

#Лабораторная работа 1, Басенко Кирилл

#task1

$$\text{simplify}\left(\left(\frac{\frac{x^3 + 3x^2 - 9x - 27}{x^3 - 5x^2 - 15x - 72}}{\frac{49x^4 - 882x^2 + 3969}{x^4 - 8x^3 - 27x + 216}}\right)\right);$$

$$\frac{1}{49}$$

(1)

#task2

$$\text{collect}((4x - 3)(3x^2 + 1)(5x + 2), x);$$

$$4x(3x^2 + 1)(5x + 2) - 3$$

(2)

#task3

$$\text{factor}(4x^4 - 31x^3 + 33x^2 - 93x + 63);$$

$$(x - 7)(4x - 3)(x^2 + 3)$$

(3)

#task4

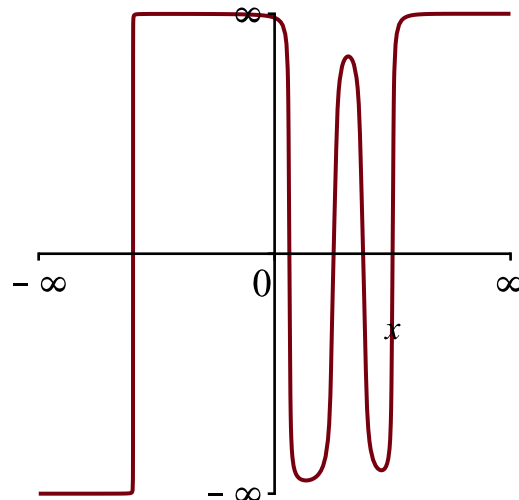
restart;

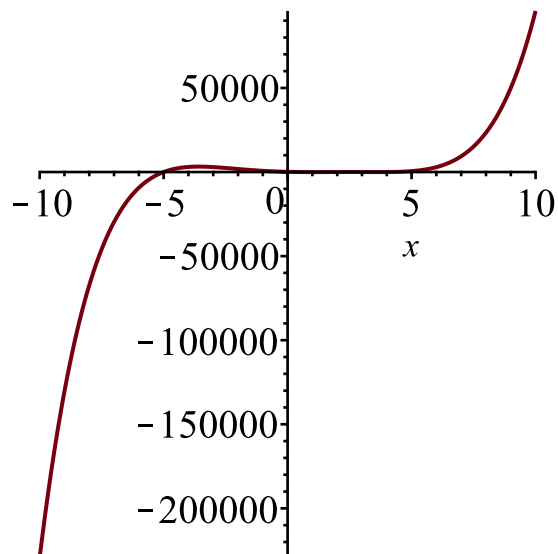
$$y := x \rightarrow (2x^5 - 9x^4 - 34x^3 + 231x^2 - 346x + 120) :$$

plot(y(x), x=-infinity..infinity);

plot(y(x));

solve(y(x));





2, 3, 4, $\frac{1}{2}$, -5

(4)

#task5

$\text{convert}\left(\frac{(5x^4 + 7x^3 + 3x - 1)}{(x^2 + 2) \cdot (x - 1)^2 \cdot (x^2 - 9)}, \text{parfrac}\right);$

$$-\frac{7}{12(x-1)^2} - \frac{229}{144(x-1)} + \frac{301}{132(x-3)} - \frac{103}{528(x+3)} + \frac{-49x-25}{99(x^2+2)}$$

(5)

#task6

$f := x \rightarrow \ln^2(x + 1) :$

$g := x \rightarrow 2 \cos(3x) - 1.5 :$

$h := x \rightarrow f(x) - g(x) :$

$\text{plot}(h(x), x = -1 .. 1);$

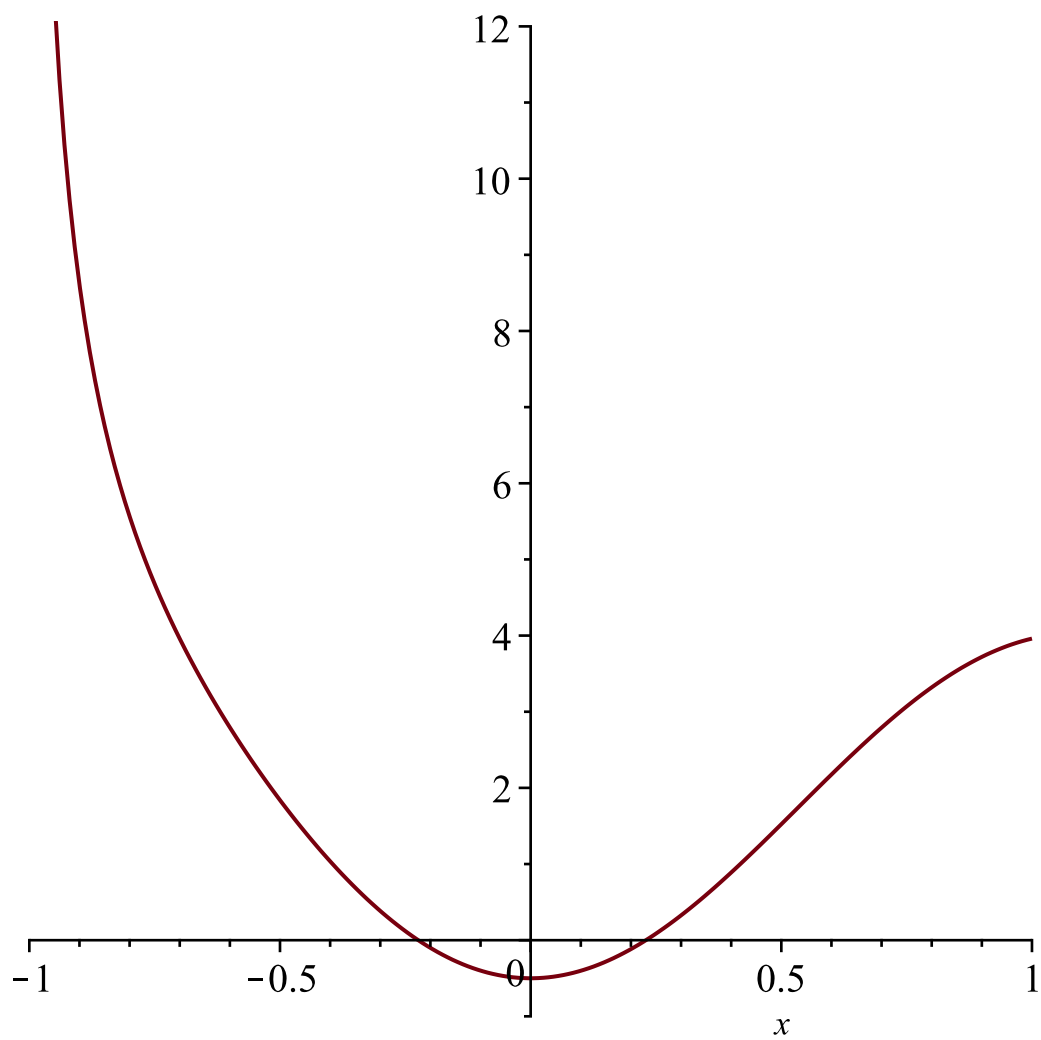
$\text{plot}(h(x), x = -\text{infinity} .. \text{infinity});$

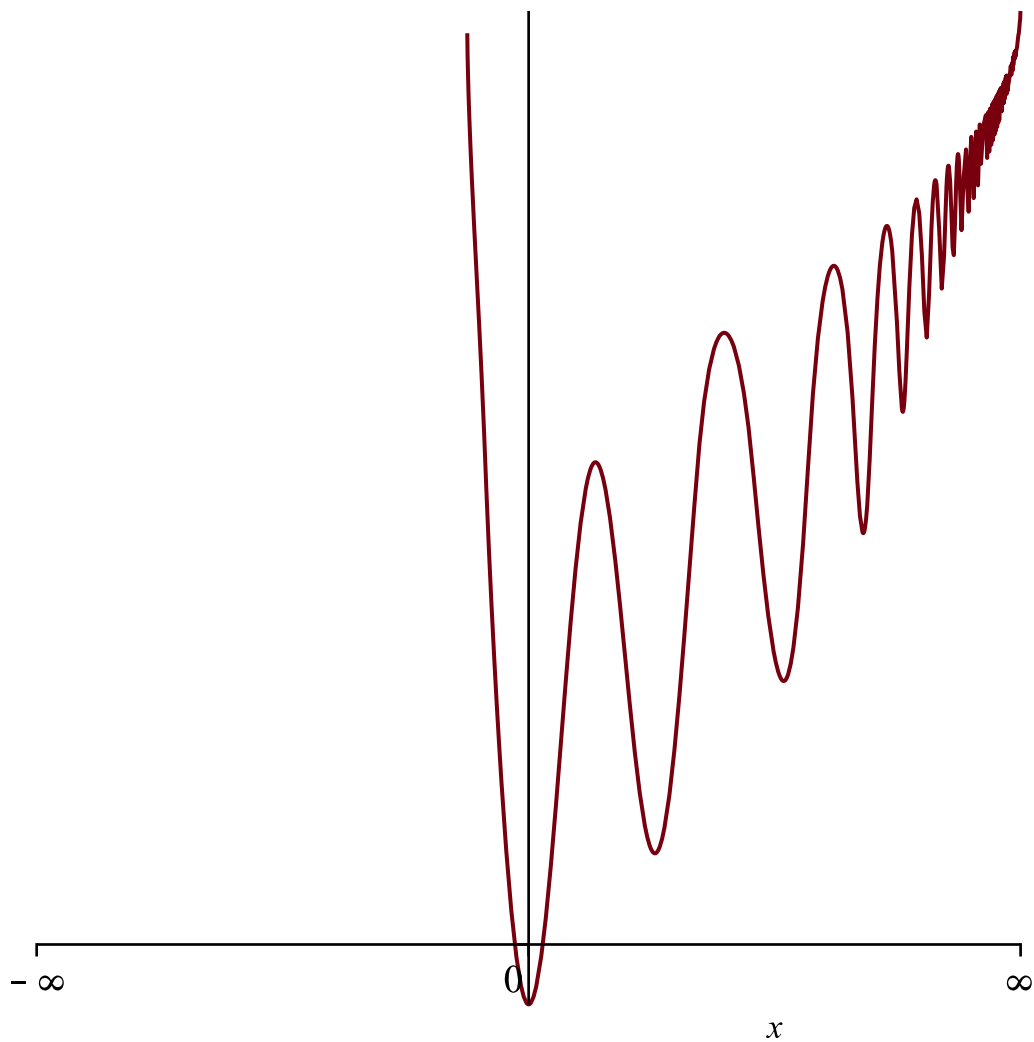
$\text{fsolve}(h(x), x = -1 .. 0) :$

$\text{evalf}(\%, 5);$

$\text{fsolve}(h(x), x = 0 .. 1) :$

$\text{evalf}(\%, 5);$





−0.22419

0.22991

(6)

#task7

$y := n \rightarrow \frac{(5 + 2)}{(3 n - 1)} :$

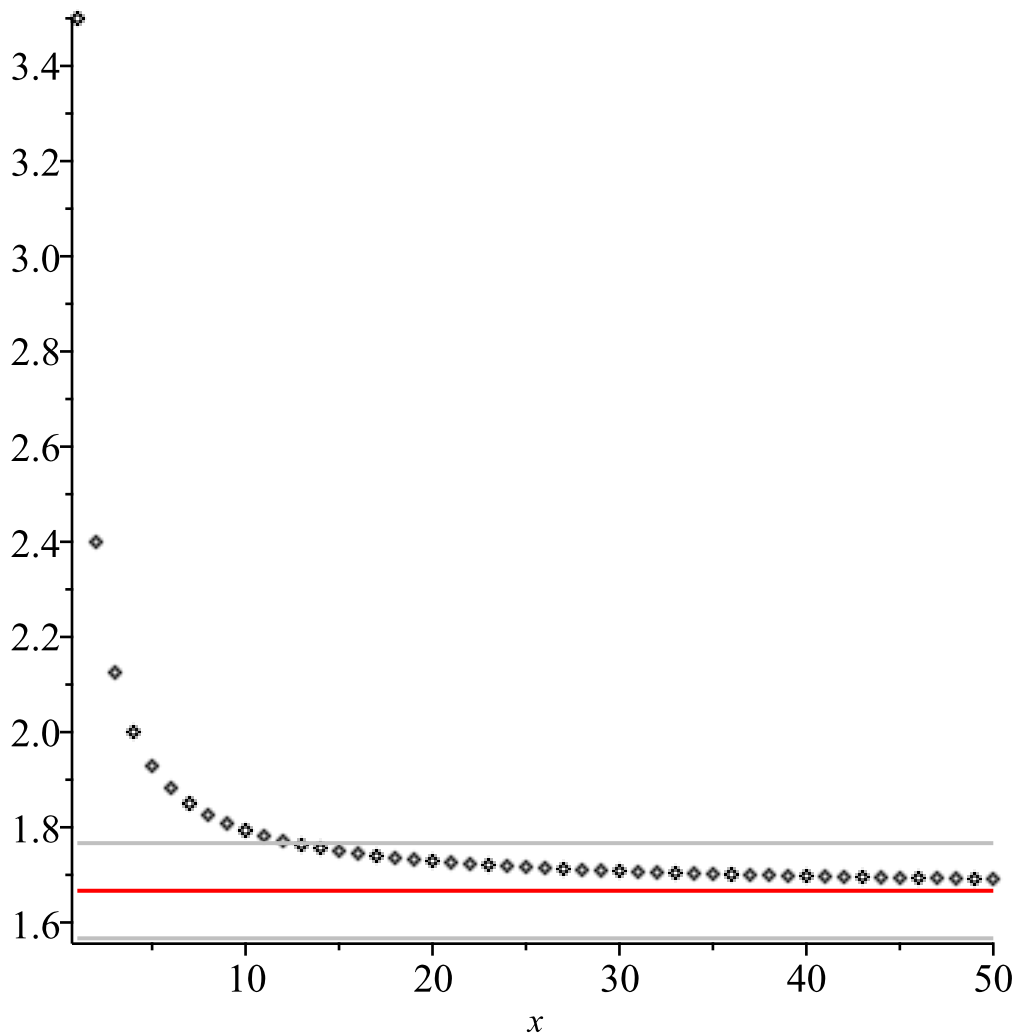
$solve\left(\left\{\left|y(n) - \frac{5}{3}\right| < 0.1, n \geq 1\right\}, n\right);$

$y1 := plots[pointplot]\left(\left\{seq\left(\left[n, \frac{(5 n + 2)}{(3 n - 1)}\right], n = 1 .. 50\right)\right\}\right) :$

$y2 := plot\left(\left[\frac{5}{3} - 0.1, \frac{5}{3}, \frac{5}{3} + 0.1\right], x = 1 .. 50, color = [gray, red, gray]\right) :$

$plots[display](y1, y2);$

{1.654088050 < n, n < 1.822695035}



#task8

$$\lim_{n \rightarrow \infty} \left((n \cdot (n+2))^{\frac{1}{2}} - (n^2 - 2n + 3)^{\frac{1}{2}} \right);$$

$$\lim_{n \rightarrow \infty} \left(\frac{(3n^2 - 5n)}{3n^2 - 5n + 7} \right);$$

2

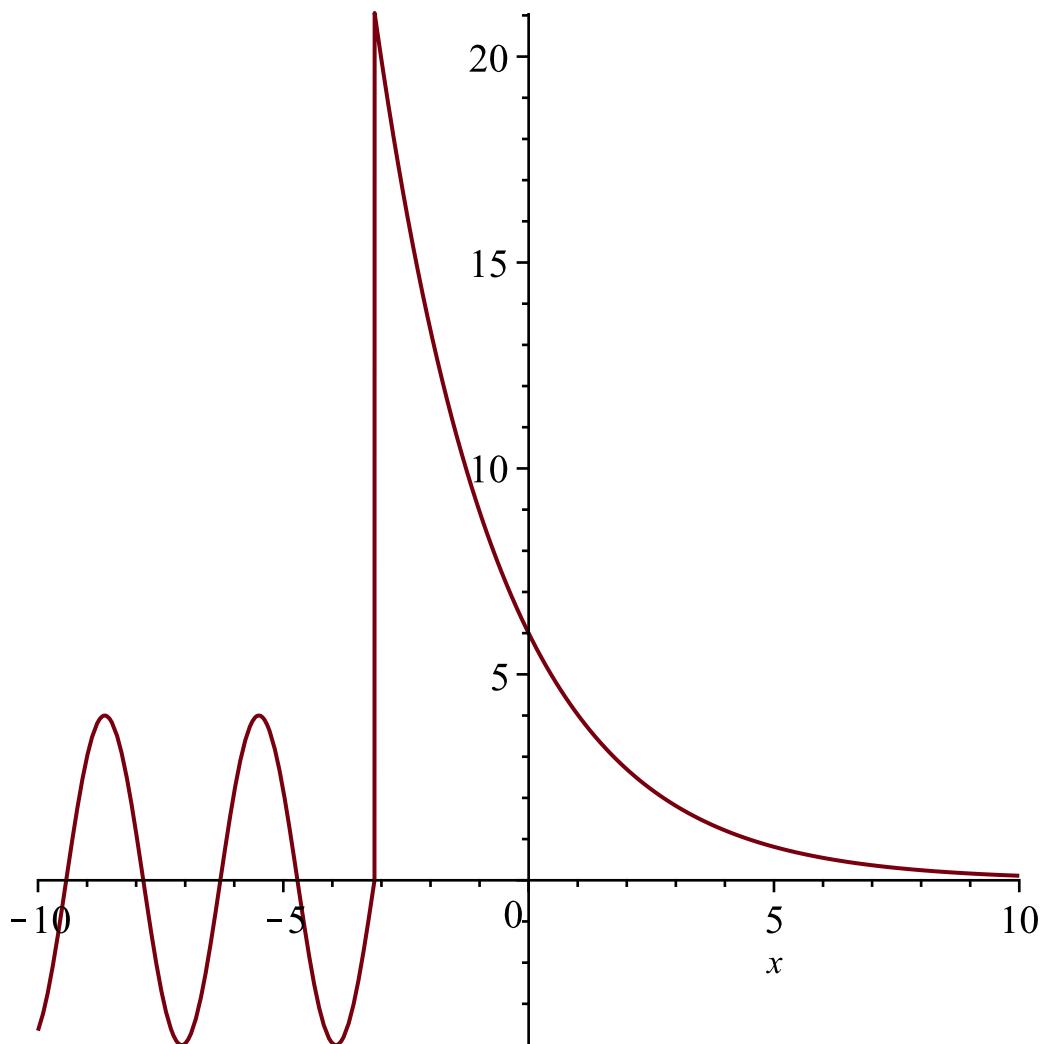
1

(7)

#task9

$$y := x \rightarrow \text{piecewise} \left(x < -\text{Pi}, 4 \sin(2x), x \geq -\text{Pi}, \frac{6}{\exp(0.4 \cdot x)} \right);$$

$$\text{plot}(y(x), x = -10 .. 10);$$



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

0.
21.08151375

(8)

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

0.
-4. ... 4.

(9)

$\text{int}(y(x), x);$

$$\left\{ \begin{array}{ll} -2. \cos(2. x) & x \leq -3.141592654 \\ -\frac{15.}{e^{0.4000000000x}} + 50.70378436 & -3.141592654 < x \end{array} \right.$$

(10)

$\text{diff}(y(x), x);$

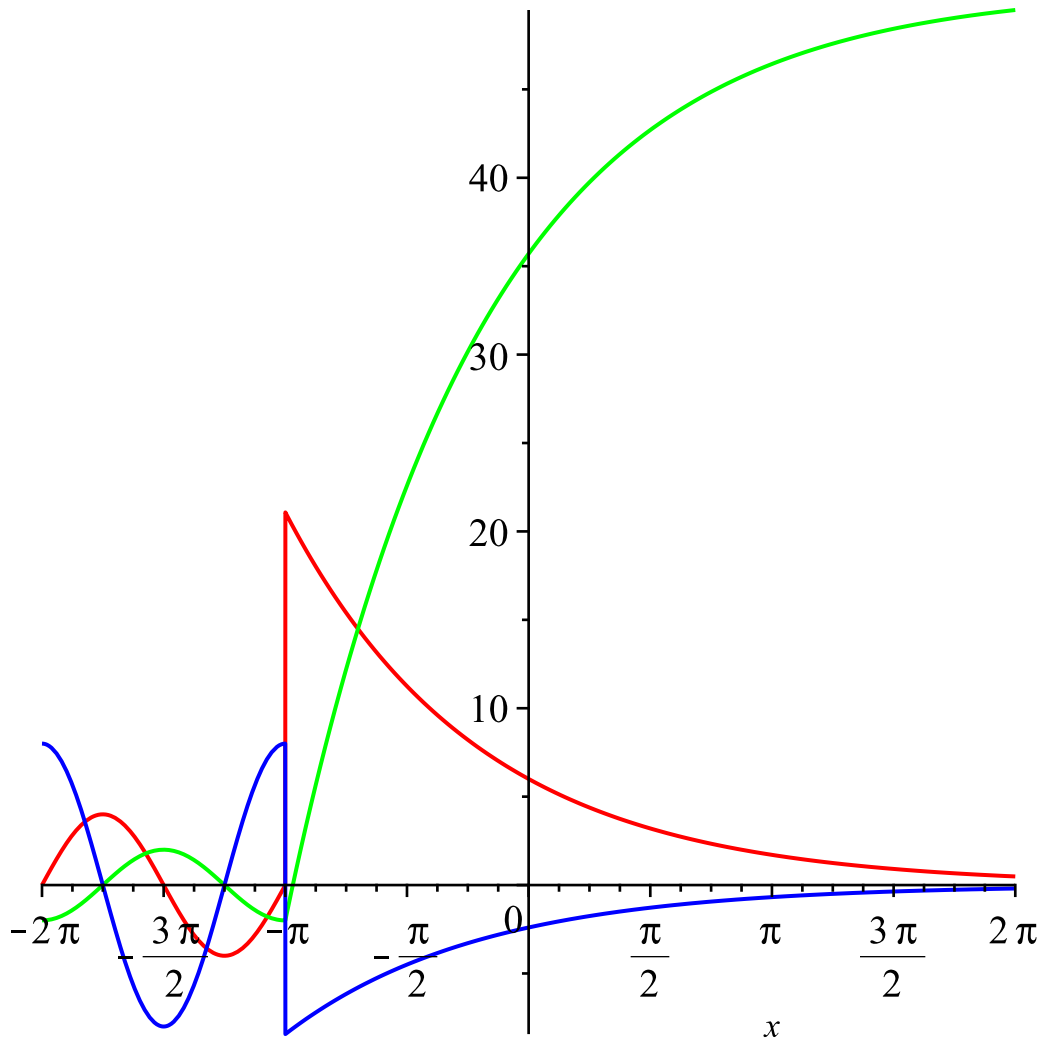
(11)

$$\left\{ \begin{array}{ll} 8 \cdot \cos(2 \cdot x) & x < -3.141592654 \\ \text{Float(undefined)} & x = -3.141592654 \\ -\frac{2.4000000000}{e^{0.4000000000x}} & -3.141592654 < x \end{array} \right.$$

```

y_int := x → int(y(x), x) :
y_diff := x → diff(y(x), x) :
plot([y(x), y_int(x), y_diff(x)], x, color=[red, green, blue]);

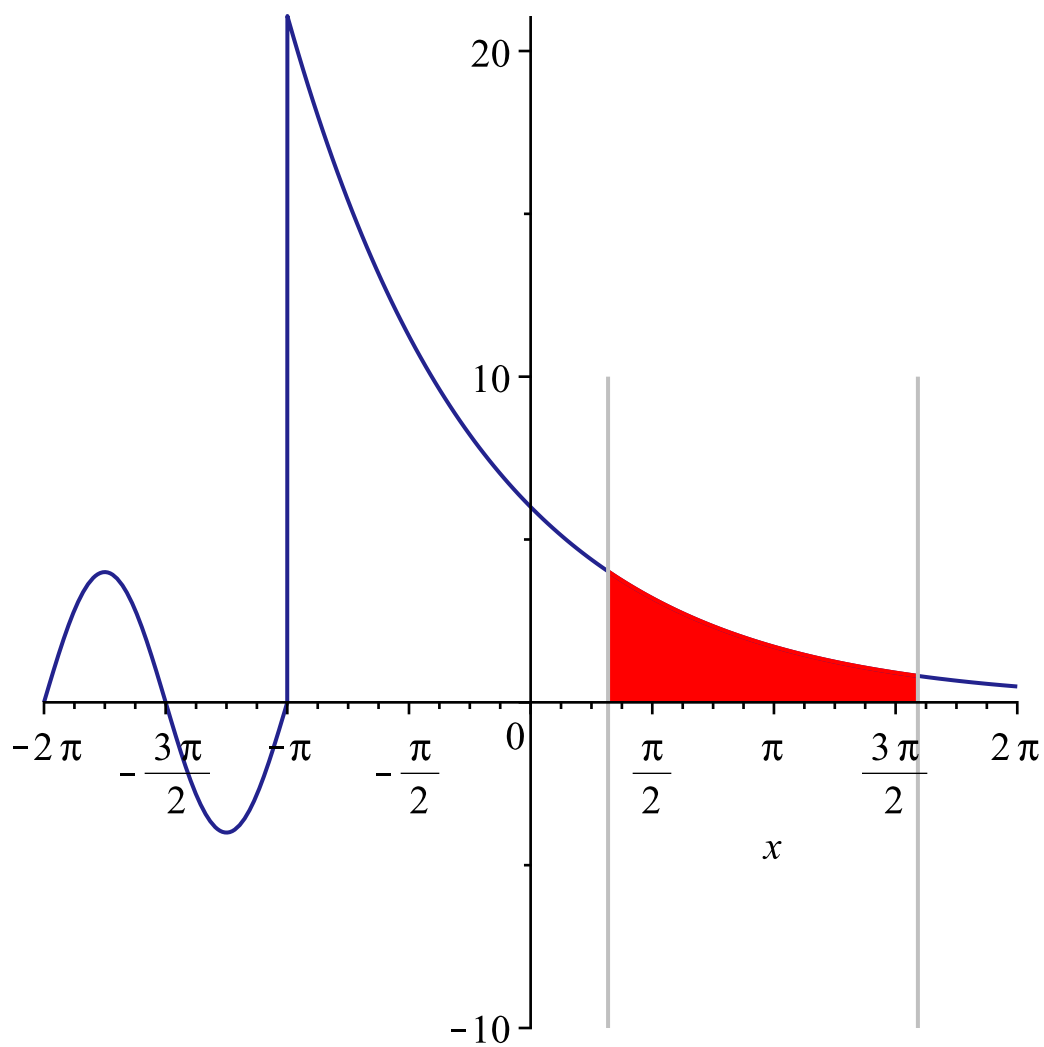
```



```

plot_y := plot(y(x), color=navy) :
plot_ytrap := plot(y(x), x=1..5, color=red, filled=true) :
line1 := plot([1, z, z=-10..10], color=gray) :
line2 := plot([5, z, z=-10..10], color=gray) :
plots[display](plot_y, plot_ytrap, line1, line2);
int(y(x), x=1..5);

```



8.024771442

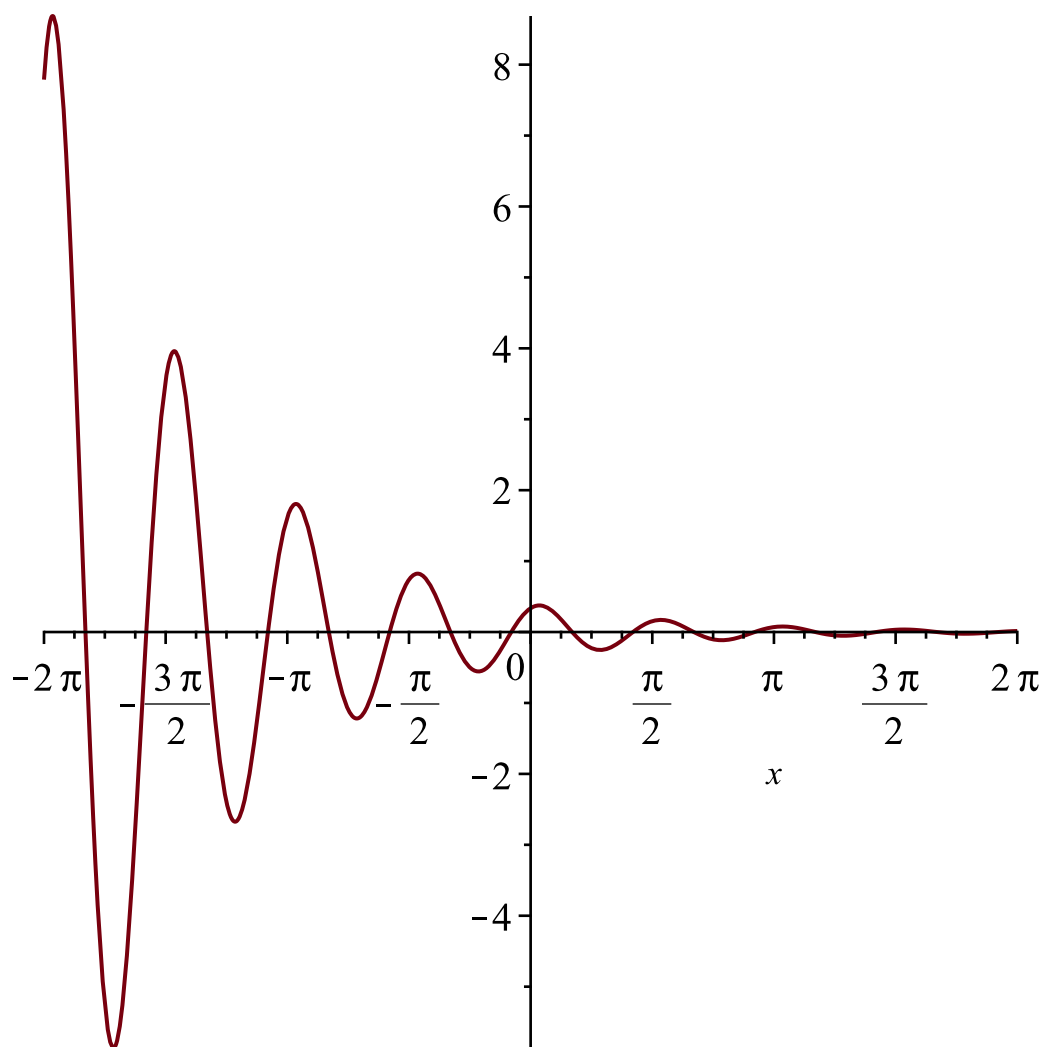
(12)

#task10

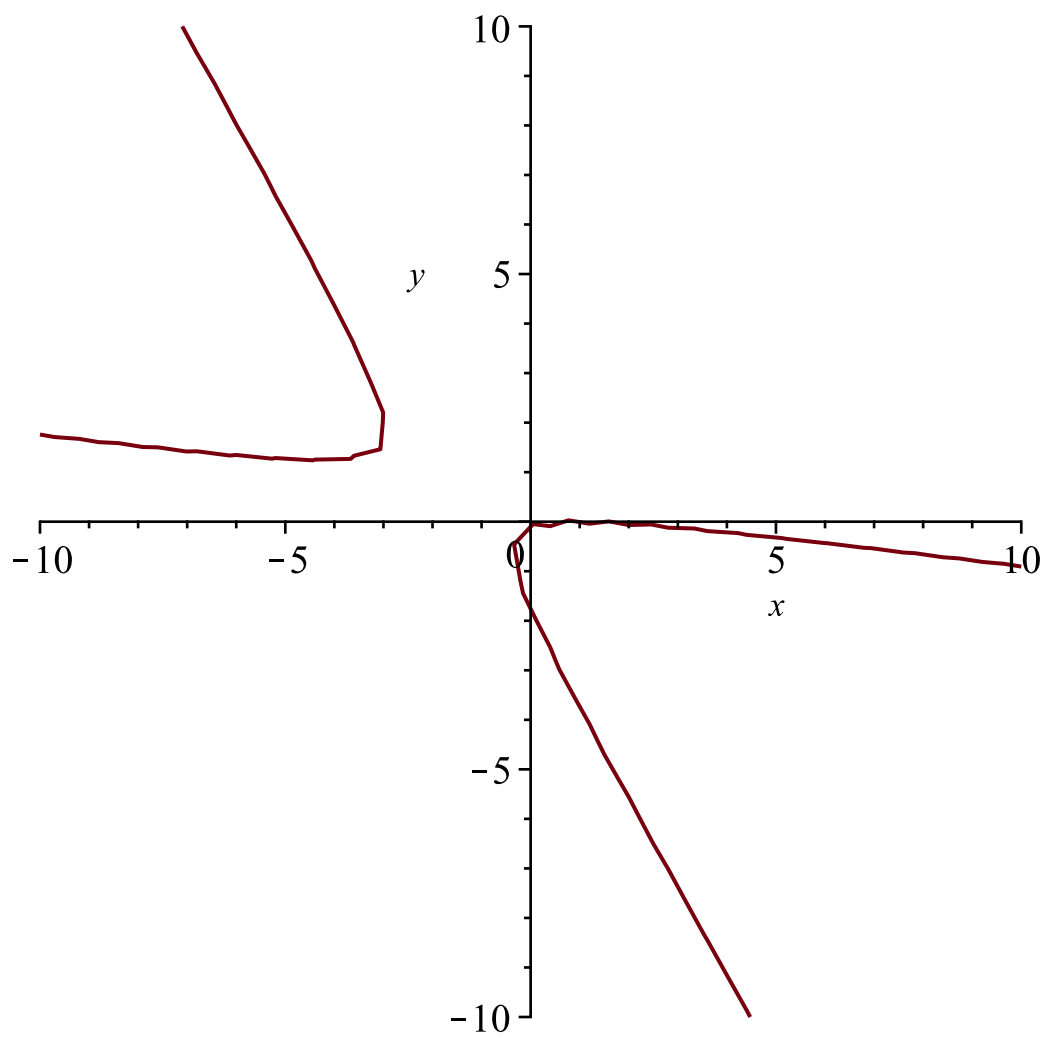
restart :

$y := x \rightarrow \frac{0.4}{\exp(0.5 x)} \sin(4 x + 1) :$

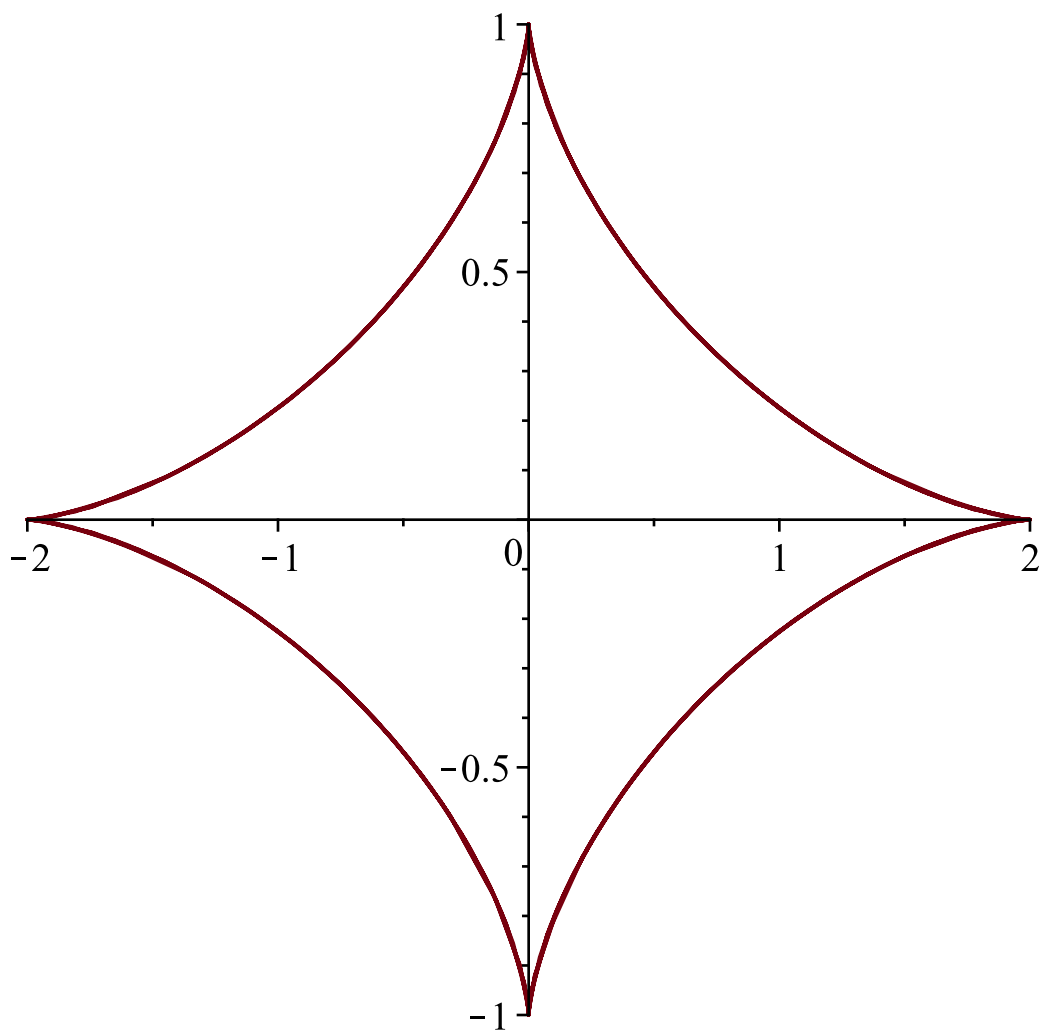
$\text{plot}(y(x), x);$



$f := (x, y) \rightarrow 7x^2 + 60xy + 32y^2 - 14x + 60y + 7 = 0 :$
 $\text{plots}[\text{implicitplot}](f(x, y), x = -10 .. 10, y = -10 .. 10);$



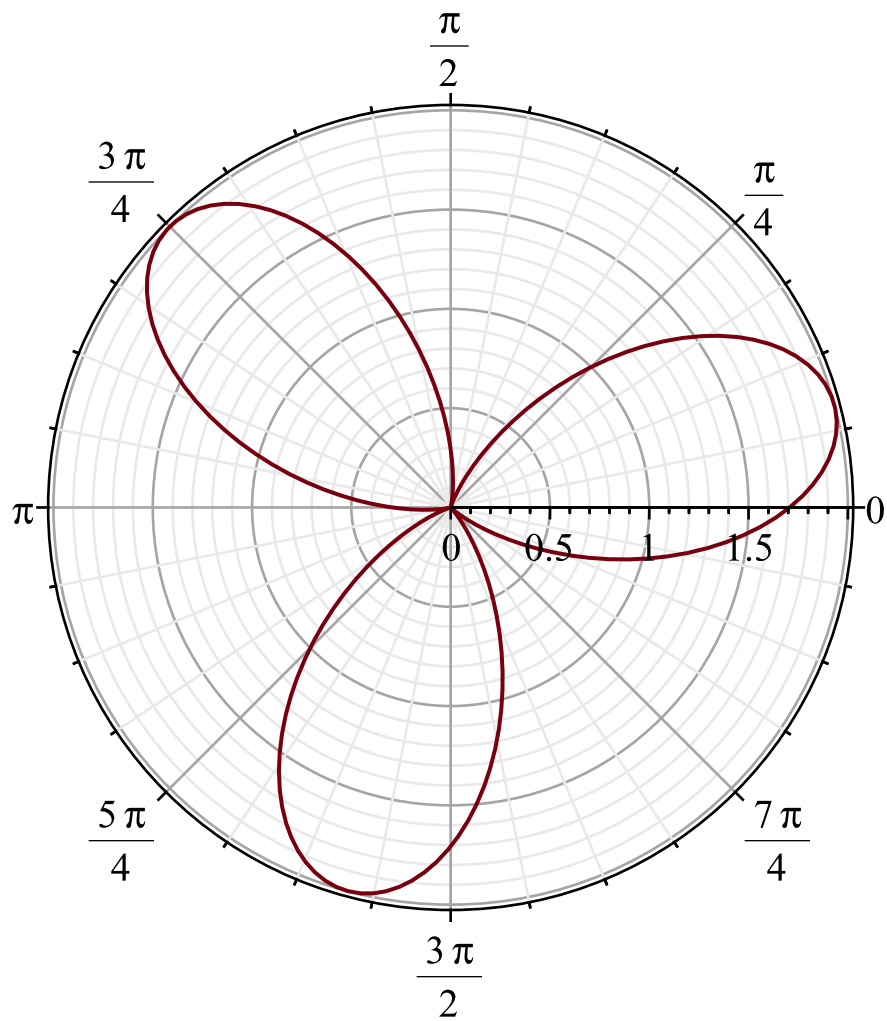
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plot([2*(cos(t))^3, (sin(t))^3, t=-15..15]);
```



```

ro := phi → 1 + sin(3 phi +  $\frac{\text{Pi}}{4}$ ):
plots[polarplot](ro(phi), phi);

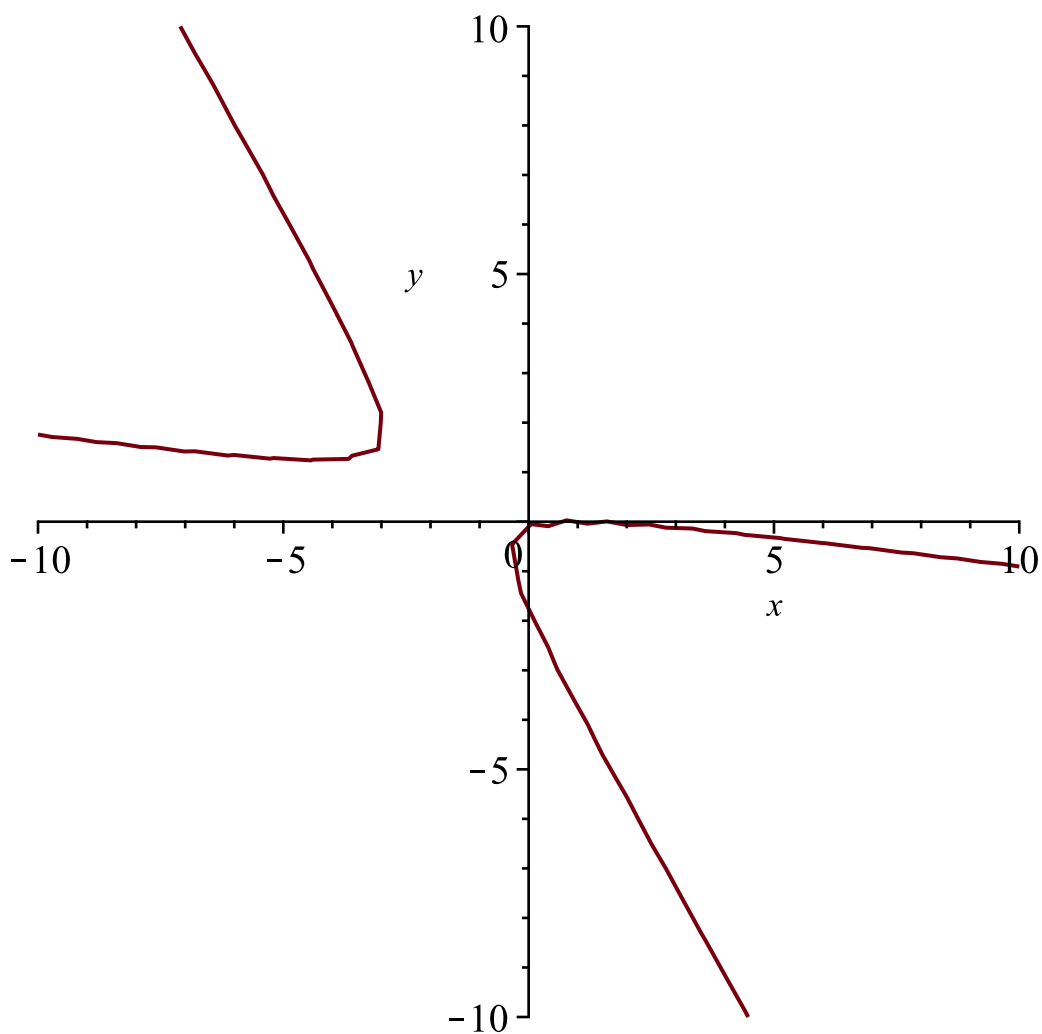
```



#orthogonalization

$f := (x, y) \rightarrow 7x^2 + 60x \cdot y + 32y^2 - 14x + 60y + 7 = 0 :$

plots[implicitplot](f(x, y), x=-10..10, y=-10..10);



```
A := Matrix([[7, 30], [30, 32]]);
```

$$A := \begin{bmatrix} 7 & 30 \\ 30 & 32 \end{bmatrix} \quad (13)$$

```
LinearAlgebra[Eigenvectors](A);
```

$$\begin{bmatrix} -13 \\ 52 \end{bmatrix}, \begin{bmatrix} -\frac{3}{2} & \frac{2}{3} \\ 1 & 1 \end{bmatrix} \quad (14)$$

```
LinearAlgebra[Normalize](Matrix([[-3/2, 1]]), 2);
```

$$\begin{bmatrix} -\frac{3\sqrt{13}}{13} & \frac{2\sqrt{13}}{13} \end{bmatrix} \quad (15)$$

```
LinearAlgebra[Normalize](Matrix([[2/3, 1]]), 2);
```

$$\begin{bmatrix} \frac{2\sqrt{13}}{13} & \frac{3\sqrt{13}}{13} \end{bmatrix} \quad (16)$$

$$X := \frac{-3 \cdot \sqrt{13}}{13} \cdot x + \frac{2 \cdot \sqrt{13}}{13} \cdot y :$$

$$Y := \frac{2 \cdot \sqrt{13}}{13} x + \frac{3 \cdot \sqrt{13}}{13} \cdot y :$$

$$Q := 7 X^2 + 60 X \cdot Y + 32 Y^2 - 14 X + 60 Y + 7 = 0 :$$

Student[Precalculus][CompleteSquare](Q);

$$52 \left(y + \frac{19 \sqrt{13}}{169} \right)^2 - 13 \left(x - \frac{81 \sqrt{13}}{169} \right)^2 + \frac{6300}{169} = 0$$

(17)