MATH 261, Spring 2001 **Due Date:**____________ **Name(s):** ______________________

Extra Project 15.3: Partial Derivatives

Objective

In this project we discuss the computation and geometry of partial derivatives.

Narrative

If you have not already done so, read Section 15.3 in the text. In this project we discuss the computation and geometry of partial derivatives.

Tasks

a) Type the command lines below into Maple; they produce a plot of the graph of $f(x, y) = -5x/(x^2+y^2+1)$.

```
> # Project 15.3:  Partial Derivatives
> restart:  with(plots):  with(plottools):
> setoptions3d(axes=normal,orientation=[20,80],grid=[50,50],lightmodel=light1,
      scaling=constrained,style=patchnogrid,shading=zgrayscale);
> f := (x,y) -> (24-x^2-2*y^2)/8;
> plot0 := plot3d(f(x,y),x=-3..3,y=-3..3,color=green):  display(plot0);
```

b) Continue by typing the command lines below into Maple; they compute the value `val` of f at $P(a, b)$.

```
> a := 2; b := 2.5;
> val := subs({x=a,y=b},f(x,y));
```

c) Continue by typing the command lines below into Maple; they plot the graph of f over a slightly smaller domain, plot the x-curve of f through $P(a, b)$ (in blue), compute f_x and $f_x(a, b)$, and then draw the tangent line to the x-curve of f through $P(a, b)$ (in red). (The curve of intersection of the graph of $z = f(x, y)$ and a plane whose equation is of the form $x = a$ is called an x-curve, and the curve of intersection of the graph of $z = f(x, y)$ and a plane whose equation is of the form $y = b$ is called an y-curve.)

```
> plot1 := plot3d(f(x,y),x=-3..3,y=-3..b,color=green):
> curve1 := spacecurve([t,b,f(t,b),t=-3..3],color=blue,thickness=2):
> f1 := (x,y) -> diff(f(x,y),x);
> slope1 := subs({x=a,y=b},f1(x,y));
> tanline1 := spacecurve({[t+a,b,slope1*t+val,t=-3..3]},color=red,thickness=2):
> display({plot1,curve1,tanline1});
```

d) Continue by typing the command lines below into Maple; they again plot the graph of f over a slightly smaller domain, plot the y-curve of f through $P(a, b)$ (in blue), compute f_y and $f_y(a, b)$, and then draw the tangent line to the y-curve of f through $P(a, b)$ (in red).

```
> plot2 := plot3d(f(x,y),x=-3..a,y=-3..3,color=green):
> curve2 := spacecurve({[a,t,f(a,t),t=-3..3]},color=blue,thickness=2):
> f2 := (x,y) -> diff(f(x,y),y);
> slope2 := subs({x=a,y=b},f2(x,y));
> tanline2 := spacecurve({[a,t+b,slope2*t+val,t=-3..3]},color=red,thickness=2):
> display({plot2,curve2,tanline2});
```

e) Finally, type the command line below into Maple; it plots both the x-curve and its tangent line at $P(a, b)$, and the y-curve and its tangent line at $P(a, b)$. Adjust the graphic to get a good view.

```
> display({plot0,curve1,tanline1,curve2,tanline2});
```

At this point, make a hard copy of your typed input and Maple's responses. Then, ...

f) By hand, label each x-curve on the graphics you created as "x-curve", the tangent to each x-curve as "tangent to x-curve", each y-curve on the graphics you created as "y-curve", and the tangent to each y-curve as "tangent to y-curve".