CHAPTER
5
Surface Area

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Three-Dimensional Objects

3-dimensional (3-D)
- an object that has length, width, and height
- you can describe a 3-D object by its faces, edges, and vertices

1. Write the name and the number of edges, faces, and vertices for each object.

<table>
<thead>
<tr>
<th>Object</th>
<th>Name</th>
<th>Faces</th>
<th>Edges</th>
<th>Vertices</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Circles

radius
- the distance from the centre of the circle to the outside edge
- $r$ shows the radius
- the radius is half the diameter: $r = d \div 2 \quad \text{or} \quad r = \frac{d}{2}$

diameter
- the distance across a circle through its centre
- $d$ shows the diameter
- the diameter is twice the radius: $d = 2 \times r \quad \text{or} \quad d = 2r$

circumference
- the distance around a circle (the perimeter)
- $C$ shows the circumference
- $C = 2 \times \pi \times r \quad \text{or} \quad C = \pi \times d$

area
- the number of square units needed to cover a 2-dimensional shape
- $A$ shows the area
- $A = \pi \times r^2 \quad \text{or} \quad A = \pi r^2$

$\pi$ is about 3.14
$r^2$ means $r \times r$
2. Find the circumference of each circle to the nearest tenth (1 decimal place).

\[ C = \pi \times d \]
\[ = 3.14 \times \underline{\quad} \quad \]
\[ = \underline{\quad} \text{ cm} \]

\[ C = 2 \times \pi \times r \]
\[ = 2 \times \underline{\quad} \times \underline{\quad} \]
\[ = \underline{\quad} \]

3. Find the area of each circle to the nearest tenth (1 decimal place).

\[ A = \pi \times r^2 \]
\[ A = \pi \times r \times r \]
\[ = \underline{\quad} \times \underline{\quad} \times \underline{\quad} \]
\[ = \underline{\quad} \text{ cm}^2 \]

Area Formulas

Area of a rectangle = \( l \times w \)
Area of a triangle = \( b \times h \div 2 \)
Area of a parallelogram = \( b \times h \)

4. Find the area of each shape.

\[ A = b \times h \div 2 \]
\[ = \underline{\quad} \times \underline{\quad} \div 2 \]
\[ = \underline{\quad} \]

\[ A = b \times h \]
\[ = \underline{\quad} \times \underline{\quad} \]
\[ = \underline{\quad} \]
City Planning

When city planners design communities, they think about many things, such as:

- types of buildings
- width of streets
- where to put bus stops

Imagine you are a city planner for a miniature community.

miniature

- a small version of something

1. A community needs different buildings. For example, food stores, banks, and hospitals are often on the main street of a community.

Use the table to organize information about the buildings a community needs.

<table>
<thead>
<tr>
<th>Type of Building</th>
<th>Where the Building Is Located in the Community</th>
<th>Shapes of Its Faces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank</td>
<td>main street</td>
<td>square, rectangle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

Discuss your answers to #1 with a partner. Then, share your ideas with the class.

2. What else does a community need? (e.g., streets, fire hydrants, and telephone wires)


3. Imagine you are in an airplane. Using grid paper, sketch part of an aerial view of a community. Draw the buildings, roads, and any other features from #2 that are important.
5.1 Warm Up

1. Draw a square and a rectangle.
   a) square
   b) rectangle

2. Use isometric dot paper to make it easier to draw 3-D shapes. Follow the steps to draw each solid.
   a) cube
   b) rectangular prism

3. Draw the top, front, and side view of your cube and rectangular prism.
   a) cube
   top       front       side
   b) rectangular prism
       top       front       side

4. Circle the diagram that shows a 90° clockwise rotation.
   a) 
   b) 

A rotation can be clockwise or counterclockwise.
5.1 Views of Three-Dimensional Objects

Working Example 1: Draw and Label Top, Front, and Side Views

Draw the top, front, and side view of each item. Label each view.

a) Tissue box

Solution

b) Compact disc case

Solution

Show You Know

Draw the top, front, and side views of this object.

top  front  side
Working Example 2: Sketch a Three-Dimensional Object When Given Views

An object made of 6 blocks has these views.
Sketch the object.

Solution
Sketch the object on isometric paper.
Draw the same object on the grid.

Show You Know
An object is made using 5 blocks.
The top, front, and side views are shown.

Sketch the object on isometric dot paper.
Working Example 3: Predict and Draw the Top, Front, and Side Views After a Rotation

The diagrams show the top, front, and side views of a computer tower.

Rotate the computer tower 90° clockwise on its base.

a) Which view will become the new front view after the rotation?

Solution

The side view will become the new front view after rotation.

b) Label the top, front, and side views after rotating the tower.

Solution

---
Stand a book on your desk.

**a)** Draw the top, front, and side views.

**b)** Rotate the book 90° clockwise around its spine.
What will the top, front, and side views look like?

The ________________ view will only change its position after the rotation.

The ________________ view will become the side view after the rotation.

The ________________ view will become the front view after the rotation.

**c)** Draw the top, front, and side views after rotating the book.

| top | front | side |
Communicate the Ideas

1. Are these views of a book correct? Circle YES or NO.
   Give 1 reason for your answer.
   _______________________________________________
   _______________________________________________
   _______________________________________________
   _______________________________________________

Check Your Understanding

Practise

2. Draw and label the top, front, and side views.

   a)  
      ![Speaker Diagram]
      top  front  side

   b)  
      ![Box Diagram]
      top  front  side
3. a) Circle the top view.

b) Put a square around the front view.

c) Put an X on the side view.

4. Draw each 3-D object using the views.

5. A microwave has these views.

Turn the microwave 90° counterclockwise.

Draw each new view.
Apply

6. Choose two 3-D objects from your classroom.

Draw the top, front, and side views for each.

Object 1: __________________________

<table>
<thead>
<tr>
<th>top</th>
<th>front</th>
<th>side</th>
</tr>
</thead>
</table>

Object 2: __________________________

<table>
<thead>
<tr>
<th>top</th>
<th>front</th>
<th>side</th>
</tr>
</thead>
</table>

7. Draw the top, front, and side views for each.

a) You can make the shapes out of blocks before you draw them.

<table>
<thead>
<tr>
<th>top</th>
<th>front</th>
<th>side</th>
</tr>
</thead>
</table>

b) 

<table>
<thead>
<tr>
<th>top</th>
<th>front</th>
<th>side</th>
</tr>
</thead>
</table>
MATH LINK

a) Choose 1 of the important buildings from your community in the Math Link on page 228.

Name of building: ____________________________________________________________

Sketch a 3-D view of the building.

[Blank space for drawing]

b) Draw and label the top, front, and side views.

<table>
<thead>
<tr>
<th>top</th>
<th>front</th>
<th>side</th>
</tr>
</thead>
</table>
5.2 Warm Up

1. Draw the top, front, and side views of each solid.

   a) 
   top    front    side
   b) 
   top    front    side

2. Measure the length, width, and height of each solid.

   a) 
   length = __________ cm
   width = __________
   height = __________

   b) 
   length = __________
   width = __________
   height = __________

3. Each side of each solid is a 2-D shape. Name the shapes in each solid.

   a) 
   __________________________
   __________________________

   b) 
   __________________________

   c) 
   __________________________
   __________________________

   d) 
   __________________________
5.2 Nets of Three-Dimensional Objects

**base of prism**
- a face that shows the shape of the prism

**rectangular prism**
- a prism with bases that are congruent rectangles

**right prism**
- a prism with sides that are perpendicular (⊥) to the bases

**net**
- a 2-dimensional shape that, when folded, creates a 3-D object

---

**Working Example 1: Draw a Net for a Three-Dimensional Object**

Draw a net for the umbrella stand.

**Solution**

Think, “What would the umbrella stand look like if you could cut it open and flatten it?”

The net has 1 __________________________ and 1 rectangle.

The width of the rectangle is equal to the distance around the circle, which is called the ____________________________.

---

**Show You Know**

Draw a net for an unopened soup can.
Working Example 2: Build a Three-Dimensional Object From a Given Net

**Triangular Prism**
- a prism with 2 triangular bases
- each base is the same size and shape
- the sides are rectangles

Can this net be folded to form a tent?

Solution

Trace the net on a sheet of paper.
Cut along the outside edges.
Fold along the inside edges.
Tape the edges together to build a **triangular prism**.

---

**Show You Know**

Build a 3-D object from this net.

![Net Diagram]

What object does it make? _____________________
Communicate the Ideas

1. Both of these nets have 6 faces.

Net A

Net B

Will both nets form a cube?

Explain your answer.

Draw the nets on grid paper. Cut them out. Try to make each 1 into a cube.

Check Your Understanding

Practise

2. Sketch a net for each object.

a) hockey puck

b) chocolate bar
3. Draw the net for each object.
   Label the measurements on the net.

   ![Net for a cylinder](image1.jpg)

   ![Net for a rectangular prism](image2.jpg)

4. a) Trace this net on grid paper.
    Cut along the outside edges of the net.
    Fold on the dotted lines to form a 3-D object.

   ![Trace net and fold](image3.jpg)

   b) What is this object called?

5. Match each solid with its net.
   Write your answers on the blanks.
   Some solids are used more than once.

   ![Rectangular prism net](image4.jpg)
   ![Cylinder net](image5.jpg)
   ![Triangular prism net](image6.jpg)

   ![Matched nets](image7.jpg)
6. A box measures $6 \text{ cm} \times 1 \text{ cm} \times 2 \text{ cm}$.
   Draw a net for the box on the grid.

7. You are designing a cookie jar.
   Draw a net for your cookie jar.
   Include all the measurements.

8. Many possible nets can make a cube. Here is 1 possible net.

   Draw 2 other possible nets.

   Net 1

   Net 2
MATH LINK

a) Draw two 3-D sketches of buildings for your miniature community:
   • a prism-shaped building
   • a cylinder-shaped building

Name of building: ____________________________  Name of building: ____________________________

b) Draw nets of the 2 buildings. Label all the measurements on the nets.
5.3 Warm Up

1. Draw each rectangle.
   a) length 3 cm, width 2.5 cm  
   b) length 43 mm, width 17 mm

2. Find the area of each rectangle.
   a) 
      \[ A = l \times w \]
      \[ = 9.1 \times 8 \]
      \[ = \underline{9.1 \times 8} \] cm²
   b) 
      \[ A = l \times w \]
      \[ = 3.4 \times 1.1 \]
      \[ = \underline{3.4 \times 1.1} \] cm²

3. Find the area of each triangle.
   a) 
      \[ A = \frac{b \times h}{2} \quad \leftarrow \text{Formula} \]
      \[ = \frac{10 \times 14}{2} \quad \leftarrow \text{Substitute} \]
      \[ = \underline{10 \times 14} \div 2 \]
      \[ = \underline{10 \times 14} \div 2 \]
      \[ = \underline{10 \times 14} \text{ m}² \quad \leftarrow \text{Answer} \]
   b) 
      \[ A = \frac{b \times h}{2} \quad \leftarrow \text{Formula} \]
      \[ = \frac{6 \times 2.2}{2} \quad \leftarrow \text{Substitute} \]
      \[ = \underline{6 \times 2.2} \div 2 \]
      \[ = \underline{6 \times 2.2} \div 2 \]
      \[ = \underline{6 \times 2.2} \text{ cm}² \quad \leftarrow \text{Answer} \]

4. Find the answer.
   a) \( 5 \times 7 = \underline{35} \)  
   b) \( 9 \times 4 = \underline{36} \)
   c) \( 24 \div 6 = \underline{4} \)  
   d) \( 30 \div 10 = \underline{3} \)
   e) \( 24 \div 2 = \underline{12} \)  
   f) \( 40 \div 2 = \underline{20} \)
### 5.3 Surface Area of a Prism

**surface area**
- the number of square units needed to cover all the faces of a 3-D object
- the sum of the areas of all the faces of an object
- measured in square units (cm², m²)

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

a) Draw the net of this right rectangular prism.

![Diagram of right rectangular prism]

**Solution**

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

**Solution**

The right rectangular prism has 6 faces. There are 3 different sizes of faces.

- **Front or back**
  \[ A = l \times w = 10 \times 6 = 60 \text{ cm}^2 \]

- **Top or bottom**
  \[ A = l \times w = 10 \times 4 = 40 \text{ cm}^2 \]

- **Ends**
  \[ A = l \times w = 6 \times 4 = 24 \text{ cm}^2 \]

Area of both sides:

- **Front and back**
  \[ = 60 \times 2 = 120 \text{ cm}^2 \]

- **Top and bottom**
  \[ = 40 \times 2 = 80 \text{ cm}^2 \]

- **Ends**
  \[ = 24 \times 2 = 48 \text{ cm}^2 \]

Surface Area = (area of front and back) + (area of top and bottom) + (area of ends)

\[ = 120 + 80 + 48 = 248 \text{ cm}^2 \]
What is the surface area of the right rectangular prism?

- **Front or back**: \[ A = 16 \times 3 = __ \times __ = __ \]
- **Top or bottom**: \[ A = 8 \times 3 = __ \times __ = __ \]
- **Ends**: \[ A = 8 \times 16 = __ \times __ = __ \]

**Surface Area** = (area of front and back) + (area of top and bottom) + (area of ends)

\[ = __ + __ + __ = __ \text{ cm}^2 \]

The surface area of the right rectangular prism is ________ cm\(^2\).
Working Example 2: Calculate the Surface Area of a Right Triangular Prism

a) Draw the net of this right triangular prism.

Solution

\[ A = l \times w \]
\[ = 9 \times \text{__________} \]
\[ = \text{__________} \text{ m}^2 \]

b) What is the surface area?

Solution

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

\[ A = (b \times h) \div 2 \]
\[ = (3 \times 2.6) \div 2 \]
\[ = \text{__________} \div 2 \]
\[ = \text{__________} \text{ m}^2 \]

The right triangular prism has 5 faces.

Surface Area = (3 \times area of rectangle) + (2 \times area of triangle)
\[ = (3 \times 27) + (2 \times 3.9) \]
\[ = \text{__________} + \text{__________} \]
\[ = \text{__________} \text{ m}^2 \]

The surface area of the right triangular prism is \text{__________} \text{ m}^2.
Find the surface area of the right triangular prism.

How many different-sized rectangles are there? ______

**small rectangle**

\[ A = l \times w \]

\[ = \text{______ cm} \]

\[ = \text{______ cm}^2 \]

**large rectangle**

\[ A = l \times w \]

\[ = \text{______ cm} \]

\[ = \text{______ cm}^2 \]

How many triangles of the same size are there? ______

\[ A = (b \times h) \div 2 \]

\[ = \left( \frac{\text{______ cm}}{2} \right) \]

\[ = \text{______ cm}^2 \]

Surface Area = (2 × area of small rectangles) + (area of large rectangle) + (2 × area of triangle)

\[ = (2 \times \text{______ cm}^2) + \text{______ cm}^2 + (2 \times \text{______ cm}^2) \]

\[ = \text{______ cm}^2 + \text{______ cm}^2 + (\text{______ cm}^2) \]

The surface area of the right triangular prism is ______ cm².
1. Write the steps that you could use to find the surface area of a prism.

   ________________________________

   ________________________________

   ________________________________

2. Find the surface area of the rectangular prism to the nearest tenth of a square centimetre (1 decimal place).

   \[ A = l \times w \]

   \[ = \text{__________} \times \text{__________} \]

   \[ = \text{__________} \]

   Area of front and back:

   \[ A = \text{__________} \times 2 \]

   \[ = \text{__________} \]

   Surface Area = (area of front and back) + (area of top and bottom) + (area of ends)

   \[ = \text{__________} + \text{__________} + \text{__________} \]

   \[ = \text{__________} \text{ cm}^2 \]

   The surface area of the right rectangular prism is ________ cm\(^2\).
3. Find the surface area of this ramp in the shape of a right triangular prism.

\[ A = l \times w \]

\[ = \text{________} \times \text{________} \]

\[ = \text{________}_m^2 \]

\[ A = (b \times h) \div 2 \]

\[ = (\text{________} \times \text{________}) \div 2 \]

\[ = \text{________}_\div 2 \]

\[ = \text{________}_m^2 \]

Surface Area = (area of 3 rectangles) + (2 \times area of triangle)

\[ = (\text{________} + \text{________} + \text{________}) + (2 \times \text{________}) \]

\[ = \text{________} + \text{________} \]

\[ = \text{________}_m^2 \]

The surface area of the ramp is \text{________}_m^2.
4. Sometimes cheese is packaged in a triangular box. How much cardboard would you need to cover this piece of cheese?

The tick marks show that the sides are equal.

\[ A = l \times w \]

\[ = \frac{3 \text{ cm} \times 5.7 \text{ cm}}{2} \]

\[ = \frac{17.1 \text{ cm}^2}{2} \]

\[ = 8.55 \text{ cm}^2 \]

\[ A = (b \times h) \div 2 \]

\[ = \frac{(3 \text{ cm} \times \text{ cm})}{2} \]

\[ = \frac{3 \text{ cm}}{2} \]

\[ = 1.5 \text{ cm}^2 \]

Surface Area = (2 × area of side rectangle) + (area of end rectangle) + (2 × area of triangle)

\[ = (2 \times 8.55 \text{ cm}^2) + (1.5 \text{ cm}^2) + (2 \times 1.5 \text{ cm}^2) \]

\[ = 17.1 \text{ cm}^2 + 1.5 \text{ cm}^2 + 3 \text{ cm}^2 \]

\[ = 21.6 \text{ cm}^2 \]

Sentence: __________
5. The area of each face of a rectangular prism is shown. What is the surface area of the prism?

```
front: 20 mm^2
end: 12 mm^2
top: 15 mm^2
```

Surface Area = (area of front and back) + (area of top and bottom) + (area of ends)

Sentence: ____________________________________________________________________________

6. Paco builds a glass greenhouse.

a) How many faces does the greenhouse have?

   The greenhouse has ___________ triangular faces and ___________ rectangular faces.

b) Draw the faces and label the measurements.

c) Find the area of each face.

d) How much glass does Paco need to buy?

Sentence: ____________________________________________________________________________
Look at the rectangular prism-shaped building you sketched in the Math Link on page 244. How much material do you need to cover the outside walls and the roof?

a) Draw and label the shapes of the front and back walls.

b) Area of front and back walls

c) Draw and label the shapes of the side walls.

d) Area of side walls

e) Draw and label the shape of the roof.

f) Area of roof

g) What is the total area of the walls and roof of the building?

Sentence: ______________________________________________________________________________________
5.4 Warm Up

1. Calculate the diameter or radius.
   
   a) ![Image of a button with 2.6 mm diameter]
   
   \[ d = 2 \times r \]
   
   \[ = 2 \times \underline{2.6} \]
   
   \[ = \underline{2.6} \text{ cm} \]
   
   b) ![Image of a coin with 28 mm diameter]
   
   \[ r = \frac{d}{2} \]
   
   \[ = \frac{28}{2} \]
   
   \[ = \underline{14} \]

2. Estimate and calculate the circumference.

   \[ C = \pi \times d \]
   
   \[ \approx 3 \times 2.2 \]
   
   \[ \approx \underline{6.6} \text{ cm} \]

3. Estimate and calculate the area.

   Round your answer to 1 decimal place.

   \[ r \approx \underline{6.2} \]
   
   \[ A = \pi \times r^2 \]
   
   \[ \approx 3 \times 6.2^2 \]
   
   \[ \approx \underline{119.8} \text{ cm}^2 \]

4. Round each number.

   a) 3.165 (tenth) \( \approx \underline{3.2} \)
   
   b) 273.185 (hundredth) \( \approx \underline{273.2} \)
5.4 Surface Area of a Cylinder

Cylinder
- a 3-D object with 2 parallel and congruent circular bases

Congruent means the exact same size.

Working Example 1: Determine the Surface Area of a Right Cylinder

a) Estimate the surface area of the can.

Solution

Surface area of can = area of 2 circles + area of 1 rectangle

To estimate, use approximate values:

\[ d \approx 8, \; so \; r = \frac{d}{2} \]

\[ \approx \]

\[ \pi \approx 3 \]

Area of circle = \( \pi \times r^2 \)

\[ \approx 3 \times \] \( r \) \( \) \( r \) \( \)

\[ \approx 3 \times \] \( r \) \( \) \( l \) \( \)

\[ \approx \]

\[ \]

There are 2 circles: \( 2 \times 48 = \]

Estimated surface area \( \approx \) area of 2 circles + area of 1 rectangle

\[ \approx \]

\[ \]

The estimated surface area is \( \) cm\(^2\).
b) What is the actual surface area of the can?  
Round your answer to the nearest hundredth of a square centimetre (2 decimal places).

**Solution**

*Method 1: Use a Net*

**Step 1:** Draw the net and label the measurements.

**Step 2:** Find the radius.
- diameter $= 7.6$ cm
- radius $= 7.6 \div 2$

**Step 3:** Find the area of 1 circle.

$$A = \pi \times r^2$$

$$= 3.14 \times 3.8^2$$

$$= 3.14 \times 3.8 \times 3.8$$

**Step 4:** Find the area of 2 circles.

$$2 \times 45.3416 = \boxed{\text{ }}$$

**Step 5:** Find the area of the rectangle using the circumference.

$$A = l \times w$$

$$A = (\pi \times d) \times w$$

$$A \approx 3.14 \times 7.6 \times 11$$

$$A \approx \boxed{\text{ }}$$

**Step 6:** Total surface area $=$ area of 2 circles + area of 1 rectangle

$$= \boxed{\text{ }} + \boxed{\text{ }}$$

$$= \boxed{\text{ }}$$

The total surface area is approximately $\boxed{\text{ }}$ cm$^2$. 

Round your answer to the nearest hundredth, (2 decimal places).
Method 2: Use a Formula

The formula for the surface area of a cylinder is

\[
S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)
\]

- 2 circles
- circle area
- rectangle area
- length is the circumference of a circle \(\pi \times d\)
- width is the height of the cylinder \(h\)

\[d = 7.6 \text{ cm} \quad r = \frac{7.6}{2} \quad h = 11 \text{ cm} \]
\[= 3.8 \text{ cm}\]

\[S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)\]
\[S.A. = 2 \times (3.14 \times 3.8^2) + (3.14 \times 7.6 \times 11)\]
\[S.A. = 2 \times (3.14 \times 3.8 \times 3.8) + (3.14 \times 7.6 \times 11)\]

\[S.A. = \quad + \quad \]
\[S.A. = \quad + \quad \]
\[S.A. = \quad \]

The surface area of the can is ______ cm\(^2\), to the nearest hundredth (2 decimal places).
Find the surface area of the cylinder to the nearest tenth of a square centimetre (1 decimal place).

\[ d = \underline{\hphantom{9}} \quad r = \underline{\hphantom{9}} \quad h = \underline{\hphantom{9}} \]

Use a net or the formula to find the answer.

Sentence: ________________________________________________________________
Working Example 2: Use the Surface Area of a Cylinder

Find the surface area of the totem pole.
Include the area of the 2 circular bases.
The pole is 2.4 m tall and has a diameter of 0.75 m.
Give your answer to the nearest hundredth of a square metre (2 decimal places).

Solution

Draw a diagram and label the dimensions.

\[ d = \quad r = \frac{d}{2} \quad h = \quad \]

\[ = \frac{\frac{0.75}{2}}{2} \quad = \quad \]

The cylinder has 2 circular bases.
The area of 1 circle \[ = \pi \times r^2 \]

\[ = 3.14 \times \quad \quad = \quad \]

Area of 2 circles \[ = 2 \times 0.4415625 \]

\[ = \quad \]

The side of the cylinder is a rectangle.
Area of rectangle \[ = (\pi \times d) \times h \]

\[ \approx 3.14 \times \quad \quad \quad = \quad \]

\[ A = \quad \]

\[ A = \quad \]

\[ A = \quad \]

S.A. = area of 2 circles + area of 1 rectangle

\[ = \quad + \quad \]

\[ = \quad \]

The total surface area is approximately \[ \quad \] m\(^2\).
Find the surface area of a small cylindrical garbage can without a lid. The height is 28 cm and the diameter is 18 cm. Give your answer to the nearest square centimetre.

Draw a cylinder and label the dimensions:

\[ d = \quad r = \quad h = \quad \]

*Area of circular base:*

Formula →

Substitute →

Solve →

*Area of rectangle:*

Formula →

Substitute →

Solve →

*Total surface area:*

Sentence: ___________________________ ___________________________
1. Jason was asked to find the surface area of a cylinder. He found the area of the circle and the circumference of the circle. Why does he need to know the circumference of the circle?

__________________________________________________________________________
__________________________________________________________________________

2. Draw a net for this cylinder.

3. Estimate the surface area of the cylinder. Then, calculate the surface area to the nearest tenth of a square centimetre (1 decimal place).

**Estimate area of circle:**
\[ A = \pi \times r^2 \]
\[ \approx 3 \times \underline{\text{[value]}}^2 \]
\[ \approx \underline{\text{[value]}} \text{ cm}^2 \]

**Calculate area of circle:**
\[ \text{Area} = \pi \times r^2 \]
\[ = \underline{\text{[value]}} \]

**Estimate area of 2 circles:**
\[ 2 \times \underline{\text{[value]}} = \underline{\text{[value]}} \]

**Estimate area of rectangle:**
\[ A = l \times w \]
\[ A = (\pi \times d) \times w \]
\[ \approx 3 \times \underline{\text{[value]}} \times \underline{\text{[value]}} \]
\[ \approx \underline{\text{[value]}} \]

**Calculate area of rectangle:**
\[ \text{Calculate surface area:} \]
\[ A = \underline{\text{[value]}} + \underline{\text{[value]}} \]
\[ = \underline{\text{[value]}} \]
4. Estimate and calculate the surface area of the cylinder. Round your answer to the nearest tenth of a square centimetre.

Estimate:  

Calculate:  

Sentence: ________________________________________________________________________
                                                                                       
                                                                                       

$r = 10$ cm  
22 cm
5. Use the formula $S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$ to calculate the surface area of each object. Round each answer to the nearest hundredth of a square unit (2 decimal places).

a) 

\[ d = 2.5 \text{ cm} \quad r = \quad h = \]

Formula →  
Substitute →  
Solve →

b) 

\[ d = 5 \text{ cm} \quad r = \quad h = \]

Formula →  
Substitute →  
Solve →

   Using the sum of the area of each face, like in #3 and #4.
   or
   Using a formula, like in #5.
   Give 1 reason for your choice.
7. Kaitlyn and Hakim each bought a tube of candy. Both containers cost the same amount.

\[d = 8 \text{ cm}\] Kaitlyn
\[d = 10 \text{ cm}\] Hakim

\[122 \text{ cm}\]
\[85 \text{ cm}\]

a) How much plastic is needed to make Kaitlyn’s container?  

\[\text{Formula} \rightarrow\]
\[\text{Substitute} \rightarrow\]
\[\text{Solve} \rightarrow\]

Sentence: ________________________________

b) How much plastic is needed to make Hakim’s container?

Sentence: ________________________________

c) Which container is made of more plastic? ________________________________

8. Paper towel is rolled around a cardboard tube. Find the outside surface area of the tube.

\[r = 2 \text{ cm}\]
\[27.5 \text{ cm}\]

Sentence: ________________________________
Look at the cylinder-shaped building that you sketched in the Math Link on page 244. How much material do you need to cover the exterior walls and the roof of the building?

a) If the curved wall of the cylinder is unrolled and flattened, what shape is it?

b) Using the dimensions labelled on the net, calculate the area of the curved wall.

\[ \begin{align*}
  d &= \phantom{0} \\
  h &= \phantom{0} \\
\end{align*} \]

Formula \[ A = (\pi \times d) \times h \]

Substitute \[ \rightarrow \]

Solve \[ \rightarrow \]

c) What shape is the roof?

d) Using the dimensions labelled on the net, calculate the area of the roof.

\[ \begin{align*}
  d &= \phantom{0} \\
  r &= \phantom{0} \\
\end{align*} \]

Formula \[ \rightarrow \]

Substitute \[ \rightarrow \]

Solve \[ \rightarrow \]

e) What is the total area of the walls and roof of the building?

\[ \text{Surface Area} = \text{area of circle} + \text{area of rectangle} \]

Sentence: \[ \____________________________________ \]
Chapter Review

Key Words
Unscramble the letters for each puzzle. Use the clues to help you.

<table>
<thead>
<tr>
<th>Puzzle</th>
<th>Clues</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. E T N</td>
<td>a flat diagram you can fold to make a 3-D object</td>
<td></td>
</tr>
<tr>
<td>2. U S F A R E C E R A A</td>
<td>the sum of the areas of the faces of an object (2 words)</td>
<td></td>
</tr>
<tr>
<td>3. I R H T G R P M I S</td>
<td>a prism with sides perpendicular to its bases (2 words)</td>
<td></td>
</tr>
<tr>
<td>4. E C N I Y D R L</td>
<td>a 3-D object with 2 parallel circular bases</td>
<td></td>
</tr>
<tr>
<td>5. I R A G N R U A L T S I M R P</td>
<td>a 3-D object with 2 parallel triangular bases (2 words)</td>
<td></td>
</tr>
<tr>
<td>6. L E U C A A N R G T R I R M S P</td>
<td>a 3-D object with 2 parallel rectangular bases (2 words)</td>
<td></td>
</tr>
</tbody>
</table>

5.1 Views of Three-Dimensional Objects, pages 230–237

7. Draw and label the top, front, and side views for these objects.

- a) ![Building Diagram]
- b) ![Book Diagram]
8. Draw each 3-D object on the isometric grid.

a) 

b) 

9. The diagram shows the top, front, and side views of a filing cabinet.

Turn the cabinet 90° clockwise.
Draw the top, front, and side views after the turn.
5.2 Nets of Three-Dimensional Objects, pages 239–244

10. Name the object formed by each net.

a) 

b) 

c) 

d) 

11. Draw the net for each object.
12. Calculate the surface area of the rectangular prism. Draw and label the dimensions for each view.

<table>
<thead>
<tr>
<th>top or bottom</th>
<th>front or back</th>
<th>ends</th>
</tr>
</thead>
</table>

Find the area of each view:

- Area of top and bottom: \(2 \times \text{________} = \text{________} \)
- Area of front and back: \(2 \times \text{________} = \text{________} \)
- Area of 2 ends: \(2 \times \text{________} = \text{________} \)

Surface Area = \((\text{area of top and bottom}) + (\text{area of front and back}) + (\text{area of ends})\)

\[= \text{________} + \text{________} + \text{________} \]

13. Find the surface area of the triangular prism.

Label the dimensions for each view.

Triangle (2)

\[\text{Area of triangle:} \quad \text{Area of small rectangle:} \quad \text{Area of large rectangle:} \]

\[S.A. = (2 \times \text{area of triangle}) + (2 \times \text{area of small rectangle}) + (\text{area of large rectangle})\]

\[= (2 \times \text{________}) + (2 \times \text{________}) + \text{________} \]

\[= \text{________} + \text{________} + \text{________} \]

\[= \text{________} \]
5.4 Surface Area of a Cylinder, pages 256–266

14. Find the surface area of the cylinder.

\[ r = \quad d = \quad h = \]

Formula →

Substitute →

Solve →

15. The candle on Kay’s table has a diameter of 3.4 cm and is 7 cm tall. Calculate the surface area.

Sentence: ___________________________________________________________________
5 Practice Test

For #1 to #5, circle the best answer.

1. The shape of the top view of this container shows a
   A  circle  B  square
   C  triangle  D  rectangle

2. One face on a cube has an area of 50 cm$^2$.
   What is the surface area of the cube?
   A  350 cm$^2$  B  300 cm$^2$
   C  200 cm$^2$  D  150 cm$^2$

3. What 3-D object has a net like this one?
   A  cube  B  cylinder
   C  triangular prism  D  rectangular prism

4. What is the surface area of this box?
   A  550 mm$^2$  B  900 mm$^2$
   C  1100 mm$^2$  D  1800 mm$^2$

5. What is the surface area of a cylinder that is 30 cm long
   and has a radius of 4 cm?
   A  427.04 cm$^2$  B  477.28 cm$^2$
   C  803.84 cm$^2$  D  854.08 cm$^2$

Short Answer

6. Label the top, front, and side views.

   [Diagram of three views of a container]
7. An object may have more than 1 net. Draw 2 different nets for this cube.

Net 1

Net 2

8. A DVD case is 14 cm long, 12 cm wide, and 1 cm thick. Calculate the surface area to the nearest tenth (1 decimal place).

Draw and label the dimensions for each view.

top  front or back  sides

Calculate the area of each view.

Sentence: _____________________________
9. Find the surface area of the cylinder.
   Use the formula $S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$

   Formula $\rightarrow$ $S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h)$

   Substitute $\rightarrow$ $S.A. = $ ____________________________

   Solve $\rightarrow$

---

**WRAP IT UP!**

Create your miniature community!
Work in a group to draw an aerial view for your community.

a) In the table below, list
   - the names of the students in your group
   - the names of the 2 buildings that each student sketched in the Math Link on page 244.

<table>
<thead>
<tr>
<th>Student</th>
<th>Building 1</th>
<th>Building 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>


b) List the buildings that a community needs.

Police station, ____________________________________________________________

c) What buildings from part b) are missing from the table in part a)?

________________________________________________________________________

d) Each student must choose a building from the list in part b).
   • make a 3-D sketch
   • draw and label the net, including dimensions
   • calculate the surface area of the walls and roof

Surface Area:


e) Draw the aerial view of your community with your group on a separate sheet of paper. Write a description.
Check off the list as you complete each part:

☐ design all the required buildings

☐ each student has done
   • a 3-D sketch, a net, the surface area calculations for 1 new building (check each other’s work)

☐ streets to travel through the community

☐ environmental areas such as water sources and parks

☐ a written description of the community
Key Word Builder

Use the clues to write the key words in the crossword puzzle.

Across
3. ___________ 6. ___________

9. The line segment where 2 faces meet.

Down
1. The number of square units needed to cover a 3-D object.
2. ___________
4. The point where 3 or more edges meet.
5. ___________
7. ___________
8. The flat or curved surface of a prism.

Name: ____________________ Date: ____________
Math Games

Let’s Face It!

Play Let’s Face It! with a partner or in a small group.

Rules:
• Remove the jacks, queens, kings, and jokers from the deck of cards.
• The aces equal 1.
• Take turns dealing the cards. Choose someone to deal first.
• Shuffle the cards and deal 3 cards, face up, to each player. The values of the cards are the dimensions of a rectangular prism.
• Calculate the surface area of your rectangular prism using pencil and paper.
• If you calculate your surface area correctly, you get 1 point (check each other’s work).
• The player with the greatest surface area scores 1 extra point for that round.
• If there is a tie, each of the tied players scores 1 point.
• The first player to reach 10 points wins the game.
• If there is a tie, continue playing until 1 person is ahead. If a player makes a mistake calculating the surface area and you catch it, you get 1 extra point!

Play a different version using these rules:
• Deal 2 cards to each player.
• Use the cards to describe the size of a cylinder. The first card gives the radius of each circle. The second card gives the height of the cylinder.
• Use a calculator to find the surface area of your cylinder. Use the formula \( S.A. = 2 \times (\pi \times r^2) + (\pi \times d \times h) \).
• Award points and decide the winner the same way as before.

Materials
• deck of playing cards
• calculator per student

My cards are a 5 of clubs, a 3 of hearts, and an 8 of spades. My rectangular prism has edges of 5 cm, 3 cm, and 8 cm.

My cards are a 4 of clubs and a 6 of clubs. The radius of each circle is 4 cm. The height of the cylinder is 6 cm.
Challenge in Real Life

Design a Bedroom

You be the interior designer.
Design your dream bedroom!
Draw a design for a bedroom that is 4 m wide, 5 m long, and 2.5 m high.
Use a sheet of grid paper.

1. a) You need to place at least 3 objects in the room. If your bed is 1, what are 2 others?

   ____________________________

   b) Draw the top view of the room on your grid paper.

   c) Use the chart to draw different views of your 3 objects.

<table>
<thead>
<tr>
<th>Object</th>
<th>Top, Front, and Side Views</th>
<th>3-D Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Materials

- grid paper
2. You need to paint the walls and ceiling of your room.

a) Draw diagrams of the ceiling and walls. Label the dimensions.

   ceiling side walls end walls

b) Find the total surface area of the walls and ceiling.

   Area of ceiling Area of side walls Area of end walls

   \[ \text{Total surface area:} \]

   \[
   \frac{\text{total surface area}}{10} = \frac{10}{10}
   \]

   \[= \text{___________} \]

   Sentence:___________________________

   You cannot buy part of a can.
Answers

Get Ready, pages 226–228

1.

<table>
<thead>
<tr>
<th>Object</th>
<th>Faces</th>
<th>Edges</th>
<th>Vertices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular prism</td>
<td>6</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Triangular prism</td>
<td>5</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Cube</td>
<td>6</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

2. a) 18.8 cm  b) 12.6 cm
3. a) 12.6 cm²  b) 78.5 cm²
4. a) 27 cm²  b) 55 cm²

Math Link

1. Answers may vary. Example:

<table>
<thead>
<tr>
<th>Type of Building</th>
<th>Where the Building Is Located</th>
<th>Shapes of Its Faces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Church</td>
<td>near houses</td>
<td>square, rectangle, triangle</td>
</tr>
<tr>
<td>School</td>
<td>near houses</td>
<td>square, rectangle</td>
</tr>
<tr>
<td>Hospital</td>
<td>near main roads, or highway</td>
<td>square, rectangle</td>
</tr>
<tr>
<td>Grocery store</td>
<td>main street</td>
<td>square, rectangle</td>
</tr>
</tbody>
</table>

2. Answers may vary. Example: streets, houses, fire hydrants, sewers, parks
3. Answers will vary. Example:

5.1 Warm Up, page 229

1. a) 2 cm  2 cm  b) 4 cm  3 cm
2. a)  b)  
3. a)  top  2 cm  2 cm  |  front  2 cm  2 cm  |  side  2 cm  2 cm  
   b)  top  2 cm  4 cm  |  front  3 cm  4 cm  |  side  3 cm  2 cm  
4. Part a) shows a 90° clockwise rotation.

5.1 Views of Three-Dimensional Objects, pages 230–237

Working Example 1: Show You Know

Working Example 2: Show You Know

Working Example 3: Show You Know

Communicate the Ideas

1. No. Answers may vary. Example: The top is labelled incorrectly as the front.

Practise

2. a)  b)  c)  
3. a) D  b) A  c) B
4. a)  b)  
5.  top  front  side

Apply

6. Answers will vary. Example:
Object 1: Desk

Object 2: Pencil case

7. a)  b)  c)  

Math Link

Answers will vary. Example: Church

a)  b)  

Math Link
5.2 Warm Up, page 238
1. a) top    front    side  b) top    front    side

2. a) \( l = 2 \text{ cm}, h = 2 \text{ cm}, w = 2 \text{ cm} \)  b) \( l = 3 \text{ cm}, h = 1.5 \text{ cm}, w = 4 \text{ cm} \)
3. a) rectangle, square  b) square  c) rectangle, circle  d) triangle, rectangle

5.2 Nets of Three-Dimensional Objects, pages 239–244

Working Example 1: Show You Know

Working Example 2: Show You Know
rectangle, square

Communicate the Ideas
1. No. It is impossible to fold B into a cube.

Practise
2. a)  

3. a)  

4. b) right triangular prism

5. cylinder; cylinder; triangular prism; rectangular prism; rectangular prism

Apply
6.  

7. Answers will vary. Example:

8. Answers may vary. Example:

Math Link
Answers will vary. Example:

5.3 Warm Up, page 245
1. a)  

2. a) 72.8 cm\(^2\)  b) 3.74 m\(^2\)
3. a) 70 cm\(^2\)  b) 6.6 cm\(^2\)
4. a) 35  b) 36  c) 4  d) 3  e) 12  f) 20

5.3 Surface Area of a Prism, pages 246–254

Working Example 1: Show You Know
400 cm\(^2\)

Working Example 2: Show You Know
96.8 cm\(^2\)

Communicate the Ideas
1. Answers may vary. Example: 1. Find any shapes that are the same size. 2. Calculate the surface area of each shape. 3. Multiply the surface area by the number of same-sized shapes. 4. Add all the surface areas together.

Practise
2. 668 cm\(^2\)
3. 20.4 m\(^2\)

Apply
4. 90.2 cm\(^2\)
5. 94 mm\(^2\)
6. a) 2, 3  
6. a) 2, 3  b)  

7. Answers may vary. Example:

8. Answers may vary. Example:

Math Link
Answers will vary. Examples:

a) front and back  b) 256 m\(^2\)  c) sides  

d) 128 m\(^2\)  e) roof  f) 128 m\(^2\)  g) 512 m\(^2\)
5.4 Warm Up, page 255
1. a) 5.2 cm  b) 14 mm
2. 6 cm; 6.908 cm
3. 108 cm²; 120.7 cm²
4. a) 3.2  b) 273.19

5.4 Surface Area of a Cylinder, pages 256–266
Working Example 1: Show You Know
1681.5 cm²

Working Example 2: Show You Know
1837 cm²

Communicate the Ideas
1. Answers may vary. Example: The circumference gives the length of the rectangle.

Practise
2. 6 cm; 6.908 cm
3. a) 726 cm², 736.3 cm²  b) 1920 cm², 2009.6 cm²
4. a) 88.31 cm²  b) 149.15 cm²
5. Answers may vary. Example: I like finding the sum of the area for each face, because I make fewer mistakes working step by step.

Apply
7. a) 3165.12 cm²  b) 2826.00 cm²  c) Kaitlyn’s container needs more plastic.
8. 345.4 cm²

Math Link
a) rectangle  b) Answers will vary. Example: 847.8 m²
c) circle  d) 254.34 m²  e) 1102.14 m²

Chapter Review, pages 267–271
1. net  2. surface area  3. right prism  4. cylinder  5. triangular prism
6. rectangular prism
7. a)  8. a)

8. a)  b)

9. top front side  

10. a) cylinder  b) triangular prism  c) rectangular prism  d) rectangular prism

11. a) 

12. 3648 mm²
13. 77 cm²
14. 94.2 m²
15. 92.88 cm²

Practice Test, pages 272–274

6. top front side

7. 

8. 388 cm²
9. 505.54 mm²

Wrap It Up!, pages 274–275
a) Answers will vary. Example:

<table>
<thead>
<tr>
<th>Student</th>
<th>Building 1</th>
<th>Building 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brady</td>
<td>school</td>
<td>barn silo</td>
</tr>
<tr>
<td>Jennifer</td>
<td>grocery store</td>
<td>office building</td>
</tr>
<tr>
<td>Taya</td>
<td>library</td>
<td>clothes store</td>
</tr>
</tbody>
</table>

b) Answers will vary. Example: police station, fire station, bank, school, hospital, grocery store, office buildings, clothing stores
c) Answers will vary. Example: hospital, police station, fire station
d) See answers provided in Math Link answers above.

e) 

Key Word Builder, page 276
Across
3. net  6. rectangular prism; 9. edge
Down
1. surface area  2. triangular prism  4. vertex  5. prisms
7. cylinder  8. face