1. Given three points A = (1,1, 1), B = (2,2, 2), C = (6,1, 3) and D = (-2,4,6).

   (1) Find the cosine of the angle between $\overline{AB}$ and the line from A to the midpoint of $\overline{BC}$.

   (2) Prove that the three points A, B and C are not collinear.

   (3) Find an equation of the plane containing all three points A, B and C.

   (4) Find the volume of the parallelepiped having incident sides extending from the first point A to each of the other three points B, C and D.

2. In each of problems given, determine whether the set of vectors is a subspace of R^n for the appropriate n.

   (1) A set S consists of all vectors in R^4 of the form (x, y, x+y, x-y).

   (2) A set S consists of all vectors in R^6 of the form (x, 0, 0,1,0,y).

3. Determine whether the given vectors (1, -2), (4, 1) and (6, 6) are linearly independent or dependent in R^2.

3. Given a matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 0 & 0 \\ 1 & 2 & 3 \end{bmatrix}$

   (1) Find the reduced form A_R of matrix A .

   (2) Determine the rank of matrix A and state the reason.

   (3) Determine a basis for the row space of matrix A and its dimension.

   (4) Determine a basis for the column space of matrix A and its dimension.

5. Given a linear system $\mathbf{AX} = \begin{bmatrix} 1 & 2 & -1 & 1 \\ 0 & 1 & -1 & 1 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{Bmatrix} = \mathbf{B} = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$.

   (1) Determine the dimension of the solution space of the homogeneous system $\mathbf{AX=O}$ if matrix $\mathbf{B=O}$.

   (2) Show that the nonhomogeneous system AX=B has a solution if $\mathbf{B} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$.

   (3) Find the general solution of nonhomogeneous system in (2).