VISUALISING 3-D SHAPES

6
CHAPTER

CONTENTS

➢ 2D SHAPES (PLANE FIGURES)

The figures which can be described by mentioning two dimensions called length and breadth, are called 2D-shapes or plane figures.

Triangles, rectangles, squares, circles etc. can be drawn on paper, these are plane figures.

➢ 3D SHAPES (SOLIDS)

The shapes like cube, cuboid, cylinder, pyramid etc. which require three dimensions i.e.length, breadth and height or depth are called solid figures or 3-dimensional figures.

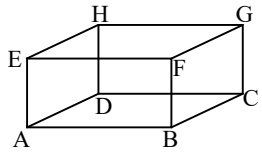
The objects having definite shape and size are called solids. A solid occupies a fixed amount of space and has three dimensions.

◈ Cuboid

It is the shape of a matchbox, a chalk box, a brick, a tile, a book, an almirah etc.

It is made of rectangles.

Definition : A solid bounded by six rectangular faces (not all equal) is called a cuboid. It has three dimensions, namely length, breadth and height.



Various parts of a cuboid are

1. **Faces :** A cuboid has 6 rectangular faces. The opposite faces of a cuboid are identical.

   In figure ABCD, EFGH, ADHE, BCGF, ABFE, DCGH are faces.

2. **Edges :** Two adjacent faces of a cuboid meet in a line segment, which is called edge of the cuboid.

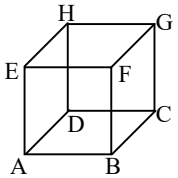
   A cuboid has 12 edges. In figure edges are AB, BC, CD, DA, EF, GH, FG, EH, CG, BF, AE, DH.

3. **Vertices :** Three edges of a cuboid meet at a point, called a vertex. A cuboid has 8 vertices. In figure 8 vertices are A, B, C, D, E, F, G, H.

◈ Cube

It is the shape of sugar lump, dice etc. A cube is made up of square faces.

Definition : A cuboid whose length, breadth and height are all equal, is called a cube. Length breadth and height of a cube are equal.



Various parts of a cube are :

1. **Faces :** A cube has six square faces. In figure, ABCD, EFGH, ADHE, BCGF, ABFE, DCGH are faces.

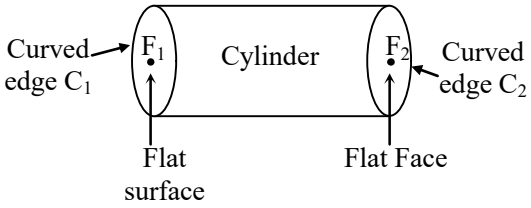
2. **Edges :** A cube has 12 edges. In figure, 12 edges are AB, BC, CD, DA, EF, GH, FG, EH, CG, BF, AE, DH.

3. **Vertices :** A cube has 8 vertices. 8 vertices are A, B, C, D, E, F, G, H.

◈ Cylinder

A solid shape in which top and bottom both are circular while the rest of the surface is curved.

It is the shape of a tube light, tin container, circular pillars, circular pipes, circular pencils, measuring jars, road rollers and gas cylinders etc.

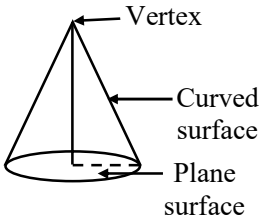


Parts of a cylinder

1. A cylinder has no vertex.
2. A cylinder has two curved edges (in figure C_1 and C_2).
3. A cylinder has one curved face and two flat faces (in figure F_1 and F_2).

◈ Cone

A cone is a solid shape having a plane circular end as the base and whole lateral surface is the curved surface tapering into a point, called the vertex of the cone.

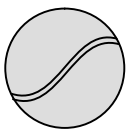


Parts of a cone :

1. A cone has one vertex.
2. A cone has one curved edge.
3. A cone has one curved face, and one flat face.

◈ Sphere

A solid (3-D) shape that has only a curved surface is called sphere.



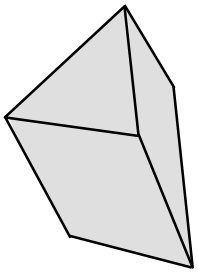
Parts of a sphere

1. A sphere has no vertex.
2. A sphere has no edge.
3. A sphere has a curved surface.

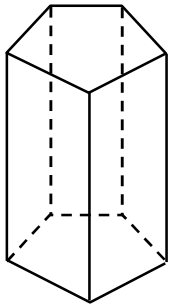
◈ Prism

A prism is a solid whose bases are identical polygon faces (triangles, quadrilaterals, pentagons etc.) and the other faces are rectangles.

Remember that if the bases of the prism are pentagon, then the prism is known as pentagonal prism.



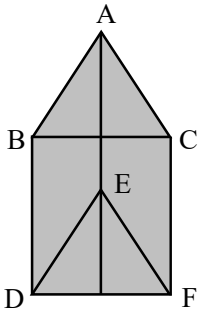
Prism



Pentagonal Prism

◈ Triangular Prism

A triangular prism is made up of two triangles at each end and three rectangles. A ridge tent is an example of a triangular prism.



Triangular prism

Parts of triangular prism :

1. It has 6 vertices A, B, C, D, E and F.
2. It has 9 edges. The edges are AB, BC, AC, DE, EF, FD, BD, CF and AE.
3. It has 5 faces. In figure, ABC, DEF, ABDE, AEFC, BDFC are faces.

Note :

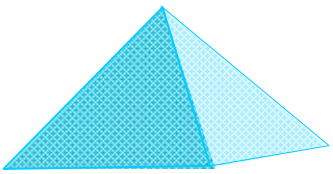
Cube and cuboid are also called square prism and rectangular prism respectively.

◈ Pyramid

A pyramid is a solid whose base is a flat rectilinear figure and whose side faces are triangles having a common vertex outside the surface of the base. This shape is usually found in ancient Egyptian sculptures.

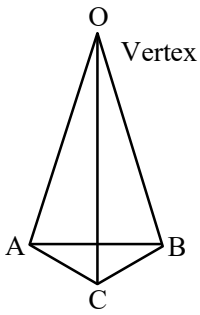
◈ Triangular Pyramid

A triangular pyramid (tetrahedron) is a solid which stands on a triangular base. It tapers to a point called the vertex of the pyramid. A pyramid is called triangular pyramid if its base is a triangle.

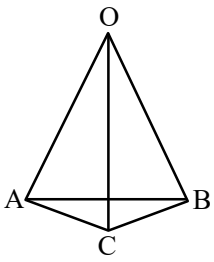


Pyramid

A triangular pyramid in which all faces are equal is called **tetrahedron.**



Triangular Pyramid



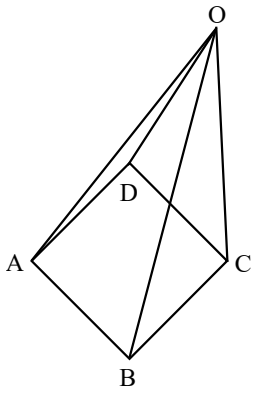
Tetrahedron

Parts of triangular pyramid :

1. It has 4 vertices (in figure A, B, C, O).
2. It has six edges. In figure edges are AB, BC, AC, OA, OC, OB.
3. It has 4 triangular faces. In figure, the faces are ABC, OAB, OCB, OAC.

◈ Square pyramid

A square pyramid is a solid which stands on a square base. Its side faces are triangles having a common vertex, called the vertex of the Pyramid.

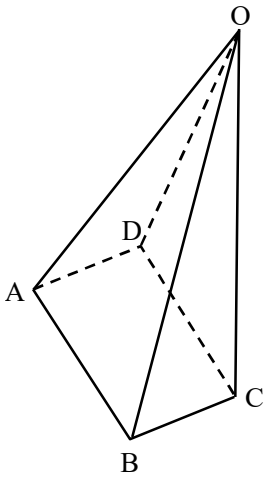


Parts of square pyramid :

1. It has 5 vertices. In figure, the vertices are O, A, B, C and D.
2. It has 8 edge. In figure, the edges are OA, OD, OC, OB, AB, BC, CD, AD.
3. It has 5 faces. In figure, 4 triangular faces and 1 square face which are OAB, OBC, OAD, OCD and ABCD.

◈ Rectangular Pyramid

A rectangular pyramid is a solid which stands on a rectangular base. It also tapers to a point. Its side faces are triangles having a common vertex, called vertex of the pyramid.



Parts of rectangular pyramid :

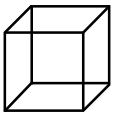
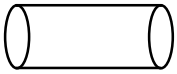
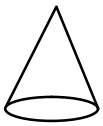
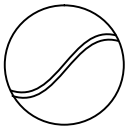
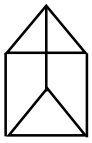
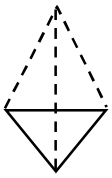
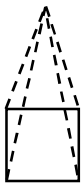
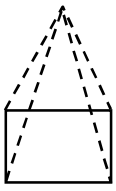
1. It has 5 vertices.
2. It has 8 edges.
3. It has 5 faces.

Note :

(i) A pyramid is named according to the shape of its non-triangular face.

(ii) All the side faces of a pyramid (triangular, rectangular, square, pentagonal etc.) are triangular.

The following table gives the summary of all above observations :

Solid	Name	No. of Vertices	No. of Edges	No. of Faces
	Cuboid	8	12	6
	Cube	8	12	6
	Cylinder	–	2	3
	Cone	1	1	2
	Sphere	–	–	1
	Triangular Prism	6	9	5
	Triangular Pyramid	4	6	4
	Square Pyramid	5	8	5
	Rectangular Pyramid	5	8	5

➢ NETS

A net is a sort of skeleton – outline in 2-D, which, when folded results in a 3-D shape.

OR

A net of a 3-D figure is the shape that can be cut out of a flat piece of paper or cardboard and folded to make the 3D-shape.

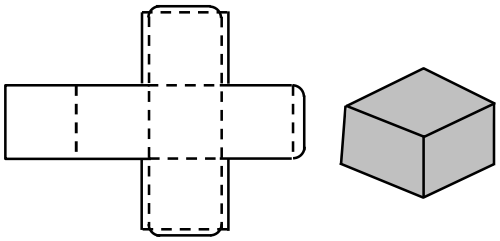
OR

A solid figure may be changed into a plane figure by cutting some of the edges of the original figure and opening it out flat as a fold-out. Such a plane figure is called a net of the solid.

➢ NETS FOR BUILDING DIFFERENT 3-D SHAPES

◈ Net of a Cube

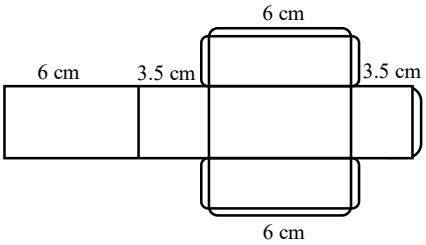
The following figure is a net of a cube which is formed by six squares.



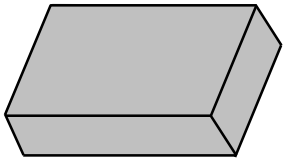
Net of a Cube Cube

◈ Net of a Cuboid

Given below is the net of a cuboid. This contains two pairs of congruent rectangle.



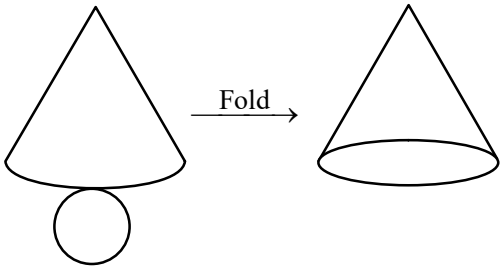
Net of a Cuboid



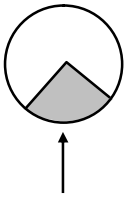
Cuboid

◈ Net of a Cone

The given below is the net of a cone. This is obtained by cutting a segment of a circle.



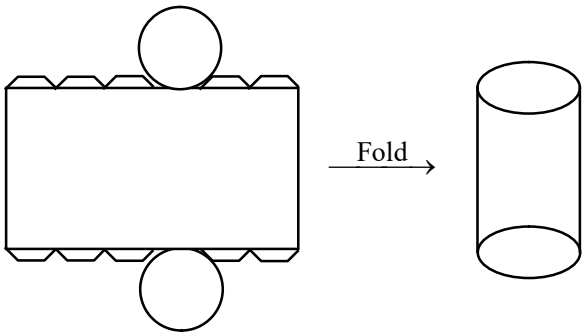
Net of a Cone Cone



Net of the Lateral Surface of a Cone

◈ Net of a Cylinder

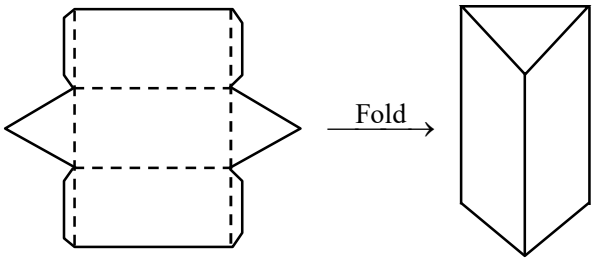
Given below is the net of a cylinder. It is a rectangle with two congruent circle whose circumference is the length of the rectangle.



Net of a Cylinder Cylinder

◈ Net of a Triangular Prism

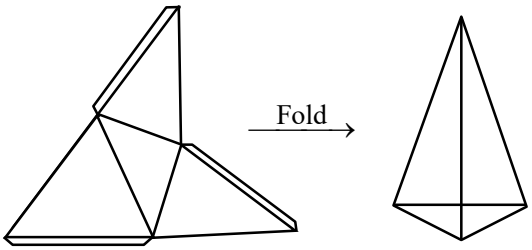
Given below is the net of a triangular prism. The net consists of three rectangles and two equilateral triangles.



Net of a Triangular Prism Triangular Prism

◈ Net of a Triangular Pyramid

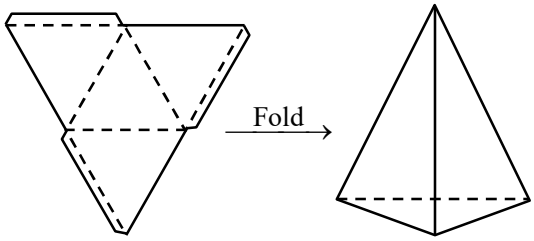
This net consists of four triangles in which three are identical isosceles triangles and one is an equilateral triangle.



Net of a Triangular Pyramid Triangular Pyramid

◈ Net of a Tetrahedron

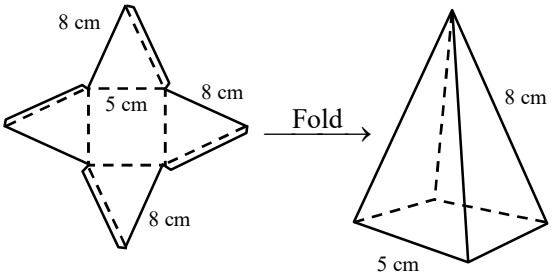
To construct this, make an equilateral triangle of any measure. Then join the midpoints of these sides to form the inner dotted triangle.



Net of a Tetrahedron Tetrahedron

◈ Net of a Square Pyramid

This net consists of a square with an isosceles triangle on each side of the square.



Net of a Square Pyramid Square Pyramid

➢ DRAWING SOLIDS ON A FLAT SURFACE

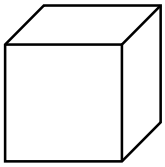
When we draw a solid shape, the images are somewhat distorted to make them appear three-dimensional as our drawing surface is paper which is flat. It is a visual illusion. There are two methods to draw 3-D figures :

(i) Oblique Sketches

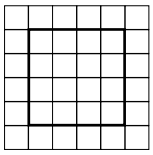
(ii) Isometric Sketches.

◈ Oblique Sketches

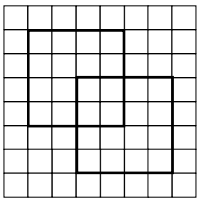
If we look at figure, just by look we can say that it is a figure of cube although its all edges are not equal. This type of sketch by which we just get the idea of the given solid is called the **oblique sketch.**



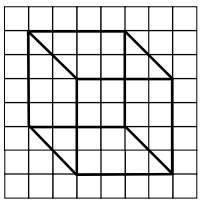
Let us learn the technique for drawing a cube.



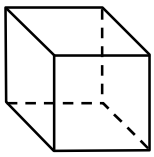
Draw a square



Draw the second square where the mid-points of two sides of both squares coincide

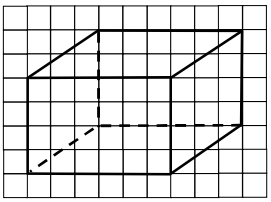


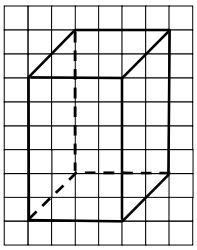
Join the corresponding vertices of both the squares



Cube

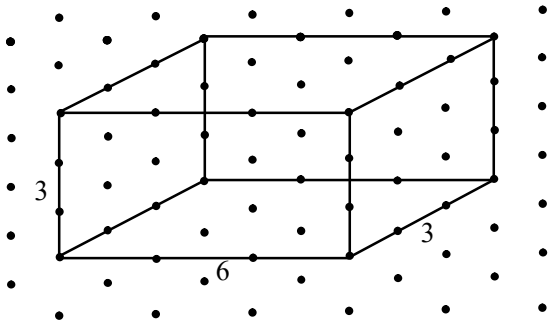
Similarly, we can draw a cuboid on squared graph sheet :





◈ Isometric Sketches

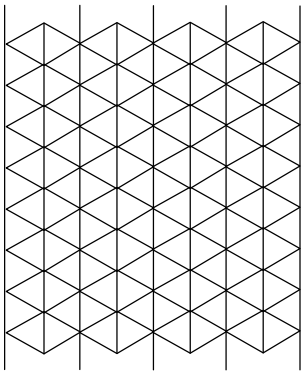
An isometric sheet is a special sheet on which dots are formed on a pattern of equilateral triangle. On isometric sheet we can draw sketches in which measurements also agree with those of a given solid.



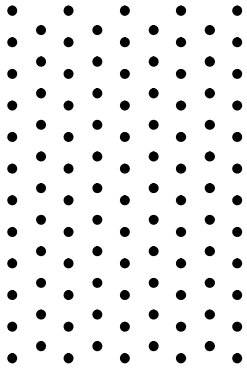
The lines on the paper are in the three directions, each of which represents a dimensions. The lines up and down represent the vertical dimension (height). The other two dimensions represent the horizontal dimensions (length and breadth). Therefore to draw a 3-D figure, we use a isometric graph sheet or isometric dot paper.

A dot sheet, on which dots are marked at equal distances is also used to draw a 3-D figure. Such a sheet is called isometric dot sheet.

A sample of each one is given below :

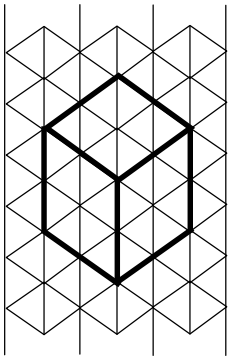


Isometric graph sheet

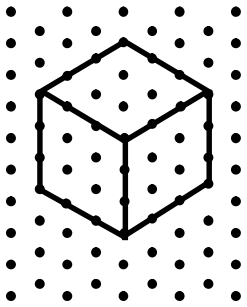


Isometric dot paper

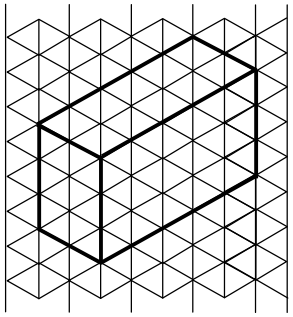
Let us draw cubes and cuboids using isometric dot paper or isometric graph sheet :



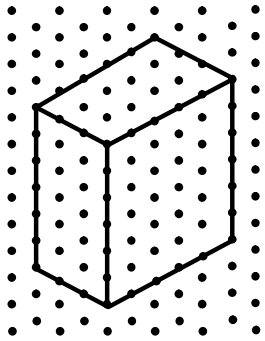
Cube of edge 2 units



Cube of edge 3 units



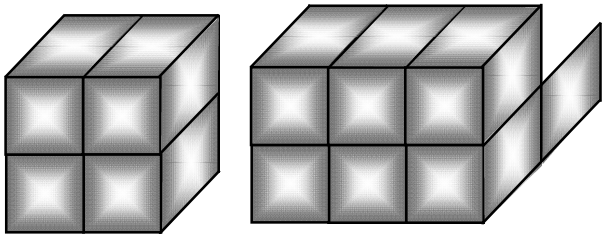
Cuboid of dimensions
5 unit × 2 units × 3 units



Cuboid of dimensions
5 units × 6 units × 3 units

We can make other shapes also by using isometric sheets.

Ex.1 In following figures find the length, breadth and height of shapes.



(i) (ii)

Sol. Clearly in fig.(i) length = 2 units, breadth = 1 unit, height = 2 units.

In fig.(ii) length = 3 units, breadth = 2 units

height is varying, from front it is 2 units and in back it is 1 unit.

IMPORTANT POINTS TO BE REMEMBERED

1. The circle, the square, the rectangle, the quadrilateral and the triangle are examples of plane figures and cube, cuboid, sphere, cylinder, cone and pyramid are examples of the solid figures.

2. Plane figures are of two-dimensions (2D) and the solid shapes are of three dimensions (3D).

3. A net of a solid is a two-dimensional cut out which when folded form the solid shape. The same solid can have several types of nets.

4. A solid shape may have some hidden parts which may not be visible. Take care to visualise these hidden parts.

EXERCISE

Q.1 From your surroundings, give two examples each of the following shapes :

(i) Cube (ii) Cuboid (iii) Cone

(iv) Cylinder (v) Sphere

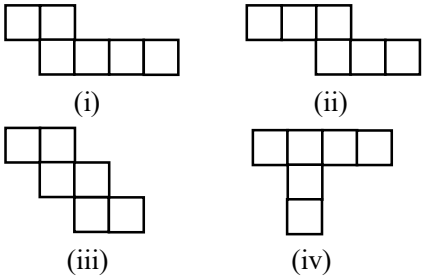
Q.2 Which of the following are 2-D figures and which are 3-D figure

(i) rectangle (ii) cylinder

(iii) circle (iv) sphere

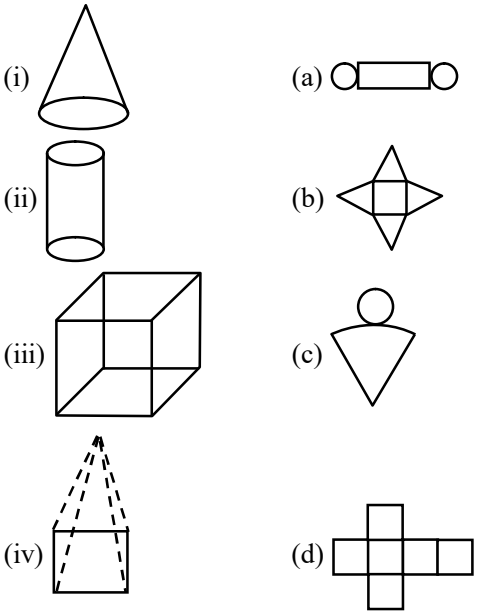
(v) octagon (vi) cone

Q.3 Identify the nets which can be used to make cubes :



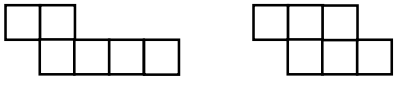
(i) (ii) (iii) (iv)

Q.4 Match the nets with appropriate solids :

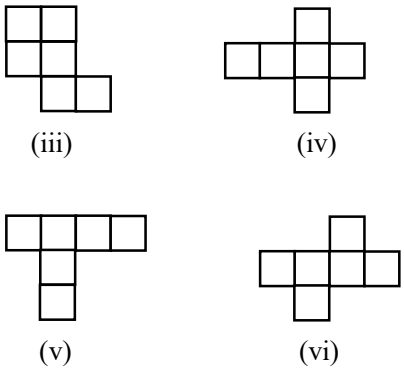


(i) (a) (ii) (b) (iii) (c) (iv) (d)

Q.5 Find the nets which can be used to make cubes :

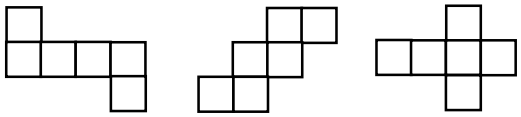


(i) (ii)



(iii) (iv) (v) (vi)

Q.6 We know that a die is a cube with dots or a number on each face. Opposite faces of a die are always total to seven. Now fill in the following nets of a cube with appropriate numbers, so as to form a die on folding it.



Q.7 Fill in the blanks :

(i) A line where two faces of a solid meet is called its ……

(ii) A regular triangular pyramid is also called…..

(iii) A square pyramid has……triangular faces.

(iv) A cube has……vertices and……..surfaces.

(v) A cylinder has one…..face and…….plane faces.

(vi) A sphere is a solid which has only……surface.

(vii) A tetrahedron is also called a …… pyramid.

(viii) A triangular prism has…….rectangular surfaces and……triangular surfaces.

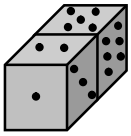
(ix) A pyramid is said to be regular if all its surfaces are…….triangles.

(x) A cone has one…….surface and one ….. surface.

Q.8 State true (T) or false (F) for the following statements :

(i) In a pyramid, all the faces except base are triangular (Base can also be a Δ).
(ii) A tetrahedron is a pyramid in which all triangular faces are equilateral triangles.
(iii) A square pyramid has 5 faces.
(iv) A triangular pyramid has four vertices.

Q.9 Two dice are placed side by side as shown :



What total would be on the face opposite to
(i) 5 + 2 (ii) 6 + 3

Q.10 Using a square graph paper, draw the cubes whose edges are :
(i) 4 cm (ii) 3.5 cm (iii) 3 cm

Q.11 Using a square graph paper, draw the cuboid whose dimensions are :
(i) 3 cm × 4 cm × 3 cm
(ii) 4 cm × 3 cm × 2 cm

Q.12 Using an isometric graph paper, draw the cubes whose edges are :
(i) 5 cm (ii) 4 cm

Q.13 Using an isometric dot paper, draw the cuboid whose dimensions are :
(i) 3 cm × 3 cm × 2 cm
(ii) 7 cm × 4 cm × 6 cm

Q.14 Fill in the blanks
(i) A cube has…….vertices.
(ii) Great pyramid in Giza (Egypt) is an example of……pyramid.
(iii) A birthday cap is an example of ……
(iv) A cricket ball is an example of …..
(v) A Almirah is an example of …….
(vi) A dice is an example of ……
(vii) A …… is a sort of Skelton-outline in 2-D, which, when folded, results in a 3-D shape.
(viii) If three cubes of dimensions 3 cm × 3 cm × 3 cm are joined, then the resultant solid is a ……...
(ix) A square prism is also called ….....
(x) A triangular pyramid has ...…. triangular faces.
(xi) A sphere has ……. vertex.
(xii) A cone has …… curved edge.
(xiii) A triangular prism is also called …..
(xiv) A solid bounded by six rectangular faces is called ……
(xv) A solid occupies a fixed amount of …..

ANSWER KEY

1. (i) Sugar lump, dice (ii) Match box, brick (iii) Ice cream cone, Joke cap (iv) Tin, Pipes (v) Ball, marble

2. (i), (iii) & (v) are 2D ; (ii), (iv), (vi) are 3D **4.** (i) → c, (ii) → a, (iii) → d, (iv) → b **5.** (iv)

7. (i) Edge (ii) Tetrahedron (iii) 4 (iv) 8, 6 (v) Curved, two (vi) Curved
(vii) Regular triangular (viii) 3, 2 (ix) Equilateral (x) Plane, curved

8. (i) F (ii) T (iii) T (iv) T **9.** (i) 2 + 5 (ii) 1 + 4

14. (i) 8 (ii) Square (iii) Cone (iv) Sphere (v) Cuboid (vi) Cube or Cuboid (vii) Net (viii) Cuboid
(ix) Cube (x) 2 (xi) no (xii) 1 (xiii) Tetrahedron (xiv) Cuboid (xv) Space