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Class: _____

M8-U5: Notes #5 - Solving by Elimination

Date: _____

You have already developed some useful strategies for solving a simple linear equation like $3x + 5 = 10$. You know that you can add or subtract the same quantity on both sides and preserve equality. The same is true for multiplication or division. These ideas, called the *Properties of Equality*, can help you develop another method for solving linear equations. This method involves combining separate linear equations (through the four basic operations) into one equation with only one variable. **Other names for this method are *Combination, Addition, or Elimination*.**

Examples:

1.
$$+ \begin{cases} x + y = 3 \\ x - y = -9 \end{cases}$$

$$\frac{2x}{2} = \frac{-6}{2}$$

$$\boxed{x = -3}$$

$$\begin{array}{r} (-3) + y = 3 \\ +3 \quad +3 \\ \hline y = 6 \end{array}$$

$$\boxed{y = 6}$$

$$\boxed{P(-3, 6)}$$

ck

$$(-3) - (6) = -9$$

$$-9 = -9 \checkmark$$

2.
$$+ \begin{cases} 2x - 4y = 10 \\ -2x + 6y = -4 \end{cases}$$

$$\frac{2y}{2} = \frac{6}{2}$$

$$\boxed{y = 3}$$

$$2x - 4(3) = 10$$

$$2x - 12 = 10$$

$$+12 \quad +12$$

$$\frac{2x}{2} = \frac{22}{2}$$

$$\boxed{x = 11}$$

$$\boxed{P(11, 3)}$$

ck

$$-2(11) + 6(3) = -4$$

$$-22 + 18 = -4$$

$$-4 = -4 \checkmark$$

Try It!

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

$$\frac{2y}{2} = \frac{4}{2}$$

$$\boxed{y = 2}$$

$$\begin{array}{r} 2x + (2) = 3 \\ -2 \quad -2 \\ \hline 2x = 1 \end{array}$$

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

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

$$\boxed{P(\frac{1}{2}, 2)}$$

ck

$$-2(\frac{1}{2}) + (2) = 1$$

$$-1 + 2 = 1$$

$$1 = 1 \checkmark$$

b.
$$+ \begin{cases} x + y = 30 \\ x - y = 6 \end{cases}$$

$$\frac{2x}{2} = \frac{36}{2}$$

$$\boxed{x = 18}$$

$$(18) + y = 30$$

$$-18 \quad -18$$

$$\boxed{y = 12}$$

$$\boxed{P(18, 12)}$$

ck

$$(18) - (12) = 6$$

$$6 = 6 \checkmark$$

Examples:

Change all the signs of the 2nd eqn.

$$3. \quad \begin{cases} 6x - 7y = -4 \\ -(-4x - 7y = 26) \end{cases} \rightarrow \begin{cases} 6x - 7y = -4 \\ 4x + 7y = -26 \end{cases}$$

$$\frac{10x = -30}{10 \quad 10}$$

$$\boxed{x = -3}$$

$$6(-3) - 7y = -4$$

$$-18 - 7y = -4$$

$$+18 \quad +18$$

$$-7y = 14$$

$$\frac{-7}{-7} \quad \frac{14}{-7}$$

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

$$\boxed{P(-3, -2)}$$

CK

$$-4(-3) - 7(-2) \stackrel{?}{=} 26$$

$$12 + 14 \stackrel{?}{=} 26$$

$$26 = 26 \checkmark$$

$$4. \quad \begin{cases} x + 3y = 9 \\ -(x - 2y = -6) \end{cases} \rightarrow \begin{cases} x + 3y = 9 \\ -x + 2y = 6 \end{cases}$$

$$\frac{5y = 15}{5 \quad 5}$$

$$\boxed{y = 3}$$

$$x + 3(3) = 9$$

$$x + 9 = 9$$

$$\boxed{x = 0}$$

$$\boxed{P(0, 3)}$$

CK

$$(0) - 2(3) \stackrel{?}{=} -6$$

$$-6 = -6 \checkmark$$

Try It!

$$a. \quad \begin{cases} 5x + 7y = 77 \\ -(5x + 3y = 53) \end{cases} \rightarrow \begin{cases} 5x + 7y = 77 \\ -5x - 3y = -53 \end{cases}$$

$$\frac{4y = 24}{4 \quad 4}$$

$$\boxed{y = 6}$$

$$5x + 7(6) = 77$$

$$5x + 42 = 77$$

$$\frac{5x = 35}{5 \quad 5}$$

$$\boxed{x = 7}$$

$$\boxed{P(7, 6)}$$

CK

$$5(7) + 3(6) \stackrel{?}{=} 53$$

$$35 + 18 \stackrel{?}{=} 53$$

$$53 = 53 \checkmark$$

$$b. \quad \begin{cases} 9x - 3y = 24 \\ -(7x - 3y = 20) \end{cases} \rightarrow \begin{cases} 9x - 3y = 24 \\ -7x + 3y = -20 \end{cases}$$

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

$$\boxed{x = 2}$$

$$9(2) - 3y = 24$$

$$18 - 3y = 24$$

$$-18 \quad -18$$

$$-3y = 6$$

$$\frac{-3}{-3} \quad \frac{6}{-3}$$

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

$$\boxed{P(2, -2)}$$

CK

$$7(2) - 3(-2) \stackrel{?}{=} 20$$

$$14 + 6 \stackrel{?}{=} 20$$

$$20 = 20 \checkmark$$

Now let's investigate some other systems that involve other uses of the elimination method.

5.
$$\begin{cases} 2x+5y=-1 \\ x+2y=0 \end{cases} \rightarrow \begin{array}{r} 2x+5y=-1 \\ -2x-4y=0 \\ \hline y=-1 \end{array}$$

$x+2(-1)=0$
 $x-2=0$
 $\quad +2 \quad +2$
 $\hline x=2$

$\boxed{P(2,-1)}$

CK
 $2(2)+5(-1)?-1$
 $4-5?-1$
 $-1=-1\checkmark$

6.
$$\begin{cases} 6x+3y=0 \\ -3x+3y=9 \end{cases} \rightarrow \begin{array}{r} 6x+3y=0 \\ -6x+6y=18 \\ \hline 9y=18 \\ \frac{9y}{9}=\frac{18}{9} \\ y=2 \end{array}$$

$6x+3(2)=0$
 $6x+6=0$
 $\quad -6 \quad -6$
 $\hline 6x=-6$
 $\frac{6x}{6}=\frac{-6}{6}$
 $x=-1$

$\boxed{P(-1,2)}$

CK
 $-3(-1)+3(2)?9$
 $3+6?9$
 $9=9\checkmark$

Try It!

a.
$$\begin{cases} 8x-9y=19 \\ 4x+y=-7 \end{cases} \rightarrow \begin{array}{r} 8x-9y=19 \\ -8x-2y=14 \\ \hline -11y=33 \\ \frac{-11y}{-11}=\frac{33}{-11} \\ y=-3 \end{array}$$

$4x+(-3)=-7$
 $\quad +3 \quad +3$
 $\hline 4x=-4$
 $\frac{4x}{4}=\frac{-4}{4}$
 $x=-1$

$\boxed{P(-1,-3)}$

CK
 $8(-1)-9(-3)?19$
 $-8+27?19$
 $19=19\checkmark$

b.
$$\begin{cases} 4x-y=6 \\ 3x+2y=21 \end{cases} \rightarrow \begin{array}{r} 8x-2y=12 \\ 3x+2y=21 \\ \hline 11x=33 \\ \frac{11x}{11}=\frac{33}{11} \\ x=3 \end{array}$$

$4(3)-y=6$
 $12-y=6$
 $\quad -12 \quad -12$
 $\hline -y=-6$
 $y=6$

$\boxed{P(3,6)}$

CK
 $3(3)+2(6)?21$
 $9+12?21$
 $21=21\checkmark$

