2.5 Applications of Trigonometry

Student Text Pages
120–129

Suggested Timing
80 min

Tools
- scientific calculators

Optional
- TI-Nspire™ CAS graphing calculators
- TI-84 Plus graphing calculators
- computers with *The Geometer's Sketchpad®*
- linking cubes

Related Resources
BLM 2-10 Section 2.5 Applications of Trigonometry
BLM 2-11 Section 2.5 Achievement Check Rubric
BLM A-5 Problem Solving Checklist

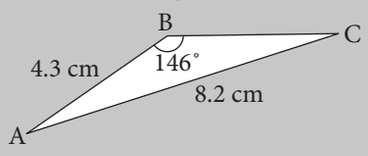
Link to Prerequisite Skills

Students should complete all the Prerequisite Skills questions before proceeding with this section.

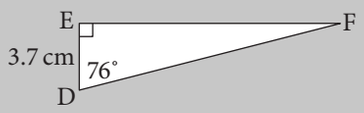
Warm-Up

1. Solve each triangle.

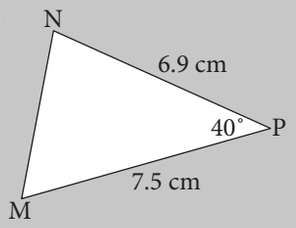
a)



b)



c)



Warm-Up Answers

1. a) $\angle C = 17°$, $\angle A = 17°$, BC = 4.3 cm
b) $\angle F = 14°$, DF = 15.3 cm, EF = 14.8 cm
c) MN = 4.96 cm, $\angle N = 76°$, $\angle M = 64°$

Teaching Suggestions

Warm-Up

- Display the Warm-Up questions. Have students complete the questions independently. Then, discuss the solutions as a class.

Section Opener

- Have a brief discussion about the Olympics and the various events. Some students may not be familiar with the triathlon (swim, bike, run). Explain that when moving from one leg of the race to another, the athletes pass through a transition zone where they change their equipment.
- There is no Investigate in this section.
- The purpose of this section is to consolidate and extend students' skills in applying various trigonometric tools to solve problems. Many of the problems in this section have multiple steps. Remind students to reflect on each solution to ensure they have completely answered the question, and that no steps were left out or left incomplete.
- If students have programmed their TI-Nspire™ CAS or TI-84 Plus graphing calculators to perform algorithmic computations for the sine law and cosine law, as described in the **Use Technology** section, they may find these programs useful in this section.

Examples

- In Example 1, information, which is given indirectly, is used to apply the cosine law to solve a problem related to setting a swim course. Students should read the question carefully to find the information about the third side of the triangle.
- Example 2 is a multi-step problem that uses the sine law twice, along with geometric reasoning, perimeter, and number sense to solve a problem related to a bike course. Remind students to reflect on their answer and check that their answer matches what the question is asking for. Students might find it a challenge to ensure they have completely answered these types of complex problems.
- In Example 3, the cosine ratio, the Pythagorean theorem, area, and number sense concepts are all applied to solve a multi-step problem related to the cost of adding soil to a garden.

Key Concepts

- Ensure students understand the Key Concepts.

Discuss the Concepts

- It might be interesting to complete **question D1** as a role-play.
- **Questions D2 and D3** could be completed in pairs or by using a think-pair-share approach.
- **Question D3** illustrates an important point regarding problem-solving efficiency. Remind students to think about the best tool to use for a problem before solving the problem.

Discuss the Concepts Suggested Answers (page 125)

D1. Sven. The sine law cannot be used since no side-angle pair is known.

D2. a) Yes. Start with the cosine law to determine one of the angles, use the sine law or the cosine law to calculate another angle, and then use the angle sum of triangles property to find the third angle.

b) No. Cannot use the cosine law or the sine law to find any of the side lengths.

D3. The triangle is a right triangle, so the primary trigonometric ratios were used. This is more efficient than using the sine law or the cosine law.

Practise (A)

- You may wish to have students work in pairs or small groups to complete the Practise questions.
- Encourage students to refer to the Examples before asking for assistance.
- **Question 1** could be done using cutouts, so that students can move the pieces around.

Apply (B)

- **Question 3** provides an opportunity to assess students' reasoning and communicating skills, as well as their ability to select tools and strategies.
- For **question 4**, encourage students to sketch a diagram and label the given information.
- For **question 5**, students familiar with golf might like to explain how the different irons are designed to give different distances with the same strength of stroke. (The loft is altered from club to club). If you have golf clubs, you could bring in a few to show to the class.
- For **question 7**, encourage students to sketch a diagram and label the given information. They need to recall the average speed-distance-time relationship: speed = distance ÷ time.

Common Errors

- Some students do not choose the most efficient trigonometric formula to solve a problem. For example, they use the cosine law when the sine law can be used, or they use the sine law in a right triangle when a trigonometric ratio could be used.

R_x Point out to students that this is not an error, but choosing the right formula for a problem means they will have fewer and simpler calculations. Consider having students present various solutions to multi-step problems and discuss the relative strengths of the different methods.

Accommodations

Gifted and Enrichment—have students calculate the optimal angle for various shots on a simulated pool table. Use pencils and marbles for the cue and pool balls, and the lid of a shoebox for the pool table.

Visual—have students work in groups to complete solutions to various problems on chart paper. Post the solutions around the room as models for other application questions.

Perceptual—construct a T-Chart listing all the strategies that can be used to solve triangle problems on the left side, and when or how to use each strategy on the right side

Spatial—have students check their diagrams with a partner before completing their solutions

Memory—have students work in groups to develop a story, song, rhyme, or play that incorporates all the terms and formulas from the Word Wall in a presentation to the class

ESL—provide a partner to assist with reading and interpreting the Examples and Practise questions. Allow students to work in pairs. Ensure students understand that multi-step problems can be solved using one or more tools: the primary trigonometric ratios, the sine law, the cosine law, or the Pythagorean theorem.

- Q**uestion 8** relates to the running portion of the triathlon, completing the race scenario that started in the section opener. This question could be used as an assignment or a performance task.
- For **question 9**, there is pre-made sketch on the Ministry-licensed *The Geometer's Sketchpad*® Version 4 CD that involves a billiards simulation, similar to this problem. Students may be interested in manipulating this sketch.
- **Question 10** is an Achievement Check question. It can be used for diagnostic or formative assessment, or assigned as a small summative assessment piece. You may wish to use **BLM 2-11 Section 2.5 Achievement Check Rubric** to assist you in assessing your students. Students familiar with baseball may find this problem interesting. It might be helpful to students who are less familiar with the sport to see this question role-played.
- **Question 11** links to the Chapter Problem. Remind students to keep the solution to this question handy as it may help them with the Chapter Problem Wrap-Up.

Extend (C)

- Assign the Extend questions to students who are not being challenged by the Apply questions.
- Some students may wish to use *The Geometer's Sketchpad*® to complete **question 12**.
- **Question 13** is related to vectors and will challenge students' ability to apply three-dimensional spatial reasoning. Linking cubes or other concrete materials may be a useful visual aid in solving this problem.

Achievement Check Answers (page 128)

10. a) 63.6 ft

b) Yes. Bud is 13.5 ft away from first base.

Literacy Connect

- Allow students to work with a partner to interpret the word problems and draw the related diagrams to assistant them in their solution.
- Remind students that solving trigonometric word problems often requires a combination of tools and strategies, as outlined in the Key Concepts.

Mathematical Process Expectations

Process Expectation	Questions
Problem Solving	6, 8, 9, 11–13
Reasoning and Proving	1, 10
Reflecting	3, 4, 5, 8
Selecting Tools and Computational Strategies	1, 3, 4, 6, 7, 9–13
Connecting	4–13
Representing	7, 8, 12, 13
Communicating	3, 8, 10

Ongoing Assessment

- Use **BLM A-5 Problem Solving Checklist** to assess students' responses to **question 8**.

Extra Practice

- Use **BLM 2-10 Section 2.5 Applications of Trigonometry** for extra practice or remediation.