

Solving Systems of Equations

A **system of equations** consists of two or more equations that must be considered simultaneously.

A solution to a system of equations is a **Point Of Intersection (POI)**.

Method 1: Graphing

Using one grid...

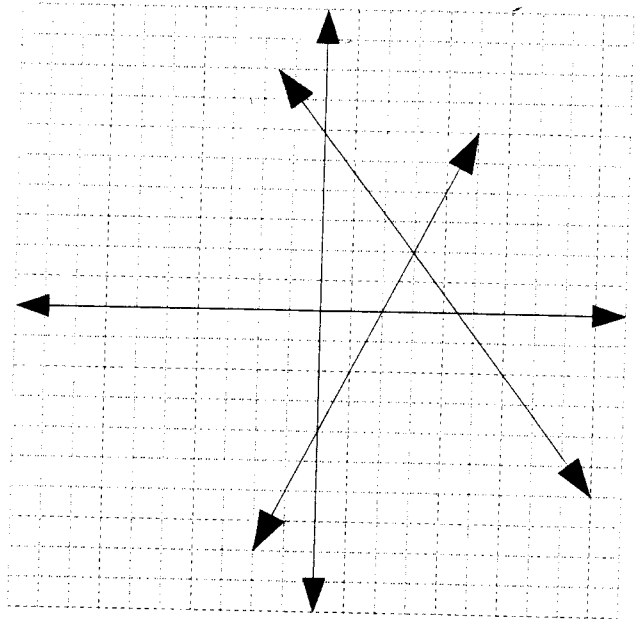
1. Plot each equation on the grid
2. Determine the location of the POI

Example:

$$y = 2x - 4$$

$$y = -\frac{4}{3}x + 6$$

POI is (3,2).



Method 2: Substitution

If the same variable is isolated...

1. Set both equations equal to each other
2. Solve for unknown variable
3. Substitute value into original equations

Example: $y = 2x + 1$ and $y = 3x - 4$

$$2x + 1 = 3x - 4$$

$$2x - 3x = -4 - 1$$

$$-x = -5$$

$$x = 5$$

$$y = 2(5) + 1$$

$$y = 11$$

$$y = 3(5) - 4$$

$$y = 11$$

POI is (5,11).

If one variable is isolated...

1. Substitute directly into the second equation
2. Solve for unknown variable
3. Substitute value into original equations

Example: $y = 2x - 3$ and $3x - 2y = 2$

$$3x - 2(2x - 3) = 2$$

$$3x - 4x + 6 = 2$$

$$-x = 2 - 6$$

$$x = 4$$

$$y = 2(4) - 3$$

$$y = 5$$

$$3(4) - 2y = 2$$

$$y = 5$$

POI is (4,5).

Method 3: Elimination

If terms have the same coefficient, and the same sign...

1. Subtract one equation from the other
2. Solve for the unknown variable
3. Substitute value into original equations

Example: $2x - 3y = 4$ and $4x - 3y = 14$

$$\begin{array}{r} 2x - 3y = 4 \\ 4x - 3y = 14 \\ \hline \end{array}$$

$$\begin{array}{r} -2x = -10 \\ x = 5 \end{array}$$

$$\begin{array}{r} 2(5) - 3y = 4 \\ y = 2 \end{array}$$

$$\begin{array}{r} 4(5) - 3y = 14 \\ y = 2 \end{array}$$

POI is (5,2).

If terms have the same coefficient, but different signs...

1. Add one equation to the other
2. Solve for the unknown variable
3. Substitute value into original equations

Example:

$$\begin{array}{r} 3x - 5y = 7 \\ 2x + 5y = 13 \\ \hline \end{array}$$

$$\begin{array}{r} 5x = 20 \\ x = 4 \end{array}$$

$$\begin{array}{r} 3(4) - 5y = 7 \\ y = 1 \end{array}$$

$$\begin{array}{r} 2(4) + 5y = 13 \\ y = 1 \end{array}$$

POI is (4,1).

If no terms have the same coefficient...

1. Multiply one or more equations by a number so that some variable has the same coefficient
2. Add or subtract as required
3. Solve for the unknown variable
4. Substitute value into original equations

Example: $2x + 3y = 2$ and $5x + 4y = -9$

$$\begin{array}{r} 2x + 3y = 2 \quad (\times 5) \\ 5x + 4y = -9 \quad (\times 2) \\ \hline \end{array}$$

$$\begin{array}{r} 10x + 15y = 10 \\ 10x + 8y = -18 \\ \hline \end{array}$$

$$\begin{array}{r} 7y = 28 \\ y = 4 \end{array}$$

$$\begin{array}{r} 2x + 3(4) = 2 \\ x = -5 \end{array}$$

$$\begin{array}{r} 5x + 4(4) = -9 \\ x = -5 \end{array}$$

POI is (-5,4).