1-1 Variables and Expressions

Vocabulary

Review

What mathematical *operation* is shown in each equation? Write *addition, subtraction, multiplication,* or *division.*

1. $6 \cdot 2 = 12$ multiplication

2. $14 - 4 = 10$ subtraction

3. $27 \div 3 = 9$ division

4. $13 + 7 = 20$ addition

Vocabulary Builder

variable (noun) VEHR ee uh bul

Related Words: vary (verb), varied (adjective), various (adjective)

Definition: A **variable** is a symbol, usually a letter, that represents one or more values of a quantity that changes.

Main Idea: The value given to a **variable** can change or vary. A quantity that changes, or varies, is called a *variable quantity.*

Example: The letter y is the **variable** in the algebraic expression $4 + y$. You can replace y with different numbers to find values for the expression.

a, x, and m are often used as **variables**.
100, $\frac{1}{a}$, and $3m$ are *not variables*.

Use Your Vocabulary

5. Circle the *variable*(*s*) in each algebraic expression.

$8 + 4(x)$ $(y) + 12$ $9(z) + (y)$ $\frac{8}{(w)} + 4(w)$

An **algebraic expression** is a mathematical phrase that includes one or more variables. A **numerical expression** is a mathematical phrase involving numbers and operation symbols, but no variables.

6. Write **N** next to each *numerical expression.* Write **A** next to each *algebraic expression.*

A $6x$ A $\frac{5}{r} - 4$ N $11 + 5$ A $30 + 14k$

Problem 1 Writing Expressions With Addition and Subtraction

Got It? **What is an algebraic expression for 18 more than a number n?**

7. Complete the table with *add* or *subtract.*

Phrase	Math Operation
more than a number	add
less a number	subtract
sum of two numbers	add
fewer than a number	subtract

8. Circle the expression you could use to find 18 more than 6.

6×18 $\quad$ $6 + 18$ $\quad$ $18 - 6$ $\quad$ $18 + 18 + 18 + 18 + 18 + 18$

9. Now write an algebraic expression for 18 more than a number n.

n + 18

Problem 2 Writing Expressions With Multiplication and Division

Got It? **What is an algebraic expression for the following word phrase?**

6 times a number n

10. Complete each sentence with *add, subtract, multiply,* or *divide.* One word is used more than once.

The phrase "8 less than a number" tells you to ? 8. — subtract

The phrase "the product of a number x and 4" tells you to ? x and 4. — multiply

The phrase "the quotient of 6 and a number" tells you to ? 6 by x. — divide

The phrase "n times 12" tells you to ? n and 12. — multiply

The phrase "the sum of a number n and 59" tells you to ? n and 59. — add

11. Now write an algebraic expression for 6 times a number n.

6 · n

Problem 3 Writing Expressions With Two Operations

Got It? **What is an algebraic expression for the following word phrase?**
8 less than the product of a number *x* and 4

12. Write an algebraic expression for the product of a number *x* and 4.

4x

13. Underline the correct phrase to complete the sentence.

The phrase "8 less than a certain number" tells you to

subtract 8 from a number / subtract a number from 8 .

14. Cross out the expressions that do NOT represent the word phrase "8 less than the product of a number *x* and 4."

$4x - 8$ ~~$4x + 8$~~ ~~$x - 8$~~ ~~$8x - 4$~~

Problem 4 Using Words for an Expression

Got It? **What word phrase can you use to represent each algebraic expression?**

$x + 8.1$ $10x + 9$ $\frac{n}{3}$ $5x - 1$

15. Complete the word phrase for each expression.

the ? of a number *x* and 8.1 — sum

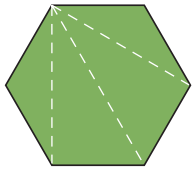
the ? of 10 ? a number *x* and 9 — sum / times

the quotient of ? and 3 — a number *n*

1 ? the product of ? — less than / 5 and a number *x*

Problem 5 Writing a Rule to Describe a Pattern

Got It? **Suppose you draw a segment from any one vertex of a regular polygon to the other vertices. A sample for a regular hexagon is shown at the right. Use the table to find a pattern. What is a rule for the number of nonoverlapping triangles formed? Give the rule in words and as an algebraic expression.**



Triangles in Polygons

Number of Sides of Polygon	Number of Triangles
4	4 − 2
5	5 − 2
6	6 − 2
n	■

16. Use the table. Find the number of nonoverlapping triangles in each figure.

a polygon with 4 sides: 2

a polygon with 5 sides: 3

17. Underline the correct word or words to complete the sentence.

The value of the expression in the table for a 6-sided figure is / is not the same as the number of triangles in the drawing of the hexagon.

18. Give a rule in words to find the number of nonoverlapping triangles in a polygon.

Answers may vary. Sample: Subtract 2 from the number of sides of the polygon.

19. Write an algebraic expression for the number of nonoverlapping triangles in a polygon that has n sides.

$n - 2$

Lesson Check • Do you UNDERSTAND?

Reasoning **Use the table to decide whether $49n + 0.75$ or $49 + 0.75n$ represents the total cost to rent a truck that you drive n miles.**

Truck Rental Fees

Number of Miles	Cost
1	\$49 + (\$.75 × 1)
2	\$49 + (\$.75 × 2)
3	\$49 + (\$.75 × 3)
n	■

20. Write a rule in words for the pattern shown in the table.

Answers may vary. Sample: \$49 more than the product of \$.75 and the number n

21. Now write an algebraic expression to represent the total cost of renting a truck.

$49 + 0.75n$

Math Success

Check off the vocabulary words that you understand.

☐ variable ☐ algebraic expression ☐ numerical expression

Rate how well you can *write algebraic expressions.*

Need to review 0 2 4 6 8 10 Now I get it!

1-2 Order of Operations and Evaluating Expressions

Vocabulary

Review

To *simplify* a numerical expression means to replace it with its single numerical value. Circle the *simplified form* of each expression.

1. $2 \cdot 3 \cdot 4$

$4 \cdot 3 \cdot 2$	$6 \cdot 4$	9	(24)

2. $\frac{1}{2} \cdot 36$

$36 \cdot \frac{1}{2}$	12	(18)	$36\frac{1}{2}$

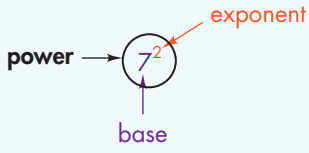
3. $16 - 4 + 7$

$16 - 7 + 4$	5	10	(19)

Vocabulary Builder

power (noun) POW er

Related Words: base, exponent



Definition: A **power** is a number that can be expressed using a base and an exponent.

Main Idea: **Powers** provide a shorthand way for showing repeated multiplication.

Example: The diagram above shows a **power**, its *base*, and its *exponent*. You can read the expression as, "seven to the second power."

Use Your Vocabulary

4. Circle the expression that shows a base of 7 and an exponent of 3.

3^7	$7(3)$	(7^3)	$\frac{3}{7}$

5. Underline the correct word to complete the sentence.

$A(n)$ exponent / power is a number that can be expressed using a base and an exponent.

6. For each expression, underline the base, circle the exponent, and draw a box around the power.

$2^{(5)}$	$4^{(x)}$	$m^{(7)}$	$w^{(2)}$

Problem 1 Simplifying Powers

Got It? What is the simplified form of 3^4?

7. Follow the steps to find the simplified form of the expression.

1 Identify the base and the exponent in the expression 3^4.

base: 3 exponent: 4

2 Expand the expression to show the repeated multiplication indicated by the exponent.

$3^4 =$ 3 · 3 · 3 · 3

3 Write the simplified form of the expression 3^4.

$3^4 =$ 81

take note

Key Concept Order of Operations

1. Perform any operation(s) inside grouping symbols, such as parentheses ( ) and brackets [ ]. A fraction bar also acts as a grouping symbol.
2. Simplify powers.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

Problem 2 Simplifying a Numerical Expression

Got It? What is the simplified form of $5 \cdot 7 - 4^2 \div 2$?

8. Circle the part of the expression that you should simplify first.

$5 \cdot 7 - (4^2) \div 2$

9. Without simplifying the expression, explain how you know that subtraction will be the last operation. Answers may vary. Sample given.

Following the Order of Operations, addition and subtraction are always the last operations you do.

10. Simplify $5 \cdot 7 - 4^2 \div 2$. Show and justify each step.

$5 \cdot 7 - 4^2 \div 2 = 5 \cdot 7 - 16 \div 2$ Simplify powers.

$= 35 - 8$ Multiply and divide.

$= 27$ Subtract.

Problem 3 Evaluating Algebraic Expressions

Got It? What is the value of the expression when $a = 3$ and $b = 4$?

$3b - a^2$

11. $3b - a^2 = 3 \cdot$ **4** $-$ **3** ^{2} Substitute 3 for a and 4 for b.

12. $=$ **12** $-$ **3** ^{2} Multiply.

13. $=$ **12** $-$ **9** Simplify the power.

14. $=$ **3** Subtract.

Problem 4 Evaluating a Real-World Expression

Got It? The shipping cost for an order at an online store is $\frac{1}{10}$ the cost of the items you order. What is an expression for the total cost of a given order? What are the total costs for orders of \$43, \$79, \$95, and \$103?

15. Complete the model.

Relate total cost of an order is the cost of the items plus the shipping costs: $\frac{1}{10} \cdot$ the cost of the items

Define Let $c =$ the cost of the items.

Write total cost $=$ **c** $+$ $\frac{\textbf{1}}{\textbf{10}} \cdot$ **c**

16. Use the model to complete the table for each value of c.

Cost of Items	Shipping Cost	Total Cost of Order
\$43	$\frac{1}{10} \cdot$ \$43 = \$4.30	\$43 + \$4.30 = \$ **47.30**
\$79	$\frac{1}{10} \cdot$ \$79 = \$ **7.90**	\$79 + \$7.90 = \$ **86.90**
\$95	$\frac{1}{10} \cdot$ \$95 = \$ **9.50**	\$95 + \$ **9.50** = \$104.50
\$103	$\frac{1}{10} \cdot$ \$103 = \$ **10.30**	\$103 + \$ **10.30** = \$ **113.30**

Lesson Check • Do you UNDERSTAND?

Error Analysis **A student simplifies an expression as shown below. Find the error and simplify the expression correctly.**

$$23 - 8 \cdot 2 + 3^2 = 23 - 8 \cdot 2 + 9$$
$$= 15 \cdot 2 + 9$$
$$= 30 + 9$$
$$= 39$$

17. What operation did the student do first? Is this correct? Explain.

The student simplified the power 3^2 as 9 first. Explanations may vary. Sample: Yes, the Order of Operations tells you to simplify powers first.

18. What operation did the student do next? Is this correct? Explain.

The student subtracted 8 from 23 next. Explanations may vary. Sample: No, the student should have multiplied 8 and 2 next.

19. Now simplify the expression $23 - 8 \cdot 2 + 3^2$ correctly.

$$23 - 8 \cdot 2 + 3^2 = 23 - 8 \cdot 2 + 9$$
$$= 23 - 16 + 9$$
$$= 7 + 9$$
$$= 16$$

Math Success

Check off the vocabulary words that you understand.

☐ power ☐ exponent ☐ base ☐ simplify ☐ evaluate

Rate how well you can *evaluate expressions using the Order of Operations.*

Need to review — 0 2 4 6 8 10 — Now I get it!

1-3 Real Numbers and the Number Line

Vocabulary

Review

1. Circle the numbers that are *perfect squares*.

1 12 16 20
100 121 200 289

Vocabulary Builder

square root (noun) **skwer root**

Definition: The **square root** of a number is a number that when multiplied by itself is equal to the given number.

Using Symbols: $\sqrt{16} = 4$

Using Words: The **square root** of 16 is 4. It means, "I multiply 4 by itself to get 16."

square root
$\sqrt{16} = 4$
because
$4^2 = 16$

Use Your Vocabulary

2. Use what you know about *perfect squares* and *square roots* to complete the table.

Number	Number Squared
1	1
2	4
3	9
4	16
5	25
6	36

Number	Number Squared
7	49
8	64
9	81
10	100
11	121
12	144

Problem 1 Simplifying Square Root Expressions

Got It? What is the simplified form of $\sqrt{64}$?

3. Circle the equation that uses the positive square root of 64.

$16 \cdot 4 = 64$ $\quad$ $32 \cdot 2 = 64$ $\quad$ $8 \cdot 8 = 64$

4. The simplified form of $\sqrt{64}$ is **8**.

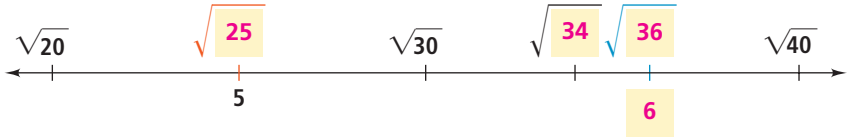
Problem 2 Estimating a Square Root

Got It? What is the value of $\sqrt{34}$ to the nearest integer?

5. Use the number lines below to find the perfect squares closest to 34.

Write 25, 34, and 36 in the correct positions on the number line.

Complete the number line with square roots.



6. Since 34 is closer to **36** than to **25**,

$\sqrt{34}$ is closer to **6** than to **5**.

So, the value of $\sqrt{34}$ to the nearest integer is **6**.

You can classify numbers using *sets*. A **set** is a well-defined collection of objects. Each object in the set is called an **element** of the set. A **subset** of a set consists of elements from the given set. You can list the elements of a set within braces { }.

7. Complete the *sets* of numbers.

Natural numbers

$\{1, \mathbf{2}, 3, \ldots\}$

Whole numbers

$\{\mathbf{0}, 1, \mathbf{2}, 3, \ldots\}$

Integers

$\{\ldots, -2, \mathbf{-1}, 0, 1, \mathbf{2}, 3, \ldots\}$

A **rational number** is any number that you can write in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$. A rational number in decimal form is either a terminating decimal such as 5.45 or a repeating decimal such as 0.333..., which you can write as $0.\overline{3}$.

8. Cross out the numbers that are NOT *rational numbers*.

~~π~~ $\quad$ $-\frac{7}{4}$ $\quad$ ~~$\sqrt{5}$~~ $\quad$ $0.\overline{9}$ $\quad$ 7.35

An **irrational number** cannot be represented as the quotient of two integers. In decimal form, irrational numbers do not terminate or repeat. Irrational numbers include π and $\sqrt{2}$.

Problem 3 Classifying Real Numbers

Got It? To which subsets of the real numbers does each number belong?

$\sqrt{9}$ $\quad \frac{3}{10}$ $\quad -0.45$ $\quad \sqrt{12}$

9. Is each number an element of the set? Place a ✔ if it is. Place an ✗ if it is not.

Number	Whole Numbers	Integers	Rational Numbers	Irrational Numbers
$\sqrt{9}$	✔	✔	✔	✗
$\frac{3}{10}$	✗	✗	✔	✗
-0.45	✗	✗	✔	✗
$\sqrt{12}$	✗	✗	✗	✔

Take note

Concept Summary Real Numbers

10. Write each of the numbers -7, -5.43, 0, $\frac{3}{7}$, π, and $\sqrt{7}$ in a box below. The number 5 has been placed for you.

Real Numbers

Rational numbers: $\frac{3}{7}$, -5.43

Integers: -7

Whole numbers: 0

Natural numbers: 5

Irrational numbers: π, $\sqrt{7}$

Problem 4 Comparing Real Numbers

Got It? What is an inequality that compares the numbers $\sqrt{129}$ and 11.52?

11. What is the approximate value of $\sqrt{129}$ to the nearest hundredth?

11.36

12. Use $<$, $>$, or $=$ to complete the statement.

$\sqrt{129}$ $<$ 11.52

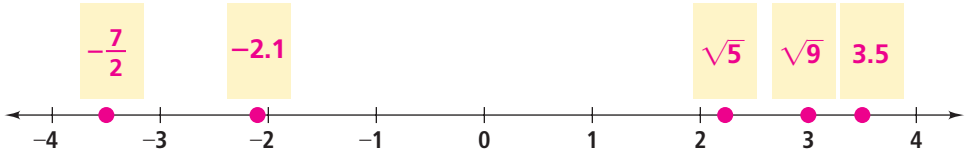
Problem 5 Graphing and Ordering Real Numbers

Got It? **Graph 3.5, -2.1, $\sqrt{9}$, $-\frac{7}{2}$, and $\sqrt{5}$ on a number line. What is the order of the numbers from least to greatest?**

13. Simplify the radicals and convert the fraction to a mixed number.

$\sqrt{9} =$ 3 $\quad -\frac{7}{2} =$ $-3\frac{1}{2}$ $\quad \sqrt{5} \approx$ 2.24

14. Now use the number line to graph the five original numbers. Be sure to label each point with the correct number.



15. Now list the five original numbers from *least* to *greatest*.

$-\frac{7}{2}$, −2.1, $\sqrt{5}$, $\sqrt{9}$, 3.5

Lesson Check • Do you UNDERSTAND?

Reasoning **Tell whether $\sqrt{100}$ and $\sqrt{0.29}$ are *rational* or *irrational*. Explain.**

16. First try to simplify the expression. If it does not simplify, put an ✗ in the box.

$\sqrt{100} =$ 10 $\quad \sqrt{0.29} =$ ✗

17. Tell whether each square root is *rational* or *irrational*. Explain your reasoning.

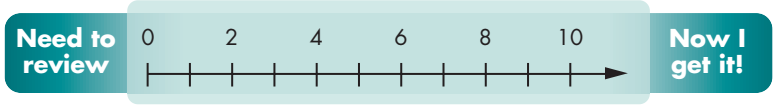
Explanations may vary. Sample: The number $\sqrt{100}$ is rational because 100 is a perfect square. The number $\sqrt{0.29}$ is irrational because 0.29 is not a perfect square.

Math Success

Check off the vocabulary words that you understand.

☐ square root ☐ rational numbers ☐ irrational numbers ☐ real numbers

Rate how well you can *classify and order real numbers*.



1-4 Properties of Real Numbers

Vocabulary

Review

Answers may vary. Samples are given.

1. Write two examples of *numerical expressions* and *algebraic expressions.*

Numerical Expressions		Algebraic Expressions	
$6 + 5$	$210 \times 6 - 9$	$6x$	$4y + 7$

2. **Reasoning** Lan has three pens and some pencils. Why does she need an algebraic expression to represent the number of writing tools she has? Explain.

Sample: Lan has an unknown number of pencils, so she will need to use a variable to represent that number. Using a variable makes it an algebraic expression.

Vocabulary Builder

counterexample (noun) KOWN tur eg ZAM pul

Definition: A **counterexample** is an example that shows that a statement is not always true.

Related Words: counteract (verb), counterargument (noun), counterclockwise (adjective)

Example: For all real numbers, $a + b = a \cdot b$ is a *false* statement. You can show the statement is false by using a **counterexample** like the one below.

$5 + 3 = 8$ is *not* equal to $5 \cdot 3 = 15$.

You need only one **counterexample** to prove that a statement is false.

Use Your Vocabulary

Draw a line from each statement to a *counterexample* that shows it to be false.

Statement	Counterexample
3. If you live in Miami, you live in Florida.	Mexico is in North America.
4. If you live near an ocean, you live near the Atlantic Ocean.	People in California live near the Pacific Ocean.
5. If you live in North America, you live in the United States.	Miami is a city in Ohio.

take note

Properties Properties of Real Numbers

Draw a line from each property in Column A to the equation that illustrates it in Column B.

Column A	Column B
6. Associative Property of Addition	$15y + 0 = 15y$
7. Associative Property of Multiplication	$7b \cdot 2 = 2 \cdot 7b$
8. Commutative Property of Addition	$(c \cdot 3) \cdot 5 = c \cdot (3 \cdot 5)$
9. Commutative Property of Multiplication	$6x + 5y = 5y + 6x$
10. Identity Property of Addition	$a \cdot 1 = a$
11. Identity Property of Multiplication	$(g + 11h) + 9h = g + (11h + 9h)$
12. Multiplication Property of -1	$7k \cdot 0 = 0$
13. Zero Property of Multiplication	$15m \cdot (-1) = -15m$

Problem 1 Identifying Properties

Got It? **What property is illustrated by $4x \cdot 1 = 4x$?**

14. For each question, determine if the stated characteristic is or is not being illustrated by $4x \cdot 1 = 4x$.

Is the same number being added to both sides of the equation?	Yes / (No)
Are groupings being changed in the equation?	Yes / (No)
Is 0 or 1 part of the equation?	(Yes) / No

15. Think of the operation symbol that will make the equation $4x \blacksquare 1 = 4x$ true. What property is illustrated by $4x \cdot 1 = 4x$?

Identity Property of Multiplication

Problem 2 Using Properties for Mental Calculations

Got It? **A can holds 3 tennis balls. A box holds 4 cans. A case holds 6 boxes. How many tennis balls are in 10 cases? Use mental math.**

16. Complete the boxes below to write an expression for the number of tennis balls in 10 cases.

Relate	number of cases of tennis balls	times	number of boxes per case	times	number of cans per box	times	number of tennis balls per can
Write	10	·	6	·	4	·	3

17. Mental Math Circle the simplified expression.

24 60 120 (720)

18. What is one of the properties you used to simplify the expression? Explain how you used the property.

Answers may vary. Sample: I used the Associative Property of Multiplication to group numbers to make them easier to work with.

Problem 3 Writing Equivalent Expressions

Got It? **Simplify each expression.**

$2.1(4.5x)$ $6 + (4h + 3)$ $\frac{8m}{12mn}$

In Exercises 19–20, each expression is simplified. Justify each step.

19. $2.1(4.5x) = (2.1 \cdot 4.5)x$ — Associative Property of Multiplication

$= 9.45x$ — Simplify.

20. $6 + (4h + 3) = (4h + 3) + 6$ — Commutative Property of Addition

$= 4h + (3 + 6)$ — Associative Property of Addition

$= 4h + 9$ — Simplify.

21. Complete each step of the simplification.

$$\frac{8m}{12mn} = \frac{2 \cdot \boxed{4} \cdot \boxed{m} \cdot 1}{3 \cdot 4 \cdot m \cdot n}$$

$$= \frac{2}{3} \cdot \frac{\boxed{4}}{\boxed{4}} \cdot \frac{\boxed{m}}{\boxed{m}} \cdot \frac{1}{n} = \frac{2}{3} \cdot \boxed{1} \cdot \boxed{1} \cdot \frac{1}{n} = \frac{2}{3} \cdot \boxed{\frac{1}{n}} = \boxed{\frac{2}{3n}}$$

Problem 4 Using Deductive Reasoning and Counterexamples

Got It? Reasoning **Is the statement *true* or *false*? If it is false, give a counterexample. If true, use properties of real numbers to show the expressions are equivalent.**

For all real numbers j and k, $j \cdot k = (k + 0) \cdot j$.

22. Simplify the right side of the equation above and state the property that you used.

$(k + 0) \cdot j =$ $\boxed{k}$ $\cdot j$ — Identity Property of Addition

23. Complete: The simplified expression is equal to $j \cdot k$ by the ? Property of Multiplication. — Commutative

24. So, the statement $j \cdot k = (k + 0) \cdot j$ is ?. — (True) / False

Got It? **Reasoning** **Is the statement *true* or *false*? If it is false, give a counterexample. If true, use properties of real numbers to show the expressions are equivalent.**

For all real numbers m and n, $m(n + 1) = mn + 1$.

Evaluate each expression for $m = 4$ and $n = 5$.

25. $m(n + 1) = 4 \cdot (5 + 1)$

$= 4 \cdot 6$

$= 24$

26. $mn + 1$

$4 \cdot 5 + 1 = 20 + 1$

$= 21$

27. Is the value of the expression in Exercise 25 equal to the value of the expression in Exercise 26?

Yes / (No)

28. Is the original statement *true* or *false*? If it is false, give a counterexample. If true, use properties of real numbers to show the expressions are equivalent.

False. Explanations may vary. Sample: The two sides of the equation are not equal for $m = 4$ and $n = 5$, so they are not always equal.

Lesson Check • Do you UNDERSTAND?

Justify each step to show that $3 \cdot (10 \cdot 12) = 360$.

29. The left side of the expression is simplified below. Write a reason for each step.

$3 \cdot (10 \cdot 12) = 3 \cdot (12 \cdot 10)$	Commutative Property of Multiplication
$= (3 \cdot 12) \cdot 10$	Associative Property of Multiplication
$= 36 \cdot 10$	Multiply within parentheses.
$= 360$	Multiply.

Math Success

Check off the vocabulary words that you understand.

- ☐ Commutative Properties
- ☐ Associative Properties
- ☐ Identity Properties
- ☐ equivalent expressions
- ☐ deductive reasoning
- ☐ counterexample

Rate how well you can *use the properties of addition and multiplication.*

Need to review — 0 2 4 6 8 10 — Now I get it!

1-5 Adding and Subtracting Real Numbers

Vocabulary

Review

1. Cross out the expressions that do NOT show a *difference*.

~~15 + 6~~ 14 − 3 ~~4 · 8~~ ~~48 ÷ 12~~

2. Circle the expression that shows a *sum*.

45 − 26 12 ÷ 3 (42 + 3) 22 − 9

3. Find the *difference* of 20 and 15.

5

4. Find the *sum* of 38 and 19.

57

Vocabulary Builder

inverse (noun) **in** VUHRS

Related Word: invert (verb)

Definition: An **inverse** is the opposite, or reverse, of something.

Example: −5 and 5 are additive **inverses,** or *opposites*. They are the same distance from zero on a number line.

What It Means: Additive **inverses** have a sum of 0.

additive inverses
$-5 + 5 = 0$
$5 + (-5) = 0$

Use Your Vocabulary

5. Write the additive *inverse* of each number.

7 **−7** −3 **3** −11 **11** 9 **−9**

The **absolute value** of a number is its distance from 0 on a number line. The **absolute value** of −7, written $|-7|$, is equal to 7, because −7 is 7 units from 0 on a number line.

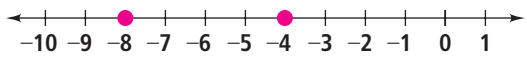
Compare. Write <, >, or =.

6. $|3|$ **=** $|-3|$ **7.** $|-3|$ **=** 3 **8.** −3 **<** $|-3|$ **9.** $|3|$ **>** −3

Problem 1 Using Number Line Models

Got It? **What is $-8 + 4$? Use a number line.**

10. Use the number line to help you find the sum.



Start at 0.

Move 8 units left. Graph a point at –8 on the number line.

Then move 4 units right. Graph a point at –4 on the number line.

11. Underline the correct word to complete each sentence.

The number -8 tells you to start at 0 and move 8 units to the left / right.

The number 4 tells you to then move 4 units to the left / right.

12. Complete: $-8 + 4 =$ **−4**

take note

Key Concept Adding Real Numbers

To add two numbers with the **same sign**, add their absolute values. The sum has the same sign as the addends.

To add two numbers with **different signs,** subtract their absolute values. The sum has the same sign as the addend with the greater absolute value.

Problem 2 Adding Real Numbers

Got It? **What is the sum $-16 + (-8)$?**

13. The addends -16 and -8 have different signs / the same sign.

14. When -16 and -8 are added, the answer will be positive / negative.

15. Complete: $-16 + (-8) =$ **−24**

Got It? **What is the sum $-11 + 9$?**

16. The addends -11 and 9 have different signs / the same sign.

17. When -11 and 9 are added, the answer will be positive / negative.

18. Complete: $-11 + 9 =$ **−2**

Got It? **What is the sum $9 + (-11)$?**

19. The addends of this exercise and those of Exercise 18 are the same / different.

20. Complete: $9 + (-11) =$ **−2**

Got It? **What is the sum $-6 + (-2)$?**

21. Complete: $-6 + (-2) =$ **−8**

take note

Key Concept Subtracting Real Numbers

To subtract a real number, add its opposite: $a - b = a + (-b)$.

Complete to find each difference.

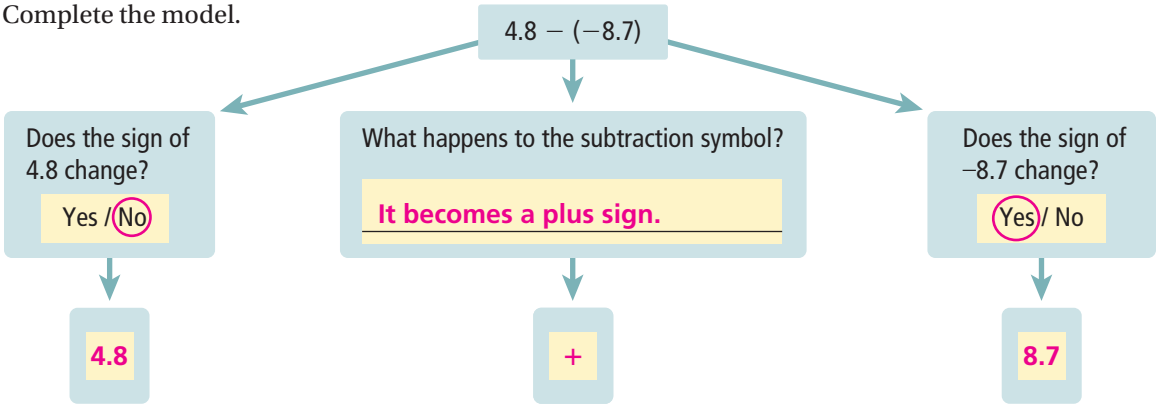
22. $-7 - 2 = -7 + (\ -2\ )$
$= -9$

23. $8.2 - (-2.1) = 8.2 + 2.1$
$= 10.3$

Problem 3 Subtracting Real Numbers

Got It? **What is $4.8 - (-8.7)$?**

24. Complete the model.



25. Now simplify the expression.

$4.8 + 8.7 = 13.5$

Got It? **Reasoning** **For what values of a and b does $a - b = b - a$?**

26. Test values of a and b that are different.

Suppose $a = -5$ and $b = 4$.

$a - b = -5 - (4) = -5 + (-4) = -9$

$b - a = 4 - (-5) = 4 + 5 = 9$

When $a \neq b$, does $a - b = b - a$? Yes / No

27. Now test values of a and b that are the same.

Suppose $a = -6$ and $b = -6$.

$a - b = -6 - (-6) = -6 + 6 = 0$

$b - a = -6 - (-6) = -6 + 6 = 0$

When $a = b$, does $a - b = b - a$? Yes / No

28. For what values of a and b does $a - b = b - a$?

Answers may vary. Sample: If a and b are the same value, then $a - b = b - a$.

Problem 4 Adding and Subtracting Real Numbers

Got It? **A robot submarine dives 803 ft to the ocean floor. It rises 215 ft as the water gets shallower. Then the submarine dives 2619 ft into a deep crevice. Next, it rises 734 ft to photograph a crack in the wall of the crevice. What is the location of the crack in relation to sea level?**

29. Follow the steps to find the location of the crack in relation to sea level.
Hint: Use 0 to represent sea level.

1 The submarine dives 803 ft. Where is the submarine in relation to sea level?
0 ft + **−803** ft = −803 ft

2 The submarine rises 215 ft as the water gets shallower. Now where is the submarine in relation to sea level?
−803 ft + 215 ft = **−588** ft

3 Then the submarine dives 2619 ft. Now where is the submarine in relation to sea level?
−588 ft + (−2619 ft) = **−3207** ft

4 Next, the submarine rises 734 ft to photograph the crack in the wall of the crevice. Where is the submarine (and the crack) in relation to sea level?
−3207 ft + **734** ft = **−2473** ft

Lesson Check • Do you UNDERSTAND?

Error Analysis **Your friend says that since $-a$ is the opposite of a, the opposite of a number is always negative. Describe and correct the error.**

30. Use a counterexample to describe and correct your friend's error. **Answers may vary.**

Sample: The opposite of −3 is 3, which is a positive number. The counterexample proves that the opposite of a number is not always negative.

Math Success

Check off the vocabulary words that you understand.

☐ absolute value ☐ opposites ☐ additive inverses

Rate how well you can *add and subtract real numbers*.

Need to review 0 2 4 6 8 10 Now I get it!

1-6 Multiplying and Dividing Real Numbers

Vocabulary

Review

1. How is a *product* different from a *quotient*?

Answers may vary. Sample: A product is the result of multiplying.

A quotient is the result of dividing.

2. Circle the *product* of 12 and 4. Underline the *quotient* of 12 and 4.

3 8 16 (48)

Vocabulary Builder

reciprocal (noun) **rih SIP ruh kul**

Related Term: multiplicative inverse

Definition: Two numbers are **reciprocals** if their product is 1.

Main Idea: To write the **reciprocal** of a fraction, switch the numerator and denominator of the fraction.

Examples: $\frac{4}{5}$ and $\frac{5}{4}$, $-\frac{7}{8}$ and $-\frac{8}{7}$, 5 and $\frac{1}{5}$, $1\frac{1}{2}$ and $\frac{2}{3}$

reciprocals

$\frac{a}{b}$ and $\frac{b}{a}$, where $a \neq 0$ and $b \neq 0$

Use Your Vocabulary

3. Draw a line from each expression in Column A to its *reciprocal* in Column B.

Column A	Column B
$\frac{3}{4}$	2
$\frac{1}{2}$	$-\frac{3}{5}$
-2	$-\frac{1}{2}$
$1\frac{3}{4}$	$\frac{4}{3}$
$-\frac{5}{3}$	$\frac{4}{7}$

take note

Key Concept Multiplying and Dividing Real Numbers

The product or quotient of two real numbers with different signs is negative.

The product or quotient of two real numbers with the same sign is positive.

The quotient of 0 and any nonzero real number is 0.

The quotient of any real number and 0 is undefined.

4. Write *negative, positive, undefined,* or *zero* for each result.

$5(-9)$	$-8(-2)$	$0 \div 9$	$9 \div 0$
negative	positive	zero	undefined

5. Write 4 or (-4) to make each equation true.

$6 \cdot$ 4 $= 24$ $\quad 6 \cdot$ (-4) $= -24$ $\quad 24 \div$ (-4) $= -6$ $\quad 24 \div$ 4 $= 6$

Problem 1 Multiplying Real Numbers

Got It? What is each product?

$6(-15)$ $\quad 12(0.2)$ $\quad -\frac{7}{10}\left(\frac{3}{5}\right)$ $\quad (-4)^2$

6. In $6(-15)$ and $-\frac{7}{10}\left(\frac{3}{5}\right)$, the signs of the numbers are the same / different.

So, the product of 6 and (-15) and the product of $-\frac{7}{10}$ and $\frac{3}{5}$ will be positive / negative.

7. Multiply.

$6(-15) =$ -90 $\quad -\frac{7}{10}\left(\frac{3}{5}\right) =$ $-\frac{21}{50}$

8. In $12(0.2)$ and $(-4)(-4)$, the signs of the numbers are the same / different.

9. Multiply.

$12(0.2) =$ 2.4 $\quad (-4)^2 = (-4)(-4) =$ 16

Problem 2 Simplifying Square Root Expressions

Got It? What is the simplified form of $\sqrt{100}$?

10. Circle the equation that uses the positive square root of 100.

$2 \cdot 50 = 100$ $\quad 4 \cdot 25 = 100$ $\quad$ (10 · 10 = 100)

11. Will the simplified form of $\sqrt{100}$ be *positive* or *negative*? Explain.

Positive. Explanations may vary. Sample: If there is no minus sign before the radical, it is the principal root, which is positive.

12. The simplified form of $\sqrt{100}$ is 10.

Problem 3 Dividing Real Numbers

Got It? **You make five withdrawals of equal amounts from your bank account. The total amount you withdraw is $360. What is the change in your account balance each time you make a withdrawal?**

13. Complete the model.

Relate	total amount withdrawn	divided by	number of withdrawals	is	change in account balance each time
Write	–360	÷	5	=	–72

14. The change in the account balance per withdrawal is −$ 72 .

take note

Property Inverse Property of Multiplication

For every nonzero real number a, there is a **multiplicative inverse** $\frac{1}{a}$ such that $a\left(\frac{1}{a}\right) = 1$.

The reciprocal of a nonzero number of the form $\frac{a}{b}$ is $\frac{b}{a}$. The product of a number and its reciprocal is 1, so the reciprocal of a number is its multiplicative inverse.

Dividing by a fraction is equivalent to multiplying by the reciprocal of the fraction. In general, $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$ for b, c, and $d \neq 0$.

Problem 4 Dividing Fractions

Got It? **What is the value of $\frac{3}{4} \div \left(-\frac{5}{2}\right)$?**

Underline the correct word to complete each sentence.

15. The expression shows multiplication / division .

16. To divide fractions, multiply the first / second fraction by the reciprocal of the first / second fraction.

17. Simplify the expression below.

$\frac{3}{4} \div \left(-\frac{5}{2}\right) = \frac{3}{4} \cdot \left(-\frac{2}{5}\right)$ Multiply by the reciprocal of $-\frac{5}{2}$.

$= -\frac{6}{20}$ Multiply.

$= -\frac{3}{10}$ Simplify.

Got It? **Reasoning** **Is $\frac{3}{4} \div \left(-\frac{5}{2}\right)$ equivalent to $-\left(\frac{3}{4} \div \frac{5}{2}\right)$? Explain.**

18. Dividing a number by $\frac{5}{2}$ is equivalent to multiplying the number by $\frac{2}{5}$.

19. Simplify $-\left(\frac{3}{4} \div \frac{5}{2}\right)$.

$$-\left(\frac{3}{4} \div \frac{5}{2}\right) = -\left(\frac{3}{4} \cdot \frac{2}{5}\right)$$
$$= -\left(\frac{6}{20}\right)$$
$$= -\frac{3}{10}$$

20. Is $\frac{3}{4} \div \left(-\frac{5}{2}\right)$ equivalent to $-\left(\frac{3}{4} \div \frac{5}{2}\right)$? Explain.

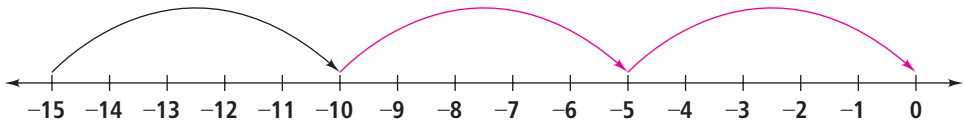
Yes. Explanations may vary. Sample: The fractions are in the same order, and there is one negative sign in each problem.

Lesson Check • Do you UNDERSTAND?

Reasoning **Use a number line to explain why $-15 \div 3 = -5$.**

21. In words, $-15 \div 3$ means dividing -15 into 3 equal groups.

22. To model $-15 \div 3$ on a number line, start at -15. Then use arrows to show three equal groups. The first equal group is shown.



23. What do the three arrows showing the equal groups represent?

Answers may vary. Sample: The three arrows showing the equal groups represent the " ÷ 3" in $-15 \div 3 = -5$.

24. Divide: $-15 \div 3 =$ -5.

Math Success

Check off the vocabulary words that you understand.

☐ Inverse Property of Multiplication ☐ multiplicative inverse ☐ reciprocal

Rate how well you can *multiply and divide real numbers.*

Need to review  Now I get it!

1-7 The Distributive Property

Vocabulary

Review

1. Circle the *property* of addition illustrated by $7 + 0 = 7$.

Associative Property | Commutative Property | **Identity Property** | Zero Property

2. Circle the *property* of multiplication illustrated by $4 \cdot 0 = 0$.

Associative Property | Commutative Property | Identity Property | **Zero Property**

3. Circle the *property* of addition that is illustrated by $(63 + 9) + 1 = 63 + (9 + 1)$.

Associative Property | Commutative Property | Identity Property

4. Circle the *property* of multiplication that is illustrated by $52 \cdot (-1) = -52$.

Identity Property | Zero Property | **Property of -1**

Vocabulary Builder

distribute (verb) **dih STRIB yoot**

Other Word Forms: distributive (adjective), distribution (noun)

Definition: To **distribute** means to give out or hand out.

$7(3 + 6) = 7 \cdot 3 + 7 \cdot 6$

The factor 7 is **distributed** to the 3 and the 6.

Use Your Vocabulary

Complete each sentence with *distribute, distribution,* or *distributed*.

5. The teacher __?__ a marked test to each student in the class. **distributed**

6. The __?__ of tests grades shows that there are 12 A's, 10 B's, and 8 C's. **distribution**

7. After reviewing the test scores, the teacher will __?__ tonight's homework. **distribute**

take note

Property Distributive Property

8. Complete the table.

Algebra Let a, b, and c be real numbers.	Example
$a(b + c) = ab + ac$	$3(10 + 4) = 3 \cdot$ **10** $+ 3 \cdot$ **4**
$(b + c)a = ba + ca$	$(5 + 3)7 = 5 \cdot$ **7** $+ 3 \cdot$ **7**
$a(b - c) = ab - ac$	$9(8 - 2) = 9 \cdot$ **8** $- 9 \cdot$ **2**
$(b - c)a = ba - ca$	$(28 - 6)4 = 28 \cdot$ **4** $- 6 \cdot$ **4**

Problem 1 Simplifying Expressions

Got It? What is the simplified form of $5(x + 7)$?

9. Circle how you read the expression $5(x + 7)$.

5 times x plus 7 | 5 times the quantity x plus 7

10. To simplify $5(x + 7)$, which number do you distribute? How do you know?

Answers may vary. Sample: You distribute the 5 outside the parentheses. It multiplies each number inside the parentheses.

11. Finish simplifying the expression.

$$5(x + 7) = 5 \cdot \textbf{x} + \textbf{5} \cdot 7$$
$$= \textbf{5x + 35}$$

Got It? What is the simplified form of $12(3 - \frac{1}{6}t)$?

12. Complete the steps to simplify the expression.

$$12(3 - \tfrac{1}{6}t) = \textbf{12} \cdot 3 - \textbf{12} \cdot \tfrac{1}{6}t$$
$$= \textbf{36} - \frac{\textbf{12}}{6} \cdot t$$
$$= \textbf{36} - \textbf{2} \cdot t$$

Problem 2 Rewriting Fraction Expressions

Got It? **What sum or difference is equivalent to $\frac{4x - 16}{3}$?**

13. Recall that a fraction $\frac{a}{b}$ can be written as $\frac{1}{b} \cdot a$.

So, $\frac{4x}{3}$ can be written as $\frac{\boxed{1}}{\boxed{3}} \cdot 4x$.

14. Now complete the steps to find an expression equivalent to $\frac{4x - 16}{3}$.

$\frac{4x - 16}{3} = \boxed{\frac{1}{3}} \cdot (4x - 16)$ Write the division as multiplication.

$= \boxed{\frac{1}{3}} \cdot (4x) - \boxed{\frac{1}{3}} \cdot (16)$ Use the Distributive Property.

$= \boxed{\frac{4}{3}} x - \boxed{\frac{16}{3}}$ Simplify.

The Multiplication Property of -1 states that $-1 \cdot x = -x$. To simplify an expression such as $-(x + 6)$, you can rewrite the expression as $-1(x + 6)$.

Problem 3 Using the Multiplication Property of -1

Got It? **What is the simplified form of $-(a + 5)$?**

15. Underline the correct word to complete the sentence.

A negative sign in front of the parentheses means that the entire expression inside the parentheses is the same / opposite.

16. Simplify $-(a + 5)$ by completing each step.

$-(a + 5) = -\boxed{1} \cdot (a + 5)$ Multiplication Property of -1

$= (\boxed{-1})(a) + (\boxed{-1})(5)$ Distributive Property

$= \boxed{-a - 5}$ Simplify.

Problem 4 Using the Distributive Property for Mental Math

Got It? **Julia commutes to work on the train 4 times each week. A round-trip ticket costs $7.25. What is her weekly cost for tickets? Use mental math.**

17. The expression $4 \cdot 7.25$ is simplified below using steps that could be used to do the problem mentally. Complete the missing parts.

$4(7.25) = 4(7 + \boxed{0.25})$ Write 7.25 as $7 + 0.25$.

$= \boxed{4} \cdot 7 + \boxed{4} \cdot 0.25$ Distributive Property

$= \boxed{28} + \boxed{1}$ Multiply.

$= \boxed{29}$ Add.

18. The weekly cost for her tickets is $ \boxed{29} .

A *term* is a number, a variable, or the product of a number and one or more variables. *Like terms* have the same variable factors.

Circle the variable factors in each expression. Then circle *Yes* if they are *like terms* or *No* if they are not.

19. $3x^2 + 5x^2$

Yes / No

20. $z^2w - zw^2$

Yes / No

$5x^2 + 3xy - 2xy + 19$

terms

$3xy$ and $2xy$ are *like terms* because they both have the variable factor xy.

Problem 5 Combining Like Terms

Got It? **What is the simplified form of $3y - y$?**

21. Are the terms $3y$ and $-y$ *like terms*?

Yes / No

22. Use the Distributive Property to write $3y - y$ as a product. Then simplify.

$3y - y = y($ 3 $-$ 1 $)$

$= y($ 2 $)$

Lesson Check • Do you UNDERSTAND?

Reasoning **Is each expression in simplified form? Justify your answer.**

$4xy^3 + 5x^3y$ $\quad -(y - 1)$ $\quad 5x^2 + 12xy - 3yx$

23. Does $4xy^3 + 5x^3y$ have any like terms?

Yes / No

Is the expression simplified?

Yes / No

24. Can the -1 in front of $-(y - 1)$ be distributed?

Yes / No

Simplify the expression.

$-y + 1$

25. Can the last term of $5x^2 + 12xy - 3yx$ be written as $3xy$?

Yes / No

Simplify the expression.

$5x^2 + 9xy$

Math Success

Check off the vocabulary words that you understand.

☐ Distributive Property ☐ term ☐ like terms

Rate how well you can *use the Distributive Property*.

Need to review 0 2 4 6 8 10 Now I get it!

1-8 An Introduction to Equations

Vocabulary

Review

1. Circle each pair of *opposites.*

$\frac{1}{5}$ and 5	-17 and 17	0 and 1	$\frac{3}{20}$ and $-\frac{3}{20}$

2. An *equation* is a mathematical sentence that uses an equal sign (=). Circle each equation below.

$y - 3 = 12$	$7 = \frac{w}{7}$	$5x - 7 + 2$	$43 = 43$

Use mental math to solve each *equation.*

3. $10 + \boxed{3} = 13$ **4.** $17 = 8 + \boxed{9}$ **5.** $43 + \boxed{56} = 99$

Vocabulary Builder

solution (noun) **suh LOO shun**

Related Word: solve (verb)

Definition: A **solution** is any value or values that make an equation true.

Example: The **solution** of the equation $x + 4 = 12$ is 8.

Nonexample: 6 is NOT a **solution** of the equation $x - 4 = 10$.

7 is a **solution** of $x + 2 = 9$ because $7 + 2 = 9$.

Use Your Vocabulary

6. Cross out the equation for which 24 is NOT the *solution.*

$x + 4 = 28$	$y - 2 = 22$	~~$3w = 24$~~	$\frac{48}{2} = z$

7. Circle the equation for which 20 is the *solution.*

$10 + m = 20$	$25 = n - 5$	$5x + 5 = 95$	$\frac{y}{5} = 4$

8. Circle the *solution* of $7 - x = 9$.

-16	-2	2	16

An equation is *true* if the expressions on either side of the equal sign are equal. An equation is *false* if the expressions on either side of the equal sign are not equal. An equation that contains one or more variables is called an **open sentence**.

Problem 1 Classifying Equations

Got It? **Is the equation $3y + 6 = 5y - 8$ *true, false,* or *open*? Explain.**

9. Does the equation contain one or more variables? (Yes) / No

10. Is the equation *true, false,* or *open*? Explain.

Open. Sample: $3y + 6 = 5y - 8$ is open because it contains a variable.

Got It? **Is the equation $16 - 7 = 4 + 5$ *true, false,* or *open*? Explain.**

11. $16 - 7 =$ 9

12. $4 + 5 =$ 9

13. Does $16 - 7 = 4 + 5$? (Yes) / No

14. Is the equation *true, false,* or *open*? Explain.

True. Sample: $16 - 7 = 4 + 5$ is true because $16 - 7$ is equal to $4 + 5$.

Got It? **Is the equation $32 \div 8 = 2 \cdot 3$ *true, false,* or *open*? Explain.**

15. $32 \div 8 =$ 4

16. $2 \cdot 3 =$ 6

17. Does $32 \div 8 = 2 \cdot 3$? Yes / (No)

18. Is the equation *true, false,* or *open*? Explain.

False. Sample: $32 \div 8 = 2 \cdot 3$ is false because $32 \div 8 = 4$, but $2 \cdot 3 = 6$.

Problem 2 Identifying Solutions of an Equation

Got It? **Is $m = \frac{1}{2}$ a solution of the equation $6m - 8 = -5$?**

19. Complete the reasoning model below.

Think	Write
I can substitute $\frac{1}{2}$ for m.	$6 \cdot \frac{1}{2} - 8 \stackrel{?}{=} -5$
Now I can simplify.	$3 - 8 \stackrel{?}{=} -5$ $-5 = -5$
Finally, I can write a sentence to answer the question.	$\frac{1}{2}$ is / is not a solution of $6m - 8 = -5$.

Problem 3 Writing an Equation

Got It? **The length of the ball court at La Venta is 14 times the height of its walls. Write an equation that can be used to find the height of a model of the court that has a length of 49 cm.**

20. Complete the model below.

Relate the length of the model court | is | fourteen | times | the height of its walls

Define Let h = ?. Circle your choice below.

area of wall | (height of wall) | width of wall

Write 49 = 14 · h

21. Now write an equation that you can use to find the height of the model.

$49 = 14 \cdot h$

Problem 4 Using Mental Math to Find Solutions

Got It? **What is the solution of $12 - y = 3$? Use mental math.**

22. Think: "What number added to / subtracted from 12 is equal to 3?"

23. Circle the solution.

15 | 12 | (9) | 6

24. Check your work.

Sample: $12 - 9 = 3$

Problem 5 Using a Table to Find a Solution

Got It? **What is the solution of $25 - 3p = 55$? Use a table.**

25. Complete the table for each value of p.

p	$25 - 3p$	Value of $25 - 3p$
0	$25 - 3 \cdot$ 0	25
10	$25 - 3 \cdot$ 10	–5
–5	$25 - 3 \cdot$ –5	40
–10	$25 - 3 \cdot$ –10	55

26. Complete each sentence.

When p = –10, the value of $25 - 3p$ is 55.

So, the solution of $25 - 3p = 55$ is –10.

Problem 6 Estimating a Solution

Got It? What is the solution of $3x + 3 = -22$? Use a table.

27. Use the table at the right to help you estimate and find the integer values of x between which the solution must lie.

28. The solution lies between **–8** and **–9**.

x	$3x + 3$	Value of $3x + 3$
–2	$3 \cdot$ **–2** $+ 3$	**–3**
–7	$3 \cdot$ **–7** $+ 3$	**–18**
–8	$3 \cdot$ **–8** $+ 3$	**–21**
–9	$3 \cdot$ **–9** $+ 3$	**–24**

Lesson Check • Do you UNDERSTAND?

Compare and Contrast Use two different methods to find the solution of the equation $x + 4 = 13$. Which method do you prefer? Explain.

29. Solve the problem using mental math.

Explanations may vary. Sample: I know that 9 + 4 = 13. So, the solution is 9.

30. Solve the problem using a table.

Values may vary. Sample:

x	$x + 4$	Value of $x + 4$
0	**0 + 4**	**4**
5	**5 + 4**	**9**
9	**9 + 4**	**13**

31. Explain which method you prefer.

Answers may vary. Accept all reasonable explanations.

Math Success

Check off the vocabulary words that you understand.

☐ equation ☐ open sentence ☐ solution of an equation

Rate how well you can *solve an equation.*

Need to review 0 2 4 6 8 10 **Now I get it!**

1-9 Patterns, Equations, and Graphs

Vocabulary

Review

1. Draw a line from each pair of numbers in Column A to its description in Column B.

Column A	Column B
$\frac{5}{6}$ and $-\frac{5}{6}$	opposites (additive inverses)
$\frac{3}{4}$ and $\frac{4}{3}$	reciprocals (multiplicative inverses)
-2 and $-\frac{1}{2}$	

Vocabulary Builder

inductive reasoning (noun) **in DUK tiv REE zun ing**

Definition: **Inductive reasoning** is the process of reaching a conclusion based on an observed pattern.

Main Idea: You can use **inductive reasoning** to go from a set of particular observations to a general rule.

Example: Each piece of ice in this bucket is cold. I conclude, by **inductive reasoning,** that all ice is cold.

Use Your Vocabulary

Use the table at the right for Exercises 2–4. Complete each statement with one of the words or phrases below.

add inductive reasoning multiply pattern subtract

Item Number	Value
1	1
2	4
3	9
4	16
5	■

2. To find the value of Item 5, you can look for a ? . — **pattern**

3. To obtain the value for an item, you can ? the item number by itself. — **multiply**

4. You can use ? to predict the value of Item 5. — **inductive reasoning**

Problem 1 Identifying Solutions of a Two-Variable Equation

Got It? **Is the ordered pair (5, 20) a solution of the equation $y = 4x$?**

5. Complete the reasoning model below.

Think	Write
In (5, 20), I need to identify the *x*-coordinate and the *y*-coordinate.	*x*-coordinate: 5 ; *y*-coordinate: 20
Now I can substitute 5 for *x* and 20 for *y*.	$y = 4x$ $20 = 4 \cdot 5$
Then I can simplify the equation.	$20 = 20$

6. Is (5, 20) a solution of $y = 4x$? Yes / No

Problem 2 Using a Table, an Equation, and a Graph

Got It? **Will runs 6 laps before Megan joins him at the track. They then run together at the same pace. How can you represent the relationship between the number of laps Will runs and the number of laps Megan runs in different ways? Use a table, an equation, and a graph.**

Exercises 7 and 8 help you use a table to represent the relationship.

7. Complete the table.

Number of laps Megan runs	0	1	2	3	4	5	6	7
Number of laps Will runs	6	7	8	9	10	11	12	13

8. Circle the relationship that is represented in the table.

Will runs 13 more laps than Megan. | Megan runs 6 times as many laps as Will. | Will runs 7 more laps than Megan. | Will runs 6 more laps than Megan.

Exercises 9–11 help you write an equation to represent the relationship.

9. Let x = the number of laps Megan runs.

Then let y = the number of laps Will runs.

10. Underline the correct words to complete the sentence.

In the relationship, *y* will always be greater than / less than *x*.

11. Now write an equation to represent the relationship.

$y = x + 6$

Exercises 12–14 help you graph the relationship.

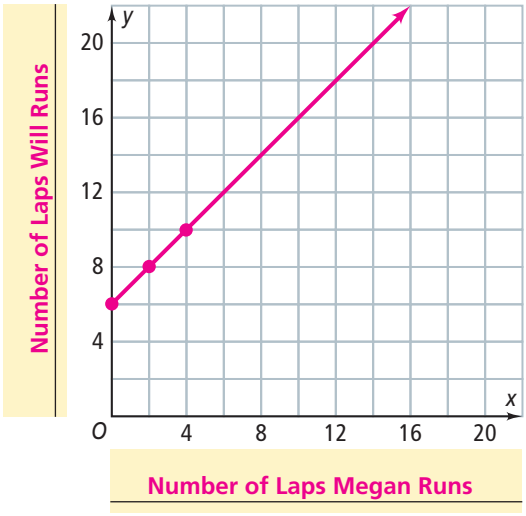
12. The ordered pair that corresponds to Megan arriving at the track is (0 , 6).

13. Use the table in Exercise 7. Write three more ordered pairs.

(2, 8) (4 , 10) (6 , 12)

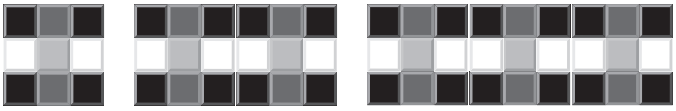
14. Graph the ordered pairs you wrote in Exercises 12 and 13 on the coordinate plane at the right. Then connect the points with a line. Be sure to label the axes.

For Exercise 13, answers for the third ordered pair may vary. The *x*-value must be 6 less than the *y*-value. The third ordered pair should be graphed on the grid.



Problem 3 Extending a Pattern

Got It? **Use the figure below. Make a table showing the number of black (B) tiles and the total number of tiles in each figure. How many tiles in all will be in a figure with 24 black (B) tiles?**



15. Complete the table.

Figure	Number of Black (B) Tiles	Total Number of Tiles
1	4	9
2	8	18
3	12	27

16. **Multiple Choice** For each new figure, how does the total number of tiles change as the number of black (B) tiles increases by 4?

(A) it doubles (B) it triples (C) it increases by 4 (D) it increases by 9

17. A figure with 24 black (B) tiles will have 54 total tiles.

Got It? **Make a table showing the number of light gray (LG) tiles and the number of white (W) tiles in each figure. How many white (W) tiles will be in a figure with 24 light gray (LG) tiles?**

18. Complete the table.

Figure	Number of Light Gray (LG) Tiles	Number of White (W) Tiles
1	1	2
2	2	4
3	3	6

19. Circle the correct description of the relationship between the figure number and the number of light gray (LG) tiles.

They are the same. | The number of light gray (LG) tiles is double the figure number. | The number of light gray (LG) tiles is triple the figure number.

20. Circle the correct description of the relationship between the number of light gray (LG) tiles and the number of white (W) tiles.

They are the same. | The number of white (W) tiles is double the number of light gray (LG) tiles. | The number of white (W) tiles is triple the number of light gray (LG) tiles.

21. A figure with 24 light gray (LG) tiles will have 48 white (W) tiles.

Lesson Check • Do you UNDERSTAND?

Reasoning **Which of (3, 5), (4, 6), (5, 7), and (6, 8) are solutions of $y = x + 2$? What is the pattern in the solutions of $y = x + 2$?**

22. Check each ordered pair in the equation $y = x + 2$. Circle the solutions.

(3, 5) (4, 6) (5, 7) (6, 8)

23. In Exercise 22, each value of y is greater than / less than each value of x.

24. Describe the pattern in the solutions of $y = x + 2$. Answers may vary.

Sample: Each y-value is 2 greater than each x-value.

Math Success

Check off the vocabulary words that you understand.

☐ solution of an equation ☐ inductive reasoning

Rate how well you can *identify solutions of a two-variable equation.*

Need to review 0 2 4 6 8 10 Now I get it!