Show all your work on the exam paper, legibly and in detail, to receive full credit. The use of a calculator or any other electronic device is prohibited. You may only use techniques discussed to date in class. You must simplify all answers unless you are explicitly instructed not to.

(12 points) Find the equation to a sphere with center \((-2, 1, 3)\) that is tangent to the \(yz\)-plane.

(13 points) Find a vector with length \(\sqrt{17}\) that points in the same direction as the vector from point \(A: (1, 2, 9)\) to point \(B: (8, 2, 3)\)
(12 points) Given that \( \mathbf{v} = \mathbf{i} - 3\mathbf{j} + 2\mathbf{k} \) and \( \mathbf{w} = \mathbf{i} + \mathbf{j} \), find \( 2\mathbf{v} - 3\mathbf{w} \) and \( \frac{1}{\|\mathbf{v}\|} \mathbf{v} \).

(13 points) Given that \( \mathbf{v} = \langle -2, 1, 6 \rangle \) and \( \mathbf{b} = \langle 0, -2, 1 \rangle \), express \( \mathbf{v} \) as the sum of a vector parallel to \( \mathbf{b} \) and a vector orthogonal to \( \mathbf{b} \). Clearly indicate which one is parallel to \( \mathbf{b} \) and which one is orthogonal to \( \mathbf{b} \).
Consider the following lines:

\[ L_1 : x = 1 + t, \ y = 1 - t, \ z = 2t \]
\[ L_2 : x = 2 - t, \ y = t, \quad z = 4 \]

(a) (10 points) Show that the lines intersect and find their point of intersection.
(b) (10 points) Find the equation of the plane that contains both lines.
Consider the following planes:

\[ x + y + z = 1 \]
\[ x + 2y + 2z = 1 \]

(a) (6 points) Show that the two planes are not parallel.

(b) (7 points) Find the acute angle of intersection between the two planes. You may leave the angle in the form of an inverse trigonometric function.

(c) (7 points) Find the line of intersection of the two planes.
(10 points) Where does the line $x = 1 + t, y = 3 - t, z = 2t$ intersect the cylinder $x^2 + y^2 = 16$?