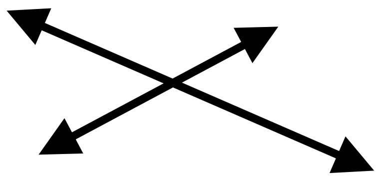
# Math-3A
# Lesson 11-7

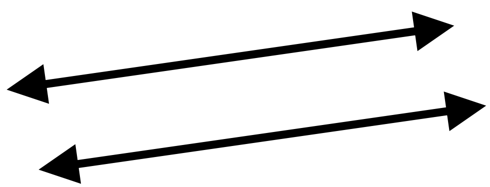
Solving Systems of Equations by Substitution

# Categories of Solutions:

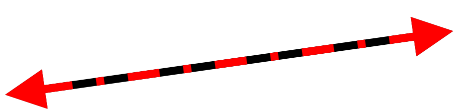
Ways 2 lines can be graphed:



Cross → one solution



Parallel →no solutions



Same line → infinitely many solutions

# How do you know how many solutions there are? (1, 0, or infinite #)

$$y = 3x + 1$$
$$y = 2x + 1$$

Not same line, not parallel → one solution.

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

parallel → no solutions

$$2x + 2y = 2$$
$$x + y = 1$$

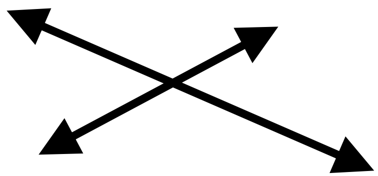
1st equation is a multiple of the 2nd equation
→ same line

→ infinite # of solutions.

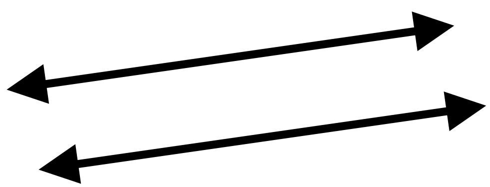
Which Category ?

$$y = 2x + 6$$

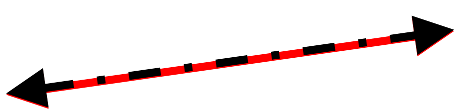
$$y = 4x - 2$$



Cross → one solution



Parallel →no solutions

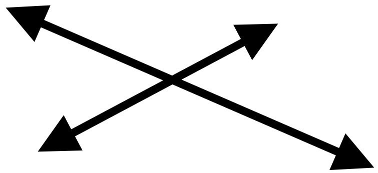


Same line → infinitely many solutions

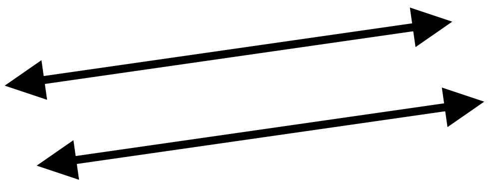
Which Category ?

$$y = 2x + 4$$

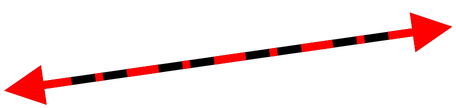
$$y = 2x - 7$$



Cross → one solution



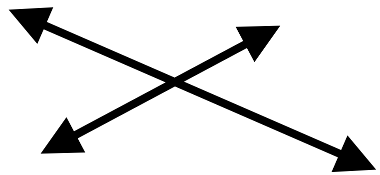
Parallel →no solutions



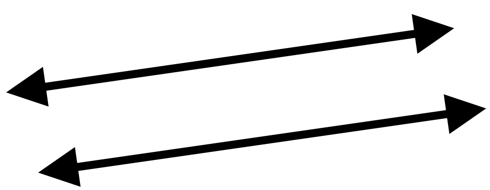
Same line → infinitely many solutions

Which
Category ?

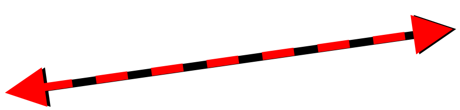
$$2x + 3y = 6$$
$$4x + 6y = 12$$



Cross → one solution



Parallel →no solutions



Same line → infinitely many solutions

# Methods of Solving Systems

1. Graphing: The points of intersection are the solutions.

2. Substitution:

3. Elimination: we'll do this later.

Solve by graphing

$$6x + 2y = 3$$
$$y = -3x + 1$$

→ No solutions

$$6x + 2y = 3$$
$$y = -3x + 1$$

→ $y = -3x + 3/2$

The lines were parallel.

x – 3y = 5

-x + 5y = 3

Solution: (17, 4)

y = 2x + 6

y = 5x + 8

Solution: (-2/3, 13/3)

$$2x - y = 2$$
$$4x + 2y = 8$$

Solution: (3/2, 1)

# Substitution Method

1. Solve one equation for one of the variables (already done if in “y =“ form).

$y = -2x + 8$

$y = 3x – 2$

2. Substitute the value of the variable into the other equation.

$(\quad) = -2x + 8$

$3x – 2 = -2x + 8$

$+2x \qquad +2x$

3. Solve for the single variable.

$5x – 2 = 8$

$+2 \quad +2$

$5x = 10$

$÷5 \quad ÷5$

$x = 2$

4. Substitute the value of the solved-for variable into either equation to find the other varable.

$y = 3x – 2$

$y = 3(\quad) – 2$

$y = 3(2) – 2$

$y = 6 – 2$

$y = 4$

5. Test your solution (2, 4) in the other equation.

$y = -2x + 8$

$(4) = -2(2) + 8$

# Solve the System of Equations Using the Substitution Method

$y = -3$

$y = -6x + 21$

(4, -3)

$y = -8x + 22$

$y = 4x - 2$

(2, 6)

$y = 6x - 3$

$y = -4x - 3$

(0, -3)

## Equations in Standard Form

$2x + y = 8$

$-3x + 3y = -3$

1. Solve both equations for the same variable.

$y = -2x + 8$ $y = x - 1$

2. Substitute the value of the variable into the other equation.

$-2x + 8 = x - 1$

$+2x \quad +2x$

$8 = 3x - 1$

$+1 \quad +1$

$9 = 3x$

$\div 3 \quad \div 3$

$x = 3$

3. Solve for the single variable.

4. Substitute the value of the solved-for variable into <u>either equation</u>.

$2x + y = 8$

$2(3) + y = 8$

$6 + y = 8$

$y = 2$

5. Test your solution (2, 4) in the <u>other equation.</u>

$-3(3) + 3(2) = -3$

$-9 + 6 = -3$

How do you know how many solutions there are? (1, 0, or infinite #)

$$6x + 2y = 3 \qquad 6x + 2(-3x + 1) = 3 \qquad 2 = 3$$
$$y = -3x + 1 \qquad 6x - 6x + 2 = 3$$

All the variables "disappeared" and the equation is <u>false</u>:

→ No solutions

How can that be?

$$6x + 2y = 3 \rightarrow y = -3x + \tfrac{3}{2}$$
$$y = -3x + 1$$

The lines were parallel.

How do you know how many solutions there are? (1, 0, or infinite #)

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

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

$$4 = 4$$

All the variables "disappeared" and the equation is <u>true</u>:

→ Infinitely many solutions

How can that be?

$$6x + 2y = 4 \quad \longrightarrow \quad y = -3x + 2$$
$$y = -3x + 2$$

Different versions of the same equation!