

Writing Expressions and Equations

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CONCEPT

1

Writing Expressions and Equations

Introduction

Riding the T



Kara and her twin brother Marc are going to be spending one month in Boston with their grandparents. They are very excited! Not only is it summer in Boston and the weather will be terrific, but Boston has a fantastic subway system called the T and they will be able to ride it to get all around.

Kara is very excited about visiting the museums, but Marc who is a huge baseball fan is hoping for a trip to Fenway Park before the month is up. Seeing the Red Sox play would be a huge bonus!

On the first day, the twins Grandpa told them that they were going to spend the day learning how to ride the subway. Given that the twins are 14 and that they will be traveling together, Grandpa feels comfortable that they will be fine. After a quick discussion on safety, they were ready to go.

Grandpa said that each ride on the subway would cost $.85$ for a teenager. They would be riding to the Boston Common and back, and they may take another ride too.

Kara goes upstairs to get her money and tries to figure out how much they will need in all. She is having a tough time because she doesn't know how many train rides they will take in all. She tells Marc what she is trying to figure out.

Well until we know the number of rides, you can't figure out the total, he says. But you can write an expression.

An expression? How can Kara do this? What does an expression mean? Why would you want one?

This lesson is all about expressions and equations. Learning how to write expressions can be very helpful when you have a variable that can change such as the number of train rides. Pay attention and at the end of the lesson you will be able to help Kara write an expression to show the amount of money needed for multiple train rides.

What You Will Learn

In this lesson, you will learn how to do the following skills.

- Write addition and subtraction phrases as single-variable expressions.
- Write multiplication and division phrases as single-variable expressions.
- Write single variable equations from verbal models.
- Model real-world situations with simple equations.

Teaching Time

I. Write Addition and Subtraction Phrases as Single-Variable Expressions

An expression shows how numbers and/or variables are connected by operations, such as addition, subtraction, multiplication, and division. Notice in the examples that an expression does not have an equal sign. This is because the value of the variable in each expression can change, or you could say that we can evaluate an expression using different given values for the variable.

$$50 - 2$$

$$4 - a$$

$$12z$$

$$\frac{4x}{3}$$

Three of the expressions above include variables, such as a , z , and x .

An expression that includes one or more variables is called an algebraic expression. Each variable in an algebraic expression can have a different value. Once again, you will not see an equal sign with an algebraic expression. We can use algebraic expressions to represent words or phrases.

Often in word problems or in other situations in math, you will be given a set of words or a phrase that you will need to rewrite as an expression. When you do this, you will be looking for words that mean different operations or things in math. This way you can write an expression that correctly represents the words or phrase.

We are going to start with addition and subtraction phrases. Take a look at this chart.

TABLE 1.1:

Addition Expressions		Subtraction Expressions	
1 plus a	$1 + a$	4 less d	$4 - d$
2 and b	$2 + b$	6 less than g	$g - 6$
3 more than c	$3 + c$	h fewer than 7	$7 - h$

The bolded key words in the phrases above provide clues about whether or not you should write an addition or a subtraction expression. While key words can be a helpful guide, it is important not to rely on them totally. It is always most important to think about which operation makes the most sense for a particular situation.



Write these key words in your notebook and then continue with the first example.

Example

Abdul has \$5 more than Xavier has. Let x stand for the number of dollars Xavier has. Write an algebraic expression to show the number of dollars Abdul has.

The phrase is \$5 more than Xavier. Use a number, an operation sign, or a variable to represent each part of that phrase.

$$\begin{array}{ccc} \text{\$5 more than Xavier} & & \\ \downarrow & \downarrow & \downarrow \\ 5 & + & x \end{array}$$

Notice that in this phrase, the key words more than means you should write an addition expression.

So, the expression $5 + x$ represents the number of dollars Abdul has. We also could have written this as $x + 5$ because addition is commutative. That means, the order in which numbers are added does not matter.

Our answer is $x + 5$.

Example

6 less than a number

Notice the key words less than which means subtraction.

A number means a variable.

Because it says 6 less than a number, the 6 will follow the variable.

$$x - 6$$

Our answer is $x - 6$.

Remember, sometimes writing an expression is not as simple as relying on key words.

Example

Lian is x inches shorter than Hannah. Hannah is 65 inches tall. Write an algebraic expression to show Lian's height in inches.

The phrase is x inches shorter than Hannah. You also know that Hannah's height is 65 inches.

There are no key words, so you need to think about what makes sense. If Lian is shorter than Hannah, her height will be less than 65 inches. So, write a subtraction expression. Use 65 to represent Hannah's height. Since Lian's height is less than Hannah's height, you will need to subtract x inches from Hannah's height to represent Lian's height.

$$\begin{array}{ccc} \text{\underline{x inches shorter than Hannah.}} & & \\ \square & \downarrow & \square \\ \square & \downarrow & \square \\ \square & \downarrow & \square \\ 65 & - & x \end{array}$$

The answer is $65 - x$.

7A. Lesson Exercises

Write an expression for each phrase.

1. A number plus five

2. Six more than a number
3. Fifteen less than a number



Take a few minutes to check your answers with a friend.

II. Write Multiplication and Division Phrases as Single-Variable Expressions

Just as you can write addition and subtraction expressions from words or phrases, you can also write multiplication and division expressions. Once again, you can use key words to help you with this. The more familiar you become with the key words that identify a multiplication or division expression, the better you will become at writing expressions.

Here are some examples of how words or phrases can be translated into multiplication or division expressions.

TABLE 1.2:

Multiplication Expressions		Division Expressions	
9 times k	$9 \times k$ or $9k$	8 divided into n groups	$8 \div n$ or $\frac{8}{n}$
twice as much as m	$2 \times m$ or $2m$	q shared equally by 3 people	$q \div 3$ or $\frac{q}{3}$
		half of r	$r \div 2$ or $\frac{r}{2}$
		one-third of p	$p \div 3$ or $\frac{p}{3}$

The bolded key words in the phrases above provide clues about whether or not you should write a multiplication or a division expression. Remember, key words can be a helpful guide, but you should always think about which operation makes sense for a particular situation.



Write these key words in your notebook and then continue with the lesson.

Example

Write an algebraic expression to represent this phrase: 3 times a number, t .

The phrase is 3 times a number, t . Use a number, an operation sign, or a variable to represent each part of that phrase.

$$\begin{array}{ccc} \underline{3 \text{ times a number, } t} & & \\ \downarrow & \downarrow & \downarrow \\ 3 & \times & t \end{array}$$

Notice that in this phrase, the key word *times* means you should write a multiplication expression.

So, the expression $3 \times t$ or $3t$ represents the phrase. We also could have written this as $t \times 3$ because multiplication is commutative. That means, the order in which numbers are multiplied does not matter.



Example

Mr. Warren separated 30 students into n equal groups. Write an algebraic expression to represent the number of students in each group.

The phrase is *separated 30 students into n equal groups*.

Think about what makes sense. Separating 30 students into n equal groups means *dividing* 30 students into n equal groups. So, write a division expression.

$$\begin{array}{ccc} \underline{\text{separated } 30 \text{ students into } n \text{ equal groups}} & & \\ \downarrow & \downarrow & \downarrow \\ 30 & \div & n \end{array}$$

Division is not commutative. The order in which we divide numbers matters. So, while $30 \div n$ represents the number of students in each group, $n \div 30$ does not.

The answer is $30 \div n$.

7B. Lesson Exercises

Write a multiplication or division expression for each phrase.

1. **Four times a number**
2. **Sixteen divided into a number of groups**
3. **The product of five and a number**



Take a few minutes to check your answers with a neighbor.

III. Write Single Variable Equations from Verbal Models

What is the difference between an equation and an expression? Well, **an expression is a phrase without an equal sign.** This means that the variable in an expression can be changed and the expression can be evaluated differently. **An equation has an equal sign. Therefore one side of an equation is equal to a value on the other side.**

Now, let's examine how to write equations.

The same key words that helped you write expressions may also help you write equations. Here are some additional key words that you may find helpful.

TABLE 1.3:

Key Words for Addition or Multiplication Equations

how many **all together**

how many **in all**

how many **total**

Key Words for Subtraction Equations

how many **more**

how many **fewer**

how many **left**

how much **change**

Key Words for Division Equations

how many **in each**



Take a few minutes to write down these key words and phrases in your notebook.

Example

4 times a number is twelve.

First, notice that we have the word times which means to multiply. We also have the word is which is a key word for equals.

$4 \text{ times } x = 12$

The equation is $4x = 12$.

Example

Seven less than a number is fourteen.

First, notice we have the words less than which means subtraction. Then we have the word is which is a key

word for equals.

$$x - 7 = 14$$

The answer is $x - 7 = 14$.

7C. Lesson Exercises

Write an equation for each verbal phrase.

1. **Six and a number is twenty.**
2. **Eighteen divided by a number is three.**
3. **Five times a number is twenty-five.**



Take a few minutes to check your answers.

IV. Model Real-World Situations with Simple Equations

We can also apply this to word problems that represent real life situations.



Example

Kelvin has twice as many stamps in his collection as Murray has in his. If Kelvin has 60 stamps in his collection, write an equation to represent m , the number of stamps in Murray's collection.

Use a number, an operation sign, a variable, or an equal sign to represent each part of that problem. Since Kelvin has 60 stamps in his collection, represent the number of stamps in Kelvin's collection as 60.

Kelvin has twice as many stamps...as Murray.

$$\begin{array}{ccc} \downarrow & \downarrow & \downarrow \\ 60 & = & 2m \end{array}$$

This equation $60 = 2m$, represents m , the number of stamps in Murray's collection.



Example

Carrie made 3 liters of lemonade for a party. After the party, she had 0.5 liter of lemonade left. Write an equation to represent n , the number of liters of lemonade that her guests drank.

Use a number, an operation sign, a variable, or an equal sign to represent each part of that problem. Since the question tells us how many liters of lemonade were *left* after the party, write a subtraction equation.

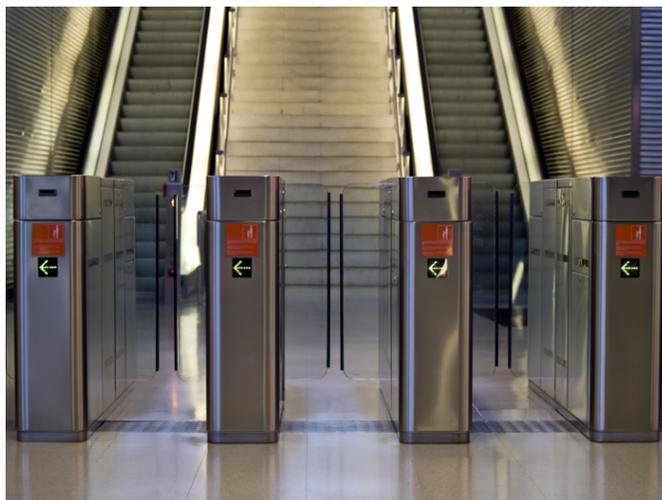
Since she had 0.5 liter of lemonade left, n is the number of liters that were drunk at the party. For this problem, it may help to write an equation in words and then translate those words into an algebraic equation.

$$\begin{array}{ccccccc}
 \text{(number of liters made)} & - & \text{(number of liters guests drank)} & = & \text{(number of liters left)} \\
 \downarrow & & \downarrow & & \downarrow & & \downarrow \\
 3 & & - & & n & & = & & 0.5
 \end{array}$$

This equation, $3 - n = 0.5$, represents n , the number of liters of lemonade that Carrie's guests drank during the party.

Real Life Example Completed

Riding the T



Here is the original problem once again. Reread it and underline any important information.

Kara and her twin brother Marc are going to be spending one month in Boston with their grandparents. They are very excited! Not only is it summer in Boston and the weather will be terrific, but Boston has a fantastic subway system called the T and they will be able to ride it to get all around.

Kara is very excited about visiting the museums, but Marc who is a huge baseball fan is hoping for a trip to Fenway Park before the month is up. Seeing the Red Sox play would be a huge bonus!

On the first day, the twins Grandpa told them that they were going to spend the day learning how to ride the subway. Given that the twins are 14 and that they will be traveling together, Grandpa feels comfortable that they will be fine. After a quick discussion on safety, they were ready to go.

Grandpa said that each ride on the subway would cost .85 for a teenager. They would be riding to the Boston Common and back, and they may take another ride too.

Kara goes upstairs to get her money and tries to figure out how much they will need in all. She is having a tough time because she doesnt know how many train rides they will take in all. She tells Marc what she is trying to figure out.

Well until we know the number of rides, you cant figure out the total, he says. But you can write an expression.

An expression? How can Kara do this? What does an expression mean? Why would you want one?

Now that you know what an expression is, you can write one to help Kara figure out the amount of money depending on the number of train rides.

The amount of money per ride does not vary. It costs .85 per ride for a teenager.

The number of train rides does vary. This is where a variable is very useful. It can change according to the number of train rides. Lets use x .

The expression is $.85x$.

If Kara changes the variable x according to the number of train rides that she and Marc take, then she can figure out the cost per day of riding the train.

If they go on four train rides for example, here is the expression.

$.85(4)$

Evaluating this expression, the cost would be \$3.40.

Expressions are very helpful for figuring out different problems with changeable parts like this one.

Vocabulary

Here are the vocabulary words that are found in this lesson.

Expression

a number sentence with variables, numbers and operations.

Variable

a letter used to represent an unknown quantity.

Algebraic Expression

a combination of multiple variables, numbers and operations.

Equation

a number sentence with an equal sign where the quantity on one side of the equals is the same as the quantity on the other side.

Time to Practice

Directions: Write an expression for each phrase.

1. 5 more than a number
2. A number plus six
3. 8 and a number
4. Seven less than a number
5. Eight take a way four
6. Nine more than a number
7. The product of four and a number
8. Six times a number
9. Twelve times a number
10. Fourteen divided by a number

Directions: Write a simple equation for each phrase.

11. Four and a number is twelve
12. Sixteen divided by a number is two.
13. The product of five and a number is thirty.
14. Eight times a number is sixty-four.
15. Nine times a number is ninety.
16. Five less than a number is ten.
17. Eight take away four is a number.
18. Twenty divided by a number is four.
19. Eighty divided by a number is four.
20. Seventeen less than a number is thirty.

Directions: Write an algebraic expression for each situation below.

21. Arturo has 8 fewer stickers in his collection than Julissa has in hers. Let j represent the number of stickers in Julissa's collection. Write an expression to represent the number of stickers in Arturo's collection.
22. Let c represent the number of cookies on a plate. Three friends share all the cookies on the plate equally. Write an expression to represent the number of cookies each friend has after they are shared equally.
23. Carly is twice as old as her sister. Let s represent her sister's age in years. Write an expression to represent Carly's age in years.
24. The length of a rectangle is 3 inches longer than its width. Let w stand for the width in inches. Write an expression to represent the length in inches.

Directions: Write an algebraic equation for each word problem below.

25. The chorus teacher divides all the students in the chorus into 3 equal groups. Each of the groups has 6 students in it. Write an equation that could be used to represent n , the total number of students in the chorus.
26. Matt's dog weighs 30 pounds. His dog weighs 20 pounds more than his cat. Write an equation that could be used to represent c , the weight, in pounds, of Matt's cat.