# 4-4.4-32

## AI24BTECH11002 - K.AKSHAY TEJA

#### **Ouestion:**

Show that the vectors  $\mathbf{a} = \hat{i} - 2\hat{j} + 3\hat{k}$ ,  $\mathbf{b} = 2\hat{i} + 3\hat{j} - 4\hat{k}$ ,  $\mathbf{c} = \hat{i} - 3\hat{j} + \hat{k}$  are not coplanar.

## **Solution:**

Vector	Description
Vector A	$\begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}$
Vector B	$\begin{pmatrix} 2\\3\\-4 \end{pmatrix}$
Vector C	$\begin{pmatrix} 1 \\ -3 \\ 1 \end{pmatrix}$

TABLE 0: Position Vectors

The given vectors are coplanar if

$$Rank \begin{pmatrix} \mathbf{A} & \mathbf{B} & \mathbf{C} \end{pmatrix}^{\mathsf{T}} \neq 2$$
 (0.1)

$$\implies \begin{pmatrix} 1 & -2 & 3 \\ 2 & 3 & -4 \\ 1 & -3 & 5 \end{pmatrix} \xrightarrow{R_2 \leftarrow R_2 - 2R_1} \begin{pmatrix} 1 & -2 & 3 \\ 0 & 7 & -10 \\ 1 & -3 & 5 \end{pmatrix} \tag{0.2}$$

$$\xrightarrow{R_3 \leftarrow R_3 - R_1} \begin{pmatrix} 1 & -2 & 3 \\ 0 & 7 & -10 \\ 0 & -1 & 2 \end{pmatrix} \xrightarrow{R_2 \leftarrow \frac{1}{7}R_2} \begin{pmatrix} 1 & -2 & 3 \\ 0 & 1 & -\frac{10}{7} \\ 0 & -1 & 2 \end{pmatrix}$$
 (0.3)

$$\stackrel{R_3 \leftarrow R_3 - R_1}{\longleftrightarrow} \begin{pmatrix} 1 & -2 & 3 \\ 0 & 1 & -\frac{10}{7} \\ 0 & 0 & \frac{4}{7} \end{pmatrix}$$
(0.4)

The rank of the matrix is 3. Therefore the given vectors are not coplanar.

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### Planes and Vectors Visualization

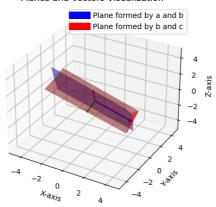


Fig. 0.1: Line and Vectors