**Review of Exam 1– Tuesday, September 20th**

**1.** Let $\mathbf{a} = (-\sqrt{3}, 0, -1, 0)$ and $\mathbf{b} = (1, 1, 0, 1)$ be vectors in $\mathbb{R}^4$.
(a) Find the distance between the points $(-\sqrt{3}, 0, -1, 0)$ and $(1, 1, 0, 1)$.
(b) Find the angle between $\mathbf{a}$ and $\mathbf{b}$.

**2.** Consider the equation of the plane $x + 2y + 3z = 12$.
(a) Find a normal vector to the plane. (Just look at the equation!)
(b) Find where the $x$, $y$ and $z$-axes intersect the plane. Using this information, sketch the portion of the plane in the first octant where $x \geq 0, y \geq 0, z \geq 0$.
(c) Using the points in part (b), find two non-parallel vectors that are parallel to the plane.
(d) Using part (c) and the cross product, find another normal vector to the plane. Show that this vector is parallel to the vector from part (a).
(e) Using the new normal vector and one of the points from (b), find an alternative equation for the plane. Compare this new equation to $x + 2y + 3z = 12$. How are these two equations related? Is it clear that they describe the same set of points $(x, y, z)$ in $\mathbb{R}^3$?

**3.** Consider the function $f\colon \mathbb{R}^2 \to \mathbb{R}$ given by

$$f(x, y) = \frac{2x^3 y}{x^6 + y^2} \quad \text{for } (x, y) \neq \mathbf{0}$$

In this problem, you'll consider $\lim_{(x,y)\to\mathbf{0}} f(x, y)$.

1. Look at the values of $f$ on the $x$- and $y$-axes. What do these values show the limit $\lim_{(x,y)\to\mathbf{0}} f(x, y)$ must be **if it exists**?

2. Show that along each line in $\mathbb{R}^2$ through the origin, the limit of $f$ exists and is 0.

3. Despite this, show that the limit $\lim_{(x,y)\to\mathbf{0}} f(x, y)$ does not exist by finding a curve over which $f$ takes on the constant value 1.

**4.** The Discussion Worksheet on September 14th.