1. Find a unit vector orthogonal to the vectors \( V = 6 \mathbf{i} - 7 \mathbf{j} + \mathbf{k}, \ W = -\mathbf{i} + 2 \mathbf{j} - 3 \mathbf{k} \). What is the volume of the parallelopiped determined by these three vectors?

2. Find a vector which makes an angle of 30° with the plane determined by the vectors \( V = 6 \mathbf{i} - 7 \mathbf{j} + \mathbf{k}, \ W = -\mathbf{i} + 2 \mathbf{j} - 3 \mathbf{k} \).

3. Find a vector normal to the plane given by the equation\[ 3x - 2y + z = 14. \]

4. Find a vector normal to the plane through \( P : (0, 0, 0), \ Q : (1, 0, -1), \ R : (0, 1, 1) \).

5. Find the equation of the plane through the origin which is normal to the line given parametrically by\[ X = (3 \mathbf{i} + 2 \mathbf{j} - \mathbf{k}) + t(-\mathbf{i} + \mathbf{j} + 2 \mathbf{k}). \]

6. Find \( V_1 \cdot (V_2 \times V_3) \) where\[ V_1 = -\mathbf{i} + 2 \mathbf{j} + \mathbf{k}, \ V_2 = 2 \mathbf{i} - 2 \mathbf{j} + 3 \mathbf{k}, \ V_3 = \mathbf{i} - 2 \mathbf{k}. \]

7. Show that if \( \det(U, V, W) = |U||V||W| \), then the three vectors are mutually orthogonal.

8. Find the symmetric equations of the line through the point (2, -1, 3) which is perpendicular to the vectors \( V = 2 \mathbf{i} - \mathbf{j} + 3 \mathbf{k} \) and \( W = \mathbf{i} - \mathbf{j} + \mathbf{k} \).

9. Find the parametric equations of the line through the point (2, -1, 3) which is parallel to the two planes given by the equations\[ 3x + z = 4, \quad x - 2y + 5z = 1. \]

10. Find the equation of the plane through the point (2, -1, 3) which is parallel to the vectors \( \mathbf{i} - 2\mathbf{j} + 3\mathbf{k} \) and \( 3\mathbf{i} - 2\mathbf{j} + \mathbf{k} \).

11. Find the distance of the point (2, 0, 1) from the plane given by the equation\[ \frac{x - 2}{3} + \frac{y + 1}{4} + \frac{z - 1}{2} = 0. \]

12. Let \( L_1, \ L_2 \) be two lines in three dimensions which do not intersect. There are points \( P_1, \ P_2 \) on \( L_1, \ L_2 \) respectively such that the line joining \( P_1 \) and \( P_2 \) intersects each line at a right angle. These are the points on the two lines which are closest together. Find a formula for the distance between \( P_1 \) and \( P_2 \), in terms of the equations of the lines\[ L_1 : \ X = Q_1 + tN_1 \quad L_2 : \ X = Q_2 + sN_2. \]