Lesson 3-1

Order of Operations

KEY Concept

You must follow the **order of operations** to evaluate mathematical expressions correctly.

Order of Operations	Symbol
1. Simplify grouping symbols.	(parentheses) [brackets] $\frac{2-1}{b-3}$ fraction bar
2. Find the values of all powers.	base → 2^5 ← exponent
3. Multiply and divide in order from left to right.	× • ÷ /
4. Add and subtract in order from left to right.	+ −

VOCABULARY

base
In a power, the number used as a factor; in 10^3, the base is 10. That is, $10^3 = 10 \times 10 \times 10$.

exponent
In a power, the number of times the base is used as a factor; in 5^3, the exponent is 3. That is, $5^3 = 5 \times 5 \times 5$.

order of operations
the rules that tell which operation to perform first when more than one operation is used

Sometimes parentheses are used to set a number apart from other operations. If there is no operation to be performed inside the parentheses, check for **exponents**.

Example 1

Find the value of $4 - 2 + 16 \div 4$.

Use the order of operations. There are no grouping symbols or exponents.

$4 - 2 + 16 \div 4 = 4 - 2 + 4$ Multiply and divide from left to right.
$= 2 + 4$ Add and subtract from left to right.
$= 6$

From left to right, subtraction comes first in this expression.

YOUR TURN!

Find the value of $10 - 5 + 6 \cdot 3$.

Use the order of operations. There are no grouping symbols or exponents.

$10 - 5 + 6 \cdot 3 = 10 - 5 +$ _____
$=$ _____ $+$ _____
$=$ _____

Example 2

Find the value of $71 - \frac{36 - 12}{6 + 2} \cdot 4^2$.

$71 - \frac{36 - 12}{6 + 2} \cdot 4^2 = 71 - \frac{24}{8} \cdot 4^2$ Simplify grouping symbols.

$= 71 - \frac{24}{8} \cdot 16$ Simplify exponents.

$= 71 - 3 \cdot 16$ Divide.

$= 71 - 48$ Multiply.

$= 23$ Subtract.

YOUR TURN!

Find the value of $56 \div 14 + (1 + 4)^2 \cdot 2 - 4$.

$56 \div 14 + (1 + 4)^2 \cdot 2 - 4$

$= 56 \div 14 +$ _____ $\cdot 2 - 4$

$= 56 \div 14 +$ _____ $\cdot 2 - 4$

$=$ _____ $+$ _____ $- 4$

$=$ _____ $- 4$

$=$ _____

Example 3

Write and simplify an expression to answer the question.

Seth arranged 24 chairs in rows of 6. He took 1 chair out of each row. Then, he placed 10 more chairs on the stage. How many chairs did Seth leave on the stage?

1. Translate each phrase.

Word Phrase	Math Meaning
4 rows	4
24 chairs in rows of 6	$24 \div 6$
1 chair from each row	-1
Ten more	$+10$

2. Write the expression.

$[4 \cdot (24 \div 6 - 1)] + 10$

3. Simplify the expression.

$[4 \cdot (4 - 1)] + 10 = 12 + 10 = 22$

Seth arranged 22 chairs.

YOUR TURN!

Write and simplify an expression to answer the question.

Susana bought 2 packs of 8 fruit bars. She gave 13 fruit bars away to her friends. Then she purchased 3 packs of granola bars with 6 bars in each pack. How many snacks does Susana have now?

1. Translate each phrase.

Word Phrase	Math Meaning
2 packs of 8	
Gave away 13	
Then she purchased	
3 packs of 6	

2. Write the expression.

_____

3. Simplify the expression.

(____ − ____) + ____ = ____ + ____ = ____

Susana has _____ snack bars.

GO ON

Who is Correct?

Find the value of $25 \div 5 + (8 - 4)^2 \cdot 2$.

Cedric

$25 \div 5 + (8 - 4)^2 \cdot 2$
$= 25 \div 5 + 4^2 \cdot 2$
$= 5 + 16 \cdot 2$
$= 21 \cdot 2$
$= 42$

Gracia

$25 \div 5 + (8 - 4)^2 \cdot 2$
$= 5 + (64 - 16) \cdot 2$
$= 5 + (48) \cdot 2$
$= 5 + 96$
$= 101$

Hannah

$25 \div 5 + (8 - 4)^2 \cdot 2$
$= 25 \div 5 + 4^2 \cdot 2$
$= 25 \div 5 + 16 \cdot 2$
$= 5 + 32$
$= 37$

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

Guided Practice

Name the step that should be performed first in each expression.

1 $8 \cdot 3 + (30 - 3) \div 6^2$ _____

2 $17 \div 1 - (12 + 2) \cdot 2$ _____

3 $18 + 5^2 \div 5 + 4 \cdot 3$ _____

4 $8 + 17 \div 7 \cdot 5 - 6$ _____

Step by Step Practice

5 Find the value of $17 - 6 \cdot (3 - 2)^2 - 5 + 2$.

Step 1 Use the order of operations. Simplify the grouping symbols.

$17 - 6 \cdot (3 - 2)^2 - 5 + 2 = 17 - 6 \cdot (\_\_\_\_\_)^2 - 5 + 2$

Step 2 Simplify the exponent.

$17 - 6 \cdot 1^2 - 5 + 2 = 17 - 6 \cdot \_\_\_\_\_ - 5 + 2$

Step 3 Multiply and divide.

$17 - 6 \cdot 1 - 5 + 2 = 17 - \_\_\_\_\_ - 5 + 2$

Step 4 Add and subtract.

$17 - 6 - 5 + 2 = \_\_\_\_\_ - 5 + 2$
$= \_\_\_\_\_ + 2$
$= \_\_\_\_\_$

Find the value of each expression.

6 $64 \div 16 + (5 \cdot 2)^2 - 23 = 64 \div 16 + (\_\_\_\_\_)^2 - 23$

$= 64 \div 16 + \_\_\_\_\_ - 23$

$= \_\_\_\_\_ + \_\_\_\_\_ - 23$

$= \_\_\_\_\_ - 23$

$= \_\_\_\_\_$

7 $50 \div (9 + 1) \cdot 4 \div 2 = \_\_\_\_\_$

8 $30 \div \frac{43 - 8}{3 + 4} \div 2 \cdot 12 = \_\_\_\_\_$

9 $20 - 4^2 \div 4 \cdot 2 + (20 - 17) = \_\_\_\_\_$

10 $(21 - 20)^2 \cdot 50 \div 5 - (72 \div 8) = \_\_\_\_\_$

Step by Step Practice

Problem-Solving Strategies

- ☐ Draw a diagram.
- ☐ Guess and check.
- ☐ Act it out.
- ☑ Write an expression.
- ☐ Work backward.

11 TRANSPORTATION McArthur Community Center has 2 vans that hold 12 passengers each. They own 6 more minibuses that will hold 20 passengers each. How many passengers can the community center transport in all?

Understand Read the problem. Write what you know.

There are _____ vans with _____ passengers each and _____ minibuses with _____ passengers each.

Plan Pick a strategy. One strategy is to write and simplify an expression.

Solve Translate each phrase.

Word Phrase	2 vans of 12	More	6 buses of 20
Math Meaning			

Write and simplify the expression using the order of operations.

$= \_\_\_\_\_ + \_\_\_\_\_$

$= \_\_\_\_\_ + \_\_\_\_\_$

$= \_\_\_\_\_$

The community center can transport _____ passengers.

Check You can draw a picture to check your answer.

GO ON

Write and simplify an expression to solve each problem.

12 **GARDENS** Cierra likes to plant flowers. She planted 2 daffodils. She also planted 3 rows of 4 tulips. Five of the flowers were eaten by squirrels. How many flowers were left? Check off each step.

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

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

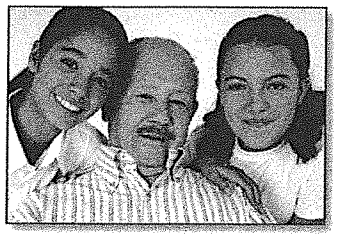
_____ **Solve: The answer is** _____.

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

13 **SUPPLIES** Caine bought 3 packs of markers. Each pack had 5 markers. He gave 7 markers to his brother. Then he bought 2 more packs with 18 markers in each. How many markers does Caine have now?

Word Phrase	3 packs of 5	Gave away 7	More	2 packs of 18
Math Meaning				

14 **PHOTOGRAPHY** Marcos was using his new digital camera at a family reunion. He took 6 pictures of each of his four aunts. He deleted 2 of the photos. Then he took 10 pictures of each of his 8 cousins. Finally, he took 4 photos that included his grandfather. How many photos are left on his camera?



Word Phrase	Math Meaning
6 pictures of 4 aunts	
deleted 2	
10 pictures of each of his 8 cousins	
4 photos of grandfather	

15 **Reflect** Explain why $40 \div 4 + 6$ has a different value than $40 \div (4 + 6)$.

Skills, Concepts, and Problem Solving

Name the step that should be performed first in each expression.

16 $5 \cdot 2 + (17 \div 1) - 22$ _____

17 $4 \cdot (2 - 6)^2 + 12 \div 3$ _____

18 $(6 - 2^2 \cdot 4) - 16 \div 2$ _____

19 $9 + (6 - 1 \cdot 14) \div 2^2$ _____

20 $3[(75 + 75) \cdot 3] - 25$ _____

21 $\frac{18 + 66}{35 - 14} \cdot 3 + 2$ _____

Find the value of each expression.

22 $14 - (7 + 5) + 7 \cdot 4^2 = 14 -$ _____ $+ 7 \cdot 4^2$

$= 14 -$ _____ $+ 7 \cdot$ _____

$= 14 -$ _____ $+$ _____

$=$ _____ $+$ _____

$=$ _____

23 $48 \div \frac{(37 + 3)}{(9 - 4)} - 4 \div 2 \cdot 7^2 = 48 \div$ ___ $- 4 \div 2 \cdot 7^2$

$= 48 \div$ _____ $- 4 \div 2 \cdot 7^2$

$= 48 \div$ _____ $- 4 \div 2 \cdot$ _____

$=$ _____ $-$ _____ $\cdot$ _____

$=$ _____ $-$ _____

$=$ _____

24 $50 \div 5 + 3 \cdot 2^2 - (15 - 9) =$ _____

25 $3^2 + 8 \div 2 - (10 + 2) =$ _____

26 $18 - 5^2 \cdot 0 + 16 - 15 =$ _____

27 $(9 - 6)^2 + 8 \div 4 + 5 \cdot 6 =$ _____

28 $\frac{27 + 23}{16 + 9} \cdot 5 =$ _____

29 $\frac{4^2}{2 + (27 \cdot 0)} =$ _____

30 $10[8(2^2 + 2) - (2 \cdot 6)] =$ _____

31 $5[(17 \cdot 1) - 3(25 \div 5)] =$ _____

GO ON

Write and simplify an expression to solve each problem.

32 COLLECTIONS Evan had 100 bobble heads. He sold 5 sets of 10 bobble heads. He then bought 3 sets of 12 bobble heads. Then Evan sold 25 bobble heads. How many bobble heads does Evan have left?

Word Phrase	Math Meaning
had 100	
sold	
5 sets of 10	
bought	
3 sets of 12	
sold 25	

33 BOOKS Each week Serena uses her library card. On her first visit she borrowed 2 stacks of 8 books. She returned 9 books on the second week. On the third week, Serena borrowed 2 stacks of 5 books. How many books does Serena have now?

Word Phrase	2 stacks of 8	returned 9	2 stacks of 5
Math Meaning			

Vocabulary Check **Write the vocabulary word that completes each sentence.**

34 The _____ is a set of rules that tells what order to follow when evaluating an expression.

35 A(n) _____ is the number of times a base is multiplied by itself.

36 **Writing in Math** Does $40 - (7 - 5)$ equal $(40 - 7) - 5$? Explain.

STOP