

MathLinks 8

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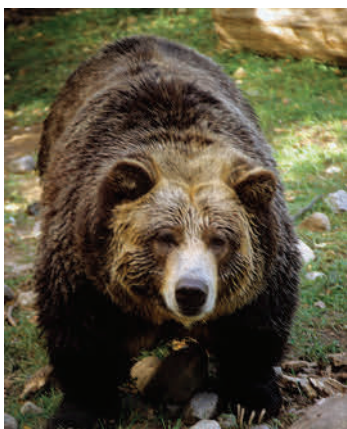
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A Tour of Your Textbook

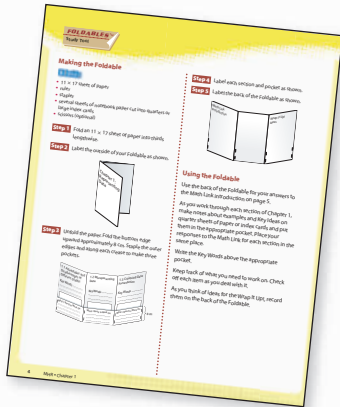
Chapter Opener

Each chapter begins with a two-page spread which introduces you to what you will learn in the chapter.

Foldables™

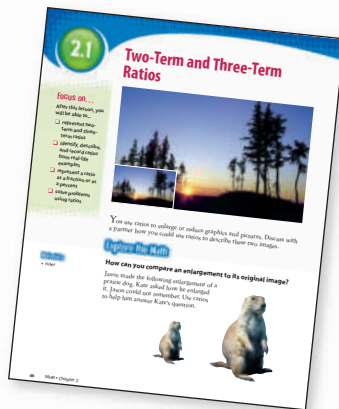


Each chapter includes a Foldable to help you organize what you are learning and keep track of what you need to work on. Instructions on where and how to record information on the Foldable will help you use it as a study tool.



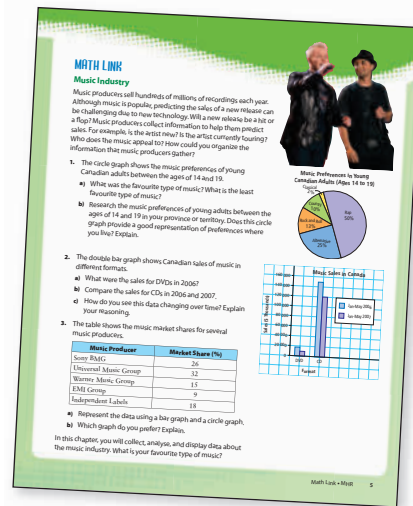
Numbered Sections

The numbered sections often start with a visual to connect the topic to a real setting. The purpose of this introduction is to help you make connections between the math in the section and the real world, or to make connections to what you already know.



Math Link

Each chapter introduces a Math Link that helps you connect math and your own personal experiences. You will often revisit the Math Link at the end of a lesson. This is an opportunity for you to build concepts and understanding. The Wrap It Up! at the end of each chapter gives you an opportunity to demonstrate your understanding of the chapter concepts.



A three-part lesson follows.

- An activity is designed to help you build your own understanding of the new concept and lead toward answers to the key question.

Materials

- centimetre cubes

Explore the Math

base (of a prism or cylinder)

- any face of a prism that shows the named shape of the prism
- the base of a rectangular prism is any face
- the base of a triangular prism is a triangular face.
- the base of a cylinder is a circular face

height (of a prism or cylinder)

- the perpendicular distance between the two bases of a prism or cylinder

How does the area of the base of a right prism relate to its volume?

- Use centimetre cubes to build models of four different right rectangular prisms.
 - What is the area of the **base** for each model? Record your data.
 - What is the **height** of each model? Record your data.

- Examples and Solutions** demonstrate how to use the concept.

Example 1: Determine the Volume Using the Base and the Height

Determine the volume of each right prism or cylinder.

a) b) c)

Key Ideas

- The volume of a right cylinder or a right prism can be determined by multiplying the area of the base by the height of the cylinder or prism.

Volume = area of base \times height of cylinder or prism.

$V = 20 \times 8$
 $V = 160$
 The volume of the cylinder is 160 cm³.

Volume = area of base \times height of prism

$V = 17 \times 10$
 $V = 170$
 The volume of the triangular prism is 170 cm³.

- A summary of the main new concepts is given in the Key Ideas box.

Communicate the Ideas

- Evan calculated the volume of a right cylinder. Charlotte calculated the volume of a right rectangular prism. Did either of them make an error in their solutions? Explain how you know.

- Questions in the Communicate the Ideas section let you talk or write about the concepts and assess whether you understand the ideas.

Check Your Understanding

- Practise:** These are questions to check your knowledge and understanding of what you have learned.
- Apply:** In these questions, you need to apply what you have learned to solve problems.
- Extend:** These questions may be more challenging and may make connections to other lessons.

Check Your Understanding

Practise

For help with #3 and #4, refer to Example 1 on pages 247–248.

- Determine the volume of each right prism or cylinder.

a) b) c)

- What is the volume of each right prism?
 - area of base = 12 cm², height = 8 cm
 - area of base = 18 cm², height = 4 cm
 - height = 9 cm, area of base = 14 cm²

250 MHR • Chapter 7

How does MathLinks 8 help you learn?

Understanding Vocabulary

Key Words are listed on the Chapter Opener. Perhaps you already know the meaning of some of them. Great! If not, watch for these terms the first time they are used in the chapter. The meaning is given close by in the margin.

Key Words

- two-term ratio
- three-term ratio
- part-to-part ratio
- part-to-whole ratio
- rate
- unit rate
- unit price
- proportion

two-term ratio

- compares two quantities measured in the same units
- written as $a:b$ or a to b

blue:red is 6:4

A Literacy Link at the beginning of each chapter provides tips to help you read and interpret the chapter content.

Other Literacy Links throughout the chapter assist you in reading and interpreting items in math. These tips will help you in other subjects as well.

Literacy Link

A KWL chart can help you understand and learn new material more easily.

- The K in KWL stands for **Know**.
- The W in KWL stands for **Want**.
- The L in KWL stands for **Learned**.

Copy the following KWL chart into your math journal or notebook. Brainstorm with a partner what you already know about representing data.

- Record your ideas in the first column.
- List any questions you have about representing data in the second column.
- After you complete the chapter, complete the final column of the KWL chart.

Representing Data

What I Know	What I Want to Know	What I Learned

Literacy Link

In math, the word of often means to multiply.

Understanding Concepts

The Explore the Math activities are designed to help you construct your own understanding of new concepts. The key question tells you what the activity is about. Short steps, with illustrations, lead you to make some conclusions in the Reflect on Your Findings question.

8.1 Exploring Integer Multiplication

Focus on...

After this lesson, you will be able to...

- 1. multiply integers using integer chips

Get the Facts

The Columbia Icefield is the largest mass of ice in North America below the Arctic Circle. The icefield lies across the Alberta-British Columbia border in the Rockies. Six large glaciers flow from the icefield. One of them, the Athabasca Glacier, is a popular tourist destination in Jasper National Park.

The Athabasca Glacier has been melting for over a century. The front edge or "snout" of the glacier has been receding at an average of approximately 12 m per year. At that rate, how far would it recede in four years?

Explore the Math

How can you use integer chips to multiply two integers?

1. Multiplication can be expressed as a repeated addition.
 - $(+3) \times (+2) = (+2) + (+2) + (+2)$
2. Express $(+4) \times (+3)$ as a repeated addition.
 - a. Copy and complete the multiplication statement $(+3) \times (+2) = \square$.
 - b. Use red integer chips to model the addition $(+2) + (+2) + (+2)$.
 - c. Copy and complete the multiplication statement $(+3) \times (+2) = \square$.
3. Express $(+3) \times (-5)$ as a repeated addition.
 - a. Copy and complete the multiplication statement $(+4) \times (+3) = \square$.
 - b. Use blue integer chips to model the addition.
 - c. Copy and complete the multiplication statement $(+3) \times (-5) = \square$.

Reflect on Your Findings

3. How can you use integer chips to multiply two integers? In your observations, state when you use zero pairs. How do you determine the number of zero pairs to use?

Example 2: Solve Equations

Kia is making a square quilt with a 4 cm wide border around it. She wants the completed quilt to have a perimeter of 600 cm. What must the dimensions of Kia's quilt be before she adds the border?

Method 1: Divide First

Because the variable x is added to both sides of the equation, divide both sides by 4 to undo the multiplication.

$$4x + 8 = 600$$

$$\frac{4x + 8}{4} = \frac{600}{4}$$

$$x + 2 = 150$$

Subtract 2 to undo the addition.

$$x + 2 - 2 = 150 - 2$$

$$x = 148$$

Method 2: Use the Distributive Property First

Because the variable x is multiplied by 4, multiply both sides by $\frac{1}{4}$ to undo the multiplication.

$$4x + 8 = 600$$

$$\frac{4x + 8}{4} = \frac{600}{4}$$

$$x + 2 = 150$$

Subtract 2 from both sides of the equation.

$$x + 2 - 2 = 150 - 2$$

$$x = 148$$

Divide both sides of the equation by 4.

The quilt dimensions before adding the border should be 142 cm \times 142 cm.

Check: Left Side = $4(142) + 8 = 568 + 8 = 576$
Right Side = 600

The solution is correct.

The Examples and their worked Solutions include several tools to help you understand the work.

- Notes in a thought bubble help you think through the steps.
- Sometimes different methods of solving the same problem are shown. One way may make more sense to you than the other.
- Problem Solving Strategies are pointed out.
- Calculator key press sequences are shown where appropriate.
- Most Examples are followed by a Show You Know. These questions help you check that you understand the skill covered in the Example.

The exercises begin with **Communicate the Ideas**. These questions focus your thinking on the **Key Ideas** you learned in the section. By discussing these questions in a group, or doing the action called for, you can see whether you understand the main points and are ready to begin the **Check Your Understanding**.

The first few questions in the **Check Your Understanding** can often be done by following one of the worked Examples.

Key Ideas

- To estimate the square root of a whole number that is not a perfect square:
 - Locate the perfect squares on either side of the number.
 - Calculate the square roots of these two perfect squares.
 - Estimate based on the position between the two perfect squares. For example, estimate the square root of 17: $\sqrt{17} \approx 4.1$.
- To identify a whole number that has a square root between two given numbers,
 - determine the perfect squares of the two consecutive whole numbers.
 - Choose a whole number between the two perfect squares. For example, identify a whole number that has a square root between 3 and 6: $3^2 = 9$, $6^2 = 36$.
 - $\sqrt{30}$ will have a value between 5 and 6.
- When using a calculator to find the square root of a natural number that is not a perfect square, the value shown on the calculator is only an approximation.
 - $\sqrt{2}$ 2.000000000

Check Your Understanding

Practice

For help with #1 to #5, refer to Example 1 on page 96.

- Estimate the square root of each number, to one decimal place. Check with a calculator.
 - 72 103 55
- Estimate each value, to one decimal place. Check your answer with a calculator.
 - $\sqrt{14}$ $\sqrt{86}$ $\sqrt{136}$

For help with #6 to #9, refer to Example 2 on page 97.

- What is an example of a whole number that has a square root between 9 and 10?
- Identify a whole number with a square root between 11 and 12.
- Identify all possible whole numbers with a square root larger than 2 and smaller than 3.
- What are all possible whole numbers that have a square root between 4 and 5?

Apply

- Kali uses an entire can of paint on a square backyard for the school play. The label on the can states that one can covers 27 m^2 of wall surface. Estimate the backyard's side length, to one decimal place.

11. The square has an area of 20 cm^2 .

12. While shopping online, Jilana finds a square rug with an area of 11 m^2 . He needs to know if it will fit in his $4 \text{ m} \times 5 \text{ m}$ bedroom.

13. Stella is planning an outdoor wedding. She would like a square dance floor with an area of 115 m^2 .

14. Stella finds out that the dance floor will be made up of floorboards that each measure 1 m^2 . What are the two side lengths the dance floor can have that are closest to what she wants?

15. What are the two square areas for the dance floor that Stella can choose from?

16. Which area will Stella choose? Explain.

Problem Solving

At the beginning of the student resource there is an overview of the four steps you can use to approach **Problem Solving**. Samples of problem solving strategies are shown. You can refer back to this section if you need help choosing a strategy to solve a problem. You are also encouraged to use your own strategies.

Problem Solving

People solve mathematical problems at home, at work, and at play. There are many different ways to solve problems. In Model 1 and 2, you are encouraged to try different methods and to use your own ideas. Your method may be different but it may also work.

A Problem Solving Model

Where do you begin with problem solving? It may help to use the following four-step process:

- Understand**
 - Read the problem carefully.
 - Think about the problem. Express it in your own words.
 - What information do you have?
 - What further information do you need?
 - What is the problem asking you to do?
- Plan**
 - Select a strategy for solving the problem. Sometimes you need more than one strategy.
 - Consider other problems you have solved successfully. Is this problem like one of them? Can you use a similar strategy? Strategies that you might use include:
 - Model It
 - Draw a Diagram
 - Make an Organized List or Table
 - Work Backwards
 - Guess and Check
 - Look for a Pattern
 - Estimate and Check
 - Solve a Simpler Problem
 - Use a Variable
 - Solve an Equation
 - Make an Assumption
 - Decide whether any of the following might help. Plan how to use them.
 - tools such as a ruler or a calculator
 - materials such as grid paper or a number line
- Do It!**
 - Solve the problem by carrying out your plan.
 - Use mental math to estimate a possible answer.
 - Do the calculation.
 - Record each of your steps.
 - Explain and justify your thinking.
- Look Back**
 - Examine your answer. Does it make sense?
 - Is your answer close to your estimate?
 - Does your answer fit the facts given in the problem?
 - Is the answer reasonable? If not, make a new plan. Try a different strategy.
 - Consider solving the problem a different way. Do you get the same answer?
 - Compare your methods with those of your classmates.

Problem 1

Caroline has a rectangular vegetable garden that measures 4 m by 6 m . She wants to divide the garden into three equal sections to plant three different vegetables. What is the area of each section?

Strategy

Strategy	Example
Use a Variable	The garden is a rectangle with a length of 6 m and a width of 4 m . $A = l \times w$ $A = 6 \times 4$ $A = 24$ The area of the garden is 24 m^2 . Use 24 square tiles to model the garden. Each tile represents 1 m^2 .
Model It	Divide the tiles into three equal groups to represent the three sections. There are eight tiles in each group. The area of each section is 8 m^2 .
Use a Variable	The garden is a rectangle with a length of 6 m and a width of 4 m . $A = l \times w$ $A = 6 \times 4$ $A = 24$ The area of the garden is 24 m^2 . Let S represent the area of each section. $S = \text{area of garden} \div \text{number of sections}$ $S = 24 \div 3$ $S = 8$ The area of each section is 8 m^2 .

Mental Math and Estimation



This Mental Math and Estimation logo does one of two things:

- It signals where you can use mental math and estimation.
- It provides useful tips for using mental math and estimation.

You could also determine 1.5% of $\$20\,000$ as:

- 30% of $20\,000$ is 6000 .
- 3% of $20\,000$ is 600 .
- 1.5% of $20\,000$ is 300 .

Other Features

Did You Know?

The Columbia Icefield is a major source of fresh water. Melt water from the icefield feeds rivers that flow to the Arctic Ocean, the Pacific Ocean, and Hudson's Bay.

Did You Know?

These are interesting facts related to math topics you are learning.

History Link

In Roman times, the term centurion was used to describe an officer in the Roman Legion who was in charge of 100 soldiers. There was one centurion per cent, meaning there was one centurion per 100 soldiers. What other English words do you know that include cent?

Subject Links

This feature links the current topic to another subject area.

Web Links

You can find extra information related to some questions on the Internet. Log on to www.mathlinks8.ca and you will be able to link to recommended Web sites.



To generate tessellations on the computer, go to www.mathlinks8.ca and follow the links.

Chapter Review and Practice Test

There is a **Chapter Review** and a **Practice Test** at the end of each chapter. The chapter review is organized by section number so you can look back if you need help with a question. The test includes the different types of questions that you will find on provincial tests: multiple choice, numerical response, short answer, and extended response.

Cumulative Review

To help you reinforce what you have learned, there is a review of the previous four chapters at the end of Chapters 4, 8, and 12. Each of these special reviews is followed by a **Task**.

Task

These tasks require you to use skills from more than one chapter. You will also need to use your creativity.

Math Games and Challenge in Real Life

The last two pages of each chapter provide **Math Games** and a **Challenge in Real Life**. **Math Games** provide an interesting way to practise the skills you learned during the chapter. Most games can be played with a partner.

Some can be played with a larger group. Enjoy them with your friends and family. The **Challenge in Real Life** provides an interesting problem that shows how the math you learned in the chapter relates to jobs, careers, or daily life.

Answers

Answers are provided for all **Practise, Apply, Extend, and Review** questions. Sample answers are given for questions that have a variety of possible answers or that involve communication. If you need help, read the sample and then try to give an alternative response. Answers are omitted for the **Math Link** questions and for **Practice Tests** because teachers may use these questions to assess your progress.

Glossary

Refer to the illustrated **Glossary** at the back of the student resource if you need to check the exact meaning of mathematical terms.

Task

Test the Efficiency of a Ramp

Civil engineers design and build structures such as bridges, roads, and ramps. Before doing the actual construction, they test the design for strength and efficiency. Your team's task is to design a ramp that allows a vehicle to travel the farthest.

- Use books, a chair, or other material to create a platform with a height of your choice. Round the height to the nearest centimetre. Height, $a =$
- Design a ramp so that a vehicle can roll down without falling off the side. Record the length of the ramp from the edge of the platform to the floor to the nearest centimetre. Length of ramp, $a =$
- Does your ramp design use a right triangle? Using the method of your choice, calculate the length of the base in your triangle, b . Justify your response.
- Test your ramp by placing your vehicle at the top of the ramp, with the six front wheels even with the edge of the platform. Let go of the vehicle without pushing it. Measure the distance the vehicle travels from the foot of the ramp to where it stops. You may wish to do three trials and take the average distance.
- Repeat steps 2 and 4 for at least two different lengths of ramp. Complete the chart provided to you.
- The most efficient ramp is the one that allows the vehicles to travel the farthest. Based on your results, what is the ratio of a to b distances that resulted in the most efficient design? Express your answer as a percent. Complete your notes to those found by other teams. Explain any similarities and differences.

Math Games

Rolling Ratios

- Play Rolling Ratios with a partner. These are the rules:
 - Each player rolls one die to decide who will play first. If there is a tie, roll again.
 - In one round, each player takes a turn.
 - For each turn, roll all three dice.
 - Record the ratio of the least value to the sum of the rolled values, in fraction form.
- Express the fraction as a decimal. If necessary, use a calculator and round to the nearest hundredth.
- Add the decimals from your turns. The first player to reach 2.5 or higher wins.
- If both players reach 2.5 in the same round, the player with the higher total wins.
- If the totals are tied, the players continue playing until one of them pulls ahead.
- Modify the rules of the game. For example, change the number of dice or choose a different ratio. Play your modified version of the game.

Challenge in Real Life

Running a Small Business

Small business owners need to keep track of their finances—both the money they take in from customers and the money they pay out to suppliers.

You be the small business owner! Assume that you own a games store. Part of your job is to keep track of your financial accounts.

The table below shows information about some of the games you carry.

- You buy them from a supplier at cost price.
- You sell them to customers at a higher price.

Buy from Supplier	Game X	\$14
	Game Y	\$10
	Game Z	\$6
Sell to Customers	Game X	\$24
	Game Y	\$11
	Game Z	\$11

- Choose a + or - sign to place beside each value in the table. Choose the sign by considering how each value affects your account (money in or money out). Justify your choice of signs.
- Show how the multiplication or division of integers can be used to model each situation below. Justify your choices.
 - You buy 12 copies of Game Z from the supplier.
 - You spend \$72 to buy these copies of Game Z from the supplier.
 - You sell three copies of Game Y to customers.
 - A customer returns two copies of Game X for a refund.
 - You find that four copies of Game Y have defects. You return them to the supplier.
- If you buy 36 copies of Game X from the supplier, how many will you have to sell to break even on them? Show your thinking.
- Create a scenario for a typical week of buying, selling, returns, and so on. Design a table that summarizes your transactions for the multiplication and division of integers can be applied.

Problem Solving

People solve mathematical problems at home, at work, and at play. There are many different ways to solve problems. In *MathLinks 8*, you are encouraged to try different methods and to use your own ideas. Your method may be different but it may also work.

A Problem Solving Model

Where do you begin with problem solving? It may help to use the following four-step process.

Understand

Read the problem carefully.

- Think about the problem. Express it in your own words.
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Plan

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- Decide whether any of the following might help. Plan how to use them.
 - tools such as a ruler or a calculator
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Do It!

Solve the problem by carrying out your plan.

- Use mental math to estimate a possible answer.
- Do the calculations.
- Record each of your steps.
- Explain and justify your thinking.

Look Back

Examine your answer. Does it make sense?

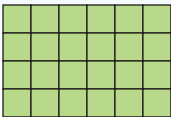
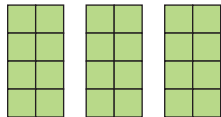
- Is your answer close to your estimate?
- Does your answer fit the facts given in the problem?
- Is the answer reasonable? If not, make a new plan. Try a different strategy.
- Consider solving the problem a different way. Do you get the same answer?
- Compare your methods with those of your classmates.

Here are several strategies you can use to help solve problems. Your ideas on how to solve the problems might be different from any of these.

Problem 1

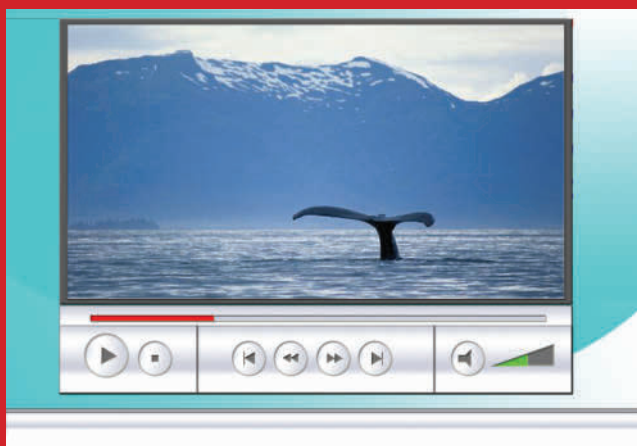
Carolyn has a rectangular vegetable garden that measures 4 m by 6 m. She wants to divide the garden into three equal sections to plant three different vegetables. What is the area of each section?



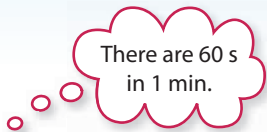
Strategy	Example
Use a Variable	<p>The garden is a rectangle with a length of 6 m and a width of 4 m.</p> $A = l \times w$ $A = 6 \times 4$ $A = 24$ <p>The area of the garden is 24 m².</p>
Model It	<p>Use 24 square tiles to model the garden. Each tile represents 1 m².</p> <div style="text-align: center;">  </div> <p>Divide the tiles into three equal groups to represent the three sections.</p> <div style="text-align: center;">  </div> <p>There are eight tiles in each group. The area of each section is 8 m².</p>
Use a Variable	<p>The garden is a rectangle with a length of 6 m and a width of 4 m.</p> $A = l \times w$ $A = 6 \times 4$ $A = 24$ <p>The area of the garden is 24 m².</p> <p>Let S represent the area of each section.</p> $S = \text{area of garden} \div \text{number of sections}$ $S = 24 \div 3$ $S = 8$ <p>The area of each section is 8 m².</p>

Problem 2

Amil is downloading some software. It has taken 56 s to complete $\frac{1}{4}$ of the download. What is the total time that the download will likely take?

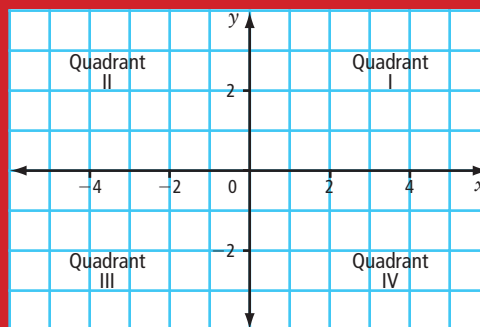


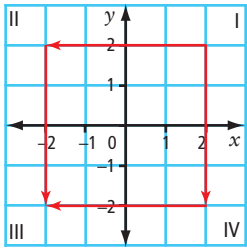
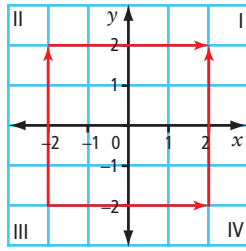
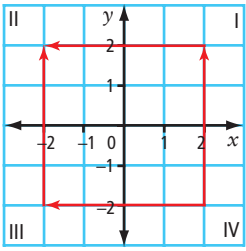
Strategy	Example
Solve an Equation	<p>Let t represent the total time required to complete the download. $\frac{1}{4}$ of the total time is 56 s. The equation that models this situation is $\frac{t}{4} = 56$.</p> $\frac{t}{4} = 56$ $\frac{t}{4} \times 4 = 56 \times 4 \quad \text{Multiply both sides of the equation by 4.}$ $t = 224$ <p>The download will take about 224 s, or 3 min and 44 s.</p>
Estimate and Check	<p>Estimate that 56 s is close to 60 s, which is 1 min. $\frac{1}{4}$ of the download takes about 1 min. Multiply by 4 to estimate the total download time.</p> $1 \times 4 = 4$ <p>The total download will likely take about 4 min.</p> <p>Check:</p> $56 \times 4 = 224$ <p>The download will take about 224 s, or 3 min and 44 s.</p> <p>The estimate and the calculated values are close.</p>



Problem 3



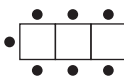
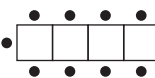
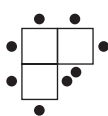
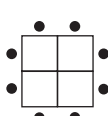
A teacher is playing a guessing game with her class. Her clue is "After a reflection in each axis of a Cartesian plane, a point is in quadrant II. What quadrant did the point start in?" What is the solution?



Strategy	Example
<p>Identify all Possibilities</p>	<p>The point can be reflected in x-axis and then in the y-axis or it can be reflected in the y-axis and then the x-axis. After the two reflections, the point lies in quadrant II. So, the possible starting quadrants are quadrants I, III, or IV.</p> <p>List all the possibilities, using quadrants I, III, and IV as the starting quadrants.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="326 850 639 1265"> <p>Starting in Quadrant I</p>  <p>Both possibilities result in quadrant III as a final position.</p> </div> <div data-bbox="639 850 1008 1265"> <p>Starting in Quadrant III</p>  <p>Both possibilities result in quadrant I as a final position.</p> </div> <div data-bbox="1008 850 1370 1265"> <p>Starting in Quadrant IV</p>  <p>Both possibilities result in quadrant II as a final position.</p> </div> </div> <p>The point started in quadrant IV.</p>

Problem 4

Sharon's family owns and operates a small restaurant. They have many small square tables and stacking chairs. What is the greatest number of people that can be seated when 10 tables are put together?

Strategy	Example		
Make an Assumption	Assume that only one person can sit along each side of a table.		
Draw a Diagram	Diagram	Number of Tables	Number of People
Make an Organized List or Table		1	4
Look for a Pattern		2	6
		3	8
		4	10
Identify all Possibilities	<p>When 10 tables are put together in a line, $4 + 2 \times 9$ people can be seated. This is 22 people.</p> <p>Consider other possible arrangements.</p> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">  </div> <div> <p>When 3 tables are put together in an L-shape, 8 people can be seated. This is the same as when the tables are in a line.</p> </div> </div> <div style="display: flex; align-items: flex-start; margin-top: 20px;"> <div style="margin-right: 20px;">  </div> <div> <p>When 4 tables are put together to form a square, 8 people can be seated. This is less than when the tables are in a line.</p> </div> </div> <p>Other arrangements of tables cannot seat more people than when the tables are arranged in a line. So, the greatest number of people that can be seated when 10 tables are put together is 22 people.</p>		

The table shows a pattern. One table seats four people. With each extra table, two more people can be seated.