

# Assignment - 1

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**Abstract—**This is a simple document to learn about writing vectors and matrices using latex, draw figures using Python, Latex.

Download all and latex-tikz codes from

svn co [https://github.com/arjunjc93/Assignment-1\\_new.git](https://github.com/arjunjc93/Assignment-1_new.git)

## 1 VECTORS (CBSE-MATH-X-2006-SET 2-Q.11)

1.1. Draw the graphs of the following equations:

$$3x - 4y + 6 = 0 \quad (1.1.1)$$

$$\text{or } \begin{pmatrix} 3 & -4 \end{pmatrix} \mathbf{x} = -6 \quad (1.1.2)$$

$$3x + y - 9 = 0 \quad (1.1.3)$$

$$\text{or } \begin{pmatrix} 3 & 1 \end{pmatrix} \mathbf{x} = 9 \quad (1.1.4)$$

Also determine the co-ordinates of the vertices of the triangle formed by these lines and the x-axis.

**Solution:**

- a) We have equations of two lines: Which is written in vector form:

$$\begin{pmatrix} 3 & -4 \end{pmatrix} \mathbf{x} = -6 \quad (1.1.5)$$

and

$$\begin{pmatrix} 3 & 1 \end{pmatrix} \mathbf{x} = 9 \quad (1.1.6)$$

where

$$\mathbf{x} = \begin{pmatrix} x \\ y \end{pmatrix} \quad (1.1.7)$$

Both equations are written together in matrix form as:

$$\begin{pmatrix} 3 & -4 \\ 3 & 9 \end{pmatrix} \mathbf{x} = \begin{pmatrix} -6 \\ 9 \end{pmatrix} \quad (1.1.8)$$

Augmented matrix for above is:

$$\begin{pmatrix} 3 & -4 & -6 \\ 3 & 1 & 9 \end{pmatrix} \quad (1.1.9)$$

This can be reduced as follows:

$$\begin{pmatrix} 3 & -4 & -6 \\ 3 & 1 & 9 \end{pmatrix} \xleftrightarrow[R_1 \leftarrow R_2]{R_2 \leftarrow R_1} \begin{pmatrix} 3 & 1 & 9 \\ 3 & -4 & -6 \end{pmatrix} \quad (1.1.10)$$

$$\xleftrightarrow{R_1 \leftarrow \frac{R_1}{3}} \begin{pmatrix} 1 & \frac{1}{3} & 3 \\ 3 & -4 & -6 \end{pmatrix} \quad (1.1.11)$$

$$\xleftrightarrow{R_2 \leftarrow R_2 - 3R_1} \begin{pmatrix} 1 & \frac{1}{3} & 3 \\ 0 & -5 & -15 \end{pmatrix} \quad (1.1.12)$$

$$\xleftrightarrow{R_2 \leftarrow -\frac{1}{5}R_2} \begin{pmatrix} 1 & \frac{1}{3} & 3 \\ 0 & 1 & 3 \end{pmatrix} \quad (1.1.13)$$

$$\xleftrightarrow{R_1 \leftarrow R_1 - \frac{1}{3}R_2} \begin{pmatrix} 1 & 0 & 2 \\ 0 & 1 & 3 \end{pmatrix} \quad (1.1.14)$$

$$\therefore \mathbf{P} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad (1.1.15)$$

is the point of intersection of the lines and the vertex of the triangle formed by the two lines with x-axis as base.

- b) To find out intersection of (1.1.5) with the x axis:

equation of x axis is

$$\begin{pmatrix} 0 & 1 \end{pmatrix} \begin{pmatrix} x \end{pmatrix} = 0 \quad (1.1.16)$$

we have 2 equations:

$$\begin{pmatrix} 3 & -4 \end{pmatrix} \mathbf{x} = -6 \quad (1.1.17)$$

$$\begin{pmatrix} 0 & 1 \end{pmatrix} \mathbf{x} = 0 \quad (1.1.18)$$

Augmented matrix for above is:

$$\begin{pmatrix} 3 & -4 & -6 \\ 0 & 1 & 0 \end{pmatrix} \quad (1.1.19)$$

This can be reduced as follows:

$$\begin{pmatrix} 3 & -4 & -6 \\ 0 & 1 & 0 \end{pmatrix} \xrightarrow{R_1 \leftarrow \frac{1}{3}R_1} \begin{pmatrix} 1 & -\frac{4}{3} & -2 \\ 0 & 1 & 0 \end{pmatrix} \quad (1.1.20)$$

$$\xrightarrow{R_1 \leftarrow R_1 + \frac{4}{3}R_2} \begin{pmatrix} 1 & 0 & -2 \\ 0 & 1 & 0 \end{pmatrix} \quad (1.1.21)$$

$$(1.1.22)$$

$$\therefore \mathbf{Q} = \begin{pmatrix} -2 \\ 0 \end{pmatrix} \quad (1.1.23)$$

is the point of intersection of the line (1.1.5) with the x axis.

- c) To find out intersection of (1.1.6) with the x axis:

equation of x axis is

$$\begin{pmatrix} 0 & 1 \end{pmatrix} \mathbf{x} = 0 \quad (1.1.24)$$

we have 2 equations:

$$\begin{pmatrix} 3 & 1 \end{pmatrix} \mathbf{x} = 9 \quad (1.1.25)$$

$$\begin{pmatrix} 0 & 1 \end{pmatrix} \mathbf{x} = 0 \quad (1.1.26)$$

Augmented matrix for above is:

$$\begin{pmatrix} 3 & 1 & 9 \\ 0 & 1 & 0 \end{pmatrix} \quad (1.1.27)$$

This can be reduced as follows:

$$\begin{pmatrix} 3 & 1 & 9 \\ 0 & 1 & 0 \end{pmatrix} \xrightarrow{R_1 \leftarrow \frac{1}{3}R_1} \begin{pmatrix} 1 & \frac{1}{3} & 3 \\ 0 & 1 & 0 \end{pmatrix} \quad (1.1.28)$$

$$\xrightarrow{R_1 \leftarrow R_1 - \frac{1}{3}R_2} \begin{pmatrix} 1 & 0 & 3 \\ 0 & 1 & 0 \end{pmatrix} \quad (1.1.29)$$

$$(1.1.30)$$

$$\mathbf{R} = \begin{pmatrix} 3 \\ 0 \end{pmatrix} \quad (1.1.31)$$

is the point of intersection of the line (1.1.6) with the x axis.

$$\mathbf{P} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad (1.1.32)$$

$$\mathbf{Q} = \begin{pmatrix} -2 \\ 0 \end{pmatrix} \quad (1.1.33)$$

$$\mathbf{R} = \begin{pmatrix} 3 \\ 0 \end{pmatrix} \quad (1.1.34)$$

$$(1.1.35)$$

represent the vertices of the triangle formed by the lines (1.1.5) & (1.1.6) with the X-axis.

P is the vertex of the triangle. Q is the point at which  $3x - 4y + 6 = 0$  meets the X-axis. R is the point at which  $3x + y - 9 = 0$  meets the X-axis.

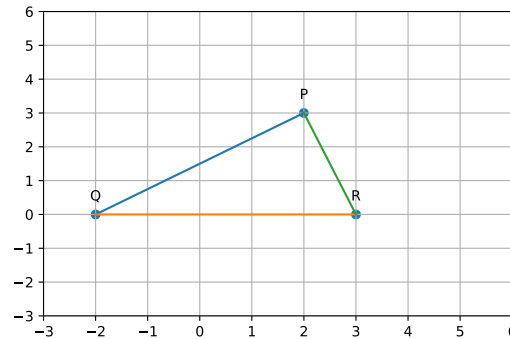


Fig. 1.1. Two lines representing given equations meet at point  $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$