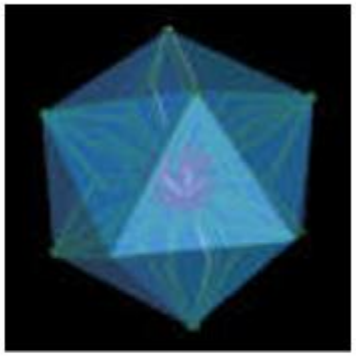
Solids

A 3-D object having length, breadth and thickness and bounded by surfaces which may be either plane or curved, or combination of the two.

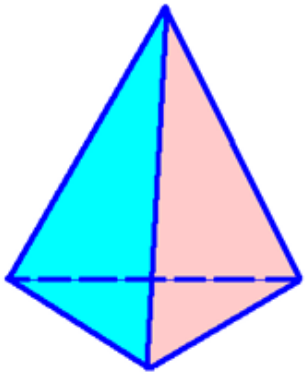


- Classified under two main headings
  - Polyhedron
  - Solids of revolution

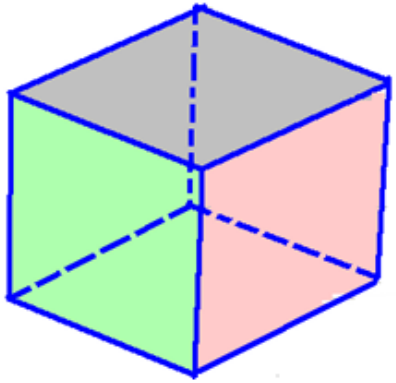
- **Regular polyhedron** – solid bounded only by plane surfaces (faces). Its faces are formed by regular polygons of same size and all dihedral angles are equal to one another.

- **Other polyhedra** – when faces of a polyhedron are not formed by equal identical faces, they may be classified into prisms and pyramids.

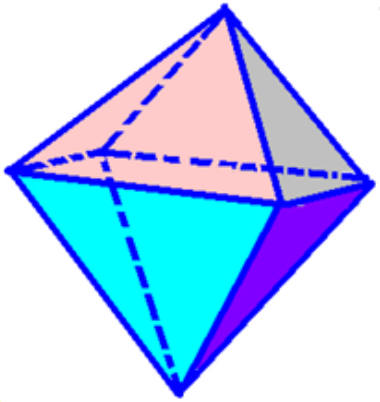
Five regular polyhedra



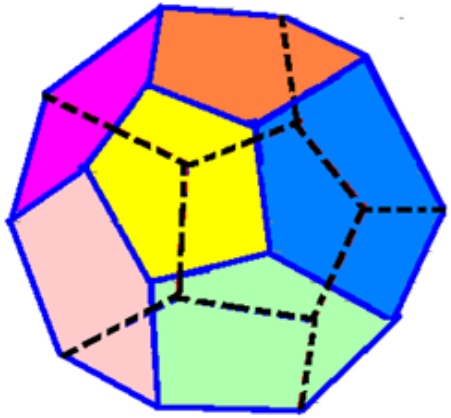
Tetrahedron – four equal equilateral triangular faces



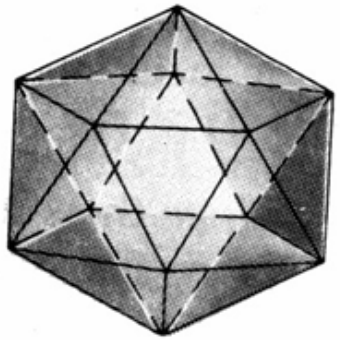
Cube/hexahedron – six equal square faces



Octahedron– eight equal equilateral triangular faces



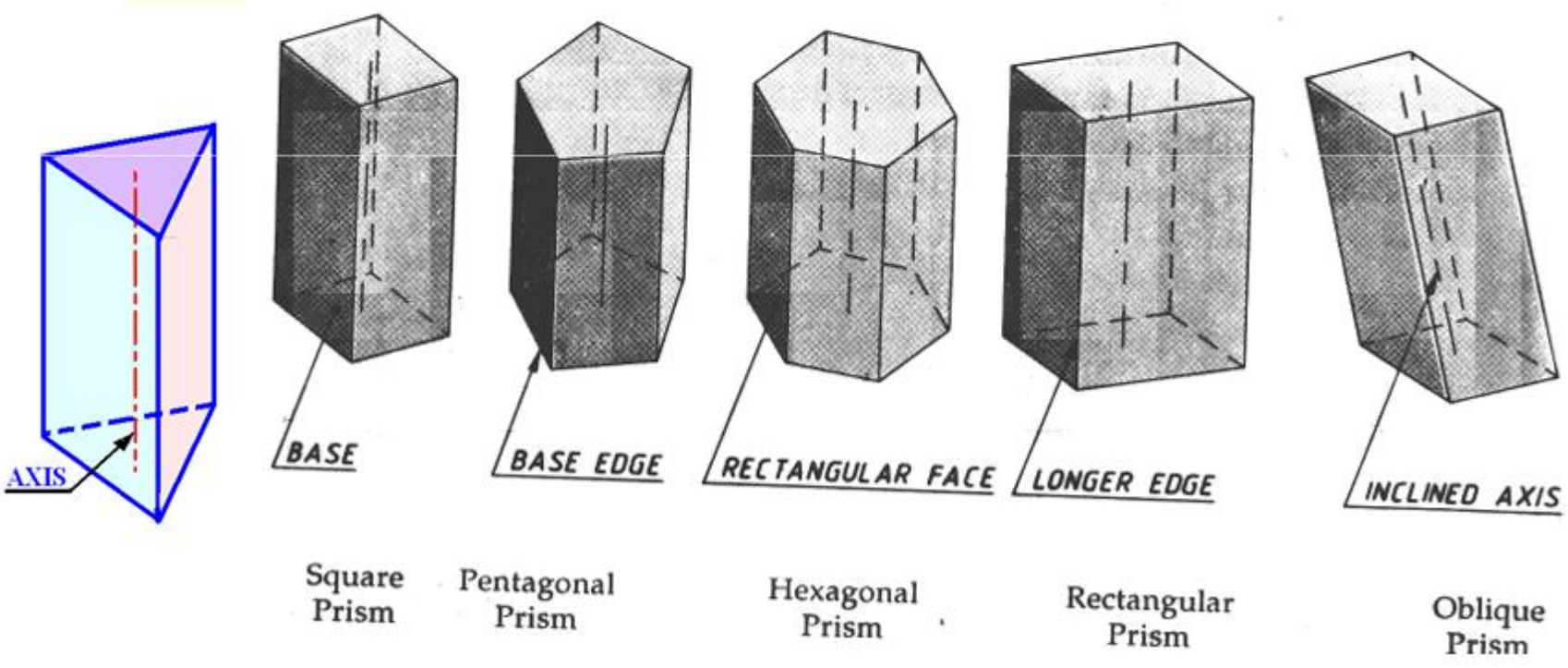
Dodecahedron – twelve equal regular pentagonal faces

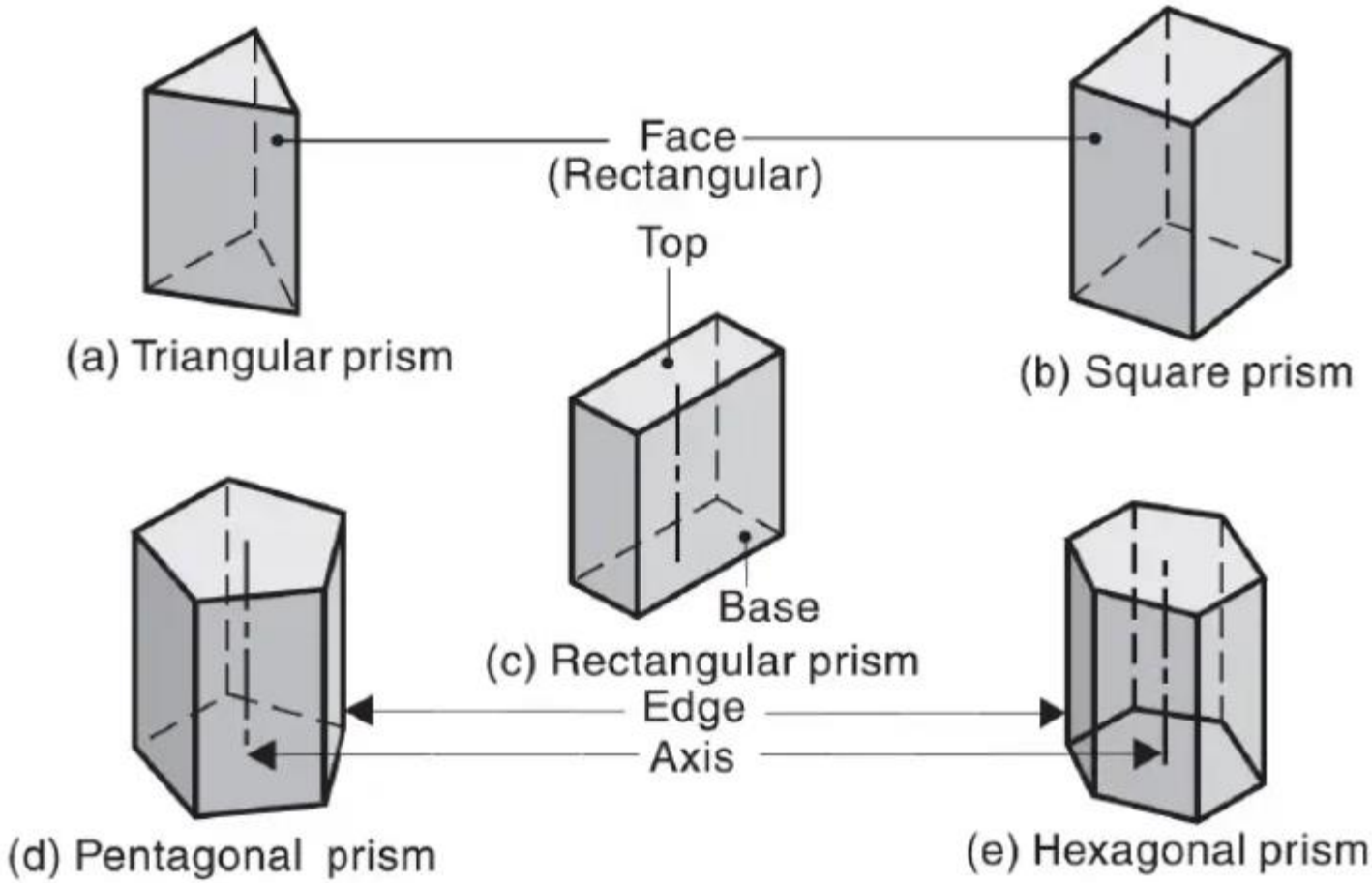


Icosahedron– twenty equal equilateral triangular faces

Prism – a polyhedron formed by two equal parallel regular polygon, end faces connected by side faces which are either rectangles or parallelograms.

Different types of prisms




Face
(Rectangular)
Top
Base
Edge
Axis
(a) Triangular prism
(b) Square prism
(c) Rectangular prism
(d) Pentagonal prism
(e) Hexagonal prism

Pyramids – a polyhedron formed by a **plane surface as its base** and a **number of triangles as its side faces**, all meeting at a point, called **vertex** or **apex**.

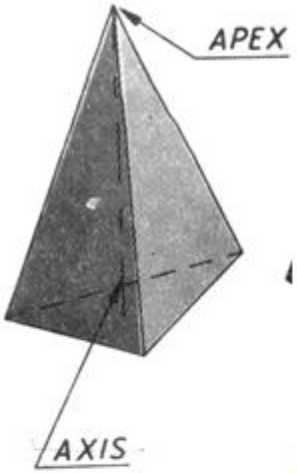
Axis – the imaginary line connecting the apex and the center of the base.

Inclined/slant faces – inclined triangular side faces.

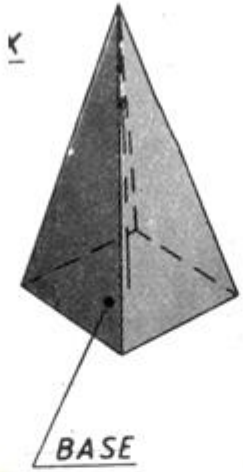
Inclined/slant/longer edges – the edges which connect the apex and the base corners.

Right pyramid – when the axis of the pyramid is perpendicular to its base.

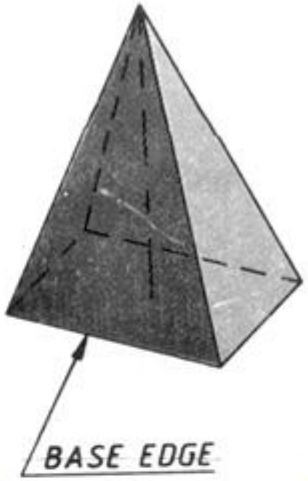
Oblique pyramid – when the axis of the pyramid is inclined to its base.



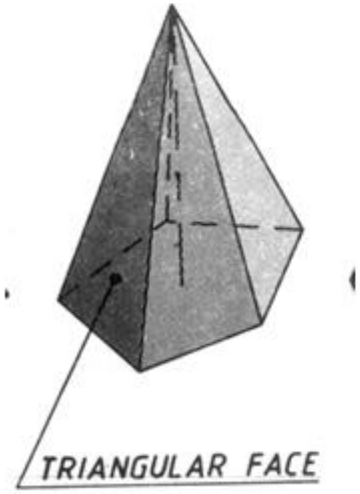
Triangular pyramid



Square pyramid

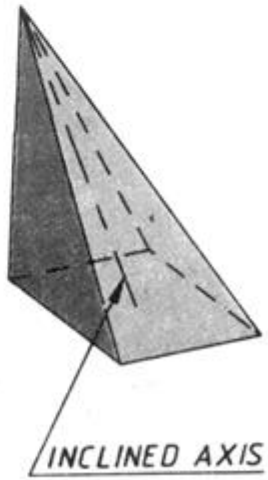


Rectangular pyramid

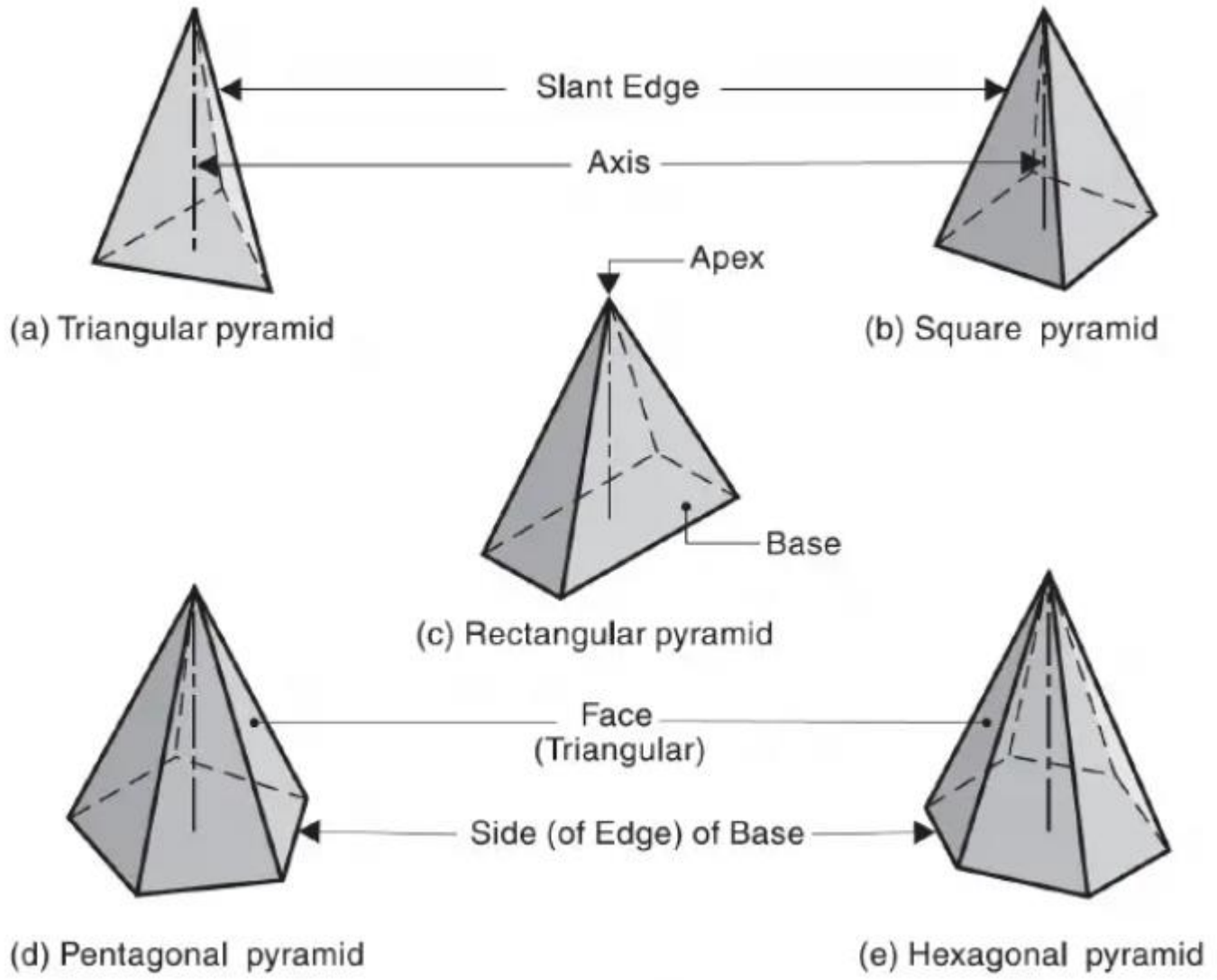


Pentagonal pyramid

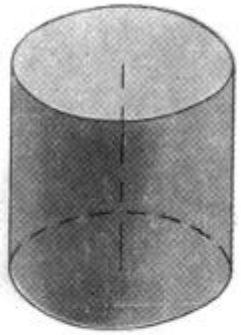
Hexagonal pyramid



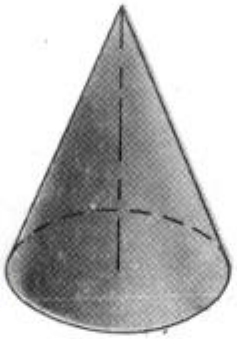
Oblique pyramid


Slant Edge
Axis
Apex
Base
Face
(Triangular)
Side (of Edge) of Base
(a) Triangular pyramid
(b) Square pyramid
(c) Rectangular pyramid
(d) Pentagonal pyramid
(e) Hexagonal pyramid

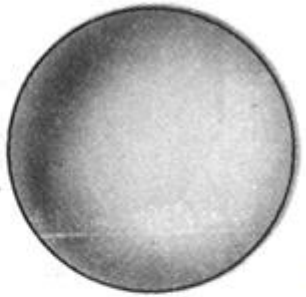
Solids of revolution – when some of the plane figures are revolved about one of their sides – solids of revolution is generated.



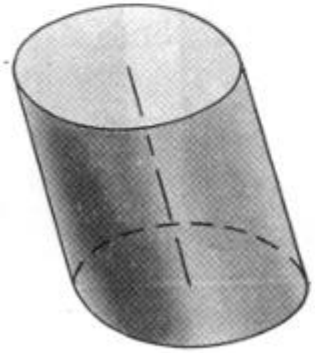
Cylinder – when a rectangle is revolved about one of its sides, the other parallel side generates a cylinder.



Cone – when a right triangle is revolved about one of its sides, the hypotenuse of the right triangle generates a cone.

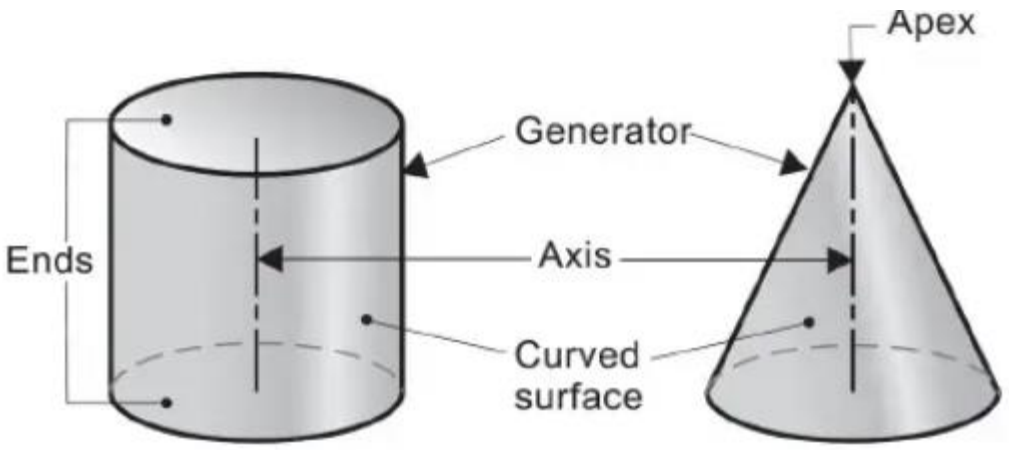


Sphere – when a semi-circle is revolved about one of its diameter, a sphere is generated..

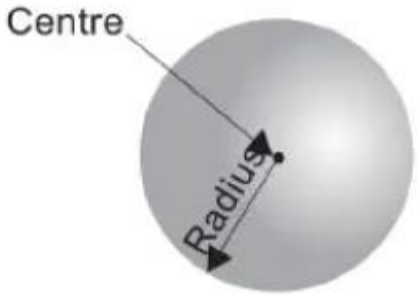


Oblique cylinder – when a parallelogram is revolved about one of its sides, the other parallel side generates a cylinder.

Oblique cone



(a) Cylinder (b) Cone



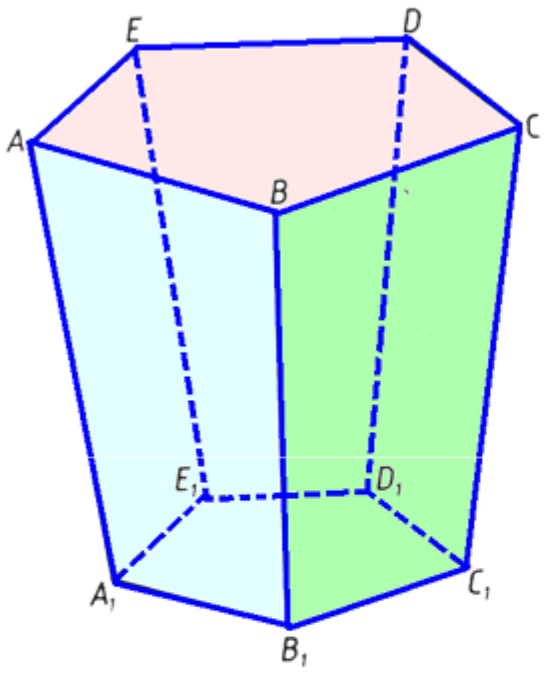
(c) Sphere

Visibility – when drawing the orthographic views of an object, it will be required to show some of the **hidden details as invisible** and are shown on the orthographic views by **dashed lines**

Rules of visibility

All outlines of every view are visible – the outlines of all the views are shown by full lines.

In the top view, the highest portions of the object are visible.



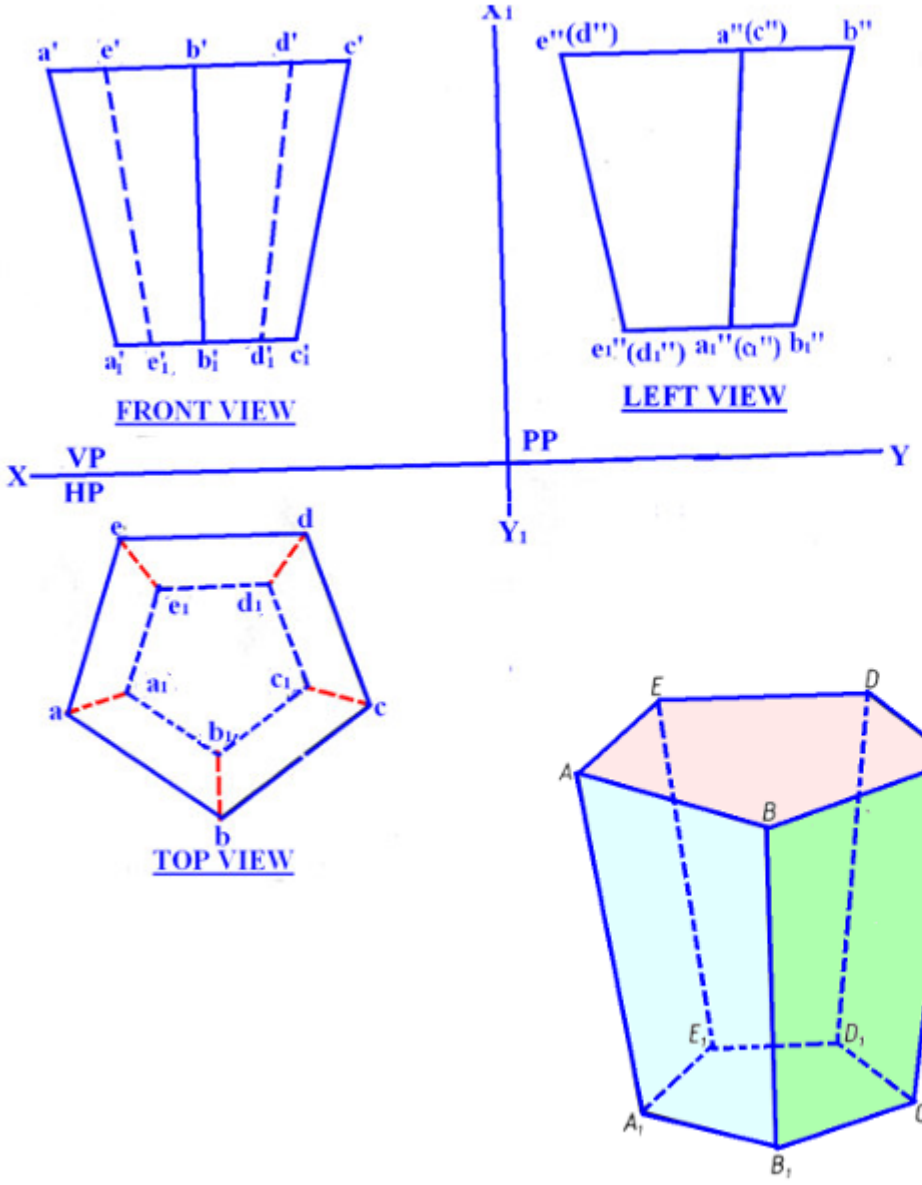
Frustum of a pentagonal pyramid – the top face ABCDE is the highest, it is completely visible in the top view.

In the top view, edges **ab, bc, cd, de** and **ea** are shown as **full lines**. The bottom pentagonal faces $A_1B_1C_1D_1E_1$ is smaller than the top face, hence **invisible**.

The slant edges AA_1, BB_1, CC_1, DD_1 and EE_1 are invisible in the top view, hence they are shown as **lines of dashes.**

The line connecting a visible point and an invisible point is shown as an invisible line of dashes unless they are outlines.

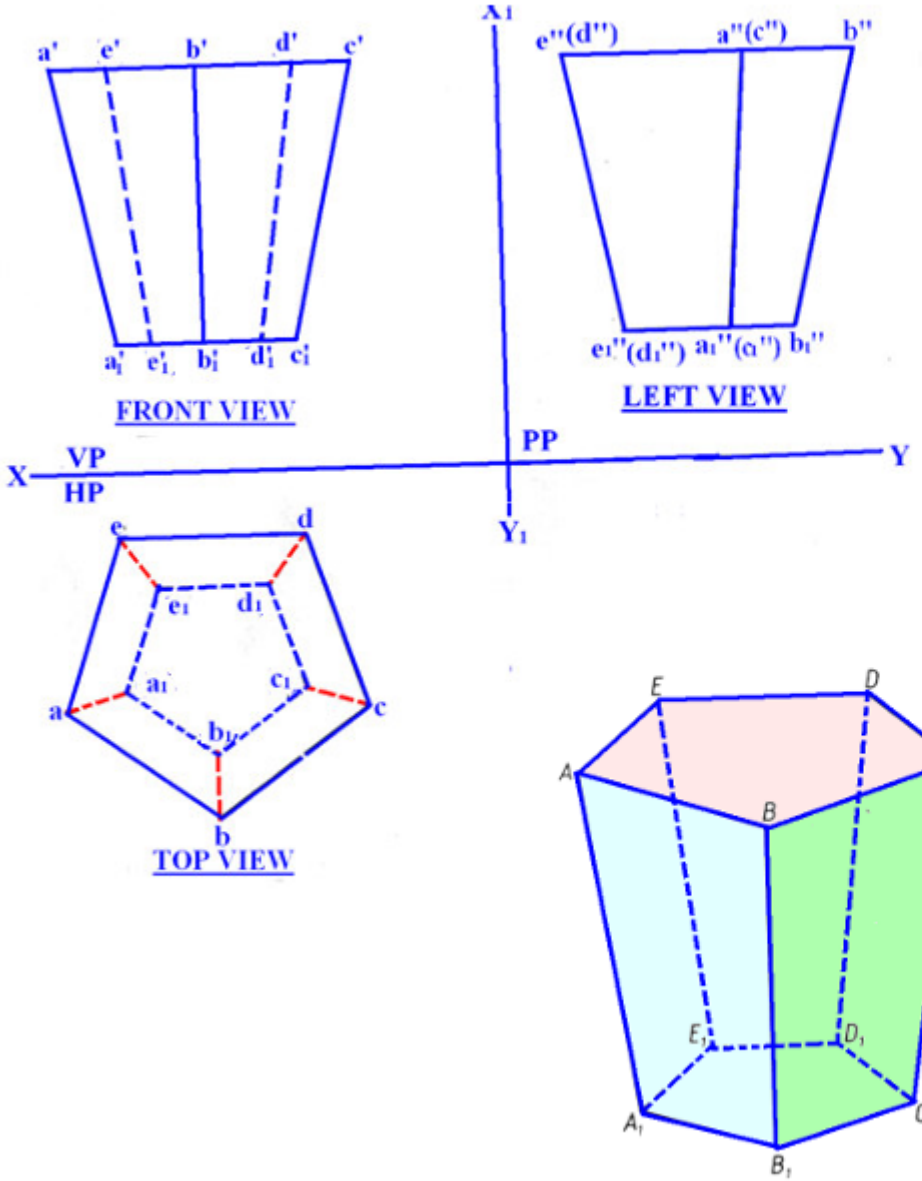
In the side view - the face lying on that side are visible.



As sheen in the left side view, the corners **e, a, b** and **e_1, a_1, b_1** lie on left side and are visible in the left view.

Hence the lines, **e"e_1"**, **a"a_1"** and **b"b_1"** are shown as full lines. The edges **d"d_1"**, **c"c_1"** coincide with the visible edges **e"e_1"** and **a"a_1"** respectively.

In the side view - the face lying on that side are visible.



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Projections of solids placed in different positions

The solids may be placed on HP in various positions

(1) The way the axis of the solid is held with respect to HP or VP or both -

- **Perpendicular to HP or VP**
- **Parallel to either HP or VP and inclined to the other**
- **Inclined to both HP and VP**

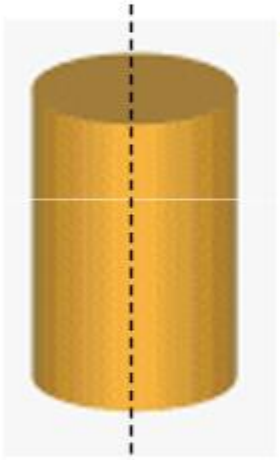
Axis of the solid perpendicular to HP

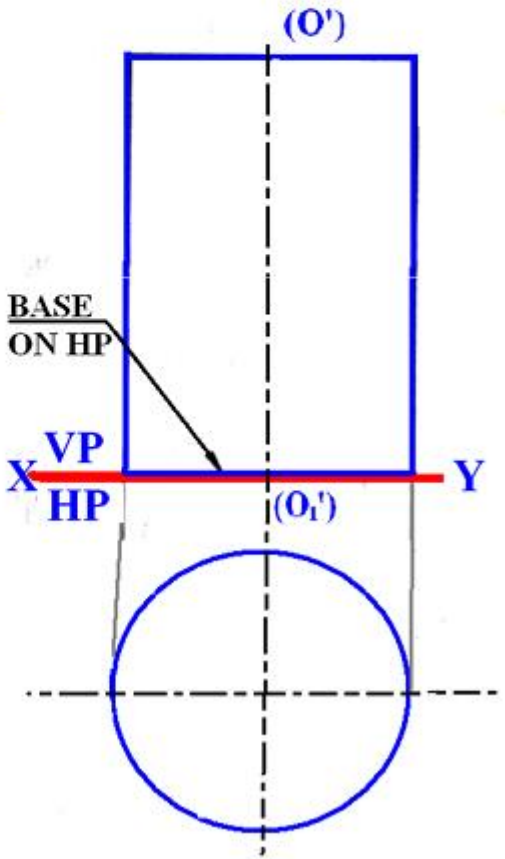
A solid when placed on HP with its axis perpendicular to it, then it will have its base on HP. This is the simplest position in which a solid can be placed.

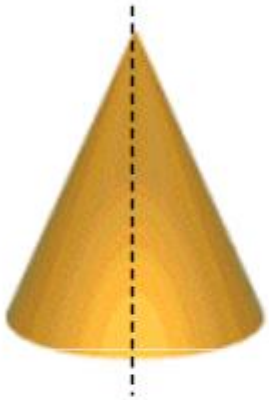
When the solid is placed with the base on HP position, in the top view, the base will be projected in its true shape.

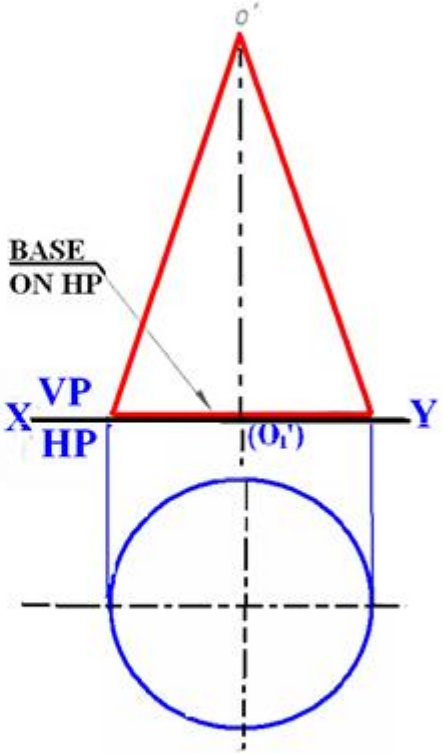
Hence, when the base of the solid is on HP, the top view is drawn first and then the front view and the side views are projected from it.

Only one position in which a cylinder or a cone may be placed with its base on HP.

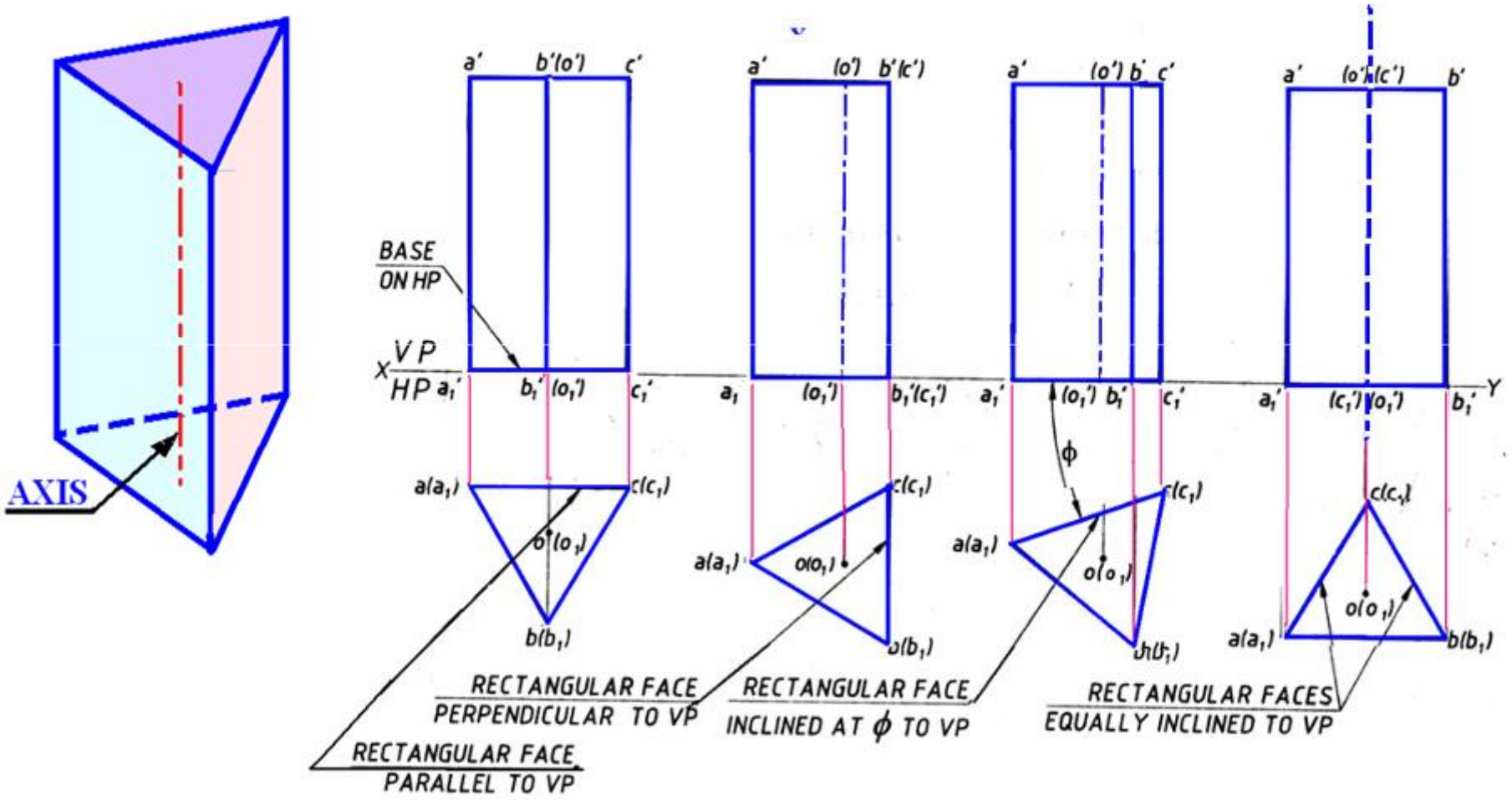




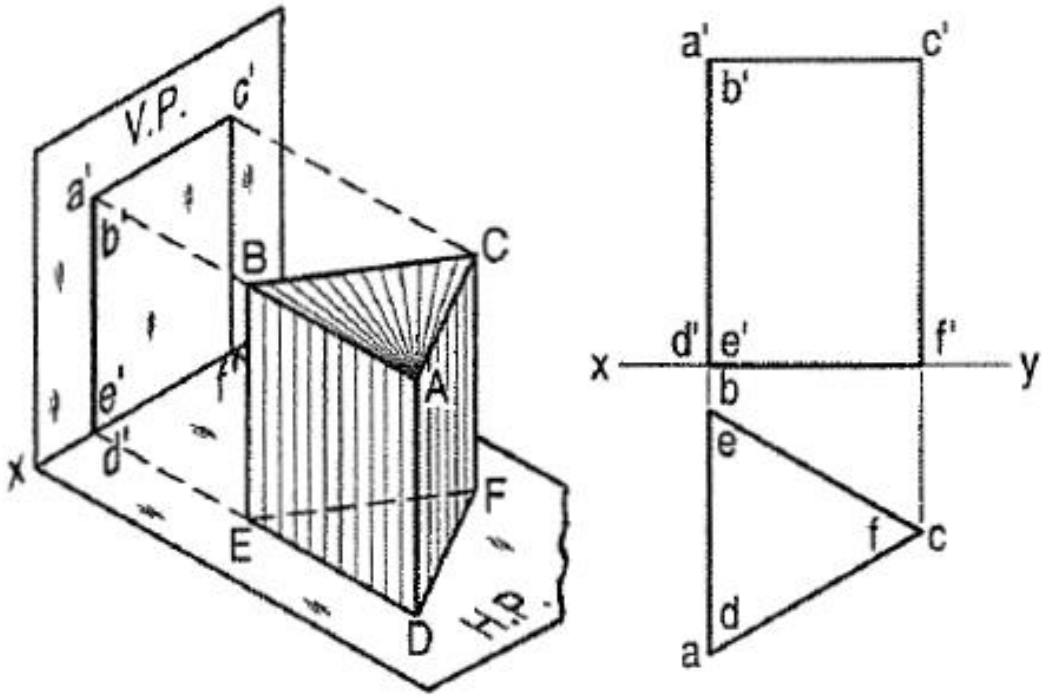




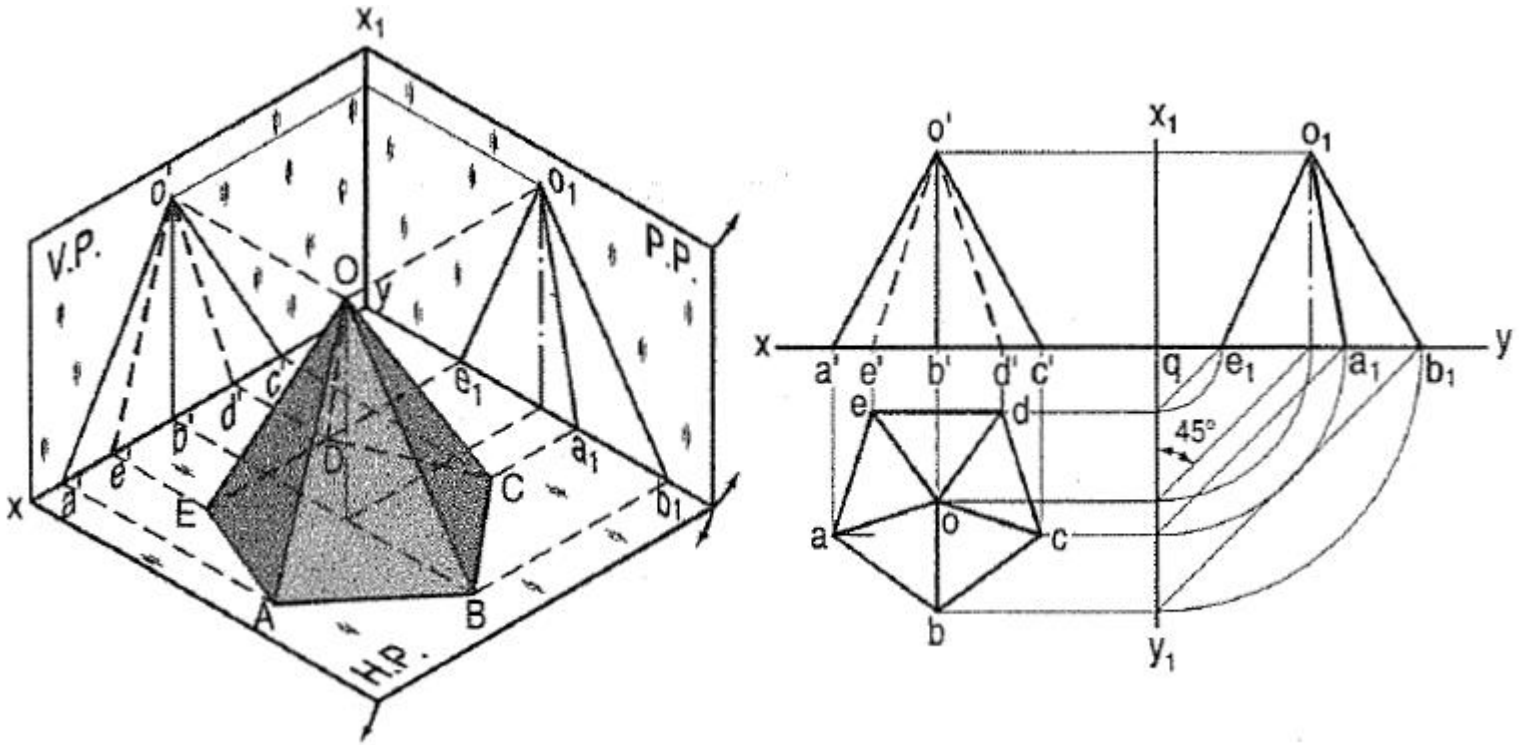
Four positions of a prism placed with its base on HP.



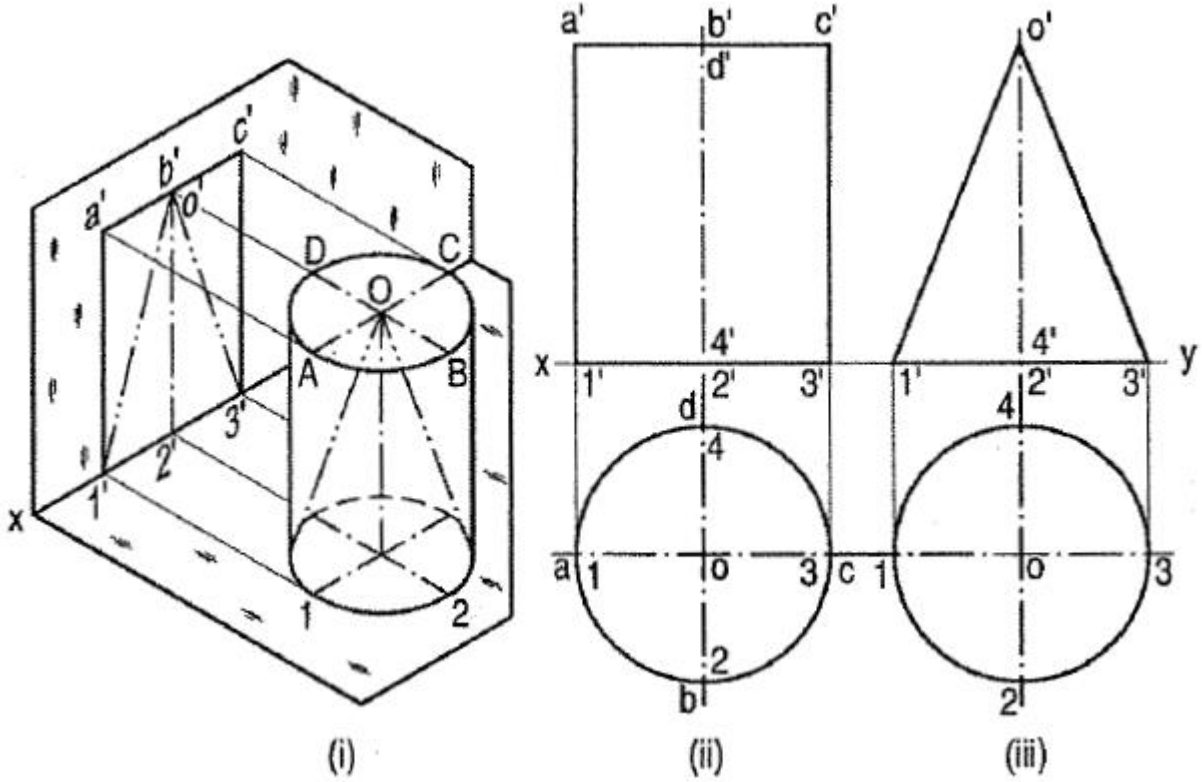
Draw the projections of a triangular prism, base 40 mm *side and axis 50* mm *long, resting on one of its bases on the H.P. with a vertical face perpendicular to the V.P. .*



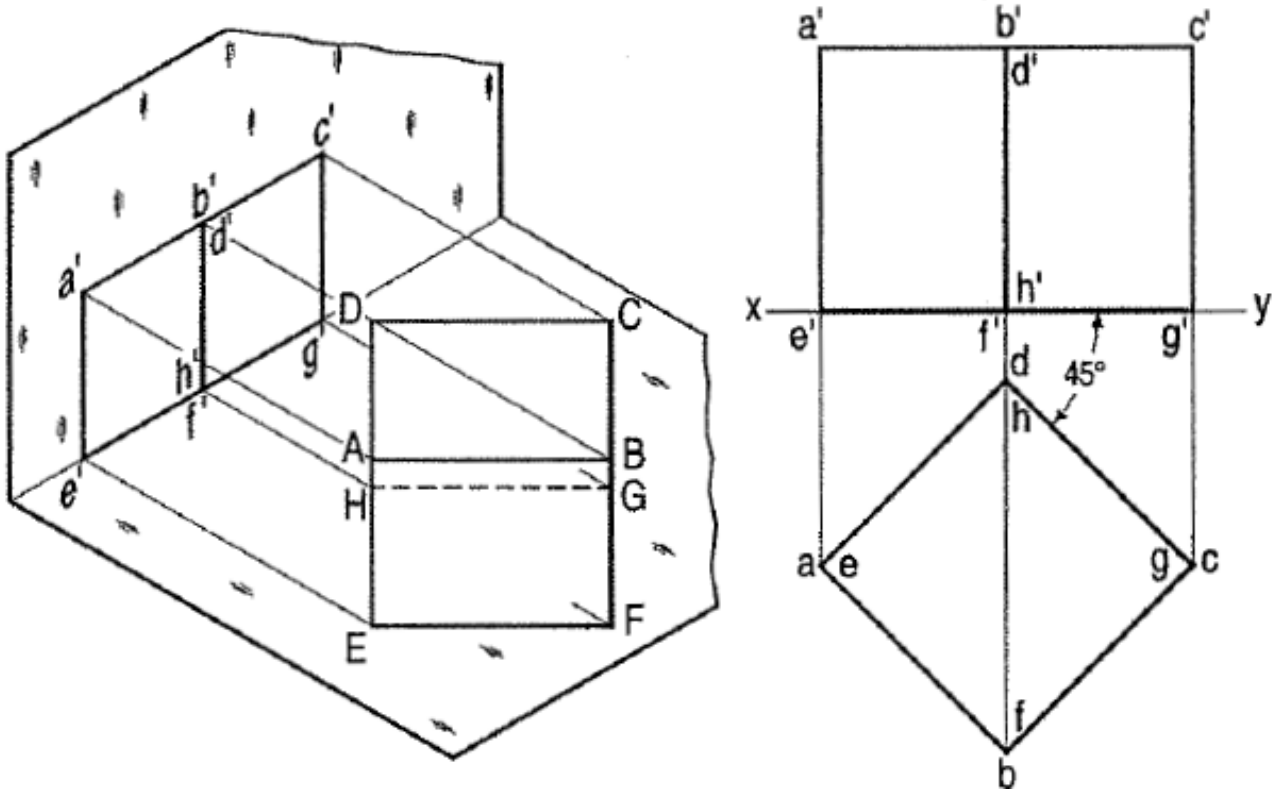
Draw the projections of a pentagonal pyramid, base 30 mm edge and axis 50 mm long, having its base on the H.P. and an edge of the base parallel to the V.P. Also draw its side view.



Draw the projections of (i) a cylinder, base 40 mm diameter and axis 50 mm Jong, and (ii) a cone, base 40 mm diameter and axis 50 mm long, resting on *the H.P. on their respective bases.*



A cube of 50 mm long edges is resting on the H.P. with its vertical faces equally inclined to the V.P. Draw its projections.



A hexagonal prism has one of its rectangular faces parallel to the H.P. Its axis is perpendicular to the V.P. and 3.5 cm *above the ground.*