2.1 The Pythagorean Theorem

Strand
Measurement and Trigonometry

Student Text Pages
46–53

Suggested Timing
80 min

Tools
- 1-cm grid paper
- coloured paper
- protractors
- rulers
- scissors
- tape

Related Resources
BLM 2.1.1 Practice: The Pythagorean Theorem
BLM G3 Centimetre Grid Paper

Specific Expectations

Solving Problems Involving the Trigonometry of Right Triangles

In this section, students will

MT2.01 determine, through investigation (e.g., using dynamic geometry software, concrete materials), the relationship between the ratio of two sides in a right triangle and the ratio of the two corresponding sides in a similar right triangle, and define the sine, cosine, and tangent ratios $\left(\text{e.g., } \sin A = \frac{\text{opposite}}{\text{hypotenuse}}\right)$

Link to Get Ready

The Get Ready segment Squares and Square Roots provides the needed skills for this section. Have students complete these questions before proceeding with Section 2.1.

Warm-Up

1. Find the square of each number.
a) 6 **b)** 9
c) 13 **d)** 11

2. Find the square of each number. Round all answers to one decimal place.
a) 3.1 **b)** 5.3
c) 7.5 **d)** 9.4

3. Find each square root.
a) 9 **b)** 225
c) 324 **d)** 16

3. Find each square root. Round all answers to one decimal place.
a) 9 **b)** 17
c) 42 **d)** 19

Warm-Up Answers

1. a) 36 **b)** 81
b) 169 **c)** 121

2. a) 9.6 **b)** 28.1
c) 56.3 **d)** 88.4

3. a) 3 **b)** 15
c) 18 **d)** 4

4. a) 3.0 **b)** 4.1
c) 6.5 **d)** 4.4

Teaching Suggestions

Warm-Up

- Write the Warm-Up questions on the board or on an overhead. Have students complete the questions independently. Then, discuss the solutions as a class. (5–10 min)

Common Errors

- Some students may add the two leg lengths first and then square them rather than squaring each leg length and then adding.

R_x Remind students of the correct order of operations, BEDMAS. Exponents are evaluated before adding.

- Some students may forget to use opposite operations when rearranging formulas.

R_x Have students show all the steps when rearranging. For example, to isolate x in $y = mx + b$, students should subtract b from both sides, simplify, then divide both sides by m.

$y - b = mx + b - b$

$y - b = mx$

$\frac{y - b}{m} = \frac{mx}{m}$

$\frac{y - b}{m} = x$

Ongoing Assessment

- You may wish to have students work on question 14 now, to build toward solving the Chapter Problem. This provides an opportunity to assess student progress.
- Alternatively, assign all Chapter Problem questions at the end of the chapter as a summative assessment.

Accommodations

ESL—Explain that the word *theorem* is another form of the word *theory*. In math, theorem is the preferred version.

Perceptual—Provide models for students to manipulate. For example, using a toy truck and a ruler (for the ramp) will help students complete the Extend the Concepts question.

Perceptual/Spatial Language—Have students draw each of the triangles described in the practice questions and label the sides with all known information.

Visual—Provide triangle cut-outs for students to evaluate (e.g., those made from wood or paper, or selections from a tangram set).

Section Opener

- Read the Section Opener aloud, explaining who Pythagoras was. Ask students to identify a right triangle in the International Space Station photograph.

Investigate

- Have each student work with a partner for this activity.
- You may wish to use **BLM G3 Centimetre Grid Paper** for this activity.
- You may wish to demonstrate how to use the squares to form a triangle so that students can see that the triangle forms in the void. After they complete the first set, ask students to label the sides of the triangle to be sure they understand the new terms.
- Add new vocabulary to the word wall created in Chapter 1. You may wish to have students update their copy of **BLM 1.CO.1 Literacy Link: Word Wall** with new vocabulary from this chapter.
- Use **BLM 2.1.1 Practice: The Pythagorean Theorem** for extra practice or remediation.

Investigate Answers (page 47)

4.

Set	Side Lengths (cm)			Areas of Squares (cm^2)			Type of Triangle (right, acute, or obtuse)
1	3	4	5	9	16	25	Right
2	5	12	13	25	144	169	Right
3	6	8	10	36	64	100	Right
4	4	5	6	16	25	36	Acute
5	4	12	14	16	144	196	Acute

5. Sample answer: in all the right triangles, the area of the biggest square is equal to the sum of the areas of the other two squares.

6. No, the last two triangles are different. They are not right triangles.

Examples

- For Example 1, remind students of the Career Profile about Cordell the carpenter, and explain that he could use the Pythagorean theorem every time he wants to make a right angle.
- Have students think about the reasonableness of their answers. In the case of Example 1, the result is reasonable because the calculated length of the hypotenuse is greater than the lengths of the legs but less than the sum of the lengths of the legs.
- Read the MathConnect aloud to be sure that students know what a truss is.
- For Example 2, ask how many students help around the house with chores such as washing windows. Highlight the real-life application of the Pythagorean theorem, pointing out the diagram.
- Have students trace the triangle formed by the wall, ground, and ladder.

Key Concepts

- Highlight the parts of several right triangles to illustrate the Key Concepts.

Discuss the Concepts

- Have students answer the questions individually. Then, take up the answers as a class.
- For question D1, record two or three students' answers on the blackboard to prompt a class discussion.

Discuss the Concepts Suggested Answers (page 49)

D1. Sample answer: since w is the hypotenuse and this is a right triangle, I could find the length of w by adding the square of the other two sides, then by finding the square root of that sum.

D2. The hypotenuse is the side opposite to the right angle. The legs are the sides that are not the hypotenuse.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- For question 1, have students create a model of this frame and the triangles included.
- You may wish to use question 5 as an additional Literacy Connect by having students discuss the route they take when they walk home. Encourage students to identify the various shapes formed by their routes (e.g., rectangle or triangle), and see if any routes have a similar shape to Jie-ling's.
- Refer interested students and/or those students that complete the questions early to the MathConnect. Students can use the links to see a demonstration of the Pythagorean theorem.

Apply the Concepts (B)

- Have students work in groups and check a wheelchair ramp at the school to answer question 6b), or you may wish to allow only students who finish early to do this part.
- Question 7 is a Literacy Connect. Literacy Connect questions offer the opportunity to explore literacy issues in the mathematics classroom. They support general Think Literacy strategies. For more information, visit http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy. A television set or a flyer showing several models may help students visualize the relationships described in this question.
- For question 9b), create a display of students' table runner models.
- For question 10, ask if any students play baseball. This question could lead to a good discussion of sports in which the playing area is another shape. Encourage students to calculate the diagonal length of those areas.
- Question 14 is a Chapter Problem. Tell students to keep the solution to this question handy as it may help them with the Chapter Problem Wrap-Up.

Extend the Concepts (C)

- Assign the Extend the Concepts questions to students who are not being challenged by questions in Apply the Concepts.
- Extend the Concepts questions can be used as a diagnostic assessment for those students considering a university-level course in grade 11.
- Question 15 helps students see that triangles appear in unexpected situations.