1.

a)

$12 + 4 - 5$

$$11 \qquad \textbf{(1)}$$

b)

2^{10}

$$1024 \qquad \textbf{(2)}$$

c)

$evalf(\sin(0.1))$

$$0.09983341665 \qquad \textbf{(3)}$$

d)

$expand((a+b)\cdot(a-b))$

$$a^2 - b^2 \qquad \textbf{(4)}$$

2.

a)

$y := x \rightarrow 3\,x^3 + 2\,x^2 - 5$

$$y := x \mapsto 3\cdot x^3 + 2\cdot x^2 - 5 \qquad \textbf{(5)}$$

$D(y)(x)$

$$9\,x^2 + 4\,x \qquad \textbf{(6)}$$

b)

$y := x \rightarrow \mathrm{sqrt}(1 + x^4)$

$$y := x \mapsto \sqrt{1 + x^4} \qquad \textbf{(7)}$$

$D(y)(x)$

$$\frac{2\,x^3}{\sqrt{x^4 + 1}} \qquad \textbf{(8)}$$

c)

$y := x \rightarrow \exp(x)\cdot\sin(x)\cdot\cos(x)$

$$y := x \mapsto e^x\cdot\sin(x)\cdot\cos(x) \qquad \textbf{(9)}$$

$D(y)(x)$

$$e^x \sin(x)\,\cos(x) + e^x \cos(x)^2 - e^x \sin(x)^2 \qquad \textbf{(10)}$$

3.

a)

$int(3\,x^3 + 2\,x^2 - 5, x = 0\,..1)$

$$-\frac{43}{12} \qquad \textbf{(11)}$$

b)

$int\left(\dfrac{1}{x^2}, x = 0\,..\mathrm{infinity}\right)$

$$\infty \tag{12}$$

c)

$int\left(e^{-x^2}, x = -\text{infinity} .. \text{infinity}\right)$

$$\int_{-\infty}^{\infty} e^{-x^2} \, dx \tag{13}$$

4.

a)

$limit\left(\dfrac{\sin(x)}{x}, x = 0\right)$

$$1 \tag{14}$$

b)

$limit\left(\dfrac{\left(x^3 + 3\,x^2 - 5\right)}{\left(2\,x^3 - 7\,x\right)}, x = \text{infinity}\right)$

$$\frac{1}{2} \tag{15}$$

c)

$limit\left(\dfrac{\left(\cos(x) + 1\right)}{x - \text{Pi}}, x = \text{Pi}\right)$

$$0 \tag{16}$$

5.

a)

$with(plots)$

$[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal,$ **(17)**
$conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot, display,$
$dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal,$
$interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot,$
$listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot,$
$pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra\_supported, polyhedraplot,$
$rootlocus, semilogplot, setcolors, setoptions, setoptions3d, shadebetween, spacecurve,$
$sparsematrixplot, surfdata, textplot, textplot3d, tubeplot]$

$f := x \rightarrow \exp(-x) - 1$

$$f := x \mapsto e^{-x} - 1 \tag{18}$$

$plot(f(x), x = -2 .. 2)$

$$e^x$$
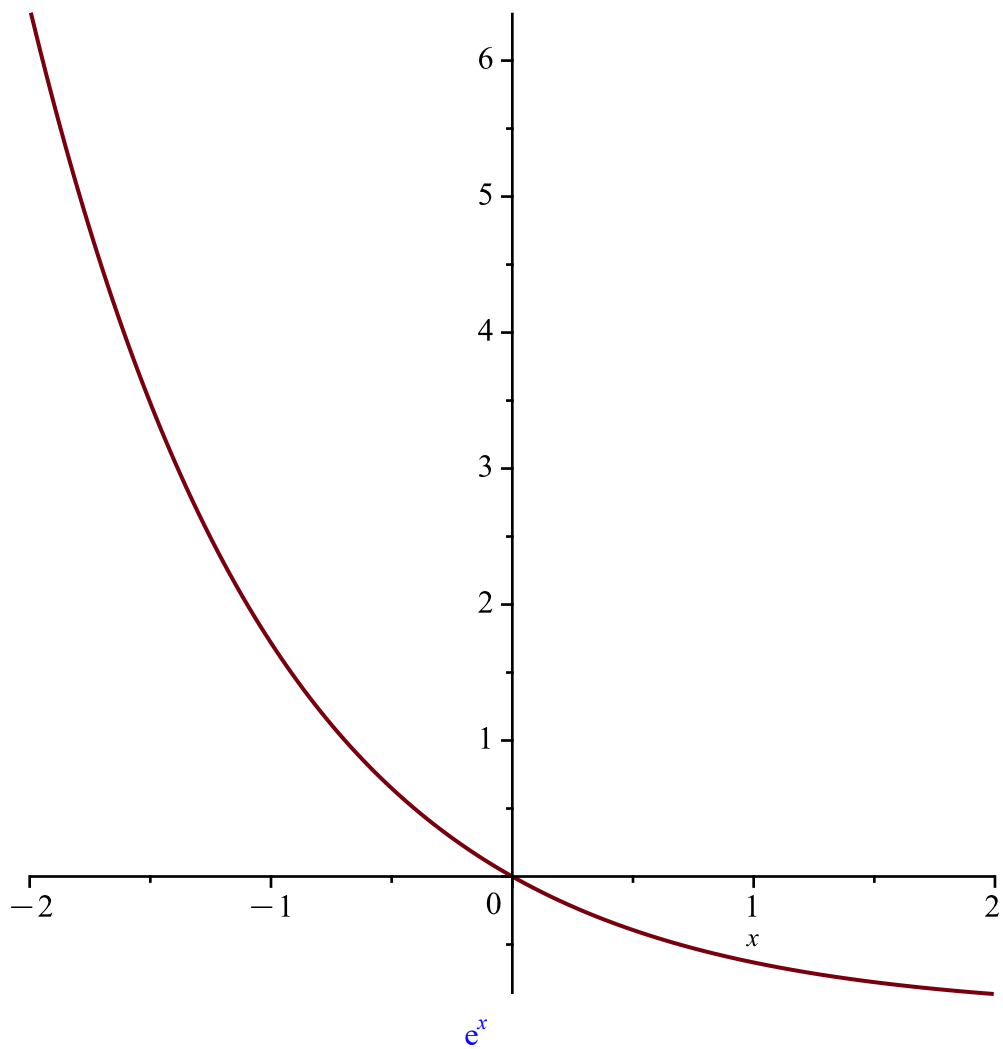
(19)

b)

$$f := x \rightarrow \left(\frac{200 \cdot \exp(r \cdot x)}{2 \cdot (\exp(r \cdot x) - 1) + 100} \right)$$

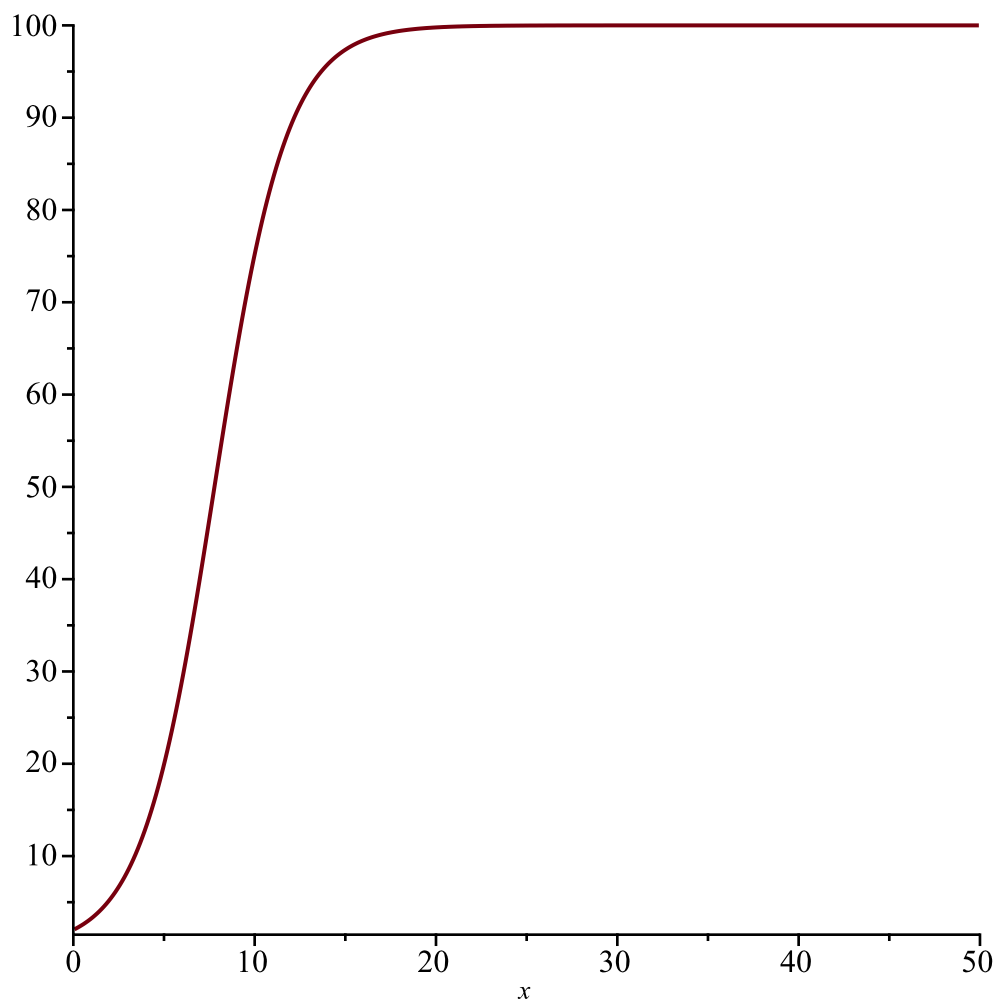$$f := x \mapsto \frac{200 \cdot e^{r \cdot x}}{2 \cdot e^{r \cdot x} + 98}$$

(20)

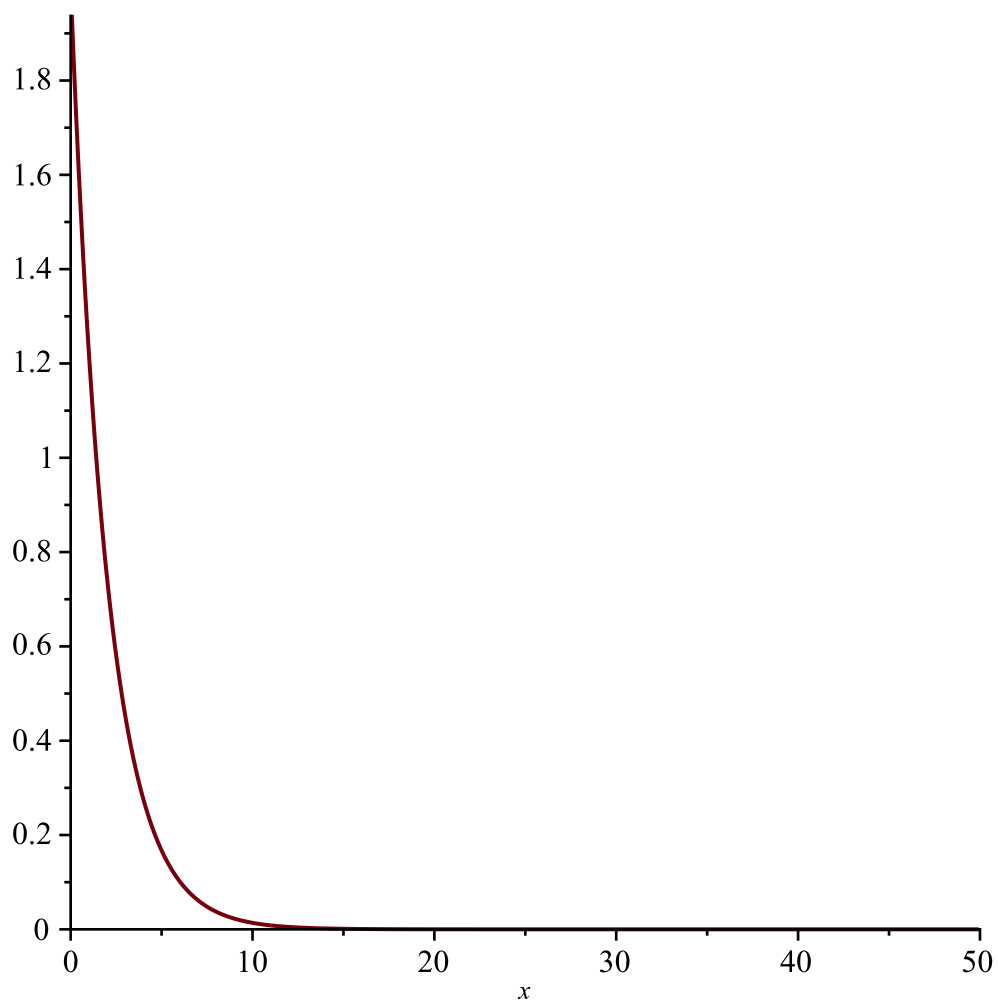$$r := 0.5$$

$$r := 0.5$$

(21)

$$plot(f(x), x = 0 .. 50)$$

$r := -0.5$

$$r := -0.5 \qquad\qquad\qquad \textbf{(22)}$$

$plot(f(x), x = 0..50)$
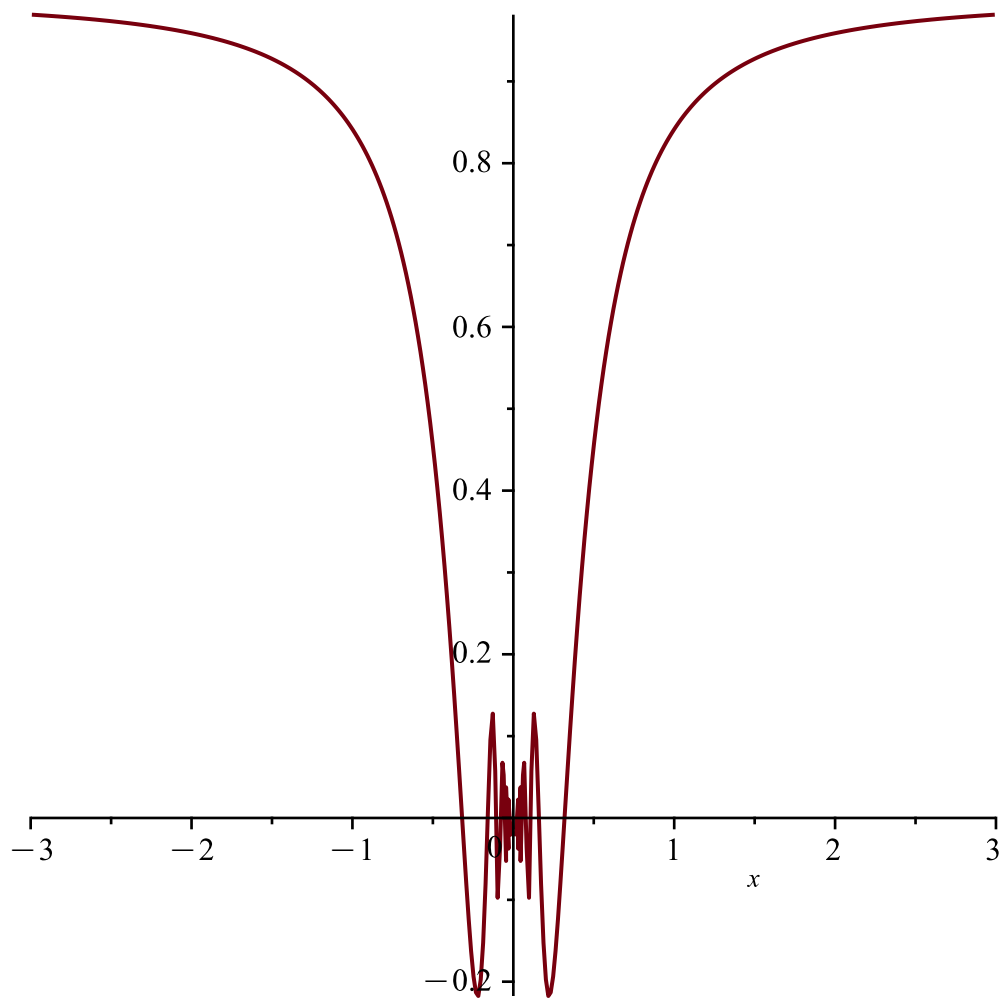
c)

$$f := x \rightarrow x \cdot \sin\left(\frac{1}{x}\right)$$

$$f := x \mapsto x \cdot \sin\left(\frac{1}{x}\right) \tag{23}$$

$$plot(f(x), x = -3..3)$$

6.

a)

$x := t \rightarrow (1 - \cos(t)) \cdot \cos(t)$

$$x := t \mapsto (1 - \cos(t)) \cdot \cos(t) \tag{24}$$

$y := t \rightarrow (1 - \cos(t)) \cdot \sin(t)$

$$y := t \mapsto (1 - \cos(t)) \cdot \sin(t) \tag{25}$$

$plot([x(t), \ y(t), t = 0 .. 2 \cdot \mathrm{Pi}])$
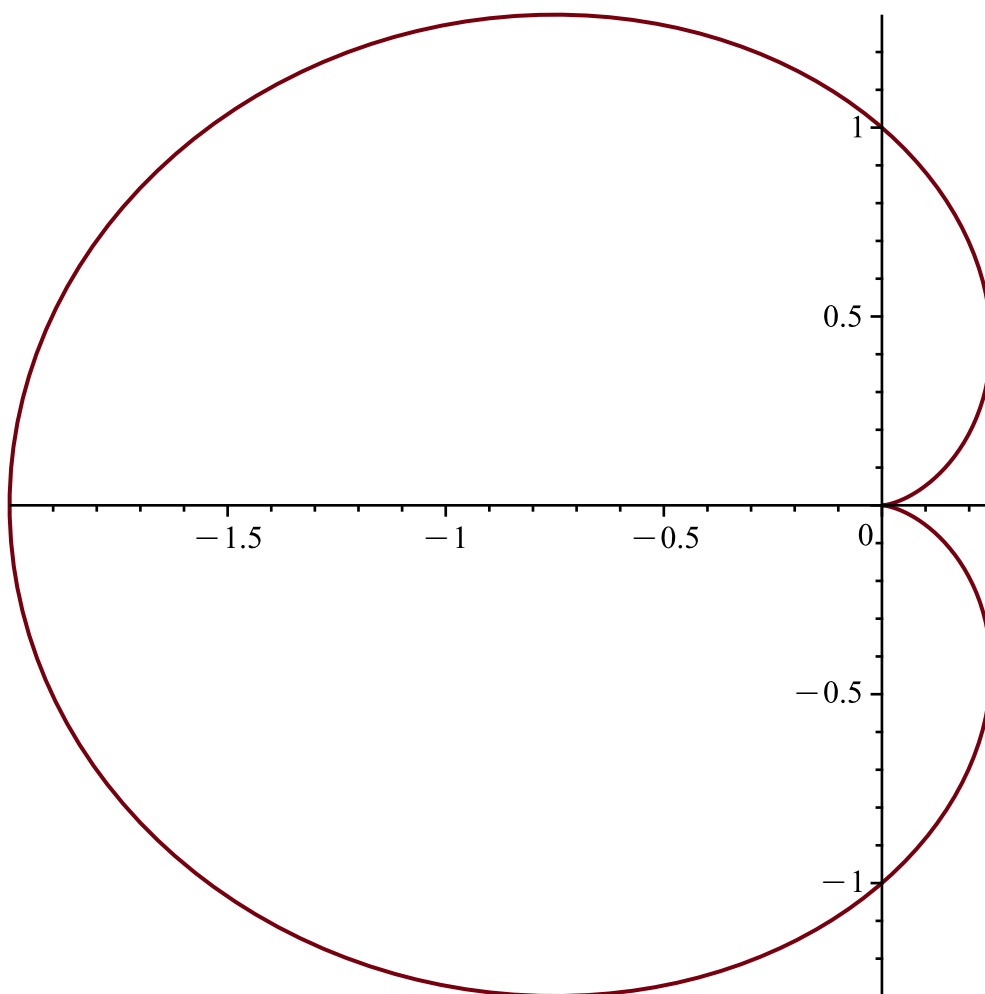
b)

$x := t \rightarrow \sin(3 \cdot t) \cdot \cos(t)$

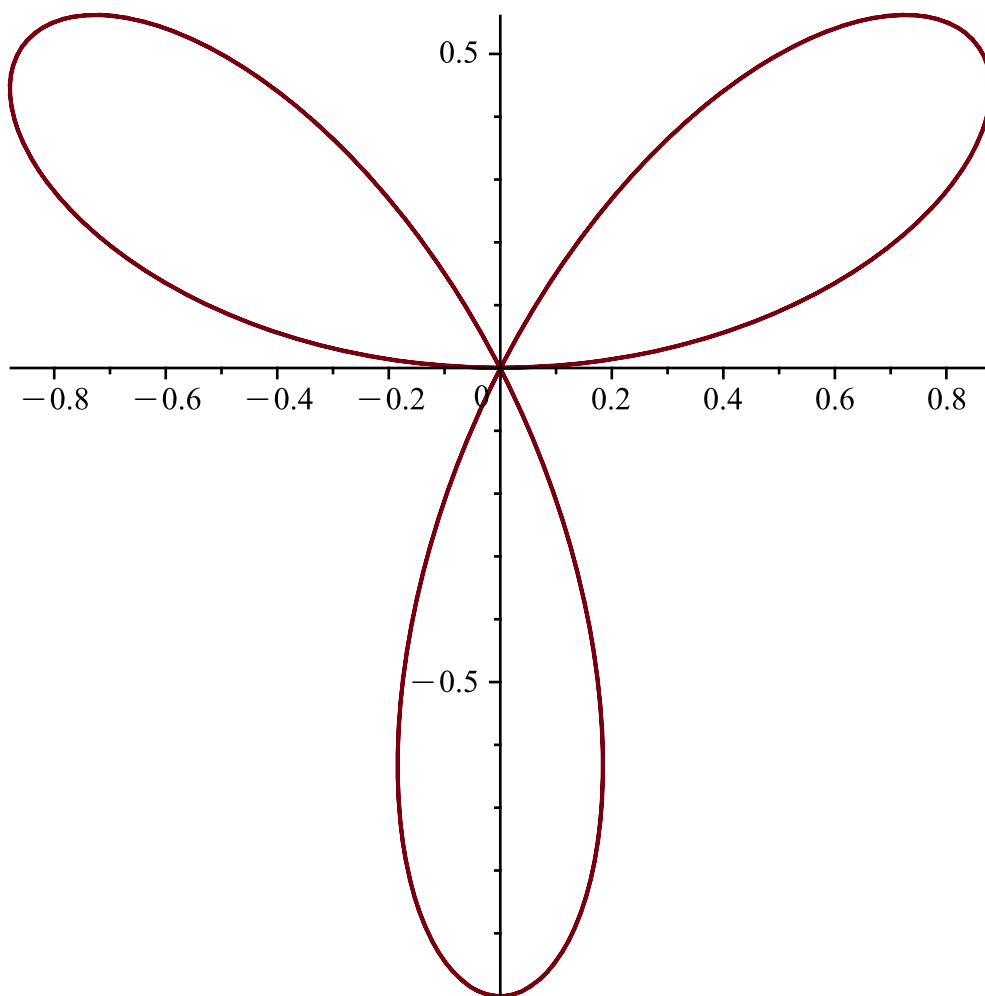$$x := t \mapsto \sin(3 \cdot t) \cdot \cos(t) \tag{26}$$

$y := t \rightarrow \sin(3 \cdot t) \cdot \sin(t)$

$$y := t \mapsto \sin(3 \cdot t) \cdot \sin(t) \tag{27}$$

$plot([x(t), y(t), t = 0 \, .. \, 2 \cdot \mathrm{Pi}])$

c)

$x := t \rightarrow t - \sin(t)$

$$x := t \mapsto t - \sin(t) \qquad \textbf{(28)}$$

$y := t \rightarrow 1 - \cos(t)$

$$y := t \mapsto 1 - \cos(t) \qquad \textbf{(29)}$$

$plot([x(t), y(t), t = 0 .. 6 \cdot \text{Pi}])$
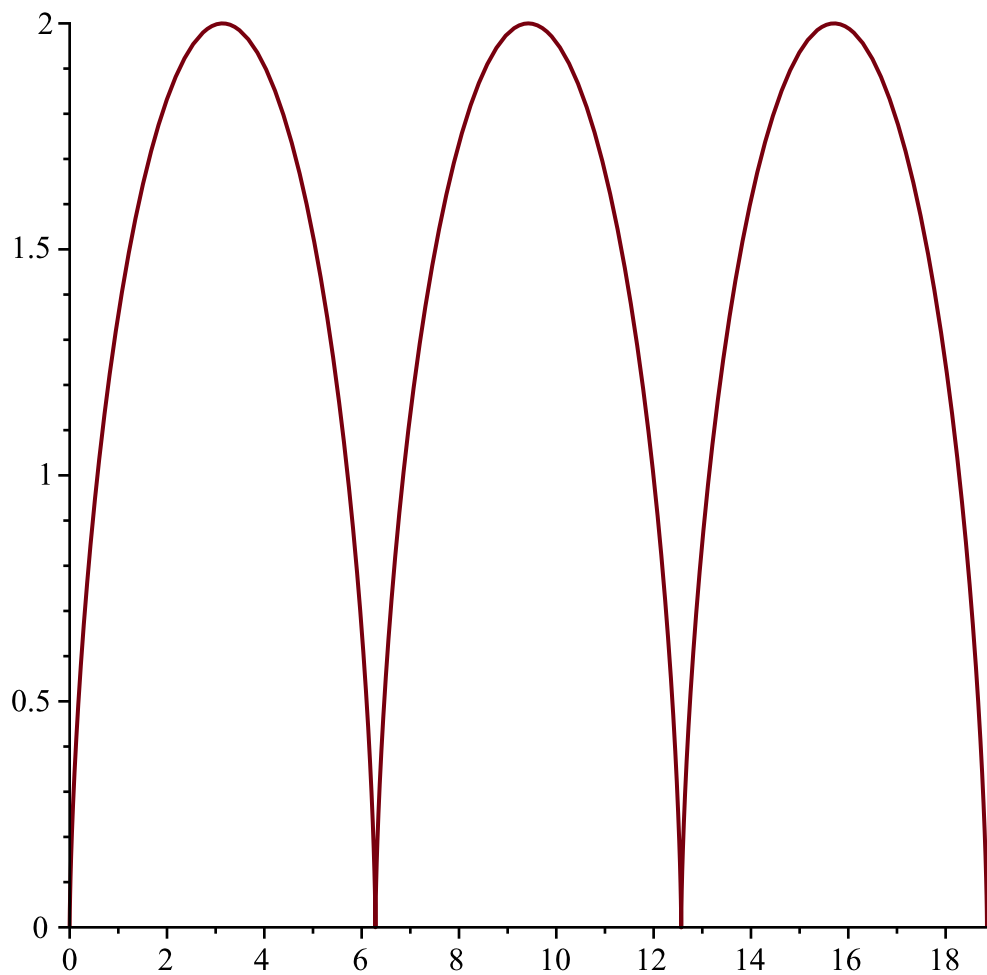
7.

a)

$$f := (t, s) \rightarrow 1 - \frac{s \cdot \cos(4 \cdot t) \cdot \cos(t)}{\mathrm{sqrt}\left(1 - s^2 \cdot (\cos(4 \cdot t))^2 \cdot (\sin(t))^2\right)}$$

$$f := (t, s) \mapsto 1 - \frac{s \cdot \cos(4 \cdot t) \cdot \cos(t)}{\sqrt{1 - s^2 \cdot \cos(4 \cdot t)^2 \cdot \sin(t)^2}} \tag{30}$$

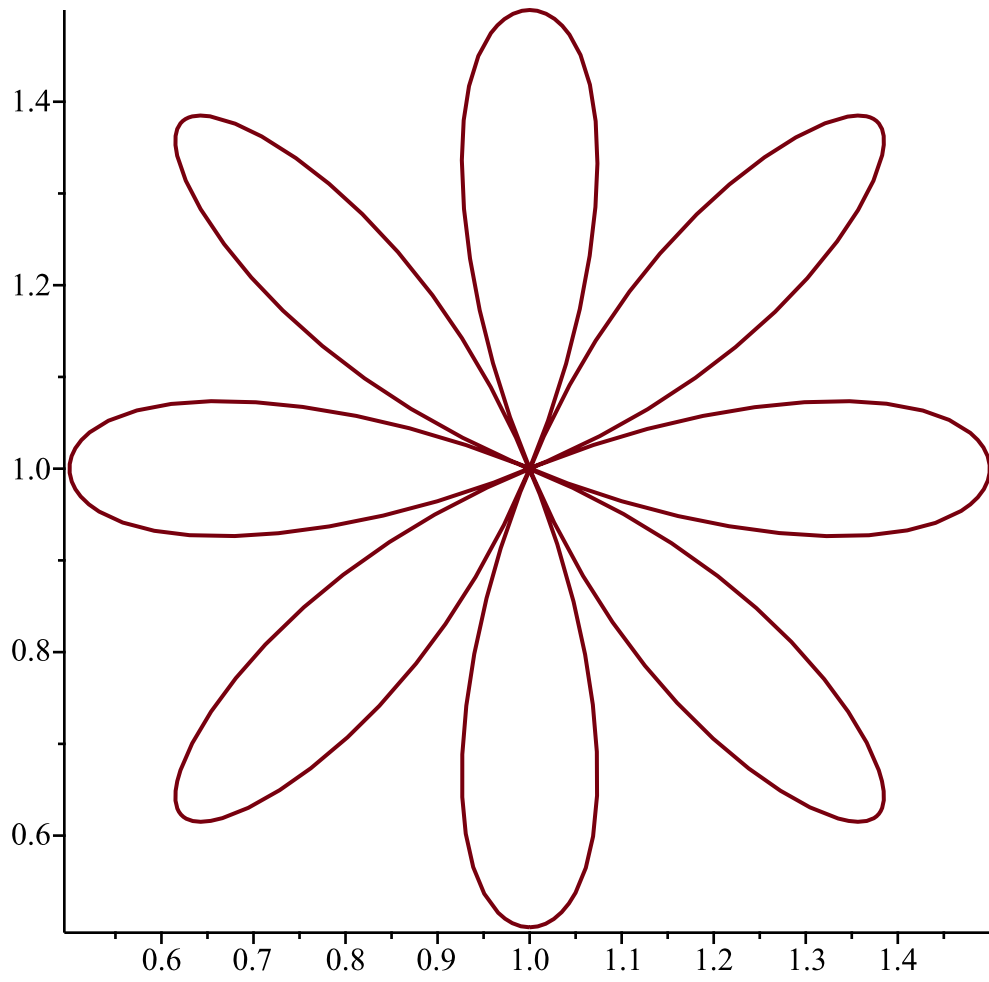$$x := (t, s) \rightarrow f\left(t - \frac{\mathrm{Pi}}{2}, s\right)$$

$$x := (t, s) \mapsto f\left(t - \frac{\pi}{2}, s\right) \tag{31}$$

$$y := (t, s) \rightarrow f(t, s)$$

$$y := (t, s) \mapsto f(t, s) \tag{32}$$

$$s := 0.5 \tag{33}$$

$$plot\left(\left[x(t, 0.5), y(t, 0.5), t = 0 \,..\, 2 \cdot \mathrm{Pi}\right]\right)$$

b)

$$listc := \left[x\left(t, \frac{s}{10}\right), y\left(t, \frac{s}{10}\right), t = 0 ..2 \cdot \text{Pi} \right] \$ s = 1 ..10;$$

$$listc := \left[1 - \frac{\cos(4\,t)\,\sin(t)}{\sqrt{100 - \cos(4\,t)^2\cos(t)^2}}, 1 - \frac{\cos(4\,t)\,\cos(t)}{\sqrt{100 - \cos(4\,t)^2\sin(t)^2}}, t = 0 ..2\,\pi \right], \left[1 \right.$$

$$\left. - \frac{2\cos(4\,t)\,\sin(t)}{\sqrt{100 - 4\cos(4\,t)^2\cos(t)^2}}, 1 - \frac{2\cos(4\,t)\,\cos(t)}{\sqrt{100 - 4\cos(4\,t)^2\sin(t)^2}}, t = 0 ..2\,\pi \right], \left[1 \right.$$

$$\left. - \frac{3\cos(4\,t)\,\sin(t)}{\sqrt{100 - 9\cos(4\,t)^2\cos(t)^2}}, 1 - \frac{3\cos(4\,t)\,\cos(t)}{\sqrt{100 - 9\cos(4\,t)^2\sin(t)^2}}, t = 0 ..2\,\pi \right], \left[1 \right.$$

$$\left. - \frac{4\cos(4\,t)\,\sin(t)}{\sqrt{100 - 16\cos(4\,t)^2\cos(t)^2}}, 1 - \frac{4\cos(4\,t)\,\cos(t)}{\sqrt{100 - 16\cos(4\,t)^2\sin(t)^2}}, t = 0 ..2\,\pi \right], \left[1 \right.$$

$$\left. - \frac{5\cos(4\,t)\,\sin(t)}{\sqrt{100 - 25\cos(4\,t)^2\cos(t)^2}}, 1 - \frac{5\cos(4\,t)\,\cos(t)}{\sqrt{100 - 25\cos(4\,t)^2\sin(t)^2}}, t = 0 ..2\,\pi \right], \left[1 \right.$$

$$\left. - \frac{6\cos(4\,t)\,\sin(t)}{\sqrt{100 - 36\cos(4\,t)^2\cos(t)^2}}, 1 - \frac{6\cos(4\,t)\,\cos(t)}{\sqrt{100 - 36\cos(4\,t)^2\sin(t)^2}}, t = 0 ..2\,\pi \right], \left[1 \right.$$

(34)

$$-\frac{7\cos(4t)\sin(t)}{\sqrt{100-49\cos(4t)^2\cos(t)^2}}, 1-\frac{7\cos(4t)\cos(t)}{\sqrt{100-49\cos(4t)^2\sin(t)^2}}, t=0..2\pi\Bigg], \Bigg[1$$

$$-\frac{8\cos(4t)\sin(t)}{\sqrt{100-64\cos(4t)^2\cos(t)^2}}, 1-\frac{8\cos(4t)\cos(t)}{\sqrt{100-64\cos(4t)^2\sin(t)^2}}, t=0..2\pi\Bigg], \Bigg[1$$

$$-\frac{9\cos(4t)\sin(t)}{\sqrt{100-81\cos(4t)^2\cos(t)^2}}, 1-\frac{9\cos(4t)\cos(t)}{\sqrt{100-81\cos(4t)^2\sin(t)^2}}, t=0..2\pi\Bigg], \Bigg[1$$

$$-\frac{10\cos(4t)\sin(t)}{\sqrt{100-100\cos(4t)^2\cos(t)^2}}, 1-\frac{10\cos(4t)\cos(t)}{\sqrt{100-100\cos(4t)^2\sin(t)^2}}, t=0..2\pi\Bigg]$$

plot([*listc*])
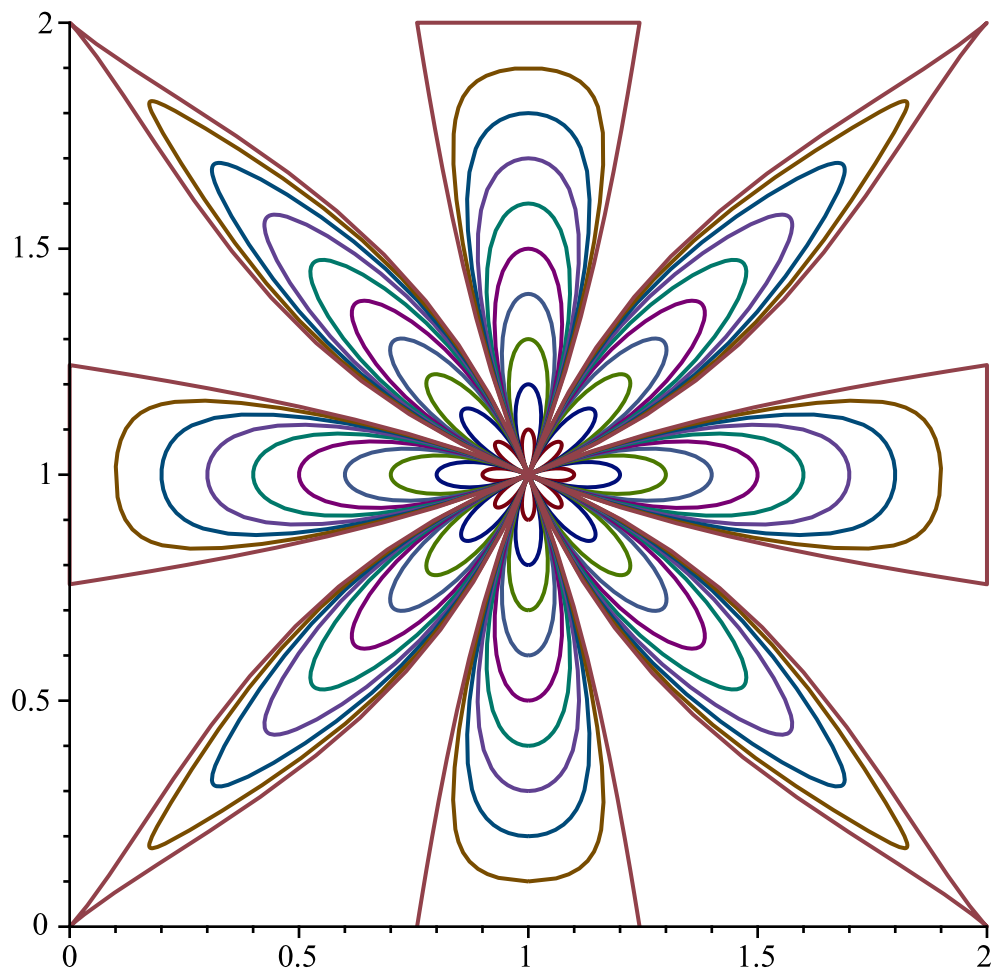
8.

a)

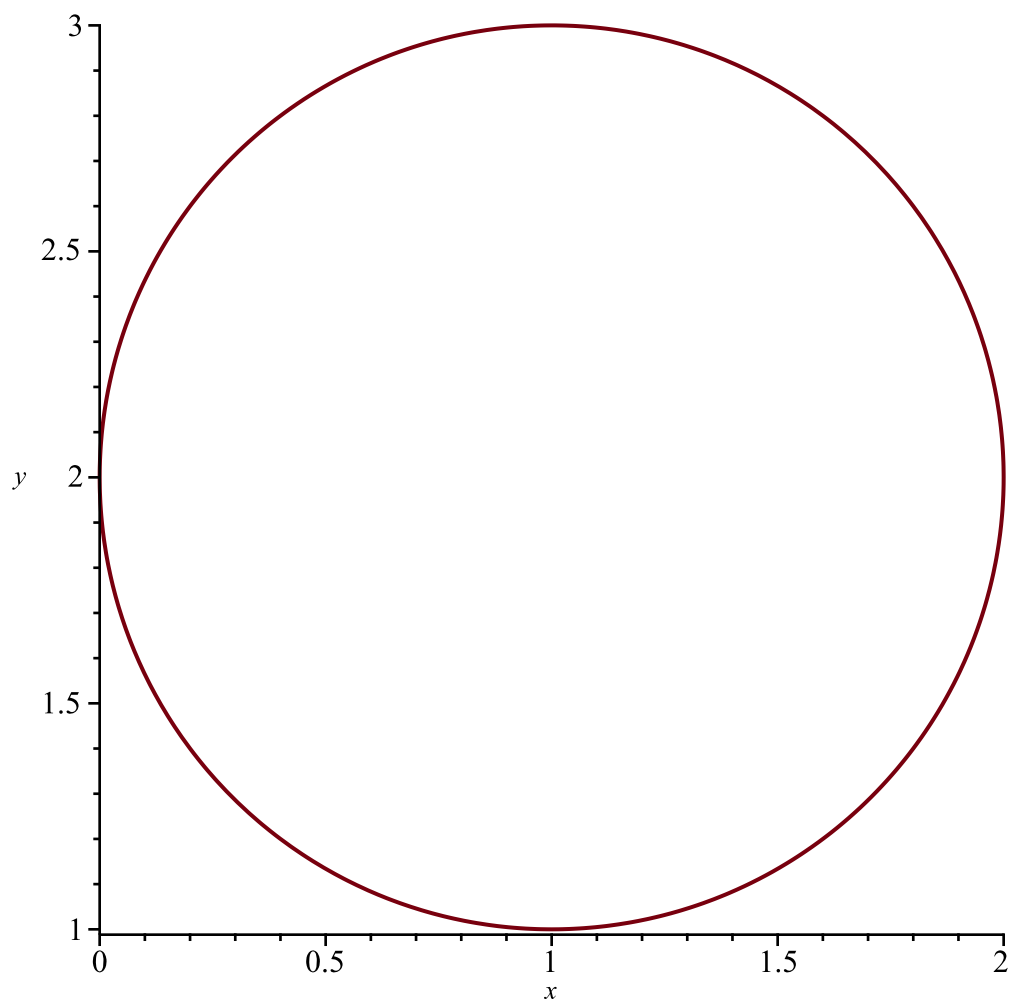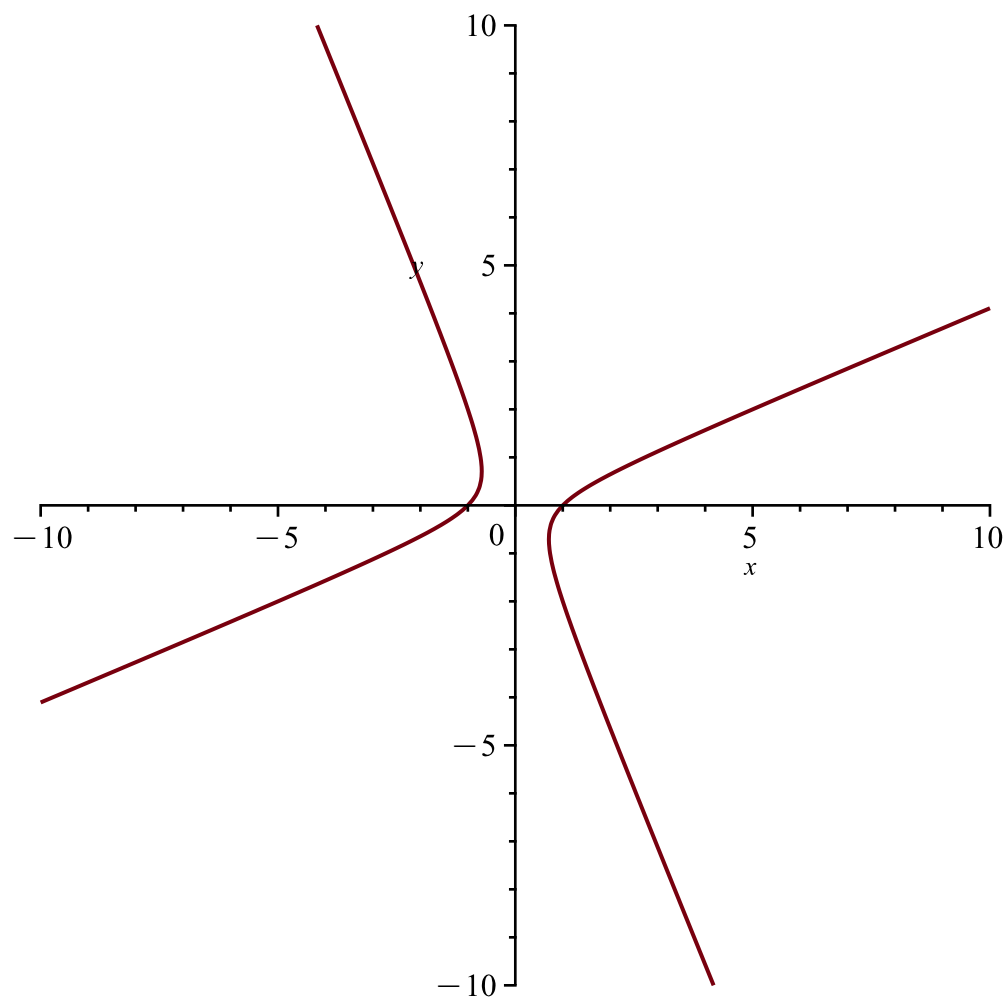*implicitplot*$(x^2+y^2-2x-4y+4=0)$

b)

$$implicitplot\left(x^2 - 2 \cdot x \cdot y - y^2 = 1, x = -10..10, y = -10..10\right)$$
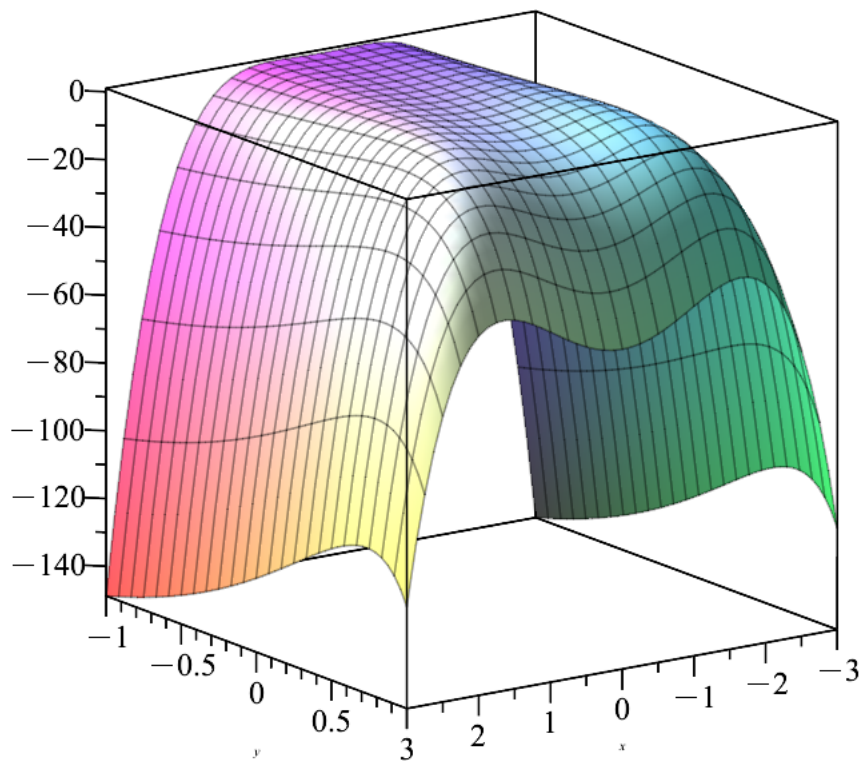
9.

a)

$z := (x, y) \rightarrow 4 \cdot x^2 \cdot \exp(y) - 2 \cdot x^4 - \exp(4 \cdot y)$

$$z := (x, y) \mapsto 4 \cdot x^2 \cdot e^y - 2 \cdot x^4 - e^{4 \cdot y}$$

(35)

$plot3d(z(x, y), x = -3 ..3, y = -1 ..1)$

b)

$z := (x, y) \to 4\,x^2 - y^2$

$$z := (x, y) \mapsto 4 \cdot x^2 - y^2 \qquad \textbf{(36)}$$

$plot3d(z(x, y), x = -100\,..100, y = -100\,..100)$
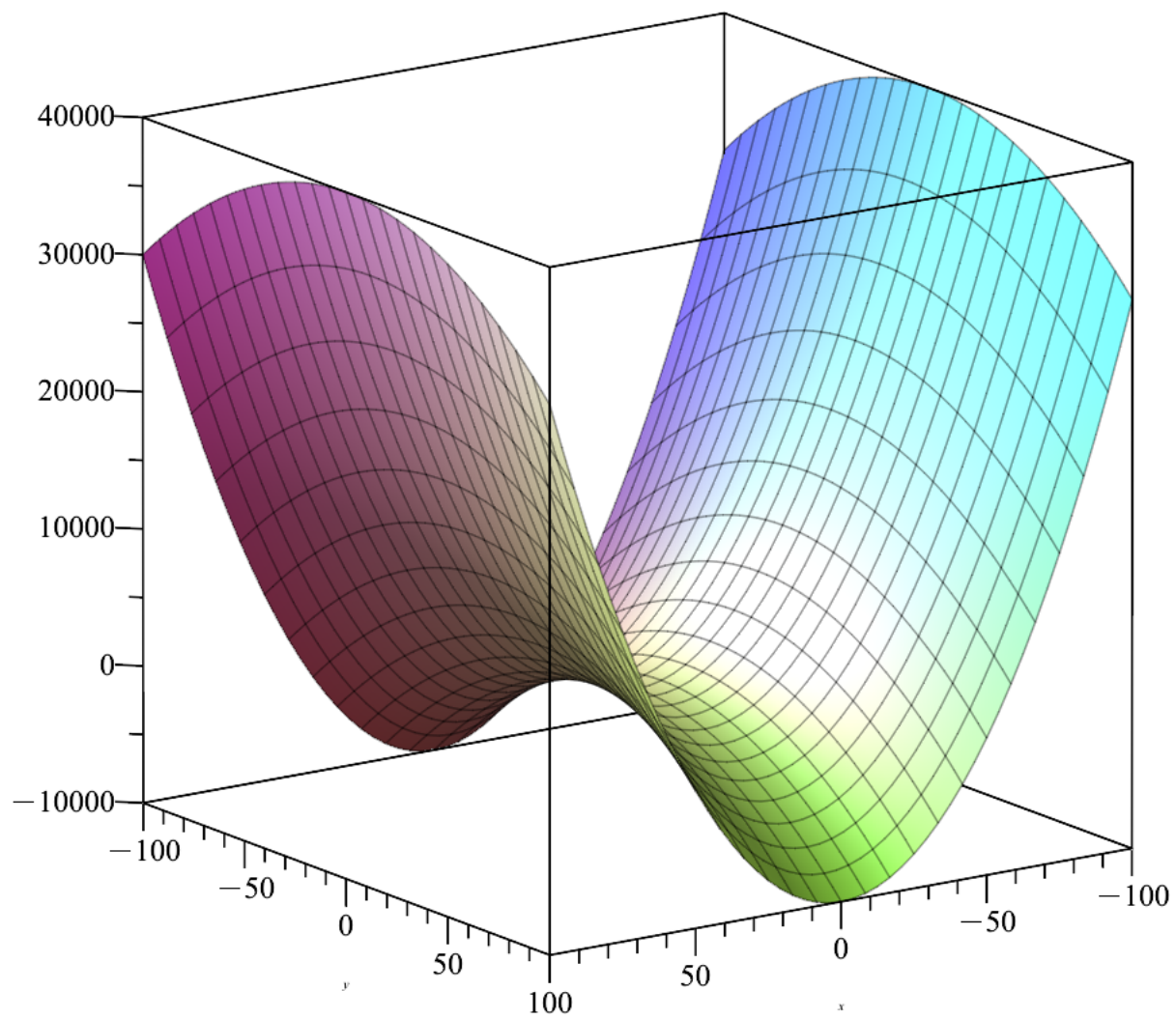
10.

a)

$A := matrix([[1, 2, -1], [0, 1, 0], [3, -1, 2]])$

$$A := \begin{bmatrix} 1 & 2 & -1 \\ 0 & 1 & 0 \\ 3 & -1 & 2 \end{bmatrix} \qquad (37)$$

$B := matrix([[1, 2, 3], [1, 1, 2], [2, 1, 1]])$

$$B := \begin{bmatrix} 1 & 2 & 3 \\ 1 & 1 & 2 \\ 2 & 1 & 1 \end{bmatrix}$$ (38)

$C := matrix([[2, 1, 1], [0, 1, -1], [4, 2, 2]])$

$$C := \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & -1 \\ 4 & 2 & 2 \end{bmatrix}$$ (39)

$evalm(2 \cdot A - B\&*C)$

$$\begin{bmatrix} -12 & -5 & -7 \\ -10 & -4 & -4 \\ -2 & -7 & 1 \end{bmatrix}$$ (40)

b)
$evalm(B^{-1})$

$$\begin{bmatrix} -\dfrac{1}{2} & \dfrac{1}{2} & \dfrac{1}{2} \\ \dfrac{3}{2} & -\dfrac{5}{2} & \dfrac{1}{2} \\ -\dfrac{1}{2} & \dfrac{3}{2} & -\dfrac{1}{2} \end{bmatrix}$$ (41)

c)
$with(linalg)$

[*BlockDiagonal, GramSchmidt, JordanBlock, LUdecomp, QRdecomp, Wronskian, addcol, addrow,* (42)
   adj, adjoint, angle, augment, backsub, band, basis, bezout, blockmatrix, charmat, charpoly,
   cholesky, col, coldim, colspace, colspan, companion, concat, cond, copyinto, crossprod, curl,
   definite, delcols, delrows, det, diag, diverge, dotprod, eigenvals, eigenvalues, eigenvectors,
   eigenvects, entermatrix, equal, exponential, extend, ffgausselim, fibonacci, forwardsub,
   frobenius, gausselim, gaussjord, geneqns, genmatrix, grad, hadamard, hermite, hessian, hilbert,
   htranspose, ihermite, indexfunc, innerprod, intbasis, inverse, ismith, issimilar, iszero, jacobian,
   jordan, kernel, laplacian, leastsqrs, linsolve, matadd, matrix, minor, minpoly, mulcol, mulrow,
   multiply, norm, normalize, nullspace, orthog, permanent, pivot, potential, randmatrix,
   randvector, rank, ratform, row, rowdim, rowspace, rowspan, rref, scalarmul, singularvals,
   smith, stackmatrix, submatrix, subvector, sumbasis, swapcol, swaprow, sylvester, toeplitz, trace,
   transpose, vandermonde, vecpotent, vectdim, vector, wronskian]

$eigenvals(C)$

$$0, 3, 2$$ (43)

eigenvects(*C*)

$$\left[2, 1, \left\{ \begin{bmatrix} 1 & -2 & 2 \end{bmatrix} \right\} \right], \left[0, 1, \left\{ \begin{bmatrix} -1 & 1 & 1 \end{bmatrix} \right\} \right], \left[3, 1, \left\{ \begin{bmatrix} -1 & 1 & -2 \end{bmatrix} \right\} \right]$$

(44)