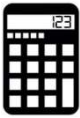


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## SOLVING SYSTEMS BY SUBSTITUTION

### N-GEN MATH<sup>®</sup> 8



Systems can be solved graphically by finding the intersection points of the graphs of the two equations. But they can also be solved algebraically in many different ways. In this lesson, we will look at how to solve systems by **substitution**. This method relies on the following **property of equality**.

#### SUBSTITUTION PROPERTY OF EQUALITY

Equals may be substituted for equals in any equation and it will remain a true equation.

Let's see how we can use this to solve a system in the first problem, which would be more difficult to solve graphically.

**Exercise #1:** Given the system  $x + y = 14$  and  $y = 3x - 2$  do the following.

(a) Show that  $x = 4$  and  $y = 10$  is a solution to this system.

(b) Solve this system by substituting  $y = 3x - 2$  into the equation  $x + y = 14$  for the variable  $y$ .

The method of substitution works particularly well if one or both of the equations has an **isolated variable** on one side of the equation.

**Exercise #2:** Solve the system shown below by substitution. Carefully show each step. Check your final solutions.

$$y + 3x = -1$$

$$x = y - 7$$



These substitutions can be tricky if subtraction is involved. Let's make sure we take a look at one of these to see mistakes that can be made.

**Exercise #3:** Solve the system below by substitution. Then, check your answer by substituting back into both original equations.

$$5x - y = 19$$

$$y = 2x - 1$$

We've seen a specialized case of substitution in Unit #5 (Equations of Lines). When both equations are solved in terms of  $y$  we often call solving such a system **setting the equations equal**.

**Exercise #4:** Find the intersection point of the lines whose equations are shown below algebraically.

$$y = 4x - 23$$

$$y = -2x + 1$$

Systems model a wide variety of problems. Some of these lend themselves well to solving by substitution.

**Exercise #5:** Michele and Nina finish a day at the amusement park with ride tickets left over. Michele has four tickets more than Nina. Together they have 20 tickets. Let  $m$  be the number of tickets Michele has remaining and  $n$  be the number of ticket Nina has remaining.

- (a) Model this scenario with a system of equations.      (b) Determine how many tickets each has left over.



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## SOLVING SYSTEMS BY SUBSTITUTION

### N-GEN MATH<sup>®</sup> 8 HOMEWORK

#### FLUENCY

1. Which of the following is the solution to the system shown below?

(1)  $x = 16$  and  $y = 8$

$$x + y = 24$$

(2)  $x = 4$  and  $y = 20$

$$y = 5x$$

(3)  $x = 10$  and  $y = 14$

(4)  $x = 2$  and  $y = 10$

\_\_\_\_\_

2. Solve each system shown below for both variables. Show your work.

(a)  $4x + y = 22$

(b)  $2c + 3d = 36$

$$y = x - 3$$

$$d = 2c + 4$$

(c)  $x + 2y = 12$

(d)  $y = x - 18$

$$x = y - 12$$

$$y = -3x + 34$$



3. Solve each of the following equations that involve subtraction. Be careful when you distribute the subtraction.

(a)  $x - 3y = 3$

$y = x - 7$

(b)  $4x - 2y = 48$

$y = -x + 6$

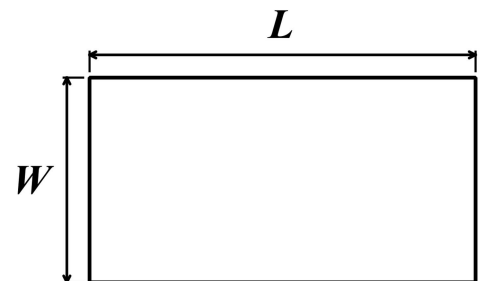
### USING YOUR MATH

4. Mia bought produce at the market consisting of potatoes and radishes. She bought a total of 11 pounds of produce. The number of pounds of potatoes that she bought,  $p$ , was seven pounds more than the number of pounds of radishes,  $r$ , that she bought.

- (a) Write a system of equations involving the variables  $p$  and  $r$  that models this situation.
- (b) Solve this system algebraically.

5. A rectangle has a length given by  $L$  and a width given by  $W$ . The perimeter of the rectangle is 70 feet. The length is 5 feet more than twice the width.

- (a) Write a system of equations that models this scenario.



- (b) Solve this system by substitution to find both the length and the width.

