1. True-False \hfill (10 pts)

(a) T F \quad \text{The vectors } \langle 2, -1, 3 \rangle \text{ and } \langle 4, -2, 1 \rangle \text{ are parallel.}

(b) T F \quad \text{The vectors } \langle 2, -1, 3 \rangle \text{ and } \langle 1, 5, 1 \rangle \text{ are orthogonal.}

(c) T F \quad \text{The vectors } \langle 8, -1, 2 \rangle \text{ and } \langle -2, 4, 7 \rangle \text{ have the same length.}

(d) T F \quad \text{The vector } \langle \frac{3}{5}, -\frac{4}{5} \rangle \text{ is a unit vector.}

(e) T F \quad \text{The vector } \langle -1, -1, 1 \rangle \text{ is perpendicular to the plane } x + y - z = 3.

2. The area of the parallelogram formed by the vectors \( \mathbf{v} = 2\mathbf{i} + \mathbf{j} \) and \( \mathbf{u} = -4\mathbf{i} + 5\mathbf{j} \) is \hfill (5 pts)

(a) 14 \quad (b) 6 \quad (c) 5 \quad (d) 3 \quad (e) 1

3. The cosine of the angle between the two vectors \( \mathbf{v} = \langle -7, 4, -4 \rangle \) and \( \mathbf{u} = \langle 4, 8, -1 \rangle \) is \hfill (5 pts)

(a) \frac{64}{49} \quad (b) 0 \quad (c) \frac{-7}{12} \quad (d) \frac{8}{63} \quad (e) \frac{8}{81}

4. The surface whose equation in cylindrical coordinates is given by \( \theta = \frac{\pi}{6} \) is \hfill (5 pts)

(a) a cone \quad (b) a cylinder \quad (c) a sphere \quad (d) a plane \quad (e) two straight lines

5. Find the point of intersection of the line given by \( \frac{x + 2}{2} = \frac{y - 7}{8} = z + 2 \) and the \( xy \)-plane. \hfill (5 pts)

[Your answer:]
6. Let \( P(2,4,6), Q(0,-1,5), R(3,1,2) \) be three points in \( \mathbb{R}^3 \). 

(a) Find the vector (in component form) from \( P \) to \( Q \).

(b) Find the symmetric equations for the line in space through points \( P \) and \( Q \).

(c) Find a vector (in component form) that is orthogonal to \( \overrightarrow{PQ} \) and \( \overrightarrow{PR} \).

(d) Find an equation for the plane determined by the points \( P,Q, \) and \( R \).

(e) Find the projection of \( \overrightarrow{PQ} \) in the direction of \( \overrightarrow{PR} \).
7. Consider the surface defined by $y - \frac{x^2}{4} - z^2 = 0$. (20 pts)

(a) Sketch and describe the trace of the surface in the $xy$-plane.

(b) Sketch and describe the trace of the surface in the $yz$-plane.

(c) Sketch and describe the trace of the surface in the $xz$-plane.

(d) Sketch and describe the trace of the surface in the plane $y = 4$.

(e) Sketch and describe the surface in 3-space.
8. Consider the vector $\mathbf{u}$ in the $yz$-plane of length 4 making an angle of 30° with the positive $y$-axis.

(a) Write the vector $\mathbf{u}$ in standard unit vector notation (as a linear combination of $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$).

(b) Write the vector in component form.

(c) Sketch the vector $\mathbf{u}$.

9. Consider the surface in 3-space defined by the equation $x^2 + y^2 = 4y$.

(a) Sketch and describe the surface in 3-space.

(b) Convert the equation into cylindrical coordinates.
10. **Bonus** Find the point \((x_1, y_1, z_1)\) that results when the point \((x_o, y_o, z_o)\) is projected onto the plane \(ax + by + cz + d = 0\).