1. (a) Find the parametric equation of the line that passes through $(1,2,-3)$ and $(-5,0,1)$.

(b) Find the parametric equation of the line that passes through $(1,2,4)$ and is parallel to $x=1-3t,\ y=1+2t,\ z=7t$.

(c) Find the equation of the plane through $(1,2,4)$ and normal to $x=1-3t,\ y=1+2t,\ z=7t$.

(d) Find the distance from the point $(-3,0,1)$ to the plane $2x+3y-z=0$.

2. Let A be an n-square matrix with eigenvalues $\lambda_1,\ldots,\lambda_n$.

(a) Prove that

$$\prod_{i=1}^{n}\lambda_i=\det A;$$

that is, prove that the product of the eigenvalues of A is equal to the determinant of A.

(b) Prove that

$$\sum_{i=1}^{n}\lambda_i=\sum_{i=1}^{n}a_{ii};$$

that is, prove that the sum of the eigenvalues of A is equal to the sum of the entries on the main diagonal of A.

3. Determine whether the matrix $M=\begin{bmatrix}2/7 & 3/7 & 6/7\\ 6/7 & 2/7 & -3/7\\ 3/7 & -6/7 & 2/7\end{bmatrix}$ is orthogonal, then find its eigenvalues.

4. Let B and C be two n-square matrices and let A be an orthogonal matrix such that $B=A^{-1}CA$. Then B is said to be *orthogonally congruent* to C. Prove that if B is orthogonally congruent to C, then C is orthogonally congruent to B.

5. Find the standard form for each of the following conic sections.

(a) $5x^2+4xy+3y^2$

(b) $7x^2+2xy-y^2$

6. Prove the Cauchy-Schwartz Inequality.

7. Prove the Triangle Inequality.

8. Let T map V^3 into V^3 and have the matrix $Q=\begin{bmatrix}3 & 1 & 2\\ 1 & 0 & 1\\ 5 & 2 & 3\end{bmatrix}$.

(a) Find the kernel of T, and determine whether T is one-to-one.

(b) Find the range of T, and determine whether T is onto.

9. Let $\mathbf{u}=\langle 2,0,3,4,6\rangle$, $\mathbf{v}=\langle 6,3,2,1,0\rangle$, and $\mathbf{w}=\langle 3,3,3,3,3\rangle$ be vectors in $\mathbb{E}^5$.

(a) Find the lengths of the sides of the triangle formed by $\mathbf{u}$, $\mathbf{v}$ and $\mathbf{w}$.

(b) Find cosines of the angles in the triangle formed by $\mathbf{u}$, $\mathbf{v}$ and $\mathbf{w}$.

10. Prove that if A is an n-square orthogonal matrix, then each row vector of A is a unit vector.