

Application Problem

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Question

A fraction becomes $\frac{1}{3}$ when 1 is subtracted from the numerator and it becomes $\frac{1}{4}$ when 8 is added to the denominator. Find the fraction.

Solution

Let the fraction be $\frac{x}{y}$.

$$\frac{x-1}{y} = \frac{1}{3}, \quad (1)$$

$$\frac{x}{y+8} = \frac{1}{4} \quad (2)$$

$$3(x-1) - y = 0 \implies 3x - y - 3 = 0, \quad (3)$$

$$4x - (y+8) = 0 \implies 4x - y - 8 = 0 \quad (4)$$

$$(3 \ -1) \begin{pmatrix} x \\ y \end{pmatrix} = 3, \quad (5)$$

$$(4 \ -1) \begin{pmatrix} x \\ y \end{pmatrix} = 8 \quad (6)$$

Augmented matrix:

$$\begin{pmatrix} 3 & -1 & 3 \\ 4 & -1 & 8 \end{pmatrix} \quad (7)$$

RREF using row operations:

$$R_2 \rightarrow R_2 - \frac{4}{3}R_1 \Rightarrow \begin{pmatrix} 3 & -1 & 3 \\ 0 & 1/3 & 4 \end{pmatrix} \Rightarrow \begin{pmatrix} 3 & -1 & 3 \\ 0 & 1 & 12 \end{pmatrix}, \quad (8)$$

$$R_1 \rightarrow R_1 + R_2 \Rightarrow \begin{pmatrix} 3 & 0 & 15 \\ 0 & 1 & 12 \end{pmatrix} \Rightarrow \begin{pmatrix} 1 & 0 & 5 \\ 0 & 1 & 12 \end{pmatrix} \quad (9)$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 5 \\ 12 \end{pmatrix} \quad (10)$$

Hence, the fraction is:

$$\boxed{\frac{5}{12}}$$

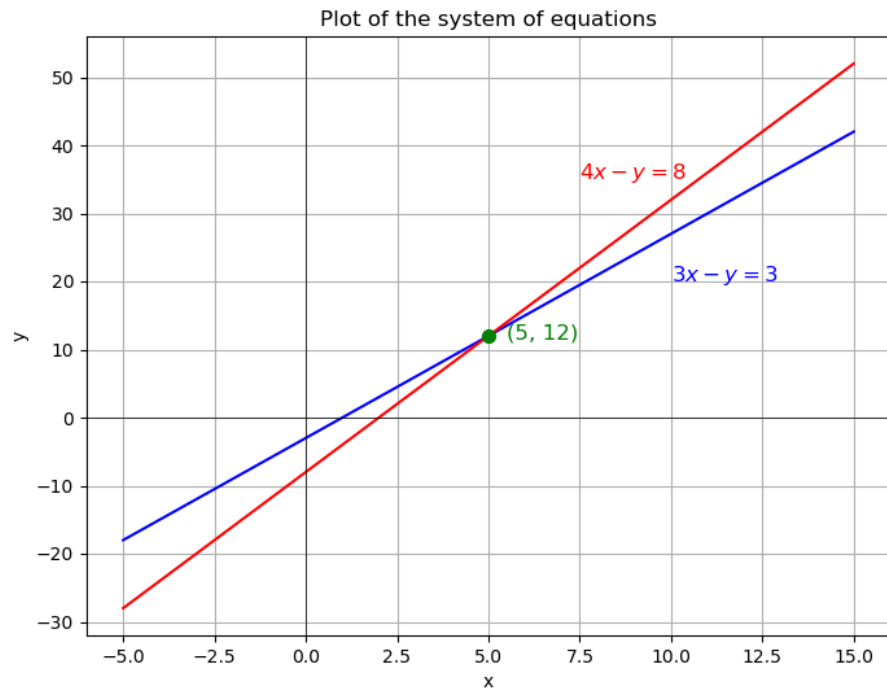


Figure 1: Equations