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) → Student:-VectorCalculus:-`+`'( Student:-VectorCalculus:-`+`'( Student:-VectorCalculus:-`*`(Student:-VectorCalculus:-`*`(10, x^2), y),
Student:-VectorCalculus:-`*`(Student:-VectorCalculus:-`*`(5, x^2))),
Student:-VectorCalculus:-`-`'(Student:-VectorCalculus:-`*`(4, y^2))),
Student:-VectorCalculus:-`-`'(x^4)),
Student:-VectorCalculus:-`-`'(Student:-VectorCalculus:-`*`(2, y^4)))
\[ f(x) := 20y - 10 - 12x^2 \]

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

The next step is to find the roots of some handwritten calculations:

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

\[ g := x \rightarrow \text{Student:-VectorCalculus:-'+'(Student:-VectorCalculus:-'+'(Student:-VectorCalculus:-'*'(4,x^3), Student:-VectorCalculus:-'*'(21,x)), 12.5) \]
> 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, -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
\texttt{\texttt{\texttt{\texttt{\texttt{rx[i]}:=\texttt{-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:}}}}}

\begin{itemize}
\item \texttt{1, -3.902022956 I, -2.545156630 121.8062652, -13821.08096}
\item \texttt{2, -0.8566568718, 0.6467721991, -5.87088797, -187.6362644}
\item \texttt{3, -2.644224301, 1.898384431, -55.93537723, 2488.717231}}
\end{itemize}

\[ h:=\text{subs(x=0,y=0,H);} \]
\[ h := 80 \]

\[ h := \text{subs(x=0,y=0,H);} \]
\[ s1:=\text{SpaceCurve( <-2.644,1.89,t>, t=-1500..150, color=blue, axes=boxed });} \]
\[ s2:=\text{SpaceCurve( <2.644,1.89,t>, t=-1500..150, color=blue, axes=boxed });} \]
\[ s3:=\text{SpaceCurve( <0,0,t>, t=-1500..150, color=blue, axes=boxed });} \]
\[ s4:=\text{plot3d(f(x,y), x = -3..3, y = -2 .. 2, color=red, axes=boxed});} \]
\[ s5:=\text{SpaceCurve( <-.85,.64,t>, t=-1500..150, color=green, axes=boxed });} \]
\[ s6:=\text{SpaceCurve( <.85,.64,t>, t=-1500..150, color=green, axes=boxed });} \]
\[ \text{display3d(s1,s2,s3,s4,s5,s6);} \]