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Lesson 21

WRITE AND SOLVE EQUATIONS

6.EE.B.5, 6.EE.B.7

WORDS TO KNOW

equation

inverse operations

INTRODUCTION

Real-World Connection

Sarah worked for 3 weeks and earned $37.50 for delivering newspapers. If she earned the same amount each week, how much money did Sarah earn per week? You can write and solve an equation to find out. Let's practice the skills in the **Guided Instruction** and **Independent Practice** and, at the end of the lesson, see how much money Sarah earned each week!

What I Am Going to Learn

- How to write and solve equations that represent real-world situations
- How to solve equations of the form $x + p = q$ and $px = q$ using inverse operations

What I May Already Know

- I know how to solve multi-step word problems using the four operations.
- I know how to write and interpret numerical expressions.

Vocabulary in Action

An **equation** is a statement that two expressions are equal.

- An equation has an equal sign to show that what is on the left is equal to what is on the right.
- You can write equations to represent situations. Look for key words: *is* usually means *equals*.
- Like expressions, some equations contain variables.
- You can solve equations with variables by using **inverse operations**.
- If the same operation is done to both sides, the equation remains equal.

THINK ABOUT IT

You have used and solved equations before: $A = l \times w$ is an equation that can be solved if you know the value of two of the three variables.

EXAMPLE

Equations:

$4 + 8 = 12$

$9 \times 4 + 3 = 30 + 9$

$3x - 16 = 6$

Writing equations to represent situations is a lot like writing expressions. Look for words that indicate the operations, and where to place the equal sign.

TURN AND TALK

Describe an equation for your partner to write. Then, reverse roles.

EXAMPLE

"3 times a number, x, **is** 12" can be written as $3x = 12$.

"8 minus a number, w, **equals** 20" can be written as $8 - w = 20$.

"One-half of a number, y, plus 12 **is** 15" can be written as $\frac{1}{2}y + 12 = 15$.

To solve an equation with a variable, use inverse operations until the variable is by itself on one side of the equation.

THINK ABOUT IT

You've solved equations like this before.

$\square + 6 = 28$

You learned to solve these by subtracting.

$28 - 6 = 22$

EXAMPLE

Solve for x: $x + 6 = 28$.

To rewrite the equation so that x is by itself, subtract 6 from both sides of the equation (subtraction is the *inverse* of addition). Since 6 is subtracted from both sides of the equation, the equation remains true.

Simplify the terms.

$x + 6 - 6 = 28 - 6$

$x = 22$

Now that x is by itself, we see that x equals 22.

Check to make sure your answer is correct. Substitute 22 back into the equation for x.

$(22) + 6 = 28$

GUIDED INSTRUCTION

1. Piper rides her bike in the morning and the afternoon. Her afternoon ride is twice as long as her morning ride. She rides 6 miles in the afternoon. Write and solve an equation to find the distance of her morning ride.

Step One Identify the unknown. Choose a variable.

The distance of the morning ride is unknown.

Let m represent "morning ride."

Step Two Write an equation.

"Her afternoon ride is twice as long as her morning ride."

"Her afternoon ride" is 6 miles.

"is" means $=$.

"Twice as long" means multiply by **2**.

$6 = \square\, m$

Step Three Isolate the variable.

m is being multiplied by 2, so the inverse operation would be to divide by 2.

Divide both sides by 2.

$6 = 2m$

$\frac{6}{2} = \frac{2m}{2}$

$\square = m$

So, Piper's morning ride is $\square$ miles long.

Step Four Use substitution to check your answer.

$6 = 2m$

$6 = 2(3)$

$6 = 6$

THINK ABOUT IT

You may have solved this problem mentally, thinking, "Half of 6 is 3," which is the same process used to solve the equation. The purpose of these problems is to get used to writing and solving equations.

2. Jordan has $15 to spend at the movies. He buys a ticket for $7 and popcorn for $3.50. Write and solve an equation to find out how much money Jordan has left.

Step One Identify the unknown. Choose a variable.

The unknown is how much money Jordan has left.

Choose a to represent money left.

Step Two Write an equation.

"Jordan has $15."

"He buys a ticket for $7 and popcorn for $3.50."

$\$7 + \$3.50$

The amount Jordan spends, plus a, equals the $15 he had to spend.

$15 = (7 + 3.50) + a$

Step Three Simplify the equation.

$15 = (7 + 3.50) + a$

$15 =$ ☐ $+ a$

Step Four Isolate the variable.

10.50 is being added to a, so the inverse operation would be to subtract 10.50 from both sides.

$15 - 10.50 = 10.50 + a - 10.50$

$4.50 = a$

So, Jordan has $☐ left to spend.

Step Five Use substitution to check your answer.

$15 = 7 + 3.50 + a$

$15 = 7 + 3.50 + (4.50)$

$15 = 10.50 + (4.50)$

$15 = 15$

TIPS AND HINTS

This equation could also be written this way:
$a = 15 - (7 + 3.50)$.

TIPS AND HINTS

If you are unsure how to solve the equation, substitute 6 into each equation to see which solution is correct.

3. Which of these equations has a solution of $x = 6$?

Ⓐ $8x = 40$

Ⓑ $x - 12 = 6$

Ⓒ $\frac{1}{2}x = 12$

Ⓓ $x + 50 = 56$

How Am I Doing?

What questions do you have?

What steps would you take to solve the equation $25 - y = 16$?

What is an example of a situation in your daily life that could be represented by an equation?

TURN AND TALK

Work with a partner. Jay spent ten more than three times the number of hours on his Science Fair project as Jamie spent on her project. Jay spent 43 hours working on his project. How many hours did Jamie spend on her project? Write and solve an equation. Show your work.

Color in the traffic signal that shows how you are doing with the skill.

INDEPENDENT PRACTICE

Answer the questions.

1. Does the equation have a solution of $x = 4$? Choose Yes or No.

a.	$9x = 36$	○ Yes	○ No
b.	$14 = x + 10$	○ Yes	○ No
c.	$48 = 44x$	○ Yes	○ No
d.	$x = 36 - 32$	○ Yes	○ No

TIPS AND HINTS

To check the solution of an equation, substitute the solution into the original equation. After simplifying both sides, a true statement should result.

2. Circle the correct answer from the drop-down menu to complete the sentence.

The equation $\left(\frac{1}{3}\right)y = 27$ is true when $y =$ [ ].

3
9
24
81

3. Circle the correct answer from the drop-down menu to complete the sentence.

The equation $36 = b - 12$ is true when $b =$ [ ].

3
24
36
48

4. Melissa and Kumar collect coins. Melissa has 5 times as many coins as Kumar. Kumar has 120 coins. Let c represent the number of coins Melissa has. What is the value of c?

Write your answer in the box.

[ ]

5. Nathan jogged three days last week. He jogged a total of 12 miles during the week, and jogged the same number of miles each day. Let j represent the number of miles Nathan jogged each day. What is the value of j?

Write your answer in the box.

6. Use the numbers in the box to make each statement true. The numbers cannot be used more than once. Write each number in the appropriate box.

7	18	30	32

If $y + 12 = 30$, then $y =$ ____.

If $63 = 9z$, then $z =$ ____.

If $m - 8 = 22$, then $m =$ ____.

If $\frac{1}{2}k = 16$, then $k =$ ____.

7. Solve for t: $6t = 30$.

Ⓐ $t = 5$

Ⓑ $t = 24$

Ⓒ $t = 36$

Ⓓ $t = 180$

THINK ABOUT IT

How can runners be affected by climate change issues, such as temperature and carbon emissions?

TIPS AND HINTS

Make sure you perform the same operation on both sides of an equation when solving the equation.

WORK SPACE

8. Part A

Alex goes shopping with his sister Allie. Alex had $23.75 to spend on clothes. He bought a T-shirt that cost $12.50. Write an equation to represent how much money (*m*) Alex has left. Solve for *m* and show your work.

Part B

Allie also has money to spend and buys a few things. She writes an equation to find out how much money (*n*) she has left to spend: $35.25 + *n* = $45.

Allie wants to buy a gift that costs $12. Does she have enough money left to buy the gift? Explain how you know.

9. Allen says that for the equation $5 + x = 20$, x can be any value because it is a variable. Is he correct? Explain your reasoning.

EXIT TICKET

6.EE.B.5, 6.EE.B.7

Now that you have mastered writing and solving equations, let's solve the problem in the Real-World Connection.

Sarah worked for 3 weeks and earned $37.50 for delivering newspapers. If she earned the same amount each week, how much money did Sarah earn per week?

Write and solve an equation to find the answer. Show your work.

Sarah earned _____ each week.