Mathematics 1c: Homework Set 1
Due: Monday, April 5th by 10am.

1. (10 Points) Using the computing site or otherwise, draw the graphs of the following functions:

   (a) $f(x,y) = 3(x^2 + 2y^2)e^{-x^2-y^2}$; **Tip:** On the computing site use $E[x]$ to take the exponent of x; there is no need to type a * for multiplication; we suggest taking x and y between -2 and 2.

   (b) $f(x,y) = (x^3 - 3x)/(1 + y^2)$

   Indicate some key features of these graphs, such as the location of the maxima and minima, important sections, etc

2. (10 Points) **Section 2.1, parts of Exercises 15, 18.** *Sketch the zero level set of the function* $f(x,y,z) = xy + yz$ *and the level set for* $c = 1$ *of the function* $f(x,y) = \max(|x|, |y|)$.

3. (15 Points) **Section 2.2, Exercise 12.** *Compute the following limits, if they exist*

   (a) $\lim\limits_{x \to 0} \dfrac{\sin 2x - 2x}{x^3}$.

   (b) $\lim\limits_{(x,y) \to (0,0)} \dfrac{\sin 2x - 2x + y}{x^3 + y}$.

   (c) $\lim\limits_{(x,y,z) \to (0,0,0)} \dfrac{2x^2 y \cos z}{x^2 + y^2}$.

4. (10 Points) **Section 2.3, Exercise 4(d)** *Show that the following function is differentiable at each point in its domain. Determine if the function is* C^1.

$$f(x,y) = \frac{xy}{\sqrt{x^2 + y^2}}.$$

5. (10 Points) **Section 2.3, Exercise 8(c).** *Compute the matrix of partial derivatives of the function* $f(x,y) = (x + y, x - y, xy)$.

6. (10 Points) **Section 2.3 Exercise 10.** *Why should the graphs of* $f(x,y) = x^2 + y^2$, *and* $g(x,y) = -x^2 - y^2 + xy^3$ *be called "tangent" at* $(0,0)$?

7. (15 Points) **Section 2.4, Exercise 18.** *Suppose that a particle following the path*

$$\mathbf{c}(t) = (e^t, e^{-t}, \cos(t))$$

flies off on a tangent at $t_0 = 1$. *Compute the position of the particle at time* $t_1 = 2$.