

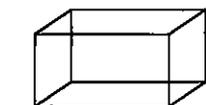
Visualising Solid Shapes

Understanding the Lesson

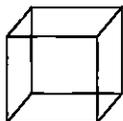
- Recognising 2D and 3D objects.
- Recognising the different shapes in nested objects.
- Different types of solids.
- Parts of a solid.
- 3D objects have different view from different angles.
- Leonhard Euler's formula $V + F - E = 2$.
- Map is different from a picture.

Conceptual Facts

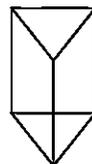
- **3-D figures:** Any shape which occupies space and has three dimensions, i.e., length, breadth and heights is called 3-D solid or a figure.
- **Parts of a solid objects:**
 - (i) Face
 - (ii) Vertex
 - (iii) Edge
- **Types of Solids:**
 - (i) Prism:



Rectangular prism (cuboid)

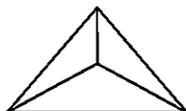


Square prism (cube)

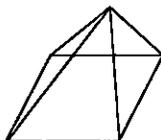


Triangular prism

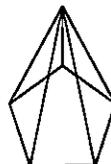
(ii) Pyramids:



Triangular pyramid

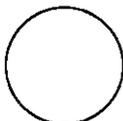


Rectangular pyramid



Pentagonal pyramid

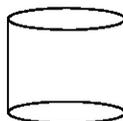
(iii) Other Solids



Sphere



Cone



Cylinder

- **Euler's Formula:**
Number of faces + Number of vertices – Number of edges = 2

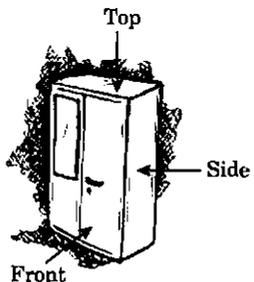
EXERCISE 10.1

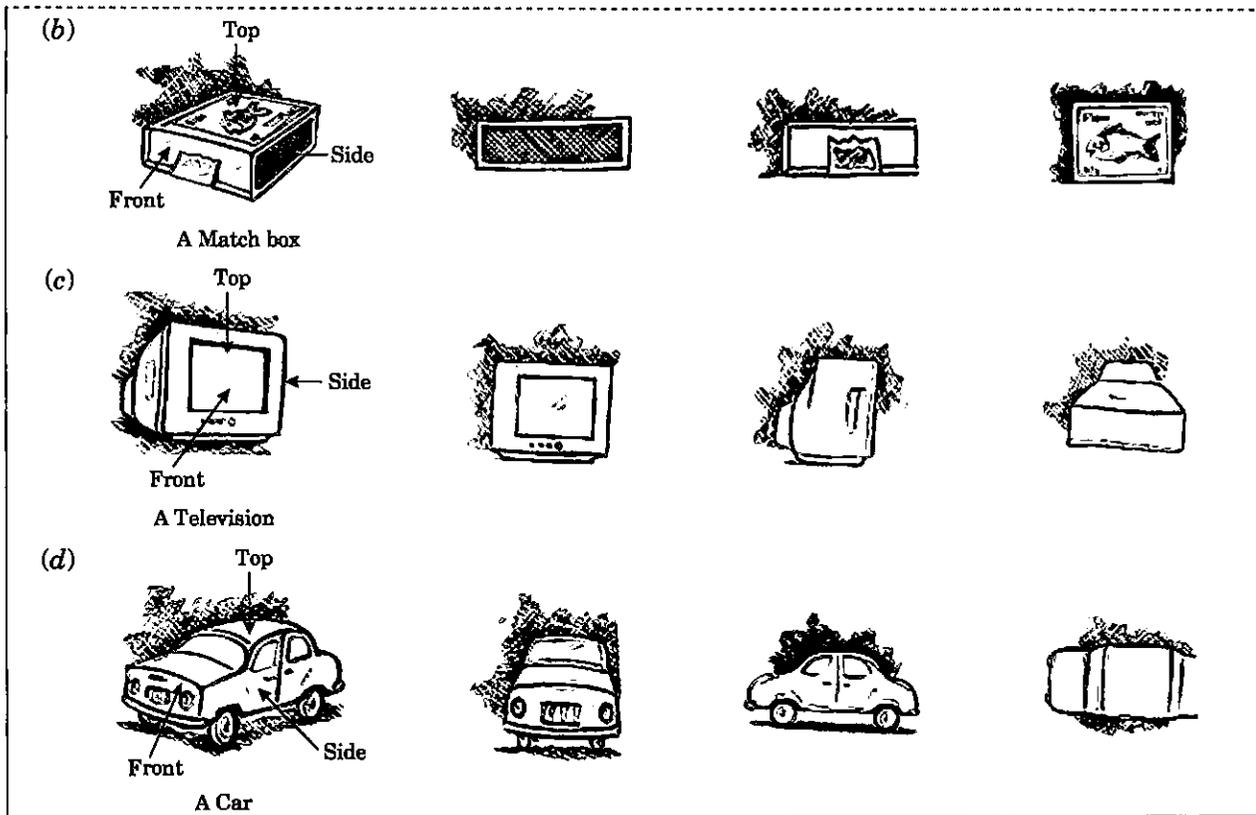
Q1. For each of the given solid, the two views are given. Match for each solid the corresponding top and front views. The first one is done for you.

Object	Side view	Top view
(a)  A bottle	(i) 	(i) 
(b)  A weight	(ii) 	(ii) 
(c)  A flask	(iii) 	(iii) 
(d)  Cup and Saucer	(iv) 	(iv) 
(e)  Container	(v) 	(v) 

- Sol. (a) A bottle → (iii) → (iv) (b) A weight → (i) → (v)
 (c) A flask → (iv) → (ii) (d) Cup and saucer → (v) → (iii)
 (e) container → (ii) → (i)

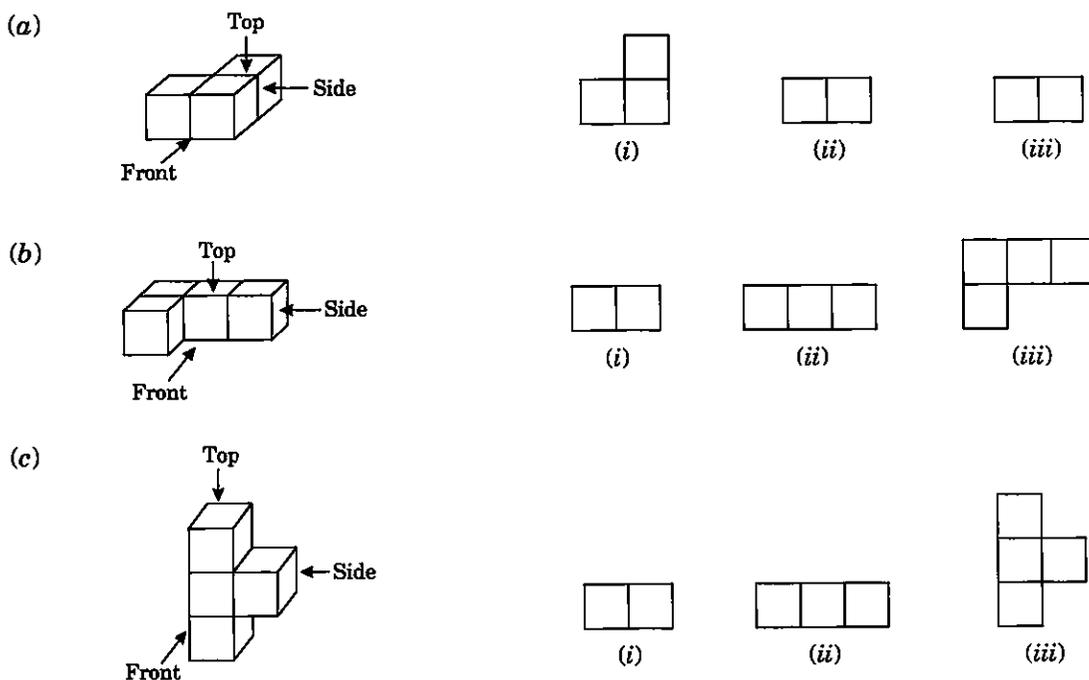
Q2. For each of the given solid, the three views are given. Identify for each solid the corresponding top, front and side views.

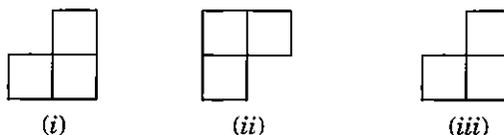
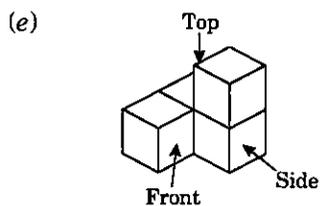
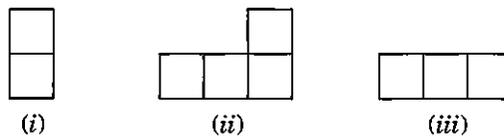
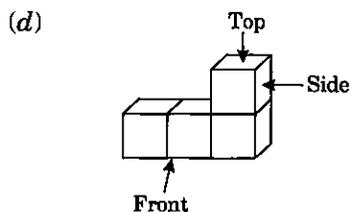
Object	(i)	(ii)	(iii)
(a)  An Almirah			



- Sol. (a) An Almirah → (i) Front → (ii) Side → (iii) Top
 (b) A Match box → (i) Side → (ii) Front → (iii) Top
 (c) A Television → (i) Front → (ii) Side → (iii) Top
 (d) A Car → (i) Front → (ii) Side → (iii) Top

Q3. For each given solid, identify the top view, front view and side view.

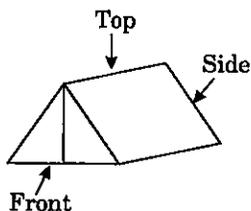




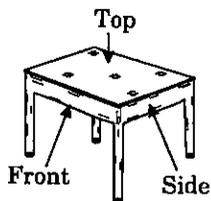
Sol. (a) (i) Top → (ii) Front → (iii) Side
 (b) (i) Side → (ii) Front → (iii) Top
 (c) (i) Top → (ii) Side → (iii) Front
 (d) (i) Side → (ii) Front → (iii) Top
 (e) (i) Front → (ii) Top → (iii) Side

Q4. Draw the front view, side view and top view of the given objects.

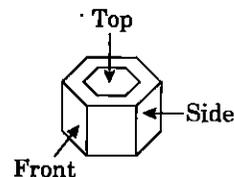
(a) A military tent



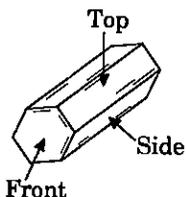
(b) A table



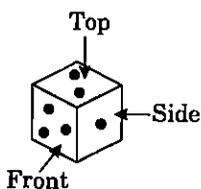
(c) A nut



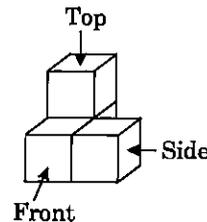
(d) A hexagonal block



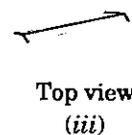
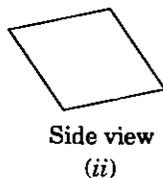
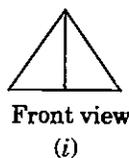
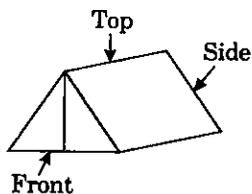
(e) A dice



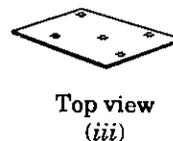
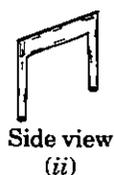
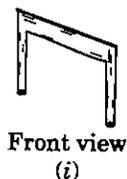
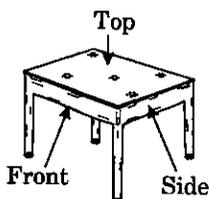
(f) A solid



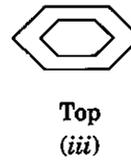
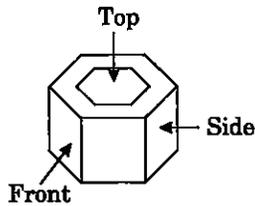
Sol. (a) A military tent



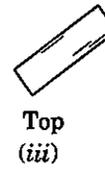
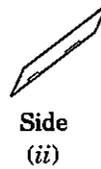
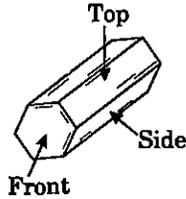
(b) A table



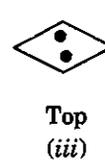
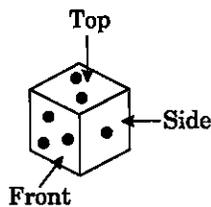
(c) A nut



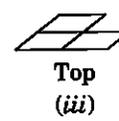
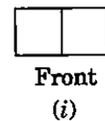
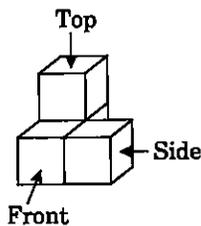
(d) A hexagonal block



(e) A dice

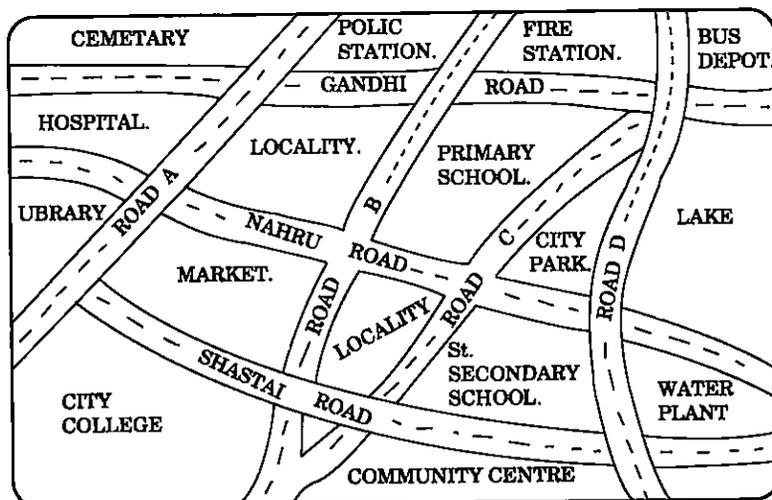


(f) A solid



EXERCISE 10.2

Q1. Look at the given map of a city.



Answer the following.

- Colour the map as follows: Blue-water, red-fire station, orange-library, yellow-schools, Green-park, Pink-College, Purple-Hospital, Brown-Cemetery.
- Mark a green 'X' at the intersection of Road 'C' and Nehru Road, Green 'Y' at the intersection of Gandhi Road and Road A.
- In red, draw a short street route from Library to the bus depot.
- Which is further east, the city park or the market?

(e) Which is further south, the primary school or the Sr. Secondary School?

- Draw a map of your class room using proper scale and symbols for different objects.
- Draw a map of your school compound using proper scale and symbols for various features like play ground, main building, garden etc.
- Draw a map giving instructions to your friend so that she reaches your house without any difficulty.

Sol. 1 to 4 each all activities. You can try yourself.

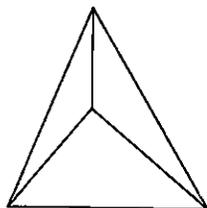
EXERCISE 10.3

Q1. Can a polyhedron have for its faces

- 3 triangles?
- 4 triangles?
- a square and four triangles?

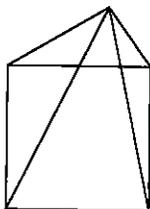
Sol. (i) No, because polyhedron must have edges meeting at vertices which are points.

(ii) Yes, because all the edges are meeting at the vertices.



(ii)

(iii) Yes, because all the eight edges meet at the vertices.



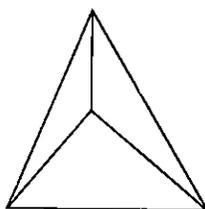
(iii)

Q2. Is it possible to have a polyhedron with any given number of faces?

(Hint: Think of a pyramid)

Sol. Yes, it is possible if the number of faces is greater than or equal to 4.

Example: Pyramid which has 4 faces.



Pyramid

Q3. Which are prisms among the following?



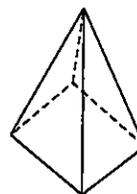
A nail

(i)



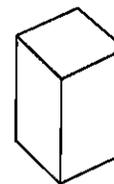
Unsharpened pencil

(ii)



A table weight

(iii)



A box

(iv)

Sol. Only (ii) unsharpened pencil and (iv) a box are the prism.

Q4. (i) How are prisms and cylinders alike?

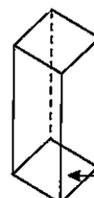
(ii) How are pyramids and cones alike?

Sol. (i) If the number of sides in a prism is increased to certain extent, then the prism will take the shape of cylinder.

(ii) If the number of sides of the pyramid is increased to same extent, then the pyramid becomes a cone.

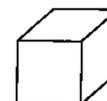
Q5. Is a square prism same as a cube? Explain.

Sol. Every square prism cannot be cube. It may be cuboid also.



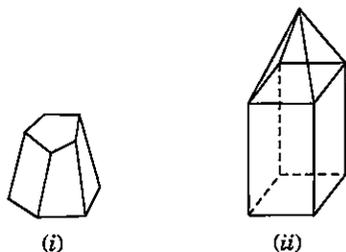
Cuboid

Square base



Cube

Q6. Verify Euler's formula for these solids.



Sol. (i) Faces = 7
Sides = 15
Vertices = 10
Euler's formula: $F + V - E = 2$
 $\Rightarrow 7 + 10 - 15 = 2$
 $\Rightarrow 2 = 2$
Hence, Euler's formula is verified.

(ii) Faces = 9
Sides = 16
Vertices = 9
Euler's Formula: $F + V - E = 2$
 $\Rightarrow 9 + 9 - 16 = 2$
 $\Rightarrow 2 = 2$
Hence, Euler's formula is verified.

Q7. Using Euler's formula find the unknown.

Faces	?	5	20
Vertices	6	?	12
Edges	12	9	?

Sol.

Faces	8	5	20
Vertices	6	6	12
Edges	12	9	30

Using Euler's Formula: $F + V - E = 2$

Q8. Can a polyhedron have 10 faces, 20 edges and 15 vertices?

Sol. Here faces = 10, Edges = 20, Vertices = 15
According to Euler's Formula:

$$F + V - E = 2$$

$$\Rightarrow 10 + 15 - 20 = 25 - 20$$

$$\Rightarrow 5 \neq 2$$

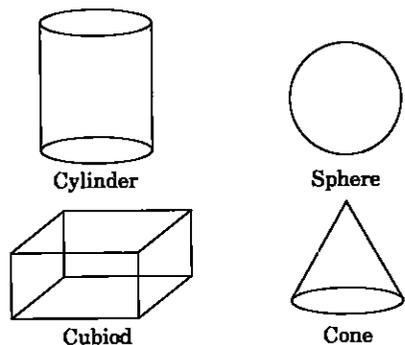
\therefore A polyhedron do not have 10 Faces, 20 Edges and 15 Vertices.

Learning More Q & A

I. VERY SHORT ANSWER (VSA) QUESTIONS

Q1. Draw any four 3-dimensional figures.

Sol.



Q2. Verify Euler's formula for a right triangular prism.

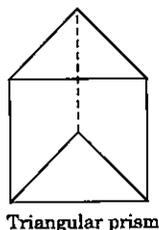
Sol. Number of vertices (V) = 6
Number of faces (F) = 5
and number of edges (E) = 9
Euler's formula:

$$V + F - E = 2$$

$$6 + 5 - 9 = 2$$

$$\therefore 2 = 2$$

Hence, the formula is verified.



Q3. Find the number of vertices of hexagonal prisms.

Sol. Number of vertices
 $= 2 \times \text{Number of sides}$
 $= 2 \times 6 = 12$

Q4. Verify whether a polyhedron can have 10 faces, 20 edges and 15 vertices.

Sol. We have
Number of faces $F = 10$
Number of edges $E = 20$
and number of vertices $V = 15$
Euler's formula:

$$V + F - E = 2$$

$$\Rightarrow 15 + 10 - 20 = 2$$

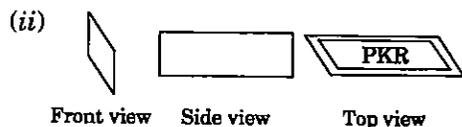
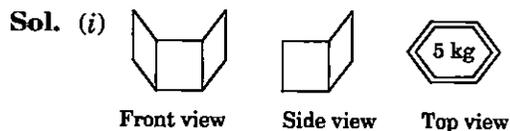
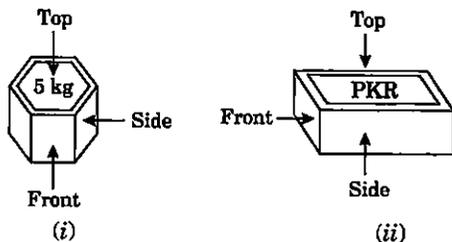
$$\Rightarrow 5 \neq 2$$

Hence, it is not possible to have a polyhedron satisfying the above data.

Q5. If $F = 18$ and $V = 10$, then find the value of E in Euler's formula.

Sol. We know that
 $V + F - E = 2$
 $\Rightarrow 10 + 18 - E = 2$
 $\Rightarrow 28 - E = 2$
 $\therefore E = 28 - 2 = 26$
Hence, the required value of $E = 26$

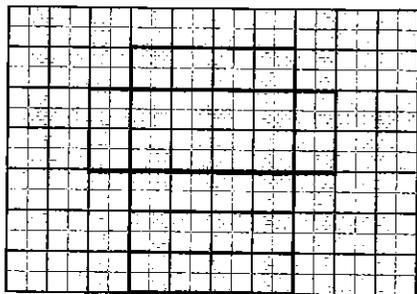
Q6. Draw the front, side and top views of the following 3-D figures.



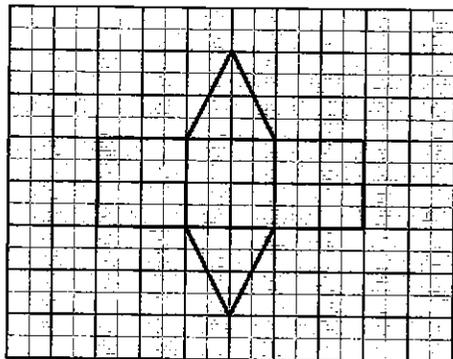
Q7. Draw the nets of the following polyhedrons.

- (i) Cuboid
- (ii) Triangular prism with base equilateral triangle.
- (iii) Square pyramid.

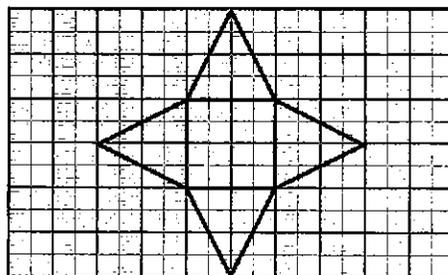
Sol. (i) Net pattern of cuboid



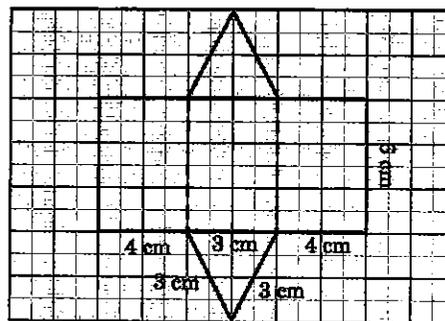
(ii) Net pattern of triangular prisms



(iii) Net pattern of square pyramid



Q8. The given net is made up of two equilateral triangles and three rectangles.



- (i) Name the solid it represents.
- (ii) Find the number of faces, edges and vertices.

Sol. (i) The given figure represents the net of triangular prism
 (ii) Number of faces = 5
 Number of edges = 9
 Number of vertices = 6

II. SHORT ANSWER (SA) QUESTIONS

Q9. Match the following:

Column I	Column II
(a)	(i) Sphere
(b)	(ii) Cylinder
(c)	(iii) Rectangle
(d)	(iv) Circle
(e)	(v) Cube
(f)	(vi) Cone

Sol. (a) ↔ (vi), (b) ↔ (v), (c) ↔ (ii), (d) ↔ (i), (e) ↔ (iii), (f) ↔ (iv)

Q10. Using Euler's formula, fill in the blanks:

	Faces	Vertices	Edges
(a)	6	8	—
(b)	—	10	15
(c)	4	—	6
(d)	5	6	—
(e)	8	12	—
(f)	7	7	—

Sol. (a) $F + V - E = 2$

$$\Rightarrow 6 + 8 - E = 2$$

$$\Rightarrow 14 - E = 2$$

$$\therefore E = 14 - 2 = 12$$

(b) $F + V - E = 2$

$$\Rightarrow F + 10 - 15 = 2$$

$$\Rightarrow F - 5 = 2$$

$$\therefore F = 2 + 5 = 7$$

(c) $F + V - E = 2$

$$\Rightarrow 4 + V - 6 = 2$$

$$\Rightarrow V - 2 = 2$$

$$\therefore V = 2 + 2 = 4$$

(d) $F + V - E = 2$

$$\Rightarrow 5 + 6 - E = 2$$

$$\Rightarrow 11 - E = 2$$

$$\therefore E = 11 - 2 = 9$$

(e) $F + V - E = 2$

$$\Rightarrow 8 + 12 - E = 2$$

$$\Rightarrow 20 - E = 2$$

$$\therefore E = 20 - 2 = 18$$

(f) $F + V - E = 2$

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

$$\Rightarrow 14 - E = 2$$

$$\therefore E = 14 - 2 = 12$$

Hence (a) $\rightarrow 12$, (b) $\rightarrow 7$, (c) $\rightarrow 4$ (d) $\rightarrow 9$, (e) $\rightarrow 18$, (f) $\rightarrow 12$

Q11. Name the solids that have:

- (i) 4 faces
- (ii) 8 triangular faces
- (iii) 6 faces
- (iv) 1 curved surface
- (v) 5 faces and 5 vertices
- (vi) 6 rectangular faces and 2 hexagonal faces

Sol. (i) Tetrahedron

(ii) Regular octahedron

(iii) Cube and cuboid

(iv) Cylinder

(v) Square and rectangular pyramid

(vi) Hexagonal prism

Q12. Complete the table:

Solid	F	V	E	F + V	E + 2
Cuboid	—	—	—	—	—
Triangular pyramid	—	—	—	—	—
Triangular prism	—	—	—	—	—
Pyramid with square base	—	—	—	—	—
Prism with square base	—	—	—	—	—

Sol. Completed table:

Solid	F	V	E	F + V	E + 2
Cuboid	6	8	12	14	14
Triangular pyramid	4	4	6	8	8
Triangular prism	5	6	9	11	11
Pyramid with square base	5	5	8	10	10
Prism with square base	6	8	12	14	14

Q13. Use isometric dot paper to sketch a rectangular prism with length 4 units, height 2 units and width 3 units. (NCERT Exemplar)

Sol. Steps:

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

This is top of the prism (Fig. 1).

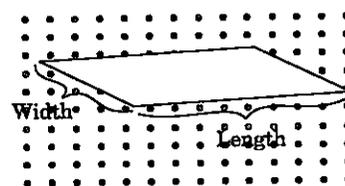


Fig. 1

- (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).

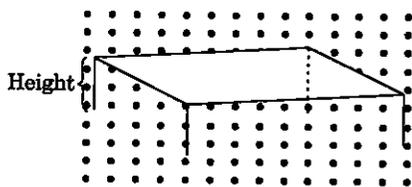


Fig. 2

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

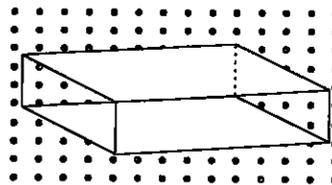
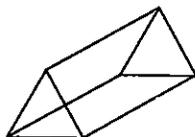


Fig. 3

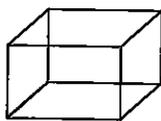
Test Yourself

I. VERY SHORT ANSWER (VSA) QUESTIONS

- Q1. Find the number of faces, vertices and edges of the following shapes.



(i)

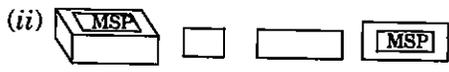
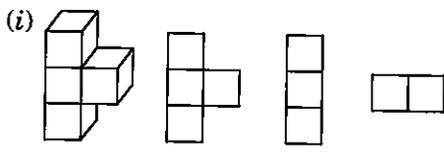


(ii)

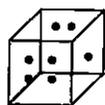
- Q2. Fill in the blanks.

- (i) If $F = 8$, $V = 6$, then $E = \dots\dots\dots$
 (ii) If $F = 7$, $V = 10$, then $E = \dots\dots\dots$
 (iii) If $V = 4$, $E = 6$, then $F = \dots\dots\dots$
 (iv) If $V = 5$, $F = 5$, then $E = \dots\dots\dots$

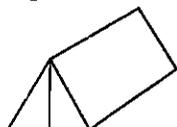
- Q3. For each of the following shapes, identify the front, side and top views:



- Q4. For each of the following, draw the front view, side view and the top view.

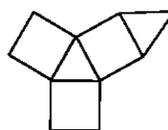


(a)

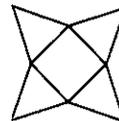


(b)

- Q5. Name the polyhedron that can be formed after folding each of the following nets:



(i)



(ii)

II. SHORT ANSWER (SA) QUESTIONS

- Q6. Write the vertices, edges and faces of the following solids.



Sphere

(i)



Cylinder

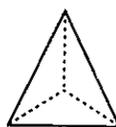
(ii)



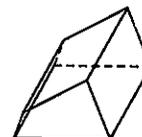
Cone

(iii)

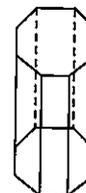
- Q7. Name the following solids and their corresponding number of faces.



(i)



(ii)



(iii)

- Q8. Draw the two-dimensional representatives of a
 (i) cube
 (ii) cuboid
 (iii) hexagonal prism

ANSWERS

1. (i) $F = 5$, $V = 6$, $E = 9$
 (ii) $F = 6$, $V = 8$, $E = 12$
 2. (i) 12 (ii) 15 (iii) 4 (iv) 8
 3. (i) Front, Side, Top (ii) Front, Side, Top
 5. (i) Triangular prism (ii) Square pyramid

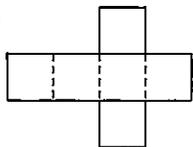
6. (i) $V = 0$, $E = 0$, $F = 1$ (Curved face)
 (ii) $V = 0$, $E = 2$ (curved edges), $F = 3$ (2 flat, 1 curved face)
 (iii) $V = 1$, $E = 2$ (curved edges), $F = 2$ (1 flat, 1 curved face)

7. (i) Tetrahedron, 4
(iii) Octahedron, 10

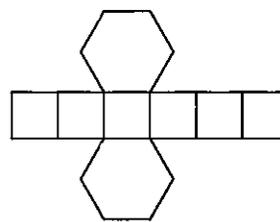
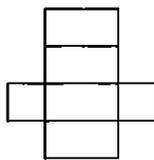
- (ii) Hexahedron, 6

- (iii)

8. (i)



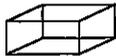
- (ii)



Internal Assessment

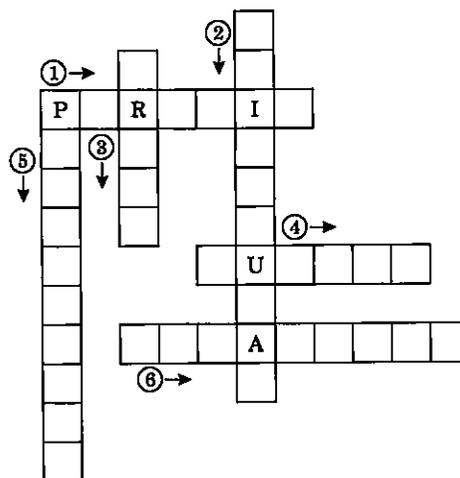
III. MULTIPLE CHOICE QUESTIONS (MCQs)

- Q1. The common name of a square prism is
(a) cube (b) pyramid
(c) polygon (d) cuboid
- Q2. A hexagonal has edges.
(a) 10 (b) 18 (c) 12 (d) 15
- Q3. The number of faces of a octagonal pyramid is
(a) 9 (b) 8 (c) 16 (d) 17
- Q4. Which of the following is a 3-dimensional figure?
(a) Parallelogram (b) Square
(c) Cylinder (d) Quadrilateral
- Q5. If $F = 20$ and $V = 12$, then value of E is
(a) 34 (b) 8 (c) 30 (d) 15
- Q6. Find the number of edges in a matchbox.
- Q7. A polyhedrons has 7 faces and 10 vertices, find the number of edges.
- Q8. Match the following:

Shape	Type of shape	Name of the shape
(i) 	(a) 3-D	(p) Cuboid
(ii) 	(b) 2-D	(q) Triangle
(iii) 	(c) 3-D	(r) Cylinder
(iv) 	(d) 2-D	(s) Square
(v) 	(e) 3-D	(t) Cone

(vi) 	(f) 3-D	(u) Pyramid
(vii) 	(g) 2-D	(v) Circle
(viii) 	(h) 3-D	(w) Sphere

- Q9. Complete the following crossword puzzle.



Hints:

1. Triangular has 4 faces.
2. prism has 4 faces.
3. Hexagonal has 8 faces.
4. has 12 edges.
5. Any bounded polygon is known as
6. pyramid has 8 faces.

ANSWERS

1. (a) 2. (b) 3. (a) 4. (c) 5. (c) 6. 12 7. 15
8. (i) → (a) → (t), (ii) → (c) → (r), (iii) → (b) → (q), (iv) → (d) → (s), (v) → (e) → (p),
(vi) → (g) → (v), (vii) → (f) → (w), (viii) → (h) → (u)
9. 1. PYRAMID 2. TRIANGULAR 3. PRISM 4. CUBOID 5. POLYHEDRON 6. HEXAGONAL