

## Solving Equations

7.EE.4.a



Addition and subtraction are inverse operations.

Multiplication and division are inverse operations.

Equations must be kept in balance. To keep an equation balanced, **always** perform the same operation on **both** sides of the equation.

You can check that an answer is correct by substituting the value of the variable back into the original equation. It should make the equation true.

$$\begin{aligned}x + 6 &= 13 & \text{for } x = 7 \\7 + 6 &= 13 \\13 &= 13 & \text{true}\end{aligned}$$

If an equation is in the form  $ax + b = c$  or  $ax - b = c$ , where  $a$ ,  $b$ , and  $c$  are rational numbers, **undo the addition or subtraction first**. Then **undo the multiplication or division**.

To **solve** an equation means to find the value of the variable that makes the equation true. Inverse operations are used to help solve equations. An **inverse operation** is an operation that “undoes” another operation.

What value of  $x$  makes the equation  $x + 6 = 13$  true?

This equation uses addition. Use the inverse operation to solve.

The inverse of addition is subtraction. Subtract 6 from both sides of the equation.

$$\begin{aligned}x + 6 - 6 &= 13 - 6 \\x &= 7\end{aligned}$$

The value 7 makes the equation  $x + 6 = 13$  true.

Some equations have more than one operation. These require an extra step to solve.

In a game, you can earn 5 points for every gem found, and an extra 50 points for finding all the gems. The equation below shows the total possible points you can earn in the game.

$$5g + 50 = 225$$

What is the value of  $g$ , the number of gems in the game?

To solve, first undo the addition by subtracting 50 from both sides.

$$\begin{aligned}5g + 50 - 50 &= 225 - 50 \\5g &= 175\end{aligned}$$

Next, undo the multiplication by dividing 5 into both sides.

$$\begin{aligned}5g \div 5 &= 175 \div 5 \\g &= 35\end{aligned}$$

There are 35 gems in the game.

Read each problem. Circle the letter of the best answer.

**SAMPLE** What value of  $k$  makes the equation below true?

$$-2(k - 3) = 8$$

A 1

B -1

C 7

D -7



The correct answer is B. First use the distributive property to remove the parentheses. Be sure to fully distribute  $-2$  to each term inside the parentheses:  $-2k + 6 = 8$ . Now, subtract 6 from both sides of the equation:  $-2k + 6 - 6 = 8 - 6$ ,  $-2k = 2$ . Then divide both sides by  $-2$ :  $-2k \div -2 = 2 \div -2$ ,  $k = -1$ .

1 What value of  $m$  makes the equation below true?

$$9m + 36 = 0$$

A -6

C 4

B -4

D 6

2 Kyra wants to solve the equation  $\frac{x}{10} + 8 = 5$ . What steps should she use on both sides of the equation?

A first divide by 10, then add 8

B first add 8, then divide by 10

C first multiply by 10, then subtract 8

D first subtract 8, then multiply by 10

3 This equation shows the cost, in dollars, of a T-shirt and  $s$  pairs of socks.

$$12 + 3s = 42$$

What is the value of  $s$ ?

A 10

C 16

B 12

D 18

4 A department store sale advertises  $\frac{1}{2}$  off all clearance items. Marie buys a clearance item and uses a \$5-off coupon. She pays a total of \$11. The equation below can be used to find the original price,  $p$ , of the clearance item.

$$\frac{1}{2}p - 5 = 11$$

What was the original price of the clearance item?

A \$8

C \$32

B \$12

D \$36

5 What value of  $y$  makes this equation true?

$$8(y - 9) = 24$$

A 3

C 9

B 6

D 12

6 A tree is 6 feet tall now. It is expected to grow 2 feet a year. In how many years is the tree expected to be 30 feet tall?

A 6

C 16

B 12

D 18

Read each problem. Write your answer.

**SAMPLE** A cell phone company charges \$60 for a cell phone and a monthly rate to use the phone. Regina will pay \$1,140 for a 24-month cell phone plan. What is the monthly rate for this cell phone plan?

**Answer** \_\_\_\_\_



The equation  $24m + 60 = 1,140$  can be used to find the monthly rate,  $m$ . To solve this equation, first subtract 60 from both sides:  $24m + 60 - 60 = 1,140 - 60$ , so  $24m = 1,080$ . Next, divide both sides by 24 to find  $m$ :  $24m \div 24 = 1,080 \div 24$ ,  $m = 45$ . The monthly rate is \$45.

7 Solve this equation for  $n$ .

$$-8n - 7 = 31$$

**Answer** \_\_\_\_\_

8 The formula  $P = 2(L + W)$  can be used to find the perimeter of a rectangle with a length,  $L$ , and a width,  $W$ . The perimeter of a rectangular shipping crate with a length of 9 feet is 30 feet. What is the width, in feet, of the crate?

**Answer** \_\_\_\_\_

9 Describe the steps used to solve the equation below for  $z$ . Then find the value of  $z$ .

$$3(-2z + 5) = -18$$

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Read each problem. Write your answer to each part.

- 10 Skylar paid \$18 to park at the airport. She bought 4 plane tickets for her family. Each plane ticket cost the same. Altogether, she paid \$610 for the plane tickets and parking.

**Part A** What is the cost for each plane ticket?

**Answer** \_\_\_\_\_

**Part B** Explain how you found your answer.

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- 11 Keith solved the equation  $3(t + 7) = 27$  for  $t$  using the distributive property to first remove the parentheses.

**Part A** What value of  $t$  makes the equation true?

**Answer** \_\_\_\_\_

**Part B** Hugo solved the same equation by first dividing both sides of the equation by 3, and then subtracting 7 from both sides. Did he use a correct method to solve this equation? Explain how you know.



What value do you get for  $t$  by following Hugo's method?

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