

# Problem 5.3.8

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## QUESTION

Solve the following system of linear equations using matrix row operations.

$$217a + 131b = 912$$

$$131a + 217b = 827$$

## MATRIX FORM

$$\mathbf{M} = \left[ \begin{array}{cc|c} 217 & 131 & 912 \\ 131 & 217 & 827 \end{array} \right]$$

## ROW OPERATIONS

Step 1:  $R_1 \leftarrow R_1 \div 217$

$$R_1 = \left[ 1 \quad \frac{131}{217} \quad \frac{912}{217} \right]$$

Now  $\mathbf{M} =$

$$\left[ \begin{array}{ccc} 1 & \frac{131}{217} & \frac{912}{217} \\ 131 & 217 & 827 \end{array} \right]$$

Step 2:  $R_2 \leftarrow R_2 - 131 \cdot R_1$

$$R_2 = \left[ 0 \quad 217 - 131 \cdot \frac{131}{217} \quad 827 - 131 \cdot \frac{912}{217} \right]$$

Simplify numerators:

$$217^2 = 47089, \quad 131^2 = 17161$$

$$217 \cdot 827 = 179459, \quad 131 \cdot 912 = 119472$$

Now  $\mathbf{M} =$

$$\left[ \begin{array}{ccc} 1 & \frac{131}{217} & \frac{912}{217} \\ 0 & \frac{47089-17161}{217} & \frac{179459-119472}{217} \end{array} \right] = \left[ \begin{array}{ccc} 1 & \frac{131}{217} & \frac{912}{217} \\ 0 & \frac{29928}{217} & \frac{59987}{217} \end{array} \right]$$

Step 3:  $R_2 \leftarrow R_2 \div \frac{29928}{217}$

$$R_2 = \left[ \begin{array}{ccc} 0 & 1 & \frac{59987}{29928} \end{array} \right]$$

Now  $\mathbf{M} =$

$$\left[ \begin{array}{ccc} 1 & \frac{131}{217} & \frac{912}{217} \\ 0 & 1 & \frac{59987}{29928} \end{array} \right]$$

Step 4:  $R_1 \leftarrow R_1 - \frac{131}{217} \cdot R_2$

$$R_1 = \left[ \begin{array}{ccc} 1 & 0 & \frac{912}{217} - \frac{131}{217} \cdot \frac{59987}{29928} \end{array} \right] = \left[ \begin{array}{ccc} 1 & 0 & \frac{650}{217} \end{array} \right]$$

Final matrix:

$$\left[ \begin{array}{ccc} 1 & 0 & 3 \\ 0 & 1 & 2 \end{array} \right]$$

**SOLUTION**

$$\boxed{\begin{pmatrix} 3 \\ 2 \end{pmatrix}}$$

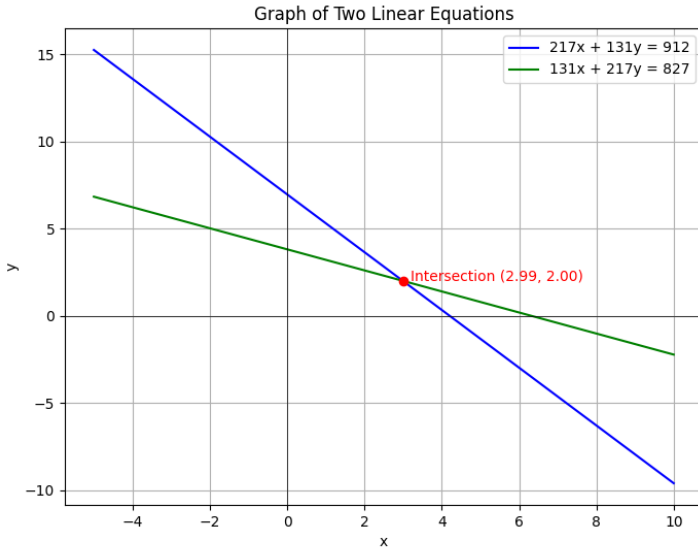
**FIGURE**

Fig. 1: System of equations from Problem 5.38