CHAPTER 12

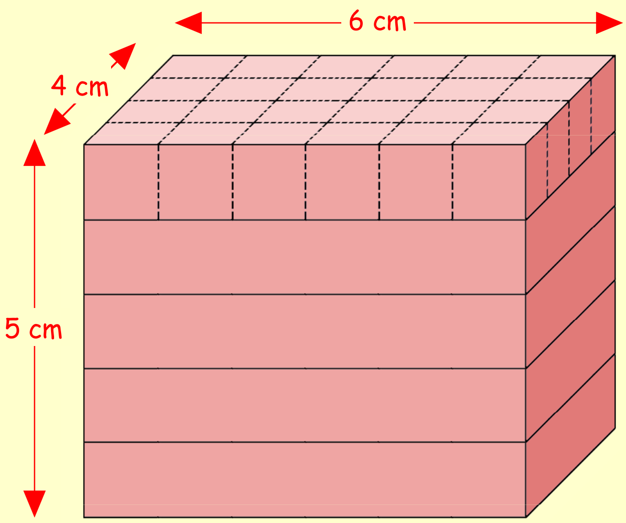
Volume

Volumes of Cubes and Cuboids *(Revision)*

Be able to calculate the volume of a cube or cuboid using a formula

The **Volume** of a shape is the amount of space it takes up.

Remember how to calculate the **volume** of a cuboid ?



The top layer has **6** rows, **4** deep = 6 x 4 = 24 cm^3.

5 layers each with 24 cm^3 = 5 x 24 = **120 cm^3**.

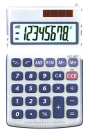
So there are 6 x 4 x 5 = **120 cm^3**.

or as a formula :-

Volume = length x breadth x height

The **Volume** of a cuboid can be found using the formula :- $V = L \times B \times H$

Exercise 1

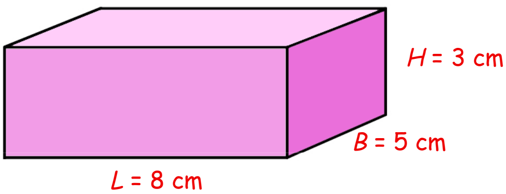


1. Copy and complete for this cuboid :- (*You may use a calculator but show all working*).

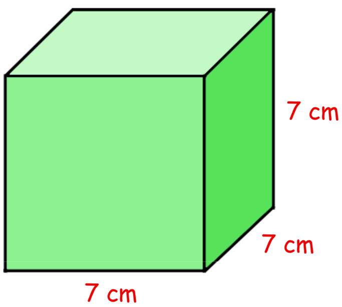
$V = L \times B \times H$

$V = 8 \times 5 \times 3$

V = ... cm^3



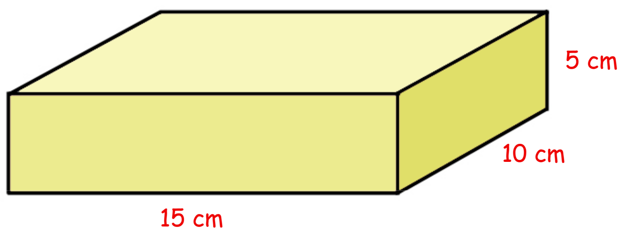
2.



Use the formula $V = L \times B \times H$ to calculate the **volume** of this cuboid.
(*Show your working*).

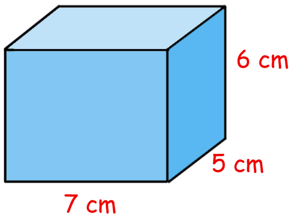
What is this cuboid better known as ?

3. Use the formula to calculate the **volume** of this cuboid.



4. Calculate the **volume** of each of the following cuboids :- (*Show your working*).

a



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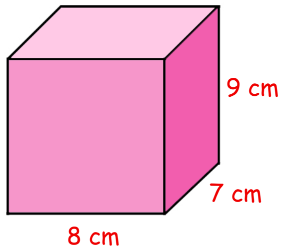

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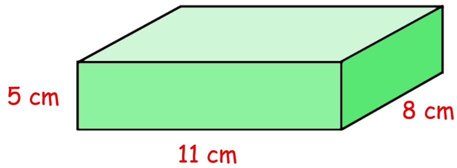

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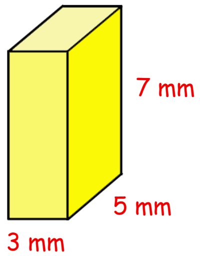
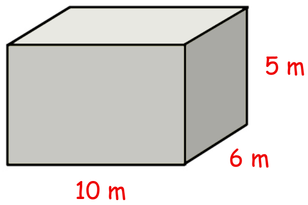
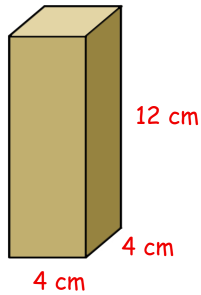


e



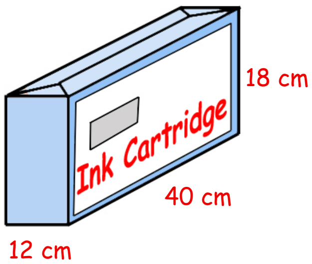
f



5. Calculate the **volume** of each box :- (*You may use a calculator but show all working*).

a

b



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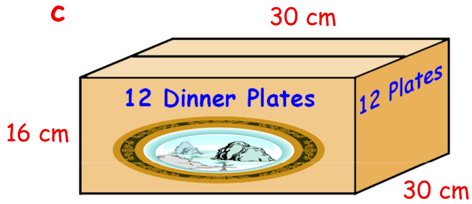

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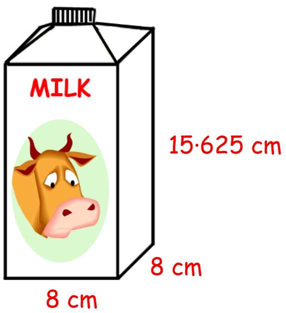

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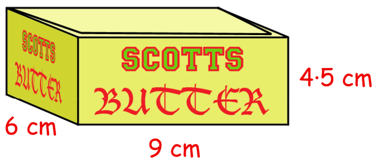

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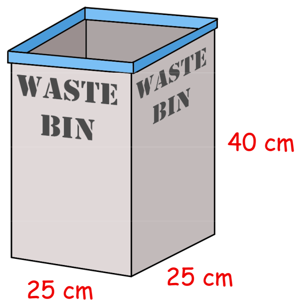
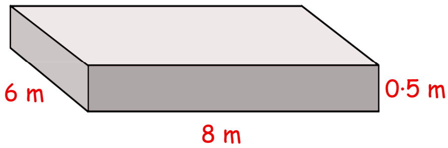


6. Calculate the **volume** of these objects, giving your answer in **mm^3**, **cm^3** or **m^3** :-

a



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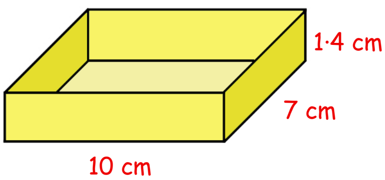

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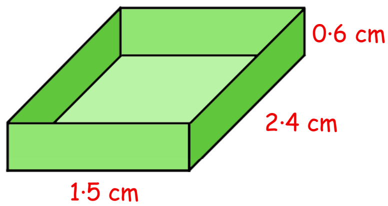

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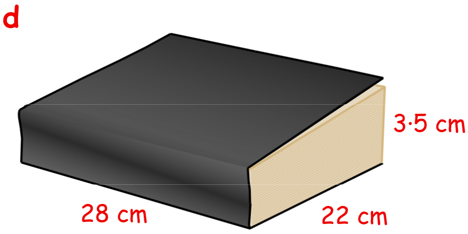

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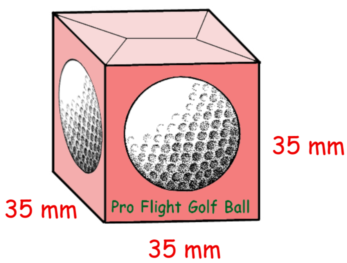
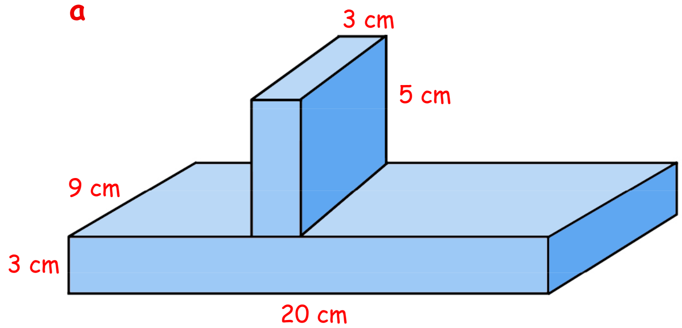


f

7. By calculating the **volume** of each "block" in the shape, find the **total volume** each time :-

a



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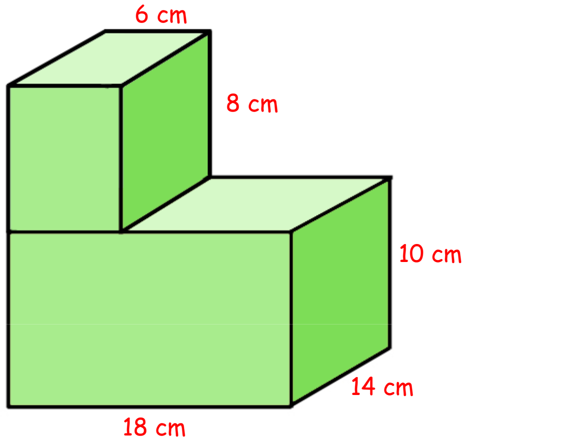

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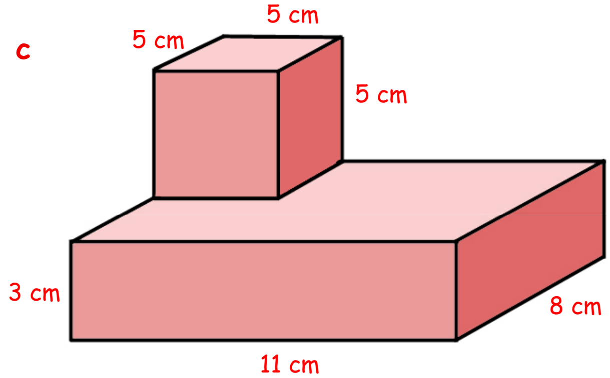

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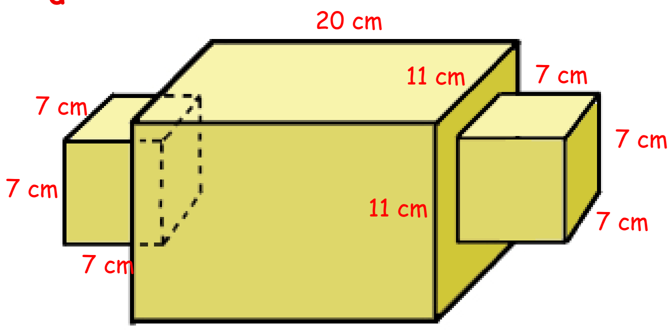

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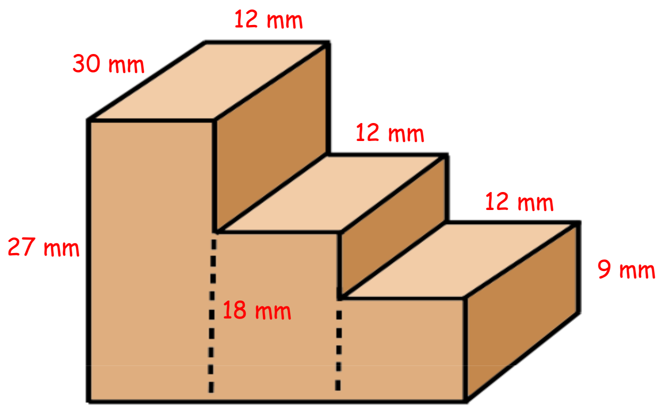

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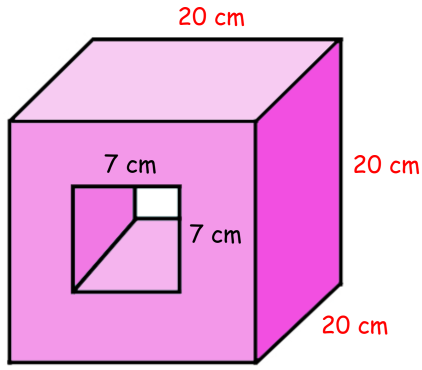
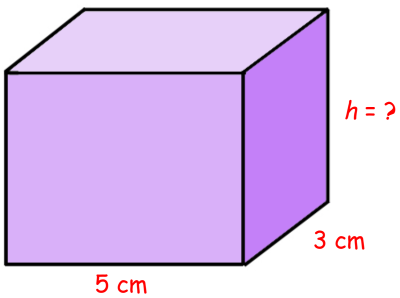


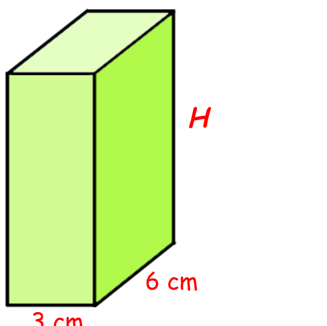
8. The **volume** of this cuboid is 60 cm^3.

Calculate its **height** (***h***).



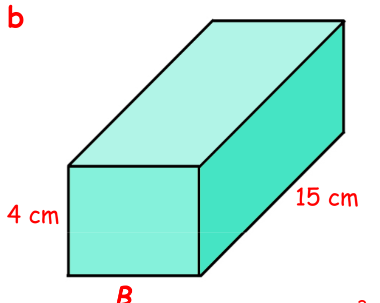
9. Calculate the length of the missing edge in each of the following cuboids :-

a



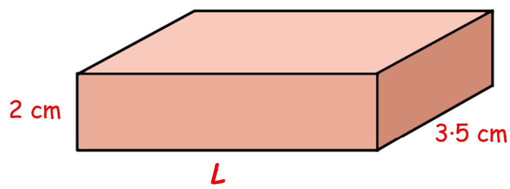
(Vol = 180 cm^3)

b



(Vol = 300 cm^3)

c



(Vol = 56 cm^3)

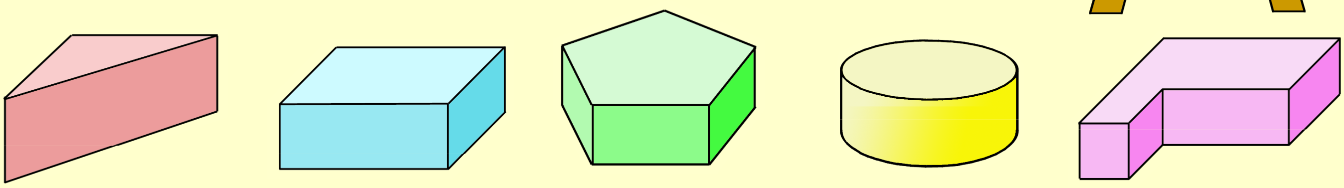
Volumes of Triangular Prisms

Be able to calculate the volume of a Triangular Prism

A **Prism** is a solid shape :-

- whose bases (or ends) are **congruent**, and
- whose bases are parallel to one another, and
- whose other faces are rectangles (or parallelograms).

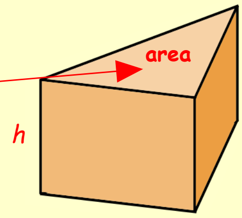
Have the same shape and size.



triangular based prism — square based prism — pentagonal based prism — circular based prism — irregular shaped prism

To find the volume of any **prism** :-

- calculate the **area** of one of the **parallel faces** (the **base**).
- multiply this by the distance between the parallel faces (the **height** ?).

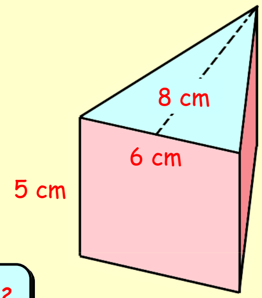


Volume of a **Triangular Prism** is :-

$$\textit{Volume} = \textit{Area}_{\text{base}} \times \textit{height}$$

Example :- The blue base of this prism is an isosceles triangle.

The prism's height is 5 centimetres. Calculate its **volume**.



Step 1 :- Find the **area** of the base first :-

$$A_{(\text{blue})\ \text{base}} = \tfrac{1}{2}\text{base} \times \text{height} = \tfrac{1}{2}\text{ of } 6 \times 8 = \mathbf{24\ cm^2}$$

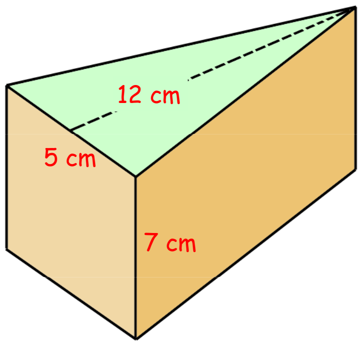
Step 2 :- Find the **volume** of the prism :-

$$V = A_{\text{base}} \times h.$$

$$V = 24\ \text{cm}^2 \times 5\ \text{cm} = \mathbf{120\ cm^3}$$

Exercise 2

1. Calculate the **volume** of this (isosceles) triangular prism.



Copy and **complete** :-

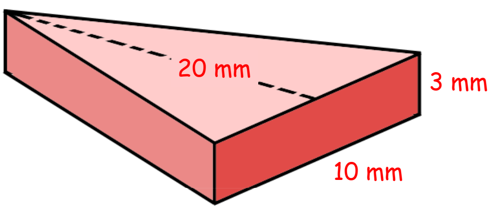
$A_{\text{base}} = \tfrac{1}{2}\text{base} \times \text{height}$

$= \tfrac{1}{2}\text{ of } 5 \times \ldots = \ldots\ldots\ \mathbf{cm^2}$

$Vol = A_{\text{base}} \times h.$

$= \ldots\ldots\ \text{cm}^2 \times 7\ \text{cm} = \ldots\ldots\ \mathbf{cm^3}$

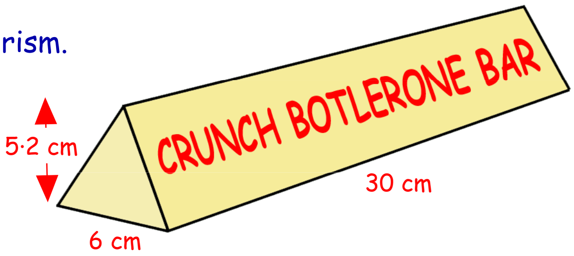
2.



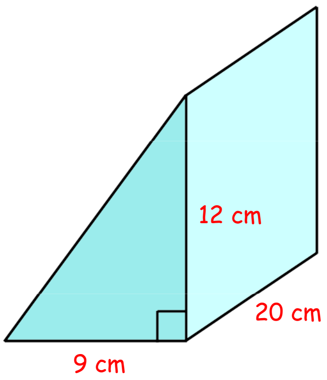
Calculate the **volume** of this (isosceles) triangular prism using the same method shown in question 1.

3. This large Botlerone Bar is an (equiangular) triangular prism.

Calculate its **volume**.



4.

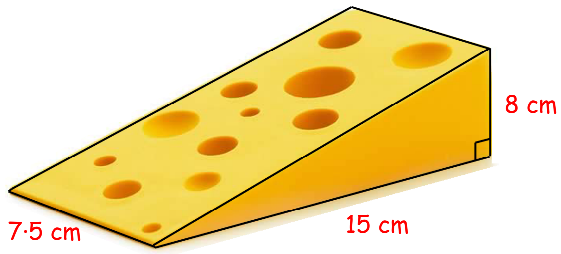


This time, the face of the prism is a **right angled triangle**.

a Calculate the **area** of the triangular face.

b Now calculate the **volume** of the **triangular prism**.

5. Calculate the **volume** of this wedge of cheese.



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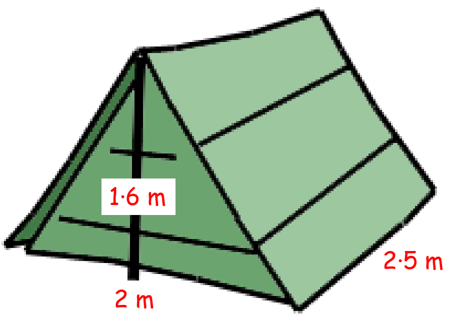
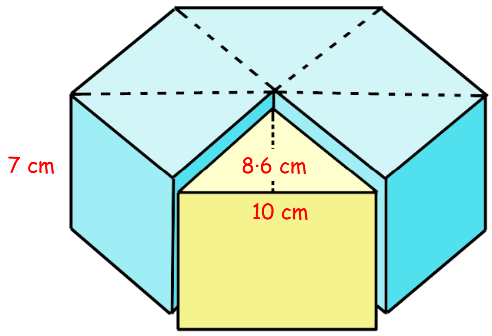


Calculate the **volume** of this 2 person tent.

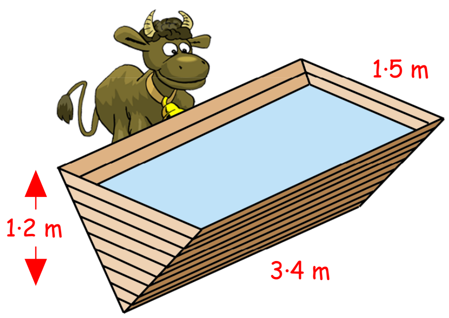
7. Here is a **hexagonal prism** with one section removed.

a Calculate the **volume** of the yellow prism.

b Now calculate the **volume** of the whole hexagonal prism.



8.



Shown is an animal drinking trough.

The ends are isosceles triangles.

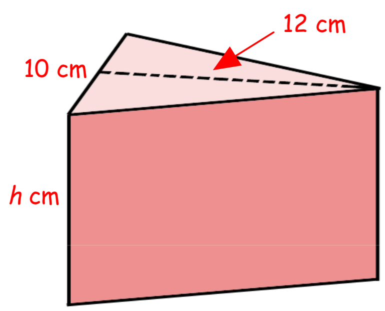
Calculate the **volume** of water in the trough when it is full.

9. The **volume** of this prism is 510 cm^3.

The isosceles triangle on top has base 10 cm and height 12 cm.

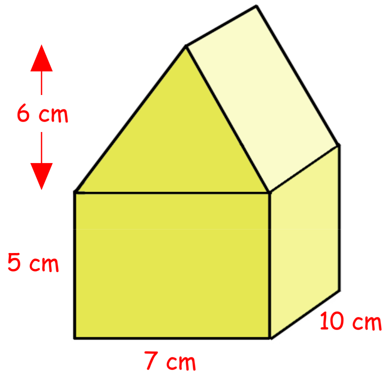
a Calculate the **area** of the top triangle.

b Now calculate the **height** of the prism.



10. Calculate the **total volume** of each of these shapes by considering the individual components.

a



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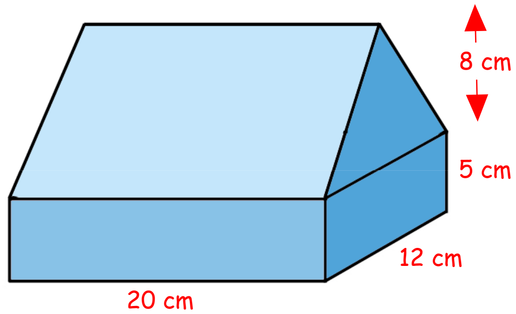

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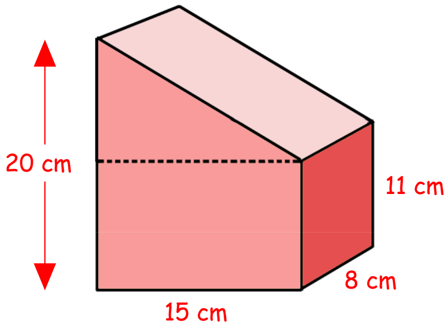

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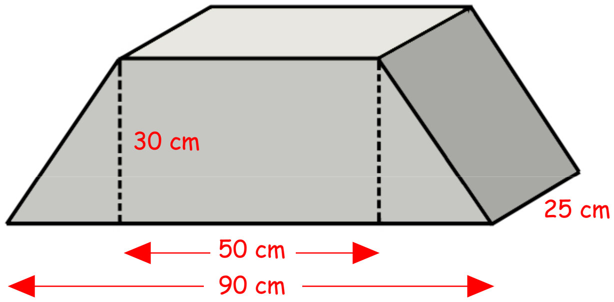
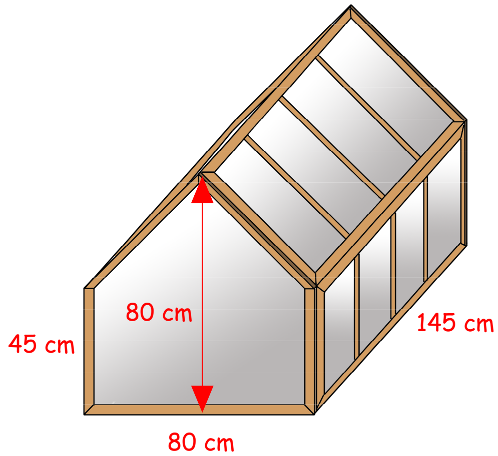
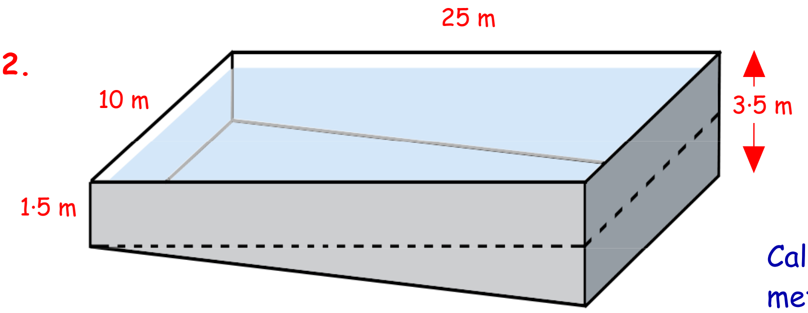


11. Sarah keeps her plants in a little mini-greenhouse.

Calculate the **total volume** of space in the greenhouse.



12.



This swimming pool is 25 metres long by 10 metres wide.

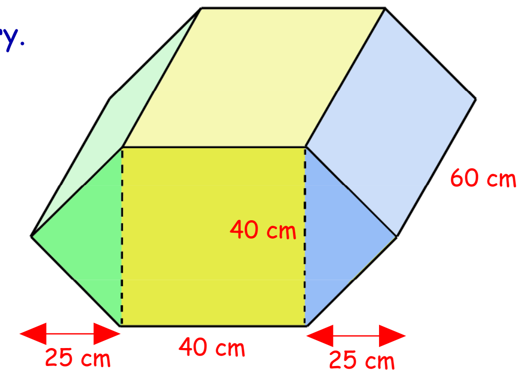
It is 1·5 metres deep at the shallow end and 3·5 metres at the deep end.

Calculate the volume of water in cubic metres in the pool when it is full.

13. Shown is a leather covered soft play toy used in a nursery.

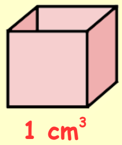
It is in the shape of a **hexagonal prism**.

By calculating the volume of the yellow cuboid and the green and blue triangular prisms, find the **total volume** of the toy.



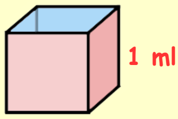
Liquid Volume - Capacity

If you have a hollow cube measuring 1 cm by 1 cm by 1 cm, it has a volume of 1 cm x 1 cm x 1 cm = **1 cm^3**.



If you now fill that small cube with water, it holds **1 cm^3**.

- **cm^3** are usually used to define the **volume** of a solid shape.



Liquid volume is measured in **millilitres** where **1 millilitre** = **1 cm^3**.

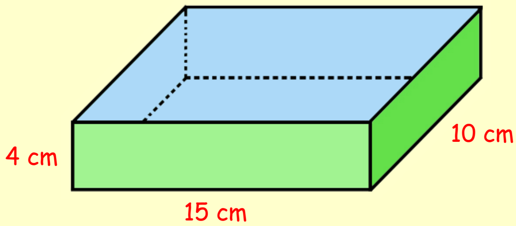
Another name for **liquid volume** is capacity. We say the cube has a **capacity** of **1 millilitre** (**1 ml**).

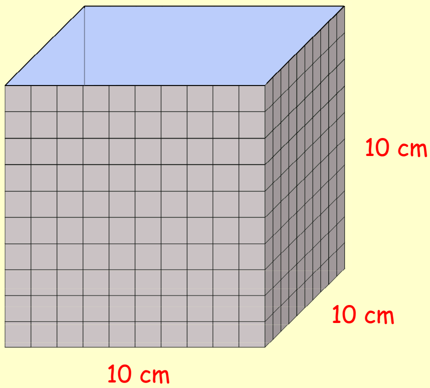
Example :- This hollow container is filled with water.

Its volume is $V = L \times B \times H$

$V = 15 \times 10 \times 4 = 600\ cm^3$

Its **capacity** is **C = 600 ml**





Note :- This box measures 10 cm by 10 cm by 10 cm

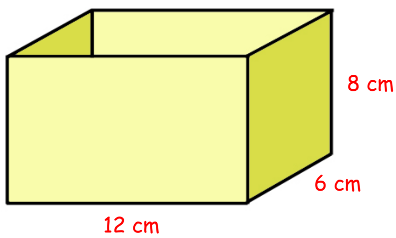
Its volume is $V = L \times B \times H$

$V = 10 \times 10 \times 10 = 1000\ cm^3$.

Its **capacity** is **C = 1000 ml** or **1 litre**.

1 litre = 1000 millilitres (1 L = 1000 ml).

Exercise 3

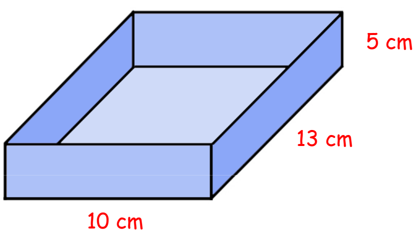


1\. a Calculate the **volume** of this box in **cm^3**.

b Now write down its **capacity** in **ml**.

2\. Determine the **capacity** of these three containers :-

a



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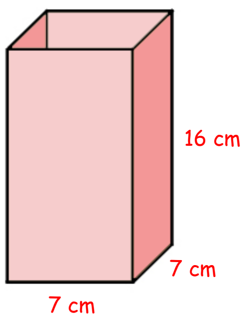
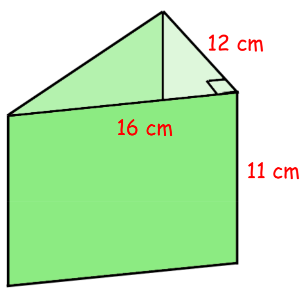


c



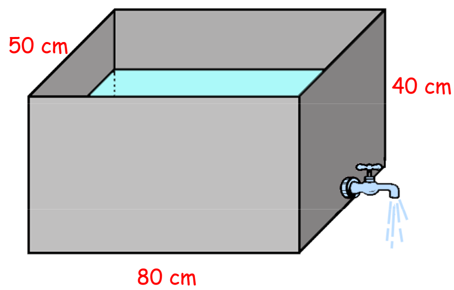
3. Change the following from **litres** to **millilitres** :- (*Remember :- 1 litre = 1000 ml*).

a	2 litres	b	5 litres	c	8 litres	d	25 litres
e	3·2 litres	f	12·75 litres	g	0·9 litre	h	11·234 litres
i	$\frac{1}{2}$ litre	j	$4\frac{1}{2}$ litres	k	$1\frac{1}{4}$ litres	l	$3\frac{3}{4}$ litres.

4. Change the following from **millilitres** to **litres** :- (*Remember :- 1000 ml = 1 litre*).

a	6000 ml	b	9000 ml	c	15000 ml	d	35000 ml
e	2500 ml	f	7250 ml	g	250 ml	h	1300 ml
i	4650 ml	j	12620 ml	k	100 ml	l	15 ml.

5. This cold storage water tank measures 80 cm by 50 cm by 40 cm.

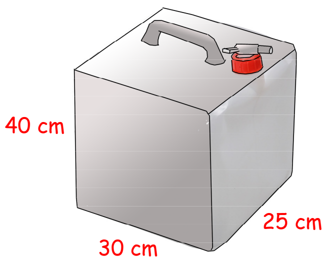


a Calculate its **volume** in cm^3.

b Calculate its **capacity** when full of water :-

(i) in **millilitres** (ii) in **litres**.

6.



Scouts use large containers like this to store their drinking water to allow them to replenish their drinks bottles.

a Calculate the **capacity** of the large container in **litres**.

b How many drinks bottles can be filled from a full container ?

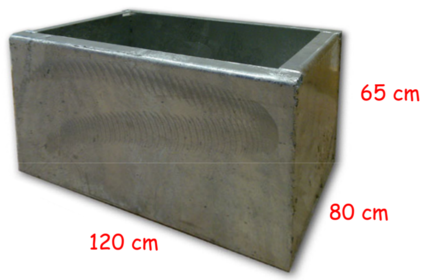
7. The inside of this rectangular paddling pool is a cuboid measuring 2·4 m by 1·5 m by 80 centimetres deep.

a Change 2·4 m and 1·5 m each to centimetres.

b Calculate the **volume** of the inside of the pool in cm^3.

c How many **litres** of water will it need to **half** fill it ?

8.



Water pours into this stainless steel storage tank at a rate of **4 litres per minute**.

How long will it take before the tank overflows ?

9. Shown is a large storage container with its internal dimensions 3 metres by 4 metres by 12 metres.

Calculate the volume of air inside the container and give your answer in litres. (***Not** 144 litres*).