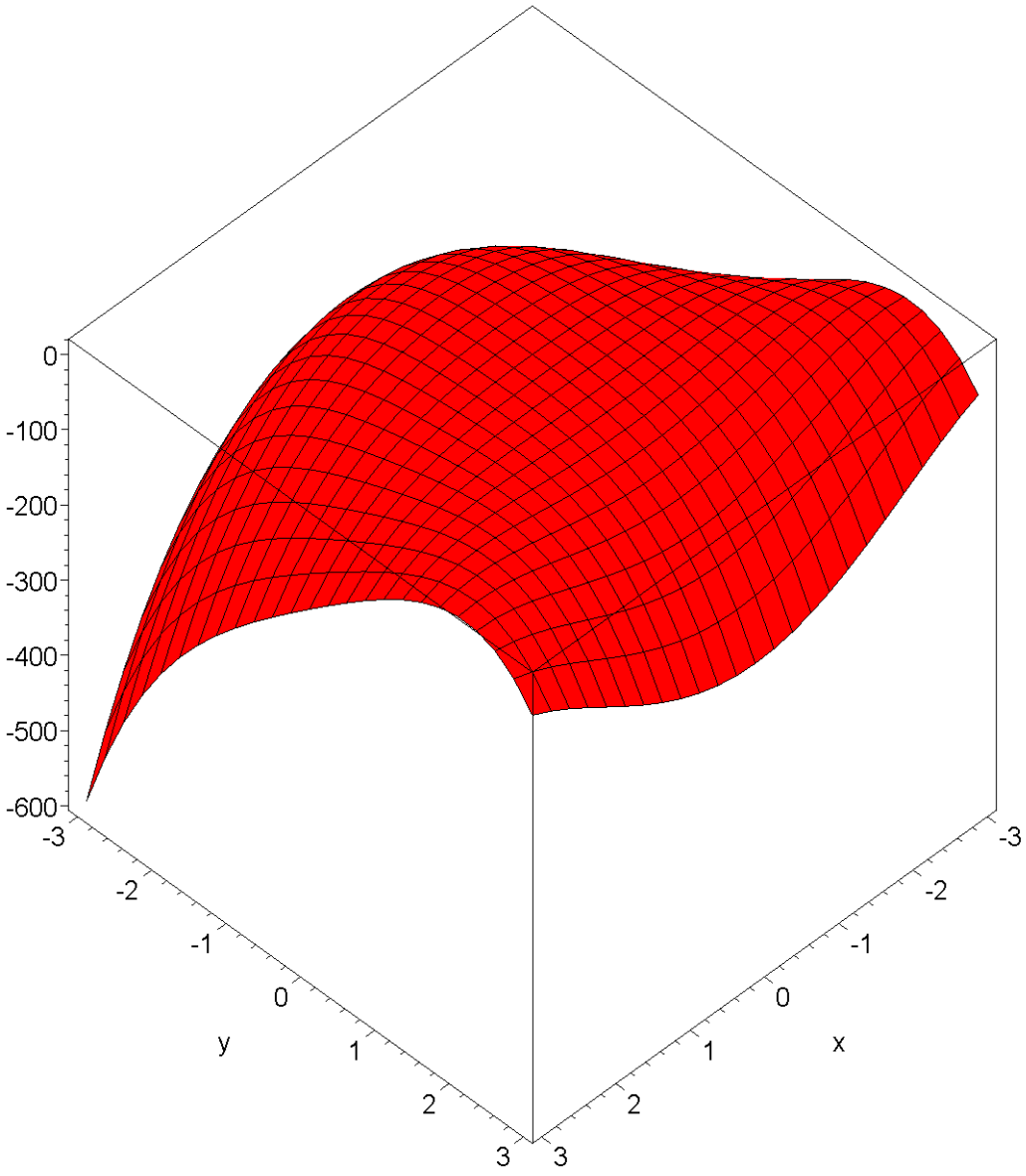
```
> restart:with(Student[VectorCalculus]):with( plots): with(student):
```

```
Warning, the assigned names <,> and <|> now have a global binding

Warning, these protected names have been redefined and unprotected: *, +, -, ., D,
Vector, diff, int, limit, series

Warning, the name changecoords has been redefined

Warning, the protected name D has had its previous binding removed and has been
assigned
```

```
>
```

```
> f:= (x,y) -> 10*x^2*y-5*x^2-4*y^2-x^4-2*y^4;plot3d(f(x,y), x =
  -3..3,y=-3 .. 3,
  color=red,axes=boxed);fxx:=diff(10*x^2*y-5*x^2-4*y^2-x^4-2*y^4,x,x
  );H:=
  diff(10*x^2*y-5*x^2-4*y^2-x^4-2*y^4,x,x)*diff(10*x^2*y-5*x^2-4*y^2
  -x^4-2*y^4,y,y)-
  diff(10*x^2*y-5*x^2-4*y^2-x^4-2*y^4,x,y)*diff(10*x^2*y-5*x^2-4*y^2
  -x^4-2*y^4,x,y);
```

$$f := (x, y) \to \mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`+`(\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`+`($$
$$\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`+`(\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`+`($$
$$\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`*`(\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`*`(10, x^2), y),$$
$$\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`-`(\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`*`(5, x^2))),$$
$$\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`-`(\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`*`(4, y^2))),$$
$$\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`-`(x^4)),$$
$$\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`-`(\mathit{Student}\text{:-}\mathit{VectorCalculus}\text{:-}`*`(2, y^4)))$$



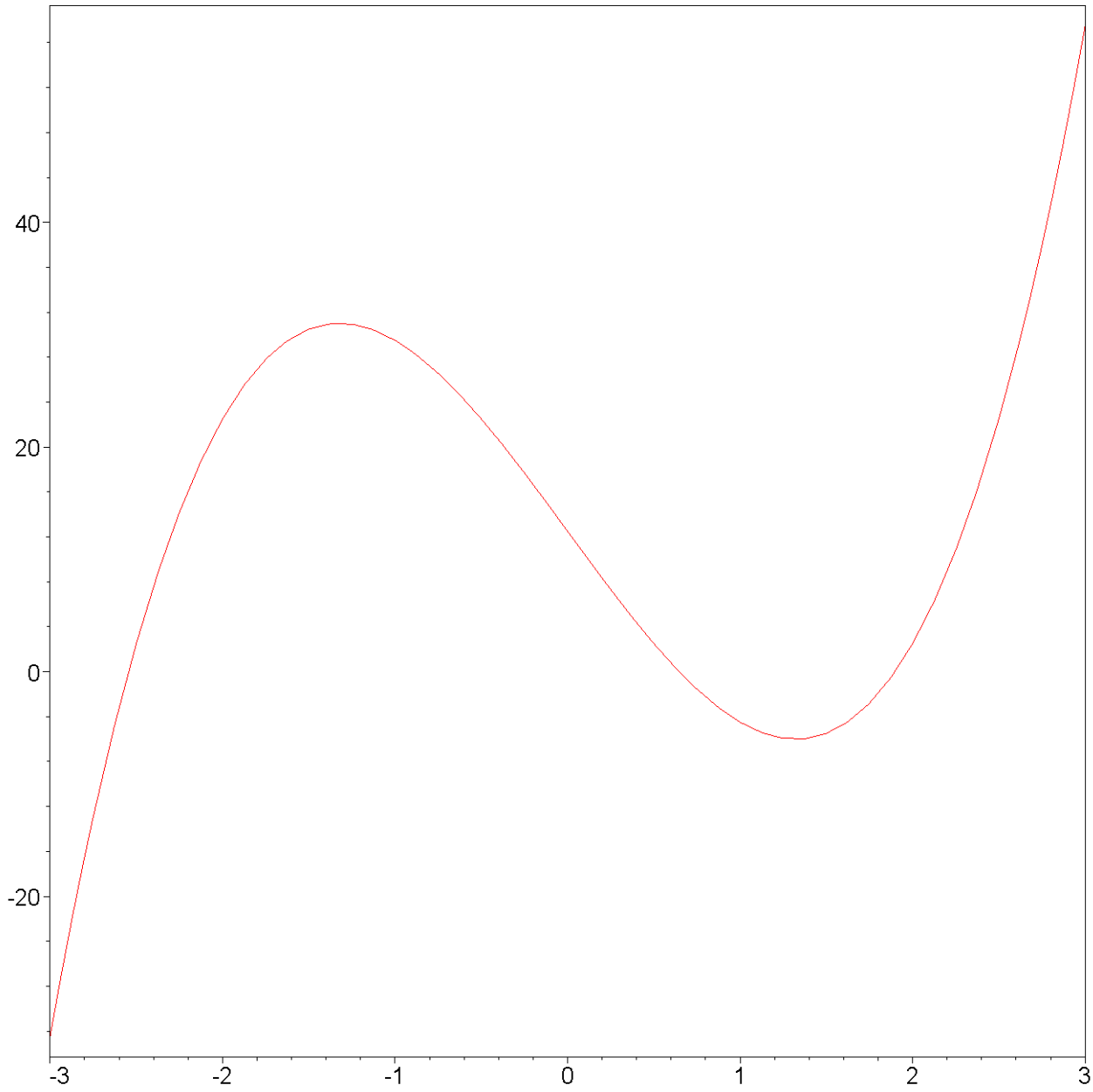
$$fxx := 20\,y - 10 - 12\,x^2$$

$$H := (20\,y - 10 - 12\,x^2)\,(-8 - 24\,y^2) - 400\,x^2$$

the next step is to find the roots of some hande calculaations

```
> g := (x) -> 4*x^3-21*x+12.5;
  plot(g(x), x = -3..3,  color=red,axes=boxed);
```

$$g := x \to Student\text{:-}VectorCalculus\text{:-}`+`(Student\text{:-}VectorCalculus\text{:-}`+`(Student\text{:-}VectorCalculus\text{:-}`*`(4, x^3), Student\text{:-}VectorCalculus\text{:-}`-`(Student\text{:-}VectorCalculus\text{:-}`*`(21, x))), 12.5)$$




```
> ry:=fsolve( g(x)=0 );# the corresponding x-values are x=+
  -sqrt[(5*y-2.5]
```

ry := -2.545156630, 0.6467721991, 1.898384431

```
> for i from 1 to 3 do
  rx[i]:=sqrt((5*ry[i]-2.5));h:=subs(x=rx[i],y=ry[i],H);valfxx:=subs
  (x=rx[i],y=ry[i],fxx);print(i,rx[i],ry[i],valfxx,h); end do:
```

1, 3.902022956 *I*, -2.545156630, 121.8062652, -13821.08096

2, 0.8566568718, 0.6467721991, -5.87088797, -187.6362644

3, 2.644224301, 1.898384431, -55.93537723, 2488.717231

```
> for i from 1 to 3 do
```

```
rx[i]:=-sqrt((5*ry[i]-2.5));h:=subs(x=rx[i],y=ry[i],H);valfxx:=sub
s(x=rx[i],y=ry[i],fxx);print(i,rx[i],ry[i],valfxx,h); end do:
```

1, -3.902022956 *I*, -2.545156630, 121.8062652, -13821.08096

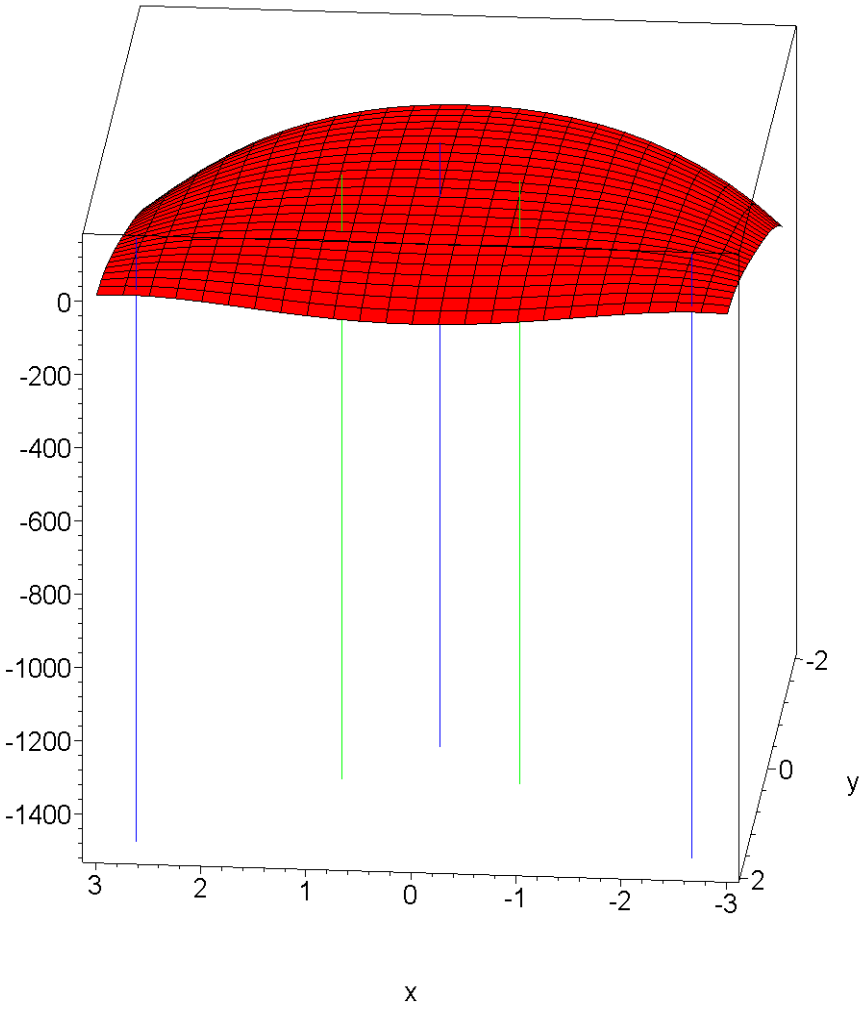
2, -0.8566568718, 0.6467721991, -5.87088797, -187.6362644

3, -2.644224301, 1.898384431, -55.93537723, 2488.717231

```
> h:=subs(x=0,y=0,H);
```

$$h := 80$$

```
>
> s1:=SpaceCurve( <-2.644,1.89,t>, t=-1500..150,color=
  blue,axes=boxed ):
  s2:=SpaceCurve( <2.644,1.89,t>, t=-1500..150,color=blue,axes=boxed
  ):
  s3:=SpaceCurve( <0,0,t>, t=-1500..150,color=blue,axes=boxed ):
  s4:=plot3d(f(x,y), x = -3..3,y=-2 .. 2, color=red,axes=boxed):
> s5:=SpaceCurve( <-.85,.64,t>, t=-1500..150,color=green,axes=boxed
  ):s6:=SpaceCurve( <.85,.64,t>, t=-1500..150,color=green,axes=boxed
  ):display3d(s1,s2,s3,s4,s5,s6);
```


0
-200
-400
-600
-800
-1000
-1200
-1400
3
2
1
0
-1
-2
-3
x
-2
0
2
y