

# 5.2.66

EE25BTECH11064 - Yojit Manral

**Question:**

Solve the system of equations

$$2x + 3y = 11 \quad (1)$$

$$2x + 4y = -24 \quad (2)$$

Hence, find the value of  $m$  for which

$$y = mx + 3 \quad (3)$$

**Solution:**

→ We have

$$\mathbf{n}_1^T \mathbf{x} = c_1$$

$$\mathbf{n}_2^T \mathbf{x} = c_2$$

$$\mathbf{n}_3^T \mathbf{x} = c_3$$

$$\mathbf{n}_1 = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad c_1 = 11 \quad (4)$$

$$\mathbf{n}_2 = \begin{pmatrix} 2 \\ 4 \end{pmatrix} \quad c_2 = -24 \quad (5)$$

$$\mathbf{n}_3 = \begin{pmatrix} -m \\ 1 \end{pmatrix} \quad c_3 = 3 \quad (6)$$

→ To solve the system of equations, they must be concurrent at a point  $\mathbf{x}$

$$\begin{pmatrix} \mathbf{n}_1^T \\ \mathbf{n}_2^T \\ \mathbf{n}_3^T \end{pmatrix} \mathbf{x} = \begin{pmatrix} c_1 \\ c_2 \\ c_3 \end{pmatrix} \Rightarrow \begin{pmatrix} 2 & 3 \\ 2 & 4 \\ -m & 1 \end{pmatrix} \mathbf{x} = \begin{pmatrix} 11 \\ -24 \\ 3 \end{pmatrix} \quad (7)$$

→ Using augmented matrix

$$\left( \begin{array}{cc|c} 2 & 3 & 11 \\ 2 & 4 & -24 \\ -m & 1 & 3 \end{array} \right) \xrightarrow[R_1 \leftrightarrow R_1 - 3R_2]{R_2 \leftrightarrow R_2 - R_1} \left( \begin{array}{cc|c} 2 & 0 & 116 \\ 0 & 1 & -35 \\ -m & 1 & 3 \end{array} \right) \quad (8)$$

$$\xrightarrow[R_3 \leftrightarrow -R_3 + R_2]{R_1 \leftrightarrow (1/2)R_1} \left( \begin{array}{cc|c} 1 & 0 & 58 \\ 0 & 1 & -35 \\ m & 0 & -38 \end{array} \right) \quad (9)$$

$$\Rightarrow x = 58, y = -35, \text{ and } mx = -38 \quad (10)$$

$$\Rightarrow m = -\frac{38}{58} = -\frac{19}{29} \quad (11)$$

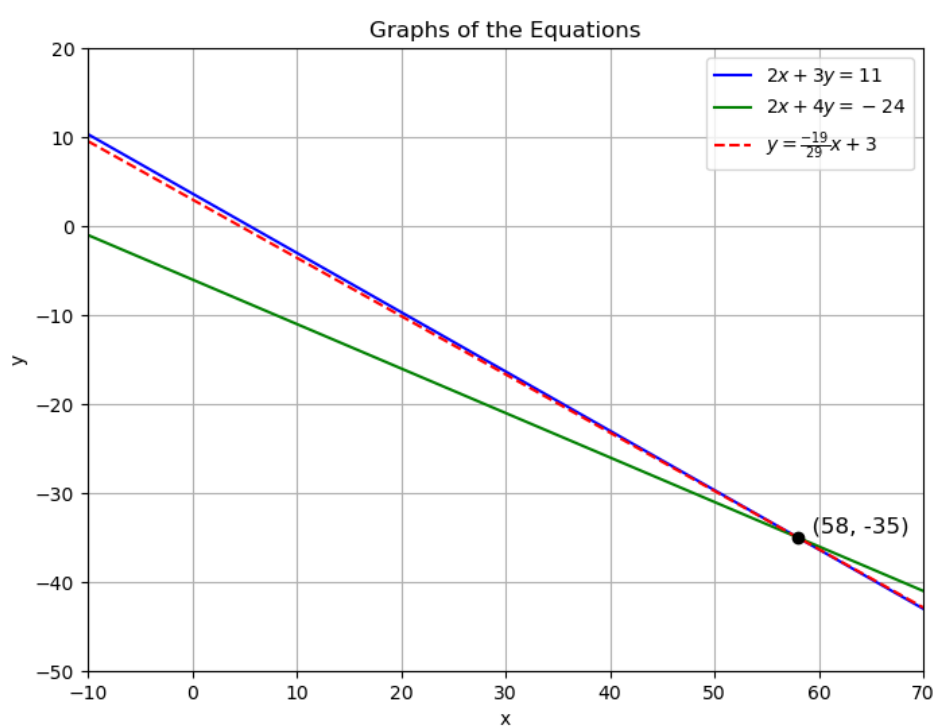


Fig. 0: Plot of the Equations