

## Solving Systems of Linear Equations by Elimination

\* The elimination method uses addition or subtraction to **ELIMINATE** one of the variables in the system.

→ When the coefficients of one of the variables are opposite, add the equations to eliminate a variable

→ When the coefficients of one of the variables are the same, subtract the equations to eliminate a variable

EX. 
$$\begin{aligned} -6x + 6y &= 6 \\ -6x + 3y &= -12 \end{aligned}$$

\* Coefficients of the x terms are the same → subtract!

$$\begin{aligned} -6x + 6y &= 6 \\ -(-6x + 3y) &= -(-12) \\ \hline 3y &= 18 \end{aligned}$$

$$\begin{aligned} -6x + 6y &= 6 \\ + 6x - 3y &= 12 \\ \hline 0x + 3y &= 18 \\ 3y &= 18 \\ \frac{3}{3} & \quad \frac{3}{3} \\ \hline y &= 6 \end{aligned}$$

\* Now that you have solved for one variable, sub it into one of the original equations to solve for the other variable.

$$\begin{aligned} -6x + 6(6) &= 6 \\ -6x + 36 &= 6 \\ -36 & \quad -36 \\ \hline -6x &= -30 \\ \frac{-6}{-6} & \quad \frac{-30}{-6} \\ \hline x &= 5 \end{aligned}$$

Solution: (5, 6)

EX.  $3x - 4y = -5$   
 $5x - 2y = -6$

\* Nothing matches right now, so multiply 1 or both equations by a number so that we can eliminate a variable.

$$\begin{array}{r} 3x - 4y = -5 \\ -2(5x - 2y = -6) \end{array}$$

\* Variables opposite  $\rightarrow$  add!

\* use -2 to get a +4y so we can eliminate the y terms

$$\begin{array}{r} 3x - 4y = -5 \\ + -10x + 4y = 12 \\ \hline -7x + 0y = 7 \\ -7x = 7 \\ \hline -1 \quad -1 \end{array}$$

$x = -1$

Sub  $x = -1$  into an original equation.

$$\begin{array}{r} 3(-1) - 4y = -5 \\ -3 - 4y = -5 \\ +3 \qquad +3 \end{array}$$

$$\begin{array}{r} -4y = -2 \\ \frac{-4y}{-4} = \frac{-2}{-4} \end{array}$$

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

Solution:  $(-1, \frac{1}{2})$

### ELIMINATION

$$\begin{cases} (2x + y = 6) \cdot 2 \\ -4x - 2y = 5 \end{cases}$$

$$\begin{array}{r} 4x + 2y = 12 \\ + \quad -4x - 2y = 5 \\ \hline \end{array}$$

$$0x + 0y = 17$$

$$0 = 17$$

NOT TRUE!

No Solution!

### ELIMINATION

$$\begin{cases} (-x + 5y = -6) \cdot 2 \\ 2x - 10y = 12 \end{cases}$$

$$\begin{array}{r} -2x + 10y = -12 \\ + \quad 2x - 10y = 12 \\ \hline \end{array}$$

$$0x + 0y = 0$$

$$0 = 0$$

TRUE!

Infinitely Many Solutions!

### ELIMINATION

$$\begin{cases} (3x + y = 2) \cdot 2 \\ x - 2y = 10 \end{cases}$$

$$\begin{array}{r} 6x + 2y = 4 \\ + \quad x - 2y = 10 \\ \hline \end{array}$$

$$7x + 0y = 14$$

$$\frac{7x}{7} = \frac{14}{7}$$

ONE SOLUTION!

$$x = 2$$

$$(2, -4)$$

$$\begin{array}{r} 2 - 2y = 10 \\ -2 \quad \quad -2 \end{array}$$

$$\frac{-2y}{-2} = \frac{8}{-2}$$

$$y = -4$$