SYSTEMS OF TWO EQUATIONS IN TWO VARIABLES

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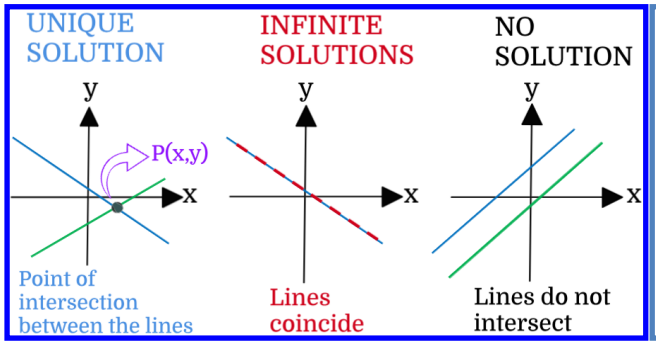


Methods to solve systems of equations:
Graphing, Elimination, Equal Values, Substitution, Determinants, and Matrix.

GRAPHING METHOD: Solve the following system of equations:

$2x + y = 5$ ------ ①

$3x - y = 0$ ------ ②

1) Isolating "y" from each equation:

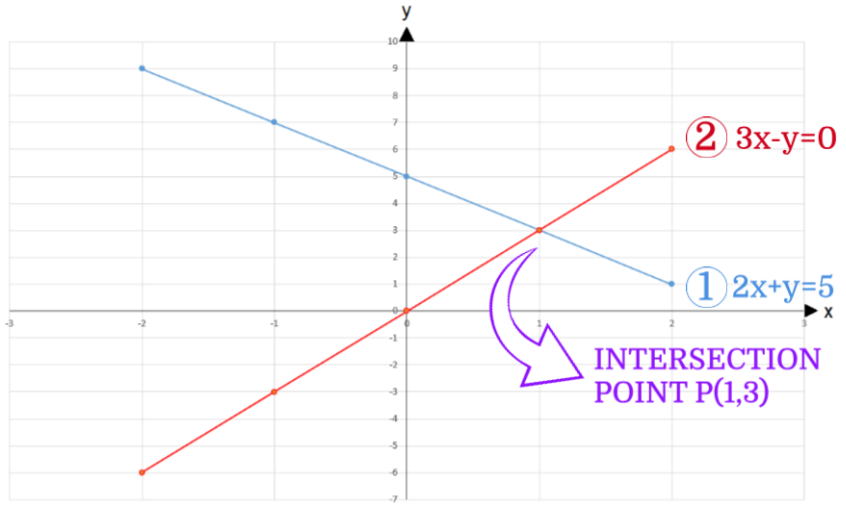
$y = 5 - 2x$ ------ ①'

$y = 3x$ ------ ②'

2) Tabulating ①' and ②' :

①' y=5-2x				②' y=3x		
x	y	P(x,y)		x	y	P(x,y)
-2	y=5-2(-2)=9	P(-2,9)		-2	y=3(-2)=-6	P(-2,-6)
-1	y=5-2(-1)=7	P(-1,7)		-1	y=3(-1)=-3	P(-1,-3)
0	y=5-2(0)=5	P(0,5)		0	y=3(0)=0	P(0,0)
1	**y=5-2(1)=3**	**P(1,3)**		**1**	**y=3(1)=3**	**P(1,3)**
2	y=5-2(2)=1	P(2,1)		2	y=3(2)=6	P(2,6)

3) Graphing ①' and ②' :



VERIFICATION: Because **x=1** ; **y=3**, substitute in:

① $2x + y = 5$	② $3x - y = 0$
2(1)+(3)=5	3(1)-(3)=0
2+3=5	3-3=0
5=5	0=0

Since "both" equalities are satisfied, we conclude that the SOLUTION is correct.

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ELIMINATION METHOD: Consists of eliminating one of the variables by adding or subtracting both equations.

ELIMINATION METHOD: Solve the following system of equations:

$2x + y = 5$ – – – – – ①

$3x - y = 0$ – – – – – ②

1) **Eliminating "x"**: we multiply ① by (3) and ② by (-2):

$6x + 3y = 15$ – – – – – ①′

$-6x + 2y = 0$ – – – – – ②′

2) Adding ①′ with ②′ :

~~$6x$~~ $+ 3y = 15$

~~$-6x$~~ $+ 2y = 0$

$5y = 15$

$y = 3$

3) **Eliminating "x"**: adding ① with ② :

$2x$~~$+y$~~ $= 5$

$3x$~~$-y$~~ $= 0$

$5x = 5$

$x = 1$

Hence, the solution point is P(x,y)=P(1,3).

EQUAL VALUES METHOD: Consists in isolating a variable from both equations, and set them equal to each other to form a new equation of a single variable

EQUAL VALUES METHOD: Solve the following system of equations:

$2x + y = 5$ – – – – – ①

$3x - y = 0$ – – – – – ②

1) Isolating "y":

$y = 5 - 2x$ – – – – – ①′

$y = 3x$ – – – – – ②′

2) Equal values between ①′ and ②′ and isolating "x":

$5 - 2x = 3x$

$x = 1$

3) Isolating "x":

$x = \frac{5 - y}{2}$ – – – – – ①″

$x = \frac{y}{3}$ – – – – – ②″

4) Equal values between ①″ and ②″ :

$\frac{5 - y}{2} = \frac{y}{3}$

$y = 3$

Hence, the solution point is P(x,y)=P(1,3).

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SUBSTITUTION METHOD: Implies isolating a variable to be substituted into the other equation.

SUBSTITUTION METHOD: Solve the following system of equations:

$2x + y = 5$ ------ ①

$3x - y = 0$ ------ ②

1) Isolating "y" from ①:

$y = 5 - 2x$ ------ ①'

2) Substituting ①' in ② and solving:

$3x - (5 - 2x) = 0$

$x = 1$

3) Substituting x=1 in ② and solving:

$3(1) - y = 0$

$y = 3$

Hence, the solution point is P(x,y)=P(1,3).

DETERMINANT: The determinant of a 2x2 matrix is the real number (Δ) calculated as:

$$\Delta = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - cb$$

DETERMINANTS METHOD: Calculate the determinant of the system (Δ_s), the determinant of "x" (Δ_x), and the determinant of "y" (Δ_y). Then:

$$x = \frac{\Delta_x}{\Delta_s} \wedge y = \frac{\Delta_y}{\Delta_s}$$

EXAMPLE: Solve the following system of equations by the Determinants method:

2x+y=5 --------①

3x-y=0 --------②

1) Calculating the determinant of the system:

$$\Delta_s = \begin{vmatrix} 2 & 1 \\ 3 & -1 \end{vmatrix} = (2)(-1) - (3)(1) = -2 - 3 = -5$$

2) Calculating the determinant of "x":

$$\Delta_x = \begin{vmatrix} 5 & 1 \\ 0 & -1 \end{vmatrix} = (5)(-1) - (0)(1) = -5 - 0 = -5$$

3) Calculating the determinant of "y":

$$\Delta_y = \begin{vmatrix} 2 & 5 \\ 3 & 0 \end{vmatrix} = (2)(0) - (3)(5) = 0 - 15 = -15$$

$$x = \frac{\Delta_x}{\Delta_s} \Rightarrow x = \frac{-5}{-5} \Rightarrow x = 1$$

$$y = \frac{\Delta_y}{\Delta_s} \Rightarrow y = \frac{-15}{-5} \Rightarrow y = 3$$

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