2.4 The Tangent Ratio

Strand
Measurement and Trigonometry

Student Text Pages
74–82

Suggested Timing
80 min

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

Related Resources
BLM 2.4.1 Practice: The Tangent Ratio
BLM 2.4.2 Achievement Check Rubric
BLM A3 Communication General Scoring Rubric
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

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

MT2.03 solve problems involving the measures of sides and angles in right triangles in real-life applications (e.g., in surveying, in navigation, in determining the height of an inaccessible object around the school), using the primary trigonometric ratios and the Pythagorean theorem

Link to Get Ready

The Get Ready segments Solving Proportions and Rounding provide the needed skills for this section. Have students complete these questions before proceeding with Section 2.4.

Warm-Up

1. Draw a right triangle ABC with the right angle at B.
- **a)** Relative to ∠C, label the opposite and adjacent sides.
- **b)** Relative to ∠A, label the opposite and adjacent sides.

2. Use a scientific calculator to find each value to four decimal places.
- **a)** sin 32°
- **b)** cos 13°
- **c)** sin 67°
- **d)** cos 55°

3. Find the value of x. Round the answer to the nearest degree.
- **a)** $\sin x = 0.3746$
- **b)** $\cos x = 0.7880$
- **c)** $\sin x = 0.9877$
- **d)** $\cos x = 0.6820$

Warm-Up Answers

1. a) adjacent = BC, opposite = AB
b) adjacent = AB, opposite = BC

2. a) 0.5299 **b)** 0.9744 **c)** 0.9205 **d)** 0.5736

3. a) 22° **b)** 38° **c)** 81° **d)** 47°

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 Section Opener aloud to stimulate class discussion of other cliffs that students know about.
- As a follow-up to this section, you may wish to take a field trip to a place where students can use their knowledge of trigonometry to find the height of a cliff or another natural or manufactured object. Another possibility is to use places around the school that students could find the heights based on some given information.

Common Errors

- Some students may key the question incorrectly on their calculators.

R_x Have students test how their calculators work and make notes for future reference.

Ongoing Assessment

- Quiz students on choosing the appropriate ratio to be used to solve a question on different triangles. Provide a journal question on when to use which of the three primary trigonometric ratios.
- You may wish to use Chapter Problem question 15 as a formative assessment. You may wait until students have finished the chapter and use the Chapter Problem and its related questions as a summative assessment piece.

Accommodations

Gifted and Enrichment—Have students make up their own inaccessible heights questions using situations around the school. You may wish to have groups challenge each other with their questions.

Memory—Help students remember the trigonometric ratios by adding to the mnemonic from the last section, to make SOH CAH TOA. SOH means Sine equals Opposite over Hypotenuse, COH means Cosine equals Adjacent over Hypotenuse, and TOA means Tan equals Opposite over Adjacent.

Investigate

- Circulate as students work on the Investigate. Ensure that they are careful in their measurements.
- Read the definition of the tangent ratio with the students and discuss it so they feel comfortable with it.
- You may wish to use **BLM G1 Grid Paper**, **BLM G2 Protractor**, and/or **BLM T1 *The Geometer's Sketchpad*® 4** to help students complete these questions.
- Use **BLM 2.4.1 Practice: The Tangent Ratio** for extra practice or remediation.

Investigate Answers (pages 74–77)

2–5. Answers will vary.

6. They are the same because the angles are the same.

12. Yes, both the angles and side lengths change.

20. The values (ratios) are the same.

21. Yes, when the legs are the same length and form an isosceles triangle. When the angles are the same, the tan of the angles are the same.

Examples

- You may wish to redraw the situation in Example 1, adding Anysha and the falls to ensure that students understand the problem. Ask students if they have been to a place like Kakabeka Falls.
- In Example 3, the unknown is the angle not the length. Review with students how to use the inverse or 2nd function on their calculators.

Key Concepts

- Remind students of the other two ratios: sine and cosine. Write out all three ratios and point out that the tangent ratio is the only one that does not use the hypotenuse.

Discuss the Concepts

- Have students answer the questions in small groups and post their answers on the board.

Discuss the Concepts Suggested Answers (page 79)

D1. Because the ratio of the sides stays the same.

D2. If you know an angle and the length of one side, you can use the tangent ratio to solve for the length of the other side.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- Circulate as students are working on the first two questions to ensure they are comfortable with their calculators. Alternatively, have students do the questions with a partner and raise their hands if they get the same answers.

Apply the Concepts (B)

- Question 8 is a Literacy Connect. Students should be able to remember the mnemonic and this will help them remember the trigonometric ratios. 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.
- Question 9 applies trigonometry to a real-life situation. To increase the relevance, you may wish to bring in a picture of a cliff such as the one described and explain where the cliff is found.
- For question 10, remind students of the Career Profile of Cordell the carpenter that they read in the Chapter Opener. Have students research in the library or on the Internet if there is a particular angle that's used for trusses. Or, students could ask a contractor or supplier. Have them report their findings back to the class. You may wish to have students write a brief report on their findings or do a presentation. If so, you may wish to use **BLM A3 Communication General Scoring Rubric** to assist you in assessing your students.
- Question 13 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.
- Question 14 is an Achievement Check. It can be used as a diagnostic or formative assessment; it can be assigned as a small summative assessment piece. This provides an opportunity for formative or self-assessment, using **BLM 2.4.2 Achievement Check Rubric**.

Achievement Check Answer (page 82)

14. The distance between the boat and the base of the cliffs is 112.9 m.

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.
- These questions take the students beyond the regular trigonometric tangent questions to ones in which the student needs to think a bit more carefully about what is happening in the situation.