# Gaussian curvature for the extensible pendulum

```
> restart;
  with(plots):
```

Potential

```
> V := m*g*y + (k/2)*(L0-sqrt((L-y)^2+x^2))^2 - (k/2)*(L0-L)^2;;
```

$$V := m\,g\,y + \frac{k\left(L0-\sqrt{(L-y)^2+x^2}\right)^2}{2} - \frac{k\,(L0-L)^2}{2} \tag{1}$$

```
>
```

Gaussian curvature sign

```
> K := (diff(V,x,x)*diff(V,y,y)-diff(v,x,y)^2): #/(1+diff(V,x,x)^2+
  diff(V,y,y)^2):
> #simplify(K);
> #diff(V,x,x)*diff(V,y,y);
```

Parameters

```
> k:=1;
  m:=1/2;
  g:=1;
  L0:=1;
  L:= m*g/k+L0;
```

$$k := 1$$

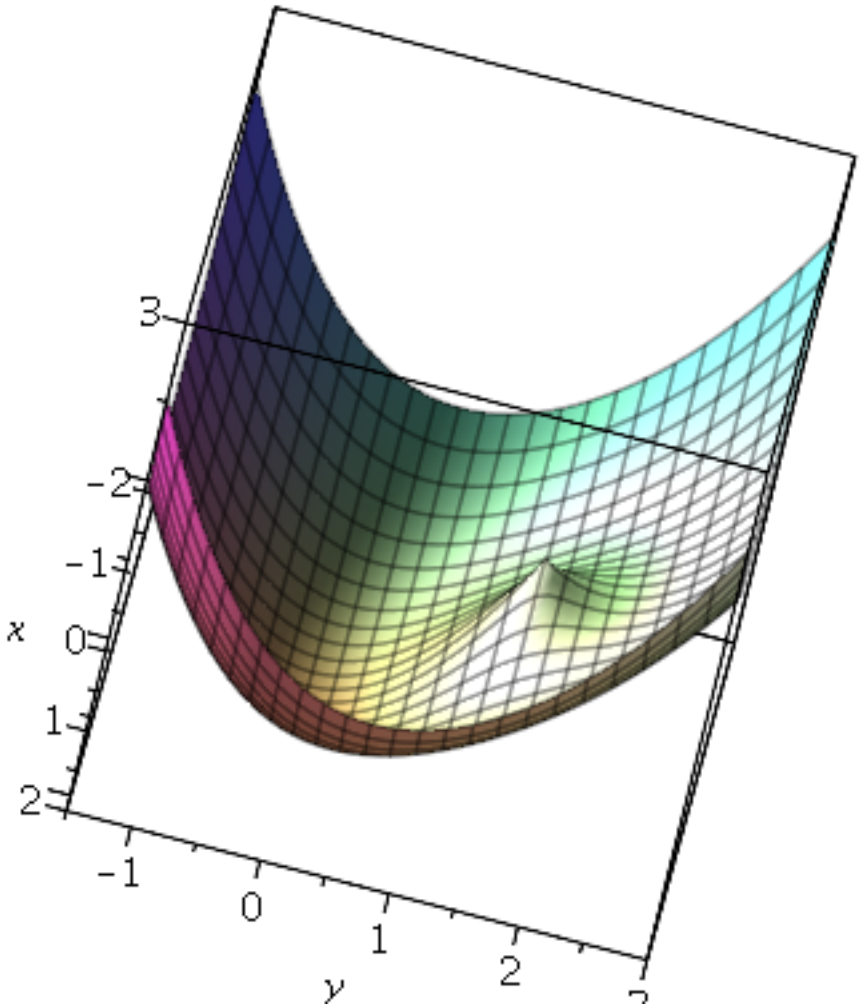
$$m := \frac{1}{2}$$

$$g := 1$$

$$L0 := 1$$

$$L := \frac{3}{2} \tag{2}$$

```
> Vplot := plot3d(V, x=-2..2, y=-1.5..3, view=-0.1..3) :;
  display({Vplot});
```

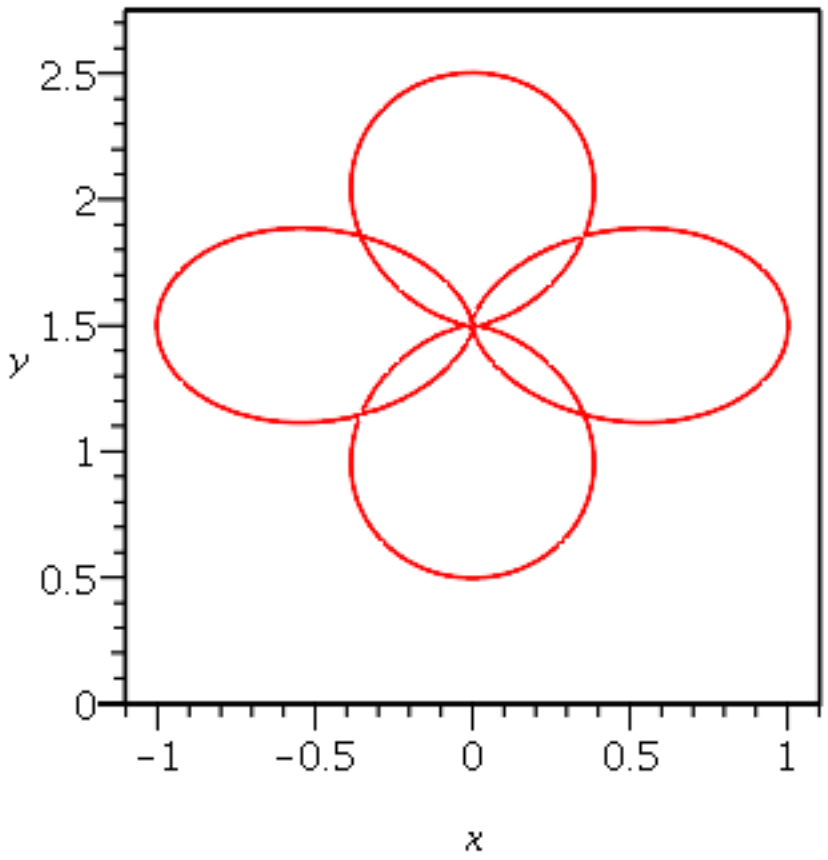



```
> simplify(subs({x=0,y=0},V));
  simplify(subs({x=0,y=0},K));
```

$$0$$

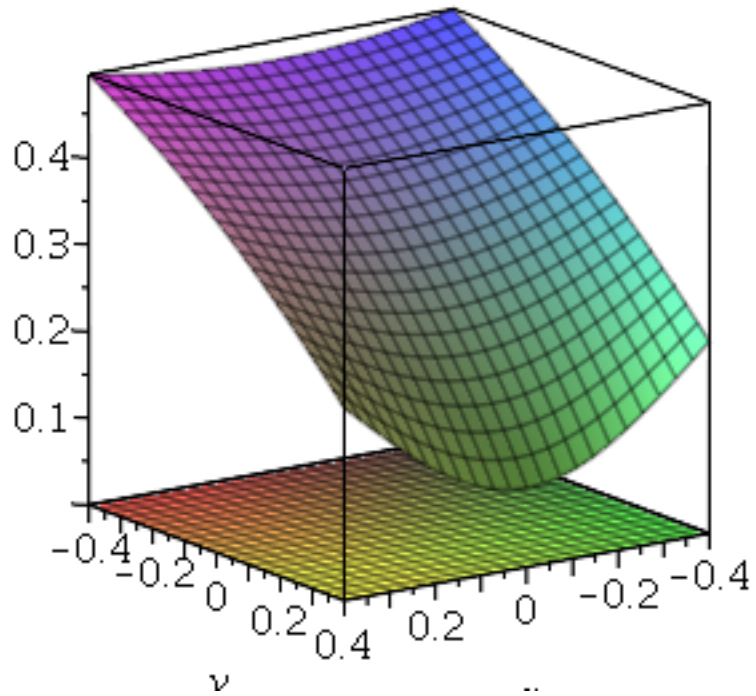
$$\frac{1}{3} \qquad (3)$$

```
> K0:=plot3d(K,x=-1.1..1.1,y=0..2.75,style=contour,contours=[0],
  color=RED,axes=BOXED,numpoints=50000,view=-1..1):;
  display({K0});
```



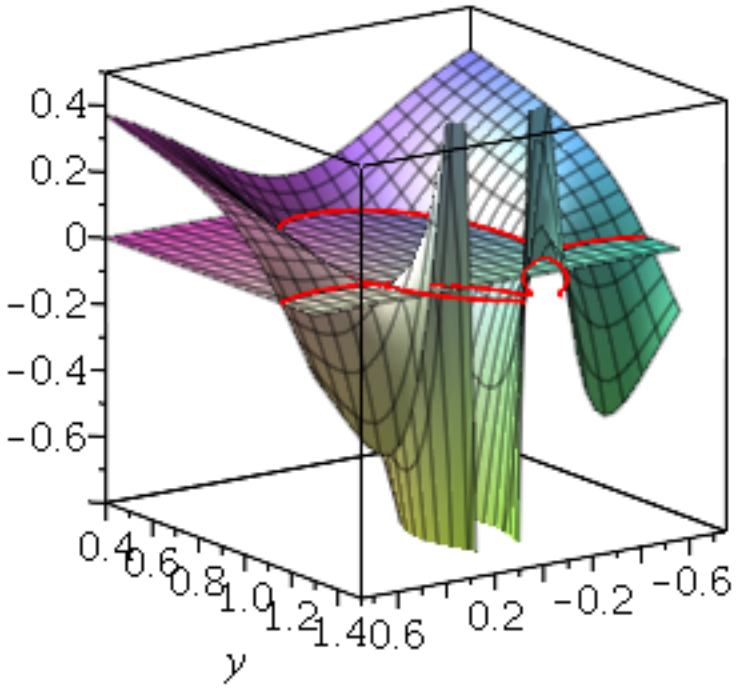

Plot K near min energy (x=0,y=0)

```
> p1:=plot3d({K,0},x=-0.4..0.4,y=-0.4..0.4,axes=BOXED,numpoints=
  500):;
  display({p1});
```




Plot K near (x=0,y=1.3)

```
> p2:=plot3d({K,0},x=-0.75..0.75,y=0.4..1.3,view=-0.8..0.5,axes=
  BOXED,numpoints=1500):;
  display({p2,K0},view=[-0.75..0.75,0.4..1.5,-0.8..0.5]);
```




Plot K far from (x=0,y=0)

```
> p3:=plot3d({K,0},x=-5..5,y=-5..5,view=-1..1,axes=BOXED,numpoints=
  500):;
  display({p3,K0},view=[-5..5,-5..5,-1..1]);
```