```
> # Лабортаорная работа 3.2. Обыкновенные дифференциальные уравнения высших порядков
> # Выполнил студент группы 153503 Киселёва Е.А.
> # Вариант 9

> restart;
  # Задание 1.
  # Решите уравнения и сравните с результатами, полученными в Maple
    . Постройте в одной системе координат несколько интегральных кривых.
  # ПЕРВАЯ ЧАСТЬ
  # 1.9.1. x=y''e^(y'')

> # y'' = p
  x1 := p→p· e^p;
  D(%);
  D(%) ;
  dx = e^p· dp + e^p·p·dp;
  dx^2 = e^p·dp^2 + e^p·dp^2 + e^p·p·dp^2;
  dx^2/dp^2 = 2·e^p + e^p·p;
  dsolve(rhs(%)·p = d^2/dp^2 y(p)) :
  y1 := rhs(%);
```

$$x1 := p \rightarrow p\, e^{p}$$

$$p \rightarrow e^{p} + p\, e^{p}$$

$$p \rightarrow 2\, e^{p} + p\, e^{p}$$

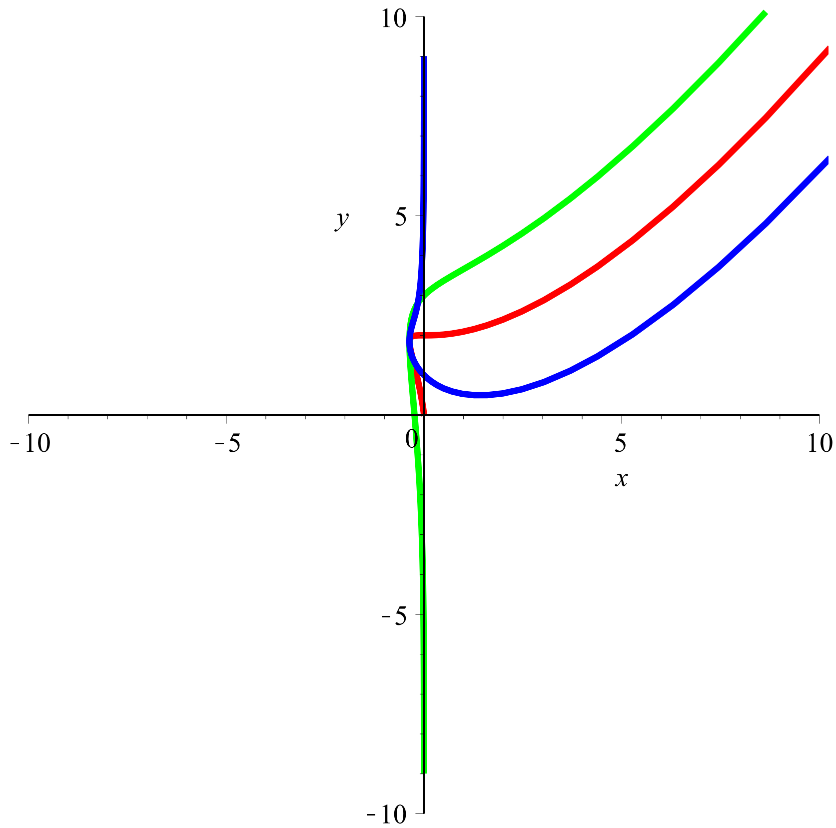
$$dx = e^{p}\, dp + e^{p}\, p\, dp$$

$$dx^{2} = 2\, e^{p}\, dp^{2} + e^{p}\, p\, dp^{2}$$

$$\frac{dx^{2}}{dp^{4}} = 2\, e^{p} + e^{p}\, p$$

$$y1 := \left(p^{2} - 2\, p + 2\right) e^{p} + \_C1\, p + \_C2 \qquad \textbf{(1)}$$

```
> p1 := plot([x1(p), subs(_C1 = 0, _C2 = 0, y1(p)), p = -10..10], x = -10..10, y = -10..10,
      thickness = 3, color = red) :
  p2 := plot([x1(p), subs(_C1 = 1, _C2 = 1, y1(p)), p = -10..10], x = -10..10, y = -10..10,
      thickness = 3, color = green) :
  p3 := plot([x1(p), subs(_C1 = -1, _C2 = -1, y1(p)), p = -10..10], x = -10..10, y = -10..10,
      thickness = 3, color = blue) :
  plots[display](p1, p2, p3)
```



> *restart*;

 # ВТОРАЯ ЧАСТЬ
 # 1.9.2. sin(x)$\cdot(y\cdot y''$-$y'^2)=2\,yy'\cdot\cos(x)$

$\sin(x)\cdot\left(y\cdot y''-(y')^2\right)=2\cdot y\cdot y'\cdot\cos(x)$;
dsolve(%);
solution := *rhs*(%)

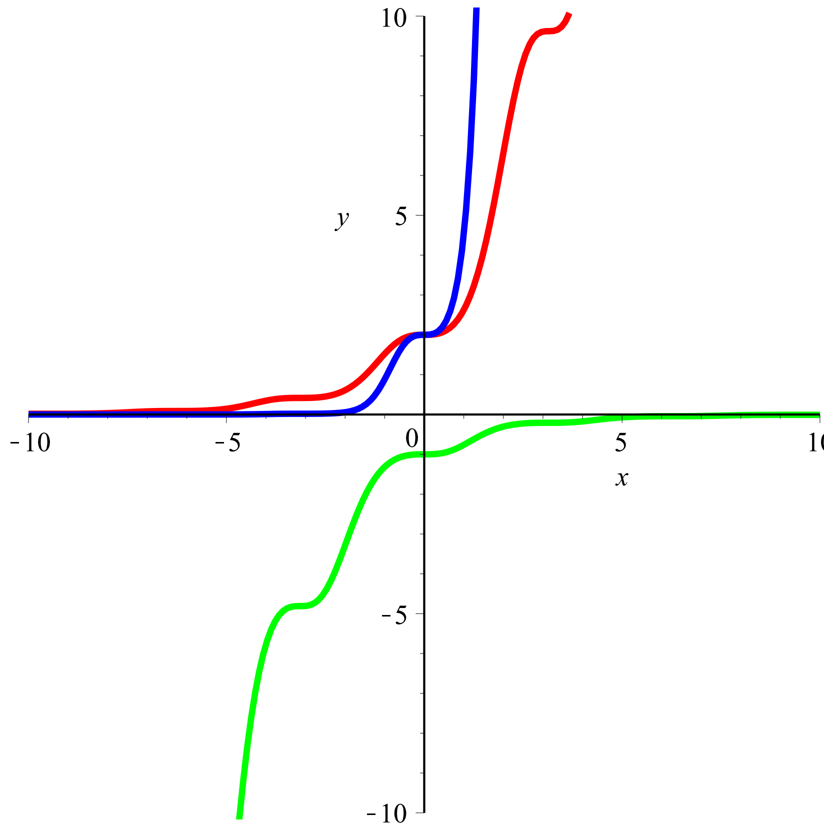
$$\sin(x)\left(y(x)\left(\frac{d^2}{dx^2}\,y(x)\right)-\left(\frac{d}{dx}\,y(x)\right)^2\right)=2\,y(x)\left(\frac{d}{dx}\,y(x)\right)\cos(x)$$

$$y(x)=e^{\frac{1}{2}\_C1\,x}\,e^{-\frac{1}{4}\_C1\sin(2x)}\,\_C2$$

$$solution:=e^{\frac{1}{2}\_C1\,x}\,e^{-\frac{1}{4}\_C1\sin(2x)}\,\_C2 \tag{2}$$

> *p1* := *plot*(*subs*(_C1 = 1, _C2 = 2, *solution*(x)), x = -10 ..10, y = -10 ..10, *thickness* = 3, *color* = *red*) :
p2 := *plot*(*subs*(_C1 = -1, _C2 = -1, *solution*(x)), x = -10 ..10, y = -10 ..10, *thickness* = 3, *color*

$= green)$:
$p3 := plot(subs(\_C1 = 3, \_C2 = 2, solution(x)), x = -10..10, y = -10..10, thickness = 3, color = blue)$:
$plots[display](p1, p2, p3);$



> $restart;$

\# ТРЕТЬЯ ЧАСТЬ
\# 1.9.3. y''(1+x·x)arctgx=y'

$(y'') \cdot (1 + x^2) \cdot \arctan(x) = y';$
$dsolve(\%);$
$solution := rhs(\%);$

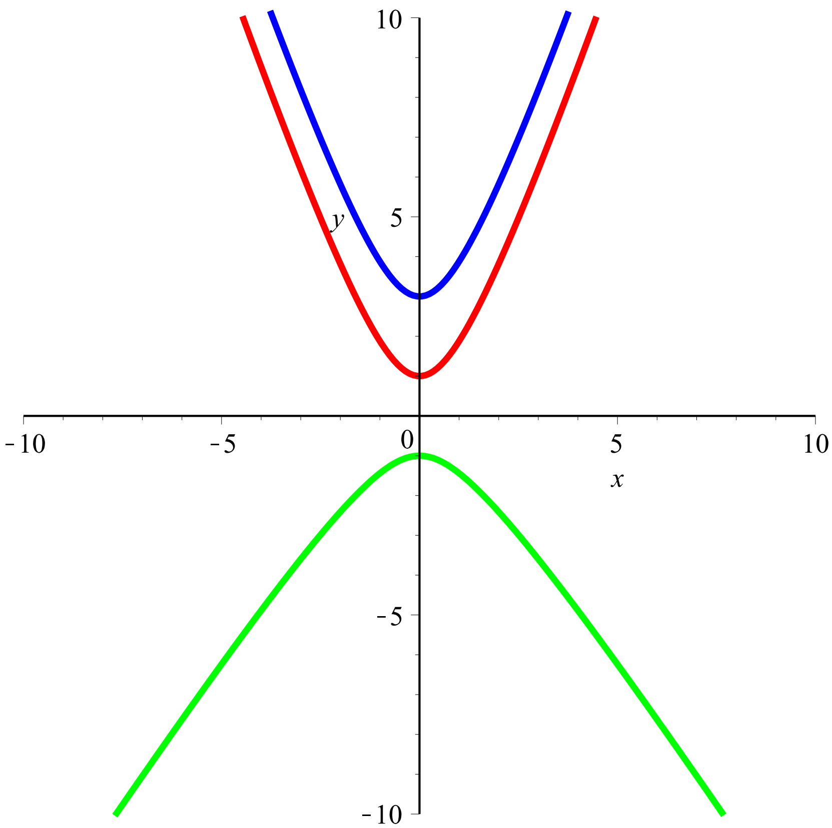
$$\left(\frac{d^2}{dx^2} y(x)\right)(x^2 + 1) \arctan(x) = \frac{d}{dx} y(x)$$

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

(3)

$$solution := \_C1 + \left(x \arctan(x) - \frac{1}{2}\ln\left(x^2+1\right)\right)\_C2 \tag{3}$$

> $p1 := plot(subs(\_C1 = 1, \_C2 = 2, solution(x)), x = -10..10, y = -10..10, thickness = 3, color = red):$
> $p2 := plot(subs(\_C1 = -1, \_C2 = -1, solution(x)), x = -10..10, y = -10..10, thickness = 3, color = green):$
> $p3 := plot(subs(\_C1 = 3, \_C2 = 2, solution(x)), x = -10..10, y = -10..10, thickness = 3, color = blue):$
> $plots[display](p1, p2, p3);$



> restart;

ЧЕТВЕРТАЯ ЧАСТЬ
1.9.4 y''-y':x+y:x:x=ex(1+x)

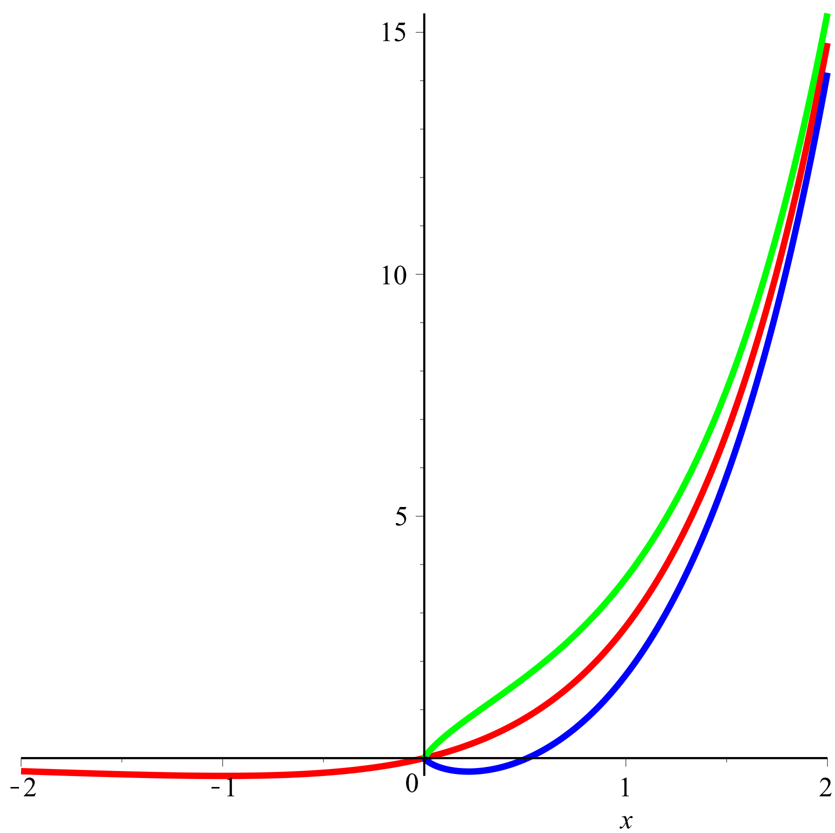
$y'' - \frac{y'}{x} + \frac{y}{x^2} = e^x \cdot (1 + x);$
$dsolve(\%);$
$solution := rhs(\%);$

$$\frac{d^2}{dx^2}\,y(x) - \frac{\frac{d}{dx}\,y(x)}{x} + \frac{y(x)}{x^2} = e^x\,(1+x)$$

$$y(x) = \ln(x)\,\_C1\,x + x\,e^x + \_C2\,x$$

$$solution := \ln(x)\,\_C1\,x + x\,e^x + \_C2\,x \qquad \textbf{(4)}$$

> *p1* := *plot*(*subs*(_C1 = 0, _C2 = 0, *solution*(*x*)), *x* = −2 ..2, *thickness* = 3, *color* = *red*, *discont* = *true*) :
p2 := *plot*(*subs*(_C1 = −1, _C2 = 1, *solution*(*x*)), *x* = −2 ..2, *thickness* = 3, *color* = *green*, *discont* = *true*) :
p3 := *plot*(*subs*(_C1 = 1, _C2 = −1, *solution*(*x*)), *x* = −2 ..2, *thickness* = 3, *color* = *blue*, *discont* = *true*) :
plots[*display*](*p1*, *p2*, *p3*);



> *restart*;
 # Задание 2.
 # Найдите общее решение уравнения и *сравните* с *результатом, полученным* в *системе Maple*
 # 2.9. tgx·y'''=2y''
tan(*x*)·*y*'''= 2·*y*'';
dsolve(%);

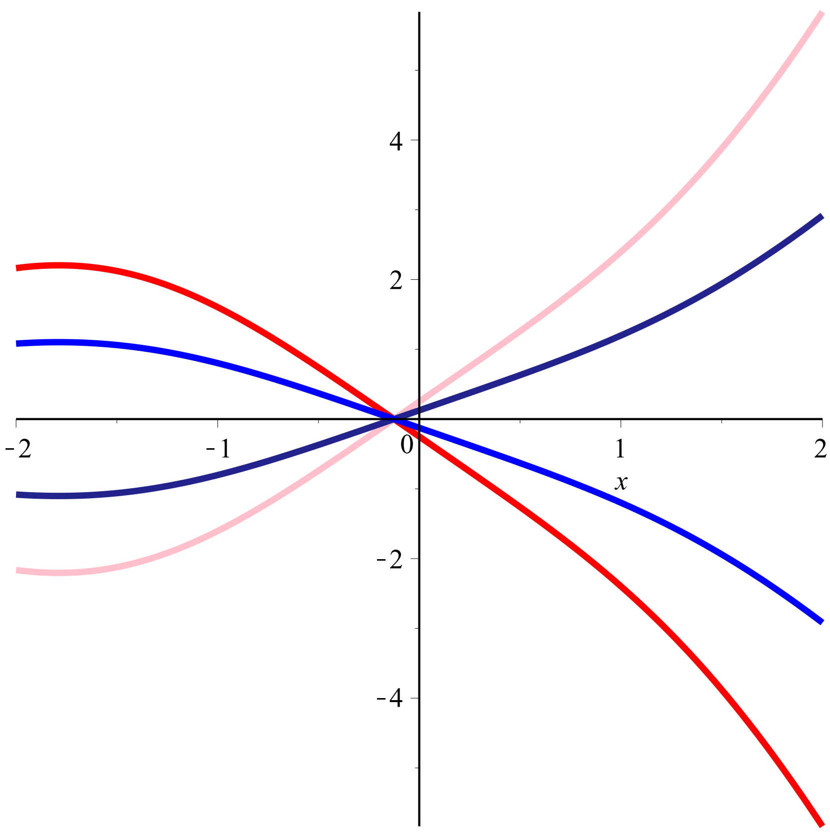
$solution := rhs(\%);$

$$\tan(x)\left(\frac{d^3}{dx^3}y(x)\right)=2\left(\frac{d^2}{dx^2}y(x)\right)$$

$$y(x)=\frac{1}{8}\_C1\cos(2x)+\frac{1}{4}\_C1x^2+\_C2x+\_C3$$

$$solution := \frac{1}{8}\_C1\cos(2x)+\frac{1}{4}\_C1x^2+\_C2x+\_C3 \quad \textbf{(5)}$$

```
> p1 := plot(subs(_C1 = -2, _C2 = -2, _C3 = 0, solution(x)), x = -2 ..2, thickness = 3, color = red,
      discont = true) :
  p2 := plot(subs(_C1 = 2, _C2 = 2, _C3 = 0, solution(x)), x = -2 ..2, thickness = 3, color = pink,
      discont = true) :
  p3 := plot(subs(_C1 = 1, _C2 = 1, _C3 = 0, solution(x)), x = -2 ..2, thickness = 3, color = navy,
      discont = true) :
  p4 := plot(subs(_C1 = -1, _C2 = -1, _C3 = 0, solution(x)), x = -2 ..2, thickness = 3, color = blue,
      discont = true) :
  plots[display](p1, p2, p3, p4);
```




```
> restart;
  # Задание 3.
```

Найдите общее решение дифференциального уравнения.
3.9. $y''+6y'+13y=e^{-3x}\cos 4x$

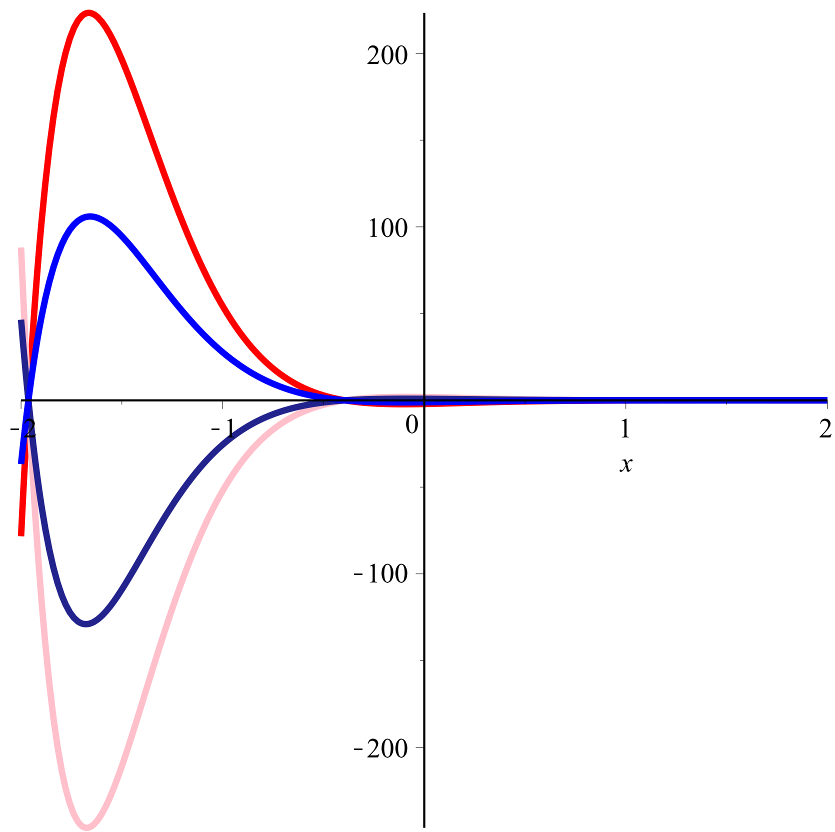
```
y'' + 6·y' + 13·y = e^(-3·x)·cos(4·x);
dsolve(%);
solution := rhs(%);
```

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

$$y(x)=e^{-3x}\sin(2x)\,\_C2+e^{-3x}\cos(2x)\,\_C1-\frac{1}{12}e^{-3x}\cos(4x)$$

$$solution:=e^{-3x}\sin(2x)\,\_C2+e^{-3x}\cos(2x)\,\_C1-\frac{1}{12}e^{-3x}\cos(4x) \qquad \textbf{(6)}$$

```
> p1 := plot(subs(_C1 =-2, _C2 =-2, solution(x)), x =-2 ..2, thickness = 3, color = red, discont = true) :
p2 := plot(subs(_C1 = 2, _C2 = 2, solution(x)), x =-2 ..2, thickness = 3, color = pink, discont = true) :
p3 := plot(subs(_C1 = 1, _C2 = 1, solution(x)), x =-2 ..2, thickness = 3, color = navy, discont = true) :
p4 := plot(subs(_C1 =-1, _C2 =-1, solution(x)), x =-2 ..2, thickness = 3, color = blue, discont = true) :
plots[display](p1, p2, p3, p4);
```



200
100
-2
-1
0
1
2
x
-100
-200

>