9.2 Surface Area of Prisms and Pyramids

Strand
Measurement and Trigonometry

Student Text Pages
372–380

Suggested Timing
80–160 min

Tools
- calculators
- cardstock paper (optional)
- grid paper
- rulers
- scissors (optional)
- several rolls of wrapping paper (optional)
- tape (optional)

Related Resources
BLM 9.2.1 Practice: Surface Area of Prisms and Pyramids
BLM 9.2.2 Formula Sheet
BLM G1 Grid Paper

Specific Expectations

Solving Problems Involving Surface Area and Volume, Using the Imperial and Metric Systems of Measurement

In this section, students will

MT3.01 use the imperial system when solving measurement problems (e.g., problems involving dimensions of lumber, areas of carpets, and volumes of soil or concrete)

MT3.02 perform everyday conversions between the imperial system and the metric system (e.g., millilitres to cups, centimetres to inches) and within these systems (e.g., cubic metres to cubic centimetres, square feet to square yards), as necessary to solve problems involving measurement

MT3.03 determine, through investigation, the relationship for calculating the surface area of a pyramid (e.g., use the net of a square-based pyramid to determine that the surface area is the area of the square base plus the area of the four congruent triangles)

MT3.04 solve problems involving the surface areas of prisms, pyramids, and cylinders, and the volumes of prisms, pyramids, cylinders, cones, and spheres, including problems involving the combinations of these figures, using the metric system or the imperial system, as appropriate

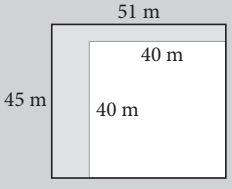
Link to Get Ready

Students will solve problems related to surface area of prisms and pyramids. Have students complete questions 1, 2, and 4 of the Get Ready before proceeding with Section 9.2.

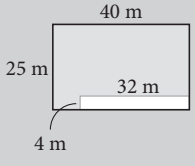
Warm-Up

1. Find the area of each shaded part.

a)



b)



2. How many cans of paint would you need to paint each of the shaded areas in question 1 with two coats of paint? Note that one can of paint covers 100 m^2.

3. If one can of paint costs $21.25, how much would the paint cost for each shaded area in question 1(including PST and GST)?

Warm-Up Answers

1. a) 695 m^2 **b)** 872 m^2

2. a) 14 cans **b)** 18 cans

3. a) \$297.50 + \$23.80 + \$17.85 = \$339.15

b) \$382.50 + \$30.60 + \$22.95 = \$436.05

Common Errors

- Some students may forget to use square units for area.

R_x Stress that area is always measured in square units.

- Some students may forget the formulas for area.

R_x Provide students with **BLM 9.2.2 Formula Sheet** to help them.

- Some students may confuse the height of a pyramid and its slant height.

R_x Encourage students to draw and label diagrams of pyramids to help them.

Ongoing Assessment

- As students work on the Investigate, circulate and observe how well students work with a partner. Consider recording each student's learning skills: group work, work habits, organization, and initiative.
- Use the solutions that students write for Practise the Concepts to assess their understanding of surface area of prisms and pyramids.
- Use Chapter Problem question 11 to assess students' ability to apply their knowledge of surface area.

Accommodations

Gifted and Enrichment—Consider having students use the Internet to compare the surface area coverage of different types or brands of paint. Alternatively, students could bring in paint cans and compare surface area coverage on different cans of paint. Students can also find out if it is more cost-efficient to buy paint in larger volumes.

Language/Memory/ESL—Have students work in pairs for the Warm-Up. As students work, circulate and coach those who are experiencing difficulty. Consider using Think–Pair–Share for the Investigate.

Motor—For the Investigate, pair students with dexterity problems with those without such difficulties.

Visual—Encourage students to draw and/or label diagrams to help them solve problems. For question 11, consider showing how a toque fits between the two pyramids in a model that you make.

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. (15–20 min)
- Demonstrate a quick way to find the final cost of a purchase by multiplying the value of the purchase before tax by 1.14.

Section Opener

- Introduce the section by making a connection with painting a room. You need to know how much paint to buy so you don't buy too much and waste money or buy too little and have to go back to the store.
- Read the question as a class and have students work with a partner to brainstorm ways on how they could figure out how much epoxy is required before sharing their solutions in a class discussion.

Investigate

- Provide students with rulers and **BLM G1 Grid Paper**.
- Consolidate the Investigate by having students discuss their findings. As a class, discuss cutting pieces of fabric for clothing or pieces of sheet metal for metal objects, such as a tool box. Ask why industries invest time and effort in designing ways to best position pattern pieces (minimize waste).
- Consider extending the activity by having students make a 3-D version of the pyramid by adding tabs to their net and using scissors and tape to assemble it. In advance, gather some rolls of wrapping paper that students can use to wrap their pyramid and check their calculations. Provide wrapping paper of different dimensions so that students can experiment with positioning the gift according to the dimensions of the paper. Have stronger students find the largest pyramid that can be gift-wrapped without needing to join two cut pieces.
- Use **BLM 9.2.1 Practice: Surface Area of Prisms and Pyramids** for extra practice or remediation.

Investigate Answers (pages 372)

1. Look for a net of a square-based pyramid. Each side of each face should be labelled 5 cm.

2. $A = \frac{1}{2}(5)(2.5\sqrt{3}) = 10.83 \text{ cm}^2$. It is not necessary to calculate the area of each face, since each face has the same dimensions.

3. There are four congruent triangular faces.
SA of triangular faces = 4 (10.83) + SA of the square base = (5) (5) = 50 + 25 = 75 cm^2.

4. You need to consider some overlap to wrap a gift so you need a little more than 68.32 cm^2.

5. Answers may vary. Sample answer: You need to position the gift on the paper to fit the dimensions of the wrapping paper.

Examples

- As a class, work through the Examples to strengthen students' understanding of calculating surface area.
- Review the formulas for area. Emphasize that to find the surface area of a prism or a pyramid, students need to find the area of each face, and then add the areas, and that area is measured in square units. You might have students add the formulas to their Discussion Chart.

- In Example 3, consider using a solid of a rectangular pyramid to clarify the difference between slant height of the pyramid (height of the triangular faces) and the height of the pyramid. Review using the Pythagorean theorem to find the values for the heights of the triangular faces.

Key Concepts

- Ensure that students understand the Key Concepts before assigning the Practise the Concepts questions.

Discuss the Concepts

- Have students complete and then discuss questions D1 and D2 in a class discussion.
- For D1 and D2, refer students to Example 3 on page 374.
- For D2, direct students to draw a diagram of the pyramid and label it (i.e., base, slant height, height) to help them answer the question. Gauge their understanding as you listen to their oral explanations of the solutions.

Discuss the Concepts Suggested Answers (page 376)

D1. The height of a pyramid is a measurement from the base of the pyramid to its peak. The slant height is a measurement from the side of the base of the pyramid to its peak along one of its triangular faces.

D2. Divide the base length by two to get the distance from the base edge to the centre of the pyramid directly under the peak. Knowing the height of the pyramid and the distance to the middle of the pyramid allows us to find the slant length using the Pythagorean theorem, where the hypotenuse is the slant height.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.

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. Consider providing students with cardstock paper and scissors and having them construct the net of the doghouse to help them answer the question.
- Question 11 is a Chapter Problem. Consider adapting question 11 into a hands-on activity using cardstock paper, scissors, and tape. You might encourage students to design their own packaging for toques. If so, you might have students select the most unique design when students present their designs to the class. Remind students to keep the solution handy to help 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 13 is related to Example 2 on page 374. You might give students an idea of the size of Menkaure's pyramid by taking students to a large wall (possibly an exterior wall at school) and calculating the surface area of the wall. Have students estimate how many walls it would take to approximate the surface area of the pyramid.