Into the Unknown

Introduction to Algebraic Expressions

2

WARM UP

In the school cafeteria, soft pretzels sell for $1.25 each. Determine how much money the cafeteria earns in each situation.

1. On Monday, the cafeteria sold 14 soft pretzels.
2. On Wednesday, the cafeteria sold 35 soft pretzels.
3. On Thursday, the cafeteria sold 50 soft pretzels.

LEARNING GOALS

- Write algebraic expressions to represent real-world and mathematical situations.
- Match algebraic and verbal expressions.
- Identify parts of an algebraic expression using mathematical terms.
- Evaluate algebraic expressions at specific values of their variables.

KEY TERMS

- variable
- algebraic expression
- coefficient
- term
- evaluate an algebraic expression

You have written and evaluated expressions made up of numbers, but often expressions are made up of numbers and letters. What situations can be represented by expressions with letters and how do you evaluate them?

Getting Started

Do You Speak Math?

Rewrite each statement using symbols.

1. fourteen more than six

2. six more than fourteen

3. seven less than thirteen

4. thirteen less than seven

5. twenty-three subtracted from thirty

6. thirty subtracted from twenty-three

7. the quotient of twelve divided by four

8. the quotient of four divided by twelve

9. one-fourth of twenty-eight

10. two to the seventh power

11. seven squared

ACTIVITY 2.1

Writing Expressions with Variables

NOTES

Consider the quantity that changes as you think about the situations in Question 1.

1. **A school lunch costs $1.85 for each student. For each situation, write a numeric expression to determine how much money is collected. Then evaluate the expression.**

   a. **Fifty-five students purchase a school lunch.**

   b. **One hundred twenty-six students purchase a school lunch.**

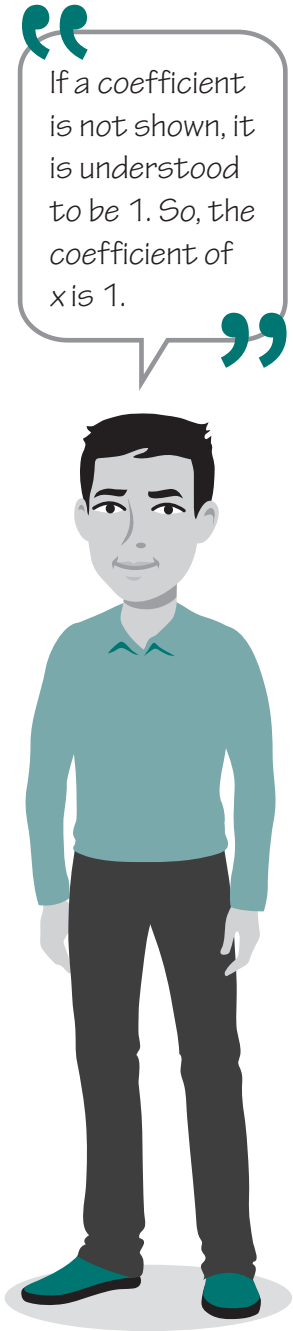
   c. **Two hundred thirteen students purchase a school lunch.**

   d. **One thousand five hundred twelve students purchase a school lunch.**

2. **Write a sentence to describe how you can determine the amount of money collected for any number of students buying school lunches.**

In Question 1 there is one quantity that changes or varies—the number of students who bought school lunches. In mathematics, letters are often used to represent quantities that vary. These letters are called **variables**, and they help you write algebraic expressions to represent situations. An **algebraic expression** is an expression that has at least one variable.

3. **Write an algebraic expression to represent the total amount of money collected for any number of students buying school lunches.**



A number that is multiplied by a variable in an algebraic expression is called a **coefficient**.

4. Identify a coefficient in the expression you wrote in Question 3.

5. The cost to rent a skating rink is $215 for a two-hour party. The cost will be shared equally among all the people who attend the party. For each number of attendees, write a numeric expression to determine how much each person will pay. Then evaluate the expression.

a. 25 attendees

b. 81 attendees

c. 108 attendees

d. Write an algebraic expression to represent how much each person will pay to attend the skate party.

6. Jimmy has three 300-minute international calling cards.

a. Complete the table to determine how many minutes are left on each card after each call.

Minutes on Card	Duration of Call	Minutes Left on Card
300	33 min	
300	57 min	
300	1 h 17 min	

b. Write an algebraic expression that represents the number of minutes remaining after each call on each card.

7. Write an algebraic expression to represent each situation. Identify the coefficient(s).

   a. Ben is selling tickets to the school play. How many will he have left if he starts with *t* tickets and sells 125 tickets?

   b. A plane descends to $\frac{5}{6}$ of its cruising altitude, *a*. What is its new altitude?

   c. A cube has an edge length of *s*.

      i. What is the volume of the cube?

      ii. What is the surface area of the cube?

   d. Used paperback books cost $6.25 each with an additional shipping and handling cost of $8.75. What is the cost of *x* books?

   e. Chairs cost $35, and sofas cost $75. How much does it cost to purchase *x* chairs and *y* sofas?

8. Write an algebraic expression to represent each word expression.

   a. the quotient of a number *n* divided by 7

   b. 5 more than *c*

NOTES

c. *m* less than 9

d. one-fourth of a number *n*

e. fourteen less than three times a number *n*

f. six times a number *n* subtracted from 21

g. one-fourth of a number *n* minus 6

h. ten times the square of a number *w* divided by 12

ACTIVITY 2.2

Matching Algebraic and Verbal Expressions

Let's play Expression Explosion! You teacher is going to hand out cards. Your goal is to identify the written or algebraic expression that corresponds to your card.

Record your pair of matching algebraic and written expressions.

1. How can you be sure that you have found the correct match?

ACTIVITY 2.3

Parts of Algebraic Expressions

NOTES

As you learned previously, an algebraic expression contains at least one variable and sometimes numbers and operations. A **term** of an algebraic expression is a number, variable, or product of numbers and variables.

WORKED EXAMPLE

Consider the expression $3x + 4y - 7$.

The expression has three terms: $3x$, $4y$, and 7. The operation between the first two terms is addition, and the operation between the second and third term is subtraction.

The first term is 3 multiplied by the variable x.

The second term is 4 multiplied by the variable y.

The third term is a constant term of 7.

$$3x + 4y - 7$$

1. Consider two algebraic expressions: $8 + 5x$ and $8 - 5x$

a. Identify the terms in each algebraic expression.

b. Identify the operation between each term in each algebraic expression.

c. What is the same in both expressions?

d. What is different in the expressions?

2. **Identify the number of terms, and then the terms themselves for each algebraic expression.**

   a. $4 - 3x$

   b. $4a - 9 + 3a$

   c. $7b - 9x + 3a - 12$

ACTIVITY 2.4

Evaluating Algebraic Expressions

To **evaluate an algebraic expression** means to determine the value of the expression for a given value of each variable. When you evaluate an algebraic expression, you substitute the given values for the variables, and then determine the value of the expression.

Don't forget to use the Order of Operations when evaluating an algebraic expression.

1. **Write a sentence to describe the meaning of each algebraic expression. Then, evaluate the algebraic expression for the given value.**

   a. $3x - 4$, for $x = 10$

   b. $11 - s$, for $s = 2$

   c. $10 - z$, for $z = 8$

   d. $5 - \frac{y}{4}$, for $y = 2$

e. $7 + 5a$, for $a = 20$

f. $\frac{b}{4}$, for $b = 8$

2. Complete each table.

a.

h	$3h - 2$
2	
$\frac{7}{3}$	
5.1	
$\frac{5}{6}$	

b.

m	$1 + m$
0	
$\frac{2}{3}$	
4	
1.7	

c.

z	$\frac{2z}{3} + 1$
1	
2	
5	
11	

d.

p	$0.5p$
0	
1	
1.5	
2.5	

NOTES

TALK the TALK

Expression Construction

1. Construct an algebraic expression for each description.

   a. There are 2 terms. The first term is a constant. It is added to the second term, which is a product of a number and a variable.

   b. There are 4 terms. The first term is a variable divided by 11. This is added to a second term, which is a constant. The third term is a second variable multiplied by three-fourths. The third term is subtracted from the first 2 terms. The last term, a different constant, is added to the other 3 terms.

   c. The cube of a variable subtracted from a constant and then added to the square of the same variable.

   d. A number multiplied by the square of a variable minus a number multiplied by the same variable minus a constant.

It is your turn to challenge your classmates!

2. Create a description for an algebraic expression and swap descriptions with a classmate. After you receive the algebraic expression back from your classmate, answer Question 3.

3. Did your classmate write an expression that fits your description?

Assignment

Write

Complete each statement with the correct term: *algebraic expression, variable, evaluate an algebraic expression, constant, coefficient.*

1. A(n) _____ is a letter used to represent a quantity that varies.
2. A(n) _____ is a number, or quantity, that a variable is multiplied by in an algebraic expression.
3. A number, or quantity, that does not change its value is called a(n) _____.
4. A mathematical phrase involving at least one variable is called a(n) _____.
5. To _____ means to determine the value of the expression.

Remember

Whenever you perform the same mathematical process over and over, you can write a mathematical phrase, called an algebraic expression, to represent the situation.

Practice

Write an algebraic expression to represent each situation.

1. A T-shirt costs $5.99.
   a. How much will you spend if you buy *x* T-shirts?
   b. Evaluate your expression to calculate the amount of money you will spend if you buy 4 shirts or 10 shirts.
2. You have 7 folders and you want to put the same number of pages in each folder.
   a. If you have a total of *p* pages, how many pages will be in each folder?
   b. Evaluate your expression to calculate the number of pages in each folder if you have 147 pages or 245 pages.
3. You have a coupon for $5 off your total bill at Mama's Meals on Main.
   a. How much will you pay after using the coupon if your bill was *b* dollars?
   b. Evaluate your expression to calculate the amount you will pay if your bill was $23.45 or $54.83.
4. You have already read two and a half hours for the Read-a-Thon.
   a. How long will you have read if you read an additional *h* hours?
   b. Evaluate your expression to calculate the amount of time you will have read if you read 3 or $5\frac{1}{2}$ additional hours.

Write an algebraic expression that represents each verbal expression.

5. six times a number plus 3
6. four times a number subtracted from 2
7. a number squared divided by 2 and added to 16
8. five plus a number and then multiplied by 8

Identify the number of terms and then the terms themselves for each algebraic expression.

9. $6y + 14$
10. $7x - 3y + 12z$
11. $104a + 224b$

Evaluate each algebraic expression for the given value.

12. $34 - y^2$ for $y = 5$
13. $m^3 + 18$ for $m = 2$
14. $\frac{d}{5} + 42$ for $d = 70$

Stretch

Farmer Lyndi raises chickens and goats.

1. Write an expression for the total number of animal legs on Lyndi's farm.
2. How many animal legs are on the farm if Lyndi has 16 chickens and 6 goats?
3. Suppose Lyndi counted 74 animal legs on the farm. How many of each animal might Lyndi have on the farm?

Review

Evaluate each numeric expression.

1. $56 \div 8 + 3 \cdot 6$
2. $9 \cdot 8 - 29 + 30 \div 15 - 15$

Determine which is the better buy.

3. \$12.99 for 42 ounces or \$2.99 for 10 ounces
4. 3 pounds for \$5.00 or \$1.50 per pound

Determine at least two equivalent ratios for each given ratio.

5. $\frac{2 \text{ eggs}}{5 \text{ cups of milk}}$
6. $\frac{20 \text{ red}}{12 \text{ blue}}$