UNIT 4: Solving SYSTEMS of Equations using ELIMINATION method!

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I can solve a system of equations by elimination.

Solving Systems Using Elimination (also called Addition Method or Combination Method)

The addition method of solving systems of equations is also called the method of elimination. This method is similar to the method you probably learned for solving simple equations. If you had the equation "$x + 6 = 11$", you would write "-6" under either side of the equation, and then you'd "add down" to get "$x = 5$" as the solution.

$$\begin{array}{r} x + 6 = 11 \\ -6 \quad -6 \\ \hline x = 5 \end{array}$$

By subtracting 6, you "eliminated" the "+6" with x!

You'll do something similar with the addition method.

- **Solve the following system using addition.**

$$\begin{array}{l} 2x + y = 9 \\ 3x - y = 16 \end{array}$$

By "adding down", we can eliminate the y-terms in both equations!

Note that, if I add down, the y's will cancel out. So I'll draw an "equals" bar under the system, and add down:

$$\begin{array}{l} 2x + y = 9 \\ 3x - y = 16 \\ \hline 5x = 25 \end{array}$$

$+y$, $-y$, $= 0$

If $5x = 25$, then $\frac{5x}{5} = \frac{25}{5}$, $x = 5$

Now I can divide through to solve for $x = 5$, and then back-solve, using either of the original equations, to find the value of y. The first equation has smaller numbers, so I'll back-solve in that one:

$$\begin{array}{l} 2x + y = 9 \\ 2(5) + y = 9 \\ 10 + y = 9 \\ y = -1 \end{array}$$

Substitute 5 for x in either equation — ... better to use the "easy" one :), $2x + y = 9$ and solve for y.

Then the solution is $(x, y) = (5, -1)$.

* It doesn't matter which equation you use for the backsolving; you'll get the same answer either way. If I'd used the second equation, I'd have gotten:

$$\begin{array}{l} 3x - y = 16 \\ 3(5) - y = 16 \\ 15 - y = 16 \\ -y = 1 \\ y = -1 \end{array}$$

...which is the same result as before.

Solution
(5, -1)
x y

Solving Systems by Elimination NOTES

1) $x + y = 9$ ← Easier!

$+ \; x - y = 5$

$2x = 14$

$\frac{2x}{2} = \frac{14}{2}$

$x = 7$

$(7) + y = 9$

$-7 \quad -7$

$y = 2$

Solution: $(7, 2)$

Check Eq 1: $(7) + (2) = 9$, $9 = 9$ ✓

Check Eq 2: $(7) - (2) = 5$, $5 = 5$ ✓

2) $2x - 3y = -7$ ← Easier!

$+ \; -2x - 8y = -4$

$-11y = -11$

$\frac{-11y}{-11} = \frac{-11}{-11}$

$y = 1$

$2x - 3(1) = -7$

$2x - 3 = -7$

$+3 \quad +3$

$\frac{2x}{2} = \frac{-4}{2}$

$x = -2$

Solution: $(-2, 1)$

Check Eq 1: $2(-2) - 3(1) = -7$, $-4 - 3 = -7$, $-4 + (-3) = -7$, $-7 = -7$ ✓

Check Eq 2: $-2(-2) - 8(1) = -4$, $4 - 8 = -4$, $4 + (-8) = -4$, $-4 = -4$ ✓

3) $-10x + 2y = -8$

$+ \; 3x - 2y = -6$ ← Easier!

$-7x = -14$

$\frac{-7x}{-7} = \frac{-14}{-7}$

$x = 2$

$3(2) - 2y = -6$

$6 - 2y = -6$

$-6 \quad -6$

$-2y = -12$

$\frac{-2y}{-2} = \frac{-12}{-2}$

$y = 6$

Check Eq 1: $-10(2) + 2(6) = -8$, $-20 + 12 = -8$, $-8 = -8$ ✓

Check Eq 2: $3(2) - 2(6) = -6$, $6 - 12 = -6$, $6 + (-12) = -6$, $-6 = -6$ ✓

Solution: $(2, 6)$

Solving Systems by Elimination... STEPS

1) Make sure that when you add your equations, one of the variables will be eliminated.
2) Add the two equations.
3) Solve for the variable. (Isolate)
4) Substitute your solution back in for your known variable to calculate the second value.
5) Write your solution as a coordinate point.
6) Check your solution by substituting your solution back into both equations.