Math 8

Module 2
Squares, Integers, and the Pythagorean Theorem

\[ a^2 + b^2 = c^2 \]
Course Overview

Welcome to Mathematics 8!

In this course you will continue your exploration of mathematics. You’ll have a chance to practice and review the math skills you already have as you learn new concepts and skills. This course will help you to increase your ability to think mathematically.

Organization of the Course

The Mathematics 8 course is made up of four modules. These modules are:

Module 1: Exploring 2-D and 3-D Connections
Module 2: Squares, Integers, and the Pythagorean Theorem
Module 3: Data, Graphing, and Linear Equations
Module 4: Fractions, Ratios, and Probability

Organization of the Modules

Each module has three sections. The sections have the following features:

Pretest
This is for students who feel they already know the concepts in the section. It is divided by lesson, so you can get an idea of where you need to focus your attention within the section.

Lessons
Each section is divided into lessons. Each lesson is made up of the following parts:

Essential Questions
Essential Questions are based on the concepts in each lesson. This activity will help you organize information and reflect on your learning.

Warm-up
This is a brief drill or review to get ready for the lesson.

Explore
This is the main teaching part of the lesson. Here you will explore new concepts and learn new skills.
Try it! Activities
These are activities for you to complete to solidify your new skills. You will mark these using Solutions at the end of each module.

At the end of each module you will find:

Solutions
This contains all of the solutions to the Pretests, Warm-ups and Try it! Activities.

Templates
Templates to pull out, cut, colour, or fold in order to complete specific activities. You will be directed to these as needed.

Glossary
This is a list of key terms and their definitions.

More about the Pretest
There is a pretest at the beginning of each section. This pretest has questions for each lesson in the section. Complete this pretest if you think that you already have a strong grasp of the topics and concepts covered in the section. Mark your answers using Solutions found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

If you get all the answers correct for one or more lessons, but not for the whole pretest, you can decide whether you can omit the activities for those lessons.
Thinking Space

The column on the outside edge of most pages is called the Thinking Space. You can use this space to

- write questions about things you don’t understand
- note things that you want to look at again
- respond to a question in the Thinking Space or the text
- draw pictures that help you understand the math
- identify words that you don’t understand
- connect what you are learning to what you already know
- make your own notes or comments

Materials and Resources

There is no textbook required for this course. All of the necessary materials and exercises are found in the modules.

In some cases, you will be referred to templates to pull out, cut, colour, or fold. These templates will always be found near the end of the module, just in front of the answer key.

You will need a scientific calculator for some of the activities. A geometry set would also be helpful, although for many activities you can use a straightedge rather than a ruler. A protractor is available in the Appendix if you don’t have one.

If you have Internet access, you might want to do some exploring online. The Math 8 Course Website will be a good starting point. Go to http://www.openschool.bc.ca/courses/math/math8/mod2.html and find the lesson that you’re working on. You’ll find relevant links to websites with games, activities, and extra practice.
COURSE OVERVIEW

**Icons**

You will see a few icons used on the left-hand side of the page. These icons are used to signal a change in activity or to bring your attention to important instructions.

- **Explore Online**
- **Essential Questions**
- **Solutions**
- **Use a Calculator**
Module 2 Overview

Module 2 consists of three sections on the multiplication and division of positive and negative numbers, squares and square roots, and the Pythagorean Theorem.

Section Overviews

Section 2.1: Multiplying and Dividing Integers

In this first section you'll review multiplication and division and decide which operation to use in word problems. You’ll also learn to multiply and divide with positive and negative numbers. Finally, you’ll review the order of operations and use its principles to calculate the answers to questions that include integer multiplication and division.

Section 2.2: Squares and Square Roots

In the second section, you’ll learn to recognize and list perfect squares through the use of a media tool called Shape Shifter. You’ll be able to recognize the square root sign $\sqrt{}$ and use the square root button on your calculator. Using your calculator, you’ll be able to find the square root of any whole number.

Section 2.3: The Pythagorean Theorem

In the final section, you’ll learn the Pythagorean Theorem and be able to decide if a triangle is a right triangle. You’ll identify Pythagorean Triples, and then use the Pythagorean Theorem to find the lengths of missing sides of right triangles.

Course Map

On the following page you’ll find a course map. If you colour in the box for each section and lesson as you complete it, you’ll easily be able to see how much of the course you’ve finished, and how much is still left to complete.
Section 1
Multiplying and Dividing Integers

In this section you will:
• learn when to multiply and when to divide
• multiply and divide with positive and negative numbers
• review order of operations

For this section you will need:
• crayon, marker, or coloured pencil

Where in the World...?

Mathematicians in China were contemplating the meaning and use of negative numbers as early as 100 BC.

This image is from the famous Chinese book the *Jiu zhang suanshu* or the *Nine Chapters on the Mathematical Art*. In the book there is a description of using different coloured counting rods—red for positive numbers and black for negative numbers.

Many years later in India and in Europe, negative numbers were used in banking and trade to represent money lost and debts owed.

Positive and negative numbers allow us to give numbers a direction. Temperature can go up and temperature can go down. When you’re walking on the sidewalk, you can go forward or you can go backward.

But what does it mean to multiply or divide negative numbers?
Section 1
Pretest

Complete this pretest if you think that you already understand the topics and concepts covered in this section. Mark your work using Solutions found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

If you get all the answers correct for one or more lessons, but not for the whole pretest, you can decide whether you can omit the activities for those lessons.

Lesson A: Should I Multiply or Divide?

1. You have 3 pies and 18 people. How many pieces should you cut each pie into to guarantee that each person will have at least one piece?

2. You have 320 CDs in your collection. You found a CD case that you like. It holds 40 CDs. How many cases do you need for your collection?

3. A health insurance plan advertises that its plan costs only $6 per day. How much does the plan cost per month? Assume that a month has 30 days.
Lesson B: Multiplying and Dividing With Negative Numbers

4. a. \(-6 \times 7 = \)
   
b. \(-12 \div (-2) = \)
   
c. \(8 \times (-11) = \)
   
d. \(150 \div (-3) = \)
   
e. \(42 \div 6 = \)
   
f. \(-9 \times (-8) = \)

5. \(\frac{(-3)(8)(-4)}{(6)(-2)} = \)

Lesson C: Expressions With More Than One Operation

6. a. \(\frac{(4)(-3)}{6} + (3)(7) = \)
   
b. \((-2)(7) - 18 \div 6 + 4 \times 9 = \)
   
c. \(42 \div (-7) + 9 = \)
   
d. \(-3 + 6 \times 9 = \)

Turn to Solutions at the end of the module and mark your work.
Lesson A
Should I Multiply or Divide?

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
### Essential Questions

Before the lesson: What I know

<table>
<thead>
<tr>
<th>Multiplication?</th>
<th>Division?</th>
<th>How do I know when to multiply or divide?</th>
</tr>
</thead>
</table>

After the lesson: What I learned

<table>
<thead>
<tr>
<th>Multiplication?</th>
<th>Division?</th>
<th>How do I know when to multiply or divide?</th>
</tr>
</thead>
</table>

What is multiplication?

What is division?
Warm-up

1. \(4 \times 5 = \)
2. \(21 \div 7 = \)
3. \(3 \times 8 = \)
4. \(63 \div 9 = \)
5. \(2 \times 7 = \)
6. \(18 \div 6 = \)
7. \(4 \times 4 = \)
8. \(15 \div 5 = \)
9. \(6 \times 4 = \)
10. \(72 \div 9 = \)
11. \(30 \div 10 = \)
12. \(11 \times 8 = \)
13. \(24 \div 3 = \)
14. \(7 \times 5 = \)
15. \(70 \div 7 = \)
16. \(6 \times 6 = \)
17. \(4 \times 8 = \)
18. \(56 \div 7 = \)
19. \(20 \div 4 = \)
20. \(5 \times 5 = \)

If you have access to the Internet and want to get more practice with multiplication and division facts, go to the Math 8 website [http://www.openschool.bc.ca/courses/math/math8/mod2.html](http://www.openschool.bc.ca/courses/math/math8/mod2.html) and click on the link under Lesson 2.1A: Should I Multiply or Divide?

Turn to Solutions at the end of the module and mark your work.
Explore Multiplication

You know lots about multiplication already.

If you have 4 groups with 3 items in each group, you can figure out the total number of items by multiplying.

\[ 4 \times 3 = 12 \]

There are twelve items all together.

Perhaps in one of the other math courses you’ve taken, you’ve learned how to do problems like this one.

Example

Susan worked at a tulip farm last spring, packaging bulbs in boxes before they were sent to the store. She put 15 bulbs in every box. On her most productive day, she filled 42 boxes. How many bulbs did she pack?

- **Groups:** boxes
- **Items:** bulbs
- **# of groups:** Susan packed _42_ boxes.
- **# of items in one group:** There were _15_ bulbs in each box.
- **Total items:** We don’t know. Multiply to find out.

\[ 42 \times 15 = 630 \]

Susan packed 630 bulbs.

Go to [http://media_openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html](http://media_openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html), click on Module 2, and watch *Solving a Multiplication Word Problem*. 
Use this structure to solve the problem.

Groups: ________________________

Items: ________________________

# of groups: ________________________

# of items in one group: ________________________

Total items: ____________
These are all multiplication problems.

1. This question is very similar to the example. Follow the example if you need help.

Susan worked at a tulip farm last spring, packaging bulbs in boxes before they were sent to the store. She put 24 bulbs in every box. On her most productive day, she filled 370 boxes. How many bulbs did she pack?

Fill in the blanks with the correct numbers.

Groups: boxes
Items: bulbs
# of groups: Susan packed ___________ boxes.
# of items in one group: There were __________ bulbs in each box.
Total items: We don’t know. Multiply to find out

_______ × _______ = _______

Susan packed _______ bulbs.

2. In the winter, Amir feeds his cows four bales of hay every day. Spring is coming and he thinks that he will be able to put the cows out on the pasture in 45 days. How many bales of hay does he need?

Fill in the blanks with the correct numbers.

Groups: days
Items: bales of hay
# of groups: Amir needs hay for ____________ days.
# of items in one group: He needs ____________ bales of hay each day.
Total items: We don’t know. Multiply to find out.

_______ × _______ = _______

Amir needs _______ bales of hay.

3. A box of collectible trading cards contains 24 packs. Each pack has 15 trading cards. How many cards are in a box?

Draw a picture that describes this situation.

Fill in the blanks with the correct numbers.

Groups: packs of trading cards
Items: cards in each pack

# of groups: _______ packs
# of items in one group: _______ cards in each pack

Total items: We don’t know. Multiply to find out.

_______ × _______ = _______

There are _______ trading cards in a box.
4. Alexis got a beading kit for her birthday. The kit contains six pouches of coloured beads, and there are 22 beads in each pouch. How many beads are in the kit?

Draw a picture that describes this situation.

Fill in the blanks with the correct numbers.

Groups: pouches of beads
Items: beads

# of groups: _______ pouches of beads
# of items in one group: _______ beads in each pouch

Total items: We don’t know. Multiply to find out.

_______ × _______ = _______

There are _______ beads in the kit.
5. Chris earns $9 per hour at the Burger Hut. He worked 21 hours last week. How much money did he make?

Draw a picture that describes this situation.

Fill in the blanks.

Groups:  

Items:  

# of groups:  

# of items in one group:  

Total items: We don’t know. Multiply to find out.

_______ × _______ = _______

Chris earned $_______ last week.
6. Jamie’s band gets paid 5¢ every time someone buys one of their songs from an Internet music store. Their latest hit has been downloaded 3726 times since it was posted this morning. How much money have they made?

Think about groups, items, and total when you solve the problem.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Turn to Solutions at the end of the module and mark your work.
**Explore Division**

How did that go? Make sure you have checked your answers before you move on.

Division is the opposite of multiplication. If you have twelve items in four equal groups, you can figure out the number of items in each group by dividing.

$$12 \div 4 = 3$$

There are three items in each group.

Go to [http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html](http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html), click on Module 2, and watch *Solving a Division Word Problem*.

When you work on this next set of questions, think about how they are different from the last set of questions.
Try It!
Activity 2

These are all division problems.

1. One day at the tulip farm, Susan’s boss bought pizza for everyone. They packed 60,000 tulips yesterday! With 24 tulips in each box, how many boxes did they fill?

   Groups:   boxes
   Items:    bulbs

   Fill in the blanks with the correct numbers.

   # of groups:   We don’t know. Divide to find out.
   # of items in one group: There were ______ bulbs in each box.
   Total items:   There were ______ bulbs altogether.
   ______ ÷ ______ = ______
   They filled ______ boxes with bulbs.

2. The calendar fundraiser is going well. The class keeps $3 for every calendar that they sell. They have set a fundraising goal of $465. How many calendars do they need to sell?

   Draw a picture that describes this situation.
Thinking Space

Groups: calendars
Items: dollars for each calendar that they sell
# of groups: We don't know. Divide to find out.

# of items in one group: The class earns $________ for each calendar that they sell.
Total items: The class wants to raise $________.

________ ÷ _________ = _________

They need to sell ________ calendars to reach their goal.

3. The landscaper for a housing development has 585 coleus seedlings ready to be transplanted.

How many seedlings can she plant at each one of 13 new houses?

Groups: new houses
Items: seedlings
# of groups: There are ________ new houses.
# of items in one group: We don't know. Divide to find out.
Total items: There are ________ seedlings.

________ ÷ _________ = _________

The landscaper can plant ________ coleus seedlings in each yard.
4. Chris needs $648 to buy a new guitar. How many hours does he need to work at the Burger Hut, where he earns $9 per hour, to make that much money?

Fill in the blanks.

Groups: ____________

Items: ____________

# of groups: We don’t know. Divide to find out.

# of items in one group: ____________

Total items: ____________

_______ ÷ _________ = _________

Chris needs to work for ________ hours to earn the money to buy the guitar.

5. Alexis has 56 beads left in her beading kit. She has worked out a design that she likes for a bracelet with 7 beads. How many bracelets can she make with the beads that she has left?

Draw a picture that describes this situation.
Fill in the blanks.

Groups: __________
Items: __________

# of groups: We don’t know. Divide to find out.

# of items in one group: __________
Total items: __________

_______ ÷ _______ = _______

Alexis can make _______ bracelets.

6. Nancy has noticed that she is nearly out of one brand of collectible trading cards at her store. One box, which contains 24 packs of cards, costs $18. How much does she pay for each pack of cards?

Think about groups, items, and total when you solve the problem.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Turn to Solutions at the end of the module and mark your work.
Explore
Deciding Whether to Use Multiplication or Division

How are multiplication questions different from division questions?

Think about groups, items in a group, and total.

If you need to find the total, you’re doing a multiplication question.

If you know the total, you’re doing a division question.
Try It!
Activity 3

There are multiplication and division problems here.

1. Amir has 192 bales of hay. If he feeds his cows 4 bales every day, how many days will his hay last?

   Think about groups, items, and total when you solve the problem.

   Draw a picture that describes this situation.

   Fill in the blanks with the description and the correct number, or write “We don’t know.”

   Groups: ____________________________

   Items: ____________________________

   Total: ____________________________

   _______ \( \div \) _______ = _______

   ____________________________

   ____________________________
2. The class has sold 32 calendars so far in this year’s fundraiser. The calendars sell for $14. How much money have they collected?

Think about groups, items, and total when you solve the problem.

Draw a picture that describes this situation.

Fill in the blanks with the description and the correct number, or write “We don’t know.”

Groups: ____________________________
Items: ____________________________
Total: ____________________________

_______ + _______ = ________

___________________________

___________________________
3. The 5 members of Jamie’s band are celebrating. They have earned $700 selling their songs at an internet music store. How much money do they each get?

Think about groups, items, and total when you solve the problem.

Draw a picture that describes this situation.

Fill in the blanks with the description and the correct number, or write “We don’t know.”

Groups: __________________________

Items: __________________________

Total: __________________________

_______ ÷ _______ = _______

______________________________

______________________________
4. The new housing development is almost finished. There are 13 new houses. The landscaper wants to put a cedar hedge along the driveway of each new home. She needs 8 plants for each hedge. How many cedar plants does she need? 

Think about groups, items, and total when you solve the problem.

Draw a picture that describes this situation.

Fill in the blanks with the description and the correct number, or write “We don’t know.”

Groups: ________________________________

Items: ________________________________

Total: ________________________________

_______ ÷ _______ = _______

__________________________________

__________________________________

Turn to Solutions at the end of the module and mark your work.

You’ve finished Lesson A. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Lesson B
Multiplying and Dividing with Negative Numbers

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
### Essential Questions

<table>
<thead>
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<th>Before the lesson: What I know</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>After the lesson: What I learned</th>
</tr>
</thead>
</table>

- When multiplying integers, how do I know if my answer will be positive or negative?
- What do I do when a question asks me to multiply and divide more than two numbers?
Warm-up

1. \(-2 + 3 =\)
2. \(6 \times 7 =\)
3. \(3 - 8 =\)
4. \(36 \div 4 =\)
5. \(7 \times 3 =\)
6. \(4 - 7 =\)
7. \(9 \times 2 =\)
8. \(12 \div 4 =\)
9. \(-15 + 7 =\)
10. \(10 - 6 =\)
11. \(24 \div 6 =\)
12. \(15 \times 3 =\)
13. \(-2 - 5 =\)
14. \(6 + 5 =\)
15. \(27 \div 9 =\)
16. \(12 - 20 =\)
17. \(4 \times 8 =\)
18. \(-9 - 2 =\)
19. \(35 \div 7 =\)
20. \(-1 + 17 =\)

Turn to Solutions at the end of the module and mark your work.
Explore
\times \text{ and } ÷ \text{ with a Positive Number and a Negative Number}

There are lots of ways to think about positive and negative numbers. Perhaps you like thinking about temperature. The temperature can be +3° C. The temperature can be –4° C. The temperature can go up (move in a positive direction). The temperature can go down (move in a negative direction).

Maybe the money analogy is your favourite. You have $10 (that’s +10). You owe $10 (that’s –10). You earn money (move in a positive direction) and you spend money (move in a negative direction).

In this lesson we’re going to think about stairs.

Start at 0.

Go up two stairs.

Do that three times.

Where are you?

+6

2 \times 3 = 6

We knew that already.
Go back to 0.

Go down two stairs.

Do that three times.

Where are you?

\[-6\]

\[-2 \times 3 = -6\]

Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch *Multiplication Steps*.

When multiplying or dividing, if the signs are DIFFERENT (one +, one −) the answer is NEGATIVE.
Try It!

Activity 1

1. Remember: If the signs are different, the answer is negative.

   a. \( 4 \times (-3) = \)
   b. \(-4 \times 3 = \)

   c. \( 12 \div 1 = \)
   d. \(-1 \times 12 = \)

   e. \( 12 \div (-4) = \)
   f. \(-12 \div 4 = \)

   g. \( 2 \times (-6) = \)
   h. \(-2 \times 6 = \)

   i. \(-12 \div 3 = \)
   j. \(12 \div (-3) = \)

   k. \(12 \div 3 = \)
   l. \(-12 \times 1 = \)

   m. \(12 \times (-1) = \)
   n. \(12 \div 2 = \)

   o. \(12 \div (-2) = \)
   p. \(12 \div (-6) = \)

   q. \(-12 \div 6 = \)
   r. \(3 \times (-4) = \)

   s. \(4 \times 3 = \)
   t. \(6 \times 2 = \)

   u. \(-6 \times 2 = \)
   v. \(6 \times (-2) = \)
2. Winter is coming and the temperature is dropping. The weather forecast says to expect the temperature to go down by 3°C every day for the next 5 days. How much colder will it be on the fifth day than it is today?

3. Margaret, Halim, and André have decided to close the store that they owned together. Their company is $900 in debt. They want to split the debt equally between the three of them. How much does each of them owe?

Turn to Solutions at the end of the module and mark your work.
Explore × and ÷ with Two Negative Numbers

Do you remember doing “fact families”?

\[
\begin{align*}
2 \times 3 &= 6 \\
3 \times 2 &= 6 \\
6 ÷ 2 &= 3 \\
6 ÷ 3 &= 2
\end{align*}
\]

Let’s look at the fact family that goes with \(2 \times (-3)\).

\[
\begin{align*}
2 \times (-3) &= -6 \\
(-3) \times 2 &= -6 \\
-6 ÷ 2 &= (-3) \\
-6 ÷ (-3) &= 2
\end{align*}
\]

The first three facts in that list follow the rule we just learned. When the signs are different, the answer is negative.

Look at the last fact. A negative number divided by a negative number is a positive number.

Multiplication and division of integers have the same rules for signs.

\[\text{When multiplying or dividing, if the signs are the SAME (both + or both -), the answer is POSITIVE.}\]
Try It!
Activity 2

When multiplying or dividing, if the signs are the SAME (both + or both –) the answer is POSITIVE.

1. $4 \times 5 =$ 2. $-4 \times (-5) =$

3. $4 \times (-5) =$ 4. $20 \div 4 =$

5. $-20 \div (-5) =$ 6. $-10 \times (-2) =$

7. $-20 \div (-2) =$ 8. $20 \div 2 =$

9. $-1 \times (-20) =$ 10. $3 \times (-8) =$

11. $-24 \div 8 =$ 12. $-4 \times 6 =$

13. $24 \times (-1) =$ 14. $24 \div (-4) =$

15. $2 \times (-12) =$ 16. $-24 \div 3 =$
### Thinking Space

<table>
<thead>
<tr>
<th>Expression</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-24 \div 1)</td>
<td>(-24)</td>
</tr>
<tr>
<td>((-7 \times -7))</td>
<td>49</td>
</tr>
<tr>
<td>(7 \times 7)</td>
<td>49</td>
</tr>
<tr>
<td>(49 \div -7)</td>
<td>-7</td>
</tr>
<tr>
<td>(49 \div 7)</td>
<td>7</td>
</tr>
<tr>
<td>(-5 \times -5)</td>
<td>25</td>
</tr>
<tr>
<td>(5 \times 5)</td>
<td>25</td>
</tr>
<tr>
<td>(-25 \div -25)</td>
<td>1</td>
</tr>
<tr>
<td>(-1 \times -5)</td>
<td>5</td>
</tr>
<tr>
<td>(-4 \times -4)</td>
<td>16</td>
</tr>
<tr>
<td>(4 \times 4)</td>
<td>16</td>
</tr>
<tr>
<td>(16 \div -4)</td>
<td>-4</td>
</tr>
<tr>
<td>(-16 \div 4)</td>
<td>-4</td>
</tr>
<tr>
<td>(4 \div 2)</td>
<td>2</td>
</tr>
<tr>
<td>(4 \div -2)</td>
<td>-2</td>
</tr>
<tr>
<td>(-4 \div 2)</td>
<td>-2</td>
</tr>
<tr>
<td>(-4 \div -2)</td>
<td>2</td>
</tr>
<tr>
<td>(56 \div 8)</td>
<td>7</td>
</tr>
</tbody>
</table>

**Turn to Solutions at the end of the module and mark your work.**
Explore
\times and \div with More Than Two Numbers

What about questions with more than two numbers?

\begin{align*}
2 \times 3 \times (-4) & \quad (2)(-3)(-4) & \quad \frac{12(-3)}{4} \\
(3)(-1)(-2)(-5) & \\
\frac{12(-3)(5)}{(-6)(-15)} & \quad \frac{5(-2)(-1)(6)}{15}
\end{align*}

Go to [http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html](http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html), click on Module 2, and watch *Simplifying*.

When an expression contains only the operations of multiplication and division, you can do the operations in any order that you like.

Did you notice anything about how negative signs affect the answer? If there is an *even* number of negative signs, the answer is *positive*. If there is an *odd* number of a negative signs, the answer is *negative*.

Let’s look at a question with more operations.

\begin{align*}
\frac{12(-3)(5)}{(-6)(-15)}
\end{align*}

The numerator is the top of a fraction. The denominator is the bottom of a fraction.

Will this answer be positive or negative? The *numerator* will be negative and the *denominator* will be positive. A negative divided by a positive is negative. This answer will be negative.

There are a number of different ways to do this question. We’re going to look at two of them.
Multiply everything that is in the numerator.

Multiply everything that is in the denominator.

Remember: the fraction bar means “divided by”.

\[
\frac{-180}{90} \text{ means } -180 \div 90.
\]

\[
= \frac{-180}{90} \text{ Divide.}
\]

\[
= -2
\]

That method works, but sometimes the numbers get pretty big. This time, let’s simplify by doing some of the division first.

\[
\frac{12(-3)(5)}{(-6)(-15)} \text{ There are an odd number of negative signs in the question. We know the answer will be negative. Take away all the negative signs and put one in front.}
\]

\[
= -\frac{12(3)(5)}{(6)(15)} \text{ When you simplify, remember to divide a number into both the numerator and denominator.}
\]

\[
= -\frac{2 \cdot 12(3)(5)}{1 \cdot (6)(15)} \text{ 6 divides into 12 twice. 6 divides into 6 once.}
\]

\[
= -\frac{2(3)(5)}{(1)(15)} \text{ 5 divides into both 5 and 15.}
\]

\[
= -\frac{2(3)(1)}{(1)(3)} \text{ 3 divides into both 3 and 3.}
\]

\[
= -\frac{2(1)(1)}{(1)(1)}
\]

\[
= -2
\]
Try It!
Activity 3

These questions will be easier if you simplify first. Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch the video Simplifying again if you want to review this.

When multiplying or dividing, if there are an EVEN number of negative signs, the answer is POSITIVE. If there are an ODD number of negative signs, the answer is NEGATIVE.

1. \( \frac{12}{(3)(-1)(2)} \)
2. \( \frac{(3)(-3)(-7)}{(-9)} \)

3. \( (4)(5)(-1) \)
4. \( \frac{(-16)(25)(-2)}{(10)(-4)} \)

5. \( (2)(-5)(7)(-2) \)
6. \( \frac{(6)(-4)(2)}{-12} \)
Go to [http://media(openschool.bc.ca/osbcmedia/ma08/courser/ma08_ui.html](http://media(openschool.bc.ca/osbcmedia/ma08/courser/ma08_ui.html), click on Module 2, and watch *Solving Mixed Multiplication and Division* to see fully-worked solutions for some of these questions.

You’ve finished Lesson B. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Lesson C
Expressions With More Than One Operation

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
Before the lesson: What I know

After the lesson: What I learned

Essential Questions

When there is more than one operation in an expression, how do I know what to do first?
Warm-up

Answer the questions. Then look up each answer in the Decoder Table. Put the letter that matches the answer in the blank beside the questions.

For example: 1. $-4 - 3 = -7$, which matches A in the Decoder Table. Put an “A” in the blank beside 1.

A  1. $-4 - 3 = -7$
   _____ 2. $\frac{(-5)(-1)(-2)(3)}{6}$
   _____ 3. $18 \div 3 =$
   _____ 4. $14 \div -7 =$
   _____ 5. $-3 \times -4 =$
   _____ 6. $(-6)(-8) =$
   _____ 7. $-3 + 9 =$
   _____ 8. $4 + 5 + 3 =$
   _____ 9. $\frac{-21}{-3}$
   _____ 10. $-8 + 6 =$
   _____ 11. $\frac{18(7)(-4)}{(-14)(3)}$
   _____ 12. $-5 + 30 =$

Decoder Table

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-7</td>
</tr>
<tr>
<td>D</td>
<td>48</td>
</tr>
<tr>
<td>E</td>
<td>-1</td>
</tr>
<tr>
<td>F</td>
<td>7</td>
</tr>
<tr>
<td>G</td>
<td>9</td>
</tr>
<tr>
<td>H</td>
<td>-2</td>
</tr>
<tr>
<td>I</td>
<td>6</td>
</tr>
<tr>
<td>M</td>
<td>5</td>
</tr>
<tr>
<td>N</td>
<td>25</td>
</tr>
<tr>
<td>O</td>
<td>2</td>
</tr>
<tr>
<td>P</td>
<td>-5</td>
</tr>
<tr>
<td>S</td>
<td>12</td>
</tr>
<tr>
<td>T</td>
<td>-6</td>
</tr>
<tr>
<td>W</td>
<td>-25</td>
</tr>
</tbody>
</table>

Now unscramble the letters to solve the riddle. The A for question 1 has already been written in.

What do sea monsters eat?

9 3 11 4 A 1 12 6 5 10 7 2 8

Turn to Solutions at the end of the module and mark your work.
**Explore**

**Order of Operations**

Something that tells us what to do with a number or numbers is called an operation.

Addition, subtraction, multiplication, and division are the operations that you know about already. These are called the basic operations.

You have probably done questions about adding and subtracting more than two numbers in other math courses.

In Lesson B, you learned about multiplying and dividing with more than two numbers.

What do you do with a question that involves many different operations?

**BEDMAS: More Than Just a Weird Word**

\[ (-2)(3) ÷ 6 + 9 - 14 ÷ (9 - 2) \]

BEDMAS is an acronym that helps you to remember the order of operations.

**BEDMAS**
First, work out everything that is in brackets.

\[
\begin{align*}
(-2)(3) & ÷ 6 + 9 - 14 ÷ (9 - 2) \\
= (-2)(3) & ÷ 6 + 9 - 14 ÷ 7
\end{align*}
\]

**BEDMAS**
Next, simplify all of the exponents. (There are no exponents in this question. You’ll learn more about this in Section 2).
**BEDMAS**
Do all of the division and multiplication in the order they appear from left to right.

\[= (-2)(3) \div 6 + 9 - 14 \div 7\]
\[= -6 \div 6 + 9 - 14 \div 7\]
\[= -1 + 9 - 2\]

**BEDMAS**
Finally, do the addition and subtraction.

\[= -1 + 9 - 2\]
\[= 8 - 2\]
\[= 6\]

Go to [http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html](http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html), click on Module 2, and watch Using Order of Operations.
Try It!
Activity 1

Solve the following.

1. \((-3)(7) = \)

2. \(4 \times 9 = \)

3. \(-13 \times 3 = \)

4. \(42 \div (-6) = \)

5. \((8)(-1)(-4) = \)

6. \(12 + 6 = \)

7. \(15 \div 5 + 7 = \)

8. \(2 - 3 \times 4 = \)

9. \(3 + \frac{4}{2} = \)

10. \(-16 + (4)(3) = \)

11. \(-5 - (2)(-1)(-18) \div 4 = \)

12. \(6 \times 5 \div 3 = \)

13. \(18 \div 2 + 4 = \)

14. \(18 \div (2 + 4) = \)
15. $6 \times 8 + 12 + 3 \times 9 = $

16. $3 + 11 \times 4 + 12 \div 3 = $

17. $7 - 3 \times 5 = $

18. $(7 - 3) \times 5 = $

19. $36 \div 9 + 2 + 1 \times 9 + 6 - 5 = $

20. $6 \times 7 \div 14 - 3 + 2 \times 4 = $

21. $5 - 1 + 2 - 4 \times 3 \div 6 = $

22. a. Make up a question that has an answer of 5. Use at least 3 numbers. Use at least 2 different operations.
23. a. Make up a question that has an answer of –2. Use at least 4 numbers. Use at least 3 different operations.

b. Show how to solve your question.

24. a. Make up a question that uses all of these symbols exactly once.

\[
1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \ 8 \ 9 \ + \ + \ - \ - \ \times \ \div
\]

For example: \( 12 \div 3 + 4 - 5 \times 6 + 7 - 89 \)

b. Show how to solve your question.
thinking Space

Turn to Solutions at the end of the module and mark your work.

You’ve finished Lesson C. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.

Section Summary

Completing this section has helped you to:

- learn when to multiply and when to divide
- multiply and divide with positive and negative numbers
- review order of operations
Section 2
Squares and Square Roots

In this section you will:
• recognize and list perfect squares
• recognize the square root sign $\sqrt{}$
• calculate the square roots of whole numbers

For this section you will need:
• calculator

Where in the World...?
Designing a house, sewing an outfit, installing new kitchen cabinets—if you know about squares and right angles, your project will look great.

You will learn the skills to solve problems like these in Section 2.
Section 2 Pretest

Complete this pretest if you think that you already understand the topics and concepts covered in this section. Mark your work using Solutions found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

If you get all the answers correct for one or more lessons, but not for the whole pretest, you can decide whether you can omit the activities for those lessons.

Lesson A: Perfect Squares

1. Circle the perfect squares.

<table>
<thead>
<tr>
<th>54</th>
<th>18</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>27</td>
<td>37</td>
</tr>
<tr>
<td>25</td>
<td>81</td>
<td>5</td>
</tr>
</tbody>
</table>

Lesson B: Square Roots of Perfect Squares

2. What is the square root of 36?

3. a. $2^2 = \underline{\hspace{2cm}}$    b. $5^2 = \underline{\hspace{2cm}}$    c. $8^2 = \underline{\hspace{2cm}}$

4. a. $9 = \underline{\hspace{2cm}}^2$    b. $16 = \underline{\hspace{2cm}}^2$    c. $49 = \underline{\hspace{2cm}}^2$
5. a. \( \sqrt{9} = \) ______  b. \( \sqrt{64} = \) ______  c. \( \sqrt{1} = \) ______

6. a. \( 11 = \sqrt{\_} \)  b. \( 2 = \sqrt{\_} \)  c. \( 5 = \sqrt{\_} \)

7. a. \( 6 - 2^2 = \) ______  b. \( (-3 + 5)^2 + 5 \times 3 = \) ______

Lesson C: Using the Pythagorean Theorem

8. Match each number on the left to its square on the right.

|   |   | a. 16  
|---|---|---
| -2.5 | b. 9  
| 4 | c. 1.21  
| -7 | d. 6.25  
| 3 | e. 49  
| 1.1 | f. 4  
| -2 |

9. Complete each statement with =, <, or >

a. \( 2 \square 5 \)

b. \( 3 - 8 \square 8 - 3 \)

c. \( 3^2 - 3 \square 6 \)

d. \( (-2)(-3) \square 18 \div (-3) \)

10. Is \( \sqrt{7} \) less than 2 or greater than 2? Why?
11. \( \sqrt{39} \) and \( \sqrt{43} \) are bigger than 6 and smaller than 7. List three more square roots that are between 6 and 7.

Lesson D: Calculating Square Roots

Use your calculator for these questions.

12. Solve.
   
   a. \( 216^2 = \)_____  
   
   b. \( 3.4^2 = \)_____  
   
   c. \( 8.17^2 = \)_____  

13. Solve.
   
   Round your answers to the nearest thousandth.
   
   a. \( \sqrt{7} = \)_____  
   
   b. \( \sqrt{24} = \)_____  
   
   c. \( \sqrt{18} = \)_____  

Turn to Solutions at the end of the module and mark your work.
Lesson A
Perfect Squares

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
### Essential Questions

<table>
<thead>
<tr>
<th>Before the lesson: What I know</th>
<th>After the lesson: What I learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why are some numbers called “perfect squares”?</td>
<td></td>
</tr>
<tr>
<td>How do I know when a number is not a perfect square?</td>
<td></td>
</tr>
<tr>
<td>How are square numbers and square shapes related to each other?</td>
<td></td>
</tr>
</tbody>
</table>
Warm-up

Before you start this lesson about perfect squares, practice some multiplication facts.

1. $2 \times 3 =$
2. $3 \times 5 =$

3. $3 \times 3 =$
4. $4 \times 2 =$

5. $4 \times 5 =$
6. $6 \times 6 =$

7. $7 \times 3 =$
8. $7 \times 7 =$

9. $8 \times 4 =$
10. $8 \times 8 =$

11. $9 \times 6 =$
12. $9 \times 9 =$

If you think you need some more practice with multiplication facts, go to the Math 8 website http://www.openschool.bc.ca/courses/math/math8/mod2.html and click on the link under Lesson 2.1A: Should I Multiply or Divide?
Find the area of these rectangles.

13. \[ \text{Area} = 5 \times 2 \]

14. \[ \text{Area} = 4 \times 3 \]

15. \[ \text{Area} = 6 \times 6 \]

16. Draw two rectangles with an area of 8. Remember to label the length of each side.

Turn to Solutions at the end of the Module and mark your work.
Explore
The ShapeShifter Tool

Go to [http://media.openschool.bc.ca/osbcmedia/ma08/course/html/ma0822a1f_shapeshifter.html](http://media.openschool.bc.ca/osbcmedia/ma08/course/html/ma0822a1f_shapeshifter.html) and open the *Shape Shifter* tool.

Click on the Rectangle button. Play with this tool for a while and discover how it works.
Try It!
Activity 1

1. Make Rectangle show “2 × 3”. Draw what you see.

2. Make Rectangle show “3 × 3”. Draw what you see.

4. Make Rectangle show a rectangle of area 12 in another way. Draw what you see.

5. Are there any other ways to draw a rectangle with an area of 12?

Turn to Solutions at the end of the Module and mark your work.
All of these shapes are rectangles. Some of the shapes are special rectangles called squares. What makes a square special?

All sides of a square are the same length. You probably knew that already.

Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/ma0822a1f_shapeshifter.html and open Shape Shifter.

Click on the Rectangle button and make it show $2 \times 2$.

The orange shape is a square. The area of the square is 4. The number 4 is called a perfect square.

Play with Rectangle and find some more perfect squares.
Try It!
Activity 2

1. Make a square with each side 3. Which perfect square did you find?

2. Try to make a square with area 8. Is 8 a perfect square?

3. Try to make a square with area 1. Is 1 a perfect square?

4. Try to make a square with area 7. Is 7 a perfect square?

5. Try to make a square with area 16. Is 16 a perfect square?

Turn to Solutions at the end of the Module and mark your work.
A perfect square is a number that is the area of a square whose sides are whole numbers.

That’s a mouthful! Let’s look at that one piece at a time.

Whole numbers are: 0, 1, 2, 3, . . .

These are squares whose sides are whole numbers:

1 x 1 = 1
2 x 2 = 4
3 x 3 = 9

How can you find the area of a square? Multiply the length by the width. In a square, the length and the width are the same. We could have said “multiply the length by the length.”

So, these numbers represent the area of a square whose sides are whole numbers.

In other words, 1, 4, and 9 are perfect squares.
What are the next three perfect squares? Here are pictures that represent each one.

4 x 4 = 16
5 x 5 = 25
6 x 6 = 36

Look at the definition again:

A perfect square is a number that is the area of a square whose sides are whole numbers.

The area of a square is the length of its side times itself.

So, we can find perfect squares by taking any whole number and multiplying it by itself.

2 x 2 = 4 4 is a perfect square.
5 x 5 = 25 25 is a perfect square.
10 x 10 = 100 100 is a perfect square.
Try It!
Activity 3

1. Multiply these numbers to find some more perfect squares.

\[ 3 \times 3 = \quad 6 \times 6 = \quad 1 \times 1 = \]
\[ 9 \times 9 = \quad 4 \times 4 = \]

2. Circle the perfect squares. Use the numbers you circled to complete the multiplication facts below.

\[
\begin{array}{cccc}
121 & 22 & 100 & 144 \\
55 & 16 & 6 & 56 \\
25 & 1 & 71 & 12 \\
63 & 64 & 49 & 8 \\
9 & 81 & 4 & 36 \\
\end{array}
\]

\[ 1 \times 1 = \quad 2 \times 2 = \]
\[ 3 \times 3 = \quad 4 \times 4 = \]
\[ 5 \times 5 = \quad 6 \times 6 = \]
\[ 7 \times 7 = \quad 8 \times 8 = \]
\[ 9 \times 9 = \quad 10 \times 10 = \]
\[ 11 \times 11 = \quad 12 \times 12 = \]
Turn to Solutions at the end of the Module and mark your work.

You've finished Lesson A. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Lesson B

Square Roots of Perfect Squares

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
## Essential Questions

<table>
<thead>
<tr>
<th>Before the lesson: What I know</th>
<th>After the lesson: What I learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>How can I find the square of a number?</td>
<td></td>
</tr>
<tr>
<td>What is a square root?</td>
<td></td>
</tr>
<tr>
<td>How are squares and square roots related?</td>
<td></td>
</tr>
<tr>
<td>What does a square root symbol look like, and what does it mean?</td>
<td></td>
</tr>
</tbody>
</table>
Warm-up

1. What is the area?

2. Multiply.
   a. 6 \times 2 =
   b. 3 \times 4 =
   c. 5 \times 5 =
   d. 2 \times 3 =
   e. 4 \times 5 =
   f. 4 \times 4 =
   g. 2 \times 8 =
   h. 3 \times 5 =
   i. 3 \times 3 =
   j. 3 \times 12 =
   k. 6 \times 6 =
   l. 4 \times 9 =
   m. 3 \times 6 =
   n. 2 \times 9 =
3. Circle the numbers that are perfect squares.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

Turn to Solutions at the end of the Module and mark your work.
Explore
Squaring a Number

In the last lesson, you learned that if you pick a whole number (say, “3”) and multiply it by itself, the answer is called a perfect square.

For example: 3 multiplied by itself is 9.

9 is a perfect square.

\[3 \times 3 = 9\]

Another way to write this is:

\[3^2 = 9\]

The little “2” that is written above the line means “multiply this number by itself.” When you’re reading an equation, say “squared.”

That little number is called an exponent.

\[3^1 \text{ means } 3 \times 3 \times 3\]

\[5^2 \text{ means } 5 \times 5\]

\[2^7 \text{ means } 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2\]

You’ll learn more about this in Grade 9.

\[3^2 = 9\]

Read this as “three squared equals nine.”

\[4^2 = 16\]

Read this as “four squared equals sixteen.”
Try It!
Activity 1

Answer these questions without your calculator.
Remember: $3^2$ means the same as $3 \times 3$.

1. $1^2 =$
2. $2^2 =$
3. $3^2 =$
4. $4^2 =$
5. $5^2 =$
6. $6^2 =$
7. $7^2 =$
8. $8^2 =$
9. $9^2 =$
10. $10^2 =$

11. This picture shows $2^2$.

```
+---+---+
|   |   |
+---+---+
```

$2 \times 2 = 4$

Draw a picture to show $5^2$.
Go to [http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html](http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html), click on Module 2, and watch *Using Order of Operations With Squares* to see two worked examples of expressions that involve many different operations.

12. Solve these expressions.

Remember BEDMAS.

- **Brackets**
- **Exponents**
- **Division and Multiplication** (in order from left to right)
- **Addition and Subtraction** (in order from left to right)

a. \(2^2 + 1 =\)

b. \((-2)(3)^2 - 4 =\)

c. \((-4 + 7) + 4^2 - 18 ÷ 3 =\)

Turn to Solutions at the end of the Module and mark your work.
Explore
Squares in ShapeShifter

Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/ma0822a1f_shapeshifter.html and open Shape Shifter.

Click on the Rectangle button. Make as many different-sized squares as you can.
Try It!
Activity 2

Draw four different squares in the blank Rectangle screens.
Turn to Solutions at the end of the Module and mark your work.
Explore
Square Roots

This equation and this diagram represent the same idea.

\[ 3^2 = 9 \]

You already know that the answer when we multiply a whole number times itself is called a “perfect square.” The other number has a name too. That other number is the length of one side of the square. We could say that it is the root of the square. It is called the square root.
Thinking Space

Try It!  
Activity 3

1. Use Rectangle to make a square with area 9. How long is the side of the square?

   What is the square root of 9?

2. Use Rectangle to make a square with area 4. How long is the side of the square?

   What is the square root of 4?

3. The area of this square is 25 cm$^2$. How long is each side?

   What is the square root of 25?

Turn to Solutions at the end of the Module and mark your work.
Explore
The Square Root Symbol

There are many ways to describe the relationship between the square and the square root.

In this example, 9 is the square and 3 is the square root.

\[ 9 = 3^2 \]  Nine is three squared.
\[ 3^2 = 9 \]  Three squared is nine.
\[ \sqrt{9} = 3 \]  The square root of nine is three.
\[ 3 = \sqrt{9} \]  Three is the square root of nine.

This symbol, \( \sqrt{\cdot} \), means “the square root of.” It is called a square root symbol.
Try It! Activity 4

1. How many perfect squares are there between 1 and 100 (including 1 and 100)?

List all the perfect squares between 1 and 100 (including 1 and 100).

How can you be sure that your list is complete?

2. Draw a diagram to represent this equation:

\[ \sqrt{25} = 5 \]

3. a. Four squared equals ______.
   \[ 4^2 = \] 

b. Nine is ______ squared.
   \[ 9 = ____^2 \]

c. ______ is the square root of four.
   \[ ____ = \sqrt{4} \]

d. One is the square root of ______.
   \[ 1 = \sqrt{____} \]

e. The square root of nine is ______.
   \[ \sqrt{9} = ____ \]

f. ______ is the square root of twenty-five.
   \[ ____ = \sqrt{25} \]
4. \(1^2 = \quad \sqrt{1} = \quad\)

\(2^2 = \quad \sqrt{4} = \quad\)

\(3^2 = \quad \sqrt{9} = \quad\)

\(4^2 = \quad \sqrt{16} = \quad\)

\(5^2 = \quad \sqrt{25} = \quad\)

\(6^2 = \quad \sqrt{36} = \quad\)

\(7^2 = \quad \sqrt{49} = \quad\)

\(8^2 = \quad \sqrt{64} = \quad\)

\(9^2 = \quad \sqrt{81} = \quad\)

\(10^2 = \quad \sqrt{100} = \quad\)

Turn to Solutions at the end of the Module and mark your work.

You’ve finished Lesson B. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Lesson C
Estimating Square Roots

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
### Essential Questions

**Before the lesson: What I know**

**After the lesson: What I learned**

**How do I estimate the square root of a number that is not a perfect square?**
Warm-up

1. a. \(4^2 = \)
   
   b. \(6^2 = \)
   
   c. \(1^2 = \)
   
   d. \(8^2 = \)
   
   e. \(5^2 = \)

2. a. \(\sqrt{9} = \)
   
   b. \(\sqrt{81} = \)
   
   c. \(\sqrt{25} = \)
   
   d. \(\sqrt{49} = \)
   
   e. \(\sqrt{4} = \)

3. a. \(8^2 = \)
   
   b. \(16 = _____^2 \)
   
   c. \(\sqrt{25} = \)
   
   d. \(7 = \sqrt{____} \)
   
   e. \(100 = _____^2 \)
   
   f. \(\sqrt{64} = \)
4. Draw a picture to represent this example.

\[ 2 = \sqrt{4} \]

Turn to Solutions at the end of the Module and mark your work.
Explore
Comparison Symbols: <, >, =

Later on in this lesson, you will be using comparison symbols to compare two numbers.

Let’s review how they are used.

= Equals
You use this symbol all the time. It means that the expression on the left is equal to the expression on the right.

\[ 27 = 27 \quad 2 + 3 = 5 \quad 6 = (-2)(-3) \quad -18 ÷ 3 = -6 \]

< Less Than and > Greater Than
You can use one of these symbols when the expression on the left is not equal to the expression on the right. The open side (the big side) of the symbol goes toward the expression that is bigger. The closed side (the small side) of the symbol goes toward the expression that is smaller.

\[ 2 < 3 \quad 8 + 2 > 4 \]

2 is less than 3 \quad 8 plus 2 is greater than 4

Some people find it helpful to think of a greedy crocodile. Its mouth is always reaching for the bigger pile of fish!
Try It!
Activity 1

Complete each statement with the correct comparison symbol: =, <, or >.

1. 7 3 + 4
2. –6 5

3. 2 3
4. 16 4

5. 8 3²
6. (–4)(–5) 12

7. 3 √25
8. –6 + 5 5 – 6

9. 6² 36
10. 5 √36

11. –24 ÷ 4 3 – 10
12. 2 2²

13. (–15)² (–15) × (–15)
14. √9 2 + 5

Turn to Solutions at the end of the Module and mark your work.
Explore
Not All Squares Are Perfect

You can take a line of any length you like and then use that line as the side of a square.

![Square with side length 3.4 cm]

In fact—we can leave out the idea of a square shape and think about square numbers.

If you pick any number (say, 3.4) and multiply it by itself, the answer is called its square.

\[ 3.4^2 = 3.4 \times 3.4 = 11.56 \]

3.4 squared is 11.56

11.56 is the square of 3.4

We could pick a negative number and multiply it by itself.

\[ (-3)^2 = (-3) \times (-3) = 9 \]

–3 squared is 9

9 is the square of –3

Wait a minute! that means that –3 is a square root of 9. In fact, every number has two square roots—one positive and one negative. The square roots of 9 are 3 and –3. The square roots of 16 are 4 and –4. You’ll learn more about this in other math courses that you take.

Every number can be squared.

\[ -17^2 = 17 \times 17 = 289 \]

\[ 1.7^2 = 1.7 \times 1.7 = 2.89 \]

\[ (-17)^2 = (-17) \times (-17) = 289 \]

\[ (-1.7)^2 = (-1.7) \times (-1.7) = 2.89 \]

When you square any number, positive or negative, the answer is always positive. Why is that?
Try It!
Activity 2

Use your thinking space or some scrap paper to figure out these answers. You can use your calculator in the next lesson.

Remember: When a whole number is squared, the answer is called a perfect square.

1. $12^2 =$

2. $(-1.2)^2 =$

3. $5.1^2 =$

4. $0.2^2 =$

5. $(-23)^2 =$

6. $35^2 =$

7. $3.5^2 =$

8. $(-0.4)^2 =$

9. $20^2 =$

Circle the answers that are perfect squares.

Turn to Solutions at the end of the Module and mark your work.
Explore
More Square Roots

We just learned that every number has a square. Does every number have a square root?

Let’s look at a couple of squares that we already know a lot about. 4 and 9 are both perfect squares.

Think of a square with area 4.

What is the root of this square? In other words, how long is its side? 
The length of the side is 2.

\[ \sqrt{4} = 2 \]

Think of a square with area 9.

What is the root of this square? In other words, how long is its side? 
The length of the side is 3.

\[ \sqrt{9} = 3 \]

The expression \( \sqrt{7} \) asks us to think about a square with area 7. What is the root of that square? How long is its side?

A square with area 7 is bigger than a square with area 4, and smaller than a square with area 9.

\[ 4 < 7 < 9 \]
So, the side length of the 7 square will be longer than the side of the 4-square. It will be shorter than the side of the 9-square. \[ \sqrt{4} < \sqrt{7} < \sqrt{9} \]

The square root of 7 is between 2 and 3. \[ 2 < \sqrt{7} < 3 \]

Make a number line that shows all integers from 1 to 10.

Now write \( = \sqrt{ \) next to each number and fill in the numbers under the square root symbols.

This is a very useful tool for estimating square roots.

Where would \( \sqrt{21} \) be on the number line?

\( \sqrt{21} \) is between 4 and 5
\[ 4 < \sqrt{21} < 5 \]

Can you estimate a value for \( \sqrt{21} \)? We know that \( \sqrt{21} \) is between 4 and 5, so 4.5 would be a good guess.

Can we make a better guess than that? Is \( \sqrt{21} \) closer to 4 or closer to 5? Look at the number line again. \( \sqrt{21} \) is closer to 5. So 4.7 is a better guess.
Try It!
Activity 3

1. Make a list of the first 10 perfect squares.

   \[1^2 = \underline{\hspace{2cm}}\]
   \[2^2 = \underline{\hspace{2cm}}\]
   \[3^2 = \underline{\hspace{2cm}}\]
   \[4^2 = \underline{\hspace{2cm}}\]
   \[5^2 = \underline{\hspace{2cm}}\]
   \[6^2 = \underline{\hspace{2cm}}\]
   \[7^2 = \underline{\hspace{2cm}}\]
   \[8^2 = \underline{\hspace{2cm}}\]
   \[9^2 = \underline{\hspace{2cm}}\]
   \[10^2 = \underline{\hspace{2cm}}\]

2. Complete this number line.

   \[
   \begin{array}{cccccccccccc}
   \sqrt{1} & \sqrt{2} & \sqrt{3} & \sqrt{4} & \sqrt{5} & \sqrt{6} & \sqrt{7} & \sqrt{8} & \sqrt{9} & \sqrt{10} \\
   \end{array}
   \]

3. Use the number line you made to answer these questions. The first one is done for you.

   a. \[2 < \sqrt{7} < 3\]
      \[\sqrt{7}\] is between 2 and 3

   b. \[4 < \sqrt{22} < \underline{\hspace{1cm}}\]
      \[\sqrt{22}\] is between \underline{\hspace{1cm}} and \underline{\hspace{1cm}}
c. $\sqrt{13} < \boxed{} < \boxed{}$  \quad $\sqrt{13}$ is between $\boxed{}$ and $\boxed{}$

d. $\boxed{} < \sqrt{61} < \boxed{}$  \quad $\sqrt{61}$ is between $\boxed{}$ and $\boxed{}$

e. $\boxed{} < \sqrt{74} < \boxed{}$  \quad $\sqrt{74}$ is between $\boxed{}$ and $\boxed{}$

f. $\boxed{} < \sqrt{42} < \boxed{}$  \quad $\sqrt{42}$ is between $\boxed{}$ and $\boxed{}$

g. $\boxed{} < \sqrt{5} < \boxed{}$  \quad $\sqrt{5}$ is between $\boxed{}$ and $\boxed{}$

h. $\boxed{} < \sqrt{57} < \boxed{}$  \quad $\sqrt{57}$ is between $\boxed{}$ and $\boxed{}$

i. $\boxed{} < \sqrt{29} < \boxed{}$  \quad $\sqrt{29}$ is between $\boxed{}$ and $\boxed{}$

j. $\boxed{} < \sqrt{3} < \boxed{}$  \quad $\sqrt{3}$ is between $\boxed{}$ and $\boxed{}$

k. $\boxed{} < \sqrt{32} < \boxed{}$  \quad $\sqrt{32}$ is between $\boxed{}$ and $\boxed{}$

l. $\boxed{} < \sqrt{95} < \boxed{}$  \quad $\sqrt{95}$ is between $\boxed{}$ and $\boxed{}$

4. a. Is $\sqrt{7}$ closer to 2 or closer to 3?

b. Which of these numbers is the best estimate of $\sqrt{7}$?

2.2 2.5 2.7

Turn to Solutions at the end of the Module and mark your work.

You've finished Lesson C. Now it's time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Lesson D
Calculating Square Roots

For this lesson, you will need:
• calculator

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
### Essential Questions

<table>
<thead>
<tr>
<th>Before the lesson: What I know</th>
<th>After the lesson: What I learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>How does my calculator’s square root button work?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Before the lesson: What I know</th>
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</tr>
</thead>
<tbody>
<tr>
<td>When I take the square root of a number that's not a perfect square, why is my calculator’s answer called an approximation?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Warm-up**

1. a. $\sqrt{1} =$  
   b. $\sqrt{4} =$  
   c. $\sqrt{9} =$  
   d. $\sqrt{16} =$  
   e. $\sqrt{25} =$  
   f. $\sqrt{36} =$  
   g. $\sqrt{49} =$  
   h. $\sqrt{64} =$  
   i. $\sqrt{81} =$  
   j. $\sqrt{100} =$  

Use your calculator.

2. Compute these squares. Remember: $4.7^2 = 4.7 \times 4.7$
   
   a. $386^2 =$  
   b. $29.4^2 =$  
   c. $1.89^2 =$  
   d. $29^2 =$  
   e. $4.3^2 =$  
   f. $1.6^2 =$
3. Where should $\sqrt{2}$ be on this number line?

$$\sqrt{2} \text{ is between } \square \text{ and } \square$$

$$\square < \sqrt{2} < \square$$

4. Practice rounding to the nearest thousandth to get ready for this lesson.

This is the thousandths place.

Look here for the clue.

3 is less than 5, so keep the thousandths digit the same and drop the other ones. (If the next digit over had been 5 or greater, we would have changed the 7 to an 8.)

That squiggly equals sign means “is approximately equal to.”

Now it’s your turn. Round these numbers to the nearest thousandth.

a. $1.863\ 95 \approx$

b. $4.217\ 36 \approx$

c. $0.981\ 6 \approx$

d. $93.812\ 493\ 7 \approx$
e. $6.413\ 51 \approx$

f. $15.218\ 75 \approx$

g. $36.246\ 203 \approx$

h. $7.812\ 84 \approx$

i. $63.512\ 1 \approx$

Turn to Solutions at the end of the Module and mark your work.
Explore
Irrational Numbers

In the last lesson you learned that $\sqrt{2}$ is between 1 and 2.

But where between 1 and 2? Is it closer to 1.2 or 1.7? Let's zoom in on that number line.

Start computing some squares. You can use your calculator for this.

- $1.1^2 = 1.21$
- $1.2^2 = 1.44$
- $1.3^2 = 1.69$
- $1.4^2 = 1.96$
- $1.5^2 = 2.25$

Add these numbers to your number line.

$2$ is between 1.96 and 2.25. So $\sqrt{2}$ must be somewhere between 1.4 and 1.5.

Let's try to be more precise. Zoom in on that section of the number line and start computing squares.
We didn’t have to go very far that time! \( \sqrt{2} \) must be somewhere between 1.41 and 1.42.

We could keep doing that—getting a more precise answer by zooming in on the number line and figuring out where \( \sqrt{2} \) is.

But we could do it FOREVER and never find a decimal number that was exactly equal to the square root of 2.

How do we know that we could do this forever? Read about the proof at the Math 8 website [http://www.openschool.bc.ca/courses/math/math8/mod2.html](http://www.openschool.bc.ca/courses/math/math8/mod2.html). Click on the link under **Lesson 2.2D: Calculating Square Roots**.

An irrational number is a number that can’t be represented by any fraction, not even a decimal fraction. If we try to write an irrational number with decimals, the fractional part would go on forever without a pattern.

\[ \sqrt{2} \text{ is an irrational number.} \]

So are \( \sqrt{3}, \sqrt{5}, \sqrt{7}, \sqrt{86}, \text{ and } \sqrt{101}. \)

Only perfect squares have “nice” square roots. Their square roots are whole numbers like 3 or 14 or 648.

All other numbers have irrational square roots.
Try It!  
Activity 1

Circle the irrational numbers.

\[
\begin{align*}
\sqrt{64} & \quad \sqrt{14} & \quad \sqrt{49} \\
\sqrt{16} & \quad \sqrt{2} & \\
\sqrt{21} & \quad \sqrt{4} & \\
\sqrt{7} & 
\end{align*}
\]

Turn to Solutions at the end of the Module and mark your work.
Explore
Calculating Square Roots

Find the square root symbol on your calculator.

\[ \sqrt{\phantom{0}} \]

Sometimes it has its own button. Sometimes it is an extra function on a button.

Look in the Appendix to see an example of a square root button on a calculator.

Every calculator works a little bit differently, so experiment with yours until you know how the square root function works. Test it with some square roots that you already know.

What happens when you ask your calculator for an irrational number, like \( \sqrt{2} \)?

The digits after the decimal point go on forever. Your calculator will probably show you as many digits as it can fit in the display window.
Try It!
Activity 2

You may use your calculator.

1. First, use estimation to check that your calculator is giving you reasonable answers. Then, write down your calculator's answers for these questions. The first one is done for you.

This squiggly line \( \approx \) means “approximately equal to.”

a. \[ 1 < \sqrt{2} < 2 \]
   \[ \sqrt{2} \approx 1.4142135623730950488016887242097 \]

b. \[ \boxed{1} < \sqrt{7} < \boxed{2} \]
   \[ \sqrt{7} \approx \] ________________

c. \[ \boxed{1} < \sqrt{18} < \boxed{2} \]
   \[ \sqrt{18} \approx \] ________________

d. \[ \boxed{1} < \sqrt{95} < \boxed{2} \]
   \[ \sqrt{95} \approx \] ________________

e. \[ \boxed{1} < \sqrt{34} < \boxed{2} \]
   \[ \sqrt{34} \approx \] ________________

f. \[ \boxed{1} < \sqrt{42} < \boxed{2} \]
   \[ \sqrt{42} \approx \] ________________

g. \[ \boxed{1} < \sqrt{27} < \boxed{2} \]
   \[ \sqrt{27} \approx \] ________________

This is a lot of digits! How many digits does your calculator show?
2. Why do you think that the calculator's answer is called an approximation?

Turn to Solutions at the end of the Module and mark your work.
Explore Rounding

The calculator’s answer is called an approximation.

No matter how many decimal places your calculator provides, we could have a more precise answer with just one more decimal place.

But that’s okay. Depending on the application, two or three decimal places are usually enough.

The calculator gives this approximation for $\sqrt{5}$.

$$\sqrt{5} \approx 2.236068$$

$$(2.236068)^2 = 5.0000001$$

That not exactly 5!
This square root is an approximation.

Round the number to the nearest hundredth. Look in the Warm-up section if you need to review rounding.

$$\sqrt{5} \approx 2.24$$

Round the number to the nearest thousandth.

$$\sqrt{5} \approx 2.236$$
Try It!
Activity 3

Use your calculator for these questions.

1. Find a decimal approximation for these square roots. Round your answers to the nearest thousandth.
   
   a. $\sqrt{19} =$
   
   b. $\sqrt{7} =$
   
   c. $\sqrt{24} =$
   
   d. $\sqrt{73} =$
   
   e. $\sqrt{48} =$
   
   f. $\sqrt{51} =$
   
   g. $\sqrt{11} =$
   
   h. $\sqrt{15} =$
   
   i. $\sqrt{41} =$

2. Find a decimal approximation for these square roots. Round your answers to the nearest hundredth.
   
   a. $\sqrt{3} =$
   
   b. $\sqrt{48} =$
   
   c. $\sqrt{33} =$
SECTION 2 | LESSON D: CALCULATING SQUARE ROOTS

Thinking Space

d. \( \sqrt{26} = \)
e. \( \sqrt{12} = \)
f. \( \sqrt{22} = \)
g. \( \sqrt{55} = \)
h. \( \sqrt{93} = \)
i. \( \sqrt{37} = \)

Turn to Solutions at the end of the Module and mark your work.

You've finished Lesson D. Now it's time to return to the Essential Questions from the beginning of the lesson and complete the final column.

Section Summary

Completing this section has helped you to:

- learn how to use the Shape Shifter Rectangle tool
- find the squares of numbers
- recognize perfect squares
- find the square roots of numbers
- learn about the square root symbol
Section 3
The Pythagorean Theorem

In this section you will:
• learn the Pythagorean Theorem
• decide if a triangle is a right triangle
• identify Pythagorean Triples
• find the lengths of missing sides of a right triangle

For this section you will need:
• 2 sheets of graph paper from the Appendix
• coloured pencils
• scissors
• calculator

Where in the World...?

Right angles are very important. They’re everywhere!

Many different societies in the ancient world had techniques to build and check for right angles—the Greeks, the Egyptians, the Babylonians, and the Chinese. It’s possible that the Mayans and the Aztecs knew how to do calculations for right triangles, but we don’t know enough about their mathematics to be sure.
Section 3 Pretest

Complete this pretest if you think that you already understand the topics and concepts covered in this section. Mark your work using the Solutions found at the end of the module.

If you get all the answers correct (100%), you may decide that you can omit the lesson activities.

If you get all the answers correct for one or more lessons, but not for the whole pretest, you can decide whether you can omit the activities for those lessons.

Lesson A: The Pythagorean Theorem

1. Draw a right triangle.

Label the legs of the triangle ‘a’ and ‘b’.

Label the hypotenuse of the triangle ‘c’.

State the Pythagorean Theorem.
Lesson B: Pythagorean Triples

2. Is this triangle a right triangle? Why or why not? Prove this using the Pythagorean Theorem.

3. Do the numbers 1.5, 2.0, and 2.5 form a Pythagorean Triple? Why or why not?

4. Is 3, 4, 7 a Pythagorean Triple? Why or why not?

5. Is 9, 12, 15 a Pythagorean Triple? Why or why not?
Lesson C: Using the Pythagorean Theorem

6. Use the Pythagorean Theorem to find the length of the hypotenuse.
Round your answer to the nearest tenth.

7. The length of the hypotenuse of a right triangle is 20 cm. The length of one of the legs is 12 cm. How long is the other leg?

Turn to the Solutions at the end of the module and mark your work.
Lesson A
The Pythagorean Theorem

For this lesson, you will need:

- 2 sheets of graph paper from the Appendix
- coloured pencils
- scissors

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When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
## Essential Questions

**Before the lesson: What I know**

**After the lesson: What I learned**

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<tr>
<th>Essential Questions</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Why are 90° angles important? They have a special name. What is it?</td>
<td>What are the names of the sides of a right triangle?</td>
<td>What does the Pythagorean Theorem say about right triangles?</td>
</tr>
</tbody>
</table>
Warm-up

Review what you learned in Section 1 about the area of squares to get ready for this lesson.

1. What is the area of this square?

   ![Square with side length 3] (3, 3)

   a. 3
   b. 6
   c. $3^2$

2. What is the area of this square?

   ![Square with side length 6] (6, 6)

   a. $6^2$
   b. 24
   c. 12

3. One side of a square is 5 cm long. What is its area?
4. We don’t know very much about this square. The letter $c$ represents the length of one side.

$$\begin{array}{|c|}
\hline
\text{Thinking Space} \\
\hline
\end{array}$$

Which expression represents the area of this square?

a. $2c$

b. $c^2$

c. $4c$

d. There isn’t enough information to answer question.

5. Match each square to its area.

$$\begin{array}{|c|}
\hline
\text{Thinking Space} \\
\hline
\end{array}$$

$$\begin{array}{|c|}
\hline
\text{Thinking Space} \\
\hline
\end{array}$$

Turn to Solutions at the end of the Module and mark your work.
Explore
Right Angles

An angle that measures 90° is called a right angle.

Why is a 90° angle so important? Why does it have a special name?

Look at these two fences.

This fence is not going to last much longer.

This fence will be up for a long time. The posts are at right angles to the ground. The crossbeam forms a right angle with the posts.

A carpenter who is building a house needs to make sure that the walls form a right angle with the floor; otherwise the building will fall over.

The corners of this page are right angles.

This symbol is used to mark a right angle.
Try It!
Activity 1

Use the corner of a piece of paper to help you find the right angles in this picture. Mark the right angles that you find.

Turn to Solutions at the end of the Module and mark your work.
Explore
Right Triangles

Do you know which triangle here is a right triangle? Why is it called a right triangle?

A right triangle is a triangle with one right angle.
Try It! Activity 2

Find all of the right triangles. Mark the right angles with this symbol:

One has already been done.

*Hint*: You can use the corner of a piece of paper to help you find the right angles.

Turn to Solutions at the end of the Module and mark your work.
Explore
The Hypotenuse

The sides of a right triangle that form the right angle are called the legs.

There is one side of a right triangle that is not a leg. It’s called the hypotenuse. It’s always the longest side of a right triangle, and it’s the side that is opposite the right angle.
Try It! Activity 3

Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/ma0822a1f_shapeshifter.html and open the Shape Shifter tool. Click on the Triangle button. Play with this tool for a while and discover how it works.

Move the vertices until you have made a right triangle.

This symbol will appear when you have made a right triangle.

Record the lengths of each side in the chart.

Shade the box with the longest side.

Repeat with other right triangles until the chart is full.

<table>
<thead>
<tr>
<th>Leg</th>
<th>Leg</th>
<th>Hypotenuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8</td>
<td>12.81</td>
</tr>
</tbody>
</table>

Turn to Solutions at the end of the Module and mark your work.
Explore
Squares and Right Triangles

For this lesson you will need:
- 2 sheets of graph paper from the Appendix
- coloured pencils
- scissors

In this activity you’re going to build a proof of a famous mathematical theorem.

Step 1: Draw a right triangle. You need to decide how big it will be.

It doesn’t matter how long the legs are. However, this activity will be easier to follow along with if the legs are of different sizes.

You will be repeating this triangle on your graph paper, so don’t make your triangle too big. Choose a number between 2 and 6 for each leg of your triangle.

Fill in the blanks:

One leg of my triangle will be ___ units long.

The other leg of my triangle will be ___ units long.

Using the grid on your graph paper as a guide, draw the two legs of your right triangle in the upper left hand corner of the page.

In this example, one leg is 4 units long and the other is 5 units long. Your triangle can be different as long as it has a right angle.
Step 2: Draw the hypotenuse of your triangle.

- Colour the triangle blue.
- Label the short leg $a$.
- Label the long leg $b$.
- Label the hypotenuse $c$.

![Diagram](image)

Step 3: Using the picture as a guide, draw three copies of your triangle.

- Colour them blue. Label the sides as you did in Step 2.

![Diagram](image)
Examine the large square you have made. Can you see that the length of each side is \( a + b \)?

Look at the smaller white square inside. The length of each side of this square is \( c \). The area of this square is \( c^2 \). Write “\( c^2 \)” in the middle of the square.

**Step 4:** On another sheet of graph paper, repeat Steps 1 and 2 with the same size of triangle that you have been using so far.

**Step 5:** Using the picture as a guide, draw three copies of your triangle. Colour them blue. Label the sides.
Step 6: Using the picture as a guide, draw a square that encloses all of your triangles.

Now there are two squares inside your big square. Colour the smaller one green. Colour the other one purple.

The length of each side of the green square is $a$. Its area is $a^2$. Write “$a^2$” in the middle of the green square.

The length of each side of the purple square is $b$. Its area is $b^2$. Write “$b^2$” in the middle of the purple square.

Examine the large square you have made. Can you see that the length of each side is $a + b$? It is exactly the same size as the first square you made!
Step 7: Cut out one of your blue triangles. Cut out the squares. Arrange them as shown in the picture.

Try that activity again with right triangles of a different size. Maybe one leg is 3 squares long and the other is 7. Make four identical right triangles, and do the activity again.
You have just done a geometric proof of the Pythagorean Theorem!

\[ a^2 + b^2 = c^2 \]

Even though Pythagoras was not the first to understand this property of right triangles, he was the first (we think) to express it in a general way that applies to all right triangles. That is why the theorem is named after him.

If you have internet access, go to the Math 8 website at http://www.openschool.bc.ca/courses/math/math8/mod2.html and click on the link under Lesson 2.3A: The Pythagorean Theorem.

You’ve finished Lesson A. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Lesson B

Pythagorean Triples

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
### Essential Questions

**Before the lesson: What I know**

**After the lesson: What I learned**

**How can I use the Pythagorean Theorem to check that an angle is a right angle?**

**What are Pythagorean Triples?**
1. State the Pythagorean Theorem.

2. Circle the whole numbers.

\[
\begin{array}{ccc}
4 & \frac{1}{2} & 7.3 \\
5.1 & 6 & \frac{1}{3} \\
1.21 & 23 & \\
\end{array}
\]
3. Solve the clues in the crossword puzzle. Write out the answers in words.

There are no spaces or dashes in crossword puzzle answers. If your answer is 41, write “FORTYONE” in the puzzle.

Across
1. $5^2$
6. $3^2$
8. $7^2$
10. $9^2 + 3^2$
12. $8^2 - 1^2$
14. $8^2 + 1$

Down
2. $6^2 - 4^2$
3. $2^2$
4. $1^2$
5. $4^2$
7. $9^2$
9. $6^2$
11. $3^3 - 2^2$
13. $3^2 + 1^2$

Turn to Solutions at the end of the Module and mark your work.
Explore
Using the Pythagorean Theorem

We can use the Pythagorean Theorem to check if an angle is a right angle.

Ken’s Picture Frame

Ken is making picture frames. He has cut the wood for the frame and has it all clamped together. Before he glues it, he wants to make sure that the corners are right angles.

First, he measures the legs. They are 3 inches and 4 inches. Then he measures the diagonal, which is the hypotenuse of the right triangle. It is 5 inches.

We’ll use the Pythagorean Theorem to find out if that corner is a right angle.

\[ a^2 + b^2 = c^2 \]

Fill in the lengths that Ken measured.

\[ 3^2 + 4^2 \, ? \, 5^2 \]

\[ a \text{ and } b \text{ represent the legs of the triangle} \]
\[ c \text{ represents the hypotenuse} \]
We don’t know yet if the left side of the equation equals the right side. Put a ? over the equals sign.

Calculate the square of each number. \[ 9^2 + 16^2 = 25 \]

That’s true! We don’t need the question mark any more.
Ken knows that corner of his picture frame is a right angle. \[ 25 = 25 \]
He can glue it now.

Alexa’s Door

Alexa is fixing a door. The corners weren’t right angles and it didn’t swing properly through the door frame.

She’s been sanding the edges for a while now, and she thinks she’s nearly done. She measures the lengths of the edges and the length of the diagonal, which is the hypotenuse of the right triangle.
Use the Pythagorean Theorem to check. \[ a^2 + b^2 = c^2 \]

Fill in the lengths that Alexa measured.

\[ c \text{ represents the hypotenuse} \quad 176^2 + 73^2 \neq 192^2 \]

We don’t know yet if the left side of the equation equals the right side.

Put a ? over the equals sign.

Use your calculator.

\[ 30976 + 5329 = 36864 \]

That’s not true! You don’t need the question mark anymore and you can cross out the equals sign. Alexa knows that corner of her door is not a right angle. She still has to do a bit more sanding.
Try It!
Activity 1

Drawings can be deceiving! When there are no right angle markings, triangles may not always look like right triangles. Use the Pythagorean Theorem to decide if these are right triangles or not.

1.

![Diagram of a triangle with sides 6, 8, and 10]

Use the Pythagorean Theorem to check. \[ a^2 + b^2 = c^2 \]

Fill in the lengths. Put a ? over the equals sign.

I know the longest side is the hypotenuse.

Figure out the square of each number. \[ 6^2 + 8^2 ? 10^2 \]

Is that true?

If it’s not true, cross out the equals sign. \[ 6^2 + 8^2 = 10^2 \]

Is this triangle a right triangle or not?

If this is a right triangle, which angle is a right angle?

Mark the right angle.

2.
Use the Pythagorean Theorem to check.

Fill in the lengths.  
Put a ? over the equals sign.  \[ \_\_\_^2 + \_\_\_^2 \neq \_\_\_^2 \]

Figure out the square of each number.  \[ \_\_\_^2 + \_\_\_^2 \neq \_\_\_^2 \]

Is that true?
If it’s not true, cross out the equals sign.  \[ \_\_\_ \neq \_\_\_ \]

Is this triangle a right triangle or not?
If this is a right triangle, which angle is a right angle?
Mark the right angle.

To see fully-worked solutions to the last two problems, go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch Is It a Right Triangle?

3.

Use the Pythagorean Theorem to check.

Is this triangle a right triangle or not?
If this is a right triangle, which angle is a right angle?
Mark the right angle.
4. Draw a picture of a triangle with sides 13, 5, and 12 cm long. Is this a right triangle? Use the Pythagorean Theorem to check.

5. Draw a picture of a triangle with sides 11, 14, and 6 cm long. Is this a right triangle? Use the Pythagorean Theorem to check.
6. a. Is this triangle a right triangle? Use the Pythagorean Theorem to check.

b. Does this triangle have a hypotenuse? If not, why not? If so, how long is it?

7. a. Is this triangle a right triangle? Use the Pythagorean Theorem to check.
b. Does this triangle have a hypotenuse? If not, why not? If so, how long is it?

Turn to Solutions at the end of the Module and mark your work.
Explore
Pythagorean Triples

Look back at the example of Ken’s picture frame.

“Satisfy” means that the numbers make the equation true.

When three whole numbers satisfy the Pythagorean Theorem, these numbers are called a Pythagorean Triple.

Ken’s picture frame measurements, 3, 4, and 5 inches form a Pythagorean Triple.

Alexa’s door frame measurements do not satisfy the Pythagorean Theorem. These numbers are not a Pythagorean Triple.

Can you tell which number in the Pythagorean Triple 3, 4, 5 is the length of the hypotenuse? The hypotenuse is always the longest side. In this triple, 3 and 4 are the lengths of the legs. The length of the hypotenuse is 5.

Look at this triangle. Can we use the Pythagorean Triple 3, 4, 5 to solve this triangle? Could the missing measurement be 5?

No! If the missing measurement is 5, then one of the legs would be the longest side. The hypotenuse is ALWAYS the longest side.
Try It!  
Activity 2

1. These are the measurements of the triangles from Activity 1.
   - 6, 8, 10
   - 3, 5, 7
   - 25, 15, 20
   - 13, 5, 12
   - 11, 14, 6
   - 2.7 inches, 3.2 inches, 4.5 inches
   - 2.8 cm, 4.5 cm, 5.3 cm

List the three Pythagorean Triples you find.

Pythagorean Triples are whole numbers. They satisfy the Pythagorean Theorem.

2. Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/ma0822a1f_shapeshifter.html and open the Shape Shifter tool. Click on the Triangle button.

   2. Make a right triangle.

   Adjust the vertices so that one leg of your right triangle is 5 units long.

   Adjust the other leg until the lengths of both legs and the hypotenuse are whole numbers. These three numbers are a Pythagorean Triple.
3. Using the Shape Shifter tool, make a right triangle.

Adjust the vertices so that one leg of your right triangle is 12 units long.

Find two different Pythagorean Triples that include the number 12.

Draw your first triangle.
4. a. In the Pythagorean Triple 5, 12, 13, which number is the length of the hypotenuse?

b. Which one of these triangles can be solved using the 5, 12, 13 Pythagorean Triple?

Circle your answer. Write in the length of the missing side.
Turn to Solutions at the end of the Module and mark your work.

You’ve finished Lesson B. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Lesson C
Using the Pythagorean Theorem

For this lesson you will need:
• calculator

When you turn the page over, you’ll find the Essential Questions for this lesson. Fill out the first column before you start working on the lesson. This will help you think about what you already know about the lesson topics.

When you’re finished the lesson, go back to the Essential Questions page and fill in the second column. Be sure to keep your page in a safe place while you’re working through the lesson.
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<td>How is finding the length of a missing leg of a right triangle different from finding the length of a missing hypotenuse?</td>
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Warm-up

Use your calculator to answer these questions.

1. Round your answers to the nearest hundredth.
   a. $4.7^2 = \underline{\quad}$
   b. $294^2 = \underline{\quad}$
   c. $\sqrt{49.6} = \underline{\quad}$
   d. $\sqrt{0.25} = \underline{\quad}$
   e. $15.3^2 = \underline{\quad}$
   f. $\sqrt{885} = \underline{\quad}$

2. Do not use your calculator. Use your answers from question 1 to answer these questions.
   a. $7.042 = \underline{\quad}$
   b. $\sqrt{22.09} = \underline{\quad}$
   c. $\sqrt{86436} = \underline{\quad}$
   d. $\sqrt{234.09} = \underline{\quad}$
   e. $29.75^2 = \underline{\quad}$
   f. $0.5^2 = \underline{\quad}$

3. Do you remember how to find the value of a variable?
   
   $j + 3 = 7$
   
   Subtract 3 from each side.
   
   $j + 3 - 3 = 7 - 3$
   
   $j = 4$

   Sometimes you might know the answer without doing the algebra steps. That’s great! Show your work anyway. It’s important to learn how to work logically. Then you’ll know exactly what to do when the questions get more difficult.
Do these questions without your calculator. Show all the steps.

a. \( x + 2 = 5 \)  
b. \( 23 + v = 86 \)

c. \( g + 153 = 2655 \)  
d. \( 14 + m = 39 \)

e. \( 8 + t = 549 \)  
f. \( d + 350 = 522 \)

4. I’m thinking of a number. If I square my number, the answer is 16. What number am I thinking of?

Turn to Solutions at the end of the Module and mark your work.
Explore
Algebra with Squares and Square Roots

The variable in an equation is just a number that you don’t know yet.

\[ x^2 = 16 \]

You read this equation by saying “x squared equals 16”.

You can think of the equation like this: “I’m thinking of a number. If I square the number, the answer is 16. What is the number?”

If you can’t think of the answer, start at the beginning with 1.

What is \(1^2\)? ......not 16!
What is \(2^2\)? ......not 16!
What is \(3^2\)? ......not 16!
What is \(4^2\)? 16! We found it! If \(x^2 = 16\), then \(x\) must be 4.

It’s not a bad method, but it only works with perfect squares. What would you do with this one?

\[ k^2 = 15 \]

We need a way to find out what \(k\) equals. Is there something that we can do to \(k^2\) that will leave us with \(k\)?

Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch Understanding Squares and Square Roots.
Take the square root of each side.

$$\sqrt{k^2} = \sqrt{15}$$

Here’s an example of where you might find the square root button on a calculator.

On the calculator shown here, you have to press the 2nd function button first and then press the square root button.

Use your calculator to find \( \sqrt{15} \). Round your answer to the nearest hundredth.

$$\sqrt{k^2} = \sqrt{15}$$

\[ k \approx 3.87 \]
Try It!
Activity 1

For this Activity you will need:

- calculator

Find the value of these variables by taking the square root of both sides of the equation.

Show all of your steps.

1. You don’t need your calculator to do any of these ones. Why not?

   a. \( x^2 = 9 \)  
   b. \( b^2 = 25 \)

   c. \( k^2 = 100 \)  
   d. \( a^2 = 49 \)

   e. \( j^2 = 1 \)  
   f. \( n^2 = 36 \)
Use your calculator for these questions.

2. Round your answers to the nearest hundredth.

   a. \(x^2 = 10\)  
   b. \(b^2 = 22\)  

   c. \(k^2 = 107\)  
   d. \(a^2 = 53\)  

   e. \(f^2 = 8\)  
   f. \(n^2 = 63\)  

Turn to Solutions at the end of the Module and mark your work.
Explore
Finding the Length of the Hypotenuse

How long is the hypotenuse of this triangle?

I can see that there is a right angle, so I know this is a right triangle.

We know that this is a right triangle.

The Pythagorean Theorem tells us how the lengths of the legs of a right triangle are related to length of the hypotenuse. If we fill in the two sides that we know, we can figure out the third.

The lengths of the legs of the triangle are 6 and 8.

(6)² + (8)² = c²

We don’t know how long the hypotenuse is.

36 + 64 = c²

Don’t think about the variable. Figure out as much as you can.

100 = c²

Take the square root of both sides.

√100 = √c²

The hypotenuse of the triangle is 10 cm long.

10 = c
Go to your http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch Finding the Length of the Hypotenuse.

The SS Minnow left the dock this afternoon. It sailed north for 45 nautical miles, then it sailed east for 32 nautical miles. How far away from the dock is the SS Minnow? Round your answer to the nearest nautical mile.

We know that this is a right triangle.

We can use the Pythagorean Theorem to describe the relationship of the lengths of the sides.

\[ a^2 + b^2 = c^2 \]

The lengths of the legs of the triangle are 45 and 32.

\[ (45)^2 + (32)^2 = c^2 \]

We don’t know how long the hypotenuse is.

Don’t think about the variable. Figure out as much as you can.

\[ 2025 + 1024 = c^2 \]

\[ 3049 = c^2 \]

Take the square root of both sides.

\[ \sqrt{3049} = \sqrt{c^2} \]

\[ 55.218 \approx c \]

The SS Minnow is approximately 55 nautical miles away from the dock.
Try It!
Activity 2

1. Find the length of the hypotenuse of this right triangle.

```
16 feet
30 feet
```

2. A right triangle has legs that are 27 m and 53 m long.
   Draw a picture of this triangle.
   How long is the hypotenuse?
   Round your final answer to the nearest tenth of a metre.
If these corners are not right angles, the drawer will not slide in and out of the dresser properly.

Khira measured the width and the length of the drawer. How long should the hypotenuse be? Round your answer to the nearest tenth of a centimetre.
**Explore**

**Finding the Length of a Leg of a Right Triangle**

I can see that there is a right angle mark, so I know this is a right triangle.

How long is the other leg of this triangle?

We know that this is a right triangle.

The Pythagorean Theorem tells us how the lengths of the three sides of a right triangle are related to each other. If we fill in the two sides that we know, we can figure out the third.

The length of one of the legs is 12. Substitute 12 for $a$ or $b$. It doesn’t matter which one. (Here we’ve substituted 12 for $b$.)

The length of the hypotenuse is 13. Substitute 13 for $c$. The hypotenuse is ALWAYS $c$.

Don’t think about the variable. Figure out as much as you can.
Thinking Space

Take the square root of both sides. \[ \sqrt{a^2} = \sqrt{25} \]

The length of the other leg is 5. \[ a = 5 \]

Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch Finding the Length of a Right Triangle Leg.
Try It!
Activity 3

1. Find the length of the other leg.

   ![Diagram of a right triangle with sides 24 miles, 51 miles, and 51 miles]

2. A right triangle has a hypotenuse that is 15 cm long. One of its legs is 7 cm long.

   Draw a picture of this triangle. Figure out the missing measurement.

   Round your answer to the nearest tenth of a centimetre.
3. Find the length of the missing side for each of these triangles. All measurements are in centimeters. Round your answers to the nearest tenth.

a. 

b. 

c. 

d. 

e. 

f. 

4. Find the length of each diagonal. Round your answers to the nearest hundredth.

a. 
\[ \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5 \text{ cm} \]

b. 
\[ \sqrt{2^2 + 2^2} = \sqrt{4 + 4} = \sqrt{8} = 2\sqrt{2} \text{ cm} \]

c. 
\[ \sqrt{6^2 + 2^2} = \sqrt{36 + 4} = \sqrt{40} \approx 6.32 \text{ cm} \]

Turn to Solutions at the end of the Module and mark your work.

You’ve finished Lesson C. Now it’s time to return to the Essential Questions from the beginning of the lesson and complete the final column.
Section Summary

Completing this section has helped you to:

• learn the Pythagorean Theorem
• decide if a triangle is a right triangle
• identify Pythagorean Triples
• find the lengths of missing sides of a right triangle
# Appendix

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Solutions

Section 1

Pretest

Lesson A: Should I Multiply or Divide?

1. \( \frac{18}{3} = 6 \) Each pie needs to be cut into 6 pieces.

2. \( \frac{320}{40} = 8 \) Eight cases are needed to hold the CD collection.

3. \( 6 \times 30 = 180 \) The health plan costs $180 per month.

Lesson B: Multiplying and Dividing With Negative Numbers

4. a. \(-6 \times 7 = -42\)
   b. \(-12 \div -2 = 6\)
   c. \(8 \times -11 = -88\)
   d. \(150 \div -3 = -50\)
   e. \(42 \div 6 = 7\)
   f. \(-9 \times -8 = 72\)

5. \(\frac{(-3)(8)(-4)}{(6)(-2)} = -8\)

Lesson C: Expressions With More Than One Operation

6. a. \(\frac{(4)(-3)}{6} + (3)(7) = 19\)
   b. \((-2)(7) - 18 \div 6 + 4 \times 9 = 19\)
   c. \(42 \div (-7) + 9 = 3\)
   d. \(-3 + 6 \times 9 = 51\)
Lesson A: Should I Multiply or Divide?

Warm-up
1.  $4 \times 5 = 20$
2.  $21 \div 7 = 3$
3.  $3 \times 8 = 24$
4.  $63 \div 9 = 7$
5.  $2 \times 7 = 14$
6.  $18 \div 6 = 3$
7.  $4 \times 4 = 16$
8.  $15 \div 5 = 3$
9.  $6 \times 4 = 24$
10. $72 \div 9 = 8$
11. $30 \div 10 = 3$
12. $11 \times 8 = 88$
13. $24 \div 3 = 8$
14. $7 \times 5 = 35$
15. $70 \div 7 = 10$
16. $6 \times 6 = 36$
17. $4 \times 8 = 32$
18. $56 \div 7 = 8$
19. $20 \div 4 = 5$
20. $5 \times 5 = 25$

Try It! Activity 1

1. Groups: boxes
   Items: bulbs
   # of groups: Susan packed 370 boxes.
   # of items in one group: There were 24 bulbs in each box.
   $370 \times 24 = 8880$
   Susan packed 8880 bulbs.

2. Groups: days
   Items: bales of hay
   # of groups: Amir needs hay for 45 days.
   # of items in one group: He needs 4 bales of hay each day.
   $45 \times 4 = 180$
   Amir needs 180 bales of hay.
3. 

Groups: packs of trading cards
Items: cards in each pack
# of groups: 24 packs
# of items in one group: 15 cards in each pack

$24 \times 15 = 360$

There are 360 trading cards in a box.

4. 

Groups: pouches of beads
Items: beads
# of groups: 8 pouches of beads
# of items in one group: 22 beads in each pouch

$8 \times 22 = 132$

There are 132 beads in the kit.

5. 

Groups: the hours that Chris worked
Items: the dollars that Chris earned per hour
# of groups: 21
# of items in one group: 9

$21 \times 9 = 189$

Chris earned $189 last week.

6. There are 3726 groups with 5¢ in each group. Multiply to find the total.

$3726 \times 5¢ = 18630¢ = $186.30$

The band has made $186.30.
Try It! Activity 2

1. Groups: boxes  
   Items: bulbs  
   # of items in one group: There were 24 bulbs in each box.
   Total items: There were 60,000 bulbs altogether.
   \[ 60,000 \div 24 = 2500 \]
   They filled 2500 boxes with bulbs.

2. Groups: calendars  
   Items: dollars for each calendar that they sell  
   # of items in one group: The class earns $3 for each calendar that they sell.
   Total items: The class wants to raise $465.
   \[ 465 \div 3 = 155 \]
   They need to sell 155 calendars to reach their goal.

3. Groups: new houses  
   Items: seedlings  
   # of groups: There are 13 new houses.
   Total items: There are 585 seedlings.
   \[ 585 \div 13 = 45 \]
   The landscaper can plant 45 coleus seedlings in each yard.

4. Groups: the hours that Chris works  
   Items: dollars ($) that Chris earns  
   # of items in one group: 9  
   Total items: 648
   \[ 648 \div 9 = 72 \]
   Chris needs to work for 72 hours to earn the money to buy the guitar.
5.  
Groups: bracelets  
Items: beads  
# of items in one group: 7  
Total items: 56  
\[56 \div 7 = 8\]  
Alexis can make 8 bracelets.

6.  
The items in this question are dollars. There are $18 in total.  
The groups are the packs of cards. There are 24 packs of cards.  
Divide to find the number of items in one group (the number of dollars per pack).  
\[18 \div 24 = 0.75\]  
Nancy pays $0.75 for each pack of cards.

**Try It! Activity 3**

1.  
Groups: The number of days.  
We don't know.  
Divide to find the number of groups.  
Items: Bales of hay needed for each day — 4.  
Total: 192 bales of hay in total  
\[192 \div 4 = 48\]  
Amir has enough hay to feed his cows for 48 days.

2.  
Groups: The calendars — 32.  
Items: Dollars for each calendar — $14.  
Total: Total amount of money they have collected.  
(We don’t know. Multiply to find the total.)  
\[32 \times 14 = 448\]  
The class has collected $448.
3. Groups: The band members — 5  
   Items: Dollars ($) each band member gets.  
           (We don’t know. Divide to find the number of items in each group.)  
   Total: Total amount in dollars ($) that the band earned. The total is 700.  
           \[ 700 ÷ 5 = 140 \]  
   Each band member gets $140.

4. Groups: The cedar hedges — 13  
   Items: Number of plants in each hedge. — 8  
   Total: Total number of plants needed.  
           (We don’t know. Multiply to find the total.)  
           \[ 13 \times 8 = 104 \]  
   The landscaper needs 104 cedar plants.

Lesson B: Multiplying and Dividing with Negative Numbers

Warm-up
1. \(-2 + 3 = 1\)  
2. \(6 \times 7 = 42\)  
3. \(3 - 8 = -5\)  
4. \(36 ÷ 4 = 9\)  
5. \(7 \times 3 = 21\)  
6. \(4 - 7 = -3\)  
7. \(9 \times 2 = 18\)  
8. \(12 ÷ 4 = 3\)  
9. \(-15 + 7 = -8\)  
10. \(10 - 6 = 4\)  
11. \(24 ÷ 6 = 4\)  
12. \(15 \times 3 = 45\)  
13. \(-2 - 5 = -7\)  
14. \(6 + 5 = 11\)  
15. \(27 ÷ 9 = 3\)  
16. \(12 - 20 = -8\)  
17. \(4 \times 8 = 32\)  
18. \(-9 - 2 = -11\)  
19. \(35 ÷ 7 = 5\)  
20. \(-1 + 17 = 16\)
Try It! Activity 1

1. a. \(4 \times -3 = -12\) 
   b. \(-4 \times 3 = -12\)
   c. \(12 \div 1 = 12\) 
   d. \(-1 \times 12 = -12\)
   e. \(12 \div -4 = -3\) 
   f. \(-12 \div 4 = -3\)
   g. \(2 \times -6 = -12\) 
   h. \(-2 \times 6 = -12\)
   i. \(-12 \div 3 = -4\) 
   j. \(12 \div -3 = -4\)
   k. \(12 \div 3 = 4\) 
   l. \(-12 \times 1 = -12\)
   m. \(12 \times -1 = -12\) 
   n. \(12 \div 2 = 6\)
   o. \(12 \div -2 = -6\) 
   p. \(12 \div -6 = -2\)
   q. \(-12 \div 6 = -2\) 
   r. \(3 \times -4 = -12\)
   s. \(4 \times 3 = 12\) 
   t. \(6 \times 2 = 12\)
   u. \(-6 \times 2 = -12\) 
   v. \(6 \times -2 = -12\)

2. \(-3 \times 5 = -15\) It will be \(15^\circ C\) colder on the fifth day than it is today.

3. \(-900 \div 3 = -300\) Each person owes \$300.

Try It! Activity 2

1. \(4 \times 5 = 20\) 
2. \(-4 \times -5 = 20\)
3. \(4 \times -5 = -20\) 
4. \(20 \div 4 = 5\)
5. \(-20 \div -5 = 4\) 
6. \(-10 \times -2 = 20\)
7. \(-20 \div -2 = 10\) 
8. \(20 \div 2 = 10\)
9. \(-1 \times -20 = 20\) 
10. \(3 \times -8 = -24\)
11. \(-24 \div 8 = -3\) 
12. \(-4 \times 6 = -24\)
13. \(24 \times -1 = -24\) 
14. \(24 \div -4 = -6\)
15. \(2 \times -12 = -24\) 
16. \(-24 \div 3 = -8\)
17. \(-24 \div 1 = -24\) 
18. \(-7 \times -7 = 49\)
19. \(7 \times 7 = 49\) 
20. \(49 \div -7 = -7\)
21. \(49 \div 7 = 7\) 
22. \(-5 \times -5 = 25\)
23. \(5 \times 5 = 25\) 
24. \(-25 \div -25 = 1\)
25. \(-1 \times -5 = 5\) 
26. \(-4 \times -4 = 16\)
27. \(4 \times 4 = 16\) 
28. \(16 \div -4 = -4\)
29. \(-16 \div 4 = -4\) 
30. \(4 \div 2 = 2\)
31. \(4 \div -2 = -2\) 
32. \(-4 \div 2 = -2\)
33. \(-4 \div -2 = 2\) 
34. \(56 \div 8 = 7\)
Try It! Activity 3

1. \( \frac{12}{(3)(-1)(2)} = -2 \)
2. \( \frac{(3)(-3)(-7)}{(-9)} \)
3. \( (4)(5)(-1) = -20 \)
4. \( \frac{(-16)(25)(-2)}{(10)(-4)} = -20 \)
5. \( (2)(-5)(7)(-2) = 140 \)
6. \( \frac{(6)(-4)(2)}{-12} = 4 \)
7. \( \frac{(24)(-14)}{(-8)(-7)(-1)} = 6 \)
8. \( \frac{(8)(-7)}{4(14)} = -1 \)
9. \( (-1)(2)(-3)(4)(-5) = -120 \)
10. \( \frac{(-15)(6)}{-9} = 10 \)
11. \( (5)(-3)(2) = -30 \)
12. \( \frac{(-21)(9)}{(7)(-3)} = 9 \)

Go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch Solving Mixed Multiplication and Division to see fully worked out solutions for some of these questions.

Lesson C: Expressions with More than One Operation

Warm-up

A 1. \( -4 - 3 = -7 \)

P 2. \( \frac{(-5)(-1)(-2)(3)}{6} = -5 \)

I 3. \( 18 + 3 = 6 \)
H 4. \( 14 - 7 = 2 \)
S 5. \( -3 	imes -4 = 12 \)
D 6. \( (-6)(-8) = 48 \)
I 7. \( -3 + 9 = 6 \)
S 8. \( 4 + 5 + 3 = 12 \)
F 9. \( \frac{-21}{-3} = 7 \)

H 10. \( -8 + 6 = -2 \)

S 11. \( \frac{18(7)(-4)}{(-14)(3)} = 12 \)

N 12. \( -5 + 30 = 25 \)

What do sea monsters eat?

FISH AND SHIPS
Try It! Activity 1

1. \((-3)(7) = -21\)  
2. \(4 \times 9 = 36\)
3. \(-13 \times 3 = -39\)  
4. \(42 \div -6 = -7\)
5. \((8)(-1)(-4) = 32\)  
6. \(12 + 6 = 18\)
7. \(15 \div 5 + 7 = 10\)  
8. \(2 - 3 \times 4 = -10\)
9. \(3 + \frac{4}{2} = 5\)  
10. \(-16 + (4)(3) = -4\)
11. \(-5 - (2)(-1)(-18) \div 4 = -14\)  
12. \(6 \times 5 \div 3 = 10\)
13. \(18 \div 2 + 4 = 9 + 4 = 13\)  
14. \(18 \div (2 + 4) = 18 \div 6 = 3\)
15. \(6 \times 8 + 12 + 3 \times 9 = 87\)  
16. \(3 \times 11 \times 4 \div 3 = 51\)
17. \(7 - 3 \times 5 = 7 - 15 = -8\)  
18. \((7 - 3) \times 5 = 4 \times 5 = 20\)
19. \(36 \div 9 + 2 + 1 \times 9 + 6 - 5 = 16\)  
20. \(6 \times 7 \div 14 - 3 + 2 \times 4 = 8\)
21. \(5 - 1 + 2 - 4 \times 3 \div 6 = 4\)

22. Answers will vary. For example:
   \[3 \times 4 - 7\] or \[5 \times (4 - 3)\]
   \[
   = 12 - 7 \\
   = 5
   
   = 5 \times 1 \\
   = 5
   \]

23. Answers will vary. For example:
   \[3 \times 4 + 1 - 15\] or \[2 \times (6 - 7)\]
   \[
   = 12 + 1 - 15 \\
   = 13 - 15
   
   = -2 \\
   = -2
   
   = 2 \times (-1) \\
   = -2
   \]

24. a. Answers will vary. Make sure you have used all 9 digits and the required operations, as in the example provided
   b. Answers will vary. Check over your answer to make sure that you have solved it correctly.
Solutions

Section 2

Pretest

Lesson A: Perfect Squares

1.

![Table of Perfect Squares]

Lesson B: Square Roots of Perfect Squares

2. 6

3. a. $2^2 = 4$  
   b. $5^2 = 25$  
   c. $8^2 = 64$

4. a. $9 = 3^2$  
   b. $16 = 4^2$  
   c. $49 = 7^2$

5. a. $\sqrt{9} = 3$  
   b. $\sqrt{64} = 8$  
   c. $\sqrt{1} = 1$

6. a. $11 = \sqrt{121}$  
   b. $2 = \sqrt{4}$  
   c. $5 = \sqrt{25}$

7. a. $6 - 2^2 = 2$  
   b. $(-3 + 5)^2 + 5 \times 3 = 19$

Lesson C: Using the Pythagorean Theorem

8.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>-2.5</td>
<td>a. 16</td>
</tr>
<tr>
<td>a</td>
<td>4</td>
<td>b. 9</td>
</tr>
<tr>
<td>e</td>
<td>-7</td>
<td>c. 1.21</td>
</tr>
<tr>
<td>b</td>
<td>3</td>
<td>d. 6.25</td>
</tr>
<tr>
<td>c</td>
<td>1.1</td>
<td>e. 49</td>
</tr>
<tr>
<td>f</td>
<td>-2</td>
<td>f. 4</td>
</tr>
</tbody>
</table>
9. a. $2 < 5$
   b. $3 - 8 < 8 - 3$
   c. $3^2 - 3 = 6$
   d. $(−2)(−3) > 18 ÷ (−3)$

10. $\sqrt{7}$ is greater than 2. $2 = \sqrt{4}$ and $\sqrt{7}$ is bigger than $\sqrt{4}$.

11. Any three of: $\sqrt{37}, \sqrt{38}, \sqrt{40}, \sqrt{41}, \sqrt{42}, \sqrt{44}, \sqrt{45}, \sqrt{46}, \sqrt{47}, \sqrt{48}$

Lesson D: Calculating Square Roots

12. a. $216^2 = 46,656$  
   b. $3.4^2 = 11.56$  
   c. $8.17^2 = 66.7489$

13. a. $\sqrt{7} = 2.646$  
   b. $\sqrt{24} = 4.899$  
   c. $\sqrt{18} = 4.243$

Lesson A: Perfect Squares

Warm-up

1. $2 × 3 = 6$  
2. $3 × 5 = 15$
3. $3 × 3 = 9$  
4. $4 × 2 = 8$
5. $4 × 5 = 20$  
6. $6 × 6 = 36$
7. $7 × 3 = 21$  
8. $7 × 7 = 49$
9. $8 × 4 = 32$  
10. $8 × 8 = 64$
11. $9 × 6 = 54$  
12. $9 × 9 = 81$

13. Area $= 2 × 5 = 10$
14. Area $= 3 × 4 = 12$
15. Area $= 6 × 6 = 36$

16. Your answer could include any of these. Did you think of any other ones?
Try It! Activity 1

1. 

![Graph showing a rectangle with dimensions 2 units by 3 units and area 6 units²]

2. 

![Graph showing a square with dimensions 3 units by 3 units and area 9 units²]

3. 

![Graph showing a rectangle with dimensions 3 units by 3 units and area 12 units²]

4. 

![Graph showing a rectangle with dimensions 2 units by 2 units and area 4 units²]

5. Your answers for questions 3, 4, and 5 could be any two of these.

![Diagram showing rectangles of different dimensions]

Try It! Activity 2

1. 9
2. I can’t make a square that has an area of 8. 8 is not a perfect square.
3. Yes, a square with sides of length 1 has area 1. 1 is a perfect square.
4. I can’t make a square that has an area of 7. 7 is not a perfect square.
5. Yes, a square with sides of length 4 has area 16. 16 is a perfect square.
Try It! Activity 3

1. \(3 \times 3 = 9\)  \(6 \times 6 = 36\)  \(1 \times 1 = 1\)
   \(9 \times 9 = 81\)  \(4 \times 4 = 16\)

2.

\[
\begin{array}{cccc}
62 & 22 & 100 & 144 \\
55 & 16 & 56 & \\
25 & 1 & 71 & 12 \\
63 & 64 & 49 & 8 \\
9 & 81 & 4 & 36 \\
\end{array}
\]

\(1 \times 1 = 1\)  \(2 \times 2 = 4\)  \(3 \times 3 = 9\)  \(4 \times 4 = 16\)
\(5 \times 5 = 25\)  \(6 \times 6 = 36\)  \(7 \times 7 = 49\)  \(8 \times 8 = 64\)
\(9 \times 9 = 81\)  \(10 \times 10 = 100\)  \(11 \times 11 = 121\)  \(12 \times 12 = 144\)

Lesson B: Square Roots of Perfect Squares

Warm-up

1.

\[
\begin{array}{ccc}
\text{Area} = & 3 \times 5 & = 15 \\
5 & & \\
\end{array}
\quad
\begin{array}{ccc}
\text{Area} = & 3 \times 3 & = 9 \\
3 & & \\
\end{array}
\]

2. a. \(6 \times 2 = 12\)  
   b. \(3 \times 4 = 12\)  
   c. \(5 \times 5 = 25\)  
   d. \(2 \times 3 = 6\)  
   e. \(4 \times 5 = 20\)  
   f. \(4 \times 4 = 16\)  
   g. \(2 \times 8 = 16\)  
   h. \(3 \times 5 = 15\)  
   i. \(3 \times 3 = 9\)  
   j. \(3 \times 12 = 36\)  
   k. \(6 \times 6 = 36\)  
   l. \(4 \times 9 = 36\)  
   m. \(3 \times 6 = 18\)  
   n. \(2 \times 9 = 18\)
3.

![Diagram with numbers 1 to 10 and 6, 9, 12, 15, 18, 25, 36, 4, 16, 8]

**Try It! Activity 1**

1.  $1^2 = 1$
2.  $2^2 = 4$
3.  $3^2 = 9$
4.  $4^2 = 16$
5.  $5^2 = 25$
6.  $6^2 = 36$
7.  $7^2 = 49$
8.  $8^2 = 64$
9.  $9^2 = 81$
10.  $10^2 = 100$
11.  $5 \times 5 = 25$
12.  a.  $2^2 + 1$
    = $4 + 1$
    = $5$
    b.  $(-2)(3)^2 - 4$
    = $(-2)(9) - 4$
    = $-18 - 4$
    = $-22$
    c.  $(-4 + 7) + 4^2 - 18 \div 3$
    = $3 + 4^2 - 18 \div 3$
    = $3 + 16 - 18 \div 3$
    = $3 + 16 - 6$
    = $13$
Try It! Activity 2

Your drawings might be different, but they should all be squares.

![Graph showing a square with height 3 and area 4 units²]

![Graph showing a square with height 4 and area 18 units²]

Try It! Activity 3

1. The length of the side of the square is 3.
   The square root of 9 is 3.
2. The length of the side of the square is 2.
   The square root of 4 is 2.
3. Each side is 5 cm long. 5 is the square root of 25.

Try It! Activity 4

1. 10
   1, 4, 9, 16, 25, 36, 49, 64, 81, 100
   Answers may vary. Your answer might be something similar to this:
   I squared all of the integers in order, without skipping any. One squared is one, two squared is four, etc. When I got to 100, I stopped.

2.

![Graph showing a square with height 5 and area 25 units²]

3. a. Four squared equals sixteen.  $4^2 = 16$
b. Nine is three squared.  $9 = 3^2$
c. Two is the square root of four.  $2 = \sqrt{4}$
d. One is the square root of one.  $1 = \sqrt{1}$
e. The square root of nine is **three**. \( \sqrt{9} = 3 \)
f. **Five** is the square root of twenty-five. \( 5 = \sqrt{25} \)

4. \[
\begin{align*}
    4^2 &= 16 & & \sqrt{16} &= 4 \\
    2^2 &= 4 & & \sqrt{4} &= 2 \\
    3^2 &= 9 & & \sqrt{9} &= 3 \\
    4^2 &= 16 & & \sqrt{16} &= 4 \\
    5^2 &= 25 & & \sqrt{25} &= 5 \\
    6^2 &= 36 & & \sqrt{36} &= 6 \\
    7^2 &= 49 & & \sqrt{49} &= 7 \\
    8^2 &= 64 & & \sqrt{64} &= 8 \\
    9^2 &= 81 & & \sqrt{81} &= 9 \\
    10^2 &= 100 & & \sqrt{100} &= 10 \\
\end{align*}
\]

**Lesson C: Estimating Square Roots**

**Warm-up**

1. a. \( 4^2 = 16 \) 
   b. \( 6^2 = 36 \) 
   c. \( 1^2 = 1 \) 
   d. \( 8^2 = 64 \) 
   e. \( 5^2 = 25 \) 
2. a. \( \sqrt{9} = 3 \) 
   b. \( \sqrt{81} = 9 \) 
   c. \( \sqrt{25} = 5 \) 
   d. \( \sqrt{49} = 7 \) 
   e. \( \sqrt{4} = 2 \) 
3. a. \( 8^2 = 64 \) 
   b. \( 16 = 4^2 \) 
   c. \( \sqrt{25} = 5 \) 
   d. \( 7 = \sqrt{49} \) 
   e. \( 100 = 10^2 \) 
4. 

![Graph](image-url)
Try It! Activity 1

1. \(7 = 3 + 4\)  
2. \(-6 < 5\)
3. \(2 < 3\)  
4. \(\sqrt{16} = 4\)
5. \(8 < 3^2\)  
6. \((-4)(-5) > 12\)
7. \(3 < \sqrt{25}\)  
8. \(-6 + 5 = 5 - 6\)
9. \(6^2 = 36\)  
10. \(5 < \sqrt{36}\)
11. \(-24 ÷ 4 > 3 - 10\)  
12. \(2 < 2^2\)
13. \((-15)^2 = (-15) \times (-15)\)
14. \(\sqrt{5} = -2 + 5\)

Try It! Activity 2

1. \(12^2 = 12 \times 12 = 144\)  
2. \((-1.2)^2 = (-1.2) \times (-1.2) = 1.44\)
3. \(5.1^2 = 5.1 \times 5.1 = 26.01\)  
4. \(0.2^2 = 0.2 \times 0.2 = 0.04\)
5. \((-23)^2 = (-23) \times (-23) = 529\)  
6. \(35^2 = 35 \times 35 = 1225\)
7. \(3.5^2 = 3.5 \times 3.5 = 12.25\)  
8. \((-0.4)^2 = (-0.4) \times (-0.4) = 0.16\)
9. \(20^2 = 20 \times 20 = 400\)

The answers to questions 1, 5, 6, and 9 should be circled.

Try It! Activity 3

1. \(1^2 = 1\)  
   \(2^2 = 4\)  
   \(3^2 = 9\)  
   \(4^2 = 16\)  
   \(5^2 = 25\)  
   \(6^2 = 36\)  
   \(7^2 = 49\)  
   \(8^2 = 64\)  
   \(9^2 = 81\)  
   \(10^2 = 100\)

2. 

\[
\begin{array}{cccccccccccc}
.1 = & & & & & & & & & & .1 = & & & & \\
\sqrt{1} & & & & & & & & & & \sqrt{1} & & & & \\
.2 = & & & & & & & & & & \sqrt{4} & & & & \\
.3 = & & & & & & & & & & \sqrt{9} & & & & \\
.4 = & & & & & & & & & & \sqrt{16} & & & & \\
.5 = & & & & & & & & & & \sqrt{25} & & & & \\
.6 = & & & & & & & & & & \sqrt{36} & & & & \\
.7 = & & & & & & & & & & \sqrt{49} & & & & \\
.8 = & & & & & & & & & & \sqrt{64} & & & & \\
.9 = & & & & & & & & & & \sqrt{81} & & & & \\
10 = & & & & & & & & & & \sqrt{100} & & & & \\
\end{array}
\]
3. a. \(2 < \sqrt{7} < 3\) \(\sqrt{7}\) is between 2 and 3  
b. \(4 < \sqrt{22} < 5\) \(\sqrt{22}\) is between 4 and 5  
c. \(3 < \sqrt{13} < 4\) \(\sqrt{13}\) is between 3 and 4  
d. \(7 < \sqrt{61} < 8\) \(\sqrt{61}\) is between 7 and 8  
e. \(8 < \sqrt{74} < 9\) \(\sqrt{74}\) is between 8 and 9  
f. \(6 < \sqrt{42} < 7\) \(\sqrt{42}\) is between 6 and 7  
g. \(2 < \sqrt{5} < 3\) \(\sqrt{5}\) is between 2 and 3  
h. \(7 < \sqrt{57} < 8\) \(\sqrt{57}\) is between 7 and 8  
i. \(5 < \sqrt{29} < 6\) \(\sqrt{29}\) is between 5 and 6  
j. \(1 < \sqrt{3} < 2\) \(\sqrt{3}\) is between 1 and 2  
k. \(5 < \sqrt{32} < 6\) \(\sqrt{32}\) is between 5 and 6  
l. \(9 < \sqrt{95} < 10\) \(\sqrt{95}\) is between 9 and 10  

4. a. \(\sqrt{7}\) is closer to 3  
b. 2.7 is the best estimate.

Lesson D: Calculating Square Roots

Warm-up

1. a. \(\sqrt{1} = 1\)  
b. \(\sqrt{4} = 2\)  
c. \(\sqrt{9} = 3\)  
d. \(\sqrt{16} = 4\)  
e. \(\sqrt{25} = 5\)  
f. \(\sqrt{36} = 6\)  
g. \(\sqrt{49} = 7\)  
h. \(\sqrt{64} = 8\)  
i. \(\sqrt{81} = 9\)  
j. \(\sqrt{100} = 10\)  

2. a. \(386^2 = 148\,996\)  
b. \(29.4^2 = 864.36\)  
c. \(1.89^2 = 3.5721\)  
d. \(29^2 = 841\)  
e. \(4.3^2 = 18.49\)  
f. \(1.6^2 = 2.56\)
3. 

\[ \sqrt{2} \] is between 1 and 2

\[ 1 < \sqrt{2} < 2 \]

4. a. 1.863 95 \approx 1.864
   b. 4.217 36 \approx 4.217
   c. 0.981 6 \approx 0.982
   d. 93.812 493 7 \approx 93.812
   e. 6.413 51 \approx 6.414
   f. 15.218 75 \approx 15.219
   g. 36.246 203 \approx 36.246
   h. 7.812 84 \approx 7.813
   i. 63.512 1 \approx 63.512

Try It! Activity 1

1. Your calculator probably doesn't show this many decimal places. That's ok. Check to see that the digits you have are correct.
   a. \[ 1 < \sqrt{2} < 2 \] \[ \sqrt{2} \approx 1.4142135623730950488016887242097 \]
   b. \[ 2 < \sqrt{7} < 3 \] \[ \sqrt{7} \approx 2.6457513110645905905016157536393 \]
2. Answers will vary. A possible answer: Since my calculator can only show a certain number of digits, it will never be the exact answer.

Try It! Activity 3

1. a. \( \sqrt{19} = 4.359 \)
   b. \( \sqrt{7} = 2.646 \)
   c. \( \sqrt{24} = 4.899 \)
   d. \( \sqrt{73} = 8.544 \)
   e. \( \sqrt{48} = 6.928 \)
   f. \( \sqrt{51} = 7.141 \)
   g. \( \sqrt{11} = 3.317 \)
   h. \( \sqrt{15} = 3.873 \)
   i. \( \sqrt{41} = 6.403 \)

2. a. \( \sqrt{3} = 1.73 \)
   b. \( \sqrt{48} = 6.93 \)
   c. \( \sqrt{33} = 5.74 \)
   d. \( \sqrt{26} = 5.10 \)
   e. \( \sqrt{12} = 3.46 \)
   f. \( \sqrt{22} = 4.69 \)
   g. \( \sqrt{55} = 7.42 \)
   h. \( \sqrt{93} = 9.64 \)
   i. \( \sqrt{37} = 6.08 \)
Solutions

Section 3

Pretest

Lesson A: The Pythagorean Theorem

1. Pythagorean Theorem: \( a^2 + b^2 = c^2 \)

Lesson B: Pythagorean Triples

2. \( a^2 + b^2 = c^2 \)
   
   \[ 1.5^2 + 2.0^2 \neq 2.5^2 \]
   
   \[ 2.25 + 4 \neq 6.25 \]
   
   \[ 6.25 = 6.25 \]
   
   Yes, this triangle is a right triangle because the lengths of the sides satisfy the Pythagorean Theorem.

3. The numbers in a Pythagorean Triple must be whole numbers. The numbers 1.5, 2.0, and 2.5 do not form a Pythagorean Triple even though they satisfy the Pythagorean Theorem.

4. \( 3^2 + 4^2 \neq 7^2 \)
   
   \[ 9 + 16 \neq 49 \]
   
   \[ 25 \neq 49 \]
   
   The numbers do not satisfy the Pythagorean Theorem.

   No, 3, 4, 7 is not a Pythagorean Triple.
5. 
\[9^2 + 12^2 = 15^2\]
\[81 + 144 = 225\]
\[225 = 225\]
The numbers satisfy the Pythagorean Theorem.
The numbers are all whole numbers.
Yes, 9, 12, 15 is a Pythagorean Triple.

Lesson C: Using the Pythagorean Theorem

6. 
\[a^2 + b^2 = c^2\]
\[3.2^2 + 4.7^2 = c^2\]
\[10.24 + 22.09 = c^2\]
\[32.33 = c^2\]
\[\sqrt{32.33} = \sqrt{c^2}\]
\[5.7 = c\]

7. 
\[a^2 + b^2 = c^2\]
\[12^2 + b^2 = 20^2\]
\[144 + b^2 = 400\]
\[b^2 = 400 - 144\]
\[b^2 = 256\]
\[\sqrt{b^2} = \sqrt{256}\]
\[b = 16\]

OR

\[a^2 + b^2 = c^2\]
\[a^2 + 12^2 = 20^2\]
\[a^2 + 144 = 400\]
\[a^2 = 400 - 144\]
\[a^2 = 256\]
\[\sqrt{a^2} = \sqrt{256}\]
\[a = 16\]

Lesson A: The Pythagorean Theorem

Warm-up

1. c. \(3^2\)
2. a. \(6^2\)
3. Area = 5 cm \(\times\) 5 cm = 25 cm\(^2\)
4. b. \(c^2\)
5.

- b. \(a^2\)
- c. \(4^2\)
- d. 9

Try It! Activity 1

There are many more right angles in this picture than just the ones shown here. How many did you find?
Try It! Activity 2

Try It! Activity 3

This chart shows only a few possible solutions.

<table>
<thead>
<tr>
<th>Leg</th>
<th>Leg</th>
<th>Hypotenuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8</td>
<td>12.81</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>9.43</td>
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<td>14</td>
<td>2</td>
<td>14.14</td>
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<td>14</td>
<td>14.56</td>
</tr>
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<td>15</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>9.22</td>
</tr>
</tbody>
</table>

Although Triangle shows only a limited number of solutions, there is an infinite (yes, really!) number of correct answers to this question. However, for every line in your chart, the hypotenuse should be the longest side. The “Hypotenuse” column should be shaded in for every row in your chart.

Lesson B: Pythagorean Triples

Warm-up

1. \( a^2 + b^2 = c^2 \)

2.
Try It! Activity 1

To see fully worked out solutions to questions 1 and 2, go to http://media.openschool.bc.ca/osbcmedia/ma08/course/html/math08_ui.html, click on Module 2, and watch Is It a Right Triangle?

1. Use the Pythagorean Theorem to check. \( a^2 + b^2 = c^2 \)

Fill in the lengths.
Put a ? over the equals sign.

\[ 6^2 + 8^2 \neq 10^2 \]

Figure out the square of each number.

\[ 36 + 64 \neq 100 \]

Is that true?
If it’s not true, cross out the equals sign.

Is this triangle a right triangle or not? Yes, this is a right triangle.

If this is a right triangle, which angle is a right angle?
Mark the right angle.
2. Use the Pythagorean Theorem to check. \( a^2 + b^2 = c^2 \)

Fill in the lengths. \( 5^2 + 3^2 \neq 7^2 \)

Put a ? over the equals sign.

Figure out the square of each number. \( 25 + 9 \neq 49 \)

Is that true?

If it’s not true, cross out the equals sign. \( 34 \neq 49 \)

Is this triangle a right triangle or not? No, this is not a right triangle.

3. Use the Pythagorean Theorem to check. \( a^2 + b^2 = c^2 \)

\( 20^2 + 15^2 \neq 25^2 \)

\( 400 + 225 \neq 625 \)

\( 625 = 625 \)

Is this triangle a right triangle or not? Yes, this is a right triangle.

If this is a right triangle, which angle is a right angle?

Mark the right angle.

4. Is this triangle a right triangle or not? Yes, this is a right triangle.
5. Is this triangle a right triangle or not? No, this is not a right triangle.

\[ a^2 + b^2 = c^2 \]
\[ 6^2 + 11^2 \neq 14^2 \]
\[ 36 + 121 \neq 196 \]
\[ 157 \neq 196 \]

6. a. No, this is not a right triangle.

\[ a^2 + b^2 = c^2 \]
\[ 2.7^2 + 3.2^2 \neq 4.5^2 \]
\[ 7.29 + 10.24 \neq 20.25 \]
\[ 17.53 \neq 20.25 \]

b. A hypotenuse is the longest side of a right triangle. This is not a right triangle, so this triangle does not have a hypotenuse.

7. a. Yes, this is a right triangle.

\[ a^2 + b^2 = c^2 \]
\[ 2.8^2 + 4.5^2 \neq 5.3^2 \]
\[ 7.84 + 20.25 \neq 28.09 \]
\[ 28.09 = 28.09 \]

b. This is a right triangle, so this triangle does have a hypotenuse. A hypotenuse is the longest side of a right triangle.

The hypotenuse is 5.3 cm long.
Try It! Activity 2

1. The triangles in questions 1, 2, 4, and 7 are right triangles, but the lengths of the sides in question 7 are not whole numbers.

   The triangles in questions 1, 2, and 4 have side lengths that form Pythagorean Triples.

   The Pythagorean Triple in question 1 is 6, 8, 10.

   The Pythagorean Triple in question 2 is 15, 20, 25.

   The Pythagorean Triple in question 4 is 5, 12, 13.

2. $5, 12, 13$ is a Pythagorean Triple.

   **Note:** 3, 4, 5 is not the correct answer. The question specifies that one of the legs is 5 units long. In this triple, 5 is the hypotenuse.

3. Your answer should include any two of these Triples.

   $5, 12, 13$ is a Pythagorean Triple.

   $9, 12, 15$ is a Pythagorean Triple.
12, 16, 20 is a Pythagorean Triple.

4. a. The hypotenuse is the longest side. The length of the hypotenuse is 13.
   b.

Lesson C: Using the Pythagorean Theorem

Warm-up
1. a. $4.7^2 = 22.09$
   b. $294^2 = 86436$
   c. $\sqrt{49.6} = 7.04$
   d. $\sqrt{0.25} = 0.5$
   e. $15.3^2 = 234.09$
   f. $\sqrt{885} = 29.75$

2. a. $7.04^2 = 49.6$
   b. $\sqrt{22.09} = 4.7$
   c. $\sqrt{86436} = 294$
   d. $\sqrt{234.09} = 15.3$
   e. $29.75^2 = 885$
   f. $0.5^2 = 0.25$
APPENDIX | SOLUTIONS: SECTION 3

3. a. \( x + 2 = 5 \)
   \[ x + 2 - 2 = 5 - 2 \]
   \[ x = 3 \]

b. \( 23 + v = 86 \)
   \[ 23 + v - 23 = 86 - 23 \]
   \[ v = 63 \]

c. \( g + 153 = 2655 \)
   \[ g + 153 - 153 = 2655 - 153 \]
   \[ g = 2502 \]

   d. \( 14 + m = 39 \)
   \[ 14 + m - 14 = 39 - 14 \]
   \[ m = 25 \]

e. \( 8 + t = 549 \)
   \[ 8 + t - 8 = 549 - 8 \]
   \[ t = 541 \]

f. \( d + 350 = 522 \)
   \[ d + 350 - 350 = 522 - 350 \]
   \[ d = 172 \]

4. \( 4 \times 4 = 16 \)
   \( (-4) \times (-4) = 16 \)

That means \( 4^2 = 16 \) and \( (-4)^2 = 16 \)

The number you are thinking of is either 4 or –4.

Try It! Activity 1

1. Answers will vary. A typical answer might be: It’s possible to think of these numbers in your head. Note: When you have worked with square numbers for a while, they are easy to recognize.

   a. \( x^2 = 9 \)
      \[ \sqrt{x^2} = \sqrt{9} \]
      \[ x = 3 \]

   b. \( b^2 = 25 \)
      \[ \sqrt{b^2} = \sqrt{25} \]
      \[ b = 5 \]

   c. \( k^2 = 100 \)
      \[ \sqrt{k^2} = \sqrt{100} \]
      \[ k = 10 \]

   d. \( a^2 = 49 \)
      \[ \sqrt{a^2} = \sqrt{49} \]
      \[ a = 7 \]

   e. \( j^2 = 1 \)
      \[ \sqrt{j^2} = \sqrt{1} \]
      \[ j = 1 \]

   f. \( n^2 = 36 \)
      \[ \sqrt{n^2} = \sqrt{36} \]
      \[ n = 6 \]
2. a. \(x^2 = 10\)
   \[\sqrt{x^2} = \sqrt{10}\]
   \[x = 3.16\]

   b. \(b^2 = 22\)
   \[\sqrt{b^2} = \sqrt{22}\]
   \[b = 4.69\]

   c. \(k^2 = 107\)
   \[\sqrt{k^2} = \sqrt{107}\]
   \[k = 10.34\]

   d. \(a^2 = 53\)
   \[\sqrt{a^2} = \sqrt{53}\]
   \[a = 7.28\]

   e. \(j^2 = 8\)
   \[\sqrt{j^2} = \sqrt{8}\]
   \[j = 2.83\]

   f. \(n^2 = 63\)
   \[\sqrt{n^2} = \sqrt{63}\]
   \[n = 7.94\]

Try It! Activity 2

1. \(a^2 + b^2 = c^2\)

   I know that the legs are 16 and 30. In the Pythagorean Theorem, \(a\) and \(b\) are the legs of the triangle.
   \[16^2 + 30^2 = c^2\]
   \[256 + 900 = c^2\]
   \[1156 = c^2\]
   \[\sqrt{1156} = \sqrt{c^2}\]
   \[34 = c\]
   The length of the hypotenuse is 34 feet.

2.

   ![Diagram of a right triangle with sides 27 m and 53 m]

   I know that the legs are 27 and 53. In the Pythagorean Theorem, \(a\) and \(b\) are the legs of the triangle.
   \[a^2 + b^2 = c^2\]
   \[27^2 + 53^2 = c^2\]
   \[729 + 2809 = c^2\]
   \[3538 = c^2\]
   \[\sqrt{3538} = \sqrt{c^2}\]
   \[59.481 = c\]
   The hypotenuse is 59.5 m long.
3. \[ a^2 + b^2 = c^2 \]
\[ 43^2 + 34^2 = c^2 \]
\[ 1849 + 1156 = c^2 \]
\[ 3005 = c^2 \]
\[ \sqrt{3005} = \sqrt{c^2} \]
\[ 54.8 = c \]  
The hypotenuse should be 54.8 cm long.

Try It! Activity 3

1. \[ a^2 + b^2 = c^2 \]
\[ 24^2 + b^2 = 51^2 \]
\[ 576 + b^2 = 2601 \]
\[ b^2 = 2601 - 576 \]
\[ b^2 = 2025 \]
\[ b = \sqrt{2025} \]
\[ b = 45 \]  
The other leg is 45 miles long.

2.

![Diagram of a right triangle with sides 7 cm, 15 cm, and unknown length]

\[ a^2 + b^2 = c^2 \]
\[ a^2 + 7^2 = 15^2 \]
\[ a^2 + 49 = 225 \]
\[ a^2 = 176 \]
\[ \sqrt{a^2} = \sqrt{176} \]
\[ a = 13.3 \]  
The other leg is 13.3 cm long.
3. a. The missing side is the hypotenuse. The length of the missing side is 7.8 cm.

\[ a^2 + b^2 = c^2 \]
\[ 5^2 + 6^2 = c^2 \]
\[ 25 + 36 = c^2 \]
\[ 61 = c^2 \]
\[ \sqrt{61} = \sqrt{c^2} \]
\[ 7.8 = c \]

The length of the missing side is 7.8 cm.

b. The missing side is a leg.

\[ a^2 + b^2 = c^2 \]
\[ 3^2 + b^2 = 7^2 \]
\[ 9 + b^2 = 49 \]
\[ b^2 = 49 - 9 \]
\[ b^2 = 40 \]
\[ \sqrt{b^2} = \sqrt{40} \]
\[ b = 6.3 \]

The length of the missing side is 6.3 cm.

c. The missing side is the hypotenuse.

\[ a^2 + b^2 = c^2 \]
\[ 3^2 + 3^2 = c^2 \]
\[ 9 + 9 = c^2 \]
\[ 18 = c^2 \]
\[ \sqrt{18} = \sqrt{c^2} \]
\[ 4.2 = c \]

The length of the missing side is 4.2 cm.

d. The missing side is the hypotenuse.

\[ a^2 + b^2 = c^2 \]
\[ 2^2 + 2^2 = c^2 \]
\[ 4 + 4 = c^2 \]
\[ 8 = c^2 \]
\[ \sqrt{8} = \sqrt{c^2} \]
\[ 2.8 = c \]

The length of the missing side is 2.8 cm.
e. The missing side is a leg.

\[ a^2 + b^2 = c^2 \]

\[ 4 + b^2 = 81 \]

\[ b^2 = 81 - 4 \]

\[ b^2 = 77 \]

\[ \sqrt{b^2} = \sqrt{77} \]

\[ b = 8.8 \]  

The length of the missing side is 8.8 cm.

d. The missing side is a leg.

\[ a^2 + b^2 = c^2 \]

\[ 4^2 + b^2 = 5^2 \]

\[ 16 + b^2 = 25 \]

\[ b^2 = 25 - 16 \]

\[ b^2 = 9 \]

\[ \sqrt{b^2} = \sqrt{9} \]

\[ b = 3 \]

Did you notice that this triangle could be solved with a Pythagorean Triple? The length of the missing side is 3 cm.

4. a.

\[ a^2 + b^2 = c^2 \]

\[ 4^2 + 3^2 = c^2 \]

\[ 16 + 9 = c^2 \]

\[ 25 = c^2 \]

\[ \sqrt{25} = \sqrt{c^2} \]

\[ 5 = c \]

Did you see the Pythagorean Triple? The length of the diagonal is 5 cm.

b.

\[ a^2 + b^2 = c^2 \]

\[ 2^2 + 2^2 = c^2 \]

\[ 4 + 4 = c^2 \]

\[ 8 = c^2 \]

\[ \sqrt{8} = \sqrt{c^2} \]

\[ 2.83 = c \]

The length of the diagonal is 2.83 cm.
c. 

\[ a^2 + b^2 = c^2 \]
\[ 2^2 + 6^2 = c^2 \]
\[ 4 + 36 = c^2 \]
\[ 40 = c^2 \]
\[ \sqrt{40} = \sqrt{c^2} \]
\[ 6.32 = c \]

The length of the diagonal is 6.32 cm.
Glossary

area
Area is the number of square units that fit inside a 2-D shape.

axis (axes)
The axes are the lines that show the number scale on a graph. The $x$-axis is horizontal, and the $y$-axis is vertical. Axis is singular and axes is plural.

bar graph
A bar graph is a graph that uses vertical or horizontal rectangular bars to show the quantity being measured. The longer (or higher) the bar, the higher value it represents.

basic operations
Basic operations include addition, subtraction, multiplication, and division.

bias
Bias occurs when a particular outcome is favoured over another.

circle graph/pie chart
A circle graph or pie chart are visual representations of data amounts that together form a total amount or a single quantity.

circumference
Circumference is the distance around a circle.

coefficient
A coefficient is a number that multiplies a variable in a mathematical expression. For example, in the expression $3x - 7$, the number 3 is a coefficient. In the expression $\frac{x}{5} + 8$, the coefficient is $\frac{1}{5}$.

constant/constant term
A constant or constant term is a number in a mathematical expression that has no variable attached to it. The number can’t be changed. For example, in the expression $3x - 7$, the constant is 7. In the expression $\frac{x}{5} + 8$, the constant is 8.
continuous data
Continuous data is data that is part of a set of numbers that can be infinitely divided into smaller and smaller fractions.

For example, time or distance information can be thought of as continuous because they exist in units smaller than we can measure.

coordinates
Coordinates are a set of numbers that can be used to describe a location of a point on a coordinate plane.

coordinate plane or Cartesian plane
A coordinate plane or Cartesian plane is a rectangular area with one or more axes. The plane is designed to show data in a visual way. It is named after its inventor, René Descartes.

congruent
Congruent means “equal to.”

cross section
A cross section is a section cut from a prism or a cylinder. The cut is made parallel to the base.

cylinder
A cylinder is a three-dimensional or 3-D shape which has two circular bases that are parallel to each other and the same distance apart.

data
Data are numbers that represent measurements. Data may represent money, time, distances, or any other amounts.

degrees
Degrees are the measurement of the size of an angle or part of a circle. A full circle is 360 degrees, also written as 360°.

denominator
The denominator is the bottom number in a fraction. It represents the total number of equal parts.

For example, in the fraction $\frac{3}{4}$, where 4 is the denominator, an object or group has been divided into 4 equal parts. (See also numerator.)
**diameter**
In a circle, the diameter is a straight line from one edge of the circle to the other, which passes through the centre of the circle.

**discrete data**
Discrete data is data that is grouped into separate categories, with no information existing between the categories.

**distributive property**
The distributive property states that if you add two numbers and then multiply the sum by another number, you’ll get the same result as if you multiply each of the two numbers by the other number and then add the products.

For example, \(4(2 + 5) = (4)(2) + (4)(5)\).

**equation**
An equation is a pair of mathematical expressions that are joined by an equals sign \((=)\), and so they represent the same amounts. An equation is a mathematical “complete sentence”.

**equilateral triangle**
An equilateral triangle is a triangle with three equal sides. In an equilateral triangle, all of the interior angles are 60°.

**equivalent**
When two things are equivalent they have the same value.

For example \(\frac{1}{2}\) and \(\frac{2}{4}\) are equivalent expressions.

**event**
An event is a specific outcome from the sample set of all possible outcomes.

For example, drawing a five of hearts from a normal deck of 52 cards is an event.

**expression**
An expression is a mathematical phrase. An expression is made of terms. Terms are joined by the mathematical operators plus or minus \((+ \text{ or } –)\) into expressions.

For example, \(5x – 7\) is a two-term expression.

**extrapolate**
To extrapolate means to estimate quantities or data beyond the last amounts measured; to extend a graph line beyond the last data point. (See also **interpolate**.)

**favourable outcome**
A favourable outcome means achieving a desired result in a probability experiment.
fraction
A fraction is a number that represents part of a whole.

For example, $\frac{1}{2}$ represents one part out of a total of two parts.

graph
A graph is a visual representation of data using lines, bars, symbols, or areas.

heptagon
A heptagon is a seven-sided closed figure.

hexagon
A hexagon is a six-sided closed figure.

histogram
A histogram is a vertical bar graph.

hypotenuse
1. the side of a right triangle that is not a leg.
2. the longest side of a right triangle.
3. the side of a right triangle that is opposite the right angle.

icon
An icon is a small symbol that represents a quantity of items for a pictograph or in a graph legend. Usually a picture or line drawing of the item is used as an icon.

improper fraction
An improper fraction is a fraction where the numerator is larger than the denominator.

For example, $\frac{7}{5}$ is an improper fraction.

independent event
In a probability experiment, an independent event is when the outcome of one event does not influence or change the possible outcome of another event.

intercept
The intercept is the location where a line graph intersects an axis.

interior angles
Interior angles are angles that are inside a figure. For polygons, interior angles are at each vertex.

interpolate
To interpolate means to estimate the data amounts between data points that were measured. (See also extrapolate.)
interval
An interval is the amount between two values; their difference.

irregular polygon
An irregular polygon is a closed figure where all the sides are not equal and all the angles are not equal.

isosceles triangle
An isosceles triangle is one with two equal sides.

legs
Legs refer to:
1. the sides of a right triangle that form the right angle.
2. the parts of the body that the feet are attached to.

line graph
A line graph is a graph using a straight, bent, or curved line to show continuous data.

linear equation/linear relation
A linear equation or linear relation is an equation, table, description or graph that shows the relationship between two variables and forms a straight-line graph.

misinterpret
To misinterpret means to misunderstand or to gain a false impression from a conversation, picture, data or text.

misleading information
Misleading information is information (such as a graph) that is technically correct but would give most viewers an inaccurate impression.

misrepresent
To misrepresent is to present information falsely, visually or in words.

mixed number
A mixed number is a number composed of a whole number and a fraction.

For example, $2\frac{1}{3}$ is a mixed number.

model
1. To model is to create a representation of real-life data.
2. A model is the graph, map, computer program or another item that represents data.
net
A net is a two-dimensional or 2-D construction of a three-dimensional or 3-D object.

numerator
The numerator is the top number in a fraction. It represents the number of equal parts you are working with.

For example, in the fraction \( \frac{3}{4} \), where 3 is the numerator, you are working with only 3 of the parts out of 4 total. (See also denominator.)

octagon
An octagon is an eight-sided closed figure.

operations
When we do something with a number or numbers, it is called an operation. Addition, subtraction, multiplication, and division are basic operations.

ordered pair
An ordered pair is a pair of numbers \((x, y)\) that represent the values that satisfy a relation and also represent a location on the graph of the relation.

origin
The origin is the point \((0,0)\) on a two-dimensional graph at which the axes intersect.

outcome
The outcome is the result of a single trial or experiment.

pentagon
A pentagon is a five-sided closed figure.

percent
A percent is a fraction of a whole, expressed as a fraction out of 100.

perfect square
A perfect square is a number that represents the area of a square whose sides are whole numbers.

For example, if a square has sides of length 3, its area is 9, and 9 is a perfect square.

It is also the result when a whole number is multiplied by itself.

For example, \(5 \times 5 = 25\), and 25 is a perfect square.

perspective
Perspective is the viewer's perception, visually or psychologically.
pictograph
A pictograph is a graph that uses icons or symbols to represent the amount measured in each category, instead of using an axis to show the measurements.

pie chart
See circle graph.

plane
A plane is a two-dimensional or 2-D surface.

point
A point is a location on a coordinate plane which can be represented by an ordered pair \((x, y)\).

polygon
A polygon is a closed geometric shape made of 3 or more line segments.

prism
A prism has three-dimensional or 3-D shapes that have the same cross section along a length.

proper fraction
A proper fraction is a fraction whose numerator is less than its denominator.

For example, \(\frac{2}{3}\) is a proper fraction.

probability
Probability is the chance or likelihood that a particular event will occur. Probabilities are often listed as ratios (e.g. 1:2 or 2 to 5), fractions (e.g. \(\frac{3}{5}\)) or percents (e.g. 15%)

proportion
A proportion is a pair of equal ratios.

Pythagorean Theorem
The Pythagorean Theorem describes the relationship among the lengths of the three sides of a right triangle: \(a^2 + b^2 = c^2\)

Pythagorean Triple
A Pythagorean Triple is a set of three whole numbers that satisfy the Pythagorean Theorem.

For example, the numbers 3, 4, and 5 form one Pythagorean Triple. The first two numbers in a Pythagorean Triple are the measurements of the legs, and the third (the largest number) is the measurement of the hypotenuse.
quadrilateral
A quadrilateral is a four-sided closed figure.

radius
In a circle, the radius is the distance from the center to the edge of the circle.

random experiment
A random experiment is a process leading to at least two outcomes with some uncertainty about which will occur.

rate
A rate is a comparison of two quantities in which each quantity is measured in different units. For example $8 per dozen roses (or $8.00/12 roses) is a rate. (See also unit rate.)

ratio
A ratio is a comparison of two or more numbers. Ratios are written with a “:” (e.g. 2:3), using words (e.g. 2 to 3), or as a fraction (e.g. $\frac{2}{3}$).

reciprocal
A reciprocal is a number that you multiply a fraction by so that the result equals one. If you start with a whole number, put it over 1 first. The easiest way to find it is to just flip the fraction over.

For example, the reciprocal of $\frac{4}{5}$ is $\frac{5}{4}$.

rectangular prism
A rectangular prism is a six-sided three-dimensional or 3-D shape made up of rectangles.

regular polygon
A regular polygon is a closed figure with all sides equal and all angles equal.

right angle
A right angle is an angle that measures 90°.

right triangle
A right triangle has one right angle.

round/round off
To round or round off is to remove unwanted place values at the right end of a number, adjusting the first remaining place value if necessary. (See also truncate.)
**sample space**
A sample space includes all the possible outcomes resulting from a probability experiment.

**satisfy**
To satisfy means to replace variables with values that make an equation into a true statement.

For example, $y = 3x$ can be satisfied with the ordered pair $(2, 6)$, but cannot be satisfied with $(4, 9)$.

**square root**
The square root symbol tells us to take the square root of the number that’s inside.

For example, $5^2 = 25$. The square root of 25 is 5.

**square root symbol**
$\sqrt{\phantom{0}}$ This symbol tells us to take the square root of the number that’s inside.

For example: $\sqrt{4} = 2$.

**surface area**
Surface area refers to the total area of the net of a three-dimensional or 3-D object. The units are squared, for example, cm$^2$, m$^2$.

**term**
A term is an item in an expression that is a constant, or variable, or coefficient-and-variable combination. (See also **expression**.)

**tessellation**
A tessellation is a tiling pattern that covers an entire plane without overlapping or leaving gaps.

**three-dimensional (3-D)**
Three-dimensional refers to an object that has length, width and depth, or a representation of an object that has the appearance of depth.

**triangular prism**
A triangular prism is a five-sided three-dimensional or 3-D shape with two triangles that are parallel and equal to each other and joined by rectangles.

**truncate**
To truncate means to remove unwanted place values at the right end of a number without adjusting the remaining place value. (See also **round/round off**.)
two-dimensional (2-D)
Two-dimensional refers to an object that has length and width, but no depth.

unit rate
A unit rate is a rate where the second term is 1.
For example, wages are often given as a unit rate.
$10.00/hr represents $10.00 earned for every 1 hour worked.

unknown
An unknown is the value(s) that provide the solution to an equation. (See also variable.)

variable
A variable is a value that is unknown or that could change. It is often represented in an expression by a letter such as $x$, but could be represented by a word or other symbol.
(See also unknown.)

vertex (vertices)
In a closed figure, the vertex refers to the point where two sides meet. Vertex is singular and vertices is plural.

view
The view refers to a two-dimensional or 2-D drawing of a three-dimensional or 3-D object from one particular position—front view, side view, top view, bottom view, etc.

volume
The volume is the amount of space an object takes up. The units are cubed, for example, cm$^3$, m$^3$.

$x$-axis
The $x$-axis is the horizontal axis of a coordinate plane. (See also coordinate plane and axis.)

$y$-axis
The $y$-axis is the vertical axis of a coordinate. See also coordinate plane and axis.)
Templates

Section 2 | Lesson D: Calculating Square Roots

Explore
Calculating Square Roots

Warm-up
Module 2 Project
Dissection Templates