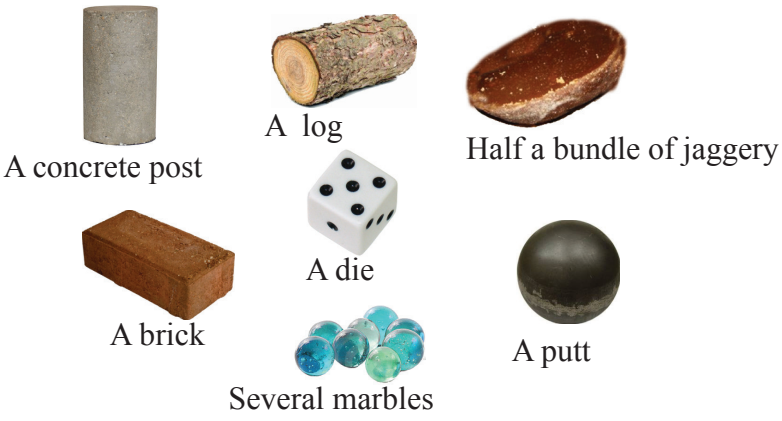
17 Solids

By studying this lesson, you will be able to,

- prepare models of a cube, cuboid and regular tetrahedron,
- identify and state the shapes of the faces of these solids and the number of faces, edges and vertices each solid has, and
- create various nets to prepare models of the above mentioned solids and create new compound solids with these models.

17.1 The surfaces, faces, edges and vertices of solids

The following figure illustrates several items that we see and use in our day to day activities.



An object of specific shape which occupies a certain amount of space is called a solid object.

Now let us consider the surfaces, faces, edges and vertices of several solids.

Every solid has an outer surface which is called the **"surface"** of the solid.

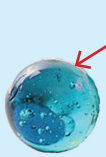
• The faces of solids

Activity 1

Step 1 - Collect several solid objects that can be found in the classroom.
Step 2 - Examine the surfaces of the objects you collected.
Step 3 - Through this examination, identify the shapes of the different surface parts and see whether they are flat or curved.
Step 4 - What are the other properties you can identify?

You may have realized from the above activity that the outer surface of solids consists of different shaped plane surface parts and/or curved surface parts.

All the surface parts of a brick are plane surfaces. These plane surfaces are called **faces**. That is, a brick has six faces.



The surface of a marble is a curved surface.

The surface of a die consists of six plane surface parts. That is, a die has six faces.

• The edges of solids

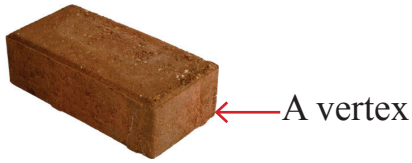
A boundary along which two surface parts of a solid meet is called an edge of the solid.

The edges of a brick are rectilinear. Such edges are called **straight edges.**

The concrete post has two edges. These edges are not rectilinear. Edges which are not straight edges are called **curved edges.**

• The vertices of solids

Let us consider solids such as a brick or a die. The place where three or more edges of such a solid meet is called a vertex.

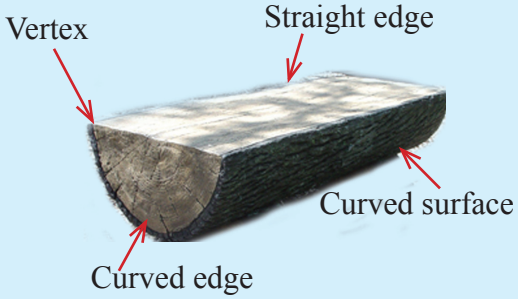


The brick has 8 vertices.

The die has 8 vertices.

Example 1

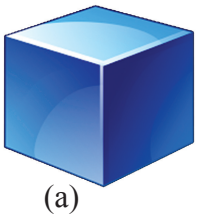
The figure illustrates a part of a log which has been split into two. Write down separately, the number of flat surface parts, curved surface parts, straight edges, curved edges and vertices that it has.



Number of flat surface parts 3.
Number of curved surface parts 1.
Number of straight edges 4.
Number of curved edges 2.
Number of vertices 4.

Exercise 17.1

(1) Complete the following table by considering the number of edges, vertices and surface parts each solid consists of.


(a)


(b)


(c)


(d)


(e)

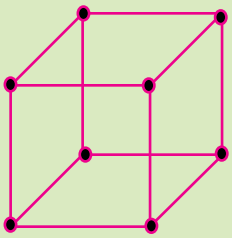
Figure	Number of faces	Number of curved surface parts	Number of straight edges	Number of curved edges	Number of vertices
a b c d e					

17.2 Cube

All the surface parts of a die are plane surfaces. All its faces take the shape of a square and are of equal size. A solid object such as a die, with all its faces square shaped and of equal size, is said to be the shape of a cube.

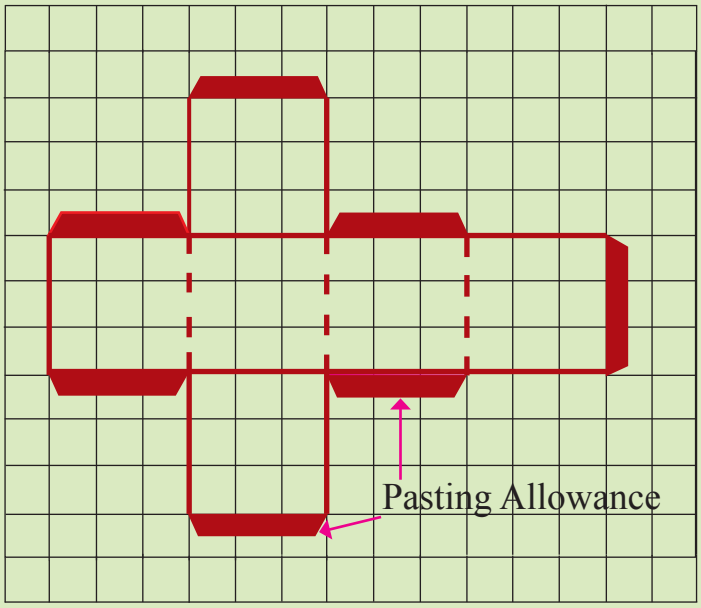
Activity 2

Step 1 - Using equal length pieces of ekel and a suitable substance such as clay to join the pieces together, prepare a framework as shown in the figure.



Step 2 - Cut out sufficient square pieces of Bristol board or some other such thick paper to paste on the framework. Using sellotape, paste the 6 square shaped pieces on the framework and prepare a model of a cube.

Step 3 - Draw the following figure on a square ruled paper.



Step 4 - Cut out the figure that you drew and either copy it or paste it on a thick piece of paper such as a Bristol board.

Step 5 - Cut out the figure on the thick piece of paper and by folding along the relevant lines and pasting down the shaded allowances, prepare a model of a cube.

Step 6 - Examine the shape of a face, and determine the number of faces, the number of edges, the number of vertices and other special properties of the model you prepared. Write down the properties you identified in your exercise book.

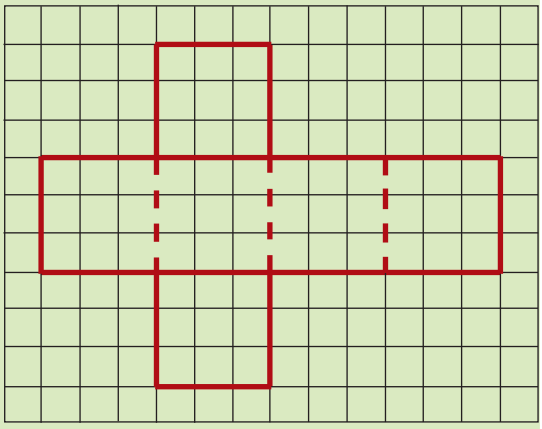


figure 1 - net of the cube

Without the pasting allowances, the above figure which was used to create a model of a cube is a **net of the cube.**

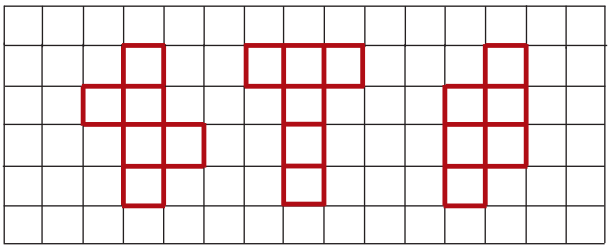
Step 7 - In your square ruled exercise book, draw two other nets that can be used to prepare a model of a cube.

The properties you can identify in a cube.

- A cube has 6 faces. The shape of each face is a square.
- All the faces of a cube are identical to each other.
- A cube has 12 edges. All 12 edges are rectilinear.
- A cube has 8 vertices.

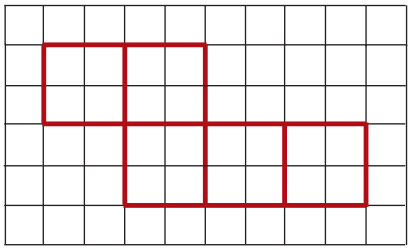
Exercise 17.2

(1) From the following figures, select the nets that can be used to create cubes and draw them in your exercise book.



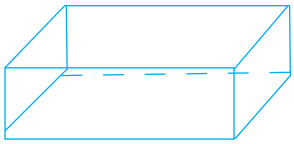
(2) Write down two solid objects which take the shape of a cube.

(3) A portion of a net that can be used to make a cube is given in the figure. Complete the net and draw it in your exercise book.



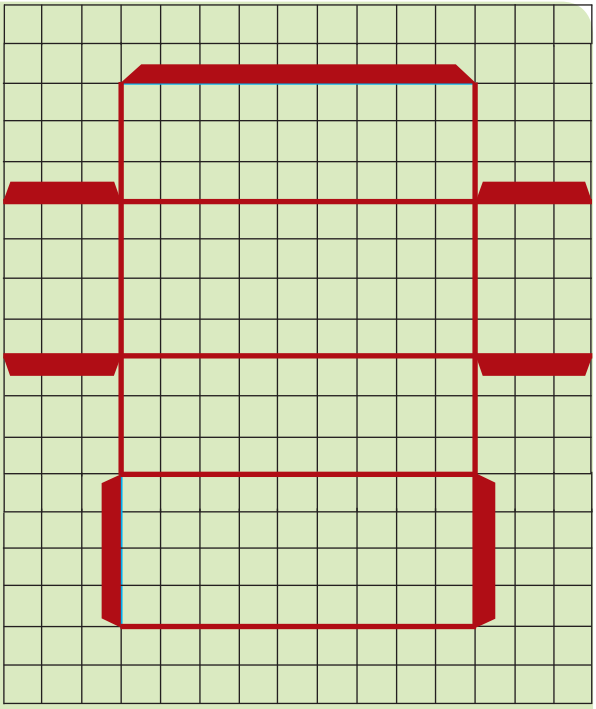
(4) Draw a suitable net to prepare a cube of side length 3 cm.

17.3 Cuboid



A brick is a solid object which takes the shape of a cuboid.

Activity 3



Step 1 – Draw the figure given here on a square ruled piece of paper. Copy or paste this on a piece of Bristol board.

Step 2 – Make a model of a cuboid by cutting the figure on the Bristol board, folding it appropriately and pasting along the allowances.

Step 3 – Measure and write down the length, breadth and height of the model you created.

Step 4 – Examine the model that you made, and identify the shapes of the faces of the cuboid, the number of faces, edges and vertices and any other special properties.

Step 5 – Write down the properties that you identified in your exercise book.

Without the pasting allowances, the above figure which was used to create a model of a cuboid is a net of the cuboid.

Step 6 – In your exercise book, draw another net that can be used to prepare a model of a cuboid.

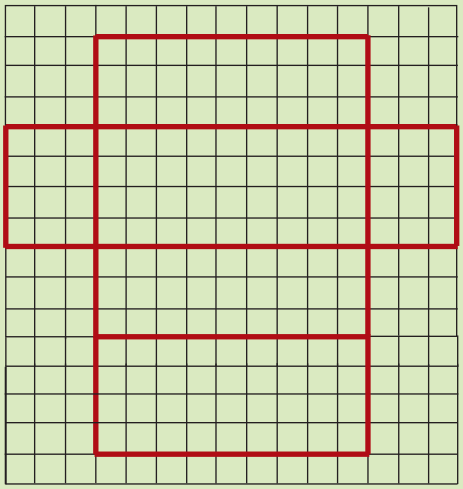


Figure 2 - net of the cuboid

The properties you can identify in a cuboid.

- A cuboid has 6 faces. The faces of a cuboid take the shape of rectangles (some of which may be squares).
- The faces which are opposite each other are equal in size and shape.
- A cuboid has 12 edges. All 12 edges are rectilinear.
- A cuboid has 8 vertices.

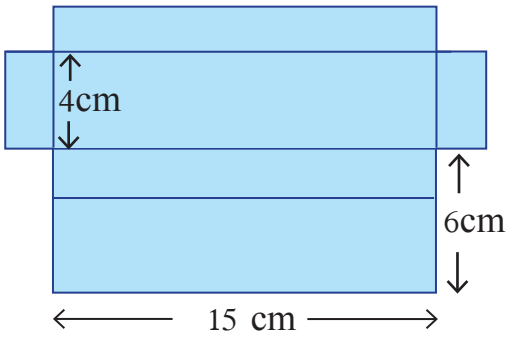
Exercise 17.3

(1) Name five objects that you can observe in your environment which take the shape of a cuboid.

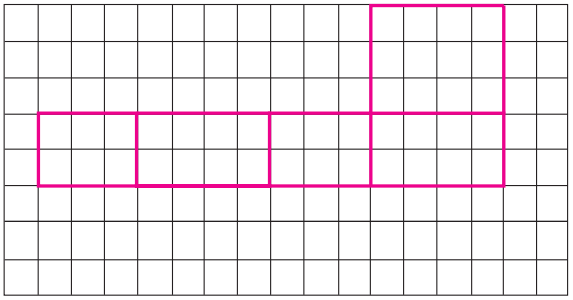
(2) (i) Draw a figure of a cuboid in your square ruled exercise book.

(ii) Measure and write down the length, breadth and height of the cuboid that was drawn.

(3) Write down the length, breadth and height of the cuboid that can be made with the net in the figure.



(4) The figure illustrates a part of a net drawn to make a cuboid. Complete it and draw it in your square ruled exercise book.



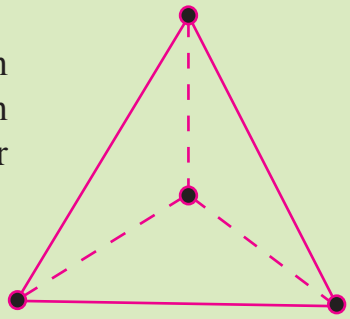
(5) It is required to make a cuboid of length 10 cm, breadth 6 cm and height 4 cm. Draw a net for the above cuboid and mark its measurements, by assuming that the length of 1 square of a square ruled page is 1 cm.

17.4 Regular Tetrahedron

Now let us identify properties of a regular tetrahedron which is a solid object, by doing the following activity.

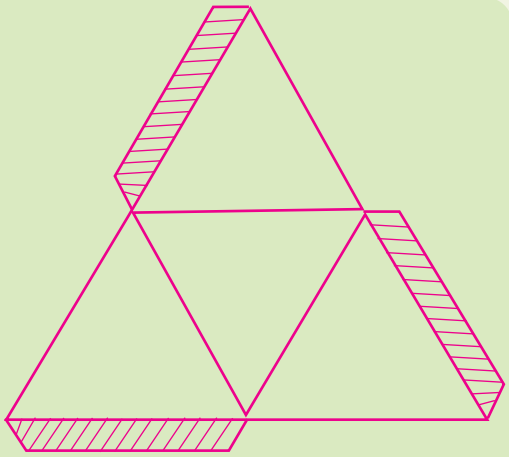
Activity 4

Step 1 - Prepare a framework as shown in the figure by using 6 equal length pieces of ekel or straws and clay, or some other suitable substance.



Step 2 - Cut out sufficient triangular pieces of Bristol board or some other such thick paper to paste on the framework. Using sellotape, paste the 4 triangular shaped pieces on the framework and prepare a model of a regular tetrahedron.

Step 3 - With the aid of a tissue paper, copy the figure given here onto a Bristol board.



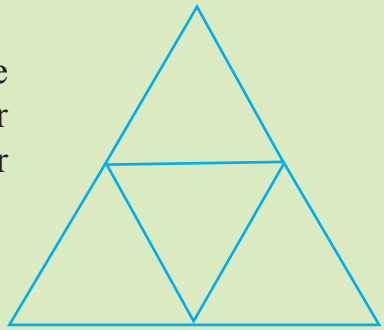
Step 4 - Cut out the figure, fold it appropriately along the straight lines and by pasting down the allowances, make a model of a solid.

Step 5 - Identify the shape of the model, the shape of its faces, the number faces, edges and vertices and any other special properties.

Step 6 - Write down the properties that you identified in your exercise book.

Step 7 - Measure the lengths of the edges of the model.

Without the pasting allowances, the figure used above to prepare a model of a regular tetrahedron is a net of the regular tetrahedron.



Step 8 - Draw another net that can be used to prepare a model of a regular tetrahedron.

What you made in the above activity is a model of a tetrahedron.

All its faces are equal and all its edges too are equal. Therefore it is a regular tetrahedron.

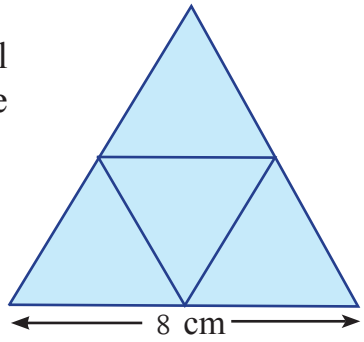
The properties you can identify in a regular tetrahedron.

- The faces of a regular tetrahedron take the shape of a triangle.
- It has 4 faces.
- A regular tetrahedron has 6 edges. All the edges are rectilinear.
- A regular tetrahedron has 4 vertices.

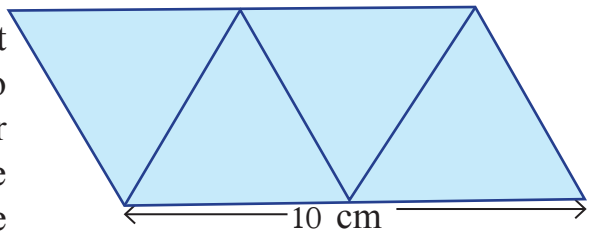
Exercise 17.4

(1) What is the shape of a face of a regular tetrahedron?

(2) What is the length of an edge of the model of a regular tetrahedron that can be made using the net given in the figure?



(3) The figure depicts a net which can be used to make a model of a regular tetrahedron. What is the length of an edge of the regular tetrahedron that can be made using this net?



(4) Draw a suitable net to create a model of a regular tetrahedron with edges of length 6 cm (Draw one triangle of the net on a tissue paper and using it prepare the net).

17.5 Compound Solids

It is possible to construct a compound solid by combining together some of the solids that you have already identified.

Activity 5

Step 1 - Using Bristol board, make models of the following solids, according to the given measurements.

- ⋆ Two cubes with edges of length 6 cm.
- ⋆ Two regular tetrahedrons with edges of length 6 cm.
- ⋆ Two identical cuboids.

Step 2 - By placing the two models of the cube together and pasting them, create a compound solid.

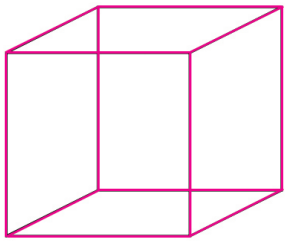
Step 3 - By placing the two regular tetrahedrons together and pasting them, create a compound solid.

Step 4 - By placing the two cuboids together and pasting them, create a compound solid.

Step 5 - Examine and compare the properties of the compound solids that were created with the properties of the solids that were used to create them.

Exercise 17.5

(1) A compound solid is made by placing the cube in the figure on an identical cube, such that two of the faces coincide, and then pasting them together.



(i) What is the name of the solid that is made?

(ii) Write down the measurements of the solid.

(2) A solid has been made by placing two identical regular tetrahedrons together, such that two of their faces coincide, and then pasting these two faces together. For this compound figure, write down

(i) the number of faces.

(ii) the number edges.

(iii) the number of vertices.

Summary

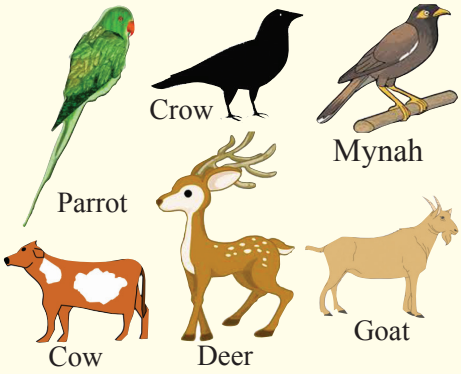
An object of specific shape which occupies a certain amount of space is called a solid.

Property / Solid	Shape of a face	Number of faces	Number of edges	Number of vertices
Cube	Square	6	12	8
Cuboid	Rectangle	6	12	8
Regular Tetrahedron	Triangle	4	6	8

Revision Exercise - 2

(1) (i) Separate the collection of animals given here into two groups based on their common characteristics.

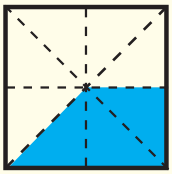
(ii) Write a suitable name for each group.



(2) (i) In the pattern of triangular numbers written in ascending order as 1, 3, 6, 10, ... write down the next two terms.

(ii) In the pattern of the multiples of 5 written in ascending order as 5, 10, 15, 20,... which term is 50?

(3) (i) Write down the shaded part in the figure as a fraction by taking the whole figure as a unit.



(ii) Find the value.

(a) $\frac{1}{5} + \frac{1}{10}$ (b) $\frac{1}{2} + \frac{2}{3}$ (c) $\frac{3}{8} + \frac{1}{4}$ (d) $\frac{4}{7} - \frac{3}{14}$ (e) $\frac{7}{12} - \frac{1}{3}$

(4) Find the value.

(i) 0.5 + 0.65 (ii) 2.76 + 1.44 (iii) 1.71 − 0.9 (iv) 2.13 − 1.89

(5) (i) Write down all the multiples of nine, which are greater than 0 and less than 90.

(ii) Write down the factors of 84.

(6) A person sold $\frac{3}{10}$ of his land and handed over $\frac{1}{5}$ to his son.

(i) Choose and write the <u>false</u> statement regarding the above two fractions.

(a) Both the fractions are proper fractions.

(b) Both the fractions are unit fractions.

(c) Only one fraction is a unit fraction.

(ii) Write the relevant values in the boxes.

$\frac{1}{5} = \frac{1 \times 2}{5 \times \square} = \frac{2}{\square}$

(iii) Find the fraction that results when $\frac{1}{5}$ and $\frac{3}{10}$ are added.

(iv) Show that the person is now left with half the land.

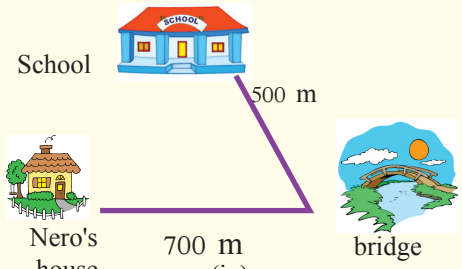
(v) The part remaining which is rectangular in shape is of length 50 m 40 cm. The width is 20 m 75 cm.

(a) How much greater is the length than the width in metres?

(b) Find the sum of the lengths of the all the sides of the remaining plot of land.

(7) (i) The length of a rectangular blackboard is 1 m and 50 cm. The width is 80 cm. Find the sum of the lengths of the four sides of the blackboard?

(ii) When one goes to the school from Nero's house across the bridge, express the distance in kilometres that one has to travel.



(8)

(i)

m	cm
5	75
+2	45

(ii)

km	m
10	660
+ 3	890

(iii)

l	ml
4	750
+ 2	350

(iv)

l	ml
5	000
− 2	050

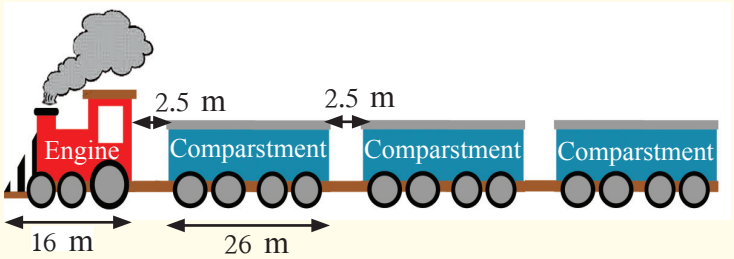
(9) Write the given numbers in ascending order in each of the following cases.

(i) $\frac{1}{12}, \frac{5}{6}, 1$

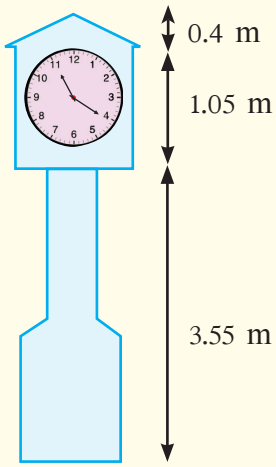
(ii) 1, 1.1, 0.1, 0.2, 0.3

(10) (i) The length of a train engine is 16 m. The length of a compartment is 26 m. The gap between two compartments when joined is 2.5 m.

What is the length of a train with an engine and three compartments?



(ii)



The illustration shows you a clock tower in a town. Express its total height in metres?

(11) (a) From among the six numbers,

675, 908, 993, 1970, 2435, 3800

(i) select and write down the numbers which are divisible by 2.

(ii) select and write down the numbers which are divisible by 5.

(iii) how many numbers are there which are divisible by both 2 and 5 ?

(b) (i) Fill in the blanks using suitable whole numbers.

$1 \times \square = 12$, $2 \times \square = 12$, $3 \times \square = 12$

(ii) Hence or otherwise, find the factors of 12.

(iii) In the same manner, find the factors of 18.

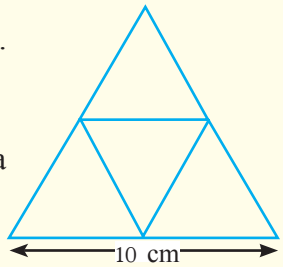
(iv) According to the above results, find the factors which are common to both the numbers 12 and 18.

(12) (i) Write down solids in which each of the following rectilinear plane figures can be observed.

Rectangle -
Square -
Triangle -

(ii) Write down 2 characteristics observed in a square and a trapezium.

(iii) A net of a regular tetrahedron is shown in the figure.



(a) What is the shape of a face of a regular tetrahedron?

(b) What is the length of an edge of the model of a tetrahedron that can be made using this net?

(13)

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

(i) Write down all the even numbers among the ten whole numbers given above.

(ii) Write down the least odd number and the greatest odd number among the ten whole numbers given above.

(iii) Write down all the prime numbers that lie between 20 and 30.

(14) (i) Several measuring units used in day to day life are given below.

metres, millilitres, centimetres, litres, kilometres

(a) Separate these measuring units into two groups having common characteristics.

(b) Write a suitable name for each group.

(c) Write down each of these measuring units along with its symbol.

(d) Write down the relationships between the measuring units in each of the groups.

(15) (i) (a) Express the amount 1 *l* 50 ml of liquid in millilitres.

(b) Express 2035 litres in terms of litres and millilitres.

(c) When 150 millilitres of water per glass is poured from one litre into 6 glasses, what is the remaining amount of water?

(ii) From 5 metres of white material, 2.5 metres are cut for a frock and 1.75 metres are cut for a shirt. Express the length of the remaining material in centimetres.

(16) (i) Write down the names of two objects which take the shape of a cuboid.

(ii) Draw a net to make a box having the shape of a cuboid.

(iii) Write down the number of faces, number of vertices and number of edges of a cuboid.