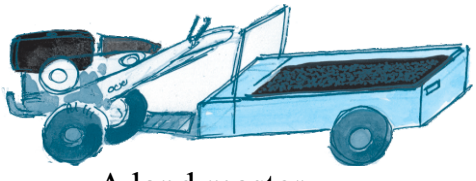
16 Volume

After studying this chapter you will be able to,

- ★ understand the concept of volume.
- ★ identify different units of volume.
- ★ identify cubic centimetre and cubic metre as units of volume.
- ★ estimate the volume of a cube and the volume of a cuboid.
- ★ calculate the volume of a cube and the volume of a cuboid.
- ★ make the maximum use of a limited space by using the knowledge of volume.



A land master

A tractor

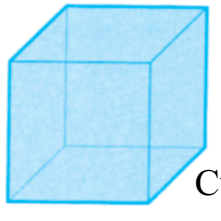
16.1 Volume

★ You may have seen how builders order building materials. Stones and sand are usually ordered in tractor loads and truck loads. Discuss other instances where measurements can be used to measure things as explained above.

In geometry any object having a definite shape and occupying space is called a **solid**. The shape of a solid object is determined by its outer surface. The amount of space occupied by a solid object is called the **volume**.

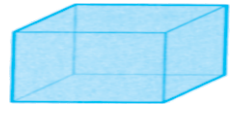
Example 1

(i)



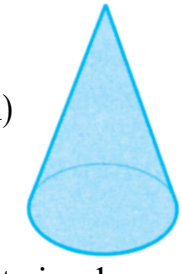
Cube

(ii)



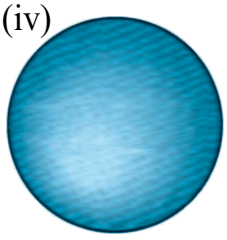
Cuboid

(iii)



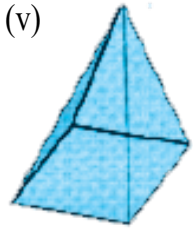
Right circular cone

(iv)



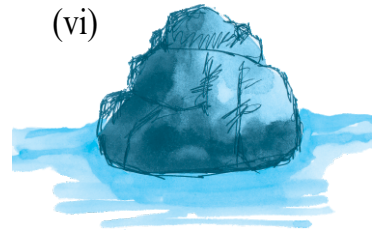
Sphere

(v)



Square based pyramid

(vi)



A stone

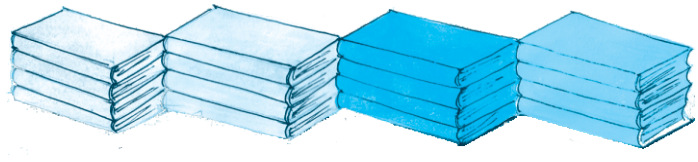
The amount of space occupied by each of the above solid objects is its volume.

Activity 16.1

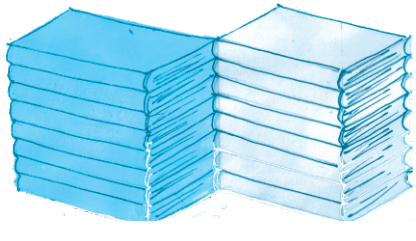
Collect 16 Mathematics text books.
Arrange the books by keeping one book on another in order as shown in the figures and form various shapes. Observe the shapes well.

(i)

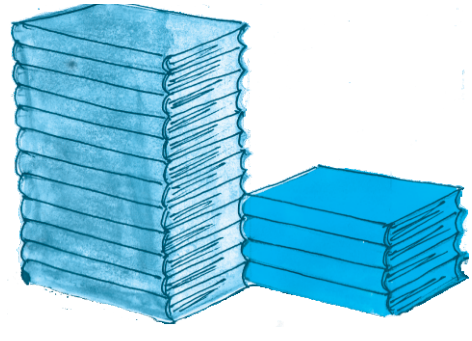
(ii)



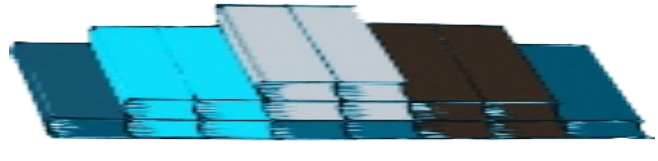
(iii)



(iv)



(v)



What can you say about the space occupied by each of the shapes? In all these occasions, the space occupied by the sixteen books is the same. The shapes shown in the five instances are however different from one another.

The volume of an object does not depend on its shape.

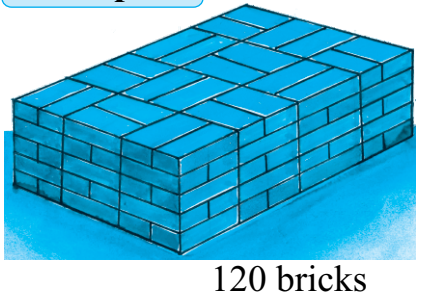
If that is so, objects of different shapes may have the same volume.

16.2 Volume in desired units

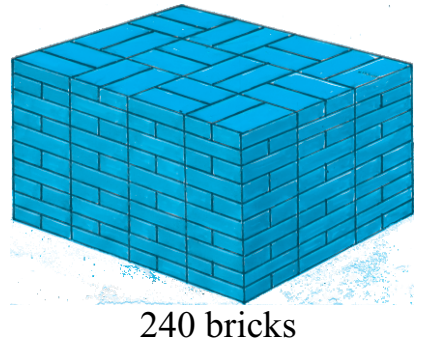
Pay attention to how materials such as packets of milk powder, cakes of soap, packets of tooth paste, packets of medicine are packed in cardboard boxes and stored in store rooms or distributed. If the size of such packets is changed, can they be packed in the same of cardboard boxes as before? Find how the number of packets that can be packeted in a cardboard box changes according to the size of the packet.

Accordingly identify the necessity of managing it to make maximum use of the space within the cardboard box.

Example 2



120 bricks



240 bricks

Two heaps of bricks of the same size arranged in order are given in the figure. The volumes of the two heaps of bricks are different from one another. There are 120 bricks in the first heap and 240 in the other.

The second heap has twice the number of bricks as that of the first heap. Accordingly the volume of the first heap can be represented by a quantity of 120 bricks and the volume of the second by 240 bricks.

Hence the volume of the second heap is twice that of the first. Here the unit of measurement of volume is one brick.

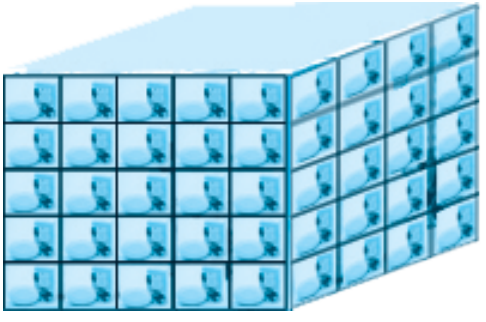
Here, 1 unit of measurement of volume = 1 brick

Example 3

100 cakes of soap are packed in one of the two boxes of the same size and 48 packets of biscuits are packed in the other. The volume of both boxes is the same.

The volume of the first box is 100 cakes of soap. The volume of the second box is 48 packets of biscuits.

Even though the volume of the two boxes is equal, since the units of measure are different, the values of the volume are different. Hence you can see the necessity for a standard unit of measure of volume.

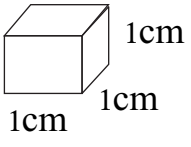


100 cakes of soap

48 packets of biscuits

16.3 Volume in standard units

Consider a cube of 1cm a side. The volume of this is taken as one cubic centimetre. It is written as 1cm^3.

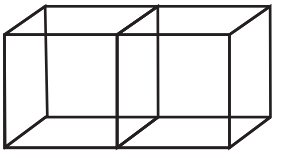


1 cubic centimetre $\rightarrow$ 1 cm^3

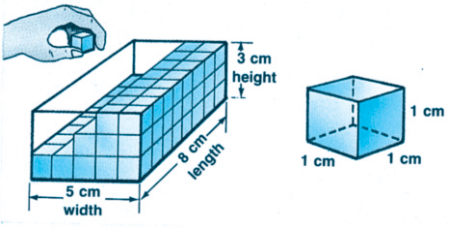
This is a standard unit used to measure volume.

The volume of a cube of which one side is 1 centimetre in length, is one cubic centimetre or 1 cm^3.

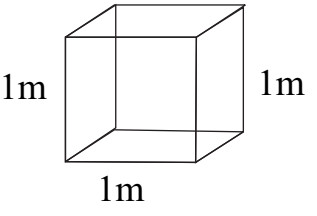
(I) Take two centicube dice having a volume of 1cm^3 each, from the set of mathematical instruments and keep them adjoined. Here the volume is 2 cm^3.



(ii) The bottom layer contains 40 centi cubes. There are three such layers. Therefore the total number of centicubes are 120. Hence the volume = 120 cm^3



(iii) The volume of a cube of side length 1 m is one cubic metre. It is written as 1 m^3. This is the international unit of measure of volume.



The volume of a cube of side length 1 m is one cubic metre or 1 m^3.

16.4 Finding the volume

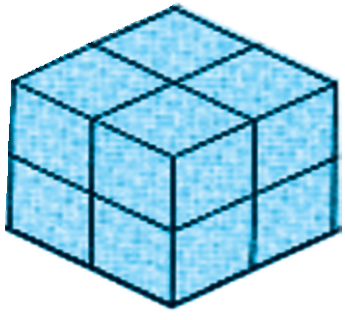
Activity 16.2

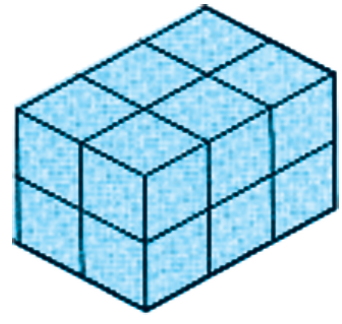
Find a few cardboard boxes. Tightly arrange centicube dice in them and find the volume of each box in centicubes.

When it is impossible to arrange the centicube dice to fill the boxes exactly, estimate the volume of each according to the number of dice packed.

Activity 16.3

Construct a few cubes different from one another with centicube dice. Obtain volume of each of the cubes by counting the number of centicube dice.

(i) 

(ii) 

According to figure (i) above, since the cube is made up of 8 centicubes its volume is $8cm^3$. Further, you will understand that in this constructed cube, the length is 2 cm, the breadth 2 cm and the height 2 cm.

$\therefore$ The volume of the cube = $8\ cm^3 = 2\ cm \times 2\ cm \times 2cm$
(length × breadth × height)
$(\text{length of one side})^3$

Similarly according to figure (ii), that cuboid is made up of 12 centicubes. Accordingly, its volume is $12\ cm^3$. Further the length of the cuboid is 3 cm, the breadth 2 cm, and the height 2 cm.

The volume of the cuboid $= 12\ cm^3$
$= 3\ cm \times 2\ cm \times 2\ cm$
(length × breadth × height)

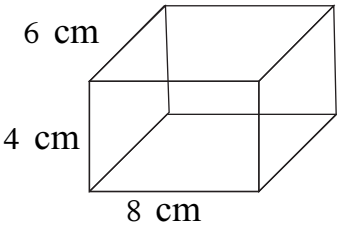
You will see that, as shown in the above figures, the volume of a cuboid can be found easily by multiplying its length, breadth and height.

Volume of a cuboid = length × breadth × height

Similarly the volume of a cube can also be found by multiplying as above.

Example 4

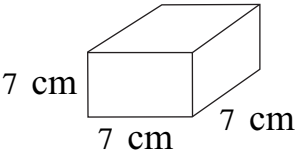
Find the volume of a cuboid of length 8 cm, breadth 6 cm and height 4 cm.



The volume = 8 cm × 6 cm × 4 cm
= 192 cm^3

Example 5

Find the volume of a cube of side 7 cm.



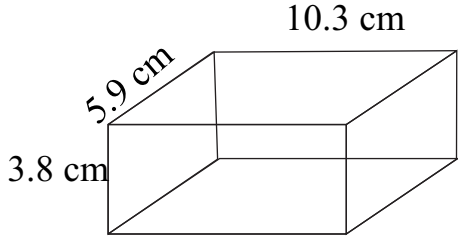
The Volume = 7 cm × 7 cm × 7 cm
= 343 cm^3

16.5 Estimating the volume

Estimation of volume is very much needed in day to-day- life. For this you will have to use the knowledge you have gained in Grade 6.

Example 6

Let us consider how the volume of a cuboid can be estimated.

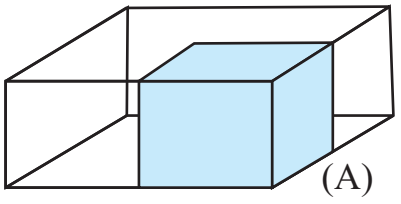


First let us estimate its length, breadth and height. It is suitable to get the given lengths to the nearest whole number. Accordingly, estimate the length as 10 cm, breadth as 6 cm and the heigth as 4 cm.

Hence the volume = 10 cm × 6 cm × 4 cm
= 240 cm^3 (estimated value).

Exercise 16.1

(1)

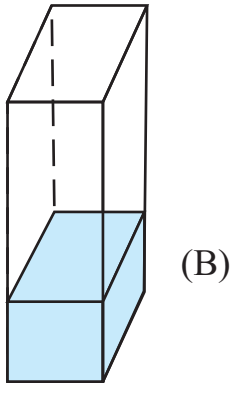


The volume of the larger cuboid shaped box (A) given in the figure, is 140 cm^3.

(i) How many shaded boxes can be put into this larger box?

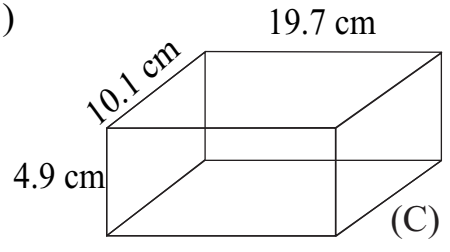
(ii) Accordingly, what is the volume of the shaded box?

(2)



The volume of the shaded part of the cuboid (B) is 24cm^3. Estimate the volume of the cuboid.

(3)



(i) Estimate rough values for the length, breadth and the height of the cuboid (C) given in the figure.

(ii) Accordingly, estimate its volume.

Exercise 16.2

(1) The length of a cuboid shaped container is 10 cm, the breadth 2 cm and the height 3 cm. Find its volume.

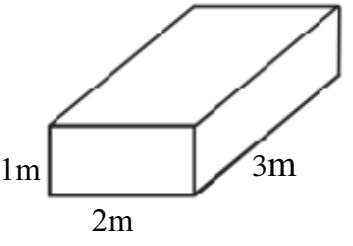
(2) The length, breadth and the height of a book are 20 cm, 10 cm and 2 cm respectively.

(i) The length of a shelf of a book rack is 100 cm, the breadth is 20cm and the height is 20 cm. Find the maximum number of books that can be arranged on one shelf.

(ii) How many books of the same length and breadth as before and thickness 1.5cm can be arranged on one shelf of the above rack?

(iii) It is needed to construct a box suitable to pack 200 books of the above type and of thickness 2 cm. The measurements of this box should be close to each other as much as possible and no space should be left after packing the books. What are the suitable measurements for that box?

(3) The length of a certain store room is 10 m and its breadth is 9 m. Height upto the ceiling is 3.5 m. Boxes of length 3 m, breadth 2 m, and height 1m have to be stored in this room.



(I) Find the maximum number of boxes that can be stored. (Every box should be kept only as shown in the figure.)

(ii) Find the volume of the room acquired by the boxes.

Summary

- ★ The amount of space occupied by a solid object is known as the **volume** of that solid object.
- ★ A solid object has a definite volume.
- ★ The standard units of measuring volume are the **cubic centimetre** and the **cubic metre.**
- ★ The volume of a cuboid or a cube can be found by length × breadth × height
- ★ By estimating the length, the breadth and the height of a cuboid or a cube, its volume can be estimated.
- ★ Using the knowledge of volume, the maximum use of space can be made.