Areas and Volumes – 2D and 3D shapes

Level: Key Stage 3

Dimension: Measures, Shape and Space
Module: Measures in two-dimensional and three-dimensional figures
Unit: Areas and Volumes

Student ability: Low to Average

Content Objectives:

After completing the activity, students will have consolidated their understanding of the ideas of area and volume

Language Objectives:

After completing the activity, students should be able to

- understand the English terms (e.g., *length, breadth, height, side, base, lateral faces, area, total surface area, volume, triangle, square, rectangle, parallelogram, trapezium, cube, cuboid, and prism*);
- describe area and volume properties in simple English, e.g.,
  - *Face A and face B are lateral faces.*
  - *The space occupied by a 3D object is its volume.*
  - *It is a prism and its base is a triangle.*
  - *cm^2 is a unit of area.*
  - *A cube is a cuboid which has equal length, width and height.*
- use the English formulae for finding the area of two-dimensional figures and the volume of three-dimensional figures, e.g., area of a trapezium
  $$= \frac{1}{2} \times (\text{upper base} + \text{lower base}) \times \text{height}$$
- understand the English instructions for completing the mathematical tasks set in the worksheets.

Prerequisite knowledge:

Students should have learned the concepts of area and volume through the medium of Chinese.

Time: 1 lesson (40 minutes)

Procedure:

1. The teacher should go through the list of terms and expressions for areas and volumes with the students, giving a clear model of pronunciation and ensuring that students can pronounce them accurately and therefore remember them better.

2. The teacher should then discuss in English with students what they have learned about the topic in their previous studies when Chinese was used as the medium of instruction. This is intended to make students feel more familiar with the topic and be more confident in learning through English.

3. The teacher should then ask the students to finish Part A of the worksheet to check how well they can recognise the vocabulary on the list.

4. The teacher should then guide the students to solve the word problems in Part B of the worksheet focusing on the comprehension of the English terms and expressions needed to solve the problems.

Explanatory Notes for Teachers:

1. The activity is designed for students who have learnt areas and volumes through the medium of Chinese.   Teachers are therefore not expected to explain the concepts again in detail.   It is reasonable to expect that students will have the pre-requisite knowledge of this topic as they have studied it in Key Stage 2.

2. If necessary, the teacher may use Chinese to do a short review of students' previous learning before introducing the terms in English.

3. Part A revises the vocabulary and helps to check how well students remember.

4. Part B consists of word problems.   These provide a good opportunity for students to gain hands-on experience in expressing their answers in English.

5. The teacher can invite students to put their answers to the word problems on the board, and the class can comment on them and/or compare the steps taken in the different approaches.   This can provide an opportunity for students to participate in classroom discussion /interaction.

6. Marks are not assigned to the questions, but teachers are free to allocate marks based on the suggested answer and students' competence.

7. The summary of content taught in Chinese (Source: textbook "Mathematics In Action"

Book 1B from Longman Press) is set out below:

稜柱
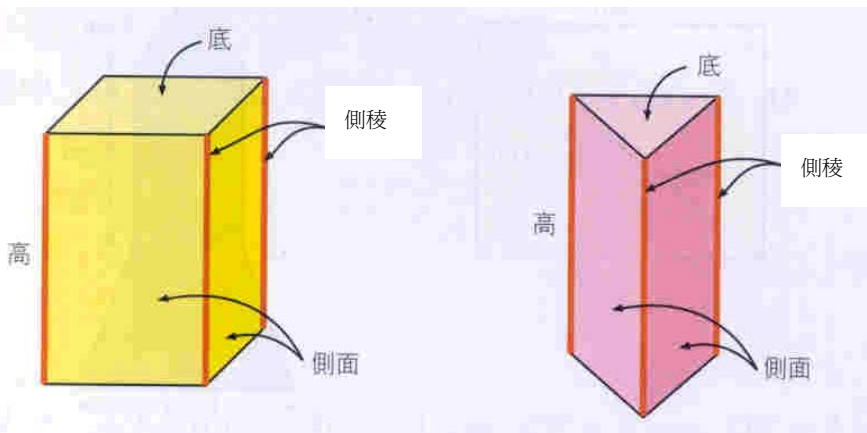
(a) 稜柱的體積 ＝ 底面積×高
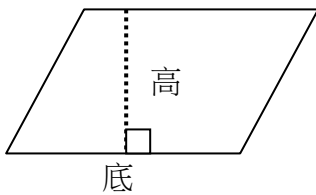(b) 稜柱的所有側面面積 ＝ 底面的周界×高
(c) 稜柱的總表面面積 ＝ 所有側面面積 ＋2×底面積

簡單平面圖形的面積:

1. 正方形的面積 ＝(邊長)^2

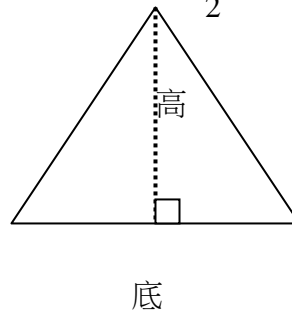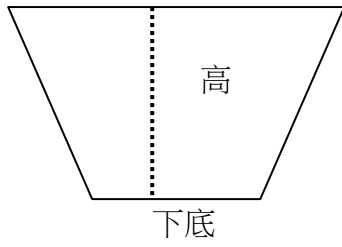

邊長

2. 長方形的面積 ＝ 長×闊

闊

長

3. 平行四邊形的面積 ＝ 底×高

高

底

4. 三角形的面積 ＝ $\frac{1}{2}$×底×高

高

底

5. 梯形的面積 ＝ $\frac{1}{2}$×(上底 ＋ 下底)×高

上底

高

下底

簡單立體圖形的體積:

1. 正方體的體積 $= (邊長)^3$

邊長

2. 長方體的體積 $=$ 長×闊×高

高

長

闊
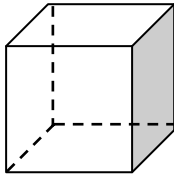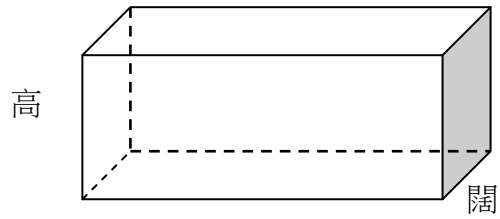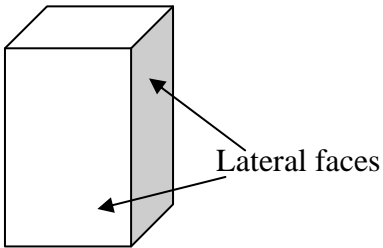
List of terms and expressions for Area (面積) **and Volume** (體積):

|	
Triangle (三角形)	Area $=\dfrac{1}{2}\times$ base $\times$ height ($\dfrac{1}{2}\times$底$\times$高)
Square (正方形)	Area $=$ (length of side)^2 and (邊長)^2
Rectangle (長方形)	Area $=$ length$\times$breadth (長$\times$闊)
Parallelogram (平行四邊形)	Area $=$ base$\times$height (底$\times$高)
Trapezium (梯形)	Area $=\dfrac{1}{2}\times$ (upper base $+$ lower base) $\times$ height 面積 $=\dfrac{1}{2}\times$(上底$+$下底)$\times$高
Cube (正方體)	Volume $=$ (length of side)^3 and (邊長)^3
Cuboid (長方體)	Volume $=$ length$\times$breadth$\times$height 體積 $=$ 長$\times$闊$\times$高
Prism (稜柱)	Volume $=$ height$\times$area of base 體積 $=$ 高$\times$底面積
Lateral face (側面)	 Lateral faces
Total surface area (總表面面積)	

Worksheet for Area & Volume

Name: _____ Class: _____ (   )

A. Use one of the following words to complete sentences 1 to 5 below.

Vocabulary: area   volume   lateral   height   width   base   prism

1. Face A and face B are _____ faces.
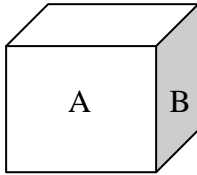
2. The space occupied by a 3D object is its _____.

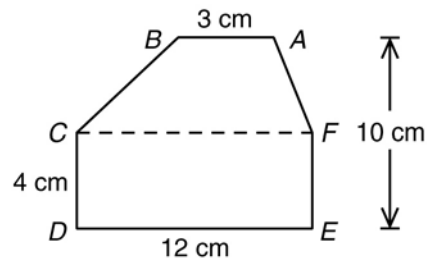3. It is a _____ .   Its _____ is a triangle.
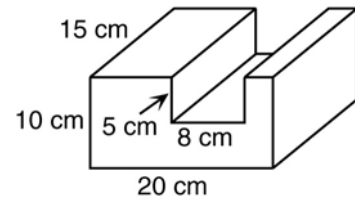

4. cm^2 is a unit of _____.

5. A cube is a cuboid which has equal length, _____ and

   _____.

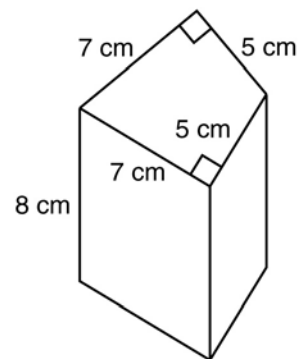B. Calculation: (Show all the steps clearly)

6. *ABCF* is a trapezium and *CDEF* is a rectangle.   Find
   the area of hexagon *ABCDEF*.

7. The figure shows a cuboid with a small cuboid cut away from it Find the volume of the remaining solid.

15 cm

10 cm 5 cm 8 cm

20 cm

8. The figure shows a prism, find
(a) the total area of all its lateral faces,
(b) its total surface area.

7 cm 5 cm

5 cm

7 cm

8 cm

Suggested answers (Area and Volume):

1. lateral

2. volume

3. prism, base

4. area

5. width, height

6. The area of the trapezium *ABCF*:

$$= \frac{1}{2} \times (AB + FC) \times (10 - CD)$$

$$= \frac{1}{2} \times (3 + 12) \times (10 - 4) \, \text{cm}^2$$

$$= 45 \, \text{cm}^2$$

The area of rectangle *CDEF*:

$$= CD \times DE$$

$$= 4 \times 12 \, \text{cm}^2$$

$$= 48 \, \text{cm}^2$$

$\therefore$ The total surface area of *ABCDEF:*

$$= (45 + 48) \, \text{cm}^2$$

$$= \underline{\underline{93 \, \text{cm}^2}}$$

7. The volume the original cuboid

$$= 20 \times 15 \times 10 \, \text{cm}^3$$

$$= 3000 \, \text{cm}^3$$

The volume of the removed cuboid:

$$= 8 \times 15 \times 5 \, \text{cm}^3$$

$$= 600 \, \text{cm}^3$$

$\therefore$ The volume of the remaining solid $= (3000 - 600) \, \text{cm}^3$

$$= \underline{\underline{2400 \, \text{cm}^3}}$$

8a. Total area of all lateral faces of the prism:

= perimeter of base of this quadrilateral $\times$ height

$$= (5 + 5 + 7 + 7) \times 8$$

$$= \underline{\underline{192 \, \text{cm}^2}}$$

8b. The total surface area of the prism

= the total area of all lateral faces + 2 $\times$ base area

$$= \left(192 + 2 \times 2 \times \frac{1}{2} \times 5 \times 7 \right) \text{cm}^2$$

$$= \underline{\underline{262 \, \text{cm}^2}}$$