Important Concepts . . .

Preview Review

Mathematics   Grade 6   TEACHER KEY

W2 - Lesson 4: Surface Area and Volume

Important Concepts of Grade 6 Mathematics

Materials Required: A textbook is not needed. This is a stand-alone course.

Mathematics Grade 6
Version 5
Preview/Review W2 - Lesson 4 TEACHER KEY

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Preview/Review Concepts
for
Grade Six Mathematics

TEACHER KEY
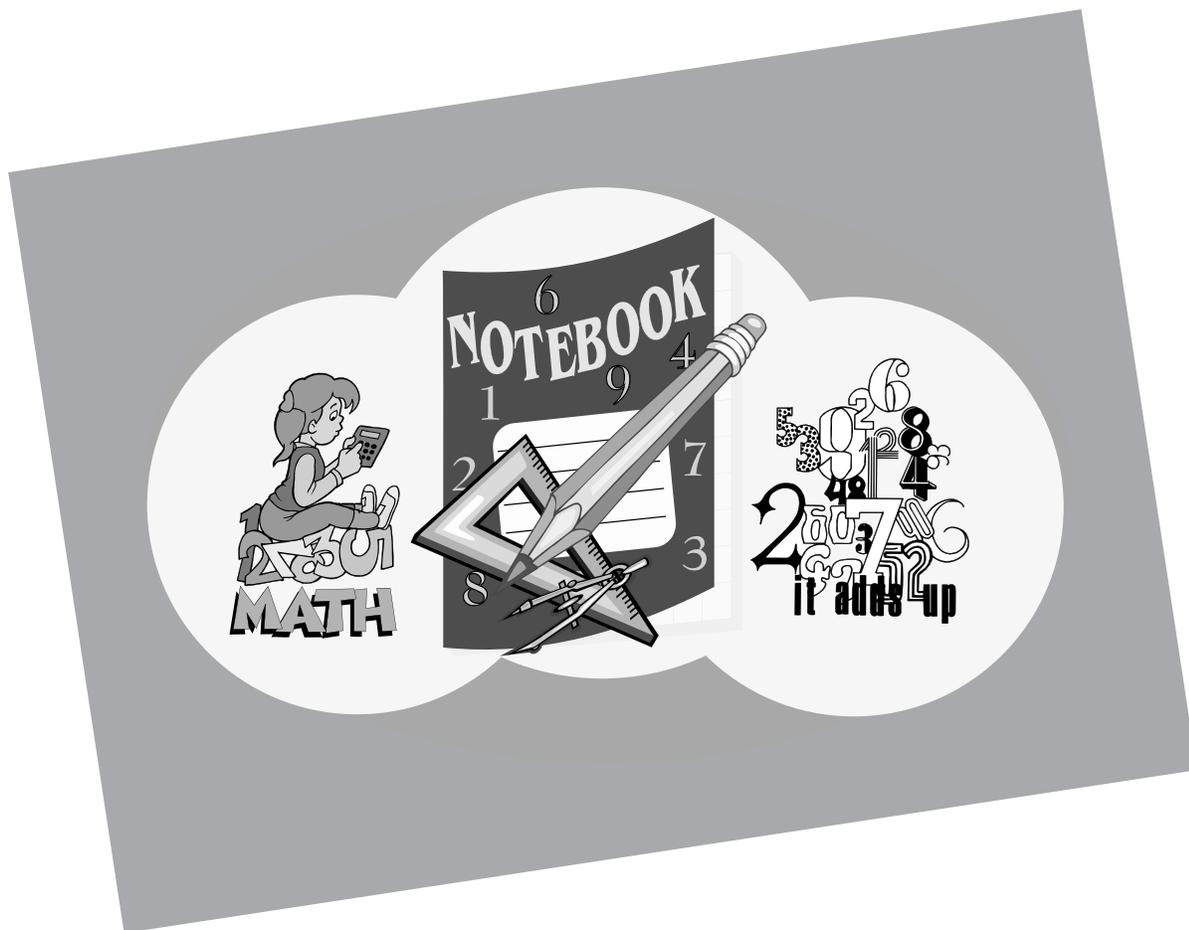
W2 - Lesson 4:
Surface Area and Volume

OBJECTIVES

By the end of this lesson, you should

- understand and calculate volume of figures

- understand and calculate surface area of figures

- solve problems of surface area and volume using metric measurement

GLOSSARY

rectangular prism - a three dimensional figure whose surfaces are all rectangular; the shape of a shoebox

surface area - the total area of the surfaces of a figure

volume - the amount of space taken up by a three-dimensional figure; often similar to capacity

W2 - Lesson 4: Surface Area and Volume

Welcome to W2 - Lesson 4! This lesson is about surface area and volume. You will use your skills in metric measurement to find volumes and total areas. The lesson has three topics:
- Volume
- Surface Area
- Problem Solving

How much paper do you need to wrap the birthday gift you bought for your friend?

Volume

The amount of space taken up by a three-dimensional figure is its **volume**. Three-dimensional means the figure takes up space in three directions: length, width, and height. The units of measurement for volume are cubed units. The most commonly used units are mm³ (cubic millimetres), cm³ (cubic centimetres), and m³ (cubic metres).

The volume of a regular figure is calculated by multiplying length, width, and height.

$$Volume = base \times width \times height$$
$$V = b \times w \times h \quad or \quad V = bwh$$

A **rectangular prism** is a three-dimensional figure whose surfaces are all rectangular in shape. A rectangular prism is shaped like a shoebox with six flat surfaces.

We use the formula to find its volume:

$$V = b \times w \times h$$
$$= 30 \times 10 \times 20$$
$$= 6\ 000 \text{ cm}^3$$
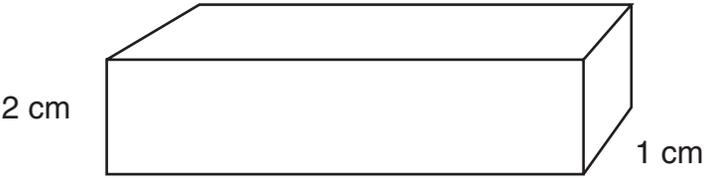

height 20 cm   →

width 10 cm   ←

base 30 cm
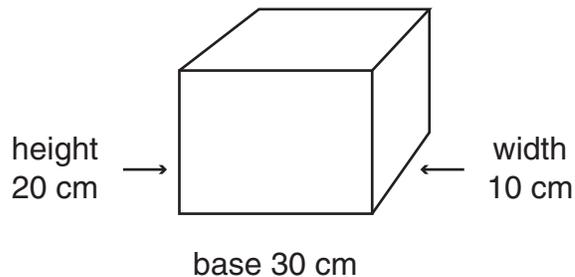
A **cube** is a rectangular prism with all sides equal. Perhaps you could also call it a square prism.

Questions

1. Use the formula $V = b \times w \times h$ to find the volume of the following rectangular prisms. For each question, write the formula, do the calculations, and then write the answer with the correct units for volume.

a.

2 cm

base 5 cm

1 cm
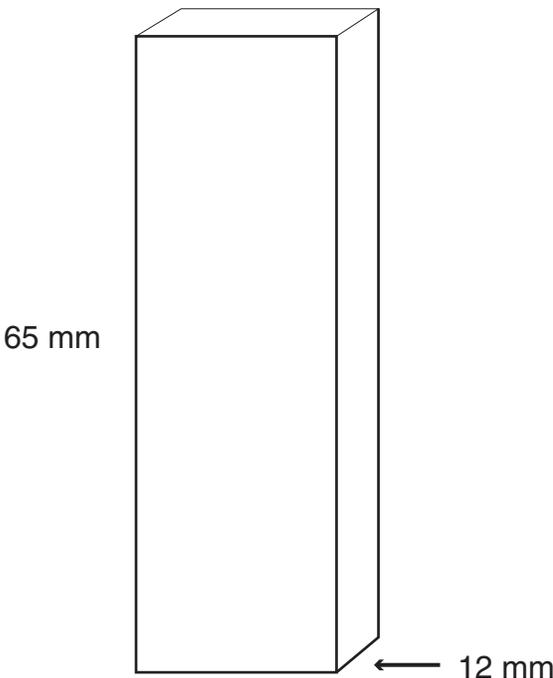
$V = b \times w \times h$
$= 5 \times 2 \times 1$
$= 10\ cm^3$

b.

65 mm

12 mm

base 23 mm

$V = b \times w \times h$
$= 23 \times 65 \times 12$
$= 17\ 940\ mm^3$

c.

14 mm

base 70 mm

6 mm

$V = b \times w \times h$
$= 14 \times 70 \times 6$
$= 5\ 880\ mm^3$

d.
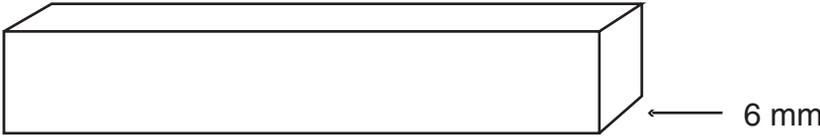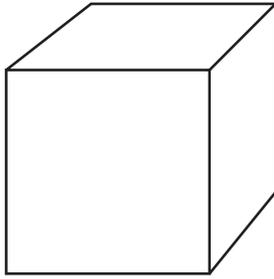
base 11 cm

$$V = b \times w \times h$$
$$= 11 \times 11 \times 11$$
$$= 1\ 331\ cm^3$$

e.

26 m

14 m
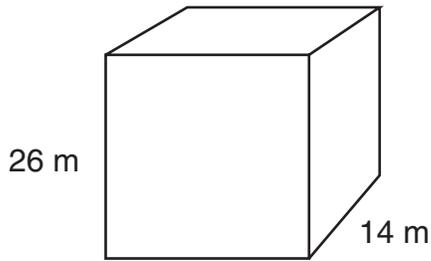
base 44 m

$$V = b \times w \times h$$
$$= 44 \times 26 \times 14$$
$$= 16\ 016\ m^3$$

f.

23 mm

10 mm
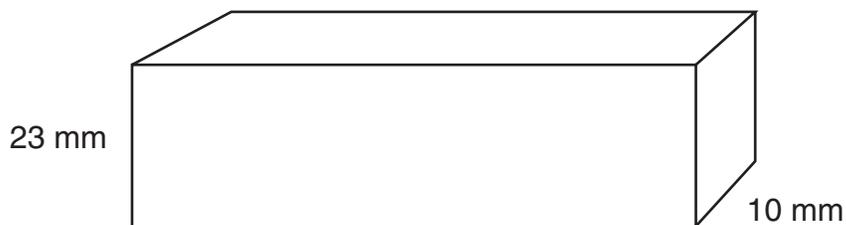
base 82 mm

$$V = b \times w \times h$$
$$= 82 \times 23 \times 10$$
$$= 18\ 860\ mm^3$$

2. Calculate the volume of the regular prisms described in the chart below. Be sure that you write the correct units of measurement in your answer. Use the blank space at the bottom of the page to do your calculations.

Figure	Base	Width	Height	Volume
A	25 cm	30 cm	42 cm	*31 500 cm³*
B	14 m	11 m	24 m	*3 696 m³*
C	65 mm	70 mm	82 mm	*373 100 mm³*
D	35 cm	25 cm	28 cm	*24 500 cm³*
E	48 m	12 m	34 m	*19 584 m³*

Surface Area

The **surface area** of a rectangular prism is the sum of the areas of all six of its faces. Remember that area is calculated in square units.
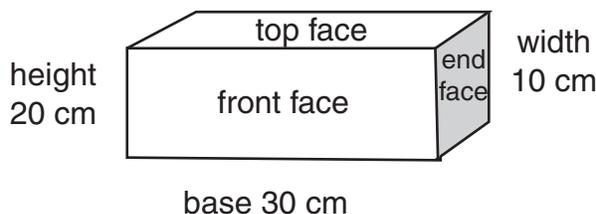
This figure has 6 sides. Notice how the surface area is calculated.

Front face: This is the side you see as a rectangle.

$$A = b \times h$$
$$= 30 \times 20$$
$$= 600 \text{ cm}^2$$

Back face: This side is not visible, but it is the side opposite the front face. It has the same area as the front face (600 cm²).

End: This is shown as the shaded part of the figure.

$$A = b \times h$$
$$= 10 \times 20$$
$$= 200 \text{ cm}^2$$

Other **end:** This is not visible, but it is the side opposite the shaded end. It has the same area as the shaded end (200 cm²).

Top face: This face is shown on the figure.

$$A = b \times h$$
$$= 10 \times 30$$
$$= 300 \text{ cm}^2$$

Bottom face: This face is not visible, but it is the side opposite the top face. It has the same area as the top face (300 cm²).

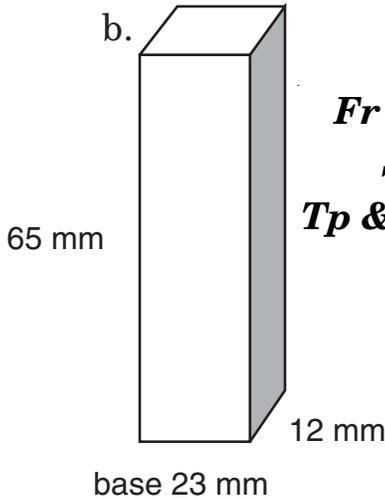Calculate the **surface area** by adding the areas of all sides.
Total area of this rectangular prism is
600 + 600 + 200 + 200 + 300 + 300 = 2 200 cm²

Questions

1. Find the surface area of the following rectangular prisms. The units of measurement for area are square units (mm², cm², or m²).

a.
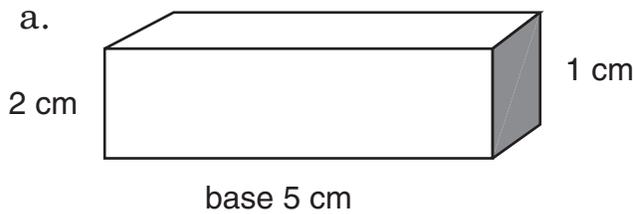
Fr & Bk $= 2(2 \times 5) = $ ***20 cm²***
Sides $= 2(2 \times 1) = $ ***4 cm²***
Tp & Btm $= 2(1 \times 5) = $ ***10 cm²***
                                    34 cm²

2 cm

1 cm

base 5 cm

b.

Fr & Bk $= 2(23 \times 65) = $ ***2 990 mm²***
Sides $= 2(12 \times 65) = $ ***1 560 mm²***
Tp & Btm $= 2(12 \times 23) = $ ***552 mm²***
                                        5 102 mm²

65 mm

12 mm

base 23 mm

c.

base 11 cm

SA $= (11 \times 11)\,6\ sides$
        $= $ ***726 cm²***
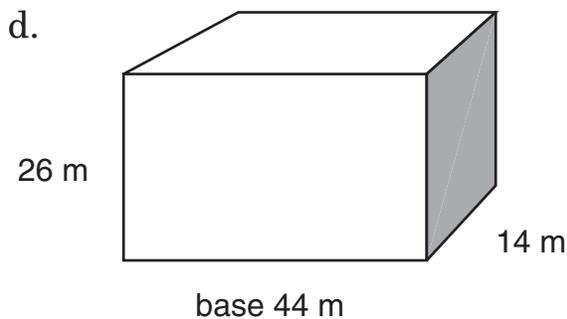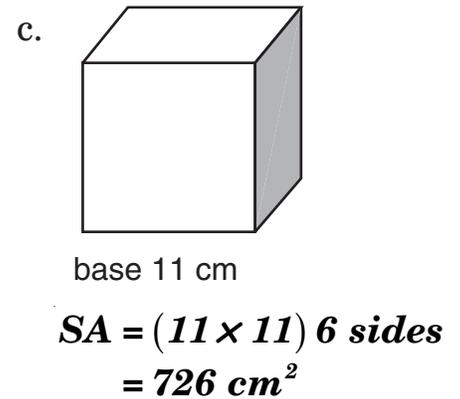
d.

Fr & Bk $= 2(44 \times 26) = $ ***2 288 mm²***
Sides $= 2(14 \times 26) = $ ***728 mm²***
Tp & Btm $= 2(44 \times 14) = $ ***1 232 mm²***
                                        4 248 mm²

26 m

14 m

base 44 m

2. Draw three rectangular prisms according to the measurements. Calculate the surface area for each regular prism. Be sure to write the correct units of measurement in your answer. Label each drawing with the corresponding letter.

Figure	Base	Width	Height	Surface Area
A	25 cm	30 cm	42 cm	
B	14 mm	11 mm	24 mm	
C	48 mm	12 mm	37 mm	

A * Diagram of prism as specified:

$$Fr \ \& \ Bk = 2\,(25 \times 42) = 2\,100 \ cm^2$$
$$Sides = 2\,(42 \times 30) = 2\,520 \ cm^2$$
$$Tp \ \& \ Btm = 2\,(25 \times 30) = \underline{1\,500 \ cm^2}$$
$$6\,120 \ cm^2$$

B * Diagram of prism as specified:

$$Fr \ \& \ Bk = 2\,(14 \times 24) = 672 \ mm^2$$
$$Sides = 2\,(11 \times 24) = 528 \ mm^2$$
$$Tp \ \& \ Btm = 2\,(14 \times 11) = \underline{308 \ mm^2}$$
$$1\,508 \ mm^2$$

C * Diagram of prism as specified:

$$Fr \ \& \ Bk = 2\,(48 \times 34) = 3\,264 \ mm^2$$
$$Sides = 2\,(12 \times 34) = 816 \ mm^2$$
$$Tp \ \& \ Btm = 2\,(48 \times 12) = \underline{1\,152 \ mm^2}$$
$$5\,232 \ mm^2$$

Problem Solving

1. A Grade Six classroom has the shape of a rectangular prism. The floor is 12 m long and 10 m wide. The walls are 2.5 m high. The students want to renovate their classroom. Below are some questions that must be answered for the renovations.
   Draw a diagram of the room and label the dimensions.

   ### *Diagram as specified.*

   2.5 m

   12 m

   10 m
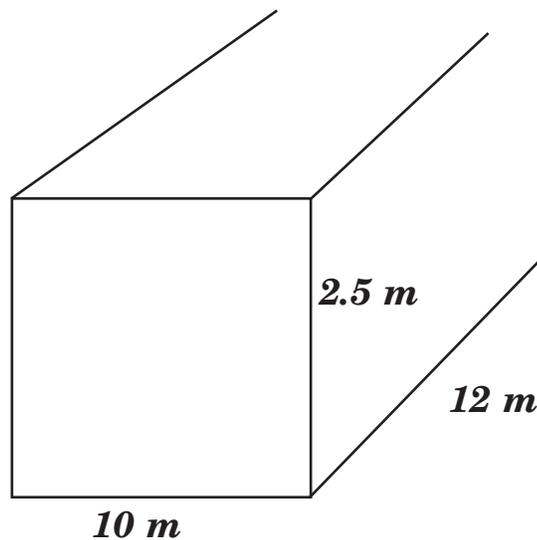
   a. What is the surface area of the floor?

   Floor = 12 × 10 = 120 m²

b. If the cost of new floor tiles (including installation) is $3.75 per square metre, what will be the cost of installing new floor tiles?

120 × 3.75 = $450.00

c. What is the surface area of the four walls? (Calculate this as if there are no windows or doors in this classroom.)

Sides   *= 2 × 2.5 × 10 = 50 m²*

Front & Back = 2 × 2.5 × 12 = 60 m²

                                110 m²

d. If one litre of paint covers an area of 20 m², how many litres of yellow paint are needed to paint the walls? (Round your answer to the nearest litre.) Always show your work!

$$\begin{array}{r} 5.5 \text{ litres} \\ 20\overline{)110} \end{array}$$

6 L of paint are needed.

(Not all the paint will be used, and you can't buy half a can of paint.)

e. If the cost of paint is $7.95 per litre, how much will the paint cost for the classroom? Always show your work and give your final answer in a complete sentence.
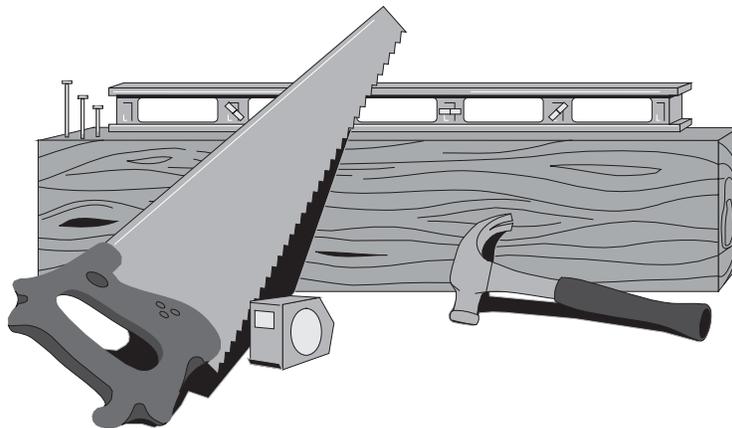
$6 \times \$7.95 = \$47.70$

It will cost $47.70 to paint the entire classroom.

f. The ceiling panels must be replaced. If each new ceiling panel is a rectangle that is 100 cm by 50 cm, how many panels are needed to replace the existing ceiling tiles?

$1\ m \times .5\ m = 0.5\ m^2$

$120\ m^2 \div 0.5\ m^2 = 240$ *ceiling panels.*

Homework Assignment

1. Samuel has a large fish tank. The dimensions of the tank are as follows.

    base = 90 cm, width = 60 cm, height = 50 cm

    a. What volume of water is needed to completely fill the fish tank? Give the answer in litres. (1L = 1 000 cm³)

    $$V = b \times w \times h$$
    $$= 90 \text{ cm} \times 60 \text{ cm} \times 50 \text{ cm}$$
    $$= 270\ 000 cm^3$$
    $$= 270\ L$$

    b. If each tropical fish needs 5000 cm³ of space for healthy living, what is the maximum number of fish that can be put in the fish tank at one time?
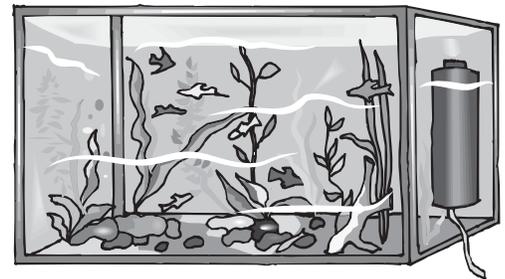
    270 000 cm³ ÷ 5 000 cm³ = 54

    54 fish can live in the tank at one time.

2. Sharon's mother entered a contest and won a new SUV. The fuel tank in the SUV is a rectangular prism. The dimensions of the fuel tank are 96 cm by 50 cm by 15 cm.

a. What is the volume of the fuel tank?

$$V = b \times w \times h$$
$$= 96\ cm \times 50\ cm \times 15\ cm$$
$$= 72\ 000\ cm^3$$

b. 1L = 1 000 cm³. How many litres of fuel are required to fill the tank of the SUV?

$$72\ 000\ cm^3 \div 1\ 000\ cm^3 = 72L$$

c. If gasoline costs 86 cents per litre, how much will a complete fill-up of the fuel tank in the new SUV cost?

$$72\ L \times \$0.86 = \$61.92$$

Self-Evaluation

Ask yourself some important questions. Write your answers in sentences for your teacher.

1. In this lesson, what part of your work was **excellent**?

   _____

   _____

   _____

2. In this lesson, what part of your work **needs improvement**?

   _____

   _____

   _____

3. If you want help for some of the work in this lesson, ask your teacher in this space.

   _____

   _____

   _____