

SM2 HANDOUT 6-3 (Solving Systems of Equations by Graphing and Substitution)

Kathryn takes her Sadie Hawkins date to Baskin Robbins. They pig out and they each have a sundae and a milkshake. It costs her \$9.

$$TC = COST_{milkshake} + COST_{sundae} \quad 9 = 2m + 2s$$

Sarah follows Kathryn's lead and takes her Sadie date to Baskin Robbins. Not to be outdone by Kathryn, Sarah and her date really pig out and each has a sundae and 2 milkshakes. It costs her \$13.

$$13 = 4m + 2s$$

How much does Baskin Robbins charge for their sundaes?
What do they charge for their shakes?

What values of "m" and "s" make both statements true?

System of two linear equations: Two equations (of lines) that each have the same two variables. (in this case 'x' and 'y')

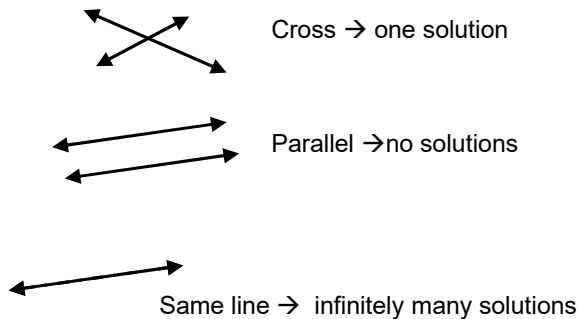
$$\begin{array}{ll} 3x + y = 7 & Ax + By = C \text{ (equation 1)} \\ 5x - 2y = -3 & Dx + Ey = F \text{ (equation 2)} \end{array}$$

Solution to an Equation: all x-y pairs that make the equation a true statement (any point on the graph of the line).

A solution of a system of two equations in two variables is an ordered pair of real numbers that is a solution of both equations.

Categories of Solutions:

Ways 2 lines can be graphed:



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

$$\begin{array}{l} y = 3x + 1 \\ y = 2x + 1 \end{array} \quad \boxed{}$$

$$\begin{array}{l} y = -2x + 3 \\ y = -2x - 4 \end{array} \quad \boxed{}$$

$$\begin{array}{l} 2x + 2y = 2 \\ x + y = 1 \end{array} \quad \boxed{}$$

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.

Solving by graphing:

Is very easy if you use a graphing calculator.

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

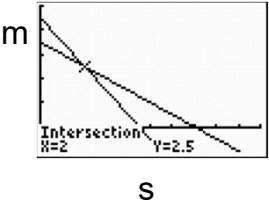


Is doable if you use graph paper BUT you must be VERY accurate to get the correct solution.

Original Word Problem:

What values of "m" and "s" make both statements true?

$9 = 2m + 2s$ $m = -s + 4.5$
 $13 = 4m + 2s$ $m = -0.5s + 3.25$



Milkshakes: _____

Sundaes: _____

Solve by graphing

$6x + 2y = 3$ →
 $y = -3x + 1$

$6x + 2y = 3$ → $y = -3x + \frac{3}{2}$
 $y = -3x + 1$

$x - 3y = 5$
 $-x + 5y = 3$

$y = 2x + 6$
 $y = 5x + 8$

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

Substitution Method

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

$y = -2x + 8$
 $y = 3x - 2$
- Substitute the value of the variable into the other equation.

$() = -2x + 8$
 $3x - 2 = -2x + 8$
 $+2x \quad +2x$
- Solve for the single variable.

$5x - 2 = 8$ $5x = 10$
 $+2 \quad +2$ $+5 \quad +5$
 $x = 2$
- Substitute the value of the solved-for variable into either equation to find the other variable.

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

$y = 3x - 2$ $y = 3(2) - 2$ $y = 4$
 $y = 3() - 2$ $y = 6 - 2$ $y = -2x + 8$ $(4) = -2(2) + 8$

Solve the System of Equations Using the Substitution Method

$y = -3$
 $y = -6x + 21$

$y = -8x + 22$
 $y = 4x - 2$

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

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 either equation.

$2x + y = 8$
 $2(3) + y = 8$
 $6 + y = 8$
 $y = 2$

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

$-3(3) + 3(2) = -3$
 $-9 + 6 = -3$

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

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

$6x + 2(-3x + 1) = 3$
 $6x - 6x + 2 = 3$
 $2 = 3$

All the variables _____ and the equation is _____:

How can that be?

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

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 _____ and the equation is _____:

How can that be?

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