2.2

Explore Ratio and Proportion in Right Triangles

Strand
Measurement and Trigonometry

Student Text Pages
54–62

Suggested Timing
80 min

Tools
- calculators
- computers
- *The Geometer's Sketchpad®*
- grid paper
- protractors
- rulers

Related Resources
BLM 2.2.1 Practice: Explore Ratio and Proportion in Right Triangles
BLM 2.2.2 Investigate Method 3: Use *Cabri Jr.*
BLM G1 Grid Paper
BLM G2 Protractor
BLM T1 *The Geometer's Sketchpad®* 4

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 $\left(\text{e.g., } \sin A = \frac{\text{opposite}}{\text{hypotenuse}}\right)$

MT2.02 determine the measures of the sides and angles in right triangles, using the primary trigonometric ratios and the Pythagorean theorem

Link to Get Ready

The Get Ready segments Solving Proportions and Rounding Squares provide the needed skills for this section. Have students complete these questions before proceeding with Section 2.2.

Warm-Up

1. Write each ratio in lowest terms.

a) $\frac{4}{18}$ **b)** $\frac{3}{8}$

c) $\frac{9}{54}$ **d)** $\frac{84}{12}$

2. Which pairs of ratios are equal?

a) $\frac{1}{2}, \frac{3}{6}$ **b)** $\frac{5}{13}, \frac{15}{38}$

c) $\frac{11}{21}, \frac{121}{210}$ **d)** $\frac{6}{21}, \frac{18}{63}$

3. Use your calculator to convert each ratio to a decimal. Round each answer to two decimal places.

a) $\frac{3}{11}$ **b)** $\frac{6}{27}$

c) $\frac{7}{125}$ **d)** $\frac{4}{52}$

Warm-Up Answers

1. a) $\frac{2}{9}$ **b)** $\frac{3}{8}$ **c)** $\frac{1}{6}$ **d)** $\frac{7}{1}$

2. a and d

3. a) 0.27 **b)** 0.22 **c)** 0.06 **d)** 0.08

Common Errors

- Some students may not be careful in their counting of grid squares for the horizontal lines.

R_x Have students check each other's work to ensure accuracy.

- Some students may incorrectly label the sides of the triangle.

R_x Have students always label the hypotenuse first, then put a finger on the angle to find the adjacent side. The remaining side is the opposite side.

Ongoing Assessment

- If you have asked students to write their answers in a journal, review them to ensure all students understand the concepts covered.
- This section is an application of the similar triangles work from Chapter 1.
- Encourage students to do a variety of questions for class and homework. You may want to have a homework quiz, where students use their notebooks to write out the solution to one of the homework questions for their portfolios.

Accommodations

ESL—Allow students to use dictionaries or translators to understand the new words.

Gifted and Enrichment—Encourage students to think of situations in which they use ratios of side lengths in triangles.

Motor—Provide photocopies of the triangles in the questions so that students do not have to copy them into their notebooks.

Perceptual—Bring in a rectangular box to use as a model for the elevator cage. Use markers or tape to show the sides and diagonal braces of the cage. You may wish to cut away triangles to further highlight the structure of the cage and reinforce the various triangles that make it up.

Visual—Provide students with a string knotted in sections as described on page 59 of the student edition. Encourage them to evaluate angles using this ancient Egyptian technique.

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)

Section Opener

- Read the opening paragraph aloud to stimulate discussion on navigation. Ask if any students are involved in any group that is interested in navigation such as the Air or Sea Cadets, or Guides and Scouts. You might ask students to search the Internet for jobs that use navigation (e.g., pilots, surveyors, and wilderness guides).

Investigate

- Circulate as student work on the Investigate to ensure they are following the steps provided.
- You may wish to have students cut their square sets from **BLM G1 Grid Paper**.
- You may wish to use **BLM T1 *The Geometer's Sketchpad*® 4** for this activity.
- If you have access to *Cabri Jr.*, you may wish to use **BLM 2.2.2 Investigate Method 3: Use *Cabri Jr.*** for the Investigate, either in addition to, or instead of the methods provided.
- **BLM G2 Protractor** may help students with question 5.
- Use **BLM 2.2.1 Practice: Explore Ratio and Proportion in Right Triangles** for extra practice or remediation.

Investigate Answers (page 54)

Method 1

3.

Triangle	Side Lengths	Ratio 1	Ratio 2	Ratio 3
ABE	AB = 20 BE = 10 AE = 22.36	$\frac{BE}{AE} = 0.45$	$\frac{AB}{AE} = 0.90$	$\frac{BE}{AB} = 0.5$
ACF	AC = 30 CF = 15 AF = 33.54	$\frac{CF}{AF} = 0.45$	$\frac{AC}{AF} = 0.90$	$\frac{CF}{AC} = 0.5$
ADG	AD = 40 DG = 20 AG = 44.72	$\frac{DG}{AG} = 0.45$	$\frac{AD}{AG} = 0.90$	$\frac{DG}{AD} = 0.5$

4. a) The values are the same.
b) The values are the same.
c) The values are the same.

5. The interior angles are the same in each triangle.

6. The ratios are the same.

Method 2

13. Sample answer:

	Lengths (cm)			Ratios		
Triangle	**AB**	**BC**	**AC**	$\frac{BC}{AB}$	$\frac{AC}{AB}$	$\frac{BC}{AC}$
1	9.58	4.90	8.23	0.51	0.86	0.595

14. Although each triangle has side lengths that are different, the ratios stay the same.

Examples

- For Example 1, suggest that students always label the hypotenuse first because it is the longest side and opposite the right angle. Then, have students put their fingers on the angle, and have them label the side touching their fingers "adjacent." Finally, tell students to label the opposite side.
- As a class, read the Key Terms definitions in the margin. You may wish to have students update their word wall.

Key Concepts

- Read over the Key Concepts with the students to ensure they understand what was learned in the section.

Discuss the Concepts

- Arrange students into pairs using an inside–outside circle. Students on the inside answer the first question. Then, have the outside circle move so students answer the second question to a new partner.
- Alternatively, have each student answer the questions as a journal entry.

Discuss the Concepts Suggested Answers (page 59)

D1. The hypotenuse is the longest side and opposite the right angle.

D2. Start by putting a finger on the angle. Label the side you are not touching "opposite." Label the longest side "hypotenuse." The remaining side is the adjacent side.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- Bring in a knotted rope to demonstrate the ancient Egyptian practice explained in the MathConnect. Have students use the rope to verify angles in the classroom (e.g., checking corners of walls, desks, or windows). As a class, prove mathematically that this ratio fits the Pythagorean theorem.
- Have students work together to ensure that they understand and are able to do the questions.

Apply the Concepts (B)

- Question 9 is a Literacy Connect. Literacy Connect questions offer the opportunity to explore literacy issues in the mathematics classroom and within the context of mathematics. This supports general Think Literacy strategies. For more information visit http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy. Have students share their answers to 9a) as this question is one in which you will see whether students really understand or not. Have the models available for other students to see, and have them solve each other's problems.
- Question 11 is a Chapter Problem. Remind 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.
- For question 13, have students work in a group to draw the triangle. Then, have them measure angles X and Z.