1) Consider the vectors $u = (2, -1, 3)$, $v = (1, -3, 4)$ and $w = (2, 2, 1)$.

   a) Find the norm of $u - 2v$ and the distance between u and w.

   b) Find a vector which is orthogonal to both u and v.

   c) Calculate the scalar triple product $u.(v \times w)$. What is the volume of the parallelepiped in $3-$space determined by the vectors u, v and w.

   d) Find the cosine of the angle between the vectors u and w.

   e) Find the vector component of u along v and the vector component of u orthogonal to v.

2) a) Find the equation of the plane φ passing through the points $P(2,-1,4)$, $Q(3,1,-1)$ and $R(1,1,1)$.

b) Find the parametric equations of the line L passing through $P_1(2,1,3)$ and $P_2(1,2,2)$,

c) Find the distance between the line L and the plane φ.

3) Consider the linear operators $T: R^2 \to R^2$ and $S: R^2 \to R^2$ where T has the standard matrix representation $[T] = \begin{bmatrix} 1 & 3 \\ 3 & 0 \end{bmatrix}$ and S is the rotational operator counterclockwise by an angle $\frac{\pi}{6}$.

a) Is the operator T one to one ? Onto? Why?

b) Find the vector $v = (ToS)(u)$, where $u = (\frac{-1}{2}, \frac{\sqrt{3}}{2})$.

c) Find $T(-1,2)$ and $S(1,1)$.

d) Find $(SoT)^{-1}(w)$ if exists, where $w = (1,1)$.

4) Determine whether the following vectors span R^3: $v_1 = (2,-1,3), v_2 = (4,1,2), v_3 = (8,-1,8)$.