

## 3.2. Advanced Algebra

### Solving Systems of Equations by Elimination

DATE: 10/30

*Target 3B. Solve a system of equations graphically and algebraically.*

*Target 3C. Understand the relationship between a system of equations and its number of solutions*



**Elimination Method:** eliminate one of the variables by adding (or subtracting) the equations. When you add two true equations, the result is a new equation that is also true.

Solve each system of equations by the elimination method.

$$\begin{array}{r} 1. \quad 4a + 2b = 15 \\ \quad -2a - 2b = -7 \\ \hline \end{array}$$

opposites  
2, -2  
⇒ eliminate

$$\frac{2a}{2} = \frac{8}{2}$$

$$a = 4$$

Now, substitute 4 into top or bottom original equation.

I choose the top one.

$$\begin{array}{r} 4(4) + 2b = 15 \\ 16 + 2b = 15 \\ -16 \quad -16 \\ \hline 2b = -1 \\ \frac{2b}{2} = \frac{-1}{2} \end{array}$$

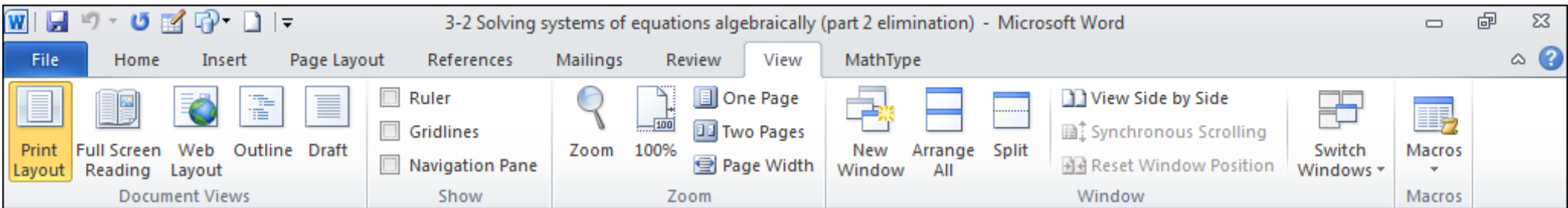
$$b = -\frac{1}{2}$$

$$\therefore \begin{matrix} a, b \\ (4, -\frac{1}{2}) \end{matrix}$$

yes!

Are the variables lined up? Do you have opposite numbers as coefficients of either variable in the top and bottom equation? **Yes!**  
Since the answer to both questions is YES, eliminate the variable.  
If the answer to question one is NO, line up the variables. If the answer to question two is NO, then follow this rule:

- CHOOSE to eliminate either variable by multiplying the top, bottom, or both equations by a number that will get you opposites on the variable you chose to eliminate.



2.  $x + 2y = 10$

$-1(x + y = 6)$

$|x + 2y = 10$

$-1x - 1y = -6$

$y = 4$

1, -1  
opposites  
⇒ eliminate

yes!  
Are the variables lined up? Do you have opposite numbers as coefficients of either variable in the top and bottom equation? No!

I choose to eliminate the x-variable by multiplying the bottom equation by -1.

$x + (4) = 6$

$x + 4 = 6$   
 $-4 -4$

$x = 2$

$\begin{pmatrix} x & y \\ 2 & 4 \end{pmatrix}$

3.  $3x - 7y = -14$

$-3(5x + 2y = 45)$

$15x - 35y = -70$

$-15x - 6y = -135$

$-41y = 205$

$-41 -41$

$y = 5$

15, -15  
opposites  
⇒ eliminate

yes!  
Are the variables lined up? Do you have opposite numbers as coefficients of either variable in the top and bottom equation? No!

I choose to eliminate x by multiplying top equation by 5 and bottom equation by -3.

$3x - 7y = -14$

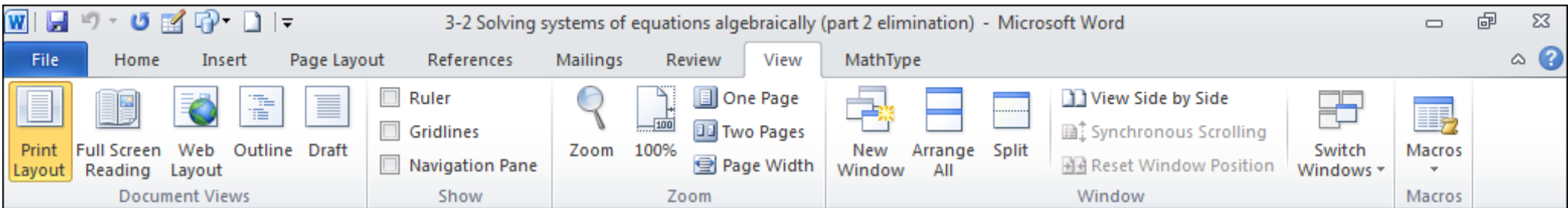
$3x - 7(5) = -14$

$3x - 35 = -14$   
 $+35 +35$

$\frac{3x}{3} = \frac{21}{3}$

$x = 7$

$\begin{pmatrix} x & y \\ 7 & 5 \end{pmatrix}$



yes!

4.  $u + v = 7$   
 $-1(2u + v = 11)$

$u + v = 7$   
 $-2u - v = -11$

$-10 = -4$   
 $-1 \quad -1$

$u = 4$

$u + v = 7$   
 $4 + v = 7$   
 $-4 \quad -4$   
 $v = 3$

$\begin{matrix} u & v \\ (4 & 3) \end{matrix}$

Are the variables lined up? Do you have opposite numbers as coefficients of either variable in the top and bottom equation? No!  
 I'm going to eliminate  $v$  by multiplying bottom equation by  $-1$ .

No!

5.  $6p - 3q = 24$   
 $2p = 7 + q$   
 $-q \quad -q$

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$2p - q = 7$

$6p - 3q = 24$   
 $-3(2p - q = 7)$  } Lined up ✓

$6p - 3q = 24$   
 $-6p + 3q = -21$

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$0 + 0 = 3$   
 $0 = 3$  FALSE

∴ No solution!

Are the variables lined up? Do you have opposite numbers as coefficients of either variable in the top and bottom equation? No!  
 Line up variables first! Eliminate the  $p$  variable by mult. bottom equation by  $-3$ .

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6.  $2m + 4n = 6$

$2(-m - 2n = -3)$

$$\begin{array}{r} 2m + 4n = 6 \\ -2m - 4n = -6 \\ \hline 0 = 0 \end{array}$$

$0 = 0$  TRUE

yes!  
Are the variables lines up? Do you have opposite numbers as coefficients of either variable in the top and bottom equation? No!  
I will eliminate  $n$  variable. Multiply bottom equation by 2.

$\therefore$  Infinite number of solutions.

7.  $(2x - y = -4)$

$-4x + 2y = 6$

$$\begin{array}{r} 4x - 2y = -8 \\ -4x + 2y = 6 \\ \hline 0 + 0 = -2 \end{array}$$

$0 + 0 = -2$

$0 = -2$  FALSE

yes!  
Are the variables lines up? Do you have opposite numbers as coefficients of either variable in the top and bottom equation? No!  
I will multiply top equation by 2 to eliminate  $y$  variable.

$\therefore$  No solution exists.