Name:

Tutorial time:

Please complete all problems below, and indicate which **one** problem you want feedback on.

1. Let $P = (1, 0, -2)$, $Q = (-3, 2, 4)$, and $R = (0, 5, -1)$ be points in $\mathbb{R}^3$.

   (a) Calculate the vectors $\vec{u} = \overrightarrow{PQ}$, $\vec{v} = \overrightarrow{QR}$, and $\vec{w} = \overrightarrow{PR}$.

   (b) Show that $\vec{u} + \vec{v} = \vec{w}$.

   (c) Explain, with a diagram, why your result in part (b) makes sense. (You do not have to accurately plot the points P, Q, R.)

2. Let $\vec{a} = \begin{bmatrix} 1 \\ 4 \\ -7 \end{bmatrix}$ and $\vec{b} = \begin{bmatrix} -3 \\ 5 \\ 2 \end{bmatrix}$.

   Find the vector $\vec{c}$ given by the linear combination $\vec{c} = 4\vec{a} - 3\vec{b}$.

3. Let $\vec{u} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$ and let $\vec{v} = \begin{bmatrix} -2 \\ 1 \end{bmatrix}$ be vectors in $\mathbb{R}^2$. Sketch the vectors $\vec{u}, \vec{v}$, and $3\vec{u} - 2\vec{v}$.

4. Recall that the *absolute value* function $|x|$ is defined by

$$|x| = \begin{cases} x, & \text{if } x \geq 0 \\ -x, & \text{if } x < 0 \end{cases}.$$

   (a) Calculate $|2|$, $|3.5|$, $|0|$, $|-5|$, and $|-7/4|$.

   (b) Explain in your own words what the effect of $|x|$ is on a real number x.

   (c) Calculate $\sqrt{(2^2)}$, $\sqrt{(0)^2}$, $\sqrt{(-1)^2}$ and $\sqrt{(-2)^2}$.

   (d) Explain why it's true that $\sqrt{x^2} = |x|$ for any real number x.

(e) Let $\vec{v} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ be a vector in $\mathbb{R}^3$, and let $c \in \mathbb{R}$ be any scalar. Recall that $\|\vec{v}\|$ is defined by

$$\|\vec{v}\| = \sqrt{x^2 + y^2 + z^2}.$$

Show that $\|c\vec{v}\| = |c|\|\vec{v}\|$. How is this related to the geometric interpretation of scalar multiplication?