math16508graphics.mw
Maple 10 Worksheet for Plotting Functions of 2 and 3 Variables
Chapter 7 FIGURE 7.9 p. 553

First load plots and student:
"shading = zhue" gives the same color for equal values of z.
```
> restart: with( student):with (plots):
   setoptions3d(shading=zhue,thickness=2,transparency=0.3);
   setoptions(thickness=2,transparency=0.3);
> f1:= proc(x,y)
       description`-x*y*exp(-(x^2 + y^2)/2)`;
       global titlef1;
       titlef1:=convert(`f1(x,y) = -x*y*exp(-(x^2 + y^2)/2)`,string)
   ;
       -x*y*exp(-(x^2 + y^2)/2);
       end proc:
   `f1(x,y) `:=f1(x,y);
```

$$f1(x,y) := -x\,y\,e^{-\frac{1}{2}x^2 - \frac{1}{2}y^2} \tag{1}$$

```
> f2:= proc(x,y)
       description``;
       global titlef2;
       titlef2:=convert(`f2(x,y) = -exp(-3*(x^2 + y^2))`,string);
       -exp(-3*(x^2 + y^2));
       end proc:
   `f2(x,y) `:=f2(x,y);
```

$$f2(x,y) := -e^{-3x^2 - 3y^2} \tag{2}$$

```
> f3:= proc(x,y)
       description``;
       global titlef3;
       titlef3:=convert(`f3(x,y) = x^4 + y^4 - 2.3*(x^2 + y^2)`,
   string);
       x^4 + y^4 - 2.3*(x^2 + y^2);
       end proc:
   `f3(x,y) `:=f3(x,y);
```

$$f3(x,y) := x^4 + y^4 - 2.3\,x^2 - 2.3\,y^2 \tag{3}$$

```
> f4:= proc(x,y)
       description``;
       global titlef4;
       titlef4:=convert(`f4(x,y) = (0.8* x^2 + y^2) *exp(1 - 1.4*x^2
   - y^2)`,string);
```

```
          (0.8* x^2 + y^2) *exp(1 - 1.4*x^2 - y^2);
        end proc:
  `f4(x,y) `:=f4(x,y);
```

$$f4(x,y) := \left(0.8\,x^2 + y^2\right)\mathrm{e}^{1-1.4\,x^2-y^2} \tag{4}$$

```
> f5:=  proc(x,y,z)
        description``;     global titlef5;
        titlef5:=convert(`f5(x,y,z) = x^2 + y^2 - 0.2*z^2`,string);
        x^2 + y^2 - 0.2*z^2;
        end proc:
  `f5(x,y,z) `:=f5(x,y,z);
```

$$f5(x,y,z) := x^2 + y^2 - 0.2\,z^2 \tag{5}$$

```
> f6:=  proc(x,y,z)
        description`-10 * x^2 - 10 * y^2 + 5 *z^2`;
        global titlef6;
        titlef6:=convert(`f6(x,y,z) = -10 * x^2 - 10 * y^2 + 5 *z^2`,
  string);
        -10 * x^2 - 10 * y^2 + 5 *z^2;
        end proc:
  `f6(x,y,z) `:=f6(x,y,z);
```

$$f6(x,y,z) := -10\,x^2 - 10\,y^2 + 5\,z^2 \tag{6}$$

```
> f7:=  proc(x,y,z)
        description``;
        global titlef7;
        titlef7:=convert(`f7(x,y,z) = 3*x^2 + y^2 +z^2`,string);
        3*x^2 + y^2 +z^2;
        end proc:
  `f7(x,y,z) `:=f7(x,y,z);
```

$$f7(x,y,z) := 3\,x^2 + y^2 + z^2 \tag{7}$$

Set up ranges
```
> onerange:= -1 .. 1;
  tworange:= -2 .. 2;
  threerange:= -3 .. 3;
  fourrange:= -4 ..4;
```

$$onerange := -1..1$$
$$tworange := -2..2$$
$$threerange := -3..3$$
$$fourrange := -4..4 \tag{8}$$

Some other functions
```
> fcone:=  proc(x,y)
```

```
        description``;
        global titlefcone;
        titlefcone:=convert(`fcone(x,y = sqrt(x^2 + y^2)`,string);
        sqrt(x^2 + y^2);
        end proc:
  `fcone(x,y) `:=fcone(x,y);
```

$$fcone(x,y) := \sqrt{x^2 + y^2} \qquad\qquad (9)$$

```
> fpara:=  proc(x,y)
        description``;
        global titlefpara;
        titlefpara:=convert(`fpara(x,y,z) = (x^2 + y^2)`,string);
        (x^2 + y^2);
        end proc:
  `fpara(x,y) `:=fpara(x,y);
```

$$fpara(x,y) := x^2 + y^2 \qquad\qquad (10)$$

```
> fellips:=  proc(x,y)
        description``;
        global titlefellips;
        titlefellips:=convert(`fpara(x,y,z) = sqrt(9 - 3*x^2 - 2*y^2)
  `,string);
        sqrt(9 - 3*x^2 - 2*y^2);
        end proc:
  `fellips(x,y) `:=fellips(x,y);
```

$$fellips(x,y) := \sqrt{9 - 3\,x^2 - 2\,y^2} \qquad\qquad (11)$$

```
> plot3d(fcone(x,y),x=fourrange,y=fourrange,axes = normal,tickmarks=
  [3,3,3],title=`titlefcone`);
  plot3d(fcone(x,y),x=onerange,y=onerange,axes = normal,tickmarks=
  [3,3,3],title=`titlefcone`);
  contourplot(fcone(x,y),x=-1..1,y=-1..1,title=cat(`contourplot\n`,
  `level curves \n`,`titlefcone`));
  contourplot3d(fcone(x,y),x=-1..1,y=-1..1,title=`titlefcone`);
```

fcone(x,y = sqrt(x^2 + y^2)
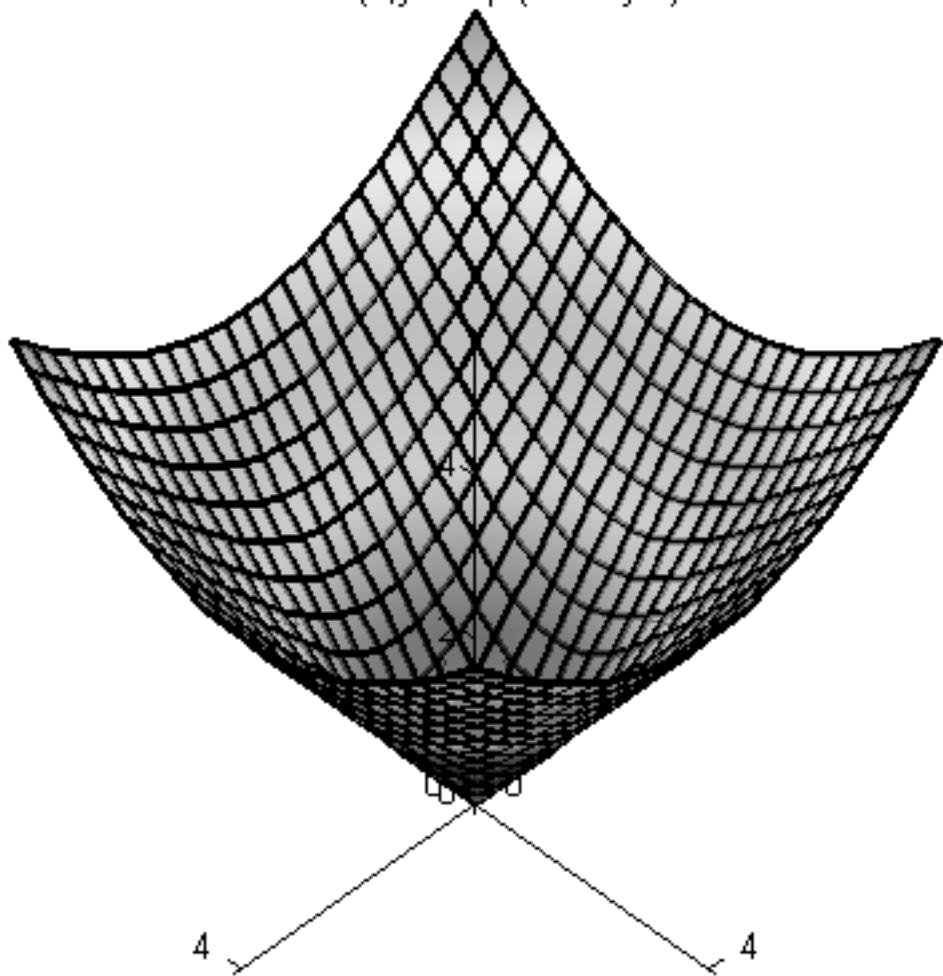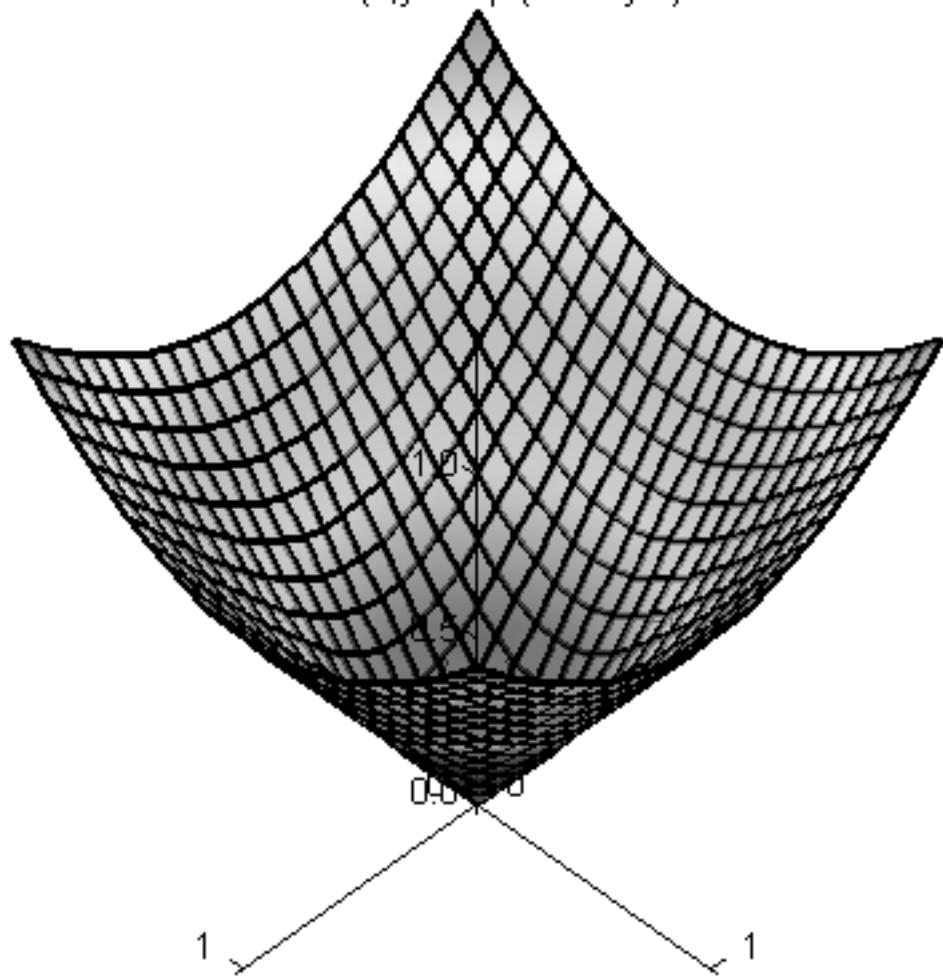
fcone(x,y = sqrt(x^2 + y^2)

contourplot
level curves
fcone(x,y = sqrt(x^2 + y^2)
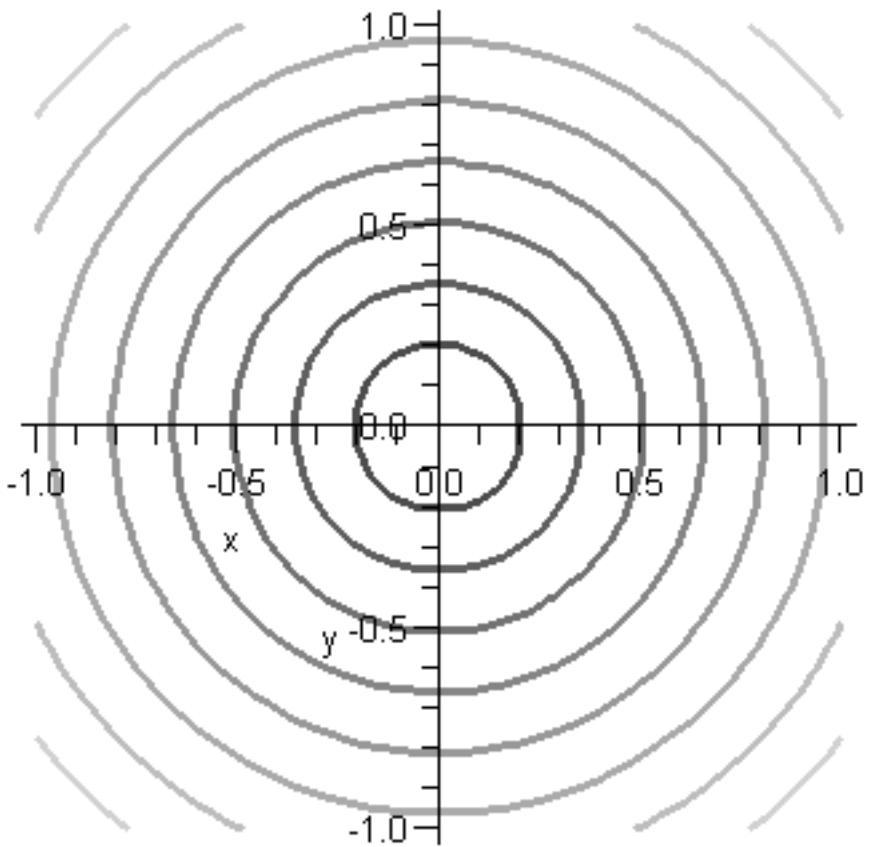
fcone(x,y = sqrt(x^2 + y^2)
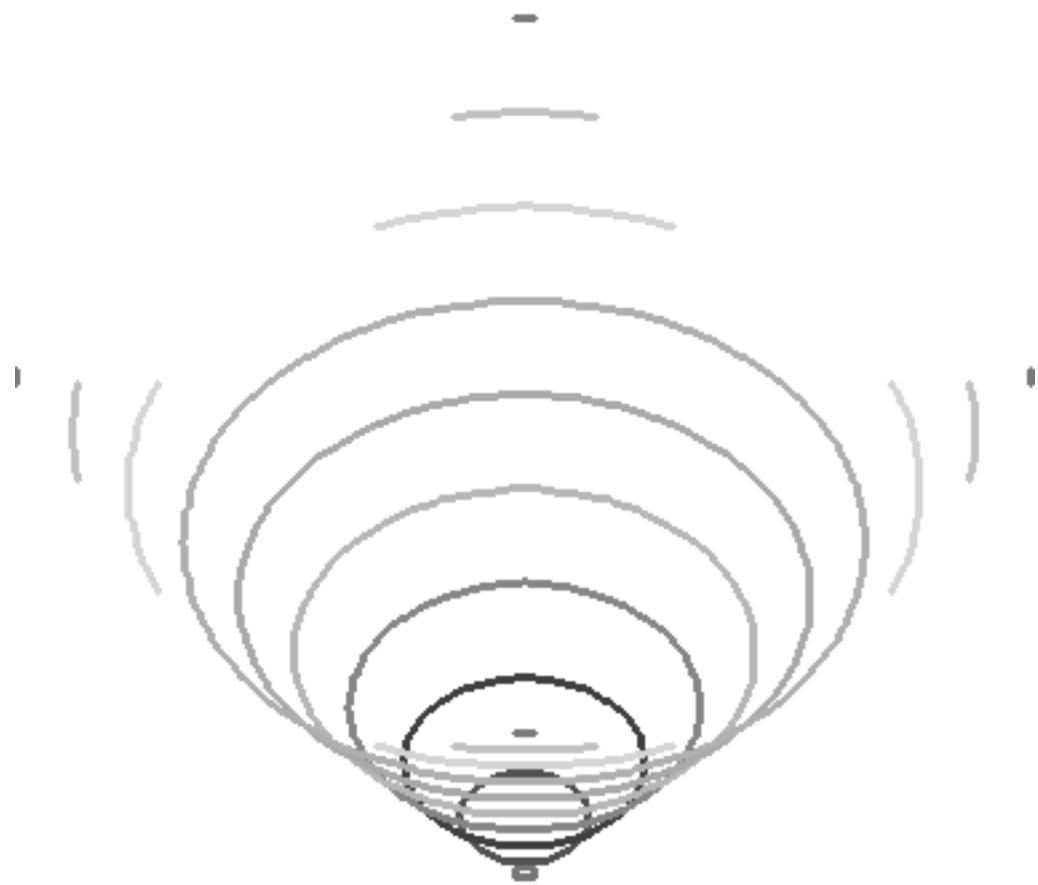

> `plot3d(fpara(x,y),x=fourrange,y=fourrange,axes = normal,tickmarks=`
  `[3,3,3],title=`titlefpara`);`
  `plot3d(fpara(x,y),x=onerange,y=onerange,axes = normal,tickmarks=`
  `[3,3,3],title=`titlefpara`);`
  `contourplot(fpara(x,y),x=-1..1,y=-1..1,title=cat(`contourplot\n`,`
  `` `level curves \n`,`titlefpara`)); ``
  `contourplot3d(fpara(x,y),x=-1..1,y=-1..1,title=cat`
  `` (`contourplot3d\n`,`level curves at height z\n`,`titlefpara`)); ``

fpara(x,y,z) = (x^2 + y^2)

fpara(x,y,z) = (x^2 + y^2)

contourplot
level curves
fpara(x ,y ,z) = (x^2 + y^2)
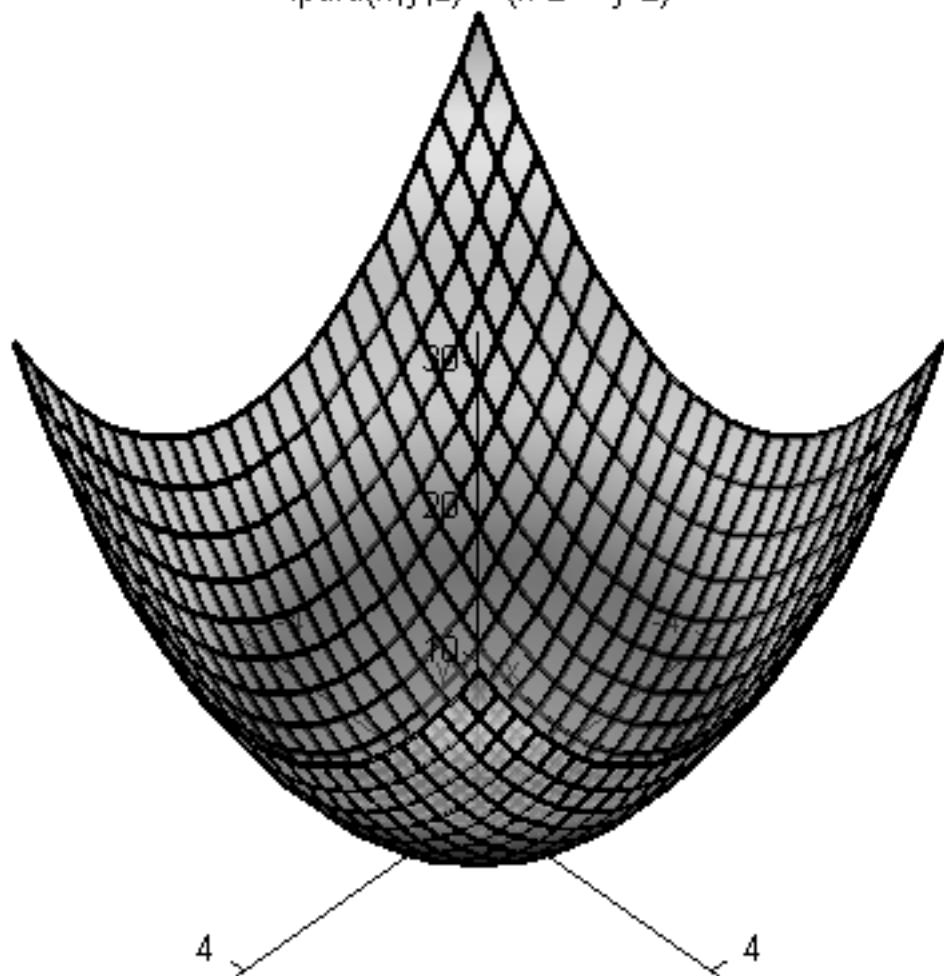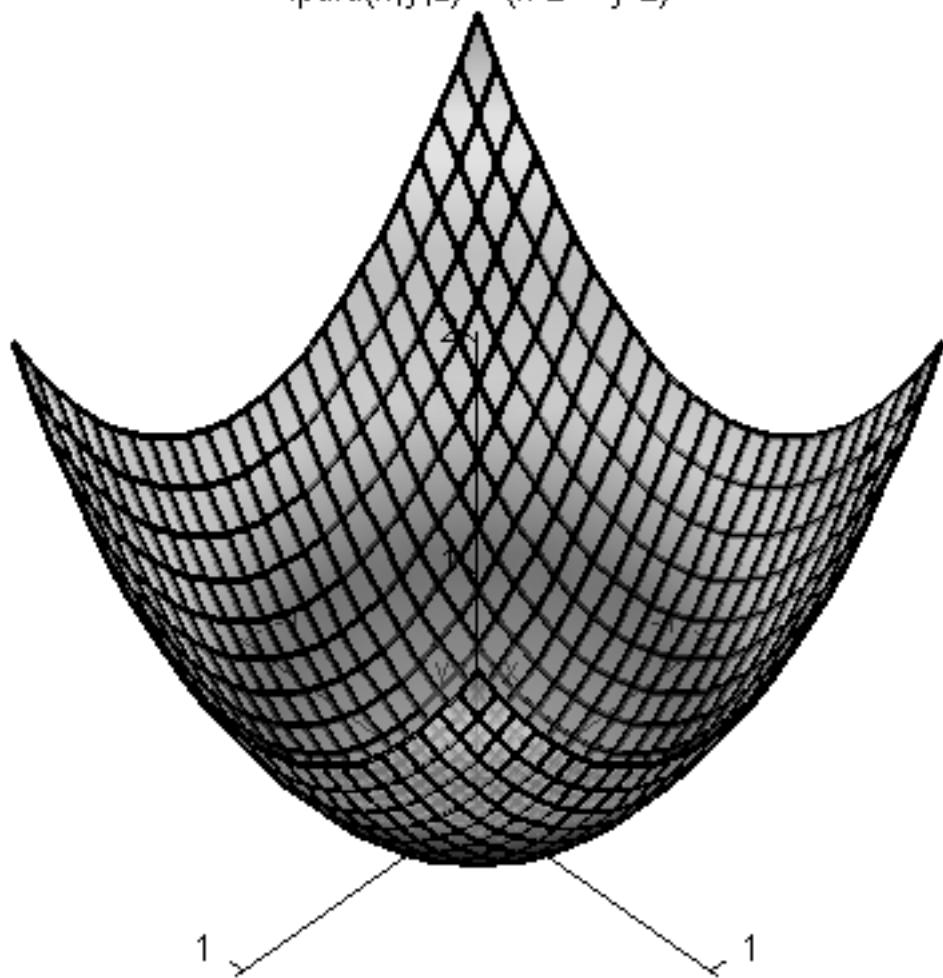
contourplot3d
level curves at height z
fpara(x,y,z) = (x^2 + y^2)
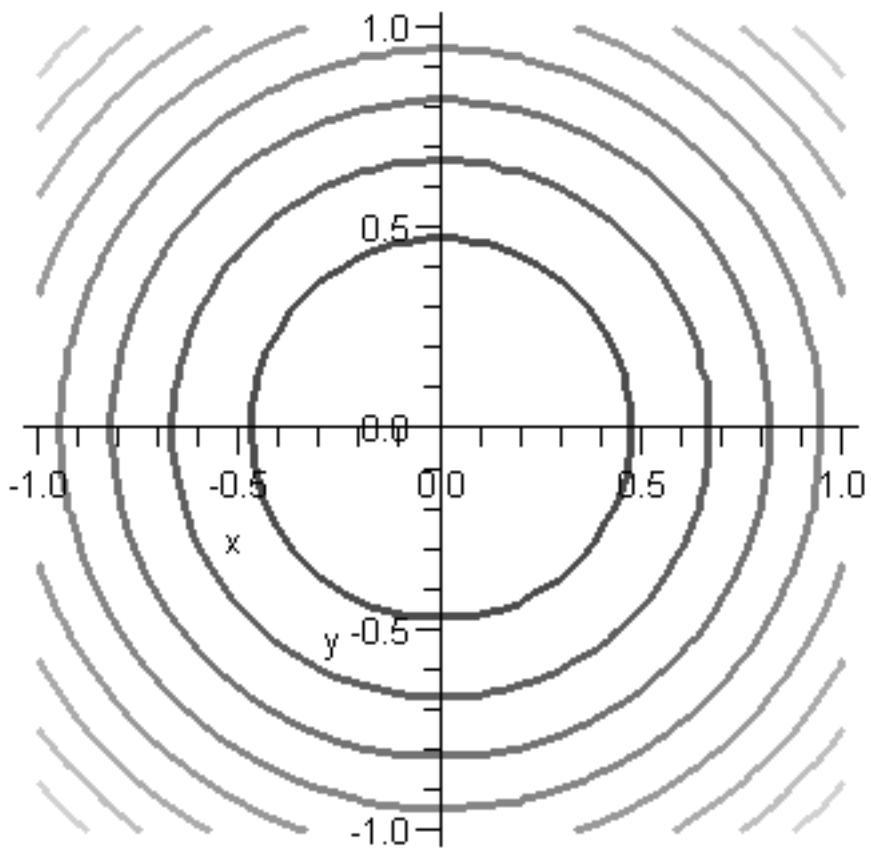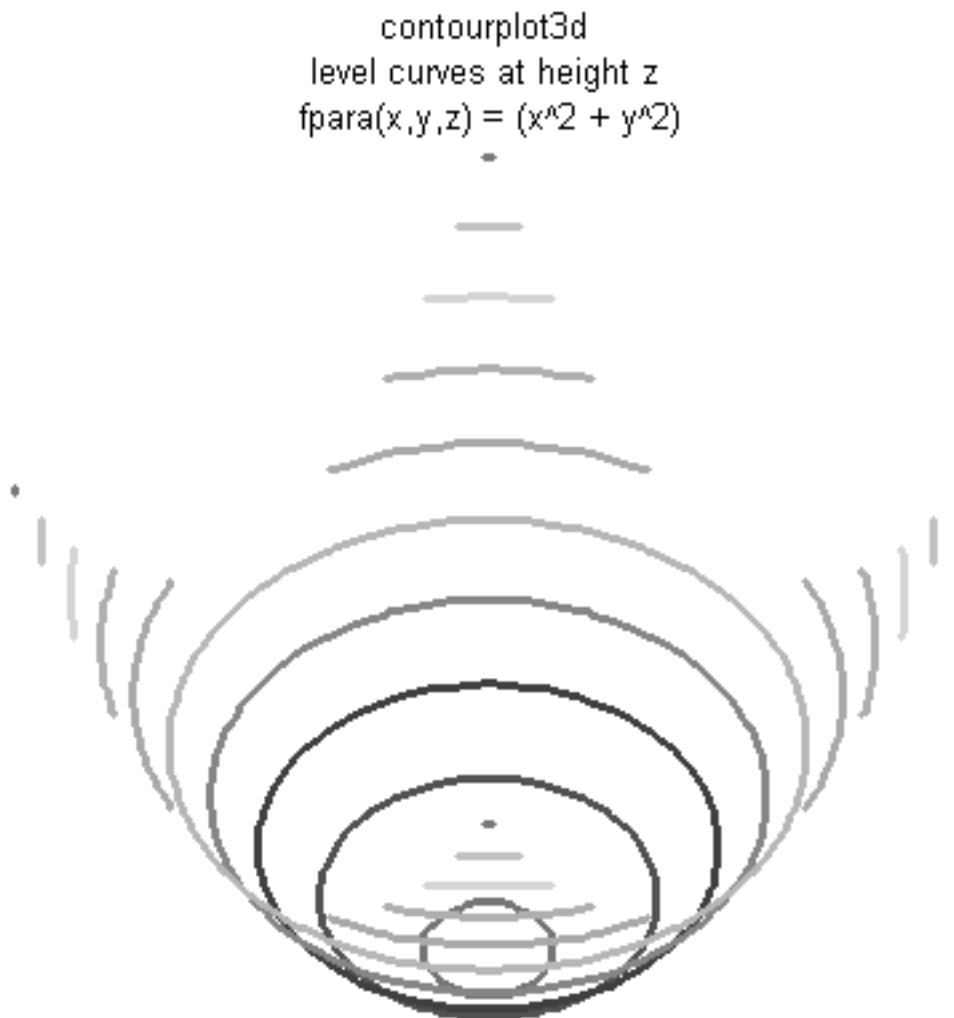

```
> plot3d(fellips(x,y),x=fourrange,y=fourrange,axes = normal,
  tickmarks=[3,3,3],title=`titlefellips`);
  plot3d(fellips(x,y),x=onerange,y=onerange,axes = normal,tickmarks=
  [3,3,3],title=`titlefellips`);
  contourplot(fellips(x,y),x=onerange,y=onerange,title=cat
  (`contourplot\n`,`level curves \n`,`titlefellips`));
  contourplot3d(fellips(x,y),x=onerange,y=onerange,title=cat
  (`contourplot3d\n`,`level curves at height z\n`,`titlefellips`));
```

fpara(x,y,z) = sqrt(9 - 3*x^2 - 2*y^2)

fpara(x,y,z) = sqrt(9 - 3*x^2 - 2*y^2)
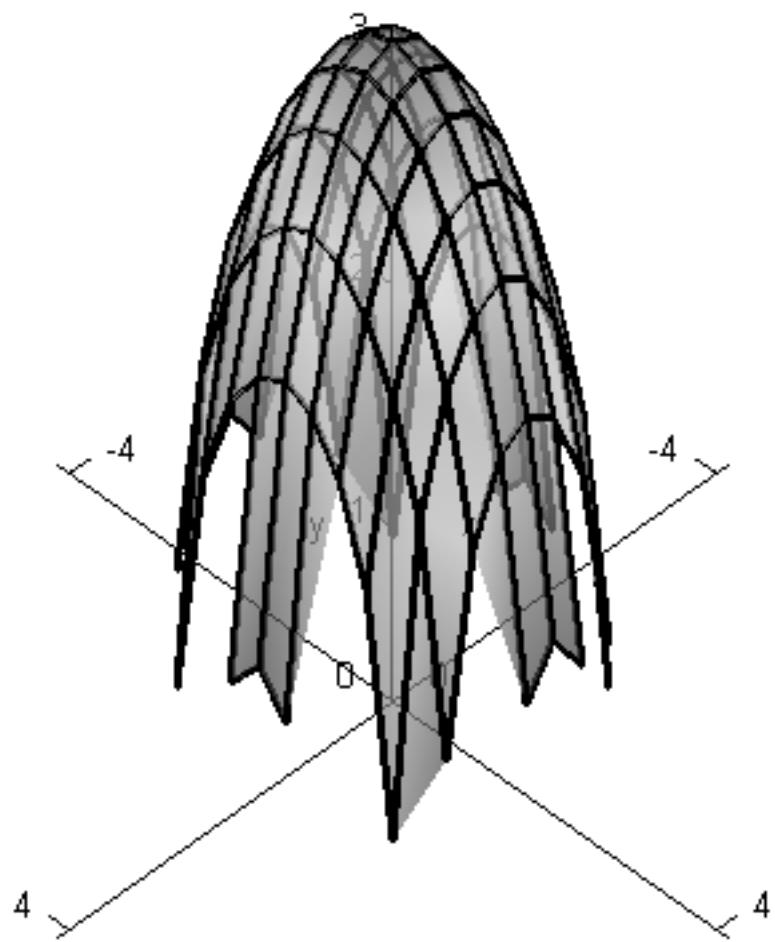
contourplot
level curves
fpara(x,y,z) = sqrt(9 - 3*x^2 - 2*y^2)
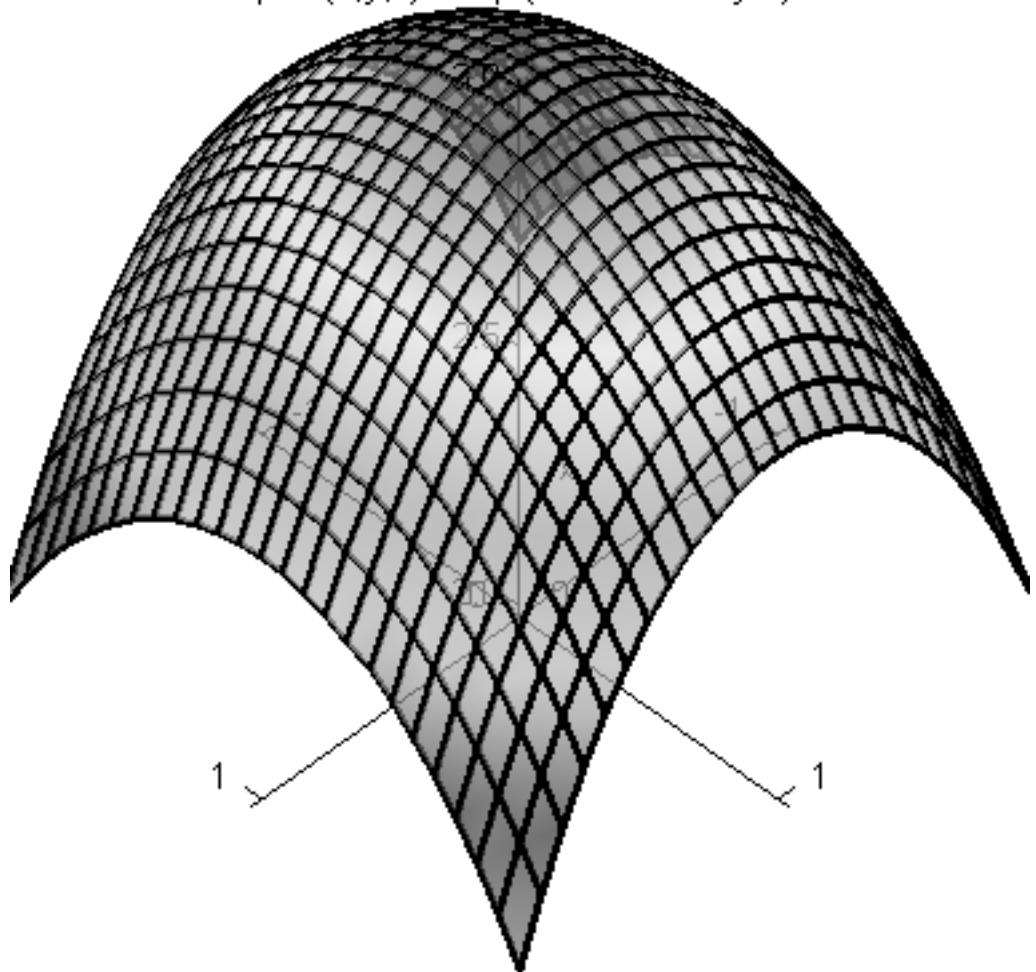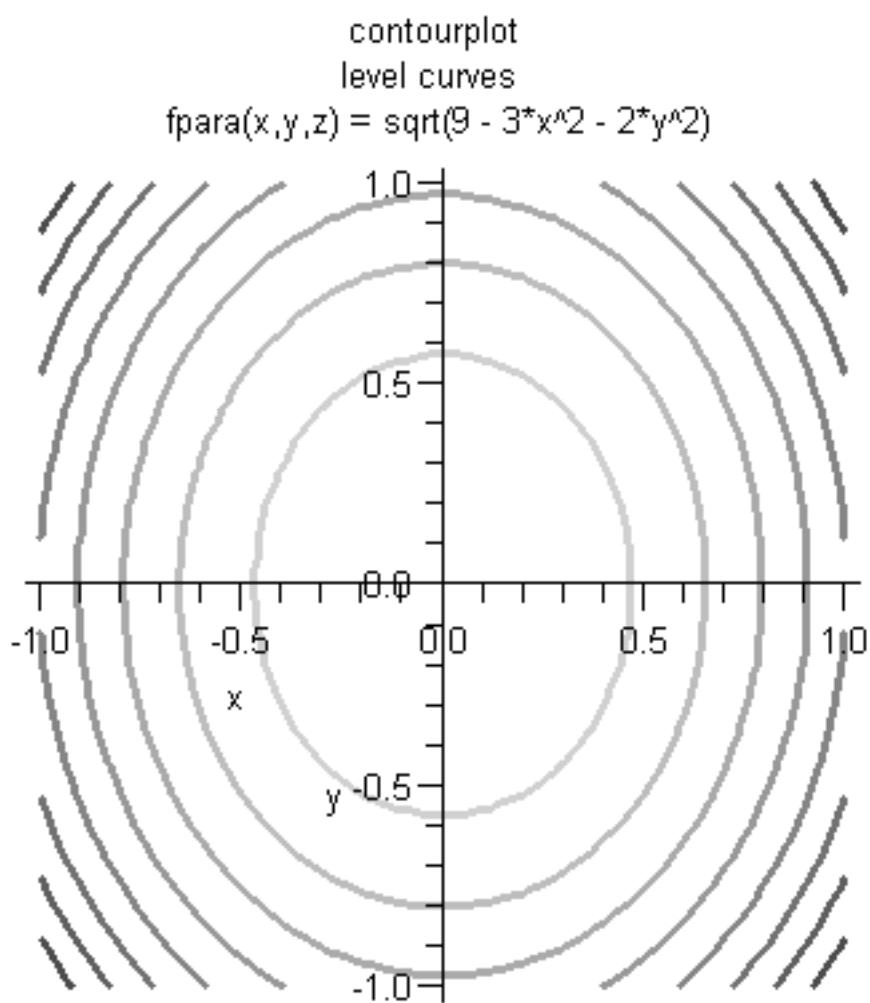
contourplot3d
level curves at height z
fpara(x,y,z) = sqrt(9 - 3*x^2 - 2*y^2)
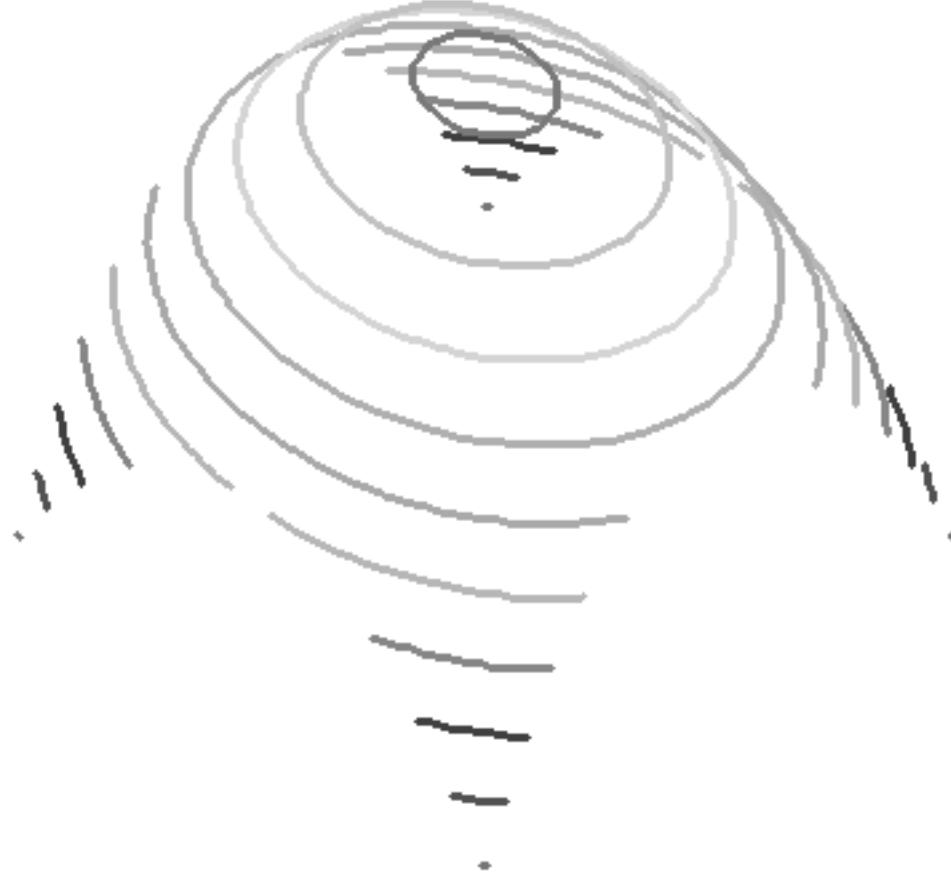
```
> plot3d(f1(x,y),x=threerange,y=threerange,axes = normal,tickmarks=
  [3,3,3],title=`titlef1`);
  contourplot(f1(x,y),x=threerange,y=threerange,tickmarks=[3,3]
  ,title=cat(`contourplot\n`,`level curves \n`,`titlef1`));
  contourplot3d(f1(x,y),x=threerange,y=threerange,tickmarks=[3,3,3],
  title=cat(`contourplot3d\n`,`level curves at height z\n`,
  `titlef1`));
```

f1(x,y) = -x*y*exp(-(x^2 + y^2)/2)
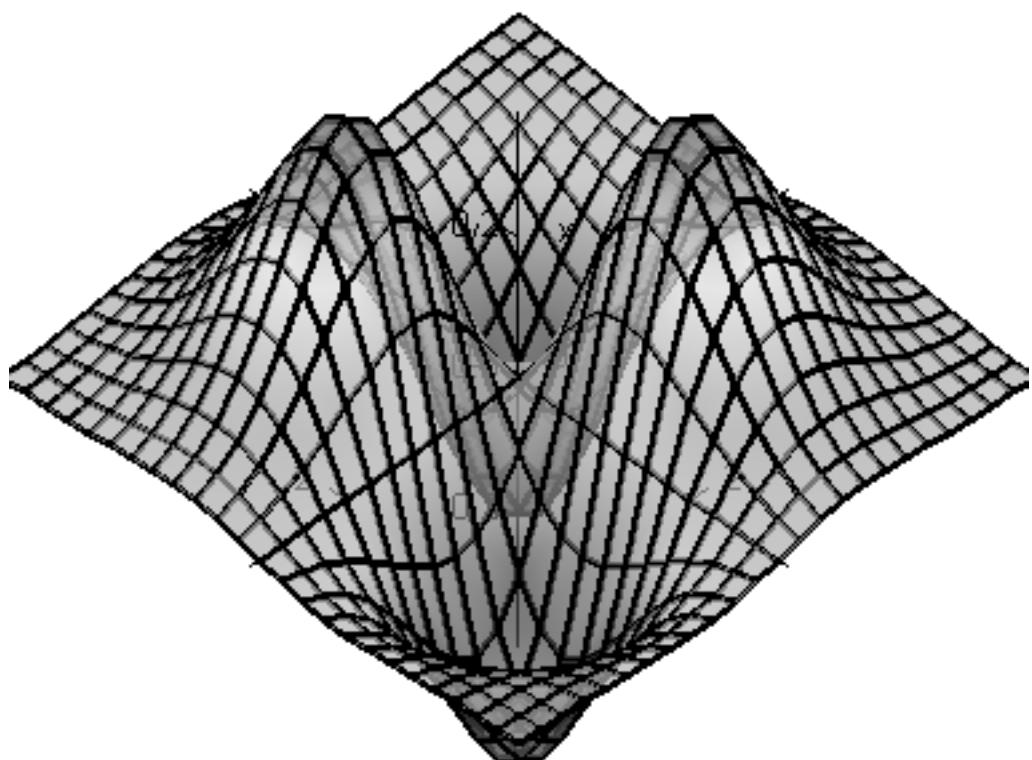
contourplot
level curves
f1(x,y) = -x*y*exp(-(x^2 + y^2)/2)
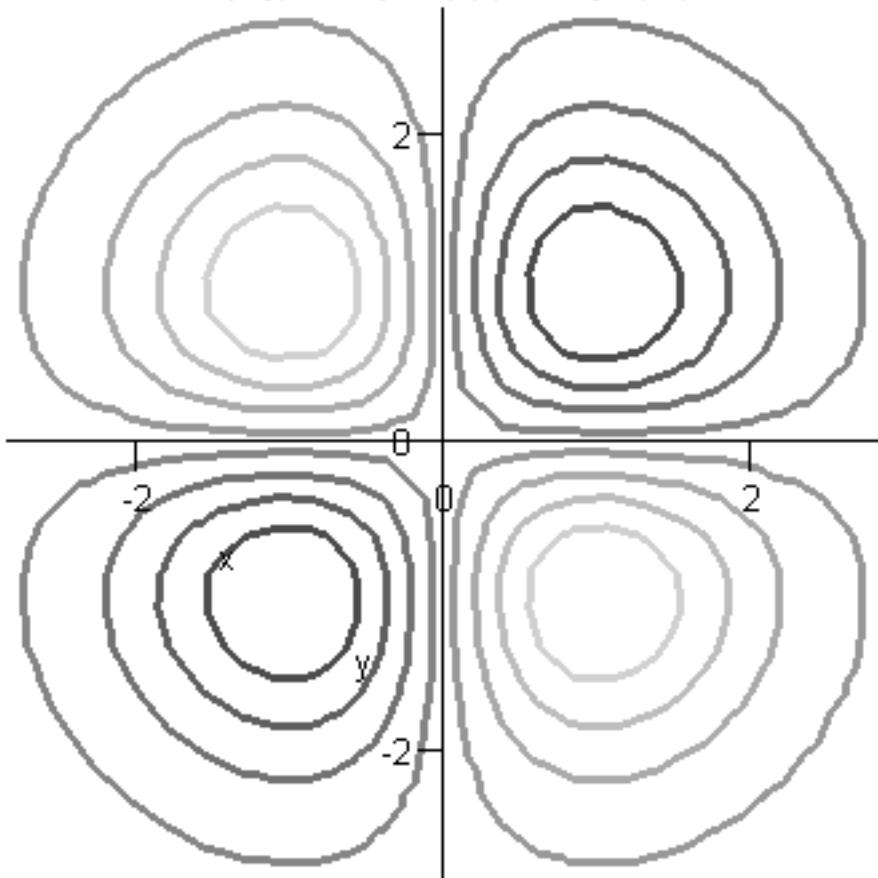
contourplot3d
level curves at height z
f1(x,y) = -x*y*exp(-(x^2 + y^2)/2)
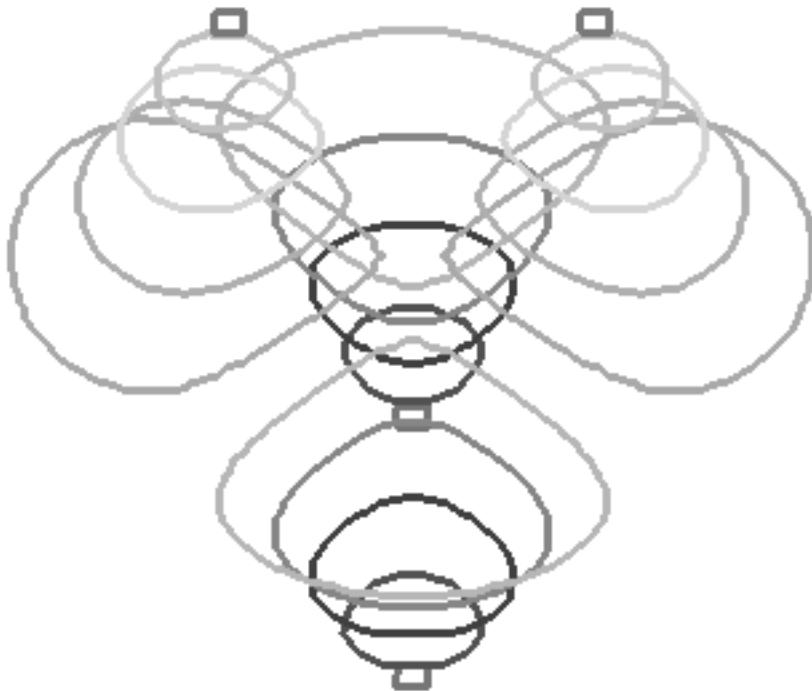

```
> plot3d(f2(x,y),x=-3..3,y=-3..3,axes = normal,tickmarks=[3,3,3],
  title=`titlef2`);
  contourplot(f2(x,y),x=-3..3,y=-3..3,title=cat(`contourplot\n`,
  `level curves \n`,`titlef2`));
  contourplot3d(f2(x,y),x=-3..3,y=-3..3,title=cat(`contourplot3d\n`,
  `level curves at height z\n`,`titlef2`));
>
```

f2(x,y) = -exp(-3*(x^2 + y^2))

-1.0
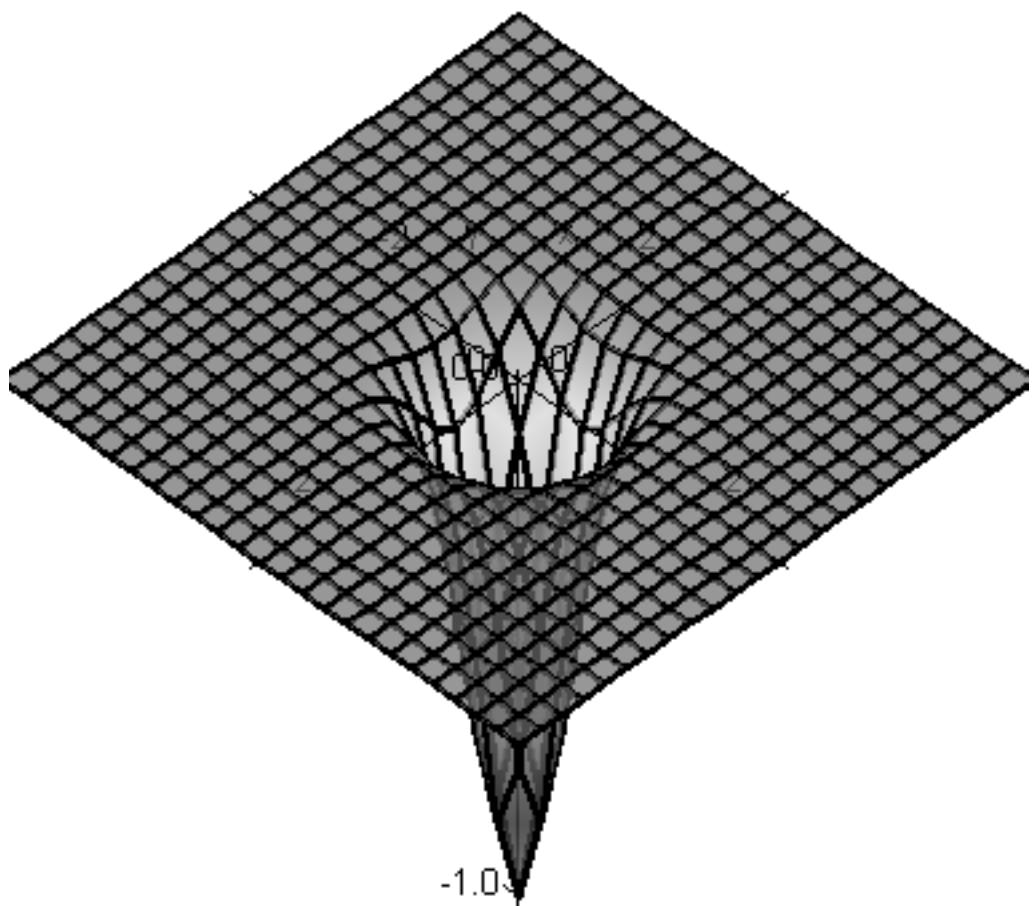
contourplot
level curves
f2(x,y) = -exp(-3*(x^2 + y^2))
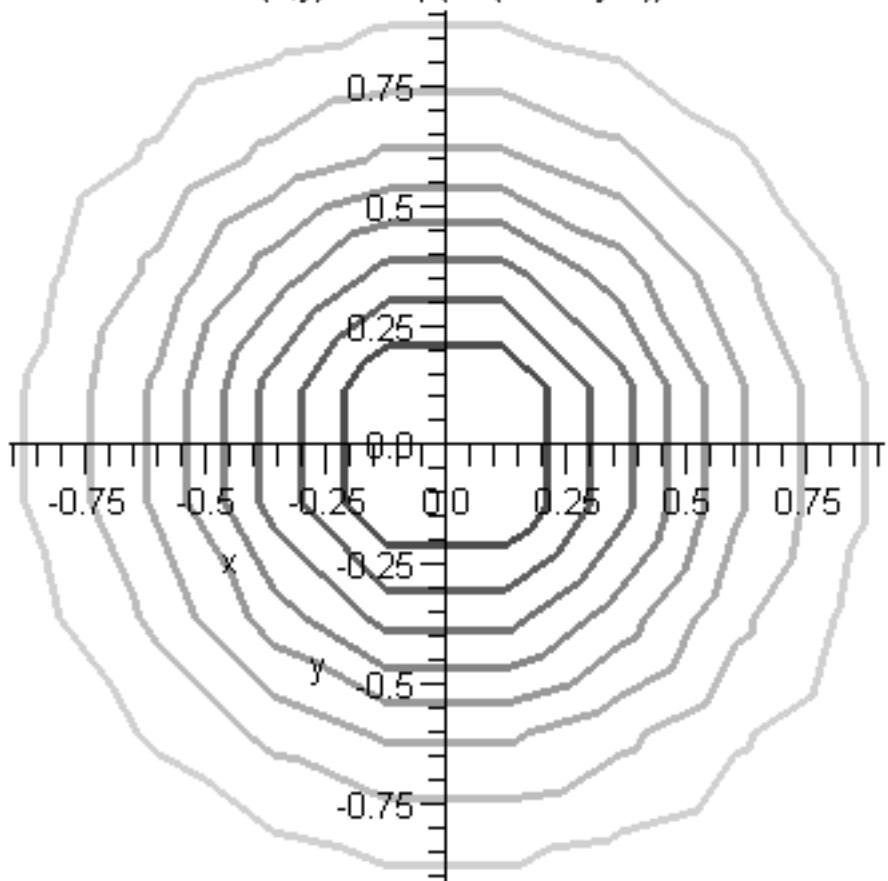
contourplot3d
level curves at height z
$f2(x,y) = -exp(-3*(x^2 + y^2))$
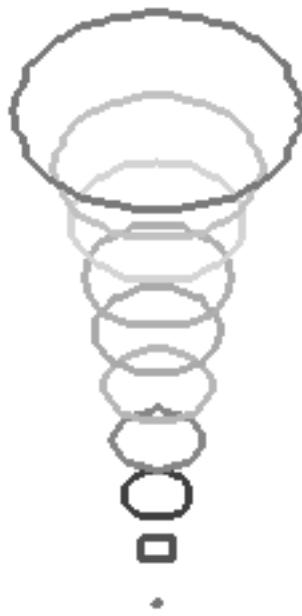
```
> plot3d(f3(x,y),x=-1..1,y=-1..1,axes = normal,tickmarks=[3,3,3],
  shading=zhue,title=`titlef3`);
  contourplot(f3(x,y),x=-1..1,y=-1..1,thickness=2,title=cat
  (`contourplot\n`,`level curves \n`,`titlef3`));
  contourplot3d(f3(x,y),x=-1..1,y=-1..1,thickness=2,title=cat
  (`contourplot\n`,`level curves at height z\n`,`titlef3`));
> plot3d(f3(x,y),x=fourrange,y=fourrange,axes = normal,tickmarks=[3,
  3,3],shading=zhue,title=`titlef3`);
```

f3(x,y) = x^4 + y^4 - 2.3*(x^2 + y^2)

contourplot
level curves
f3(x,y) = x^4 + y^4 - 2.3*(x^2 + y^2)
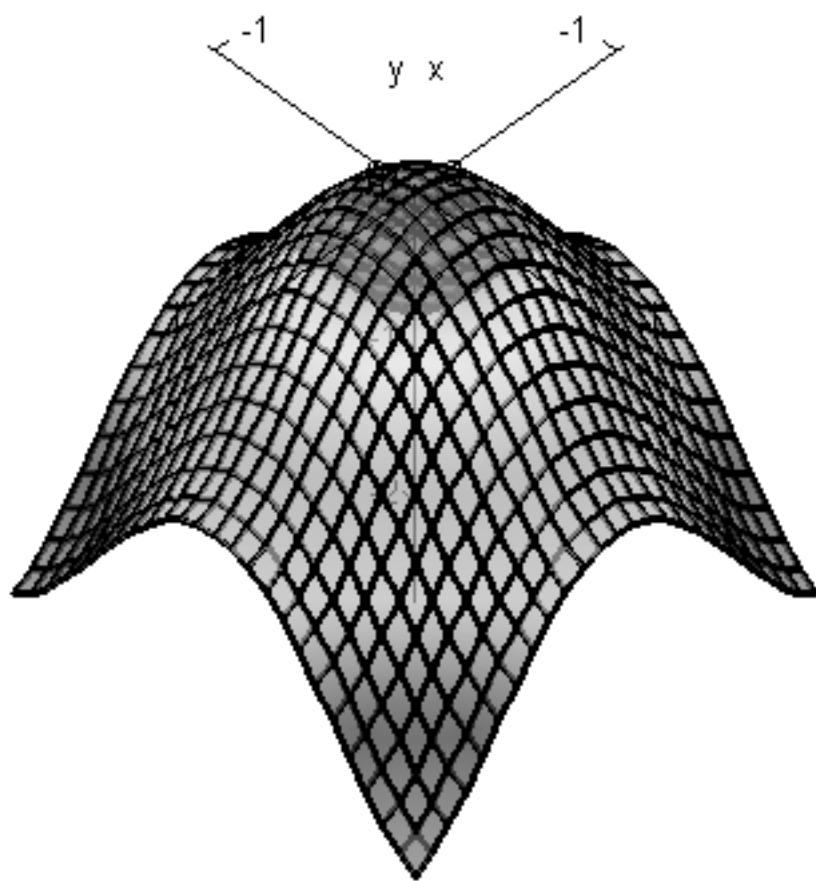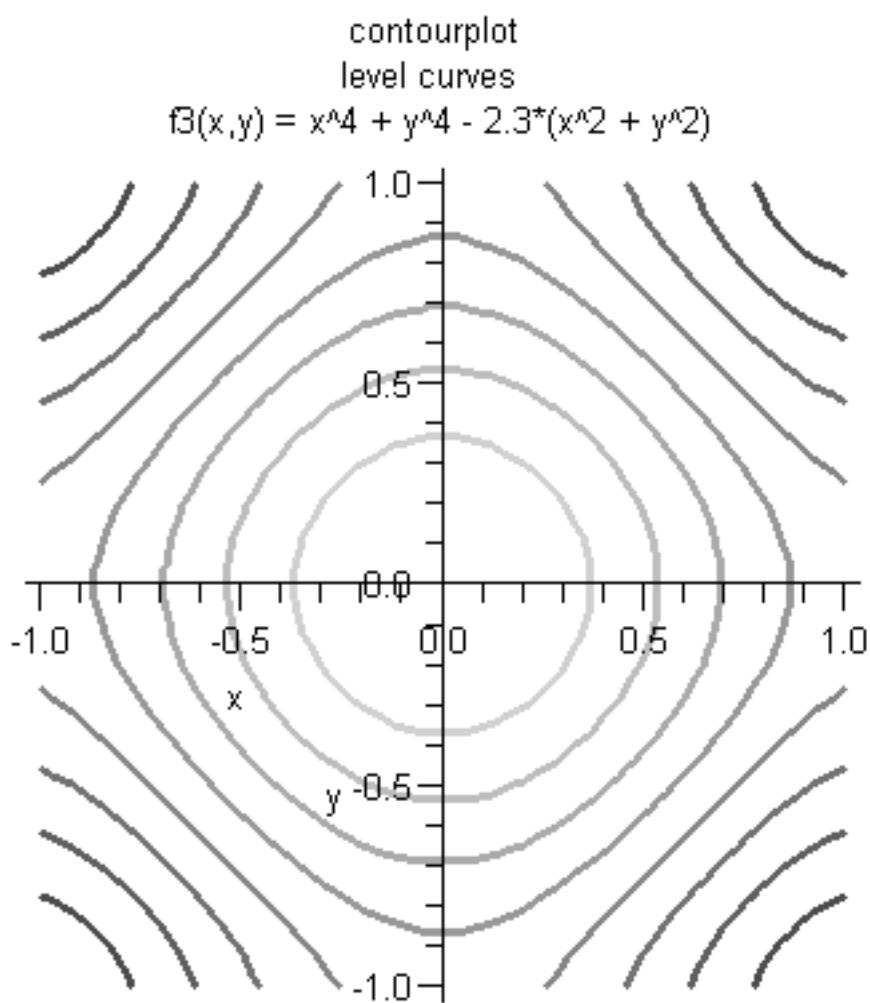
contourplot
level curves at height z
f3(x,y) = x^4 + y^4 - 2.3*(x^2 + y^2)
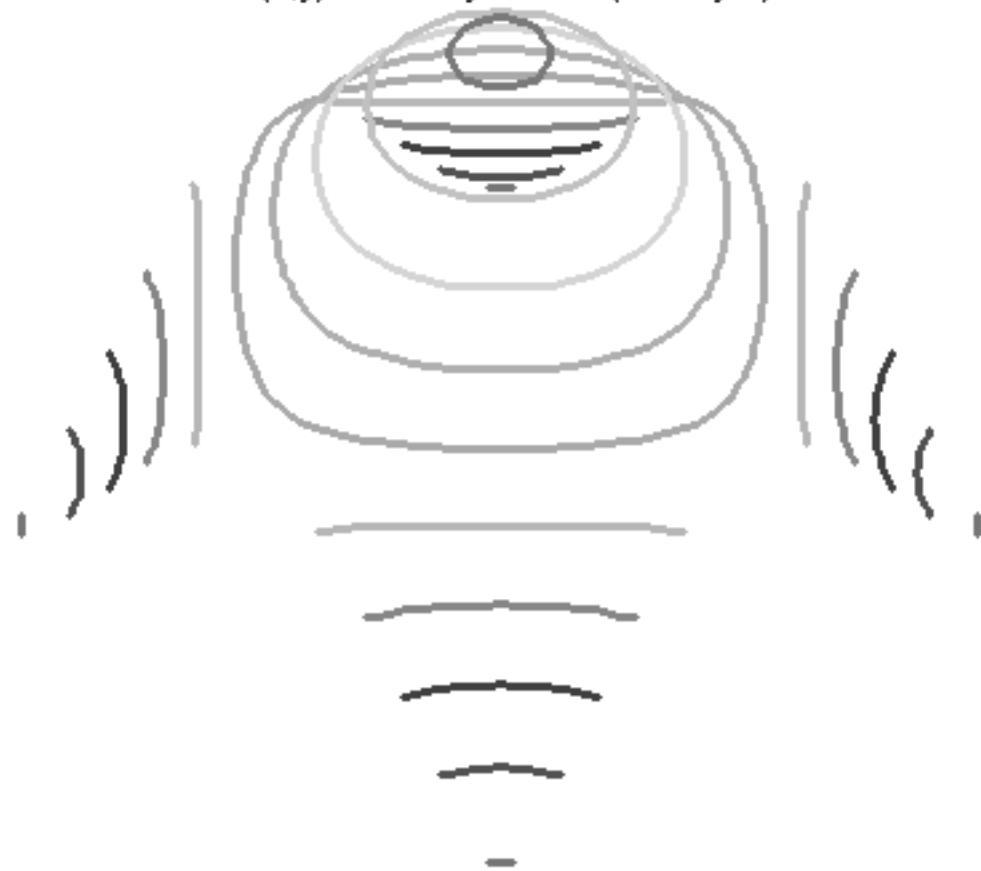
$$f3(x,y) = x^4 + y^4 - 2.3*(x^2 + y^2)$$
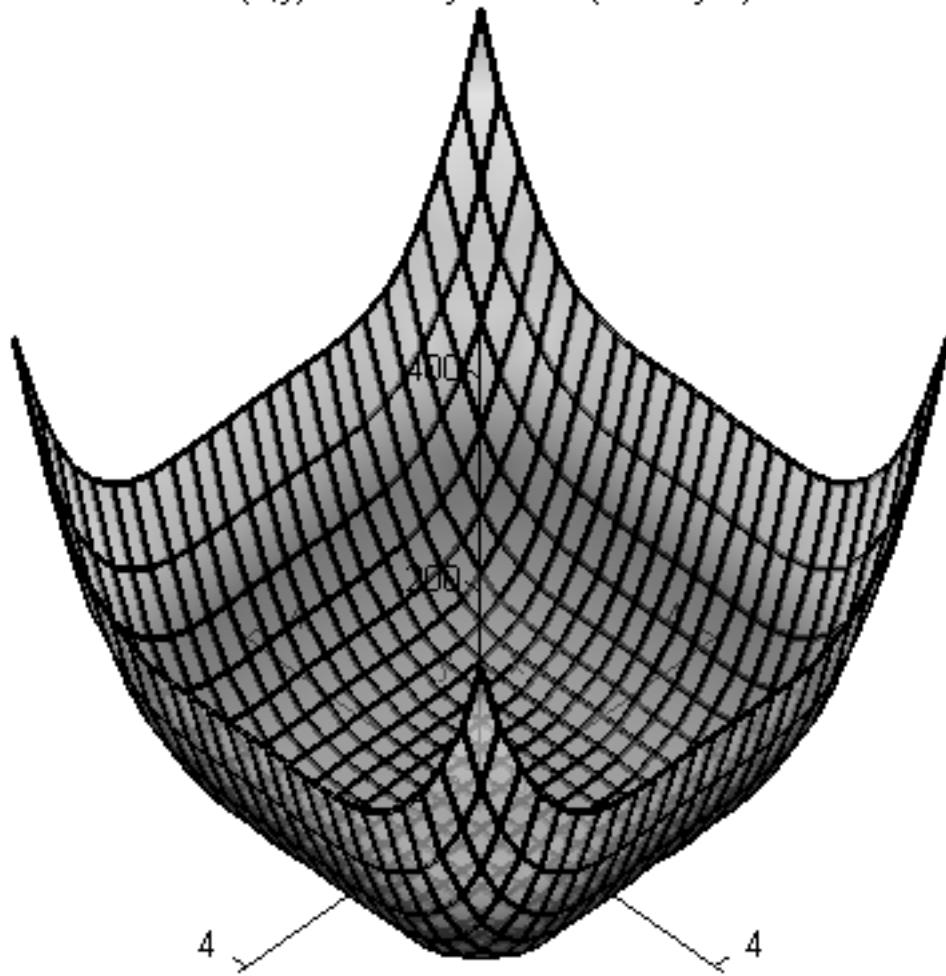

```
> plot3d(f4(x,y),x=tworange,y=tworange,axes = normal,tickmarks=[3,3,
  3],title=`titlef4`);
  contourplot(f4(x,y),x=-1..1,y=-1..1,thickness=1,title=cat
  (`contourplot\n`,`level curves \n`,`titlef4`));
  contourplot3d(f4(x,y),x=-1..1,y=-1..1,title=cat(`contourplot3d\n`,
  `level curves at height z\n`,`titlef4`));
>
```

f4(x,y) = (0.8* x^2 + y^2) *exp(1 - 1.4*x^2 - y^2)

contourplot
level curves
f4(x,y) = (0.8* x^2 + y^2) *exp(1 - 1.4*x^2 - y^2)
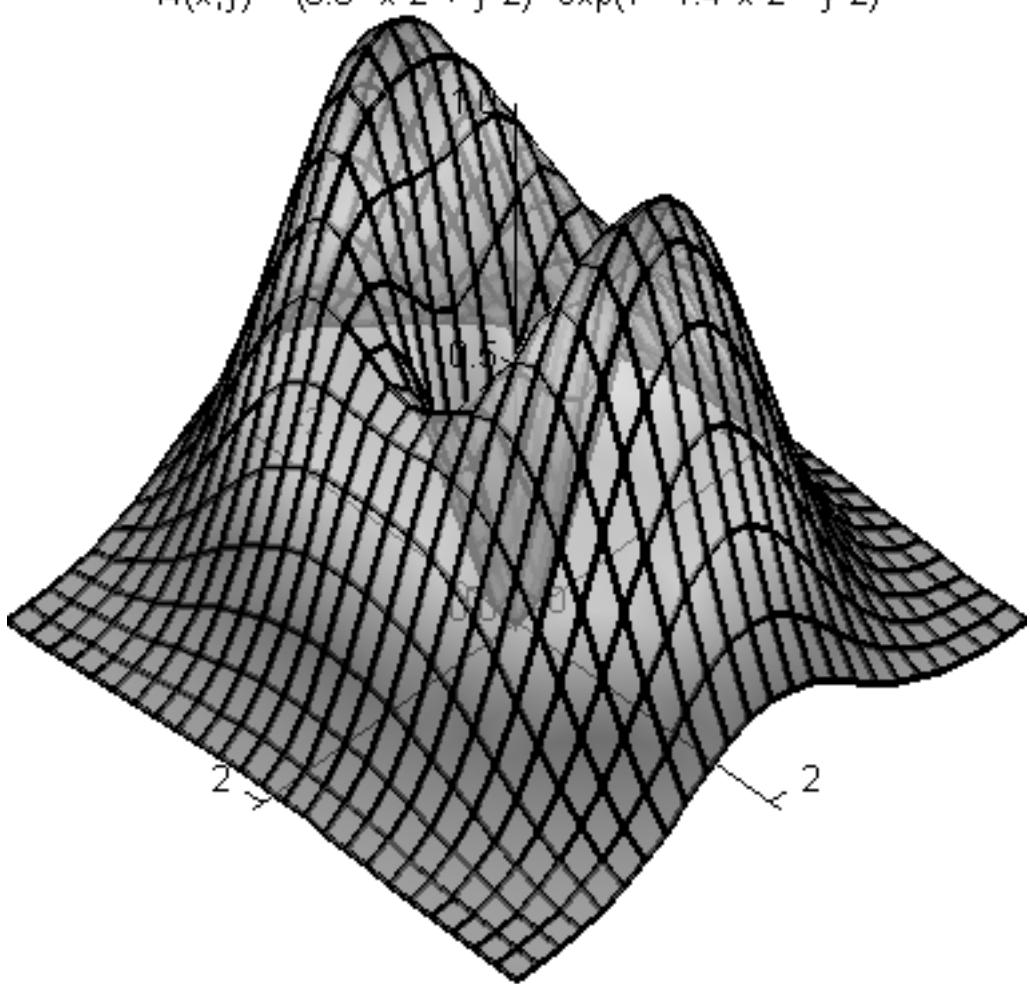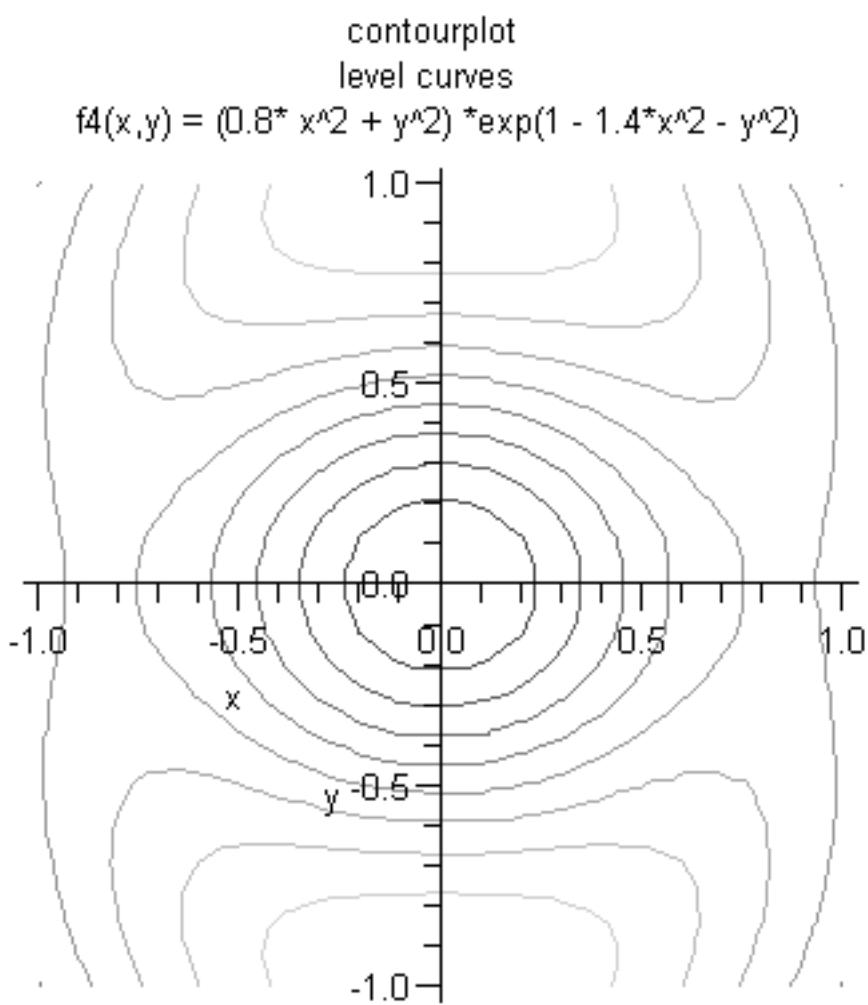
contourplot3d
level curves at height z
f4(x,y) = (0.8* x^2 + y^2) *exp(1 - 1.4*x^2 - y^2)
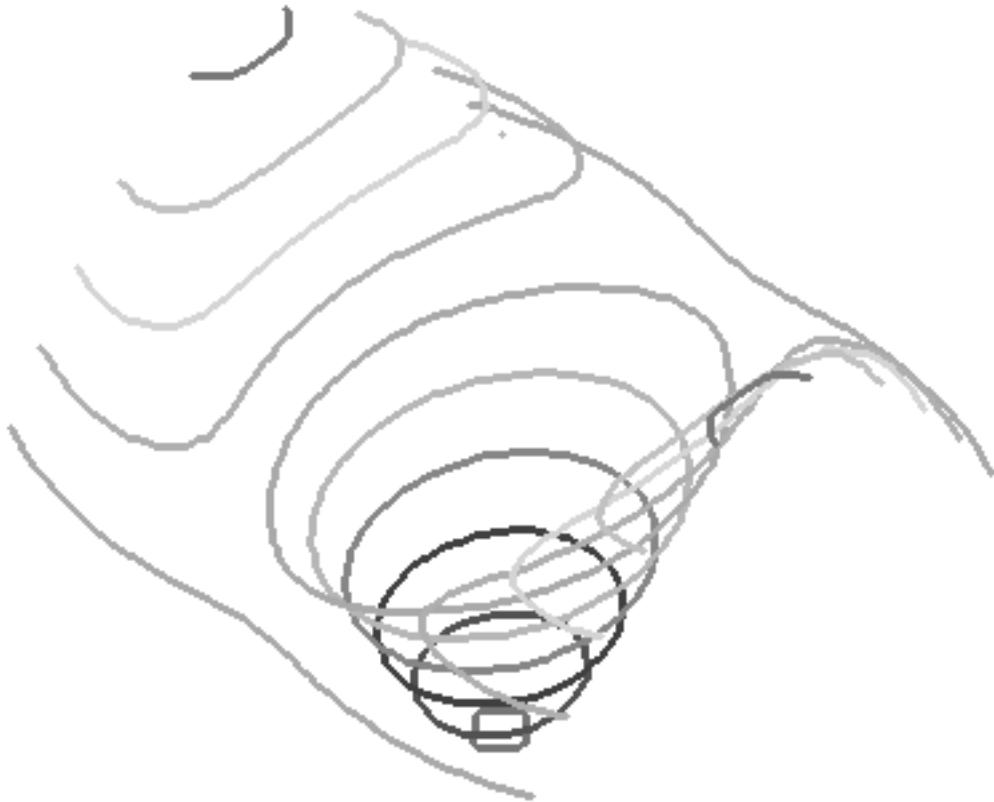

```
> implicitplot3d(f5(x,y,z)=1,x=-5..5,y=-5..5,z=-5..5,axes = normal,
  tickmarks=[3,3,3],
  contours = 20,title=cat(`implicitplot3d\n`,`titlef5`,` = 1`));
```

implicitplot3d
f5(x,y,z) = x^2 + y^2 - 0.2*z^2 = 1
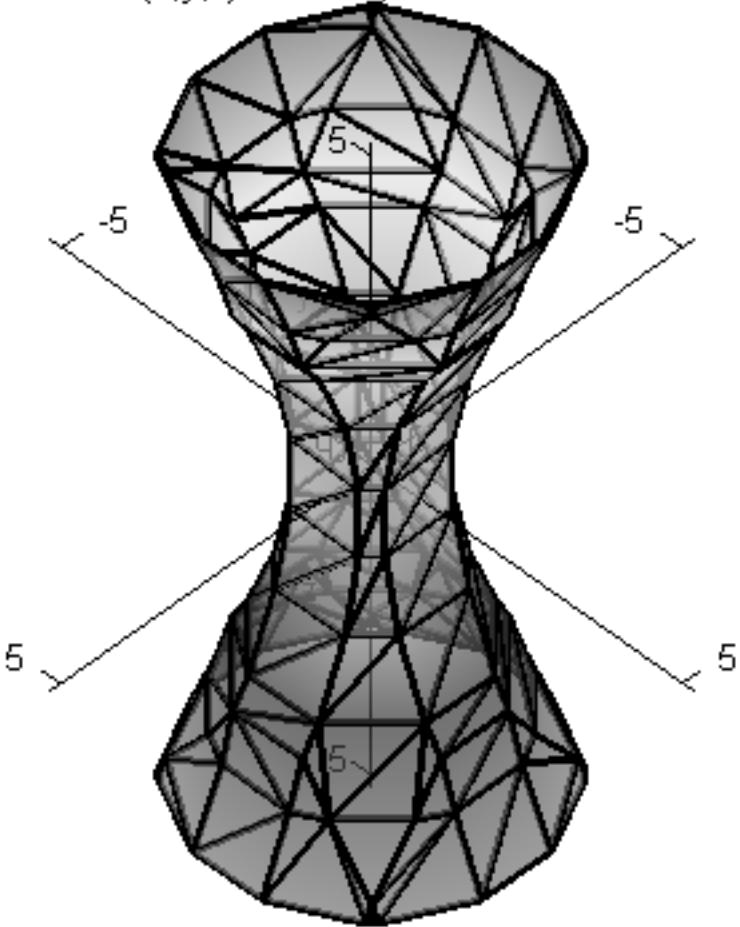
```
> implicitplot3d(f6(x,y,z)=1,x=tworange,y=tworange,z=fourrange,axes
  = normal,tickmarks=[3,3,3],title=cat(`implicitplot3d\n`,`titlef6`,
  ` =1`));
```

implicitplot3d
f6(x,y,z) = -10 * x^2 - 10 * y^2 + 5 *z^2 =1
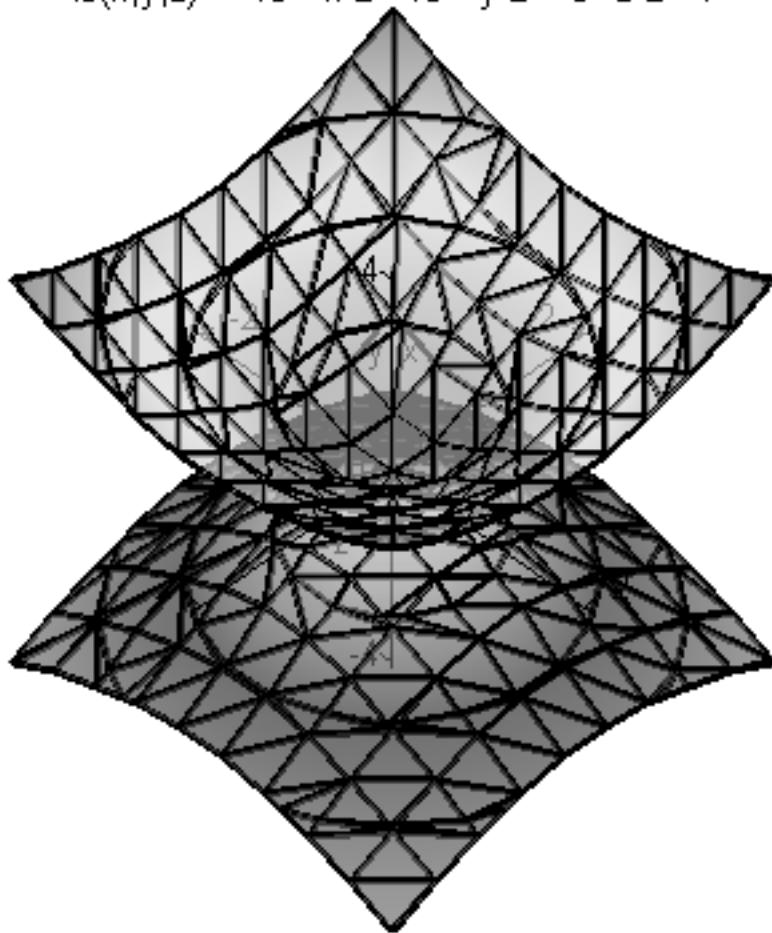
```
>  implicitplot3d(f7(x,y,z)=1,x=-1..1,y=-1..1,z=-1..1,axes = normal,
   tickmarks=[3,3,3],contours=40,title=cat(`implicitplot3d\n`,
   `titlef7`,` =1`));
```

implicitplot3d
f7(x,y,z) = 3*x^2 + y^2 +z^2 =1

-1

1

1

>