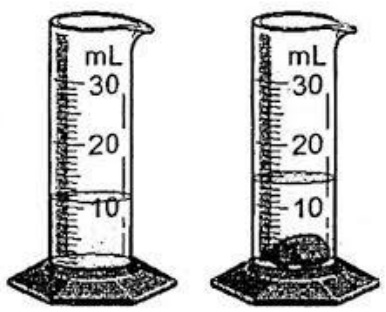
Week 13
Term 2
2022

HAWKER COLLEGE
Engage | Inspire | Achieve

EM1
Measurement

Goals



Goals for this week:

Volume and capacity

- use metric units of volume, their abbreviations, conversions between them, and appropriate choices of units (EMA26)
- understand the relationship between volume and capacity (EMA27)
- estimate volume and capacity of various objects (EMA28)
- calculate the volume of objects, such as cubes and rectangular and triangular prisms (EMA29)

Theoretical Components

Resources:
PDF file - Week 13 Notes and Exercises
YouTube Videos: Linked in the PDF File

Knowledge Checklist

- Volumes in cm^3 of rectangular prisms
- Volume of rectangular prisms and as area of cross section × height
- Application to irregular shapes
- Converting units of volume
- Relation between volume and capacity

Order

1. Read through the notes and examples
2. Work through the exercises
3. Complete the Portfolio Task
4. Complete the reflection at the end of the booklet
5. Come and see your teacher and make sure you are up to date.

Practical Components

There are 4 Exercises in this week's booklet. Read any notes and worked examples before you begin.

Remember to regularly check Google Classroom for messages.

Portfolio Task

Complete the task at the end of the brief and submit your weekly work for checking. 😊

QFO

Quiz/Forum/Other

ESSENTIAL MATHEMATICS 1

WEEK 13 NOTES AND EXERCISES

How are we ever going to use this?

- When we compare the quantities inside different sizes of food containers
- To assess the ingredients in packaged foods
- When we are calculating the amount of soil or mulch we need in our garden.

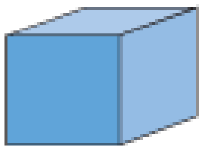
Volume and capacity are properties of three-dimensional objects. Volume is the space that an object occupies (space that is taken up by an object), while capacity describes how much a container can hold.

MEASURING VOLUME

The amount of wheat in a silo, the quantity of sand in a truck and the amount of concrete required for a driveway are applications of **volume**.

Volume measures the space within a three-dimensional object. **Cubic units** are used for volume. The diagram shows a cube with sides of 1 cm. Its volume is 1 cm^3.

Motorbikes are often described by the size of the cylinders in their engine. The cylinders in the engine in a 750 cc bike have a volume of 750 cm^3.



VOLUMES OF RECTANGULAR PRISMS

An objects volume is a measure of the space an object occupies. The formula for the volume of a rectangular prism is:

$$V = L \times D \times H$$

Where L = length, D = depth and H = height.

Example

Mia keeps her gardening tools in a box which is the shape of a rectangular prism.

a) Calculate the volume of the box in:
   (i) cubic centimetres
   (ii) cubic metres.

Solution

The formula for the volume is

$$V = L \times D \times H$$

a) i) If you want the volume in cubic centimetres, make all the measurements in centimetres before you substitute them into the formula.

$$V = 110 \times 45 \times 40 \text{ cm}^3 = 198{,}000 \text{ cm}^3$$

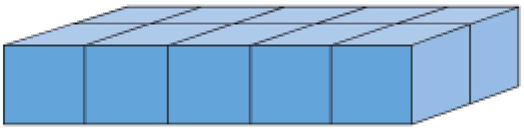
ii) If you want the volume in cubic metres, make all the measurements in metres before you substitute them into the formula.

$$V = 1.1 \times 0.45 \times 0.4 \text{ m}^3 = 0.198 \text{ m}^3$$

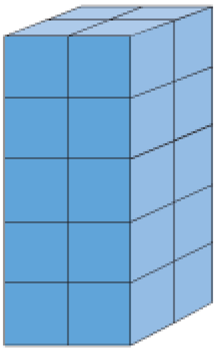
EXERCISE 1

Q1. Determine the volume of each of the following prisms, constructed from 1 cm^3 blocks.

a



b



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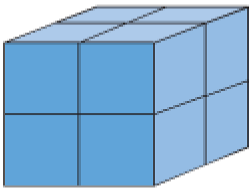
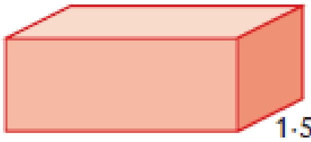
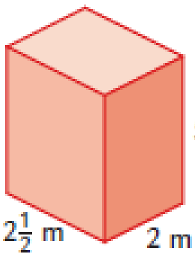


Q2. Calculate the volumes of these rectangular prisms in cubic metres. Show working.

a



b



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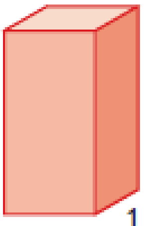
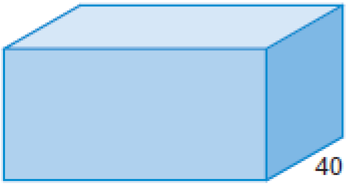


Q3. Calculate the volume of this rectangular prism in cubic centimetres and cubic metres.



VOLUMES OF REGULAR PRISMS

The volume of a prism can be calculated with the formula:

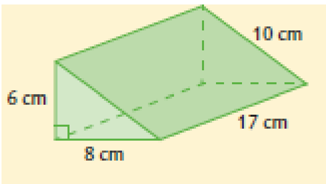
$$V = A \times H$$

where A = area of the cross-section

H = height at right angles to the cross-section.

Example

Calculate the volume of this triangular prism.



Solution

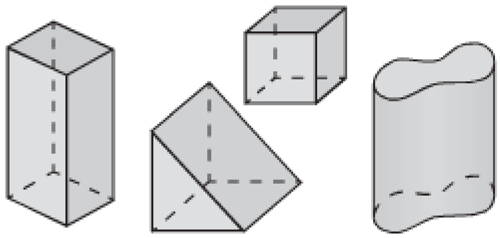
The cross-section of the prism is a triangle.

Area of triangle = $\frac{1}{2}bh$ = 0.5 × 6 × 8 = 24 cm^2

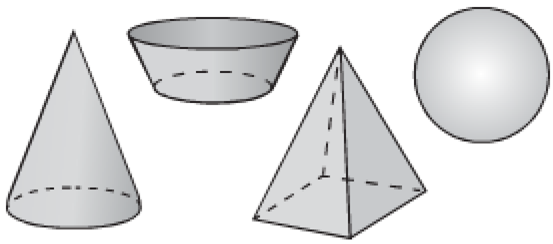
Volume = area of triangle × height = 24 × 17 = 408 cm^3

Volumes of Irregular Shapes

Examples of solids with identical ends



Examples of solids that don't have identical ends



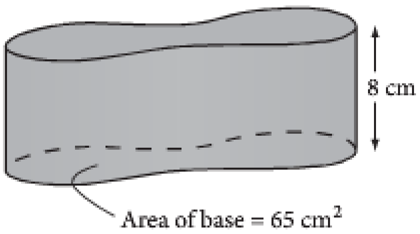
The diagrams show some solids that have identical shapes at either end, with the same cross-section throughout. The other shapes do not have identical ends or cross sections. A solid with flat sides and identical ends is called a **prism**.

The volume of a solid with identical ends = $A \times h$

where A is the area of the end or base and h is the height.

Example

The area of the base of this solid is 65 cm^2. What is the volume of the solid?



Solution

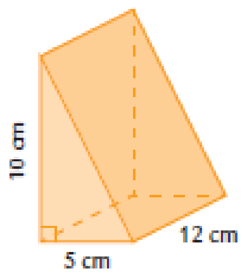
Both ends of the solid are identical, so we can use the formula V = A × h

$V = A \times h = 65 \times 8 = 520\ cm^3$

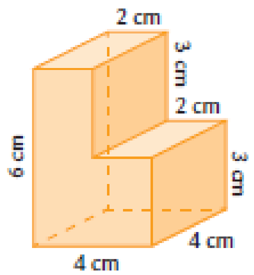
EXERCISE 2

Q1. Calculate the volume of these solids.

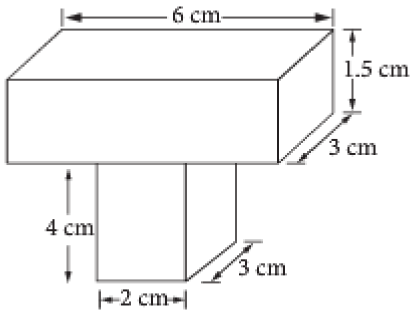
a)



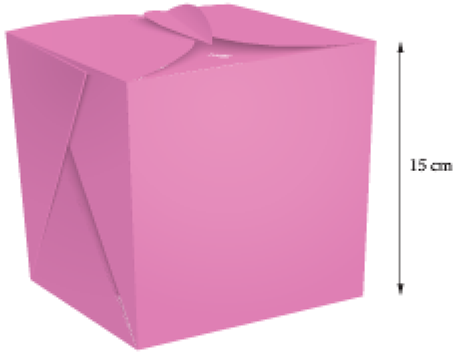
b)



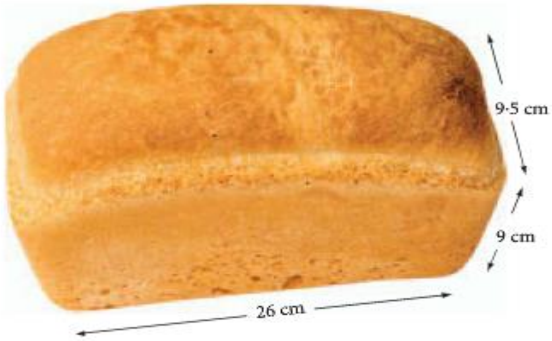
c)



Q2. The area of the food box base is 300 cm^2. Calculate the volume of the box.



Q3. The end of this loaf of bread is a rectangle 9 by 9.5 cm.



a) What is the area of the end of the loaf of bread?

b) The loaf is 26 cm long. What is the volume of the loaf of bread?

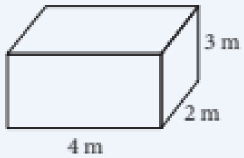
c) The loaf of bread can be cut into 22 slices. Calculate the volume of each slice of bread to the nearest cm^3.

CONVERTING UNITS

INVESTIGATION Why are volume unit conversion factors so big?

Complete the missing parts in this investigation to work out why the factors are so big.

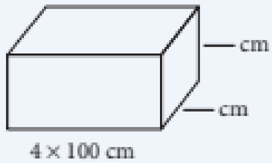
The diagram shows a rectangular prism.



Volume = 4 m × 2 m × 3 m

= _________ m^3 (Answer **a**)

The conversion factor between m and cm is 100.
Convert the dimensions of the rectangular prism to cm.
The width has been completed as an example
of what you have to do.



Volume of the prism = 4 × 100 cm × ________ cm × _______ cm

= ______ × $(100)^3$ cm^3 (Answer **b**)

This means ________ m^3 (Answer **a**) = ___________ cm^3 (Answer **b**)

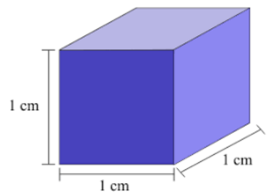
When we're converting volume units, we multiply by the cube of the length conversion factor.

The conversion factor between mm and cm is ______. (Answer **c**)

The conversion factor between mm^3 and cm^3 is _______ (Answer **c**)^3.

1 cm^3 = 10 mm × 10 mm × 10 mm = 1,000 mm^3

1 m^3 = 100 cm × 100 cm × 100 cm = 1,000,000 cm^3



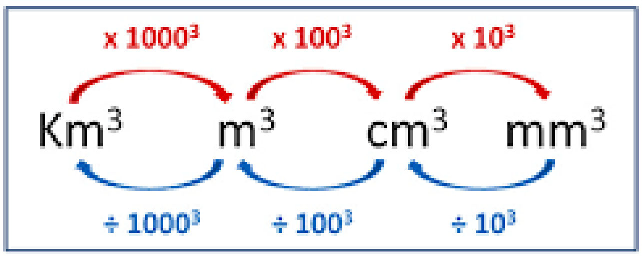
Conversions

Large to small

km^3 to m^3	multiply by 1,000,000 ,000	ie 1000 x 1000 x 1000
m^3 to cm^3	multiply by 1,000,000	ie. 100 x 100 x 100
cm^3 to mm^3	multiply by 1,000	ie. 10 x 10 x 10

Small to large

mm^3 to cm^3	divide by 1,000
cm^3 to m^3	divide by 1,000,000
m^3 to km^3	divide by 1,000,000,000



EXERCISE 3

Q1. Complete the statements.

a) 5 cm^3 = mm^3

b) 2 m^3 = cm^3

c) 500 mm^3 = cm^3

d) 0.25 m^3 = cm^3

e) 24000 cm^3 = m^3

f) 36000 mm^3 = cm^3

Q2. If you were to measure the volume of the following items what units would you use; mm^3, cm^3 or m^3?

a) your calculator

b) your maths classroom

c) an EFTPOS card

d) a glass of water

e) a mobile phone

f) the contents of a box of cereal

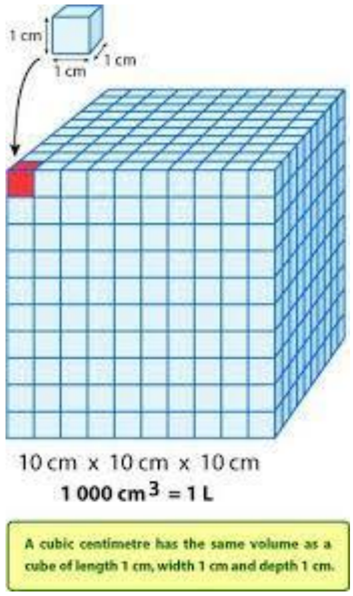
CAPACITY

Volume measures the amount of space an object takes up while capacity measures how much a container can hold.

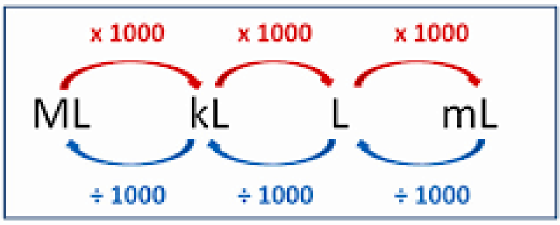
Capacity is often measured by the amount of **liquid** a container will hold. In the metric system, the unit we use to measure liquids is litres (L).

To convert between the units for volume and capacity:

Volume unit	How much it holds
1 cm^3	1 mL
1000 cm^3	1 L
1 m^3	1000 L



Converting capacity units



Example 1

Convert:

a 5 cm^3 to mL **b** 1850 mL to litres

Solution

a 1 cm^3 holds 1 mL. The number of cm^3 and mL are always the same. 5 cm^3 holds 5 mL

b When we're changing mL to L, we're changing to a bigger unit. The conversion factor between mL and L is 1000. We divide by the conversion factor when we're changing to a larger unit. 1850 mL = 1850 ÷ 1000 L = 1.85 L

Example 2

The volume of a large fish pond is 3.4 m^3. How many litres of water does it hold?

Solution

Each m^3 holds 1000 L. We multiply the number of m^3 by 1000. 3.4 m^3 holds 3.4 × 1000 L = 3400 L

Write the answer. The fish pond holds 3400 L of water.

EXERCISE 4

Q1. Convert each measurement to mL.

a) $8cm^3$ b) $1500cm^3$ c) $425cm^3$

Q2. Convert each measurement to litres.

a) 2000mL b) 3500mL c) 250mL

Q3. How many litres can a $2m^3$ container hold?

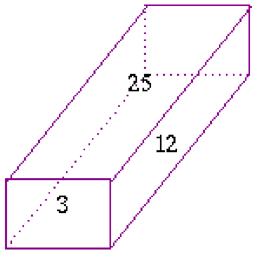
Q4. Greg is pouring $1500cm^3$ of liquid chlorine into a swimming pool. Express this quantity in litres.

Q5. What is the volume in cubic centimetres of a 1.25-litre soft drink bottle?

WEEK 14 PORTFOLIO TASK

Question 1

The diagram shows a rectangular box (a cuboid).
The areas of the faces are 3, 12 and 25 square centimetres.
What is the volume of the box?



Question 2

Aaron only has a small area where he can use to grow vegetables. He digs out a garden 3 m long by 55 cm deep and 45 cm wide. He plans to replace the old soil with compost.

a) What is the volume of soil he needs to remove? Give your answer in cubic metres.

b) Given that 1 cubic metre holds 1000 litres, how many litres of compost will he need?

c) If he takes this soil away in a wheelbarrow that holds 60 litres, how many barrow loads will he take away?

d) The compost is available in 50 litre bags. How many bags will Aaron need to buy?

e) He plans to line the edge of the garden with timber. What length of timber will he need?

MARKING RUBRIC

CRITERIA	EXPECTATIONS	POSS	MULT	GIVEN	TOTAL
Practical	Student completes practical work of the brief to an acceptable standard set by the teacher.	**2**	**3**		**/6**
Portfolio Task	Student completes the portfolio task of the brief to an acceptable standard set by the teacher.	**2**	**2**		**/4**
Communication and Reasoning	Student responses are accurate and appropriate in presentation of mathematical ideas in different contexts, with clear and logical working out shown.	**4**	**-**		**/4**
Knowledge and Application	Student submitted work selects and applies appropriate mathematical modelling and problem solving techniques to solve practical problems, and demonstrates proficiency in the use of mathematical facts, techniques and formulae.	**4**	**-**		**/4**
	Submission Guidelines				
Timeliness	Student submits the exercises and portfolio task by the set deadline. See scoring guidelines for specific details.	**2**	**-**		**/2**
		FINAL			**/20**

Student Reflection:

How did you go with this week's work?

What was interesting?

What did you find easy?

What do you need to work on?