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MINISTRY OF EDUCATION

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MATH

7

McGraw-Hill Education

Integrated Math

United Arab Emirates Edition

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2021

McGraw-Hill Education

Integrated Math

United Arab Emirates Edition

GRADE 7 • VOLUME 2

Mc Graw Hill Education

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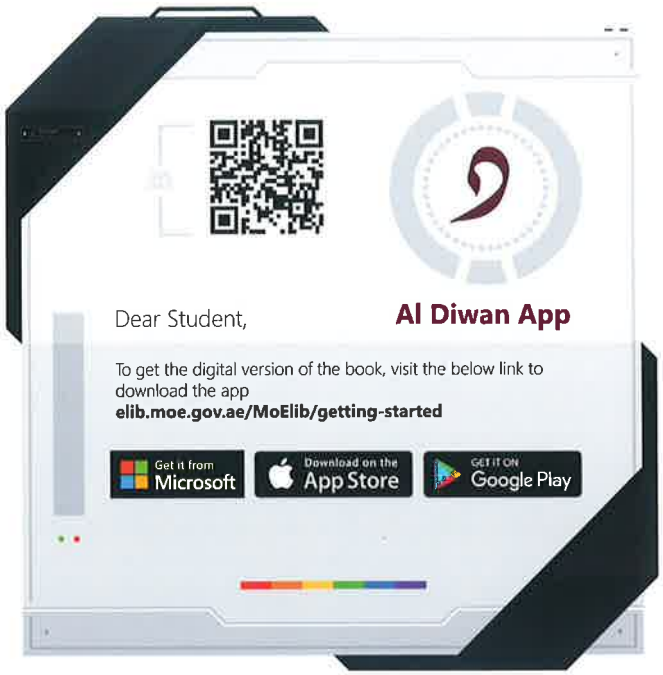
"Extensive knowledge and modern science must be acquired. The educational process we see today is in an ongoing and escalating challenge which requires hard work.
We succeeded in entering the third millennium, while we are more confident in ourselves."

H.H. Sheikh Khalifa Bin Zayed Al Nahyan
President of the United Arab Emirates



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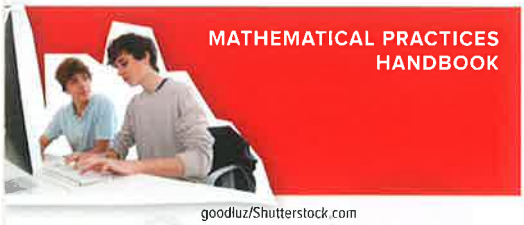
CONTENTS IN BRIEF

Units organized by domain

This book is organized into units based on groups called domains. The MP Mathematical Practices are embedded throughout the course.



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Ratios and Proportional Relationships

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The Number System

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Expressions and Equations

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Geometry

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Statistics and Probability

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Meet the Authors

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Our lead authors ensure that the McGraw-Hill mathematics programs are truly vertically aligned by beginning with the end in mind - success in Algebra 1 and beyond. By "backmapping" the content from the high school programs, all of our mathematics programs are well articulated in their scope and sequence.

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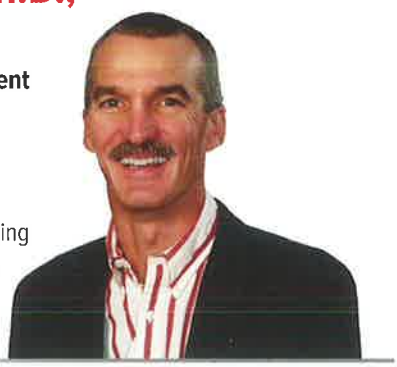

In Memoriam

Carol Malloy, Ph.D.

Dr. Carol Malloy was a fervent supporter of mathematics education. She was a Professor at the University of North Carolina, Chapel Hill, NCTM Board of Directors member, President of the Benjamin Banneker Association (BBA), and 2013 BBA Lifetime Achievement Award for Mathematics winner. She joined McGraw-Hill in 1996. Her influence significantly improved our programs' focus on real-world problem solving and equity. We will miss her inspiration and passion for education.

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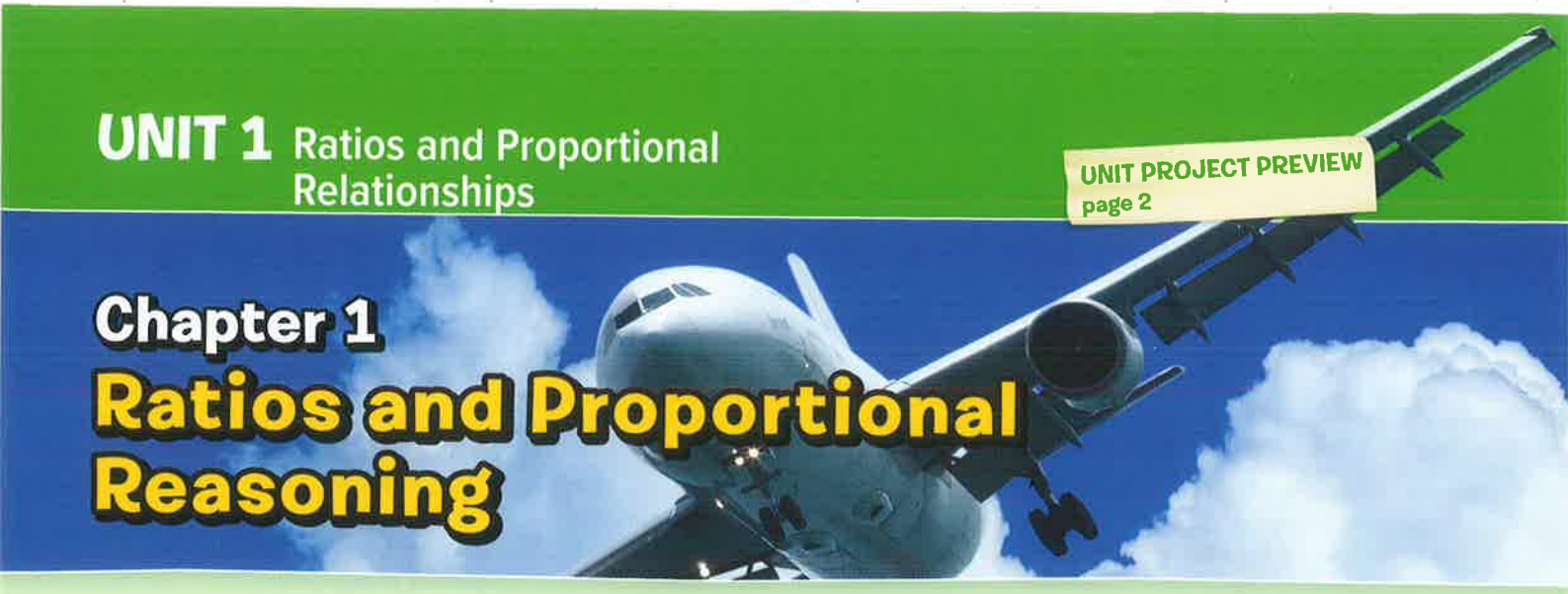
UNIT 1 Ratios and Proportional Relationships

UNIT PROJECT PREVIEW
page 2



Chapter 1 Ratios and Proportional Reasoning

Essential Question

HOW can you show that two objects are proportional?

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Chapter 2 Percents

Essential Question

HOW can percent help you understand situations involving money?

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UNIT 2 The Number System

UNIT PROJECT PREVIEW
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Chapter 3 Integers

Essential Question

WHAT happens when you add, subtract, multiply, and divide integers?

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Chapter 4 Rational Numbers

Essential Question

WHAT happens when you add, subtract, multiply, and divide fractions?

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UNIT 3 Expressions and Equations

UNIT PROJECT PREVIEW
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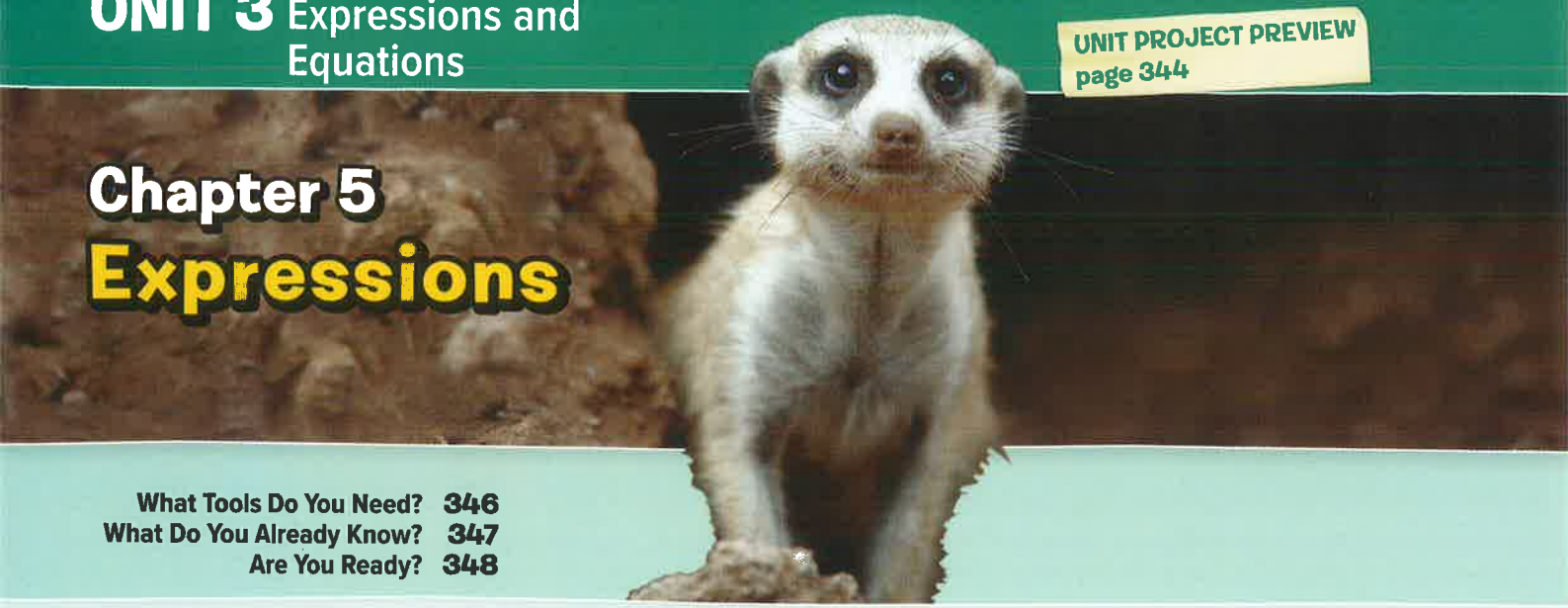

Chapter 5 Expressions

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

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Chapter 6 Equations and Inequalities

Essential Question

WHAT does it mean to say two quantities are equal?

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UNIT 4 Geometry

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Chapter 7 Geometric Figures

Essential Question

HOW does geometry help us describe real-world objects?

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Chapter 8
Measure Figures

What Tools Do You Need?
What Do You Already Know?
Are You Ready?

Essential Question

HOW do measurements help you describe real-world objects?

UNIT PROJECT

Turn Over a New Leaf

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UNIT 5 Statistics and Probability

UNIT PROJECT PREVIEW

Chapter 9 Probability

Essential Question

HOW can you predict the outcome of future events?

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Chapter 10 Statistics

What Tools Do You Need?
What Do You Already Know?
Are You Ready?

Essential Question

HOW do you know which type of graph to use when displaying data?

UNIT PROJECT

Math Genes

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This book focuses on four critical areas: (1) developing understanding of and applying proportional relationships; (2) operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings, geometric constructions, and surface area, and volume; and (4) drawing inferences about populations.

Content

Ratios and Proportional Relationships

- Analyze proportional relationships and use them to solve real-world and mathematical problems.

The Number System

- Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

Expressions and Equations

- Use properties of operations to generate equivalent expressions.
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Geometry

- Draw, construct and describe geometrical figures and describe the relationships between them.
- Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Statistics and Probability

- Use random sampling to draw inferences about a population.
- Draw informal comparative inferences about two populations.
- Investigate chance processes and develop, use, and evaluate probability models.

MP Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

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Mathematical Practices Handbook

Essential Question

WHAT practices help me explore and explain mathematics?

Mathematical Practices

The standards for mathematical practice will help you become a successful problem solver and to use math effectively in your daily life.

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What You'll Learn

MP Throughout this handbook, you will learn about each of these mathematical practices and how they are integrated in the chapters and lessons of this book.

① **Focus on Mathematical Practice**
Persevere with Problems

② **Focus on Mathematical Practice**
Reason Abstractly and Quantitatively

③ **Focus on Mathematical Practice**
Construct an Argument

④ **Focus on Mathematical Practice**
Model with Mathematics

⑤ **Focus on Mathematical Practice**
Use Math Tools

⑥ **Focus on Mathematical Practice**
Attend to Precision

⑦ **Focus on Mathematical Practice**
Make Use of Structure

⑧ **Focus on Mathematical Practice**
Use Repeated Reasoning

Place a checkmark below the face that expresses how much you know about each Mathematical Practice. Then explain in your own words what it means to you.

I have no clue. I've heard of it. I know it!

Mathematical Practices				
Mathematical Practice				What it Means to Me
①				
②				
③				
④				
⑤				
⑥				
⑦				
⑧				

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Persevere with Problems

What does it mean to persevere in solving problems?

Mathematical Practice 1

Make sense of problems and persevere in solving them.

Look up the word "persevere" in a dictionary. You might see "be persistent" or "follow something through to the end." When you persevere in solving math problems, you don't always stop at the first answer you get. You check if your solution is accurate, if it answers the problem, and if it makes sense!

Jared wants to paint his room. The dimensions of the room are 12 feet by 15 feet, and the walls are 9 feet tall. There are two windows, each with dimensions 6 feet by 5 feet. There are two doors, each with dimensions 30 inches by 6 feet. If a gallon of paint covers about 350 square feet, how many gallons of paint will he need to put two coats of paint on the wall?

1. **Understand** That's a lot of information! Go back and read the problem again. This time, circle the information given and underline what you are trying to find.

2. **Plan** Before you do ANY calculations, make a plan to solve the problem. List the steps you need to take.

3. **Solve** Apply your plan to solve the problem.

   Jared will need ☐ gallons of paint.

4. **Check** Is your solution accurate? Does it make sense? Explain.

5. Did you feel like giving up at any point while solving the problem? Explain.

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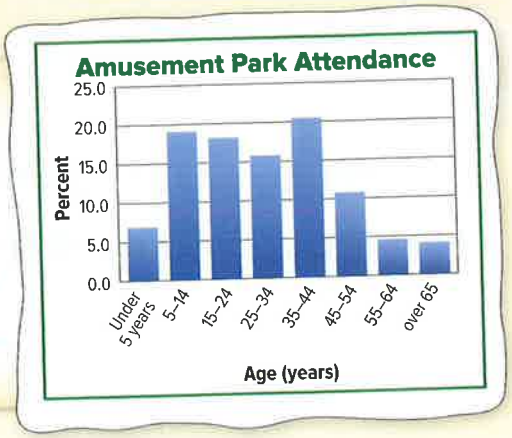
It's Your Turn!

Reason abstractly or quantitatively to find a solution.

4. The graph shows the percent of people in different age groups that recently attended an amusement park. A total of 1.045 million people attended. How many of them were less than 25 years of age?



5. Cave exploration or spelunking is a very popular activity. Your family signs up for tours at a state park. On one of the tours, your brother is lowered 160 feet below the surface by rope. Then he continues another 70 feet below the surface to a room. You take the tree top tour where you climb to an adventure course that is 60 feet above ground. What is the difference between the elevations?

6. You and your family are traveling to a football game. You and your mother leave at 8:00 A.M. Your dad needs to wait for your sister to get home from aerobic practice, so he leaves at 9:30 A.M. If your mother drives at an average rate of 50 miles per hour, and your dad drives at an average rate of 65 miles per hour, when will he pass her? Suppose the game is 205 miles away. Who will get there first?

Find it in Your Book!

MP Reason Abstractly

Look in Chapter 1. Provide an example of where Mathematical Practice 2 is used. Explain why your example represents this practice.

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Construct an Argument

Have you ever questioned something that someone else said?

Mathematical Practice 3

Construct viable arguments and critique the reasoning of others.

If your friend told you that his dog could run 45 miles per hour, would you believe him? What would your friend need to do to justify his comment? You might want to see the dog run and use a stopwatch to time him. In math, we often need to justify our conclusions as well. We can use *inductive* or *deductive* reasoning.

1. Use the Internet or another source to look up the meanings of the terms *inductive reasoning* and *deductive reasoning*. Write the meanings in your own words.

2. Label each example below as either using inductive or deductive reasoning.

_____ Reasoning

Every dog that Elijah met has fleas, so he believes that all dogs have fleas.

_____ Reasoning

Equilateral triangles have 3 congruent sides. Elena has a triangle with 3 congruent sides, so she has an equilateral triangle.

Throughout this text, you may be asked to evaluate an argument that someone else made. If you determine that the argument is false, you may be asked to provide a counterexample. A *counterexample* is just one example that shows a statement is not true.

3. Determine if the following statement is true. If it is not true, provide a counterexample:

All prime numbers are odd.

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It's Your Turn!

Complete each step in the solution shown. Use the Properties of Equality (Addition, Subtraction, Multiplication, or Division).

4. $a - 15 = 36$ Write the equation.

$+ 15 = + 15$ _____

$a = 51$ Simplify.

5. $5p = 35$ Write the equation.

$\frac{5p}{5} = \frac{35}{5}$ _____

$p = 7$ Simplify.

For each of the following statements, determine if the statement is *true* or *false*. If false, provide a counterexample.

6. All four-legged pieces of furniture are tables.

_____

7. All rectangles have 4 right angles.

_____

8. The population of Pennsylvania is about 4% of the total population of the United States. Daniel claims that since the population of the United States is about 312 million, the population of Pennsylvania must be around 17.5 million. Is his claim reasonable? Explain.

_____

_____

_____

Find it in Your Book!

MP Construct an Argument

Look in Chapter 1. Provide an example of where Mathematical Practice 3 is used. Explain why your example represents this practice.

_____

_____

_____

_____

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Model with Mathematics

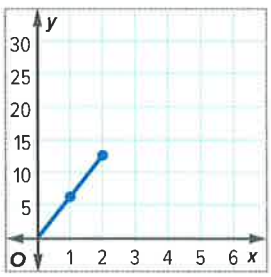
Are you a visual person or do you prefer to use words?

Mathematical Practice 4

Model with mathematics.

You might prefer to use diagrams or drawings when explaining ideas. Or you might prefer to use words. In math, we also use different ways to model the same idea. We can use words, graphs, tables, numbers, symbols, or diagrams.

1. Suppose you are selling T-shirts as a fundraiser for Key Club. The club makes a $6.30 profit for every T-shirt sold. Complete each model shown.

Words	Numbers
_____ per T-shirt	Profit ($) / Number of shirts: 6.30 / 1; 12.60 / ; 18.90 /
Symbols	**Graph**
Let p = profit t = number of T-shirts sold $p =$ ☐ t	

All of these model the same relationship between profit and number of T-shirts sold, just in different ways.

2. Which relationship would you prefer to use to determine the profit if 100 T-shirts were sold? Explain.

_____

_____

_____

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It's Your Turn!

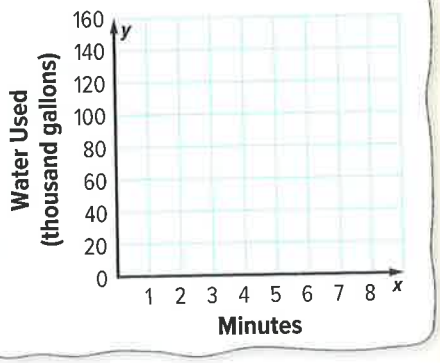
Use the models shown to solve each problem.

3. A waterpark cycles about 24,000 gallons per minute through the local river.

a. Tables Complete the table to show the number of gallons used in 1, 2, 3, 4, and 5 minutes.

Time, x (minutes)	Gallons, y (thousand gallons)

b. Graph Graph the ordered pairs on the coordinate plane.



c. Symbols Write an equation to show the number of gallons of water y used in x minutes.

4. Kitra is creating a treasure hunt for the school carnival. The scale on the map is 0.5 inch = 0.25 mile.

a. Tables Complete the table to determine the actual distance for 0.5, 1, 1.5, 2, and 2.5 inches on the map.

b. Symbols Write an equation to determine the actual distance d for m inches on the map.

Map Length m (in.)	Distance d (mi)

Find it in Your Book!

MP Model with Mathematics

Look in Chapter 6. Provide an example of where Mathematical Practice 4 is used. Explain why your example represents this practice.

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Use Math Tools

Which tools would you use to finish this piece of artwork?

Mathematical Practice 5

Use appropriate tools strategically.

You might need paints, a brush, or maybe charcoal or colored pencils. You might also need some art training! So, let's investigate how to choose and use the proper tools and strategies to solve math problems.

1. Math tools are objects like paper and pencil, calculators, algebra tiles, and rulers. List three more math tools that are helpful in solving problems.

Math Tools

2. Some math strategies are estimation, drawing a diagram, and using mental math. List three more math strategies that are helpful in solving problems.

Math Strategies

3. Describe a situation in which you would use a protractor.

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It's Your Turn!

List the tools or strategies you would use to solve each problem. Then solve the problem.

4. You need to make a scale model of your room for your art class. The scale is $\frac{3}{4}$ inch represents 1 foot. What are the dimensions of your model?

5. Your family wants to go to a Green Bay Packers football game. About how much would it cost a family of four to go to a game, park, buy 2 programs, and each have a soda and a sandwich?

Green Bay Packers Football	
Average Ticket Price	$78.84
Parking	$40.00
Soda	$4.25
Sandwich	$5.50
Program	$6

6. Your group spent $679.35 on props, hall space, and programs for a recital. The ticket prices for the recital are shown in the table. If you sold a total of 46 adult tickets and 59 student tickets, how much did the group make after paying for the supplies?

Recital Tickets	
Adult	$15.00
Student	$8.00

Find it in Your Book!

MP Use Math Tools

Look in Chapter 1. Provide an example of where Mathematical Practice 5 is used. Explain why your example represents this practice.

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Attend to Precision

What does it mean to communicate precisely?

Mathematical Practice 6

Attend to precision.

Communicating precisely is not just about giving the right answer. It also includes using terms, units, symbols, ideas, and procedures appropriately when discussing or solving problems.

Marlon drives his scooter to soccer practice every day. Each week, his scooter uses a quarter of a tank of gas. The practice field is 3 miles from his house and the gas tank holds 2.4 gallons of gas. He wants to find the unit rate per gallon of gas. Pair up with a classmate to discuss and answer the following.

1. In your own words, write the definitions for *ratio, equivalent ratio, bar diagram,* and *unit rate*.

2. How do the words from Exercise 1 relate to the problem?

3. Discuss with your partner the steps you will use to solve this problem. Summarize your discussion, and then solve the problem.

4. What units of measure will describe the unit rate per gallon of gas?

5. What is the unit rate per gallon for Marlon's scooter?

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It's Your Turn!

Solve each problem.

The state of Colorado is shaped like a rectangle as shown in the map. The rate $\frac{1 \text{ cm}}{100 \text{ km}}$ can be used to find actual distances.

6. Use equivalent rates to find the actual distance x.

a. $\frac{4.5 \text{ cm}}{x}$ **b.** $\frac{6.1 \text{ cm}}{x}$

7. What is the perimeter of the state on the map? the actual perimeter?

8. Claire is in charge of the 7th grade picnic and needs to order the food for the 90 students attending. She surveys a sample population of 18 students. Ten students chose beefburgers, 7 chose cheeseburgers, and 1 chose a veggie burger.

a. Make a conjecture about how many students at the picnic will choose each type of food.

b. Discuss with a partner if these numbers are exact or estimates. Then determine what problems Claire may have by using those numbers.

Find it in Your Book!

MP Attend to Precision

Look in Chapter 1. Provide an example of where Mathematical Practice 6 is used. Explain why your example represents this practice.

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Make Use of Structure

What is structure in mathematics?

Mathematical Practice 7

Look for and make use of structure.

Finding and making use of structure is important when solving problems. There is structure in writing and solving an equation or finding a pattern. We rely on being able to identify and use structure to sometimes find easier ways to solve problems.

At the Atlas Arcade, you can select a lunch combo from their new menu. First choose the type of sandwich. Then choose from a list of sides and a cookie.

Sandwich	Sides	Cookie
Chicken	Salad	Chocolate chip
Veggie	French fries	Oatmeal
Meatball	Onion rings	Raisin
	Soup	

1. Create a tree diagram or organized list that shows all of the possibilities for a veggie sandwich.

2. How many possible outcomes are there for a veggie sandwich?

3. How many total possibilities for all three types of sandwiches?

4. Can you think of another way to find the total number of outcomes?

5. Find a classmate that used a different method than you did and discuss the advantages and disadvantages of each method. Summarize your discussion.

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It's Your Turn!

Describe the method you would use to solve each of the following. Then solve.

6. Haney's scores on his science tests were 76%, 93%, 87%, 91%, and 83%. Haney wants a 90% test average for the term. If all tests are weighted the same, is it possible for him to get a 90% test average if there is only one more test? Explain.

7. You need to make a model of your bedroom for your art class. The scale is $\frac{3}{4}$-inch = 1 foot. What are the dimensions of your model?

8. A rectangle has a length of 4 centimeters and a width of 3 centimeters. The length and width are each multiplied by a factor of 3. Is the ratio $\frac{\text{area of new rectangle}}{\text{area of original rectangle}}$ equivalent to the ratio $\frac{\text{side length of new rectangle}}{\text{side length of original rectangle}}$? If not, explain how they are related.

Find it in Your Book!

MP Make Use of Structure

Look in Chapter 1. Provide an example of where Mathematical Practice 7 is used. Explain why your example represents this practice.

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Use Repeated Reasoning

How can repeated reasoning help me in math?

Sometimes, if you find repeated reasoning or patterns in mathematics, you can actually create shortcuts that help you in calculations.

Mathematical Practice 8

Look for and express regularity in repeated reasoning.

1. Complete the table by choosing a set of three consecutive numbers. Then compare the product of the two outer numbers to the middle number squared. The first one is started for you.

Consecutive Numbers	Product of Two Outer Numbers	Middle Number Squared
4, 5, 6	$4 \times 6 =$	$5 \times 5 =$

2. What is the relationship between the product of the two outer numbers and the middle number squared?

3. Suppose you want to find 22×24. Write an expression using the middle number that can help you find the product.

4. Use this reasoning to astound your family and friends by using mental math to find 49×51!

5. Do you think this process works for three digit numbers? How can you test your conjecture?

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It's Your Turn!

Solve.

6. Valerie is creating a treasure hunt for the school carnival. The scale on the map is 0.5 inch = 0.25 mile.

a. Table Complete the table to determine the actual distance for 0.5 inch, 1 inch, 1.5 inches, 2 inches, and 2.5 inches on the map.

b. Symbols Write an equation to find the actual distance d for m inches on the map.

_____

Map Length (in.) m	Distance (mi) d

A famous number pattern is Pascal's Triangle shown below. Use Pascal's Triangle to complete Exercises 7 and 8.

7. Complete the triangle below. What relationship exists among the numbers in each row compared to the numbers in the previous row?

_____

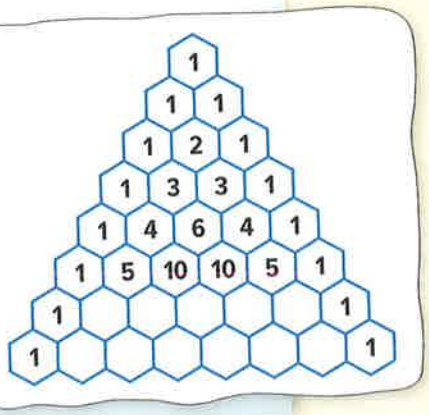
_____

8. Determine the sum of the numbers in each row. Analyze the relationship between the sum of the numbers in each row compared to the sum of the numbers in the previous row.

_____

_____

_____



Find it in Your Book!

MP Use Repeated Reasoning

Look in Chapter 5. Provide an example of where Mathematical Practice 8 is used. Explain why your example represents this practice.

_____

_____

_____

_____

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UNIT 3
Expressions and Equations

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Essential Question

HOW can you communicate mathematical ideas effectively?

Chapter 5
Expressions

Algebraic expressions can be used to represent real-world situations. In this chapter, you will apply the properties of operations to simplify and evaluate algebraic expressions.

Chapter 6
Equations and Inequalities

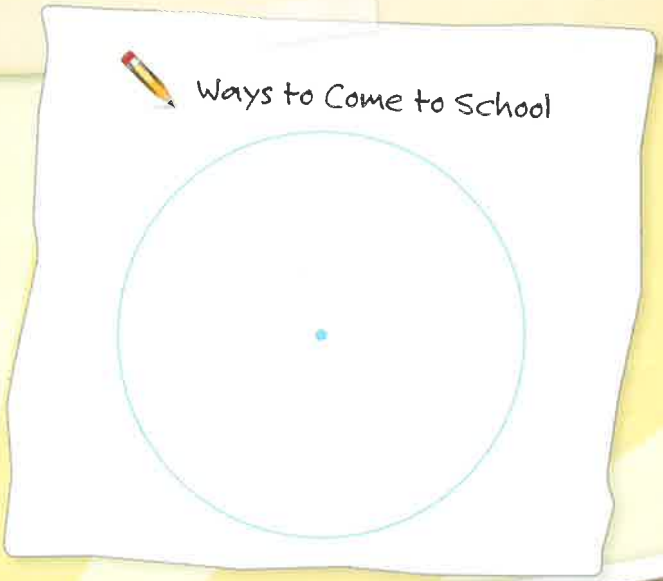
An equation is a mathematical sentence stating that two expressions are equal. In this chapter, you will use the properties of equality to solve equations algebraically. Then you will apply what you learn to solve inequalities.

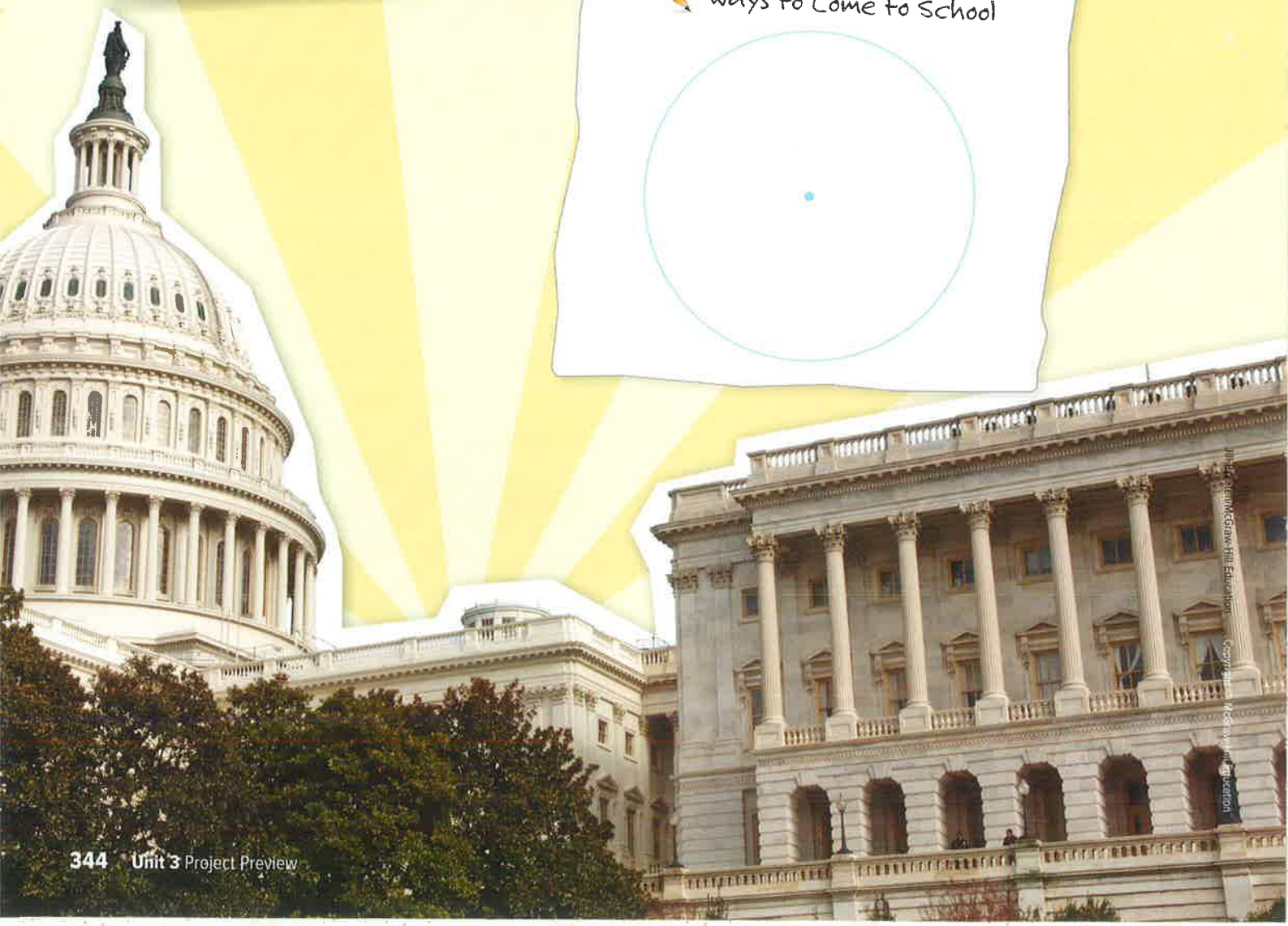
Unit Project Preview

Stand Up and Be Counted! The UAE Census is a survey of the UAE people that is taken every 10 years. The census is used to collect data about the UAE population and to determine the number of Federal National Council for each emirate.

Conduct your own mini-census. Survey twenty students about the typical way they come to school: by school bus, by car, on foot, or by some other means. Then make a circle graph of the data.

At the end of Chapter 6, you'll complete a project to find how the UAE population affects the Federal National Council. This adventure will appeal to your "census."





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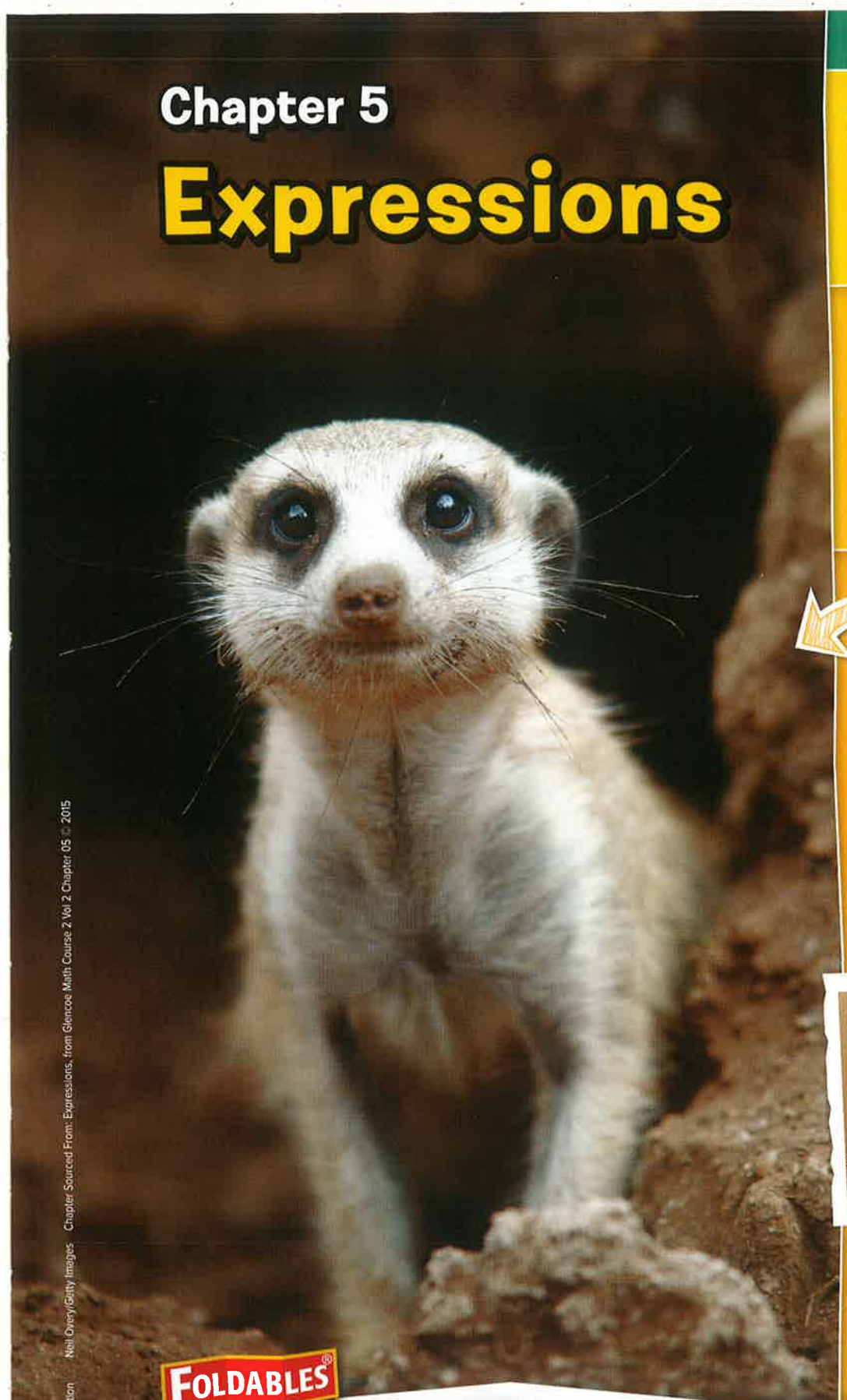
Chapter 5
Expressions



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Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

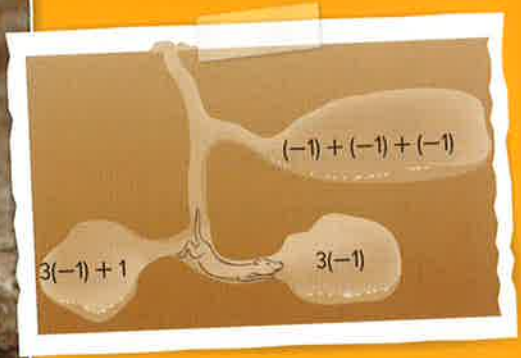
MP Mathematical Practices

1, 2, 3, 4, 5, 6, 7

Math in the Real World

Meerkats live in burrows. Because meerkats have sharp claws, they are able to dig at a rate of 1 foot per second.

Suppose a meerkat digs for 3 seconds. Cross out the expression that does not represent the underground distance dug by the meerkat.



FOLDABLES® Study Organizer

1. Cut out the Foldable from the end of the book.
2. Place your Foldable at the end of the chapter.
3. Use the Foldable throughout this chapter to help you learn about expressions.

What Tools Do You Need?

Vocabulary

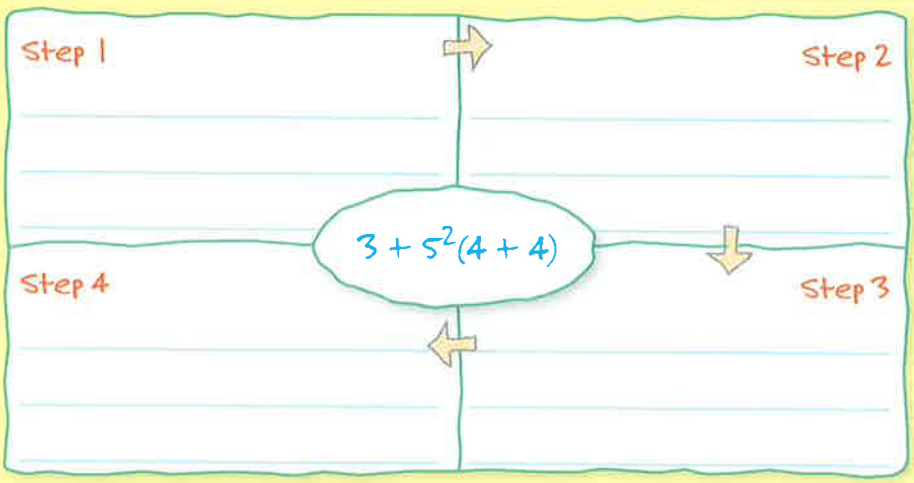
- Additive Identity Property
- algebra
- algebraic expression
- arithmetic sequence
- Associative Property
- coefficient
- Commutative Property
- constant
- counterexample
- define a variable
- Distributive Property
- equivalent expressions
- factor
- factored form
- like terms
- linear expression
- monomial
- Multiplicative Identity Property
- Multiplicative Property of Zero
- property
- sequence
- simplest form
- term
- variable

Review Vocabulary

Order of Operations The order of operations is a four-step process used to evaluate numerical expressions.

1. Evaluate the expressions inside grouping symbols.
2. Evaluate all powers.
3. Multiply and divide in order from left to right.
4. Add and subtract in order form left to right.

Use the order of operations to evaluate $3 + 5^2(4 + 4)$. Write each step in the organizer below.



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What Do You Already Know?

Read each statement. Decide whether you agree (A) or disagree (D). Place a checkmark in the appropriate column and then justify your reasoning.

Expressions			
Statement	A	D	Why?
Like terms are terms that contain different variables.			
When addition or subtraction signs separate an algebraic expression into parts, each part is called a term.			
An algebraic expression is in simplest form if it has no like terms and no parentheses.			
A property is an example that shows that a conjecture is false.			
When you use the Distributive Property to combine like terms, you are simplifying the expression.			
Equivalent expressions have the same value.			

When Will You Use This?

Here is an example of how expressions are used in the real world.

Activity Do you or your parents have a texting plan? If so, how much does it cost per text or per month? Ask your parents to help you research different texting plans. Then compare and contrast each plan.

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Are You Ready?

Try the Quick Check below.

Quick Review

Review

Example 1

Evaluate 2^5.

$2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

$= 32$

Example 2

Write $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ in exponential form.

3 is the base. It is used as a factor 7 times. So, the exponent is 7.

$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^7$

Example 3

Find $4(-2)$.

$4(-2) = -8$

The integers have different signs. The product is negative.

Example 4

Find $-5(-8)$.

$-5(-8) = 40$

The integers have the same signs. The product is positive.

Quick Check

Exponents **Evaluate each expression.**

1. $2^4 =$ _____

2. $3^3 =$ _____

3. $4^2 =$ _____

Show your work.

4. Write $4 \cdot 4 \cdot 4 \cdot 4$ in exponential form. _____

Integer Operations **Multiply.**

5. $5(-10) =$ _____

6. $-9(-4) =$ _____

7. $-5^2 =$ _____

How Did You Do?

Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.

1 2 3 4 5 6 7

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Lesson 1

Algebraic Expressions

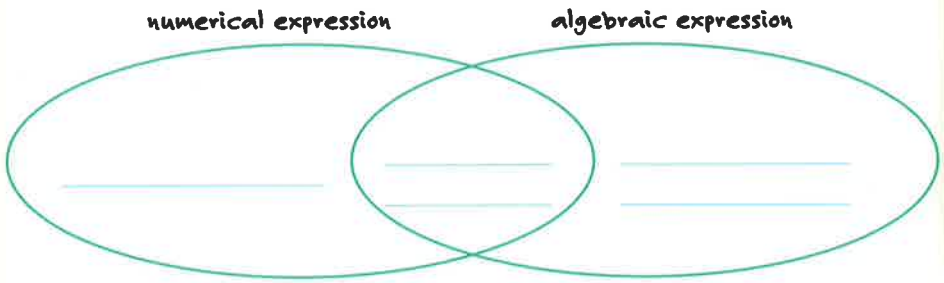
Vocabulary Start-Up

A **variable** is a symbol that represents an unknown quantity. An **algebraic expression**, such as $n + 2$, is an expression that contains variables, numbers, and at least one operation.

Variable → $n + 2$

Write each of the following phrases in the correct section of the Venn diagram: *contains an operation, has variables and numbers, has only numbers*.

Characteristics of Expressions



Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

Vocabulary

variable
algebraic expression
algebra
coefficient
define a variable

Mathematical Practices
1, 2, 3, 4

Real-World Link

The expression $(F - 32) \times \frac{5}{9}$ can be used to convert a temperature from Fahrenheit to Celsius. In this algebraic expression, the variable _____ represents the temperature in degrees Fahrenheit.

Michael Ventura/Alamy

Which Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

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Work Zone

Evaluate an Algebraic Expression

The branch of mathematics that involves expressions with variables is called **algebra**. In algebra, the multiplication sign is often omitted.

The numerical factor of a multiplication expression that contains a variable is called a **coefficient**. So, 6 is the coefficient of $6d$.

Expressions like $\frac{y}{2}$ can be written as $y \div 2$ or $y \times \frac{1}{2}$.

Order of Operations

1. Evaluate the expressions inside grouping symbols.
2. Evaluate all powers.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

Examples

1. **Evaluate $2(n + 3)$ if $n = -4$.**

$2(n + 3) = 2(-4 + 3)$ Replace n with -4.

$= 2(-1)$ Evaluate inside the parentheses.

$= -2$ Multiply.

2. **Evaluate $8w - 2v$ if $w = 5$ and $v = 3$.**

$8w - 2v = 8(5) - 2(3)$ Replace w with 5 and v with 3.

$= 40 - 6$ Do all of the multiplication first.

$= 34$ Subtract 6 from 40.

3. **Evaluate $4y^3 + 2$ if $y = 3$.**

$4y^3 + 2 = 4(3)^3 + 2$ Replace y with 3.

$= 4(27) + 2$ Evaluate the power.

$= 110$ Multiply, then add.

Got It? **Do these problems to find out.**

Evaluate each expression if $c = 8$ and $d = -5$.

a. $c - 3$ b. $15 - c$ c. $3(c + d)$

d. $2c - 4d$ e. $d - c^2$ f. $2d^2 + 5d$

a. _____

b. _____

c. _____

Show your work.

d. _____

e. _____

f. _____

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Example

4. **Athletic trainers use the formula $\frac{3(220 - a)}{5}$, where a is a person's age, to find their minimum training heart rate. Find Hala's minimum training heart rate if she is 15 years old.**

$$\frac{3(220 - a)}{5} = \frac{3(220 - 15)}{5}$$ Replace a with 15.

$$= \frac{3(205)}{5}$$ Subtract 15 from 220.

$$= \frac{615}{5}$$ Multiply 3 and 205.

$$= 123$$ Divide 615 by 5.

Hala's minimum training heart rate is 123 beats per minute.

Got It? **Do this problem to find out.**

g. To find the area of a triangle, use the formula $\frac{bh}{2}$, where b is the base and h is the height. What is the area in square centimeters of a triangle with a height of 6 centimeters and base of 8 centimeters?

Show your work.

g. _____

Fractions

The fraction bar is a grouping symbol. Evaluate the expressions in the numerator and denominator separately before dividing.

Write Expressions

To translate a verbal phrase into an algebraic expression, the first step is to define a variable. When you **define a variable**, you choose a variable to represent an unknown quantity.

Examples

5. **Hessa wants to buy a DVD player that costs AED 150. She already saved AED 25 and plans to save an additional AED 10 each week. Write an expression that represents the total amount of money Hessa has saved after any number of weeks.**

Words	savings of AED 25 plus AED 10 each week
Variable	Let w represent the number of weeks.
Expression	$25 + 10 \cdot w$

$25 + 10w$ represents the total saved after any number of weeks.

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6. **Refer to Example 5. Will Hessa have saved enough money to buy the AED 150 DVD player in 11 weeks? Use the expression 25 + 10w.**

$25 + 10w = 25 + 10(11)$ Replace w with 11.

$= 25 + 110$ Multiply.

$= 135$ Add.

Hessa will have saved AED 135 after 11 weeks. Since AED 135 < AED 150, Hessa will not have enough money to buy the DVD player.

Got It? Do this problem to find out.

h. An MP3 player costs AED 70 and song downloads cost AED 0.85 each. Write an expression that represents the cost of the MP3 player and x number of downloaded songs. Then find the total cost if 20 songs are downloaded.

Show your work.

h. _____

Guided Practice

Check

Evaluate each expression if $m = 2$, $n = 6$, and $p = -4$. (Examples 1–4)

1. $3m + 4p$ _____

2. $n^2 + 5$ _____

3. $6p^3$ _____

Show your work.

4. A Web site charges AED 0.99 to download a game and a AED 12.49 membership fee. Write an expression that gives the total cost in dirhams to download g games. Then find the cost of downloading 6 games. (Examples 5 and 6)

5. **Building on the Essential Question** Tell whether the statement below is *sometimes*, *always*, or *never* true. Justify your reasoning.

The expressions $x - 3$ and $y - 3$ represent the same value.

Rate Yourself!

How well do you understand algebraic expressions? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

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Name _____ My Homework _____

Independent Practice

Evaluate each expression if $d = 8$, $e = 3$, $f = 4$, and $g = -1$. (Examples 1 – 3)

1. $2(d + 9)$ _____

Show your work.

2. $\frac{d}{4}$ _____

3. $\frac{ef}{4}$ _____

4. $4f + d$ _____

5. $\frac{5d - 25}{5}$ _____

6. $d^2 + 7$ _____

7. $\frac{d - 4}{2}$ _____

8. $10(e + 7)$ _____

9. $\frac{2g}{2}$ _____

10. The expression $5n + 2$ can be used to find the total cost in dirhams of bowling where n is the number of games bowled and 2 represents the cost of shoe rental. How much will it cost Omar to bowl 3 games? (Example 4)

_____

11. MP **Reason Abstractly** A car rental company's fees are shown. Suppose you rent a car using Option 2. Write an expression that gives the total cost in dirhams for driving k kilometers. Then find the cost for driving 150 kilometers. (Examples 5 and 6)

_____

Car Rental Prices	
Option 1	**Option 2**
AED 20 per day	AED 50 fee
AED 2 per km	AED 2 per km

12. Refer to Exercise 11. Suppose you rent a car using Option 1. Write an expression that gives the total cost in dirhams to rent a car for d days and k kilometers. Then find the cost for renting a car for 2 days and driving 70 kilometers. (Examples 5 and 6)

_____

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Evaluate each expression if $x = 3.2$, $y = 6.1$, and $z = 0.2$.

13. $x + y - z$ _____

14. $14.6 - (x + y + z)$ _____

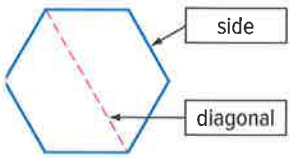
15. $xz + y^2$ _____

H.O.T. Problems Higher Order Thinking

16. MP **Reason Abstractly** Write an algebraic expression with the variable x that has a value of 3 when evaluated.

17. MP **Model with Mathematics** Write a real-world problem that can be represented by the expression $5x + 10$.

18. MP **Persevere with Problems** To find the total number of diagonals for any given polygon, you can use the expression $\frac{n(n-3)}{2}$, where n is the number of sides of the polygon.



a. Determine the minimum value that n could be. _____

b. Make a table of four possible values of n. Then complete the table by evaluating the expression for each value of n.

n	value

c. Check by drawing the diagonals of a pentagon and counting the diagonals.

19. MP **Persevere with Problems** Nasser constructed the objects below using toothpicks.

Figure 1

Figure 2

Figure 3

Write two different rules that relate the figure number to the number of toothpicks in each figure.

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Name _____ My Homework _____

Extra Practice

Evaluate each expression if $d = 8$, $e = 3$, $f = 4$, and $g = -1$.

20. $10 - e$ 7

$10 - e$

$10 - 3 = 7$

Homework Help

21. $\frac{16}{f}$ 4

$\frac{16}{f}$

$\frac{16}{4} = 4$

22. $4e^2$

23. $8g - f$

24. $\frac{(5 + g)^2}{2}$

25. $e^2 - 4$

26. The expression $\frac{w}{11}$, where w is a person's weight in kilograms, is used to find the approximate number of liters of blood in the person's body. How many liters of blood does a 55-kilograms person have?

_____

27. MP **Model with Mathematics** Refer to the graphic novel frame below. Let n represent the number of text messages. Evaluate the expression $1.5(n - 250) + 50$ to find the cost of 275 text messages. _____

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Power Up! Test Practice

28. Buthaina has x 25-fils coins, y 10-fils coins, and z 5-fils coins in her pocket. Select the appropriate operations to complete the expression that represents the total amount of change Buthaina has in her pocket.

×	÷
+	−

(AED 0.25 ☐ x) ☐ (AED 0.10 ☐ y) ☐ (AED 0.05 ☐ z)

Evaluate the expression for $x = 3$, $y = 5$, and $z = 2$. What does this value represent?

29. The prices of magazines and books at the school book fair are shown in the table. Determine if each statement is true or false.

School Book Fair Prices	
Item	**Cost**
Magazines	AED 4.95
Paperback books	AED 7.95

a. The expression $7.95b + 4.95m$ represents the cost of buying b books and m magazines. ☐ True ☐ False

b. The expression $12.90(b + m)$ represents the cost of buying b books and m magazines. ☐ True ☐ False

c. The total cost of buying 3 books and 4 magazines is AED 43.65. ☐ True ☐ False

Spiral Review

Define a variable and write each phrase as an algebraic expression.

30. 8 meters less than the height _____

31. Khawla worked 8 more hours than Amna. _____

32. Jamal has twice the number of goals as Hassan. _____

33. Hareb is 3 years younger than Husam. _____

34. The table shows the costs of different camping activities. Over the summer, Hamdah canoed 4 times and fished 3 times. Write and evaluate an expression that represents the total cost Hamdah spent canoeing and fishing.

Camping Activity Costs	
Activity	**Cost**
Canoeing	AED 8
Fishing	AED 5

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Lesson 2

Sequences

Vocabulary Start-Up

A **sequence** is an ordered list of numbers. Each number in a sequence is called a **term**. In an **arithmetic sequence**, each term is found by adding the same number to the previous term.

Complete the graphic organizer below.

arithmetic sequences

Numbers	Words
Continue each sequence. 1, 3, 5, 7, 9, ... 1, 1.5, 2, 2.5, 3, 3.5, ...	Describe each sequence. Add 2 to the previous term.

Real-World Link

Horseback Riding The number of students who went on each horseback riding trip is shown. Do the numbers represent the terms of an arithmetic sequence? Explain.

Trip	1	2	3	4	5
Number of Students	15	16	18	21	25

Which MP **Mathematical Practices** did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

Vocabulary

sequence
term
arithmetic sequence

MP Mathematical Practices
1, 2, 3, 4

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Work Zone

Describe and Extend Sequences

In an arithmetic sequence, the terms can be whole numbers, fractions, or decimals.

Examples

1. **Describe the relationship between the terms in the arithmetic sequence 8, 13, 18, 23, ... Then write the next three terms in the sequence.**

8, 13, 18, 23, ...
+5 +5 +5

Each term is found by adding 5 to the previous term.

Continue the pattern to find the next three terms.

$23 + 5 = 28$ $28 + 5 = 33$ $33 + 5 = 38$

The next three terms are 28, 33, and 38.

2. **Describe the relationship between the terms in the arithmetic sequence 0.4, 0.6, 0.8, 1.0, ... Then write the next three terms in the sequence.**

Show your work.

0.4, 0.6, 0.8, 1.0, ...
+0.2 +0.2 +0.2

Each term is found by adding 0.2 to the previous term.

Continue the pattern to find the next three terms.

$1.0 + 0.2 = 1.2$ $1.2 + 0.2 = 1.4$ $1.4 + 0.2 = 1.6$

The next three terms are 1.2, 1.4, and 1.6.

Got It? **Do these problems to find out.**

Describe the relationship between the terms in each arithmetic sequence. Then write the next three terms in the sequence.

a. 0, 13, 26, 39, ...

b. 4, 7, 10, 13, ...

c. 1.0, 1.3, 1.6, 1.9, ...

d. 2.5, 3.0, 3.5, 4.0, ...

a. _____

b. _____

c. _____

d. _____

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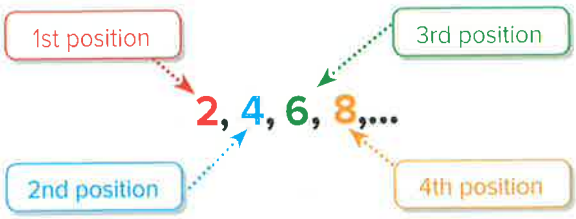
Write an Algebraic Expression

In a sequence, each term has a specific position within the sequence. Consider the sequence 2, 4, 6, 8,...



Notice that as the position number increases by 1, the value of the term increases by 2.

	Position	Operation	Value of Term	
+1	1	$1 \cdot 2 = 2$	2	+2
+1	2	$2 \cdot 2 = 4$	4	+2
+1	3	$3 \cdot 2 = 6$	6	+2
	4	$4 \cdot 2 = 8$	8	

You can also write an algebraic expression to represent the relationship between any term in a sequence and its position in the sequence. In this case, if n represents the position in the sequence, the value of the term is $2n$.

Arithmetic Sequences

When looking for a pattern between the position number and each term in the sequence, it is often helpful to make a table.

Example

3. **The greeting cards that Badria makes are sold in boxes at a gift store. The first week, the store sold 5 boxes. Each week, the store sells five more boxes. The pattern continues. What algebraic expression can be used to find the total number of boxes sold at the end of the 100th week? What is the total?**

Position	Operation	Value of Term
1	$1 \cdot 5$	5
2	$2 \cdot 5$	10
3	$3 \cdot 5$	15
n	$n \cdot 5$	$5n$

Each term is 5 times its position. So, the expression is $5n$.

$5n$ Write the expression.

$5(100) = 500$ Replace n with 100.

At the end of 100 weeks, 500 boxes will have been sold.

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STOP and Reflect

Suppose Figure 1 had 3 circles, Figure 2 had 5 circles, and Figure 3 had 7 circles. What algebraic expression represents this situation?

Show your work.

e. _____

Got It? Do this problem to find out.

e. If the pattern continues, what algebraic expression can be used to find the number of circles used in any figure? How many circles will be in the 50th figure?

Figure 1 Figure 2 Figure 3

Guided Practice

Check

Describe the relationship between the terms in each arithmetic sequence. Then write the next three terms in each sequence. (Examples 1 and 2)

1. 0, 9, 18, 27, ...

Show your work.

2. 4, 9, 14, 19, ...

3. 1, 1.1, 1.2, 1.3, ...

4. Abeer has a doll collection. The table shows the total number of dolls in her collection for three years. Suppose this pattern continues. Write an algebraic expression to find the number of dolls in her collection after n years. How many dolls will Abeer have after 25 years? (Example 3)

Year	Number of Dolls
1	6
2	12
3	18

5. **Building on the Essential Question** Explain why the following sequence is considered an arithmetic sequence.

5, 9, 13, 17, 21, ...

Rate Yourself!

How confident are you about sequences? Check the box that applies.

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Name _____ My Homework _____

Independent Practice

Describe the relationship between the terms in each arithmetic sequence. Then write the next three terms in each sequence. (Examples 1 and 2)

1. 0, 7, 14, 21, ...

Show your work.

2. 1, 7, 13, 19, ...

3 26, 34, 42, 50, ...

4. 0.1, 0.4, 0.7, 1.0, ...

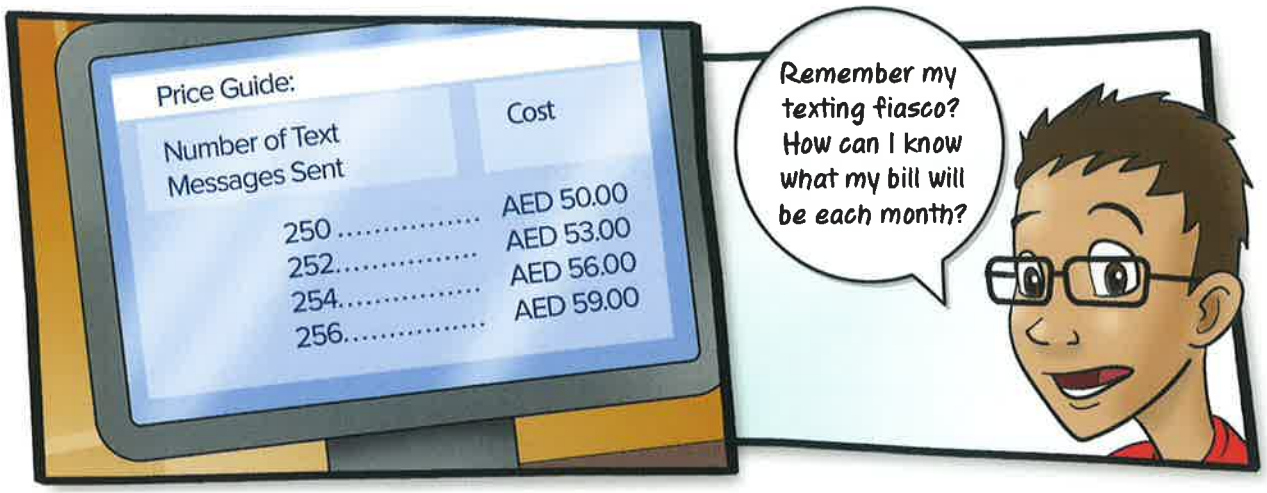
5. 2.4, 3.2, 4.0, 4.8, ...

6. 2.0, 3.1, 4.2, 5.3, ...

7 Refer to the table shown. If the pattern continues, what algebraic expression can be used to find the plant's height for any month? What will be the plant's height at 12 months? (Example 3)

Month	Height (cm)
1	3
2	6
3	9

8. MP **Model with Mathematics** Explain how the number of text messages Badr sent and the cost form an arithmetic sequence. Then write an expression to find Badr's text messaging bill if he sends n text messages over 250.



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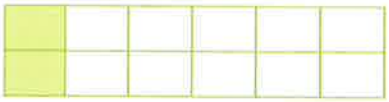
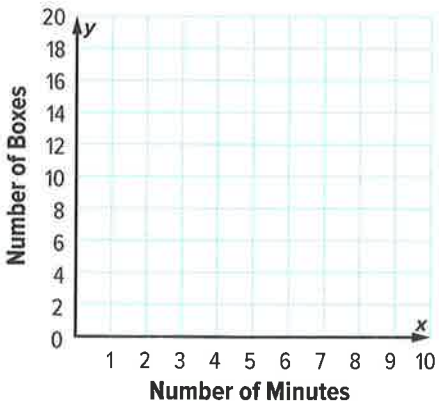
9. MP **Multiple Representations** Ghaya is stacking boxes of tissues for a store display. She stacks 3 boxes in the first minute, 6 boxes by the end of the second minute, and 9 boxes by the end of the third minute. Suppose the pattern continues for parts **a–d**.

a. **Table** Make a table of values for 1, 2, 3, 4, and 5 minutes.



b. **Symbols** Write an expression to find the *n*th term in the sequence.

c. **Graph** Graph the table of values from part **a** on the coordinate plane. Let *x* represent the number of minutes and *y* represent the number of boxes. Then describe the graph.



d. **Numbers** How many boxes will be displayed after 45 minutes?

H.O.T. Problems Higher Order Thinking

10. MP **Justify Conclusions** Write five terms of an arithmetic sequence and describe the rule for finding the terms.

MP **Persevere with Problems** **Not all sequences are arithmetic. But, there is still a pattern. Describe the relationship between the terms in each sequence. Then write the next three terms in the sequence.**

11. 1, 2, 4, 7, 11, ...

12. 0, 2, 6, 12, 20, ...

13. MP **Persevere with Problems** Use an arithmetic sequence to find the number of multiples of 6 between 41 and 523. Justify your reasoning.

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Name _____ My Homework _____

Extra Practice

Describe the relationship between the terms in each arithmetic sequence. Then write the next three terms in each sequence.

14. 19, 31, 43, 55, ...

12 is added to the previous term; 67, 79, 91

Homework Help

15. 6, 16, 26, 36, ...

10 is added to the previous term; 46, 56, 66

16. 33, 38, 43, 48, ...

17. 4.5, 6.0, 7.5, 9.0, ...

18. 1.2, 3.2, 5.2, 7.2, ...

19. 4.6, 8.6, 12.6, 16.6, ...

20. 18, 33, 48, 63, ...

21. 20, 45, 70, 95, ...

22. 38, 61, 84, 107, ...

23. MP **Reason Abstractly** Refer to the figures for parts **a** and **b.**

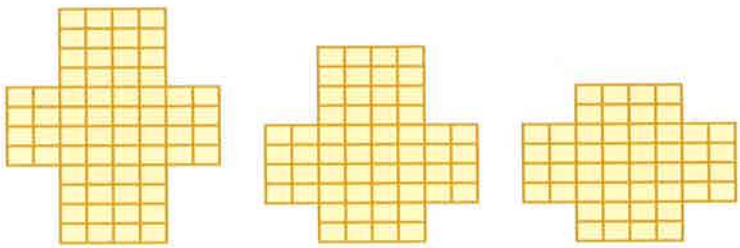

Figure 1 Figure 2 Figure 3

a. Describe the relationship between the figures and the number of rectangles shown. _____

b. If the pattern continues, how many rectangles will be in the next 2 figures? _____

The terms of an arithmetic sequence can be related by subtraction. Write the next three terms of each sequence.

24. 32, 27, 22, 17, ...

25. 45, 42, 39, 36, ...

26. 10.5, 10, 9.5, 9, ...

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Power Up! Test Practice

27. The table shows the first 5 terms of a sequence. Determine if each statement is true or false.

Position	1	2	3	4	5	n
Value of Term	2	5	10	17	26	■

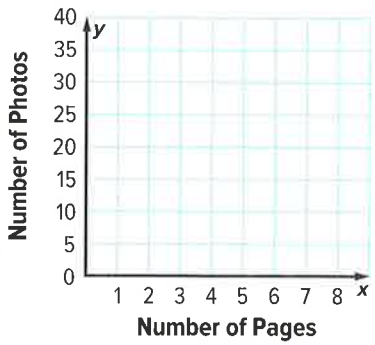
a. The expression $n^2 + 1$ can be used to find the nth term of the sequence. ☐ True ☐ False

b. The 8th term of the sequence is 65. ☐ True ☐ False

c. The table represents an arithmetic sequence. ☐ True ☐ False

28. Najat is putting photos in an album. She puts five pictures on the first page. Each page after that contains five pictures. Suppose the pattern continues. Complete the table of values for 1, 2, 3, 4, and 5 pages. Then graph the table of values on the coordinate plane. Let x represent the number of pages and y represent the total number of photos.

Number of Pages	Total Photos
1	
2	
3	
4	
5	



How many photos will Najat have on 20 pages? _____

Spiral Review

Evaluate.

29. $1^4 =$ _____

30. $3^3 =$ _____

31. $8^2 =$ _____

32. $10^4 =$ _____

33. $5^1 =$ _____

34. $7^5 =$ _____

35. Omar goes to the batting cage. He purchases three tokens and rents a helmet. If he spends a total of AED 65, how much is each token?

_____

Batting Cage Prices	
Tokens	■
Helmet Rental	AED 20

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Inquiry Lab
Sequences

Mathematical Practices 1, 3

Inquiry **HOW can geometric figures be used to model numerical patterns?**

A fencing company uses 4 planks of wood for one section of fencing, 7 planks for two sections, and 10 planks of wood for three sections. The fence sections are represented using the toothpicks shown. Determine how many planks would be used to create 5 sections of fencing.

1 Section | 2 Sections | 3 Sections

Hands-On Activity

Step 1 Find a pattern in the table. Then fill in the number of planks that would be in 4 and 5 sections of fencing.

Number of Sections	Number of Planks
1	4
2	7
3	10
4	
5	

Step 2 Check your work by using toothpicks to show 5 fence sections. Draw the result in the space below.

So, there will be _____ planks in 5 sections of fencing.

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Investigate

Collaborate

Work with a partner. Complete the table. You can use toothpicks to continue each pattern if needed.

1.

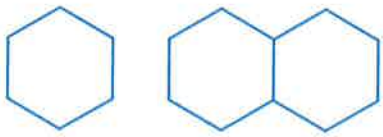

Figure 1

Figure 2

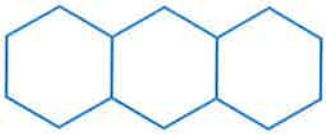

Figure 3

Figure Number	Number of Toothpicks
1	6
2	11
3	16
4	
5	

2. Refer to Exercise 1. Write an expression that could be used to find the number of toothpicks that would be needed for any figure.

3. Use your expression from Exercise 2 to find the number of toothpicks that would be needed to create Figure 10. Explain.

Create

On Your Own

4. MP **Reason Abstractly** Refer to the activity. Write an expression that could be used to find the number of planks in any number of sections.

5. MP **Justify Conclusions** Use the expression in Exercise 4 to find the number of planks that would be needed to create 10 sections of fencing. Explain.

6. Inquiry HOW can geometric figures be used to model numerical patterns?

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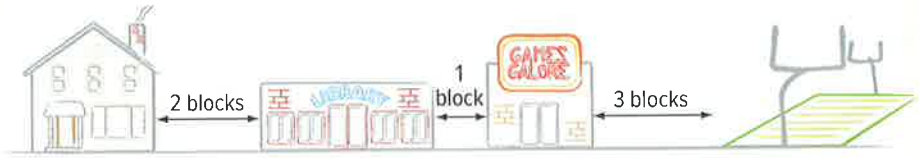
Lesson 3

Properties of Operations

Real-World Link

Driving Miss Fatema drives up and down her street to complete different errands. Some of the places on her street are shown below. The number of blocks between the places are also shown.



1. Suppose Miss Fatema drives from home to the game store and back. Write an expression for each distance.

from home to the game store: _____ from the game store to home: _____

2. Circle the property that is illustrated in Exercise 1.

Commutative Associative

3. On Monday, Miss Fatema drives from home, stops at the library, and then drives to the football field. On Tuesday, she drives from home, stops at the game store, and then drives to the football field. Write an expression for each distance.

Monday: _____ Tuesday: _____

4. Circle the property that is illustrated in Exercise 3.

Commutative Associative

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

Vocabulary

Commutative Property
Associative Property
property
Additive Identity Property
Multiplicative Identity Property
Multiplicative Property of Zero
counterexample

MP Mathematical Practices
1, 3, 4, 5, 7

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Key Concept

Properties of Operations

Work Zone

Words The **Commutative Property** states that the order in which numbers are added or multiplied does not change the sum or product.

	Addition	Multiplication
Symbols	$a + b = b + a$	$a \cdot b = b \cdot a$
Examples	$6 + 1 = 1 + 6$	$7 \cdot 3 = 3 \cdot 7$

Words The **Associative Property** states that the way in which numbers are grouped when they are added or multiplied does not change the sum or product.

	Addition	Multiplication
Symbols	$a + (b + c) = (a + b) + c$	$a \cdot (b \cdot c) = (a \cdot b) \cdot c$
Examples	$2 + (3 + 8) = (2 + 3) + 8$	$3 \cdot (4 \cdot 5) = (3 \cdot 4) \cdot 5$

A **property** is a statement that is true for any number. The following properties are also true for any numbers.

Property	Words	Symbols	Examples
Additive Identity	When 0 is added to any number, the sum is the number.	$a + 0 = a$ $0 + a = a$	$9 + 0 = 9$ $0 + 9 = 9$
Multiplicative Identity	When any number is multiplied by 1, the product is the number.	$a \cdot 1 = a$ $1 \cdot a = a$	$5 \cdot 1 = 5$ $1 \cdot 5 = 5$
Multiplicative Property of Zero	When any number is multiplied by 0, the product is 0.	$a \cdot 0 = 0$ $0 \cdot a = 0$	$8 \cdot 0 = 0$ $0 \cdot 8 = 0$

Example

1. **Name the property shown by the statement $2 \cdot (5 \cdot n) = (2 \cdot 5) \cdot n$.**

The order of the numbers and variable did not change, but their grouping did. This is the Associative Property of Multiplication.

Show your work.

a. _____

b. _____

Got It? **Do these problems to find out.**

a. $42 + x + y = 42 + y + x$ **b.** $3x + 0 = 3x$

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You may wonder if any of the properties apply to subtraction or division. If you can find a **counterexample**, an example that shows that a conjecture is false, the property does not apply.

Example

2. **State whether the following conjecture is *true* or *false*. If *false*, provide a counterexample.**

Division of whole numbers is commutative.

Write two division expressions using the Commutative Property.

$15 \div 3 \stackrel{?}{=} 3 \div 15$ State the conjecture.

$5 \neq \frac{1}{5}$ Divide.

The conjecture is false. We found a counterexample. That is, $15 \div 3 \neq 3 \div 15$. So, division is *not* commutative.

Got It? Do this problem to find out.

c. The difference of two different whole numbers is always less than both of the two numbers.

Show your work.

c. _____

Real World Example

3. **Suha wants to buy a sweater that costs AED 68, sunglasses that costs AED 84, a skirt that costs AED 32, and a blouse that costs AED 26. Use mental math to find the total cost before tax.**

Write an expression for the total cost. You can rearrange the numbers using the properties of math. Look for sums that are multiples of ten.

$68 + 84 + 32 + 26$

$= 68 + 32 + 84 + 26$ Commutative Property of Addition

$= (68 + 32) + (84 + 26)$ Associative Property of Addition

$= 100 + 110$ Add.

$= 210$ Simplify.

The total cost of the items is AED 210.

Got It? Do this problem to find out.

d. Khamis made four phone calls from his cell phone today. The calls lasted 4.7, 9.4, 2.3, and 10.6 minutes. Use mental math to find the total amount of time he spent on the phone.

Show your work.

d. _____

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Simplify Algebraic Expressions

To simplify an expression is to perform all possible operations.

Examples

Simplify each expression. Justify each step.

4. $(7 + g) + 5$

$(7 + g) + 5 = (g + 7) + 5$ Commutative Property of Addition

$= g + (7 + 5)$ Associative Property of Addition

$= g + 12$ Simplify.

5. $(m \cdot 11) \cdot m$

$(m \cdot 11) \cdot m = (11 \cdot m) \cdot m$ Commutative Property of Multiplication

$= 11 \cdot (m \cdot m)$ Associative Property of Multiplication

$= 11m^2$ Simplify.

Got It? **Do this problem to find out.**

e. $4 \cdot (3c \cdot 2)$

Show your work.

e. _____

Guided Practice

Check

Name the property shown by each statement. (Example 1)

1. $3m \cdot 0 \cdot 5m = 0$ _____

2. $7c + 0 = 7c$ _____

3. State whether the following conjecture is *true* or *false*. If *false*, provide a counterexample. (Example 2)

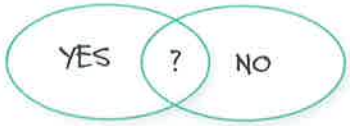
Subtraction of whole numbers is associative.

4. Simplify $9c + (8 + 3c)$. Justify each step. (Examples 3–5)

5. **Building on the Essential Question** Explain the difference between the Commutative and Associative Properties.

Rate Yourself!

Are you ready to move on? Shade the section that applies.



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Name _____ My Homework _____

Independent Practice

Name the property shown by each statement. (Example 1)

1. $a + (b + 12) = (b + 12) + a$

2. $(5 + x) + 0 = 5 + x$

3 $16 + (c + 17) = (16 + c) + 17$

4. $d \cdot e \cdot 0 = 0$

5. MP **Use a Counterexample** State whether the conjecture is *true* or *false*. If *false*, provide a counterexample. (Example 2)

Division of whole numbers is associative.

6. Huda ordered a soda for AED 2.75, a sandwich for AED 8.50, and a dessert for AED 3.85. Sales tax was AED 1.15. Use mental math to find the total amount of the bill. Explain. (Example 3)

Simplify each expression. Justify each step. (Examples 4 and 5)

7. $15 + (12 + 8a)$

8. $(5n \cdot 9) \cdot 2n$

9 $3x \cdot (7 \cdot x)$

10. $(4m \cdot 2) \cdot 5m$

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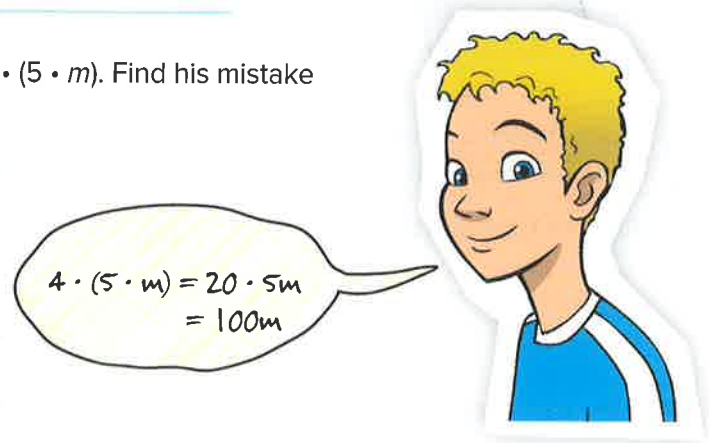
11. Simplify the expression $(7 + 47 + 3)[5 \cdot (2 \cdot 3)]$. Use properties to justify each step.

H.O.T. Problems Higher Order Thinking

12. MP **Model with Mathematics** Write about something you do every day that is commutative. Then write about another situation that is not commutative.

13. MP **Find the Error** Mansour is simplifying $4 \cdot (5 \cdot m)$. Find his mistake and correct it.



14. MP **Identify Structure** Does the Associative Property *always*, *sometimes*, or *never* hold for subtraction? Explain your reasoning using examples and counterexamples.

15. MP **Persevere with Problems** If you take any two whole numbers and add them together, the sum is always a whole number. This is the Closure Property for Addition. The set of whole numbers is *closed* under addition.

a. Is the set of whole numbers closed under subtraction? If not, give a counterexample.

b. Suppose you had a very small set of numbers that contained only 0 and 1. Would this set be closed under addition? If not, give a counterexample.

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Name _____ My Homework _____

Extra Practice

Name the property shown by each statement.

16. $9(ab) = (9a)b$

Associative (X)

Homework Help

17. $y \cdot 7 = 7y$

18. $1 \times c = c$

19. $5 + (a + 8) = (5 + a) + 8$

20. State whether the conjecture is *true* or *false*. If *false*, provide a counterexample.

Subtraction of whole numbers is commutative.

21. MP **Use Math Tools** The times for each leg of a relay for four runners are shown. Use mental math to find the total time for the relay team. Explain.

Runner	Time (s)
Jamal	12.4
Eissa	11.8
Khalifa	11.2
Majed	12.6

Simplify each expression. Justify each step.

22. $(22 + 19b) + 7$

23. $18 + (5 + 6m)$

24. $11s(4)$

25. $10y(7)$

26. $(9 + 31 + 5)[(7 \cdot 5) \cdot 4]$

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Power Up! Test Practice

27. The table shows the cost of different items at a bakery. Noura buys 2 doughnuts, a muffin, and 2 cookies. Which of the following expressions represents the total cost? Select all that apply.

- ☐ 2(2.50) + 2(2.25) + 3.50
- ☐ 2(2.50) + 3.50 + 2(2.25)
- ☐ 2(2.50 + 2.25 + 3.50)
- ☐ 3.50 + 2(2.25 + 2.50)

Item	Cost (AED)
Cookie	2.25
Doughnut	2.50
Muffin	3.50
Roll	1.25

28. Determine if the two expressions in each pair are equivalent. If they are equivalent, select the property that is illustrated.

Commutative Property
Identity Property
Associative Property
Multiplicative Property of Zero

	Equivalent?	Property
$9 \cdot 4 \div 20 = 9 \cdot 20 \div 4$		
$3b \cdot 0 \cdot c = 0$		
$35 + 2m + n = 35 + n + 2m$		
$12t \cdot 3v + 0 = 12t \cdot 3v$		

Spiral Review

Evaluate each expression if $a = 6$, $b = 15$, and $c = 9$.

29. $a + 2b$ _____

30. $c^2 - 5$ _____

31. $10 + a^3$ _____

32. $8c - 9 + 25$ _____

33. $14 + 8b \div 2$ _____

34. $3^3 \div (3a)$ _____

35. A package of pencils costs AED 7.25. A new eraser costs AED 1.75. Write an expression to find the total cost of 3 packages of pencils and 2 erasers. Then find the total cost.

_____

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Lesson 4

The Distributive Property

Real-World Link

School Supplies Mazen buys three notebooks that cost AED 5 each. He also buys three packages of pens for AED 6 each.

1. Write an expression that shows the cost of three notebooks added to the cost of three packages of pens.

$\square \times 5 + \square \times 6$

2. Write an expression that shows three times the cost of one notebook and one package of pens.

$\square(\square + \square)$

3. Evaluate both expressions. What do you notice?

4. Suppose Mazen buys five notebooks that cost AED 3 each and five packages of pens that cost AED 7 each. Circle the expressions that represent Mazen's purchases.

$5 \times 3 + 5 \times 7$ $\quad 5 \times 3 \times 5 \times 7$ $\quad 5(3 + 1)$

5. Suppose Mazen buys two rulers that cost AED 1 each and two folders that cost AED 1.50 each. Circle the expressions that represent Mazen's purchases.

$2 + 1 + 2 + 1.50$ $\quad 2(1 + 1.50)$ $\quad 2 \times 1 + 2 \times 1.50$

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

Vocabulary

Distributive Property
equivalent expressions

Mathematical Practices
1, 3, 4, 5, 7

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

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Key Concept

Use the Distributive Property

Words	The **Distributive Property** states that to multiply a sum or difference by a number, multiply each term inside the parentheses by the number outside the parentheses.	
Symbols	$a(b + c) = ab + ac$	$a(b - c) = ab - ac$
Examples	$4(6 + 2) = 4 \cdot 6 + 4 \cdot 2$	$3(7 - 5) = 3 \cdot 7 - 3 \cdot 5$

Work Zone

You can model the Distributive Property with algebraic expressions using algebra tiles. The expression $2(x + 2)$ is modeled below.

Model $x + 2$ using algebra tiles.

Double the amount of tiles to represent $2(x + 2)$.

Rearrange the tiles by grouping together the ones with the same shapes.

$$2(x + 2) = 2(x) + 2(2) \quad \text{Distributive Property}$$
$$= 2x + 4 \quad \text{Multiply.}$$

The expressions $2(x + 2)$ and $2x + 4$ are **equivalent expressions**. No matter what x is, these expressions have the same value.

Example

1. **Use the Distributive Property to evaluate $8(-9 + 4)$.**

$$8(-9 + 4) = 8(-9) + 8(4) \quad \text{Expand using the Distributive Property.}$$
$$= -72 + 32 \text{ or } -40 \quad \text{Multiply. Then add.}$$

Show your work.

a. _____

b. _____

c. _____

Got It? **Do these problems to find out.**

a. $5(-9 + 11)$ **b.** $7(10 - 5)$ **c.** $(12 - 8)9$

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Examples

Use the Distributive Property to rewrite each expression.

2. $4(x + 7)$

$4(x + 7) = 4(x) + 4(7)$ Expand using the Distributive Property.

$= 4x + 28$ Simplify.

3. $6(p - 5)$

$6(p - 5) = 6[p + (-5)]$ Rewrite $p - 5$ as $p + (-5)$.

$= 6(p) + 6(-5)$ Expand using the Distributive Property.

$= 6p + (-30)$ Simplify.

$= 6p - 30$ Definition of subtraction

4. $-2(x - 8)$

$-2(x - 8) = -2[x + (-8)]$ Rewrite $x - 8$ as $x + (-8)$.

$= -2(x) + -2(-8)$ Expand using the Distributive Property.

$= -2x + 16$ Simplify.

5. $5(-3x + 7y)$

$5(-3x + 7y) = 5(-3x) + 5(7y)$ Expand using the Distributive Property.

$= -15x + 35y$ Simplify.

6. $\frac{1}{3}(x - 6)$

$\frac{1}{3}(x - 6) = \frac{1}{3}[x + (-6)]$ Rewrite $x - 6$ as $x + (-6)$.

$= \frac{1}{3}(x) + \left(\frac{1}{3}(-6)\right)$ Expand using the Distributive Property.

$= \frac{1}{3}x + (-2)$ Simplify.

$= \frac{1}{3}x - 2$ Definition of subtraction

Got It? Do these problems to find out.

d. $6(a + 4)$

e. $(m + 3n)8$

f. $-3(y - 10)$

g. $\frac{1}{2}(w - 4)$

Show your work.

d. _____

e. _____

f. _____

g. _____

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Example

7. **Mr. Fahd needs to buy batting helmets for the baseball team. The helmets he plans to buy are AED 19.95 each. Find the total cost if Mr. Fahd needs to buy 9 batting helmets for the team.**

Rename AED 19.95 as AED 20.00 − AED 0.05. Then use the Distributive Property to find the total cost mentally.

$9(\text{AED } 20.00 - \text{AED } 0.05) = 9(\text{AED } 20.00) - 9(\text{AED } 0.05)$ Distributive Property

$= \text{AED } 180 - \text{AED } 0.45$ Multiply.

$= \text{AED } 179.55$ Subtract.

The total cost of the helmets is AED 179.55.

Show your work.

Got It? **Do this problem to find out.**

h. A sports club rents dirt bikes for AED 37.50 each. Find the total cost for the club to rent 20 bikes. Justify your answer by using the Distributive Property.

h. _____

Guided Practice

Check

Use the Distributive Property to evaluate or rewrite each expression. (Examples 1–6)

1. $(8 + 11)(-3) =$ _____

2. $-5(2x + 4y) =$ _____

3. $\frac{1}{5}(g - 10) =$ _____

Show your work.

4. A housefly can fly about 1.9 meters per second. At this rate, how far can it fly in 25 seconds? Justify your answer by using the Distributive Property. (Example 7)

5. **Building on the Essential Question** Describe how the formula to find the perimeter of a rectangle is an application of the Distributive Property.

Rate Yourself!

How confident are you about the Distributive Property? Check the box that applies.

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Name _____ My Homework _____

Independent Practice

Use the Distributive Property to evaluate each expression. (Example 1)

1. $3(5 + 6) =$ _____

2. $(6 + 4)(-12) =$ _____

3. $-6(9 - 4) =$ _____

Show your work.

4. $5(-6 + 4) =$ _____

5. $4(8 - 7) =$ _____

6. $(5 - 7)(-3) =$ _____

MP Identify Structure **Use the Distributive Property to rewrite each expression.** (Examples 2–6)

7. $3(-4x + 8) =$ _____

8. $4(x - 6y) =$ _____

9. $6(5 - q) =$ _____

10. $\frac{1}{2}(c - 8) =$ _____

11. $-3(5 - b) =$ _____

12. $(d + 2)(-7) =$ _____

13. Eiman bought roast beef for AED 59.85 per kilogram. Find the total cost if Eiman bought 4 kilograms of roast beef. Justify your answer by using the Distributive Property. (Example 7)

_____

14. The table shows the different prices of items at a movie theater.

Movie Theater Prices	
Item	**Cost (AED)**
box of candy	2.25
drink	3.25
popcorn	4.50
ticket	19.50

a. Suppose Wafa and two of her friends go to the movies. Write an expression that could be used to find the total cost for them to go to the movies and buy one of each item.

_____

b. What is the total cost for all three people?

_____

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MP **Use Math Tools** Find each product mentally. Justify your answer.

15. $9 \cdot 35 =$ _____

16. $8 \cdot 28 =$ _____

17. $112 \cdot 6 =$ _____

18. $85 \cdot 8 =$ _____

19. $4 \cdot 122 =$ _____

20. $12 \cdot 64 =$ _____

H.O.T. Problems Higher Order Thinking

21. MP **Reason Abstractly** Write an expression that when using the Distributive Property can be simplified to $12a + 18b - 6c$.

22. MP **Identify Structure** Use the Distributive Property to rewrite the expression $7bx + 7by$ as an equivalent expression.

23. MP **Persevere with Problems** Use the Distributive Property to write an equivalent expression for the expression $(a + b)(2 + y)$.

24. MP **Find the Error** Hana is using the Distributive Property to simplify $3(x + 2)$. Find her mistake and correct it.

$3(x + 2) = 3x + 2$

25. MP **Persevere with Problems** Is $3 + (x \times y) = (3 + x) \times (3 + y)$ a true statement? If so, explain your reasoning. If not, give a counterexample.

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Name _____ My Homework _____

Extra Practice

Use the Distributive Property to evaluate each expression.

26. $(3 + 6)(-8) =$ -72

$3 \cdot (-8) + 6(-8) =$

$-24 + (-48) = -72$

Homework Help

27. $4(11 - 5) =$ _____

28. $(12 - 4)(-5)$ _____

Use the Distributive Property to rewrite each expression.

29. $-8(a + b) =$ _____

30. $(2b + 8)5 =$ _____

31. $(p + 7)(-2) =$ _____

32. MP **Justify Conclusions** Wafa is planning on making a fleece blanket for her nephew. She learns that the fabric she wants to use is AED 7.99 per yard. Find the total cost of 4 yards of fabric. Justify your answer by using the Distributive Property.

_____

_____

33. You are ordering T-shirts with your school's mascot printed on them. Each T-shirt costs AED 24.75. The printer charges a setup fee of AED 30 and AED 2.50 to print each shirt. Write two expressions to represent the total cost of printing n T-shirts.

_____

_____

Use the Distributive Property to rewrite each expression.

34. $0.5x(y - z)$

$=$ _____

35. $-6a(2b + 5c)$

$=$ _____

36. $-4m(3n - 6p)$

$=$ _____

37. $3(2y + 4z)$

$=$ _____

38. $-2(3a - 2b)$

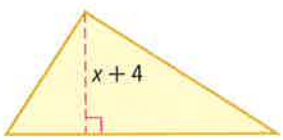
$=$ _____

39. $-6(12p - 8n)$

$=$ _____

40. Write two equivalent expressions for the area of the figure.

_____



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Power Up! Test Practice

41. A group of 3 seniors, 3 adults, and 3 children bought tickets to the aquarium.

Type of Ticket	Cost (AED)
Adult	28.95
Senior	24.95
Child	19.95

Fill in the boxes to model the total amount spent with an expression.

$\square \times (\square + \square + \square)$

How much did the group spend on tickets altogether? How does applying the Distributive Property make it easier to find this amount?

42. Mahmoud is going to summer camp. The table shows the cost of items he will need to purchase with the camp logo. He needs to buy four of each item.

Item	Cost (AED)
T-shirt	8.00
Shorts	4.50
Socks	2.25

Which of the following expressions represents the total cost of the items? Select all that apply.

- ☐ 4(14.75)
- ☐ 4(8.00) + 4.50 + 2.25
- ☐ 4(8) + 4(4.50) + 4(2.25)
- ☐ 4(8.00 + 4.50 + 2.25)

Spiral Review

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

43. $x + y - 58$ _____

44. $y^3 + x^3$ _____

45. $y^4 - 128 =$ _____

46. In the expression below, identify the coefficient and the variable.

$$4x + 450$$

coefficient: _____ variable: _____

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MP Problem-Solving Investigation
Make a Table

MP Mathematical Practices
1, 3, 4

Case #1 Mountain Biking

Ali wants to purchase a membership to a bike park. The cost depends on the number of people on the membership. It costs AED 55 for 5 people, AED 65 for 6 people, and AED 75 for 7 people.

Find the cost of a membership that includes 8 people.

1 Understand ***What are the facts?***

The cost of a membership depends on the number of people included on the membership.

2 Plan ***What is your strategy to solve this problem?***

Make a table that shows the number of people and the cost.

3 Solve ***How can you apply the strategy?***

Make a table. Find the cost for 8 people.

Number of People (p)	Cost
5	AED 55
6	AED 65
7	AED 75
8	

+10
+10
+10

So, the cost for 8 people is _____.

4 Check ***Does the answer make sense?***

The expression $10p + 5$ can be used to represent the situation.

Since AED $10(8)$ + AED 5 = AED 85, the solution is reasonable.

Analyze the Strategy

MP **Justify Conclusions** Ali wants to purchase a membership for four people. Explain how the table would change and then solve.

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Case #2 Financial Literacy

Hidaya is saving money to buy a saxophone. After 1 month, she has AED 75. After 2 months, she has AED 120. After 3 months, she has AED 165. She plans to keep saving at the same rate.

How long will it take Hidaya to save enough money to buy a saxophone that costs AED 300?

1 Understand

Read the problem. What are you being asked to find?

I need to find _____.

Underline key words and values. What information do you know?

After 1 month, Hidaya has _____. After 2 months, she has _____.

After 3 months, she has _____. She continues to save at the same rate.

Is there any information that you do *not* need to know?

I do not need to know _____.

2 Plan

Choose a problem-solving strategy.

I will use the _____ strategy.

3 Solve

Use your problem-solving strategy to solve the problem.

Months	1	2	3	4	5	6
Amount Saved (AED)	75	120	165			

+45 +45 +45 +45 +45

Hidaya will have AED 300 saved in _____.

4 Check

Use information from the problem to check your answer.

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Collaborate

Work with a small group to solve the following cases.
Show your work on a separate piece of paper.

Case #3 Carnivals

For a carnival game, containers are arranged in a triangular display. The top row has 1 container. The second row has 2 containers. The third row has 3 containers. The pattern continues until the bottom row, which has 10 containers.

A contestant knocks down 29 containers on the first throw. How many containers remain?

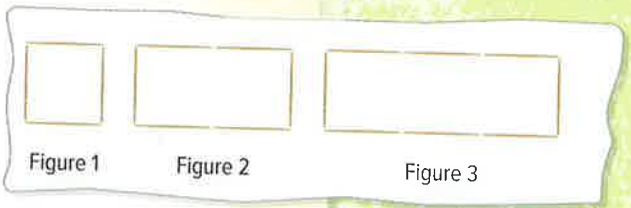
Case #4 Budget

Yasmin earns AED 2,050 each month. She spends 65% of the amount she earns. The rest of the money is equally divided and deposited into two separate accounts.

How many months until Yasmin has deposited more than AED 2,500 in one of her accounts?

Case #5 Toothpicks

Write an expression that can be used to find the number of toothpicks needed to make any figure. Then find the number of toothpicks needed to make the eighth figure.



Use any strategy!

Case #6 Diving

A diver descends to −4.5 meters after 1 minute, −9 meters 2 minutes, and −13.5 meters after 3 minutes.

If the diver keeps descending at this rate, what is their position after 12 minutes?

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Mid-Chapter Check

Vocabulary Check

Vocab

1. Fill in the blank in the sentence below with the correct term. (Lesson 1)

A _____ is a symbol that represents an unknown quantity.

2. Define *arithmetic sequence*. Then provide an example. (Lesson 2)

Skills Check and Problem Solving

Describe the relationship between the terms in each arithmetic sequence. Then write the next three terms in each sequence. (Lesson 2)

3. 5, 8, 11, 14, ...

4. 4, 11, 18, 25, ...

5. 5.8, 10.8, 15.8, 20.8, ...

Show your work.

Use the Distributive Property to rewrite each expression. (Lesson 4)

6. $4(x + 9) =$ _____

7. $2(x + 5) =$ _____

8. $3(-2x + 4) =$ _____

9. MP **Identify Structure** What property is shown by the statement $8x + 0 = 8x$? (Lesson 3)

10. MP **Persevere with Problems** A coach bought some baseball bats and five baseball gloves. Let b represent the number of bats. Write an expression that can be used to find the total cost of the bats and gloves. Then find the total cost if he bought three bats. (Lesson 1)

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Lesson 5

Simplify Algebraic Expressions

Real-World Link

Tools

Music Store Salem, Khalaf, and Ayoub work at a music store. Each week, Salem works three more than twice the number of hours that Khalaf works. Ayoub works 2 less hours than Khalaf.

1. Let x represent the number of hours that Khalaf works each week. The number of hours that Khalaf, Salem and Ayoub work can be modeled as shown below. Write an expression that represents each person's number of hours.

Khalaf's hours

Salem hours

Twice Khalaf Three more

Ayoub's hours

Khalaf Two less

Expression: _____ Expression: _____ Expression: _____

2. Model the total number of hours that Salem and Ayoub work. Draw the result below. Then write an expression for the drawing.

Expression:

_____

3. Like tiles are tiles that have the same shape. Group like tiles together and remove the zero pairs. Draw the result below. Then write an expression for your drawing.

Expression:

_____

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

Vocabulary

term
like terms
constant
simplest form

MP Mathematical Practices
1, 2, 3, 4, 6

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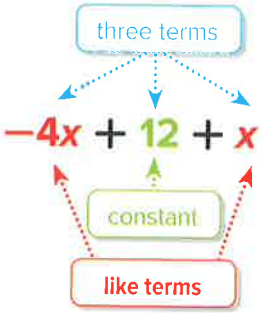
Work Zone

Identify Parts of an Expression

When addition or subtraction signs separate an algebraic expression into parts, each part is called a **term**. Recall that the numerical factor of a term that contains a variable is called the coefficient of the variable.

Like terms contain the same variables to the same powers. For example, $3x^2$ and $-7x^2$ are like terms. So are $8xy^2$ and $12xy^2$. But $10x^2z$ and $22xz^2$ are *not* like terms. A term without a variable is called a **constant**. Constant terms are also like terms.



STOP and Reflect

Circle the term below that is a like term with $-4x^3$.

$-4x^2$ x^3 -4

Example

1. **Identify the terms, like terms, coefficients, and constants in the expression $6n - 7n - 4 + n$.**

$6n - 7n - 4 + n = 6n + (-7n) + (-4) + 1n$ Rewrite the expression.

- Terms: $6n$, $-7n$, -4, n
- Like terms: $6n$, $-7n$, n All of these terms have the same variable.
- Coefficients: 6, −7, 1
- Constants: −4 This is the only term without a variable.

Show your work.

a. _____

b. _____

Got It? **Do these problems to find out.**

Identify the terms, like terms, coefficients, and constants in each expression.

a. $9y - 4 - 11y + 7$

b. $3x + 2 - 10 - 3x$

Simplify Algebraic Expressions

An algebraic expression is in **simplest form** if it has no like terms and no parentheses. Use the Distributive Property to combine like terms.

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Examples

2. **Write $4y + y$ in simplest form.**

$4y$ and y are like terms.

$4y + y = 4y + 1y$ Identity Property; $y = 1y$

$= (4 + 1)y$ or $5y$ Distributive Property; Simplify.

3. **Write $7x - 2 - 7x + 6$ in simplest form.**

$7x$ and $-7x$ are like terms. -2 and 6 are also like terms.

$7x - 2 - 7x + 6 = 7x + (-2) + (-7x) + 6$ Definition of subtraction

$= 7x + (-7x) + (-2) + 6$ Commutative Property

$= [7 + (-7)]x + (-2) + 6$ Distributive Property

$= 0x + 4$ Simplify.

$= 0 + 4$ or 4 Multiplicative Property of zero and Additive Identity Property of zero.

Got It? **Do these problems to find out.**

c. $4z - z$ **d.** $6 - 3n + 3n$ **e.** $2g - 3 + 11 - 8g$

Real World Example

4. **The cost of a jacket j after a 5% markup can be represented by the expression $j + 0.05j$. Simplify the expression. Then determine the total cost of the jacket after the markup, if the original price is AED 35.**

$j + 0.05j = 1j + 0.05j$ Identity Property; $j = 1j$

$= (1 + 0.05)j$ Distributive Property

$= 1.05j$ Simplify.

$1.05j = 1.05(35)$ Replace j with 35 to find the total cost.

$= 36.75$ Multiply.

So, the cost of the jacket after a 5% markup is AED 36.75.

Got It? **Do this problem to find out.**

f. Write an expression in simplest form for the cost of the jacket in Example 4 if the markup is 8%. Then determine the total cost after the markup.

Equivalent Expressions

To check whether $4y + y$ and $5y$ are equivalent expressions, substitute any value for y and see whether the expressions have the same value.

Show your work.

c. _____

d. _____

e. _____

f. _____

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Example

5. **At a concert, you buy some T-shirts for AED 12.00 each and the same number of CDs for AED 7.50 each. Write an expression in simplest form that represents the total amount spent.**

Let x represent the number of T-shirts and CDs.

$12x + 7.50x$ Write the expression.

$12x + 7.50x = (12 + 7.50)x$ Distributive Property

$= 19.50x$ Simplify.

The expression AED $19.50x$ represents the total amount spent.

Got It? Do this problem to find out.

g. You have some money. Your friend has AED 50 less than you. Write an expression in simplest form that represents the total amount of money you and your friend have.

Show your work.

g. _____

Guided Practice

Check

1. Identify the terms, like terms, coefficients, and constants in $5n - 2n - 3 + n$. (Example 1)

2. Write $4p - 7 + 6p + 10$ in simplest form. (Examples 2 and 3)

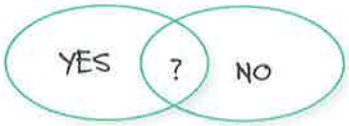
3. The cost of a game g with 7% sales tax can be represented by the expression $g + 0.07g$. Simplify the expression. Then determine the total cost of the game after sales tax if the original price is AED 52. (Example 4)

4. You go to a basketball game and buy 3 waters that cost x dirham each. Your brother buys a bottle of water and a bag of peanuts that costs AED 4.50. Write an expression in simplest form that represents the total amount of money spent altogether. (Example 5)

5. **Building on the Essential Question** Explain why $2(x - 1) + 3(x - 1) = 5(x - 1)$ is a true statement.

Rate Yourself!

Are you ready to move on? Shade the section that applies.



Erica Simone Leeds Copyright © McGraw-Hill Education

Name _____ My Homework _____

Independent Practice

Identify the terms, like terms, coefficients, and constants in each expression. (Example 1)

1. $2 + 3a + 9a$

2. $7 - 5x + 1$

3. $9 - z + 3 - 2z$

Write each expression in simplest form. (Examples 2 and 3)

4. $n + 5n =$ _____

5. $12c - c =$ _____

6. $-4j - 1 - 4j + 6 =$ _____

7. The cost of a ticket t to a concert with a 3% sales tax can be represented by the expression $t + 0.03t$. Simplify the expression. Then determine the total cost after the sales tax if the original price is AED 72. (Example 4)

Write an expression in simplest form that represents the total amount in each situation. (Example 5)

8. You rent x pairs of shoes for AED 20 each. You buy the same number of drinks for AED 9.50 each. You also pay AED 19 for a bowling lane.

9. You watch x minutes of television on Monday, the same amount on Wednesday, and 30 minutes on Friday.

10. In a municipality committee, there were 119 more members in the auditing department than in the public relations and media department. If there were m members in the public relations and media department, write an expression to represent the total members in the committee. _____

11. Nasser and his friends paid a total of AED 27 for tickets to the school football game. While at the game, they bought 5 sandwiches at x dirhams each, 4 boxes of popcorn at y dirhams each, and 2 pretzels at z dirhams each.

a. Write an expression to show the total cost of admission and the snacks.

b. Sandwiches cost AED 4, popcorn cost AED 3, and pretzels cost AED 2. What was the total cost for admission and snacks? _____

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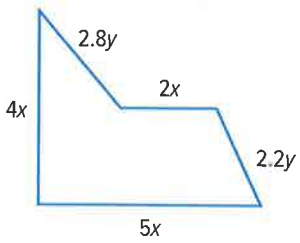
MP Reason Abstractly Write an expression in simplest form for the perimeter of each figure.

12.



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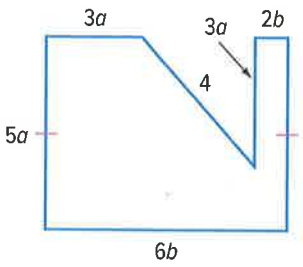

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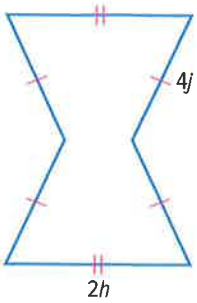

H.O.T. Problems Higher Order Thinking

15. MP Be Precise Write an expression that has three terms and simplifies to $4x - 7$. Identify the coefficient(s) and constant(s) in your expression.

16. MP Which One Doesn't Belong? Identify the expression that is not equivalent to the other three. Explain your reasoning.

$x - 2 + 3x$	$4(x - 2)$	$-2 + 7x - 3x$	$4x - 2$

17. MP Persevere with Problems Simplify the expression $8x - 2x + 12x - 3$. Show that your answer is true for $x = 2$.

18. MP Justify Conclusions Determine whether the following statement is *always*, *sometimes*, or *never* true. Explain your reasoning.

When using the Distributive Property, if the term outside the parentheses is negative, then the sign of each term inside the parentheses will change.

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Name _____ My Homework _____

Extra Practice

Identify the terms, like terms, coefficients, and constants in each expression.

19. $4 + 5y - 6y + y$

terms: 4, 5y, −6y, y

Homework Help

like terms: 5y, −6y, y

coefficients: 5, −6, 1

constant: 4

20. $n + 4n - 7n - 1$

21. $-3d + 8 - d - 2$

Write each expression in simplest form.

22. $5x + 4 + 9x$

= _____

23. $2 + 3d + d$

= _____

24. $-3r + 7 - 3r - 12$

= _____

Write an expression in simplest form that represents the total amount in each situation.

25. You subscribe to m different magazines. Your friend subscribes to 2 fewer than you.

26. Your friend is y years old. Her brother is 5 years younger.

27. You spent m minutes studying on Sunday. On Monday, you studied 15 more minutes than you did on Sunday. Tuesday, you studied 30 minutes less than you did on Monday. You studied twice as long on Wednesday as you did on Sunday. On Thursday, you studied 20 minutes less than you did on Wednesday. Write an expression in simplest form to represent the number of minutes you studied in all.

28. MP **Reason Abstractly** Write a real-world situation for $7.50y + 9$.

Simplify each expression.

29. $3(4x - 5) + 4(2x + 6)$

= _____

30. $-8(2a - 3b) - 5(6b - 4a)$

= _____

31. $10(5g + 2h - 3) - 4(3g - 4h + 2)$

= _____

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Power Up! Test Practice

32. Ibrahim, Ahmed, and Usama collect baseball cards. Ahmed has 3 fewer cards than twice the number of cards Ibrahim has. Usama has 5 more baseball cards than Ibrahim. Let x represent the number of baseball cards that Ibrahim has. Use the algebra tiles to represent the number of cards each person has.

	Ibrahim	Ahmed	Usama
Model			
Expression			

Write an expression, in simplified form, for the number of baseball cards the three friends have altogether.

33. The table shows the number of tickets needed and the number of times Shaima participated in different activities at a carnival. Write an expression, in simplified form, for the total number of tickets that Shaima used.

Activity	Tickets	Times Completed
Balloon Pop	3	a
Dunk Tank	4	b
Ring Toss	2	a
Trampoline	5	b

Spiral Review

34. Amani spends AED 25 for her lunch and AED 10 for breakfast each day Sunday through Thursday. Use the Associative Property to find how much money she spends on lunch and breakfast for 4 weeks.

Define a variable. Then write each phrase as an algebraic expression.

35. Asma has volunteered 9 more hours than Amal

36. the cost of a pair of jeans is 4 times the cost of a book

Evaluate each expression if $x = 2$, $y = 10$, and $z = 4$.

37. $5z - 10$

38. $y \div 2 + x$

39. $x^3 + (y \div x)$

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Lesson 6

Add Linear Expressions

Real-World Link

Tools

Homework Badr has 20 math problems and 11 science questions for homework. Saeed has 23 math problems and 10 science questions for homework.

1. The expression below represents the types of exercises that Badr has for homework.

   20 math problems + 11 science questions

   Complete the expression that represents the types of exercises that Saeed has for homework.

   ☐ math problems + ☐ science questions

2. Write an expression for the total number of math problems and science questions for both boys.

   ☐ math problems + ☐ science questions

3. Suppose Badr has x math problems and 5 science questions for homework and Saeed has x math problems and 6 science questions. The algebra tiles below represent the total number of math problems and science questions for both boys. Write an expression in simplest form that represents the algebra tiles.

Expression: _____

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Essential Question

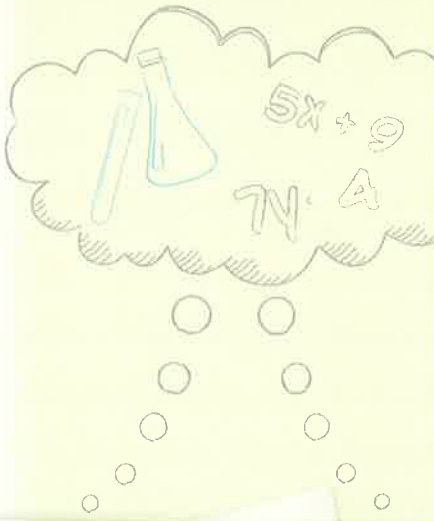
HOW can you use numbers and symbols to represent mathematical ideas?

Vocabulary

linear expression

MP Mathematical Practices

1, 2, 3, 4



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Work Zone

Add Linear Expressions

A **linear expression** is an algebraic expression in which the variable is raised to the first power and variable are not multiplied or divided. The table below gives some examples of expressions that are linear and some examples of expressions that are not linear.

Linear Expressions	Nonlinear Expressions
$5x$	$5mn$
$3x + 2$	$3x^3 + 2$
$x - 7$	$x^4 - 7$

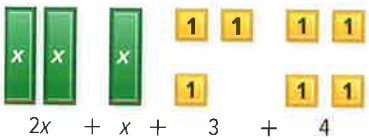
You can add linear expression with or without models. Sometimes you will need to use zero pairs.

Examples

Add.

1. $(2x + 3) + (x + 4)$

Model each linear expression.



Combine like tiles and write a linear expression for the combined tiles.

So, $(2x + 3) + (x + 4) = 3x + 7$.

2. $(2x - 1) + (x - 5)$

$(2x - 1) + (x - 5) = [2x + (-1)] + [x + (-5)]$ Definition of subtraction

$$\begin{array}{r} 2x + (-1) \\ +\ x + (-5) \\ \hline 3x + (-6) \end{array}$$

Arrange like terms in columns.

Add.

So, $(2x - 1) + (x - 5) = 3x + (-6)$ or $3x - 6$.

Show your work.

a. _____

b. _____

Got It? **Do these problems to find out.**

a. $(3x + 5) + (2x + 3)$

b. $(2x - 4) + (3x - 7)$

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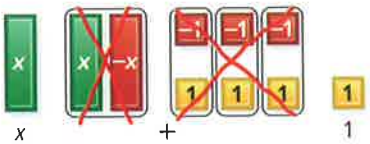
Examples

3. **Find $(2x - 3) + (-x + 4)$. Use models if needed.**

Model each linear expression.



Combine like tiles. Then remove all zero pairs and write a linear expression for the remaining tiles.

So, $(2x - 3) + (-x + 4) = x + 1$.

4. **Find $2(x + 3) + (3x + 1)$.**

$2(x + 3) + (3x + 1) = (2 \cdot x + 2 \cdot 3) + (3x + 1)$ — Use the Distributive Property.

$= (2x + 6) + (3x + 1)$ — Simplify.

$$\begin{array}{r} 2x + 6 \\ +\ 3x + 1 \\ \hline 5x + 7 \end{array}$$

Arrange like terms in columns.

Add.

So, $2(x + 3) + (3x + 1) = 5x + 7$.

5. **Find $5(x - 4) + (2x - 7)$.**

$5(x - 4) + (2x - 7) = (5 \cdot x - 5 \cdot 4) + (2x - 7)$ — Use the Distributive Property.

$= (5x - 20) + (2x - 7)$ — Simplify.

$$\begin{array}{r} 5x - 20 \\ +\ 2x - 7 \\ \hline 7x - 27 \end{array}$$

Arrange like terms in columns.

Add.

So, $5(x - 4) + (2x - 7) = 7x - 27$.

Got It? **Do these problems to find out.**

Add. Use models if needed.

c. $(x - 1) + (2x + 3)$

d. $(x - 4) + (-2x + 1)$

e. $6(x + 7) + (x + 3)$

f. $(12x + 19) + 2(x - 10)$

Show your work.

c. _____

d. _____

e. _____

f. _____

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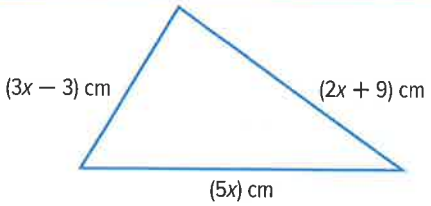
Properties
The Commutative Property allows the terms of the expression to be reordered.

Example

6. **Write a linear expression in simplest form to represent the perimeter of the triangle. Find the perimeter if the value of x is 5 centimeters.**



Write a linear expression for the perimeter of the triangle.

$(3x - 3) + (2x + 9) + (5x)$ Write each expression.

$(3x + 2x + 5x) + (-3 + 9)$ Rearrange to combine like terms.

$10x + 6$ Add.

Find the perimeter.

$10x + 6 = 10(5) + 6$ or 56 Replace x with 5. Simplify.

So, the perimeter of the triangle is 56 centimeters.

Show your work.

Got It? **Do this problem to find out.**

g. A rectangle has side lengths $(x + 4)$ meters and $(2x - 2)$ meters. Write a linear expression in simplest form to represent the perimeter. Find the perimeter if the value of x is 7 meters.

g. _____

Guided Practice

Check

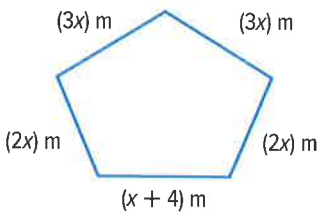
Add. Use models if needed. (Examples 1–5)

Show your work.

1. $(2x + 3) + (x + 1) =$ _____

2. $10(x - 2) + (6x - 6) =$ _____

3. Write a linear expression in simplest form to represent the perimeter of the pentagon. Then find the perimeter if the value of x is 3 meters. (Example 6)



4. **Building on the Essential Question** Explain how adding linear expressions is similar to simplifying expressions.

Rate Yourself!

How confident are you about adding linear expressions? Check the box that applies.

FOLDABLES Time to update your Foldable!

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Name _____ My Homework _____

Independent Practice

Add. Use models if needed. (Examples 1–5)

1. $(4x + 8) + (7x + 3) =$ _____

Show your work.

2. $(-3x + 7) + (-6x + 9) =$ _____

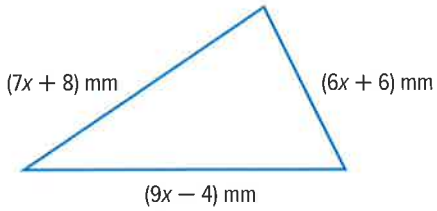
3 $(x - 10) + (3x - 6) =$ _____

4. $(-3x - 7) + (4x + 7) =$ _____

5. $2(x + 14) + (2x - 14) =$ _____

6. $(11x - 8) + 7(x - 1) =$ _____

7. Write a linear expression in simplest form to represent the perimeter of the triangle at the right. Then find the perimeter if the value of x is 10 millimeters. (Example 6)



_____

8. A rectangle has side lengths $(2x - 5)$ meters and $(2x + 6)$ meters. Write a linear expression in simplest form to represent the perimeter. Find the perimeter if the value of x is 12 meters. (Example 6)

_____

9 Find the sum of $(x + 5)$, $(-4x - 2)$, and $(2x - 1)$.

_____

Add.

10. $(-3.5x + 1.7) + (9.1x - 0.3) =$ _____

11. $(0.5x + 15) + (8.2x - 16.6) =$ _____

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12. MP **Reason Abstractly** The table shows the breakdown of the points scored in last week's basketball game.

	1st Quarter Points	2nd Quarter Points	3rd Quarter Points	4th Quarter Points	Total Free Throw Points
Panthers	$2x - 6$	$x + 2$	$2x$	$x - 6$	9

a. Write a linear expression in simplest form to represent the total points scored in the first two quarters.

b. Write a linear expression in simplest form to represent the total points scored in the game.

H.O.T. Problems Higher Order Thinking

13. MP **Reason Inductively** Write two linear expressions with a sum of $-5x + 4$.

14. MP **Construct an Argument** Will the sum of two linear expressions, each with an x-term, *always, sometimes,* or *never* have an x-term? Explain your reasoning.

15. MP **Persevere with Problems** An integer can be represented by x. The next integer can then be represented as $(x + 1)$. Write a linear expression that represents the sum of any two consecutive integers. Show that the sum of any two consecutive integers is always odd.

16. MP **Reason Inductively** Explain how algebra tiles represent like terms and zero pairs.

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Name _____ My Homework _____

Extra Practice

Add. Use models if needed.

17. $(-x + 10) + (-3x + 6) =$ $-4x + 16$

Homework Help

$-x + 10$

$(+)\ -3x + 6$

$-4x + 16$

18. $(-4x + 3) + (-2x + 8) =$ _____

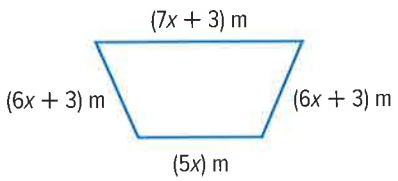
19. $(-6x + 5) + (4x - 7) =$ _____

20. $(-4x + 5) + (15x - 3) =$ _____

21. $(-5x + 4) + -1(x - 1) =$ _____

22. $17(2x - 5) + (-x + 4) =$ _____

23. Write a linear expression in simplest form to represent the perimeter of the trapezoid at the right. Then find the perimeter if the value of x is 7 meters. _____



24. MP **Reason Abstractly** The table shows the points earned by a contestant in four rounds on a game show.

Round 1	Round 2	Round 3	Round 4
$2x + 40$	$5x + 12$	100	$6x - 10$

Show your work.

a. Write a linear expression in simplest form to represent the total points earned by the contestant in rounds 1 and 2.

b. Write a linear expression in simplest form to represent the total points earned in all four rounds.

c. If the value of x is 8, what is the total points earned in all four rounds?

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Power Up! Test Practice

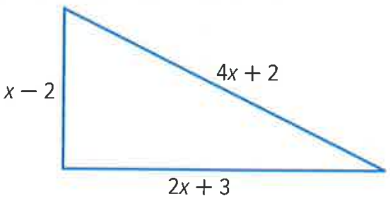
25. Hasan makes x dirhams per hour working at the grocery store. He makes y dirhams per hour working at the library. One week he worked 9 hours at the grocery store and 12 hours at the library. Determine if each statement is true or false.

a. The expression $21x$ represents Hasan's earnings from the library. ☐ True ☐ False

b. The expression $9y$ represents Hasan's earnings from the grocery store. ☐ True ☐ False

c. The expression $9x + 12y$ represents Hasan's total earnings for the week. ☐ True ☐ False

26. A triangle has the side lengths represented by the expressions shown in the figure. Select the appropriate numbers and expressions to complete the model representing the perimeter of the triangle.



	+		
	+		
+		+	
+		+	

x	-1
$2x$	1
$4x$	2
$5x$	3
$7x$	7
-2	

Spiral Review

Use the Distributive Property to evaluate each expression.

27. $7(9 - 4) =$ _____

28. $(9 + 2)6 =$ _____

29. $5(9 + 8) =$ _____

30. The number of students in each of the seventh grade homerooms that volunteer in the office are shown in the table. Use mental math to find the total number of students who volunteered. Explain.

_____

_____

Office Volunteers	
Homeroom	**Number of Students**
A	6
B	5
C	4
D	8

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Lesson 7

Subtract Linear Expressions

Real-World Link

Dog Sledding The Iditarod is a dog sledding race over 1,840 kilometers across Alaska. The table shows two winning times.

Iditarod				
	Days	**Hours**	**Minutes**	**Seconds**
Race 1	9	11	46	48
Race 2	9	5	8	41

1. What is the difference in hours, minutes, and seconds between the two races?

☐ h ☐ min ☐ s

2. Explain how you could find the difference in times between any two races, given the days, hours, minutes, and seconds.

3. Describe another situation in which finding the difference involves subtracting like units.

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

MP Mathematical Practices
1, 2, 3, 4

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems
② Reason Abstractly
③ Construct an Argument
④ Model with Mathematics
⑤ Use Math Tools
⑥ Attend to Precision
⑦ Make Use of Structure
⑧ Use Repeated Reasoning

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U.S. Air Force photo by Tech. Sgt. Keith Brown

Work Zone

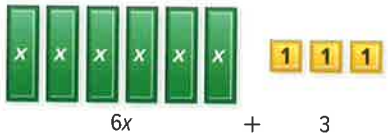
Subtract Linear Expressions

When subtracting linear expressions, subtract like terms. Use zero pairs if needed.

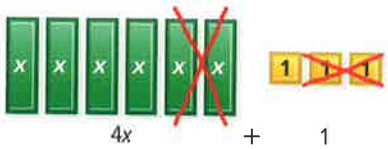
Examples

Subtract. Use models if needed.

1. $(6x + 3) - (2x + 2)$



Model the linear expression $6x + 3$.

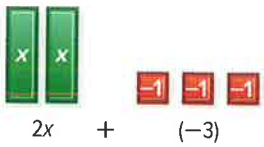


To subtract $2x + 2$, remove two x-tiles and two 1-tiles. Then write the linear expression for the remaining tiles.

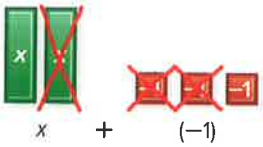
There are four x-tiles and one 1-tile remaining.

So, $(6x + 3) - (2x + 2) = 4x + 1$.

2. $(2x - 3) - (x - 2)$



Model the linear expression $2x - 3$.



To subtract $x - 2$, remove one x-tile and two -1-tiles. Then write the linear expression for the remaining tiles.

There is one x-tile and one -1-tile remaining.

So, $(2x - 3) - (x - 2) = x - 1$.

Show your work.

Got It? **Do these problems to find out.**

a. _____

b. _____

a. $(5x - 9) - (2x - 7)$

b. $(6x - 10) - (2x - 8)$

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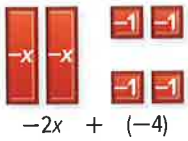
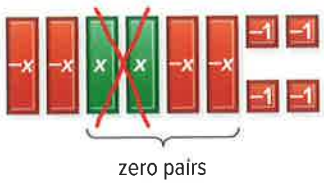
Example

3. **Find $(-2x - 4) - (2x)$. Use models if needed.**



$-2x + (-4)$

Model the linear expression $-2x - 4$.



zero pairs

Since there are no positive x-tiles to remove, add two zero pairs of x-tiles. Remove two positive x-tiles.

So, $(-2x - 4) - (2x) = -4x - 4$.

Got It? **Do these problems to find out.**

c. $(3x - 2) - (5x - 4)$

d. $(4x - 4) - (-2x + 2)$

Show your work.

c. _____

d. _____

Use the Additive Inverse to Subtract

When subtracting integers, you add the opposite, or the additive inverse. The same process is used when subtracting linear expressions.

Examples

4. **Find $(6x + 5) - (3x + 1)$.**

$$\begin{array}{r} 6x + 5 \\ (+)\ -3x - 1 \\ \hline 3x + 4 \end{array}$$

Arrange like terms in columns.

The additive inverse of $3x + 1$ is $(-3x - 1)$.

Additive Inverse

The additive inverse is found by multiplying the linear expression by -1.

5. **Find $(-4x - 7) - (-5x - 2)$.**

$$\begin{array}{r} -4x - 7 \\ (+)\ 5x + 2 \\ \hline x - 5 \end{array}$$

Arrange like terms in columns.

The additive inverse of $(-5x - 2)$ is $(5x + 2)$.

Got It? **Do these problems to find out.**

e. $(4x - 3) - (2x + 7)$

f. $(5x - 4) - (2x + 3)$

e. _____

f. _____

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Example

6. **A hat store tracks the sale of college and professional team hats for m months. The number of college hats sold is represented by $(6m + 3)$. The number of professional hats sold is represented by $(5m - 2)$. Write an expression to show how many more college hats were sold than professional hats. Then evaluate the expression if m equals 10.**

Find $(6m + 3) - (5m - 2)$.

$$\begin{array}{rl} 6m + 3 & \text{Arrange like terms in columns.} \\ (+)-5m + 2 & \text{The additive inverse of } 5m - 2 \text{ is } (-5m + 2). \\ \hline m + 5 & \end{array}$$

Evaluate the expression if $m = 10$.

$m + 5 = 10 + 5$ Substitute 10 for m.

$= 15$ Simplify.

So, 15 more college team hats were sold.

Guided Practice

Subtract. Use models if needed. (Examples 1–5)

1. $(2x + 4) - (-x + 5) =$ _____

2. $(6x + 9) - (7x - 1) =$ _____

Show your work.

3. The number of runs scored by the home team at a baseball game is represented by $(x + 7)$. The number of runs scored by the visiting team is represented by $(3x - 7)$. Write an expression to find how many more runs the home team scored than the visiting team. Then evaluate the expression if the value of x is 6. (Example 6)

4. **Building on the Essential Question** How can you use the additive inverse to help you subtract linear expressions?

Rate Yourself!

How well do you understand subtracting linear expressions? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

FOLDABLES Time to update your Foldable!

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Name _____ My Homework _____

Independent Practice

Subtract. Use models if needed. (Examples 1–5)

1. $(9x + 5) - (4x + 3) =$ _____

Show your work.

2. $(-x + 3) - (x - 5) =$ _____

3. $(3x + 4) - (x + 2) =$ _____

4. $(7x + 5) - (3x + 2) =$ _____

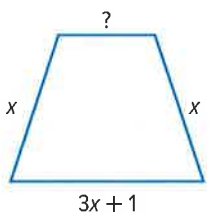
5. $(9x - 8) - (x + 4) =$ _____

6. $(9x - 12) - (5x - 7) =$ _____

7. MP **Reason Abstractly** The number of customers in a store on the first day is represented by $(6x - 3)$. The number of customers on the second day is represented by $(x - 1)$. Write an expression to find how many more customers visited the store on the first day. Then evaluate the expression if x is equal to 50. (Example 6)

_____

8. The perimeter of the garden shown is $(6x + 2)$ units. Find the length of the missing side.



_____

9. The cost for shipping a package that weighs x kilograms from Dubai to Sharjah is shown at the right. How much more does Shipping Central charge than Globe Delivery?

Company	Cost (AED)
Shipping Central	$3x + 3.50$
Globe Delivery	$2x + 2.99$

_____

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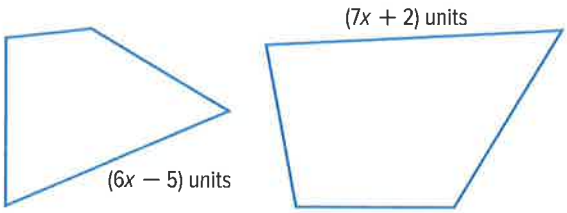
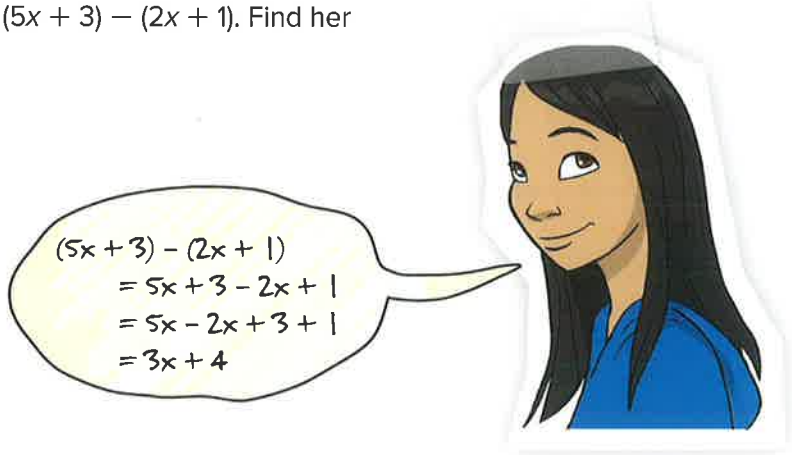
10. Find the difference in the given lengths of the polygons.



H.O.T. Problems Higher Order Thinking

11. MP **Find the Error** Suhaila is finding $(5x + 3) - (2x + 1)$. Find her mistake and correct it.



12. MP **Reason Inductively** Name two linear expressions whose difference is $5x - 4$.

13. MP **Persevere with Problems** One linear expression is subtracted from a second linear expression and the difference is $x - 5$. What is the difference when the second linear expression is subtracted from the first?

14. MP **Persevere with Problems** Suppose A and B represent linear expressions. If $A + B = 2x - 2$ and $A - B = 4x - 8$, find A and B.

15. MP **Reason Inductively** Explain how you can apply the rule for subtracting integers to linear expressions.

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Name _____ My Homework _____

Extra Practice

Subtract. Use models if needed.

16. $(-3x - 2) - (7x + 9) =$ $-10x - 11$

$-3x - 2$
$(+) -7x - 9$
$-10x - 11$

Homework Help

17. $(-2x - 1) - (x - 7) =$ _____

18. $(9x + 5) - (6x - 8) =$ _____

19. $(-8x + 1) - (8x - 1) =$ _____

20. $(4x + 10) - (-3x + 5) =$ _____

21. $(-6x - 11) - (-2x - 4) =$ _____

22. MP **Reason Abstractly** The number of questions on a math test is represented $(3x + 1)$. The number of questions on a spelling test is represented by $(x + 12)$. Write an expression to find how many more questions were on the math test. Then evaluate the expression if the value of x is 8.

_____

Subtract.

23. $(5.7x - 0.8) - (4.9x - 1.4) =$ _____

24. $\left(-\frac{5}{6}x + 5\frac{1}{2}\right) - \left(\frac{2}{3}x + 4\right) =$ _____

25. $2(x + 1) - 3x =$ _____

26. $5(x - 3) - x =$ _____

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Power Up! Test Practice

27. The costs for a large pizza and each topping for two pizzerias are shown in the table.

Pizzeria	Cost per Pizza (AED)	Cost per Topping (AED)
Pizza Pizza	10	1.25
Pizza Palace	12	1.50

Select the appropriate values to complete the model to show how much more a pizza with t toppings costs at Pizza Palace than at Pizza Pizza.

0.25	2.75	1.25	1.50
2	10	12	22

$\square + \square\, t - (\square + \square\, t) = \square + \square\, t$

28. Amna wants to frame a picture. The picture is $(12x + 4)$ units long, and the frame is $(7x + 1)$ units long. Determine if each statement is true or false.

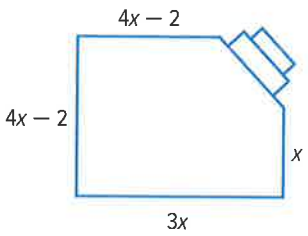
a. The picture is longer than the frame. ☐ True ☐ False

b. The frame is longer than the picture. ☐ True ☐ False

c. Amna will have to trim $(5x + 3)$ units from the picture to fit it in the frame. ☐ True ☐ False

Spiral Review

29. Rana wants to attach a string of lights to the edges of her patio for a dinner party. She does not want the string to go across the edge with the steps. Write a linear expression that represents the length of string in meters she will need. Then find the length if $x = 3$.



_____

Evaluate each expression if $x = \frac{1}{2}$ and $y = \frac{3}{4}$.

30. xy _____

31. $x - y$ _____

32. $x + y$ _____

33. x^3 _____

34. $3y + 2x$ _____

35. $x \div y$ _____

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Inquiry Lab
Factor Linear Expressions

MP Mathematical Practices 1, 3

Inquiry **HOW do models help you factor linear expressions?**

Hamad has enough 1 centimeter square glass tiles to create a rectangular piece of mosaic art that has an area of 24 square centimeters. Some of the possible dimensions of the rectangle are listed in the table. Write the two missing possible dimensions.

Length (cm)	Width (cm)
24	1
3	8

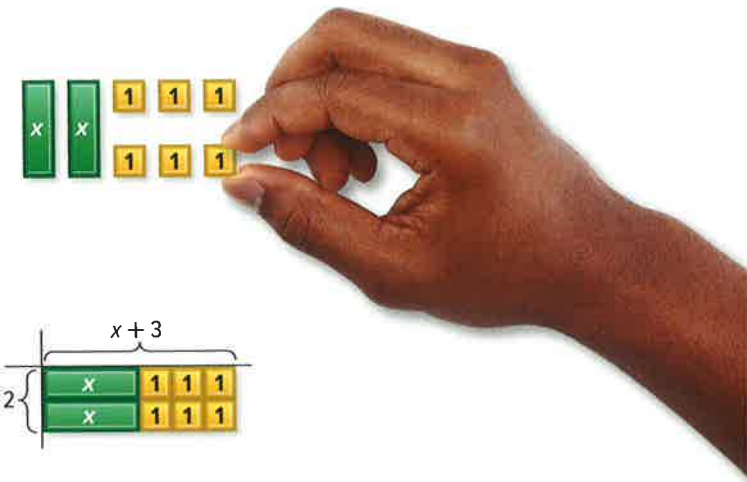
Each of the dimensions listed are factors of 24. Sometimes, you know the product and are asked to find the factors. This process is called *factoring*.

Hands-On Activity 1

Tools

Use algebra tiles to factor $2x + 6$.

Step 1 Model the expression $2x + 6$.



Step 2 Arrange the tiles into a rectangle with equal rows and columns. The total area of the tiles represents the product. Its length and width represent the factors.

The rectangle has a width of two 1-tiles and a length of one x-tile and three 1-tiles.

So, $2x + 6 = 2(x +$ ☐ $)$.

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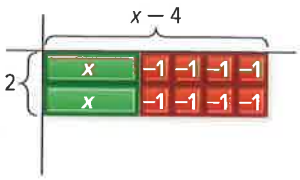
Hands-On Activity 2

Use algebra tiles to factor $2x - 8$.

Step 1 Model the expression $2x - 8$.

Step 2 Arrange the tiles into a rectangle with equal rows and columns.



The rectangle has a width of two 1-tiles and a length of one x-tile and four -1-tiles.

So, $2x - 8 =$ _____.

Hands-On Activity 3

Use algebra tiles to factor $3x - 6$.

Step 1 Draw the tiles that represent the expression $3x - 6$.

Step 2 Redraw the tiles into a rectangle with equal rows and columns.

The rectangle has a width of _____ 1-tiles and a length of one x-tile and _____ -1-tiles.

So, $3x - 6 =$ _____.

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Collaborate

Investigate

Work with a partner. Factor each expression by arranging the appropriate algebra tiles into equal rows and columns. Draw the finished product.

1. $4x + 6 =$ _____

Show your work.

2. $5x + 10 =$ _____

3. $3x + 12 =$ _____

4. $4x - 10 =$ _____

5. $3x - 9 =$ _____

6. $2x - 4 =$ _____

7. $4x + 2 =$ _____

8. $5x - 5 =$ _____

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Analyze and Reflect

Collaborate

Work with a partner to complete the table. Use algebra tiles if needed.

	Original Expression	Factored Expression	Distributive Property
	$2x + 8$	$2(x + 4)$	$2(x) + 2(4) = 2x + 8$
9.	$4x - 8$	$4(x - \square)$	$4(x) - 4(2) = 4x - 8$
10.	$6x + 2$	$2(\square x + 1)$	$2(3x) + 2(1) =$
11.	$2x - 10$		$2(x) - 2(5) =$
12.	$8x + 6$		

13. MP **Reason Inductively** How is factoring related to using the Distributive Property?

14. MP **Construct an Argument** Is the expression $2x - 2$ equivalent to the expression $2(x - 2)$? Explain.

Create

On Your Own

15. MP **Justify Conclusions** Explain how you could use algebra tiles to factor $5x + 15$.

16. Inquiry HOW do models help you factor linear expressions?

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Lesson 8

Factor Linear Expressions

Real-World Link

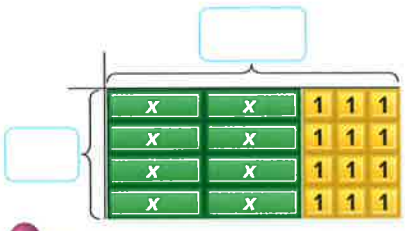
Tools

Yard Sale A rectangular yard is being separated into four equal-size sections for different items at a yard sale. The area of the yard is $(8x + 12)$ square meters.

1. How can you find the area of each section of the yard sale?

2. What is the area of each section? Explain your answer.

3. The algebra tiles represent the area of the entire yard sale. Fill in the length and width. Write an expression that represents the area in terms of the length and width of the model.



Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

Vocabulary

monomial
factor
factored form

MP Mathematical Practices
1, 2, 3, 4

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Work Zone

Find the GCF of Monomials

A **monomial** is a number, a variable, or a product of a number and one or more variables.

Monomials	Not Monomials
25, x, $40x$	$x + 4$, $40x + 120$

To **factor** a number means to write it as a product of its factors. A monomial can be factored using the same method you would use to factor a number.

The greatest common factor (GCF) of two monomials is the greatest monomial that is a factor of both.

Examples

Find the GCF of each pair of monomials.

1. $4x$, $12x$

$4x = 2 \cdot 2 \cdot x$ Write the prime factorization of $4x$ and $12x$.

$12x = 2 \cdot 2 \cdot 3 \cdot x$ Circle the common factors.

The GCF of $4x$ and $12x$ is $2 \cdot 2 \cdot x$ or $4x$.

2. $18a$, $20ab$

$18a = 2 \cdot 3 \cdot 3 \cdot a$ Write the prime factorization of $18a$ and $20ab$.

$20ab = 2 \cdot 2 \cdot 5 \cdot a \cdot b$ Circle the common factors.

The GCF of $18a$ and $20ab$ is $2 \cdot a$ or $2a$.

3. $12cd$, $36cd$

$12cd = 2 \cdot 2 \cdot 3 \cdot c \cdot d$ Write the prime factorization of $12cd$ and $36cd$.

$36cd = 2 \cdot 2 \cdot 3 \cdot 3 \cdot c \cdot d$ Circle the common factors.

The GCF of $12cd$ and $36cd$ is $2 \cdot 2 \cdot 3 \cdot c \cdot d$ or $12cd$.

Got It? **Do these problems to find out.**

Find the GCF of each pair of monomials.

a. 12, $28c$ **b.** $25x$, $15xy$ **c.** $42mn$, $14mn$

STOP and Reflect

Which of the following is not a factor of $22x$?
Circle your response.
4 2 11 x

Show your work.

a. _____

b. _____

c. _____

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Factor Linear Expressions

You can use the Distributive Property and the work backward strategy to express a linear expression as a product of its factors. A linear expression is in **factored form** when it is expressed as the product of its factors.

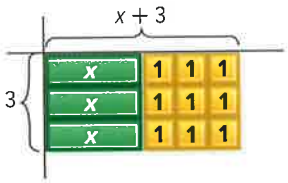
$8x + 4y = 4(2x) + 4(y)$ The GCF of $8x$ and $4y$ is 4.

$= 4(2x + y)$ Distributive Property

Examples

4. **Factor $3x + 9$.**

Method 1 **Use a model.**



Arrange three x-tiles and nine 1-tiles into equal rows and columns. The rectangle has a width of three 1-tiles, or 3, and a length of one x-tile and three 1-tiles, or $x + 3$.

Method 2 **Use the GCF.**

$3x = 3 \cdot x$ Write the prime factorization of $3x$ and 9.

$9 = 3 \cdot 3$ Circle the common factors.

The GCF of $3x$ and 9 is 3. Write each term as a product of the GCF and its remaining factors.

$3x + 9 = 3(x) + 3(3)$

$= 3(x + 3)$ Distributive Property

So, $3x + 9 = 3(x + 3)$.

5. **Factor $12x + 7y$.**

Find the GCF of $12x$ and $7y$.

$12x = 2 \cdot 2 \cdot 3 \cdot x$

$7y = 1 \cdot 7 \cdot y$

There are no common factors, so $12x + 7y$ *cannot be factored.*

Got It? **Do these problems to find out.**

Factor each expression. If the expression cannot be factored, write *cannot be factored*. Use algebra tiles if needed.

d. $4x - 28$ **e.** $3x + 33y$ **f.** $4x + 35$

Factoring Expressions

To check your factored answers, multiply your factors out. You should get your original expression as a result.

Show your work.

d. _____

e. _____

f. _____

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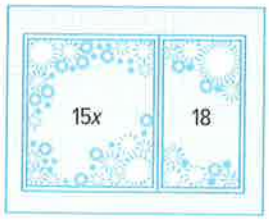
Example

6. **The drawing of a garden at the right has a total area of $(15x + 18)$ square meters. Find possible dimensions of the garden.**



Factor $15x + 18$.

$15x = 3 \cdot 5 \cdot x$ Write the prime factorization of $15x$ and 18.

$18 = 2 \cdot 3 \cdot 3$ Circle the common factors.

The GCF of $15x$ and 18 is 3. Write each term as a product of the GCF and its remaining factors.

$15x + 18 = 3(5x) + 3(6)$

$= 3(5x + 6)$ Distributive Property

So, the possible dimensions are 3 feet by $(5x + 6)$ meters.

Guided Practice

Check

Find the GCF of each pair of monomials. (Examples 1–3)

Show your work.

1. $32x$, 18

2. $27s$, $54st$

3. $18cd$, $30cd$

Factor each expression. If the expression cannot be factored, write cannot be factored. Use algebra tiles if needed. (Examples 4 and 5)

4. $36x + 24$

5. $4x + 9$

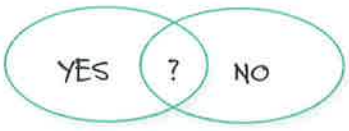
6. $14x - 16y$

7. Mr. Zayed's monthly income can be represented by the expression $25x + 120$ where x is the number of hours worked. Factor the expression $25x + 120$. (Example 6)

8. **Building on the Essential Question** Explain how the GCF is used to factor an expression. Use the term *Distributive Property* in your response.

Rate Yourself!

Are you ready to move on? Shade the section that applies.



FOLDABLES Time to update your Foldable!

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Name _____ My Homework _____

Independent Practice

Find the GCF of each pair of monomials. (Examples 1–3)

1. 24, $48m$ _____

2. $32a$, $48b$ _____

3. $36k$, $144km$ _____

Show your work.

Factor each expression. If the expression cannot be *factored*, write *cannot be factored*. Use algebra tiles if needed. (Examples 4 and 5)

4. $3x + 6$ _____

5. $2x - 15$ _____

6. $12x + 30y$ _____

7. The area of a rectangular dance floor is $(4x - 8)$ square units. Factor $4x - 8$ to find possible dimensions of the dance floor. (Example 6)

_____

8. The area of a rectangular porch is $(9x + 18)$ square units. Factor $9x + 18$ to find possible dimensions of the porch. (Example 6)

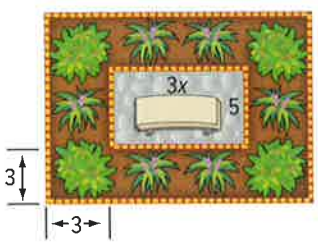
_____

9. Six friends visited a museum to see the new holograms exhibit. The group paid for admission to the museum and AED 12 for parking. The total cost of the visit can be represented by the expression AED $6x$ + AED 12. What expression would represent the cost of the visit for one person?

_____

10. The diagram represents a flower border that is 3 meters wide surrounding a rectangular sitting area. Write an expression in factored form that represents the area of the flower border.

_____



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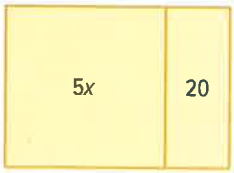
MP Reason Abstractly Write an expression in factored form to represent the total area of each rectangle.

11.



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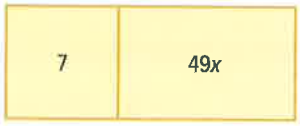

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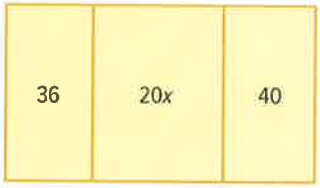

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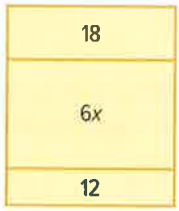
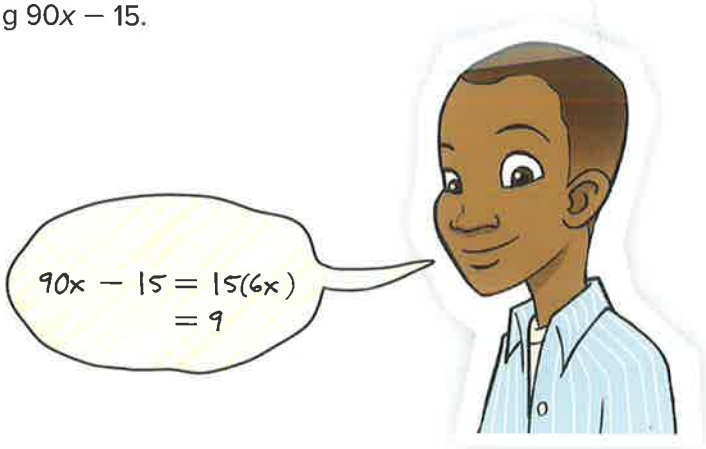


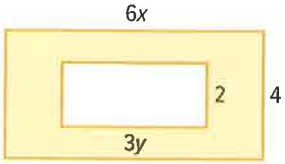
H.O.T. Problems Higher Order Thinking

15. MP Reason Inductively Write two monomials whose greatest common factor is $4m$.

16. MP Find the Error Jamal is factoring $90x - 15$. Find his mistake and correct it.



17. MP Persevere with Problems The area of a rectangle is found using the formula $A = \ell w$, where ℓ is the length and w is the width of the rectangle. Write an expression in factored form that represents the area of the shaded region at the right.



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Name _____ My Homework _____

Extra Practice

Find the GCF of each pair of monomials.

18. $63p$, 84 21

$63p = 3 \cdot 3 \cdot 7 \cdot p$

$84 = 2 \cdot 2 \cdot 3 \cdot 7$

Homework Help → The GCF of $63p$ and 84 is $3 \cdot 7$ or 21.

19. $30rs$, $42rs$ 6rs

$30rs = 2 \cdot 3 \cdot 5 \cdot r \cdot s$

$42rs = 2 \cdot 3 \cdot 7 \cdot r \cdot s$

The GCF of $30rs$ and $42rs$ is $2 \cdot 3 \cdot r \cdot s$ or $6rs$.

20. $60jk$, $45jkm$ _____

21. $40x$, $60x$ _____

22. $54gh$, $72g$ _____

23. $100xy$, $75xyz$ _____

Factor each expression. If the expression cannot be factored, write *cannot be factored*. Use algebra tiles if needed.

24. $5x + 5$ _____

25. $18x + 6$ _____

26. $4x - 7$ _____

27. $10x - 35$ _____

28. $32x + 24y$ _____

29. $30x - 40$ _____

30. Ahmed has AED 120 in his savings account and plans to save AED x each month for 6 months. The expression AED $6x$ + AED 120 represents the total amount in the account after 6 months. Factor the expression $6x + 120$.

31. A square scrapbooking page has a perimeter of $(8x + 20)$ centimeters. What is the length of one side of the scrapbooking page?

Copy and Solve **Write an expression in factored form that is equivalent to the given expression. Show your work on a separate piece of paper.**

32. $\frac{1}{2}x + 4$

33. $\frac{2}{3}x + 6$

34. $\frac{3}{4}x - 24$

35. $\frac{5}{6}x - 30$

36. $\frac{2}{5}x + 16$

37. $\frac{3}{8}x + 18$

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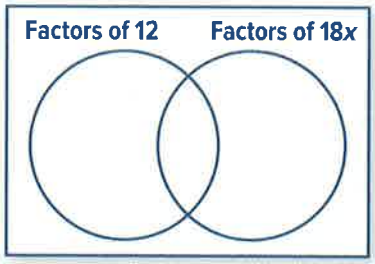
Power Up! Test Practice

38. Select the correct terms to fill in the Venn diagram to show the factors of 12 and 18x.

1	9
2	12
3	18
4	x
6	



What is the GCF of 12 and 18x? Explain how the Venn diagram helped you find the GCF.

39. Which pairs of monomials have a GCF of 4a? Select all that apply.

- ☐ 8a, 18a
- ☐ 16a, 8b
- ☐ 16ab, 12a
- ☐ 28a, 20a

Spiral Review

Use the Distributive Property to rewrite each expression.

40. $4(x + 1) =$ _____

41. $3(a + 10) =$ _____

42. $7(2b + 5) =$ _____

43. The letters P, E, M, D, A, and S form PEMDAS. This is a mnemonic device that can be used to help you remember the order of operations. Each letter stands for something. Complete the organizer.

P	Parentheses
E	_____
M	Multiplication
D	_____
A	_____
S	_____

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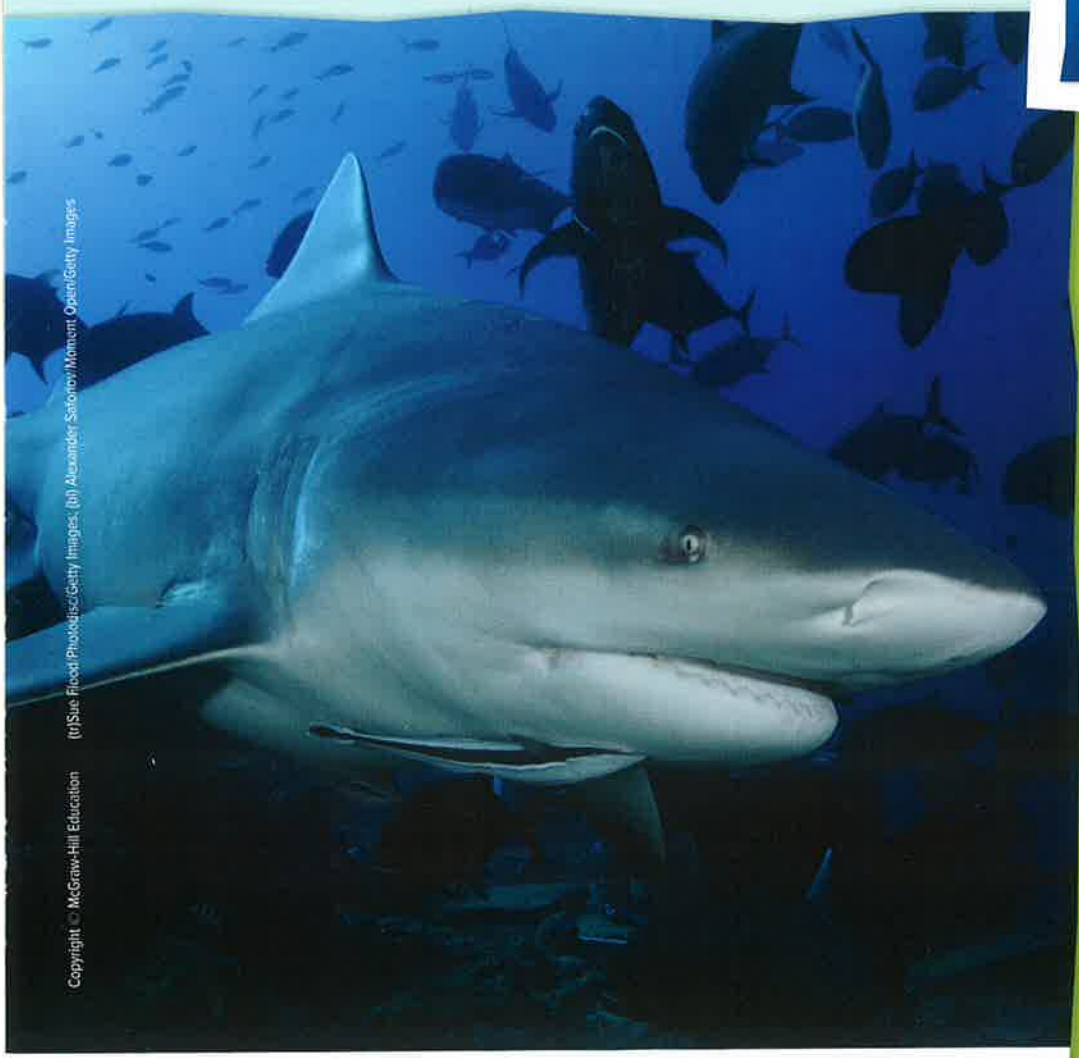
21ST CENTURY CAREER in Animal Conservation

Shark Scientist

Are you fascinated by sharks, especially those that are found around the coasts of the United States? If so, you should consider a career as a shark scientist. Shark scientists use satellite-tracking devices, called tags, to study and track the movements of sharks. By analyzing the data transmitted by the tags, scientists are able to learn more about the biology and ecology of sharks. Their research is helpful in protecting shark populations around the world.



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Is This the Career for You?

Are you interested in a career as a shark scientist? Take some of the following courses in high school.

- Algebra
- Calculus
- Physics
- Statistics

Find out how math relates to a career in Animal Conservation.

MP Tag, You're It!

The *fork length* of a shark is the length from the tip of the snout to the fork of the tail. Use the information on the note cards to solve each problem.

1. Write an expression to represent the total length of a hammerhead shark that has a fork length of m meters. _____
2. Use the expression from Exercise 1 to find the total length of a hammerhead shark that has a fork length of 3.5 meters. _____
3. Write an expression to represent the average fork length of a tiger shark, given the average fork length s of a sandbar shark. _____
4. Use the expression from Exercise 3 to find the average fork length of a tiger shark if the average fork length of a sandbar shark is 129 centimeters. _____
5. Write an expression to find the average fork length of a white shark with a total length of t centimeters. _____
6. The total length of a white shark is 204 centimeters. Use the expression in Exercise 5 to find the approximate fork length of the white shark. _____

Tiger Shark

A study found that the average fork length of a tiger shark is 55 centimeters less than twice the average fork length of a sandbar shark.

Hammerhead Shark

The total length of a hammerhead shark is about 1.3 times the fork length.

White Shark

The fork length of a white shark is about 5.74 centimeters less than 0.94 times the total length t.

MP Career Project

It's time to update your career portfolio! Describe the skills that would be necessary for a shark scientist to possess. Determine whether this type of career would be a good fit for you.

List several challenges associated with this career.

- _____
- _____
- _____
- _____
- _____

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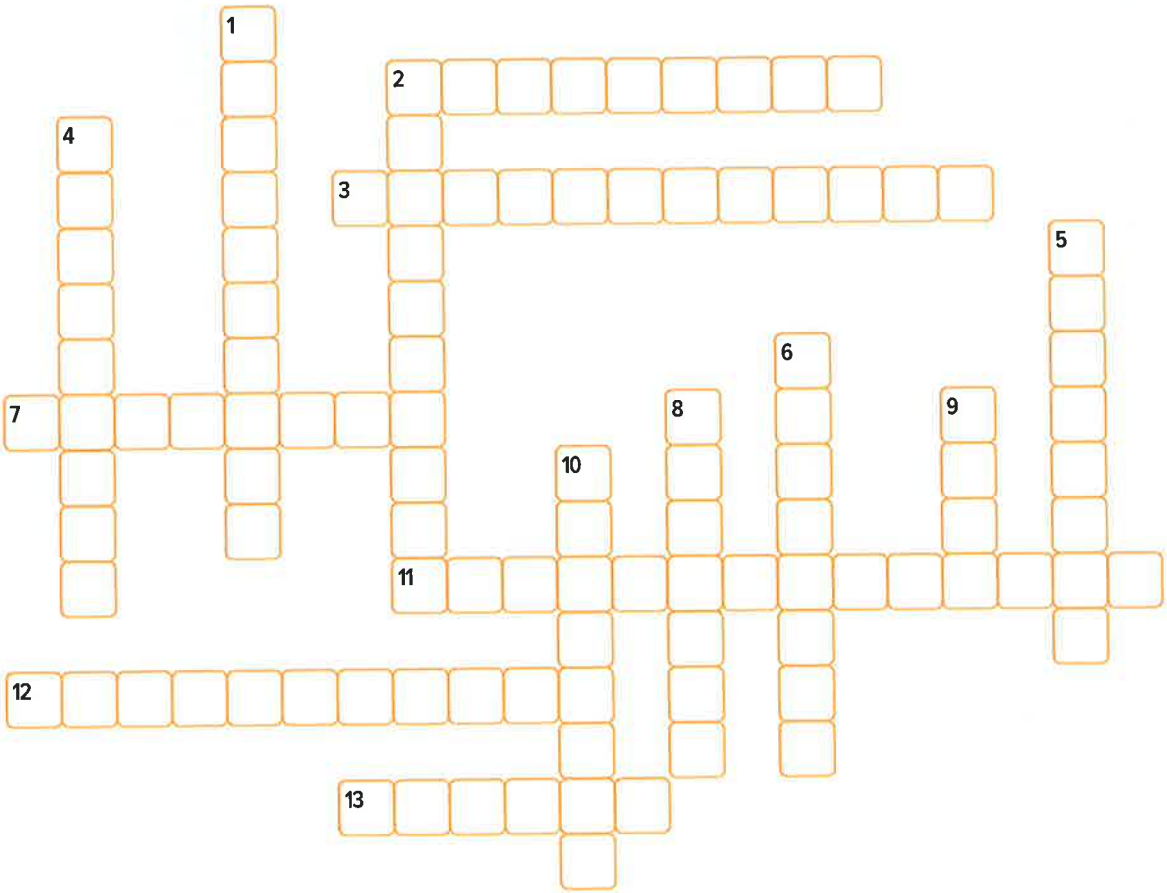
Chapter Review

Vocabulary Check

In the puzzle below, write a vocabulary term for each clue.



Across

2. a type of expression that contains a variable or variables
3. an algebraic expression that has no like terms and no parentheses is in this form (two words)
7. an ordered list of numbers
11. an example showing a statement is not true
12. the numerical factor of a multiplication expression
13. what is done to a variable to represent an unknown quantity

Down

1. expressions like $4(3 + 2)$ and $4(3) + 4(2)$
2. a sequence in which each term is found by adding the same number
4. terms that include the same variable
5. a letter or symbol
6. a statement that is true for any number or variable
8. a branch of mathematics that uses variables
9. a number in a sequence
10. a term that contains a number only

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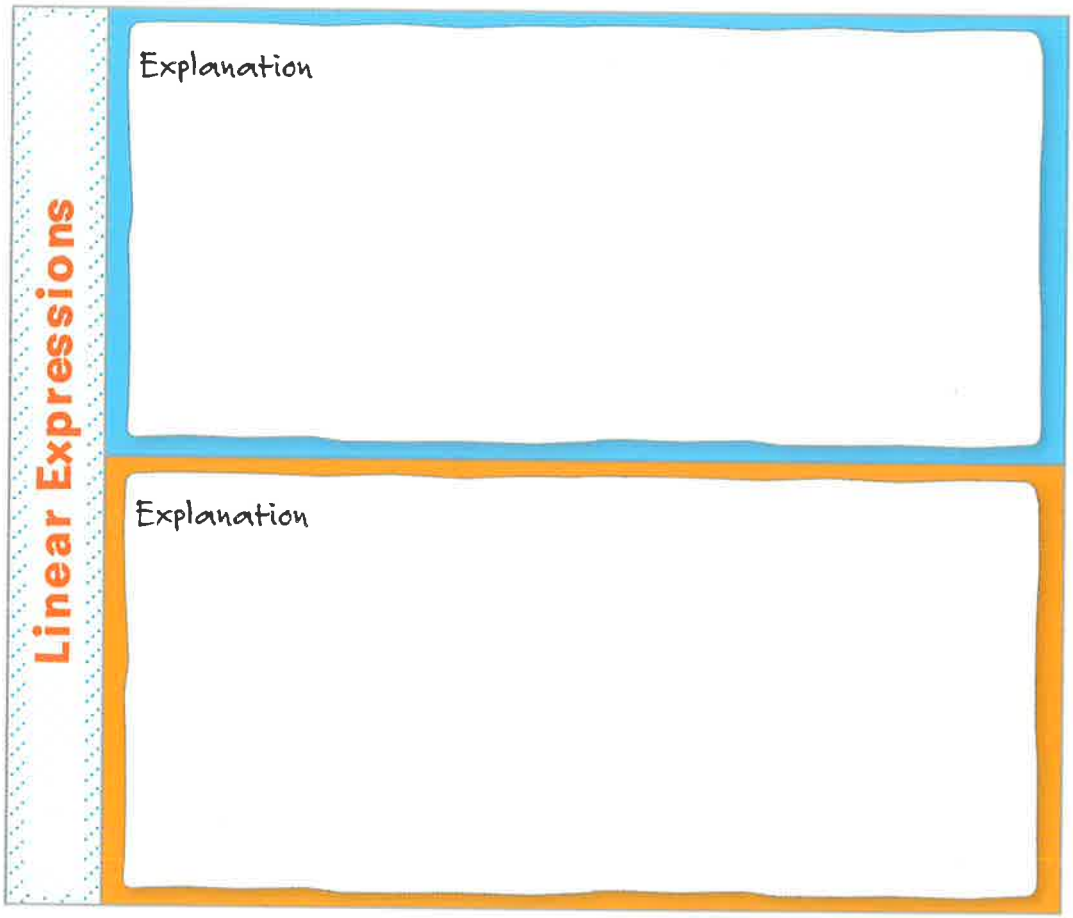
Key Concept Check

Use Your FOLDABLES

Use your Foldable to help review the chapter.

Tape here



Got it?

Draw a line to match each expression with its equivalent expression.

1. $3 + 1$

2. $4(2 - x)$

3. $3x - 2 - x + 6$

4. $2(x + 2) + (3x + 1)$

5. $3x + 21$

a. $8 - 4x$

b. $5x + 5$

c. $3(x + 7)$

d. $1 + 3$

e. $2x + 4$

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Power Up! Performance Task

Movie Time

Mr. Rasheed's family, a family of five, are going to the local movie theater. The family consists of two adults and three children. Mr. Rasheed wants to calculate the cost of the night out. He looks up the admission prices online.

Admission:

Adults — AED **20.50**

Children — AED **16.50**

All shows before 6 P.M. $\frac{1}{2}$ price

Before leaving, Mr. Rasheed decides that he will get some items at the theater concession stand, a large drink for each person and a large tub of popcorn for everyone to share. He will not know the prices of the items at the concession stand until they arrive.

Write your answers on another piece of paper. Show all of your work to receive full credit.

Part A

Write an expression that represents the cost of the admission prices and the concession stand items based on the available information. Let d represent the cost for a large drink and let p represent the cost of the popcorn. The initial expression must include parentheses. Then simplify the expression by using the Distributive Property and combining like terms.

Part B

Two children from next door join Mr. Rasheed's family. The neighbor children have movie passes and have already eaten, so Mr. Rasheed will only need to pay for two more large drinks. At the concession stand, one of the children gives Mr. Rasheed a five dirhams bill to help pay for the drinks. Write an expression that represents the cost of the drinks for the neighbor children and includes the money given to Mr. Rasheed.

Part C

While at the concession stand, Mr. Rasheed sees that the large tub of popcorn is AED 7.50, and large drinks are AED 6 each. Using your answers from Part A and Part B, write an expression that represents the total cost. Then substitute the values for the popcorn and drinks in your expression. What is the total cost for the evening?

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Reflect

Answering the Essential Question

Use what you learned about algebraic expressions to complete the graphic organizer. Then answer the chapter's Essential Question below.

When do you use a variable?

Essential Question

HOW can you use numbers and symbols to represent mathematical ideas?

How do you know which operation symbol to use?

Answer the Essential Question. HOW can you use numbers and symbols to represent mathematical ideas?

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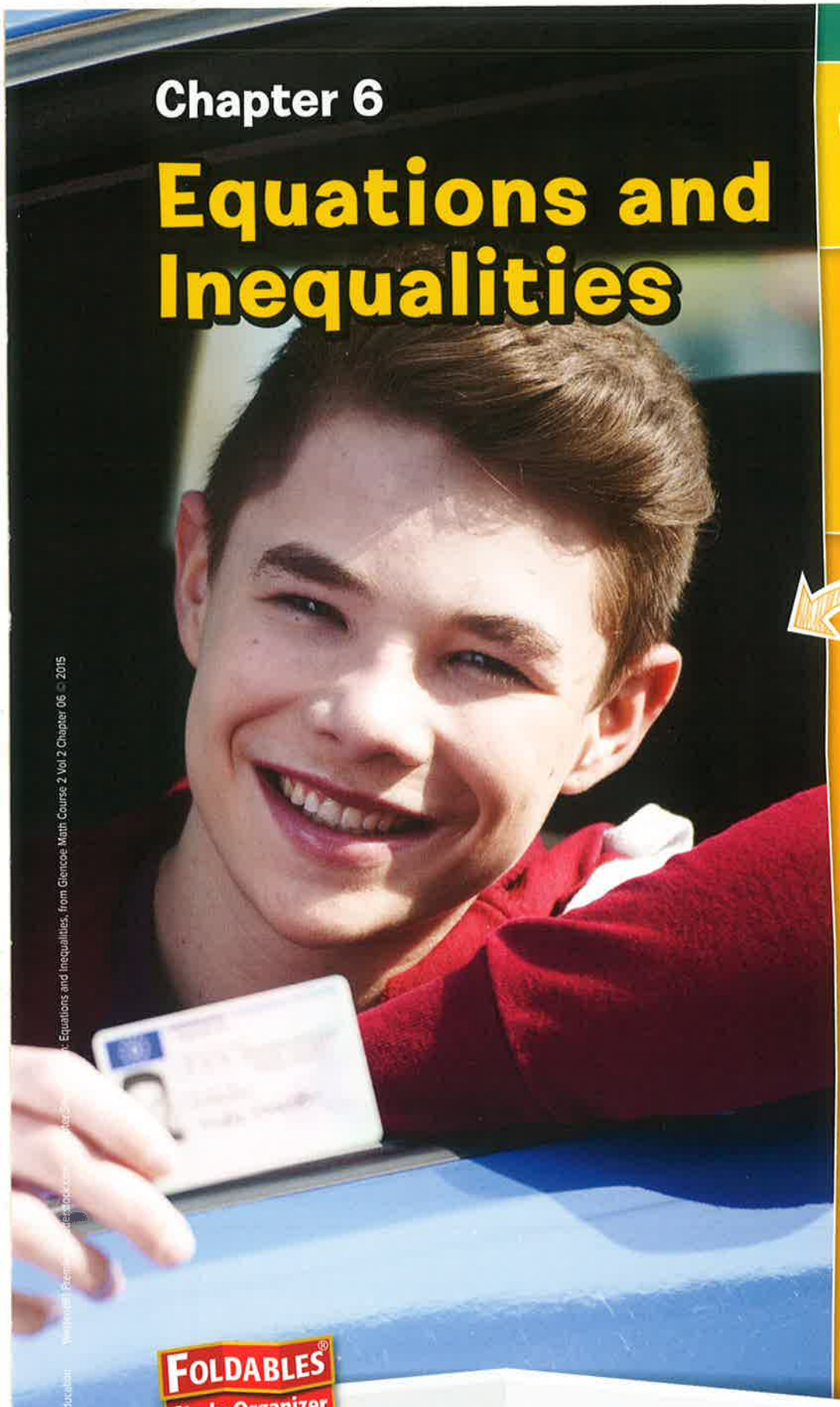
Chapter 6
Equations and Inequalities



Essential Question

WHAT does it mean to say two quantities are equal?

MP Mathematical Practices

1, 2, 3, 4, 5, 7

Math in the Real World

Driving Suppose you must be at least 18 years of age to obtain a driver's license. Circle the statement that represents this age.

FOLDABLES® Study Organizer

1. Cut out the Foldable from the end of the book.
2. Place your Foldable at the end of the chapter.
3. Use the Foldable to help you learn about equations and inequalities.

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What Tools Do You Need?

Vocabulary

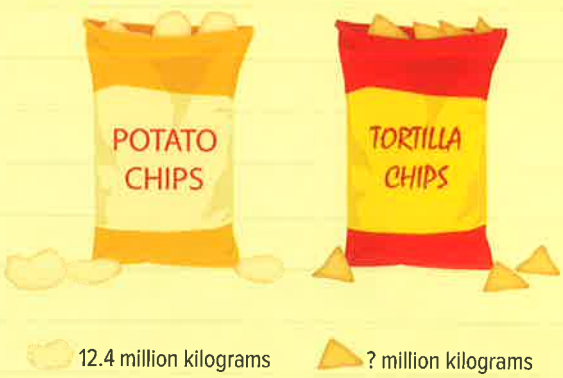
- Addition Property of Equality
- Addition Property of Inequality
- coefficient
- Division Property of Equality
- Division Property of Inequality
- equation
- equivalent equation
- inequality
- Multiplication Property of Equality
- Multiplication Property of Inequality
- solution
- Subtraction Property of Equality
- Subtraction Property of Inequality
- two-step equation
- two-step inequality

Study Skill: Reading Math

Identify Key Information Have you ever tried to solve a word problem and didn't know where to start. Start by looking for key words in the text and images. Then write the important information in one sentence.

1. Highlight or circle key words in the following real-world problem.

   During a recent Super Bowl, millions of kilograms of potato chips and tortilla chips were consumed. The number of kilograms of potato chips consumed was 3.1 million kilograms more than the number of kilograms of tortilla chips. How many kilograms of tortilla chips were consumed?



2. Write a sentence that summarizes the information provided. Include information from the text and the image.

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What Do You Already Know?

Place a checkmark below the face that expresses how much you know about each concept. Then scan the chapter to find a definition or example of it.

 I have no clue.  I've heard of it.  I know it!

Equations and Inequalities				
Concept				Definition or Example
inequalities				
solving one-step equations				
solving inequalities by addition or subtraction				
solving inequalities by multiplication or division				
solving two-step equations				
solving two-step inequalities				

When Will You Use This?

Here is an example of how equations are used in the real world.

Activity Describe a situation when you only had a set amount of money to spend and you needed to buy a certain number of items. Then explain how you determined what you could buy.

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Are You Ready?

Try the Quick Check below.

Quick Review

Review

Example 1

Write the phrase as an algebraic expression.

Phrase: five dirhams more than Amal earned

Variable: Let d represent the number of dirhams Amal earned.

Expression: $d + 5$

Example 2

Is 3, 4, or 5 the solution of the equation $x + 8 = 12$?

Value of x	$x + 8 = 12$	Are both sides equal?
3	$3 + 8 \stackrel{?}{=} 12$ $11 \neq 12$	no
4	$4 + 8 \stackrel{?}{=} 12$ $12 = 12$	yes ✓
5	$5 + 8 \stackrel{?}{=} 12$ $13 \neq 12$	no

The solution is 4 since replacing x with 4 results in a true sentence.

Quick Check

Words and Symbols **Write the phrase as an algebraic expression.**

1. 3 more runs than the Al Shabab Club team scored _____

2. a number decreased by eight _____

3. ten dirhams more than Salwa has _____

Show your work.

One-Step Equations **Identify the solution of each equation from the list given.**

4. $8 + w = 17$; 7, 8, 9 _____

5. $d - 12 = 5$; 16, 17, 18 _____

6. $6 = 3y$; 2, 3, 4 _____

7. $7 \div c = 7$; 0, 1, 2 _____

8. $a + 8 = 23$; 13, 14, 15 _____

9. $10 = 45 - n$; 35, 36, 37 _____

How Did You Do?

Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.

1 2 3 4 5 6 7 8 9

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Inquiry Lab

Solve One-Step Addition and Subtraction Equations

Inquiry **HOW can bar diagrams or algebra tiles help you solve an equation?**

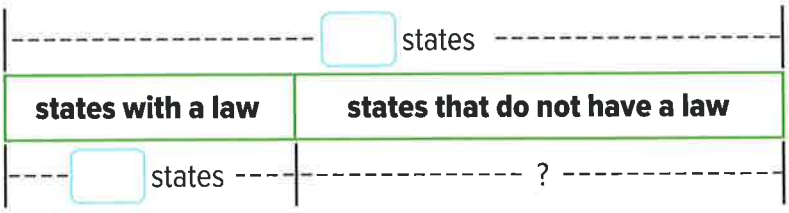
MP **Mathematical Practices** 1, 2, 3, 5

In a recent year, 19 of the 50 states had a law banning the use of handheld cell phones while driving a school bus. Determine how many states did *not* have this law.

Hands-On Activity 1

You can represent this situation with an equation.

Step 1 The bar diagram represents the total number of states and the number of states that have passed a cell phone law. Fill in the missing information.



Step 2 Write an equation from the bar diagram. Let x represent the states that do not have a cell phone law for school bus drivers.

$$19 + x = 50$$

Step 3 Use the *work backward* strategy to solve the equation. Since $19 + x = 50$, $x = 50 - 19$. So, $x =$ ☐.

Check $19 +$ ☐ $= 50$ ✓

So, ☐ states did *not* have a law banning the use of cell phones by bus drivers.

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Investigate

Collaborate

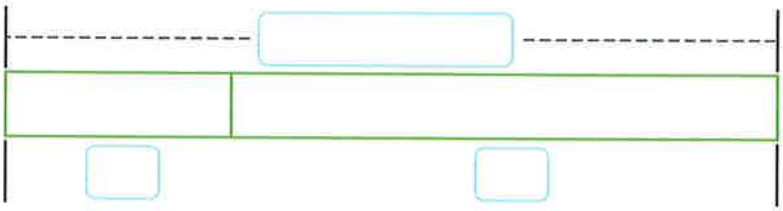
Work with a partner to solve each problem.

1. Draw a bar diagram and write an addition equation to represent the following situation. Then solve the equation.

   The sum of a number and four is equal to 18.

   Equation: _____ Solution: $x =$ _____

2. MP **Use Math Tools** Salem collects postage stamps. He sold 7 of his stamps and had 29 stamps left. Complete the bar diagram below. Then write and solve a subtraction equation to find the number of stamps Salem had at the beginning.

   Equation: _____ Solution: $n =$ _____

   So, Salem had ☐ stamps at the beginning.

Analyze and Reflect

Collaborate

3. Suppose Salem sold 15 stamps and had 21 stamps left. How would the bar diagram change?

4. MP **Reason Abstractly** Suppose Salem had 40 stamps in the beginning and sold 7 of them. How would the bar diagram change? What equation could you write to represent the situation?

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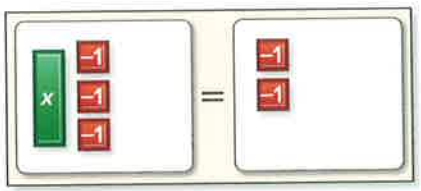
Hands-On Activity 2

Tools

Solve $x - 3 = -2$ using algebra tiles.

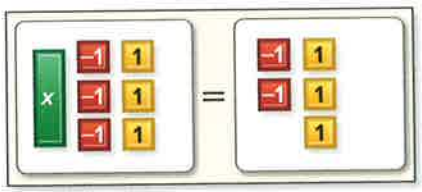
Remember a 1-tile and −1 tile combine to make a *zero pair*. You can add or subtract zero pairs from either side of an equation without changing its value.

Step 1 Model the equation.



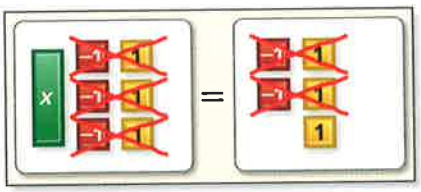
$x - 3 \quad = \quad -2$

Step 2 Add three 1-tiles to the left side of the mat and _____ 1-tiles to the right side of the mat to form zero pairs on each side of the mat.



$x - 3 + 3 \quad = \quad -2 + 3$

Step 3 Remove all of the zero pairs from each side. There is _____ 1-tile on the right side of the mat.



$x \quad = \quad 1$

Therefore, $x =$ ☐.

Check ☐ $- 3 = -2$ ✓

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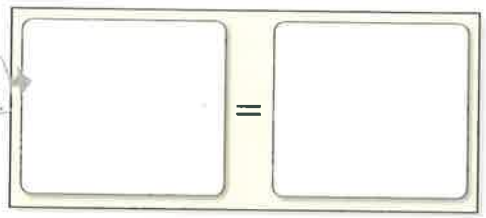
Investigate

Collaborate

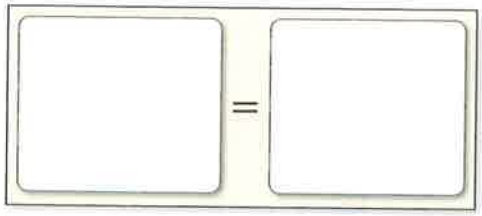
MP Use Math Tools Work with a partner to solve each equation. Use algebra tiles. Show your work using drawings.

5. $x + 4 = 4$ $x =$ _____

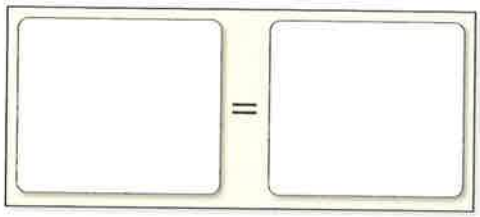
Show your work.



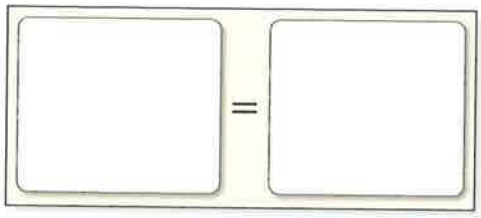
6. $-2 = x + 1$ $x =$ _____



7. $x - 1 = -3$ $x =$ _____



8. $4 = x - 2$ $x =$ _____



Analyze and Reflect

Collaborate

Work with a partner to complete the table. The first one is done for you.

	Equation	Related Equation
	$x + 3 = 4$	$x = 4 - 3$
9.	$6 + x = 10$	
10.	$x + 3 = -1$	
11.	$6 + x = -7$	

Create

On Your Own

12. **MP Construct an Argument** Write a rule that you can use to solve addition equations without using models or a drawing.

_____

_____

13. Inquiry HOW can bar diagrams or algebra tiles help you solve an equation?

_____

_____

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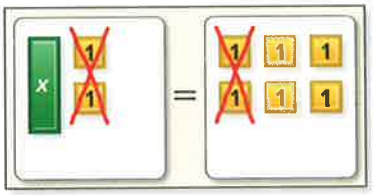
Lesson 1

Solve One-Step Addition and Subtraction Equations

Vocabulary Start-Up

Tools Vocab

An **equation** is a sentence stating that two quantities are equal. The value of a variable that makes an equation true is called the **solution** of the equation.



$$\begin{aligned} x + 2 &= 6 \\ -2 &= -2 \\ x &= 4 \end{aligned}$$

The equations $x + 2 = 6$ and $x = 4$ are **equivalent equations** because they have the same solution, 4.

Circle the equations below that are equivalent to $x = 3$. Use algebra tiles if needed.

$x + 3 = 6$	$x + 1 = 6$	$x + 6 = 8$
$x + 3 = 3$	$x + 1 = 4$	$x + 2 = 5$

Real-World Link

Video Games Amna had some video games, and then she bought 4 more games. Now she has 10 games. This scenario can be described using the equation $x + 4 = 10$.

1. What does x represent in the equation?

2. Write two different equations that are equivalent to $x + 4 = 10$.

Essential Question

WHAT does it mean to say two quantities are equal?

Vocabulary

Vocab

- equation
- solution
- equivalent equation
- Subtraction Property of Equality
- Addition Property of Equality

MP Mathematical Practices
1, 2, 3, 4, 5

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

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Key Concept

Subtraction Property of Equality

Words The **Subtraction Property of Equality** states that the two sides of an equation remain equal when you subtract the same number from each side.

Symbols If $a = b$, then $a - c = b - c$.

Work Zone

You can use bar diagrams and the *work backward* problem-solving strategy to solve equations arithmetically. Or, you can use the properties of equality to solve equations algebraically.

Examples

1. **Solve $x + 6 = 4$. Check your solution.**

$x + 6 = 4$ Write the equation.

$-6 = -6$ Subtraction Property of Equality

$x = -2$ Simplify.

Check

$x + 6 = 4$ Write the original equation.

$-2 + 6 \stackrel{?}{=} 4$ Replace x with -2.

$4 = 4$ ✓ The sentence is true.

So, the solution is -2.

Solutions
Notice that your new equation, $x = -2$, has the same solution as the original equation, $x + 6 = 4$.

2. **Solve $-5 = b + 8$. Check your solution.**

$-5 = b + 8$ Write the equation.

$-8 = -8$ Subtraction Property of Equality

$-13 = b$ Simplify.

Check

$-5 = b + 8$ Write the original equation.

$-5 \stackrel{?}{=} -13 + 8$ Replace b with -13.

$-5 = -5$ ✓ The sentence is true.

So, the solution is -13.

Show your work.

a. _____

b. _____

c. _____

Got it? **Do these problems to find out.**

Solve each equation. Check your solution.

a. $y + 6 = 9$ **b.** $x + 3 = 1$ **c.** $-3 = a + 4$

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Example

3. **An angelfish can grow to be 30 centimeters long. If an angelfish is 21 centimeters longer than a clown fish, how long is a clown fish?**

Words An angelfish is 21 centimeters longer than a clown fish.

Variable Let c represent the length of the clown fish.

Equation $30 = c + 21$

$30 = c + 21$ Write the equation.

$-21 = -21$ Subtraction Property of Equality

$9 = c$ Simplify.

A clown fish is 9 centimeters long.

Got it? **Do this problem to find out.**

Show your work.

d. The highest recorded temperature in Warsaw, Missouri, is 48°C. This is 70°C greater than the city's lowest recorded temperature. Find the lowest recorded temperature.

d. _____

Addition Property of Equality

Key Concept

Words The **Addition Property of Equality** states that the two sides of an equation remain equal when you add the same number to each side.

Symbols If $a = b$, then $a + c = b + c$.

Example

4. **Solve $x - 2 = 1$. Check your solution.**

$x - 2 = 1$ Write the equation.

$+2 = +2$ Addition Property of Equality

$x = 3$ Simplify.

The solution is 3. Check $3 - 2 = 1$ ✓

Show your work.

e. _____

f. _____

Got it? **Do these problems to find out.**

e. $y - 3 = 4$ **f.** $r - 4 = -2$ **g.** $q - 8 = -9$

g. _____

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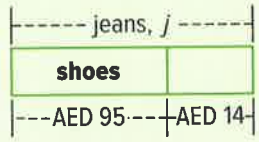
Models

A bar diagram can be used to represent this situation.



$j = 95 + 14 = 109$

Example

5. **A pair of shoes costs AED 95. This is AED 52 less than the cost of a pair of jeans. Find the cost of the jeans.**

Shoes are AED 14 less than jeans. Let j represent the cost of jeans.

$95 = j - 14$ Write the equation.

$+14 = +14$ Addition Property of Equality

$109 = j$ Simplify.

The jeans cost AED 109.

Got it? **Do this problem to find out.**

h. The average lifespan of a tiger is 17 years. This is 3 years less than the average lifespan of a lion. Write and solve an equation to find the average lifespan of a lion.

Show your work.

h. _____

Guided Practice

Solve each equation. Check your solution. (Examples 1, 2, and 4)

1. $n + 6 = 8$

Show your work.

2. $7 = y + 2$

3. $-7 = c - 6$

4. Orville and Wilbur Wright made the first airplane flights in 1903. Wilbur's flight was 111 meters. This was 36 meters longer than Orville's flight. Write an equation to represent the flights. Use a bar diagram if needed. Then solve to find the length of Orville's flight. (Examples 3 and 5)

5. **Building on the Essential Question** What are two methods for solving a real-world problem that can be represented by an equation?

Rate Yourself!

☐ I understand how to solve one-step addition and subtraction equations.

Great! You're ready to move on!

☐ I still have some questions about solving equations.

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Name _____ My Homework _____

Independent Practice

Solve each equation. Check your solution. (Examples 1, 2, and 4)

1. $a + 3 = 10$

2. $y + 5 = -11$

3. $s - 8 = 9$

Show your work.

4. $5 = x + 8$

5. $-2 = p - 1$

6. $14 = s + 7$

Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically. (Examples 3 and 5)

7. Last week Buthania practiced her bassoon a total of 7 hours. This was 2 hours more than she practiced the previous week. How many hours did Buthania practice the previous week?

8. In a recent presidential election, Ohio had 18 electoral votes. This is 20 votes less than Texas had. How many electoral votes did Texas have?

9. MP **Multiple Representations** Use the table to solve.

Tallest Wooden Roller Coasters	Height (meters)	Drop (meters)	Speed (kmph)
Colossos	h	48	109
T Express	55	45	104
El Toro	54	53	s
Voyage	49	d	107

a. **Symbols** The difference in speeds of El Toro and T Express is 8 kilometers per hour. If El Toro has the greater speed, write and solve a subtraction equation to find its speed.

b. **Diagram** Voyage has a drop that is 6.6 meters less than El Toro. Draw a bar diagram to the right and write an equation to find the height of Voyage.

Show your work.

c. **Words** Let h represent the height of the Colossos roller coaster. Explain why $h - 4 = 55$ and $h - 10 = 49$ are equivalent equations. Then explain the meaning of the solution.

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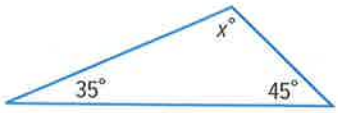
10. The sum of the measures of the angles of a triangle is 180°. Write and solve an equation to find the missing measure.

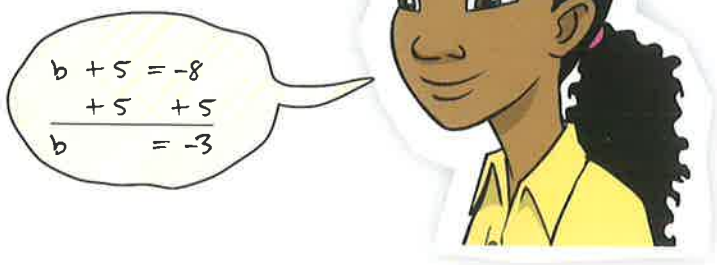


11. The sum of the measures of a quadrilateral is 360°. Write and solve an equation to find the missing measure.

H.O.T. Problems Higher Order Thinking

12. MP **Reason Inductively** Write an addition equation and a subtraction equation that have 10 as a solution.

13. MP **Find the Error** Aisha is finding $b + 5 = -8$. Find her mistake and correct it.



14. MP **Reason Abstractly** Suppose $x + y = 11$ and the value of x increases by 2. If their sum remains the same, what must happen to the value of y? Justify your response

15. MP **Which One Doesn't Belong?** Identify the equation that does not belong with the other three. Explain your reasoning.

$x + 4 = -2$	$x + 5 = -1$	$x + 2 = 8$	$3 - x = 9$

16. MP **Reason Inductively** In the equation $x + y = 5$, the value for x is a whole number greater than 2 but less than 6. Find the possible solutions for y.

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Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

17. $r + 6 = -3$

Homework Help

$r + 6 = -3$
$-6 = -6$
$r = -9$

18. $w - 7 = 11$

19. $k + 3 = -9$

20. $-1 = q - 8$

21. $9 = r + 2$

22. $y + 15 = 11$

MP Use Math Tools **Use a bar diagram to solve arthimetically. Then use an equation to solve algebraically.**

23. The Al Ittihad team scored 79 points. This was 13 points less than the Al Watan team. How many points did the Al Watan team score?

24. Hasan is $15\frac{1}{2}$ years old. This is 3 years younger than his brother Hamad. How old is Hamad?

25. The table shows a golfer's scores for four rounds of a recent Women's Open. Her total score was even with par. What was her score for the third round?

Round	Score
First	-1
Second	-3
Third	s
Fourth	$+2$

Copy and Solve **Solve each equation. Check your solution. Show your work on a separate piece of paper.**

26. $a - 3.5 = 14.9$

27. $b + 2.25 = 1$

28. $-\frac{1}{3} = r - \frac{3}{4}$

29. $x - 2.8 = 9.5$

30. $r - 8.5 = -2.1$

31. $z - 9.4 = -3.6$

32. $m + \frac{5}{6} = \frac{11}{12}$

33. $-\frac{5}{6} + c = -\frac{11}{12}$

34. $s - \frac{1}{9} = \frac{5}{18}$

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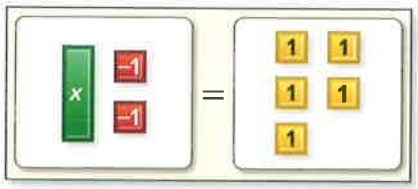
Power Up! Test Practice

35. The model represents the equation $x - 2 = 5$. Determine if each statement is true or false.

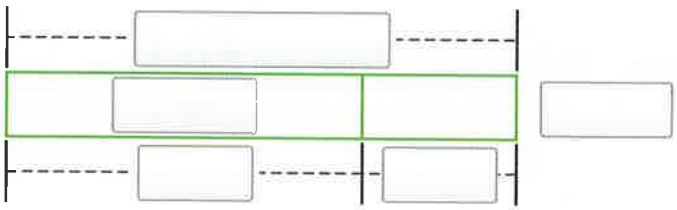


a. To solve the equation, add 2 positive counters to each side of the equation mat. ☐ True ☐ False

b. To solve the equation, add 5 negative to each side of the equation mat. ☐ True ☐ False

c. The value of x is 7. ☐ True ☐ False

36. Badria practiced the piano a total of 7 hours this week. This is 3 hours less than she practiced last week. Select the correct labels to complete the bar diagram that is used to find the number of hours w Badria practiced last week.



this week
last week, w
3 hours
4 hours
7 hours
10 hours

How many hours did Badria practice the piano last week? _____

Spiral Review

Multiply or divide.

37. $5(-4) =$ _____

38. $\frac{36}{-9} =$ _____

39. $(-10)(-6) =$ _____

40. $\frac{-42}{-7} =$ _____

41. $(-3)(12) =$ _____

42. $\frac{-54}{2} =$ _____

43. While playing a round of golf, Rana had a score of three under par after the first three holes. Write and solve an equation to find Rana's average score per hole h after three holes. _____

44. On Friday morning, the temperature dropped 2 degrees per hour for four hours. Write and solve an equation to find the total number of degrees d the temperature dropped on Friday morning. _____

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Inquiry Lab

Multiplication Equations with Bar Diagrams

Mathematical Practices 1, 2, 3

Inquiry **HOW do you know which operation to use when solving an equation?**

Hessa tutors students to earn money to buy a new Blu-ray™ player that costs AED 63. She is able to tutor seven hours in a week. How much should she charge per hour to have enough money by the end of the week?

What do you know? _____

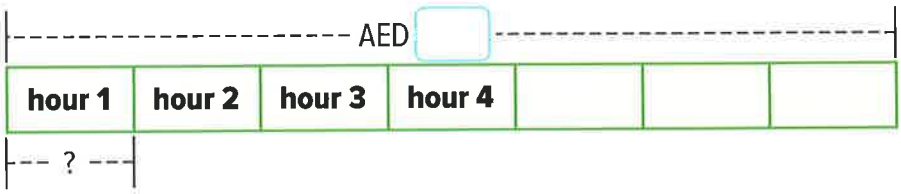
_____

What do you need to find? _____

_____

Hands-On Activity

Step 1 Draw a bar diagram that represents the money Hessa needs to earn and the number of hours she is available to tutor that week.



Step 2 Write an equation from the bar diagram. Let x represent the amount she should charge each hour.

$$7x = 63$$

Step 3 Use the *work backward* strategy to solve the equation. Since

$7x = 63$, $x = 63 \div 7$. So, $x =$ ☐.

Check $7 \times$ ☐ $= 63$ ✓

So, Hessa should charge ☐ per hour.

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Investigate

Collaborate

Work with a partner to solve.

1. The screen on Hamdan's cell phone allows for 8 lines of text per message. The maximum number of characters for each message is 160. How many characters can each line hold? Complete the bar diagram below and write an equation. Then solve the equation.

Analyze and Reflect

Collaborate

Work with a partner to answer the following question.

2. MP **Make a Conjecture Hamdan's** Refer to Exercise 1. Suppose Hamdan's cell phone allows 4 lines of text and a maximum of 80 characters for each text message. How would the bar diagram and equation change?

Create

On Your Own

3. MP **Reason Abstractly** Halima spent AED 70 for 4 hours of cooking classes. How much did she spend per hour of cooking class? Draw a bar diagram below and write an equation. Then solve the equation.

Show your work.

4. Inquiry HOW do you know which operation to use when solving an equation?

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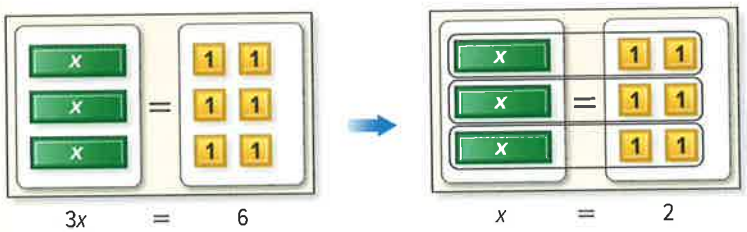
Lesson 2

Multiplication and Division Equations

Vocabulary Start-Up

The expression $3x$ means *3 times the value of x*. The numerical factor of a multiplication expression like $3x$ is called a **coefficient**. So, 3 is the coefficient of x.

The figure below illustrates the multiplication equation $3x = 6$.

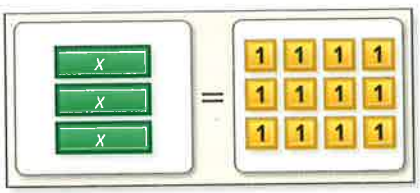


Since there are 3 *x*s, each *x* is matched with 2.

The solution of $3x = 6$ is 2.

Write an equation that represents each of the models below. Identify the coefficient in your equation. Then solve.

1.

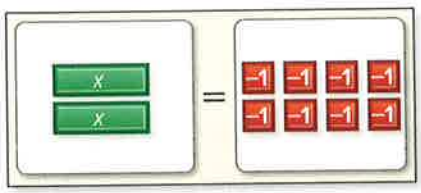


Equation: _____

Coefficient: ☐

Solution: ☐

2.



Equation: _____

Coefficient: ☐

Solution: ☐

Essential Question

WHAT does it mean to say two quantities are equal?

Vocabulary

coefficient
Division Property of Equality
Multiplication Property of Equality

MP Mathematical Practices
1, 2, 3, 4, 7

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems
② Reason Abstractly
③ Construct an Argument
④ Model with Mathematics
⑤ Use Math Tools
⑥ Attend to Precision
⑦ Make Use of Structure
⑧ Use Repeated Reasoning

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Distance Formula

The distance formula, distance = rate x time, can be written as $d = rt$, $r = \frac{d}{t}$, or $t = \frac{d}{r}$.

Example

5. **The distance d Rana travels in her car while driving 60 kilometers per hour for 3 hours is given by the equation $\frac{d}{3} = 60$. How far did she travel?**

$\frac{d}{3} = 60$ Write the equation.

$\frac{d}{3}(3) = 60(3)$ Multiplication Property of Equality

$d = 180$ Simplify.

Rana traveled 180 kilometers.

Guided Practice

Solve each equation. Check your solution. (Examples 1, 2, and 4)

1. $6c = 18$

Show your work.

2. $24 = -8x$

3. $7m = -28$

4. $\frac{p}{9} = 9$

5. $\frac{a}{12} = -3$

6. $\frac{n}{-10} = -4$

7. Houriyya earns AED 24 per hour helping her grandmother. Write and solve an equation to find how many hours she needs to work to earn AED 192. (Example 3)

8. A shark can swim at an average speed of 40 kilometers per hour. At this rate, how far can a shark swim in 2.4 hours? Use $r = \frac{d}{t}$. (Example 5)

9. **Building on the Essential Question** How is the process for solving multiplication and division one-step equations like solving one-step addition and subtraction equations?

Rate Yourself!

How confident are you about solving one-step multiplication and division equations? Check the box that applies.

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Name _____ My Homework _____

Independent Practice

Solve each equation. Check your solution. (Examples 1, 2, and 4)

1. $7a = 49$

Show your work.

2. $-6 = 2x$

3. $-32 = -4b$

4. $\frac{u}{6} = 9$

5. $-8 = \frac{c}{-10}$

6. $54 = -9d$

7 $-12y = 60$

8. $\frac{r}{20} = -2$

9. $\frac{g}{10} = -9$

10. Najla wants to buy a digital camera that costs AED 300. Suppose she saves AED 15 each week. In how many weeks will she have enough money for the camera? Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically. (Example 3)

Show your work.

11 A race car can travel at a rate of 205 kilometers per hour. At this rate, how far would it travel in 3 hours? Use $r = \frac{d}{t}$. Write an equation and then solve. (Example 5)

12. A certain hurricane travels at 20.88 kilometers per hour. The distance from Cuba to Key West is 145 kilometers. Write and solve a multiplication equation to find about how long it would take the hurricane to travel from Cuba to Key West.

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13. **Multiple Representations** Hiyam saves AED 5.50 for each hour she works. She needs to save an additional AED 44 to buy an E-reader. How many more hours does Hiyam need to work to pay for the E-reader?

a. **Diagram** Draw a bar diagram that represents the situation.

b. **Algebra** Write an equation that represents the situation.

c. **Words** Describe the process you would use to solve your equation. Then solve.

H.O.T. Problems Higher Order Thinking

14. **Reason Abstractly** Describe a real-world situation in which you would use a division equation to solve a problem. Write your equation and then solve your problem.

Situation:

Equation: Solution:

15. **Identify Structure** *True* or *false*. To solve the equation $5x = 20$ you can use the Multiplication Property of Equality. Explain your reasoning.

16. **Persevere with Problems** Solve $3|x| = 12$. Explain your reasoning.

17. **Persevere with Problems** Explain how you would solve $\frac{-30}{x} = 6$. Then solve the equation.

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Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

18. $-4j = 36$

Homework Help

$-4j = 36$

$\frac{-4j}{-4} = \frac{36}{-4}$

$j = -9$

19. $-4s = -16$

20. $63 = -9d$

21. $\frac{m}{10} = 7$

$\frac{m}{10} = 7$

$\frac{m}{10}(10) = 7(10)$

$m = 70$

22. $\frac{h}{-3} = 12$

23. $\frac{g}{12} = -10$

24. The width of a computer monitor is 1.25 times its height. Find the height of the computer monitor at the right. Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically. _____

25. A dragonfly, the fastest insect, can fly a distance of 15 meters at a speed of 7.5 feet per second. Find the time in seconds. Write the equation in the form $d = rt$, then solve.

_____

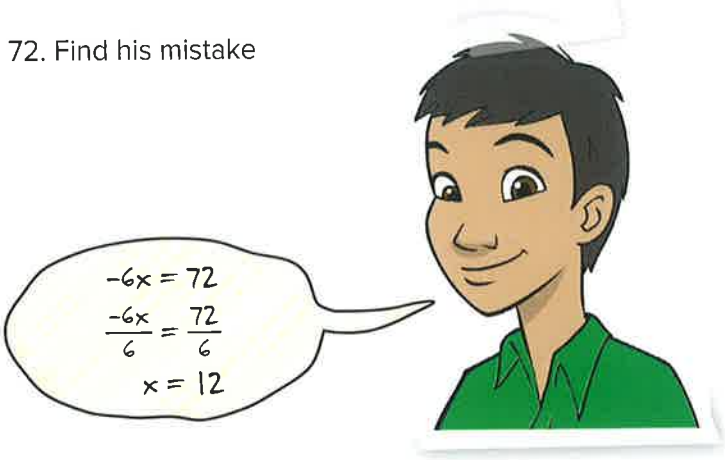
26. MP **Find the Error** Amer is solving $-6x = 72$. Find his mistake and correct it.

_____

_____

_____

_____



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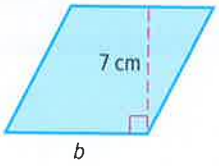
Power Up! Test Practice

27. The formula $A = bh$ can be used to find the area A of a parallelogram with base b and height h. The parallelogram shown has an area of 56 square inches.



What is the length of the base? ☐

28. The table shows the prices of different satellite radio plans. Mrs. Khadija paid AED 99 for m months of satellite radio under Plan A. Fill in each box to write a multiplication equation to represent the situation.

Satellite Radio Plans	
Plan	**Cost per Month (AED)**
A	16.50
B	14.35
C	11.99

☐ × ☐ = ☐

m	**16.50**
11.99	**99**
14.35	

How many months of service did Mrs. Khadija purchase? ☐

Spiral Review

Write each improper fraction as a mixed number and each mixed number as an improper fraction.

29. $\frac{10}{3} =$ _____

30. $\frac{40}{7} =$ _____

31. $\frac{101}{100} =$ _____

32. $2\frac{2}{7} =$ _____

33. $3\frac{1}{4} =$ _____

34. $10\frac{5}{9} =$ _____

Divide.

35. $6 \div 1.5 =$ _____

36. $3.6 \div 0.4 =$ _____

37. $2.73 \div 1.3 =$ _____

Multiply. Write in simplest form.

38. $\frac{2}{9} \times \frac{7}{5} =$ _____

39. $\frac{3}{4} \times 7 =$ _____

40. $\frac{5}{8} \times \frac{4}{15} =$ _____

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Inquiry Lab

Solve Equations with Rational Coefficients

Inquiry **HOW can you use bar diagrams to solve equations with rational coefficients?**

MP **Mathematical Practices** 1, 3

Two thirds of Ahmed's homeroom class plan to participate in the school talent show. If 16 students from the class plan to participate, how many students are in the homeroom class?

What do you know? _____

_____

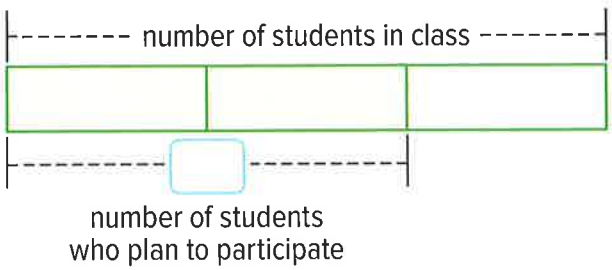
What do you need to find? _____

_____

Hands-On Activity

You can represent the situation above with an equation.

Step 1 Draw a bar diagram that represents the total number of students in the class and how many plan to participate.



Step 2 Write an equation from the bar diagram. Let c represent the total number of students in the class. _____

Step 3 Find the number of students represented by the sections of the bar. Write that number in each section of the bar in Step 1.

Since each section represents 8 students, there are 8×3 or ☐ students in the class.

Check $\frac{2}{3} \times 24 = \frac{2}{3} \times \frac{24}{1}$

$= \frac{48}{3}$ or 16 ✓

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Investigate

Work with a partner to solve the following problem.

1. Reham is spending $\frac{3}{5}$ of her monthly allowance on a costume for the talent show. She plans to spend AED 24. Draw a bar diagram to represent the situation. Then write and solve an equation to find the amount of Reham's monthly allowance.

Equation: _____ Solution: _____

Analyze and Reflect

Work with a partner to answer the following question.

2. MP **Make a Conjecture** Suppose Reham planned on spending $\frac{3}{4}$ of her monthly allowance on a costume. How would the diagram and equation be different?

Create

3. MP **Model with Mathematics** Write a real-world problem that could be represented by the equation $\frac{2}{3}x = 12$. Then solve the equation.

4. Inquiry HOW can you use bar diagrams to solve equations with rational coefficients?

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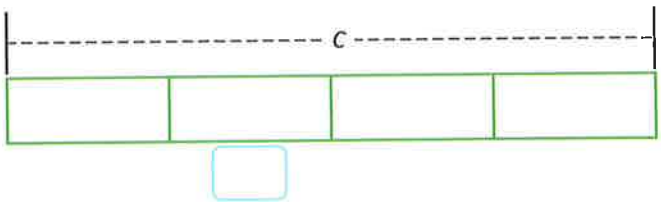
Lesson 3

Solve Equations with Rational Coefficients

Real-World Link

Social Networks Three-fourths of the students in Sally's class belong to a social network. There are 15 students in her class that belong to a social network.

1. Create a bar diagram and shade $\frac{3}{4}$, or 0.75, of it.



Label 15 along the bottom to show the amount of the bar that represents 15 students.

2. Based on the diagram, circle the equation that can be used to find c, the number of students in Sally's class.

$15c = \frac{3}{4}$ $\quad 0.75c = 15$ $\quad 4c = 15$

3. Based on what you know about solving equations, explain how you could solve the equation you circled in Exercise 2.

4. How many students are in Sally's class?

Essential Question

WHAT does it mean to say two quantities are equal?

MP Mathematical Practices
1, 2, 3, 4

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

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Work Zone

Division with Decimals

$$\begin{array}{r} 64. \\ 0.25\overline{)\,16.00} \\ -\ 150 \\ \hline 100 \\ -\ 100 \\ \hline 0 \end{array}$$

Decimal Coefficients

If the coefficient is a decimal, divide each side by the coefficient.

Example

1. **Solve $16 = 0.25n$. Check your solution.**

$16 = 0.25n$ Write the equation.

$\frac{16}{0.25} = \frac{0.25n}{0.25}$ Division Property of Equality

$64 = n$ Simplify.

Check $16 = 0.25n$ Write the original equation.

$16 \stackrel{?}{=} 0.25 \cdot 64$ Replace n with 64.

$16 = 16$ ✓ This sentence is true.

The solution is 64.

Show your work.

a. _____

b. _____

c. _____

Got it? **Do these problems to find out.**

a. $6.4 = 0.8m$ **b.** $-2.8p = 4.2$ **c.** $-4.7k = -10.81$

Real World

Example

2. **Sumayya's coach agreed to buy ice cream for all of the team members. Ice cream cones are AED 2.40 each. Write and solve an equation to find how many cones the coach can buy with AED 30.**

Let n represent the number of cones the coach can buy.

$2.4n = 30$ Write the equation; AED 2.40 = 2.4.

$\frac{2.4n}{2.4} = \frac{30}{2.4}$ Division Property of Equality

$n = 12.5$ Simplify.

Since the number of ice cream cones must be a whole number, there is enough money for 12 ice cream cones.

Got it? **Do this problem to find out.**

d. Suppose the ice cream cones cost AED 2.80 each. How many ice cream cones could the coach buy with AED 42?

d. _____

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Fraction Coefficients

Recall that two numbers with a product of 1 are called multiplicative inverses, or reciprocals. If the coefficient in a multiplication equation is a fraction, multiply each side by the reciprocal of the coefficient.

Examples

3. Solve $\frac{3}{4}x = \frac{12}{20}$.

$\frac{3}{4}x = \frac{12}{20}$ — Write the equation.

$\left(\frac{4}{3}\right) \cdot \frac{3}{4}x = \left(\frac{4}{3}\right) \cdot \frac{12}{20}$ — Multiply each side by the reciprocal of $\frac{3}{4}$, $\frac{4}{3}$.

$\frac{\overset{1}{\cancel{4}}}{\underset{1}{3}} \cdot \frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}}x = \frac{\overset{1}{\cancel{4}}}{\underset{1}{\cancel{3}}} \cdot \frac{\overset{4}{\cancel{12}}}{\underset{5}{\cancel{20}}}$ — Divide by common factors.

$x = \frac{4}{5}$ — Simplify. Check the solution.

4. Solve $-\frac{7}{9}d = 5$. Check your solution.

$-\frac{7}{9}d = 5$ — Write the equation.

$\left(-\frac{9}{7}\right) \cdot \left(-\frac{7}{9}\right)d = \left(-\frac{9}{7}\right) \cdot 5$ — Multiply each side by the reciprocal of $-\frac{7}{9}$, $-\frac{9}{7}$.

$\left(-\frac{9}{7}\right) \cdot \left(-\frac{7}{9}\right)d = \left(-\frac{9}{7}\right) \cdot \frac{5}{1}$ — Write 5 as $\frac{5}{1}$.

$\left(-\frac{\overset{1}{\cancel{9}}}{\underset{1}{7}}\right) \cdot \left(-\frac{\overset{1}{\cancel{7}}}{\underset{1}{\cancel{9}}}\right)d = \left(-\frac{9}{7}\right) \cdot \frac{5}{1}$ — Divide by common factors.

$d = -\frac{45}{7}$ or $-6\frac{3}{7}$ — Simplify.

Check

$-\frac{7}{9}d = 5$ — Write the original equation.

$-\frac{7}{9}\left(-\frac{45}{7}\right) \stackrel{?}{=} 5$ — Replace d with $-\frac{45}{7}$.

$\frac{315}{63} \stackrel{?}{=} 5$ — Simplify.

$5 = 5$ ✓ — This sentence is true.

Got it? Do these problems to find out.

e. $\frac{1}{2}x = 8$ f. $-\frac{3}{4}x = 9$ g. $-\frac{7}{8}x = -\frac{21}{64}$

Fractions as Coefficients

The expression $\frac{3}{4}x$ can be read as $\frac{3}{4}$ of x, $\frac{3}{4}$ multiplied by x, $3x$ divided by 4, or $\frac{x}{4}$ multiplied by 3.

Show your work.

e. _____

f. _____

g. _____

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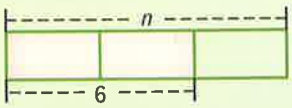
Bar Diagrams

A bar diagram can be used to represent this situation.



$n = 6 \div \frac{2}{3} = \frac{6}{1} \times \frac{3}{2} = 9$

Example

5. **Hessa needs $\frac{2}{3}$ meter of fabric to make each hat for the school play. Write and solve an equation to find how many hats she can make with 6 meters of fabric.**

Write and solve a multiplication equation. Let n represent the number of hats.

$\frac{2}{3}n = 6$ Write the equation.

$\left(\frac{3}{2}\right) \cdot \frac{2}{3}n = \left(\frac{3}{2}\right) \cdot 6$ Multiply each side by $\frac{3}{2}$.

$n = 9$ Simplify.

So, Hessa can make 9 hats.

Guided Practice

Solve each equation. Check your solution. (Examples 1, 3, and 4)

1. $1.6k = 3.2$

Show your work.

2. $-2.5b = 20.5$

3. $-\frac{1}{2} = -\frac{5}{18}h$

Write and solve an equation. (Examples 2 and 5)

4. The average growth of human hair is 1.25 centimeters per month. Find how long it takes a human to grow 7.5 centimeters of hair.

Equation: _____ Solution: _____

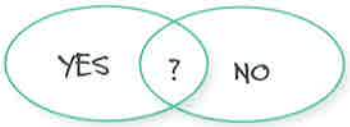
5. Three fourths of the fruit in a refrigerator are apples. There are 24 apples in the refrigerator. How many pieces of fruit are in the refrigerator?

Equation: _____ Solution: _____

6. **Building on the Essential Question** What is the process for solving a multiplication equation with a rational coefficient? _____

Rate Yourself!

Are you ready to move on? Shade the section that applies.



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Name _____ My Homework _____

Independent Practice

Solve each equation. Check your solution. (Examples 1, 3, and 4)

1. $1.2x = 6$

Show your work.

2. $14.4 = -2.4b$

3 $-3.6h = -10.8$

4. $\frac{2}{5}t = \frac{12}{25}$

5. $-3\frac{1}{3} = -\frac{1}{2}g$

6. $-\frac{7}{9}m = \frac{11}{6}$

7 **Financial Literacy** Ibrahim deposited $\frac{3}{4}$ of his paycheck into the bank. The deposit slip shows how much he deposited. Write and solve an equation to find the amount of his paycheck. (Example 2)


DEPOSIT
CHECKS 46.50
Name: Ibrahim Khamis
Date: 9/22
Great Savings Bank
Transaction #
DEPOSIT AED46.50

Equation: _____ Solution: _____

8. Twenty-four students brought their permission slips to attend the class field trip to the local art museum. If this represented eight tenths of the class, how many students are in the class? Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically. (Example 5)

Equation: _____ Solution: _____

9. MP **Justify Conclusions** Seventy-five percent, or 15, of the students in Rana's homeroom class are going on a field trip. Two thirds, or 12, of the students in Hessa's homeroom class are going on the field trip. Which class has more students? Justify your answer. _____

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10. **Reason Abstractly** Noura and Rana are making stuffed animals for a toy drive. The table shows the fabric purchases they made. Who purchased the more expensive fabric?

Explain your reasoning.

Purchaser	Amount Purchased (m)	Amount Paid (AED)
Noura	$\frac{2}{3}$	4
Rana	0.8	6

H.O.T. Problems Higher Order Thinking

11. **Reason Inductively** Complete the statement: If $8 = \frac{m}{4}$, then $m - 12 =$ ■. Explain.

12. **Which One Doesn't Belong?** Identify the pair of numbers that does not belong with the other three. Explain.

$\frac{9}{6}, \frac{6}{9}$ $\quad$ $4, \frac{1}{4}$ $\quad$ $\frac{3}{5}, 5$ $\quad$ $\frac{2}{7}, \frac{7}{2}$

13. **Persevere with Problems** The formula for the area of a trapezoid is $A = \frac{1}{2}h(b_1 + b_2)$, where b_1 and b_2 are both bases and h is the height. Find the value of h in terms of A, b_1, and b_2. Justify your answer.

14. **Model with Mathematics** Write a real-world problem that can be represented by the equation $224 = 3.5r$. Then solve the problem and explain the solution.

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Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

15. $0.4d = 2.8$

Homework Help

$0.4d = 2.8$

$\frac{0.4d}{0.4} = \frac{2.8d}{0.4}$

$d = 7$

16. $-5w = -24.5$

17. $-22.8 = 6n$

18. $\frac{7}{8}k = \frac{5}{6}$

$\frac{7}{8}k = \frac{5}{6}$

$\left(\frac{8}{7}\right) \cdot \frac{7}{8}k = \left(\frac{8}{7}\right) \cdot \frac{5}{6}$

$k = \frac{40}{42}$ or $\frac{20}{21}$

19. $-6\frac{1}{4} = \frac{3}{5}c$

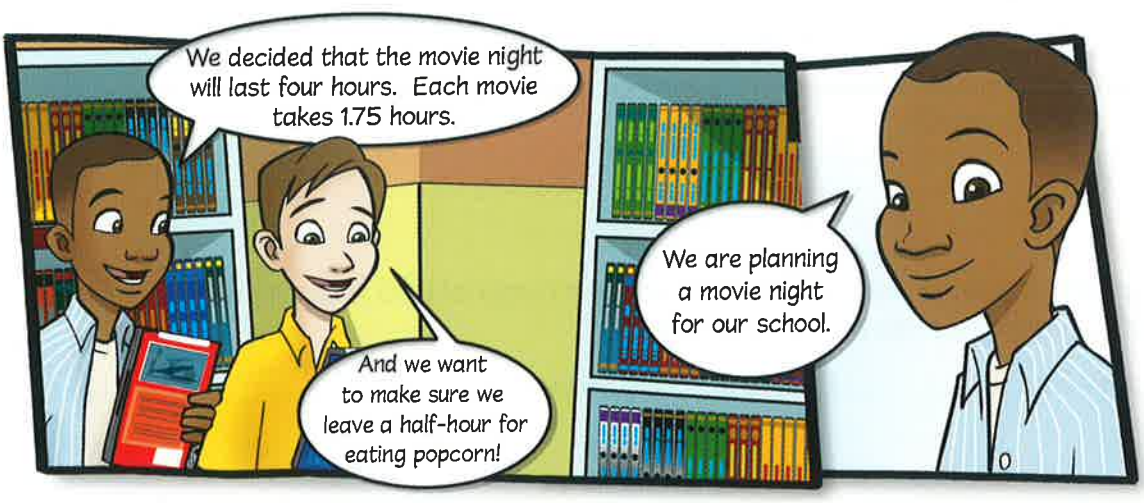
20. $-\frac{4}{7}v = -8\frac{2}{3}$

21. The Mammoth Cave Discovery Tour includes an elevation change of 42 meters. This is $\frac{7}{15}$ of the elevation change on the Wild Cave Tour. What is the elevation change on the Wild Cave Tour? Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically.

Equation: _____ Solution: _____

22. MP **Model with Mathematics** Refer to the graphic novel frame below. Write and solve an equation to find how many movies they have time to show.

Equation: _____ Solution: _____



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Power Up! Test Practice

23. Which of the following high speed trains are traveling at a rate of 240 kilometers per hour? Select all that apply.

- ☐ a train that travels 160 kilometers in $\frac{2}{3}$ hour
- ☐ a train that travels 256 kilometers in $\frac{5}{6}$ hour
- ☐ a train that travels 200 kilometers in $\frac{4}{5}$ hour
- ☐ a train that travels 144 kilometers in $\frac{3}{5}$ hour

24. The table shows the results of a survey. Of those surveyed, 275 students said they prefer adventure books.

Write an equation that could be used to find the total number of students s who were surveyed. _____

How many students were surveyed? _____

Book Preference	
Type	**Fraction of Students**
Biography	$\frac{1}{8}$
Adventure	$\frac{5}{8}$
Mystery	$\frac{1}{4}$

Spiral Review

Use the order of operations to evaluate each expression.

25. $6 \times 4 - 2 =$ _____

26. $70 - 5 \times 4 =$ _____

27. $18 \div 2 - 7 =$ _____

28. Write *add, divide, multiply,* and *subtract* in the correct order to complete the following sentence.

When using the order of operations to evaluate an expression,

always _____ and _____ before you _____

and _____.

Write and evaluate an expression for each situation.

29. Used paperback books are AED 0.25, and hardback books are AED 0.50. If you buy 3 paperback books and 5 hardback books, how much money do you spend?

Expression: _____ Solution: _____

30. Suppose you order 2 pizzas, 2 garlic breads, and 1 order of BBQ wings. How much change would you receive from AED 70?

Expression: _____ Solution: _____

Item	Cost
14" pizza	AED 18
garlic bread	AED 7
BBQ wings	AED 9

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Inquiry Lab
Solve Two-Step Equations

Inquiry **HOW can a bar diagram or algebra tiles help you solve a real-world problem?**

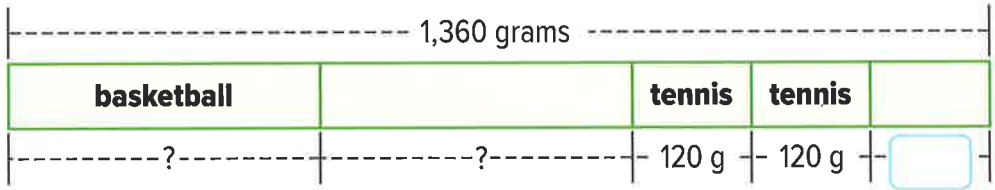
MP Mathematical Practices
1, 2, 3, 4

Reham plays basketball and tennis. She has two basketballs and three tennis balls that weigh a total of 1,360 grams. Each tennis ball weighs 60 grams. What is the weight of a basketball?

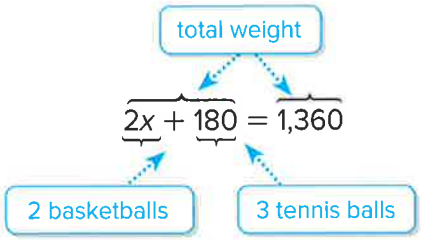
Hands-On Activity 1

You can use a bar diagram to represent the situation.

Step 1 Draw a bar diagram that represents the total weight.



Step 2 Write an equation that is modeled by the bar diagram. Let x represent the weight of a basketball.



Step 3 Use the bar diagram to solve the equation. Subtract the weight of the tennis balls, ____ grams, from the total weight, ____ grams.

The two basketballs together weigh ____ − ____, or ____ grams.

Divide the weight by ____ to find the weight of one basketball.

So, $x =$ ____. The weight of one basketball is ____ ÷ ____, or ____ grams.

Check $2 \cdot$ ____ $+ 6 = 48$ ✓

The weight of one basketball is ____ grams.

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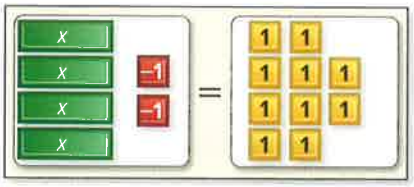
Hands-On Activity 2

Tools

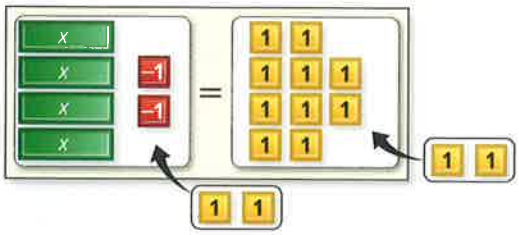
You can use algebra tiles to model and solve the equation $4x - 2 = 10$.

Step 1 Model the equation.



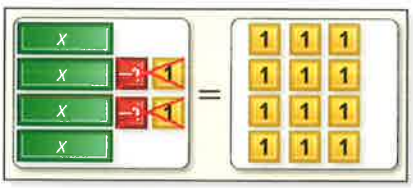
$4x - 2 = 10$

Step 2 Add ☐ 1-tiles to each side of the mat to form zero pairs on the left side.



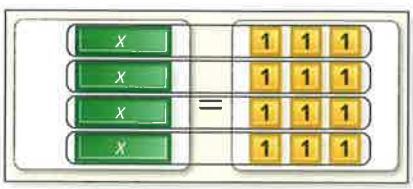
$4x - 2 + 2 = 10 + 2$

Step 3 Remove both zero pairs from the left side so that the variable is by itself.



$4x = 12$

Step 4 Divide the remaining tiles into ☐ equal groups.



$\frac{4x}{4} = \frac{12}{4}$

So, $x =$ ☐.

Check $4 \cdot$ ☐ $- 2 = 10$ ✓

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Investigate

Collaborate

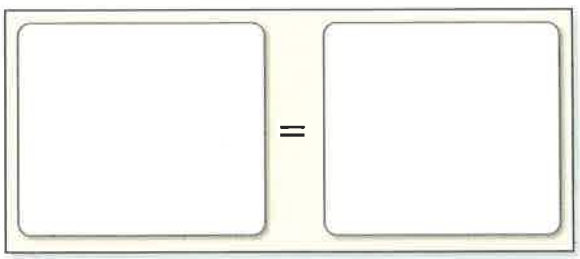
Work with a partner to solve the following problem.

1. MP **Reason Abstractly** Ahmed is saving money to buy a skateboard that costs AED 185. He has already saved AED 65. He plans to save the same amount each week for three weeks. Draw a bar diagram. Then write an equation. How much should Ahmed save each week?

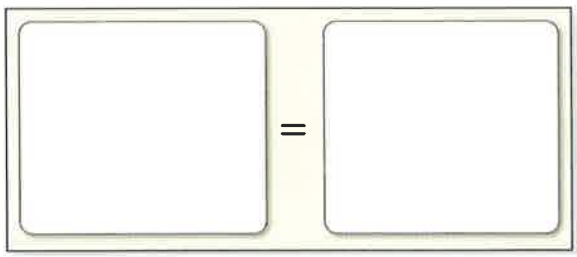
Show your work.

Work with a partner to solve each equation. Use algebra tiles. Show your work using drawings.

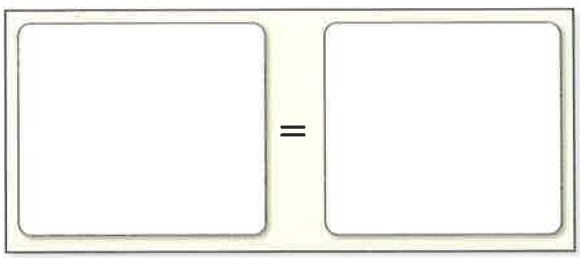
2. $2x + 1 = 5$ $x =$ _____



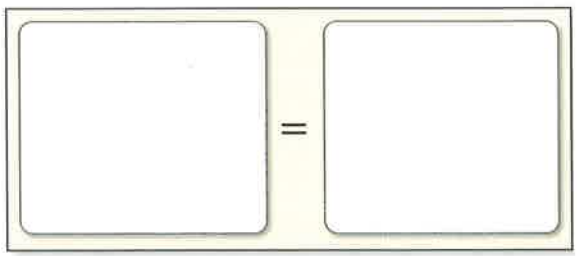
3. $3x + 2 = 11$ $x =$ _____



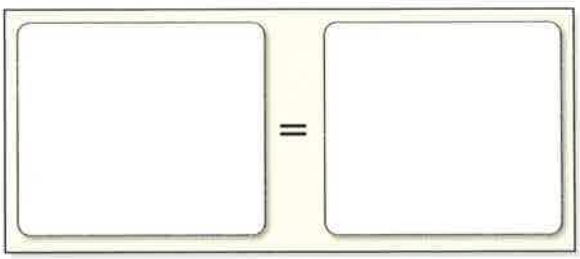
4. $4x + 3 = -5$ $x =$ _____



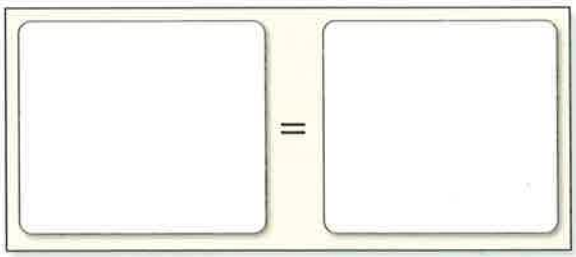
5. $2x - 1 = 7$ $x =$ _____



6. $5x - 2 = -7$ $x =$ _____



7. $3x - 4 = 5$ $x =$ _____



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Analyze and Reflect

Collaborate

8. MP **Reason Inductively** Work with a partner. Read the steps to model and solve an equation using algebra tiles. Then circle each correct equation.

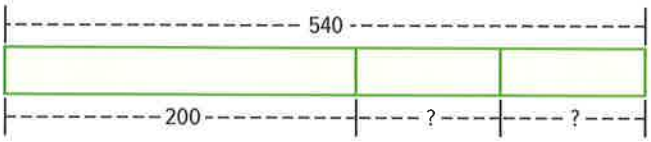
Steps to Solve	Choices of Equation		
• Add three 1-tiles to each side of the mat. • Divide tiles into two equal groups.	$2x + 3 = 15$	$3x + 2 = 15$	$2x - 3 = 15$
• Add four 1-tiles to each side of the mat. • Divide tiles into three equal groups.	$3x - 4 = 11$	$3x + 4 = 11$	$4x - 3 = 11$
• Remove seven 1-tiles from each side of the mat. • Divide tiles into three equal groups.	$7x + 3 = 10$	$3x + 7 = 10$	$3x - 7 = 10$
• Add two −1-tiles to each side of the mat. • Remove two zero pairs from the left side of the mat. • Divide tiles into five equal groups.	$5x - 2 = -8$	$5x + 2 = -8$	$2x + 5 = -8$

9. MP **Construct an Argument** What did you observe while choosing the correct equations in the table above?

Create

On Your Own

10. MP **Model with Mathematics** Write a real-world problem and an equation that the bar diagram below could represent. Then solve your problem.



11. Inquiry HOW can a bar diagram or algebra tiles help you solve a real-world problem?

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Lesson 4

Solve Two-Step Equations

Real-World Link

Balloons A company charges AED 2 for each balloon in an arrangement and a AED 3 delivery fee. You have AED 9 to spend. The equation $2x + 3 = 9$, where x is the number of balloons, represents the situation. Work backward to solve for x.

Start with the amount of money you have to spend. → Subtract the AED 3 delivery fee. → Since each balloon is AED 2, divide by two.

So, you can purchase ☐ balloons.

Check your work by substituting your solution into the equation.

$$2(\square) + 3 \stackrel{?}{=} 9.$$

$$\square + 3 \stackrel{?}{=} 9$$

$$\square = 9$$

1. How many balloons could you have purchased if there was a AED 1 delivery charge?

Start with the amount of money you have to spend. → Subtract the AED 1 delivery fee. → Since each balloon is AED 2, divide by two.

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

Essential Question

WHAT does it mean to say two quantities are equal?

Vocabulary

two-step equation

MP Mathematical Practices

1, 2, 3, 4

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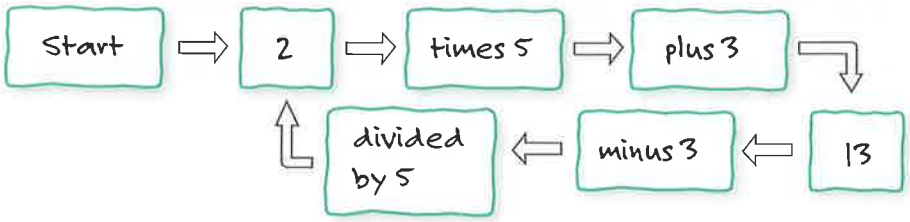
Work Zone

Solve Two-Step Equations

Recall that the *order of operations* ensures that numerical expressions, such as $2 \cdot 5 + 3$, have only one value. To reverse the operations, undo them in reverse order.



A **two-step equation**, such as $2x + 3 = 9$, has two different operations, multiplication and addition. To solve a two-step equation, undo the operations in reverse order of the order of operations.

This equation is written as $px + q = r$, where p, q, and r are rational numbers.

Step 1 Undo the addition or subtraction first.

Step 2 Undo the multiplication or division.

Examples

1. **Solve $2x + 3 = 9$. Check your solution.**

$$\begin{aligned} 2x + 3 &= 9 && \text{Write the equation.} \\ -3 &= -3 && \text{Undo the addition first by subtracting 3 from each side.} \\ 2x &= 6 \\ \frac{2x}{2} &= \frac{6}{2} && \text{Next, undo the multiplication by dividing each side by 2.} \\ x &= 3 && \text{Simplify.} \end{aligned}$$

Check

$$\begin{aligned} 2x + 3 &= 9 && \text{Write the original equation.} \\ 2(3) + 3 &\stackrel{?}{=} 9 && \text{Replace } x \text{ with 3.} \\ 9 &= 9 \ \checkmark && \text{The sentence is true.} \end{aligned}$$

The solution is 3.

STOP and Reflect

What are the two operations you would perform to solve $3x - 4 = 8$? Write your answer below.

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2. **Solve $3x + 2 = 23$. Check your solution.**

$3x + 2 = 23$ Write the equation.

$-2 = -2$ Undo the addition first by subtracting 2 from each side.

$3x = 21$

$\frac{3x}{3} = \frac{21}{3}$ Division Property of Equality

$x = 7$ Simplify.

Check $3x + 2 = 23$ Write the original equation.

$3(7) + 2 \stackrel{?}{=} 23$ Replace x with 7.

$23 = 23$ ✓ The sentence is true.

The solution is 7.

3. **Solve $-2y - 7 = 3$. Check your solution.**

$-2y - 7 = 3$ Write the equation.

$+7 = +7$ Undo the subtraction first by adding 7 to each side.

$-2y = 10$

$\frac{-2y}{-2} = \frac{10}{-2}$ Division Property of Equality

$y = -5$ Simplify.

The solution is -5. Check the solution.

4. **Solve $4 + \frac{1}{5}r = -1$. Check your solution.**

$4 + \frac{1}{5}r = -1$ Write the equation.

$-4 = -4$ Undo the addition first by subtracting 4 from each side.

$\frac{1}{5}r = -5$

$5 \cdot \frac{1}{5}r = 5 \cdot (-5)$ Multiplication Property of Equality

$r = -25$ Simplify.

The solution is -25. Check the solution.

Got it? **Do these problems to find out.**

Solve each equation. Check your solution.

a. $2x + 4 = 10$ **b.** $3x + 5 = 14$ **c.** $5 = 2 + 3x$

d. $4x + 5 = 13$ **e.** $-5s + 8 = -2$ **f.** $-2 + \frac{2}{3}w = 10$

Equations

Remember, solutions of the new equation are also solutions of the original equation.

Show your work.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

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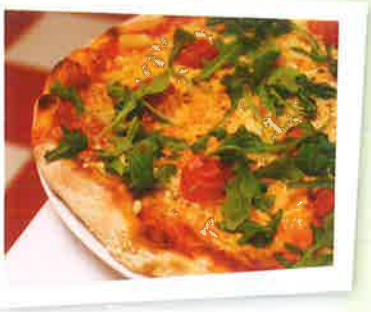

Solve Arithmetically

You can use a bar diagram to solve an equation arithmetically.

Subtract 27 from 78. Then divide by 8.5.
78 − 27 = 51; 51 ÷ 8.5 = 6

Real World

Example

5. **Suha had her graduation celebration at a restaurant. It cost AED 27 for pizza and AED 8.50 per friend for dessert. How many friends did Suha have at the restaurant if she spent AED 78?**

Words	Cost of pizza	plus	Cost of 1 dessert	times	number of friends	equals AED 78.
Variable	Let n represent the number of friends.					
Equation	27	+	8.50	·	n	= 78

$27 + 8.50n = 78$ Write the equation.

$-27 \quad = -27$ Subtract 27 from each side.

$8.50n = 51$

$\frac{8.50n}{8.50} = \frac{51}{8.50}$ Division Property of Equality

$n = 6$ Simplify.

Suha can have 6 friends at her graduation party.

Guided Practice

Check

Solve each equation. Check your solution. (Examples 1–4)

1. $13 = 1 + 4s$

Show your work.

2. $-3y - 5 = 10$

3. $-7 = 1 + \frac{2}{3}n$

4. Shaikha wants to buy some CDs that each cost AED 14, and a DVD that costs AED 23. She has AED 65. Write and solve an equation to find how many CDs she can buy. (Example 5)

Equation: _____

Solution: _____

5. **Building on the Essential Question** When solving an equation, explain why it is important to perform identical operations on each side of the equals sign.

_____

_____

_____

Rate Yourself!

How well do you understand solving two-step equations? Circle the image that applies.

FOLDABLES Time to update your Foldable!

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Name _____ My Homework _____

Independent Practice

Solve each equation. Check your solution. (Examples 1–4)

1. $3x + 1 = 10$

Show your work.

2. $-3 + 8n = -5$

3 $4h - 6 = 22$

4. $-8s + 1 = 33$

5. $-4w - 4 = 8$

6. $5 + \frac{1}{7}b = -2$

7. MP **Reason Abstractly** Khalid is saving money to buy a bike that costs AED 189. He has saved AED 99 so far. He plans on saving AED 10 each week. In how many weeks will he have enough money to buy the bike? Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically. (Example 5)

Show your work.

Solve each equation. Check your solution.

8. $2r - 3.1 = 1.7$

9. $4t + 3.5 = 12.5$

10. $8m - 5.5 = 10.1$

11 Temperature is usually measured on the Fahrenheit scale (°F) or the Celsius scale (°C). Use the formula $F = 1.8C + 32$ to convert from one scale to the other.

a. Convert the temperature for Alaska's record low in July to Celsius. Round to the nearest degree.

b. Hawaii's record low temperature is −11°C. Find the difference in degrees Fahrenheit between Hawaii's record low temperature and the record low temperature for Alaska in January.

Alaska Record Low Temperatures (°F) by Month	
January	−80
April	−50
July	16
October	−48

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12. MP **Model with Mathematics** Refer to the graphic novel frame below. Jamal figured that they will spend AED 39 for popcorn. Each movie cost AED 19. Write and solve an equation to find how many movies they can purchase.

H.O.T. Problems Higher Order Thinking

13. MP **Reason Inductively** Refer to Exercise 11. Is there a temperature in the table at which the number of degrees Celsius is the same as the number of degrees Fahrenheit? If so, find it. If not, explain why not.

14. MP **Persevere with Problems** Suppose your school is selling magazine subscriptions. Each subscription costs AED 20. The company pays the school half of the total sales in dirhams. The school must also pay a one-time fee of AED 18. Write and solve an equation to determine the fewest number of subscriptions that can be sold to earn a profit of AED 200.

15. MP **Model with Mathematics** Write a real-world problem that can be represented by the equation $\frac{(12 + 14) \times h}{2} = 52$. Then solve the problem.

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Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

16. $5x + 4 = 19$

Homework Help

$5x + 4 = 19$
$-4 = -4$
$\frac{5x}{5} = \frac{15}{5}$
$x = 3$

17. $6m + 1 = -23$

18. $5 + 4d = 37$

19. $-7y + 3 = -25$

20. $25 + \frac{11}{12}b = 47$

21. $15 - \frac{1}{2}b = -3$

22. It costs AED 17.50 to enter a petting zoo. Each cup of food to feed the animals is AED 2.50. If you have AED 22.50, how many cups can you buy? Use a bar diagram to solve arithmetically. Then use an equation to solve algebraically.

Show your work.

23. MP **Multiple Representations** The perimeter of a rectangle is 48 centimeters. Its length is 16 centimeters. What is the width w?

a. Draw a bar diagram that represents this situation.

b. Write and solve an equation that represents this situation.

c. How does solving the equation arithmetically compare to solving an equation algebraically?

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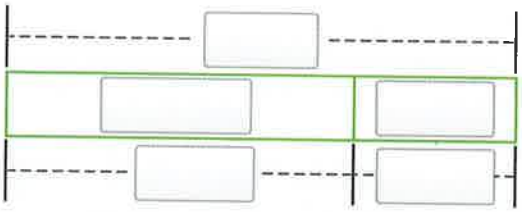
Power Up! Test Practice

24. Admission to an amusement park costs AED 40 and game tickets cost AED 5 each. Yousif has AED 100 to pay for admission and game tickets. Select the correct labels to complete the bar diagram that can be used to find the number of game tickets t that Yousif can purchase.



admission
game tickets
5
40
100
$5t$
t

How many game tickets can Yousif purchase? _____

25. A rental car company charges a fixed fee of AED 90 plus AED 3 per kilometers. Let c represent the total cost of renting a car and driving it k kilometers.

Write an equation that could be used to find the total cost of renting a car and driving it any number of kilometers. _____

Khalid's family paid AED 798 for their car rental. How many kilometers did they drive? _____

Spiral Review

Use the Distributive Property to rewrite each expression.

26. $2(x + 7) =$ _____

27. $6(10 + n) =$ _____

28. $5(k - 4) =$ _____

Factor each expression.

29. $5x + 5 \cdot 7 =$ _____

30. $4n + 4 \cdot 2 =$ _____

31. $10t + 10 \cdot 3 =$ _____

32. $7v + 7 \cdot 8 =$ _____

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Inquiry Lab
More Two-Step Equations

Inquiry **HOW are equations in $p(x + q) = r$ form different from $px + q = r$ equations?**

MP **Mathematical Practices** 1, 3, 4

Ahmed has two summer jobs. He delivers newspapers and helps with the gardening. He works at each job three days a week and earns a total of AED 240. The table shows his earnings each day. How much does he earn each day newspaper delivery?

Job	Daily Earnings (AED)
Newspaper delivery	x
Gardening	30

What do you know? _____

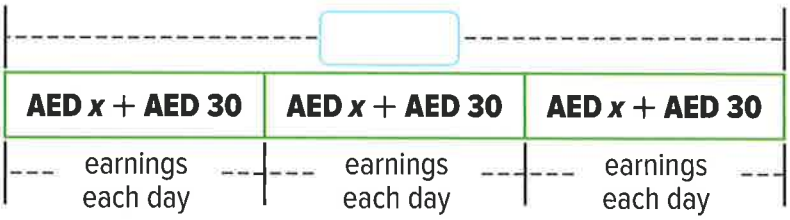
_____

What do you need to find? _____

_____

Hands-On Activity 1

Step 1 Draw a bar diagram that represents the situation.



Step 2 Write an equation that is modeled by the bar diagram.

3(AED x + AED 30) = ☐

From the diagram, you can see that one third of Ahmed's total earnings is equal to AED × + AED 30. So, AED × + AED 30 = $\frac{\text{AED } 240}{3}$ or ☐.

Ahmed earns ☐ − AED 30, or ☐ each day delivering newspapers.

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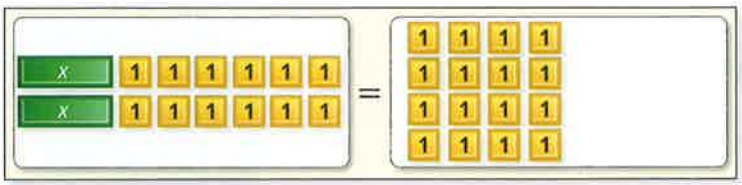
Ismail and his brother bought two sandwiches and two lemonades. The sandwiches cost AED 6 each. They spent a total of AED 16. How much did each lemonade cost?

Hands-On Activity 2

Tools

Use algebra tiles to model the situation described above.

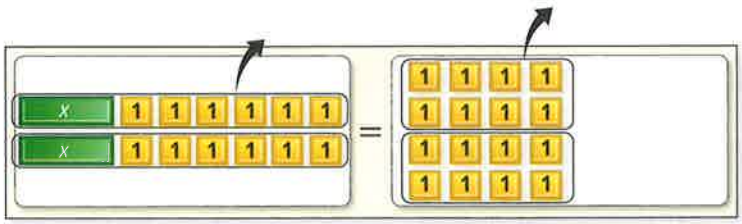
Step 1 Model $2(x + 6) = 16$ using algebra tiles. Use ☐ groups of $(x + 6)$ tiles.



$2(x + 6) \quad = \quad 16$

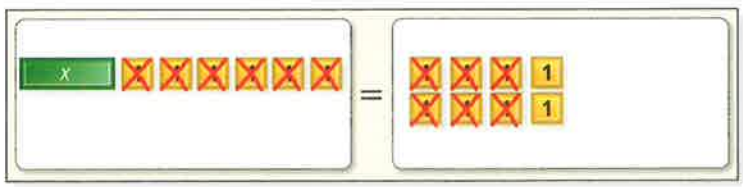
Step 2 Divide the tiles into ☐ equal groups on each side of the mat.

Remove ☐ group from each side.



$x + 6 \quad = \quad 8$

Step 3 Remove the same number of 1-tiles from each side.



$x \quad = \quad 2$

So, $x =$ ☐. Each lemonade costs ☐.

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Collaborate

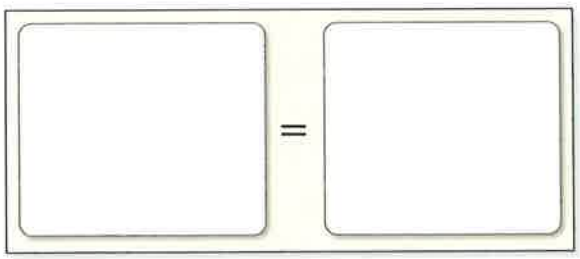
Investigate

Work with a partner to model and solve each equation. Use a bar diagram for Exercises 1 and 2. Use algebra tiles for Exercises 3–6.

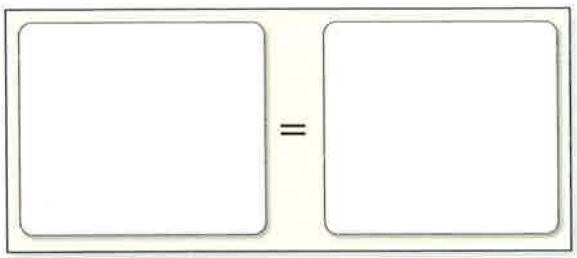
1. $3(x + 5) = 21$ $x =$ _____

2. $2(x - 3) = 10$ $x =$ _____

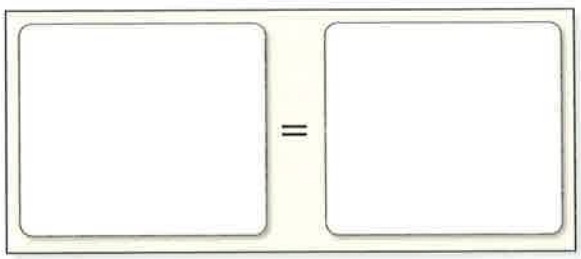
3. $4(x + 1) = 8$ $x =$ _____



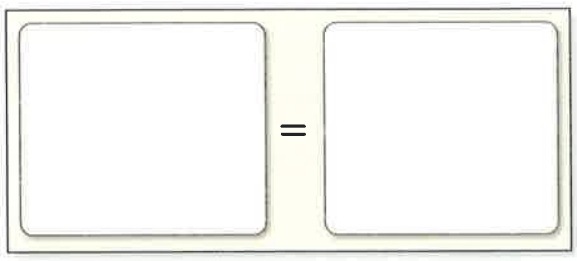
4. $3(x + 2) = -12$ $x =$ _____



5. $2(x - 1) = 6$ $x =$ _____



6. $3(x - 4) = -3$ $x =$ _____



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Analyze and Reflect

Collaborate

Work with a partner to write and solve an equation that represents each problem.

7. Refer to Activity 1. If Ahmed worked four days a week and made AED 360, how much did he earn delivering newspapers each day?

8. Refer to Activity 2. If Ismail and his brother spent a total of AED 15, how much did each lemonade cost?

9. MP **Reason Inductively** After modeling an equation using algebra tiles, Shaima used the steps shown below to solve the equation. Write two different equations in $p(x + q) = r$ form that Shaima could have solved.

Step 1 Divide the tiles into three equal groups on both sides of the mat.

Step 2 Remove two groups from each side.

Step 3 Add four 1-tiles to each side.

Equation 1: _____ Equation 2: _____

Create

On Your Own

10. MP **Model with Mathematics** Write a real-world problem that can be represented by the equation $4(x + 15) = 140$. Then solve the problem.

11. Inquiry HOW are equations in $p(x + q) = r$ form different from $px + q = r$ equations?

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Lesson 5

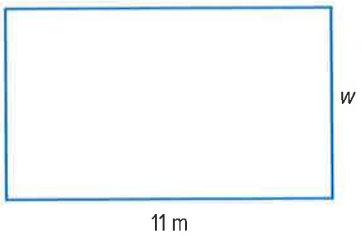
More Two-Step Equations

Real-World Link

Museums A new exhibit about dinosaurs is being constructed. The exhibit is a rectangle that is 11 meters long. It has a perimeter of 34 meters. Follow the steps to write an equation that can be used to find the width of the museum exhibit.

Step 1 Draw a diagram to help visualize the exhibit.

Label the length and width. Let w represent the width.



Step 2 Write an expression that represents the sum of the length and width of the exhibit. _____

Step 3 Write an expression that represents twice the sum of the length and width. _____

Step 4 Write an equation that represents the perimeter of the exhibit. _____

Essential Question

WHAT does it mean to say two quantities are equal?

MP Mathematical Practices

1, 2, 3, 4

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

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Work Zone

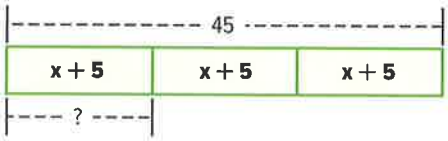
Solve Two-Step Equations

An equation like $2(w + 36) = 114$ is in the form $p(x + q) = r$. It contains two factors, p and $(x + q)$, and is considered a two-step equation. Solve these equations using the properties of equality.

Examples

1. **Solve $3(x + 5) = 45$.**

Method 1 **Solve arithmetically.**



Draw a bar diagram. From the diagram, you can see that $x + 5 = 45 \div 3$ or 15. So, $x = 15 - 5$ or 10.

Method 2 **Solve algebraically.**

$3(x + 5) = 45$ Write the equation.

$\frac{3(x + 5)}{3} = \frac{45}{3}$ Division Property of Equality

$x + 5 = 15$ Simplify.

$-5 = -5$ Subtraction Property of Equality

$x = 10$ Simplify.

2. **Solve $5(n - 2) = -30$.**

$5(n - 2) = -30$ Write the equation.

$\frac{5(n - 2)}{5} = \frac{-30}{5}$ Division Property of Equality

$n - 2 = -6$ Simplify.

$+2 = +2$ Addition Property of Equality

$n = -4$ Simplify. Check the solution.

Check Your Work
Remember to plug your solution back into the original equation to see if it makes a true statement.

Show your work.

a. _____

b. _____

c. _____

Got it? **Do these problems to find out.**

a. $2(x + 4) = 20$ **b.** $3(b - 6) = 12$ **c.** $-7(6 + d) = 49$

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Equations with Rational Coefficients

Sometimes the factor p, in $p(x + q)$, will be a fraction or decimal.

Examples

3. **Solve $\frac{2}{3}(n + 6) = 10$. Check your solution.**

$\frac{2}{3}(n + 6) = 10$ Write the equation.

$\frac{3}{2} \cdot \frac{2}{3}(n + 6) = \frac{3}{2} \cdot 10$ Multiplication Property of Equality

$(n + 6) = \frac{3}{2} \cdot \left(\frac{10}{1}\right)$ $\frac{2}{3} \cdot \frac{3}{2} = 1$; write 10 as $\frac{10}{1}$.

$n + 6 = 15$ Simplify.

$-6 = -6$ Subtraction Property of Equality

$n = 9$ Simplify.

Check

$\frac{2}{3}(n + 6) = 10$ Write the original equation.

$\frac{2}{3}(9 + 6) \stackrel{?}{=} 10$ Replace n with 9. Is this sentence true?

$10 = 10$ ✓ The sentence is true.

4. **Solve $0.2(c - 3) = -10$. Check your solution.**

$0.2(c - 3) = -10$ Write the equation.

$\frac{0.2(c - 3)}{0.2} = -\frac{10}{0.2}$ Division Property of Equality

$c - 3 = -50$ Simplify.

$+3 = +3$ Addition Property of Equality

$c = -47$ Simplify.

Check

$0.2(c - 3) = -10$ Write the original equation.

$0.2(-47 - 3) \stackrel{?}{=} -10$ Replace c with -47. Is this sentence true?

$-10 = -10$ ✓ The sentence is true.

Got it? **Do these problems to find out.**

d. $\frac{1}{4}(d - 3) = -15$ **e.** $0.75(6 + d) = 12$ **f.** $(t + 3)\frac{5}{9} = 40$

Reciprocals

The product of a number and its reciprocal is 1.

Show your work.

d. _____

e. _____

f. _____

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STOP and Reflect

Solve the problem in Example 5 arithmetically. How does the arithmetic solution compare to the algebraic solution? Write your answer below.

Real World Example

5. **Jamal and two cousins received the same amount of money to go to a movie. Each boy spent AED 15. Afterward, the boys had AED 30 altogether. Write and solve an equation to find the amount of money each boy received.**

Let m represent the amount of money each boy received.

$3(m - 15) = 30$ Write the equation.

$\frac{3(m - 15)}{3} = \frac{30}{3}$ Division Property of Equality

$m - 15 = 10$ Simplify.

$+ 15 = + 15$ Addition Property of Equality

$m = 25$ Simplify.

So, each boy received AED 25.

Guided Practice

Check

Solve each equation. Check your solution. (Examples 1–4)

1. $2(p + 7) = 18$

2. $(4 + g)(-11) = 121$

3. $(v + 5)\left(-\frac{1}{9}\right) = 6$

4. $0.8(m - 5) = 10$

5. Mr. Faisal had three sheets of stickers. He gave 20 stickers from each sheet to his students and has 12 total stickers left. Write and solve an equation to find how many stickers were originally on each sheet. (Example 5)

Equation: _____

Solution: _____

6. **Building on the Essential Question** What is the difference between $px + q = r$ and $p(x + q) = r$?

_____

_____

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.

FOLDABLES Time to update your Foldable!

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Name _____ My Homework _____

Independent Practice

Solve each equation. Check your solution. (Examples 1–4)

1. $8(s + 3) = 72$

2. $-7(z - 6) = -70$

3 $(t + 8)(-2) = 12$

4. $\frac{8}{11}(n - 10) = 64$

5. $-0.6(r + 0.2) = 1.8$

6. $\left(w - \frac{4}{9}\right)\left(-\frac{2}{3}\right) = -\frac{4}{5}$

7 The length of each side of an equilateral triangle is increased by 5 centimeters, so the perimeter is now 60 centimeters. Write and solve an equation to find the original length of each side of the equilateral triangle. (Example 5)

Equation: _____ Solution: _____

8. MP **Multiple Representations** Usama and three of his friends went to the movies. They originally had a total of AED 40. Each boy had the same amount of money and spent AED 7.50 on a ticket. How much money did each boy have left after buying his ticket?

a. Model Draw a bar diagram that represents the situation.

b. Algebra Write and solve an equation that represents the situation.

c. Words Explain how you solved your equation.

d. Words Compare the arithmetic solution and the algebraic solution.

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9. Mrs. Khadija bought one ruler, one compass, and one mechanical pencil at the prices shown in the table for each of her 12 students.

Item	Price (AED)
compass	1.49
mechanical pencil	0.59
ruler	0.49

   a. Suppose Mrs. Khadija had 36 fils left after buying the school supplies. Write an equation to find the amount of money Mrs. Khadija initially had to spend on each student.

   b. Describe a two-step process you could use to solve your equation. Then solve the equation.

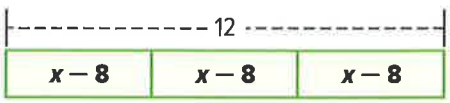
H.O.T. Problems Higher Order Thinking

10. MP **Model with Mathematics** Write a real-world situation that can be represented by the equation $2(n + 20) = 110$.

11. MP **Find the Error** Maysoun is solving the equation $6(x + 3) = 21$. Find her mistake and correct it.

12. MP **Persevere with Problems** Solve $p(x + q) = r$ for x.

13. MP **Use Math Tools** Write an equation to represent the bar diagram at the right. Then write a real-world problem that can be represented by the equation and the diagram.



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Name _____ My Homework _____

Extra Practice

Solve each equation. Check your solution.

14. $0.25(3 + a) = 0.5$

Homework Help

$0.25(3 + a) = 0.5$

$\frac{0.25(3 + a)}{0.25} = \frac{0.5}{0.25}$

$3 + a = 2$

$a = -1$

15. $12(x - 20) = -48$

16. $-28 = 7(n + 3)$

17. $(t + 9)20 = 140$

18. $\frac{5}{9}(8 + c) = -20$

19. $(d - 3)\frac{2}{5} = 30$

20. MP **Reason Abstractly** Abeer bought a necklace for each of her three sisters. She paid AED 7 for each necklace. Suppose she had AED 9 left. Write and solve an equation to find how much money Abeer had initially to spend on each sister.

Equation: _____

Solution: _____

Solve each equation. Check your solution.

21. $1\frac{3}{5}(t - 6) = -0.4$ _____

22. $\left(x + 5\frac{1}{2}\right)0.75 = \frac{5}{8}$ _____

23. Mr. Khalid bought fruit to make fruit salad. He bought $2\frac{1}{2}$ kilograms of apples and spent AED 4.50 on apples and oranges. Write and solve an equation to determine the number of kilograms of oranges Mr. Khalid bought.

_____

Fruit	Price per kilogram (AED)
apples	1.20
bananas	0.50
grapes	1.50
oranges	1.20

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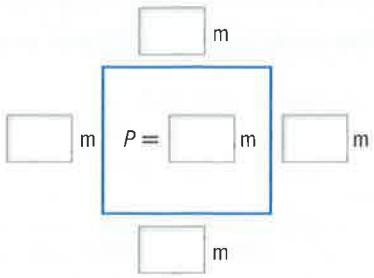
Power Up! Test Practice

24. A rectangular classroom is 10 meters long and has a perimeter of 36 meters. Label the drawing with the correct values to represent the situation. Let w represent the width of the classroom.



Write an expression that represents the sum of the length and width. _____

Write an expression that represents twice the sum of the length and width. _____

Write an equation you could use to find the perimeter of the classroom. _____

What is the width of the classroom? _____

25. Which of the following are operations that you should use to solve the equation $p(x - q) = r$ for x? Select all that apply.

- ☐ Subtract q from both sides.
- ☐ Divide both sides by p.
- ☐ Multiply both sides by p.
- ☐ Add q to both sides.

Spiral Review

Solve each equation.

26. $x + 3 = 5$

27. $x - 2 = -6$

28. $4x = 12$

29. $-6x = -24$

30. $\frac{x}{2} = -1$

31. $\frac{x}{-3} = 1$

Write the number or numbers from the set {−3, −2, −1, 0, 1, 2, 3} that make each statement true.

32. $4m = 12$ _____

33. $y - 1 = 1$ _____

34. $v > 0$ _____

35. $r \leq 0$ _____

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MP Problem-Solving Investigation
Work Backward

MP Mathematical Practices
1, 3, 4

Case #1 Yard Work

Ayman earned extra money by doing yard work for his neighbor. Then he spent AED 5.50 at the convenience store and four times that amount at the bookstore. Now he has AED 7.75 left.

How much money did Ayman have before he went to the convenience store and the bookstore?

1 **Understand** ***What are the facts?***

You know Ayman has AED 7.75 left. You need to find the amount before his purchases.

2 **Plan** ***What is your strategy to solve this problem?***

Start with the end result and work backward.

3 **Solve** ***How can you apply the strategy?***

He has AED 7.75 left.

Undo the four times AED 5.50 spent at the bookstore.
Since AED 5.50 × 4 is AED 22, add AED 7.75 and AED 22.

AED 7.75
+ AED 22.00
AED 29.75

Undo the AED 5.50 spent at the convenience store.

+ AED 5.50

Add AED 5.50 and _____.

AED 35.25

So, Ayman's starting amount was _____.

4 **Check** ***Does the answer make sense?***

Assume Ayman started with AED 35.25. He spent AED 5.50 and AED 22. He had AED 35 − AED 5.50 − AED 22 or _____ left. So, AED 35.25 is correct. ✓

Analyze the Strategy

MP **Construct an Argument** Describe how to solve a problem by working backward. _____

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Case #2 Money

Nisreen spent AED 8 on a movie ticket. Then she spent AED 5 on popcorn and one half of what was left on a drink. She had AED 2 left.

How much did she have initially?

1 Understand

Read the problem. What are you being asked to find?

I need to find _____.

Underline key words and values. What information do you know?

I know Nisreen has _____ left and that she spent _____, _____, and _____.

Is there any information that you do *not* need to know?

I do not need to know _____.

2 Plan

Choose a problem-solving strategy.

I will use the _____ strategy.

3 Solve

Use your problem-solving strategy to solve the problem.

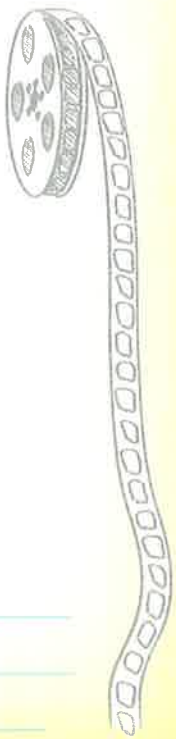
Nisreen has AED 2 left.

Undo the half-of-what-was-left amount. Multiply by 2. _____

Undo the spent AED 5. Add AED 5. _____

Undo the spent AED 8. Add AED 8. _____

So, Nisreen had _____ initially.



4 Check

Use information from the problem to check your answer.

Nisreen's initial amount: _____

Amount after spending AED 8: _____

Amount after spending AED 5: _____

Amount after spending half of what was left: _____

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Collaborate

Work with a small group to solve the following cases. Show your work on a separate piece of paper.

Case #3 Waterfalls

Angel Falls in Venezuela is 979 meters high. It is 26.5 meters higher than 2.5 times the architectural height of the Empire State Building.

Find the architectural height, in meters, of the Empire State Building.

Case #4 Number Theory

Rashid works at a kite factory. He checks all the kites before they are packaged. Rashid discovered that for every 28 kites that he inspected, 7 kites did not pass: 4 kites did not have tails, and 3 kites had the wrong colors.

Of the 476 kites Rashid examined, how many did not have tails and how many had the wrong colors?

Case #5 Time

Tarek's morning schedule is shown.

At what time does Tarek wake up if he arrives at school at 7:35?

Tarek's Schedule	
Activity	**Time**
Wake up	■
Get ready for school — $\frac{3}{4}$ h	■
Walk to school — $\frac{5}{12}$ h	7:35.

Use any strategy!

Case #6 Money

Zayed has saved AED 28 to spend at the arcade.

If he has 2 bills and 3 coins how many of each kind does he have?

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Mid-Chapter Check

Vocabulary Check

1. Define *equation*. Give an example of two equivalent equations. (Lesson 1)

2. Fill in the blank with the correct term. (Lesson 2)

   A _____ is the numerical factor of a multiplication expression like $3x$.

Skills Check and Problem Solving

Solve each equation. Check your solution. (Lessons 1–5)

3. $21 + m = 33$

4. $a - 5 = -12$

5. $5f = -75$

Show your work.

6. $15 = \frac{b}{15}$

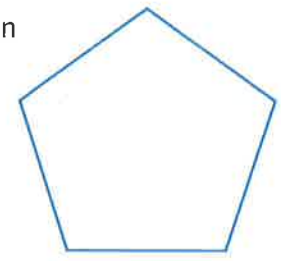
7. $19 = 4p + 5$

8. $3(n - 7) = -30$

9. Fatema has 11 adult Fantail goldfish. This is 7 fewer Fantail goldfish than her friend Alia has. Write and solve a subtraction equation to determine the number of Fantail goldfish g that Alia has. (Lesson 1)

   Equation: _____ Solution: _____

10. MP **Persevere with Problems** The pentagon shown is a regular pentagon, so each side has the same length. The perimeter of the pentagon is 22.5 centimeters. What is the value of x? _____



$(x - 1.5)$ cm

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Inquiry Lab
Solve Inequalities

Inquiry **HOW is an inequality like an equation? How is it different?**

MP Mathematical Practices 1, 2, 3, 4

Mr. Ahmed volunteered to drive Rashid and his friends to the school fundraiser. The car can carry up to 5 people, including the driver. How many friends can ride in the car with Rashid?

What do you know? _____

_____

What do you need to find? _____

_____

Hands-On Activity 1

Tools

The real-world situation described above can be represented by the inequality $x + 2 \leq 5$. Let x represent the friends that can ride with Rashid.

$x + 2 \leq 5$

- $x + 2$: Mr. Ahmed, Rashid, and friends
- $\leq$: Maximum number of people

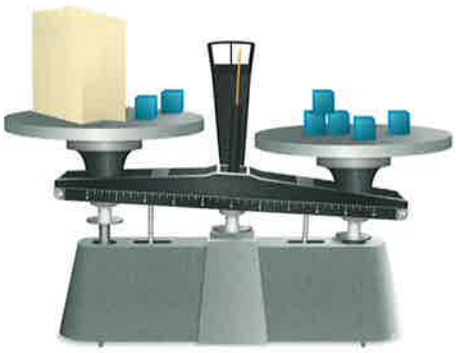
You can use a balance to model and solve the inequality $x + 2 \leq 5$.

Step 1 On one side of a balance, place a paper bag and ☐ cubes to model $x + 2$.

Step 2 On the other side of a balance, place ☐ cubes.

Add one cube to the bag at a time. Then complete the table.

Number of Friends, x	$x + 2$	Less than or equal to 5?
1	3	yes
2		
3		
4		



$x + 2 \quad \leq \quad 5$

So, up to ☐ friends can ride with Rashid to the school fundraiser.

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An *inequality* is a mathematical sentence that compares quantities. The table shows two examples of inequalities.

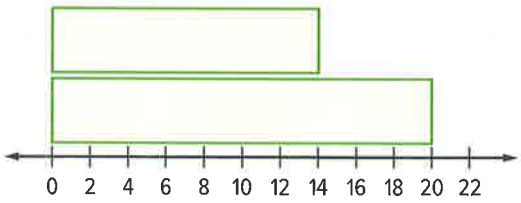
Words	Symbols
x is less than two	$x < 2$
x is greater than or equal to four	$x \geq 4$

To solve an inequality means to find values for the variable that make the sentence true. You can use bar diagrams to solve inequalities.

Hands-On Activity 2

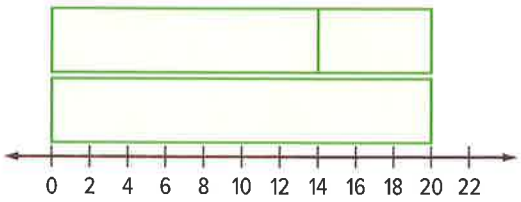
An airline charges for checked luggage that weighs more than 20 kilograms. Alia's suitcase currently weighs 14 kilograms and she still needs to pack her shoes. Find the maximum amount her shoes can weigh so Alia will not be charged a fee.

Step 1 In the bar diagram, write the maximum weight Alia's luggage can be without a fee. Label the weight of Alia's luggage without her shoes.



Kilograms

Step 2 In the bar diagram, write an x beside the bar that represents the weight of Alia's luggage.



Kilograms

The weight of Alia's suitcase plus the weight of her shoes must be less than or equal to the maximum luggage weight.

This can be written as $14 + x \leq 20$.

Using the bar diagram, Alia's shoes cannot weigh more than $20 - 14$ or ____ kilograms.

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Investigate

Collaborate

Work with a partner to solve the following problems.

MP **Reason Inductively** For Exercises 1–3, assume the paper bag is weightless. Write the inequality represented by each balance. Then write the different possible numbers of cubes in the paper bag if the sides of each balance remain unlevel.

1.

Show your work.

Inequality: _____

Number of Cubes: _____

2.

Inequality: _____

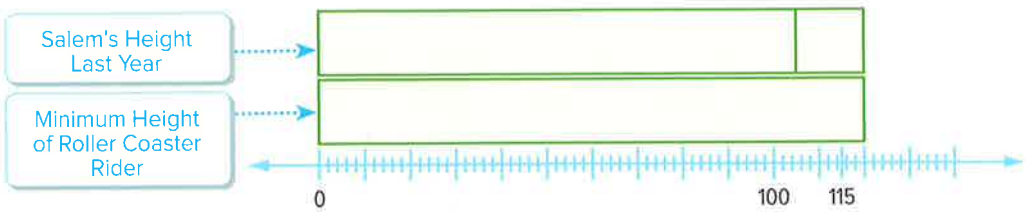
Number of Cubes: _____

3.

Inequality: _____

Number of Cubes: _____

4. MP **Reason Abstractly** At an amusement park, roller coaster riders are required to be at least 120 centimeters tall. Last year, Salem was 105 centimeters tall. Complete the bar diagram to determine the number of centimeters x Salem needed to grow this year to be able to ride the roller coaster. Then write an inequality to represent the situation.



So, Salem needed to grow at least _____ centimeters.

Inequality: _____

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Analyze and Reflect

Collaborate

Work with a partner to circle the correct inequality for each situation. The first one is done for you.

	Real-World Situation	Inequalities	
	Fawzia wants to score at least 84% on the next history test.	$x \leq 84$	$x \geq 84$
5.	To see a certain movie, you must be at least 13 years old.	$n \leq 13$	$n \geq 13$
6.	Rana has AED 4.99 left on a music download gift card. She has a download costing AED 1.99 in her online shopping cart. How much money does Rana have left to spend?	$x + 1.99 \leq 4.99$	$x + 1.99 > 4.99$
7.	In some countries, teens must be at least 18 years old to obtain a driver's license.	$x < 18$ $x \leq 18$	$x > 18$ $x \geq 18$
8.	Khamis' family budgets a maximum amount of AED 125 per week for groceries. Mr. Khamis already spent AED 40. How much more can Khamis' family spend on groceries?	$x + 40 < 125$ $x + 40 \leq 125$	$x + 40 > 125$ $x + 40 \geq 125$
9.	Sultan pays AED 30 for a ticket to an amusement park. He cannot spend more than AED 150. How much more money can Sultan spend at the amusement park?	$x + 30 < 150$ $x + 30 \leq 150$	$x + 30 > 150$ $x + 30 \geq 150$

Create

On Your Own

10. MP **Model with Mathematics** Write a real-world situation that could be represented by $x + 20 \geq 50$.

11. Inquiry HOW is an inequality like an equation? How is it different?

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Lesson 6

Solve Inequalities by Addition or Subtraction

Real-World Link

Mail A first class stamp can be used for letters and packages weighing 360 grams or less. Rasheed is mailing pictures to his grandmother, and only has a first class stamp. His envelope weighs 60 grams. Follow the steps to determine how much the pictures can weigh so that Rasheed can use the stamp.

Step 1 Let x represent the weight of the pictures. Write and solve an equation to find the maximum weight of the pictures.

weight of the envelope		weight of the pictures		maximum weight of the package
☐	+	x	=	☐

Solve for x.

So, the maximum weight of the pictures is ☐ ounces.

Step 2 Replace the equals sign in your equation with the less than or equal to symbol, ≤.

$60 + x$ ☐ 360

Refer to Step 2. Name three possible values of x that will result in a true sentence.

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Essential Question

WHAT does it mean to say two quantities are equal?

Vocabulary

Subtraction Property of Inequality
Addition Property of Inequality
inequality

MP Mathematical Practices
1, 2, 3, 4

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Key Concept

Solve Inequalities

Words You can solve inequalities by using the **Addition Property of Inequalities** and the **Subtraction Property of Inequalities**. When you add or subtract the same number from each side of an inequality, the inequality remains true.

Symbols For all numbers a, b, and c,

1. if $a > b$, then $a + c > b + c$ and $a - c > b - c$.
2. if $a < b$, then $a + c < b + c$ and $a - c < b - c$.

Examples

$$\begin{array}{r} 2 < 4 \\ +3 \quad +3 \\ \hline 5 < 7 \end{array} \qquad \begin{array}{r} 6 > 3 \\ -4 \quad -4 \\ \hline 2 > -1 \end{array}$$

Work Zone

An **inequality** is a mathematical sentence that compares quantities. Solving an inequality means finding values for the variable that make the inequality true.

The table below gives some examples of the words you might use when describing different inequalities.

Inequalities				
Words	• is less than • is fewer than	• is greater than • is more than • exceeds	• is less than or equal to • is no more than • is at most	• is greater than or equal to • is no less than • is at least
Symbols	$<$	$>$	$\leq$	$\geq$

Examples

1. **Solve $x + 3 > 10$.**

$$\begin{array}{rl} x + 3 > 10 & \text{Write the inequality.} \\ -3 \quad -3 & \text{Subtract 3 from each side.} \\ x > 7 & \text{Simplify.} \end{array}$$

Therefore, the solution is $x > 7$.

You can check this solution by substituting a number greater than 7 into the original inequality. Try using 8.

Check

$$\begin{array}{rl} x + 3 > 10 & \text{Write the inequality.} \\ 8 + 3 \stackrel{?}{>} 10 & \text{Replace } x \text{ with 8. Is this sentence true?} \\ 11 > 10 & \text{This is a true statement. } \checkmark \end{array}$$

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2. **Solve $-6 \geq n - 5$.**

$-6 \geq n - 5$ Write the inequality.

$+5 \quad +5$ Add 5 to each side.

$-1 \geq n$ Simplify.

The solution is $-1 \geq n$ or $n \leq -1$.

You can check this solution by substituting -1 or a number less than -1 into the original inequality.

Show your work.

Got it? **Do these problems to find out.**

Solve each inequality.

a. $a - 3 < 8$

b. $0.4 + y \geq 7$

a. _____

b. _____

Example

3. **Solve $a + \frac{1}{2} < 2$. Graph the solution set on a number line.**

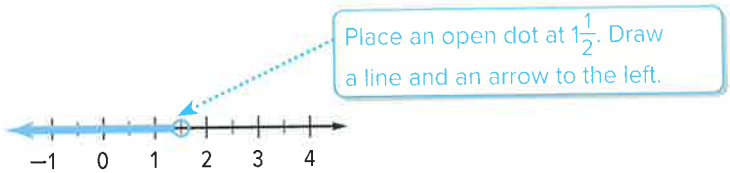
$a + \frac{1}{2} < 2$ Write the inequality.

$-\frac{1}{2} \quad -\frac{1}{2}$ Subtract $\frac{1}{2}$ from each side.

$a < 1\frac{1}{2}$ Simplify.

The solution is $a < 1\frac{1}{2}$. Check your solution.

Graph the solution.



Open and Closed Dots

When graphing inequalities, an open dot is used when the value should not be included in the solution, as with > and < inequalities. A closed dot indicates the value is included in the solution, as with ≤ and ≥ inequalities.

Got it? **Do these problems to find out.**

Solve each inequality. Graph the solution set on the number line provided.

c. $h + 4 > 4$

d. $x - 6 \leq 4$

c. _____

d. _____

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Write Inequalities

Inequalities can be used to represent real-world situations. You will want to first identify a variable to represent the unknown value.

Example

4. **Saleh has AED 60 to ride go-karts and play games at the city fair. Suppose the go-karts cost AED 15.50. Write and solve an inequality to find the most he can spend on games.**

Words	Cost of go-kart	plus	cost of games	must be less than or equal to	total amount.
Symbols	Let x = the cost of the games.				
Inequality	15.50	+	x	$\leq$	60

$15.5 + x \leq 60$ Write the inequality. (15.50 = 15.5)

$-15.5 \quad -15.5$ Subtract 15.5 from each side.

$x \leq 44.5$ Simplify.

So, the most Saleh can spend on games is AED 44.50.

Guided Practice

Solve each inequality. Graph the solution set on a number line. (Examples 1–3)

1. $6 + h \geq 12$

2. $14 + t > 5$

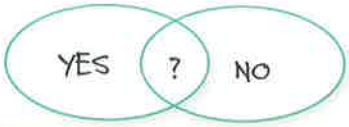
Show your work.

3. An elevator can hold 1,300 kilograms or less. Write and solve an inequality that describes how much more weight the elevator can hold if it is currently holding 1,100 kilograms. Interpret the solution. (Example 4)

4. **Building on the Essential Question** Explain when you would use addition and when you would use subtraction to solve an inequality.

Rate Yourself!

Are you ready to move on? Shade the section that applies.



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Name _____ My Homework _____

Independent Practice

Solve each inequality. (Examples 1 and 2)

1. $h - 16 \leq -24$ _____

Show your work.

2. $y + 6 \geq -13$ _____

3 **3.** $-3 < n - 8$ _____

4. $3 \leq m + 1.4$ _____

5. $x + 0.7 > -0.3$ _____

6. $w - 8 \geq 5.6$ _____

Solve each inequality. Graph the solution set on a number line. (Example 3)

7. $m + 5 \geq -1$ _____

8. $-11 > t + 7$ _____

MP **Reason Abstractly** **Write an inequality and solve each problem. For Exercises 11 and 12, interpret the solution.** (Example 4)

9 **9.** Four more than a number is more than 13.

Inequality: _____

Solution: _____

10. The sum of a number and 19 is at least 8.2.

Inequality: _____

Solution: _____

11. The high soccer team can have no more than 26 players. Write and solve an inequality to determine how many more players can make the team if the coach has already chosen 17 players.

Inequality: _____ Solution: _____

Interpretation: _____

12. Bilal has 1,500 minutes per month on his cell phone plan. How many more minutes can he use if he has already talked for 785 minutes?

Inequality: _____ Solution: _____

Interpretation: _____

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13. Refer to the diagram below.

a. A hurricane has winds that are at least 120 kilometers per hour. Suppose a tropical storm has winds that are 70 kilometers per hour. Write and solve an inequality to find how much the winds must increase before the storm becomes a hurricane.

Inequality: _____ Solution: _____

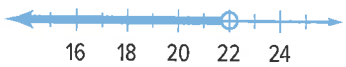
b. A *major storm* has wind speeds that are at least 180 kilometers per hour. Write and solve an inequality that describes how much greater these wind speeds are than the slowest hurricane.

Inequality: _____ Solution: _____

H.O.T. Problems Higher Order Thinking

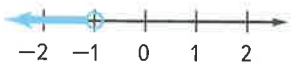
14. MP **Reason Inductively** Compare and contrast the solutions of $a - 3 = 15$ and $a - 3 \geq 15$. _____

15. MP **Model with Mathematics** Write an addition inequality for the solution set graphed below.



16. MP **Persevere with Problems** Solve $x + b > c$ for x.

17. MP **Reason Inductively** Does the graph shown at the right show the solution set of the inequality $x + 3 \geq 2$? If not, explain how you would change the graph to show the actual solution set.



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Name _____ My Homework _____

Extra Practice

Solve each inequality.

18. $10 < b - 8$ $18 < b$

Homework Help

$10 < b - 8$

$+8 \quad +8$

$18 < b$

19. $1.2 + m \leq 5.5$ _____

20. $c - 1\frac{1}{4} > -2\frac{1}{2}$ _____

MP Model with Mathematics **Solve each inequality. Graph the solution set on a number line.**

21. $-21 < a - 16$ _____

22. $t - 6.2 < 4$ _____

Write an inequality and solve each problem.

23. Eight less than a number is less than 10.

Inequality: _____

Solution: _____

24. The difference between a number and $21\frac{1}{2}$ is no more than $14\frac{1}{4}$.

Inequality: _____

Solution: _____

25. There were a total of 125 cars at a car dealership. A salesperson sold 68 of the cars in one month. Write and solve an inequality that describes how many more cars, at most, the salesman has left to sell. Interpret the solution.

Inequality: _____ Solution: _____

Interpretation: _____

Copy and Solve **Solve each inequality. Graph the solution set on a number line. Show your work on a separate sheet of paper.**

26. $n - \frac{1}{5} \leq \frac{3}{10}$

27. $6 > x + 3\frac{1}{3}$

28. $c + 1\frac{1}{4} < 5$

29. $9 \leq m - 2\frac{1}{5}$

30. $\frac{3}{4} + d > 4\frac{1}{2}$

31. $-\frac{7}{8} \leq n + 3\frac{5}{16}$

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Power Up! Test Practice

32. Zayed can send up to 250 text messages each month. So far this month, he has sent 141 text messages. Let t represent the number of text messages Zayed can send during the rest of the month.

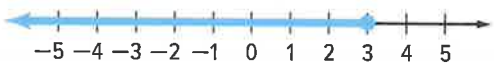
Write an inequality to model the situation

Solve the inequality for t.

Graph the solution on the number line.

Interpret the solution to the inequality. Explain your reasoning.

33. Which inequality has the solution set shown in the number line below? Select all that apply.



- ☐ $x + 4 \leq 7$
- ☐ $12 > x + 9$
- ☐ $x + 1 \leq 2$
- ☐ $-7 \geq x - 10$

Spiral Review

Solve each equation. Then graph each solution on the number line below.

34. $x + 2 = 1$

35. $x - 1 = -5$

36. $2x = 10$

37. $-2x = 4$

38. $\frac{x}{2} = 1$

39. $\frac{x}{-2} = 3$

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Lesson 7

Solve Inequalities by Multiplication or Division

Real-World Link

Science An astronaut in a space suit weighs about 132 kilograms on Earth, but only 22 kilograms on the Moon.

weight on Earth		weight on Moon
132 kg	>	22 kg

1. If the astronaut and space suit each weighed half as much, would the inequality still be true?

$$\frac{132}{2} > \frac{22}{2}$$ Divide each side by 2.

$$\square > \square$$

Is the inequality still true? Circle yes or no.

Yes No

2. Is the weight of one astronaut greater on Pluto or Earth? Would the weight of 5 astronauts be greater on Pluto or on Earth? Explain by using an inequality.

Location	Weight of Astronaut (kg)
Earth	132
Moon	22
Pluto	30
Jupiter	360

3. Is the weight of one astronaut greater on Jupiter or on Earth? Would the weight of 5 astronauts be greater on Jupiter or on Earth? Explain by using an inequality.

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Essential Question

WHAT does it mean to say two quantities are equal?

Vocabulary

Multiplication Property of Inequality

Division Property of Inequality

MP Mathematical Practices

1, 2, 3, 4, 7

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Key Concept

Multiplication and Division Properties of Inequality, Positive Number

Words The **Multiplication Property of Inequality** and the **Division Property of Inequality** state that an inequality remains true when you multiply or divide each side of an inequality by a positive number.

Symbols For all numbers a, b, and c, where $c > 0$,

1. if $a > b$, then $ac > bc$ and $\frac{a}{c} > \frac{b}{c}$.
2. if $a < b$, then $ac < bc$ and $\frac{a}{c} < \frac{b}{c}$.

These properties are also true for $a \geq b$ and $a \leq b$.

Work Zone

STOP **and Reflect**

What does the inequality $c > 0$ mean? Explain below.

You can solve inequalities by using the Multiplication Property of Inequality and the Division Property of Inequality.

Examples

1. **Solve $8x \leq 40$.**

$8x \leq 40$ Write the inequality.

$\frac{8x}{8} \leq \frac{40}{8}$ Divide each side by 8.

$x \leq 5$ Simplify.

The solution is $x \leq 5$. You can check this solution by substituting 5 or a number less than 5 into the inequality.

2. **Solve $\frac{d}{2} > 7$.**

$\frac{d}{2} > 7$ Write the inequality.

$2\left(\frac{d}{2}\right) > 2(7)$ Multiply each side by 2.

$d > 14$ Simplify.

The solution is $d > 14$. You can check this solution by substituting a number greater than 14 into the inequality.

Got it? **Do these problems to find out.**

a. $4x < 40$

b. $6 \geq \frac{x}{7}$

Show your work.

a. _____

b. _____

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Multiplication and Division Properties of Inequality, Negative Number

Key Concept

Words When you multiply or divide each side of an inequality by a negative number, the inequality symbol must be reversed for the inequality to remain true.

Symbols For all numbers a, b, and c, where $c < 0$,

1. if $a > b$, then $ac < bc$ and $\frac{a}{c} < \frac{b}{c}$.
2. if $a < b$, then $ac > bc$ and $\frac{a}{c} > \frac{b}{c}$.

Examples

$7 > 1$

$-2(7) < -2(1)$ Reverse the symbols.

$-14 < -2$

$-4 < 16$

$\frac{-4}{-4} > \frac{16}{-4}$

$1 > -4$

These properties are also true for $a \geq b$ and $a \leq b$.

STOP and Reflect

What does the inequality $c < 0$ mean? Expain below.

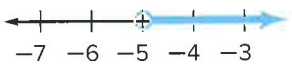
Examples

3. **Solve $-2g < 10$. Graph the solution set on a number line.**

$-2g < 10$ Write the inequality.

$\frac{-2g}{-2} > \frac{10}{-2}$ Divide each side by -2 and reverse the symbol.

$g > -5$ Simplify.

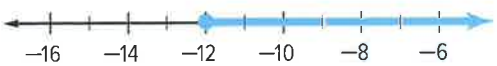


4. **Solve $\frac{x}{-3} \leq 4$. Graph the solution set on a number line.**

$\frac{x}{-3} \leq 4$ Write the inequality.

$-3\left(\frac{x}{-3}\right) \geq -3(4)$ Multiply each side by -3 and reverse the symbol.

$x \geq -12$ Simplify.



Got it? **Do these problems to find out.**

c. $\frac{k}{-2} < 9$

c. _____

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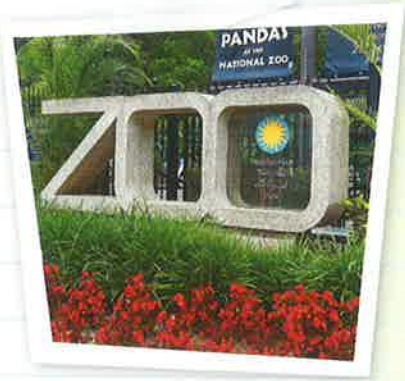

Example

5. **Omar earns AED 8 per hour working at the zoo. Write and solve an inequality that can be used to find how many hours he must work in a week to earn at least AED 120. Interpret the solution.**

Words	Amount earned per hour	times	number of hours	is at least	amount earned each week.
Variable	Let x represent the number of hours.					
Inequality	8	•	x	$\geq$	120	

$8x \geq 120$ Write the inequality.

$\frac{8x}{8} \geq \frac{120}{8}$ Divide each side by 8.

$x \geq 15$ Simplify.

So, Omar must work at least 15 hours.

Guided Practice

Solve each inequality. Graph the solution set on a number line. (Examples 1–4)

1. $-3n \leq -22$

2. $\frac{t}{-4} < -11$

3. At a baseball game you can get a sandwich for AED 2. You have AED 10 to spend. Write and solve an inequality to find the number of sandwiches you can buy. Interpret the solution. (Example 5)

4. **Building on the Essential Question** Explain when you should reverse the inequality symbol when solving an inequality.

Rate Yourself!

How confident are you about solving multiplication and division inequalities? Check the box that applies.

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Name _____ My Homework _____

Independent Practice

Solve each inequality. (Examples 1 and 2)

1. $6y < 18$ _____

Show your work.

2. $-3s \geq 33$ _____

3 $60 \leq \frac{m}{3}$ _____

4. $\frac{t}{-2} < 6$ _____

5. $\frac{m}{-14} \leq -4$ _____

6. $-56 \leq -8x$ _____

7. $12n \leq 54$ _____

8. $\frac{h}{9} > \frac{1}{4}$ _____

9. $\frac{w}{-5} \geq 9$ _____

Solve each inequality. Graph the solution set on a number line. (Examples 3 and 4)

10. $4x \geq 36$ _____

11 $20 < 5t$ _____

12. $\frac{s}{-6} > -16$ _____

13. $\frac{x}{-4} \geq 8$ _____

14. A pool charges AED 20 each visit, or you can buy a membership. Write and solve an inequality to find how many times a person should use the pool so that a membership is less expensive than paying each time. Interpret the solution. (Example 5)

Inequality: _____ Solution: _____

Interpretation: _____

_____

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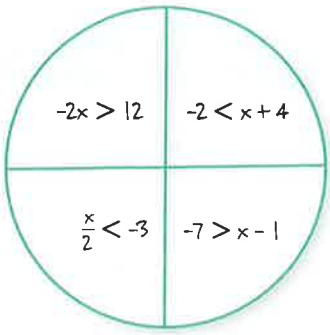
15. MP **Reason Inductively** Cross out the inequality that does not belong in the organizer shown at the right. Then explain your reasoning.



Write an inequality for each sentence. Then solve the inequality.

16. Sixteen is less than eight times a number.

Inequality: _____

Solution: _____

17. The product of a number and five is at the most 30.

Inequality: _____

Solution: _____

H.O.T. Problems Higher Order Thinking

18. MP **Identify Structure** Write two different inequalities that have the solution $y > 6$. One inequality should be solved using multiplication properties, and the other should be solved using division properties.

19. MP **Persevere with Problems** You score 15, 16, 17, 14, and 19 points out of 20 possible points on five tests. What must you score on the sixth test to have an average of at least 16 points?

20. MP **Reason Inductively** The inequalities $3x > 2$ and $9x > 6$ are equivalent inequalities. Write another inequality that is equivalent to $3x > 2$ and $9x > 6$.

21. MP **Persevere with Problems** Consider the inequalities $b \geq 4$ and $b \leq 13$.

a. Graph each inequality on the number line.

b. Do the solution sets of the two inequalities overlap? If so, what does this overlapping area represent?

c. A compound inequality is an inequality that combines two inequalities. Write a compound inequality for the situation.

d. Look back at the graph of the solutions for both inequalities. Make another graph that shows only the solution of the inequality.

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Name _____ My Homework _____

Extra Practice

Solve each inequality.

22. $-10n > -20$ $n < 2$

Homework Help

$\frac{-10n}{-10} < \frac{-20}{-10}$

$n < 2$

23. $-7y < 35$

24. $15 < 3r$

25. $12p \geq -72$

26. $\frac{t}{-7} > 10$

27. $-8 < \frac{y}{5}$

Solve each inequality. Graph the solution set on a number line.

28. $\frac{h}{5} \leq -12$

29. $-3w < -39$

30. $15 < 4x$

31. $10 \leq \frac{t}{-2}$

32. MP **Reason Abstractly** Each game at a carnival costs AED 5, or you can pay AED 150 and play an unlimited amount of games. Write and solve an inequality to find how many times you should play a game so that the unlimited game play is less expensive than paying each time. Interpret the solution.

Inequality: _____ Solution: _____

Interpretation: _____

Write an inequality for each sentence. Then solve the inequality.

33. The product of a number and 4 is at least −12.

Inequality: _____

Solution: _____

34. Five times a number is less than −45.

Inequality: _____

Solution: _____

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Power Up! Test Practice

35. Manal earns AED 7 per hour babysitting. She wants to earn at least AED 105 for a camping trip. Determine if each statement is true or false.

a. The inequality $\frac{h}{7} \geq 105$ models how many hours Manal must babysit to earn at least AED 105. ☐ True ☐ False

b. The inequality $7h \geq 105$ models how many hours Manal must babysit to earn at least AED 105. ☐ True ☐ False

c. Manal must babysit up to 15 hours in order to earn at least AED 105. ☐ True ☐ False

36. Soccer balls cost AED 24 each at Sports Emporium. Coach Amer can spend at most AED 120 on equipment for the soccer team. Let b represent the number of soccer balls Coach Amer can buy.

Write an inequality to model the situation. ☐

Solve the inequality for b. ☐

Graph the solution on the number line.

How many soccer balls can Coach Amer buy? List all of the possible answers.

☐

Spiral Review

Solve each equation. Check your solution.

37. $5k + 6 = 16$

38. $-14 = 2x - 8$

39. $-4n + 3 = 13$

40. $25 = 7m + 4$

41. $10.5 + h = 22.5$

42. $14n - 32 = 22$

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Lesson 8

Solve Two-Step Inequalities

Real-World Link

Newspapers Amani is placing an ad in the local newspaper for a pottery class. The cost of placing an ad is shown in the table.

Service	Cost (AED)
10-day ad with 3 lines	38.00
each additional line	9.00

1. Complete the equation to find the total cost c of an ad with 4 or more lines. Use x as the variable.

cost of a 10-day add with only 3 lines | cost of each additional line | total cost

$\square + \square x = \square$

2. How much will it cost to place the ad if it is 5 lines long?

_____

3. Suppose Amani can spend only AED 50 on the ad. Does she have enough money to place the ad? Circle yes or no.

yes no

If the answer is no, how much more money will Amani need? Explain. _____

_____

Essential Question

WHAT does it mean to say two quantities are equal?

Vocabulary

two-step inequality

MP Mathematical Practices
1, 2, 3, 4, 5

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems
② Reason Abstractly
③ Construct an Argument
④ Model with Mathematics
⑤ Use Math Tools
⑥ Attend to Precision
⑦ Make Use of Structure
⑧ Use Repeated Reasoning

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Work Zone

Solve a Two-Step Inequality

A **two-step inequality** is an inequality that contains two operations. To solve a two-step inequality, use inverse operations to undo each operation in reverse order of the order of operations.

Examples

1. **Solve $3x + 4 \geq 16$. Graph the solution set on a number line.**

$3x + 4 \geq 16$ Write the inequality.

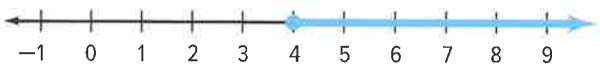
$-4 \quad -4$ Subtract 4 from each side

$3x \geq 12$ Simplify.

$\frac{3x}{3} \geq \frac{12}{3}$ Divide each side by 3.

$x \geq 4$ Simplify.

Graph the solution set.



Draw a closed dot at 4 with an arrow to the right.

2. **Solve $5 + 4x < 33$. Graph the solution set on a number line.**

$5 + 4x < 33$ Write the inequality.

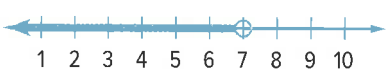
$-5 \quad -5$ Subtract 5 from each side.

$4x < 28$ Simplify.

$\frac{4x}{4} < \frac{28}{4}$ Divide each side by 4.

$x < 7$ Simplify.

Graph the solution set.



Draw an open dot at 7 with an arrow to the left.

Show your work.

Got it? **Do this problem to find out.**

a. _____

a. Solve $2x + 8 > 24$. Graph the solution on the number line provided.

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Examples

3. **Solve $7 - 2x > 11$. Graph the solution set on a number line.**

$7 - 2x > 11$ Write the inequality.

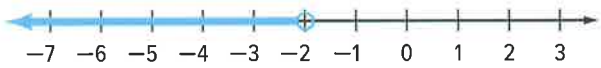
$-7 \quad -7$ Subtract 7 from each side.

$-2x > 4$ Simplify.

$\frac{-2x}{-2} < \frac{4}{-2}$ Divide each side by -2. Reverse inequality symbol.

$x < -2$ Simplify. Check your solution.

Graph the solution set.



Draw an open dot at -2 with an arrow to the left.

You can check the solution by substituting a number less than -2 into the original inequality. Try using -3.

Check $7 - 2x > 11$ Write the inequality.

$7 - 2(-3) \stackrel{?}{>} 11$ Replace x with -3. Is the sentence true?

$13 > 11$ This is a true statement. ✓

4. **Solve $\frac{x}{2} - 5 < -8$. Graph the solution set on a number line.**

$\frac{x}{2} - 5 < -8$ Write the inequality.

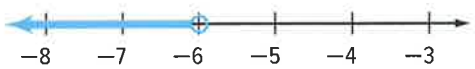
$+5 \quad +5$ Add 5 to each side.

$\frac{x}{2} < -3$ Simplify.

$\frac{x}{2}(2) < -3(2)$ Multiply each side by 2.

$x < -6$ Simplify. Check your solution.

Graph the solution set.



Draw an open dot at -6 with an arrow to the left.

Got it? **Do these problems to find out.**

Solve each inequality. Graph the solution set on the number line provided.

b. $\frac{x}{2} + 9 \geq 5$

c. $8 - \frac{x}{3} \leq 7$

Solving Inequalities

Remember that if multiplying or dividing by a negative number when solving inequalities, reverse the direction of the inequality symbol.

Show your work.

b. _____

c. _____

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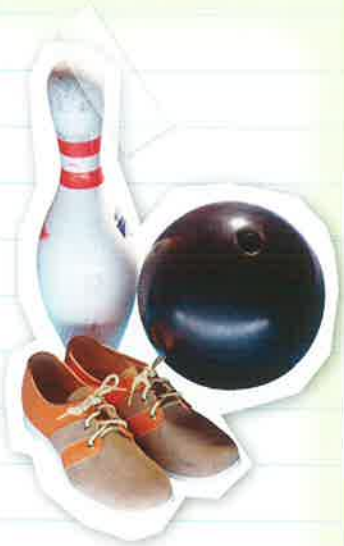

Example

5. **Halfway through the bowling league season, Jamal has 34 strikes. He averages 2 strikes per game. Write and solve an inequality to find how many more games it will take for Jamal to have at least 61 strikes, the league record. Interpret the solution.**

The number of strikes plus two strikes per game is at least 61. Let g represent the number of games he needs to bowl.

$$\begin{aligned} 34 + 2g &\geq 61 && \text{Write the inequality.} \\ -34 \quad & \quad -34 && \text{Subtract 34 from each side.} \\ 2g &\geq 27 && \text{Simplify.} \\ \frac{2g}{2} &\geq \frac{27}{2} && \text{Divide each side by 2.} \\ g &\geq 13.5 && \text{Simplify.} \end{aligned}$$

Jamal should have at least 61 strikes after 14 more games.

Guided Practice

Solve each inequality. Graph the solution set on a number line. (Examples 1–4)

1. $5x - 7 \geq 43 =$

2. $11 \leq 7 + \frac{x}{5}$

3. **Financial Literacy** A rental car company charges AED 50 plus AED 2 per kilometer to rent a car. Mr. Bilal does not want to spend more than AED 500 for his rental car. Write and solve an inequality to find how many kilometers he can drive and not spend more than AED 500. Interpret the solution. (Example 5)

4. **Building on the Essential Question** Compare $2x + 8 > 18$ and $2x + 8 \leq 18$.

Rate Yourself!

How well do you understand solving two-step inequalities? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

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Name _____ My Homework _____

Independent Practice

Solve each inequality. Graph the solution set on a number line. (Examples 1–4)

1. $6x + 14 \geq 20$

Show your work.

2. $4x - 13 < 11$

3 $-20 > -2x + 4$

4. $\frac{x}{13} + 3 \geq 4$

5 Jassim needs at least AED 830 for a new video game system. He has already saved AED 200. He earns AED 30 an hour at his job. Write and solve an inequality to find how many hours he will need to work to buy the system. Interpret the solution. (Example 5)

Inequality: _____ Solution: _____

Interpretation: _____

MP Reason Abstractly **Write and solve an inequality for each sentence.**

6. Three times a number increased by four is less than −62.

7. The quotient of a number and −5 increased by one is at most 7.

8. The quotient of a number and 3 minus two is at least −12.

9. The product of −2 and a number minus six is greater than −18.

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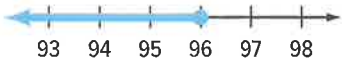
Write a two-step inequality that could be represented by each number line.

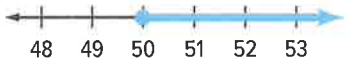
10.

11.

12.



13.



H.O.T. Problems Higher Order Thinking

14. MP **Model with Mathematics** Write a real-world example that could be solved by using the inequality $4x + 8 \geq 32$. Then solve the inequality.

15. MP **Persevere with Problems** In five games, you score 16, 12, 15, 13, and 17 points. Write and solve an inequality to determine how many points you must score in the sixth game to have an average of at least 15 points.

16. MP **Use Math Tools** Solve $-x + 6 > -(2x + 4)$. Then graph the solution set on the number line.

Solution:

17. MP **Model with Mathematics** Write and solve a real-world problem that can be represented by the inequality $4(x - 2.8) \leq 45$.

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Name _____ My Homework _____

Extra Practice

Solve each inequality. Graph the solution set on a number line.

18. $4x - 15 \leq 5$ $x \leq 5$

Homework Help

$4x - 15 \leq 5$
$+15 \quad +15$
$4x \leq 20$
$x \leq 5$

19. $-73 \geq 15 + 11x$ _____

20. $\frac{x}{5} - 2 > 1$ _____

21. $9 \leq \frac{x}{14} + 6$ _____

22. Ayesha is starting a babysitting business. She spent AED 26 to make signs to advertise. She charges an initial fee of AED 5 and then AED 3 for each hour of service. Write and solve an inequality to find the number of hours she will have to babysit to make a profit. Interpret the solution.

Inequality: _____ Solution: _____

Interpretation: _____

23. MP **Reason Abstractly** As a salesperson, Ahmed earns AED 550 per week plus AED 30 per sale. This week, he wants his pay to be at least AED 850. Write and solve an inequality for the number of sales Ahmed needs to make. Interpret the solution.

Inequality: _____ Solution: _____

Interpretation: _____

24. Jamal and his sister went to the movies. They had AED 34 altogether and spent AED 9.50 per ticket. Jamal and his sister bought the same snacks. Write and solve an inequality for the amount that each person spent on snacks. Interpret the solution.

Inequality: _____ Solution: _____

Interpretation: _____

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Power Up! Test Practice

25. Which of the following are operations that you should use to solve $-2x - 5 < 7$ for x? Select all that apply.

- ☐ Subtract 7 from both sides.
- ☐ Add 5 to both sides.
- ☐ Divide both sides by -2.
- ☐ Reverse the inequality symbol.

26. The table shows the cost of renting a jet ski.

Rental Period	Cost (AED)
First hour	AED 55
Each additional 15-minutes	AED 10

Abdalla can spend no more than AED 105 on a jet ski rental. Let x represent the number of additional 15-minute increments. Fill in each box to write an inequality to represent the situation.

☐ + ☐ ≤ ☐

$10x$	10
$55x$	55
$105x$	105
<	≤
>	≥

What is the greatest length of time Abdalla can rent the jet ski?

☐

Spiral Review

Solve and graph each inequality.

27. $n + 1 > -2$

Solution: _____

28. $-2y > 12$

Solution: _____

29. $\frac{t}{-1} > -2$

Solution: _____

Solve each equation. Check your solution.

30. $5y + 6 = 46$ _____

31. $-4k - 1 = 47$ _____

32. $5 = 8m + 1$ _____

33. Ali's dad is 30 years of age. He is 2 years more than four times Ali's age m. Write and solve a two-step equation to determine Ali's age.

Equation: _____ Solution: _____

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21ST CENTURY CAREER in Veterinary Medicine

Veterinary Technician

If you love being around animals, enjoy working with your hands, and are good at analyzing problems, a challenging career in veterinary medicine might be a perfect fit for you. Veterinary technicians help veterinarians by helping to diagnose and treat medical conditions. They may work in private clinics, animal hospitals, zoos, aquariums, or wildlife rehabilitation centers.

Is This the Career for You?

Are you interested in a career as a veterinary technician? Take some of the following courses in high school.

- Algebra
- Animal Science
- Biology
- Chemistry
- Veterinary Assisting

Find out how math relates to a career in Veterinary Medicine.

MP Vet Techs Don't Monkey Around

For each problem, use the information in the tables to write an equation. Then solve the equation.

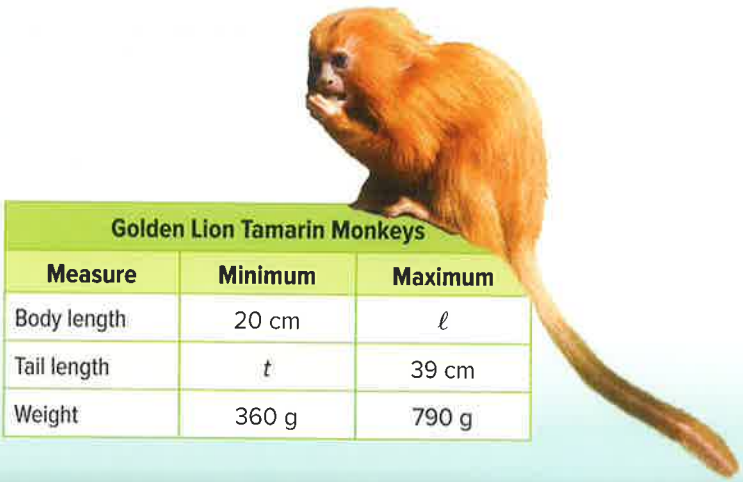
1. The minimum tail length of an emperor tamarin is 4 centimeters greater than that of a golden lion tamarin. What is the minimum tail length of a golden lion tamarin?

2. The minimum body length of a golden lion tamarin is 8.5 centimeters less than the maximum body length. What is the maximum body length?

3. Tamarins live an average of 15 years. This is 13 years less than the years that one tamarin in captivity lived. How long did the tamarin in captivity live?

4. The maximum weight of a golden lion tamarin is about 1.97 times the maximum weight of an emperor tamarin. What is the maximum weight of an emperor tamarin? Round to the nearest tenth.

5. For an emperor tamarin, the maximum total length, including the body and tail, is 67.5 centimeters. What is the maximum body length of an emperor tamarin?



Golden Lion Tamarin Monkeys		
Measure	**Minimum**	**Maximum**
Body length	20 cm	ℓ
Tail length	t	39 cm
Weight	360 g	790 g

Emperor Tamarin Monkeys		
Measure	**Minimum**	**Maximum**
Body length	23 cm	b
Tail length	35 cm	42 cm
Weight	303 g	w

MP Career Project

It's time to update your career portfolio! Go online and research a career as a veterinary technician. Include brief descriptions of the work environment, education and training requirements, and the job outlook.

Do you think you would enjoy a career as a veterinary technician? Why or why not?

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Chapter Review

Vocabulary Check

Unscramble each of the clue words.

TOW-SETP

7

PYORERPT

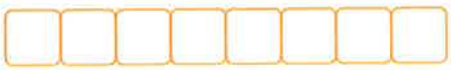
8

DODTIINA

6

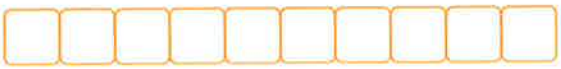
NIIOSDIV

LABVIERA



5

AILEYQUITN



2

BISTAUTORNC

3

NUATIEQO

1

TIULINTICPOLMA

4

Use the numbered letters to find another vocabulary term from this chapter.

1 2 3 4 5 6 7 8

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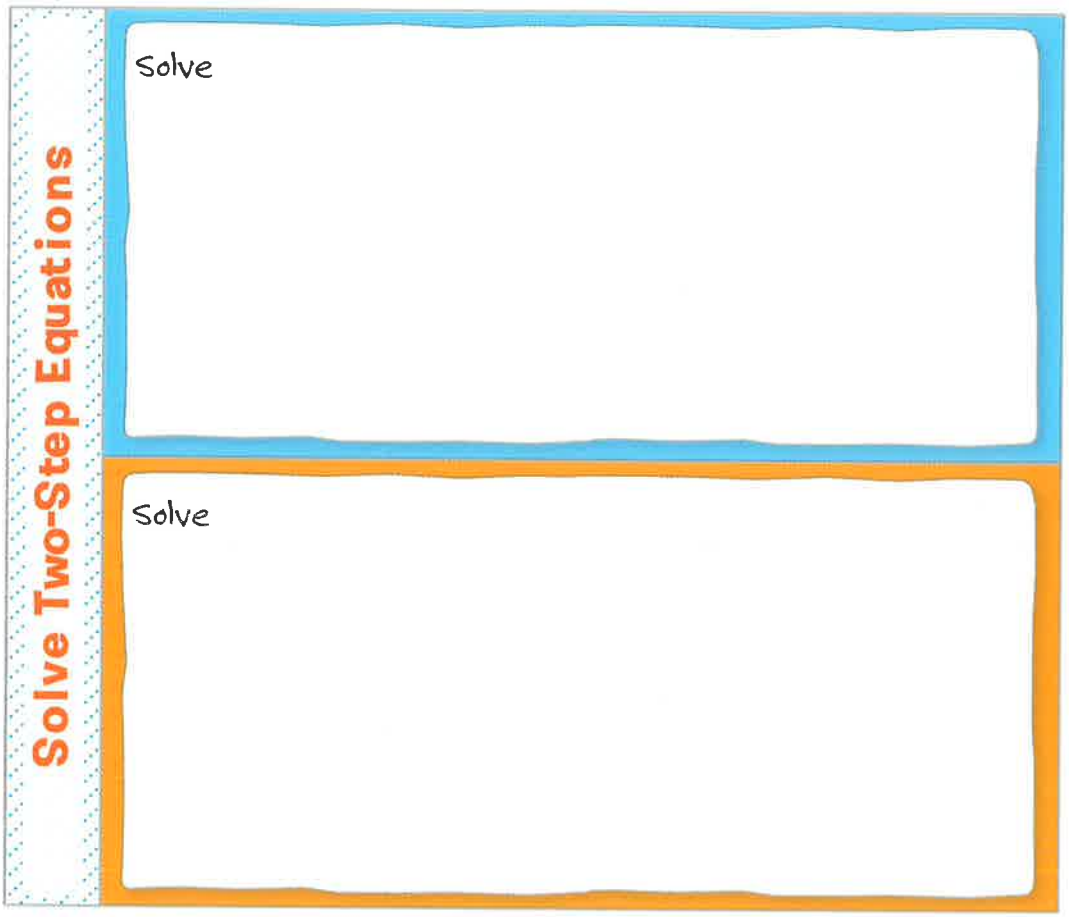
Key Concept Check

Use Your FOLDABLES

Use your Foldable to help review the chapter.

Tape here



Got it?

Match each phrase with the correct term.

1. the value of a variable that makes an equation true
2. the numerical factor in a multiplication expression
3. equations that have the same solution
4. a sentence stating that two quantities are equal

a. equivalent equations

b. equation

c. Addition Property of Equality

d. coefficient

e. formula

f. solution

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Power Up! Performance Task

Fall Reading

Hareb's English teacher assigned a book to be read by October 31st. The students may select a book from the table, and Hareb chose *City Streets*.

Book	Number of Pages
City Streets	387
Life and Time	411
Myopia	435

Write your answers on another piece of paper. Show all of your work to receive full credit.

Part A

By October 19th, Hareb had read 35 pages. Starting on October 20th, he decides to read the same number of pages each day until he finishes the book on October 30th. Write and solve an equation to represent the situation. Let p represent the number of pages read per day. How many pages does Hareb read per day?

Part B

Hareb's friend, Bilal, selected *Myopia*. He read eight pages in class on October 19th and begins reading again on October 23rd. He needs to read at least 350 pages by the end of the day on October 28th. Write and solve an inequality to represent this situation and graph the solution on a number line. Let p represent the number of pages read per day. How many pages must Bilal read per day to accomplish his goal?

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Reflect

Answering the Essential Question

Use what you learned about equations and inequalities to complete the graphic organizer.

When do you use an equals sign?

Essential Question

WHAT does it mean to say two quantities are equal?

When do you use an inequality symbol?

Answer the Essential Question. WHAT does it mean to say two quantities are equal?

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UNIT PROJECT

Stand Up and Be Counted The UAE Census is used to determine the number of Federal National Council members that each emirate is assigned. In this project you will:

- **Collaborate** with your classmates as you research Census data and the Federal National Council.
- **Share** the results of your research in a creative way.
- **Reflect** on how you can communicate mathematical ideas effectively.

Collaborate

Go Online Work with your group to research and complete each activity. You will use your results in the Share section on the following page.

1. Explore the official UAE Census web site to find the 2010 emirate populations. There will be interactive maps that display this information. Write down a few facts you find interesting.

2. Create a table that displays the population and the number of Federal National Council members for your emirate and three other emirates. Then create a line plot for the number of Federal National Council members.

3. Write an equation that uses any emirate's population x and its number of Federal National Council members y to describes the number of people per Federal National Council *member*.

4. Use your equation from Exercise 3 to determine the approximate number of people per Federal National Council member for the four states you chose. Interpret the results.

5. Look at the 2000 and 2010 census. How did the population of your emirate and emirates in your region change? Did the population change affect the number of Federal National Council members assigned?

6. Emirates can be categorized by population size and density. Write at least two inequalities that compare the emirates using these categories.

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Share

Collaborate

With your group, decide on a way to share what you have learned about the U.S. House of Representatives and state populations. Some suggestions are listed below, but you can also think of other creative ways to present your information. Remember to show how you used mathematics to complete each of the activities in this project!

- Act as a Census representative and create a presentation to encourage people to participate in the census and explain why it is important.
- Write a letter or email to your Representative about what you learned in this project and how it can be used to improve your community.

Check out the note on the right to connect this project with other subjects.

Connect with Social Studies

Civic Literacy Research the Electoral College. Some questions to consider are:

- Why was it established?
- What is the relationship between the United States House of Representatives and the Electoral College?

Reflect

On Your Own

7. **Answer the Essential Question** How can you communicate mathematical ideas effectively?

   a. How did you use what you learned about expressions to help you communicate mathematical ideas effectively in this project?

   b. How did you use what you learned about equations and inequalities to help you communicate mathematical ideas effectively in this project?

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UNIT 4
Geometry

Essential Question

HOW can you use different measurements to solve real-life problems?

Chapter 7
Geometric Figures

Geometric shapes can be drawn freehand, with a ruler and protractor, or using technology. In this chapter, you will draw two- and three-dimensional figures. You will also solve problems involving scale drawings of geometric figures.

Chapter 8
Measure Figures

Real-life problems involving area, surface area, and volume can be solved by using formulas. In this chapter, you will use formulas to find the area and circumference of a circle and to find the surface area and volume of prisms and pyramids.

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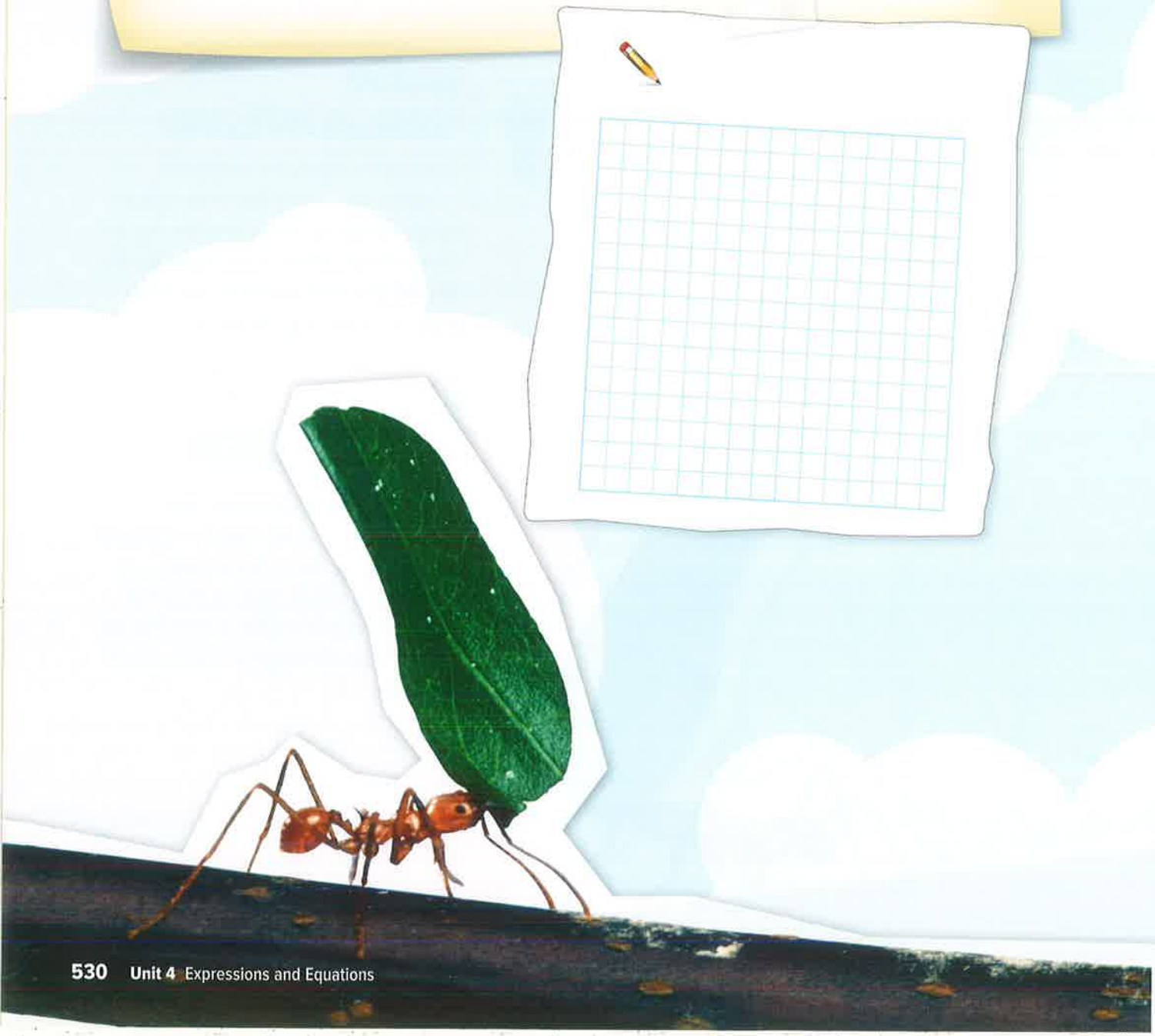
Collaborate

Unit Project Preview

Turn Over a New Leaf Leaves serve an important purpose for plants and trees, and there are scientific reasons why they are flat.

Make a sketch of a leaf. Estimate the area of the leaf in square units.

At the end of Chapter 8, you'll complete a project to investigate the relationship between the volume and surface area of a leaf. So, put on your hiking shoes, and don't forget to bring along your measuring tools. You're about to go on a nature hike!



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Chapter 7
Geometric Figures

Essential Question

HOW does geometry help us describe real-world objects?

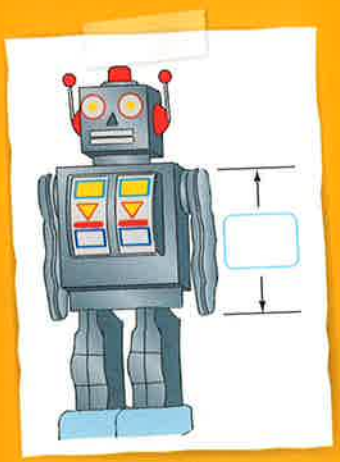
MP Mathematical Practices

1, 2, 3, 4, 5, 6, 7, 8

Math in the Real World

Robots that could be programmed and digitally operated were invented by George Devol in 1954.

The actual length of the robot's arm is 45 centimeters. A drawing of the robot is $\frac{1}{5}$ the size of the actual robot. Fill in the blank below with the correct measurement for the robot's arm.



FOLDABLES® Study Organizer

1. Cut out the Foldable on from end of book.
2. Place your Foldable at the end of the chapter.
3. Use the Foldable throughout this chapter to help you learn about geometric figures.

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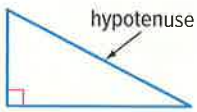
What Tools Do You Need?

Vocabulary

acute angle	diagonal	right triangle
acute triangle	edge	scale
adjacent angles	equilateral triangle	scale drawing
base	face	scale factor
complementary angles	isosceles triangle	scale model
cone	obtuse angle	scalene triangle
congruent	obtuse triangle	skew line
congruent segments	plane	straight angle
coplanar	polyhedron	supplementary angles
cross section	prism	triangle
cylinder	pyramid	vertex
	right angle	vertical angles

Study Skill: Reading Math

The Language of Mathematics Many of the words you use in math and science are also used in everyday language, such as the leg of a person and the leg of a right triangle.

Usage	Example
Some words are used in science and in mathematics, but the meanings are different.	$x + 4 = -2$ $x = -6$ solution 
Some words are used only in mathematics.	

Explain how the everyday meaning of *face* is different than its mathematical meaning.

Everyday meaning: _____

Mathematical meaning: _____

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What Do You Already Know?

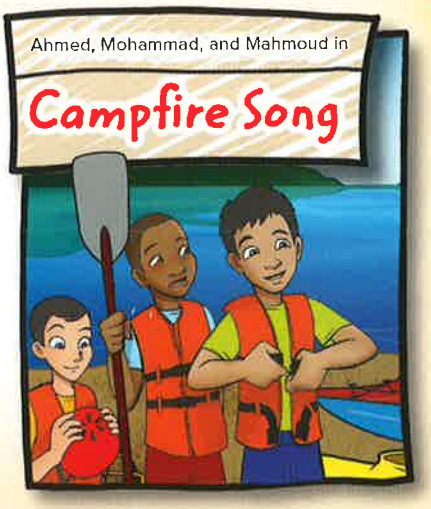
Read each statement. Decide whether you agree (A) or disagree (D). Place a checkmark in the appropriate column and then justify your reasoning.

Geometric Figures			
Statement	A	D	Why?
The common endpoint shared by the two sides of an angle is called the origin.			
A pair of adjacent supplementary angles forms a right angle.			
The sum of the measures of the angles in any triangle is 180°.			
A scale drawing/model represents an object that is too large or too small to be drawn at actual size.			
An isosceles triangle has three congruent sides.			
A cylinder has two parallel congruent circular bases.			

When Will You Use This?

Here are a few examples of how scale drawings are used in the real world.

Activity Use the Internet to find a map of the area where you live. Find the map distance, in centimeters, between your school and your home. Describe a method you could use to find the actual distance once you know the map distance.



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Are You Ready?

Try the Quick Check below. Check

Quick Review

Review

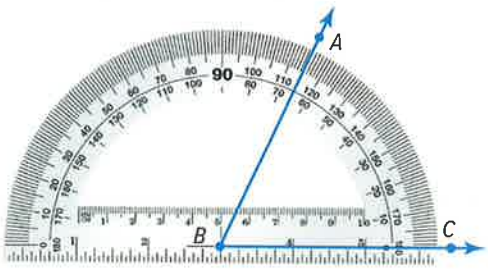
Example 1

Use a protractor to measure angle *ABC*.

Align the center of the protractor with the vertex of the angle.

Make sure one ray of the angle passes through zero on the protractor.

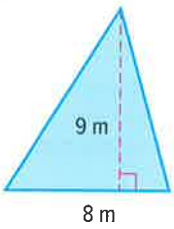
Read the measure on the protractor where the other ray crosses the protractor.



The angle measures 65°.

Example 2

Find the area of the triangle.



$A = \frac{1}{2}bh$ Area of a triangle

$A = \frac{1}{2}(8 \cdot 9)$ Replace b with 8 and h with 9.

$A = 36$ Simplify.

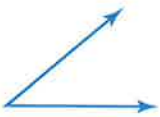
The area of the triangle is 36 square meters.

Quick Check

Angle Measures **Use a protractor to measure each angle.**

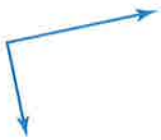
1.

Show your work.



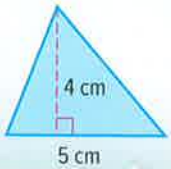
2.

3.



Area **Find the area of each triangle.**

4.



5. base: 3.2 m
height: 4.2 m

How Did You Do?

Which problems did you answer correctly in the Quick Check? Shade those exercise numbers below.

1 2 3 4 5

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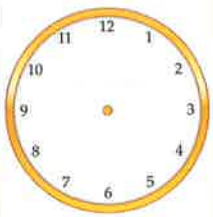
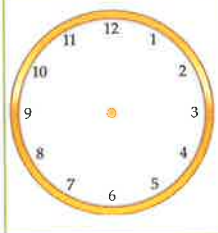
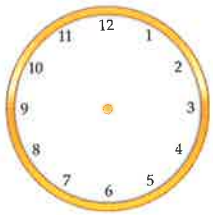
Lesson 1
Classify Angles

Vocabulary Start-Up

An angle is formed by two rays that share a common endpoint. The **vertex** is the point where the two rays meet.

Complete the table by drawing the hands of a clock to represent each angle.

Type of Angle			
Right	**Acute**	**Obtuse**	**Straight**
exactly 90°	less than 90°	greater than 90°	exactly 180°
			

Essential Question

HOW does geometry help us describe real-world objects?

Vocabulary

vertex
right angle
acute angle
obtuse angle
straight angle
vertical angles
congruent
adjacent angles

Math Symbols

$\angle$
$\cong$

Mathematical Practices

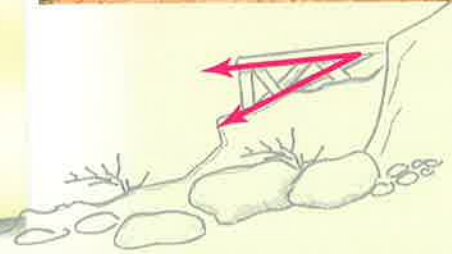
1, 3, 4, 7

Real-World Link

The angle formed by a bike ramp is shown.

1. What type of angle is formed?

2. Estimate the measure of the angle.



Which **Mathematical Practices** did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

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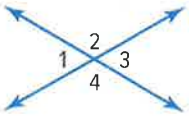
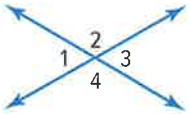
Key Concept

Name and Identify Angles

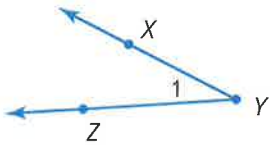
Words	Models	Symbols
Two angles are **vertical** if they are opposite angles formed by the intersection of two lines. Vertical angles are **congruent** or have the same measure.	 ∠1 and ∠3, ∠2 and ∠4	∠1 ≅ ∠3 ∠2 ≅ ∠4
Two angles are **adjacent** if they share a common vertex, a common side, and do not overlap.		Adjacent angle pairs are ∠1 and ∠2, ∠2 and ∠3, ∠3 and ∠4, and ∠4 and ∠1.

Work Zone

You can name an angle by its vertex and by its points.

Example

1. **Name the angle shown at the right. Then classify it as *acute, right, obtuse,* or *straight*.**



- Use the vertex as the middle letter and a point from each side, ∠*XYZ* or ∠*ZYX*.
- Use the vertex only, ∠*Y*.
- Use a number, ∠1.

Since the angle is less than 90°, it is an acute angle.

Symbols
The symbol for angle is ∠.
The symbol ≅ means is congruent to.

Show your work.

Got it? **Do these problems to find out.**

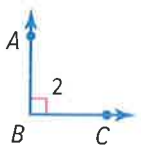
Name each angle in four ways. Then classify each angle as *acute, right, obtuse,* or *straight*.

a. _____

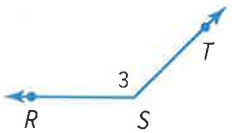
b. _____

c. _____

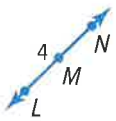
a.



b.



c.



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Example

2. **Identify a pair of vertical angles and adjacent angles in the diagram at the right. Justify your response.**

Since ∠2 and ∠4 are opposite angles formed by the intersection of two lines, they are vertical angles.

Since ∠1 and ∠2 share a common side and vertex, and they do not overlap, they are adjacent angles.

Got it? **Do this problem to find out.**

Show your work.

d. Refer to the diagram in Example 2. Identify different pairs of vertical and adjacent angles. Justify your response.

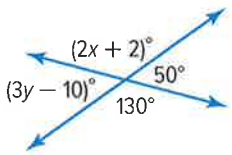
d. _____

Find a Missing Measure

You can use what you learned about vertical and adjacent angles to find the value of a missing measure.

Example

3. **What is the value of x in the figure?**



The angle labeled $(2x + 2)°$ and the angle labeled 130° are vertical angles.

Since vertical angles are congruent, $(2x + 2)°$ equals 130°.

$2x + 2 = 130$ Write the equation.

$-2 = -2$ Subtract 2 from each side.

$\frac{2x}{2} = \frac{128}{2}$ Divide each side by 2.

$x = 64$

So, the value of x is 64.

Got it? **Do this problem to find out.**

e. What is the value of y in the figure in Example 2?

e. _____

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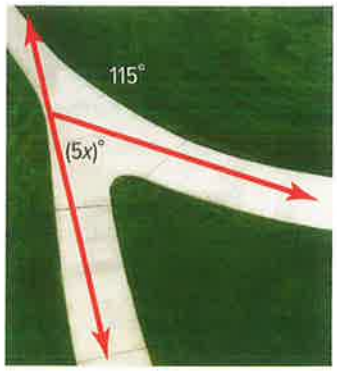
Example

4. **What is the value of x shown in the sidewalk?**



The angle labeled 115° and the angle labeled $5x$ are adjacent angles. Together they form a straight angle or 180°.

$$115 + 5x = 180$$ Write the equation.

$$-115 \quad = -115$$ Subtract 115 from each side.

$$\frac{5x}{5} = \frac{65}{5}$$ Divide each side by 5.

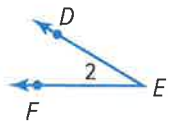
$$x = 13$$

So, the value of x is 13.

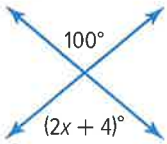
Guided Practice

Check

1. Name the angle below in four ways. Then classify it as *acute*, *right*, *obtuse*, or *straight*. (Example 1)



2. Find the value of x in the figure. (Examples 3–4)



3. Identify a pair of vertical angles and adjacent angles on the railroad crossing sign. Justify your response. (Example 2)

Show your work.

4. **Building on the Essential Question** Describe the differences between vertical and adjacent angles.

Rate Yourself!

How confident are you about classifying angles? Check the box that applies.

FOLDABLES Time to update your Foldable!

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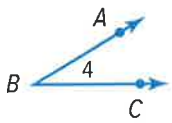
Name _____ My Homework _____

Independent Practice

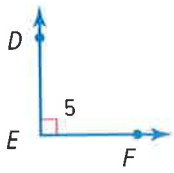
Name each angle in four ways. Then classify the angle as *acute*, *right*, *obtuse*, or *straight*. (Example 1)

1.

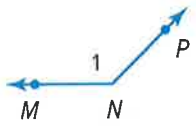


Show your work.

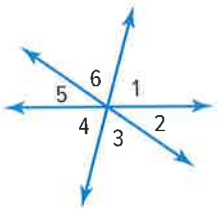
2.



3



MP **Identify Structure** **Refer to the diagram at the right. Identify each angle pair as *adjacent*, *vertical*, or *neither*.** (Example 2)



4. ∠2 and ∠5 _____

5 ∠4 and ∠6 _____

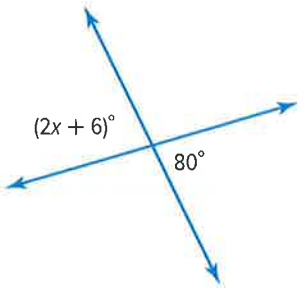
6. ∠3 and ∠4 _____

7. ∠5 and ∠6 _____

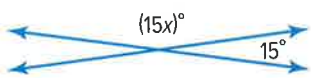
8. ∠1 and ∠3 _____

9. ∠1 and ∠4 _____

10. What is the value of x in the figure at the right? (Examples 3 and 4) _____



11. What is the value of x in the figure at the right? (Examples 3 and 4) _____



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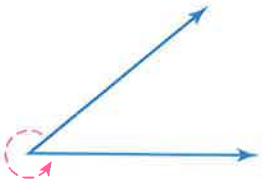
12. Angles ABC and DBE are vertical angles. If the measure of $\angle ABC$ is 40°, what is the measure of $\angle ABD$?

H.O.T. Problems Higher Order Thinking

13. MP **Model with Mathematics** Draw examples of angles that represent real-world objects. Be sure to include at least three of the following angles: acute, right, obtuse, straight, vertical, and adjacent. Verify by measuring the angles.

14. MP **Reason Inductively** Explain how you can use a protractor to measure the angle shown. Find the measure of the angle.

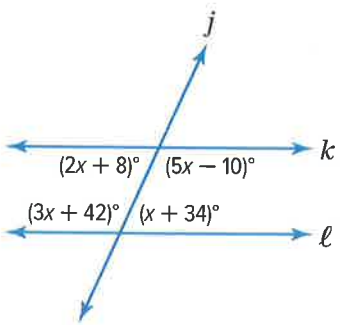


MP **Persevere with Problems** **Determine whether each statement is *true* or *false*. If the statement is true, provide a diagram to support it. If the statement is false, explain why.**

15. A pair of obtuse angles can also be vertical angles.

16. A pair of straight angles can also be adjacent angles.

17. MP **Reason Inductively** Lines ℓ and k shown at the right are parallel and are intersected by line j. Explain how you can write and solve equations to find the measure of each angle. Then find the measure of each angle.



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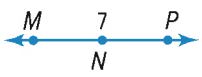
Name _____ My Homework _____

Extra Practice

Name each angle in four ways. Then classify the angle as *acute*, *right*, *obtuse*, or *straight*.

18.

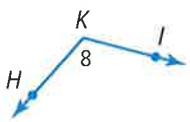


Homework Help

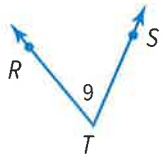
∠MNP, ∠PNM, ∠N, ∠7;

straight

19.



20.



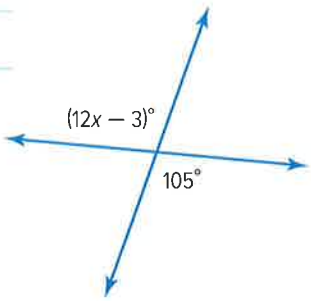
21. The corner where the states of Utah, Arizona, New Mexico, and Colorado meet is called the Four Corners.

a. Identify a pair of vertical angles. Justify your response.

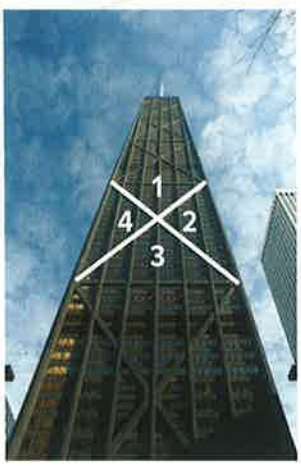
b. Identify a pair of adjacent angles. Justify your response.

22. What is the value of x in the figure at the right?

23. What is the value of x in the figure at the right?



24. MP **Identify Structure** The John Hancock Center in Chicago is shown at the right. Classify each pair of angles.



a. ∠1 and ∠2 _____ **b.** ∠2 and ∠4 _____

c. ∠3 and ∠4 _____ **d.** ∠1 and ∠3 _____

e. If the measure of ∠2 is 66°, what are the measures of the other angles? _____

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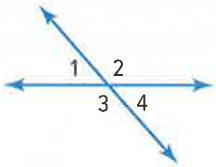
Power Up! Test Practice

25. Refer to the figure at the right.



Fill in each box to make a true statement.

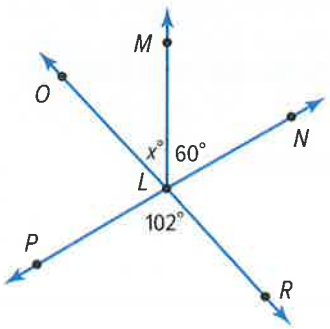
a. ∠1 and ∠4 are ☐ angles.

b. ∠3 and ∠4 are ☐ angles.

c. ∠2 and ∠4 are ☐ angles.

d. ∠2 and ∠3 are ☐ angles.

26. In the figure below, ∠*OLN* and ∠*PLR* are vertical angles.



Select values to complete the equation to find the measure of ∠*MLO*.

☐ + ☐ = ☐

$x°$	30°	60°
90°	102°	180°

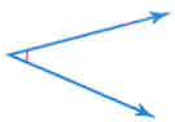
What is the measure of ∠*MLO*? ☐

Spiral Review

Use a protractor to find the measure of each angle.

27. 

28. 

29. 

30. Name the line segment at the right in two ways.

31. What is the name for a quadrilateral with all right angles and opposite sides that are parallel and congruent?

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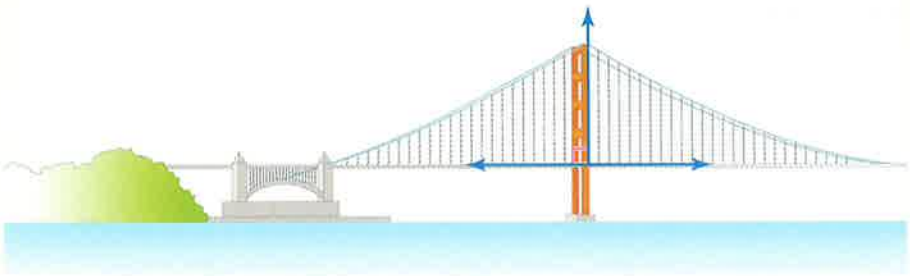
Lesson 2

Complementary and Supplementary Angles

Real-World Link

Bridges Engineers use angles to construct bridges. The Golden Gate Bridge is created by combining angles as shown.



1. What types of angles make up the two angles marked in the drawing of the bridge? _____

2. What is the sum of the two angles marked in the drawing of the bridge? _____

3. In the space below, draw a figure that contains two angles that have a sum of 90°.

Show your work.

Essential Question

HOW does geometry help us describe real-world objects?

Vocabulary

complementary angles
supplementary angles

Math Symbols
$m\angle 1$

MP Mathematical Practices
1, 3, 4, 7

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems	⑤ Use Math Tools
② Reason Abstractly	⑥ Attend to Precision
③ Construct an Argument	⑦ Make Use of Structure
④ Model with Mathematics	⑧ Use Repeated Reasoning

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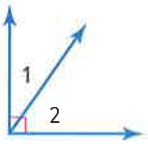
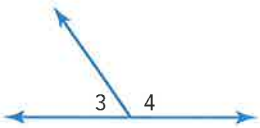
Key Concept

Pairs of Angles

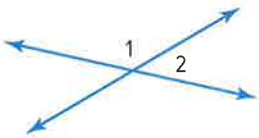
Words	Models	Symbols
Two angles are **complementary** if the sum of their measures is 90°.		$m\angle 1 + m\angle 2 = 90°$
Two angles are **supplementary** if the sum of their measures is 180°.		$m\angle 3 + m\angle 4 = 180°$

A special relationship exists between two angles with a sum of 90°. A special relationship also exists between two angles with a sum of 180°. The symbol $m\angle 1$ means *the measure of angle 1.*

Examples

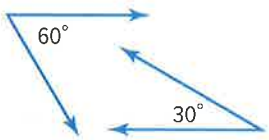
Identify each pair of angles as *complementary, supplementary,* or *neither*.

1.



$\angle 1$ and $\angle 2$ form a straight angle. So, the angles are supplementary.

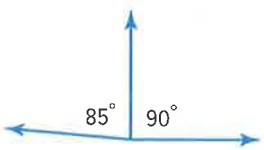
2.



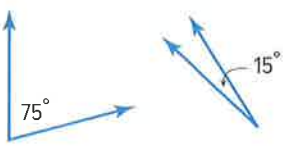
$60° + 30° = 90°$ The angles are complementary.

Got it? **Do these problems to find out.**

a.



b.



Work Zone

Show your work.

a. _____

b. _____

Adjacent

As shown in Example 2, angles do not need to be adjacent to be complementary or supplementary angles.

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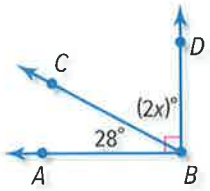
Find a Missing Measure

You can use angle relationships to find missing measures.

Examples

3. **Find the value of x.**

Since the two angles form a right angle, they are complementary.



Words	The sum of the measures of $\angle ABC$ and $\angle CBD$	is	90°.
Variable	Let $2x$ represent the measure of $\angle CBD$.		
Equation	$28 + 2x$	$=$	90

$28 + 2x = 90$ Write the equation.

$-28 \quad = -28$ Subtract 28 from each side.

$\frac{2x}{2} = \frac{62}{2}$ Divide each side by 2.

$x = 31$

So, the value of x is 31.

4. **The angles shown are supplementary. Find the value of x.**

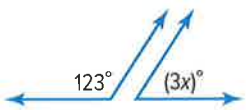
$123 + 3x = 180$ Write the equation.

$-123 \quad = -123$ Subtract 123 from each side.

$\frac{3x}{3} = \frac{57}{3}$ Divide each side by 3.

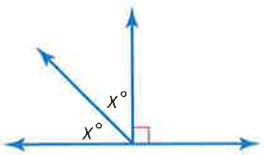
$x = 19$

So, the value of x is 19.



Got it? **Do this problem to find out.**

c. Find the value of x.



STOP and Reflect

Circle true or false.
The sum of two angles that are supplementary is 180°.

True False

Show your work.

c. _____

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Example

5. **The picture shows a support brace for a gate. Find the value of *x*.**

The angle labeled 80° and the angle labeled 10*x* are supplementary angles.

$80 + 10x = 180$ Write the equation.

$-80 \quad = -80$ Subtract 80 from each side.

$\frac{10x}{10} = \frac{100}{10}$ Divide each side by 10.

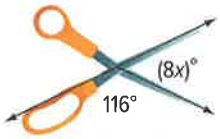
$x = 10$

So, the value of *x* is 10.

Got it? **Do this problem to find out.**

Show your work.

d. A pair of scissors forms the angles shown. What is the value of *x*?



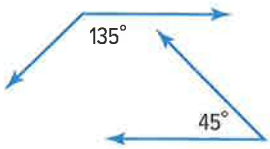
d. _____

Guided Practice

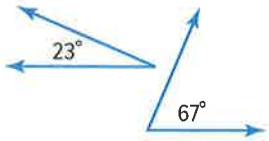
Check

Identify each pair of angles as *complementary, supplementary,* or *neither*.
(Examples 1 and 2)

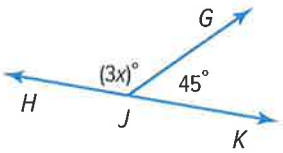
1.



2.



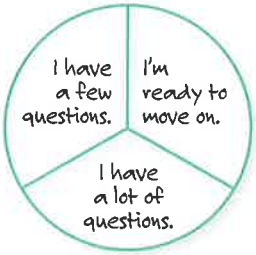
3. Find the value of *x*. (Examples 3–5)



4. **Building on the Essential Question** How are vertical, adjacent, complementary, and supplementary angles related?

Rate Yourself!

Are you ready to move on? Shade the section that applies.



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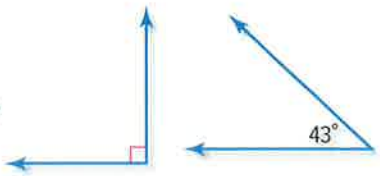
Name _____ My Homework _____

Independent Practice

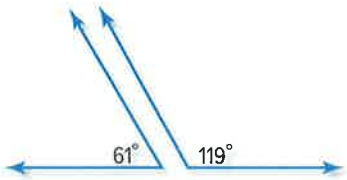
Identify each pair of angles as *complementary, supplementary,* or *neither*.
(Examples 1 and 2)

1.

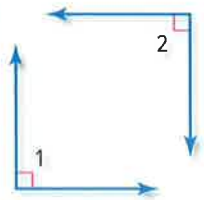
Show your work.



2.

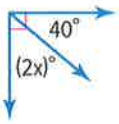


3

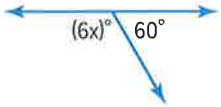


Find the measure of *x* in each figure. (Examples 3 and 4)

4.



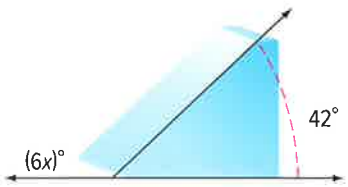
5.



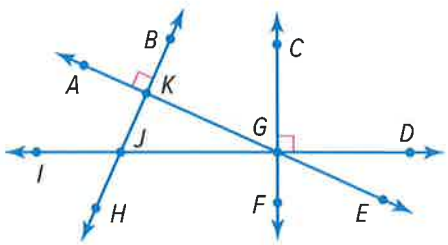
6. $\angle A$ and $\angle B$ are complementary angles. The measure of $\angle B$ is $(4x)°$, and the measure of $\angle A$ is 50°. What is the value of x? (Example 5)

7 A skateboard ramp forms a 42° angle as shown.

Find the value of x. (Example 5)



Use the figure at the right to name the following.



8. a pair of supplementary angles

9. a pair of complementary angles

10. a pair of vertical angles

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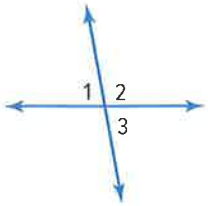
11. Use the figure at the right.



a. Are $\angle 1$ and $\angle 2$ vertical angles, adjacent angles, or neither? $\angle 2$ and $\angle 3$? $\angle 1$ and $\angle 3$?

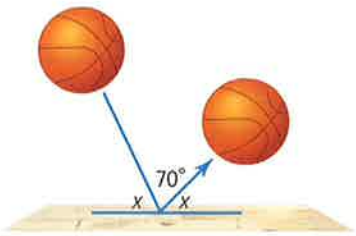
b. Write an equation representing the sum of $m\angle 1$ and $m\angle 2$. Then write an equation representing the sum of $m\angle 2$ and $m\angle 3$.

c. Solve the equations you wrote in part **b** for $m\angle 1$ and $m\angle 3$, respectively. What do you notice?

d. MP **Make a Conjecture** Use your answer from part **c** to make a conjecture as to the relationship between vertical angles.

H.O.T. Problems Higher Order Thinking

12. MP **Reason Inductively** When a basketball hits a hard, level surface, it bounces off at the same angle at which it hits. Use the figure to find the angle at which the ball hit the floor.

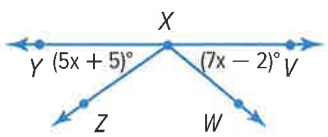


13. MP **Persevere with Problems** Find the measure of each angle in the given situation.

a. complementary angles E and F, where $m\angle E = (x - 10)°$ and $m\angle F = (x + 2)°$

b. supplementary angles B and C, where $m\angle B = (2x - 40)°$ and $m\angle C = (2x + 20)°$

14. MP **Persevere with Problems** In the figure shown, the sum of the measures of $\angle YXZ$ and $\angle WXV$ is 75°. What is the measure of $\angle ZXW$?



15. MP **Reason Inductively** Is the statement below *always*, *sometimes*, or *never* true? Explain.

If two angles are right angles, they must be supplementary.

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Name _____ My Homework _____

Extra Practice

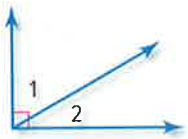
Identify each pair of angles as *complementary, supplementary,* or *neither*.

16.

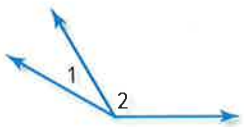
Homework Help

∠1 and ∠2 form a straight angle. So, the angles are supplementary.

17.



18.



19. $\angle J$ and $\angle K$ are supplementary. The measure of $\angle J$ is $(9x)°$ and the measure of $\angle K$ is 45°. What is the value of x?

20. $\angle C$ and $\angle D$ are complementary. The measure of $\angle C$ is $(4x)°$ and the measure of $\angle D$ is 26°. What is the value of x?

MP **Identify Structure** **Determine whether each statement is *always, sometimes,* or *never* true. Explain your reasoning.**

21. Two obtuse angles are supplementary.

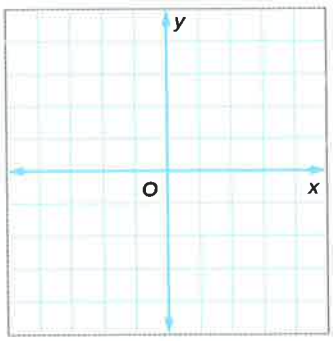
22. Two vertical angles are complementary.

23. MP **Multiple Representations** Line a passes through (1, 4) and (−4, −1). Line b passes through (−3, 4) and (2, −1).

a. Graphs Graph each line on the same coordinate plane.

b. Words Describe the lines.

c. Numbers What is the slope of each line?



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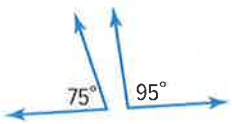
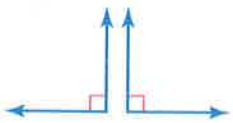
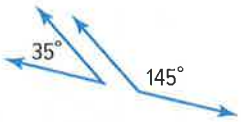
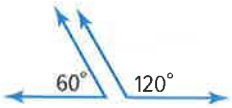
Power Up! Test Practice

24. Which angle pairs below are supplementary? Select all that apply.

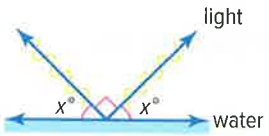
☐ 

☐ 

☐ 

☐ 

25. The angle at which the light ray hits the water is equal to the angle at which the light ray is reflected from the water.



Select values to complete the equation below to find the value of x.

$2 \times$ ☐ $+$ ☐ $=$ ☐

$x°$
45°
60°
90°
180°

What is the measure of the angle at which the light ray hits the water?

☐

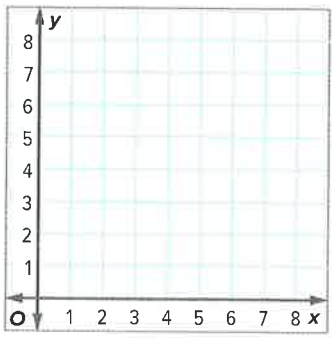
What is the measure of the angle at which the light ray is reflected from the water?

☐

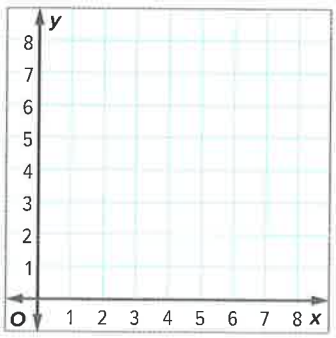
Spiral Review

Graph each figure with the given vertices on the coordinate plane. Then classify each figure.

26. (1, 3), (1, 6), (5, 5), and (5, 3)



27. (1, 2), (5, 2), (5, 6), and (1, 6)



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Inquiry Lab
Create Triangles

Inquiry **WHAT do you notice about the measures of the sides or the measures of the angles that form triangles?**

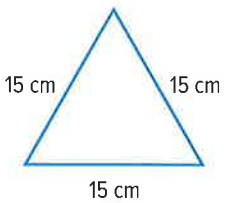
MP Mathematical Practices
1, 3, 5, 8

Salem has a sailboat. The sail on his boat is in the shape of a triangle with side lengths of 6 meters, 8 meters, and 10 meters. These dimensions work to form a triangle, but not just any three lengths form a triangle. Complete the Activity below to determine which side lengths form triangles.

Hands-On Activity 1

Step 1 Measure and cut several plastic straws into lengths that equal 3, 4, 4, 5, 8, 8, 8, 13, 15, 15, 15, and 15 centimeters.

Step 2 Arrange three of the pieces that each measure 15 centimeters to see if you can form a triangle.



So, you can form a triangle with side lengths of 15 centimeters, 15 centimeters, and 15 centimeters.

Step 3 Continue using pieces of straw to try to form triangles using the different combinations of side lengths given. Determine whether or not the lengths form a triangle. Complete the table.

Side 1	Side 2	Side 3	Do the sides form a triangle?
15 cm	15 cm	15 cm	yes
3 cm	4 cm	5 cm	
8 cm	8 cm	13 cm	
3 cm	4 cm	8 cm	
4 cm	4 cm	5 cm	
8 cm	3 cm	15 cm	
4 cm	8 cm	15 cm	

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Investigate

Collaborate

Work with a partner. Try to create triangles using the given side lengths. Circle *yes* if you can make a triangle or *no* if you cannot.

1. 5 cm, 8 cm, 15 cm

Yes or No

2. 13 cm, 8 cm, 15 cm

Yes or No

3. 13 cm, 4 cm, 4 cm

Yes or No

Analyze and Reflect

Collaborate

Work with a partner.

4. The table below contains the dimensions you used in Step 3 of the Activity. Transfer your results from the Investigation into the fourth column and then complete the fifth column.

Side 1	Side 2	Side 3	Do the sides form a triangle?	Is Side 1 + Side 2 greater than or less than Side 3?
15 cm	15 cm	15 cm	yes	greater than
3 cm	4 cm	5 cm		
8 cm	8 cm	13 cm		
3 cm	4 cm	8 cm		
4 cm	4 cm	5 cm		
8 cm	3 cm	15 cm		
4 cm	8 cm	15 cm		

5. What do you notice about the figures with a Side 1 and Side 2 sum that is less than the length of Side 3? _____

Create

On Your Own

6. Can you create a triangle that has the same shape as the triangle in the Activity, but different side lengths? Explain.

7. MP **Reason Inductively** Could you form a triangle using the side lengths of 7, 8, and 25 centimeters? Explain. _____

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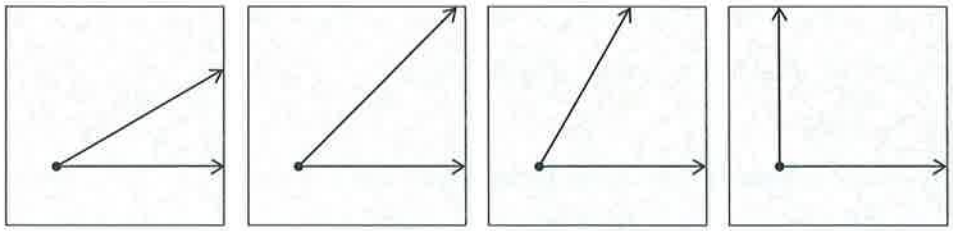
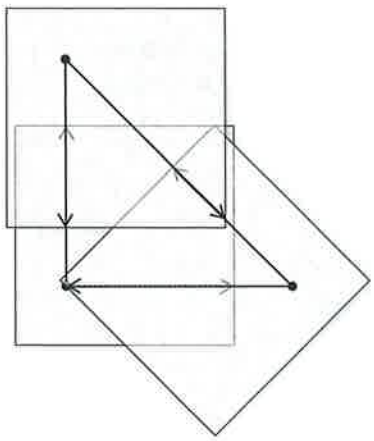
Hands-On Activity 2

Use angles of different sizes to determine which ones form a triangle.

Step 1 Draw two sets of angles measuring 30°, 45°, 60°, and 90° on different pieces of patty paper. Extend the rays of each angle to the edges of the patty paper.



Step 2 Try to form a triangle with one 90° angle and two 45° angles.



So, a 90° angle and two 45° angles form a triangle.

Step 3 Try to form triangles using the angle measures that are given in the table. Fill in *yes* or *no* in the fourth column of the table.

Angle 1	Angle 2	Angle 3	Do the angles form a triangle?
90°	45°	45°	yes
30°	60°	90°	
30°	45°	60°	
30°	30°	60°	

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Investigate

Collaborate

Work with a partner.

8. Draw another 60° angle on a piece of patty paper. Describe the angles and side lengths of the figure you form using three 60° angles.

Show your work.

9. Draw angles measuring 20°, 70°, and 90° on pieces of patty paper.

a. Do the angles form a triangle?

b. Can you create more than one triangle that is the same shape with different side lengths? What are the side lengths of your triangle?

Analyze and Reflect

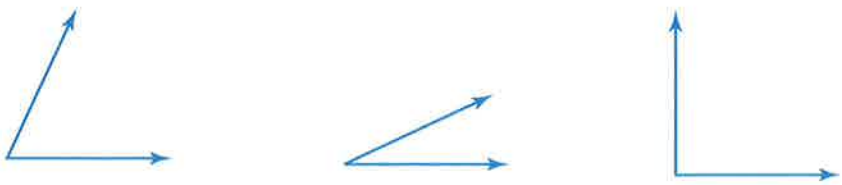
Collaborate

10. MP **Identify Repeated Reasoning** Refer back to the table in Step 3 of Activity 2. Compare the sum of the angle measures. Describe any patterns that are found.

Create

On Your Own

11. MP **Use Math Tools** Use a protractor to measure the three angles below. Would you be able to form a triangle from these angles? Explain.



12. Inquiry WHAT do you notice about the measures of the sides or the measures of the angles that form triangles?

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Lesson 3
Triangles

Real-World Link

Ramps Mazen practices jumping on a ski ramp. The front of the ramp is a triangle like the one shown below.

1. Draw an X through the type of angle that is not shown in the triangle.

right acute obtuse

2. Measure the unknown angle. Describe the relationship between the 80° angle and the unknown angle.

3. Draw a triangle with one obtuse angle.

Show your work.

4. Is it possible to draw a triangle with two obtuse angles? Explain.

Essential Question

HOW does geometry help us describe real-world objects?

Vocabulary

acute triangle
right triangle
obtuse triangle
scalene triangle
isosceles triangle
equilateral triangle
triangle
congruent segments

Math Symbols

△

MP Mathematical Practices
1, 2, 3, 4

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

① Persevere with Problems
② Reason Abstractly
③ Construct an Argument
④ Model with Mathematics
⑤ Use Math Tools
⑥ Attend to Precision
⑦ Make Use of Structure
⑧ Use Repeated Reasoning

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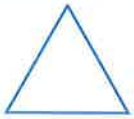
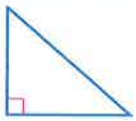
Key Concept

Classify Triangles



all acute angles

acute triangle



1 right angle

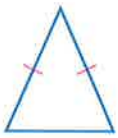
right triangle

1 obtuse angle

obtuse triangle

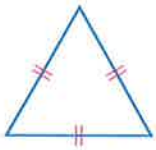
no congruent sides

scalene triangle



at least 2 congruent sides

isosceles triangle



3 congruent sides

equilateral triangle

Work Zone

Congruent Segments

The tick marks on the sides of the triangle indicate that those sides are congruent.

A **triangle** is a figure with three sides and three angles. The symbol for triangle is △.

Every triangle has at least two acute angles. One way you can classify a triangle is by using the third angle. Another way to classify triangles is by their sides. Sides with the same length are **congruent segments**.

Example

1. **Draw a triangle with one obtuse angle and no congruent sides. Then classify the triangle.**

Show your work.

Draw an obtuse angle.
The two segments of the angle should have different lengths.

Connect the two segments to form a triangle.

The triangle is an obtuse scalene triangle.

Got it? **Do this problem to find out.**

Draw a triangle that satisfies the set of conditions below. Then classify the triangle.

a. a triangle with one right angle and two congruent sides

a. _____

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Example

2. **Classify the triangle on the house by its angles and by its sides.**

The triangle has one obtuse angle and two congruent sides. So, it is an obtuse isosceles triangle.

Got it? **Do this problem to find out.**

b. Classify the triangle shown by its angles and by its sides.

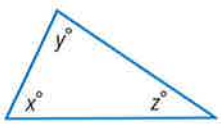
b. _____

STOP and Reflect

How would you classify a triangle with a right angle and two congruent sides?

Angles of a Triangle

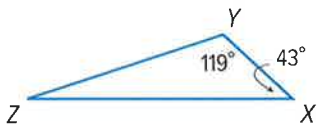
Key Concept

Words	The sum of the measures of the angles of a triangle is 180°.	**Model**	
Algebra	$x + y + z = 180$		

You can write and solve an equation to find the missing angle measure of a triangle.

Example

3. **Find $m\angle Z$.**



The sum of the angle measures in a triangle is 180°.

$m\angle Z + 43° + 119° = 180°$ Write the equation.

$m\angle Z + 162° = 180°$ Simplify.

$-162° = -162°$ Subtract 162° from each side.

$m\angle Z = 18°$

So, $m\angle Z$ is 18°.

Got it? **Do this problem to find out.**

c. In $\triangle ABC$, if $m\angle A = 25°$ and $m\angle B = 108°$, what is $m\angle C$?

c. _____

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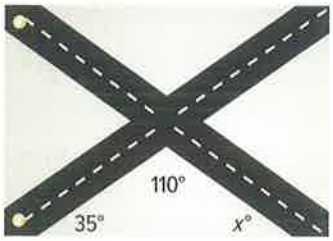
Example

4. **An intersection of a road is shown. What is the missing measure in the triangle?**



To find the missing measure, write and solve an equation.

$x + 110 + 35 = 180$ The sum of the measures is 180.

$x + 145 = 180$ Simplify.

$-145 = -145$ Subtract 145 from each side.

$x = 35$

The missing measure is 35°.

Guided Practice

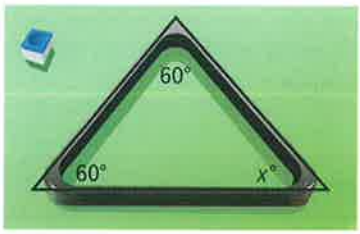
Check

1. Draw a triangle with three acute angles and two congruent sides. Classify the triangle. (Examples 1 and 2)

Show your work.

2. Find $m\angle T$ in $\triangle RST$ if $m\angle R = 37°$ and $m\angle S = 55°$. (Example 3)

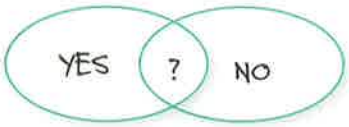
3. A triangle is used in the game of pool to rack the pool balls. Find the missing measure of the triangle. (Example 4)



4. **Building on the Essential Question** How can triangles be classified?

Rate Yourself!

Are you ready to move on? Shade the section that applies.



FOLDABLES Time to update your Foldable!

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Name _____ My Homework _____

Independent Practice

Draw a triangle that satisfies each set of conditions. Then classify the triangle. (Example 1)

1. a triangle with three acute angles and three congruent sides

Show your work.

2. a triangle with one right angle and no congruent sides

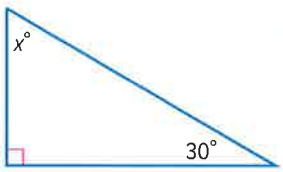
Classify the marked triangle by its angles and by its sides. (Example 2)

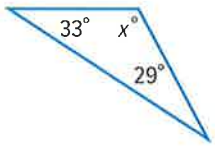
3. 

4. 

5. 

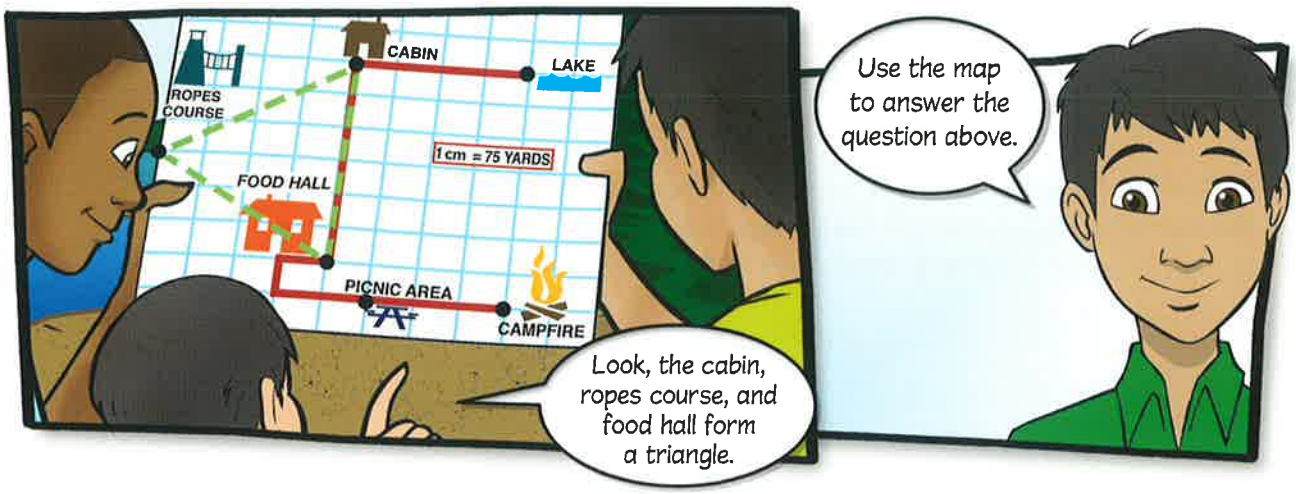
Find the value of x. (Examples 3 and 4)

6. 

7. 

8. 

9. **Model with Mathematics** Refer to the graphic novel below. Classify the triangle formed by the cabin, ropes course, and mess hall by its angles and sides.



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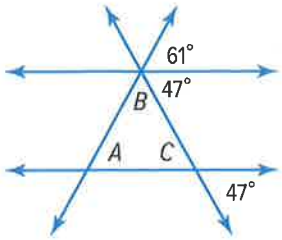
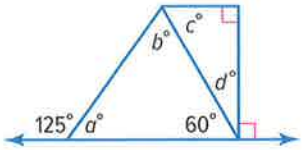
10. Triangle ABC is formed by two parallel lines and two other intersecting lines. Find the measure of each angle A, B, and C of the triangle.



H.O.T. Problems Higher Order Thinking

11. MP **Persevere with Problems** Apply what you know about triangles to write and solve equations to find the missing angle measures in the figure.



12. MP **Model with Mathematics** Draw an acute scalene triangle. Describe the angles and sides of the triangle.

13. MP **Justify Conclusions** Determine whether each statement is *sometimes*, *always*, or *never* true. Justify your answer.

a. It is possible for a triangle to have two right angles.

b. It is possible for a triangle to have two obtuse angles.

14. MP **Reason Inductively** Hareb says that an equilateral triangle is sometimes an obtuse triangle. Noura says that an equilateral triangle is always an acute triangle. Is either of them correct? Explain your reasoning.

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Name _____ My Homework _____

Extra Practice

Classify the marked triangle in each object by its angles and by its sides.

15.

Homework Help

The triangle has all acute angles and two congruent sides. It is an acute isosceles triangle.

16.

17.

Draw a triangle that satisfies each set of conditions. Then classify the triangle.

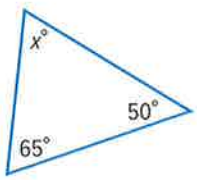
18. a triangle with three acute angles and no congruent sides _____

Show your work.

19. a triangle with one obtuse angle and two congruent sides _____

Find the value of x.

20.



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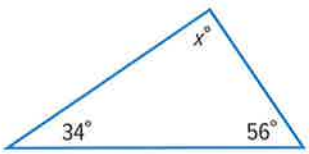

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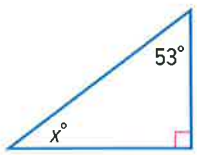
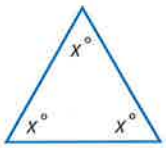


23. Find $m\angle Q$ in $\triangle QRS$ if $m\angle R = 25°$ and $m\angle S = 102°$. _____

MP Reason Abstractly **Find the value of x in each triangle.**

24.



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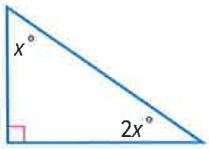

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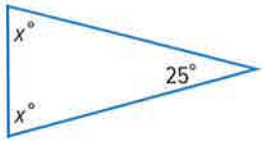

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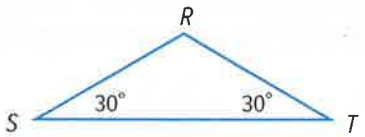
Power Up! Test Practice

27. Refer to the figure shown. Determine if each statement is true or false.



a. To find $m\angle R$, subtract 30° from 90°. ☐ True ☐ False

b. The measure of $\angle R$ is 120°. ☐ True ☐ False

c. Triangle *RST* is an acute triangle. ☐ True ☐ False

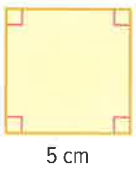
28. In a right triangle, the measure of one of the angles is 43°. Sketch a diagram to represent this situation.

What is the measure of the other angle? ☐

Spiral Review

Find the area of each figure.

29.



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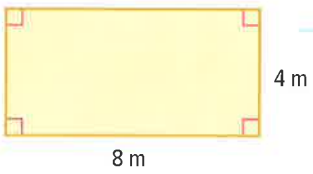

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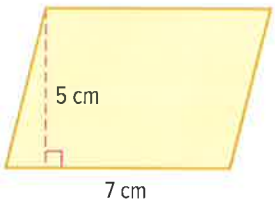

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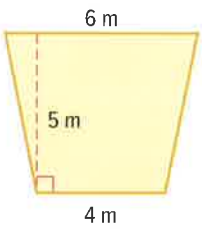

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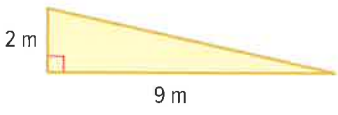

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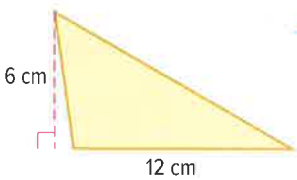

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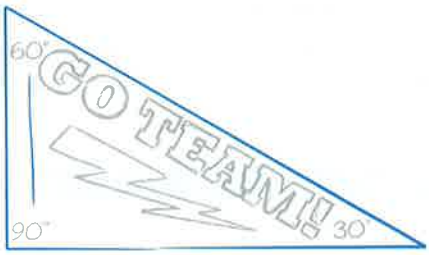
Inquiry Lab
Draw Triangles

Mathematical Practices 1, 3, 5

Inquiry **HOW can you use technology to draw geometric shapes?**

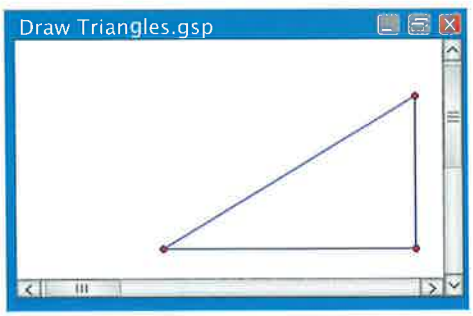
The Spirit Club is selling triangular-shaped pennants for Homecoming. Amani is making a poster to advertise the pennants. She wants to use a computer program to draw a model of the pennant.



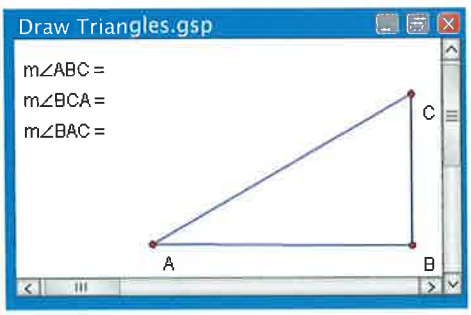
Hands-On Activity 1

You can use dynamic geometry software such as The Geometer's Sketchpad® to draw triangles given three angle measures. In this investigation, you will draw a triangle with angle measures of 30°, 60°, and 90°.

Step 1 First, click on **Edit**. Go to **Preferences**. Change the angle precision from *hundredths* to *units*. Next, use the **Straightedge (segment)** tool. Click and drag three times to create a triangle like the one shown.



Step 2 Using the **Selection Arrow**, click on each of the vertex points *A*, *B*, and *C*. Then select **Measure** and **Angle**. Labels will automatically be assigned to the vertices. You found that the measure of $\angle ABC$ is ____.



Step 3 Click on points *B*, *C*, and *A*. Click **Measure** and **Angle** again. Repeat for points *B*, *A*, and *C*. The angle measures should be displayed on your screen.

Step 4 If the angles do not measure 30°, 60°, and 90°, use the **Selection Arrow** to move the vertices. Click and drag one or more points so that the angles move.

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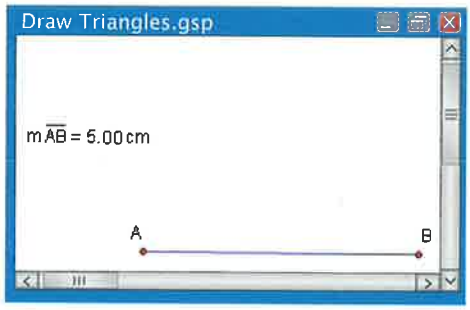
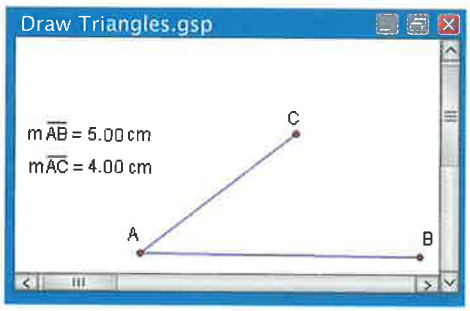
Hands-On Activity 2

You can also use The Geometer's Sketchpad® to draw triangles given three side measures. In this Activity, you will draw a triangle with side measures of 3 centimeters, 4 centimeters, and 5 centimeters.

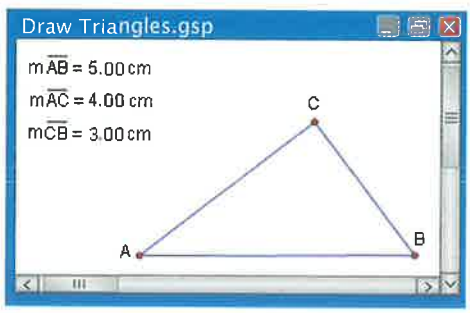
Step 1 First, click on **Edit**. Go to **Preferences**. Check that the distance precision is set to hundredths. Using the **Straightedge (segment)** tool, click and drag to create a line segment with endpoints *A* and *B*. Use the **Selection Arrow** to select the segment. Click on **Measure** and **Length**. Then drag one of the endpoints so that the line segment measures 5 centimeters.



Step 2 Next, create a line segment from point *A* that is 4 centimeters long using the **Straightedge (segment)** tool. Draw the segment first and then measure it to make sure it is 4 centimeters.



Step 3 Finally, connect points *C* and *B* with a line segment that is 3 centimeters long.



You have created a triangle with side lengths of 3 centimeters, 4 centimeters, and 5 centimeters.

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Collaborate

Investigate

MP Use Math Tools Work with a partner to construct each triangle. Once you have constructed a triangle, draw the text and image that appears on your display.

1. $\angle ABC = 90°$
   $\angle BCA = 70°$
   $\angle BAC = 20°$

Show your work.

2. $\angle ABC = 90°$
   $\angle BCA = 45°$
   $\angle BAC = 45°$

3. Explain the steps you would take to create a triangle if you were given the measures of all three angles.

4. $\overline{AB} = 4$ centimeters
   $\overline{AC} = 6$ centimeters
   $\overline{CB} = 9$ centimeters

5. $\overline{AB} = 2$ centimeters
   $\overline{AC} = 5$ centimeters
   $\overline{CB} = 4$ centimeters

6. **MP Justify Conclusions** Explain the steps you would take to create a triangle if you were given the lengths of all three sides.

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Analyze and Reflect

Collaborate

Work with a partner to answer each of the following questions.

7. Is it possible to use dynamic geometry software to draw a triangle with angles of 50°, 65°, and 70°? Explain.

8. Is it possible to use dynamic geometry software to draw a triangle with side measures of 3, 6, and 10 centimeters? Explain.

Create

On Your Own

9. MP **Reason Inductively** You know the rule to find the sum of the interior angles of a triangle. Does a similar rule exist for the sum of the interior angles of a quadrilateral? Use dynamic geometry software to draw four different quadrilaterals and complete the table below to find out. (*Hint:* Do not draw more than one square or rectangle.)

	$m\angle 1$	$m\angle 2$	$m\angle 3$	$m\angle 4$	Sum of Angles
Quadrilateral 1					
Quadrilateral 2					
Quadrilateral 3					
Quadrilateral 4					

10. Inquiry HOW can you use technology to draw geometric shapes?

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MP Problem-Solving Investigation
Make a Model

MP Mathematical Practices
1, 4, 6

Case #1 Science Project

Maha is making a model of Mount Sumbing for a science project. The height of the actual volcano is about 2,500 meters. She uses a scale of 250 meters equals 1 centimeter.

What is the height of the volcano in Maha's model?

1 Understand *What are the facts?*

- The height of the actual volcano is about 2,500 meters.
- The scale for her model is 250 meters = 1 centimeter.

2 Plan *What is your strategy to solve this problem?*

Draw a model that represents the actual volcano and Maha's volcano to help you visualize the problem.

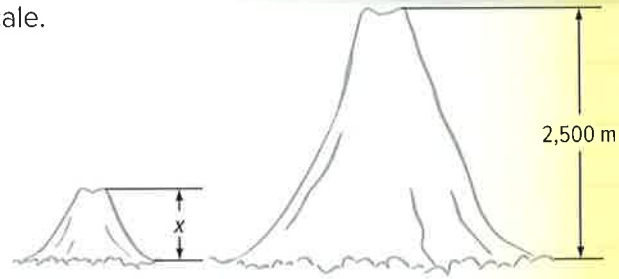
3 Solve *How can you apply the strategy?*

The scale is 250 meters = 1 centimeter.
Write and solve a proportion using the scale.

$$\frac{250 \text{ m}}{1 \text{ cm}} = \frac{\square \text{ m}}{x \text{ cm}}$$

$$250 \cdot x = 1 \cdot \square$$

$$x = \square \text{ cm}$$



So, Maha's model has a height of _____.

4 Check *Does the answer make sense?*

Multiply the height of the model by 250 to see if it matches the actual height.

Analyze the Strategy

MP **Be Precise** The height of Mount Sumbing is about 8,500 meters. What scale could Maha use to represent the model in the U.S. Customary System?

_____

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Mid-Chapter Check

Vocabulary Check

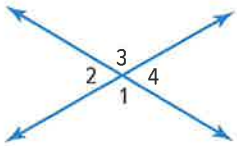
1. MP **Be Precise** Define *complementary angles*. Give an example of two angles that would be complementary. (Lesson 2)

2. Fill in the blank in the sentence below with the correct term. (Lesson 3)

   A _____ triangle is made up of one right angle and no congruent sides.

Skills Check and Problem Solving

Refer to the figure below for Exercises 3–5. (Lessons 1 and 2)



3. Identify a pair of vertical angles.

4. Identify a pair of supplementary angles.

5. Suppose $m\angle 1 = 127°$. Find the measures of the other angles.

6. What is $m\angle A$ in $\triangle ABC$ if $m\angle B = 35°$ and $m\angle C = 92°$?

7. MP **Reason Inductively** Classify the triangle that satisfies each set of conditions.

   a. one right angle and two congruent sides

   b. one obtuse angle and no congruent sides

   c. three acute angles and three congruent sides

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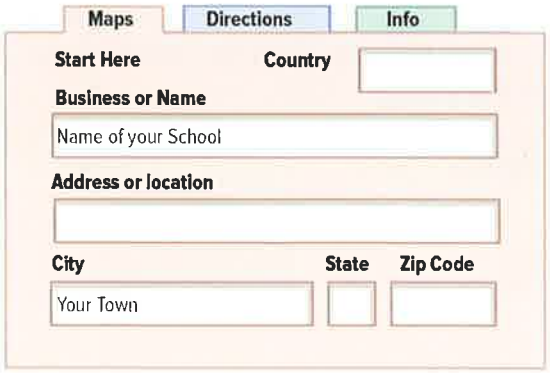
Inquiry Lab

Investigate Online Maps and Scale Drawings

Inquiry **HOW is the zoom feature of an online map like the scale of a drawing?**

MP Mathematical Practices 1, 3, 4, 5

Maps and blueprints are *scale drawings* of the locations and buildings they represent. Unlike maps printed on paper, online map services allow users the opportunity to view a location from different distances.



Hands-On Activity 1

Step 1 Use the online map service provided to you by your teacher. Locate your school on a map.

Step 2 Measure the length of the scale bar in centimeters on the online map. Find the scale distance of the map. Write these values in the Original View table in Step 4.

Step 3 Click on the satellite or aerial view. Use the zoom feature to zoom in until your school shows up on the map.

Step 4 Measure the length of the scale bar in centimeters. Find the new scale distance for the map. Write these values in the Zoom View table.

Original View	
Scale Bar	
Scale Distance	

Zoom View	
Scale Bar	
Scale Distance	

What happens when you use the zoom feature?

Describe the appearance of the map as you zoomed in.

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Investigate

MP Use Math Tools **Work with a partner to answer the following questions about using an online map service.**

1. Locate the local public library on the map. Write the scale bar and scale distance values in the Original View table below Exercise 2.

2. Click on the satellite or aerial view. Use the zoom feature to zoom in until the building shows up on the map. Write the scale bar and scale distance values in the Zoom View table.

Original View	
Scale Bar	
Scale Distance	

Zoom View	
Scale Bar	
Scale Distance	

Analyze and Reflect

Work with a partner to answer the following questions about using an online map.

3. Refer to Activity 1. Write a ratio $\frac{\text{scale bar}}{\text{scale distance}}$ for the original view and the zoom view.

   Original View: _____ Zoom View: _____

4. How many times bigger is the zoom view?

5. How does zooming in affect the scale on the map? _____

6. When using the zoom feature on an online map, what changes and what stays the same? _____

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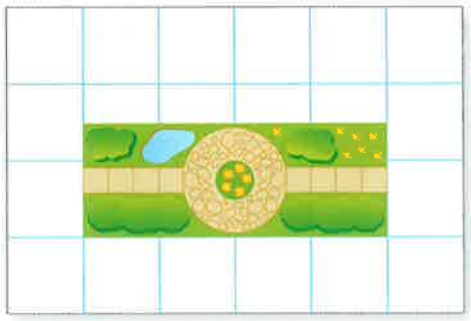
Hands-On Activity 2

The diagram shown represents a garden. The scale is 1 centimeter = 30 meters. That means that each square on the grid measures 1 centimeter by 1 centimeter or 30 meters by 30 meters.



Step 1 Write the length and width of the drawing of the garden.

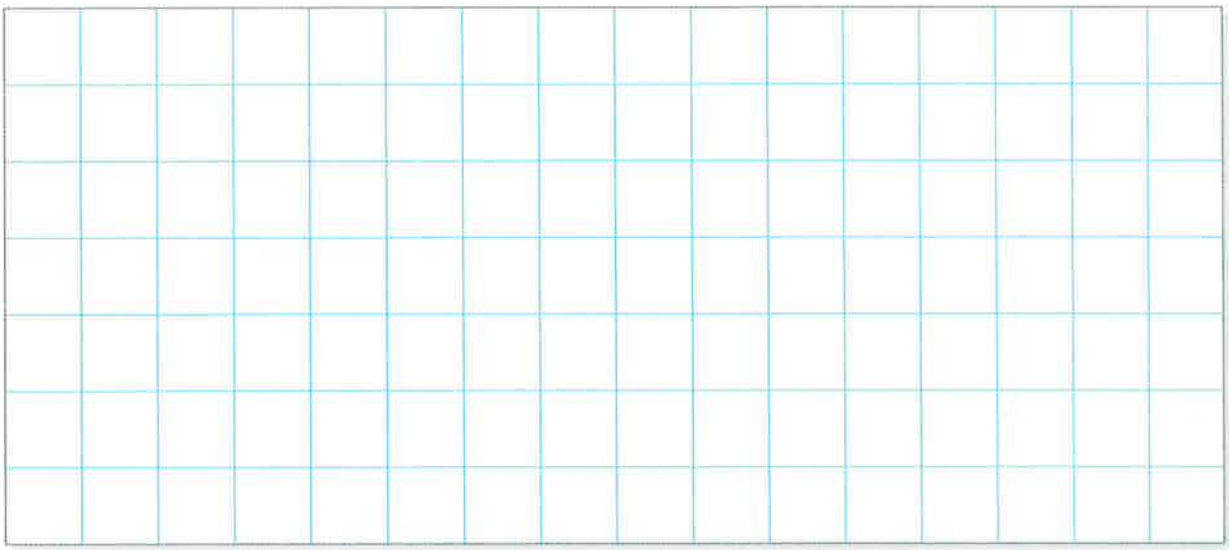
Length: _____ centimeters Width: _____ centimeters

Step 2 Use the scale to find the dimensions of the garden.

Length: _____ meters Width: _____ meters

Step 3 On the grid below, draw the garden so that the scale is 1 centimeter = 10 meters. Write the dimensions of your drawing.

Length: _____ centimeters Width: _____ centimeters



Step 4 Use the scale on your drawing to compute the dimensions of the garden. How do the dimensions compare to the dimensions in Step 2?

Length: _____ meters Width: _____ meters

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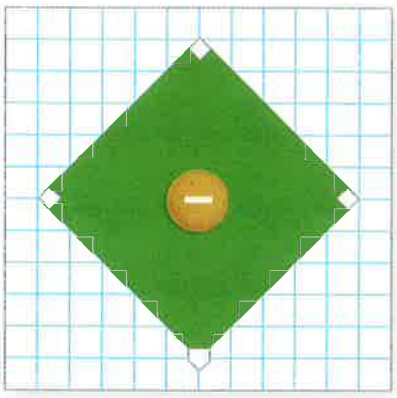
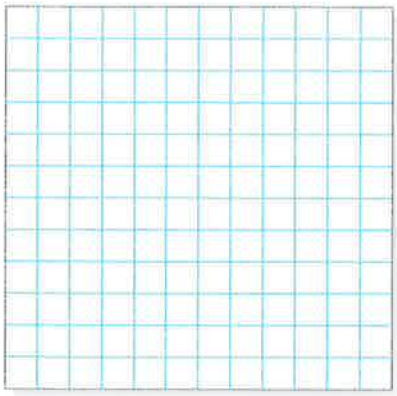
Investigate

Work with a partner to answer the following questions about reproducing a scale drawing.

7. Recreate the drawing of the baseball diamond below using the new scale.

current scale: 1 unit = 15 m
new scale: 1 unit = 30 m

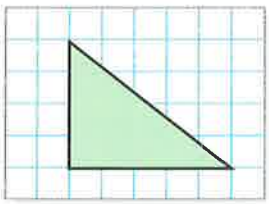




8. A drawing of the Statue of Liberty is 8 centimeters tall. The scale is 1 centimeter = 6 meters. How tall would the drawing be if the scale were 0.5 centimeter = 12 meters? _____

Analyze and Reflect

9. MP **Reason Inductively** The triangle shown in the drawing has an area of 40 square meters. What is the scale of the drawing? _____



Create

10. MP **Model with Mathematics** Using a separate piece of grid paper, create a map of your classroom or a room in your home. Identify the scale you used.

11. Inquiry How is the zoom feature of an online map like the scale of a drawing?

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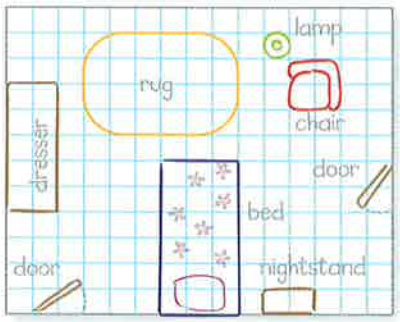
Lesson 4

Scale Drawings

Real-World Link

Room Model Architects make detailed drawings of rooms and buildings. Sindiyya made a drawing of a bedroom. Follow the steps below to make a model of a room of your choosing.



Step 1 Measure the length of three objects in the room. Record each length to the nearest $\frac{1}{2}$ centimeters in the table below.

Object	Length (cm)	Length (units)

Step 2 Let 1 unit represent 60 centimeters. So, 4 units = 240 meters. Convert all your measurements to units. Record these values.

Step 3 On grid paper, make a drawing of your room like the one shown.

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

Essential Question

HOW does geometry help us describe real-world objects?

Vocabulary

scale drawing
scale model
scale
scale factor

MP Mathematical Practices
1, 2, 3, 4, 5

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Work Zone

Use a Scale Drawing or a Scale Model

Scale drawings and **scale models** are used to represent objects that are too large or too small to be drawn or built at actual size. The **scale** gives the ratio that compares the measurements of the drawing or model to the measurements of the real object. The measurements on a drawing or model are proportional to the measurements on the actual object.

Example

1. **What is the actual distance between Hagerstown and Annapolis?**

Step 1 Use a centimeter ruler to find the map distance between the two cities. The map distance is about 4 centimeters.

Step 2 Write and solve a proportion using the scale. Let d represent the actual distance between the cities.

	Scale		Length	
map →	1 centimeter	=	4 centimeter	← map
actual →	40 kilometers		d kilometers	← actual

$1 \times d = 40 \times 4$ Cross products

$d = 160$ Simplify.

The distance between the cities is about 160 kilometers.

Scale

A map scale can be written in different ways, including the following:

1 cm = 40 km

1 cm : 40 km

$\frac{1 \text{ cm}}{40 \text{ km}}$

Show your work.

Got it? **Do this problem to find out.**

a. On the map of Arkansas shown, find the actual distance between Clarksville and Little Rock. Use a ruler to measure.

a. _____

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Example

2. **A graphic artist is creating an advertisement for this cell phone. If she uses a scale of 5 centimeters = 1 centimeter, what is the length of the cell phone on the advertisement?**

Write a proportion using the scale. Let a represent the length of the advertisement cell phone.

	Scale		Length	
advertisement →	$\frac{5 \text{ centimeters}}{1 \text{ centimeter}}$	=	$\frac{a \text{ centimeters}}{10 \text{ centimeters}}$	← advertisement
actual →				← actual

$5 \cdot 10 = 1 \cdot a$ Cross products

$50 = a$ Simplify.

The length of the cell phone on the advertisement is 50 centimeters long.

Got it? **Do this problem to find out.**

b. A scooter is 1 meter long. Find the length of a scale model of the scooter if the scale is 1 centimeter = 10 centimeters.

Scale

The scale is the ratio of the drawing/model measure to the actual measure. It is not always the ratio of a smaller measure to a larger measure.

Show your work.

b. _____

Find a Scale Factor

A scale written as a ratio without units in simplest form is called the **scale factor.**

Example

3. **Find the scale factor of a model sailboat if the scale is 1 centimeter = 0.75 meter.**

$\frac{1 \text{ centimeter}}{0.75 \text{ meter}} = \frac{1 \text{ centimeter}}{75 \text{ centimeters}}$ Convert 0.75 meter to centimeters.

$= \frac{1}{75}$ Divide out the common units.

The scale factor is $\frac{1}{75}$.

Got it? **Do this problem to find out.**

c. What is the scale factor of a model car if the scale is 1 centimeter = 0.25 meter?

c. _____

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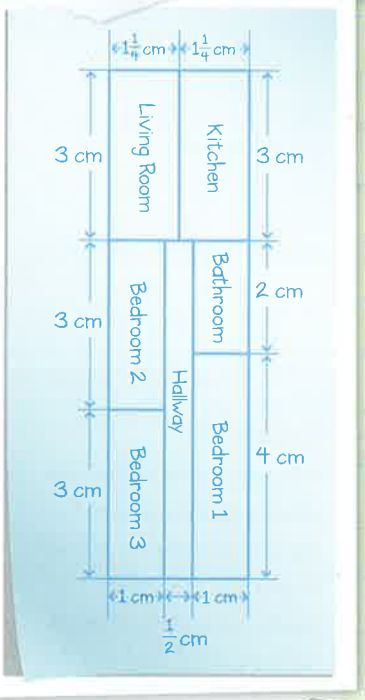

Example

4. **A floor plan for a home is shown at the left where 1 centimeter represents 2 meters of the actual home. What is the actual area of bedroom 1?**

Length of Bedroom 1.

$\frac{1 \text{ cm}}{2 \text{ m}} = \frac{4 \text{ cm}}{w}$ ← floor plan ← actual

$1w = 8$ Find cross products.

$w = 8$

Width of Bedroom 1.

$\frac{1 \text{ cm}}{2 \text{ m}} = \frac{1 \text{ cm}}{x}$ ← floor plan ← actual

$1x = 2$ Find cross products.

$x = 2$

So, the area of bedroom 1 is 8×2 or 16 square meters.

Got it? **Do this problem to find out.**

d. What is the actual area of bedroom 3?

Show your work.

d. _____

Guided Practice

Check

1. On a map, the distance from Akron to Cleveland measures 2 centimeters. What is the actual distance if the scale of the map shows that 1 centimeter is equal to 30 kilometers? (Example 1)

2. An engineer makes a model of a bridge using a scale of 1 centimeter = 1 meter. The length of the actual bridge is 50 meters. What is the length of the model? (Example 2)

3. Yasmin is constructing a scale model of her room. The rectangular room is 25 centimeters by 20 centimeters. If 1 centimeter represents 0.25 meters of the actual room, what is the scale factor and the actual area of the room? (Examples 3 and 4)

4. **Building on the Essential Question** Explain how you could use a map to estimate the actual distance between Miami, Florida, and Atlanta, Georgia.

Rate Yourself!

How well do you understand scale drawings? Circle the image that applies.

Clear | Somewhat Clear | Not So Clear

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Name _____ My Homework _____

Independent Practice

MP Use Math Tools **Find the actual distance between each pair of locations in South Carolina. Use a ruler to measure.** (Example 1)

1. Columbia and Charleston _____

Show your work.

2. Hollywood and Sumter _____

Find the length of each model. Then find the scale factor. (Examples 2 and 3)

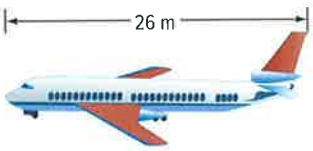
3.

0.5 cm = 1.5 m

_____

_____

4.



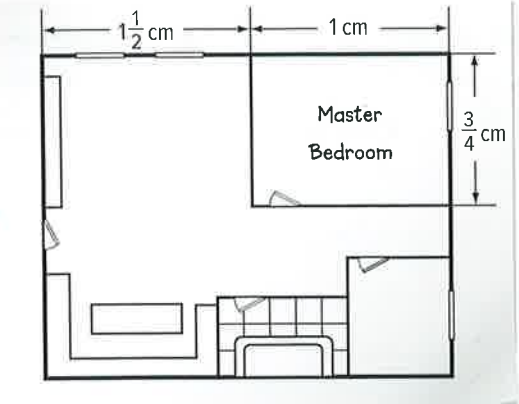
1 cm = 1 m

_____

_____

5. A model of an apartment is shown where 1 centimeter represents 4 meters in the actual apartment. Find the actual area of the master bedroom. (Example 4)

_____



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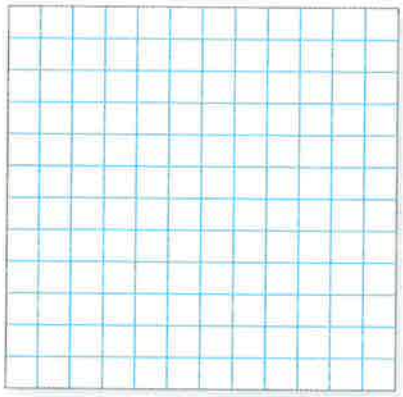
6. **Model with Mathematics** Refer to the graphic novel frames below. The scale on the map shows that 1 centimeter is equal to 75 meters. If the red line represents the path they took, how far have Ahmed, Mohammad, and Mahmoud traveled since they left the lake? Each square on the map is 1 centimeter long.

H.O.T. Problems Higher Order Thinking

7. **Model with Mathematics** On the grid paper, create a scale drawing of a room in your home. Include the scale that you used.



8. **Reason Abstractly** A statue of a camel was made using a scale of 3 centimeters = 1 centimeters Write an expression to represent the height of the statue if the camel is x centimeters in height. Then find its actual height if the height of the statue is 579 centimeters.

9. **Justify Conclusions** Determine whether the following statement is *always*, *sometimes*, or *never* true. Justify your reasoning.

If the scale factor of a scale drawing is greater than one, the scale drawing is larger than the actual object.

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Name _____ My Homework _____

Extra Practice

MP Use Math Tools **Find the actual distance between each pair of cities in New Mexico. Use a ruler to measure.**

10. Carlsbad and Artesia 50 km

Homework Help

$\frac{1 \text{ cm}}{25 \text{ km}} = \frac{2 \text{ cm}}{d \text{ km}}$

$1 \times d = 25 \times 2$

$d = 50$

11. Hobbs and Eunice _____

12. Artesia and Eunice _____

13. Lovington and Carlsbad _____

14. Find the length of the model. Then find the scale factor. The length of an actual bird is shown at the right.

1 cm = 0.5 cm

Copy and Solve **Show your work on a separate piece of paper.**

15. A model of a tree is made using a scale of 1 centimeter = 3 meters. What is the height of the actual tree if the height of the model is 11 centimeters

16. A map of Bakersfield has a scale of 1 centimeter = 3.2 kilometers. If the city is 13 centimeters across on the map, what is the actual distance across the city?

17. Tarek is creating a scale drawing of the area of his school. The rectangular drawing shows the length as 50 centimeters and the width as 47.5 centimeters. The drawing uses a scale of 1 centimeter = 36 centimeters. What is the actual area of the school in square meters?

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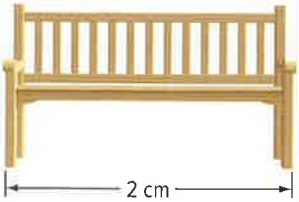
Power Up! Test Practice

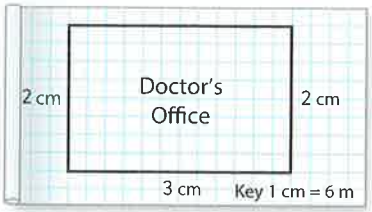
18. A landscape designer created a scale drawing of a bench that will be in a garden as shown. The actual width of the bench is 2 meters, and the actual height is 1 meter. Fill in each box to complete the following statements.



a. The scale of the drawing is ☐ centimeter(s) = ☐ meter.

b. The height of the scale drawing is ☐ centimeter(s).

19. A scale drawing of a doctor's office is shown. What are the actual dimensions of the doctor's office? Explain how you found your answer.



Spiral Review

20. A carpenter sawed a piece of wood into 3 pieces. The ratio of wood pieces is 1:3:6. The longest piece is 0.75 m longer than the shortest piece. Use the *draw a diagram* strategy to find the length of the original piece.

Solve each proportion.

21. $\frac{2}{5} = \frac{b}{25}$

22. $\frac{3}{7} = \frac{a}{49}$

23. $\frac{2}{9} = \frac{x}{99}$

24. Hala has 60 baseball cards. This is at least six more than three times as many cards as Nisreen. Write and solve an inequality to represent the situation.

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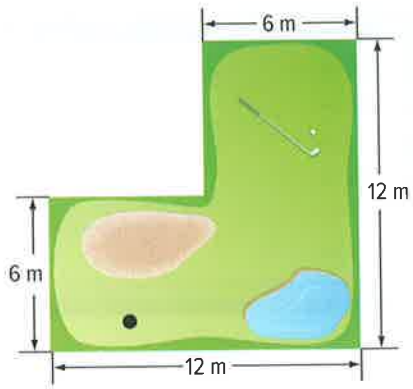
Inquiry Lab
Scale Drawings

MP **Mathematical Practices**
1, 3, 5

inquiry **WHAT happens to the size of a scale drawing when it is reproduced using a different scale?**

The owner of the miniature golf course wants to create a sign with an image of the 18th hole on it. Use the dimensions shown to create a scale drawing using the Geometer's Sketchpad®. Use the scale 1 centimeter = 3 meters.



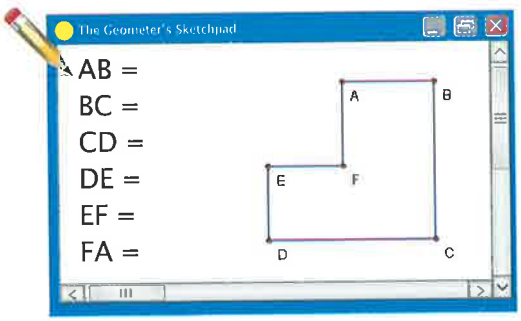
Hands-On Activity

Step 1 Determine the length the 6 meter side and the 12 meter side will be in the drawing.

Scale	Length	Scale	Length
$\frac{1 \text{ cm}}{3 \text{ m}} = \frac{x \text{ cm}}{6 \text{ m}}$		$\frac{1 \text{ cm}}{3 \text{ m}} = \frac{x \text{ cm}}{12 \text{ m}}$	
$1 \cdot 6 = 3 \cdot x$		$1 \cdot 12 = 3 \cdot x$	
$x =$ ☐		$x =$ ☐	

So, the 6 meter side will be ☐ centimeters and the 12 meter side will be ☐ centimeters in the drawing.

Step 2 Create the drawing using a dynamic geometry software. Then fill in the correct length for each line segment.



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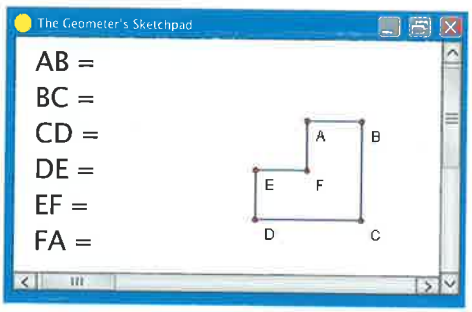
Investigate

Collaborate

Work with a partner. Use a dynamic geometry software.

1. MP **Use Math Tools** The owner wants a different size image of the 18th hole to place on the scorecards. Use the scale 1 centimeter = 6 meters. Fill in the new lengths of the line segments and draw the new scale drawing on the screen below. (*Hint:* You don't have to redraw the figure. Try clicking and dragging on the sides of your first drawing to adjust the side lengths.)



Analyze and Reflect

Collaborate

2. What happened to the size of the scale drawing when the scale changed from 1 centimeter = 3 meters to 1 centimeter = 6 meters?

Create

On Your Own

3. MP **Reason Inductively** Suppose you drew the miniature golf hole again at the scale 1 centimeter = 2 meters. Would the size of your drawing be larger or smaller than the drawing in the Activity? Explain.

4. Inquiry WHAT happens to the size of a scale drawing when it is reproduced using a different scale?

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Lesson 5

Draw Three-Dimensional Figures

Real-World Link

New York City In art class, Rasheed studied buildings known for their unusual architecture. He studied the Flatiron Building shown.

Three-dimensional figures, such as the Flatiron Building, have length, width, and height. They can be viewed from different perspectives, including the *side* view and the *top* view.

1. What is the two-dimensional figure that makes up the side view?

2. What is the two-dimensional figure that makes up the top view?

3. Sketch the side view of the Flatiron Building.

4. Sketch the top view of the Flatiron Building.

Show your work.

5. The top view, side view, and front view of a three-dimensional figure are shown below. Sketch the figure.

top

side

front

Essential Question

HOW does geometry help us describe real-world objects?

MP Mathematical Practices
1, 3, 4

Which MP Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

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Work Zone

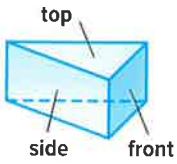
Draw a Three-Dimensional Figure

You can draw different views of three-dimensional figures. The most common views drawn are the top, side, and front views.

The top, side, and front views of a three-dimensional figure can be used to draw a corner view of the figure.

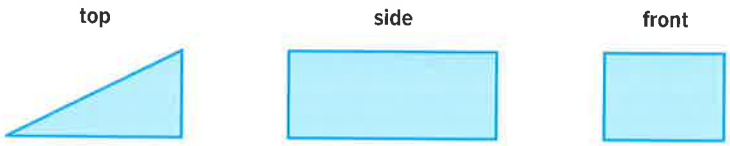
Examples

1. **Draw a top, a side, and a front view of the figure at the right.**



The top view is a triangle.

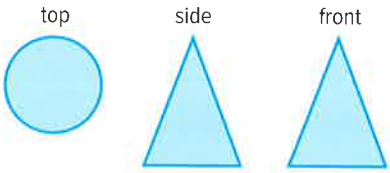
The side and front view are rectangles.



2. **Draw a top, a side, and a front view of the figure at the right.**

The top view is a circle.

The side and front view are triangles.



Show your work.

Got it? **Do this problem to find out.**

a. Draw a top, a side, and a front view of the figure at the right.

a. _____

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Example

3. **Draw a top, a side, and a front view of the video console shown.**

The top view is a rectangle.

The side and front views are also rectangles.

Got it? **Do this problem to find out.**

b. Draw a top, a side, and a front view of the tent shown.

Show your work.

b. _____

Example

4. **Draw a corner view of the three-dimensional figure whose top, side, and front views are shown.**

top

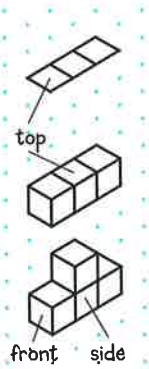
side

front

Step 1 Use the top view to draw the base of the figure, a 1-by-3 rectangle.

Step 2 Add edges to make the base a solid figure.

Step 3 Use the side and front views to complete the figure.



Got it? **Do this problem to find out.**

c. Draw a corner view of the three-dimensional figure whose top, side, and front views are shown.

top

side

front

c. _____

Plane Figures

In geometry, three-dimensional figures are solids and two-dimensional figures such as triangles, circles, and squares are plane figures.

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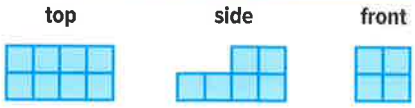
Example

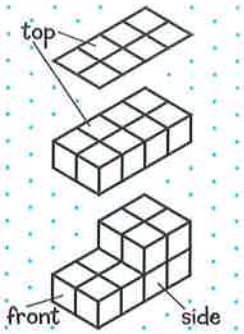
5. **Draw a corner view of the three-dimensional figure whose top view, side view, and front view are shown.**



Step 1 Use the top view to draw the base of the figure, a 2-by-4 rectangle.

Step 2 Add edges to make the base a solid figure.

Step 3 Use the side and front views to complete the figure.



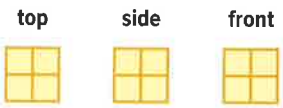
Guided Practice

Check

1. Draw a top, a side, and a front view of the figure. (Examples 1–3)

Show your work.

2. Draw a corner view of the three-dimensional figure whose top view, side view, and front view are shown. (Examples 4–5)



3. **Building on the Essential Question** How does drawing the different views of a three-dimensional figure help you have a better understanding of the figure?

Rate Yourself!

How confident are you about drawing three-dimensional figures? Check the box that applies.

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Name _____ My Homework _____

Independent Practice

Draw a top, a side, and a front view of each figure. (Examples 1–2)

1

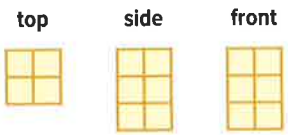
Show your work.

2.

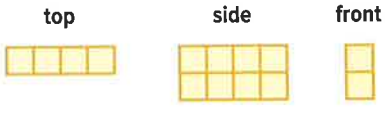
3 Draw a top, a side, and a front view of the eraser shown. (Example 3)

Draw a corner view of each three-dimensional figure whose top view, side view, and front view are shown. (Examples 4–5)

4.



5.



6. Name a real-world object that has a top view of a triangle, and a side and front view that are each rectangles. _____

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7. **Model with Mathematics** The Quetzalcoatl pyramid in Mexico is shown. Use the photo to sketch views from the top, side, and front of the pyramid.

H.O.T. Problems Higher Order Thinking

8. **Model with Mathematics** Choose an object in your classroom or in your home. Sketch any view of the object. Choose among a top, a side, or a front view.

9. **Which One Doesn't Belong?** Identify the figure that does not have the same characteristic as the other three. Explain your reasoning.

10. **Persevere with Problems** Draw a three-dimensional figure in which the front and top views each have a line of symmetry but the side view does not.

11. **Reason Inductively** Determine whether each statement is *always, sometimes,* or *never* true.

a. The bases of a cylinder have different radii. _____

b. Two planes intersect in a single point. _____

c. Three planes do not intersect in a point. _____

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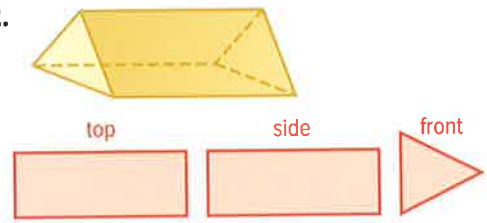
Name _____ My Homework _____

Extra Practice

Draw a top, a side, and a front view of each figure.

12.

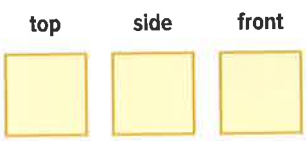


Homework Help

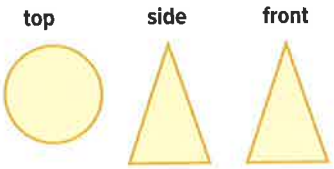
13.

Draw a corner view of each three-dimensional figure whose top view, side view, and and front view are shown.

14.



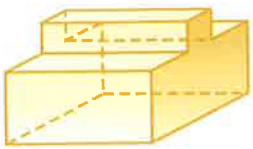
15.



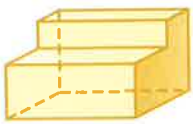
Draw a top, a side, and a front view of each figure.

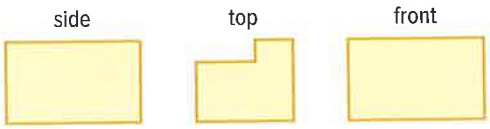
16.

17.



18. MP **Find the Error** Ahmed drew the side, top, and front view of the figure shown at the right. Find his mistake and correct it.





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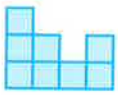
Power Up! Test Practice

19. The top, side, and front view of a figure made of cubes are shown.

top

front

side



Which of the following can be represented by these views? Select all that apply.

☐ 

☐ 

☐ 

☐ 

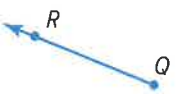
20. Draw the front, top, and side views of the three-dimensional figure shown at the right.

Spiral Review

Identify each figure as a *line segment*, *line*, or *ray*. Then name each figure using symbols. 5.G.3

21.

22.



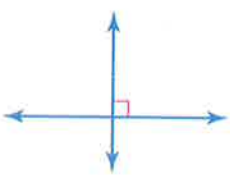
23.

Describe each pair of lines as *intersecting*, *perpendicular*, or *parallel*. Choose the most specific term. 5.G.3

24.

25.

26.



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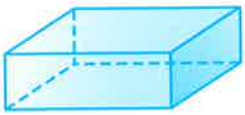
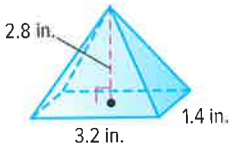
Lesson 6
Cross Sections

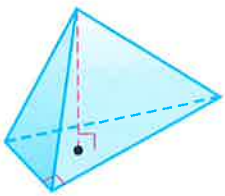
Vocabulary Start-Up

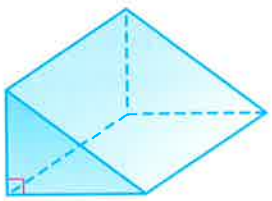
A **prism** is a three-dimensional figure with at least two parallel, congruent faces called **bases** that are polygons. A **pyramid** is a three-dimensional figure with one base that is a polygon. Its other faces are triangles.

Write *prism* or *pyramid* on the line below each figure.









Real-World Link

The Heroes Arts Club is shown below. Is the shape of the building a *prism* or *pyramid*? Explain.

Essential Question

HOW does geometry help us describe real-world objects?

Vocabulary

prism
bases
pyramid
plane
coplanar
parallel
polyhedron
edge
face
vertex
diagonal
skew lines
cylinder
cone
cross section

Mathematical Practices
1, 3, 4

Which Mathematical Practices did you use? Shade the circle(s) that applies.

1. Persevere with Problems
2. Reason Abstractly
3. Construct an Argument
4. Model with Mathematics
5. Use Math Tools
6. Attend to Precision
7. Make Use of Structure
8. Use Repeated Reasoning

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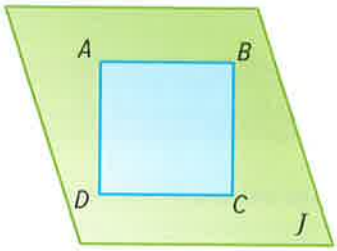
Work Zone

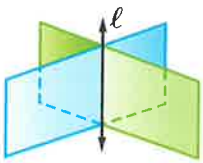
Identify Three-Dimensional Figures

A **plane** is a flat surface that goes on forever in all directions. The figure at the right shows rectangle *ABCD*. Line segments *AB* and *DC* are **coplanar** because they lie in the same plane. They are also **parallel** because they will never intersect, no matter how far they are extended.

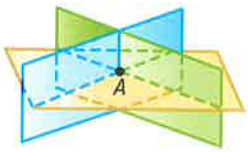


Just as two lines in a plane can intersect or be parallel, there are different ways that planes may be related in space.

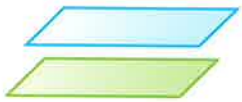
Intersect in a Line



Intersect at a Point

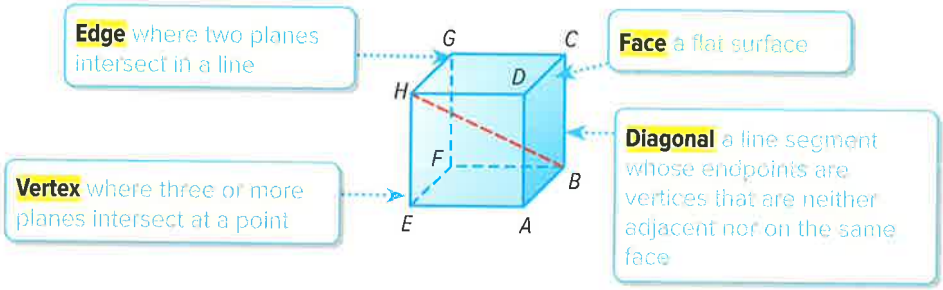


No Intersection



These are called *parallel planes*.

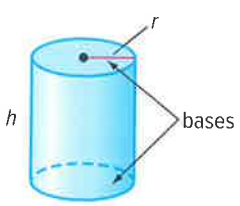
Intersecting planes can form three-dimensional figures. A **polyhedron** is a three-dimensional figure with flat surfaces that are polygons. Prisms and pyramids are both polyhedrons. Some terms associated with three-dimensional figures are *edge*, *face*, *vertex*, and *diagonal*.



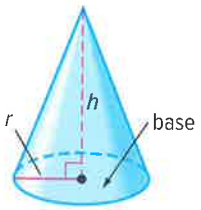
Notice in the figure above, $\overline{GC}$ and $\overline{DA}$ do not intersect. These segments are not parallel because they do not lie in the same plane. Lines that do not intersect and are not coplanar are called **skew lines**.

There are also solids that are not polyhedrons. A **cylinder** is a three-dimensional figure with two parallel congruent circular bases connected by a curved surface. A **cone** has one circular base connected by a curved side to a single vertex.

cylinder



cone



Polygons

The table below lists some common names of polygons.

Sides	Name
5	pentagon
6	hexagon
7	heptagon
8	octagon
9	nonagon
10	decagon

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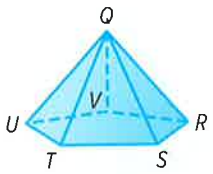
Examples

Identify the figure. Name the bases, faces, edges, and vertices. Then, identify a pair of skew lines.

1. 

The figure has one base that is a pentagon, so it is a pentagonal pyramid.

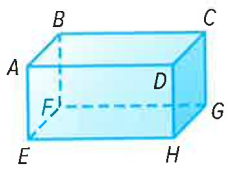
base: *RSTUV*

faces: *RSTUV, QVR, QRS, QST, QTU, QUV*

edges: $\overline{QR}$, $\overline{QS}$, $\overline{QT}$, $\overline{QU}$, $\overline{QV}$, $\overline{VR}$, $\overline{RS}$, $\overline{ST}$, $\overline{TU}$, $\overline{UV}$

vertices: *Q, R, S, T, U, V*

skew lines: $\overline{QV}$ and $\overline{TS}$

2. 

The figure has rectangular bases that are parallel and congruent, so it is a rectangular prism.

bases: *ABCD* and *EFGH*, *ABFE* and *DCGH*, *ADHE* and *BCGF*

faces: *ABCD, EFGH, ABFE, DCGH, ADHE, BCGF*

edges: $\overline{AB}$, $\overline{BC}$, $\overline{CD}$, $\overline{AD}$, $\overline{EF}$, $\overline{FG}$, $\overline{GH}$, $\overline{EH}$, $\overline{AE}$, $\overline{BF}$, $\overline{CG}$, $\overline{DH}$

vertices: *A, B, C, D, E, F, G, H*

skew lines: $\overline{AE}$ and $\overline{FG}$

Got it? **Do this problem to find out.**

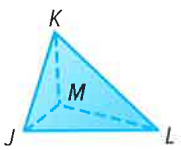
a. 

figure name: _____

base: _____

faces: _____

edges: _____

vertices: _____

skew lines : _____

Common Error

In the drawing of a rectangular prism, the bases do not have to be on the top and bottom. Any two parallel rectangles are bases. In a triangular pyramid, any face is a base.

Identify Cross Sections

The intersection of a solid and a plane is called a **cross section** of the solid.

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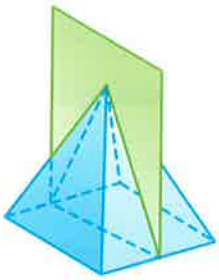
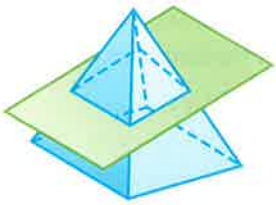
Example

3. **Describe the shape resulting from a vertical, angled, and horizontal cross section of a square pyramid.**



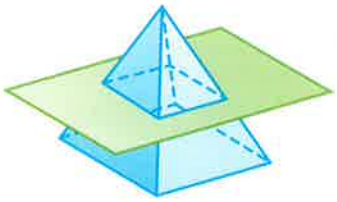
Vertical Slice

The cross section is a triangle.



Angled Slice

The cross section is a trapezoid.



Horizontal Slice

The cross section is a square.

Show your work.

Got it? **Do this problem to find out.**

b. _____

b. Describe the shape resulting from a vertical, angled, and horizontal cross section of a cylinder.

Guided Practice

Check

1. Identify the figure. Then name the bases, faces, edges, and vertices. Then, identify a pair of skew lines. (Examples 1–2)

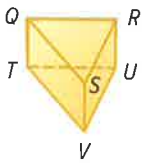


figure name: _____

bases: _____

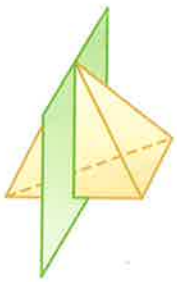
faces: _____

edges: _____

vertices: _____

skew lines: _____

2. Describe the shape resulting from the cross section shown. (Example 3) _____



3. **Building on the Essential Question** How can knowing the shape of the base of a three-dimensional figure help you name the figure?

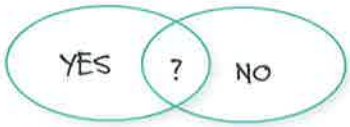
_____

_____

_____

Rate Yourself!

Are you ready to move on? Shade the section that applies.



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Name _____ My Homework _____

Independent Practice

Identify each figure. Name the bases, faces, edges, and vertices. Then, identify a pair of skew lines. (Examples 1–2)

1

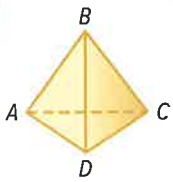


figure name: _____

bases: _____

faces: _____

_____

edges: _____

_____

vertices: _____

skew lines: _____

2.

figure name: _____

bases: _____

faces: _____

_____

edges: _____

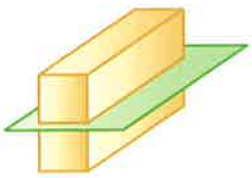
_____

vertices: _____

skew lines _____

Describe the shape resulting from each cross section. (Example 3)

3



_____

4.

_____

5.

_____

6. A basketball is shaped like a *sphere*.

   a. Draw a basketball with a vertical, angled, and horizontal slice.

Show your work.

   b. Describe the cross section made by each slice.

_____

   c. Is the basketball a polyhedron? Explain.

_____

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7. MP **Use a Counterexample** State whether the following conjecture is *true* or *false*. If *false*, provide a counterexample.

Two planes in three-dimensional space can intersect at one point.

8. Draw and label a hexagonal prism. Then identify each of the following.

   a. parallel planes

   b. skew lines

   c. intersecting planes

Show your work.

H.O.T. Problems Higher Order Thinking

9. MP **Model with Mathematics** Draw the cross sections of a polyhedron, cylinder, or cone. Exchange papers with another student. Identify the three-dimensional figures represented by the cross sections.

Show your work.

MP **Persevere with Problems** **Determine whether each statement is *always*, *sometimes*, or *never* true. Explain your reasoning.**

10. A pyramid has parallel faces.

11. A prism has 2 bases and 4 faces.

12. A parallelogram cannot be a cross section of a triangular prism.

13. A pyramid has a rectangular base.

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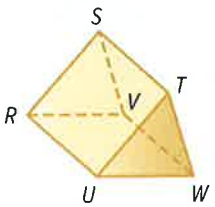
Name _____ My Homework _____

Extra Practice

Identify each figure. Then name the bases, faces, edges, and vertices. Then identify a pair of skew lines.

14.



Homework Help

figure name: triangular prism

bases: RSV and UTW

faces: RSV, UTW, RSTU, SVWT, VRUW

edges: $\overline{RS}$, $\overline{SV}$, $\overline{RV}$, $\overline{UT}$, $\overline{TW}$, $\overline{UW}$, $\overline{RU}$, $\overline{VW}$, $\overline{ST}$

vertices: R, S, T, U, V, W

skew lines: Sample answer: $\overline{TU}$ and $\overline{WV}$

15.

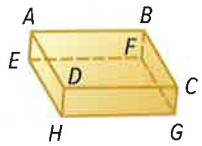


figure name: _____

bases: _____

faces: _____

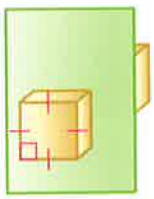
edges: _____

vertices: _____

skew lines: _____

Describe the shape resulting from each cross section. (Example 4)

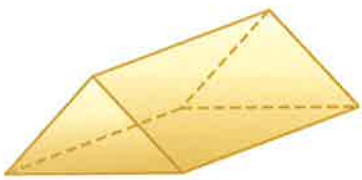
16.



17.

18.

19. MP **Find the Error** Sally is identifying the figure at the right. Find her mistake and correct it.



The figure has a triangular base. It is a triangular pyramid.

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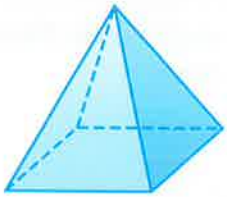
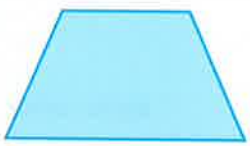
Power Up! Test Practice

20. The figure shown is a square pyramid. Which of the following are cross sections of the pyramid? Select all that apply.





21. Match each number of faces, edges, and vertices to the correct solid figure.

Figure 1
Figure 2
Figure 3

Figure 1

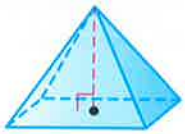


Figure 2

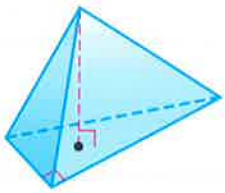
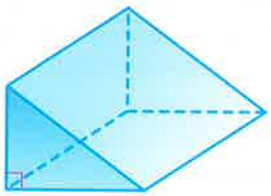


Figure 3



a. 4 faces, 6 edges, 4 vertices

b. 5 faces, 8 edges, 5 vertices

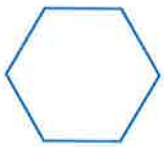
c. 5 faces, 9 edges, 6 vertices

Spiral Review

Name each polygon.

22.

23.



24.

25. Find the measure of the missing angle of the polygon.

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21ST CENTURY CAREER in Design Engineering

Roller Coaster Designer

If you have a passion for amusement parks, a great imagination, and enjoy building things, you might want to consider a career in roller coaster design. Roller coaster designers combine creativity, engineering, mathematics, and physics to develop rides that are both exciting and safe. In order to analyze data and make precise calculations, a roller coaster designer must have a solid background in high school math and science.

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Is This the Career for You?

Are you interested in a career as a roller coaster designer? Take some of the following courses in high school to get started in the right direction.

- Algebra
- Calculus
- Geometry
- Physics
- Trigonometry

Turn the page to find out how math relates to a career in Design Engineering.

MP A Thrilling Ride

Use the information in the table to solve each problem.

1. In a scale drawing of SheiKra, a designer uses a scale of 1 centimeter = 2 meters. What is the height of the roller coaster in the drawing? _____

2. On a model of Montu, the height of the loop is 32 centimeters. What is the scale? _____

3. In a scale drawing of Montu, the height of the roller coaster is 25 centimeters. What is the scale factor? _____

4. SheiKra has a hill that goes through a tunnel. On a model of the roller coaster, the hill is 60 centimeters tall and the scale is 1 centimeter = 0.75 meter. What is the actual height of the tunnel hill? _____

5. An engineer is building a model of SheiKra. She wants the model to be about 80 centimeters high. Choose an appropriate scale for the model. Then use it to find the loop height of the model. _____

Busch Gardens Tampa

Roller Coaster	Coaster Height (m)	Loop Height (m)
SheiKra	60	45
Montu	50	32

MP Career Project

It's time to update your career portfolio! Describe a roller coaster that you, as a roller coaster designer, would create. Include the height and angle of the tallest drop, the total length, maximum speed, number of loops and tunnels, and color scheme. Be sure to include the name of your roller coaster.

What problem-solving skills might you use as a roller coaster designer?

- _____
- _____
- _____
- _____
- _____

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Chapter Review

Vocabulary Check

Complete the crossword puzzle using the vocabulary list at the beginning of the chapter.

Across

2. a three-dimensional figure with two parallel, congruent bases that are polygons

4. a triangle with an angle greater than 90 degrees and less than 180 degrees

8. a three-dimensional figure with two parallel congruent circular bases connected by a curved surface

11. a triangle with three congruent sides

12. segments with the same length

14. used to represent an object that is too large to be built at actual size (2 words)

15. two angles with a sum of 90 degrees

Down

1. angles that share a common vertex, a common side, and do not overlap

3. two angles with a sum of 180 degrees

5. a figure with three sides and three angles

6. the ratio that compares the measurements of a model and the real object

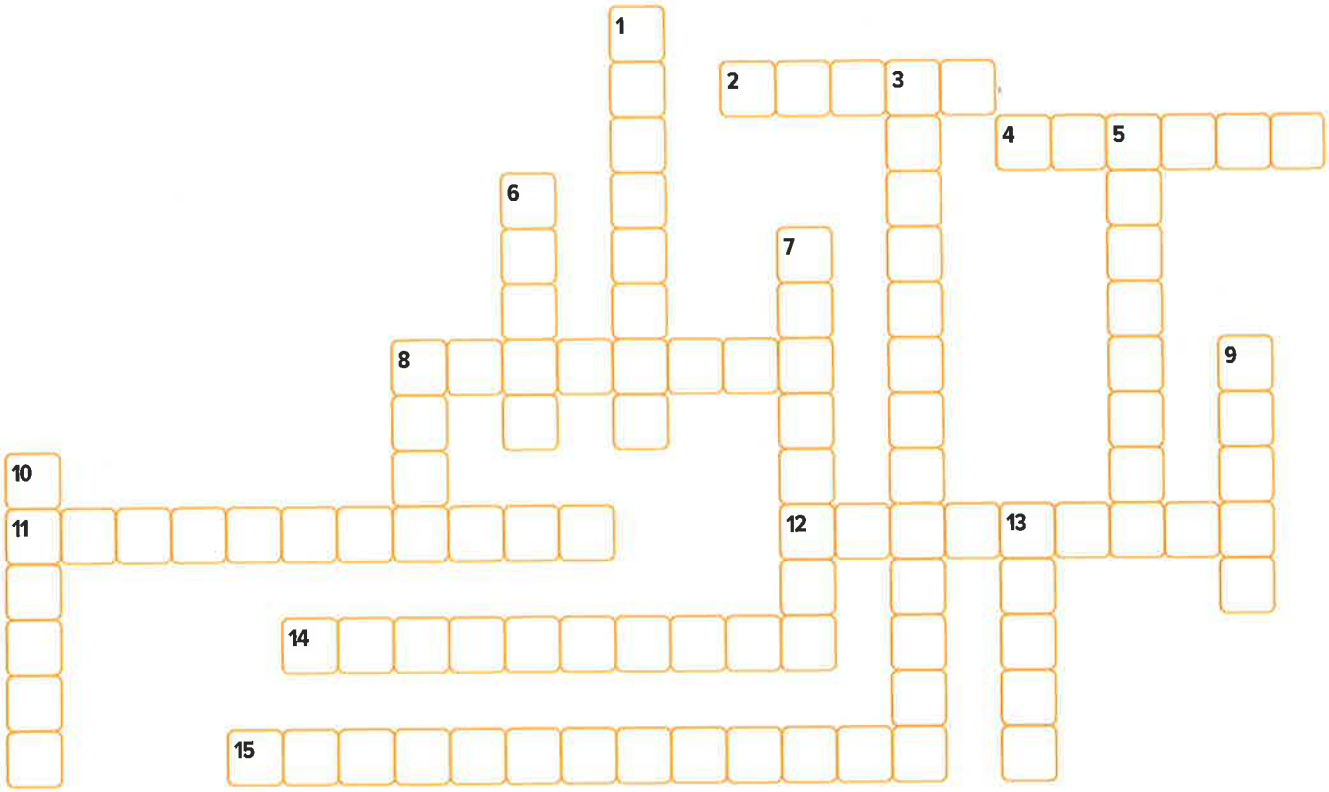
7. opposite angles that are formed by the intersection of two lines

8. a three-dimensional figure with one circular base connected by a curved side to a single vertex

9. an angle less than 90 degrees

10. where two rays meet to form an angle

13. a 90 degree angle



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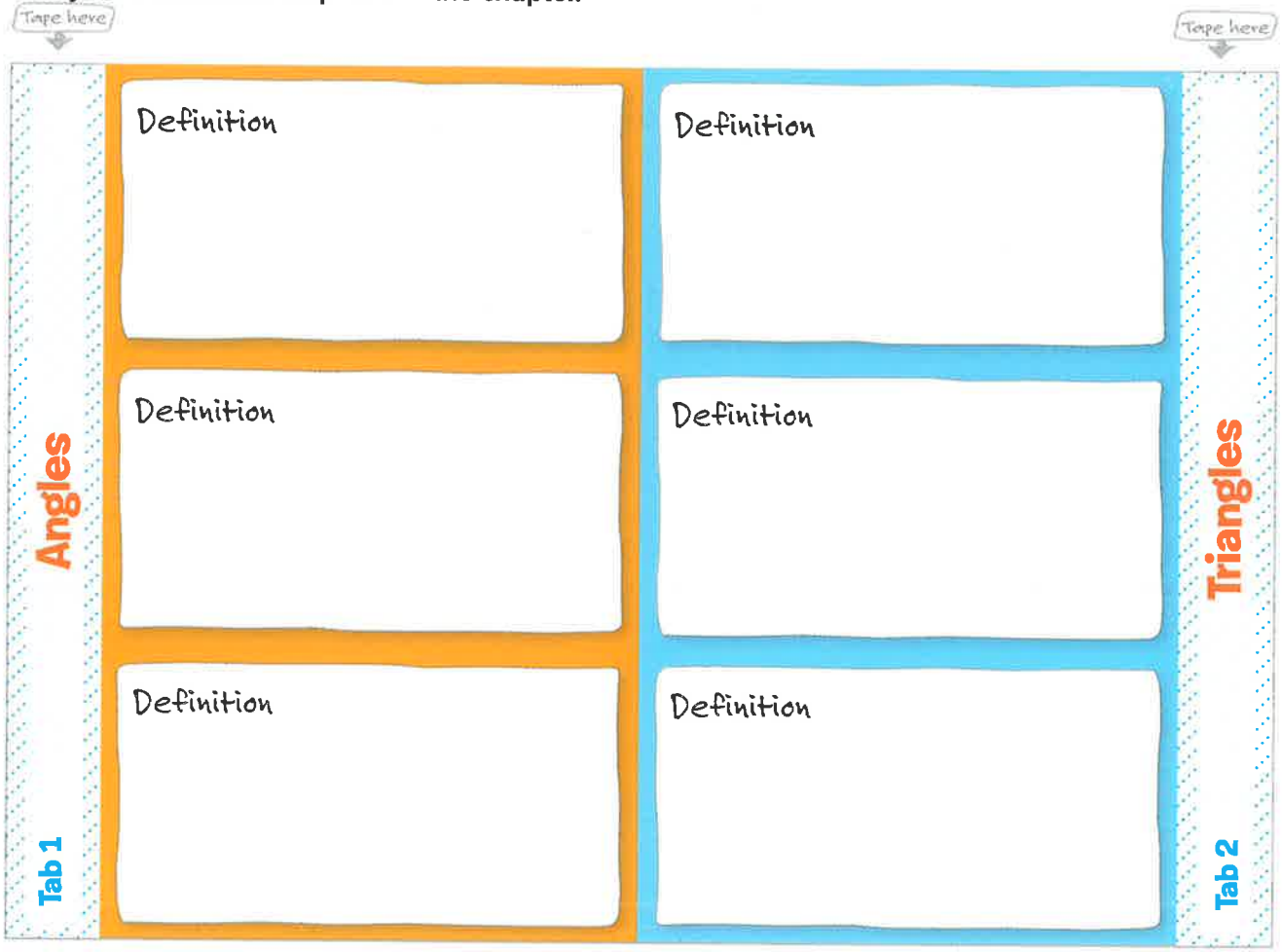
Use Your FOLDABLES

Use your Foldable to help review the chapter.



Got it?

Circle the correct term or number to complete each sentence.

1. The point where two rays meet is the (base, vertex).
2. Opposite angles formed by the intersection of two lines are (vertical, adjacent) angles.
3. Two angles are complementary if the sum of their measures is (90°, 180°).
4. A scalene triangle has (all, no) congruent sides.
5. A (scale drawing, three-dimensional figure) is used to represent objects that are too large or too small to be drawn or built at actual size.

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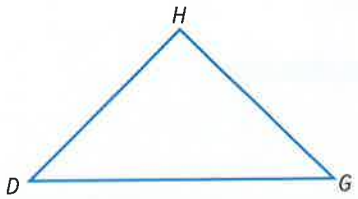
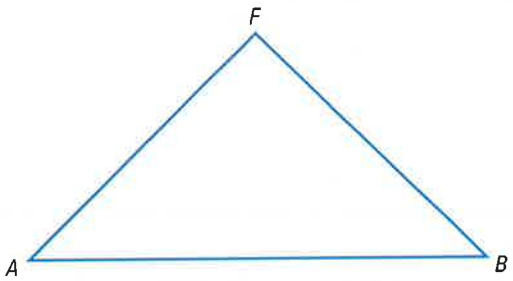
Power Up! Performance Task

Stacking Triangles

Abdalla has drawn two different triangles.





Write your answers on another piece of paper. Show all of your work to receive full credit.

Part A

Triangle *DHG* is a scale drawing of triangle *AFB*. Use a ruler. Measure and label the side lengths of triangle *AFB* and triangle *DHG*. What scale factor was used to make triangle *DHG*?

Part B

Use a scale factor of 2 to make a new scale drawing of triangle *DHG*. Label the new triangle *XYZ*.

Part C

Extend line *DG* though point *J* and extend line *HG* through point *K*. Find the measure of angle *HGJ* and angle *JGK*. Name a pair of complementary or supplementary angles. Justify your response.

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Reflect

Answering the Essential Question

Use what you learned about geometric figures to complete the graphic organizer.

How do polygons help us describe real-world objects?

Essential Question

HOW does geometry help us describe real-world objects?

How do polyhedrons help us describe real-world objects?

Answer the Essential Question. HOW does geometry help us describe real-world objects?

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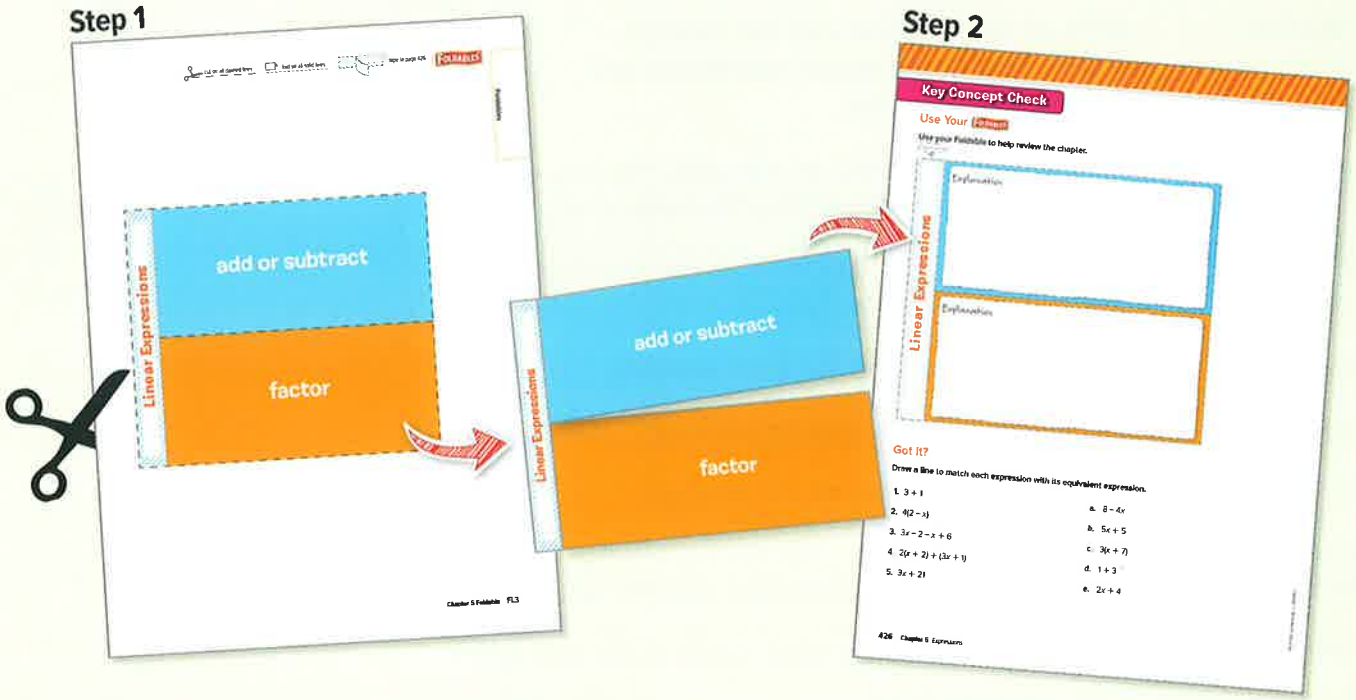
FOLDABLES® Study Organizers

What Are Foldables and How Do I Create Them?

Foldables are three-dimensional graphic organizers that help you create study guides for each chapter in your book.

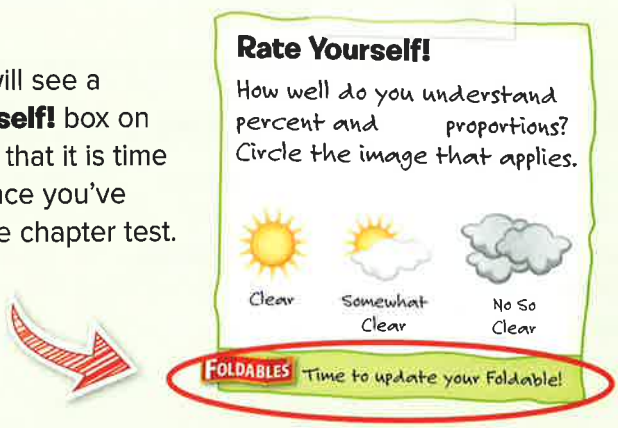
Step 1 Go to the back of your book to find the Foldable for the chapter you are currently studying. Follow the cutting and assembly instructions at the top of the page.

Step 2 Go to the Key Concept Check at the end of the chapter you are currently studying. Match up the tabs and attach your Foldable to this page. Dotted tabs show where to place your Foldable. Striped tabs indicate where to tape the Foldable.



How Will I Know When to Use My Foldable?

When it's time to work on your Foldable, you will see a Foldables logo at the bottom of the **Rate Yourself!** box on the Guided Practice pages. This lets you know that it is time to update it with concepts from that lesson. Once you've completed your Foldable, use it to study for the chapter test.



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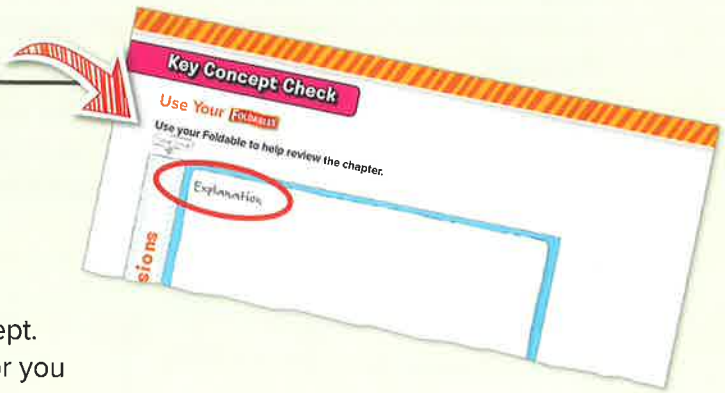
How Do I Complete My Foldable?

No two Foldables in your book will look alike. However, some will ask you to fill in similar information. Below are some of the instructions you'll see as you complete your Foldable. **HAVE FUN** learning math using Foldables!

Instructions and what they mean



Best Used to...	Complete the sentence explaining when the concept should be used.
Definition	Write a definition in your own words.
Description	Describe the concept using words.
Equation	Write an equation that uses the concept. You may use one already in the text or you can make up your own.
Example	Write an example about the concept. You may use one already in the text or you can make up your own.
Formulas	Write a formula that uses the concept. You may use one already in the text.
How do I ...?	Explain the steps involved in the concept.
Models	Draw a model to illustrate the concept.
Picture	Draw a picture to illustrate the concept.
Solve Algebraically	Write and solve an equation that uses the concept.
Symbols	Write or use the symbols that pertain to the concept.
Write About It	Write a definition or description in your own words.
Words	Write the words that pertain to the concept.

Meet Foldables Author Dinah Zike

Dinah Zike is known for designing hands-on manipulatives that are used nationally and internationally by teachers and parents. Dinah is an explosion of energy and ideas. Her excitement and joy for learning inspires everyone she touches.

Courtesy of Dinah Zike
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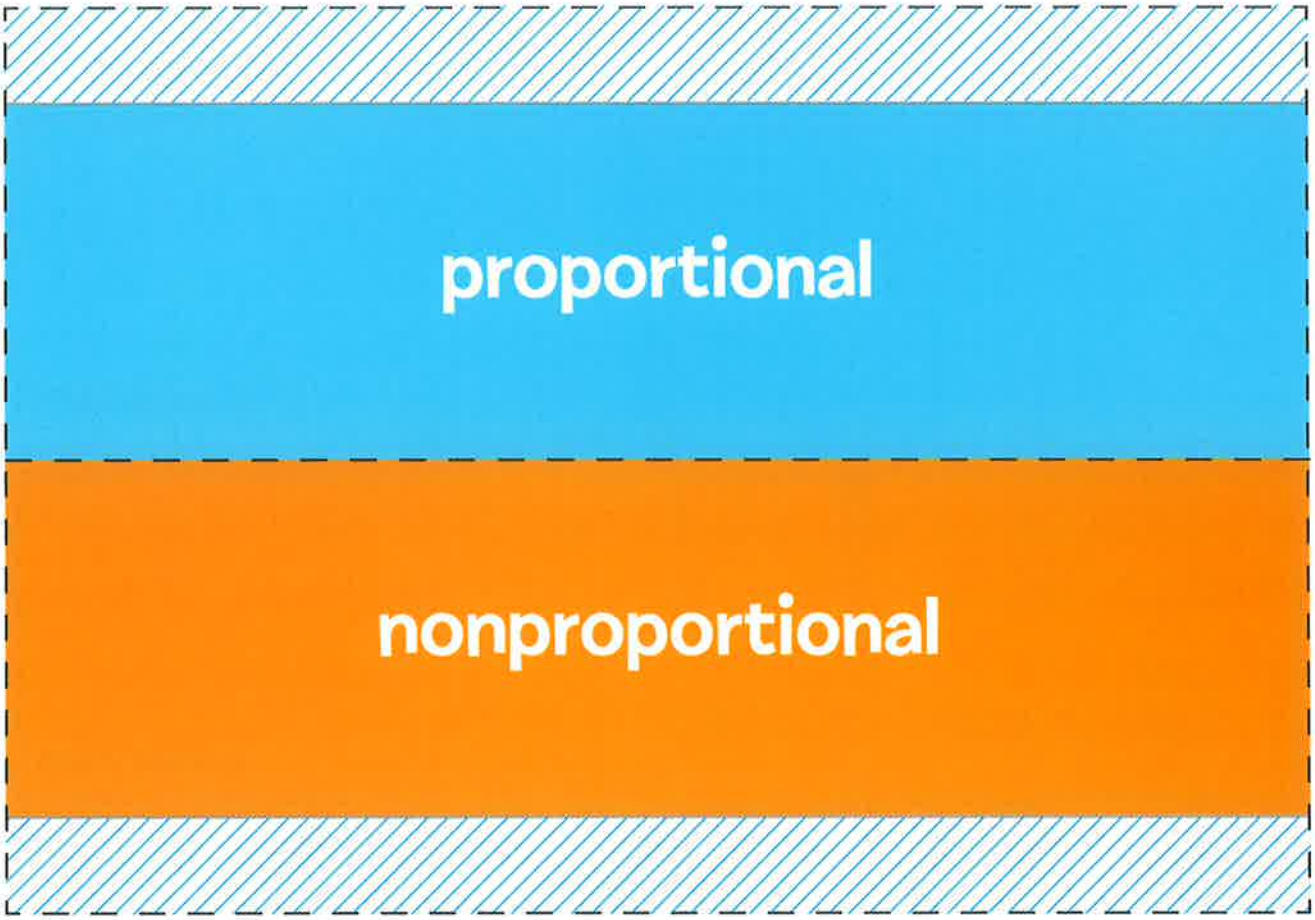

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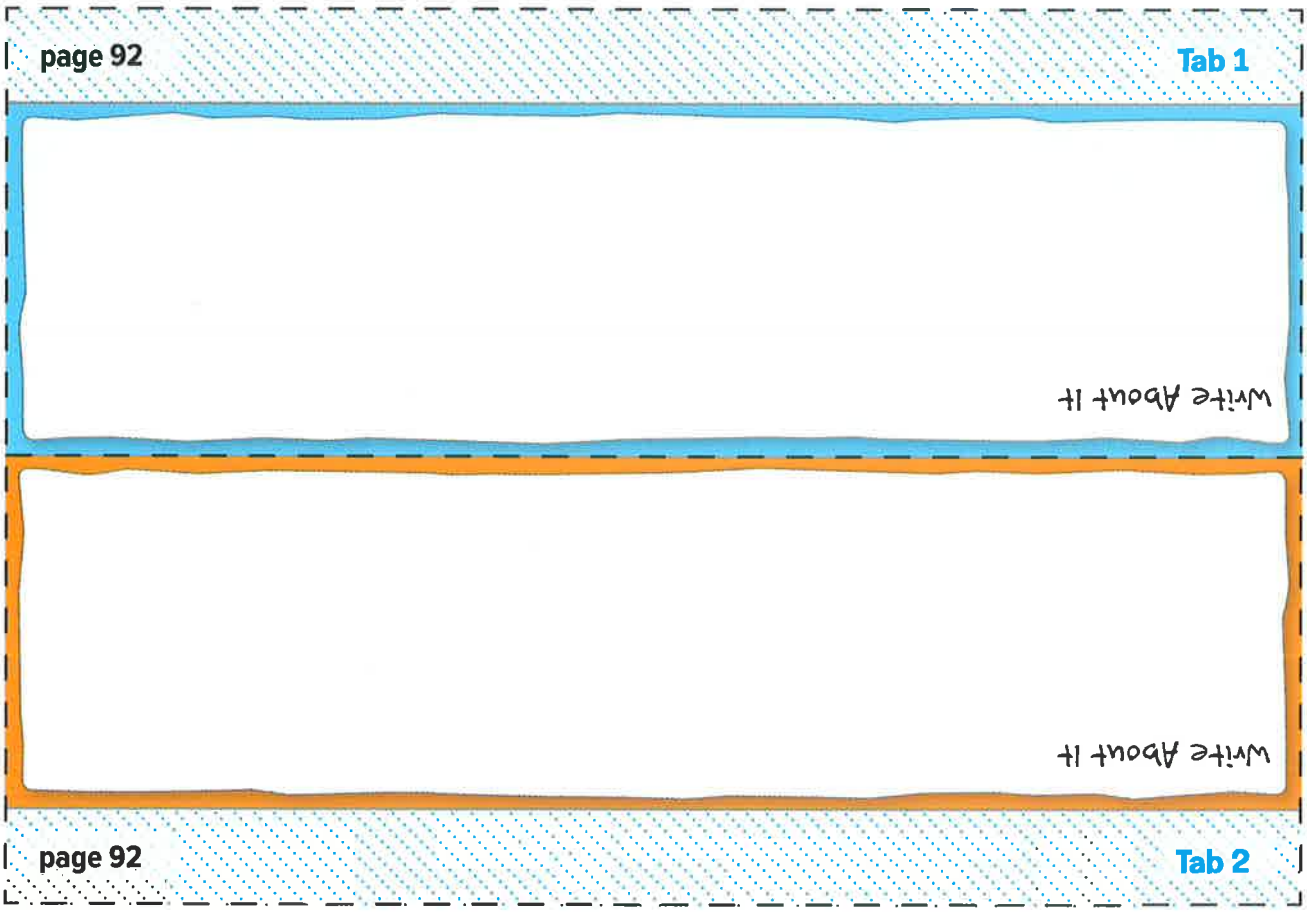

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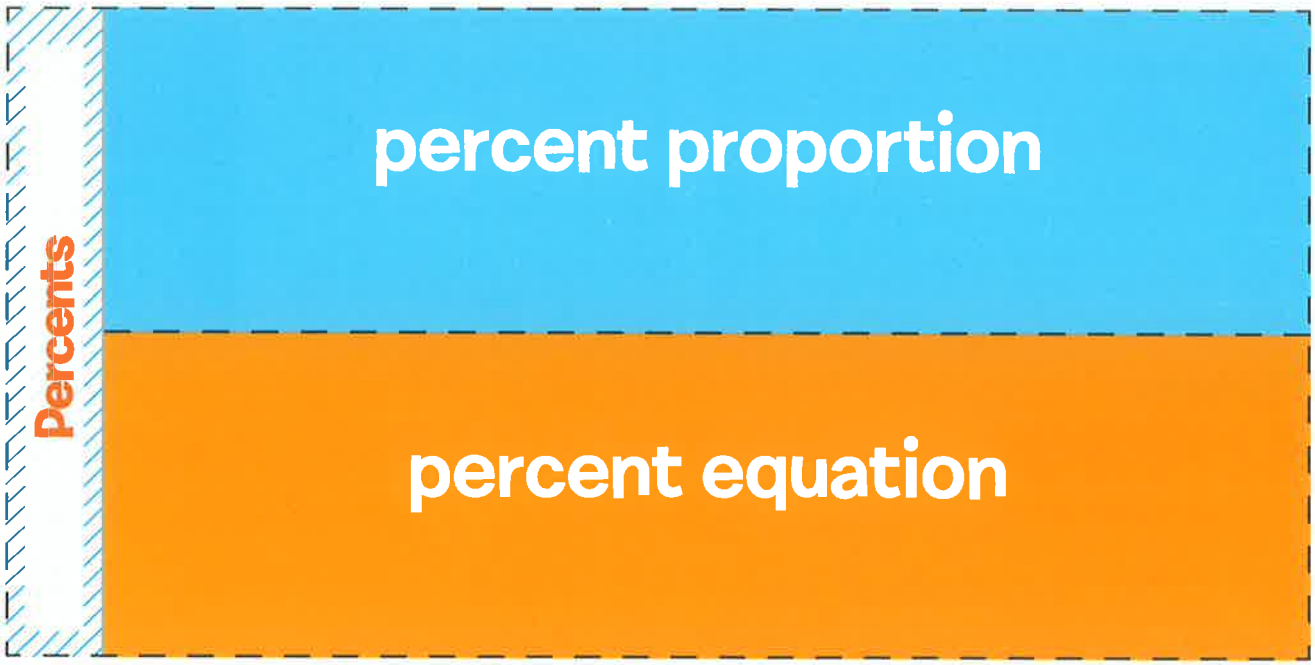

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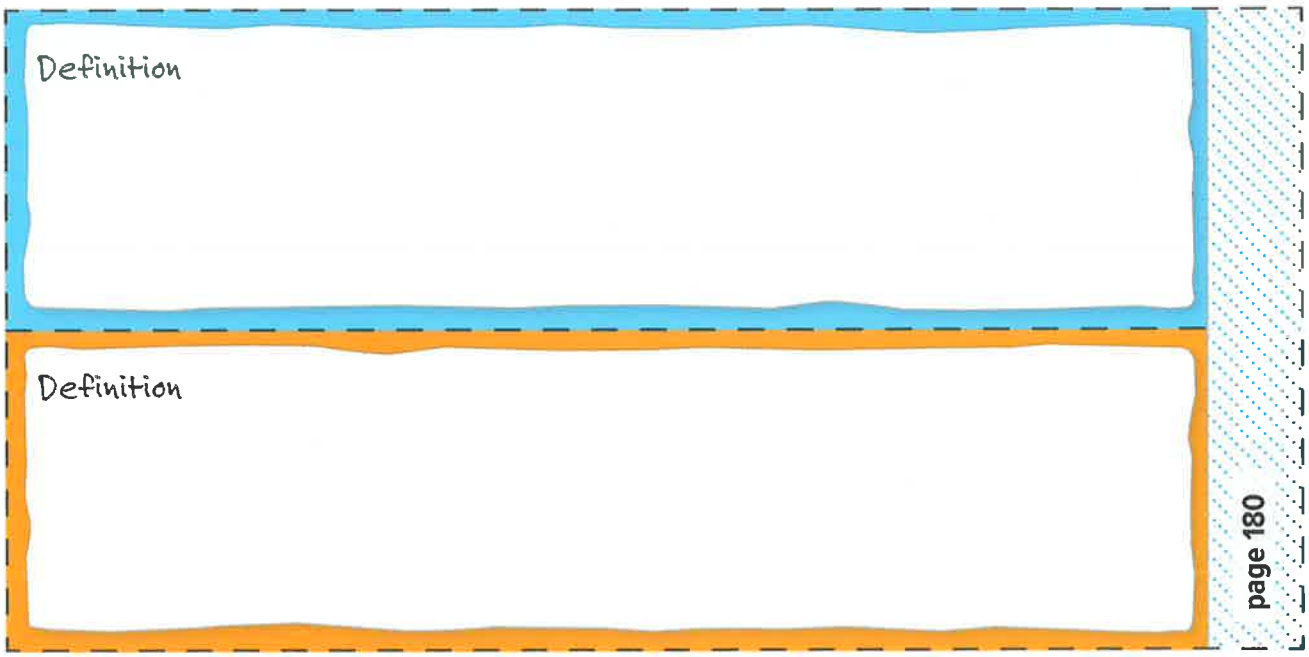

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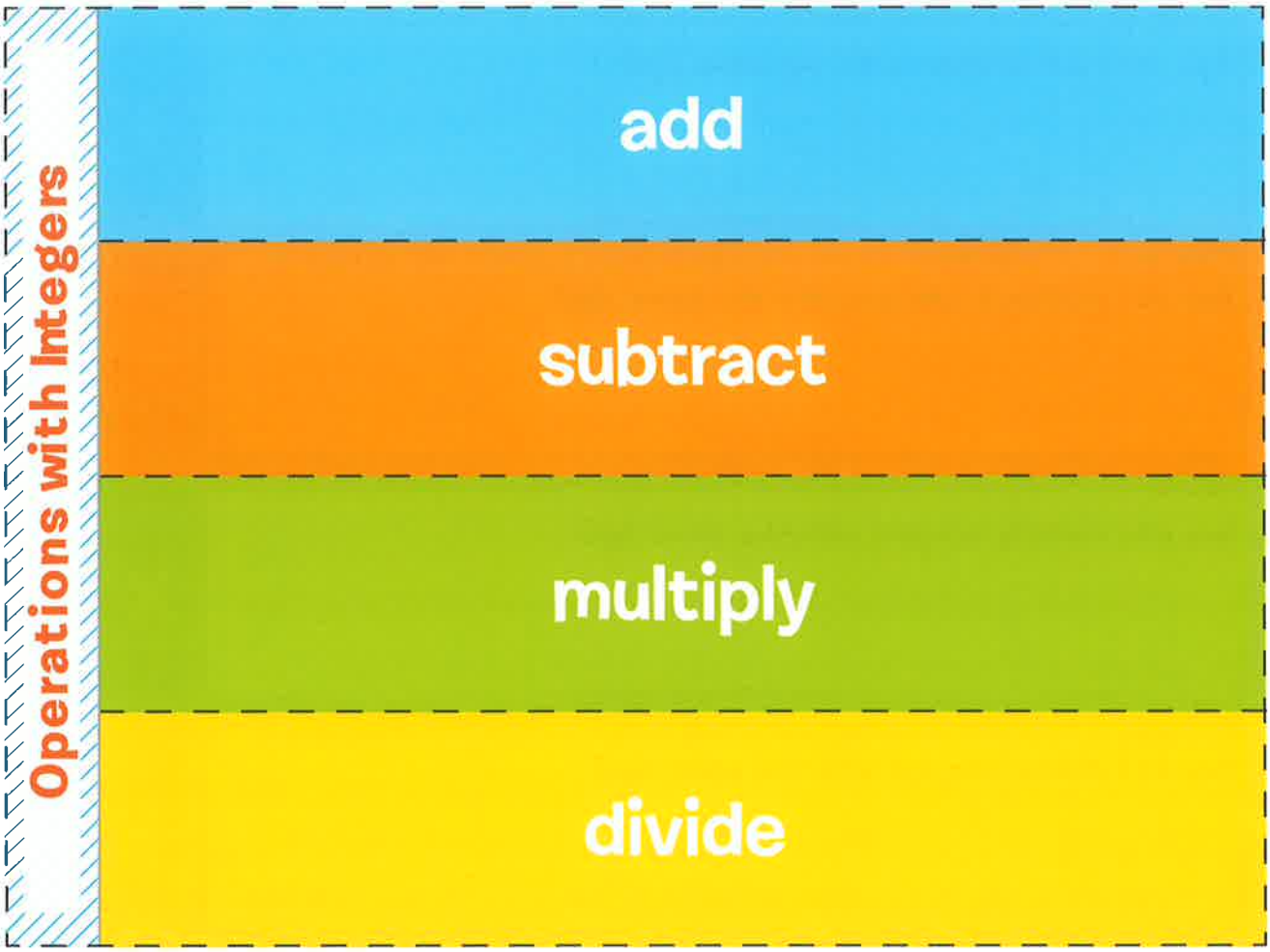

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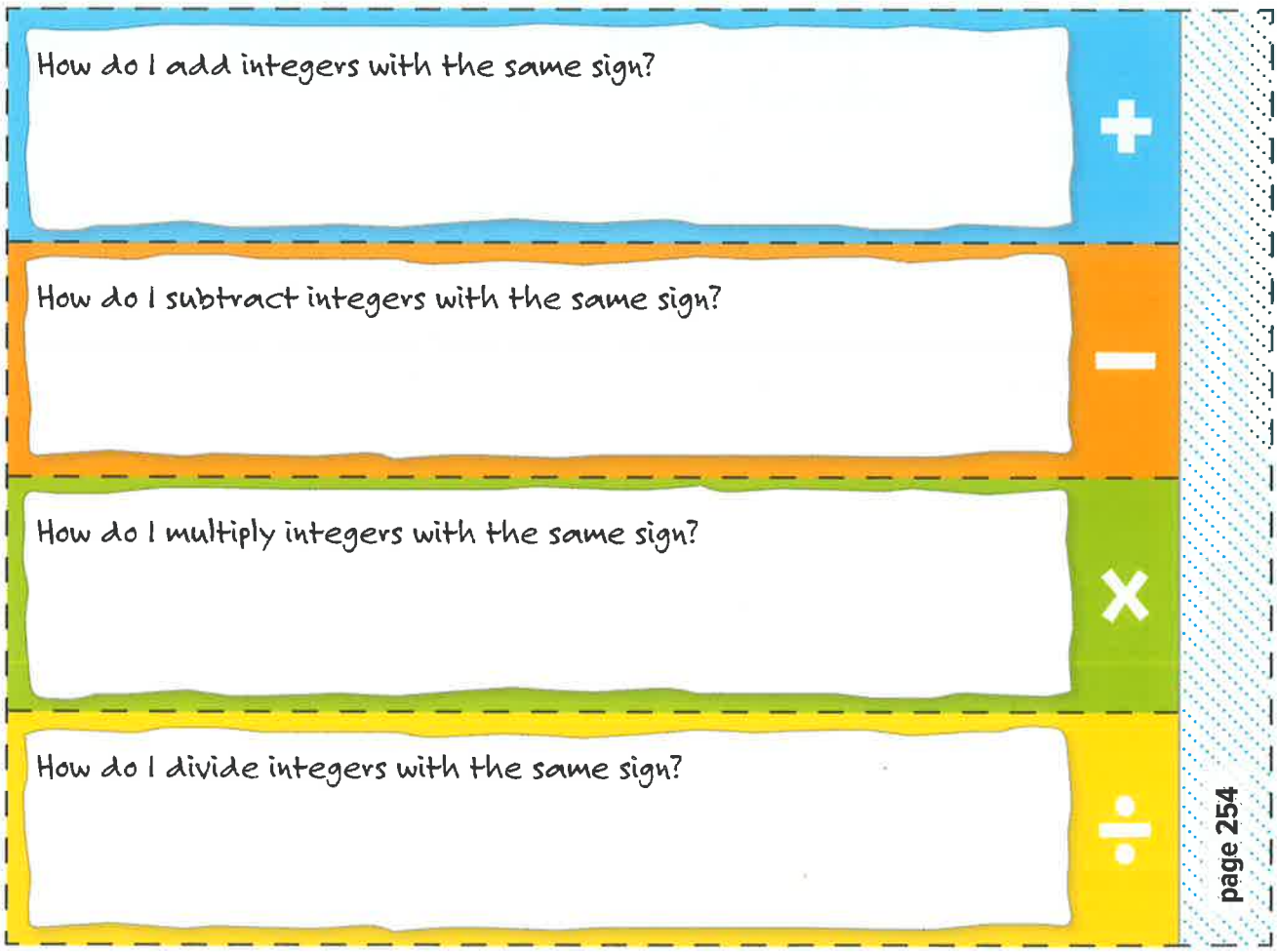

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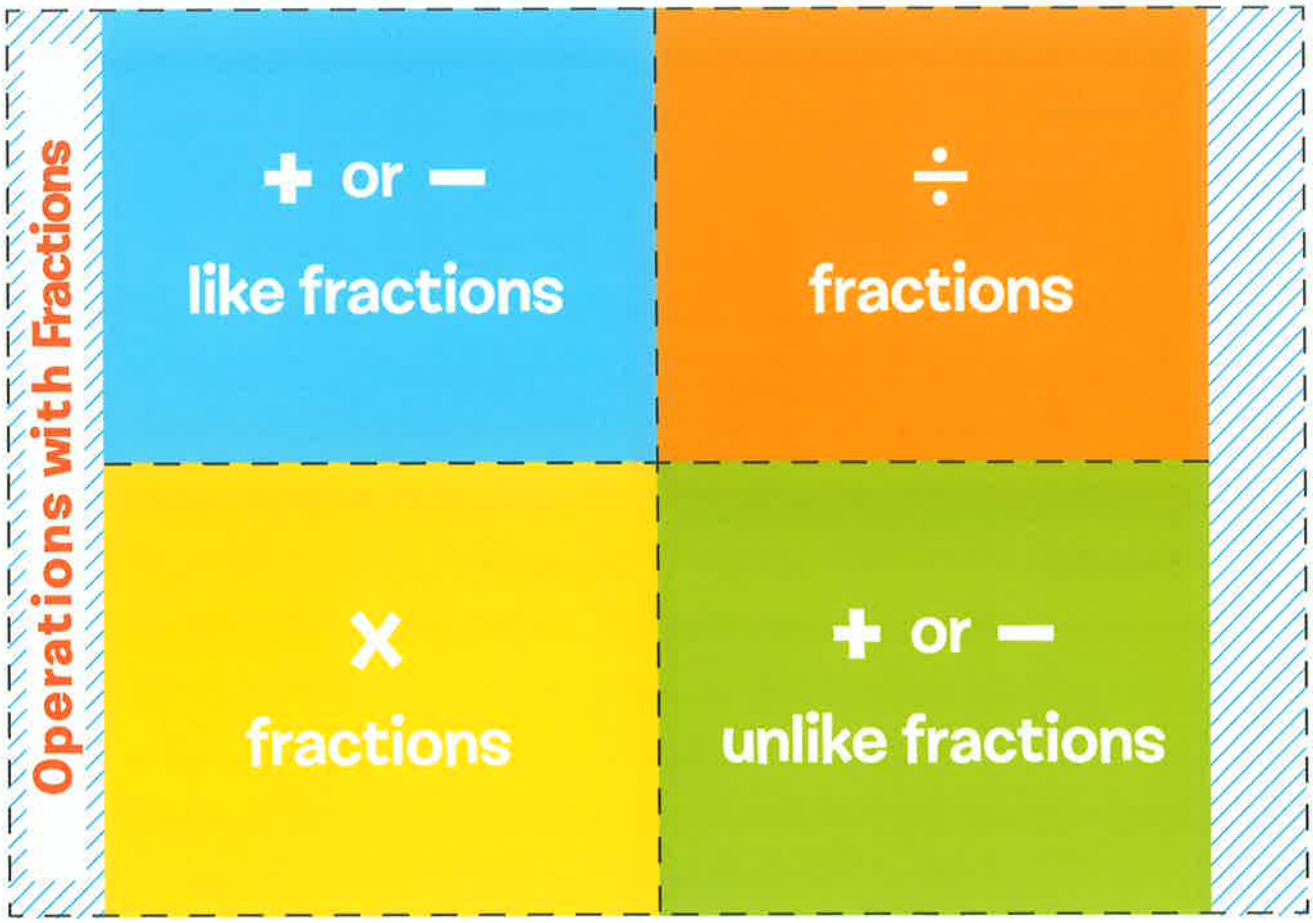

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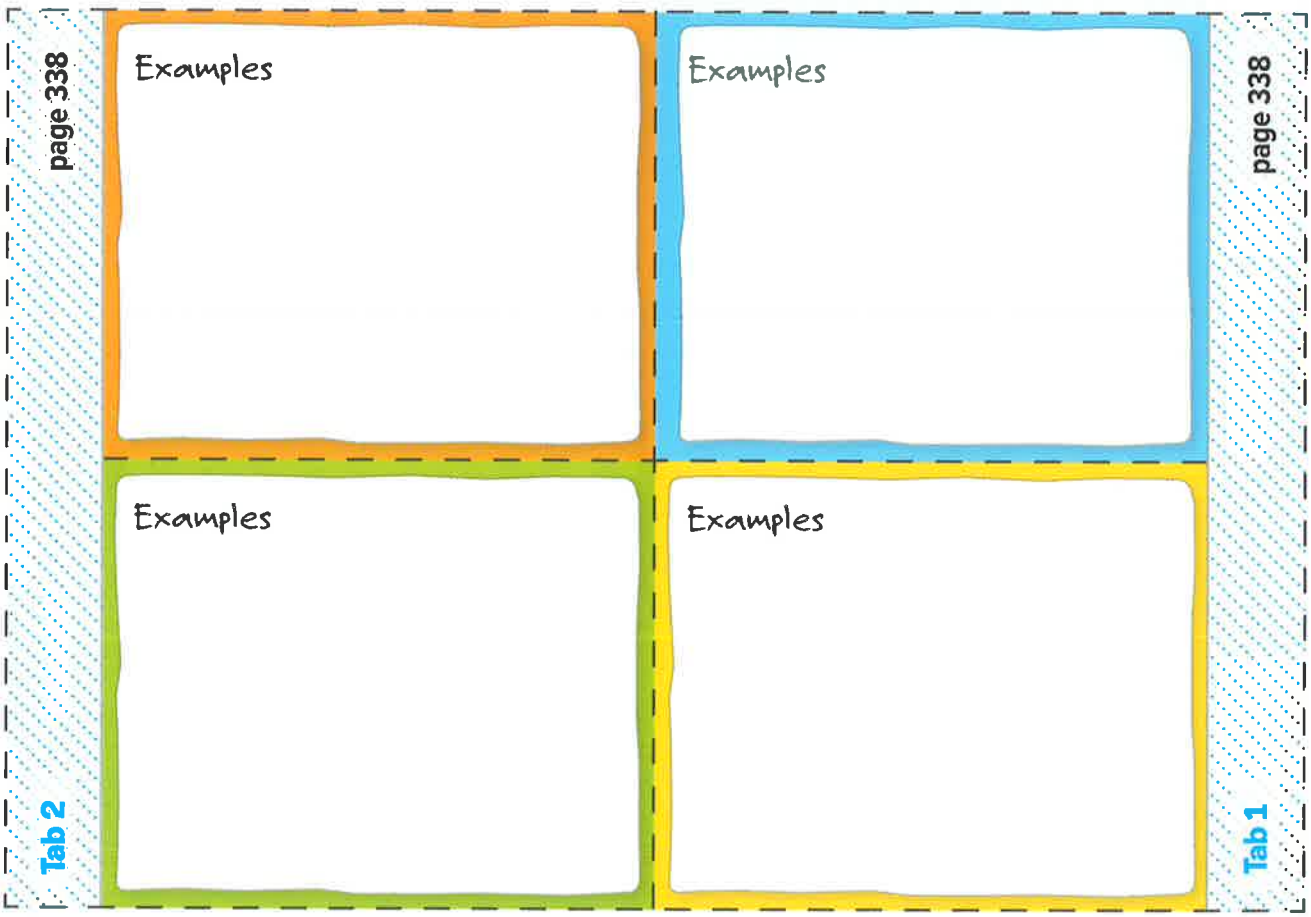

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Glossary

Aa

absolute value The distance the number is from zero on a number line.

acute angle An angle with a measure greater than 0° and less than 90°.

acute triangle A triangle having three acute angles.

Addition Property of Equality If you add the same number to each side of an equation, the two sides remain equal.

Addition Property of Inequality If you add the same number to each side of an inequality, the inequality remains true.

Additive Identity Property The sum of any number and zero is the number.

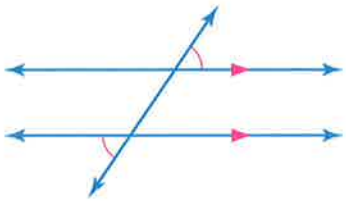
additive inverse Two integers that are opposites. The sum of an integer and its additive inverse is zero.

adjacent angles Angles that have the same vertex, share a common side, and do not overlap.

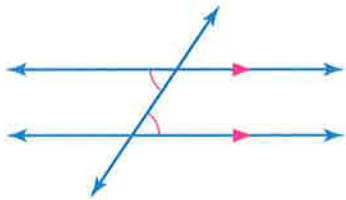
algebra A branch of mathematics that involves expressions with variables.

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

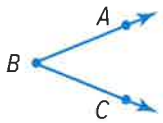
alternate exterior angles Angles that are on opposite sides of the transversal and outside the parallel lines.



alternate interior angles Angles that are on opposite sides of the transversal and inside the parallel lines.



angle Two rays with a common endpoint form an angle. The rays and vertex are used to name the angle.



$\angle ABC$, $\angle CBA$, or $\angle B$

arithmetic sequence A sequence in which the difference between any two consecutive terms is the same.

Associative Property The way in which numbers are grouped does not change their sum or product.

Bb

bar notation In repeating decimals, the line or bar placed over the digits that repeat. For example, $2.\overline{63}$ indicates that the digits 63 repeat.

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

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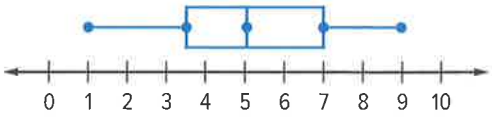
base One of the two parallel congruent faces of a prism.

biased sample A sample drawn in such a way that one or more parts of the population are favored over others.

box plot A method of visually displaying a distribution of data values by using the median, quartiles, and extremes of the data set. A box shows the middle 50% of the data.

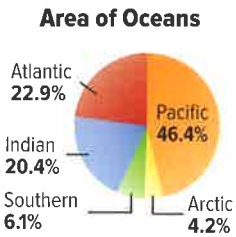


Cc

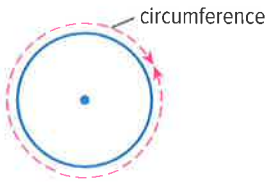
center The point from which all points on circle are the same distance.

circle The set of all points in a plane that are the same distance from a given point called the center.

circle graph A graph that shows data as parts of a whole. In a circle graph, the percents add up to 100.



circumference The distance around a circle.

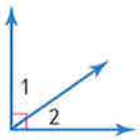


coefficient The numerical factor of a term that contains a variable.

common denominator A common multiple of the denominators of two or more fractions. 24 is a common denominator for $\frac{1}{3}$, $\frac{5}{8}$, and $\frac{3}{4}$ because 24 is the LCM of 3, 8, and 4.

Commutative Property The order in which two numbers are added or multiplied does not change their sum or product.

complementary angles Two angles are complementary if the sum of their measures is 90°.



∠1 and ∠2 are complementary angles.

complementary events The events of one outcome happening and that outcome not happening. The sum of the probabilities of an event and its complement is 1 or 100%. In symbols, $P(\text{A}) + P(\textit{not A}) = 1$.

complex fraction A fraction $\frac{A}{B}$ where A or B are fractions and B does not equal zero.

composite figure A figure that is made up of two or more three-dimensional figures.

compound event An event consisting of two or more simple events.

cone A three-dimensional figure with one circular base connected by a curved surface to a single vertex.

congruent Having the same measure.

congruent angles Angles that have the same measure.

∠1 and ∠2 are congruent angles.

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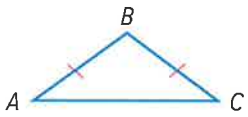
congruent figures Figures that have the same size and same shape and corresponding sides and angles with equal measure.

congruent segments Sides with the same length.



Side $\overline{AB}$ is congruent to side $\overline{BC}$.

constant A term that does not contain a variable.

constant of proportionality A constant ratio or unit rate of two variable quantities. It is also called the constant of variation.

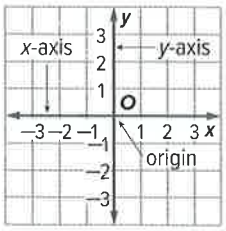
constant of variation The constant ratio in a direct variation. It is also called the constant of proportionality.

constant rate of change The rate of change in a linear relationship.

continuous data Data that take on any real number value. It can be determined by considering what numbers are reasonable as part of the domain.

convenience sample A sample which consists of members of a population that are easily accessed.

coordinate plane A plane in which a horizontal number line and a vertical number line intersect at their zero points. Also called a coordinate grid.



coplanar Lines or points that lie in the same plane.

corresponding angles Angles in the same position on parallel lines in relation to a transversal.

corresponding sides The sides of similar figures that are in the same relative position.

counterexample A specific case which proves a statement false.

cross product The product of the numerator of one ratio and the denominator of the other ratio. The cross products of any proportion are equal.

cross section The cross section of a solid and a plane.

cube root One of three equal factors of a number. If $a^3 = b$, then a is the cube root of b. The cube root of 125 is 5 since $5^3 = 125$.

cubed The product in which a number is a factor three times. Two cubed is 8 because $2 \times 2 \times 2 = 8$.

cylinder A three-dimensional figure with two parallel congruent circular bases connected by a curved surface.

Dd

decagon A polygon having ten sides.

defining a variable Choosing a variable and a quantity for the variable to represent in an expression or equation.

degrees The most common unit of measure for angles. If a circle were divided into 360 equal-sized parts, each part would have an angle measure of 1 degree.

dependent events Two or more events in which the outcome of one event affects the outcome of the other event(s).

dependent variable The variable in a relation with a value that depends on the value of the independent variable.

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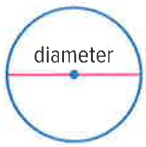
derived unit A unit that is derived from a measurement system base unit, such as length, mass, or time.

diagonal A line segment that connects two nonconsecutive vertices.

diameter The distance across a circle through its center.



dimensional analysis The process of including units of measurement when you compute.

direct variation The relationship between two variable quantities that have a constant ratio.

discount The amount by which the regular price of an item is reduced.

discrete data When solutions of a function are only integer values. It can be determined by considering what numbers are reasonable as part of the domain.

disjoint events Events that cannot happen at the same time.

Distributive Property To multiply a sum by a number, multiply each addend of the sum by the number outside the parentheses. For any numbers a, b, and c, $a(b + c) = ab + ac$ and $a(b - c) = ab - ac$.

Example: $2(5 + 3) = (2 \times 5) + (2 \times 3)$ and $2(5 - 3) = (2 \times 5) - (2 \times 3)$

Division Property of Equality If you divide each side of an equation by the same nonzero number, the two sides remain equal.

Division Property of Inequality When you divide each side of an inequality by a negative number, the inequality symbol must be reversed for the inequality to remain true.

domain The set of input values for a function.

double box plot Two box plots graphed on the same number line.

double dot plot A method of visually displaying a distribution of two sets of data values where each value is shown as a dot above a number line.

Ee

edge The line segment where two faces of a polyhedron intersect.

enlargement An image larger than the original.

equation A mathematical sentence that contains an equals sign, =, stating that two quantities are equal.

equiangular In a polygon, all of the angles are congruent.

equilateral In a polygon, all of the sides are congruent.

equilateral triangle A triangle having three congruent sides.

equivalent equations Two or more equations with the same solution.

equivalent expressions Expressions that have the same value.

equivalent ratios Two ratios that have the same value.

evaluate To find the value of an expression.

experimental probability An estimated probability based on the relative frequency of positive outcomes occurring during an experiment. It is based on what *actually* occurred during such an experiment.

exponent In a power, the number that tells how many times the base is used as a factor. In 5^3, the exponent is 3. That is, $5^3 = 5 \times 5 \times 5$.

exponential form Numbers written with exponents.

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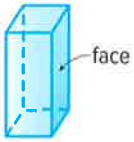
Ff

face A flat surface of a polyhedron.



factor To write a number as a product of its factors.

factored form An expression expressed as the product of its factors.

factors Two or more numbers that are multiplied together to form a product.

fair game A game where each player has an equally likely chance of winning.

first quartile For a data set with median *M*, the first quartile is the median of the data values less than *M*.

formula An equation that shows the relationship among certain quantities.

function A relationship which assigns exactly one output value for each input value.

function rule The operation performed on the input of a function.

function table A table used to organize the input numbers, output numbers, and the function rule.

Fundamental Counting Principle Uses multiplication of the number of ways each event in an experiment can occur to find the number of possible outcomes in a sample space.

Gg

gram A unit of mass in the metric system equivalent to 0.001 kilogram. The amount of matter an object can hold.

graph The process of placing a point on a number line or on a coordinate plane at its proper location.

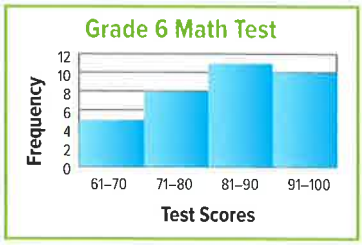
gratuity Also known as a tip. It is a small amount of money in return for a service.

Hh

heptagon A polygon having seven sides.

hexagon A polygon having six sides.

histogram A type of bar graph used to display numerical data that have been organized into equal intervals.



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Ii

Identity Property of Zero The sum of an addend and zero is the addend. Example: $5 + 0 = 5$

independent events Two or more events in which the outcome of one event does not affect the outcome of the other event(s).

independent variable The variable in a function with a value that is subject to choice.

indirect measurement Finding a measurement using similar figures to find the length, width, or height of objects that are too difficult to measure directly.

inequality An open sentence that uses $<$, $>$, $\neq$, $\leq$, or $\geq$ to compare two quantities.

integer Any number from the set {..., −4, −3, −2, −1, 0, 1, 2, 3, 4, ...}, where ... means continues without end.

interquartile range A measure of variation in a set of numerical data. It is the distance between first and third quartiles of the data set.

inverse variation A relationship where the product of x and y is a constant k. As x increases in value, y decreases in value, or as y decreases in value, x increases in value.

irrational number A number that cannot be expressed as the ratio of two integers.

isosceles triangle A triangle having at least two congruent sides.

Kk

kilogram The base unit of mass in the metric system. One kilogram equals 1,000 grams.

Ll

lateral face In a polyhedron, a face that is not a base.

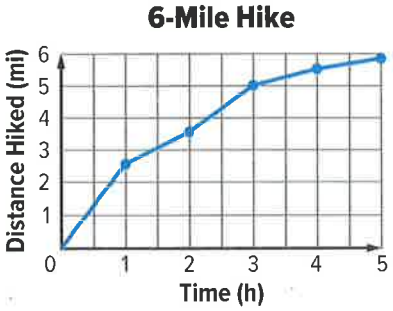
lateral surface area The sum of the areas of all of the lateral faces of a solid.

least common denominator (LCD) The least common multiple of the denominators of two or more fractions. You can use the LCD to compare fractions.

like fractions Fractions that have the same denominators.

like terms Terms that contain the same variables raised to the same power. Example: $5x$ and $6x$ are like terms.

line graph A type of statistical graph using lines to show how values change over a period of time.



linear expression An algebraic expression in which the variable is raised to the first power, and variables are not multiplied nor divided.

linear function A function for which the graph is a straight line.

linear relationship A relationship for which the graph is a straight line.

liter The base unit of capacity in the metric system. The amount of dry or liquid material an object can hold.

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Mm

markdown An amount by which the regular price of an item is reduced.

markup The amount the price of an item is increased above the price the store paid for the item.

mean The sum of the data divided by the number of items in the data set.

mean absolute deviation A measure of variation in a set of numerical data, computed by adding the distances between each data value and the mean, then dividing by the number of data values.

measures of center Numbers that are used to describe the center of a set of data. These measures include the mean, median, and mode.

measures of variation A measure used to describe the distribution of data.

median A measure of center in a set of numerical data. The median of a list of values is the value appearing at the center of a sorted version of the list—or the mean of the two central values, if the list contains an even number of values.

meter The base unit of length in the metric system.

metric system A decimal system of measures. The prefixes commonly used in this system are kilo-, centi-, and milli-.

mode The number or numbers that appear most often in a set of data. If there are two or more numbers that occur most often, all of them are modes.

monomial A number, variable, or product of a number and one or more variables.

Multiplication Property of Equality If you multiply each side of an equation by the same nonzero number, the two sides remain equal.

Multiplication Property of Inequality When you multiply each side of an inequality by a negative number, the inequality symbol must be reversed for the inequality to remain true.

Multiplicative Identity Property The product of any number and one is the number.

Multiplicative Property of Zero The product of any number and zero is zero.

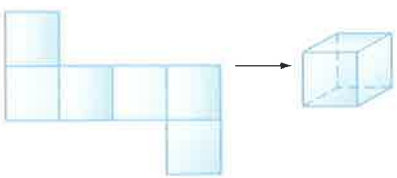
multiplicative inverse Two numbers with a product of 1. For example, the multiplicative inverse of $\frac{2}{3}$ is $\frac{3}{2}$.

Nn

negative exponent Any nonzero number to the negative n power. It is the multiplicative inverse of its nth power.

negative integer An integer that is less than zero. Negative integers are written with a $-$ sign.

net A two-dimensional figure that can be used to build a three-dimensional figure.



nonagon A polygon having nine sides.

nonlinear function A function for which the graph is *not* a straight line.

nonproportional The relationship between two ratios with a rate or ratio that is not constant.

numerical expression A combination of numbers and operations.

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Oo

obtuse angle Any angle that measures greater than 90° but less than 180°.

obtuse triangle A triangle having one obtuse angle.

octagon A polygon having eight sides.

opposites Two integers are opposites if they are represented on the number line by points that are the same distance from zero, but on opposite sides of zero. The sum of two opposites is zero.

order of operations The rules to follow when more than one operation is used in a numerical expression.

1. Evaluate the expressions inside grouping symbols.
2. Evaluate all powers.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

ordered pair A pair of numbers used to locate a point in the coordinate plane. An ordered pair is written in the form (*x*-coordinate, *y*-coordinate).

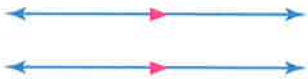
origin The point at which the *x*-axis and the *y*-axis intersect in a coordinate plane. The origin is at (0, 0).

outcome Any one of the possible results of an action. For example, 4 is an outcome when a number cube is rolled.

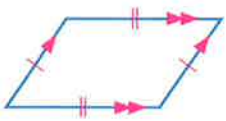
outlier A data value that is either much *greater* or much *less* than the median.

Pp

parallel lines Lines in a plane that never intersect.



parallelogram A quadrilateral with opposite sides parallel and opposite sides congruent.



pentagon A polygon having five sides.

percent equation An equation that describes the relationship between the part, whole, and percent.

$$\text{part} = \text{percent} \cdot \text{whole}$$

percent error A ratio that compares the inaccuracy of an estimate (amount of error) to the actual amount.

percent of change A ratio that compares the change in a quantity to the original amount.

$$\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$$

percent of decrease A negative percent of change.

percent of increase A positive percent of change.

percent proportion One ratio or fraction that compares part of a quantity to the whole quantity. The other ratio is the equivalent percent written as a fraction with a denominator of 100.

$$\frac{\text{part}}{\text{whole}} = \frac{\text{percent}}{100}$$

perfect squares Numbers with square roots that are whole numbers. 25 is a perfect square because the square root of 25 is 5.

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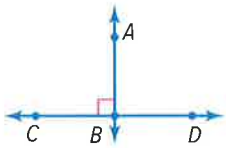
permutation An arrangement, or listing, of objects in which order is important.

perpendicular lines Lines that meet or cross each other to form right angles.



pi The ratio of the circumference of a circle to its diameter. The Greek letter π represents this number. The value of pi is 3.1415926. . . . Approximations for pi are 3.14 and $\frac{22}{7}$.

plane A two-dimensional flat surface that extends in all directions.

polygon A simple closed figure formed by three or more straight line segments.

polyhedron A three-dimensional figure with faces that are polygons.

population The entire group of items or individuals from which the samples under consideration are taken.

positive integer An integer that is greater than zero. They are written with or without a + sign.

powers Numbers expressed using exponents. The power 3^2 is read *three to the second power,* or *three squared.*

precision The ability of a measurement to be consistently reproduced.

principal The amount of money deposited or borrowed.

prism A polyhedron with two parallel congruent faces called bases.

probability The chance that some event will happen. It is the ratio of the number of favorable outcomes to the number of possible outcomes.

probability model A model used to assign probabilities to outcomes of a chance process by examining the nature of the process.

properties Statements that are true for any number or variable.

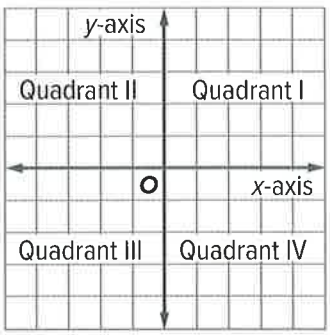
proportion An equation stating that two ratios or rates are equivalent.

proportional The relationship between two ratios with a constant rate or ratio.

pyramid A polyhedron with one base that is a polygon and three or more triangular faces that meet at a common vertex.

Qq

quadrant One of the four regions into which the two perpendicular number lines of the coordinate plane separate the plane.



quadrilateral A closed figure having four sides and four angles.

quartile A value that divides the data set into four equal parts.

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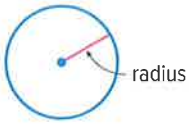
Rr

radical sign The symbol used to indicate a nonnegative square root, $\sqrt{\ }$.

radius The distance from the center of a circle to any point on the circle.



random Outcomes occur at random if each outcome occurs by chance. For example, rolling a number on a number cube occurs at random.

range The set of output values for a function.

range The difference between the greatest and least data value.

rate A ratio that compares two quantities with different kinds of units.

rate of change A rate that describes how one quantity changes in relation to another. A rate of change is usually expressed as a unit rate.

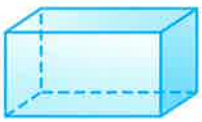
rational numbers The set of numbers that can be written in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$.
Examples: $1 = \frac{1}{1}, \frac{2}{9}, -2.3 = -2\frac{3}{10}$

real numbers A set made up of rational and irrational numbers.

reciprocal The multiplicative inverse of a number.

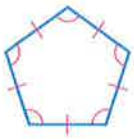
rectangle A parallelogram having four right angles.

rectangular prism A prism that has two parallel congruent bases that are rectangles.



reduction An image smaller than the original.

regular polygon A polygon that has all sides congruent and all angles congruent.



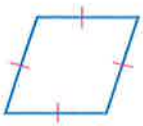
regular pyramid A pyramid whose base is a regular polygon and in which the segment from the vertex to the center of the base is the altitude.

relation Any set of ordered pairs.

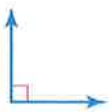
relative frequency A ratio that compares the frequency of each category to the total.

repeating decimal The decimal form of a rational number.

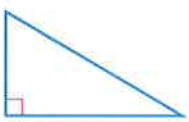
rhombus A parallelogram having four congruent sides.



right angle An angle that measures exactly 90°.



right triangle A triangle having one right angle.



Ss

sales tax An additional amount of money charged on items that people buy.

sample A randomly selected group chosen for the purpose of collecting data.

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sample space The set of all possible outcomes of a probability experiment.

scale The scale that gives the ratio that compares the measurements of a drawing or model to the measurements of the real object.

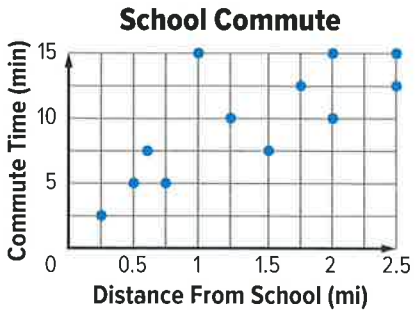
scale drawing A drawing that is used to represent objects that are too large or too small to be drawn at actual size.

scale factor A scale written as a ratio without units in simplest form.

scale model A model used to represent objects that are too large or too small to be built at actual size.

scalene triangle A triangle having no congruent sides.

scatter plot In a scatter plot, two sets of related data are plotted as ordered pairs on the same graph.

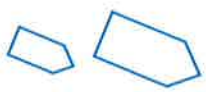


selling price The amount the customer pays for an item.

semicircle Half of a circle. The formula for the area of a semicircle is $A = \frac{1}{2}\pi r^2$.

sequence An ordered list of numbers, such as 0, 1, 2, 3 or 2, 4, 6, 8.

similar figures Figures that have the same shape but not necessarily the same size.



similar solids Solids with the same shape. Their corresponding linear measures are proportional.

simple event One outcome or a collection of outcomes.

simple interest The amount paid or earned for the use of money. The formula for simple interest is $I = prt$.

simple random sample An unbiased sample where each item or person in the population is as likely to be chosen as any other.

simplest form An expression is in simplest form when it is replaced by an equivalent expression having no like terms or parentheses.

simplify Write an expression in simplest form.

simulation An experiment that is designed to model the action in a given situation.

skew lines Lines that do not intersect and are not coplanar.

slant height The height of each lateral face.

slope The rate of change between any two points on a line. It is the ratio of vertical change to horizontal change. The slope tells how steep the line is.

solution A replacement value for the variable in an open sentence. A value for the variable that makes an equation true. Example: The *solution* of $12 = x + 7$ is 5.

square The product of a number and itself. 36 is the square of 6.

square A parallelogram having four right angles and four congruent sides.

square root The factors multiplied to form perfect squares.

squared The product of a number and itself. 36 is the square of 6.

standard form Numbers written without exponents.

statistics The study of collecting, organizing, and interpreting data.

straight angle An angle that measures exactly 180°.

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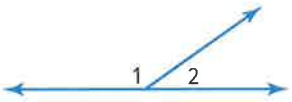
Subtraction Property of Equality If you subtract the same number from each side of an equation, the two sides remain equal.

Subtraction Property of Inequality If you subtract the same number from each side of an inequality, the inequality remains true.

supplementary angles Two angles are supplementary if the sum of their measures is 180°.



∠1 and ∠2 are supplementary angles.

surface area The sum of the areas of all the surfaces (faces) of a three-dimensional figure.

survey A question or set of questions designed to collect data about a specific group of people, or population.

systematic random sample A sample where the items or people are selected according to a specific time or item interval.

Tt

term Each number in a sequence.

term A number, a variable, or a product or quotient of numbers and variables.

terminating decimal A repeating decimal which has a repeating digit of 0.

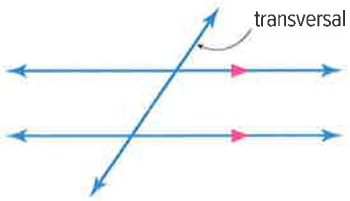
theoretical probability The ratio of the number of ways an event can occur to the number of possible outcomes. It is based on what *should* happen when conducting a probability experiment.

three-dimensional figure A figure with length, width, and height.

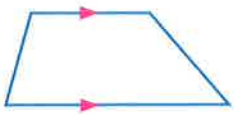
third quartile For a data set with median M, the third quartile is the median of the data values greater than M.

tip Also known as a gratuity, it is a small amount of money in return for a service.

transversal The third line formed when two parallel lines are intersected.



trapezoid A quadrilateral with one pair of parallel sides.



tree diagram A diagram used to show the sample space.

triangle A figure with three sides and three angles.

triangular prism A prism that has two parallel congruent bases that are triangles.

two-step equation An equation having two different operations.

two-step inequality An inequality than contains two operations.

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Uu

unbiased sample A sample representative of the entire population.

unfair game A game where there is not a chance of each player being equally likely to win.

uniform probability model A probability model which assigns equal probability to all outcomes.

unit rate A rate that is simplified so that it has a denominator of 1 unit.

unit ratio A unit rate where the denominator is one unit.

unlike fractions Fractions with different denominators.

Vv

variable A symbol, usually a letter, used to represent a number in mathematical expressions or sentences.

vertex A vertex of an angle is the common endpoint of the rays forming the angle.

vertex The point where three or more faces of a polyhedron intersect.

vertex The point at the tip of a cone.

vertical angles Opposite angles formed by the intersection of two lines. Vertical angles are congruent.

∠1 and ∠2 are vertical angles.

visual overlap A visual demonstration that compares the centers of two distributions with their variation, or spread.

volume The number of cubic units needed to fill the space occupied by a solid.

voluntary response sample A sample which involves only those who want to participate in the sampling.

***x*-axis** The horizontal number line in a coordinate plane.

Xx

***x*-coordinate** The first number of an ordered pair. It corresponds to a number on the *x*-axis.

Yy

***y*-axis** The vertical number line in a coordinate plane.

***y*-coordinate** The second number of an ordered pair. It corresponds to a number on the *y*-axis.

Zz

zero pair The result when one positive counter is paired with one negative counter. The value of a zero pair is 0.

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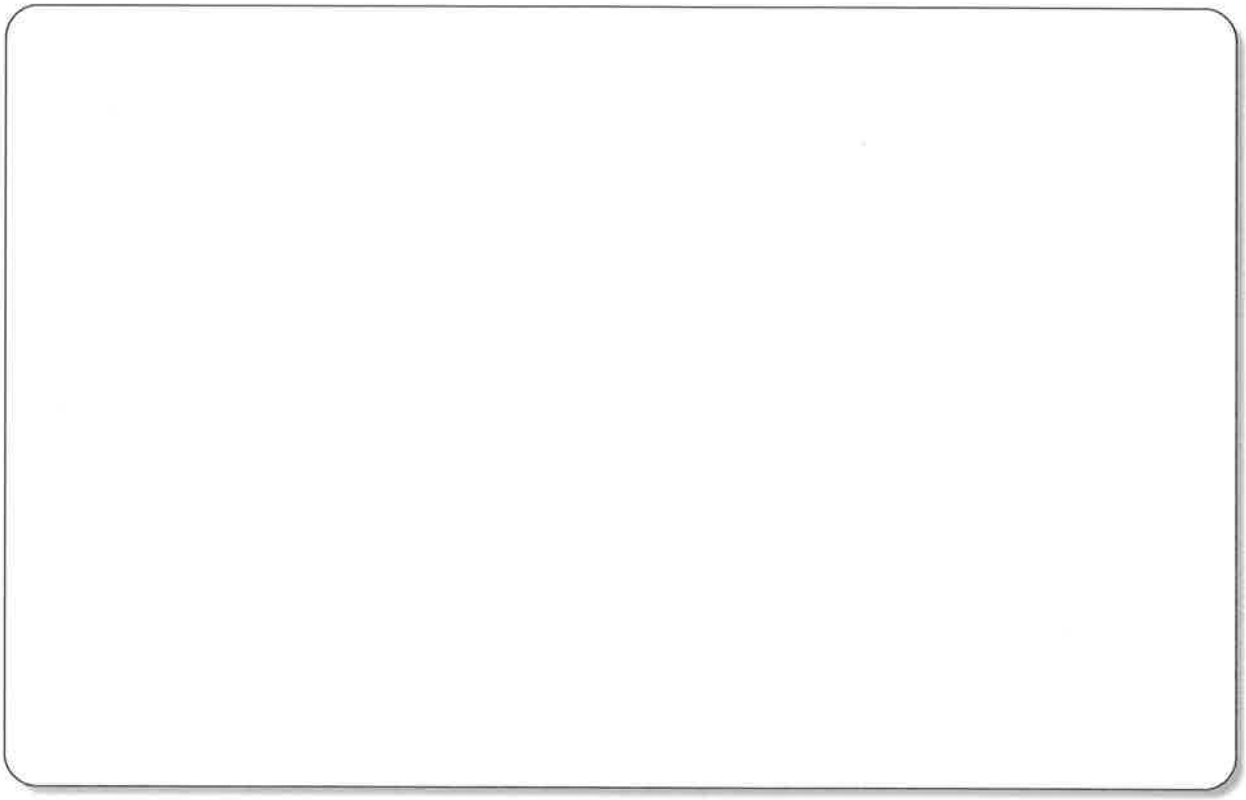

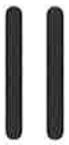

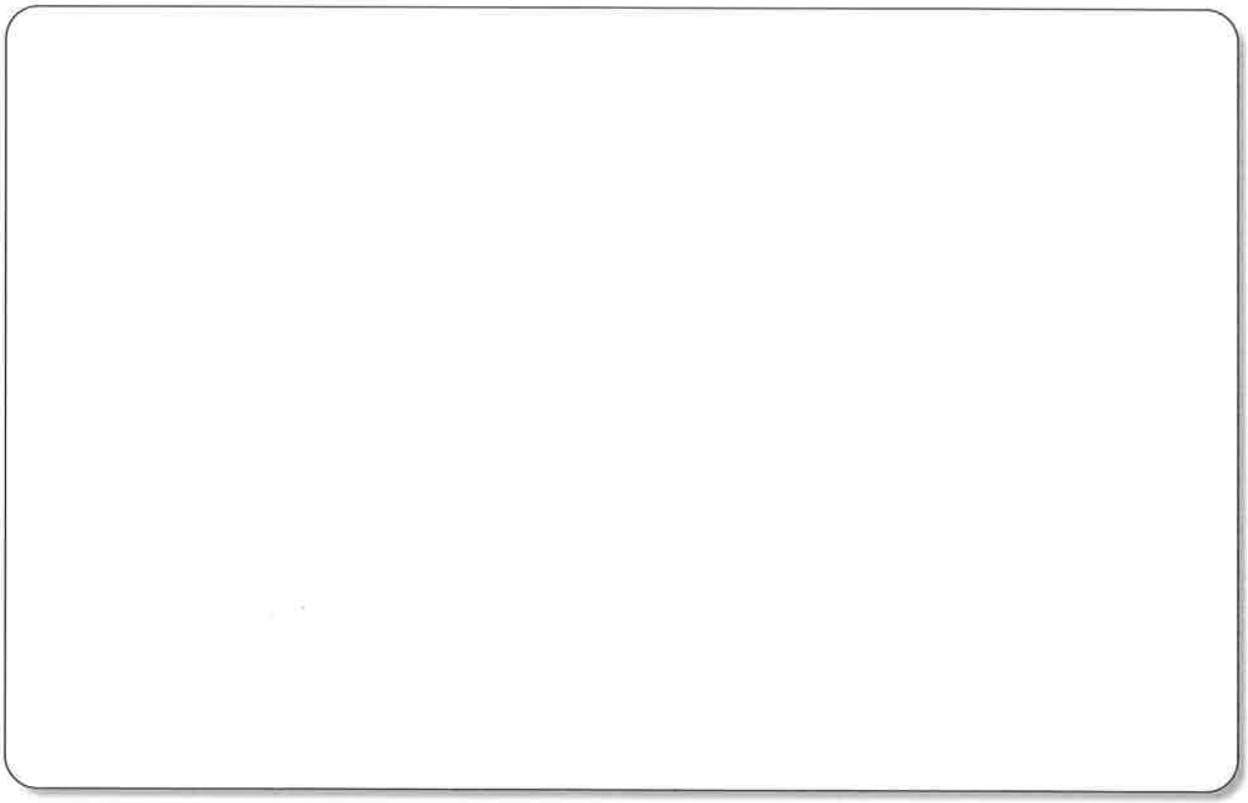

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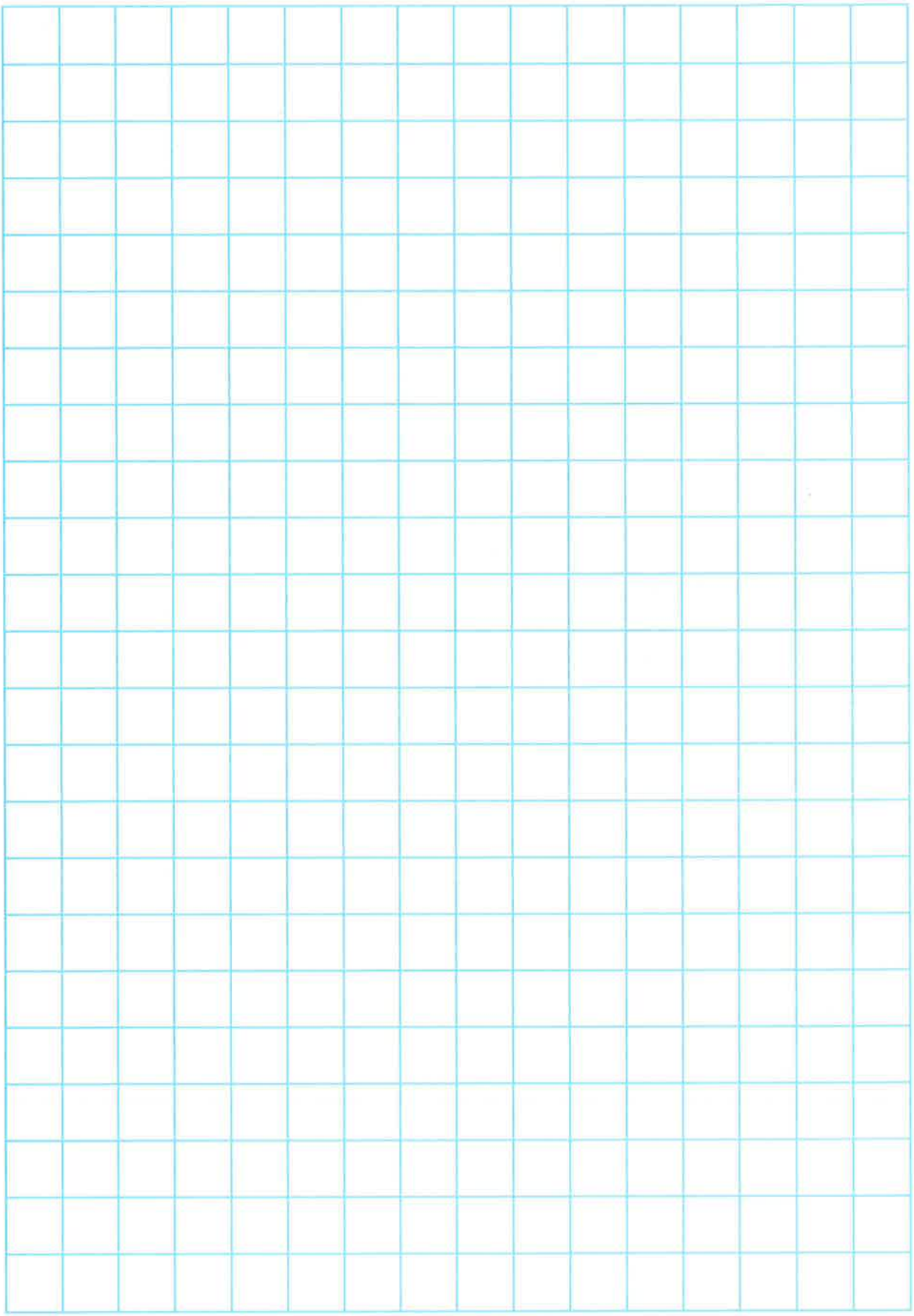

WM2 **Centimeter Grid**

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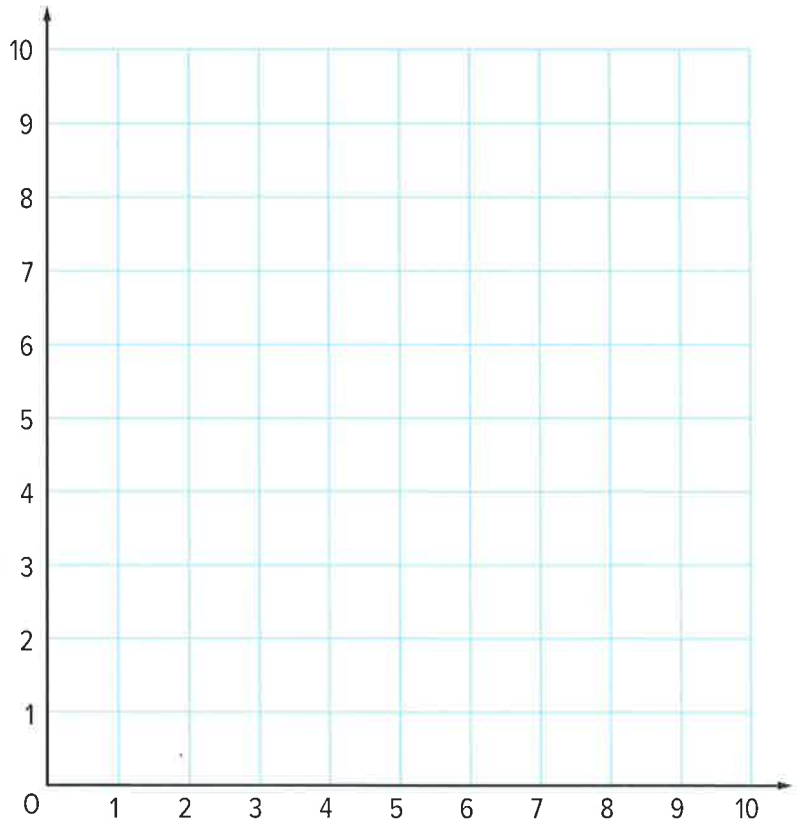

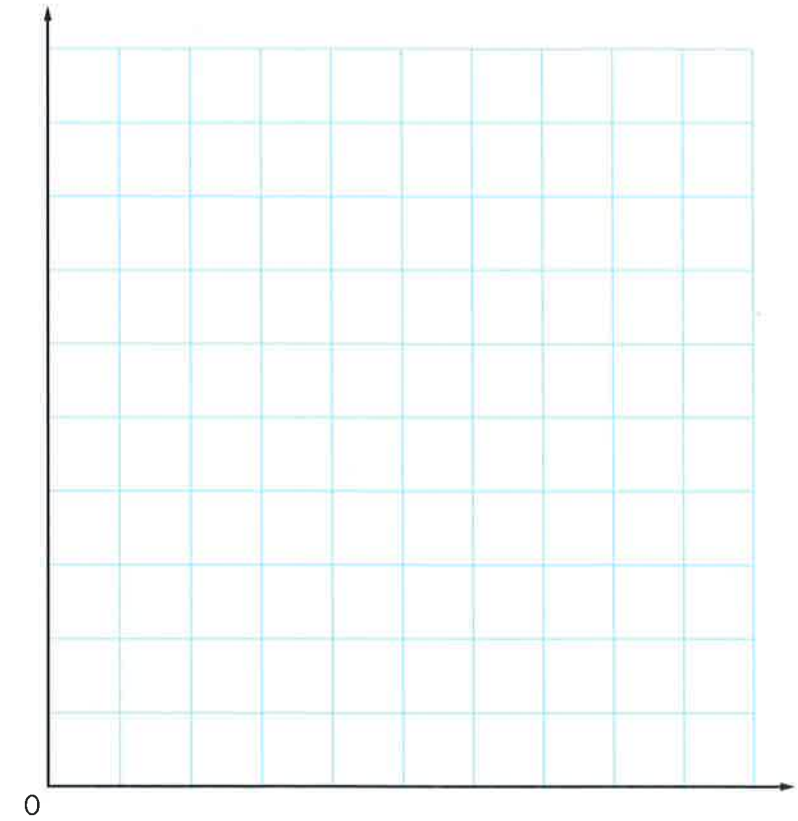

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