5.2.36

Kavin B-EE25BTECH11033

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Question

Solve the following system of linear equations.

$$3x - 5y - 4 = 0$$

$$9x = 2y + 7$$

Theoretical Solution

The equation of line L_1 is,

$$\begin{pmatrix} 3 & -5 \end{pmatrix} \mathbf{x} = 4 \tag{1}$$

The equation of line L_2 is,

$$\begin{pmatrix} 9 & -2 \end{pmatrix} \mathbf{x} = 7 \tag{2}$$

On putting the equations in a matrix, we will get

$$\implies \begin{pmatrix} 3 & -5 \\ 9 & -2 \end{pmatrix} \mathbf{x} = \begin{pmatrix} 4 \\ 7 \end{pmatrix} \tag{3}$$

Theoretical Solution

So the augmented matrix is,

$$\begin{pmatrix} 3 & -5 & \bigm| & 4 \\ 9 & -2 & \bigm| & 7 \end{pmatrix} \tag{4}$$

$$R_2 \to R_2 - 3R_1 \implies \begin{pmatrix} 3 & -5 & \bigm| & 4 \\ 0 & 13 & \bigm| & -5 \end{pmatrix} \tag{5}$$

$$R_2 \to \frac{1}{13}R_2 \implies \begin{pmatrix} 3 & -5 & \bigm| & 4 \\ 0 & 1 & \bigm| & -5/13 \end{pmatrix} \tag{6}$$

$$R_1 \to R_1 + 5R_2 \implies \begin{pmatrix} 3 & 0 & \bigm| & 27/13 \\ 0 & 1 & \bigm| & -5/13 \end{pmatrix} \tag{7}$$

$$R_1 \to \frac{1}{3}R_1 \implies \begin{pmatrix} 1 & 0 & \bigm| & 9/13 \\ 0 & 1 & \bigm| & -5/13 \end{pmatrix} \tag{8}$$

$$\implies \mathbf{x} = \begin{pmatrix} x \\ y \end{pmatrix} \equiv \begin{pmatrix} 9/13 \\ -5/13 \end{pmatrix} \tag{9}$$

Therefore the two lines will intersect at $\begin{pmatrix} 9/13 \\ -5/13 \end{pmatrix}$.

Plot

Graph of the given equations