Vector Problems

Let \( \vec{a} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \), \( \vec{b} = \begin{pmatrix} 0 \\ -1 \\ 2 \end{pmatrix} \), \( \vec{c} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \), and \( \vec{d} = \begin{pmatrix} 1 \\ t \\ t^2 \end{pmatrix} \).

1. Compute
   (a) \( \vec{a} + 2\vec{b} \)
   (b) \( ||\vec{b} - \vec{d}|| \)
   (c) \( \vec{c} \cdot \vec{d} \)
   (d) the angle between \( \vec{a} \) and \( \vec{c} \)
   (e) The line through \( P(3, 2, 1) \) and parallel to \( \vec{b} \).
   (f) \( \vec{b} \times \vec{c} \)
   (g) Find a vector perpendicular to both \( \vec{c}, \vec{d} \).

2. Find the vertex \( E \) in the parallelogram \( ABCE \), where \( A(1, 0, 0), B(0, -1, 2), C(3, 2, 1) \).

3. Find real numbers \( s, t \) such that \( \vec{c} = s\vec{a} + t\vec{b} \).

4. (a) Find the equation of the line \( l \) through \( A(1, 0, 1), B(0, -2, 3) \)
   (b) Find the equation of the plane through \( A \) and perpendicular to \( l \).

5. (a) Orthogonally project \( \vec{b} \) onto \( \vec{c} \):
   Find the decomposition \( \vec{b} = \vec{b}' + \vec{b}'' \)
   (b) Orthogonally project \( \vec{c} \) onto \( \vec{b} \):
   Find the decomposition \( \vec{c} = \vec{c}' + \vec{c}'' \)

6. Find the distance of point \( D(1, 0, -3) \) from the plane \( 2x - 3y + z - 5 = 0 \). Does \( D \) lie above or below the plane?

7. Do problem 6.13 number 5 with \( A(1, 0, 0), B(-3, 01), C(2, 2, 2) \).

8. Do the planes \( 2x - 3y + z = 5 = 0 \) and \( -x + y + 2z - 3 = 0 \) intersect and if so, find the line of intersection.

9. Do problem 6.13 number 8 with \( A(1, 0, 0), B(-3, 01), D(2, 2, 2), E(3, 1, 2) \).