```
> restart;
> #Digits:=20
> with( plots )
```

[*animate*, *animate3d*, *animatecurve*, *arrow*, *changecoords*, *complexplot*, *complexplot3d*, *conformal*, *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*] **(1)**

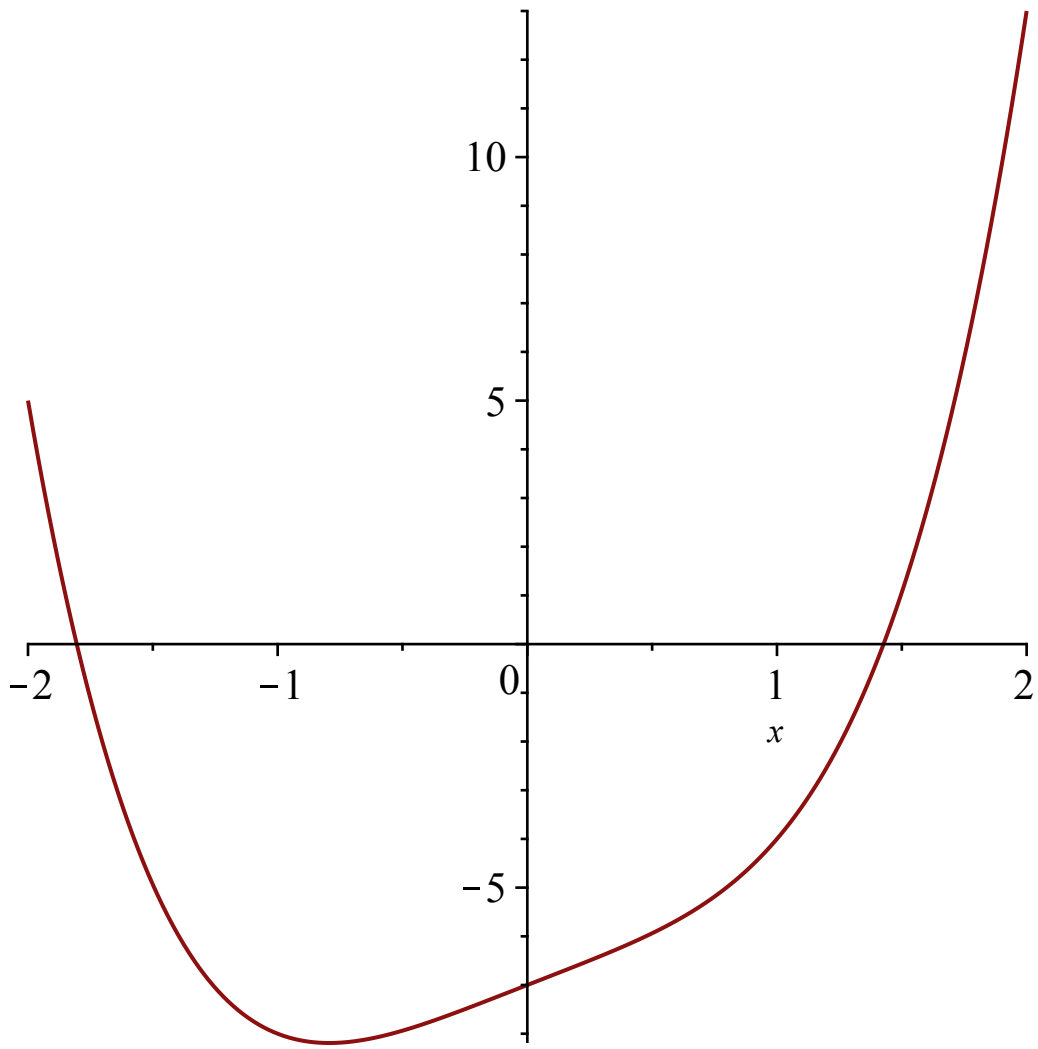
```
> g := x→x^4 + 2·x − 7
```

$$g := x \mapsto x^4 + 2\,x - 7 \quad \textbf{(2)}$$

```
>
> g1 := x→1/(1 + exp(−x))
```

$$g1 := x \mapsto \frac{1}{1 + e^{-x}} \quad \textbf{(3)}$$

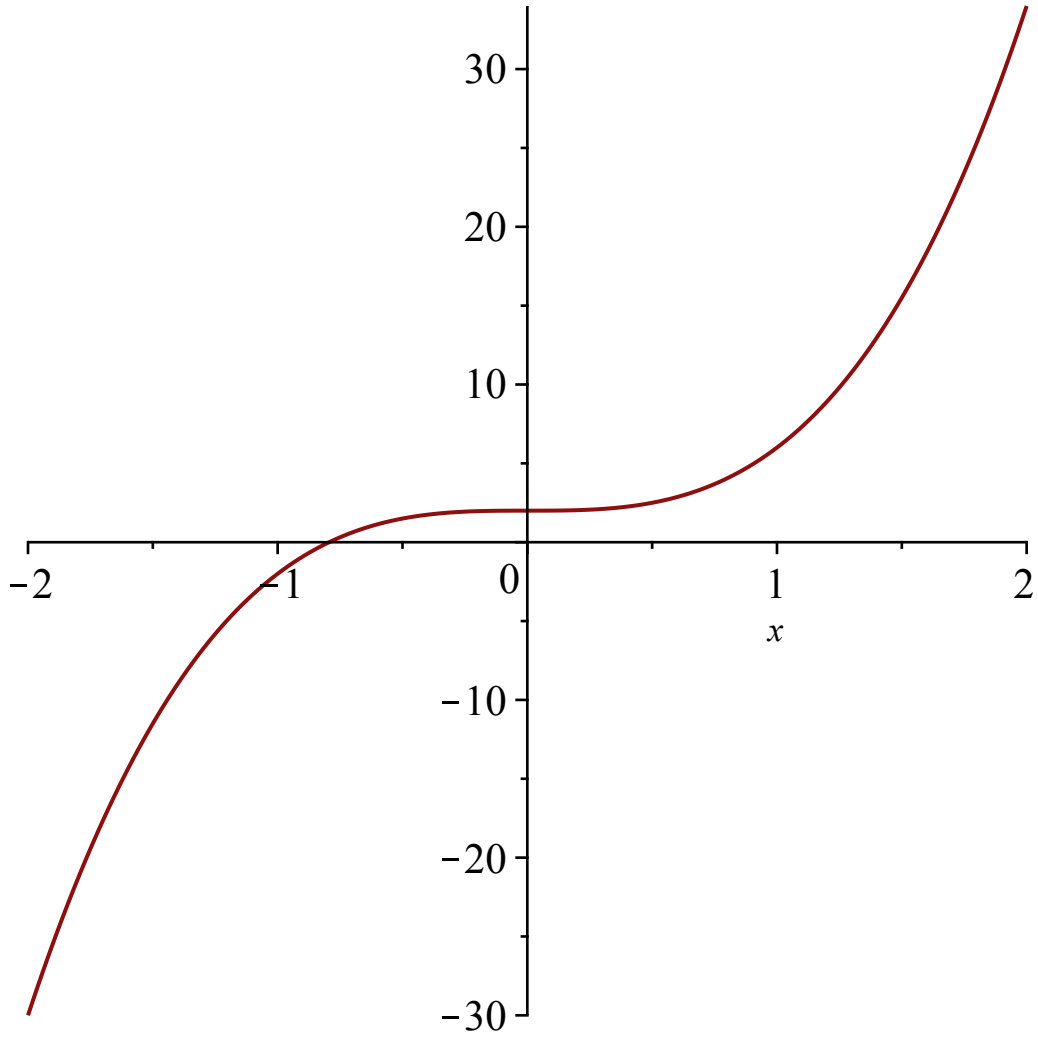
```
> #g := x→ − ln(g1(3·x + 2)·(1 − g1(4·x + 1)))
> plot(g(x), x = −2..2)
```




```
>
>
>
> D(g)(2)
```

34 **(4)**

```
> plot(D(g)(x), x=-2..2)
```



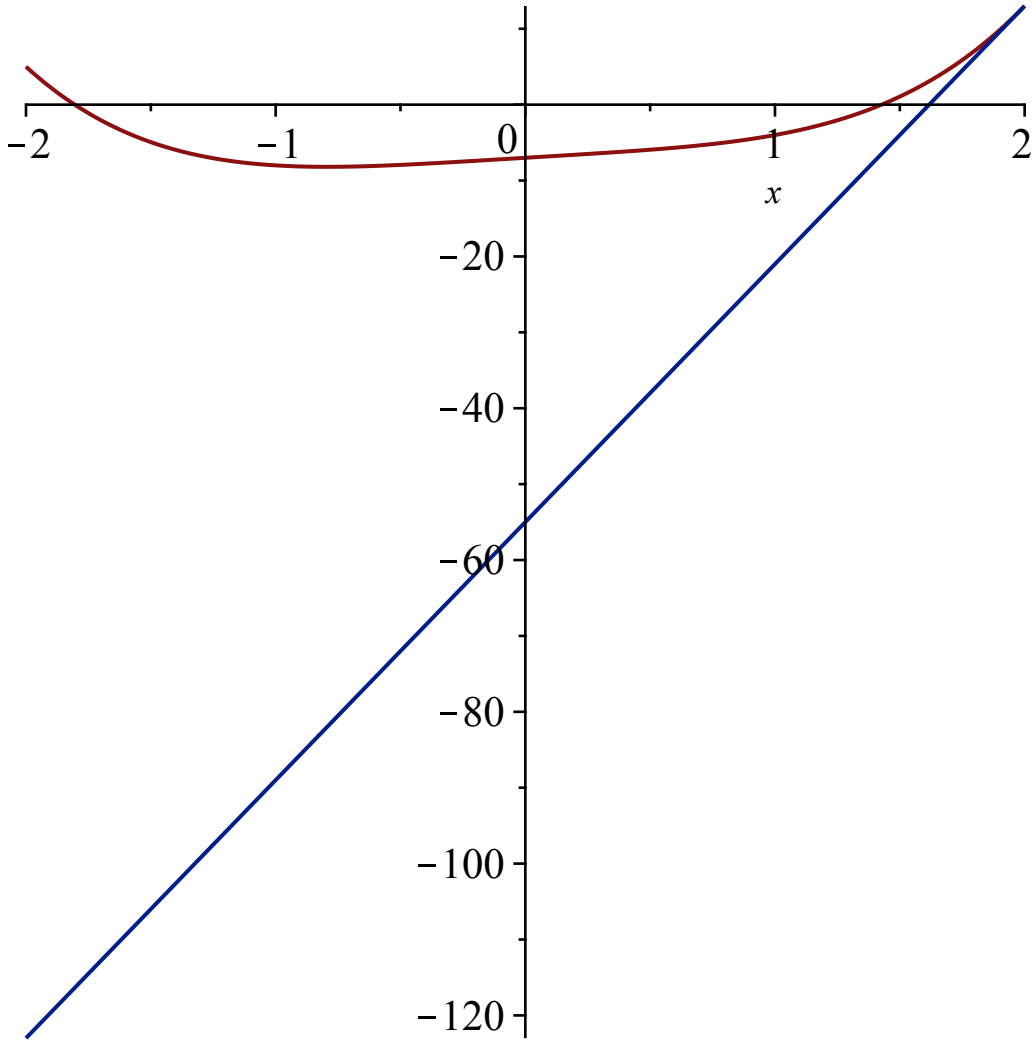

```
> a := 2 #only do this at start of loops
```

$$a := 2 \quad \textbf{(5)}$$

```
>
>
>
>
> mm := D(g)(a) :
>
> bb := g(a) - mm·a :
> gLinear := x→mm·x + bb
```

$$gLinear := x \mapsto mm\,x + bb \quad \textbf{(6)}$$

```
> plot( [g(x), gLinear(x) ], x=-2..2)
```




```
> evalf(mm)
```

34. **(7)**

```
> evalf(g(a))
```

13. **(8)**

```
> evalf(a − .1·mm)
```

−1.4 **(9)**

```
> a := a − .1·mm :

> #### End of one d
>
>
>
>
>
>
>
>
>
```

>

> $f := (x, y) \to x^2 + y^2$

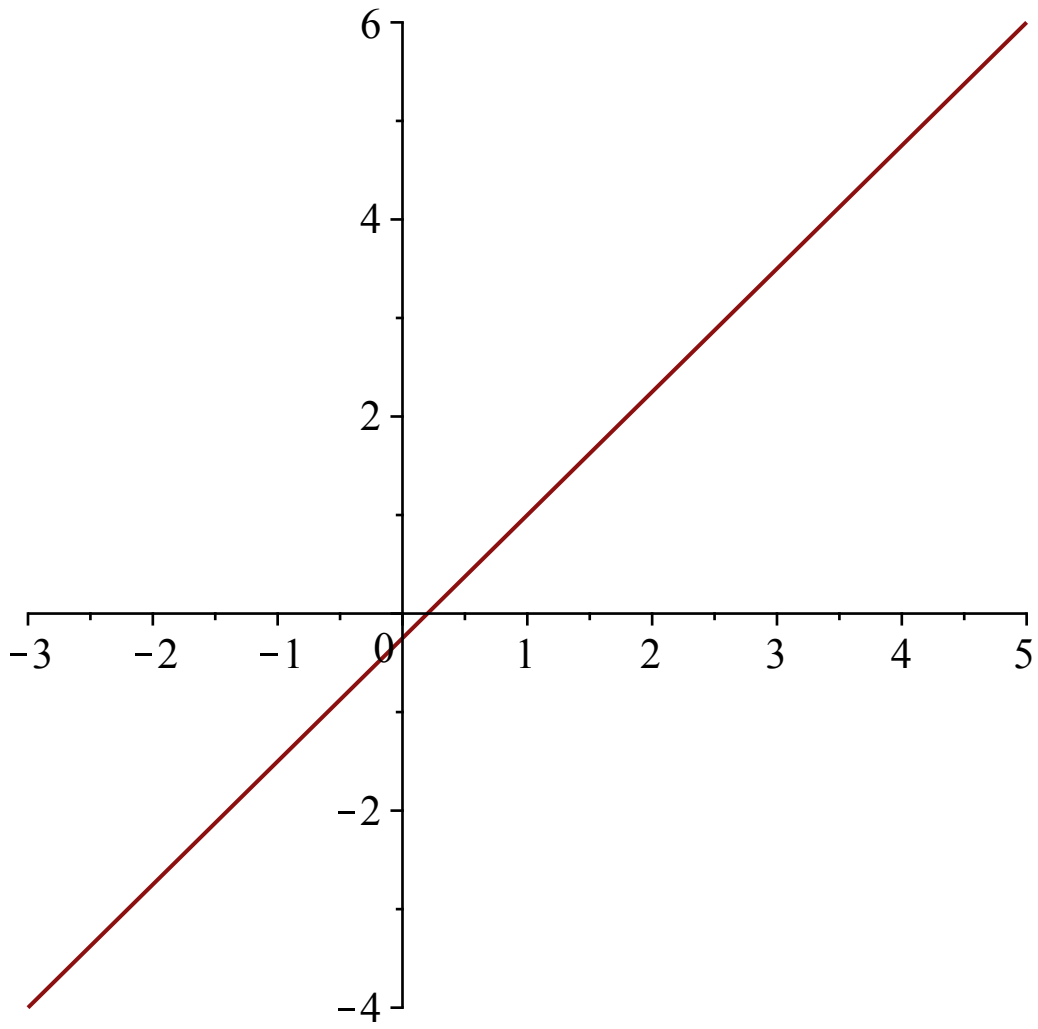
$$f := (x, y) \mapsto x^2 + y^2 \quad \textbf{(10)}$$

>

> $x0 := 1; y0 := 1; r0 := 4; r1 := 5$

$$x0 := 1$$
$$y0 := 1$$
$$r0 := 4$$
$$r1 := 5 \quad \textbf{(11)}$$

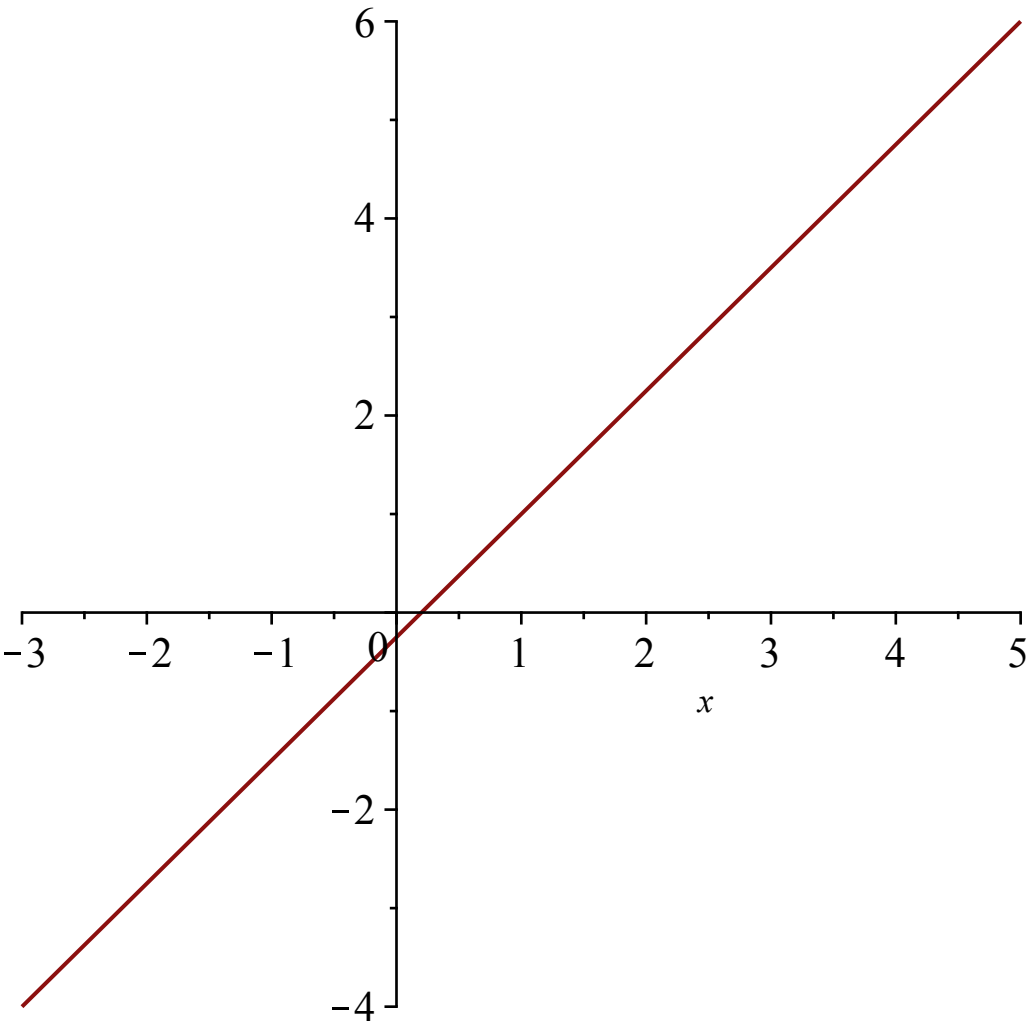
> $plot([x0 + t \cdot r0, y0 + t \cdot r1, t = -1..1])$



> $m := \frac{r1}{r0}; b := y0 - m \cdot x0;$

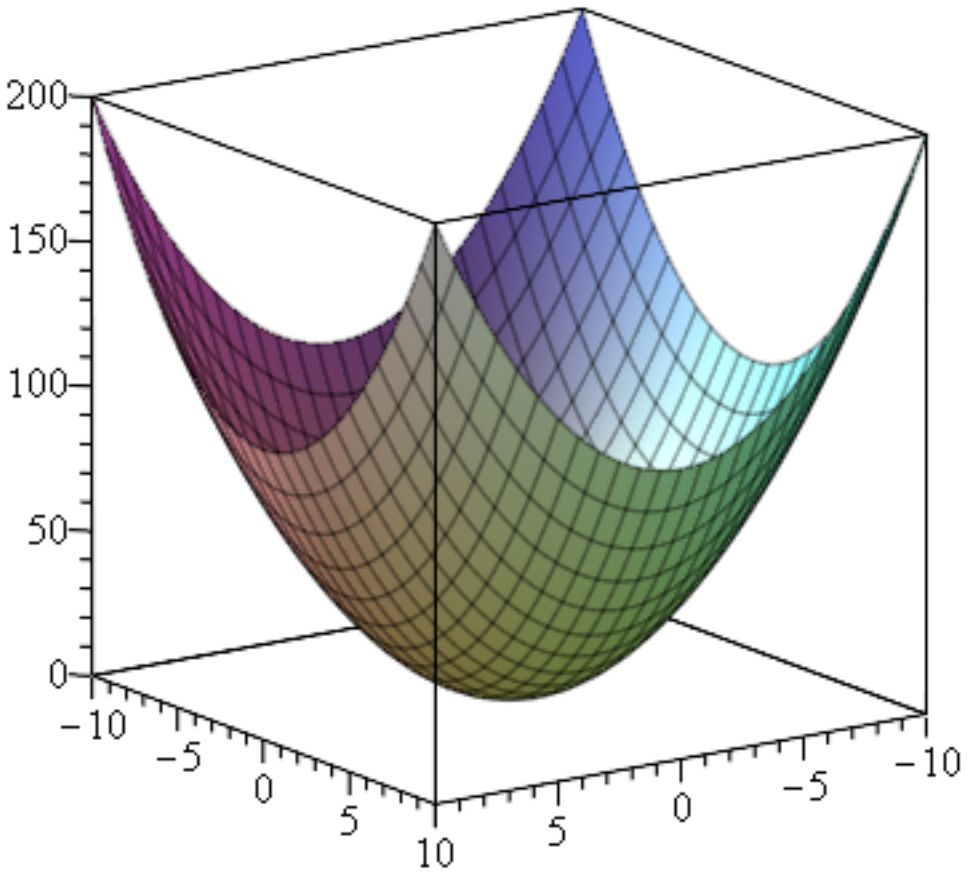
$$m := \frac{5}{4}$$
$$b := -\frac{1}{4} \quad \textbf{(12)}$$

> $plot(m \cdot x + b, x = -3..5)$



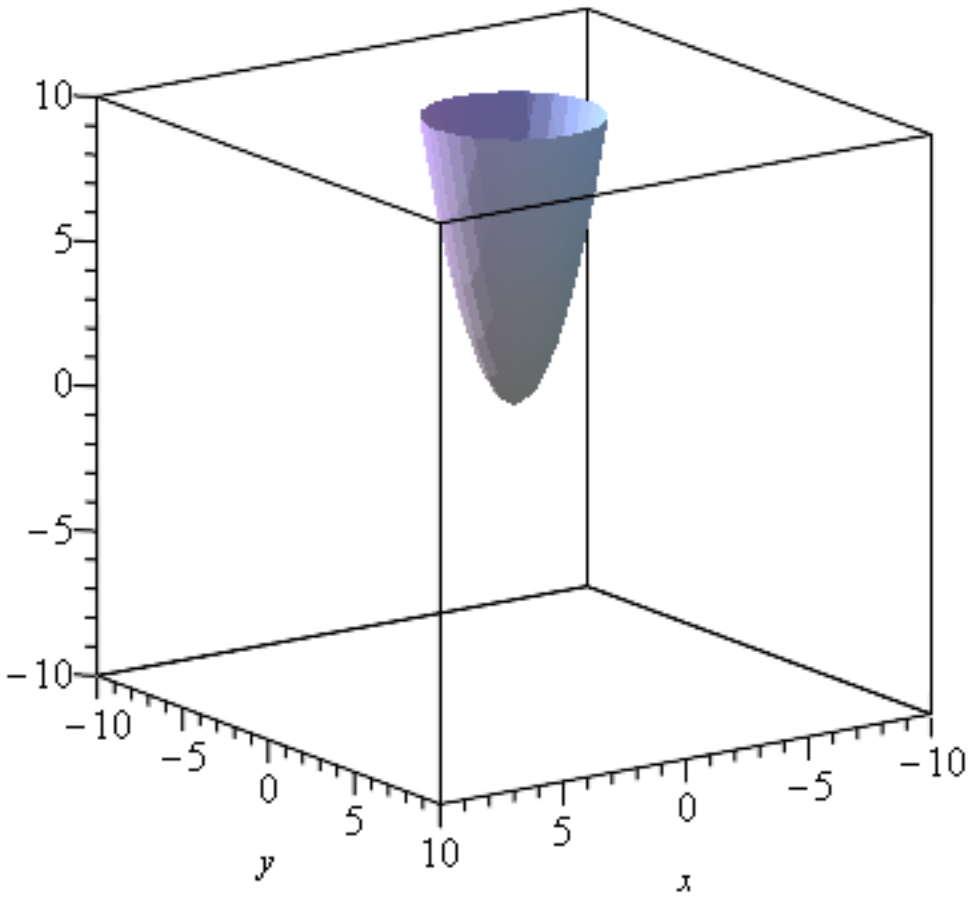
>

> $plot3d([x, y, f(x, y)], x = -10..10, y = -10..10)$

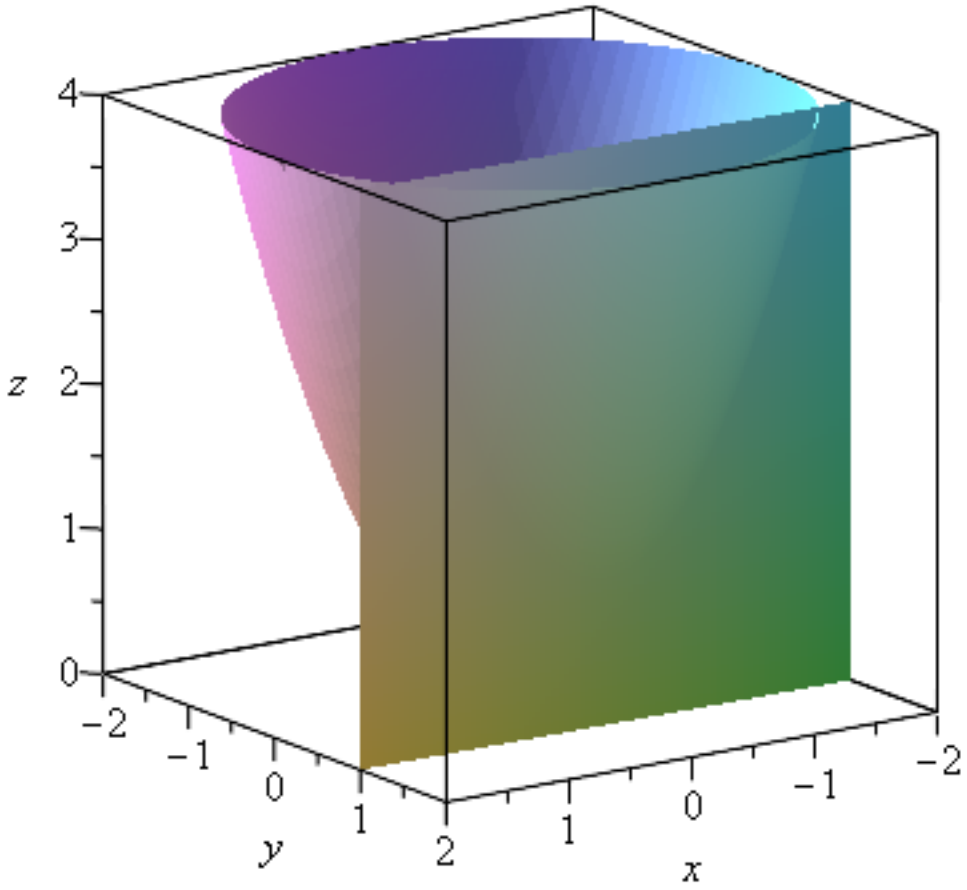


>

> $implicitplot3d(z = f(x, y), x = -10..10, y = -10..10, z = -10..10, style = surface, numpoints = 50000, scaling = constrained)$



> *implicitplot3d*([*y* = *y0*, *z* = *f* (*x*, *y*)], *x* = −2 ..2, *y* = −2 ..2, *z* = 0 ..4, *style* = *surface*, *numpoints* = 50000, *scaling* = *constrained*)



> *y0*

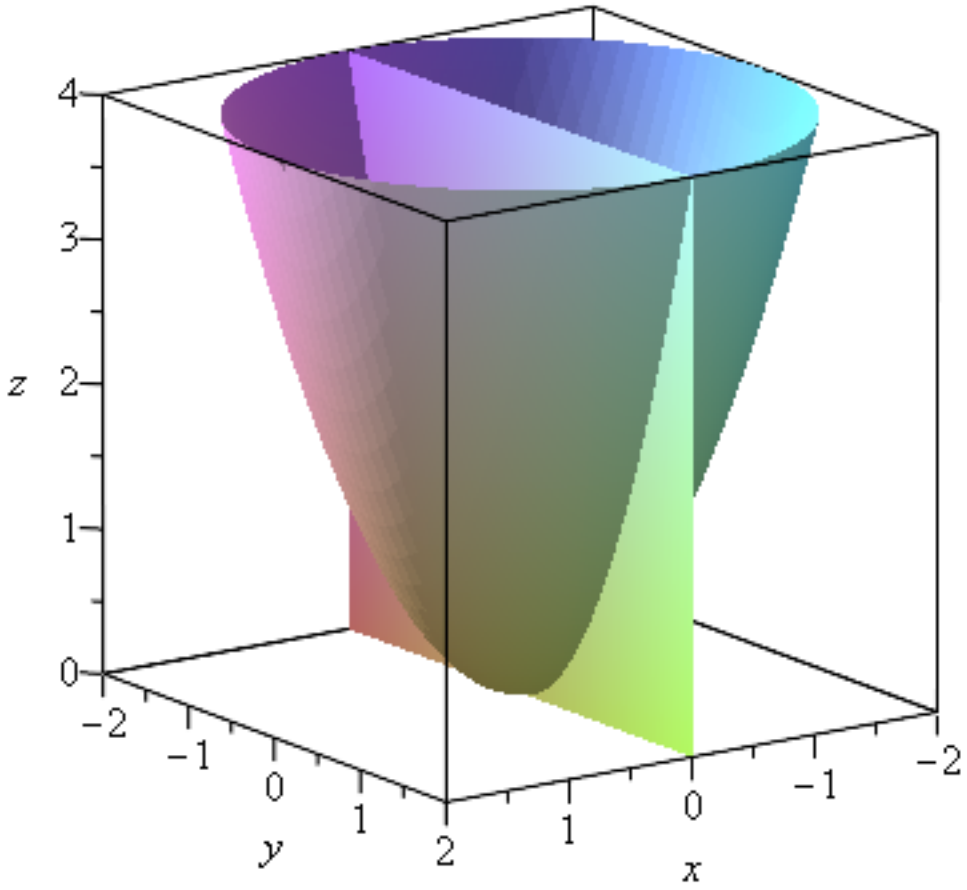
$$1 \quad \textbf{(13)}$$

> *#y0 := y0 + .5*

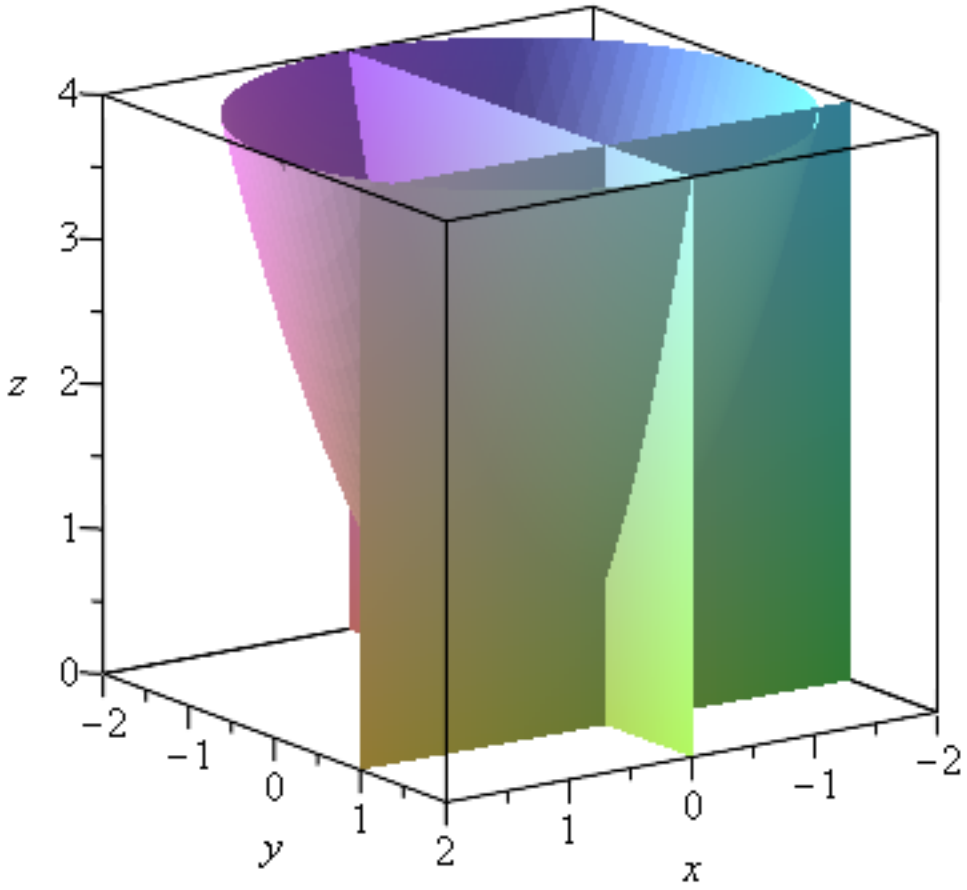
> *x0 := 0*

$$x0 := 0 \quad \textbf{(14)}$$

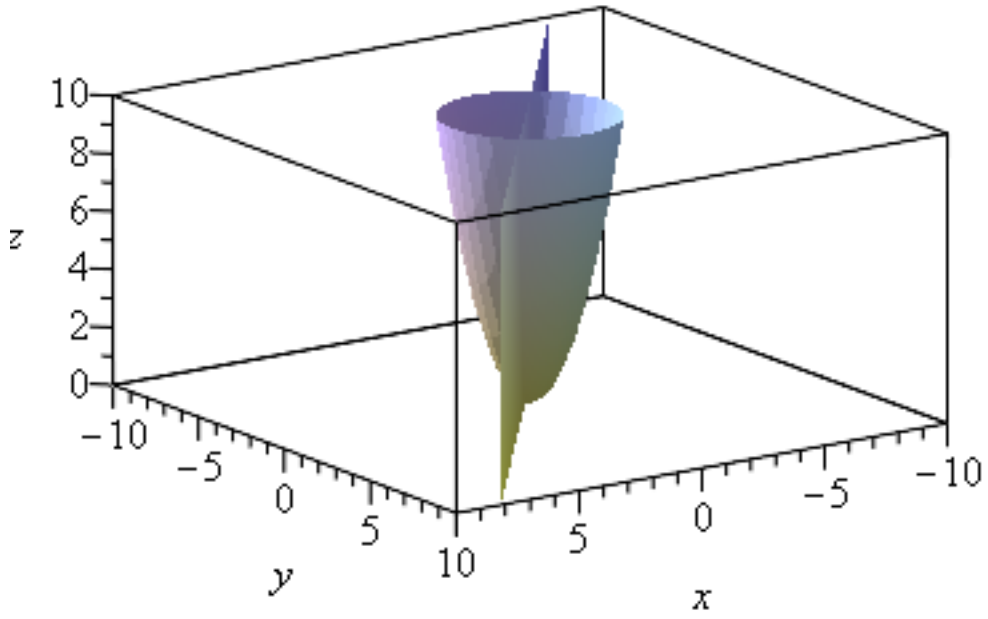
> *implicitplot3d([x = x0, z = f(x, y)], x = -2 ..2, y = -2 ..2, z = 0 ..4, style = surface, numpoints = 50000, scaling = constrained)*



> *implicitplot3d*([*x* = *x0*, *y* = *y0*, *z* = *f*(*x*, *y*)], *x* = −2 ..2, *y* = −2 ..2, *z* = 0 ..4, *style* = *surface*, *numpoints* = 50000, *scaling* = *constrained*)



> *implicitplot3d*([$y = m \cdot x + b$, $z = f(x, y)$], $x = -10..10$, $y = -10..10$, $z = 0..10$, *style* = *surface*, *numpoints* = 50000, *scaling* = *constrained*)



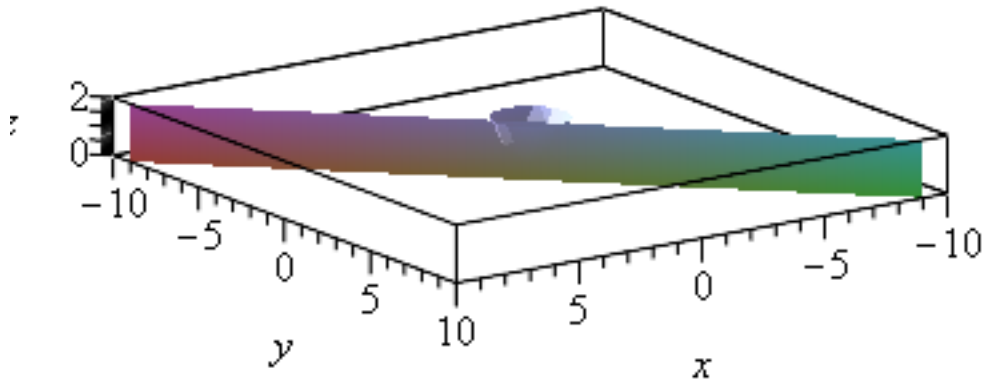
>

> $m := -1; b := y0 - m \cdot x0;$#m=1 gives highest descent, m=-1 worse

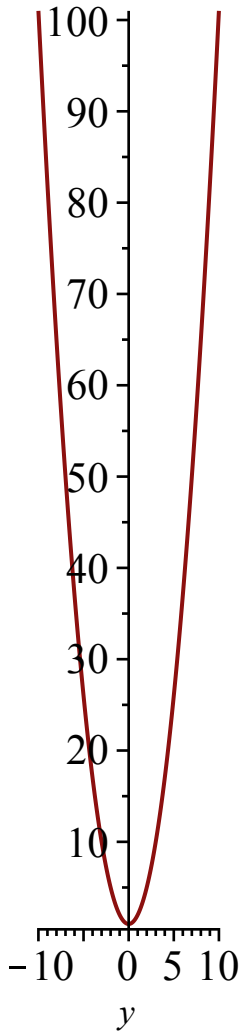
$$m := -1$$

$$b := 1 \quad \textbf{(15)}$$

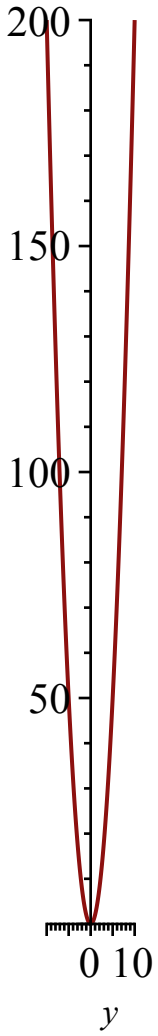
> implicitplot3d([y = m·x + b, z = f(x, y)], x = -10 ..10, y = -10 ..10, z = 0 ..2, style = surface, style = surface, numpoints = 50000, scaling = constrained)




```
> plot(f(1, y), y = -10 ..10, scaling = constrained)#x=1
```




```
> plot(f(y, y), y = -10 ..10, scaling = constrained)#this is at x=y
```



> $x0 := .5; y0 := .7$

$$x0 := 0.5$$
$$y0 := 0.7 \quad \textbf{(16)}$$

> $D[1](f)(x, y)$

$$2x \quad \textbf{(17)}$$

>

> $D[1, 1](f)(x, y)$

$$2 \quad \textbf{(18)}$$

> $h := (x, y) \to 3 \cdot x^5 + 4 \cdot y^3 + x^5 \cdot y^3$

$$h := (x, y) \mapsto x^5 y^3 + 3x^5 + 4y^3 \quad \textbf{(19)}$$

> $D[2](h)(x, y)$

$$3x^5 y^2 + 12y^2 \quad \textbf{(20)}$$

> $D[1, 1](h)(x, y)$

$$20x^3 y^3 + 60x^3 \quad \textbf{(21)}$$

> $D[2, 2, 2](h)(x, y)$

$$6x^5 + 24 \quad \textbf{(22)}$$

```
> D[1, 1, 2](h)(x, y)
```

$$60\,x^3\,y^2 \tag{23}$$

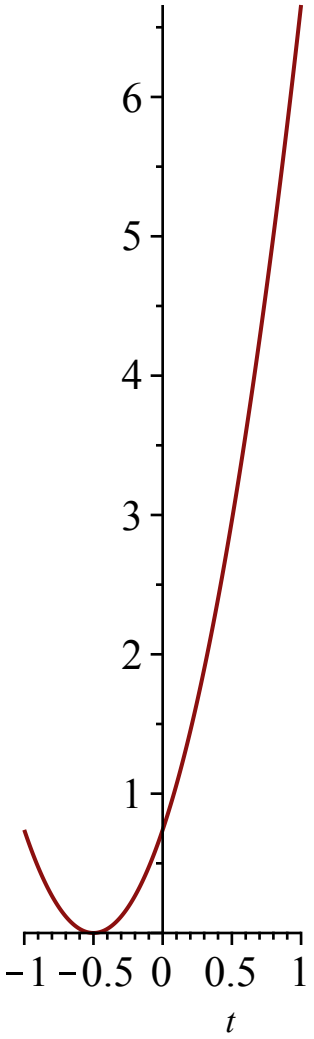
```
>
> Grx := D[1](f)(x0, y0)
```

$$Grx := 1.0 \tag{24}$$

```
> Gry := D[2](f)(x0, y0)
```

$$Gry := 1.4 \tag{25}$$

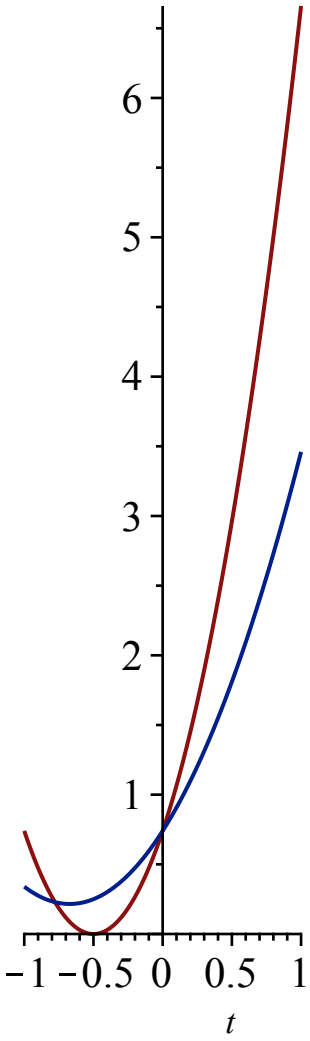
```
> plot(f(x0 + Grx·t, y0 + Gry·t), t = -1..1, scaling = constrained)
```




```
> NotGry := .4
```

$$NotGry := 0.4 \tag{26}$$

```
> plot([f(x0 + Grx·t, y0 + Gry·t), f(x0 + Grx·t, y0 + NotGry·t)], t = -1..1, scaling
      = constrained)
```




```
> vx := 1; vy := 2;
```

$$vx := 1$$

$$vy := 2 \quad \textbf{(27)}$$

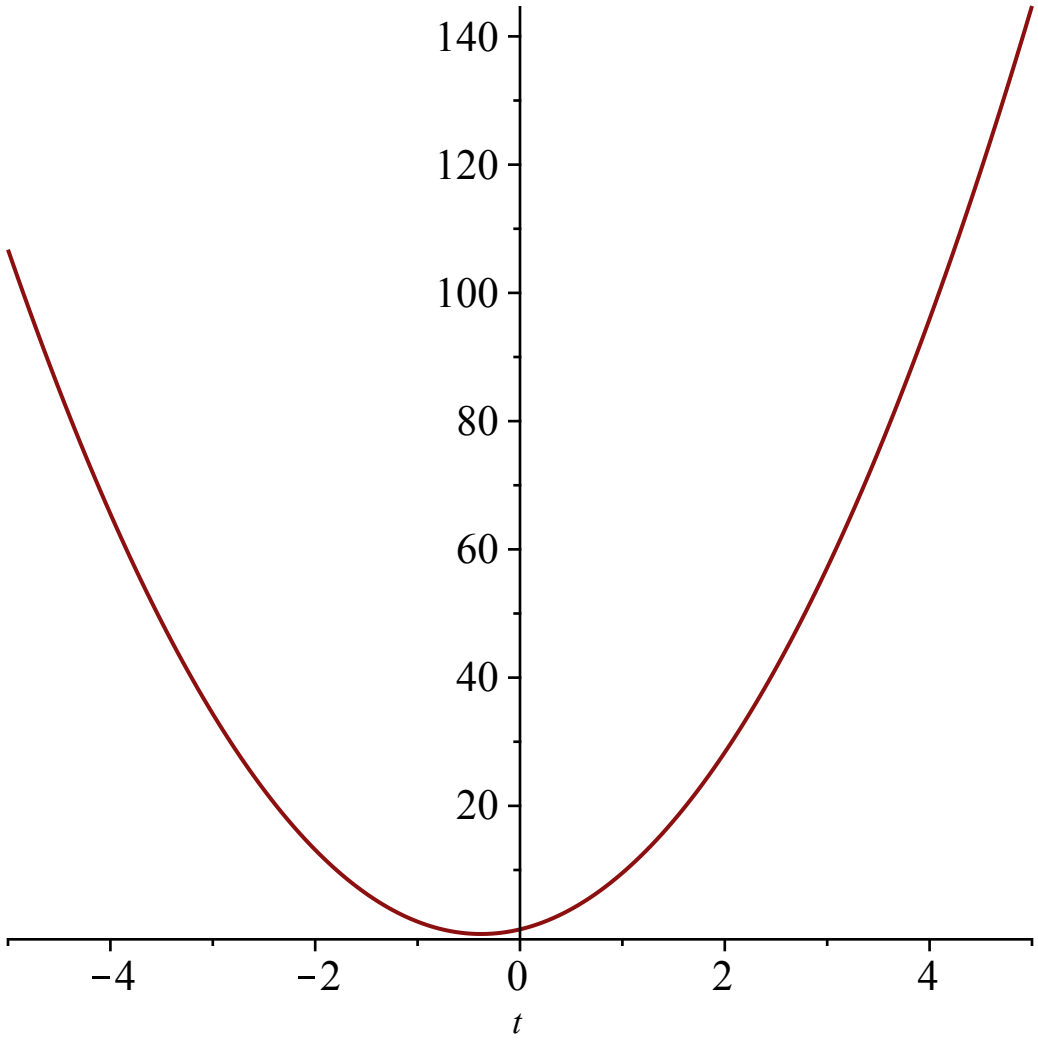
```
> ff := t→ f(x0 + vx·t, y0 + vy·t)
```

$$ff := t \mapsto f(vx\,t + x0, vy\,t + y0) \quad \textbf{(28)}$$

```
> ff(1)
```

$$9.54 \quad \textbf{(29)}$$

```
> plot(ff(t), t=-5..5)
```




```
>
```

```
> diff(ff(t), t)
```

$$3.8 + 10\,t \tag{30}$$

```
> gg := t→ t^2
```

$$gg := t \mapsto t^2 \tag{31}$$

```
> hh := t→t^3
```

$$hh := t \mapsto t^3 \tag{32}$$

```
> fff(t) := f(gg(t), hh(t))
```

$$fff := t \mapsto f(gg(t), hh(t)) \tag{33}$$

```
> diff(fff(t), t)
```

$$6\,t^5 + 4\,t^3 \tag{34}$$

```
> x0; y0
```

$$0.5$$
$$0.7 \tag{35}$$

```
>
```