0. Read The Following Sections:

Chapter 10. Vectors and the Geometry of Space: Section 10.1 Three-Dimensional Coordinate Systems, 10.2 Vectors, 10.3 The Dot Product

1. Show that the equation represents a sphere, and find its center and radius:

\[ x^2 + y^2 + z^2 - 2x - 4y + 8z = 15 \]

2. Sketch the surface in the \( xyz \)-coordinate space \( \mathbb{R}^3 \) represented by

\[ x + y = 1 \]

3. Compute \( 2\vec{u} - 3\vec{v} \) where \( \vec{u} = \langle 3, -2, 5 \rangle \) and \( \vec{v} = \langle -1, 4, 3 \rangle \)

4. Find a unit vector that has the opposite direction as \( \vec{v} = \langle 2, 2, -1 \rangle \)

5. \( \vec{v} = \langle -6, 12, -2 \rangle \). Find \( \lambda, \mu, \eta \) such that \( \vec{v} = \lambda\vec{a} + \mu\vec{b} + \eta\vec{c} \), where \( \vec{a} = \langle 1, 1, -1 \rangle \), \( \vec{b} = \langle 1, -1, 1 \rangle \), \( \vec{c} = \langle -1, 1, 1 \rangle \)

6. Prove the following two vectors are orthogonal:

\[ \vec{u} = \langle -5, 3, 6 \rangle, \vec{v} = \langle 6, -8, 9 \rangle \]

7. Find an unit vector that makes an angle of \( \frac{\pi}{3} \) with \( \vec{v} = \langle 1, \sqrt{3}, -2\sqrt{3} \rangle \) and perpendicular to \( \vec{k} = \langle 0, 0, 1 \rangle \).

8. Find the scalar projection and vector projection of \( \vec{v} = \langle 1, 2, 3 \rangle \) onto \( \vec{u} = \langle 3, 6, -2 \rangle \)

9. Show that if \( \vec{u} + \vec{v} \) and \( \vec{u} - \vec{v} \) are orthogonal, then \( |\vec{u}| = |\vec{v}| \)