**DIRECTIONS:**

- Attach this page to the front of your homework (don't forget your name!).

- Show all work, clearly and in order.

- When required, **do not forget the units**!

- Circle your final answers. **You will loose points if you do not circle your answers**.

| Question | Points | Score |
|----------|--------|-------|
| 1 | 1 | |
| 2 | 4 | |
| 3 | 2 | |
| 4 | 2 | |
| 5 | 1 | |
| Total | 10 | |

**Problem 1:** (1 point) Consider the function $f(x,y) = 4 - x^2 - y^2$. Use level curves to construct the graph of the function . You should be able to do this without a graphing calculator. Show the level curves as well as the full graph of $f$! (Hint: This becomes trivial when write the function $f$ in cylindrical coordinates).

**Problem 2:** (4 points) In this problem you will establish rigorously that

$$lim_{(x,y)\to(0,0)} \frac{x^3 + y^3}{x^2 + y^2} = 0.$$

**(a)** (1 points) Show that $|x| \leq ||(x,y)||$ and $|y| \leq ||(x,y)||$.

**(b)** (1 points) Show that $|x^3 + y^3| \leq 2(x^2 + y^2)^{\frac{3}{2}}$. (Hint: Begin with the triangle inequality, and then use part (a).)

**(c)** (1 points) Show that if $||(x,y)|| \leq \delta$, then $\left|\frac{x^3+y^3}{x^2+y^2}\right| \leq 2\delta$.

**(d)** (1 points) Now prove that $lim_{(x,y)\to(0,0)} \frac{x^3+y^3}{x^2+y^2} = 0$.

**Problem 3:** (2 points) Find the equation of the plane tangent to the graph $z = e^{x+y}\cos(xy)$ at the point $(0,1,e)$.

**Problem 4:** (2 points) Suppose the "Amazing Steve" is fired from a cannon at the angle $\theta$ with initial velocity $\mathbf{v}_0 = v_0 cos\theta \mathbf{i} + v_0 sin\theta \mathbf{j}$. Ignore air resistance so that the only force acting on Steve after time $t = 0$

is gravity. Describe his trajectory with a parametric equation $\mathbf{x}(t)$. What is the geometry of his trajectory (i.e. what kind of curve is it)?

**Problem 5** (1 point) List your project group member names (including your own), email addresses, and phone numbers. Remember groups must consist of 3-4 people.

    1. Name:        Email:        Phone Number

    2. Name:        Email:        Phone Number

    3. Name:        Email:        Phone Number

    4. Name:        Email:        Phone Number