plot(sol\_2, x, legend = ["\_C1 = 2"], color = blue):$

> $\_C1 := 3:$
> $plotC1\_7 := plot(sol\_2, x, legend = ["\_C1 = 3"], color = purple):$

> $plot\_special := plot(sol\_1, x, legend = ["Special solution"], color = gray):$

> $plots[display](plotC1\_1, plotC1\_2, plotC1\_3, plotC1\_4, plotC1\_5, plotC1\_6, plotC1\_7, plot\_special);$



> *restart*;

>

> ***#Задание 7***

#1

> $deq := x = y'' \cdot \exp(y''):$
> $sol := dsolve(deq, y(x));$

$$sol := y(x) = \frac{x^2}{8\,\mathrm{LambertW}(x)^2} + \frac{3\,x^2}{4\,\mathrm{LambertW}(x)} - \frac{3\,x^2}{4} + \frac{\mathrm{LambertW}(x)\,x^2}{2} + \_C1\,x + \_C2 \qquad \mathbf{(6.1)}$$

> *#Функция LambertW(x) - это W-функция Ламберта, которая используется системой Maplesoft Maple, когда невозможно найти решение уравнения в виде уонечного числа элементарных функий. Поэтому, чтобы найти такое решение, необходимо сделать*

замену y''=t. Тогда

> $dy' := t;$
$deq\_new := subs(y''=t, deq);$

$$\frac{d}{dx}\, dy(x) := t$$

$$deq\_new := x = t\,e^{t} \tag{6.2}$$

> $dx\_dt := diff(rhs(deq\_new), t); \quad \# \frac{dx}{dt}$

$$dx\_dt := e^{t} + t\,e^{t} \tag{6.3}$$

> $dy\_1\_dx := t \cdot dx\_dt; \quad \# \frac{dy'}{dx}$

$$dy\_1\_dx := t\left(e^{t} + t\,e^{t}\right) \tag{6.4}$$

> $y\_1 := int(dy\_1\_dx, t) + C\_1; \quad \#y'$

$$y\_1 := e^{t}\left(t^{2} - t + 1\right) + C\_1 \tag{6.5}$$

> $dy\_dx := y\_1 \cdot dx\_dt; \quad \# \frac{dy}{dx}$

$$dy\_dx := \left(e^{t}\left(t^{2} - t + 1\right) + C\_1\right)\left(e^{t} + t\,e^{t}\right) \tag{6.6}$$

> $y := simplify(int(dy\_dx, t) + C\_2);$

$$y := \frac{\left(4\,t^{3} - 6\,t^{2} + 6\,t + 1\right) e^{2\,t}}{8} + C\_1\,e^{t}\,t + C\_2 \tag{6.7}$$

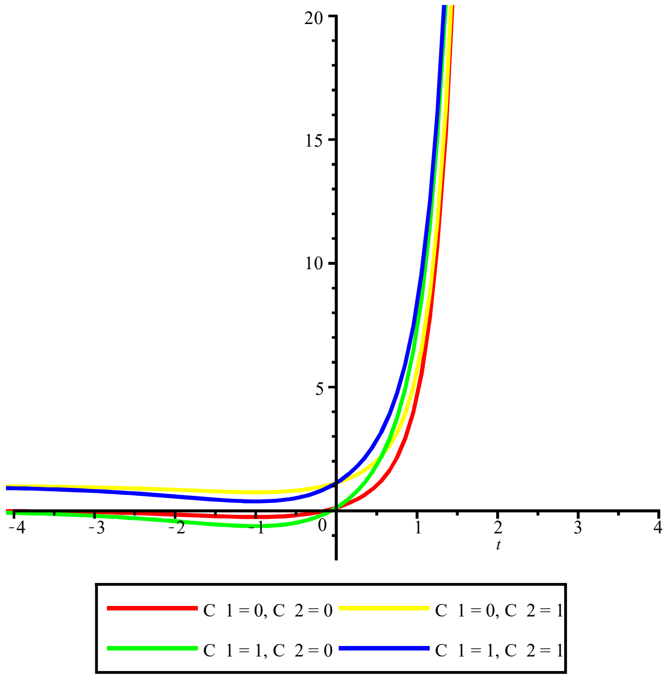
> plot_1 := plot(subs(C_1 = 0, C_2 = 0, y), view = [-4..4, -2..20], legend = "C_1 = 0, C_2 = 0", color = red) :

> plot_2 := plot(subs(C_1 = 0, C_2 = 1, y), view = [-4..4, -2..20], legend = "C_1 = 0, C_2 = 1", color = yellow) :

> plot_3 := plot(subs(C_1 = 1, C_2 = 0, y), view = [-4..4, -2..20], legend = "C_1 = 1, C_2 = 0", color = green) :

> plot_4 := plot(subs(C_1 = 1, C_2 = 1, y), view = [-4..4, -2..20], legend = "C_1 = 1, C_2 = 1", color = blue) :

> plots[display](plot_1, plot_2, plot_3, plot_4);



> *restart*;

#2

> $deq := \sin(x)\cdot\left(y\cdot y'' - (y')^2\right) = 2\cdot y\cdot y'\cdot\cos(x)$:
$sol := dsolve(deq, y(x))$;

$$sol := y(x) = \mathrm{e}^{\frac{\_C1\, x}{2}}\, \mathrm{e}^{-\frac{\_C1 \sin(2x)}{4}}\, \_C2 \qquad \textbf{(7.1)}$$

> $y := rhs(sol)$;

$$y := \mathrm{e}^{\frac{\_C1\, x}{2}}\, \mathrm{e}^{-\frac{\_C1 \sin(2x)}{4}}\, \_C2 \qquad \textbf{(7.2)}$$

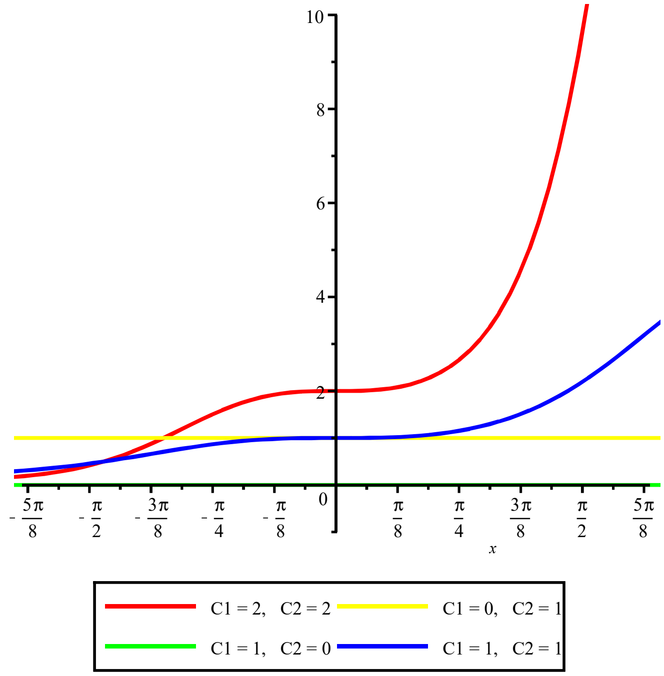
> *plot_1* := *plot*(*subs*(_C1 = 2, _C2 = 2, *y*), *view* = [-2 ..2, -1 ..10], *legend* = "_C1 = 2, _C2 = 2", *color* = *red*) :

> *plot_2* := *plot*(*subs*(_C1 = 0, _C2 = 1, *y*), *view* = [-2 ..2, -1 ..10], *legend* = "_C1 = 0, _C2 = 1", *color* = *yellow*) :

> *plot_3* := *plot*(*subs*(_C1 = 1, _C2 = 0, *y*), *view* = [-2 ..2, -1 ..10], *legend* = "_C1 = 1, _C2 = 0", *color* = *green*) :

> *plot_4* := *plot*(*subs*(_C1 = 1, _C2 = 1, *y*), *view* = [-2 ..2, -1 ..10], *legend* = "_C1 = 1, _C2 = 1", *color* = *blue*) :

> *plots*[*display*](*plot_1*, *plot_2*, *plot_3*, *plot_4*);



> *restart*;

>

#3

> $deq := y'' \cdot \left(1 + x^2\right) \cdot \arctan(x) = y'$:
$sol := dsolve(deq, y(x))$;

$$sol := y(x) = \_C1 + \left(x \arctan(x) - \frac{\ln\left(x^2 + 1\right)}{2}\right) \_C2 \quad \textbf{(8.1)}$$

> $y := rhs(sol)$;

$$y := \_C1 + \left(x \arctan(x) - \frac{\ln\left(x^2 + 1\right)}{2}\right) \_C2 \quad \textbf{(8.2)}$$

> *plot_1* := *plot*(*subs*(_C1 = 0, _C2 = 0, *y*), *view* = [-2 ..2, -1 ..5], *legend* = "_C1 = 2, _C2 = 2", *color* = *red*) :

> *plot_2* := *plot*(*subs*(_C1 = 0, _C2 = 1, *y*), *view* = [-2 ..2, -1 ..5], *legend* = "_C1 = 0, _C2 = 1", *color* = *yellow*) :

> *plot_3* := *plot*(*subs*(_C1 = 1, _C2 = 0, *y*), *view* = [-2 ..2, -1 ..5], *legend* = "_C1 = 1, _C2 = 0", *color* = *green*) :

> *plot_4* := *plot*(*subs*(_C1 = 1, _C2 = 1, *y*), *view* = [-2 ..2, -1 ..5], *legend* = "_C1 = 1, _C2 = 1", *color* = *blue*) :

> *plots*[*display*](*plot_1*, *plot_2*, *plot_3*, *plot_4*);

> *restart*;

#4

> $deq := y'' - \frac{y'}{x} + \frac{y}{x^2} = 9 \cdot x^2 \cdot \ln(x) + 3 \cdot x^2$:
$sol := dsolve(deq, y(x))$;

$$sol := y(x) = x\_C1\ln(x) + x\_C2 + \frac{x^4(3\ln(x) - 1)}{3} \quad \textbf{(9.1)}$$

> $y := rhs(sol);$

$$y := x\_C1\ln(x) + x\_C2 + \frac{x^4(3\ln(x) - 1)}{3} \quad \textbf{(9.2)}$$

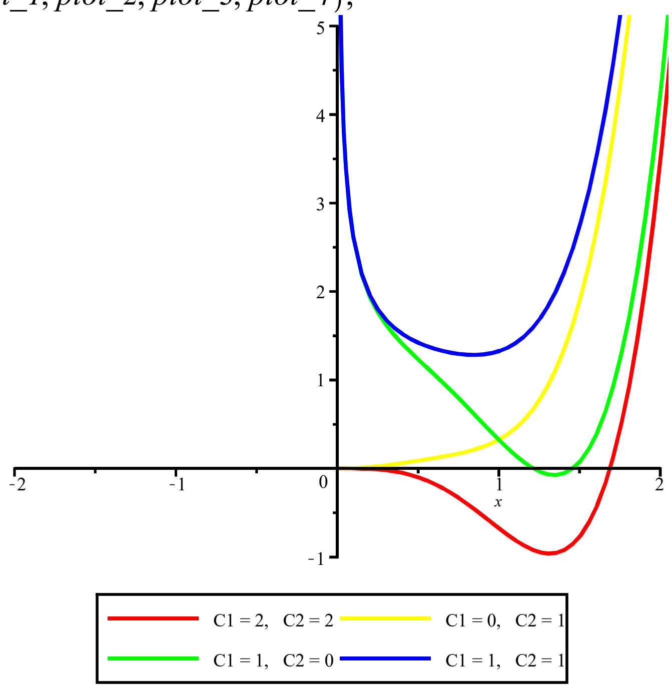
> plot_1 := plot(subs(_C1 = 0, _C2 = 0, y), view = [-2..2, -1..5], legend = "_C1 = 2, _C2 = 2", color = red) :

> plot_2 := plot(subs(_C1 = 0, _C2 = 1, y), view = [-2..2, -1..5], legend = "_C1 = 0, _C2 = 1", color = yellow) :

> plot_3 := plot(subs(_C1 = 1, _C2 = 0, y), view = [-2..2, -1..5], legend = "_C1 = 1, _C2 = 0", color = green) :

> plot_4 := plot(subs(_C1 = 1, _C2 = 1, y), view = [-2..2, -1..5], legend = "_C1 = 1, _C2 = 1", color = blue) :

> plots[display](plot_1, plot_2, plot_3, plot_4);



> restart;

>

> **#Задание 8**

> $deq := \tan(x)\cdot y''' = 2\cdot y''$:
$sol := dsolve(deq, y(x));$

$$sol := y(x) = -\frac{\_C1\left(-x^2 - \frac{\cos(2x)}{2}\right)}{4} + \_C2\,x + \_C3 \quad \textbf{(23)}$$

> restart;

>

> **#Задание 9**

> $deq := y'' + 6\cdot y' + 13\cdot y = \exp(-3\cdot x)\cdot\cos(4\cdot x);$
$sol := dsolve(deq, y(x));$

$$deq := \frac{d^2}{dx^2}\, y(x) + 6\, \frac{d}{dx}\, y(x) + 13\, y(x) = e^{-3x} \cos(4\, x)$$

$$sol := y(x) = e^{-3x} \sin(2\, x)\, \_C2 + e^{-3x} \cos(2\, x)\, \_C1 - \frac{e^{-3x} \cos(4\, x)}{12} \quad \textbf{(24)}$$

> *restart*;

>

> ***#Задание 10***

> $sys := \{y1' = -3\cdot y1 + y2, y2' = 2\cdot y2\};$

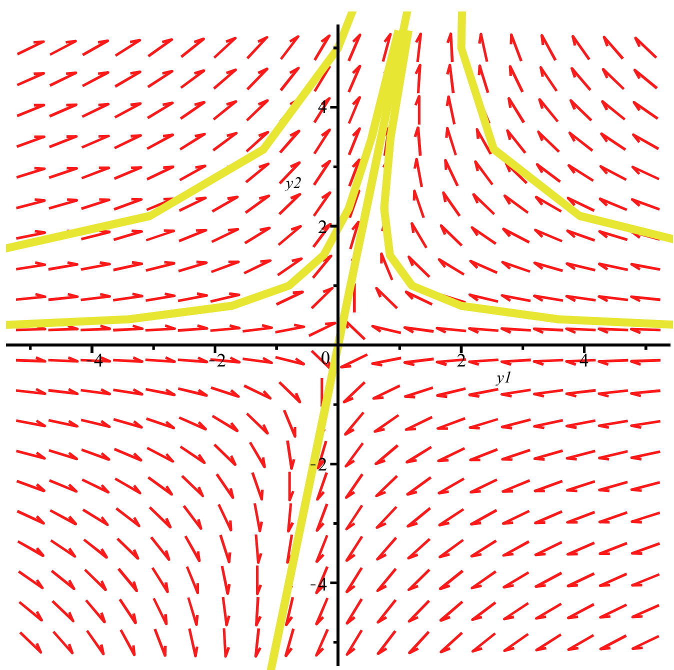
$$sys := \left\{ \frac{d}{dx}\, y1(x) = -3\, y1(x) + y2(x),\ \frac{d}{dx}\, y2(x) = 2\, y2(x) \right\} \quad \textbf{(25)}$$

#Фазовый портрет

> $sol := dsolve(sys);$

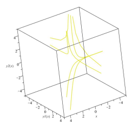
$$sol := \left\{ y1(x) = \frac{\_C2\, e^{2x}}{5} + \_C1\, e^{-3x},\ y2(x) = \_C2\, e^{2x} \right\} \quad \textbf{(10.1)}$$

> $DETools[phaseportrait]\left([sys[1], sys[2]], [y1(x), y2(x)], x = -5 .. 5, \left[\left[0, \frac{1}{5}, 1\right], \left[0, -\frac{1}{5}, -1\right], [0, 1, 5], [0, -1, -5], \left[0, \frac{6}{5}, 1\right], [0, 2, 5], \left[0, -\frac{4}{5}, 1\right], [0, 0, 5] \right], y1 = -5 .. 5, y2 = -5 .. 5 \right);$



#Пространственные кривые

$> DETools[DEplot3d]\left([sys[1], sys[2]], [y1(x), y2(x)], x = -5 .. 5, \left[\left[0, \frac{1}{5}, 1\right], \left[0, -\frac{1}{5}, -1\right], [0, 1, 5], [0, -1, -5], \left[0, \frac{6}{5}, 1\right], [0, 2, 5], \left[0, -\frac{4}{5}, 1\right], [0, 0, 5]\right], y1 = -5 .. 5, y2 = -5 .. 5\right);$



$> A := Matrix([[-3 - \lambda, 1], [0, 2 - \lambda]]) :$

$> values := solve(A[1, 1] \cdot A[2, 2] = 0);$

$$values := -3, 2 \tag{26}$$

> #Т. к. одно собственное значение матрицы < 0 , а второе - > 0, то точка покоя неустойчива и является седлом.

$> sol := dsolve(sys);$

$$sol := \left\{ y1(x) = \frac{\_C2\, e^{2x}}{5} + \_C1\, e^{-3x}, y2(x) = \_C2\, e^{2x} \right\} \tag{27}$$

>

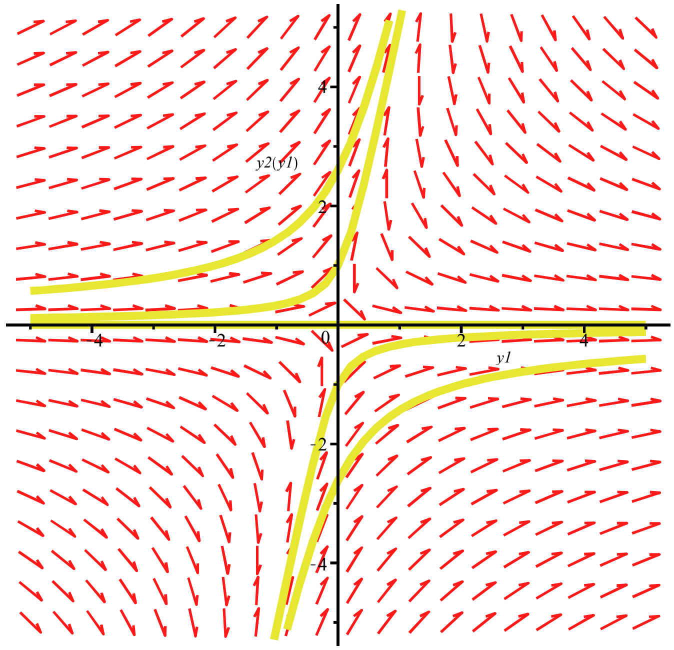
#Поле направлений функции y2(y1)

$> dfe := diff(y2(y1), y1) = \frac{2 \cdot y2}{-3 \cdot y1 + y2};$

$$dfe := \frac{d}{dy1}\, y2(y1) = \frac{2\, y2}{-3\, y1 + y2} \tag{12.1}$$

> $DETools[DEplot](dfe, y2(y1), y1=-5..5, y2=-5..5, [y2(0)=1, y2(-1)=0, y2(1)=0, y2(0)=-1, y2(2)=-1, y2(-2)=1]);$

Warning, y2 is present as both a dependent variable and a name. Inconsistent specification of the dependent variable is deprecated, and it is assumed that the name is being used in place of the dependent variable.



> $restart;$

>

> ***#Задание 11***

> $sys := \{y1' = 5 \cdot y1 + 2 \cdot y2, y2' = -9 \cdot y1 - 6 \cdot y2\};$

$$sys := \left\{ \frac{d}{dx}\, y1(x) = 5\, y1(x) + 2\, y2(x),\ \frac{d}{dx}\, y2(x) = -9\, y1(x) - 6\, y2(x) \right\} \quad \textbf{(28)}$$

> $sol := dsolve(sys, \{y1(x), y2(x)\});$

$$sol := \left\{ y1(x) = \_C1\, e^{-4x} + \_C2\, e^{3x},\ y2(x) = -\frac{9\,\_C1\, e^{-4x}}{2} - \_C2\, e^{3x} \right\} \quad \textbf{(29)}$$

> $restart;$

>

> ***#Задание 12***

> $sys := \{y1' = y1 + y2, y2' = 4 \cdot y1 + y2 + 1\};$

$$sys := \left\{ \frac{d}{dx}\, y1(x) = y1(x) + y2(x),\ \frac{d}{dx}\, y2(x) = 4\, y1(x) + y2(x) + 1 \right\} \quad \textbf{(30)}$$

> $sol := dsolve(sys, \{y1(x), y2(x)\});$

$$sol := \left\{ y1(x) = e^{3x}\,\_C2 + e^{-x}\,\_C1 - \frac{1}{3},\ y2(x) = 2\, e^{3x}\,\_C2 - 2\, e^{-x}\,\_C1 + \frac{1}{3} \right\} \quad \textbf{(31)}$$

> $DEtools[DEplot](sys, [y1(x), y2(x)], x = 0 .. 10, y1 = -2 .. 2, y2 = -2 .. 2, arrows = line):$

> $sol\_y1 := rhs(sol[1]):$

> $sol\_y2 := rhs(sol[2]):$

```
> koshi_deq_y1 := simplify(subs(x = 0, sol_y1 = 1)) :
> koshi_deq_y2 := simplify(subs(x = 0, sol_y2 = 0)) :
> koshi_sys := {koshi_deq_y1, koshi_deq_y2};
```

$$koshi\_sys := \left\{\_C2 + \_C1 - \frac{1}{3} = 1, 2\,\_C2 - 2\,\_C1 + \frac{1}{3} = 0\right\} \quad \textbf{(32)}$$

```
> koshi_sol := solve(koshi_sys, {_C1, _C2});
```

$$koshi\_sol := \left\{\_C1 = \frac{3}{4}, \_C2 = \frac{7}{12}\right\} \quad \textbf{(33)}$$

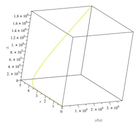
```
> koshi_sol_y1 := subs({_C1 = 3/4, _C2 = 7/12}, sol_y1);
  koshi_sol_y2 := subs({_C1 = 3/4, _C2 = 7/12}, sol_y2);
```

$$koshi\_sol\_y1 := \frac{7\,e^{3x}}{12} + \frac{3\,e^{-x}}{4} - \frac{1}{3}$$

$$koshi\_sol\_y2 := \frac{7\,e^{3x}}{6} - \frac{3\,e^{-x}}{2} + \frac{1}{3} \quad \textbf{(34)}$$

#Чертеж

```
> with(DEtools) :
  DEplot3d(sys, [y1(x), y2(x)], x = 0 .. 5, [[y1(0) = 1, y2(0) = 0]]);
```



> *restart*;