System of Equations

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Question

Solve the following system of equations:

$$\begin{aligned} x - y &= 8, \\ 3x - 3y &= 16 \end{aligned}$$

Solution

Each equation can be expressed in vector form as a dot product:

$$\begin{pmatrix} 1 & -1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = 8, \tag{1}$$

$$\begin{pmatrix} 3 & -3 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = 16. \tag{2}$$

Stacking these gives the matrix equation

$$\begin{pmatrix} 1 & -1 \\ 3 & -3 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 8 \\ 16 \end{pmatrix}. \tag{3}$$

In augmented form,

$$\begin{pmatrix} 1 & -1 & 8 \\ 3 & -3 & 16 \end{pmatrix}. \tag{4}$$

Applying the row operation $R_2 \to R_2 - 3R_1$,

$$\begin{pmatrix} 1 & -1 & 8 \\ 0 & 0 & -8 \end{pmatrix}. \tag{5}$$

This yields the contradiction

$$0 = -8. \tag{6}$$

Hence the system is inconsistent,

$$\boxed{\text{No solution}}$$

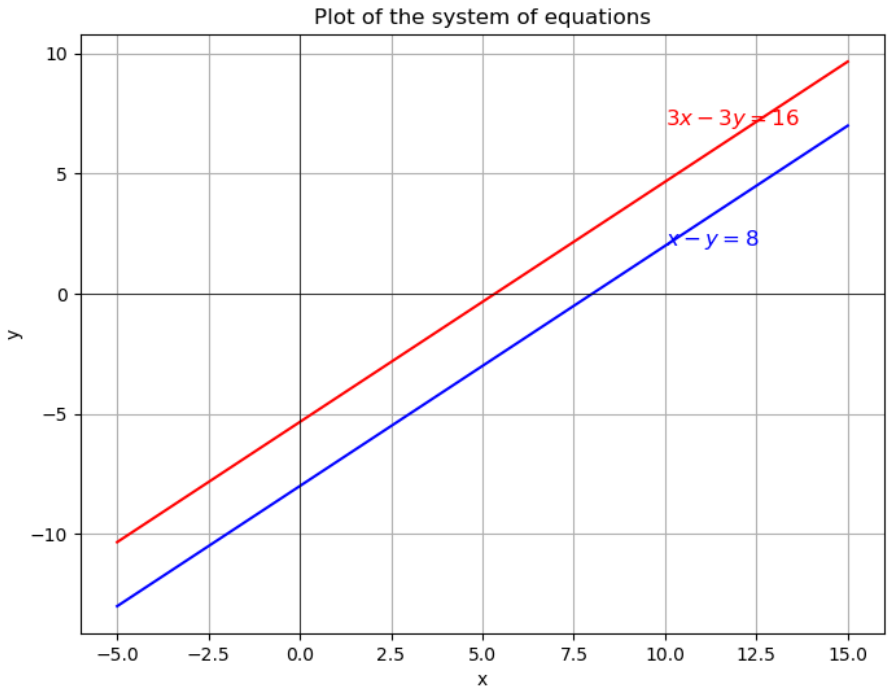

Figure 1: Lines