Evaluate Algebraic Expressions

KEY Concept

To **evaluate** an **algebraic expression**, substitute a value for a variable. Then perform the operations.

$$n = 2 \qquad p = -3$$

$$
\begin{aligned}
4n + 5p &= 4(2) + 5(-3) \\
&= 8 + (-15) \\
&= -7
\end{aligned}
$$

Remember to use the **order of operations** after substituting, or replacing, the variables with numbers.

VOCABULARY

algebraic expression
a combination of numbers, variables, and at least one operation

evaluate
to find the *value* of an *algebraic expression* by replacing variables with numbers

order of operations
the rules that tell which operation to perform first when more than one operation is used
1. Simplify the expressions inside grouping symbols, like parentheses.
2. Find the value of all powers.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

Example 1

Evaluate $\triangle + (9 - 2) + \square$ when $\triangle = 3$ and $\square = 1$.

1. Replace $\triangle$ with 3 in the expression.

   $\triangle + (9 - 2) + \square = 3 + (9 - 2) + \square$

2. Replace $\square$ with 1 in the expression.

   $3 + (9 - 2) + 1$

3. Simplify. Follow the order of operations.

   $3 + (9 - 2) + 1 = 3 + 7 + 1$
   $\qquad\qquad\qquad = 11$

YOUR TURN!

Evaluate $2 \bigcirc^2 + 4 \heartsuit$ when $\bigcirc = 2$ and $\heartsuit = 3$.

1. Replace $\bigcirc$ with 2 in the expression.

   _____

2. Replace $\heartsuit$ with 3 in the expression.

   _____

3. Simplify. Follow the order of operations.

   _____

GO ON

Example 2

Evaluate $4 \div y + x \cdot 3 - 7$ when $x = 5$ and $y = 2$.

1. Replace x with 5 and y with 2 in the expression.

   $4 \div y + x \cdot 3 - 7 = 4 \div 2 + 5 \cdot 3 - 7$

2. Simplify using the order of operations.

   $4 \div 2 + 5 \cdot 3 - 7$

$= 2 + 5 \cdot 3 - 7$	Divide.
$= 2 + 15 - 7$	Multiply.
$= 17 - 7$	Add.
$= 10$	Subtract.

YOUR TURN!

Evaluate $3y^2 + x \cdot 3 - 2$ when $x = 4$ and $y = 2$.

1. Replace y with 2 and x with 4. Write the expression.

   _____

2. Simplify using the order of operations.
   $3(2)^2 + 4 \cdot 3 - 2$

   $=$ _____ _____

   $=$ _____ _____

   $=$ _____ _____

   $=$ _____ _____

Who is Correct?

Evaluate the expression $12x - 5 + 4y \cdot 2$ when $x = 4$ and $y = 2$.

Ines

$12x - 5 + 4y \cdot 2$

$= 12(4) - 5 + 4(2) \cdot 2$

$= 48 - 5 + 8 \cdot 2$

$= 43 + 8 \cdot 2$

$= 56 \cdot 2$

$= 112$

Sinclair

$12x - 5 + 4y \cdot 2$

$= 12(4) - 5 + 4(2) \cdot 2$

$= 48 - 5 + 8 \cdot 2$

$= 48 - 5 + 16$

$= 59$

Robyn

$12x - 5 + 4y \cdot 2$

$= (12x + 4y) - 5 \cdot 2$

$= 14xy - 10$

$= 14(4)(2) - 10$

$= 102$

Circle correct answer(s). Cross out incorrect answer(s).

▶ Guided Practice

Evaluate each expression when $\star = 6$.

1 $9 \cdot \star$ _____

2 $72 \div \star$ _____

3 $4 + \star - 5 \cdot 3 \div 3$

4 $8 \cdot 4 + \star + 7$

Evaluate each expression when ☺ = 8 and ♣ = 6.

5 $☺^2 + 9 - 7 + ♣ \cdot 10$

Replace symbols with values: _____

Value of the expression: _____

6 $10^2 \div 20 - (-6 + ♣) \cdot ☺$

Replace symbols with values: _____

Value of the expression: _____

7 $(27 - 18)^2 + ☺ - 12 \div 4 + ♣ \cdot 2$

Replace symbols with values:

_____

Value of the expression: _____

8 $16 \div 4 \cdot ♣ - 2 + (☺ - 5)$

Replace symbols with values:

_____

Value of the expression: _____

Step (by) Step Practice

9 Evaluate the expression $5y + 2z - 4$ when $y = 7$ and $z = 10$.

Step 1 $5y$ means 5 _____ y. Replace y with _____ in the expression.

Step 2 $2z$ means 2 _____ z. Replace z with _____ in the expression.

Step 3 Write the expression with all substitutions made.
Simplify using the order of operations.

$5 \cdot 7 + 2 \cdot 10 - 4 =$ _____ + _____ − _____

$=$ _____ − _____

$=$ _____

The value of the expression is _____.

Evaluate each expression when $x = 2$ and $y = 5$.

10 $7y - (5 + 1) \div 2 \cdot x^2 = 7(\underline{\hspace{1cm}}) - (5 + 1) \div 2 \cdot (\underline{\hspace{1cm}})^2$

$$= 7(\underline{\hspace{1cm}}) - \underline{\hspace{1cm}} \div 2 \cdot 2^2$$

$$= 7(\underline{\hspace{1cm}}) - \underline{\hspace{1cm}} \div 2 \cdot \underline{\hspace{1cm}}$$

$$= \underline{\hspace{1cm}} - \underline{\hspace{1cm}} \cdot \underline{\hspace{1cm}}$$

$$= \underline{\hspace{1cm}} - \underline{\hspace{1cm}}$$

$$= \underline{\hspace{1cm}}$$

11 $5 - x \div 2 + (3 \cdot 2)^2 - 5 \cdot 0 = 5 - \underline{\hspace{1cm}} \div 2 + (3 \cdot 2)^2 - 5 \cdot 0$

$$= 5 - \underline{\hspace{1cm}} \div 2 + \underline{\hspace{1cm}}^2 - 5 \cdot 0$$

$$= 5 - \underline{\hspace{1cm}} \div 2 + \underline{\hspace{1cm}} - 5 \cdot 0$$

$$= 5 - \underline{\hspace{1cm}} + \underline{\hspace{1cm}} - \underline{\hspace{1cm}}$$

$$= \underline{\hspace{1cm}}$$

12 $16 + 4^2 \cdot x - 5 + (8 - y) - 0$

Replace variables with values:

_____

Value of the expression: _____

13 $5y^2 - 10 \div 5 + 3 \cdot 5x$

Replace variables with values:

_____

Value of the expression: _____

14 $(x^2 - 1) + 3 \cdot 4 \div (7 - 1) + y$

Replace variables with values:

_____

Value of the expression: _____

15 $100 \div y^2 + (x + 7)^2$

Replace variables with values:

_____

Value of the expression: _____

Step by Step Problem-Solving Practice

Solve.

16 BICYCLING It takes Larisa an hour to bicycle 12 miles. The total number of miles biked is b.

Use the expression $b \div 12$ to find how many hours it will take her to finish a trail ride. How long will it take for Larisa to complete a 60-mile trail?

Understand	Read the problem. Write what you know.
	Larisa is completing a trail that is _____ miles long.
	She bikes _____ miles each hour.
Plan	Pick a strategy. One strategy is to use an equation.
	Use h to represent hours. Write an equation using h and the expression $b \div 12$.
	$h = b \div 12$
Solve	In the equation, replace b with _____.
	$h = $ _____ $\div 12$
	Simplify.
	$h = 60 \div 12$
	$h = $ _____
	It will take Larisa _____ hours to complete the trail.
Check	Multiply to check your division.

17 CLOTHES Shawnell wants to buy an $8 T-shirt and 3 sweaters. Use the variable expression $8 + 3s$ to find the total cost, where s represents the cost per sweater. Evaluate the expression for sweaters that cost $18 each. Check off each step.

_____ **Understand:** I underlined key words.

_____ **Plan:** To solve the problem, I will _____.

_____ **Solve:** The answer is _____.

_____ **Check:** I checked my answer by _____.

GO ON

18 FOOD Gabe's Grocery pays $26 per case for oranges. Write an expression for the cost of c cases. Find the cost of 8 cases. _____

19 [Reflect] Does the expression $50 \div k - 2$ have a greater value when $k = 5$ or $k = 10$? Explain.

_____

_____

▶ Skills, Concepts, and Problem Solving

Evaluate each expression when ◇ = 5 and ○ = 3.

20 $4 + ○ - ◇$ _____

21 $16 \cdot ○ + ◇$ _____

22 $2^2 - 6 + ◇ \cdot ○^2$

23 $15 \div ○ \cdot ◇ - 11 + 7$

_____

_____

Evaluate each expression when $x = 9$ and $y = 3$.

24 $18 \div x \cdot (10 + y - x)$ _____

25 $90 - x^2 + 6 \div y \cdot 2$ _____
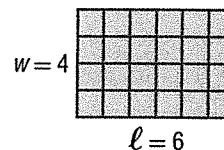
26 $x^2 \div y + 7 \cdot 2 - (6 \cdot 1)$ _____

27 $(8 \cdot 1) + 17 \cdot (4y - x)$ _____

28 $y^2 \div y + (x + y) \cdot 1$ _____

29 $(2x - 1) + x^2$ _____

Solve.

30 GEOMETRY The area of a rectangle equals the expression $\ell \cdot w$, where ℓ represents the length and w represents the width. Evaluate the expression to find the area of the rectangle at the right. _____

$w = 4$

$\ell = 6$

31 RECREATION Lamar plays a math game in which whole numbers are worth 10 points, decimals are worth 15 points, and fractions are worth 20 points. The total score equals the expression $10w + 15d + 20f$, when w represents the number of whole numbers, d represents the number of decimals, and f represents the number of fractions. Find Lamar's score when $w = 7, f = 11$, and $d = 15$.

_____

Vocabulary Check Write the vocabulary word that completes each sentence.

32 The amount of a number is its _____.

33 Finding the value of an algebraic expression by replacing variables with numbers is called _____ the expression.

34 **Writing in Math** Explain how to evaluate $r - 8 \cdot 2$ when $r = 30$.

_____

_____

▶ Spiral Review

Find the value of each expression. (Lesson 3-1, p. 98)

35 $56 \div \dfrac{(24 + 16)}{(21 - 16)} \cdot 6^2 \div 9 = 56 \div \underline{\quad} \cdot 6^2 \div 9$

$= 56 \div \underline{\quad} \cdot 6^2 \div 9$

$= 56 \div \underline{\quad} \cdot \underline{\quad} \div 9$

$= \underline{\quad} \cdot \underline{\quad} \div 9$

$= \underline{\quad} \div 9$

$= \underline{\quad}$

36 $27 - (16 + 5) + 7 \cdot 3^2 = 27 - \underline{\quad} + 7 \cdot 3^2$

$= 27 - \underline{\quad} + 7 \cdot \underline{\quad}$

$= 27 - \underline{\quad} + \underline{\quad}$

$= \underline{\quad} + \underline{\quad}$

$= \underline{\quad}$

Solve.

37 FOOD   Imani was grocery shopping for the week. She bought 3 packs of each of 6 snack crackers. Then she bought 2 pieces of each of 4 different fruits. At the checkout counter she returned one pack of snack crackers. How many items did Imani purchase?

Word Phrase	Math Meaning
3 packs of 6 crackers	
2 pieces of 4 kinds of fruit	
returned one pack of crackers	

_____

STOP