Name:_____ **9/13/2018**

Math 20300-ST Calculus III **Quiz 1**

Please show all work and **box your final answers**. If you need more room, you may use the backs of the pages. Calculators are not allowed. Good luck!

1. Give equations for the spheres with center $(2, -5, 3)$ that touch
   (a) (4 points) the xz-plane.

   (b) (4 points) the origin.

2. (6 points) Find the angle between the vectors $\vec{a} = \langle \sqrt{3}, 1 \rangle$ and $\vec{b} = \langle 1, \sqrt{3} \rangle$.

3. (6 points) Let $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$, and $\mathbf{d}$ be vectors. State whether each of the following expressions is meaningful or not. If yes, state whether the result is a scalar or a vector.

(a) $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})$

(b) $(\mathbf{a} \cdot \mathbf{b}) \times \mathbf{c}$

(c) $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$

(d) $\mathbf{a} \cdot (\mathbf{b} \cdot \mathbf{c})$

(e) $(\mathbf{a} \cdot \mathbf{b}) \times (\mathbf{c} \cdot \mathbf{d})$

(f) $(\mathbf{a} \times \mathbf{b}) \cdot (\mathbf{c} \times \mathbf{d})$

4. (6 points) Find a *unit vector* that is orthogonal to the vector $\vec{v} = \langle 1, 2, 3 \rangle$.

5. Consider the three points $P(1,0,1)$, $Q(-2,1,3)$, and $R(4,2,5)$.

   (a) (6 points) Find a vector orthogonal to the plane containing P, Q, and R.

   (b) (4 points) Find the area of the triangle with vertices P, Q, and R.