5.3 Surface Area of a Prism

Focus on...

After this lesson, you will be able to...

- ❑ link area to surface area
- ❑ find the surface area of a right prism

Most products come in some sort of packaging. You can help conserve energy and natural resources by purchasing products that

- are made using recycled material
- use recycled material for packaging
- do not use any packaging

What other ways could you reduce packaging?

Explore the Math

Materials

- empty cardboard box (cereal box, granola box, snack box, etc.)
- scissors
- ruler
- scrap paper

How can you determine the surface area of a package?

1. Choose an empty cardboard box. Cut along edges of the box so it unfolds to form a net.

Do you need to include the material used in the overlapping flaps? Why or why not?

2. Suppose you want to design an advertisement to place on the outside of your box. How can you determine the surface area you have to work with?

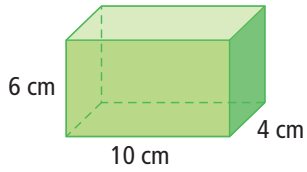
Reflect on Your Findings

3. a) Share your method with several of your classmates. Discuss any similarities or differences between the methods.

b) Which method do you prefer to use? Justify your response.

Example 1: Calculate the Surface Area of a Right Rectangular Prism

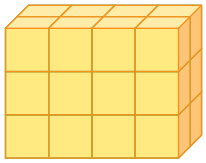
a) Draw the net of this right rectangular prism.



b) What is the **surface area** of the prism?

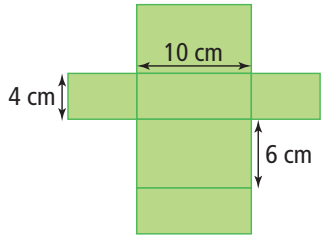
surface area

- the number of square units needed to cover a 3-D object
- the sum of the areas of all the faces of an object



Solution

a)



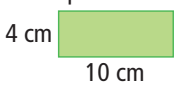
b) The right rectangular prism has faces that are three different sizes.

front or back

$A = l \times w$
$A = 10 \times 6$
$A = 60$

The area of the front or back is 60 cm^2.

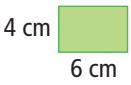
top or bottom



$A = l \times w$
$A = 10 \times 4$
$A = 40$

The area of the top or bottom is 40 cm^2.

ends



$A = l \times w$
$A = 6 \times 4$
$A = 24$

The area of each end is 24 cm^2.

Area is measured in square units. For example, square centimetres, square metres, etc.

The surface area is the sum of the areas of all the faces.

The front and back have the same area:
$A = 60 \times 2$
$A = 120$

The top and bottom have the same area:
$A = 40 \times 2$
$A = 80$

The two ends have the same area:
$A = 24 \times 2$
$A = 48$

Strategies

How else could you calculate the surface area?

Surface area = (area of front and back) + (area of top and bottom) + (area of ends)
$= 120 + 80 + 48$
$= 248$

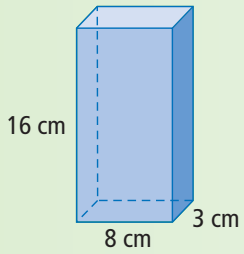
The surface area of the right rectangular prism is 248 cm^2.

You could add the areas you calculated first. $60 + 40 + 24 = 124$

Each area is the same as the area of one other face, so you could then multiply the total by two. $124 \times 2 = 248$

Show You Know

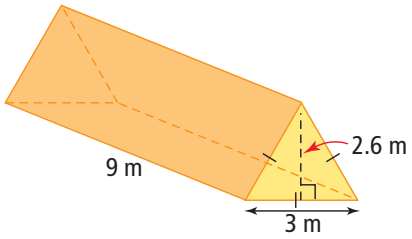
What is the surface area of this right rectangular prism?



Example 2: Calculate the Surface Area of a Right Triangular Prism

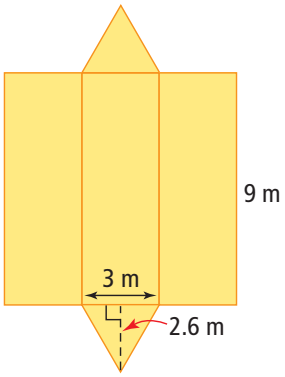
a) Draw the net of this right triangular prism.

b) What is the surface area?



Solution

a)



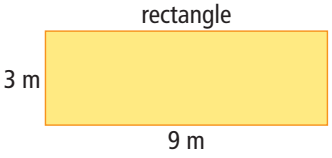
Strategies

Draw a Diagram

Strategies

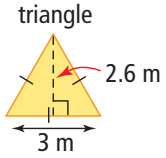
What other strategies could you use?

b) The bases of the prism are equilateral triangles. The sides of the prism are rectangles.



$A = l \times w$
$A = 9 \times 3$
$A = 27$

The area of one rectangle is 27 m^2.



$A = (b \times h) \div 2$
$A = (3 \times 2.6) \div 2$
$A = 7.8 \div 2$
$A = 3.9$

The area of one triangle is 3.9 m^2.

Literacy Link

An *equilateral triangle* has three equal sides and three equal angles. Equal sides are shown on diagrams by placing tick marks on them.

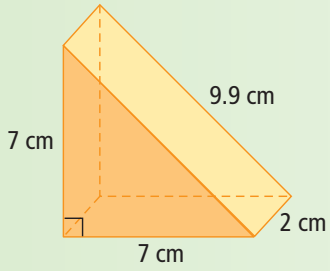
This right triangular prism has five faces.
There are three rectangles of the same size and two triangles of the same size.

Surface area $= (3 \times \text{area of rectangle}) + (2 \times \text{area of triangle})$
$= (3 \times 27) + (2 \times 3.9)$
$= 81 + 7.8$
$= 88.8$

The surface area of the right triangular prism is 88.8 m^2.

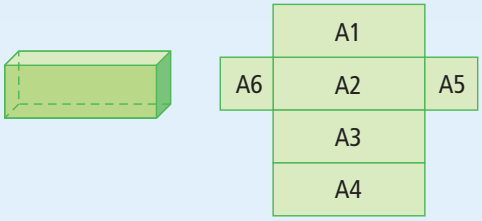
Show You Know

Find the surface area of this triangular prism.



Key Ideas

- Surface area is the sum of the areas of all the faces of a 3-D object.



Surface Area = A1 + A2 + A3 + A4 + A5 + A6, where A1 represents the area of rectangle 1, A2 represents the area of rectangle 2, etc.

Communicate the Ideas

1. Write a set of guidelines that you could use to find the surface area of a prism. Share your guidelines with a classmate.

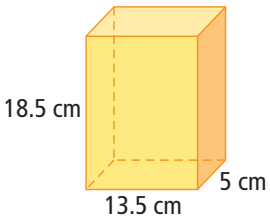
2. A right rectangular prism has six faces. Why might you have to find the area of only three of the faces to be able to find the surface area? Use pictures and words to explain your thinking.

Check Your Understanding

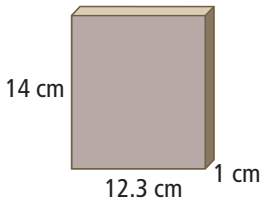
Practise

For help with #3 and #4, refer to Example 1 on page 177.

3. Find the surface area of this right rectangular prism to the nearest tenth of a square centimetre.

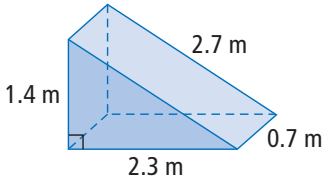


4. Find the surface area of this CD case.



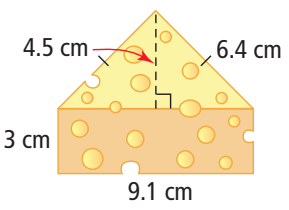
For help with #5 to #7, refer to Example 2 on pages 178–179.

5. Calculate the surface area of this ramp in the shape of a right triangular prism. Give your answer to the nearest tenth of a square metre.



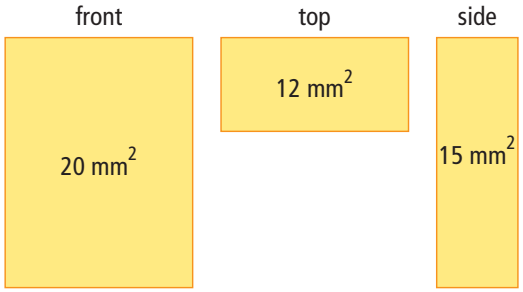
Apply

6. Cheese is sometimes packaged in a triangular box. How much cardboard would you need to cover this piece of cheese if you do not include overlapping? Calculate your answer to the nearest tenth of a square centimetre.

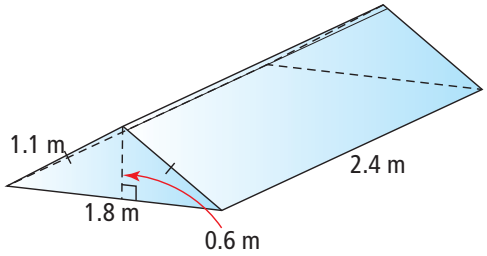


The tick marks on the two sides of the triangle indicate that these sides are equal.

7. Given the area of each face of a right rectangular prism, what is the surface area?



8. Paco builds a glass greenhouse.

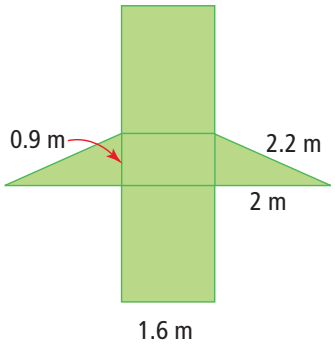


a) How many glass faces does the greenhouse have?

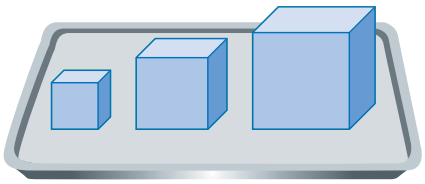
b) How much glass does Paco need to buy?

9. What is the minimum amount of material needed to make the cover of this textbook if there is no overlap? Give your answer to the nearest square millimetre.

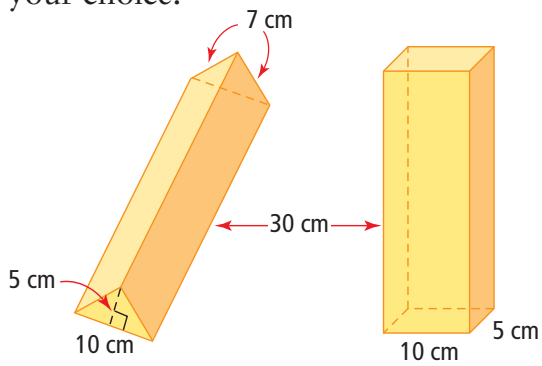
10. Jay wants to make a bike ramp. He draws the following sketch. What is the surface area of the ramp?



11. Dallas wants to paint three cubes. The cubes measure 1 m × 1 m × 1 m, 2 m × 2 m × 2 m, and 3 m × 3 m × 3 m, respectively. What total surface area will Dallas paint if he decides not to paint the bottoms of the three cubes?



12. Tadika has a gift to wrap. Both of these containers will hold her gift. Which container would allow her to use the least amount of wrapping paper? Explain your choice.



Extend

13. A square cake pan measures 30 cm on each side and is 5 cm deep. Cody wants to coat the inside of the pan with non-stick oil. If a single can of non-stick oil covers an area of 400 000 cm^2, how many pans can be coated with a single can?

14. Ethan is hosting games night this weekend. He bought ten packages of playing cards. Each package measures 9 cm × 6.5 cm × 1.7 cm. He wants to build a container to hold all ten packages of cards.

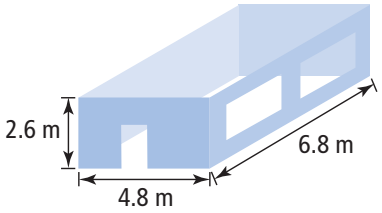
a) What are the minimum inside dimensions of the container?

b) Is there more than one kind of container that would work? Draw diagrams to help explain your answer.

15. a) If the edge length of a cube is doubled, find the ratio of the old surface area to the new surface area.

b) What happens if the edge length of a cube is tripled? Is there a pattern?

16. Shelby wants to paint the walls and ceiling of a rectangular room.



Type of Paint	Size of Paint Can	Cost
Wall paint	4 L 1 L	$24.95 $7.99
Ceiling paint	4 L	$32.95

One litre of paint covers 9.5 m^2.

a) What is the least amount of paint Shelby can buy to paint the room (subtract 5 m^2 for the door and windows)?

b) How much will the paint cost, including the amount of tax charged in your region?

MATH LINK

For the prism-shaped building you created in the Math Link on page 175, how much material do you need to cover the exterior walls and the roof of the building?