

UNIT 6

VISUALISING SOLID SHAPES

(A) Main Concepts and Results

- **3D shapes/objects** are those which do not lie completely in a plane.
- 3D objects have different views from different positions.
- A **solid** is a polyhedron if it is made up of only polygonal faces, the faces meet at edges which are line segments and the edges meet at a point called vertex.
- Euler's formula for any polyhedron is,

$$F + V - E = 2$$

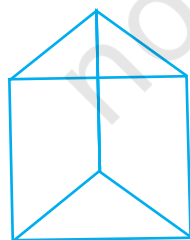
Where F stands for number of faces, V for number of vertices and E for number of edges.

- Types of polyhedrons:

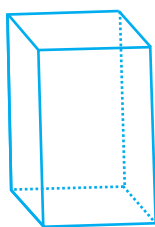
(a) Convex polyhedron

A convex polyhedron is one in which all faces make it convex.

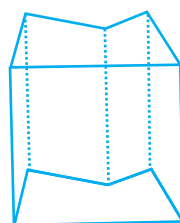
e.g.



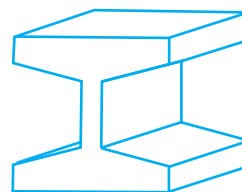
(1)



(2)



(3)



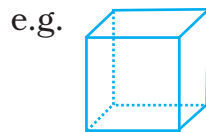
(4)

(1) and (2) are convex polyhedrons whereas (3) and (4) are non convex polyhedron.

(b) **Regular polyhedra** or platonic solids:

A polyhedron is regular if its faces are congruent regular polygons and the same number of faces meet at each vertex.

For example, a cube is a platonic solid because all six of its faces are congruent squares. There are five such solids—tetrahedron, cube, octahedron, dodecahedron and icosahedron.

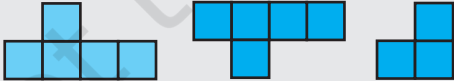



Cube

- A **prism** is a polyhedron whose bottom and top faces (known as bases) are congruent polygons and faces known as lateral faces are parallelograms (when the side faces are rectangles, the shape is known as right prism).
- A **pyramid** is a polyhedron whose base is a polygon and lateral faces are triangles.
- A **map** depicts the location of a particular object/place in relation to other objects/places.


Try This


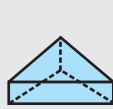


The front, top and side of a figure are shown. Use centimetre cubes to build the figure. Then sketch the figure.

1. 
 Front Top Side

2. 
 Front Top Side

3. The views below represent a three-dimensional figure that cannot be built from cubes. Determine which three-dimensional figures match the views.


 Front Top Side

A  B  C  D 

- Scale is the relationship between the drawing's/model's dimensions to the actual object's dimensions.
- In a map, symbols are used to depict the different objects and places.
- Maps involve a scale which is fixed for a particular map.

Think and Discuss

1. **Explain** how you would find the surface area of an open-top box that is shaped like a rectangular prism.
2. **Describe** the shapes in a net used to cover a cylinder.

(B) Solved Examples

In examples 1 and 2, write the correct answer from the given four options.

Example 1 : A prism is a polyhedron whose lateral faces are
 (a) Circles (b) Triangles
 (c) Parallelograms (d) Rhombuses or Rhombi

Solution : Correct answer is (c).

Example 2 : A pyramid is a polyhedron whose lateral faces are
 (a) Rectangles (b) Triangles
 (c) Parallelograms (d) Rhombuses or Rhombi

Solution : Correct answer is (b).

In examples 3 and 4, fill in the blanks to make the statements true

Example 3 : In a regular polyhedron _____ number of faces meet at each vertex.

Solution : same.

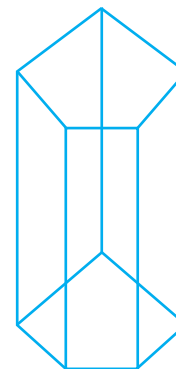
Example 4 : A pentagonal prism has _____ edges.

Solution : 15.

In examples 5 and 6, state whether the statements are true or false.

Example 5 : A sphere is a polyhedron.

Solution : False.

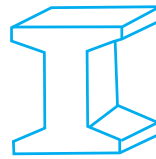


Pentagonal prism

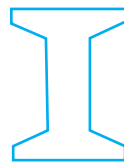
Example 6 : In a prism the lateral faces need not be congruent

Solution : True.

Example 7 : Draw the top, front and side views of the given solid.



Solution :



Front view






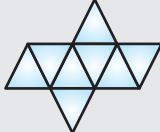

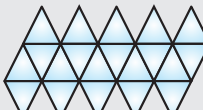

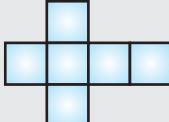

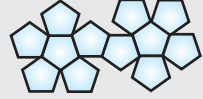
Top view



Side view

Activity

Use a compass and straight edge to create a larger version of each net on a cardboard. Fold each net into a polyhedron.

| REGULAR POLYHEDRONS | | | |
|---------------------|--------------|---|---|
| NAME | FACES | EXAMPLE | NET |
| Tetrahedron | 4 triangles |  |  |
| Octahedron | 8 triangles |  |  |
| Icosahedron | 20 triangles |  |  |
| Cube | 6 squares |  |  |
| Dodecahedron | 12 pentagons |  |  |

Example 8 : Use isometric dot paper to sketch a rectangular prism with length 4 units, height 2 units and width 3 units.

Solution : Steps:

- (1) Draw a parallelogram with sides 4 units and 3 units.

This is top of the prism (Fig 1).

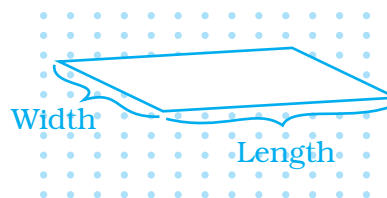


Fig. 1

- (2) Start at one vertex. Draw a line passing through two dots. Repeat for other three vertices. Draw the hidden edges as dashed line (Fig 2).

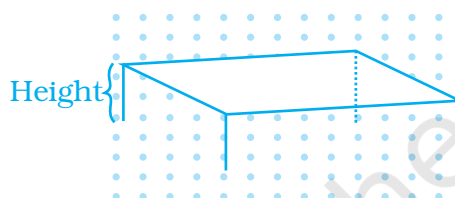


Fig. 2

- (3) Connect the ends of the lines to complete the prism (Fig 3).

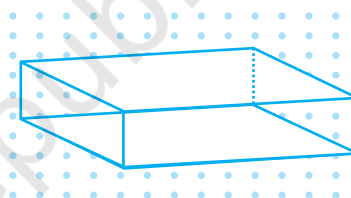


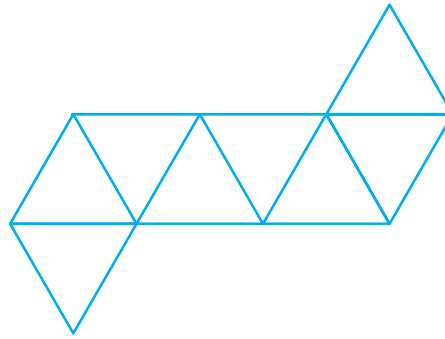
Fig. 3

Try This

1. Complete the table for the number of vertices V, edges E and faces F for each of the polyhedrons you made.
2. **Make a Conjecture**
What do you think is true about the relationship between the number of vertices, edges and faces of a polyhedron?

| POLYHEDRON | V | E | F | V - E + F |
|---------------------|---|---|---|-----------|
| Tetrahedron | | | | |
| Octahedron | | | | |
| Icosahedron | | | | |
| Cube | | | | |
| Dodecahedron | | | | |

Example 9 : Identify the shape whose net is given below.

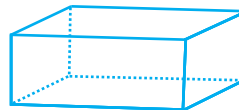


Solution : This shape is entirely made of equilateral triangles. When folded, it results in a regular octahedron. Note that since these are all equilateral and congruent faces, it is a **regular polyhedron**.

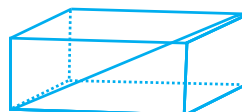
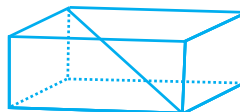
Use Nets to Create Polyhedrons

A polyhedron is formed by four or more polygons that intersect only at their edges. The faces of a regular polyhedron are all congruent regular polygons and the same number of faces intersect at each vertex. Regular polyhedrons are also called Platonic solid. There are exactly five regular polyhedrons.

Example 10 : The solid given below is a rectangular prism or cuboid. Make all the diagonals of this shape.

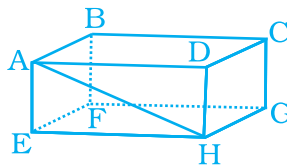


Solution : There are only four diagonals as shown below.

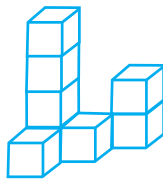


Note that in a 3D shape, diagonals connect two vertices that do not lie on the same face.

E.g. the line segment from A to H in figure below is not a diagonal for the solid. Diagonals must pass through the inside of the shape. However, AH is diagonal of face ADHE.



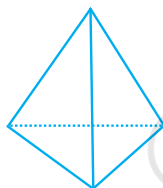
Example 11: Count the number of cubes in the given shapes.



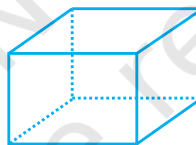
Solution : (i) 8 cubes

(ii) 6 cubes

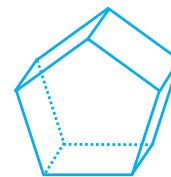
Example 12: Name the following polyhedrons and verify the Euler's formula for each of them.



(a)



(b)



(c)

Solution :

| S. No | Polyhedron | F | V | F + V | E | F + V - E |
|-------|------------------|---|----|-------|----|-----------|
| (a) | Tetrahedron | 4 | 4 | 8 | 6 | 2 |
| (b) | Cube | 6 | 8 | 14 | 12 | 2 |
| (c) | Pentagonal prism | 7 | 10 | 17 | 15 | 2 |

Volume, the space inside a three-dimensional object, is measured in cubic unit. If the blocks you build are each 1 cubic unit, then the volume of a block structure is equal to the number of blocks in the structure. For example, a structure made from eight blocks has a volume of 8 cubic units. If the blocks have an edge length of 1 cm, the structure's volume is 8 cm³.

Example 13 : A polyhedron has 7 faces and 10 vertices. How many edges does the polyhedron have?

Solution : For any polyhedron,

$$F + V - E = 2$$

$$\text{Here, } F = 7, V = 10, E = ?$$

Using above formula,

$$\Rightarrow 7 + 10 - E = 2$$

$$\Rightarrow 17 - E = 2$$

$$\Rightarrow 17 - 2 = E$$

$$\Rightarrow E = 15$$

Example 14 : Find the number of vertices in a polyhedron which has 30 edges and 12 faces.

Solution : For any polyhedron,

$$F + V - E = 2$$

$$\text{Here, } F = 12, V = ?, E = 30$$

Using above formula,

$$12 + V - 30 = 2$$

$$V - 18 = 2$$


$$V = 2 + 18$$

$$V = 20$$

Example 15 : The distance between City A and City B on a map is given as 6 cm. If the scale represents 1 cm = 200 km, then find the actual distance between City A and City B.

Solution : Actual distance represented by 1 cm = 200 km

Think and Discuss

What is the surface area of a single block in square units? 

If the edge lengths of a block are 2 cm, what is the block's surface area?

What is the volume of the structure at the right in cubic units? 

What is the surface area of the structure above in square units?

(Remember: Count only the squares on the outside of the structure.)

Actual distance represented by 6 cm = 6×200 km
 = 1200 km

So, actual distance between City A and City B is 1200 km.

Example 16 : Height of a building is 9 m and this building is represented by 9 cm on a map. What is the scale used for the map?

Solution : Scale of map = $\frac{\text{Size drawn}}{\text{Actual size}}$
 $= \frac{9 \text{ cm}}{900 \text{ cm}}$ (because 9 m = 900 cm)
 $= \frac{1}{100}$

Thus, scale is 1:100.

Example 17 : The scale on a map is 1 mm : 4 m. Find the distance on the map for an actual distance of 52 m.

Solution : Distance on map for an actual distance of 4 m = 1 mm
 Distance on map for actual distance of 52 m = $\frac{1}{4} \times 52$
 = 13 mm

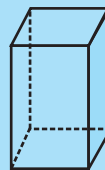
Thus, distance on map for actual distance of 52 m is 13 mm.

All **prisms** have two identical, parallel faces. These two faces are always polygons. A prism's other faces are always parallelograms.

A prism is sometimes referred to by the shape of the two identical faces on its ends. For example, a triangular prism has triangular faces on its ends, and a *rectangular prism* has rectangular faces on its ends.



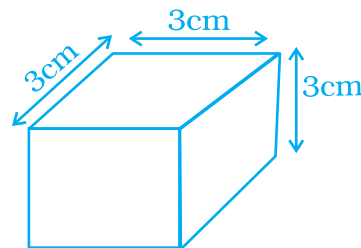
Triangular Prism



Rectangular Prism

Example 18 : Application of problem solving strategy

Determine the number of edges, vertices and in the following figure:



Solution : Understand and Explore the problem

- What information is given in the question?
A cube with one of its corner cut.
- What are you trying to find?
The no. of edges, vertices and faces.
- Is there any information that is not needed?
The measures of edges are not needed.

Plan a strategy

- Think of the definitions of an edge, vertex and faces and try to co-relate them to the figure given above.

Solve

- The polygonal regions are called faces, hence there are 7 faces.
- The line segment formed by the intersection of two faces is called edges, hence there are 15 edges.
- Edges meet at vertices which are points, hence there are 10 vertices.

Revise

- The above answer is verified using Euler's Formula.

$$F + V = E + 2$$

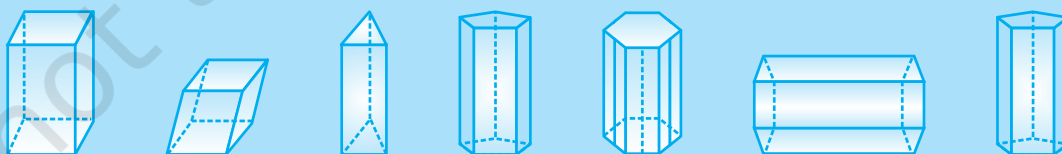
For the above problem, $F = 7, V = 10, E = 15$

$$F + V = 7 + 10 = 17$$

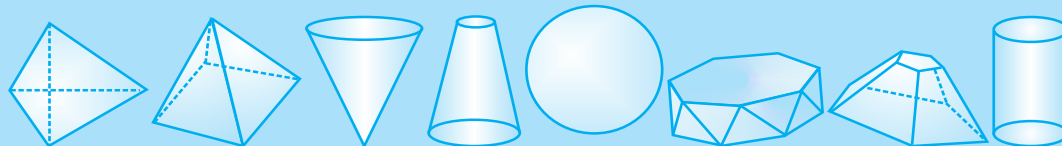
$$E + 2 = 15 + 2 = 17$$

Hence $F + V = E + 2$ is verified.

These figures are prisms.



These figures are not prisms.

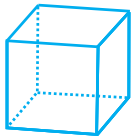


(C) Exercise

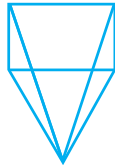
In each of the questions 1 to 21, out of four options only one is correct.

Write the correct answer.

1. Which amongst the following is not a polyhedron?



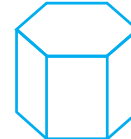
(a)



(b)



(c)



(d)

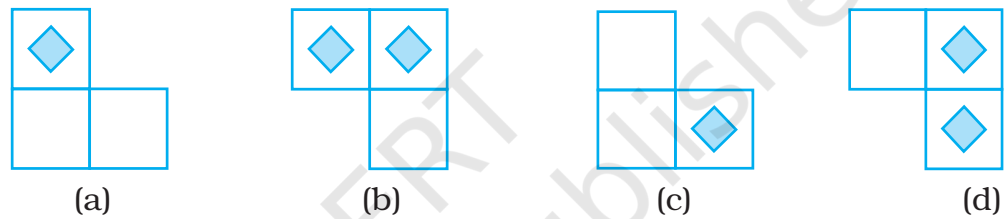
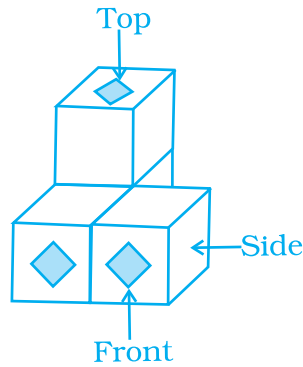
2. Which of the following will not form a polyhedron?
 (a) 3 triangles (b) 2 triangles and 3 parallelogram
 (c) 8 triangles (d) 1 pentagon and 5 triangles
3. Which of the following is a regular polyhedron?
 (a) Cuboid (b) Triangular prism
 (c) Cube (d) Square prism
4. Which of the following is a two Dimensional figure?
 (a) Rectangle (b) Rectangular Prism
 (c) Square Pyramid (d) Square Prism
5. Which of the following can be the base of a pyramid?
 (a) Line segment (b) Circle (c) Octagon (d) Oval
6. Which of the following 3D shapes does not have a vertex?
 (a) Pyramid (b) Prism (c) Cone (d) Sphere
7. Solid having only line segments as its edges is a
 (a) Polyhedron (b) Cone (c) Cylinder (d) Polygon

Think and Discuss

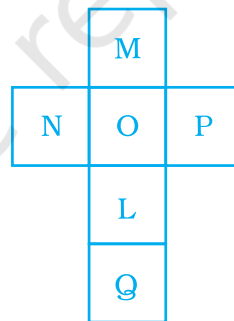
What do all the prisms have in common?

How are the non-prisms different from the prisms?

8. In a solid if $F = V = 5$, then the number of edges in this shape is
 (a) 6 (b) 4 (c) 8 (d) 2
9. Which of the following is the top view of the given shape?

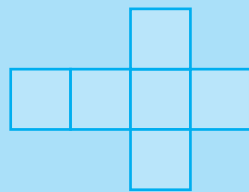


10. The net shown below can be folded into the shape of a cube. The face marked with the letter L is opposite to the face marked with which letter?

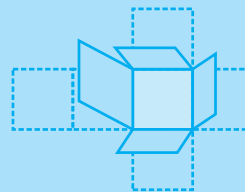


- (a) M (b) N (c) Q (d) O

A net is a flat figure that can be folded to form a closed, three-dimensional object. Such an object is called a solid.

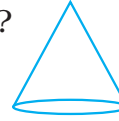


Net

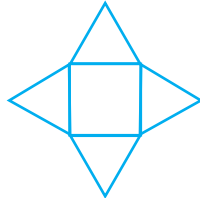


Solid Cube

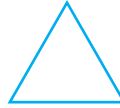
11. Which of the nets given below will generate a cone?



(a)



(b)

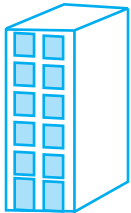


(c)

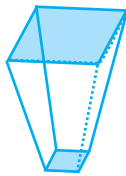


(d)

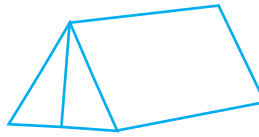
12. Which of the following is not a prism?



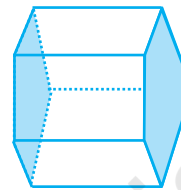
(a)



(b)



(c)



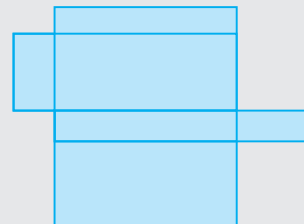
(d)

13. We have 4 congruent equilateral triangles. What do we need more to make a pyramid?

- (a) An equilateral triangle.
- (b) A square with same side length as of triangle.
- (c) 2 equilateral triangles with side length same as triangle.
- (d) 2 squares with side length same as triangle.

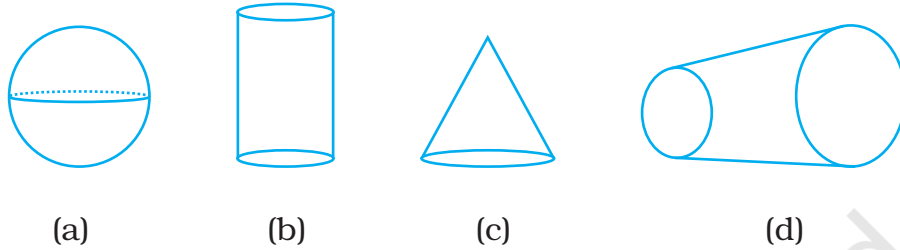
Share and Summarise

1. Explain how to find the surface area of a solid from the net for that solid.
2. Here is a net for a rectangular solid. Take whatever measurements you think are necessary to find the solid's volume and surface area. Explain what measurements you took and what you did with them.

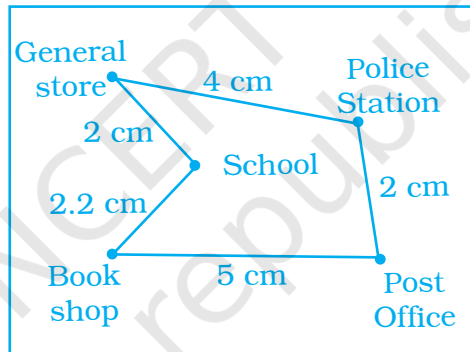


The **surface area** of a three-dimensional object is the space covering the object's surface. If you could pick up the object and flatten it so you could see all sides at once, the area of the flat figure would be the surface area. (Don't forget to count the bottom surface!) Surface area is also measured in square units.

14. Side of a square garden is 30 m. If the scale used to draw its picture is 1 cm : 5 m, the perimeter of the square in the picture is
 (a) 20 cm (b) 24 cm (c) 28 cm (d) 30 cm
15. Which of the following shapes has a vertex.



16. In the given map, the distance between the places is shown using the scale 1 cm : 0.5 km. Then the actual distance (in km) between school and the book shop is



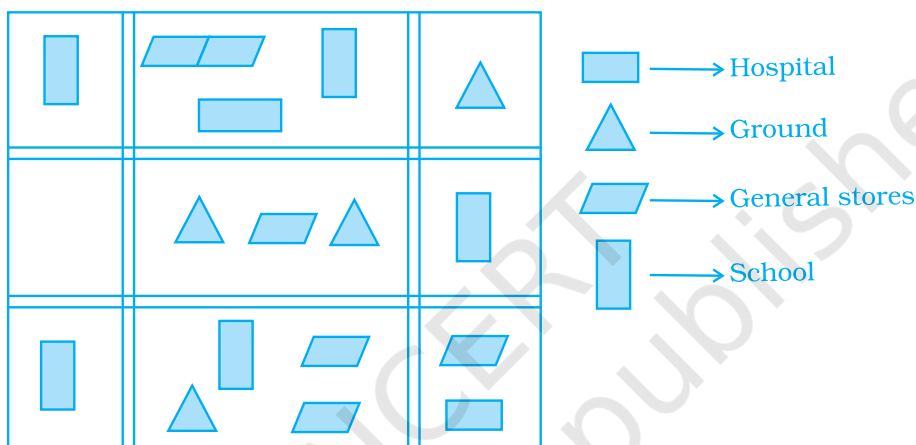
- (a) 1.25 (b) 2.5 (c) 2 (d) 1.1

Vocabulary Connections

To become familiar with some of the vocabulary terms in the chapter, consider the following.

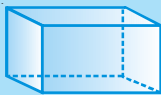
1. What does the term area total tell you about the meaning of surface area?
2. The word edge comes from the Latin word *acer*, meaning *sharp*. How does the Latin root help you define an edge of a three-dimensional figure?
3. The word vertex can mean *peak* or *highest* point. What part of a cone or pyramid is the vertex?
4. The word prism comes from the Greek word *priein*, meaning *to saw*. How might you describe a prism in terms of something sawn or cut off?

17. Which of the following cannot be true for a polyhedron?
 (a) $V = 4, F = 4, E = 6$ (b) $V = 6, F = 8, E = 12$
 (c) $V = 20, F = 12, E = 30$ (d) $V = 4, F = 6, E = 6$
18. In a blueprint of a room, an architect has shown the height of the room as 33 cm. If the actual height of the room is 330 cm, then the scale used by her is
 (a) 1:11 (b) 1:10 (c) 1:100 (d) 1:3
19. The following is the map of a town. Based on it answer question 19-21.



The number of hospitals in the town is

- (a) 1 (b) 2 (c) 3 (d) 4



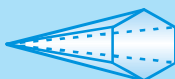
There are two rectangular bases.
There are four rectangular faces.
 The figure is a rectangular prism.



There is one rectangular base.
There are four triangular faces.
 The figure is a rectangular pyramid.



There are two triangular bases.
There are three rectangular faces.
 The figure is a triangular prism.

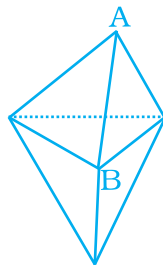


There is one hexagonal base.
There are six triangular faces.
 The figure is a hexagonal pyramid.

20. The ratio of the number of general stores and that of the ground is
 (a) 1 : 2 (b) 2 : 1 (c) 2 : 3 (d) 3 : 2
21. According to the map, the number of schools in the town is
 (a) 4 (b) 3 (c) 5 (d) 2

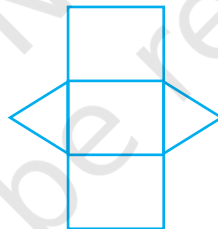
In questions 22 to 41, fill in the blanks to make the statements true.

22. Square prism is also called a _____.
23. Rectangular prism is also called a _____.



24. In the figure, the number of faces meeting at B is _____.

25. A pyramid on an n sided polygon has _____ faces.
26. If a solid shape has 12 faces and 20 vertices, then the number of edges in this solid is _____.



27. The given net can be folded to make a _____.

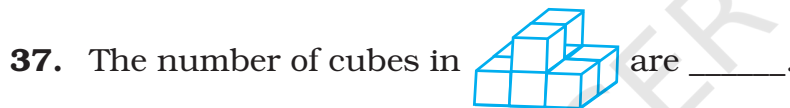
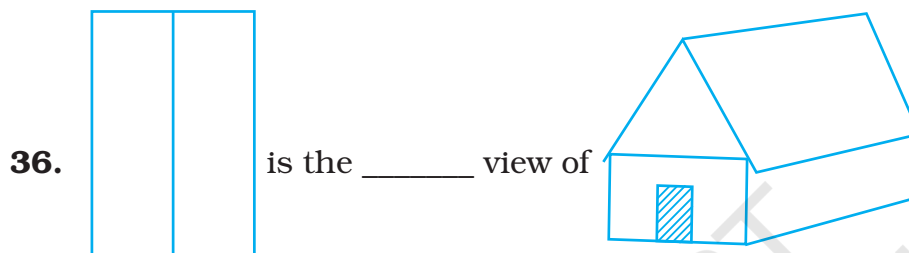
28. A solid figure with only 1 vertex is a _____.
29. Total number of faces in a pyramid which has eight edges is _____.
30. The net of a rectangular prism has _____ rectangles.

(Hint: Every square is a rectangle but every rectangle is not a square.)

Three-dimensional figures have three dimensions: length, width and height. A flat surface of a three-dimensional figure is a **face**. An **edge** is where two faces meet.

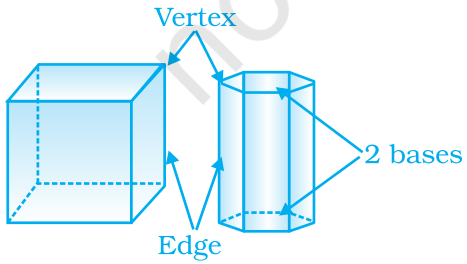
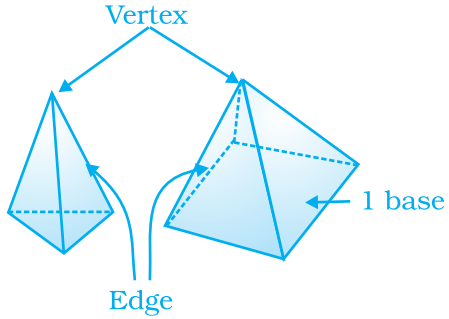
A **polyhedron** is a three-dimensional figure whose faces are all polygons. A **vertex** of a polyhedron is a point where three or more edges meet. The face that is used to name a polyhedron is called a **base**.

31. In a three-dimensional shape, diagonal is a line segment that joins two vertices that do not lie on the _____ face.
32. If 4 km on a map is represented by 1 cm, then 16 km is represented by _____ cm.
33. If actual distance between two places A and B is 110 km and it is represented on a map by 25 mm. Then the scale used is _____.
34. A pentagonal prism has _____ faces.
35. If a pyramid has a hexagonal base, then the number of vertices is _____.



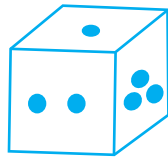
38. If the sum of number of vertices and faces in a polyhedron is 14, then the number of edges in that shape is _____.
39. Total number of regular polyhedra is _____.

A *prism* has two bases, and a *pyramid* has one base.

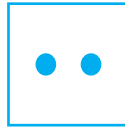
| Prisms | Pyramids |
|---|---|
| <p>A Prism is a polyhedron that has two parallel, congruent bases. The bases can be any polygon. The other faces are parallelograms.</p>  | <p>A pyramid is a polyhedron that has one base. The base can be any polygon. The other faces are triangles.</p>  |

40. A regular polyhedron is a solid made up of _____ faces.
41. For each of the following solids, identify the front, side and top views and write it in the space provided.

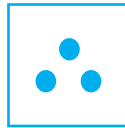
(a)



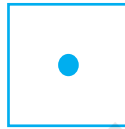
(i)



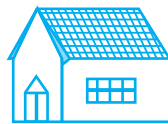
(ii)



(iii)



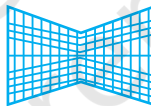
(b)



(i)



(ii)



(iii)





The faces are all polygons, so the figure is a polyhedron.

There is one triangular base.

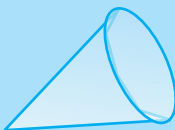
The figure is a triangular pyramid.



The faces are not all polygons, so the figure is not a polyhedron.

There are two circular bases.

The figure is a cylinder.

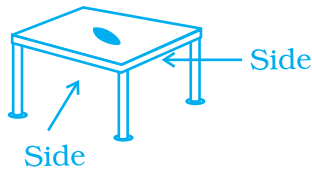


The faces are not all polygons, so the figure is not a polyhedron.

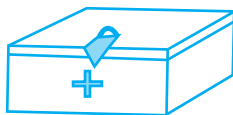
There is one circular base.

The figure is a cone.

(c)



(d)



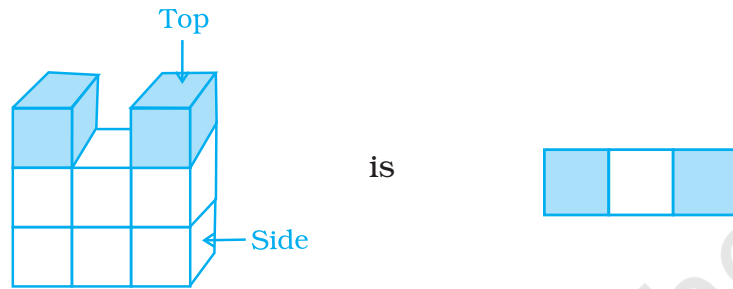
In each of the questions 42 to 61, state whether the following statements are true (T) or false (F).

42. The other name of cuboid is tetrahedron.
43. A polyhedron can have 3 faces.
44. A polyhedron with least number of faces is known as a triangular pyramid.
45. Regular octahedron has 8 congruent faces which are isosceles triangles.

Think and Discuss

1. **Explain** how to identify a prism or a pyramid.
2. **Compare and contrast** cylinders and prisms. How are they alike? How are they different?
3. **Compare and contrast** pyramids and cones. How are they alike? How are they different?

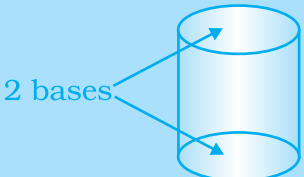
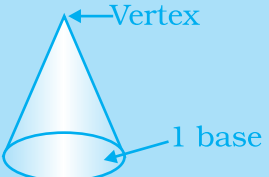
- 46. Pentagonal prism has 5 pentagons.
- 47. Every cylinder has 2 opposite faces as congruent circles, so it is also a prism.
- 48. Euler's formula is true for all three-dimensional shapes.
- 49. A polyhedron can have 10 faces, 20 edges and 15 vertices.
- 50. The top view of



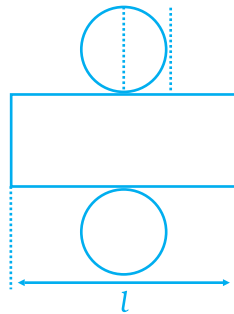
- 51. The number of edges in a parallelogram is 4.
- 52. Every solid shape has a unique net.
- 53. Pyramids do not have a diagonal.
- 54. The given shape is a cylinder.

- 55. A cuboid has atleast 4 diagonals.
- 56. All cubes are prisms.

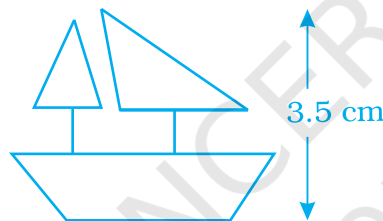
Cylinders and **cones** are not polyhedrons because they are not made of faces that are all polygons.

| Cylinders | Cones |
|--|---|
| <p>A cylinder has two parallel, congruent bases that are circles.</p>  | <p>A cone has one base that is a circle and a surface that comes to a point called the vertex.</p>  |

57. A cylinder is a 3-D shape having two circular faces of different radii.
 58. On the basis of the given figure, the length of a rectangle in the net of a cylinder is same as circumference of circles in its net.



59. If a length of 100 m is represented on a map by 1 cm, then the actual distance corresponding to 2 cm is 200 m.
 60. The model of a ship shown is of height 3.5 cm. The actual height of the ship is 210 cm if the scale chosen is 1: 60.

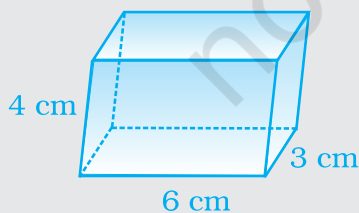


61. The actual width of a store room is 280 cm. If the scale chosen to make its drawing is 1:7, then the width of the room in the drawing will be 40 cm.

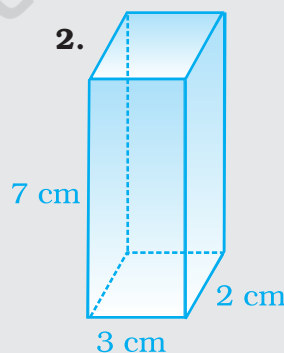
Try This

Find the volume of each prism.

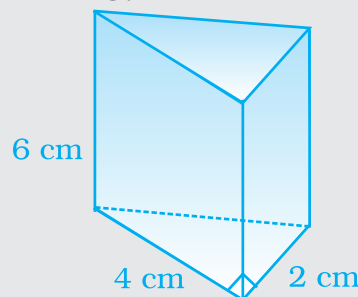
1.





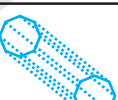

2.



3.



62. Complete the table given below:

| S. No | Solid | Shape of Solid | Number of faces F | Number of Vertices V | Number of edges E | F + V | E + 2 |
|-------|---------------------|---|-------------------|----------------------|-------------------|-------|-------|
| a. | Cuboid |  | | | | | |
| b. | Triangular Pyramid |  | | | | | |
| c. | Square Pyramid |  | | | | | |
| d. | Rectangular Pyramid |  | | | | | |
| e. | Pentagonal Pyramid |  | | | | | |
| f. | Hexagonal Pyramid |  | | | | | |
| g. | Triangular Prism |  | | | | | |
| h. | Square Prism |  | | | | | |
| i. | Cube |  | | | | | |
| j. | Pentagonal Prism |  | | | | | |
| k. | Octagonal Prism |  | | | | | |
| l. | Heptagonal Prism |  | | | | | |

63. How many faces does each of the following solids, have?

- (a) Tetrahedron
- (b) Hexahedron
- (c) Octagonal Pyramid
- (d) Octahedron

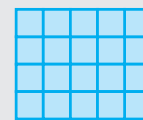
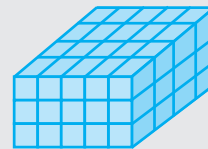
64. Draw a prism with its base as regular hexagon with one of its face facing you. Now draw the top view, front view and side view of this solid.
65. How many vertices does each of the following solids have?
- | | |
|-----------------|-----------------------|
| (a) Cone | (b) Cylinder |
| (c) Sphere | (d) Octagonal Pyramid |
| (e) Tetrahedron | (f) Hexagonal Prism |
66. How many edges does each of following solids have?
- | | |
|---------------------|-----------------------|
| (a) Cone | (b) Cylinder |
| (c) Sphere | (d) Octagonal Pyramid |
| (e) Hexagonal Prism | (f) Kaleidoscope |

Explore the volume of Prisms and Cylinders

The volume of a three-dimensional figure is the number of cubes it can hold. One cube represents one cubic unit of volume.

Activity

- Use centimetre cubes to build the rectangular prism shown. What are the length, width and height of the prism? How many cubes does the prism hold?
- You can find out how many cubes the prism holds without counting every cube. First look at the prism from above. How can you find the number of cubes in the top layer without counting every cube?
- Now look at the prism from the side. How many layers does the prism have? How can you use this to find the total number of cubes in the prism?



Top

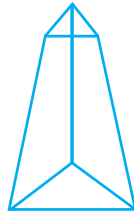


Side

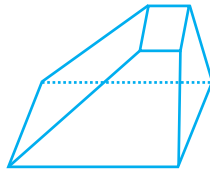
Think and Discuss

- Describe a shortcut for finding the number of cubes in a rectangular prism.
- Suppose you know the area of the base of a prism and the height of the prism. How can you find the prism's volume?
- Let the area of the base of a prism be B and the height of the prism be h . Write a formula for the prism's volume V .

67. Look at the shapes given below and state which of these are polyhedra using Euler's formula.



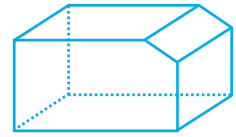
(a)



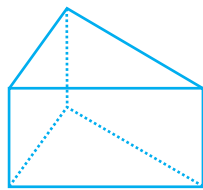
(b)



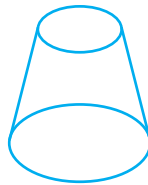
(c)



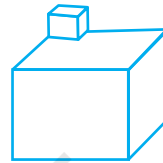
(d)



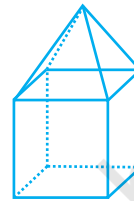
(e)



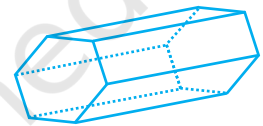
(f)



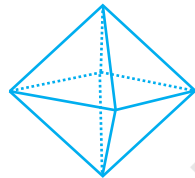
(g)



(h)



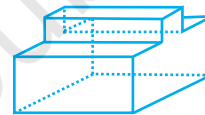
(i)



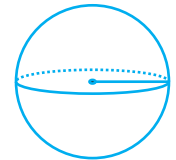
(j)



(k)



(l)

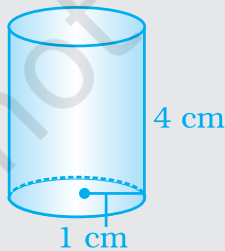


(m)

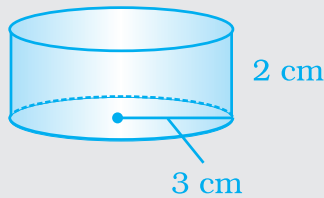
Try This

Find the volume of each cylinder.
Use 3.14 for π and round to the nearest tenth.

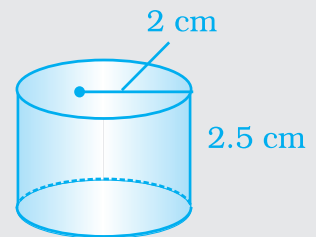
1.



2.

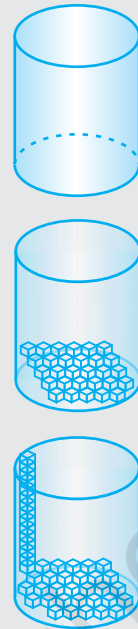


3.

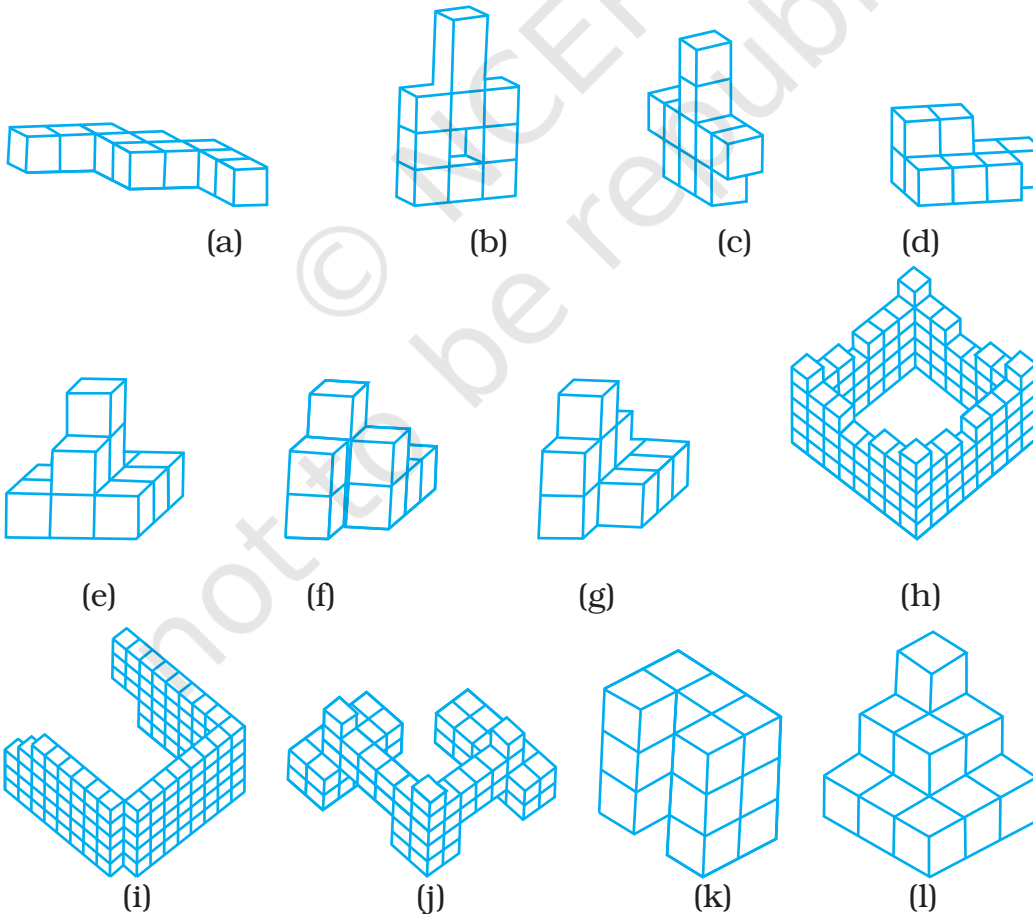


Activity

1. Use a similar process to that in earlier Activity to develop the formula for the volume of a cylinder. You will need an empty can or other cylindrical pot. Remove one of the bases.
2. Arrange centimetre cubes in a single layer at the bottom of the cylinder. Fit as many cubes into the layer as possible. How many cubes are in this layer?
3. To find how many layers of cubes would fit in the cylinder, make a stack of cubes along the inside of the cylinder. How many layers would fit in the cylinder?
4. How can you use what you know to find the approximate number of cubes that would fit in the cylinder?



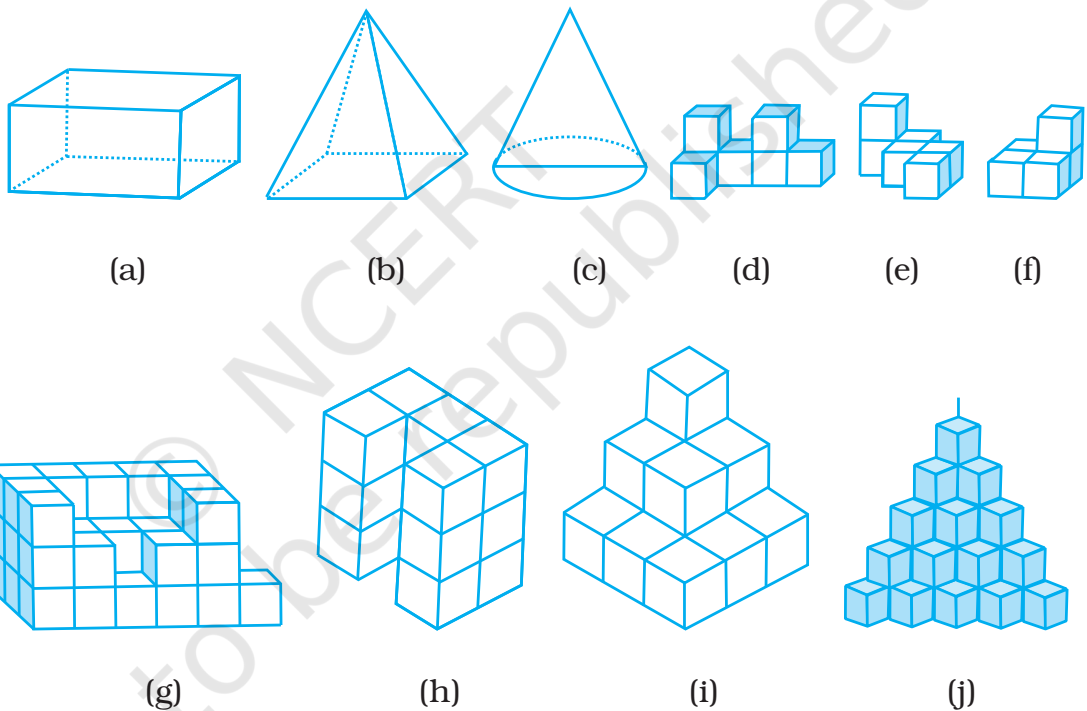
68. Count the number of cubes in the given shapes.



Think and Discuss

1. Suppose you know the area of the base of a cylinder and the height of the cylinder. How can you find the cylinder's volume?
2. Let the area of the base of a cylinder be B and the height of the cylinder be h . Write a formula for the cylinder's volume V .
3. The base of a cylinder is a circle with radius r . How can you find the area of the base? How can you use this in your formula for the volume of a cylinder?

69. Draw the front, side and top view of the given shapes.



Try This

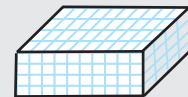
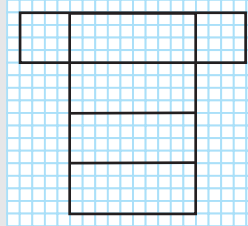
1. Use a net to construct a rectangular prism that is 3 cm by 6 cm by 9 cm.
2. Use a net to construct a cylinder with a height of 3 cm and a radius of 1.5 cm (Hint: The length of the rectangle in the net must match the circumference of the circles, so the length should be $2\pi r = 2\pi (1.5) \approx 9.42$ cm.)

Use Nets to Build Prisms and Cylinders

A net is a pattern of two-dimensions that can be folded to make a three-dimensional figure. You can use 1 cm graph paper to help you make nets.

Activity

- Use a net to construct a rectangular prism.

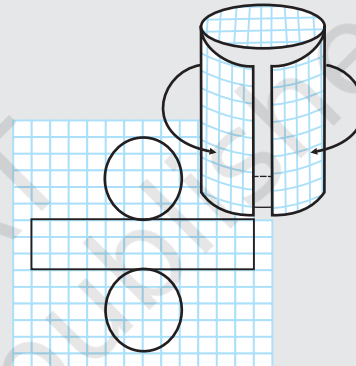


- Draw the net at right on a piece of graph paper. Each rectangle is 10 squares by 4 squares. The two squares are 4 small squares on each side.

- Cut out the net. Fold the net along the edges of each rectangle to make a rectangular prism. Tape the edges to hold them in place.

- Use a net to construct a cylinder.

- Draw the net at right on a piece of graph paper. The rectangle is 25 squares by 8 squares. Use a compass to make the circles. Each circle has a radius of 4 squares.



- Cut out the net. Fold the net as shown to make a cylinder. Tape the edges to hold them in place.

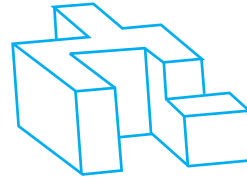
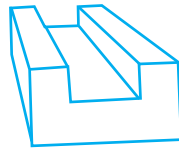
- Using Euler's formula, find the value of unknown x , y , z , p , q , r , in the following table.

| | (i) | (ii) | (iii) | (iv) | (v) | (vi) |
|-----------------|-----|------|-------|------|-----|------|
| Faces | 7 | y | 9 | p | 6 | 8 |
| Vertices | 10 | 12 | z | 6 | q | 11 |
| Edges | x | 18 | 16 | 12 | 12 | r |

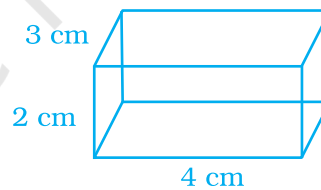
Think and Discuss

- What are the dimensions, in inches, of the rectangular prism that you built?
- What is the height, in cm, of the cylinder that you built? What is the cylinder's radius?

71. Can a polyhedron have $V = F = 9$ and $E = 16$? If yes, draw its figure.
72. Check whether a polyhedron can have $V = 12$, $E = 6$ and $F = 8$.
73. A polyhedron has 60 edges and 40 vertices. Find the number of its faces.
74. Find the number of faces in the given shapes:



75. A polyhedron has 20 faces and 12 vertices. Find the edges of the polyhedron.
76. A solid has forty faces and, sixty edges. Find the number of vertices of the solid.
77. Draw the net of a regular hexahedron with side 3 cm. (Hint: Regular hexahedron - cube)
78. Draw the net of a regular tetrahedron with side 6 cm.
79. Draw the net of the following cuboid:



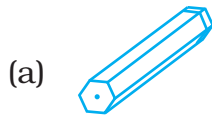
Think and Discuss

1. **Tell** whether a figure's surface area has increased or decreased if each dimension of the figure is changed by a factor of $\frac{1}{3}$.
2. **Explain** how the surface area of a figure is changed if each dimension is multiplied by a factor of 3.
3. **Explain** how the volume of a figure is changed if each dimension is multiplied by a factor of 2.

80. Match the following:

Figure

Name



(a) Hexahedron



(b) Hexagonal Prism



(c) Square Pyramid



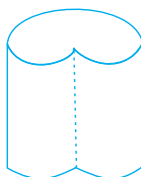
(d) Cone

81. Complete the table given below by putting tick mark across the respective property found in the solids mentioned.

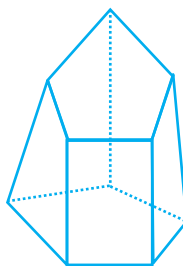
Solids

| Properties | Cone | Cylinder | Prism | Pyramid |
|--|------|----------|-------|---------|
| 1. The figure is a Polyhedron. | | | | |
| 2. The figure has diagonals. | | | | |
| 3. The shape has curved edges | | | | |
| 4. The base of figure is a polygon. | | | | |
| 5. The bases are congruent | | | | |
| 6. The base of figure is a polygon and other faces meet at a single point. | | | | |
| 7. The base of figure is a curved edge and other faces meet at a single point. | | | | |

82. Draw the net of the following shape.

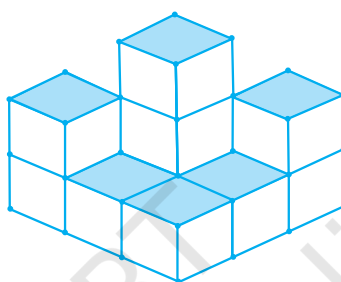


83. Draw the net of the following solid.

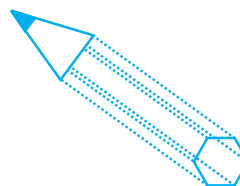


(Hint: Pentagons are not congruent.)

84. Find the number of cubes in the base layer of the following figure.

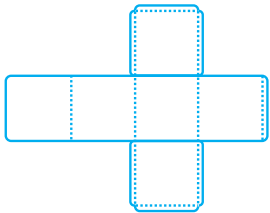
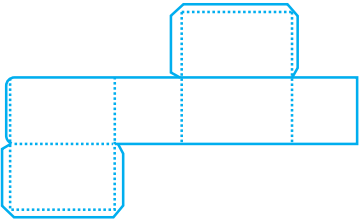
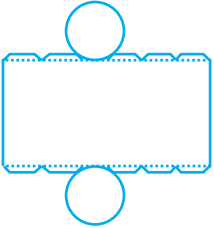

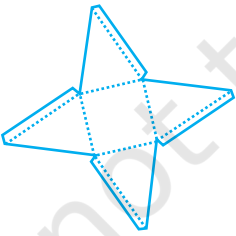
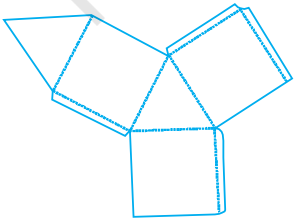


85. In the above figure, if only the shaded cubes are visible from the top, draw the base layer.
86. How many faces, edges and vertices does a pyramid have with n sided polygon as its base?
87. Draw a figure that represents your mathematics textbook. What is the name of this figure? Is it a prism?
88. In the given figures, identify the different shapes involved.

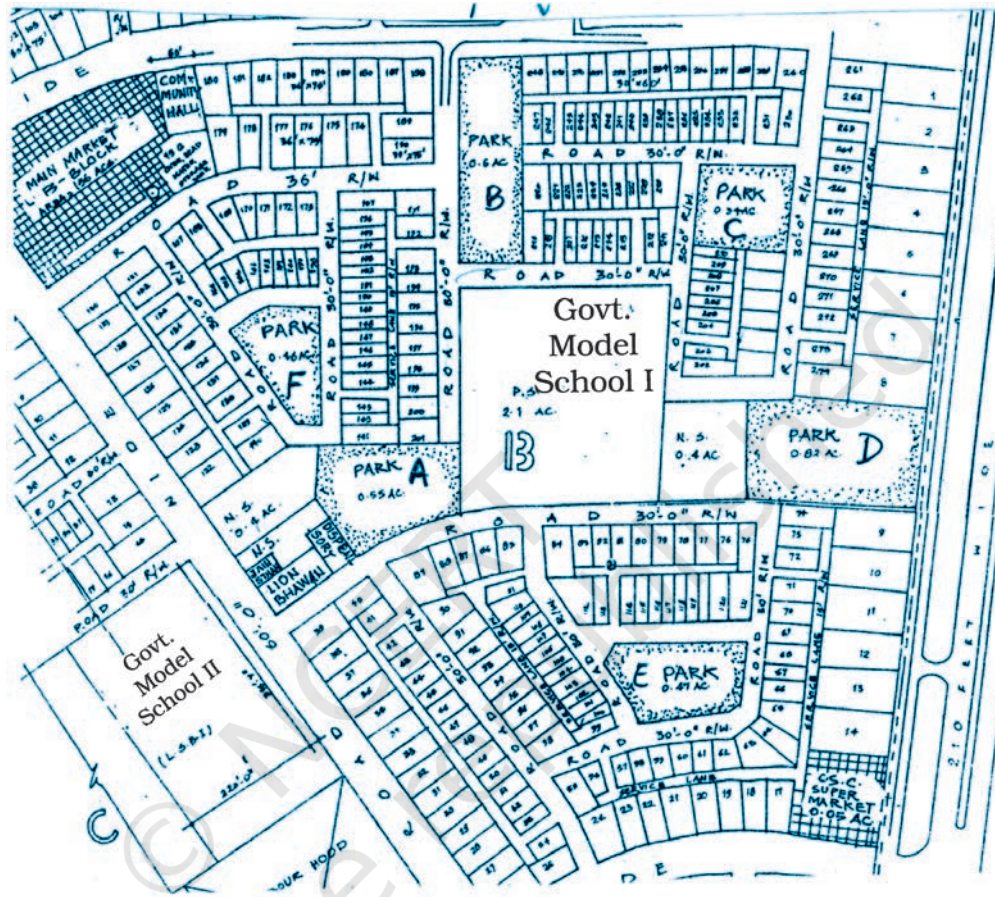


89. What figure is formed if only the height of a cube is increased or decreased?
90. Use isometric dot paper to draw each figure.
- A tetrahedron.
 - A rectangular prism with length 4 units, width 2 units and height 2 units.

91. Identify the nets given below and mention the name of the corresponding solid in the space provided.

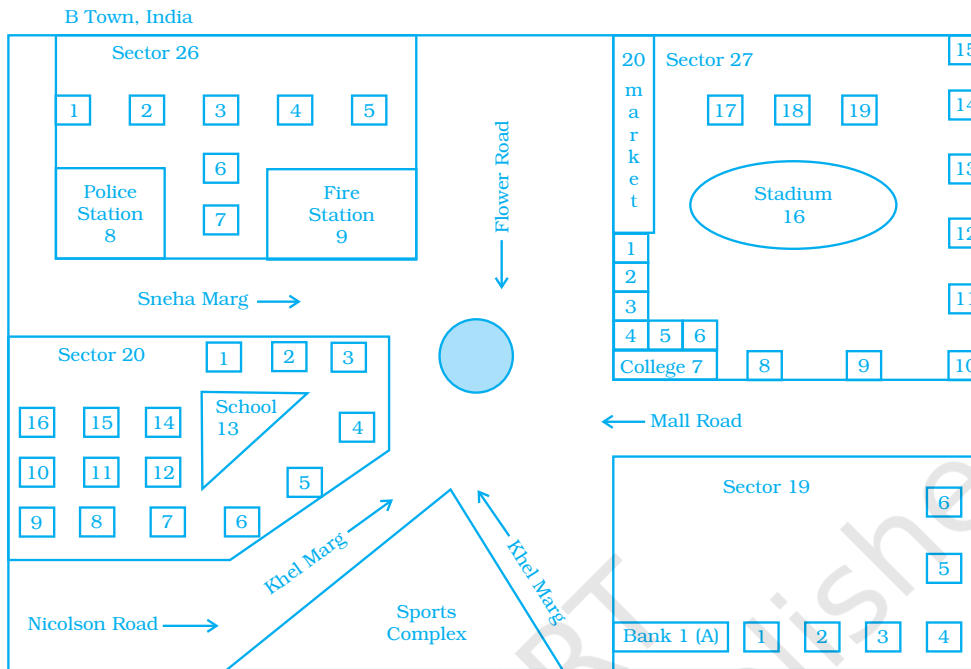
| Nets | Name of Solid |
|---|---------------|
| (a)  | |
| (b)  | |
| (c)  | |
| (d)  | |
| (e)  | |
| (f)  | |

92. Draw a map of your school playground. Mark all necessary places like 2 library, Playground, Medical Room, Classrooms, Assembly area, etc.
93. Refer to the given map to answer the following questions.



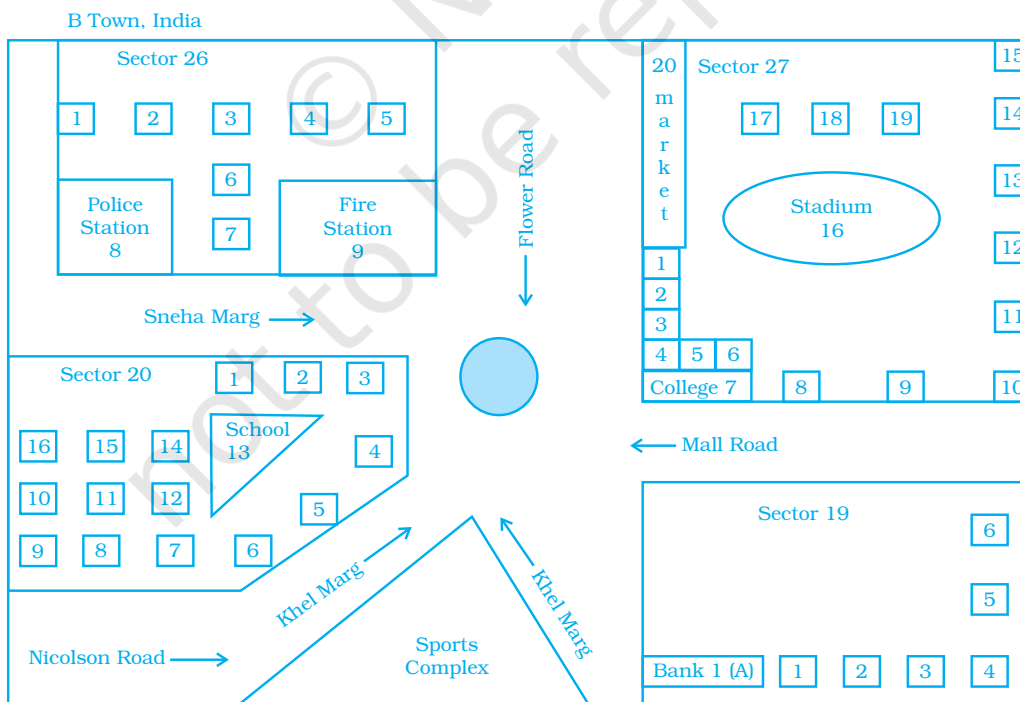
- (a) What is the built-up area of Govt. Model School I ?
- (b) Name the schools shown in the picture.
- (c) Which park is nearest to the dispensary?
- (d) To which block does the main market belong?
- (e) How many parks have been represented in the map?
94. Look at the map given below.
Answer the following questions.
- (a) Which two hospitals are opposite to each other?
- (b) A person residing at Niti Bagh has to go to Chirag Delhi after dropping her daughter at Asiad Tower. Mention the important landmarks he will pass alongwith the roads taken.

(c) Name of which road is similar to the name of some month.



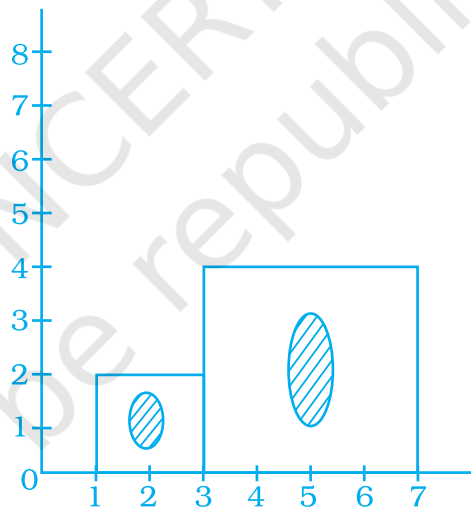
95. Look at the map given below.

Houses



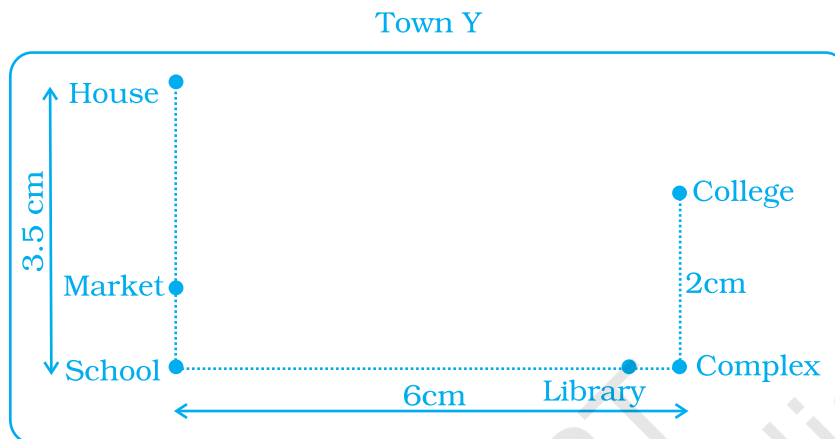
Now answer the following questions.

- (a) Name the roads that meet at round about.
 - (b) What is the address of the stadium?
 - (c) On which road is the Police Station situated?
 - (d) If Ritika stays adjacent to bank and you have to send her a card, what address will you write?
 - (e) Which sector has maximum number of houses?
 - (f) In which sector is Fire Station located?
 - (g) In the map, how many sectors have been shown?
- 96.** A photographer uses a computer program to enlarge a photograph. What is the scale according to which the width has enlarged?

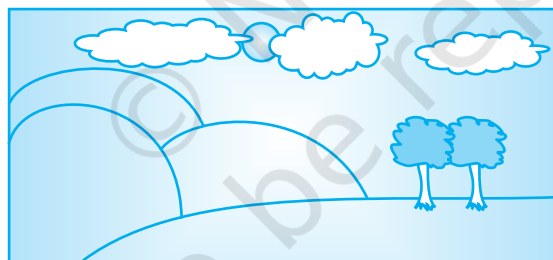


- 97.** The side of a square board is 50 cm. A student has to draw its image in her notebook. If the drawing of the square board in the notebook has perimeter of 40 cm, then by which scale the figure has been drawn?
- 98.** The distance between school and house of a girl is given by 5 cm in a picture, using the scale 1 cm : 5 km. Find the actual distance between the two places?

99. Use a ruler to measure the distance in cm between the places joined by dotted lines. If the map has been drawn using the scale 1 cm : 10 km, find the actual distances between
- (1) School and Library
 - (2) College and Complex
 - (3) House and School



100. The actual length of a painting was 2 m. What is its length in the photograph if the scale used is 1 mm : 20 cm.

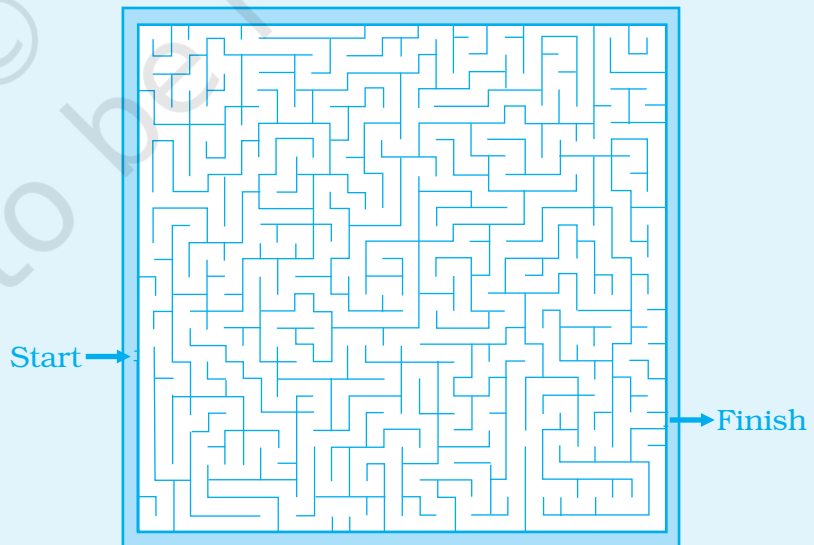
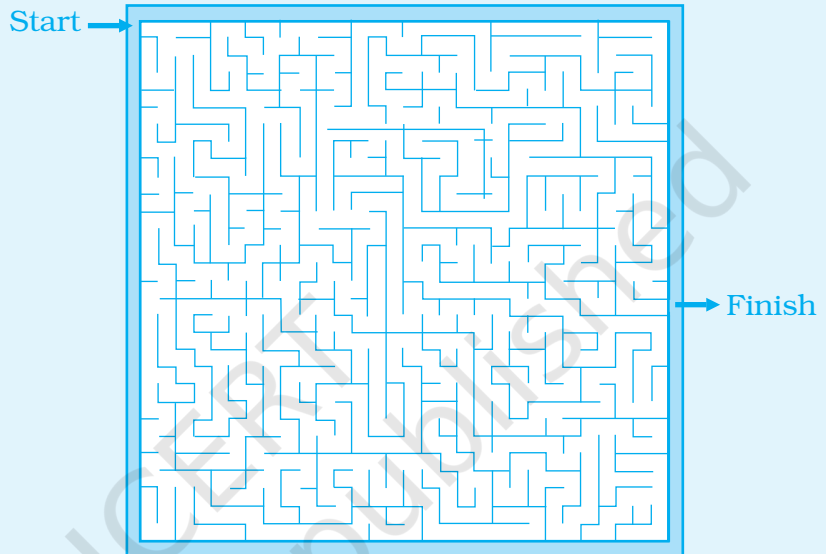


101. Find the scale.
- (a) Actual size 12 m
Drawing size 3 cm
 - (b) Actual size 45 feet
Drawing size 5 inches
102. In a town, an ice cream parlour has displayed an ice cream sculpture of height 360 cm. The parlour claims that these ice creams and the sculpture are in the scale 1:30. What is the height of the ice creams served?

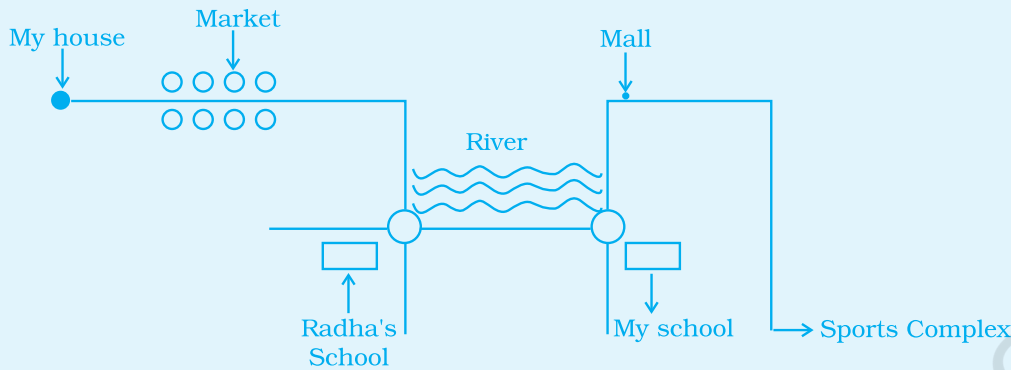
(D) Activities

Activity 1 : Find the most appropriate way to reach from start to finish.

(Use a coloured pen of your choice to show the path traced.)



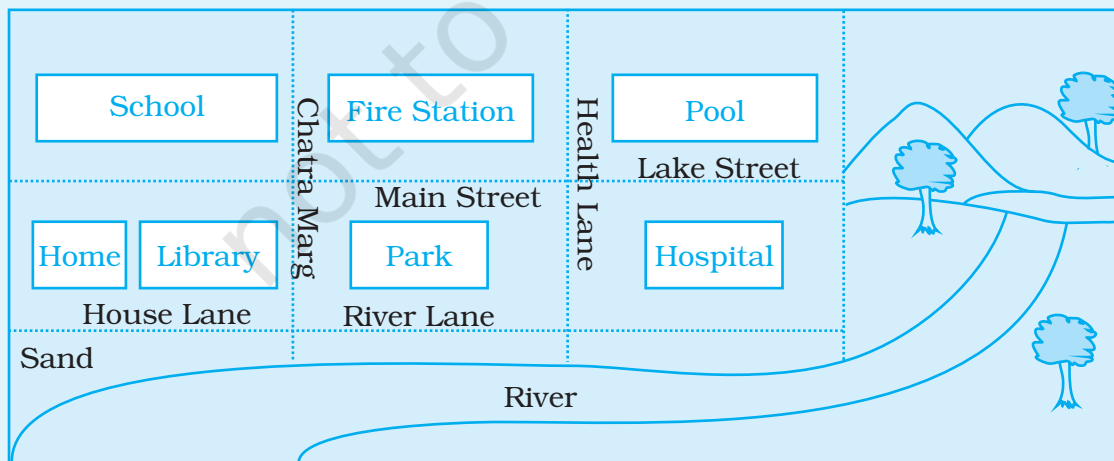
Activity 2 : Rohit is a 7 year old young boy. His uncle Raj asked him to draw a map to reach Sport's Complex from his (Rohit's) house. He drew the following map.



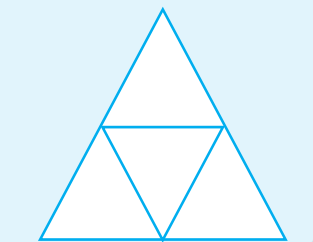
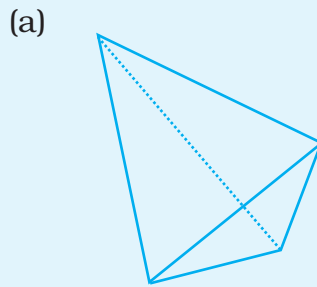
Can you help Uncle Raj by drawing a better map considering yourself as Rohit's Father/Mother.

Activity 3 : Look at the map of city given on the next page:

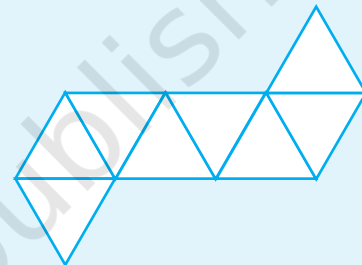
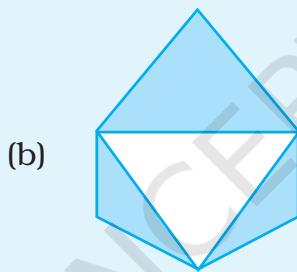
- (a) Colour the map using the given colour code as follows.
Blue-water, Red-Fire station, White-Hospital, Green-Parks, Cream-River Bed, Brown-Mountains.
- (b) Mark the shortest route from House to Pool with the help of arrows.
- (c) Put X at the intersection of Chatra Marg and House Lane.



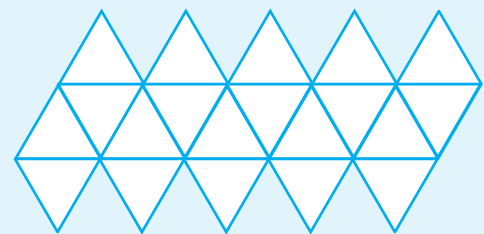
Activity 4 : Draw the nets given below on coloured sheets by taking each side of the triangle as 3cm, and try to form the shapes shown in front of it. Count the number of edges, faces and vertices in ends and verify the Euler's formula.



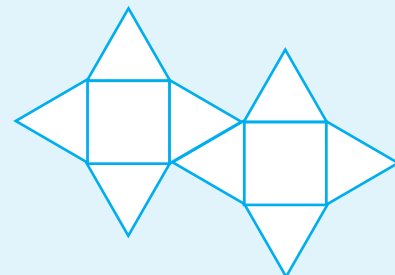
4 equilateral triangles



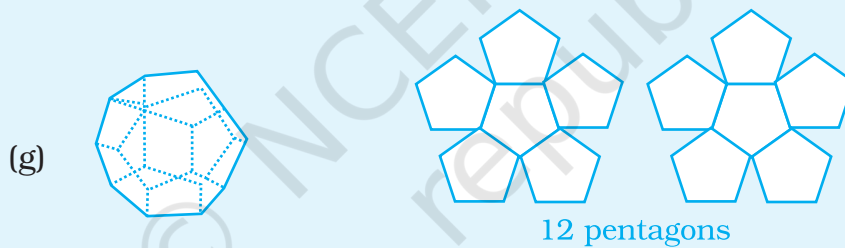
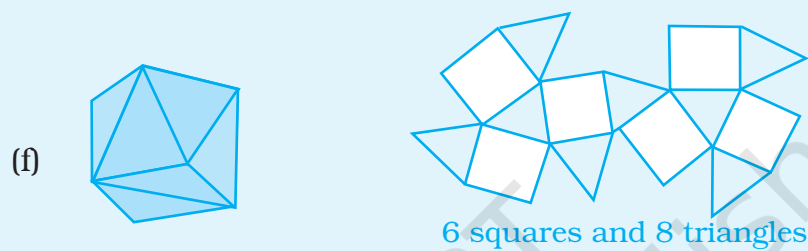
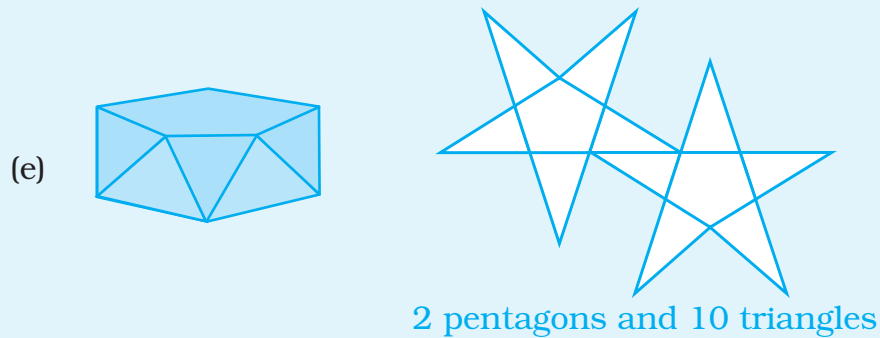
8 equilateral triangles



20 equilateral triangles



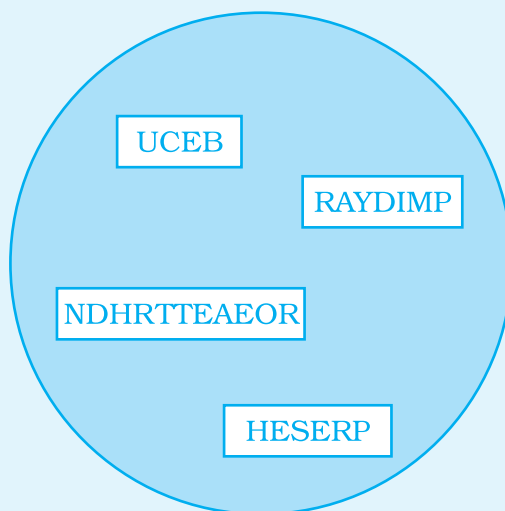
2 squares and 8 triangles



Activity 5 : Guess who am I? My name is given in the box below. Oops! Spelling of my name is jumbled up.

Try to identify it from the clues given below and write it in the blank space.

- (1) I am a polyhedron with least number of faces. _____
- (2) I am a prism whose all faces are square. _____
- (3) Looks like marbles but have no vertex. _____
- (4) I am a solid whose base is polygonal and other faces are triangles. _____



6. Draw the map of your locality, showing the details of your sector/ block. Also highlight the appropriate landmarks which will help your friend to locate your house in your sector/block.

Activity 7 : Crossword Puzzle

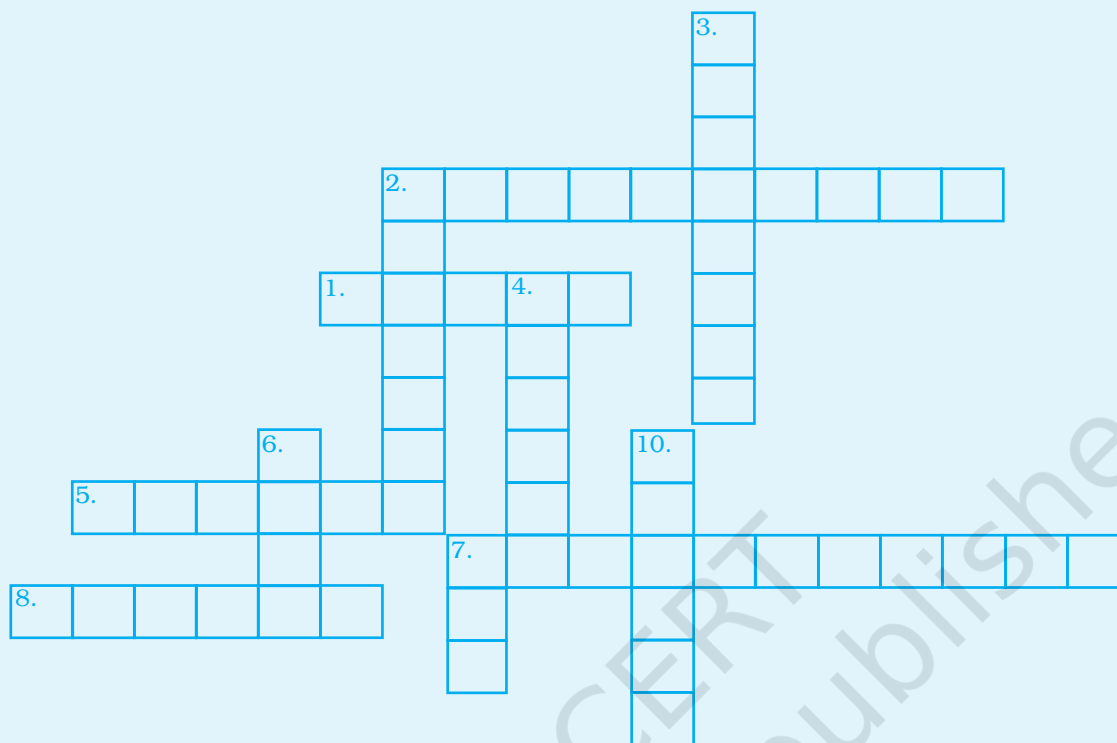
Answer the following based on the hints given below.

Across

1. Polyhedron whose lateral faces are parallelograms.
2. Prism having fifteen edges.
5. Another name for a square prism.
7. Polyhedron made up of four triangles.
9. Polyhedron made up of convex polygons.

Down

2. Polyhedron whose lateral faces are triangles.
3. In a solid shape, the line segment joining two vertices not lying on the same face.
4. A 3-D shape having no vertex.
6. A solid figure having only one vertex.
7. Number of pentagons in a pentagonal prism.
10. Point where edges of a solid shape meet.



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