

Name: KEY Hour: \_\_\_\_\_ Date: \_\_\_\_\_

## NOTES: Section 7.3 – Solving Linear Systems by Elimination

Goals: #1 - I can solve a linear system algebraically using the elimination method and then check my solution algebraically.

Homework: Section 7.3 Worksheet



Warm Up: Solve the linear system by using substitution. Check your answer algebraically.

1.  $x + 2y = 1$   
 $5x + 3y = -23$

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

$$x = 1 - 2y$$

$$5(1 - 2y) + 3y = -23$$

$$5 - 10y + 3y = -23$$

$$5 - 7y = -23$$

$$-7y = -28$$

$$y = 4$$

$$x = 1 - 2y$$

$$x = 1 - 2(4)$$

$$x = 1 - 8$$

$$x = -7$$

$$(-7, 4)$$

Notes:

There are several ways to solve a linear system WITHOUT using graphs.

Another algebraic method is called elimination.

- Step 1: Arrange the equations in standard form:  
 $Ax + By = C$
- Step 2: Multiply, if necessary, the equations to match two variables with opposite signs.
- Step 3: Add the equations together from step 2, eliminate, & solve.
- Step 4: Substitute the value from step 3 into either of the original equations & solve.
- Step 5: Check the solution in both original equations.

Example #1: Solve the linear system using elimination.

$$\begin{aligned} 1. \quad & 2x - 3y = 4 \\ & -4x + 5y = -8 \end{aligned}$$

$$\begin{aligned} 2. \quad & 3x + 5y = 6 \\ & -4x + 2y = 5 \end{aligned}$$

Step #1: Standard Form:  $Ax + By = C$

$$\begin{aligned} 2x - 3y &= 4 \\ -4x + 5y &= -8 \end{aligned} \quad \checkmark$$

$$\begin{aligned} 3x + 5y &= 6 \\ -4x + 2y &= 5 \end{aligned} \quad \checkmark$$

Step #2: Multiply equations to match variables w/ opposite signs.

$$\begin{aligned} 2(2x - 3y) &= 4 \\ 4x - 6y &= 8 \\ -4x + 5y &= -8 \end{aligned} \quad \checkmark$$

$$\begin{aligned} 4(3x + 5y) &= 6 \\ 12x + 20y &= 24 \\ 3(-4x + 2y) &= 5 \\ -12x + 6y &= 15 \end{aligned} \quad \checkmark$$

Step #3: Add, eliminate, & solve.

$$\begin{array}{r} + \quad 4x - 6y = 8 \\ -4x + 5y = -8 \\ \hline -y = 0 \\ \boxed{y = 0} \end{array}$$

$$\begin{array}{r} + \quad 12x + 20y = 24 \\ -12x + 6y = 15 \\ \hline 26y = 39 \\ \boxed{y = 1.5} \end{array}$$

Step #4: Substitute & solve.

$$\begin{aligned} 2x - 3(0) &= 4 \\ 2x &= 4 \\ \boxed{x = 2} \end{aligned} \quad \boxed{(2, 0)}$$

$$\begin{aligned} 3x + 5(1.5) &= 6 \\ 3x + 7.5 &= 6 \quad (-0.5, 1.5) \\ 3x &= -1.5 \\ \boxed{x = -0.5} \end{aligned}$$

Step #5: Check your solution.

$$\begin{aligned} 2(2) - 3(0) &\stackrel{?}{=} 4 & -4(2) + 5(0) &\stackrel{?}{=} -8 \\ 4 - 0 &= 4 & -8 + 0 &= -8 \\ 4 &= 4 \checkmark & -8 &= -8 \checkmark \end{aligned}$$

$$\begin{aligned} 3(-0.5) + 5(1.5) &\stackrel{?}{=} 6 & 2 + 3 &\stackrel{?}{=} 5 \\ -1.5 + 7.5 &= 6 & 5 &= 5 \checkmark \\ b &= b \checkmark & & \end{aligned}$$

Example #2: Solve the linear system using elimination.

1.  $3x + 2y = 8$

$2y = 12 - 5x$

2.  $4x + 7y = -9$

$3x = 3y + 18$

Step #1: Standard Form ( $Ax + By = C$ ).

$3x + 2y = 8$  ✓

$2y = 12 - 5x$   
 $+5x \quad +5x$

$5x + 2y = 12$  ✓

$4x + 7y = -9$  ✓

$3x = 3y + 18$

$-3y \quad -3y$   
 $3x - 3y = 18$  ✓

Step #2: Multiple to match variables with opposite signs.

$-1(3x + 2y = 8)$   
 $-3x - 2y = -8$  ✓  
 $5x + 2y = 12$

$3(4x + 7y = -9)$

$12x + 21y = -27$

$7(3x - 3y = 18)$

$21x - 21y = 126$  ✓

Step #3: Add, eliminate, & solve.

$-3x - 2y = -8$   
 $+ 5x + 2y = 12$   


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 $2x = 4$

$+12x + 21y = -27$   
 $21x - 21y = 126$   


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 $33x = 99$

$x = 2$

$x = 3$

Step #4: Substitute & solve.

$2y = 12 - 5(2)$

$2y = 12 - 10$

$2y = 2$

$y = 1$

$3(3) = 3y + 18$

$9 = 3y + 18$

$-9 = 3y$

$y = -3$

$(3, -3)$

Step #5:

$(2, 1)$

$3(2) + 2(1) \stackrel{?}{=} 8$

$6 + 2 \stackrel{?}{=} 8$

$8 = 8$  ✓

$2(1) \stackrel{?}{=} 12 - 5(2)$

$2 \stackrel{?}{=} 12 - 10$

$2 = 2$  ✓

$4(3) + 7(-3) \stackrel{?}{=} -9$

$12 - 21 \stackrel{?}{=} -9$

$-9 = -9$  ✓

$3(3) \stackrel{?}{=} 3(-3) + 18$

$9 \stackrel{?}{=} -9 + 18$

$9 = 9$  ✓

You practice: Solve the linear system using elimination.

2.  $3x + 4y = 6$

$2x - 5y = -19$

Step #1: ✓

Step #2:  $5(3x + 4y = 6)$   
 $4(2x - 5y = -19)$

$15x + 20y = 30$   
 $8x - 20y = -76$  ✓

Step #3:  $15x + 20y = 30$   
 $+ 8x - 20y = -76$   


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 $23x = -46$   
 $x = -2$

Step #4:  $3(-2) + 4y = 6$   
 $-6 + 4y = 6$   
 $4y = 12$   
 $y = 3$   
 $(-2, 3)$

Step #5:  $3(-2) + 4(3) \stackrel{?}{=} 6$   
 $-6 + 12 \stackrel{?}{=} 6$   
 $6 = 6$  ✓

$2(-2) - 5(3) \stackrel{?}{=} -19$   
 $-4 - 15 \stackrel{?}{=} -19$   
 $-19 = -19$  ✓

2.  $-13 = 4x - 3y$

$5x + 2y = 1$

$-13 = 4x - 3y$   
 $4x - 3y = -13$  ✓  
 $5x + 2y = 1$  ✓

$2(4x - 3y = -13)$   
 $3(5x + 2y = 1)$

$8x - 6y = -26$   
 $15x + 6y = 3$  ✓

$8x - 6y = -26$   
 $+ 15x + 6y = 3$   


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 $23x = -23$   
 $x = -1$

$5(-1) + 2y = 1$   
 $-5 + 2y = 1$   
 $2y = 6$   
 $y = 3$   
 $(-1, 3)$

$-13 \stackrel{?}{=} 4(-1) - 3(3)$   
 $-13 \stackrel{?}{=} -4 - 9$   
 $-13 = -13$  ✓  
 $5(-1) + 2(3) \stackrel{?}{=} 1$   
 $-5 + 6 \stackrel{?}{=} 1$   
 $1 = 1$  ✓