Math Virtual Learning

Grade 8

Solving Linear Systems: Substitution

May 21, 2020

Math 8

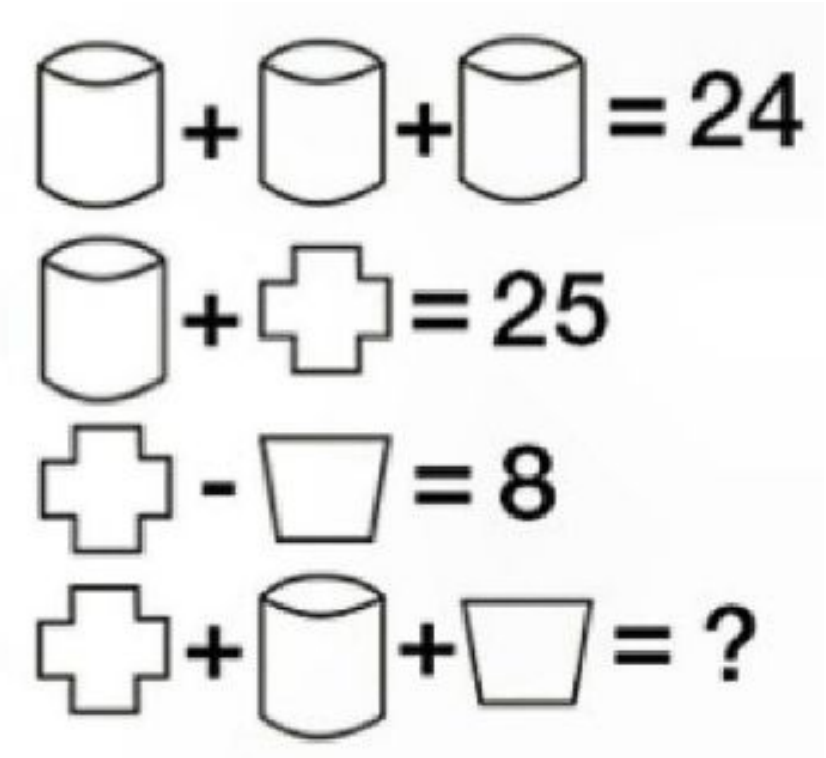
Lesson: May 21, 2020

Objective/Learning Target:

I can solve linear systems by substitution.

Warm-Up: Can you solve this puzzle?

Answer below



Solution: cylinder = 8, plus sign = 17 trapezoid = 9

8 + 17 + 9 = 34

Review: Number of Solutions

One Solution

$$5x = 2x + 21$$
$$-2x = -2x$$
$$\frac{3x}{3} = \frac{21}{3}$$

$$x = 7$$

Infinite Solutions

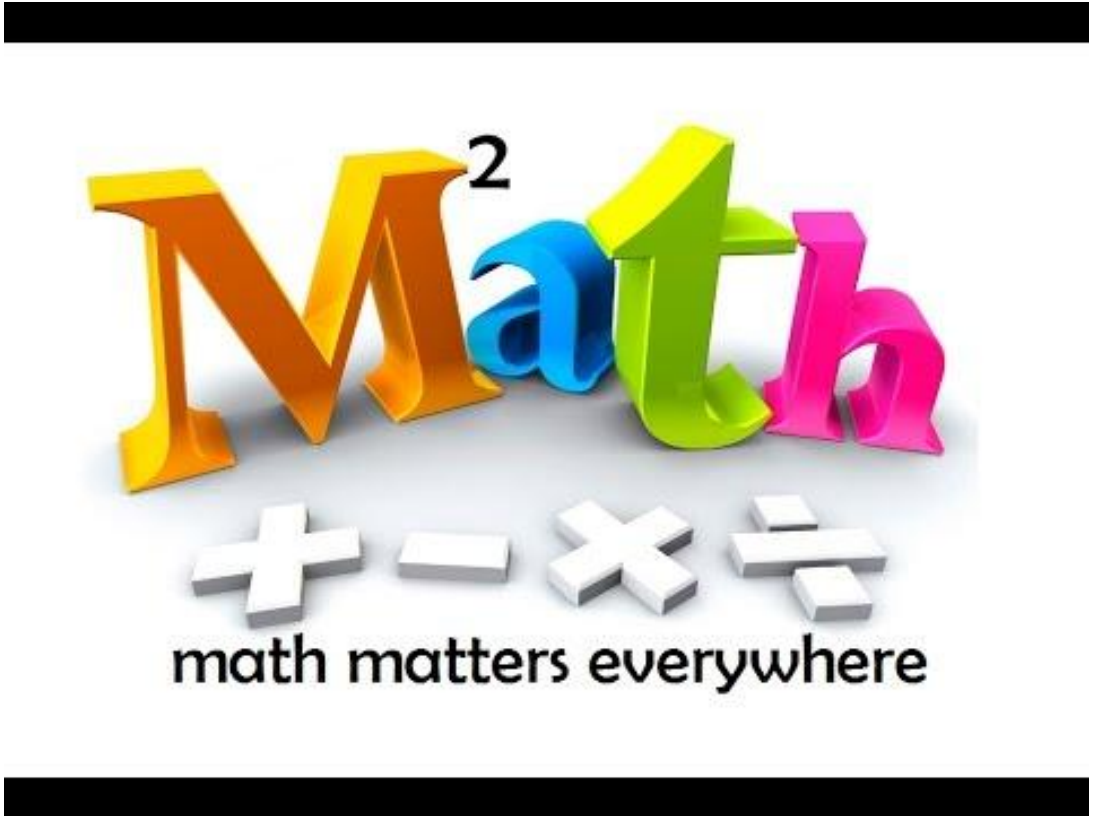
$$3x + 5 = 2x + 5 + x$$
$$3x + 5 = 3x + 5$$
$$-3x \quad -3x$$
$$5 = 5$$

No Solution

$$5x + 15 = 5x + 8$$
$$-5x \quad = \quad -5x$$
$$15 = 8$$

Video:

Take notes on a piece of paper as you watch this video.



How To: Substitute a System of Equations

$y = -4x - 21$
$y = 3x$

① $-4x - 21 = 3x$
② $+4x \quad +4x$

$-21 = 7x$

$\frac{-21}{7} = \frac{7x}{7}$

$-3 = x$

③ $y = 3(-3)$
$y = -9$

① **Substitute** one equation into the other equation.
Notice: both equations are solved for y. We will substitute the –4x – 21 into the second equation where there is y.

② **Solve** for x. (Use the appropriate inverses.)
***Add 4x** to both sides, then **divide by 7**, and **x = –3**.*

③ **Substitute** the value of x into one of the original equations to find the value of y.
*Plug **x = –3** into y = 3x and **solve** for y.* **y = –9**

④ **Write your answer as an ordered pair.**

You can check that your solution is correct by plugging it into both equations. You must plug in the x and y values.

Example 1: System *with One Solution*

$$y = 6x$$
$$2x + y = 24$$

$2x + 6x = 24$

$\frac{8x}{8} = \frac{24}{8}$

$x = 3$

$y = 6(3)$

$y = 18$

Step 1: Substitute 6x in place of y into the 2nd equation

Step2: Solve for x. Combine like terms (2x + 6x = 8x) and divide by 8 to find that x = 3

Step 3: Find the value of y. Substitute x = 3 back into an original equation and solve.

Step 4: Write your answer as an ordered pair.

Solution to the system is: (3, 18)

Example 2: System *with No Solution*

$$y = -3x - 2$$
$$y = -3x + 8$$

$$-3x + 8 = -3x - 2$$
$$+3x \qquad +3x$$
$$8 = -2$$

Step 1: Substitute $-3x + 8$ in place of y in the 1st equation.

Step 2: Solve for x. Add $3x$ to both sides, then notice:

When you get an untrue statement such as $8 = -2$, there is no value of x that will work in the problem.

There is NO SOLUTION

Example 3: System *with Infinite Solutions*

$y = 2(x + 4)$

$-8 + y = 2x$

$y = 2x + 8$

$-8 + y = 2x$

$-8 + 2x + 8 = 2x$

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

$2x = 2x$

Step 1: Simplify the 1st equation by using the distributive property

Step 2: Substitute $2x + 8$ in for y into the 2nd equation

Step 3: Solve for x. Combine like terms (-8 and 8), and then notice:

When you get a true statement, such as $2x = 2x$, any value you put in for x will work in this problem.

There are INFINITE SOLUTIONS

Example 4: System *with Infinite Solutions*

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

$$2x - y = -4$$
$$-2x \quad -2x$$
$$-y = -2x - 4$$
$$y = 2x + 4$$

$$6x - 3(2x + 4) = -12$$
$$6x - 6x - 12 = -12$$
$$-12 = -12$$

Step 1: Solve one equation for one variable.
(I chose to solve for y in the first equation. Notice that I want y to be positive so I multiplied through by -1.)

Step 2: Substitute the value of y into the 2nd equation.

Step 3: Solve for x. Distribute and combine like terms, then…

Notice that you get a true statement: $-12 = -12$

There are Infinite Solutions

Example 5: System *with One Solution*

$$x - 3y = -13$$
$$2x + y = 16$$

$$x - 3y = -13$$
$$+3y \quad +3y$$
$$x = 3y - 13$$

$$2(3y - 13) + y = 16$$
$$6y - 26 + y = 16$$
$$7y - 26 = 16$$
$$+26 \quad +26$$
$$7y = 42$$
$$\frac{7y}{7} = \frac{42}{7}$$
$$y = 6$$

$$x - 3(6) = -13$$
$$x - 18 = -13$$
$$+18 \quad +18$$
$$x = 5$$

Step 1: Solve one equation for one variable.
(I chose to solve for x in the first equation.)

Step 2: Substitute the value of x into the 2nd equation.

Step 3: Solve for y. Distribute the 2, then add 26, and then divide by 7 to find $y = 6$.

Step 4: Find the value of x. Substitute $y = 6$ back into an original equation and solve.

Step 5: Write your answer as an ordered pair.

Solution to the system is: (5, 6)

Practice 1:

Answers on next slide

Solve and find the solution(s) to each of the systems.

1. $3x + 2y = 14$
   $y = -5x$

2. $x + 7y = 0$
   $2x - 8y = 22$

3. $3(x + 4y) = -24$
   $x + 4y = -8$

4. $x - y = -8$
   $y = -x + 10$

Practice 1: *Answer Key*

1. (-2, 10)

2. (7, -1)

3. Infinite solutions

4. (1, 9)

Additional Resources:

Solving Systems of Equations with Substitution - Khan Academy

Solve a System of Equations with Substitution - Math Games

Solve a System of Equations with Substitution - IXL