

Solving Systems Algebraically

Essential question: *How can you solve a system of equations algebraically?*

You have already seen how to solve a system of equations by graphing. Now you will learn to solve systems using algebra.

COMMON CORE

CC.8.EE.8b
CC.8.EE.8c

1 EXAMPLE Solving Systems Algebraically

Solve each system algebraically.

A
$$\begin{cases} y = 7x + 10 \\ y = 9x + 38 \end{cases}$$

$$7x + 10 = 9x + 38$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} + 38$$

$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}}$$

$$= x$$

Substitute the expression for y given in the first equation for the value of y in the second equation.

Then use properties of equality to solve the equation for x.

Substitute the value of x into one of the original equations to solve for y.

The solution of the system is (_____, _____).

B
$$\begin{cases} 3x + 4y = 31 \\ 2x - y = 6 \end{cases}$$

$$2x - y = 6$$

$$\underline{\hspace{2cm}} - y = 6 - \underline{\hspace{2cm}}$$

$$-y(-1) = (6 - \underline{\hspace{2cm}})(-1)$$

$$= -6 + \underline{\hspace{2cm}}$$

$$3x + 4y = 31$$

$$3x + 4(\underline{\hspace{2cm}}) = 31$$

$$3x + (-24) + \underline{\hspace{2cm}} = 31$$

$$11x - 24 = 31$$

$$\underline{\hspace{2cm}} = 55$$

$$11x =$$

$$x =$$

Solve one equation for one of the variables. Because y is by itself in the second equation, solving that equation for y is a good place to start.

Substitute the expression for y into the first equation and solve for x.

Substitute the value of x into one of the original equations to solve for y .

The solution of the system is (_____, _____).

REFLECT

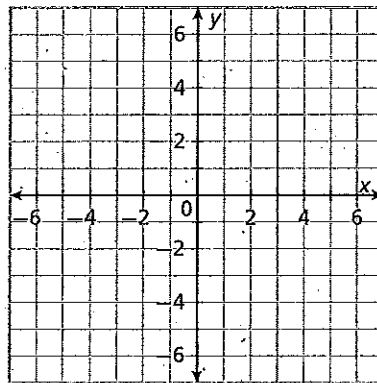
1. How can you check your answer?

You can use a graph to estimate the solution of a system of equations before solving algebraically.

2 EXAMPLE Using a Graph to Estimate the Solution of a System

Solve the system $\begin{cases} x - 4y = 4 \\ 2x - 3y = -3 \end{cases}$

- A Sketch a graph of each linear function by substituting some values for x and generating values of y .
- B The lines appear to intersect near $(-5, -2)$. How can you tell whether $(-5, -2)$ is the solution of the system?



- C Solve the system algebraically.

The solution is (_____, _____).

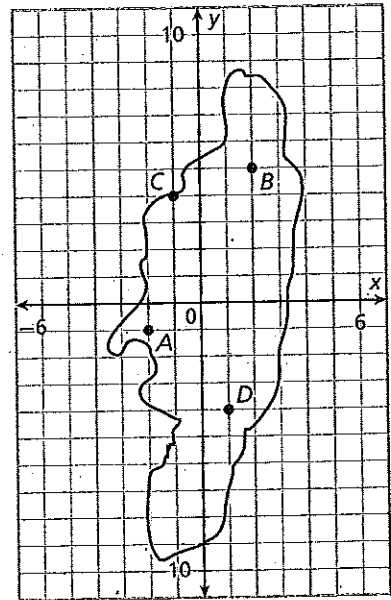
- D Use the estimate you made using the graph to judge the reasonableness of your solution.
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REFLECT

2. How can you determine that the system $\begin{cases} 5x - 2y = 8 \\ 5x - 2y = -3 \end{cases}$ has no solution without graphing or using algebraic methods?
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3 EXAMPLE Problem Solving with Systems of Equations

Aaargh! There's pirate treasure to be found,
 So search on the island, all around.
 Draw a line through *A* and *B*.
 Then a second line through *C* and *D*.
 Dance a jig, "X" marks the spot,
 If the lines intersect, that's the treasure's plot!



- A. Give the coordinates of each point and find the slope of the line through each pair of points.

A: (____, ____)

C: (____, ____)

B: (____, ____)

D: (____, ____)

Slope:

Slope:

- B. Use the slopes of the lines to determine whether they will intersect.
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-

- C. Write equations in slope-intercept form describing the line through points *A* and *B* and the line through points *C* and *D*.

Line through *A* and *B*:

Line through *C* and *D*:

D. Solve the system algebraically.

The solution is (_____, _____).

PRACTICE

Solve each system of equations algebraically.

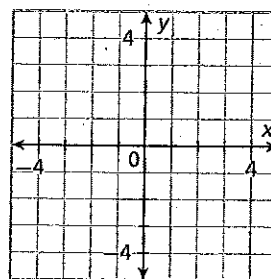
1.
$$\begin{cases} y = \frac{2}{3}x - 5 \\ y = -x + 10 \end{cases}$$

2.
$$\begin{cases} 3x + 2y = 9 \\ y = 4x - 1 \end{cases}$$

3.
$$\begin{cases} 5x - 2y = 4 \\ 2x - y = 1 \end{cases}$$

4. **Error Analysis** Zach solves the system $\begin{cases} x + y = -3 \\ x - y = 1 \end{cases}$ and finds the solution $(1, -2)$.

Use a graph to explain whether Zach's solution is reasonable.



5. **Error Analysis** Angelica solves the system $\begin{cases} 3x - y = 0 \\ \frac{1}{4}x + \frac{3}{4}y = \frac{5}{2} \end{cases}$

and finds the solution $(1, 3)$. Use substitution to explain whether Angelica's solution is correct.

Angelo bought apples and bananas at the fruit stand. He bought 20 pieces of fruit and spent \$11.50. Apples cost \$0.50 and bananas cost \$0.75 each.

6. Write a system of equations to model the problem. (Hint: One equation will represent the number of pieces of fruit. A second equation will represent the money spent on the fruit.)

7. Solve the system algebraically. Tell how many apples and bananas Angelo bought.