Algebra I – Unit 7
Solving Linear Systems by Graphing

DEFINITION: A **system of linear equations** (also called a **linear system**) is a set of two or more linear equations.

Example: $x + 2y = 7$ Equation 1
$3x - 2y = 5$ Equation 2

A **solution to a system of linear equations** is an ordered pair that makes **BOTH equations TRUE** – an "x" value and a "y" value that work in both equations.

A. Is it a solution?

- To determine whether an ordered pair is a solution to a linear system, substitute the coordinates into each equation for the correct variables and evaluate.
- If BOTH equations result in TRUE statements, then the ordered pair IS a solution.

Examples:

1. Tell whether the ordered pair (1, 5) is a solution to the system: *Substitute 1 for "x" and 5 for "y" into each equation.*

x y

yes

$-5x + y = 0$

$-5(1) + 5 = 0$
$-5 + 5 = 0$
$0 = 0$ ✓

$5x + y = 10$

$5(1) + 5 = 10$
$5 + 5 = 10$
$10 = 10$ ✓

2. Tell whether the ordered pair (7, -5) is a solution to the system:

no

$y = -6x + 37$

$-5 = -6(7) + 37$
$-5 = -42 + 37$
$-5 = -5$ ✓

$4x - 3y = 24$

$4(7) - 3(-5) = 24$
$28 + 15 = 24$
$43 \neq 24$ X

Your Turn – tell whether the ordered pair is a solution.

(-3, 1)

yes

$x + y = -2$
$x + 5y = 2$

$-3 + 1 = -2$
$-2 = -2$ ✓

$-3 + 5(1) = 2$
$2 = 2$ ✓

(2, -6)

yes

$4x + 3y = -10$
$2y = -3x - 6$

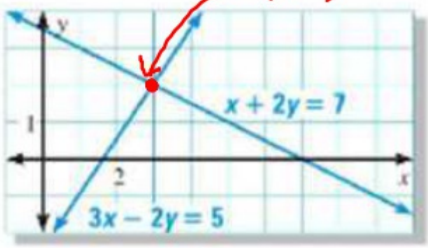
$4(2) + 3(-6) = -10$
$8 - 18 = -10$ ✓

$2(-6) = -3(2) - 6$
$-12 = -6 - 6$
$-12 = -12$ ✓

B. Solution on a Graph – The Point of Intersection

- When the linear system is shown on a graph, the Solution is the ordered pair of the point of intersection.
- To check the solution: Substitute the coordinates of the point into both equations to make sure the point makes BOTH EQUATIONS TRUE.

(3,2)



Example 1:

Where do the lines appear to intersect? (3,2)

Check the point in BOTH equations to make sure the point makes BOTH EQUATIONS TRUE.

Plug in 3 for "x" and 2 for "y".

$x + 2y = 7$

$3+2(2)=7$

$3+4=7$

$7=7$ ✓

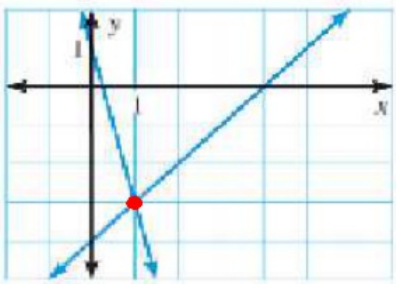
$3x - 2y = 5$

$3(3)-2(2)=5$

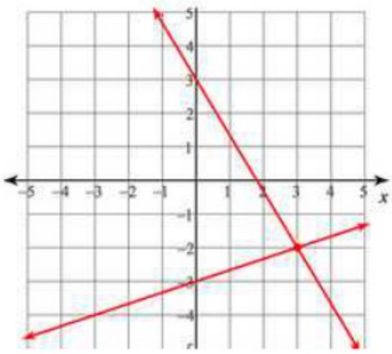
$9-4=5$

$5=5$ ✓

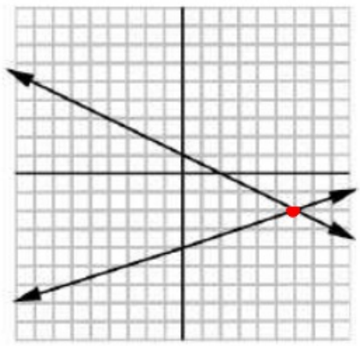
Practice – use the graph to solve the linear system.



Solution: (1,-3)



Solution: (3,-2)



Solution: (6,-2)

Steps for Solving a Linear System Using Graphing:

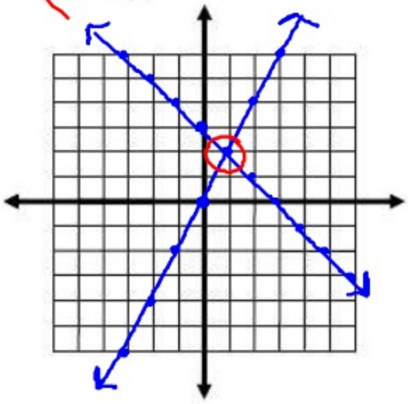
1. **Graph each equation** on the same coordinate plane.

2. **Locate the point of intersection** and write it down.

$y = 2x$

$y = -x + 3$

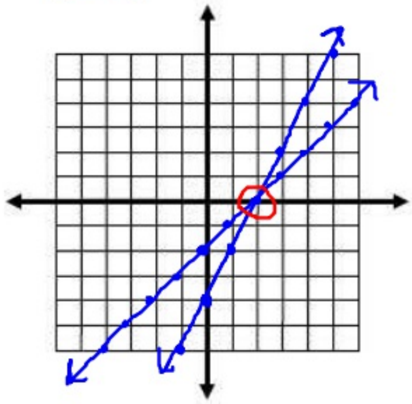
Solution: (1, 2)



$y = 2x - 4$

$y = x - 2$

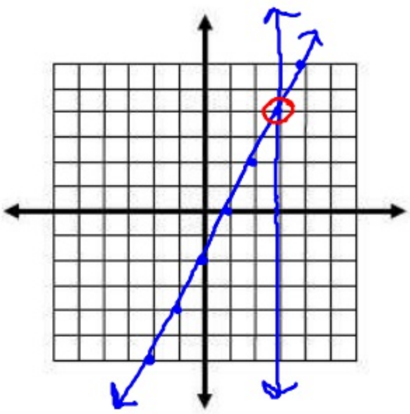
Solution: (2, 0)



$y = 2x - 2$

$x = 3$

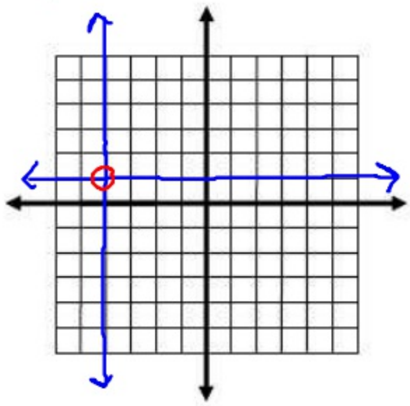
Solution: (3, 4)



$y = 1$

$x = -4$

Solution: (-4, 1)



Special Cases of Linear Systems

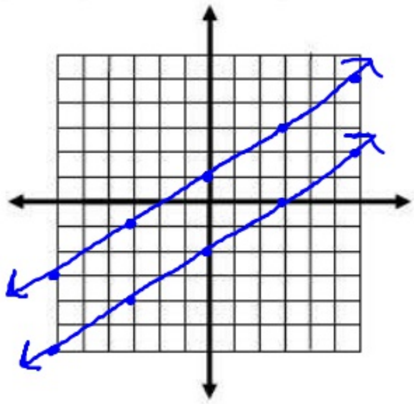
1. If the two equations represent **PARALLEL** lines, the system of equations has **NO SOLUTION**.

- This is called inconsistent (vocabulary you might see on the SOL).

$y = \frac{2}{3}x - 2$

$y = \frac{2}{3}x + 1$

Solution: no solution



2. If the two equations represent the EXACT SAME line, the system of equations has INFINITE SOLUTIONS.

- This is called consistent and dependent (vocabulary you might see on the SOL).

$y = -3x + 4$

$6x + 2y = 8$

Solution: infinite solutions

$$6x + 2y = 8$$
$$\underline{-6x \qquad -6x}$$
$$\frac{2y}{2} = \frac{-6x}{2} + \frac{8}{2}$$
$$y = -3x + 4$$