DHANALAKSHMI COLLEGE OF ENGINEERING

Dr.V.P.R NAGAR, CHENNAI-601301

DEPARTMENT OF MECHANICAL ENGINEERING

GE 6152 – ENGINEERING GRAPHICS

First Year/ I – Semester

STUDENT'S SUPPORT MATERIAL

UNIT – 3:	***PROJECTION OF SOLIDS***
	Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to the principal planes by rotating object method and auxiliary plane method.

Introduction

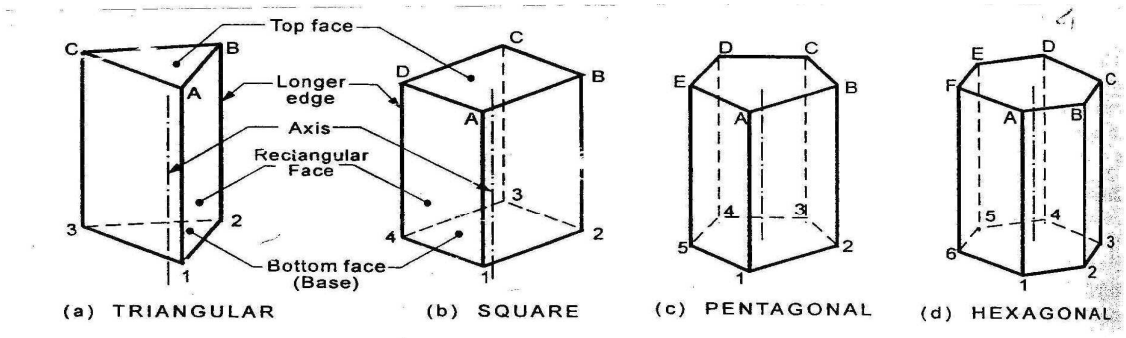
A solid is three dimensional object having length, breadth and thickness.

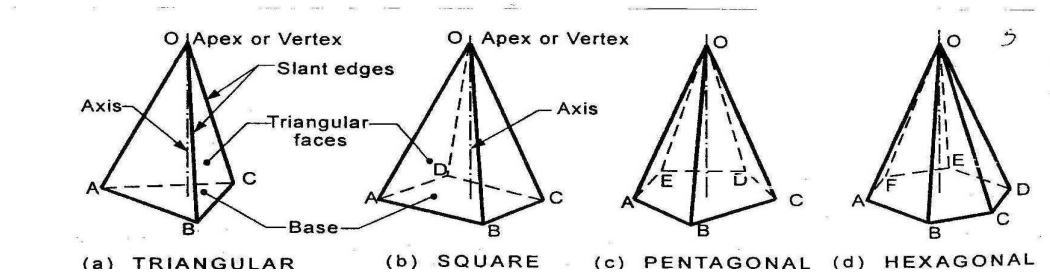
Type of Solids

1. Polyhedron
2. Solids of revolution

Polyhedron

A polyhedron which consists of many sided solid figure bounded by only plane surfaces or faces. If all the faces of a polyhedron are having the same size and shape than the solid bounded by plane surfaces are generally called as prism and pyramids.





Prisms

A prism is a polyhedron having two equal and similar faces (called top face and bottom face or base), parallel to each other and joined by other faces which may be rectangles or parallelograms. An imaginary line joining the centre of faces is axis.

Types of Regular Prisms

Prism is named according to the shape of its base as: **Triangular, Square, Rectangular, Pentagonal, Hexagonal**, etc.

Nomenclatures of a prism

Axis, Top face, Bottom face (Base), Rectangular faces and Longer edges.

Pyramids

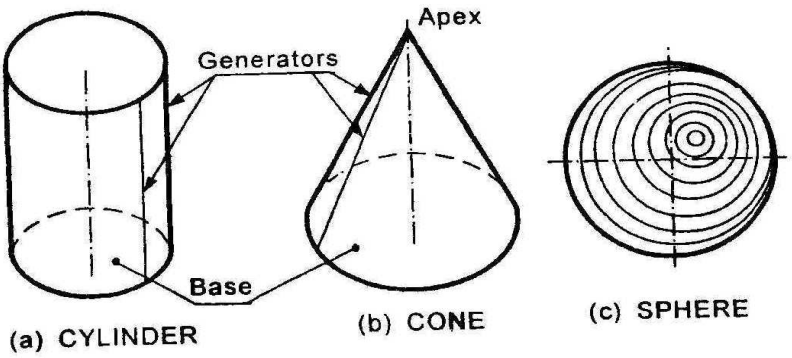
A pyramid is a polyhedron having a plane figure as its base and a number of equal isosceles triangular faces meeting at a point called vertex or apex. Pyramid is said to be right regular when its axis is perpendicular to the base, which is a regular plane figure. The line joining the apex and the corner of the base is called slant edge.

Types of Regular Pyramids

The pyramid is also named according to the shape of its base as: Triangular, Square, Rectangular, Pentagonal, Hexagonal, etc.

Solids of revolution

Solids of revolution are obtained by plane figure about a fixed axis. Here, we will confine cylinder, cone and sphere.

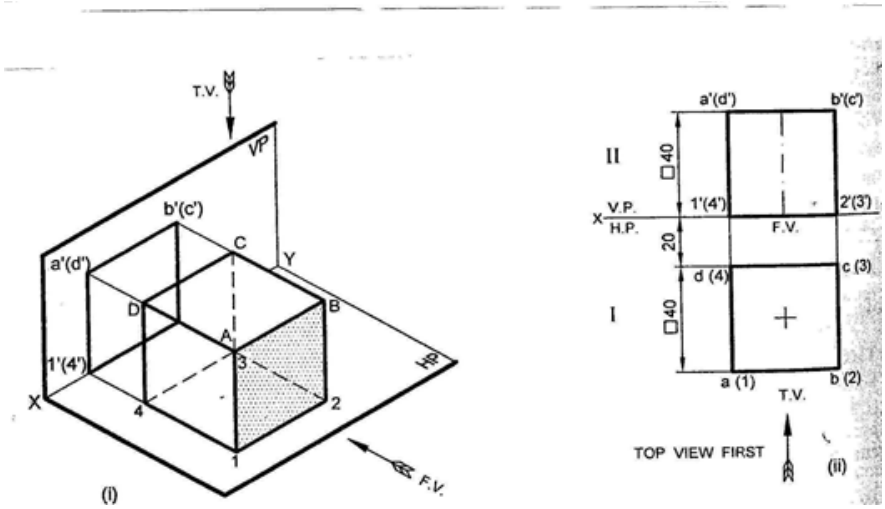


Conditions:

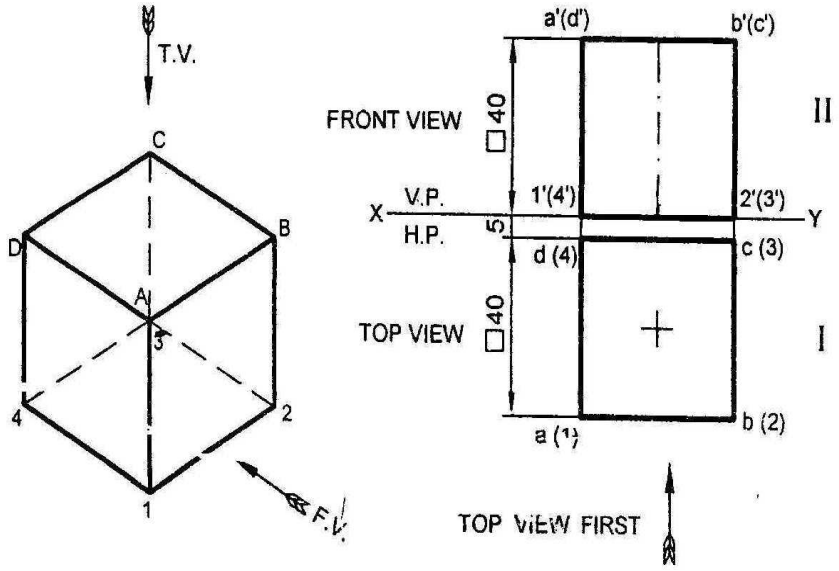
1) Axis of the solid parallel to VP and perpendicular to HP
2) Axis of the solid parallel to HP and perpendicular to VP
3) Axis parallel to both HP and VP
4) Axis inclined to HP and parallel to VP
5) Axis inclined to VP and parallel to HP
6) Axis inclined to both HP and VP (Not in syllabus)

1) Axis of the solid parallel to VP and perpendicular to HP (Simple Position)

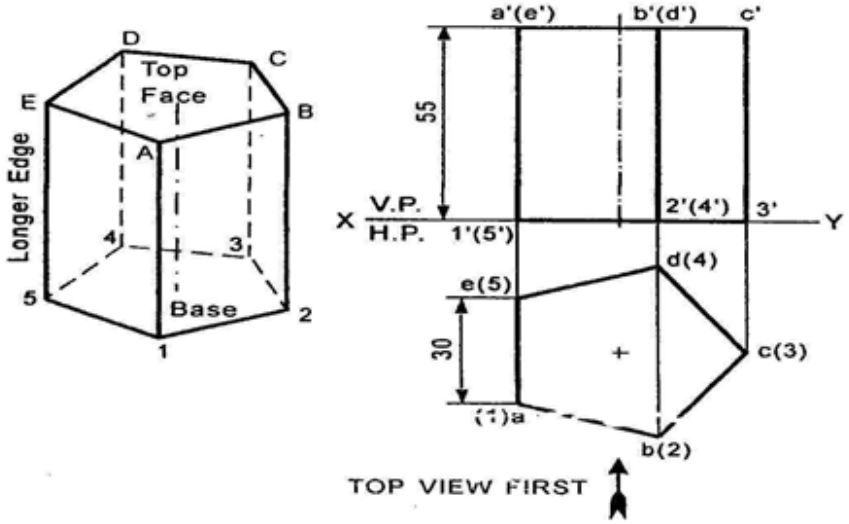
Solved Problem – 1: ***Draw the top and front views of a cube of 40 mm side resting with one of its square faces on HP such that one of its vertical faces is parallel to and 20 mm infornt of VP.***



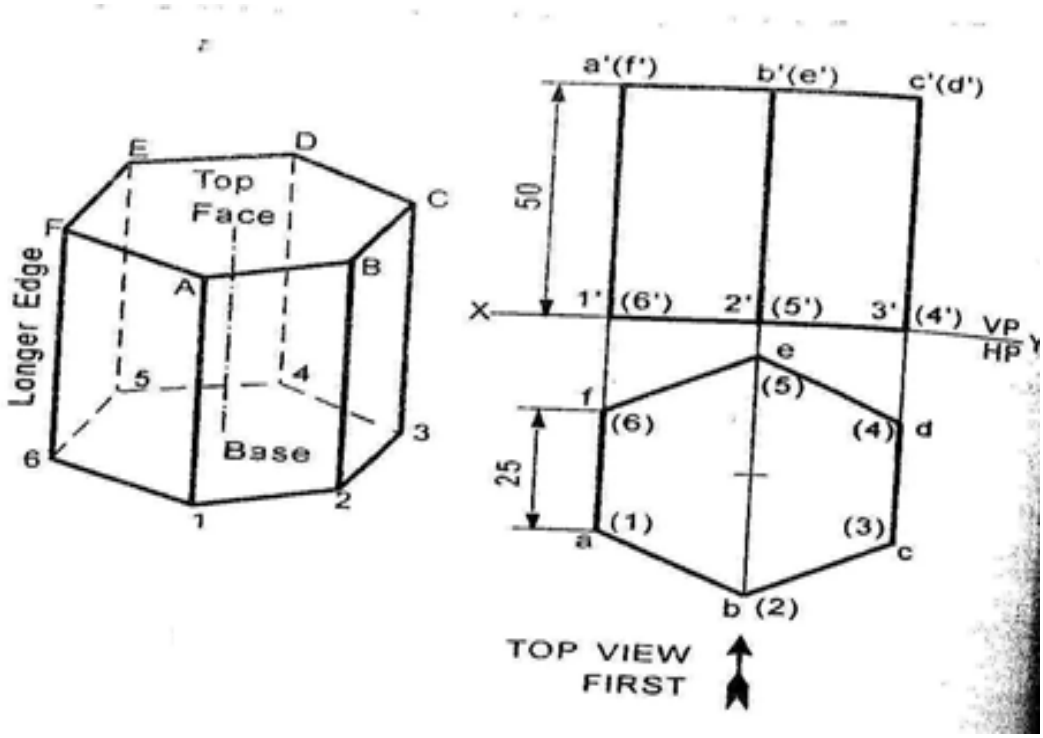
Solved Problem – 2: ***A cube of 40 mm side rests with one of its square faces on HP such that one of it vertical faces is perpendicular to VP. Draw its projections. The nearest edge parallel to VP is 5 mm in front of it.***



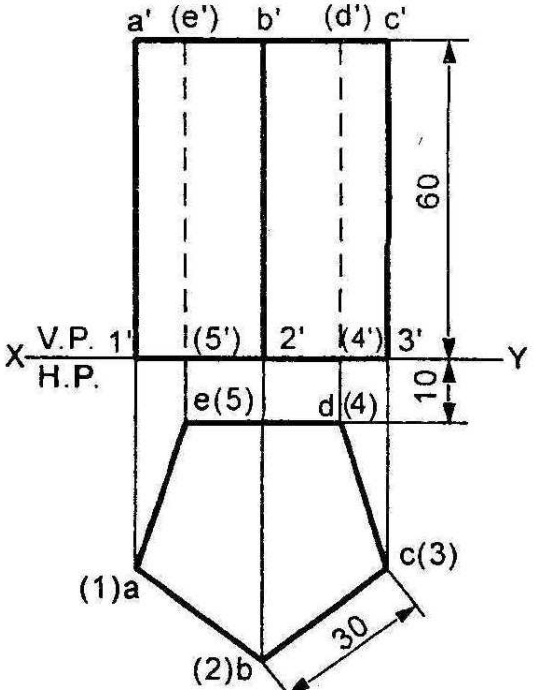
Solved Problem – 3: ***Draw the projections of a regular pentagonal prism side of base 30 mm and axis 55 mm resting with its base on HP such that one of its rectangular faces is perpendicular to VP.***



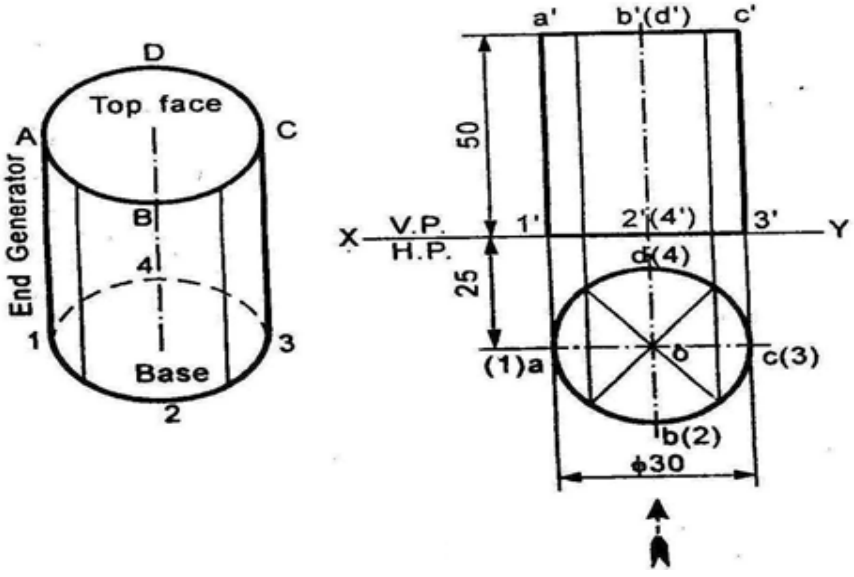
Solved Problem – 4: ***Draw the projections of a hexagonal prism of side of base 25 mm and height 50 mm resting with its base on HP such that one of its rectangular faces is perpendicular to VP.***



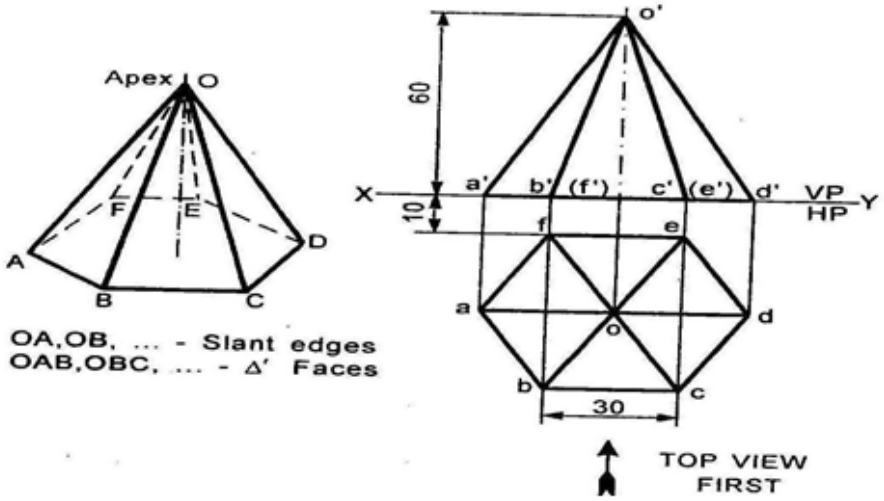
Solved Problem – 5: ***Draw the projections of a pentagonal prism, side of base 30 mm and axis 60 mm long resting with its base on Hp such that one of its rectangular faces is parallel to and 10 mm infront of VP.***



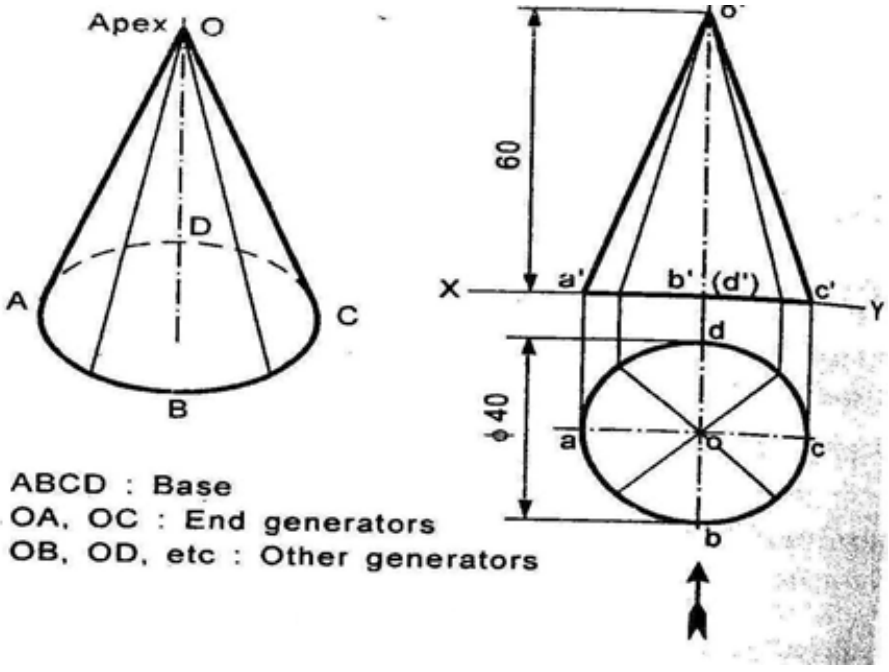
Solved Problem – 6: ***Draw the projections of a cylinder of base 30 mm diameter and axis 50 mm long resting with its base on HP and axis 25 mm infront of VP.***



Solved Problem – 7: ***A hexagonal pyramid, side of base 30 mm and height 60 mm rests with its base on HP such that one of the edges of the base is parallel to and 10 mm infront of VP. Draw its projections.***

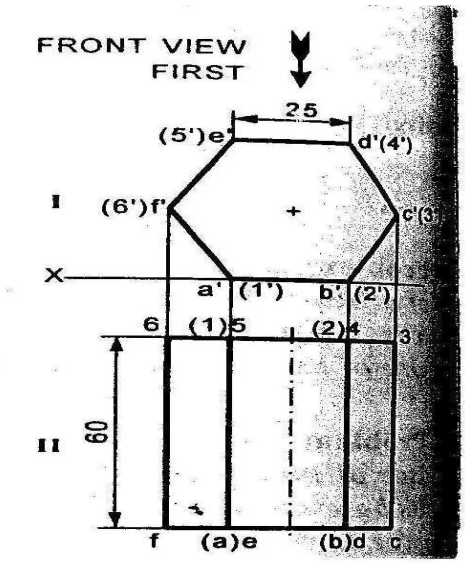


Solved Problem – 8: ***Draw the projection of a right circular cone of base 40 mm diameter and height 60 mm when resting with its base on HP.***



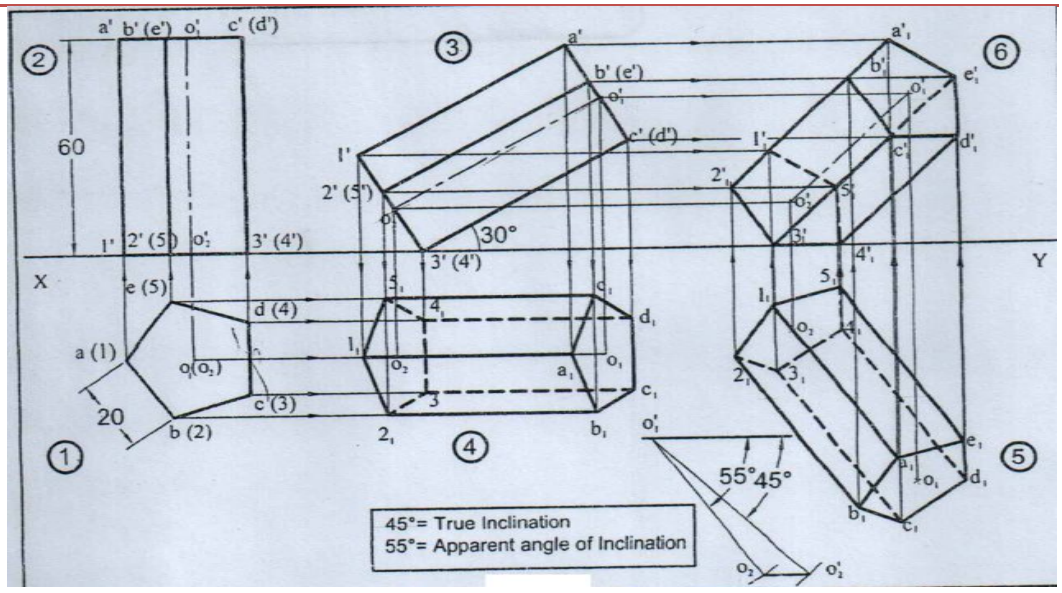
2) Axis of the solid parallel to VP and perpendicular to HP (Simple Position)

Solved Problem -9: ***A hexagonal prism, side of base 25 mm and axis 60 mm long, lies with one of it rectangular faces on the HP such that the axis is perpendicular to the VP. Draw its projections***

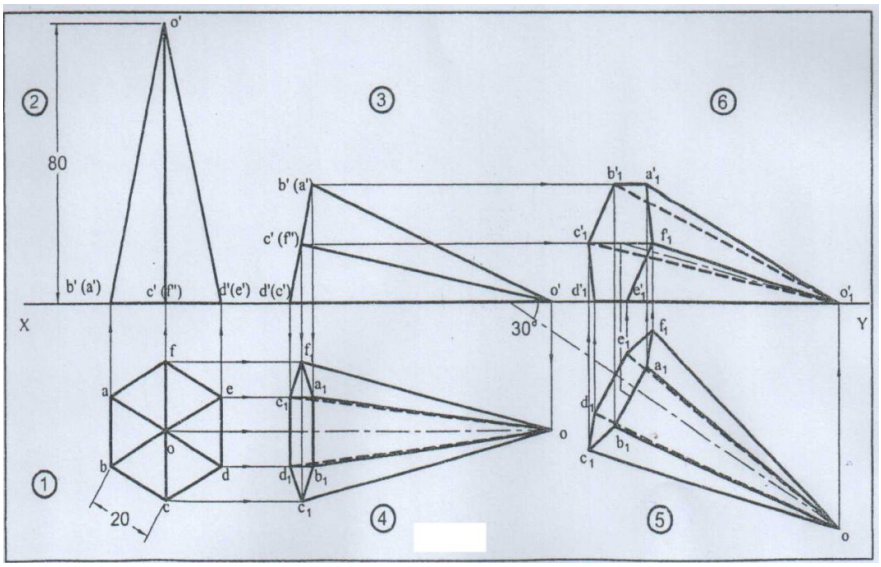


3) Axis parallel to both HP and VP

Solved Problem -10: ***A pentagonal prism of base 20 mm and axis length 60 mm rests on rests on the ground on one of its base edges such that its axis is inclined at 30º to the ground and 45º to the V.P. Draw its projections.***

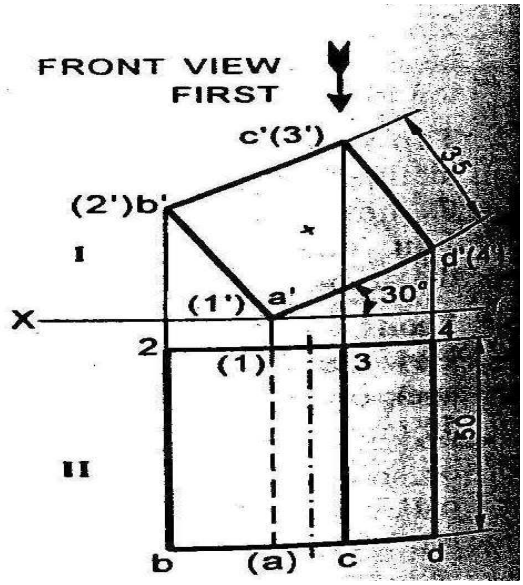


Solved Problem -11: ***A Hexagonal pyramid of base side 20 mm and height 80 mm rests on HP. With one of its triangular faces such that the plan of axis is inclined at 30º to XY line and the base being drawn nearer to the V.P. Draw the projections of the solid in this position.***



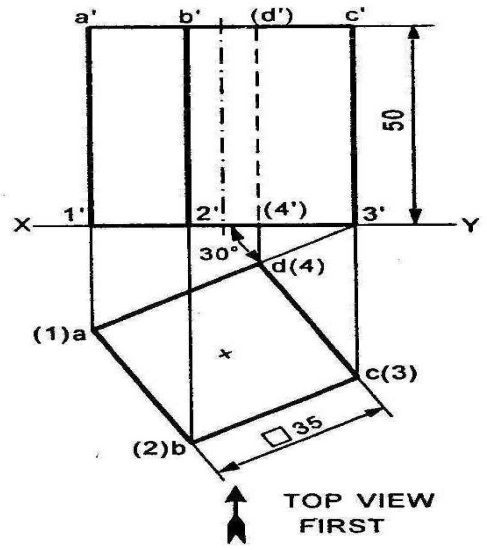
4) Axis inclined to HP and parallel to VP (Simple Position)

Solved Problem -12: ***A square prism, side of base 35 mm and axis 50 mm long lies with one of its longer edges on HP such that its axis is perpendicular to VP. Also one of its rectangular faces containing that longer edge is inclined at 30˚ to HP. Draw its projections.***

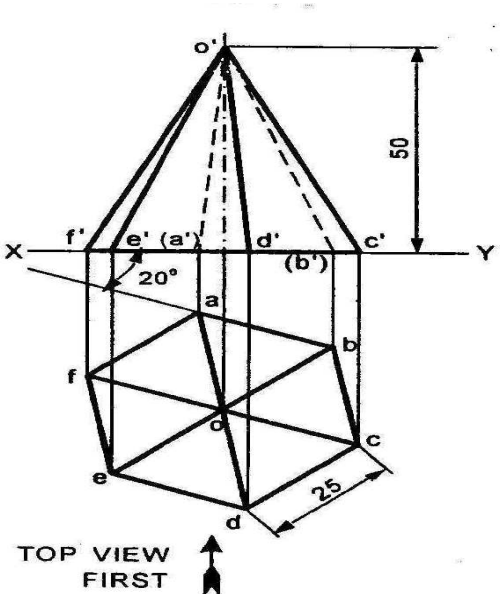


5) Axis inclined to VP and parallel to HP (Simple Position)

Solved Problem -13: ***A square prism, side of base 35 mm and height 50 mm rests with its base on HP such that one of its rectangular faces is inclined at 30˚ to VP. Draw its projections***



Solved Problem -14: ***A hexagonal pyramid, side of base 25 mm and height 50 mm rests with its base on HP such that one of the edges of the base is inclined at 20˚ to VP. Draw the top and front views of the pyramid.***

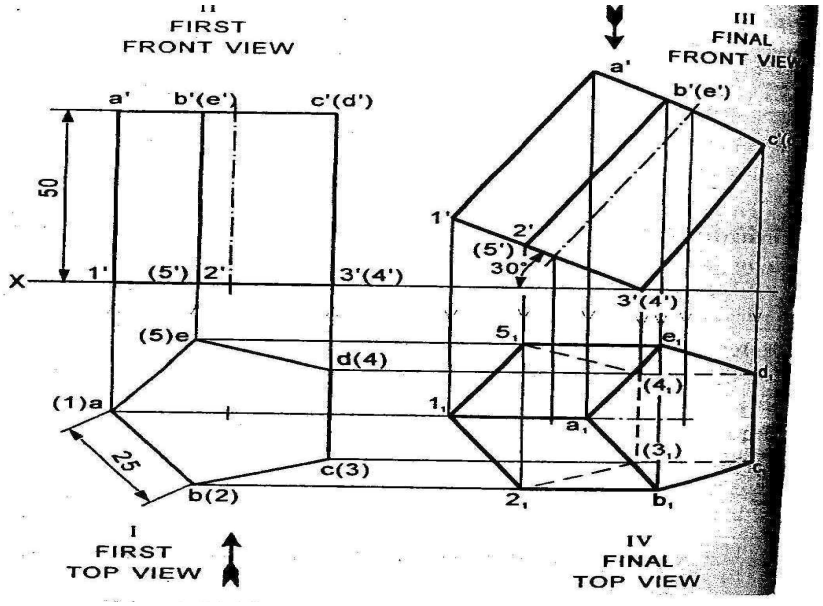


CHANGE OF POSITION METHOD

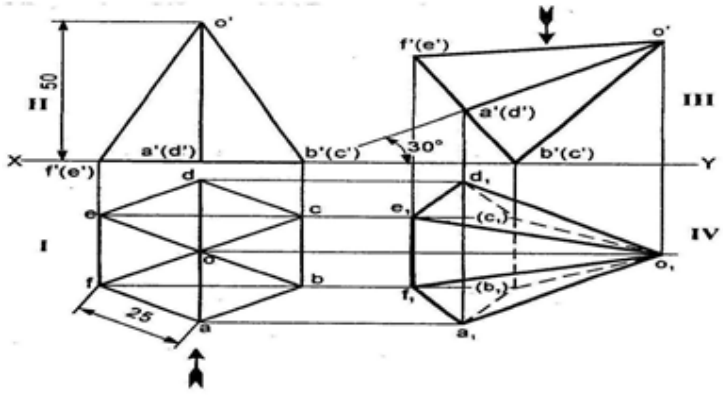
AXIS INCLINED TO ONE PLANE AND PARALLEL TO OTHER

AXIS OF SOLID INCLINED TO HP AND PARALLEL TO VP
(Simple and Final Position)

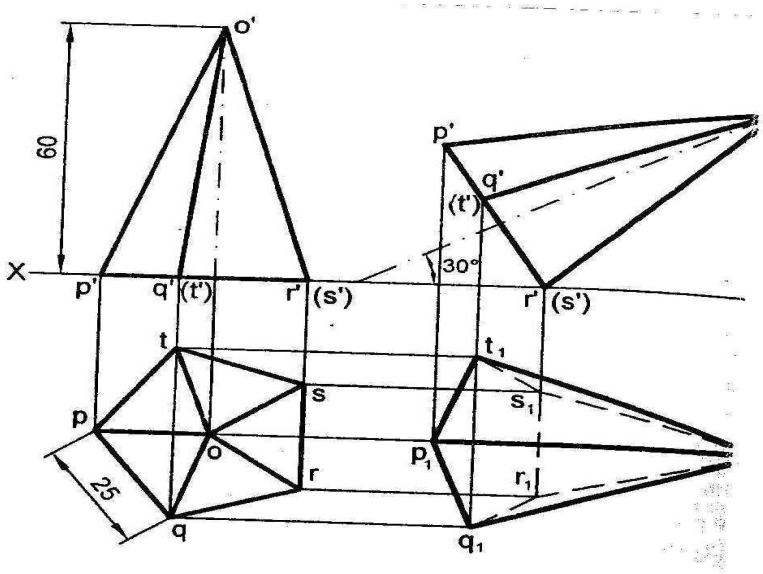
Solved Problems –15: ***A pentagonal prism, side of base 25 mm and axis 50 mm long, rests with one of its edges on HP such that the base containing that edge makes an angle of 30˚ to HP and its axis is parallel to VP. Draw its projections.***



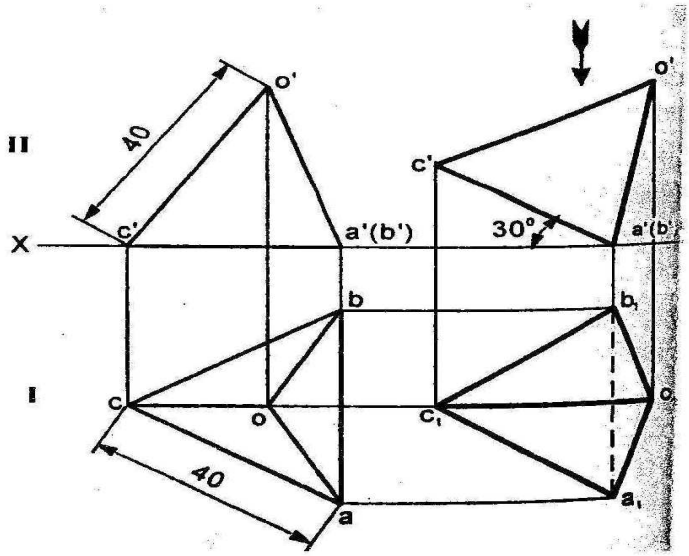
Solved Problems– 16: ***A hexagonal pyramid, side of base 25 mm and axis 50 mm long, rests with one of the edges of its base on HP and its axis is inclined at 30˚ to HP and parallel to VP. Draw its projections.***



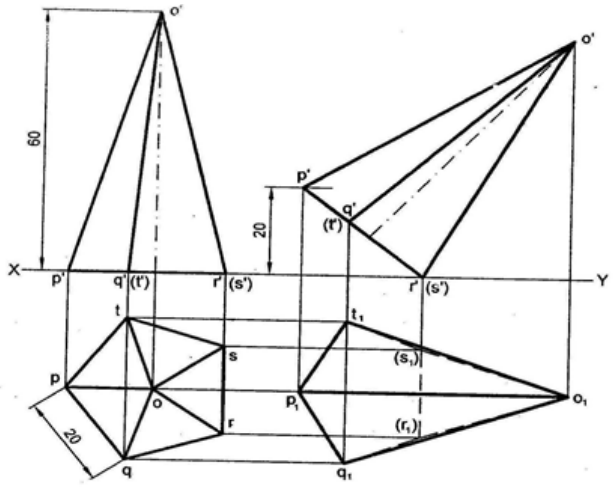
Solved Problems– 17: ***Draw the projections of a pentagonal pyramid of base 25 mm side and axis 60 mm long when it is lying on HP on one of its base edges, such that the axis is parallel to VP and inclined at 30˚ to HP.***



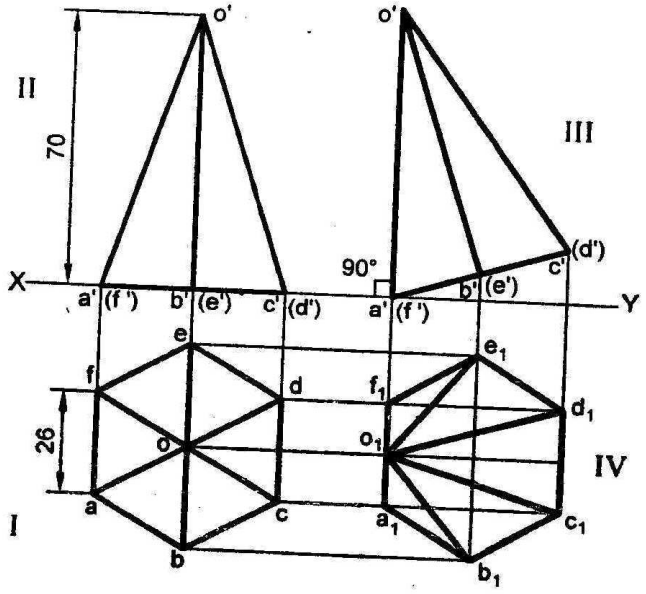
Solved Problems– 18: ***A tetrahedron of 40 mm side rests with one of its edges on HP and perpendicular to VP. The triangular face containing that edge is inclined at 30˚ to HP. Draw its projection.***



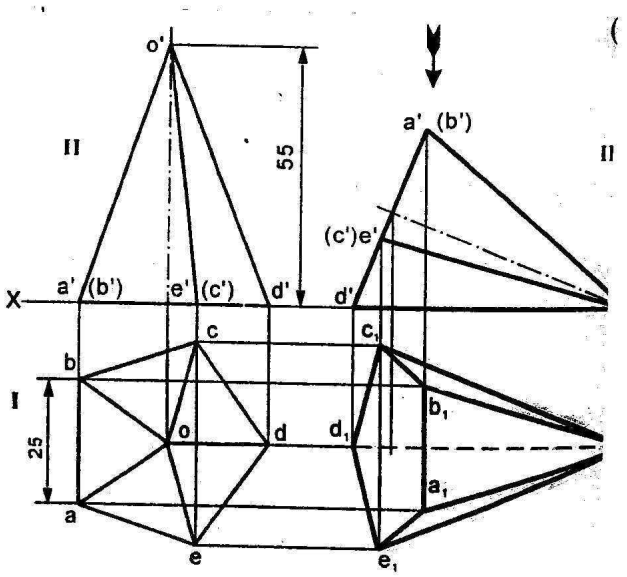
Solved Problems– 19: ***A right pentagonal pyramid of base side 20 mm and altitude 60 mm rests on one of its edges of the base in HP, the base being lifted up until the highest corner in it is 20 mm above HP. Draw the projections of the pyramid when the edge on which it rests is made perpendicular to VP.***



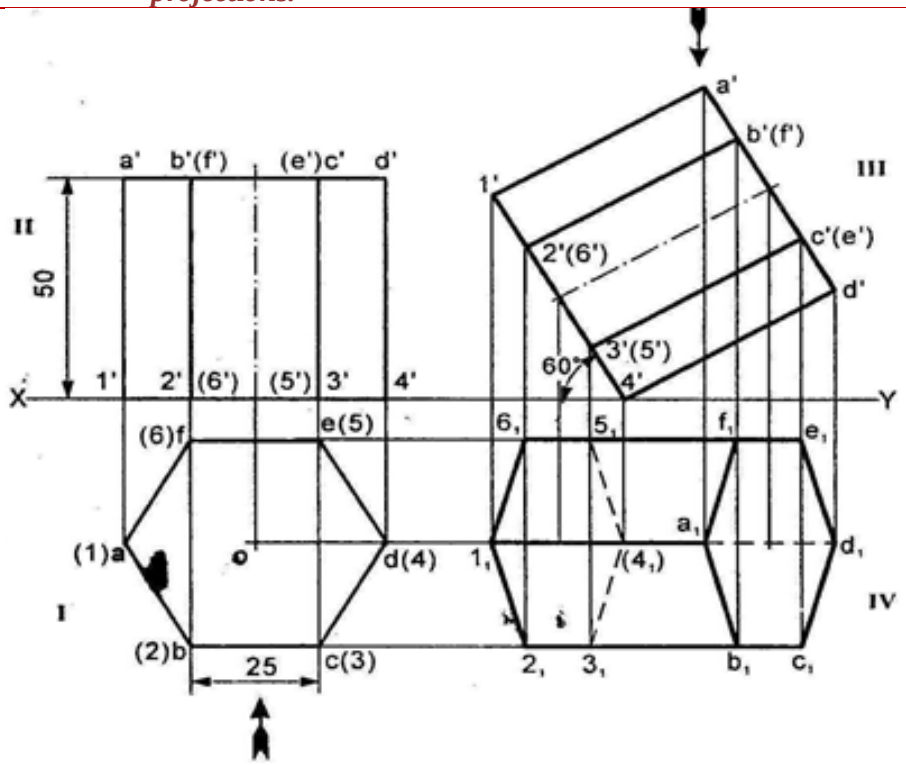
Solved Problems - 20: ***A hexagonal pyramid of 26 mm side of base and 70 mm height rests on HP on one of its base edges such that the triangular face containing the resting edge is perpendicular to both HP and VP. Draw its projections.***



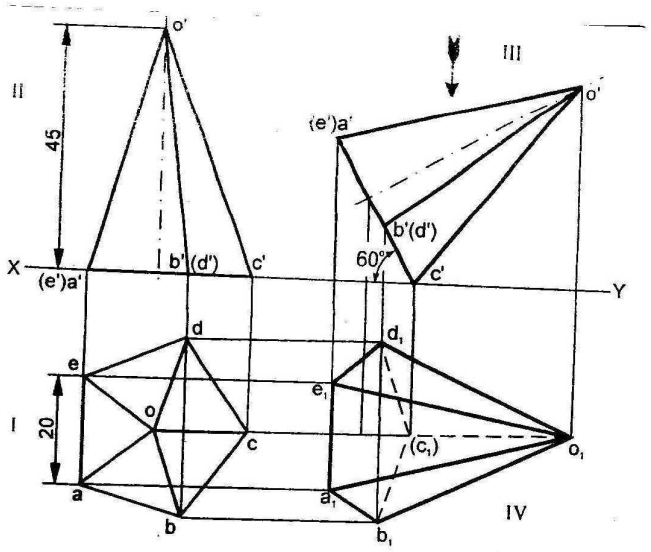
Solved Problems– 21: ***A pentagonal pyramid, side of base 25 mm and axis 55 mm long, lies with one of its slant edges on HP such that its axis is parallel to VP. Draw its projections.***



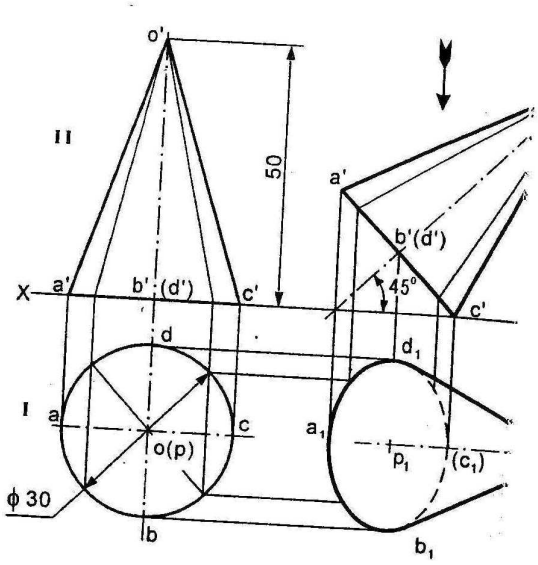
Solved Problems 22: ***A hexagonal prism, side of base 25 mm and axis 50 mm long rests with one of its base corners on HP such that its base makes an angle of 60° to HP and its axis is parallel to VP. Draw its projections.***



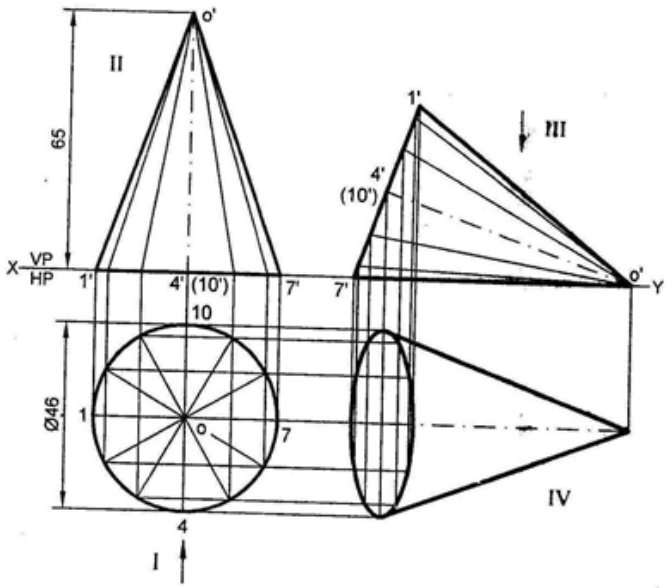
Solved Problems 23: ***A pentagonal pyramid side of base 20 mm and axis 45 mm long rests with one of its corners on HP such that the base is inclined at an angle of 60˚ to HP and one side of base is perpendicular to VP. Draw its projections.***



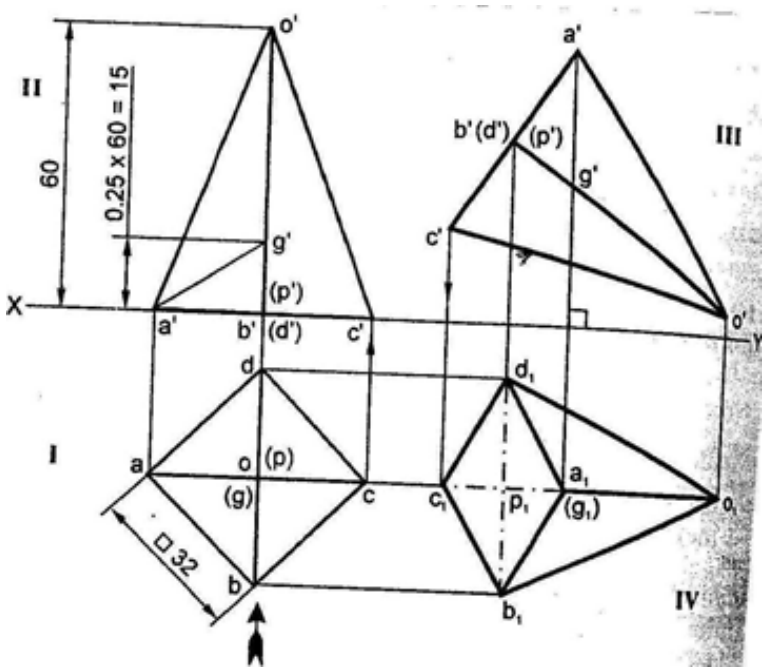
Solved Problems– 24: ***Draw the projections of cone, base 30 mm diameter and axis 50 mm long, resting on HP on a point of its base circle with the axis making an angle of 45˚ with HP and parallel to VP.***



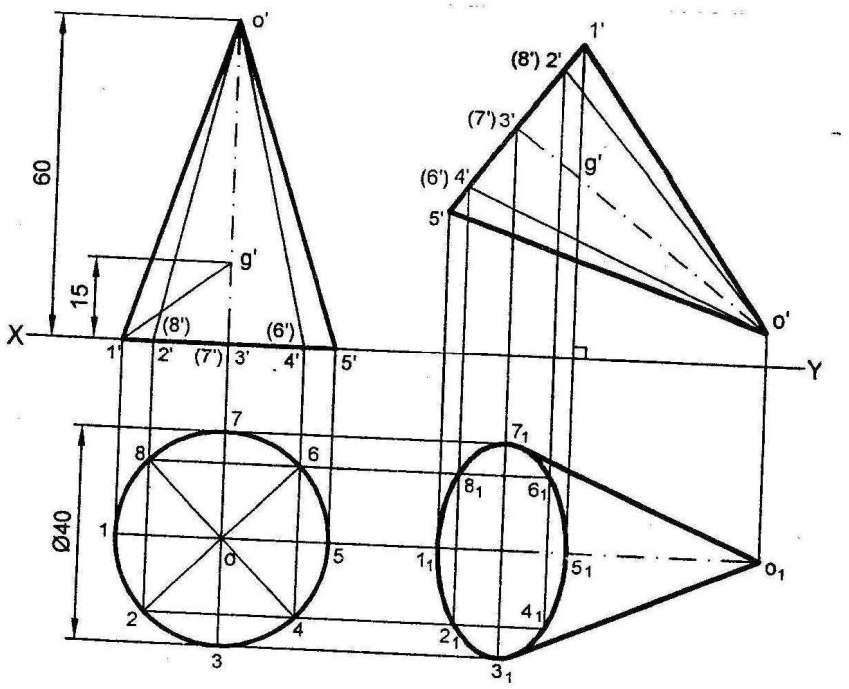
Solved Problems– 25: ***Draw the top and front views of a cone of base diameter 46 mm and height 65 mm lying with one of its generators on HP. The axis is parallel to VP.***



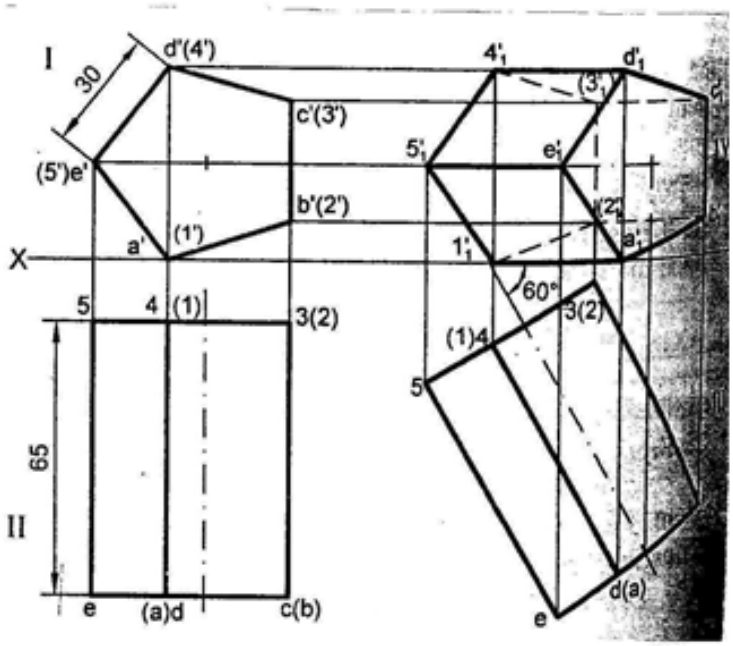
Solved Problems– 26: ***A square pyramid, base 32 mm side and axis 60 mm long, is freely suspended from one of the corners of its base with the axis parallel to VP.***



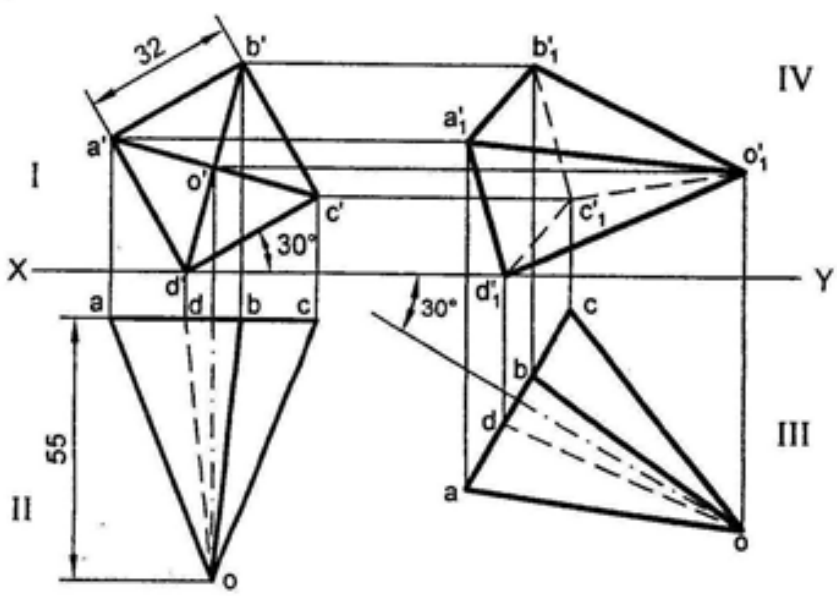
Solved Problems– 27: ***A cone of diameter 40 mm and height 60 mm is freely suspended from one of its base points such that the axis is parallel to VP. Draw its front and top views.***



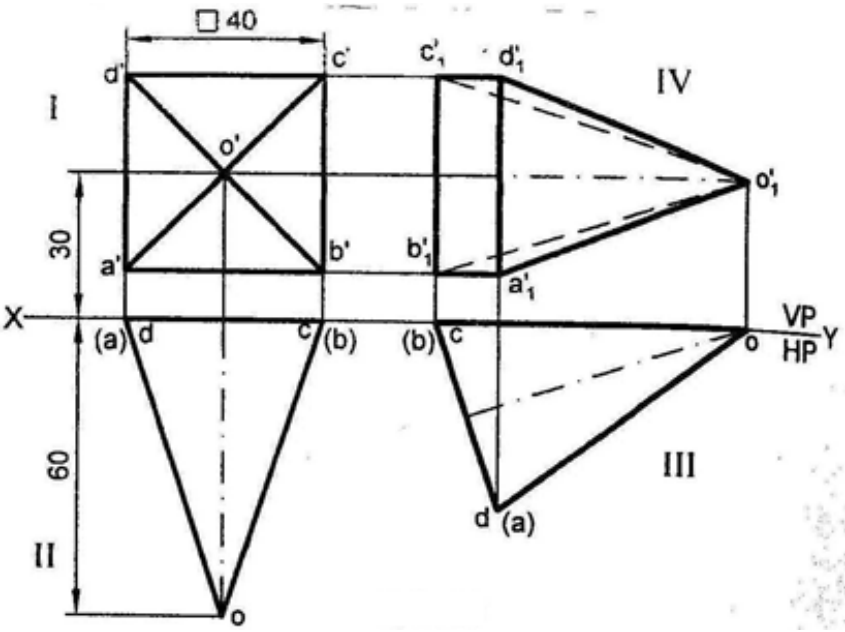
Solved Problems– 28: ***Draw the projections of a pentagonal prism of 30 mm side of base and 65 mm long. It is lying on one of its longer edges on HP with one rectangular face perpendicular to HP such that the axis makes 60˚ with VP.***



Solved Problems– 28: ***Draw the projections of a square pyramid of 32 mm side of base and axis 55 mm. It is resting on HP on one of its base corners with a base side containing the corner making 30° with HP. The axis is inclined at 30° to VP and is parallel to HP. The vertex is away from the VP.***



Solved Problems– 29: ***A square pyramid of base end 40 mm and axis 60 mm is lying on VP on one of its triangular faces with the plane containing the axis parallel to HP and 30 mm above it. Draw the projections of the pyramid.***

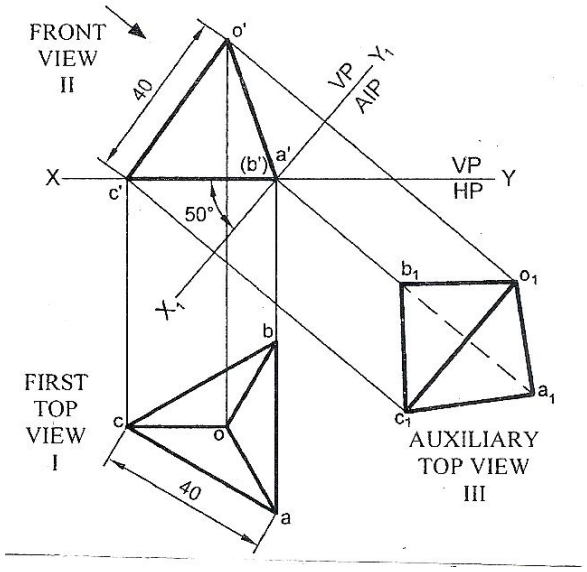


Auxiliary Projections of Solids

Solved Problems – 30:	***A tetrahedron of 40mm side rests with one of its edges on HP and perpendicular to VP. The triangular face containing that edge is inclined at an angle of 50° to HP. Draw the projections.***

Simple Position

1. Assume the tetrahedron resting with its base on HP such that an edge is perpendicular to VP. D raw the top view first. Project the front view. The edge a' (b') is seen as appoint on XY.



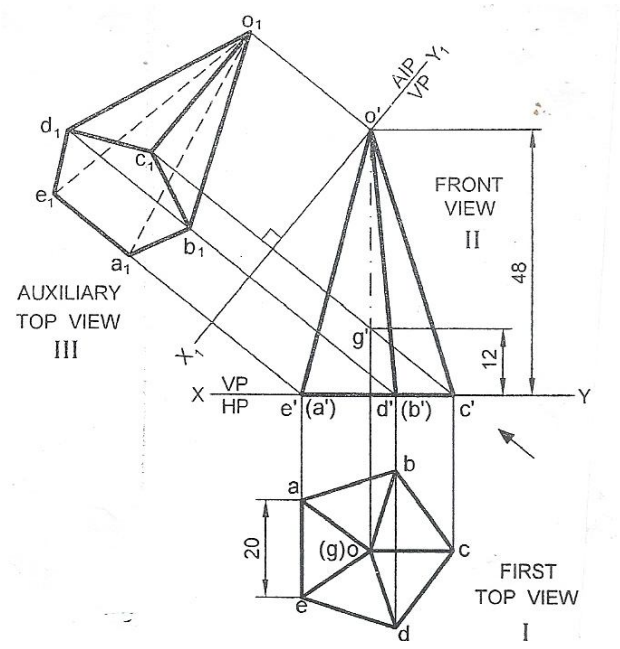
Auxiliary Top View

2. Base (triangular face on HP) of the tetrahedron is inclined at 50° to HP. Instead of tilting the front view such that its base is inclined at 50° to XY, draw X_1 Y_1 through a'(b') at 50° to the base in the front view.
3. From all corners in the front view draw projectors perpendicular to X_1 Y_1 to projectthe auxiliary top view.
4. Measure the distances of all the corners in first top view from XY and transfer the same with references to X_1 Y_1 on the corresponding projectors. Complete the Auxiliary Top View.

Solved Problems –31: ***A Pentagonal pyramid of side of base 20mm and the altitude 48mm is freely suspended from a string attached to one corner of the base of the pyramid. The string is held such that the apex of the pyramid is just touching the HP. The axis of the pyramid is parallel to the VP. Draw its projections.***

Simple Position:

1. Top view a, b, c, d, and e. The point c is the corner of the base of the pyramid from which the pyramid is suspended.



2. Draw the top view such that the line joining c and the center of gravity (g) of the pyramid parallel to XY. Project front view as shown.

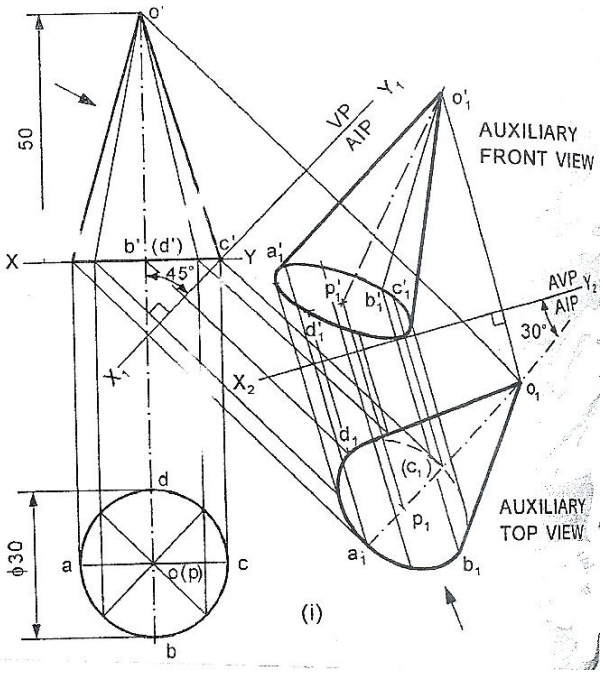
Auxiliary Top View

3. Mark the front view g' of the center of gravity and the axis at 12mm from the base.
4. Draw X_1 Y_1 perpendicular to c' g'. Also, the apex of the pyramid is just touching the HP. Thus o' should lie on X_1 Y_1 perpendicular to c' g' so as to pass through o'.
5. Project the Auxiliary Top View

Solved Problems – 33:	***Draw the projection of a cone, base 30mm diameter and axis 50mm long, when it is resting on HP on a point of its base circle with (i) the axis making an angle of 45° with HP and its top view making 30° with VP (ii) the axis making an angle of 45° with HP and 30° with VP.***

Simple Position:

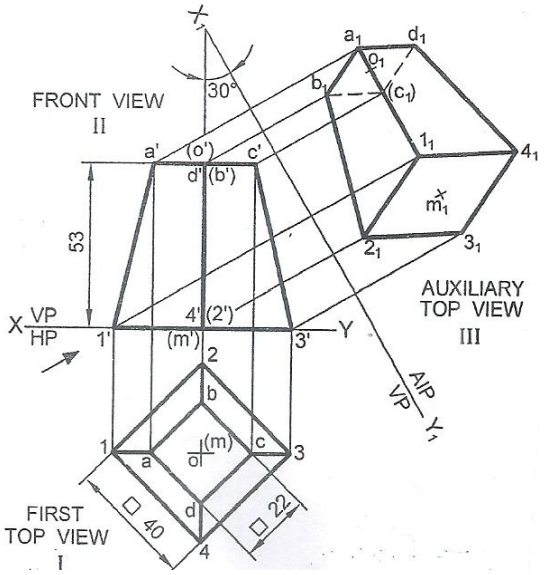
1. First assume cone resting with its base on HP such that its axis is perpendicular to HP. Draw the top view first and then front view



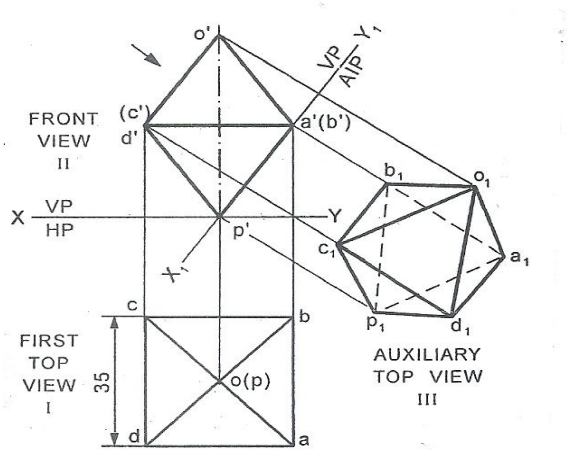
Auxiliary Top View

2. The cone has to rest with a point of its base circles on HP such that its axis has to make 45° with HP. Instead of tilting the front view of the cone for this position, draw $X_1 Y_1$ though c' at 45° to the front view of the axis.
3. From the front view draw projectors perpendicular to $X_1 Y_1$. Measure the distances of the points on the base circle and the apex in the first top view from XY.
4. Transfer the same with reference to $X_1 Y_1$ on the corresponding projectors and complete the auxiliary top view. Here the inner portion of the ellipse between the tangents through o_1, is shown as dashed line.

Solved Problems – 34: ***A frustum of a square pyramid, base side 40mm, top side 22mm and altitude 53mm has its bases equally inclined to VP. Its axis is parallel to VP. It is tilted such that its axis is inclined at 30° to HP. Draw the projections.***



Solved Problems – 35: ***An octahedron of 35mm side lies with one of its faces on HP and an edge of that face makes an angle of 90° with VP. Draw its projection.***



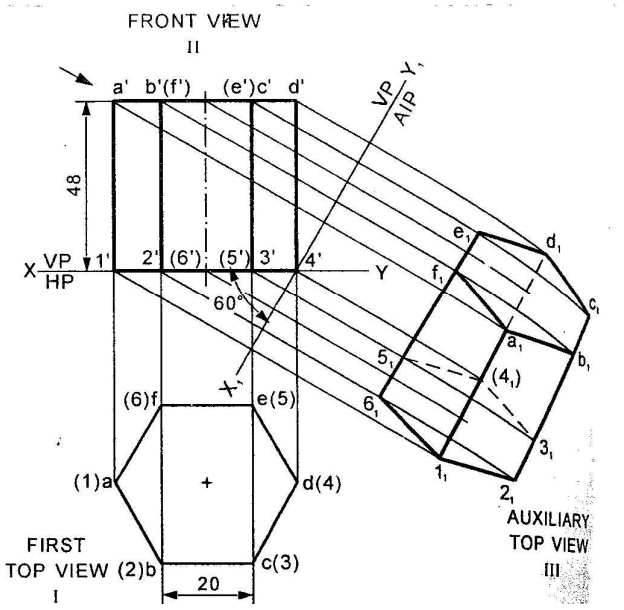
Simple Position

1. First assume the octahedron to rest with one of its corners on HP such that the axis through it is perpendicular to HP and an edge is perpendicular to VP. For this simple position draw top view first.
2. Project the front view. In the front view, triangular face p' a' (b') is seen as a line.

Auxiliary Top View

3. Draw X_1 Y_1. so as to contain p' a' (b') in the front view. Transfer corresponding distances from the first top view. Thus, complete the auxiliary top view.

Solved Problems – 36: ***A hexagonal prism, side of base 20mm and axis 48mm long, rests with its base on HP such that an edge of the base is parallel to VP. Draw the projection of the prism on an Auxiliary Inclined Plane (A.I.P) which makes an angle of 60° with the HP.***



Simple Position

1. Prism rests with its base on HP and edge of the base is parallel to VP. For this portion, draw top and front view.

Auxiliary Top View A.I.P.

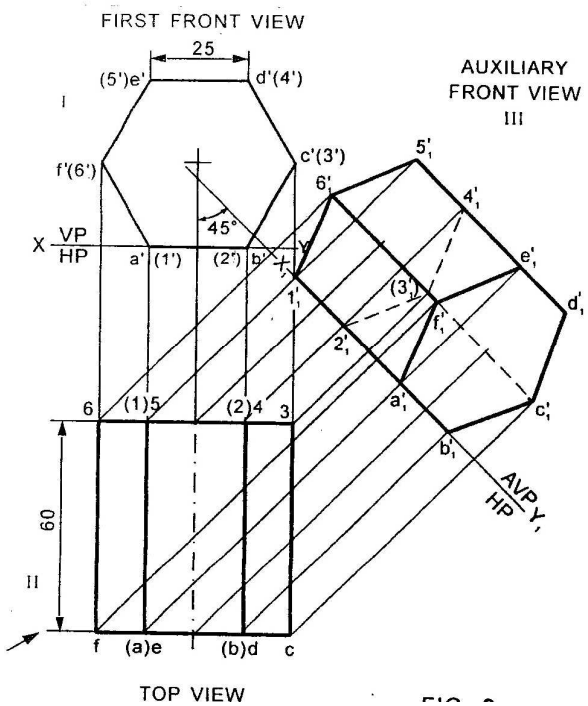
2. A.I.P is inclined at 60° to HP. Hence draw new reference line X_1 Y_1 at an angle of 60° to XY reference line to project Auxiliary Top View.

3. From all corners of the prism in the front view, draw projectors perpendicular to X_1 Y_1.
4. Measure the distances of all the corners from XY in the first top view and transfer the same with reference to X_1 Y_1 on the corresponding projectors. Thus locate all the points in the Auxiliary Top View.

To mark visible and invisible edges in the Auxiliary Top View.

5. Look at the front view in the direction of arrow shown.
6. End face nearer to the observer is visible. So draw $a_1b_1c_1d_1e_1f_1$ by continuous thick lines in Auxiliary Top View.
7. Draw the boundary lines of the above view by thick lines.
8. The line a'l' is visible and hence draws a_1l_1 by thick line.
9. The point 4' is invisible in the front view. Hence draw the edges $(4_1)3_1$, $(4_1)5_1$, and $(4_1)\,d_1$ as dashed lines in Auxiliary Top View.

Solved Problems – 37: ***A hexagonal prism, side of base 25mm and axis 60mm long, lies with one of its rectangular faces on HP, such that the axis is inclined at 45° to VP. Draw its projections.***



Simple Position:

1. Assume the prism to be lying with one of its rectangular faces on HP and its axis perpendicular to VP. Draw the front and top views.

Auxiliary Front View on A.V.P

2. Axis is inclined at 45° to VP. Instead of tilting the top view of the prism such that its axis is inclined at 45° to XY, draw $X_1 Y_1$ at 45° to the top view of the axis.
3. From all the corners of the prism in the top view, draw projectors perpendicular to $X_1 Y_1$ to project auxiliary front view.
4. Measure the distances of all the corners in the first front view from XY and transfer the same reference to $X_1 Y_1$ on the corresponding projectors.
5. Look at the top view in the direction of arrow. The end faces nearer to the observer is visible and hence draw a_1, b_1, c_1, d_1, e_1, f_1 by thick lines.
6. F6 is visible, Draw f_1' 6_1' by thick line in auxiliary front view. The point 3 is not visible. Mark it as (3_1') in the auxiliary front view. Draw (3_1') 2_1', (3_1') 4_1' and (3_1') $c_{1'}$ is dashed lines.