PROJECTION OF SOLIDS

PROJECTIONS OF SOLIDS

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

- It is completely bounded by a surface or surfaces which may be curved or plane.

- The shape of the solid is described by drawing its two orthographic views usually on the two principle planes i.e. H.P. & V.P.

PROJECTIONS OF SOLIDS (Contd….)

- For some complicated solids, in addition to the above views, side view is also required.

- A solid is an aggregate of points, lines and planes and all problems on projections of solids would resolve themselves into projections of points, lines and planes.

Classification of Solids:

Solids may be divided into two main groups;

(A)Polyhedra

(B)Solids of revolution

(A) Polyhedra :

A *Polyhedra* is defined as a solid bounded by planes called *faces* which meet in straight lines called *edges*.

There are *seven* regular Polyhedra which may be defined as stated below;

(1) Prism

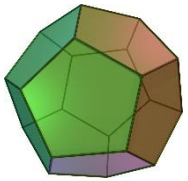
(2) Pyramid

(3) Tetrahedron

(4) Cube or Hexahedron

(5) Octahedron

(6) Dodecahedron



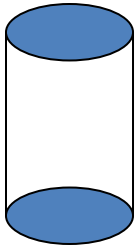
(7) Icosahedron

SOLIDS

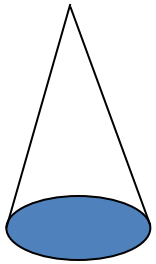
To understand and remember various solids in this subject properly, those are classified & arranged in to two major groups.

Group A	Group B
Solids having top and base of same shape	Solids having base of some shape and just a point as a top, called apex.

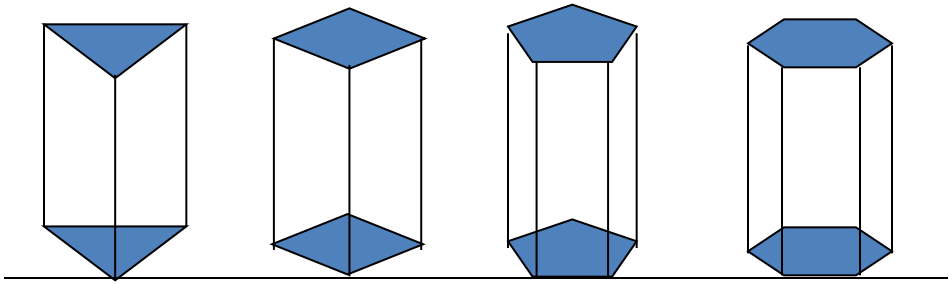
Cylinder



Cone

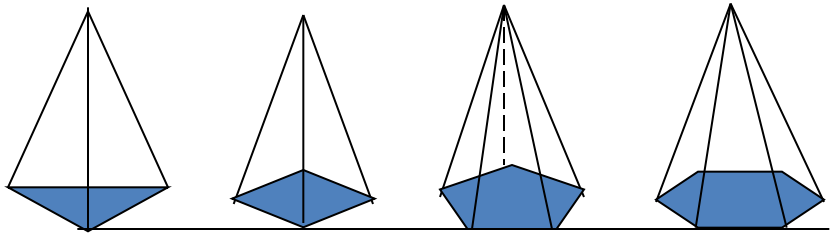


Prisms



Triangular Square Pentagonal Hexagonal

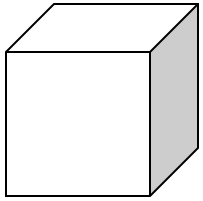
Pyramids



Triangular Square Pentagonal Hexagonal

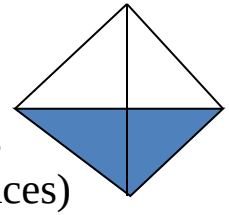
Cube

(A solid having six square faces)



Tetrahedron

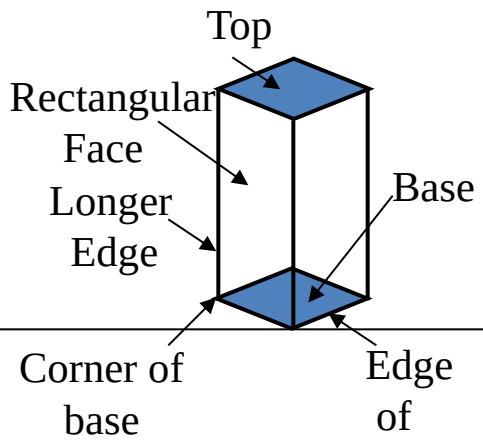
(A solid having Four triangular faces)



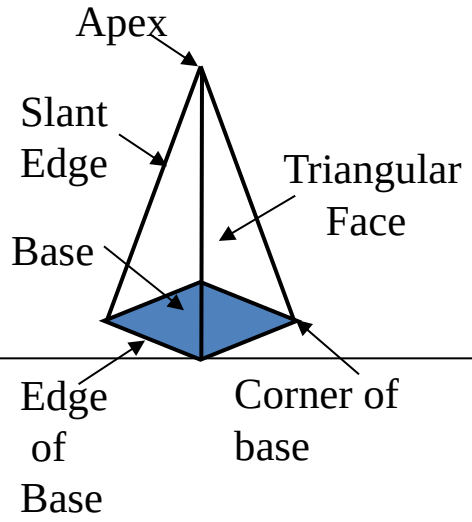
SOLIDS

Dimensional parameters of different solids.

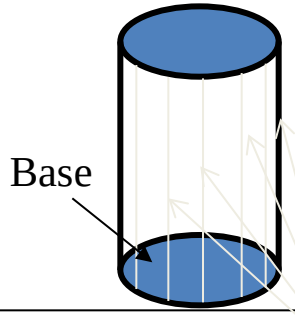
Square Prism



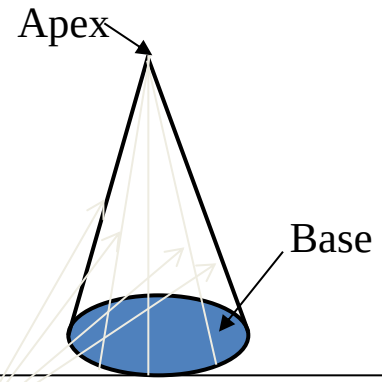
Square Pyramid



Cylinder

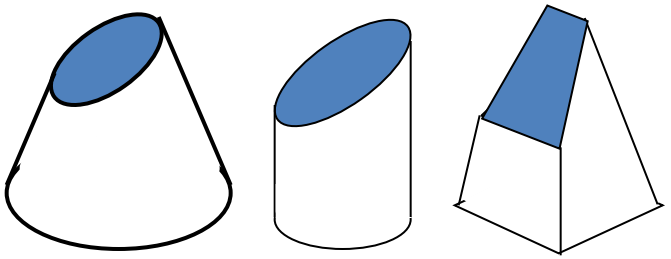


Cone

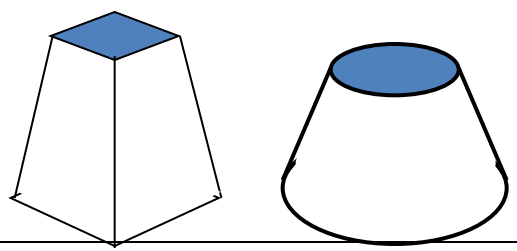


Generators

Imaginary lines generating curved surface of cylinder & cone.



Sections of solids(top & base not parallel)

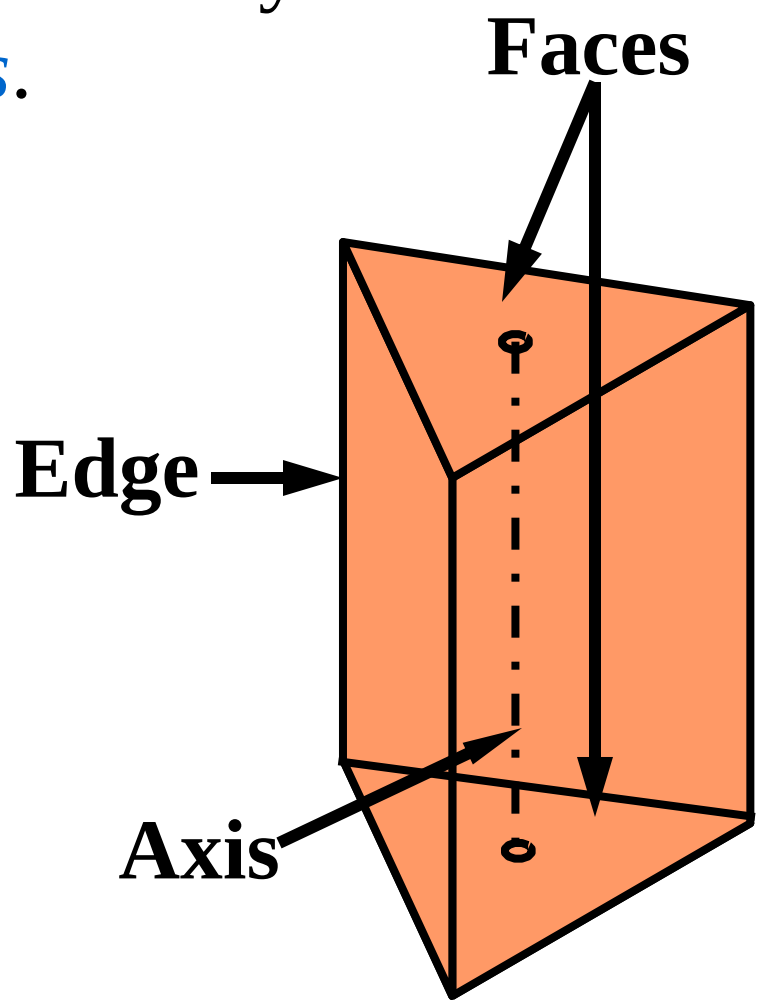


Frustum of cone & pyramids.
(top & base parallel to each other)

(1) Prism:

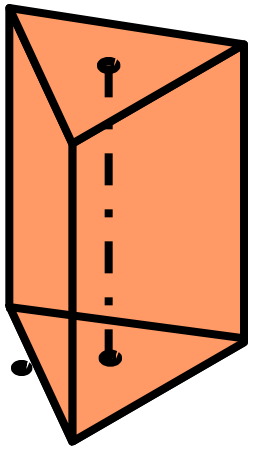
It is a polyhedra having *two equal and similar faces* called its ends or bases, parallel to each other and joined by other faces which are *rectangles*.

-The imaginary line joining the Centres of the bases or faces is called *Axis* of Prism.

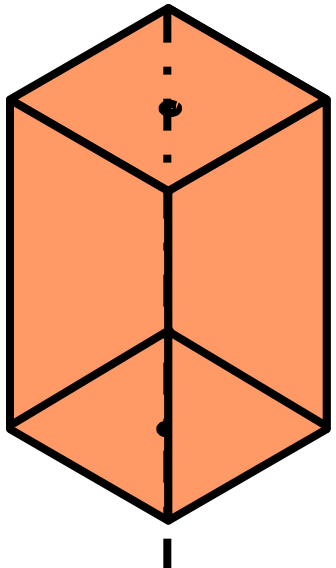


According to the shape of its base, prism can be sub classified into following types:

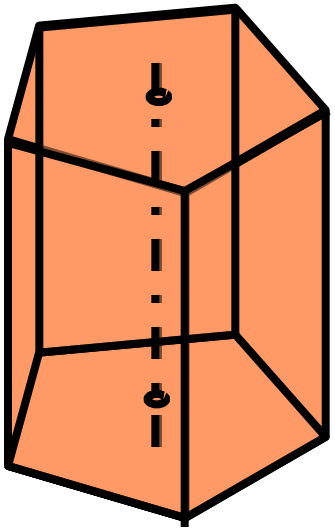
(a) Triangular Prism:



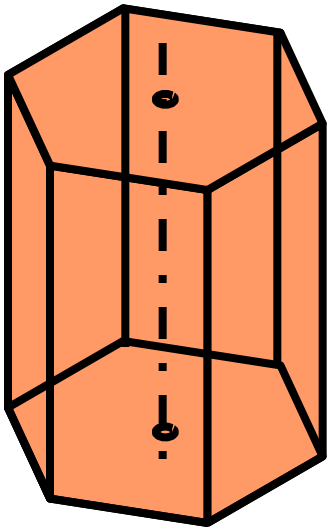
(b) Square Prism:



(c) Pentagonal Prism:



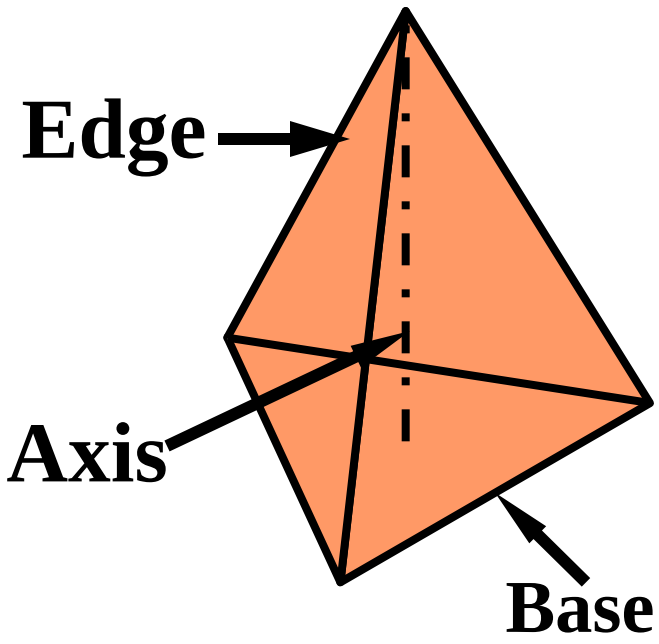
(d) Hexagonal Prism:



(2) Pyramid:

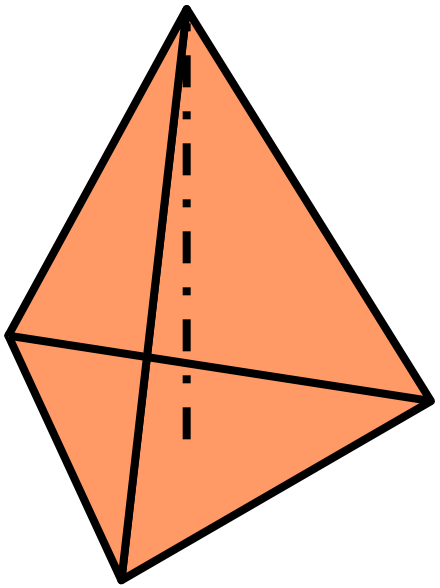
This is a polyhedra having plane surface as a base and a number of triangular faces meeting at a point called the *Vertex* or *Apex*.

-The imaginary line joining the Apex with the Centre of the base is called *Axis* of pyramid.

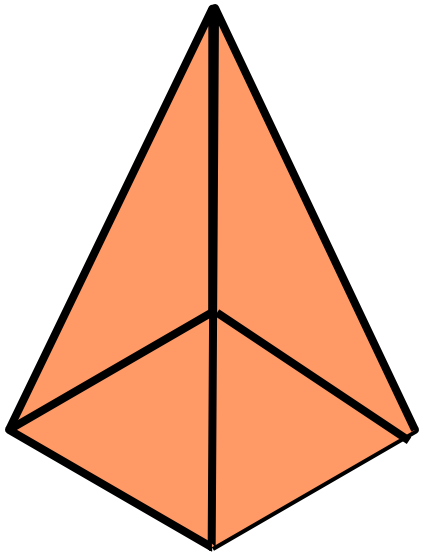


According to the shape of its base, pyramid can be sub classified into following types:

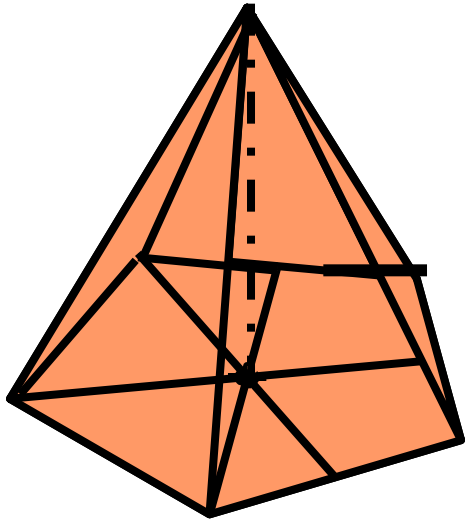
(a) Triangular Pyramid:



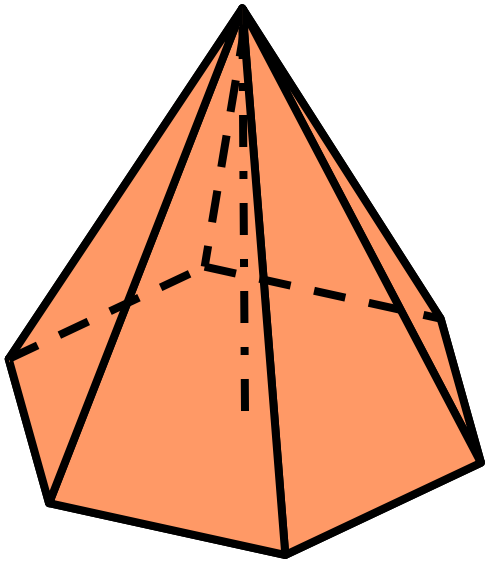
(b) Square Pyramid:



(c) Pentagonal Pyramid:



(d) Hexagonal Pyramid:



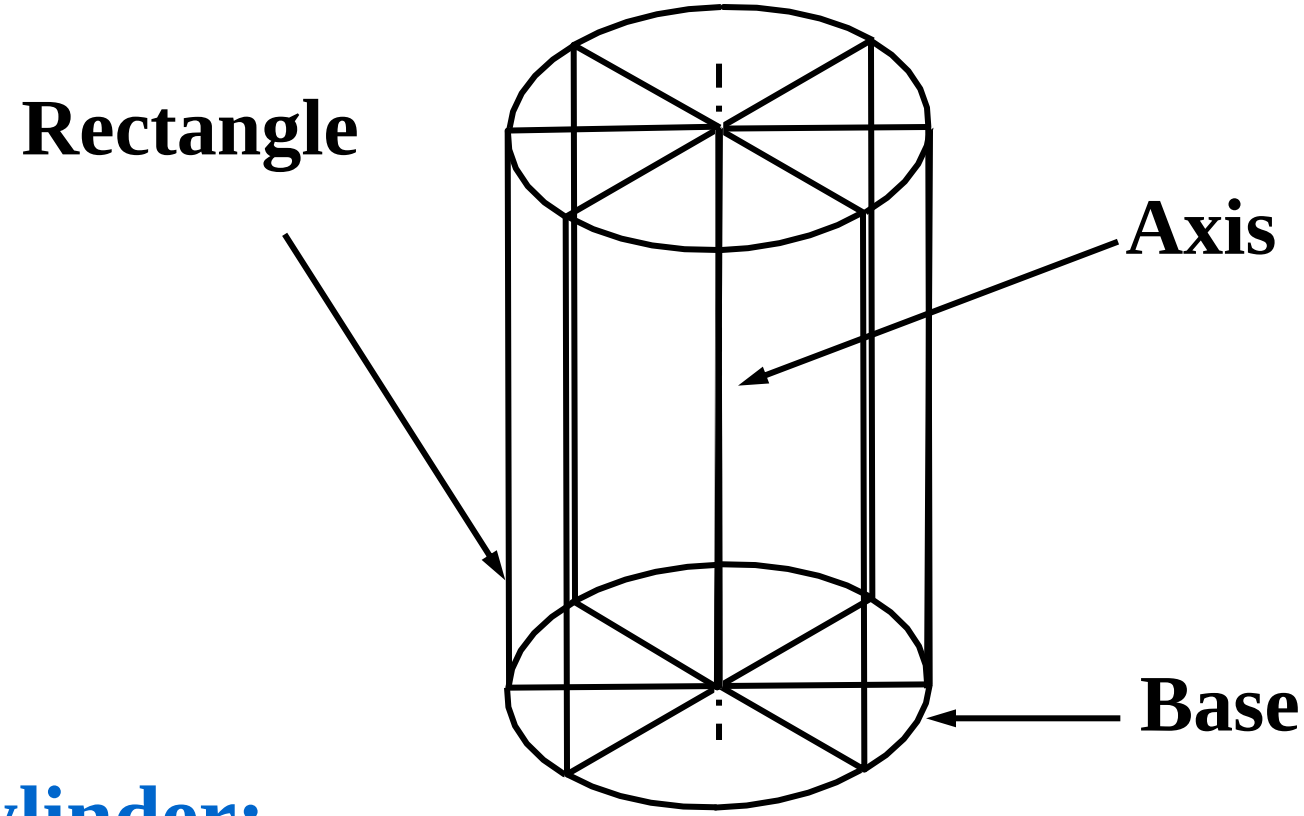
(B) Solids of Revolutions:

When a solid is generated by revolutions of a plane figure about a fixed line (Axis) then such solids are named as *solids of revolution.*

Solids of revolutions may be of following types;

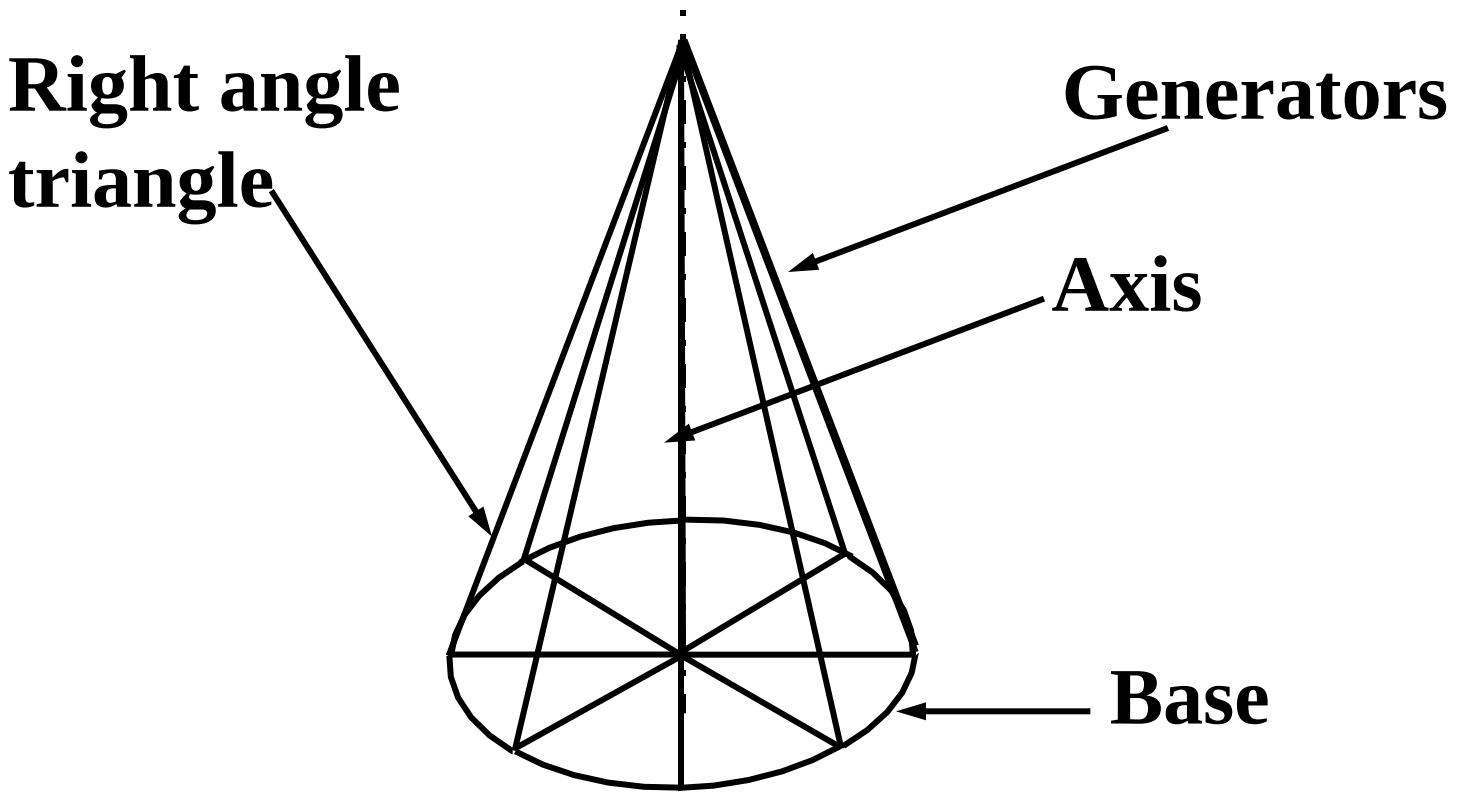
(1)Cylinder
(2)Cone
(3)Sphere
(4)Ellipsoid
(5)Paraboloid
(6)Hyperboloid

(2) Cone
(3) Sphere
(4) Ellipsoid
(5) Paraboloid
(6) Hyperboloid



(1) Cylinder:

A right regular cylinder is a solid generated by the revolution of a rectangle about its vertical side which remains fixed.



(2) Cone:

A right circular cone is a solid generated by the revolution of a right angle triangle about its vertical side which remains fixed.

Important Terms Used in Projections of Solids:

(1) Edge or generator:

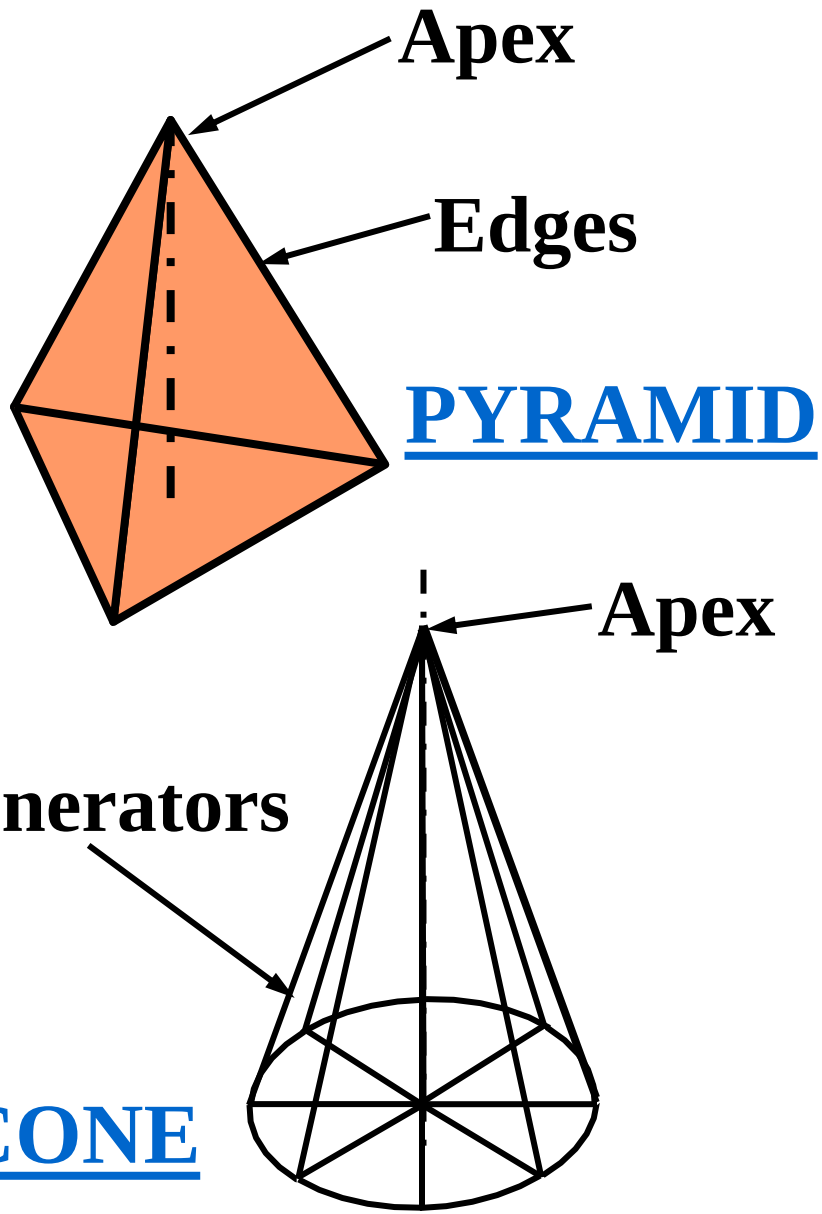
For *Pyramids & Prisms*, edges are the lines separating the triangular faces or rectangular faces from each other.

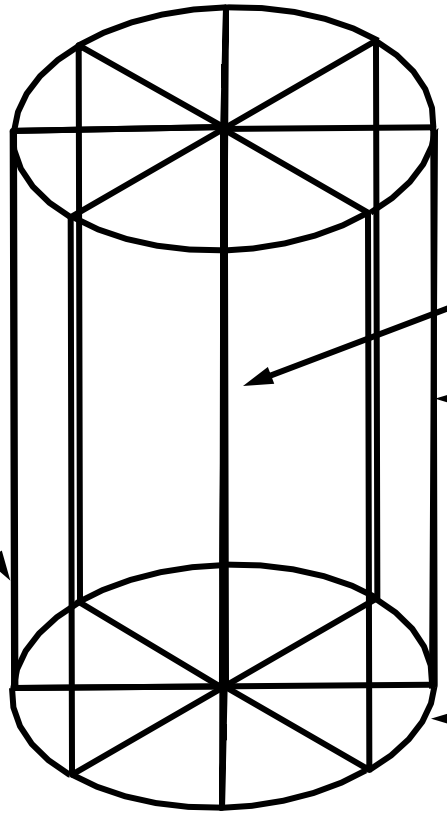
For *Cylinder*, generators are the straight lines joining different points on the circumference of the bases with each other

Important Terms Used in Projections of Solids:

(2) Apex of solids:

For *Cone and Pyramids* Apex is the point where all the generators or the edges meet.





Rectangle

Axis

Generators

Base

Edge

Axis

CYLINDER

PRISM

Important Terms Used in Projections of Solids:

(3) Axis of Solid:

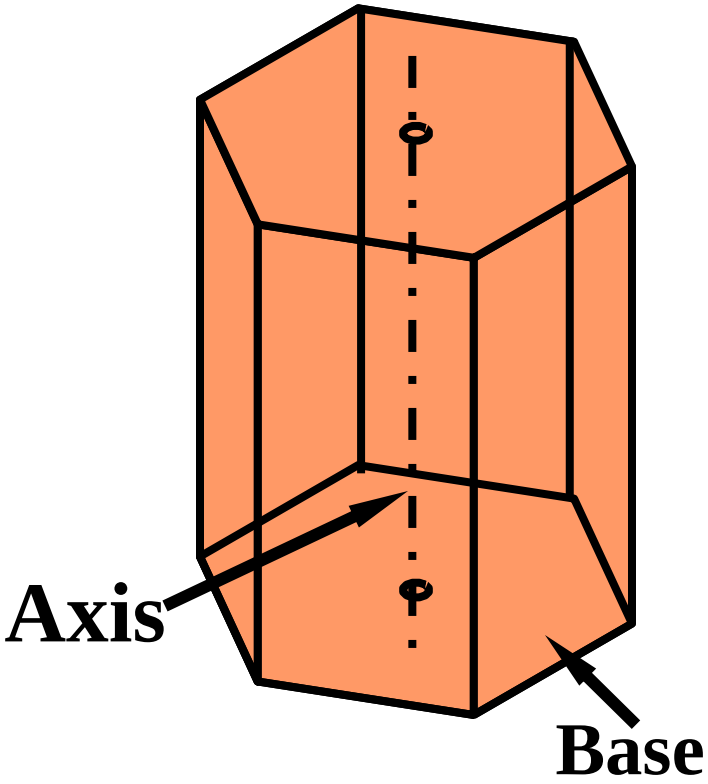
For *Cone and Pyramids*, Axis is an imaginary *line joining centre of the base to the Apex*.

For *Cylinder and Prism*, Axis is an imaginary *line joining centres of ends or bases*.

Important Terms Used in Projections of Solids:

(4) Right Solid:

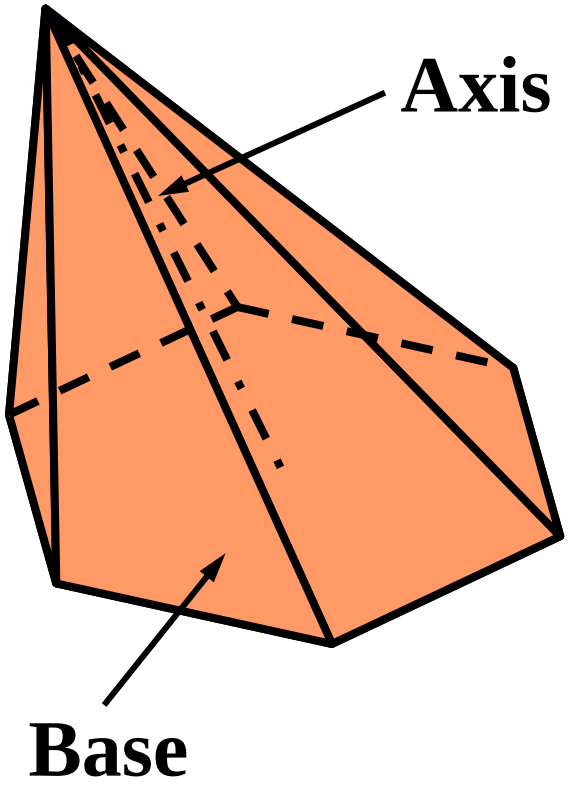
A solid is said to be a *Right Solid* if its axis is perpendicular to its base.



Important Terms Used in Projections of Solids:

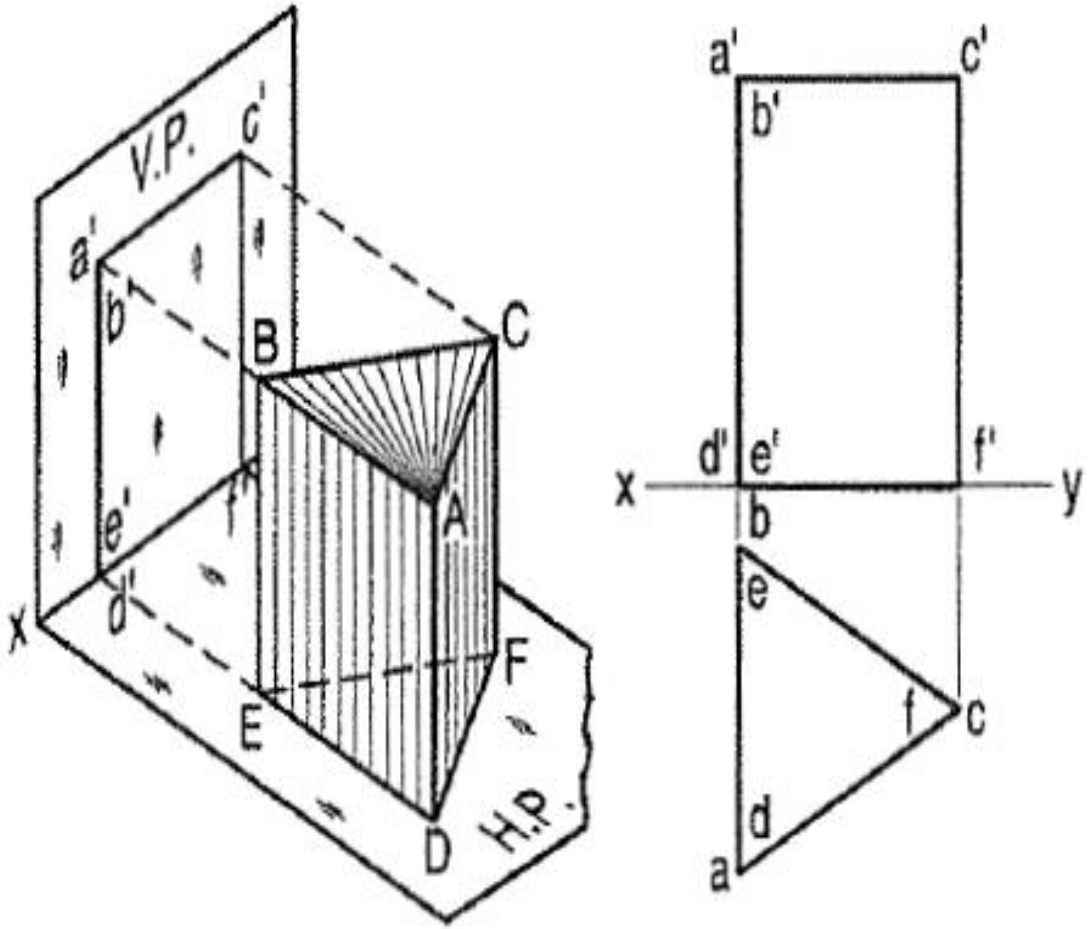
(5) Oblique Solid:

A solid is said to be a *Oblique Solid* if its axis is inclined at an angle other than 90° to its base.

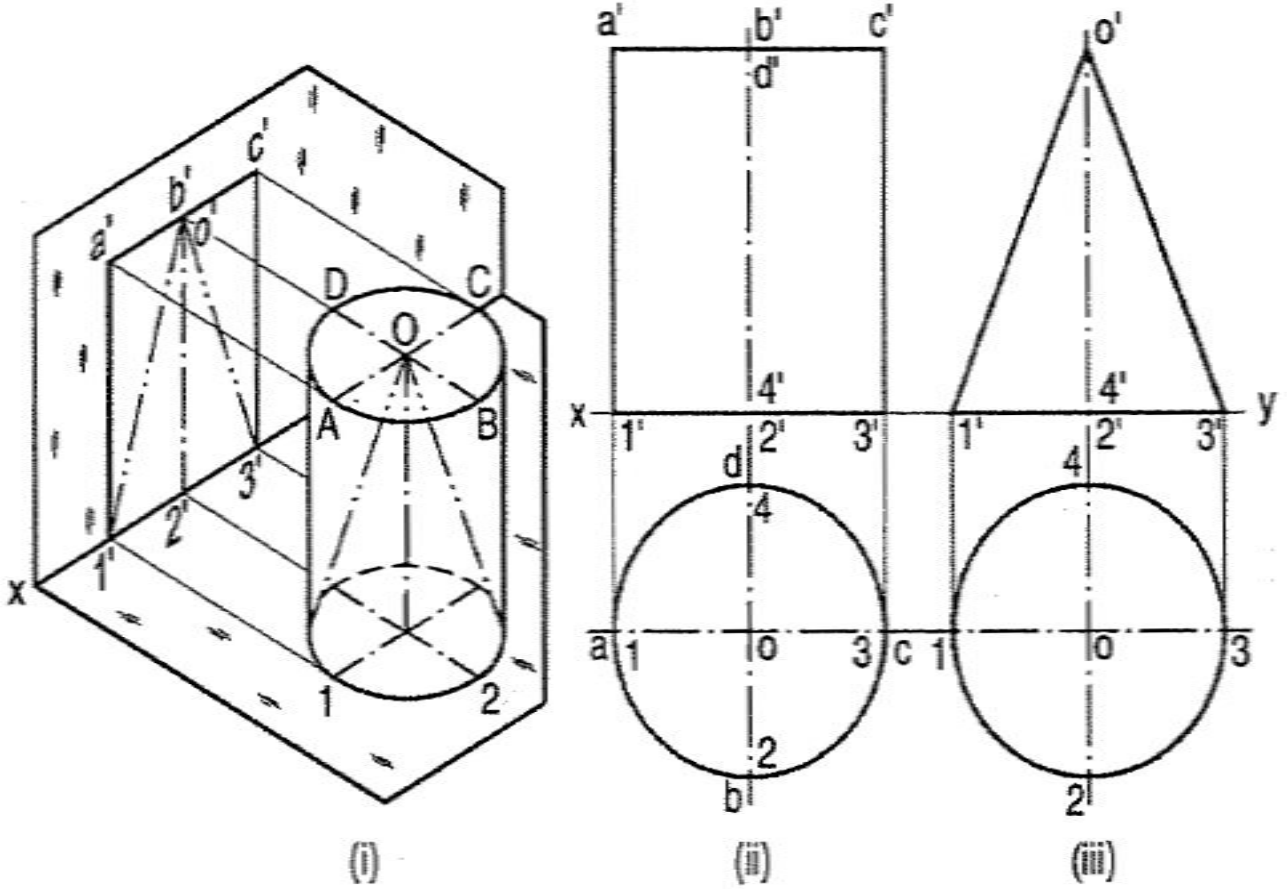


Axis perpendicular to the H.P.

Q: 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.*

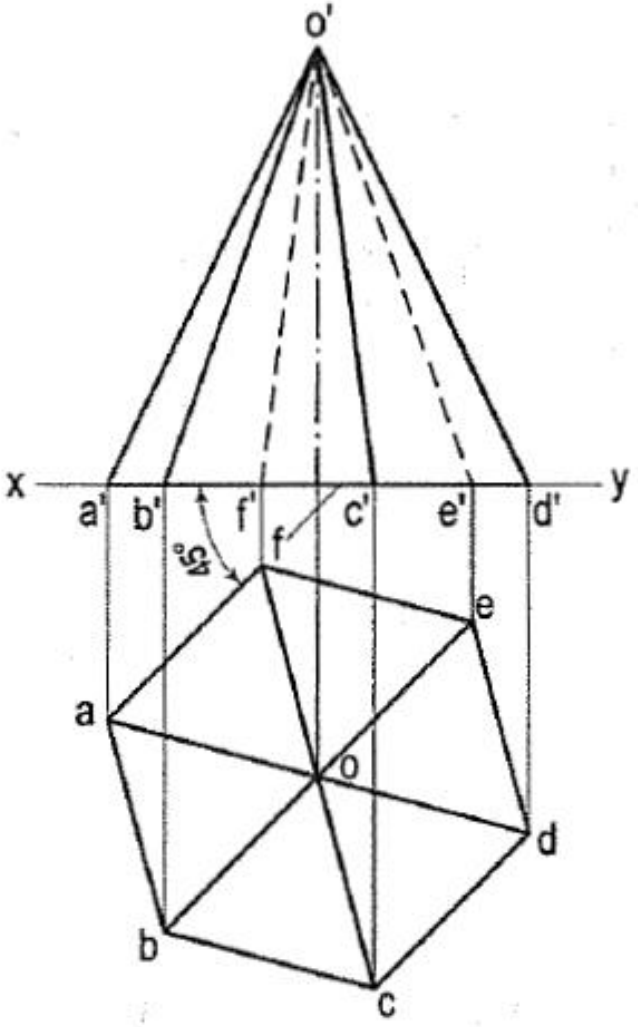


Q: Draw the projections of (i) a cylinder, base 40 mm diameter and axis 50 mm long, and (ii) a cone, base 40 mm diameter and axis 50 mm long, resting on *the H.P. on their respective bases.*



Q: Draw the projections of a hexagonal pyramid, base 30 mm side and axis 60 *mm long, having its base on the H.P. and one of the edges of the base inclined at 45° to the V.P.*

- In the top view, draw a line *af* 30 mm long and inclined at 45° to *xy.*
- Construct a regular hexagon on *af.* Mark its centre o and complete the top view by drawing lines joining it with the corners.
- Project up the front, showing the line o'e' and *o'f* for hidden edges as dashed lines.



STEPS TO SOLVE PROBLEMS IN SOLIDS

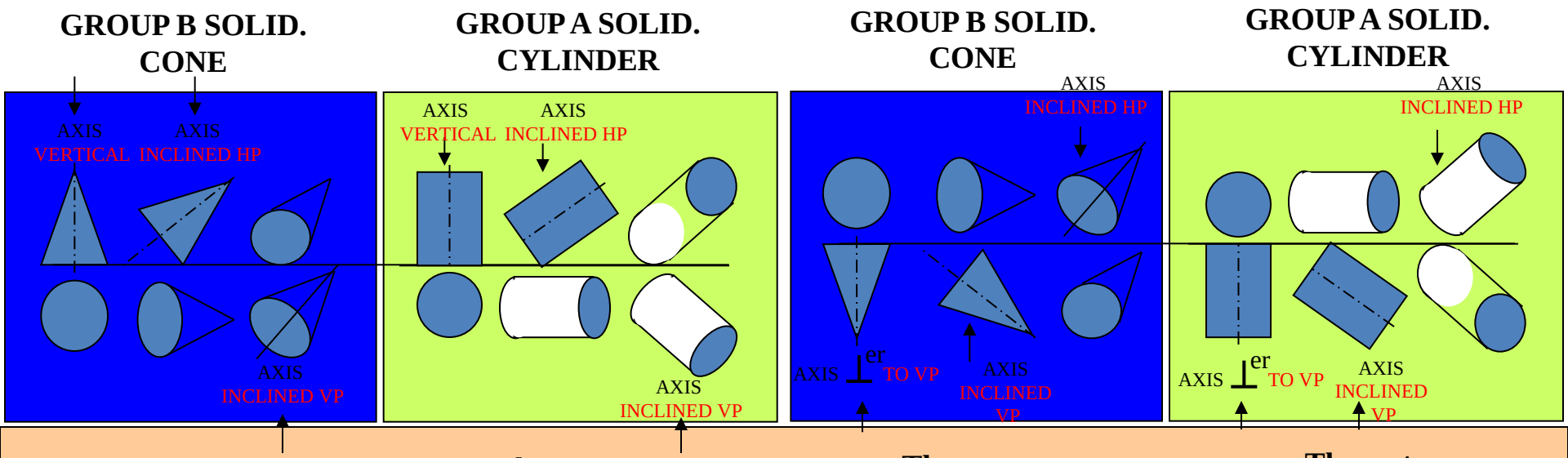
Problem is solved in three steps:

STEP 1: ASSUME SOLID STANDING ON THE PLANE WITH WHICH IT IS MAKING INCLINATION.
(IF IT IS INCLINED TO HP, ASSUME IT STANDING ON HP)
(IF IT IS INCLINED TO VP, ASSUME IT STANDING ON VP)
IF STANDING ON HP - IT'S TV WILL BE TRUE SHAPE OF IT'S BASE OR TOP:
IF STANDING ON VP - IT'S FV WILL BE TRUE SHAPE OF IT'S BASE OR TOP.
BEGIN WITH THIS VIEW:
IT'S OTHER VIEW WILL BE A RECTANGLE (IF SOLID IS *CYLINDER OR ONE OF THE PRISMS)*:
IT'S OTHER VIEW WILL BE A TRIANGLE (IF SOLID IS ***CONE OR ONE OF THE PYRAMIDS):***
DRAW FV & TV OF THAT SOLID IN STANDING POSITION:

STEP 2: CONSIDERING SOLID'S INCLINATION (AXIS POSITION) DRAW IT'S FV & TV.

STEP 3: IN LAST STEP, CONSIDERING REMAINING INCLINATION, DRAW IT'S FINAL FV & TV.

GENERAL PATTERN (THREE STEPS) OF SOLUTION:

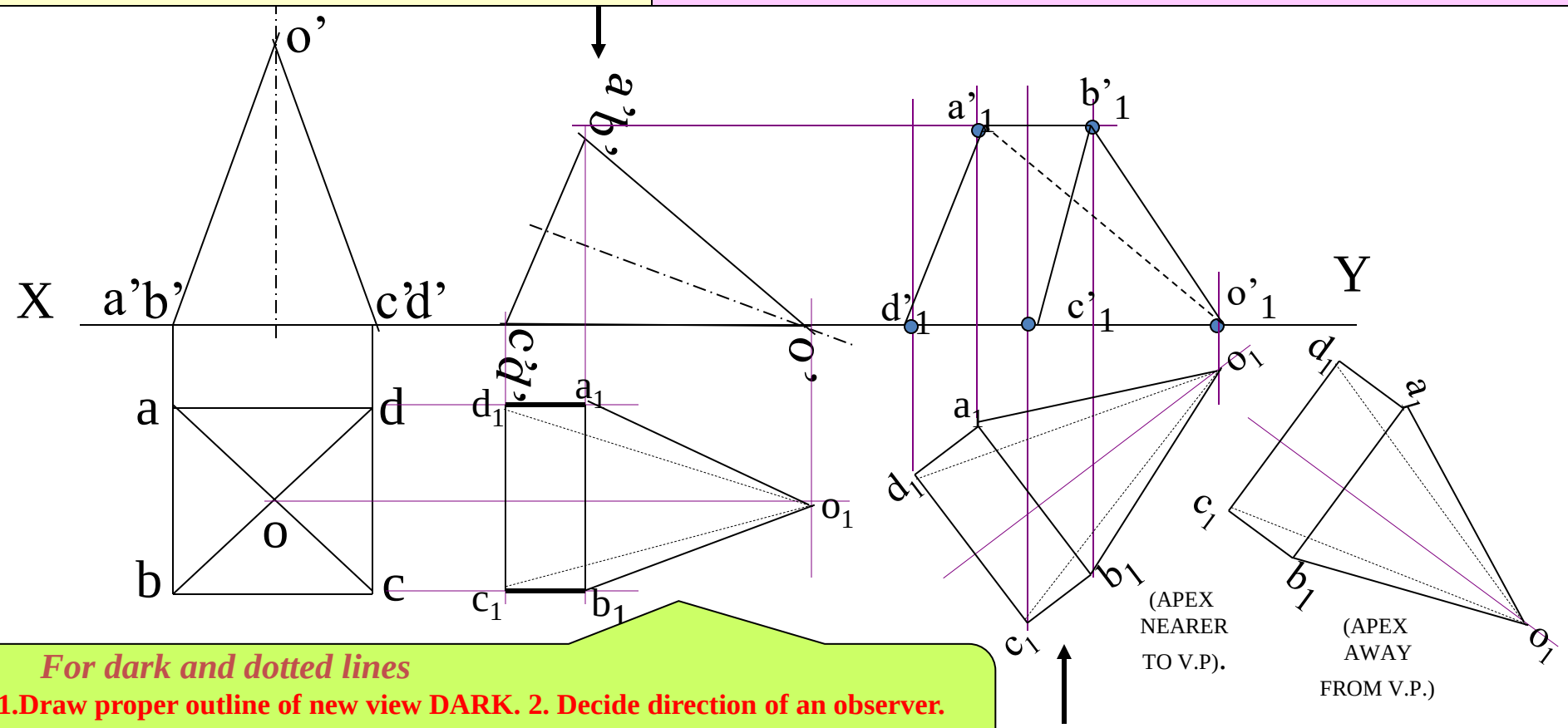


Problem 1. A square pyramid, 40 mm base sides and axis 60 mm long, has a triangular face on the ground and the vertical plane containing the axis makes an angle of 45^0 with the VP. Draw its projections. Take apex nearer to VP

Solution Steps :

Triangular face on Hp , means it is lying on Hp:

1. Assume it standing on Hp.
2. It's Tv will show True Shape of base(square)
3. Draw square of 40mm sides with one side vertical Tv & taking 50 mm axis project Fv. (a triangle)
4. Name all points as shown in illustration.
5. Draw 2nd Fv in lying position I.e.o'c'd' face on xy. And project it's Tv.
6. Make visible lines dark and hidden dotted, as per the procedure.
7. Then construct remaining inclination with Vp (Vp containing axis ic the center line of 2nd Tv.Make it 45^0 to xy as shown take apex near to xy, as it is nearer to Vp) & project final Fv.



For dark and dotted lines

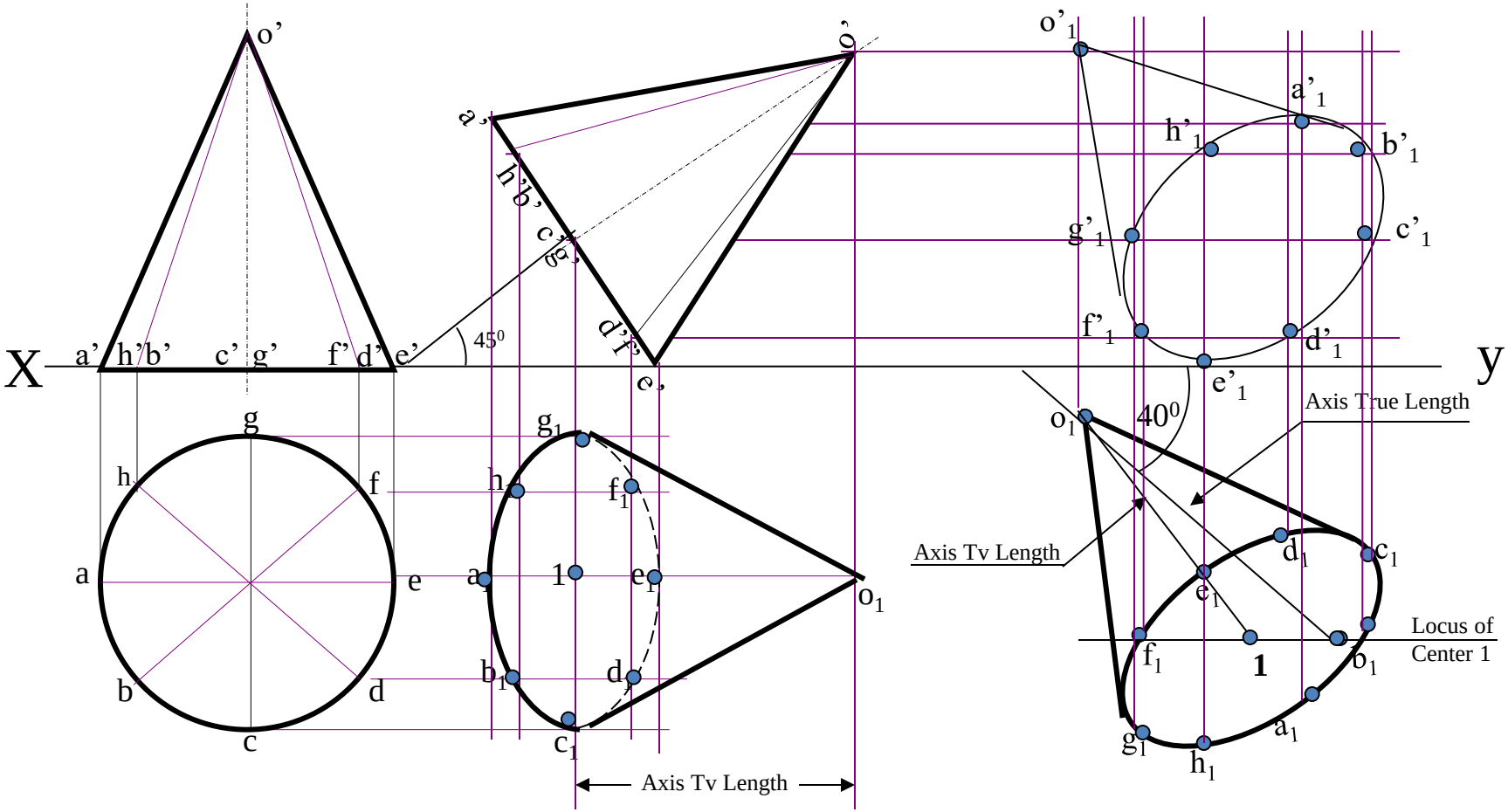
1.Draw proper outline of new view DARK. 2. Decide direction of an observer.
3. Select nearest point to observer and draw all lines starting from it-dark.
4. Select farthest point to observer and draw all lines (remaining)from it- dotted.

Problem : A right circular cone, 40 mm base diameter and 60 mm long axis is resting on Hp on one point of base circle such that it's axis makes 45^0 inclination with Hp and 40^0 inclination with Vp. Draw it's projections.

Problem : A right circular cone, 40 mm base diameter and 60 mm long axis is resting on Hp on one point of base circle such that it's axis makes 45^0 inclination with Hp and 40^0 inclination with Vp. Draw it's projections.

This case resembles to **problem no.7 & 9 from projections of planes** topic. In previous all cases 2nd inclination was done by a parameter not showing TL.Like Tv of axis is inclined to Vp etc. But here it is clearly said that the axis is 40^0 inclined to Vp. Means here TL inclination is expected. So the same construction done in those Problems is done here also. See carefully the final Tv and inclination taken there.

So assuming it standing on HP begin as usual.



Problem 2:

A cone 40 mm diameter and 50 mm axis is resting on one generator on HP which makes 30^0 inclination with VP. Draw it's projections.

Problem 2:

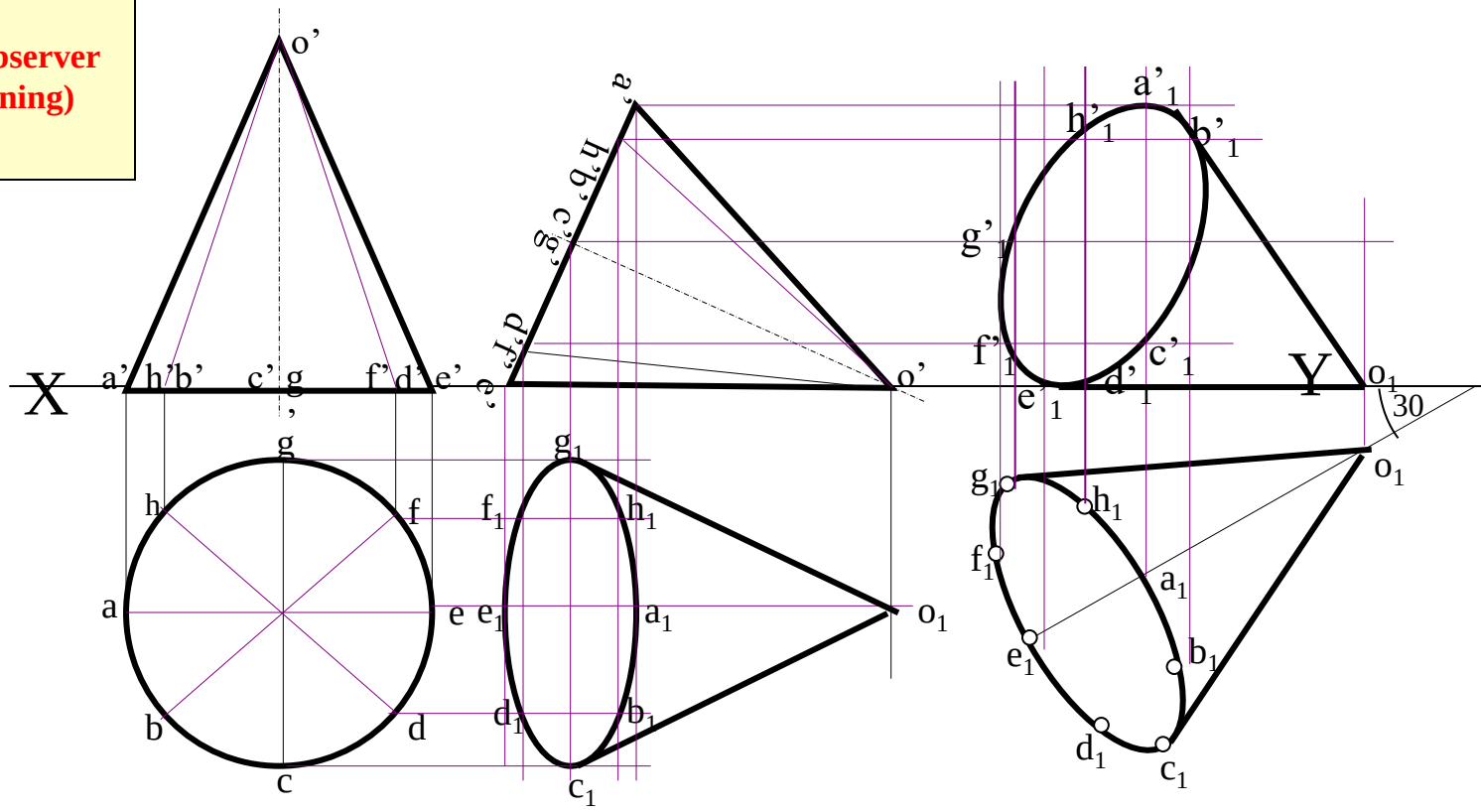
A cone 40 mm diameter and 50 mm axis is resting on one generator on Hp which makes 30^0 inclination with Vp Draw it's projections.

For dark and dotted lines

1.Draw proper outline of new vie DARK.
2. Decide direction of an observer.
3. Select nearest point to observer and draw all lines starting from it-dark.
4. Select farthest point to observer and draw all lines (remaining) from it- dotted.

Solution Steps:

Resting on Hp on one generator, means lying on Hp:
1.Assume it standing on Hp.
2.It's Tv will show True Shape of base(circle)
3.Draw 40mm dia. Circle as Tv & taking 50 mm axis project Fv. (a triangle)
4.Name all points as shown in illustration.
5.Draw 2nd Fv in lying position I.e.o'e' on xy. And project it's Tv below xy.
6.Make visible lines dark and hidden dotted, as per the procedure.
7.Then construct remaining inclination with Vp (generator o_1e_1 30^0 to xy as shown) & project final Fv.



Problem 3:

A cylinder 40 mm diameter and 50 mm axis is resting on one point of a base circle on V.P. while it's axis makes 45^0 with V.P. and FV of the axis 35^0 with H.P. Draw projections..

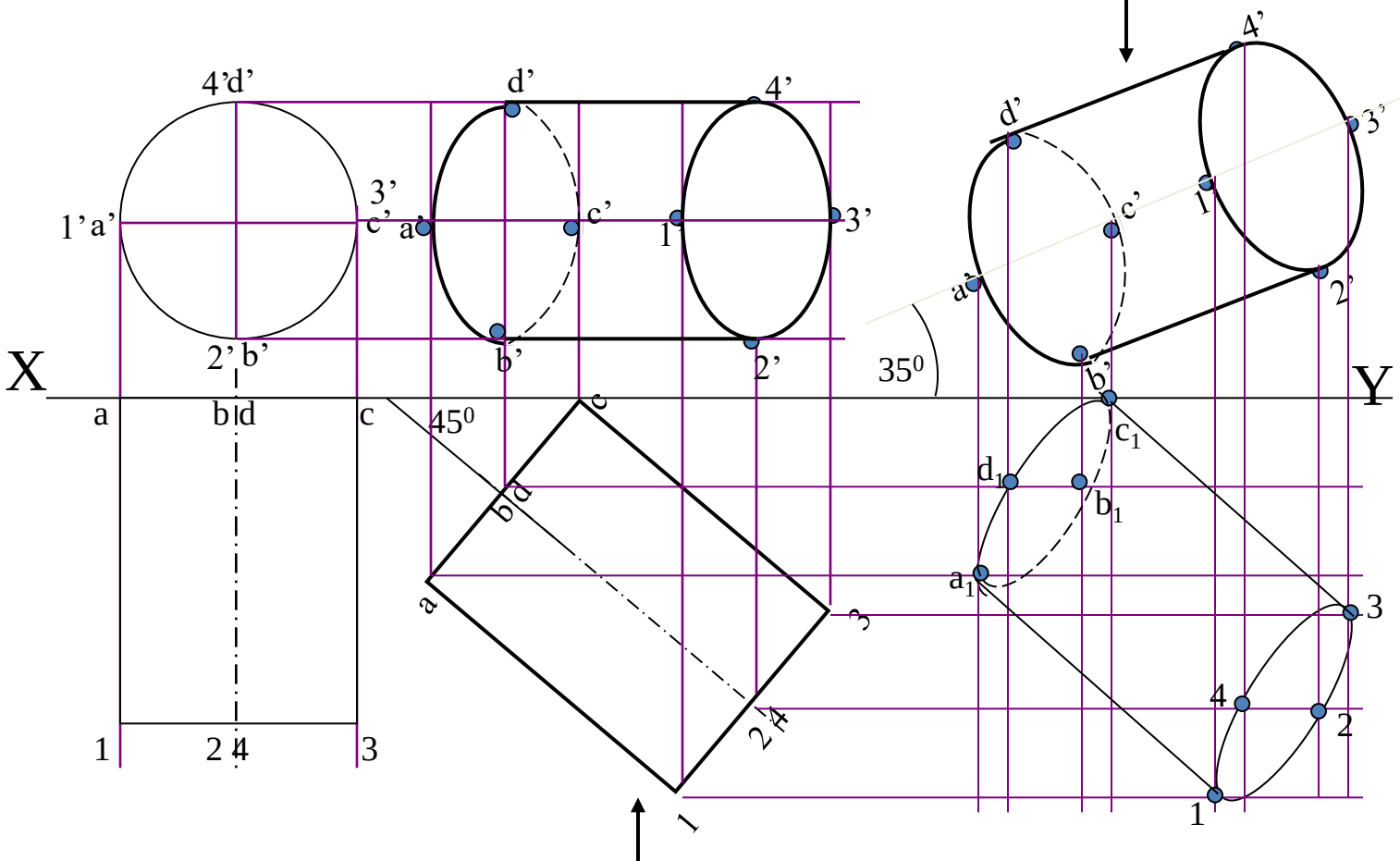
Problem 3:

A cylinder 40 mm diameter and 50 mm axis is resting on one point of a base circle on V.P. while it's axis makes 45^0 with V.P. and FV of the axis 35^0 with H.P. Draw projections..

Solution Steps:

Resting on Vp on one point of base, means inclined to Vp:

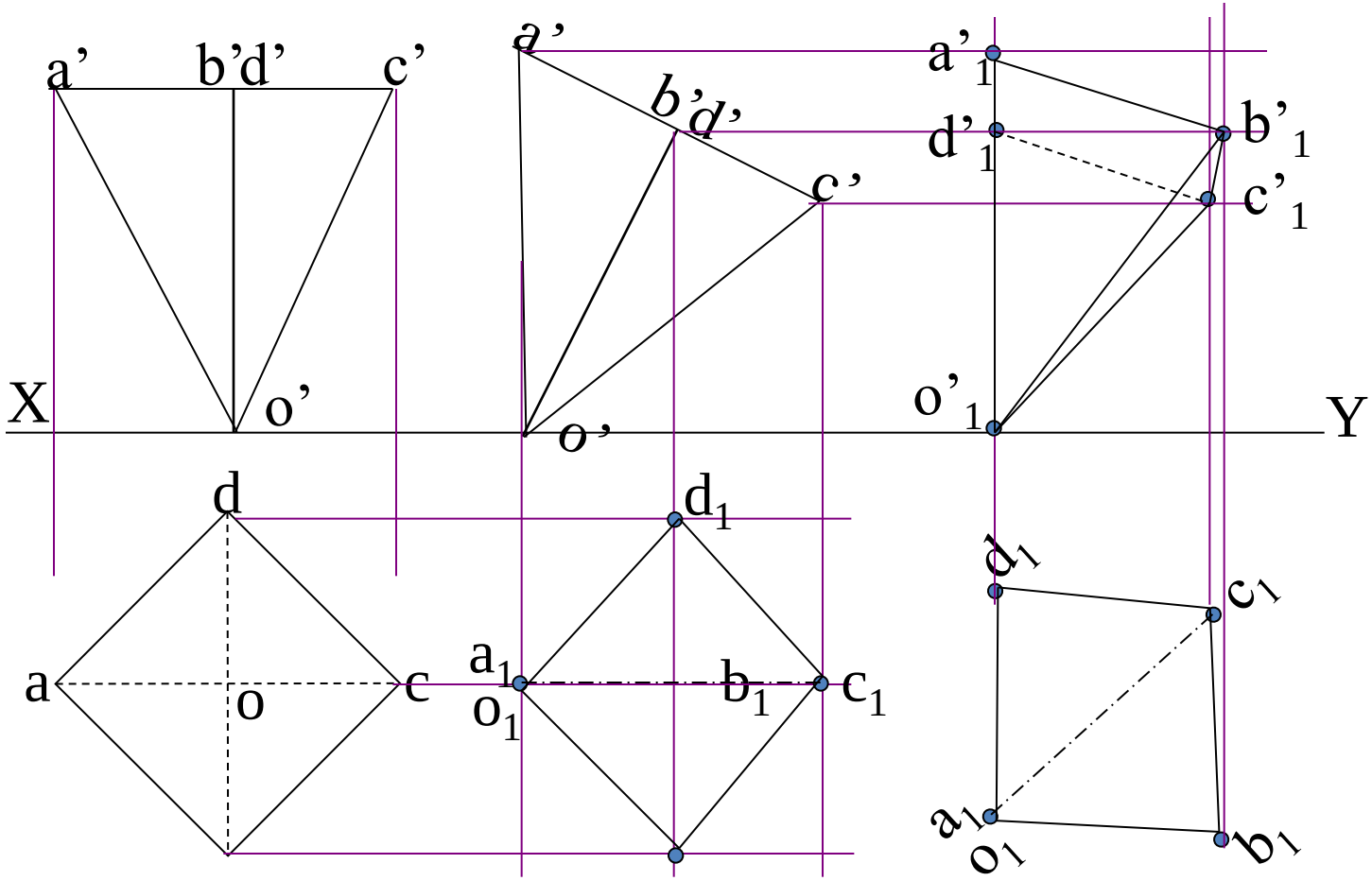
1. Assume it standing on Vp
2. It's Fv will show True Shape of base & top(circle)
3. Draw 40mm dia. Circle as Fv & taking 50 mm axis project Tv. (a Rectangle)
4. Name all points as shown in illustration.
5. Draw 2nd Tv making axis 45^0 to xy And project it's Fv above xy.
6. Make visible lines dark and hidden dotted, as per the procedure.
7. Then construct remaining inclination with Hp (Fv of axis I.e. center line of view to xy as shown) & project final Tv.



Problem 4: A square pyramid 30 mm base side and 50 mm long axis is resting on it's apex on Hp, such that it's one slant edge is vertical and a triangular face through it is perpendicular to Vp. Draw it's projections.

Solution Steps :

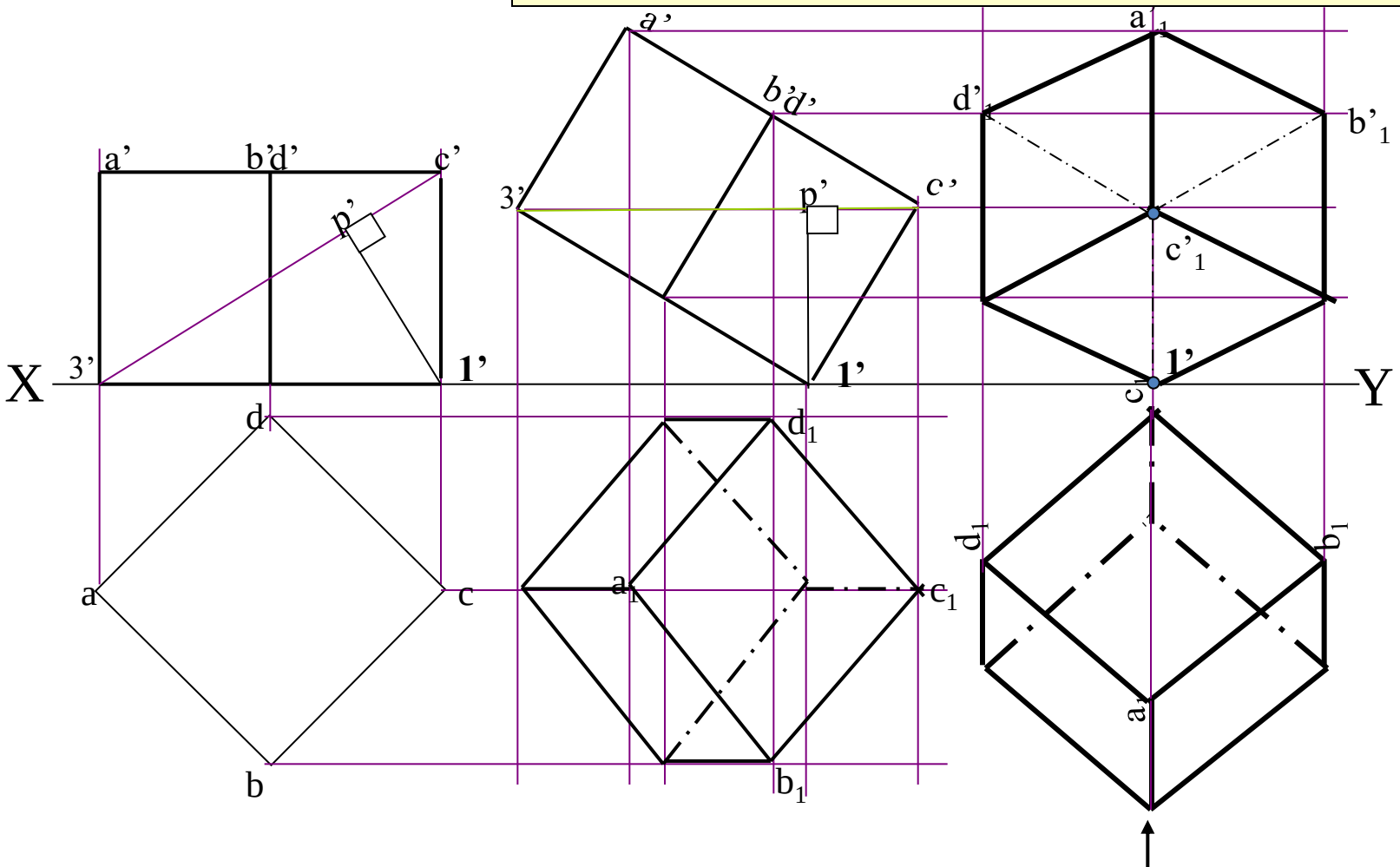
1. Assume it standing on Hp but as said on apex.(inverted).
2. It's Tv will show True Shape of base(square)
3. Draw a corner case square of 30 mm sides as Tv(as shown) Showing all slant edges dotted, as those will not be visible from top.
4. taking 50 mm axis project Fv. (a triangle)
5. Name all points as shown in illustration.
6. Draw 2nd Fv keeping o'a' slant edge vertical & project it's Tv
7. Make visible lines dark and hidden dotted, as per the procedure.
8. Then redrew 2nd Tv as final Tv keeping $a_1o_1d_1$ triangular face perpendicular to Vp I.e.xy. Then as usual project final Fv.



Problem 5: A cube of 50 mm long edges is so placed on Hp on one corner that a body diagonal is parallel to Hp and perpendicular to Vp Draw it's projections.

Solution Steps:

1.Assuming standing on Hp, begin with Tv,a square with all sides equally inclined to xy.Project Fv and name all points of FV & TV.
2.Draw a body-diagonal joining c' with 3'(This can become // to xy)
3.From 1' drop a perpendicular on this and name it p'
4.Draw 2nd Fv in which 1'-p' line is vertical ***means*** c'-3' diagonal must be horizontal. .Now as usual project Tv..
6.In final Tv draw same diagonal is perpendicular to Vp as said in problem. Then as usual project final FV.

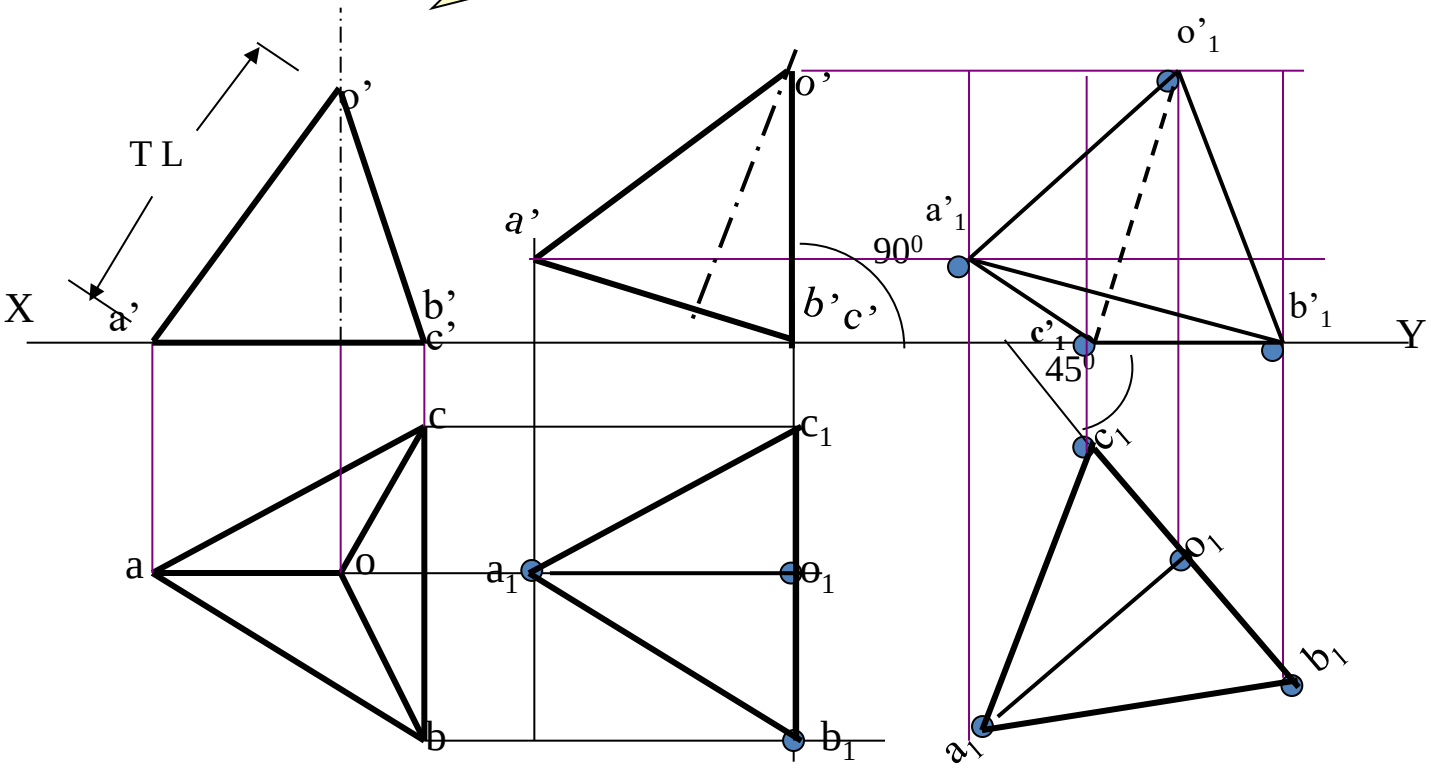


Problem 6: A tetrahedron of 50 mm long edges is resting on one edge on Hp while one triangular face containing this edge is vertical and 45^0 inclined to Vp. Draw projections.

IMPORTANT:
Tetrahedron is a special type of triangular pyramid in which base sides & slant edges are equal in length. Solid of four faces. Like cube it is also described by One dimension only.. Axis length generally not given.

Solution Steps

As it is resting assume it standing on Hp.
Begin with Tv , an equilateral triangle as side case as shown:
First project base points of Fv on xy, name those & axis line.
From a' with TL of edge, 50 mm, cut on axis line & mark o' (as axis is not known, o' is finalized by slant edge length)
Then complete Fv.
In 2nd Fv make face o'b'c' vertical as said in problem.
And like all previous problems solve completely.



Q13.22: A hexagonal pyramid base 25 mm side and axis 55 mm long has one of its slant edge on the ground. A plane containing that edge and the axis is perpendicular to the H.P. and inclined at 45º to the V.P. Draw its projections when the apex is nearer to the V.P. than the base.