VISUALISING SOLID SHAPES

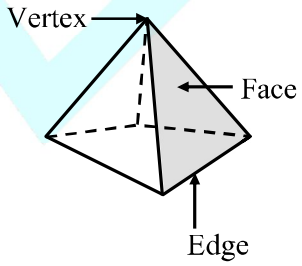
CONTENTS

➢ POLYHEDRONS

A polyhedron is a solid shape which is bounded by polygons which are called its **faces**, these faces meet at **edges** which are line segments and the edges meet at **vertices** which are points.

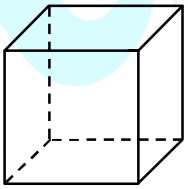
Eg. :

(1) A pyramid which has 5 vertices, 5 faces, 8 edges

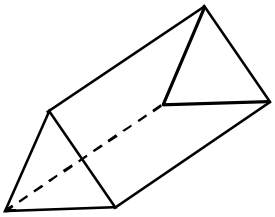


(2) A cuboid which has 8 vertices, 6 faces, 12 edges

(3) A cube has 8 vertices, 6 faces, 12 edges



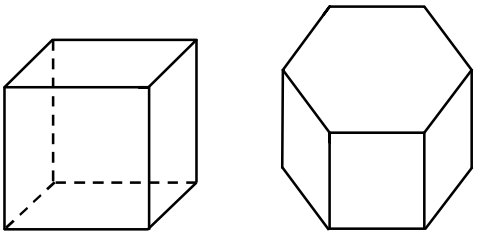
(4) A triangular prism has 6 vertices, 5 faces, 9 edges



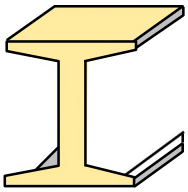
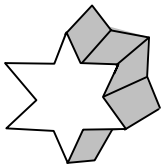
Note : A sphere, a cylinder and a cone are not polyhedrons.

◈ Convex Polyhedrons

A polyhedron is convex if any two points on its surface can be joined by a line segment that entirely lies inside or on the polyhedron.



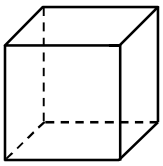
These are convex polyhedrons

These are not convex polyhedrons.

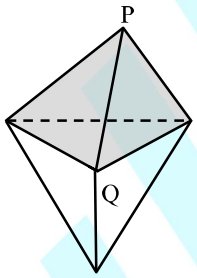
◈ Regular Polyhedrons

A polyhedron is said to be **regular** if its faces are made up of regular polygons and the same number of faces meet at each vertex.



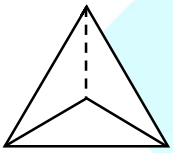
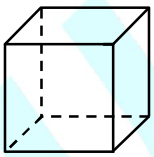
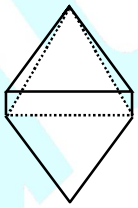
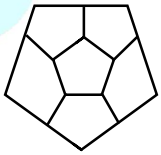
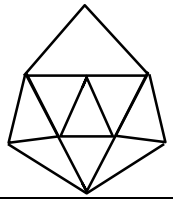
A cube is a regular polyhedron as its faces are made up of regular polygons. Also the vertices are formed by the same number of faces.

This polyhedron is not regular even through all the faces are congruent because at P, 3 faces meet but at Q, 4 faces meet.



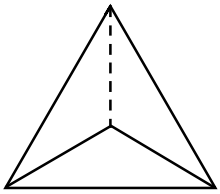
➢ PLATONIC SOLIDS

There are only five regular polyhedrons. These are known as Platonic solids.

Name	Figure	Faces	Edges	Vertices
1. Tetrahedron		4 (Triangular)	6	4
2. Cube or Hexahedron e.g., Ice-cube		6 (Square)	12	8
3. Octahedron e.g., Diamond Crystals		8 (Triangular)	12	6
4. Dodecahedron		12 (Pentagonal)	30	20
5. Icosohedron		20	30	12

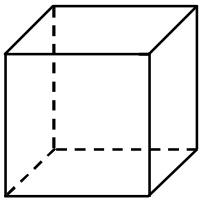
➢ SOLID SHAPES (POLYHEDRONS)

Let us look at the solid shapes once more. In class VII, we have studied some of the regular polyhedrons. They are tetrahedrons and cubes. A regular polyhedron has all its faces congruent. Such solids are also called platonic solids.



4 Faces

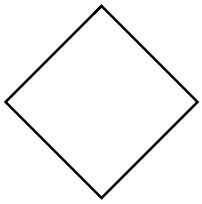
All edges are equal.
All faces are equal.
A regular tetrahedron



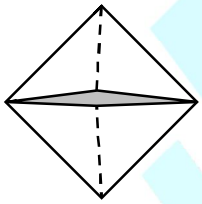
6 Faces

All sides are equal
All faces are equal
A cube or a regular Hexahedron

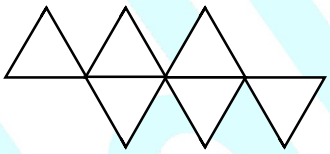
Now look at the solids in figure. This is also regular hexahedron as it has six faces and all six faces are equal.



What we see



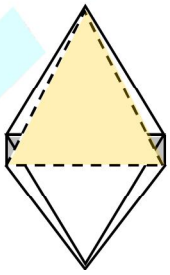
Drawing



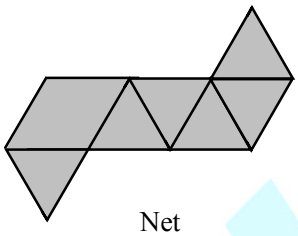
Net

Regular octahedron has 8 faces and equal edges. The faces are eight equilateral triangles as shown in figure.

What we see

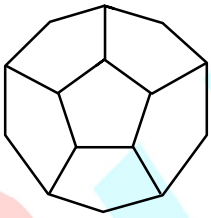


Drawing

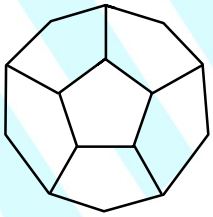


Net

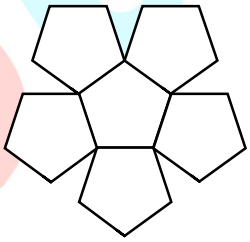
Solid shown in figure is a Dodecahedron having equal regular pentagons as faces. In greek language do means two and deca means ten. Hence dodeca means Twelve.



What we see

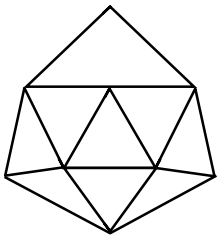


Drawing

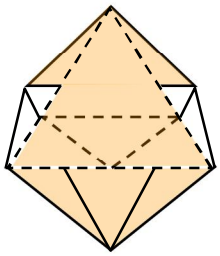


Net of one side

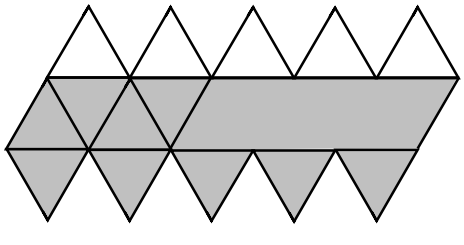
Shows a regular polyhedron having 20 congruent faces. It is called an icosohedron.



What we see



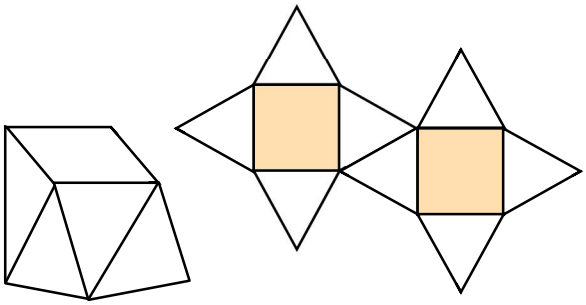
Drawing



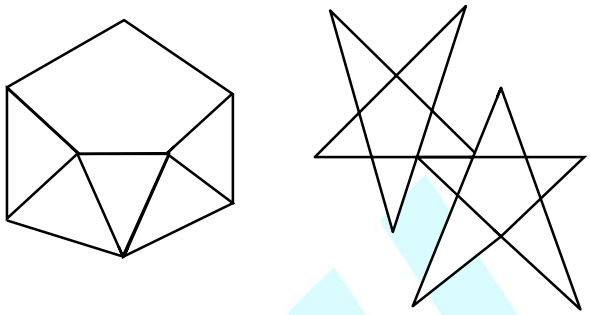
Net

There are many other polyhedrons made with combination of two or three two dimensional shapes.

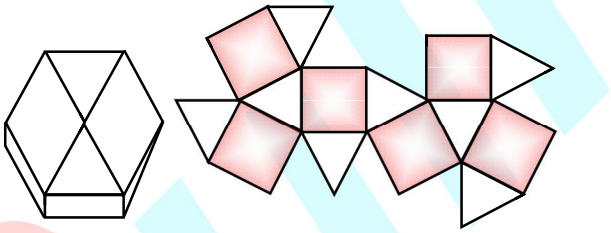
Let us take a quick look at some of them. These are not regular polyhedrons as all of their faces are not congruent to each other.



(a) Square antiprism 2 Squares and 8 Triangles



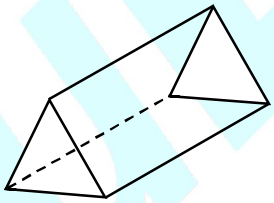
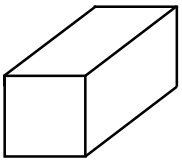
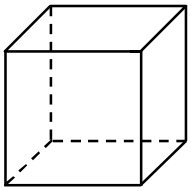
(b) Pentagonal antiprism 2 Pentagons and 10 Triangles

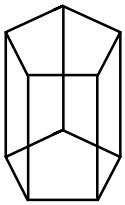
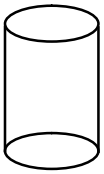


(c) Cuboctahedron 6 Squares and 8 Triangles

➢ PRISMS

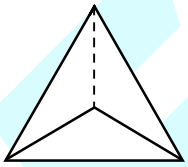
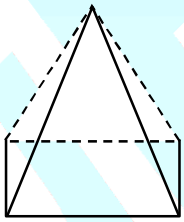
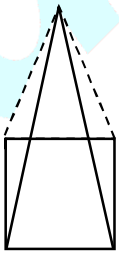
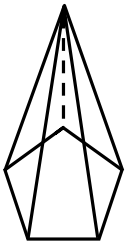
A solid whose base and top are identical polygons and the sides are rectangles, is known as a prism. It is a polyhedron, two of whose faces are congruent polygons in parallel planes and whose other faces are parallelograms.

Types	Figure	Faces	Edges	Vertices
1. Triangular Prism		5	9	6
2. Cuboid Rectangular Prism		6	12	8
3. Square Prism		6	12	8
4. Cube		6	12	8

Types	Figure	Faces	Edges	Vertices
5. Pentagonal Prism		7	15	10
6. Cylinder		3	2	—

➢ PYRAMIDS

A pyramid is a polyhedron whose base is a polygon (of any number of sides) and whose other faces are triangles with a common vertex.

Types	Figure	Faces	Edges	Vertices
1. Triangular Pyramid		4	6	4
2. Rectangular Pyramid		5	8	5
3. Square Pyramid		5	8	5
4. Pentagonal Pyramid		6	10	6

➢ EULER'S FORMULA

The table below shows the number of faces, edges and vertices of each of the platonic solids.

Here, v stands for vertices, f for faces and e for edges.

Solid	f	v	e	f + v	e + 2
Hexahedron (Cube)	6	8	12	6 + 8 = 14	12 + 2 = 14
Octahedron	8	6	12	8 + 6 = 14	12 + 2 = 14
Dodecahedron	12	20	30	12 + 20 = 32	30 + 2 = 32
Icosohedron	20	12	30	20 + 12 = 32	30 + 2 = 32

The above table clearly shows that

f + v = e + 2.

Leonard Euler (1707 – 1783) discovered this formula which established the relationship among the number of faces, edges and vertices of a polyhedron.

◈ **Euler's Formula**

f + v = e + 2

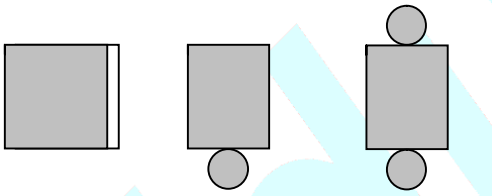
where f = number of faces

v = number of vertices

e = number of edges

➢ NETS OF SOLIDS

(a) Net of cylinder shown in figure.

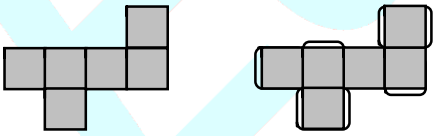


(i) (Open at both ends with tabs)

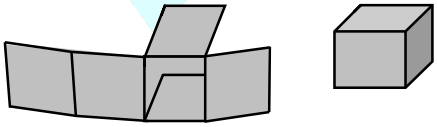
(ii) (Closed at one end without tabs)

(iii) (Closed at both ends without tabs)

(b) Net of a cube shown in figure

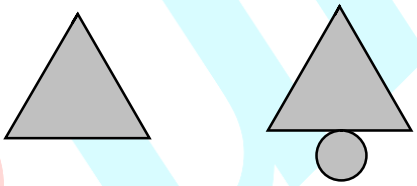


(i) Without tabs (ii) With tabs



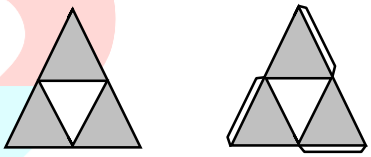
(iii) Making of a cube (iv) Cube

(c) Net of a cone shown in figure.



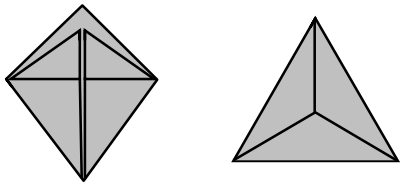
(i) Open (ii) Closed

(d) Net of a tetrahedron shown in figure



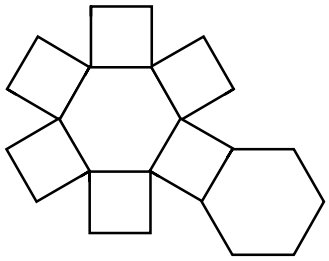
(a) Without tabs (ii) With tabs

Making a tetrahedron

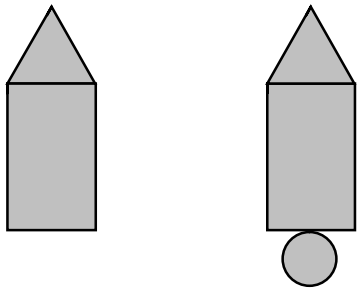


(i) (ii)

(e) Net of a hexagonal prism shown in figure.



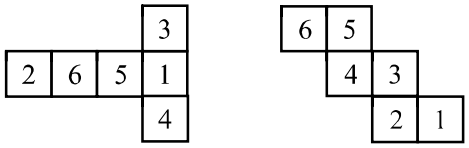
(f) Net of cylinder surmounted by a cone figure.



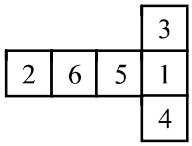
(a) Open base (b) Closed base

❖ EXAMPLES ❖

Ex.1 Dice are cubes where the sum of number on opposite sides must be 7. Which of the following are dice.



Sol.



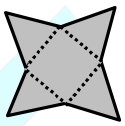
In this $4 + 3 = 7$

$1 + 6 = 7$

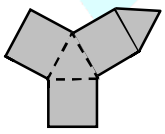
$2 + 5 = 7$

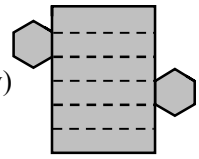
So, this is the dice.

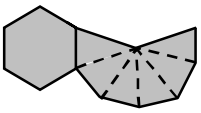
Ex.2 Name the solid that results from folding each net.

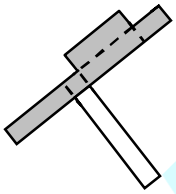
Sol. (i)  – Pyramid with square base

(ii)  – Prism with rectangular base

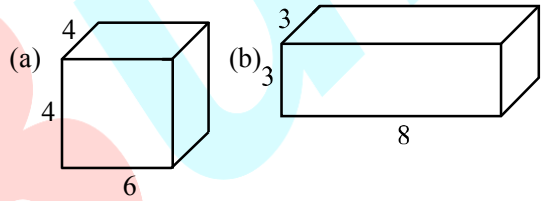
(iii)  – Prism with rectangular base

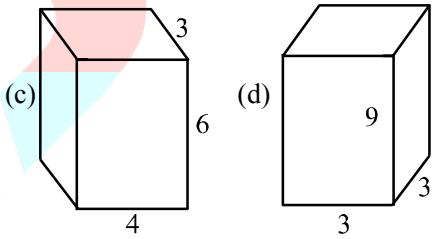
(iv)  – Prism with hexagonal base

(v)  – Pyramid with hexagonal base

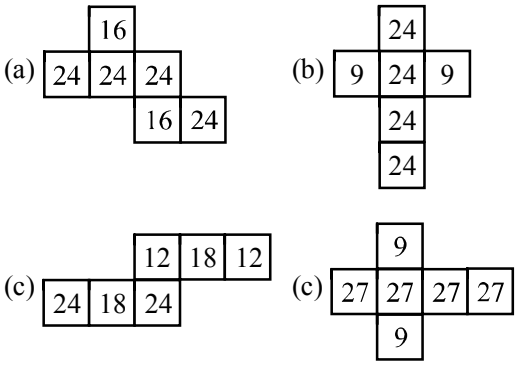
(vi)  – Prism with square base

Ex.3 Write the Nets with area of faces for the following :





Sol. Nets with areas of faces

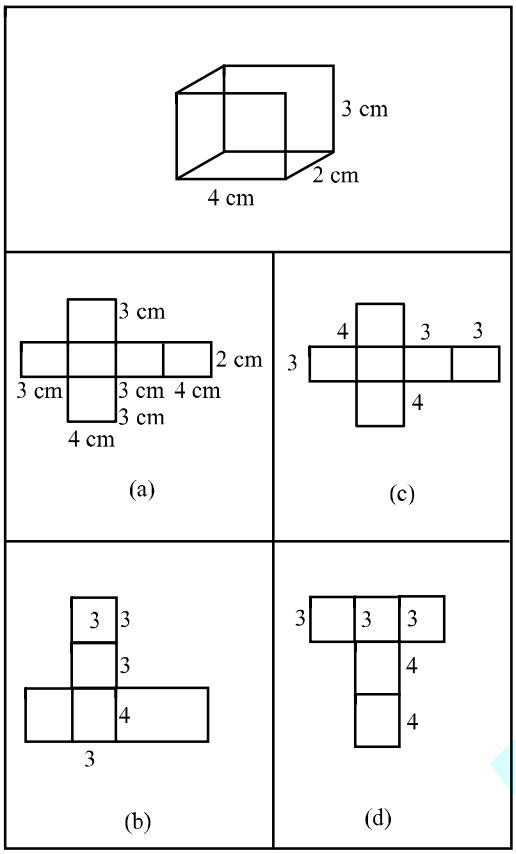


➢ IDENTIFYING AND MATCHING PICTURES

We have studies nets in previous class. Let us identify and match the correct picture.

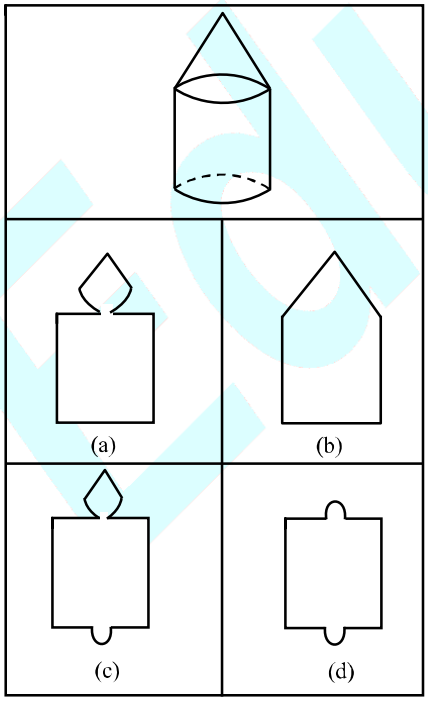
Ex.4 Match the given net with the correct figure :

(i)



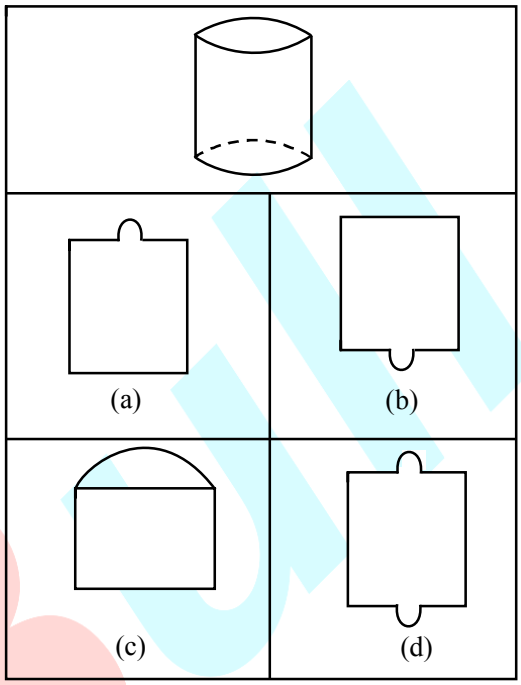
Sol. (a)

(ii)



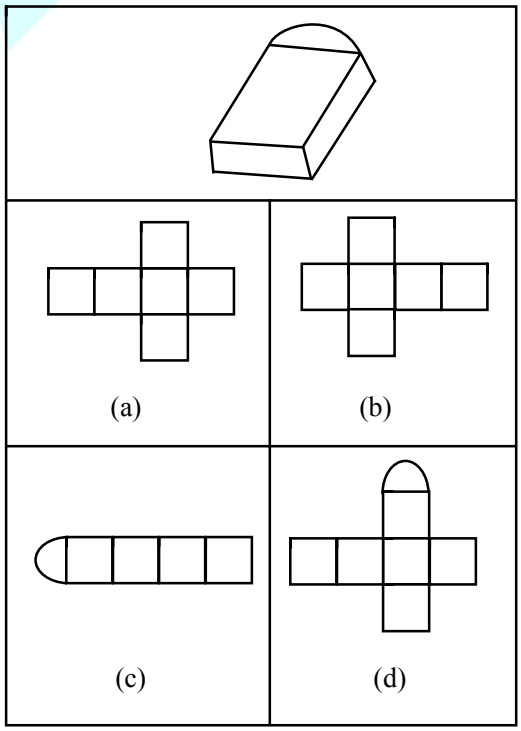
Sol. (c)

(iii)



Sol. (d)

(iv)



Sol. (d)