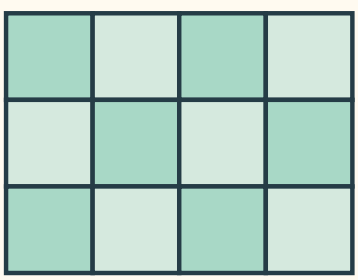
MATHS FIELD GUIDE · GRADE 5

Volume counts space in cubic units

OPENING PROBLEM

One layer of unit cubes forms this grid. How many cubes?



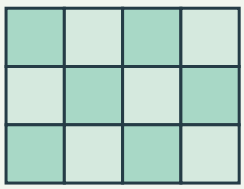
02 Build a solid from equal layers
03 Rules and worked cases
04 Stack the storage cubes
05 Compare the models
06 Follow the faces through a fold
07 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Build a solid from equal layers

Volume = area of one layer × perpendicular height for a prism.

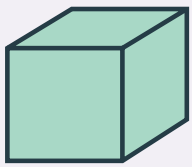
1



One layer of unit cubes forms this grid. How many cubes?

Three rows of four make 12 cubes.

2



How many 1 cm cubes fill this cube?

Nine fit in a layer. Three layers give 27 cm³.

3

Layers	Volume (cm³)
1	12
2	24
5	60

Which box has volume 60 cm³ if its base is 12 cm²?

The height is 5 cm. Divide the volume by the base area.

4

240 cm³
↓
240 mL
↓
0.24 L

How does water help compare capacity and volume?

One cubic centimetre of internal space holds one millilitre.

Base 8 cm², height 3 cm
24 cm³.

Volume 24 cm³, height 6 cm
base 4 cm².

CHAPTER PROBLEM

Two non-overlapping parts have volumes twelve and nine cubic units. Find their combined volume.

Twenty-one cubic units. The parts do not overlap.

MATHS REFERENCE · GRADE 5

Volume counts space in cubic units

Volume measures how much three-dimensional space a solid occupies.

One cubic centimetre is the space occupied by a cube with all three edge lengths equal to one centimetre.

Cases to recognise

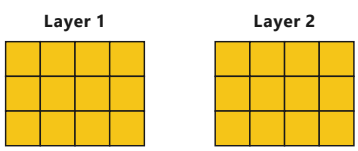
Situation	What to do and why
Base 5 by 3 cubes, four layers	Fifteen per layer gives 60 cubic units.
Volume 84 cm³ on a 7 by 3 cm base	Divide by 21 cm² to get a height of 4 cm.

Read the model

Count a complete layer

A layer with four cubes along its length and three across has twelve unit cubes.

Two complete layers contain twenty-four cubes. Count hidden cubes too, not just those on the outside.

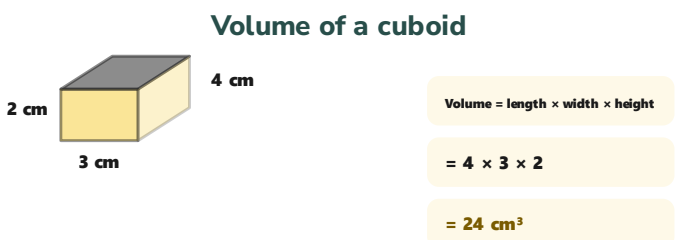


Each square shows one unit cube.

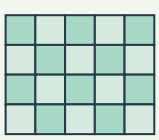
Connect layers to a formula

A solid cuboid with length 4 cm, width 3 cm and height 2 cm has twelve cubes in each layer and two layers.

Volume = length × width × height = 24 cm³. This follows from counting cubes, not just a rule to memorise.



volume The amount of three-dimensional space occupied.
cubic unit A volume unit based on a unit cube.
layer One complete level of cubes.
composite solid A solid formed from simpler parts.



Each tile is 1 cm² of a tank's base. How much water covers it 1 cm deep?

Twenty cubic centimetres, or 20 mL.

WORKED INVESTIGATION

Stack the storage cubes

Cover the base of a crate with four unit cubes along its length and three across. Each full layer has twelve cubes.

Look at this part	What it tells you
One layer	12 cubes
Two layers	24 cubes
Five layers	60 cubes

Work it through

For a crate 4 cm by 3 cm by 5 cm, each 1 cm cube occupies 1 cm³. Counting layers gives 60 cm³ even when the middle cubes are hidden.

Catch the mistake

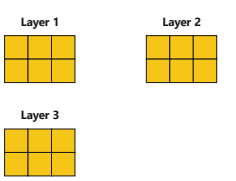
Counting only cubes you can see misses the buried cubes. Use the number in a full layer and the number of layers.

Compare the cases

Try another layer arrangement

Three cubes along and two across give six cubes in one layer.

Three such layers contain eighteen unit cubes.



Each square shows one unit cube.

Keep dimensions and units compatible

Use three perpendicular dimensions measured in the same length unit.

Centimetres multiplied three times give cubic centimetres, written cm³, not cm or cm².

Change one condition

Turn the crate on its end. A 3 by 5 layer now has 15 cubes and four layers give the same volume.

Depth (cm)	1	2	5
Volume (mL)	20	40	100

How much higher will 60 mL raise the level?

60 ÷ 20 = 3 cm, provided the straight-sided tank has room.

VOLUME COUNTS SPACE IN CUBIC UNITS

Compare the models

Area and volume answer different questions

A rectangle's area counts square units covering a surface.

A cuboid's volume counts cubic units filling space. Looking only at its front face misses the depth.

Combine without double-counting

A composite solid can be split into non-overlapping cuboids.

Add the volumes of the parts. If they overlap, adding both full volumes would count the shared region twice.

A missing region is subtraction

A larger block has volume forty cubic units. A non-overlapping cut-out removes eight cubic units.

Thirty-two cubic units remain. The removed region must be part of the original block.

A hollow box needs a clear question

Outside dimensions describe the volume of the outer cuboid.

The space available inside depends on inside dimensions. Thick walls reduce that internal space.

Explain your reasoning

Find the cuboid's volume from the shown dimensions.

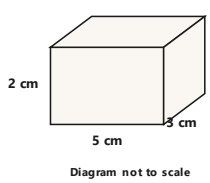


Diagram not to scale

30 cm³. 5 × 3 × 2 = 30; each dimension is in centimetres.

Two more worked cases

Situation	Reasoning
Two non-overlapping blocks of volumes 24 and 15	Add to get 39 cubic units.
Remove a 2 by 2 by 1 corner from a 3 by 3 by 3 block	Four cubes leave 27 − 4 = 23 cubes.

Internal sides 10 cm each

↓

10 × 10 × 10 cm³

↓

1000 mL = 1 L

Why use internal dimensions?

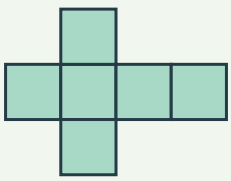
Water fills the space between the walls. The material itself occupies some of the outside volume.

ILLUSTRATED PROBLEM SHEET

Follow the faces through a fold

Six squares make a cube net only when the fold covers each face once.

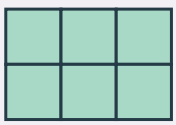
1



A strip of four makes the sides. What do the two spare squares cover?

One closes the top and one closes the bottom.

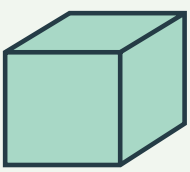
2



Can this two-by-three rectangle close into a cube?

No. Four squares meet at an interior corner, but only three cube faces meet at a vertex.

3

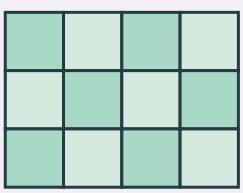


6 faces

How many edges does a cube have?

Six faces have four edges each. Each edge belongs to two faces, so 24 ÷ 2 = 12.

4



Cut a 4 by 3 rectangular face from card. Is this one face of a cube?

No. Cube faces are squares. It can be a face of a cuboid.

One square face
four edges.

Six cube faces
twelve distinct edges, as each edge is shared.

CHAPTER PROBLEM

Why is cm² not a correct unit for the volume of a cuboid?

Square centimetres measure area. Volume counts cubes and uses cubic centimetres, cm³.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 Double the three dimensions of a box. How does volume change?	Two times as many cubes fit in each of three directions. The factor is eight.
02 In a cube net two squares share a full edge. Can they end up as opposite faces?	No. They meet along that same edge after folding.
03 A box holds 72 unit cubes in equal layers of 4 by 3. How tall is it in cube lengths?	Each layer contains 12 cubes. Six layers contain 72, so its height is six cube lengths.
04 A stack has six layers of five by four cubes, then ten cubes are removed. How many remain?	$6 \times 20 - 10 = 110$.
05 A 2 cm cube is cut into 1 cm cubes. How many?	Two fit along each of three directions: $2^3 = 8$.

Tank capacity 1.2 L
↓
Already holds 750 mL
↓
1200 − 750 = 450 mL

Will another half-litre fit?

No. Half a litre is 500 mL. It exceeds the remaining space by 50 mL.

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