> $restart;$
$\#1$

$$simplify\left(\frac{\frac{(x^4 - x^3 - 11x^2 + 9x + 18)}{(x^4 - 3x^3 - 7x^2 + 27x - 18)}}{\frac{(x^3 - 9x^2 + 26x - 24)}{(x^3 - 8x^2 + 19x - 12)}}\right);$$

$$\frac{x+1}{x-2} \qquad (1)$$

> $\#2$
$restart;$

> $expand((2x-1)\cdot(3x^2+5)\cdot(5x+2));$

$$30x^4 - 3x^3 + 44x^2 - 5x - 10 \qquad (2)$$

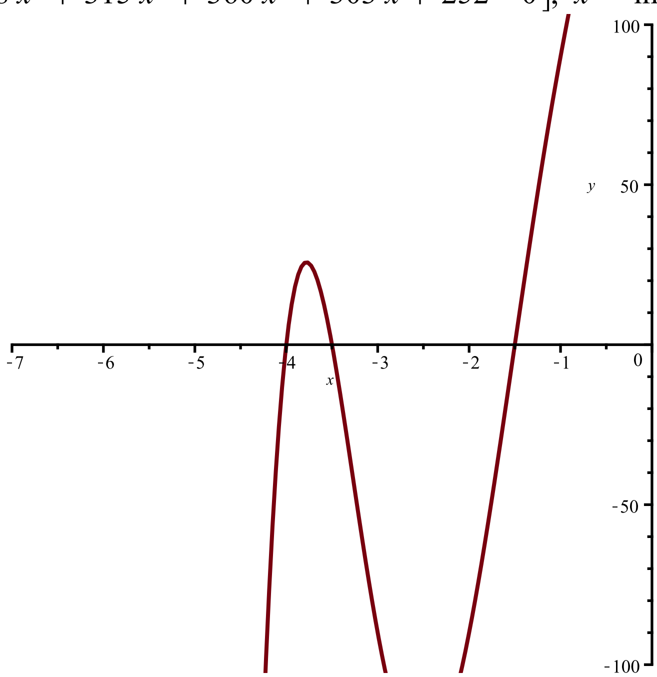
> $\#3$
$restart;$

> $factor(14x^4 - 46x^3 - 82x^2 + 138x + 120);$

$$2\,(7x+5)\,(x-4)\,(x^2-3) \qquad (3)$$

> $\#4$
$restart;$

> $plot([12x^5 + 108x^4 + 315x^3 + 360x^2 + 303x + 252], x = -7..0, y = -100..100);$
$fsolve([12x^5 + 108x^4 + 315x^3 + 360x^2 + 303x + 252 = 0],\ x = -\text{infinity}..\text{infinity});$



$$\{x = -4.\},\ \{x = -3.500000000\},\ \{x = -1.500000000\} \qquad (4)$$

> $\#5$
$restart;$

$$convert\left(\frac{(5x^4+7x^3+5x-4)}{(x^2+4)\cdot(x-2)^2\cdot(x^2-1)}, parfrac\right);$$

$$\frac{11}{90\,(x+1)}+\frac{-19\,x-23}{20\,(x^2+4)}+\frac{13}{10\,(x-1)}+\frac{71}{12\,(x-2)^2}-\frac{17}{36\,(x-2)} \qquad \textbf{(5)}$$

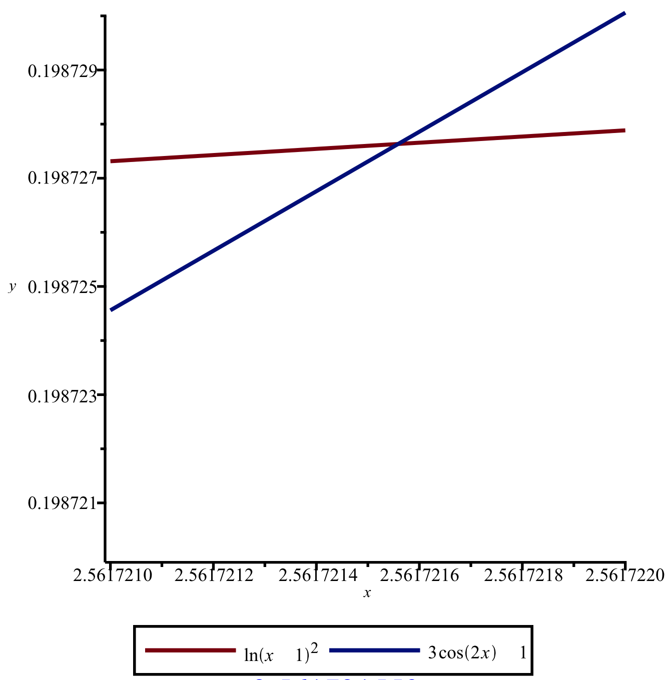
\>

#6
restart;

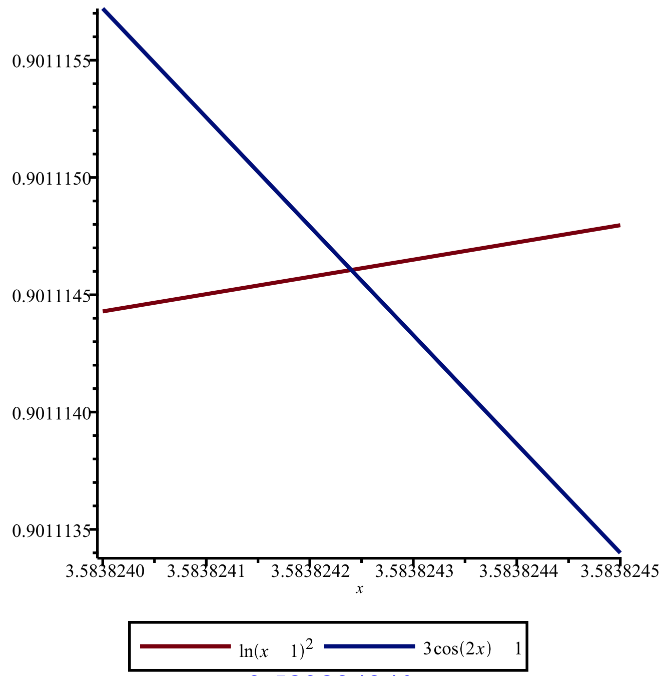
$f1 := \ln^2(x-1);$
$f2 := 3\cos(2x)-1;$

$plot([f1, f2], x = 2.561721\,..\,2.561722, y = 0.19872\,..\,0.19873, legend = [f1, f2]);$
$fsolve(\ln^2(x-1) = 3\cos(2x)-1, x = 2\,..\,2.6);$
$plot([f1, f2], x = 3.583824\,..\,3.5838245, legend = [f1, f2]);$
$fsolve(\ln^2(x-1) = 3\cos(2x)-1, x = 3\,..\,3.6);$

$$f1 := \ln(x-1)^2$$
$$f2 := 3\cos(2\,x)-1$$



2.561721559



$$3.583824240 \tag{6}$$

\>

\> #7

restart;

$$An := \frac{5\,n \quad 2}{2\,n \quad 1};$$

$$e := 10^{\ \ 1};$$

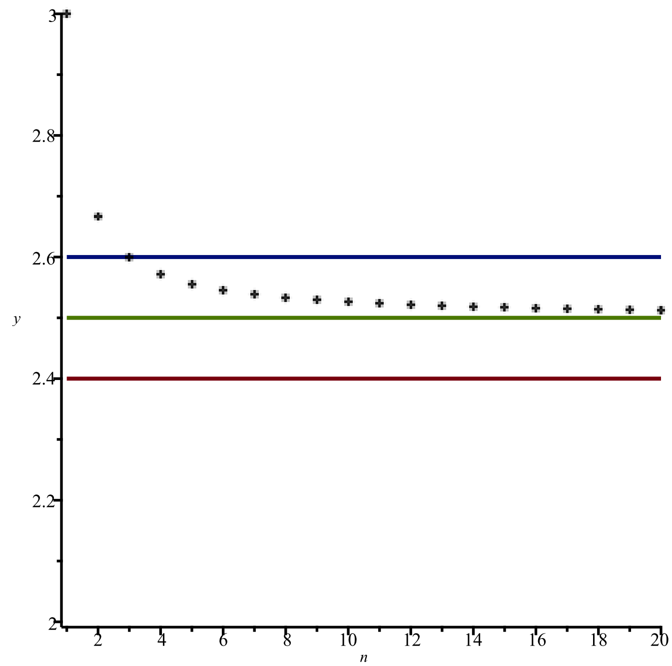
$$a := \frac{5}{2};$$

y1 := *a*   *e* :
y2 := *a* + *e* :
y3 := *a* :
with(*plots*) :
P1 := *plot*([*y1*, *y2*, *y3*], *n* = *1* ..*20*, *y* = 2 ..3, *discont* = *true*) :
P2 := *pointplot*({*seq*([*n*, *An*], *n* = 1 ..20)}) :
display(*P1*, *P2*);

$$An := \frac{5\,n \quad 2}{2\,n \quad 1}$$

$$e := \frac{1}{10}$$

$$a := \frac{5}{2}$$



> $solve(a - e < An < a + e)$;

$$(-\infty, -2), (3, \infty) \qquad \textbf{(7)}$$

> #8
$restart$;

$limit\left(n \cdot \left(\left(n^2+1\right)^{\frac{1}{2}} - \left(n^2-1\right)^{\frac{1}{2}} \right), n = \text{infinity}\right)$;

$limit\left(\left(\frac{(3\,n^2 - 6\,n + 7)}{(3\,n^2 + 20\,n - 1)} \right)^{1-n}, n = \text{infinity} \right)$;

$$\frac{1}{e^{\frac{26}{3}}} \qquad \textbf{(8)}$$

> #9
$restart$;

$y(x) := piecewise\left(x < -\text{Pi}, 5 \cdot \sin(2\,x), x \geq -\text{Pi}, 7 \cdot \exp\left(-\frac{1}{2} \cdot x\right)\right)$;

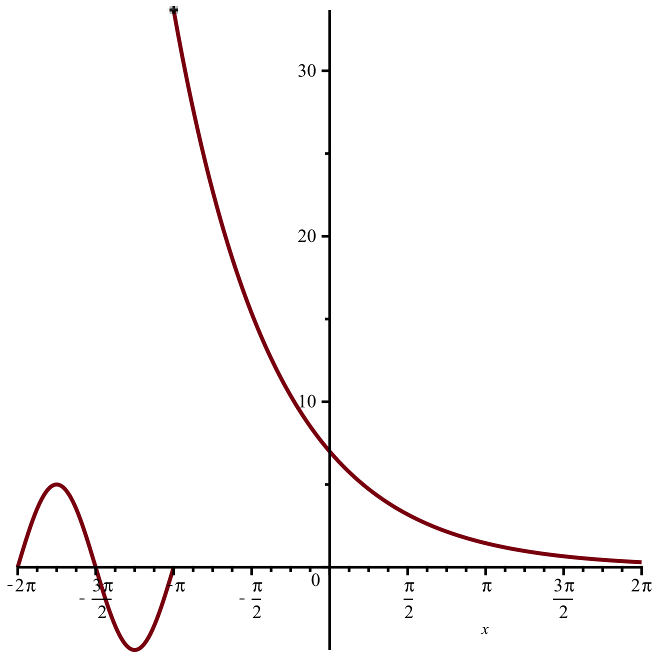
$plot(y(x\ ), discont = true)$;

$limit(y(x), x = \text{infinity})$;
$limit(y(x), x = -\text{infinity})$;

$limit(y(x), x = -\text{Pi}, right)$;

$limit(y(x), x = -\mathrm{Pi}, left);$

$$y := x \mapsto \begin{cases} 5 \cdot \sin(2 \cdot x) & x < -\pi \\ 7 \cdot \mathrm{e}^{-\frac{x}{2}} & -\pi \le x \end{cases}$$



$$0$$

$$-5\,..5$$

$$7\,\mathrm{e}^{\frac{\pi}{2}}$$

$$0 \tag{9}$$

> $diff(y(x), x);$

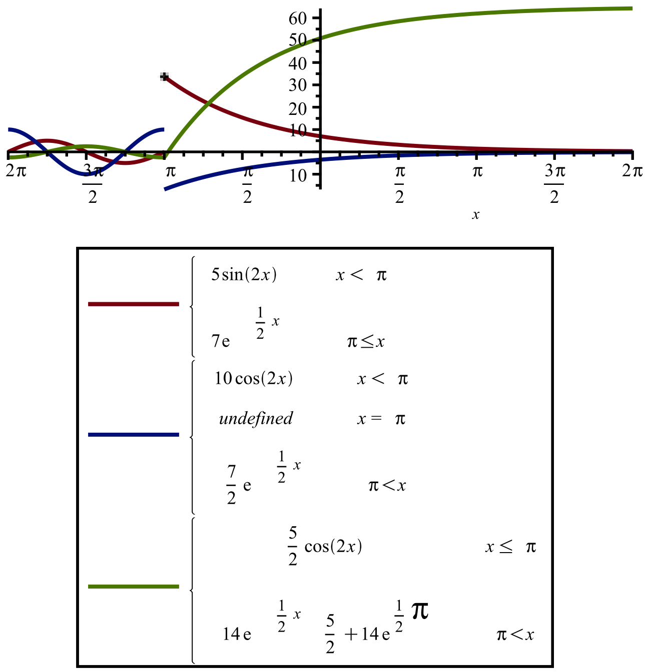
$$\begin{cases} 10\cos(2\,x) & x < -\pi \\ undefined & x = -\pi \\ -\frac{7\,\mathrm{e}^{-\frac{x}{2}}}{2} & -\pi < x \end{cases} \tag{10}$$

> $int(y(x), x);$

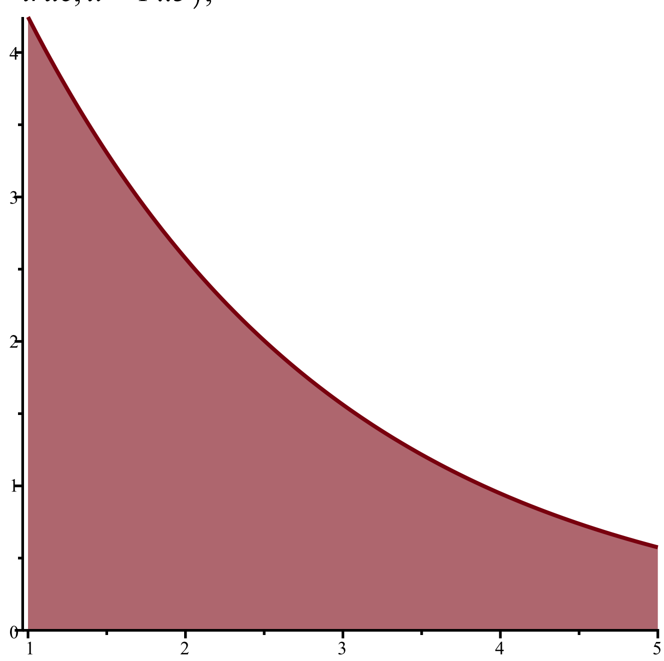
(11)

$$
\begin{cases} -\dfrac{5\cos(2x)}{2} & x \leq -\pi \\[2ex] -14\,\mathrm{e}^{-\frac{x}{2}} - \dfrac{5}{2} + 14\,\mathrm{e}^{\frac{\pi}{2}} & -\pi < x \end{cases} \tag{11}
$$

```
> plot([y(x), diff(y(x), x), int(y(x), x)], legend = [y(x), diff(y(x), x), int(y(x), x)], discont
    = true);
```




```
> plot([y(x)], filled = true, x = 1 ..5);
```




```
> int(y(x), x = 1 ..5);
```

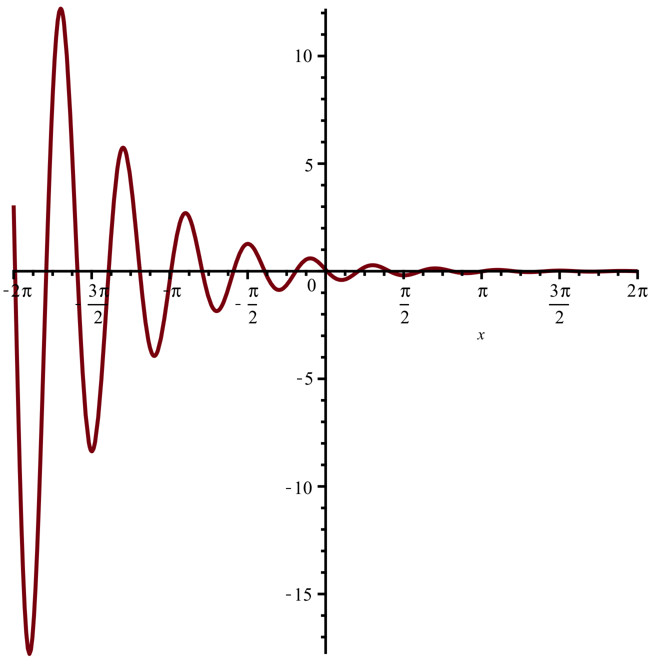
$$14\,e^{-\frac{1}{2}} - 14\,e^{-\frac{5}{2}} \qquad \textbf{(12)}$$

> *#10*

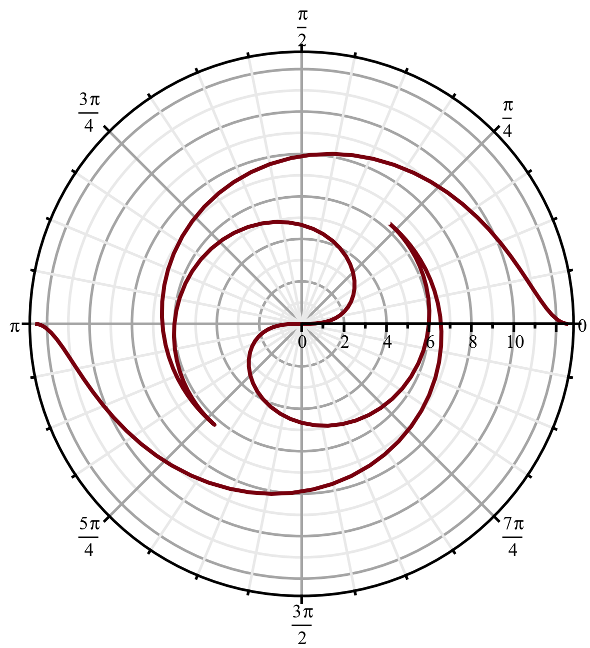
#1
$y1 := 0.5 \cdot \exp(-0.6\,x) \cdot \sin(5\,x + 3);$

$plot(y1);$

$$y1 := 0.5\,e^{-0.6\,x} \sin(5\,x + 3)$$



> $plots[polarplot]([2(t + \sin(t)), 2(1 - \cos(t)), t=-2\,\mathrm{Pi}..2\,\mathrm{Pi}]);$

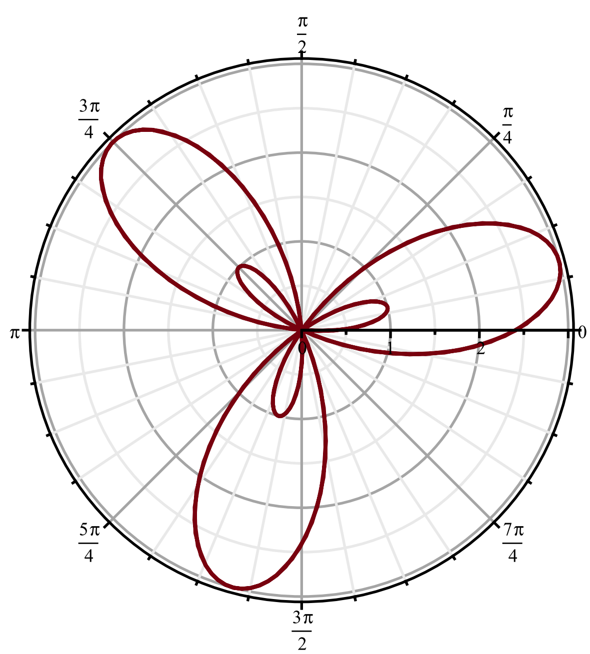


> *#4*

$\rho(\varphi) := 1 + 2 \cdot \sin\left(3\varphi + \frac{\mathrm{Pi}}{4}\right);$

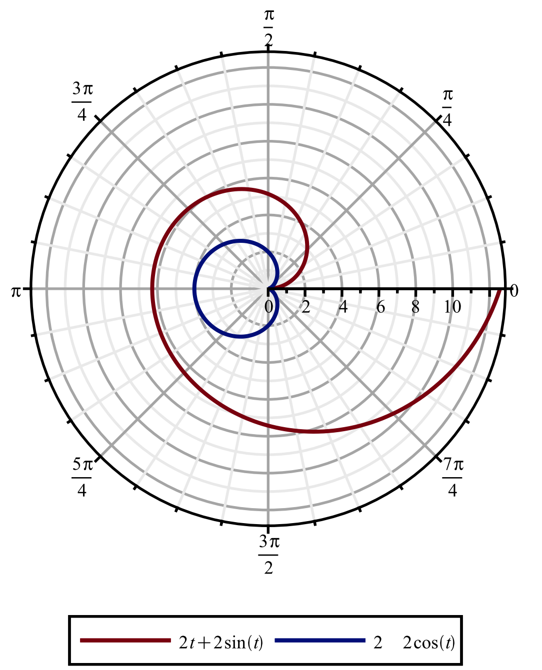
plots[*polarplot*]$(\rho(\varphi), \varphi = -2\,\mathrm{Pi}..2\,\mathrm{Pi});$

$$\rho := \varphi \mapsto 1 + 2 \cdot \sin\left(3 \cdot \varphi + \frac{\pi}{4}\right)$$



> *#3*

plots[*polarplot*]$([2 \cdot (t + \sin(t)), 2(1 - \cos(t))]$, *legend* $= [2 \cdot (t + \sin(t)), 2(1 - \cos(t))])$



>

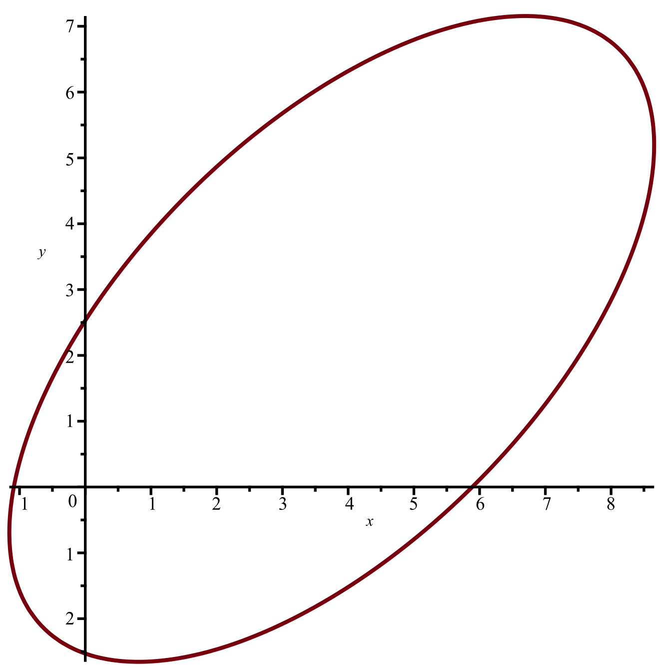
#2

restart;

$F := 5\,x^2 \quad 6\,x \cdot y + 5\,y^2 \quad 24\,x \quad 32;$

$plots[implicitplot](F(x, y) = 0, x = \quad 10 .. 10, y = \quad 10 .. 10);$

$$F := 5\,x^2 \quad 6\,x\,y + 5\,y^2 \quad 24\,x \quad 32$$



>

> $A := Matrix([[5, 3], [3, 5]]);$

(13)

$$A := \begin{bmatrix} 5 & 3 \\ 3 & 5 \end{bmatrix} \tag{13}$$

> $r := LinearAlgebra[Eigenvectors](A);$

$$r := \begin{bmatrix} 2 \\ 8 \end{bmatrix}, \begin{bmatrix} -1 & 1 \\ 1 & 1 \end{bmatrix} \tag{14}$$

> $with[plots] : with(LinearAlgebra) :$

> $e1 := Normalize(Column(r[2], [1]), Euclidean)$

$$e1 := \begin{bmatrix} -\frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} \end{bmatrix} \tag{15}$$

> $e2 := Normalize(Column(r[2], [2]), Euclidean)$

$$e2 := \begin{bmatrix} \frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} \end{bmatrix} \tag{16}$$

> $expr := subs\big(x = e1[1] \cdot x1 + e2[1] \cdot y1, y = e1[2] \cdot x1 + e2[2] \cdot y1, 5\,x^2 - 6\,x \cdot y + 5\,y^2 - 24\,x - 32\big) :$

> $expr := simplify(expr);$

$$expr := (12\,x1 - 12\,y1)\,\sqrt{2} + 8\,x1^2 + 2\,y1^2 - 32 \tag{17}$$

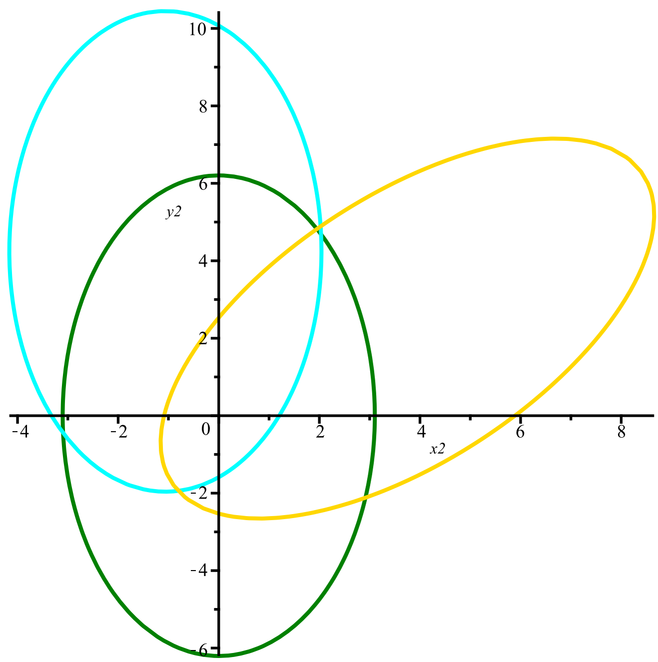
> $NotConon := Student[Precalculus][CompleteSquare](expr);$

$$NotConon := 2\,\left(y1 - 3\,\sqrt{2}\right)^2 + 8\,\left(x1 + \frac{3\,\sqrt{2}}{4}\right)^2 - 77 \tag{18}$$

> $Conon := subs\left(y1 = y2 + 3\,\sqrt{2}, x1 = x2 - \frac{3\,\sqrt{2}}{4}, NotConon\right);$

$$Conon := 8\,x2^2 + 2\,y2^2 - 77 \tag{19}$$

> $plots[implicitplot]\left(\left[Conon = 0, 2\,\left(y2 - 3\,\sqrt{2}\right)^2 + 8\,\left(x2 + \frac{3\,\sqrt{2}}{4}\right)^2 - 77, 5\,x2^2 - 6\,x2 \cdot y2 + 5\,y2^2 - 24\,x2 - 32\right], x2 = -15..15, y2 = -15..15\right)$



10
8
6
y2
4
2
-4
-2
0
2
4
6
8
x2
-2
-4
-6