1. (20 points) Graph (or describe) the following equations in three dimensional space.
   (a) \( z = x^2 \)
   (b) \( x^2 + y^2 + (z - 3)^2 = 9 \)
   (c) \( 2x + y + 3z = 6 \)
   (d) \( x = 2t + 1, \ y = t + 1, \ z = 3t \)

2. (15 points) Let \( \mathbf{v} = i + 5j - 4k \) and \( \mathbf{w} = 2i - j + 5k \). Find
   (a) a unit vector with the same direction as \( \mathbf{v} \)
   (b) \( \mathbf{v} \cdot \mathbf{w} \)

3. (10 points) Find the work done by the force \( \mathbf{F} = \langle 2, 1, 1 \rangle \) in moving an object from point \( (0, 1, -2) \) to point \( (2, 3, 1) \). Force is given in pounds and distance is measured in feet.

4. (5 points) For the vectors drawn below, is \( \mathbf{v} \cdot \mathbf{w} \) positive, negative or zero?

5. (5 points) For the vectors drawn below, which is larger \( |\mathbf{u}_1 \times \mathbf{v}_1| \) or \( |\mathbf{u}_2 \times \mathbf{v}_2| \)?

6. (10 points) Find the equation of the plane that contains the points \( (5, -1, 1) \), \( (1, 0, 4) \), and \( (1, 2, 0) \).

7. (10 points) Find parametric equations of the line that contains the point \( (4, 3, 6) \) and is perpendicular to both the lines
   \[ \begin{align*}
   L_1 & : x = 1 - t, \ y = 3 + 4t, \ z = 2 + t \\
   L_2 & : x = t, \ y = 2 - t, \ z = -3 + 6t.
   \end{align*} \]

8. (15 points) Let \( L \) be the line with equations \( x = 2t, \ y = 3 - t, \ z = -1 + 4t \) and let \( P \) be the plane \( 7x + 3y - z = 5 \).
   (a) Find the point at which the line intersects the plane.
   (b) Find the smaller of the two angles between the line and the plane.

9. (10 points) Find the distance between the planes \( x - 2y - z = 10 \) and \( x - 2y - z = 3 \).

10. (Extra Credit - 5 points) Find the distance (shortest distance) between the skew lines
    \[ \begin{align*}
    L_1 & : x = 1 + t, \ y = 1 + 6t, \ z = 2t \\
    L_2 & : x = 1 + 2t, \ y = 5 + 15t, \ z = -2 + 6t.
    \end{align*} \]