Math 2110Q Worksheet 1 - Solutions
August 31, 2016

1. Find the distance between $P = (4, -2, 1)$ and $Q = (3, 0, 1)$. (2 pts.)
Solution: Via the formula,

$$d = \sqrt{(4-3)^2 + (-2-0)^2 + (1-1)^2} = \sqrt{1+4+0} = \sqrt{5}.$$

2. Given $\vec{a} =< -1, 2, 2 >$ and $\vec{b} =< -3, 5, 0 >$, find $\vec{b} - \vec{a}$ and $3\vec{a}$. (2 pts.)
Solution:

$$\vec{b} - \vec{a} = \langle -3 - (-1), 5 - 2, 0 - 2 \rangle = \langle -2, 3, -2 \rangle .$$
$$3\vec{a} = \langle 3 \cdot (-1), 3 \cdot 2, 3 \cdot 2 \rangle = \langle -3, 6, 6 \rangle .$$

3. What are the projections of $(2, 3, 4)$ onto the yz-plane and onto the xz-plane? (2 pts.)
Solution: For the yz-plane, just zero-out the x-coordinate value. For the xz-plane, just zero-out the y-coordinate value. The answers are then $(0, 3, 4)$ and $(2, 0, 4)$, respectively.

4. Find $| < 3, -1, -2 > |$. (2 pts.)
Solution: You need to know that this notation means to find the magnitude of the vector, which is

$$\sqrt{(3)^2 + (-1)^2 + (-2)^2} = \sqrt{9+1+4} = \sqrt{14}.$$

5. Use set notation to define the 3D surface satisfying $y = 2x + 1$. What kind of surface is this? (2 pts.)
Solution: This is a PLANE. The set of points is

$$\{(x, y, z) \,|\, y = 2x + 1\} .$$

6. Write the equation for a sphere of radius π with center $(2, 6, -1)$. (2 pts.)
Solution: If you remember the standard form for the equation, then just insert $(x_0, y_0, z_0) = (2, 6, -1)$ and $r = \pi$ to get

$$(x-2)^2 + (y-6)^2 + (z+1)^2 = \pi^2.$$

7. Find the center and radius of the sphere S, where

$$S = \left\{(x, y, z) \,|\, 2 + x^2 + y^2 + z^2 - 2x + 4y + 2z = 0\right\} . \quad \text{(3 pts.)}$$

Solution: Complete the square and get into standard form:

$$\begin{aligned} &2 + x^2 + y^2 + z^2 - 2x + 4y + 2z = 0 \\ &\Rightarrow x^2 + y^2 + z^2 - 2x + 4y + 2z = -2 \\ &\Rightarrow (x-1)^2 + (y+2)^2 + (z+1)^2 = -2 + (-1)^2 + (2)^2 + (1)^2 \\ &\Rightarrow (x-1)^2 + (y+2)^2 + (z+1)^2 = 4. \end{aligned}$$

We now see that the center is $(1, -2, -1)$ and the radius is $\sqrt{4} = 2$.