Solving Systems of Equations

Solving a system of equations by SUBSTITUTION with "y =" or "x =" equation

Given a system of equations:

$y = 2x - 6$

$y = 9 - x$

Combine the equations by replacing the 'y' with '2x – 5' in the equation **y** = 9 - x.

solve the new equation

2x – 6 = 9 - x

2x + x = 9 + 6

3x = 15

x = 5

Back substitute to find y

y = 2x – 6

y = 2(5) – 6

y = 10 – 6

y = 4

Write the answer

The solution is (5, 4)

Solving a system of equation using ELIMINATION method

Given a system of equations

4x + 2y = 10 multiply by 3 → 12x + 6y = 30

x – 3y = 6 multiply by 2 → 2x – 6y = 12

Add the equations and solve for the remaining variable

14x = 42

x = 3

Back Substitute

x – 3y = 6

3 – 3y = 6

(–3) + 3 – 3y = (–3) + 6

–3y = 3

y = –1

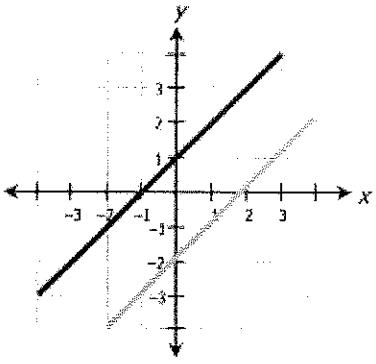
Write the solution

The solution is (3, –1)

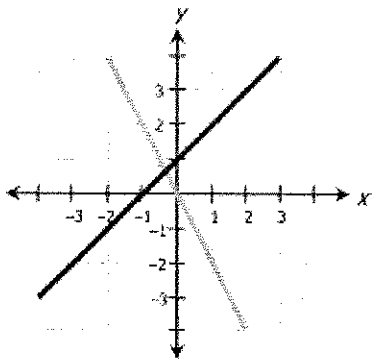
Cut out and put into Notes Notebook

Types of Solutions for Systems of Equations

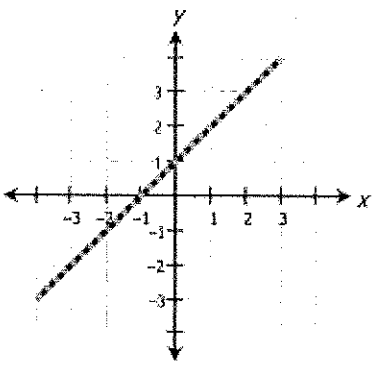
- **One Solution** – When lines intersect at one point, there is only one solution, (x, y). This solution can be found graphically or algebraically (using substitution or elimination)



No Solution



One Solution



Infinite Solutions

- **No Solutions** – When lines are parallel, there is no common solution. What does this mean algebraically? If we consider the slope-intercept forms of the two lines ($y = mx + b$), it means that the slopes (m) are the same and the y-intercepts (b) are different.
  - When solving for one of the values you will find a FALSE statement like 5 = 3

- **Infinitely Many Solutions** – When lines overlap, there are infinitely many solutions. Algebraically, this means that the two lines have the same slopes (m) and the same y-intercepts (b).
  - When solving for one of the values you will find a TRUE statement 4 = 4

Example

$2x + y = 5$
$4x + 2y = 10$

How many solutions does the pair of linear equations shown above have? _____

How do you know?

$2x+y=5 \rightarrow 2(2x+y=5)$
$4x+2y=10 \rightarrow 4x+2y=10$

$4x+2y=10$
$4x+2y=10$
Same equations → Infinitely many solutions