Directions:

1. Section: Math251-007
2. Write your name with one character in each box below.
3. Show all work. No credit for answers without work.

1. **[3 points]** Find the unit vector in the same direction as $2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$. Simplify as much as possible.

$\vec{a} = \langle 2, -3, 6 \rangle$ $\quad |\vec{a}| = \sqrt{2^2 + (-3)^2 + 6^2} = \sqrt{4+9+36} = \sqrt{49} = 7$

So unit vector in same direction is $\frac{1}{|\vec{a}|}\vec{a} = \frac{1}{7}\langle 2, -3, 6 \rangle = \boxed{\langle \frac{2}{7}, \frac{-3}{7}, \frac{6}{7} \rangle}$

2. **[3 points]** Find the vector with magnitude 6 in the same direction as $\overrightarrow{PQ}$, where $P = (5, 2, -1)$ and $Q = (1, 2, 1)$.

$\vec{u} = \overrightarrow{PQ} = \langle 1-5, 2-2, 1-(-1) \rangle = \langle -4, 0, 2 \rangle$.

Want a scalar $\alpha \geq 0$ such that $|\alpha \vec{u}| = \alpha |\vec{u}| = 6$, take $\alpha = \frac{6}{|\overrightarrow{PQ}|} = \frac{6}{\sqrt{(-4)^2+0^2+2^2}} = \frac{6}{\sqrt{20}}$

$= \frac{2 \cdot 3}{2\sqrt{5}} = \frac{3}{\sqrt{5}}$.

So the desired vector is $\boxed{\frac{3}{\sqrt{5}} \langle -4, 0, 2 \rangle}$.

3. **[2 points]** Find a simplified equation in variables x, y, and z whose solution set equals the points (x, y, z) that are equally distant from $(1, -1, 3)$ and $(0, 0, 0)$.

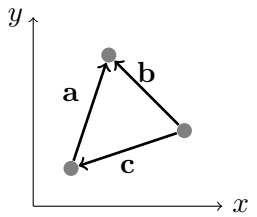
$[\text{Dist}((x,y,z), (1,-1,3))]^2 = [\text{Dist}((x,y,z), (0,0,0))]^2$

$(x-1)^2 + (y-(-1))^2 + (z-3)^2 = (x-0)^2 + (y-0)^2 + (z-0)^2$

$x^2 - 2x + 1 + y^2 + 2y + 1 + z^2 - 6z + 9 = x^2 + y^2 + z^2$

$\boxed{2x - 2y + 6z = 11}$

4. **[2 points]** Vectors **a**, **b**, and **c** are shown below. Find a formula for **c** in terms of **a** and **b**.



$\vec{c} + \vec{a} = \vec{b}$, so $\boxed{\vec{c} = \vec{b} - \vec{a}}$.