1. Prove that for any two non-zero vectors $\vec{a}$ and $\vec{b}$, $\vec{b} - \text{proj}_a\vec{b}$ is perpendicular to $\vec{a}$. Show all steps and give reasons.

2. Consider the two vectors $\vec{a} = \langle -3, 4 \rangle$ and $\vec{b} = \langle 1, 3 \rangle$.

   a) Sketch both vectors on the axes to the right. (with tails at the origin)

   b) Find the angle (degrees) between $\vec{a}$ and $\vec{b}$.

   c) Find the scalar component of $\vec{b}$ onto $\vec{a}$, $(\text{comp}_a\vec{b})$.

   d) Find the vector projection of $\vec{b}$ onto $\vec{a}$, $(\text{proj}_a\vec{b})$ and sketch it in your graph above.
3. Consider the three points in space: P(1, 0, 0), Q(0, 2, 0), and R(0, 0, 3).
   a) Sketch the triangle in 3-d space on the axes to the right.
   b) Find the area of the triangle ΔPQR.

   c) Find parametric equations for the line going through the points P and R.

4. Find an equation for the plane going through the origin and perpendicular to the line given parametrically by \( x = 1 + 2t, y = 1 + 3t, z = -2 + 4t. \)

5. State whether each of the following is a vector, a scalar, or makes no sense:
   (a) \((\vec{a} \cdot \vec{b})\vec{c}\)
   (b) \((\vec{a} \times \vec{b}) \cdot |\vec{c}|\)
   (c) \((\vec{a} \times \vec{b}) \times \vec{c}\)
   (d) \(\vec{a} \cdot (\vec{b} \times \vec{c})\)
   (e) \((\vec{a} \cdot \vec{b}) \times \vec{c}\)
   (f) \((\vec{a} \cdot \vec{b}) + |\vec{c}|\)
6. Two forces $\vec{F}_1$ and $\vec{F}_2$ each with magnitude 10 Newtons make angles of $30^\circ$ and $60^\circ$ respectively with the positive $x$-axis in the 2-d plane. If $\vec{F} = \vec{F}_1 + \vec{F}_2$, find the magnitude and the angle $\vec{F}$ makes with the positive $x$-axis.

7. Find the distance between the point $P(1, 1, 1)$ and the plane $x + 2y + 3z = 1$.

8. Where does the line given parametrically by $x = 3 + t, \ y = 2 + 3t, \ z = -2 + 2t$ intersect the plane $x + y - z = 3$?