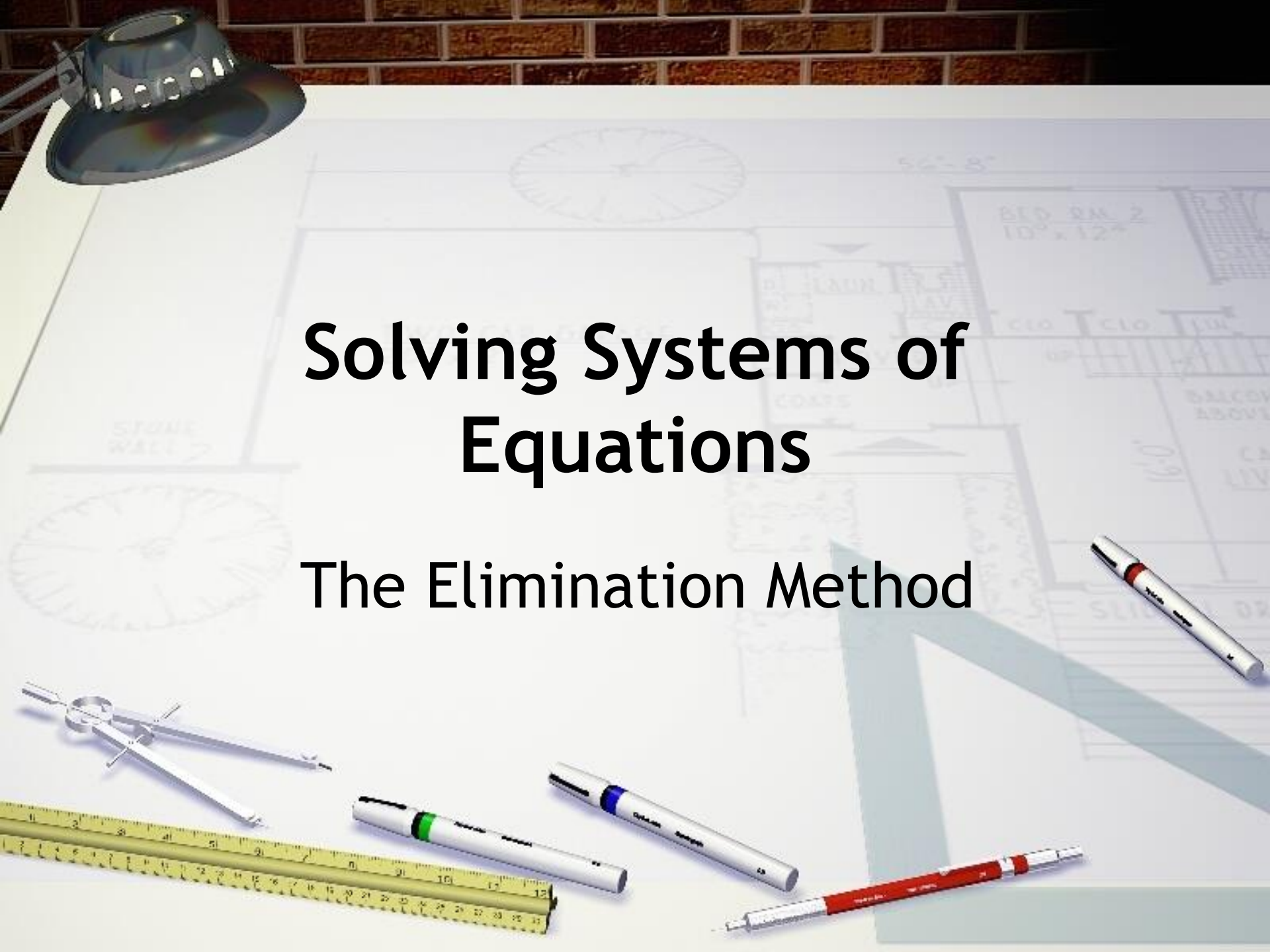
Solving Systems of Equations

The Elimination Method



Essential Questions

- How do you solve systems of equations using the Elimination Method?

Shoulder Buddy

- What does “eliminate” mean to you?
- On Your Own: write down as many different ways you can describe the word “eliminate”
- Share with your partner your thoughts
- Share with the class

Getting rid of???

- How do we get rid of a number in math?
- We CANCEL it out which means we need OPPOSITE NUMBERS!!

Are the equations of the system in standard form?

Ax + By = C

Ax + By = C

Example 1

$$\begin{cases} -2x + y = 5 \\ 2x + 2y = 7 \end{cases}$$

$+$ ($2x + 2y = 7$)

$3y = 12$

$\frac{3y}{3} = \frac{12}{3}$

$y = 4$

$2x + 2(4) = 7$

$2x + 8 = 7$

$-8 \quad -8$

$2x = -1$

$\frac{2x}{2} = \frac{-1}{2}$

$x = -\frac{1}{2}$

$\left(-\frac{1}{2}, 4\right)$

SOLVE BY ELIMINATION

Directions: Fill in the blanks

$$4x + y = 10$$
$$+(2x - y = 2)$$
$$6x = 12$$

1. Which variable has the same coefficient and opposite signs?

   y

2. To eliminate this variable we add both equations together.

3. The resulting equation is $6x = 12$

4. Solve: $\frac{6x}{6} = \frac{12}{6}$ $x = 2$

5. To find the other variable we substitute our answer in step 4 into one of the original equations. Let's use the equation

$$4x + y = 10$$

6. $4(2) + y = 10$

7. $8 + y = 10$

$-8 \qquad -8$

8. $y = 2$

9. The solution to the system is $(2, 2)$

10. Check:

11.	$4x + y = 10$	$2x - y = 2$
12.	$4(2) + 2$	$2(2) - 2$
13.	$8 + 2$	$4 - 2$
14.	$10 = 10$ ✓	$2 = 2$ ✓

Example 2

Consider the system

$$\begin{cases} 3x + y = 14 \\ 4x - y = 7 \end{cases}$$

$+ \left(\right.$

$7x = 21$

$\frac{7x}{7} = \frac{21}{7}$

$x = 3$

$3(3) + y = 14$

$9 + y = 14$

$-9 \quad -9$

$y = 5$

$(3, 5)$

NOTE: **We use the Elimination Method, if we can immediately cancel out two like terms.**

Your turn…

1. $\begin{cases} 2x + y = 5 \\ 3x - y = 15 \end{cases}$

ANS: (4, -3)

2. $\begin{cases} x + 6y = 11 \\ -x + 2y = 5 \end{cases}$

ANS: (-1, 2)

Example 3

Consider the system

$$\begin{cases} 6x + 11y = -5 \\ 6x + 9y = -3 \end{cases}$$

Example 3

Consider the system

$$\begin{array}{rl} & 6x + 11y = -5 \\ + & 6x + 9y = -3 \\ \hline & 12x + 20y = -8 \end{array}$$

When we add equations together, nothing cancels out

Now What????

Example 3 Again

Consider the system

$$\begin{cases} 6x + 11y = -5 \\ 6x + 9y = -3 \end{cases}$$

$-1 \cdot (6x + 9y = -3)$

$6x + 11y = -5$

$+ (-6x - 9y = 3)$

$2y = -2$

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

$y = -1$

What do we need in order to eliminate?

$6x + 11(-1) = -5$

$6x - 11 = -5$

$+11 \quad +11$

$6x = 6$

$\frac{6x}{6} = \frac{6}{6}$

$x = 1$

$(1, -1)$

Example 4

Consider the system

$$\begin{cases} 4x + 2y = 2 \\ 5x + 2y = 4 \end{cases} \cdot -1$$

$4x + 2y = 2$

$-5x - 2y = -4$

$-x = -2$

$-1 \quad -1$

$x = 2$

$4(2) + 2y = 2$

$8 + 2y = 2$

$-8 \quad -8$

$2y = -6$

$y = -3$

$(2, -3)$

Your turn 3

Consider the system

$$\begin{cases} 5x - 2y = 3 \\ 5x + y = -9 \end{cases}$$

-1

$-5x + 2y = -3$

$5x + y = -9$

$3y = -12$

$\frac{3y}{3} = \frac{-12}{3}$

$y = -4$

$5x - 4 = -9$

$+4 \quad +4$

$5x = -5$

$\frac{5x}{5} = \frac{-5}{5}$

$x = -1$

$(-1, -4)$

Pass It Around Roles

- Everyone has a job to help the group find the solution ☺
- Job 1: Starter – Get the problem started by completing steps 1&2
- Job 2: Finisher – Finish solving the problem by completing step 3 (Make sure that you check "starter's" work)
- Job 3: Verifier – Verify the solution by plugging back into BOTH equations
- You will rotate to a new job on the next problem
- Work together if someone gets "stuck" doing their job

Pass it Around

$x + y = 10$
$x - y = 2$

(6, 4)

Pass It Around

$$2x - y = -6$$
$$2x + 3y = 14$$

(-.5, 5)

Pass it Around

$x + 5y = -13$

$2x - 5y = -20$

(-11, -.4)

Pass It Around

$$2x - 3y = 6$$
$$x + 3y = 12$$

(6, 2)

Elimination using Multiplication

LEQ: How do you solve a system of equations using the elimination method?

How do you eliminate?

- Tell your shoulder buddy what is the first thing you look for to eliminate a variable?
- (Think about what is the 1st step of the elimination method)
- **Look for Opposite Numbers**
- Flow Chart Elimination.pdf

Solving Systems Using the Elimination Method

Fabulous Flow Chart for Elimination Exhilaration

Start Here!

Are the equations of the system in standard form?

Ax + By = C
Ax + By = C

x & y on same side

If NO → Using appropriate algebra, rearrange the equations to get them in standard form.

Then go here

If yes

Pick a letter, any letter!!
Choose a variable to eliminate!
Your choice!!

Are the coefficients of the variable you choose opposites?
(That means...is one negative and one positive?????)

If NO → Make them opposites by distributing a -1 to **every** term in the equation!

Then go here

If yes

Are the coefficients of the variable you choose the same?

If NO → Swap coefficients and distribute throughout the entire equation.

Then go here

If yes

Add vertically!

Solve for the remaining variable.

Substitute the answer back into the original system of equations to solve for the other unknown variable.

When you are finished, you should have a solution that represents an (x,y) ordered pair which is the point of intersection on a graph!

Solution: (x, y)

What to Eliminate?!?!

Consider the system

$4x + 2y = 6$

$x + 3y = -6$ ← Multiply by -4 to eliminate the x term

What to Eliminate?!?!

Consider the system

$$\begin{cases} -2x + 2y = 6 \\ x + 3y = -6 \end{cases}$$

← Multiply by 2 to eliminate the x term

What to Eliminate?!?!

Consider the system

$$\begin{cases} -2x + y = 6 \\ 8x + 3y = -6 \end{cases}$$

Multiply by -3 to eliminate the y term

What to Eliminate?!?!

Consider the system

$$\begin{cases} x - 5y = 16 \\ 3x + y = -6 \end{cases}$$

Multiply by 5 to eliminate the y term

Example 5: Elimination using Multiplication

Consider the system

$-3\,(x + 2y = 6)$

$3x + 3y = -6$

Elimination using Multiplication

Consider the system

$$\begin{array}{rl} & -3x + -6y = -18 \\ + & 3x + 3y = -6 \\ \hline & -3y = -24 \\ & y = 8 \end{array}$$

ANS: (x, 8)

Elimination using Multiplication

Consider the system

$$\begin{cases} x + 2y = 6 \\ 3x + 3y = -6 \end{cases}$$

← Substitute y =8 into equation

y =8

$x + 2(8) = 6$

$x + 16 = 6$

$x = -10$

ANS: (x, 8)

Elimination using Multiplication

Consider the system

$$\begin{cases} x + 2y = 6 \\ 3x + 3y = -6 \end{cases}$$

← Substitute y =14 into equation

y =8

$x + 2(8) = 6$

$x + 16 = 6$

$x = -10$

ANS: (-10 , 8)

Example 6

Consider the system

$$\begin{cases} 3x + 4y = 22 \\ x - 5y = -37 \end{cases}$$

Your turn

1. $\begin{cases} x + 2y = 5 \\ 2x + 6y = 12 \end{cases}$

ANS: (3, 1)

2. $\begin{cases} x + 2y = 4 \\ x - 4y = 16 \end{cases}$

ANS: (8, -2)

Example 7: More multiplying

Consider the system

$$\begin{cases} 3x + 4y = -25 & \leftarrow \text{Multiply by } 2 \\ 2x - 3y = 6 & \leftarrow \text{Multiply by } -3 \end{cases}$$

Consider the system

$2(3x + 4y = -25)$

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

Consider the system

$$6x + 8y = -50$$

$$+ \quad -6x + 9y = -18$$

$$17y = -68$$

$$y = -4$$

ANS: (x, -4)

Consider the system

$$\begin{cases} 3x + 4y = -25 \\ 2x - 3y = 6 \end{cases}$$

Substitute $y = -4$

$$2x - 3(-4) = 6$$

$$2x + 12 = 6$$

$$2x + 12 = 6$$

$$2x = -6$$

$$x = -3$$

ANS: (x, -4)

Consider the system

$$\begin{cases} 3x + 4y = -25 \\ 2x - 3y = 6 \end{cases}$$

Substitute $y = -4$

$$2x - 3(-4) = 6$$

$$2x + 12 = 6$$

$$2x + 12 = 6$$

$$2x = -6$$

$$x = -3$$

ANS: (-3 , -4)

Example 8

Consider the system

$$\begin{cases} 2x + 2y = -8 \\ 3x - 3y = 18 \end{cases}$$

Your turn

1. $\begin{cases} x + 2y = 5 \\ 2x + 6y = 12 \end{cases}$

2. $\begin{cases} x + 2y = 4 \\ x - 4y = 16 \end{cases}$

Your turn

1.

$$\begin{cases} 4x + y = 9 \\ 3x + 2y = 8 \end{cases}$$

2.

$$\begin{cases} 2x + 3y = 1 \\ 5x + 7y = 3 \end{cases}$$

JOURNAL

Solve the system using elimination method:

$$2x + 5y = 7$$

$$3x + y = -9$$

The solution is:

a. (12, -4)

b. (-4, 3)

c. (4, -21)

d. No Solution

YES!

The solution is (4, -21). You can verify this by plugging it into the system:

$$2(4) + 5(-21) = 7$$

$$3(4) + (-21) = -9$$

Question 3

Journal

- What kinds of errors have you made in using the elimination method to solve system of equations?
- What do you think you can do to reduce those errors?

Comic Book

- Create a Comic book to explain how to solve systems of equations using the elimination method.
- Your Comic Book must have a hero and describe in detail all of the steps
- You can use an example if it helps you ☺

Classwork

- Complete your Comic Book
- If you don’t finish in class complete tonight for homework.

Journal

- You now have worked with three different methods for solving systems of linear equations. How do you decide when to use the following?:
- Graphing method
- Substitution method
- Elimination method

Homework

- Complete Comic Book mini project.

Quote

"The difference between perseverance and obstinacy is that one comes from a strong will, and the other from a strong won't."

Henry Ward Beecher