Name: _____ Date: _____

Solving Systems of Linear Equations

Two or more equations with the same set of variables are called a **system of equations**. For example, $y = 4x$ and $y = 4x + 2$ together are a system of equations.

You can estimate the solution of a system of equations by graphing the equations on the same coordinate plane. The ordered pair for the point of intersection of the graphs is the solution of the system because the point of intersection simultaneously satisfies both equations.

Example

Tutor

1. Solve the system $y = -2x - 3$ and $y = 2x + 5$

0 Sol

(-2, 1)

Let's use substitution!

$-2x - 3 = 2x + 5$

$+2x \quad +2x$

$-3 = 4x + 5$

$-5 \quad -5$

$-8 = 4x$

$\frac{-8}{4} = \frac{4x}{4}$

$x = -2$

$y = 2(-2) + 5$

$y = -4 + 5$

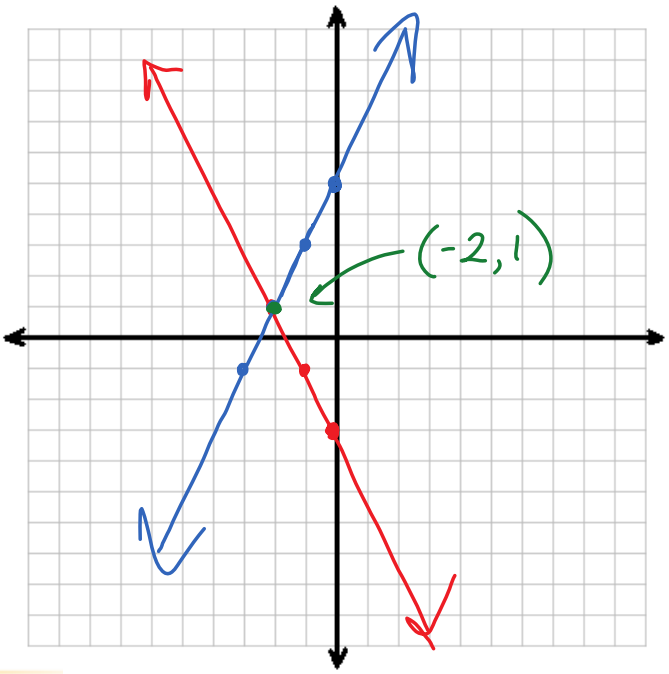
$y = 1$

$y = -2(-2) - 3$

$y = 4 - 3$

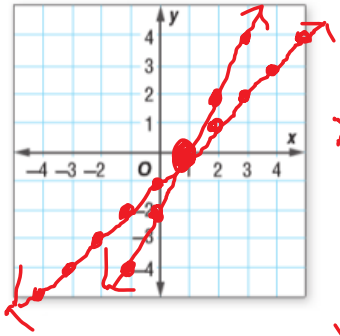
$y = 1$

Now let's graph to check our solution!



Got It? Do these problems to find out.

a. $y = x - 1$
$y = 2x - 2$



Solution - (1, 0)

$x = 0$

$x - 1 = 2x - 2$

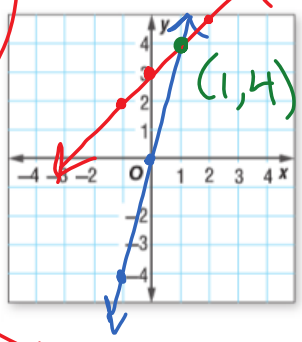
$+2 \quad +2$

$x + 1 = 2x$

$x = 1$

b. $y = 4x$
$y = x + 3$

(1, 4)



$4x = x + 3$

$-x \quad -x$

$3x = 3$

$\frac{3x}{3} = \frac{3}{3}$

$x = 1$

$y = 4(1)$

$y = 4$

c. $y = 2x + 1$
$3x + 4y = 26$

(2, 5)

$3x + 4y = 26$
$-3x \quad -3x$
$4y = -3x + 26$
$\frac{4y}{4} = \frac{-3x}{4} + \frac{26}{4}$
$y = -\frac{3}{4}x + \frac{26}{4}$

$\frac{8}{4}x + \frac{4}{4} = -\frac{3}{4}x + \frac{26}{4}$
$+\frac{3}{4}x \quad -\frac{4}{4} \quad +\frac{3}{4}x \quad -\frac{4}{4}$
$\frac{11}{4}x = \frac{22}{4}$
$x = 2$

$y = 2(2) + 1$
$y = 5$

$3x + 4(2x + 1) = 26$
$3x + 8x + 4 = 26$
$11x + 4 = 26$
$-4 \quad -4$
$11x = 22$
$\frac{11x}{11} = \frac{22}{11}$
$x = 2$

d. $2x + 5y = 44$
$y = 6x - 4$

(2, 8)

$2x + 5(6x - 4) = 44$
$2x + 30x - 20 = 44$
$32x - 20 = 44$
$+20 \quad +20$
$32x = 64$
$\frac{32x}{32} = \frac{64}{32}$
$x = 2$

$y = 6(2) - 4$
$y = 12 - 4$
$y = 8$

Examples

Tutor

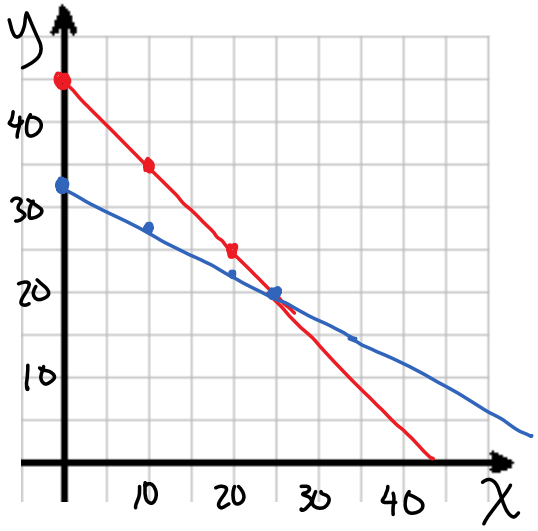
Gregory's Motorsports has motorcycles (two wheels) and ATVs (four wheels) in stock. The store has a total of 45 vehicles, that, together, have 130 wheels.

2. **Write a system of equations that represents the situation.**

x = motorcycles
y = ATVs

$2x + 4y = 130$
$x + y = 45$

(25, 20)



3. **Solve the system of equations. Interpret the solution.**

$x + y = 45$
$-x \quad -x$
$y = -x + 45$

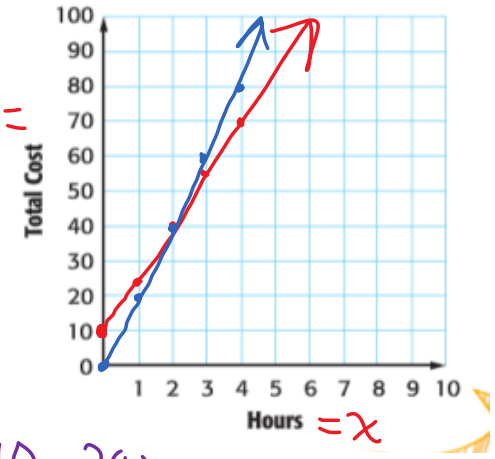
$2x + 4(-x + 45) = 130$
$2x - 4x + 180 = 130$
$-180 \quad -180$
$-2x = -50$
$\frac{-2x}{-2} = \frac{-50}{-2}$
$x = 25$

$25 + y = 45$
$y = 20$

There are 25 motorcycles and 20 ATVs.

Got It? Do this problem to find out.

c. Creative Crafts gives scrapbooking lessons for $15 per hour plus a $10 supply charge. Scrapbooks Incorporated gives lessons for $20 per hour with no additional charges. Write and solve a system of equations that represents the situation. Interpret the solution.



y =

Each store charges the same amount ($40) for 2 hours.

$y = 15x + 10$ $\quad y = 20x$

$15x + 10 = 20x$
$-15x \quad -15x$
$10 = 5x$
$\frac{10}{5} = \frac{5x}{5}$ $\quad x = 2$

$y = 20(2)$ $\quad (2, 40)$
$y = 40$

Number of Solutions

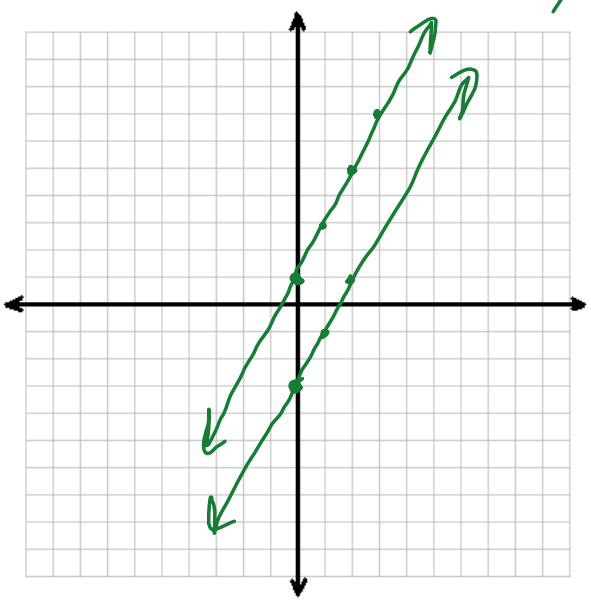
The graph of a system of equations indicates the number of solutions.

- If the lines intersect, there is one solution.
- If the lines are parallel, there is no solution.
- If the lines are the same, there are an infinite number of solutions.

Solve each system of equations by graphing.

4. $y = 2x + 1$
$y = 2x - 3$

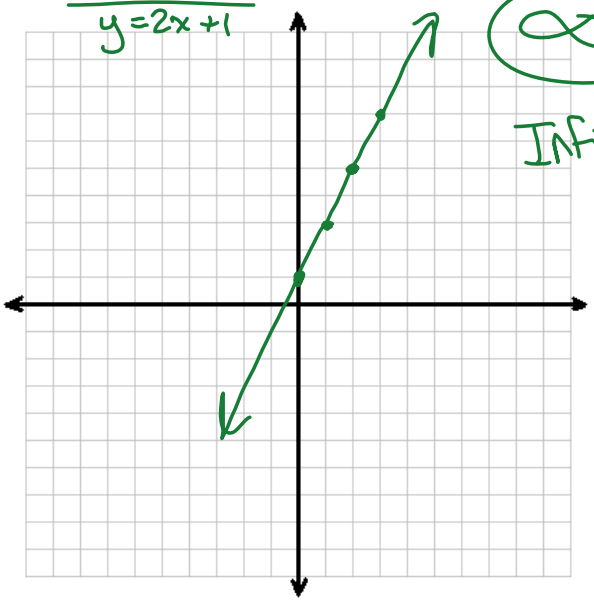
No solution ∅



5. $y = 2x + 1$
$y - 3 = 2x - 2$
$+3 \quad +3$
$y = 2x + 1$

$y = 2x + 1$
$-3 \quad -3$

∞ Infinite



How do we determine the number of solutions of two linear equations without graphing?

b. $y = 4x$
$y = x + 3$

Slopes are different, ∴ two intersecting lines, one solution

4. $y = 2x + 1$
$y = 2x - 3$

Same slope, different y-int = parallel (||)

no solution

5. $y = 2x + 1$
$y - 3 = 2x - 2$ $y=2x+1$
$+3 \quad +3$

Same slope & y-int = same line

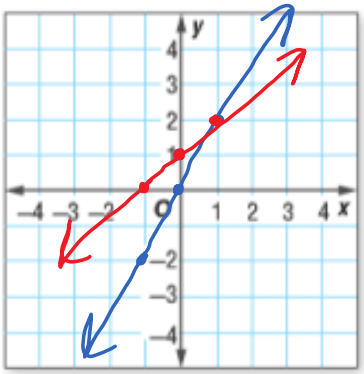
infinite solutions

Do you notice any similarities or patterns in the parts of the equations when there are no solutions? Infinite solutions? One solution?

Now you try! Determine if the system as no solution, one solution, or infinite solutions. Graph the equations check/confirm your answer.

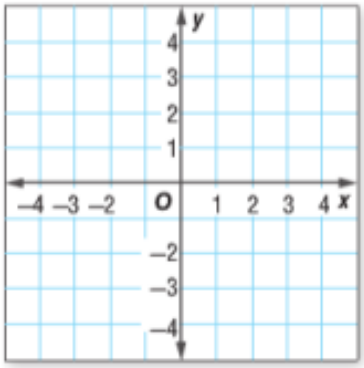
15. $y = 2x$
$y = x + 1$

(1, 2)
one solution



16. $y = \frac{3}{4}x$
$3x - 4y = 0$

infinite solutions



$3x - 4\left(\frac{3}{4}x\right) = 0$

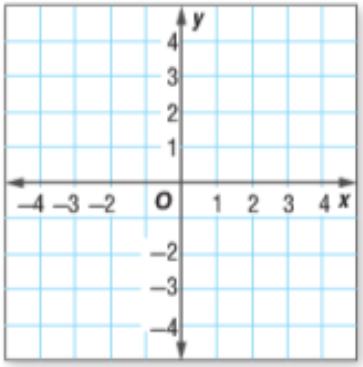
$3x - 3x = 0$

$0 = 0$

17. $y = \frac{1}{2}x + 1$
$y = \frac{1}{2}x - 2$

|| ∅

no soln



Now let's try solving systems of equations using elimination!

1. **Solve the system $y = -2x - 3$ and $y = 2x + 5$**

Got It? **Do these problems to find out.**

a. $y = x - 1$
$y = 2x - 2$

b. $y = 4x$
$y = x + 3$

c. $y = 2x + 1$
$3x + 4y = 26$

d. $2x + 5y = 44$
$y = 6x - 4$

Guided Practice

Solve each system of equations algebraically. (Examples 1 and 2)

1. $y = x + 7$

$y = 4$ _____

Show your work.

2. $y = x + 5$

$y = 3x$ _____

3. $y = x - 9$

$y = -4x$ _____

4. $x + 3y = 1$

$y = 2x + 5$ _____

5. Seven people went to the movies. The number of adults was one more than the number of children. Write a system of equations that represents the number of adults and children. Solve the system algebraically. Interpret the solution. (Examples 3 and 4)

_____

6. **Building on the Essential Question** How can you solve a system of equations? _____

_____

Rate Yourself!

How confident are you about solving systems of equations algebraically? Check the box that applies.

For more help, go online to access a Personal Tutor.

Tutor

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