MATH 11: MULTIVARIABLE CALCULUS
FALL 2018
HOMEWORK #1

Please turn in your completed homework assignment by leaving it in the boxes labeled "Math 11" in the hallway outside of Kemeny 108 anytime before 3:30 p.m. on Wednesday, September 19.

Problem 1. For each pair of spheres below (1 and 2, 2 and 3, 1 and 3), choose the correct relationship (a, b, c, d, or e). Be sure to explain your reasoning.

[a.] The spheres intersect in a circle.
[b.] The spheres do not intersect at all, and one is contained inside the other.
[c.] The spheres do not intersect at all, and neither is contained inside the other.
[d.] The spheres meet at a single point, and one is contained inside the other.
[e.] The spheres meet at a single point, and neither is contained inside the other.

Note that a sphere is the *surface* of a solid ball. For example, if two spheres have the same center and different radii, they do not intersect at all, and the smaller one is contained inside the larger one.

Hint: To put these equations into standard form, you may have to complete the square.

Sphere 1: $(x-1)^2 + (y+1)^2 + z^2 = 16$

Sphere 2: $x^2 + y^2 + z^2 - 4x - 2z + 4 = 0$

Sphere 3: $x^2 - 4x + y^2 - 6y + z^2 + 6z = -6$

Problem 2. Use the dot product to show that all three altitudes in a triangle intersect in one point.

Problem 3. Show that

$$(a \cdot a)(b \cdot b) - (a \cdot b)^2 = (a \times b) \cdot (a \times b).$$

Use this equality to find a geometric interpretation for $(a \cdot a)(b \cdot b) - (a \cdot b)^2$.

Date: Due Wednesday, September 19, 3:30 p.m.