Linear Systems: Solving by Elimination

Date lesson Notes

MINDS ON:

When adding 2765 + 1948, or subtracting 7549 – 3616 it's easier when you stack them:

$$\begin{array}{r} 2968 \\ +\ 1748 \\ \hline 4716 \end{array} \qquad \begin{array}{r} 7649 \\ -\ 3516 \\ \hline 4233 \end{array}$$

The same is true for polynomials. (3x + 2y) + (2x – 5y) can be written as:

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

IMPORTANT:

You want to stack the x's on top of each other and the y's on top of each other so they line up.

EXAMPLES:

Subtraction can be tricky because you need to remember to subtract each term...

1. (4x - 7y) - (3x – 2y) ⟶ $\begin{array}{r} 4x - 7y \\ -(3x - 2y) \\ \hline = x - 5y \end{array}$

2. (–5x + 3y) – (–2x + 8y) ⟶ $\begin{array}{r} -5x + 3y \\ -\ (-2x + 8y) \\ \hline = -3x - 5y \end{array}$

YOUR TURN!

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

4. (-3x – 5y) – (7x + 2y) $\begin{array}{r} -3x - 5y \\ -(7x + 2y) \\ \hline -10x - 7y \end{array}$

QUESTION:

How would you make the following equal to zero? Would you add or would you subtract the terms?

$\begin{array}{r} 3x \\ -\ 3x \\ \hline 0 \end{array}$ SUBTRACT $\qquad \begin{array}{r} -5y \\ +\ 5y \\ \hline 0 \end{array}$ ADD $\qquad \begin{array}{r} 12x \\ +\ -12x \\ \hline 0 \end{array}$ ADD $\qquad \begin{array}{r} -100y \\ -\ -100 \\ \hline 0 \end{array}$ SUBTRACT

TO MAKE A TERM ZERO.... If the signs are OPPOSITE, then ADD.

If the signs are the SAME, then SUBTRACT.

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EXAMPLE 1 - Use ELIMINATION to solve this system.

STEP 1: Determine which variable you will eliminate and decide on the operation to be used. (addition or subtraction?)	Same coefficient $4x - 5y = 7$ ① $+ \quad -4x + 3y = -5$ ②
STEP 2: Add or subtract the like-terms (be careful with the signs)	ADD Because opposite signs. $0 - 2y = 2$ $-2y = 2$
STEP 3: Solve the resulting equation.	$\frac{-2y}{-2} = \frac{2}{-2}$ $\boxed{y = -1}$
STEP 4: Substitute the value found for one variable into either equation to solve for the other variable.	Sub $y = -1$ into ① $4x - 5(-1) = 7$ $4x + 5 = 7$ $4x = 7 - 5$ $\frac{4x}{4} = \frac{2}{4}$ $\boxed{x = \frac{1}{2}}$
STEP 5: State the point of intersection	$\therefore$ POI is $(\frac{1}{2}, -1)$

Check your solution in both original equations.

Check in (1) LS	Check in (1) RS	Check in (2) LS	Check in (2) RS
$4x - 5y$ $= 4(\frac{1}{2}) - 5(-1)$ $= \frac{4}{2} + 5$ $= 2 + 5$ $= 7$	$= 7$	$-4x + 3y$ $= -4(\frac{1}{2}) + 3(-1)$ $= \frac{-4}{2} - 3$ $= -2 - 3$ $= -5$	$= -5$

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STEP 1: Determine which variable you will eliminate and decide on the operation to be used. (addition or subtraction?)	$2x + 3y = 5$ **(1)** $- \quad 4x + 3y = 1$ **(2)**
STEP 2: Add or subtract the like-terms (be careful with the signs)	SUBTRACT (same signs) $-2x + 0 = 4$
STEP 3: Solve the resulting equation.	$-2x = 4$ $\frac{-2x}{-2} = \frac{4}{-2}$ $\boxed{x = -2}$
STEP 4: Substitute the value found for one variable into either equation to solve for the other variable.	Sub. $x = -2$ into (1) $2(-2) + 3y = 5$ $-4 + 3y = 5$ $3y = 5 + 4$ $\frac{3y}{3} = \frac{9}{3}$ $\boxed{y = 3}$
STEP 5: State the point of intersection	POI. is $(-2, 3)$

Check your solution in both original equations.

Check in (1)		Check in (2)	
LS $2x + 3y$ $= 2(-2) + 3(3)$ $= -4 + 9$ $= 5$	**RS** $= 5$	**LS** $4x + 3y$ $= 4(-2) + 3(3)$ $= -8 + 9$ $= 1$	**RS** $= 1$

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PRACTICE QUESTIONS: Solve the following systems using Elimination …

a) $2x + y = 7$ (1)
$-$ $x + y = 5$ (2)

SUBTRACT

$x + 0 = 2$
$\boxed{x = 2}$

Sub. $x=2$ into (2)
$(2) + y = 5$
$y = 5 - 2$
$\boxed{y = 3}$

$\therefore$ POI is $(2, 3)$.

b) $2x + 3y = 4$ (1)
$+$ $-2x - 7y = 16$ (2)

ADD

$0 - 4y = 20$
$-4y = 20$
$\frac{-4y}{-4} = \frac{20}{-4}$
$\boxed{y = -5}$

sub $y = -5$ into (1)
$2x + 3(-5) = 4$
$2x - 15 = 4$
$2x = 4 + 15$
$\frac{2x}{2} = \frac{19}{2}$ $\boxed{x = \frac{19}{2}}$

$\therefore$ POI is $(19/2, -5)$

Rearrange first so the x's and y's line up!

c) $5y = -3x + 14$ (1) $3x + 5y = 14$
$2x - 5y = 1$ (2)

ADD

$3x + 5y = 14$
$2x - 5y = 1$
$5x + 0 = 15$
$\frac{5x}{5} = \frac{15}{5}$
$\boxed{x = 3}$

Sub. $x = 3$ into (2)
$2(3) - 5y = 1$
$6 - 5y = 1$
$-5y = 1 - 6$
$\frac{-5y}{-5} = \frac{-5}{-5}$
$\boxed{y = 1}$

Rearrange first so the x's and y's line up!

d) $-2y + x = -19$ (1)
$5x = -2y + 1$ (2) $\to$ $2y + 5x = 1$ (3)

$-2y + x = -19$
$+$ $2y + 5x = 1$
$0 + 6x = -18$
$\frac{6x}{6} = \frac{-18}{6}$
$\boxed{x = -3}$

Sub $x = -3$ into (1)
$-2y + (-3) = -19$
$-2y - 3 = -19$
$-2y = -19 + 3$
$\frac{-2y}{-2} = \frac{-16}{-2}$
$\boxed{y = 8}$

$\therefore$ POI is $(-3, 8)$