PROJECTIONS OF SOLIDS

PROJECTIONS OF SOLIDS

Definition of Solid:

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.

-For some complicated solids, in addition to the above principle 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:

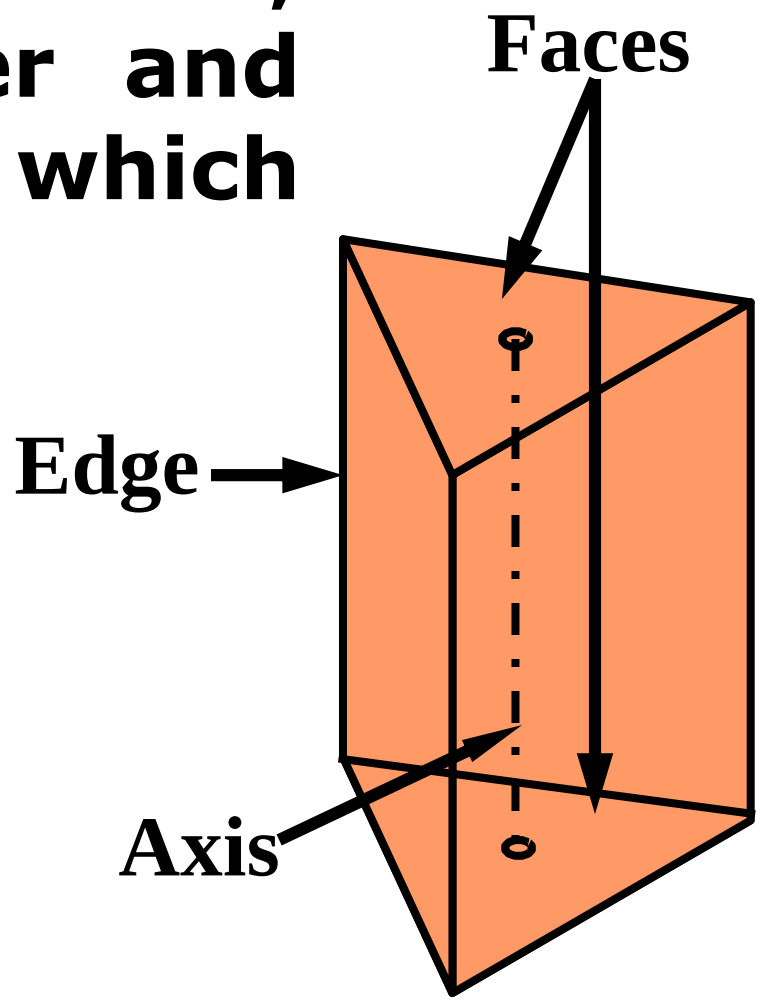
(6) Dodecahedron:

(7) Icosahedron:

(1) Prism:

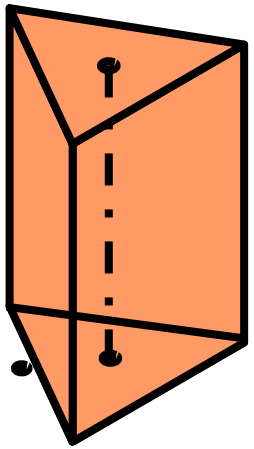
It is a polyhedra having *two equal and similar faces* called its ends or bases, parallel to each other and joined by other faces which are *rectangles*.

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

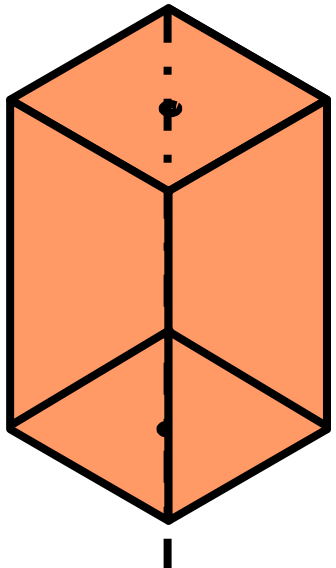


According to the shape of its base, prism can be sub classified into following types:

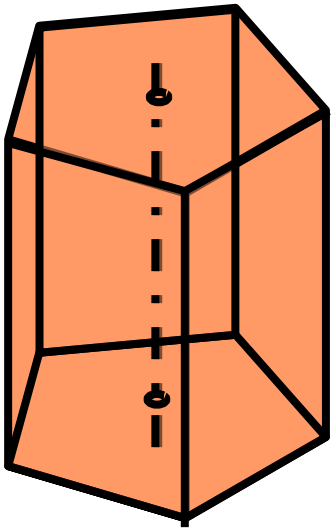
(a) Triangular Prism:



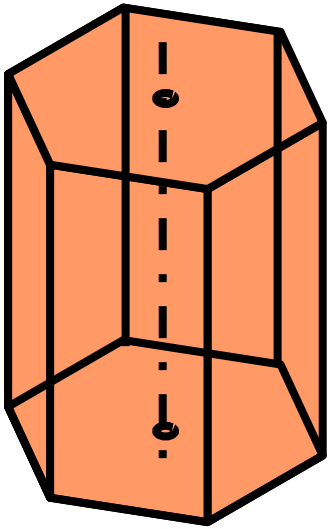
(b) Square Prism:



(c) Pentagonal Prism:



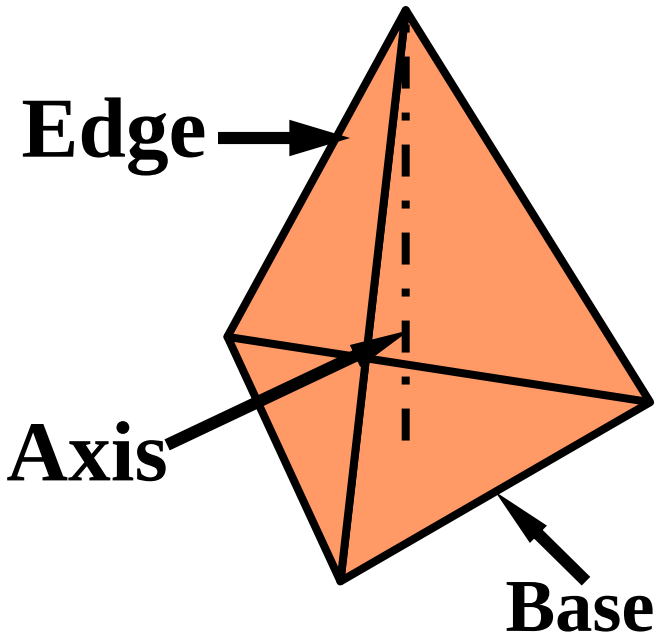
(d) Hexagonal Prism:



(2) Pyramid:

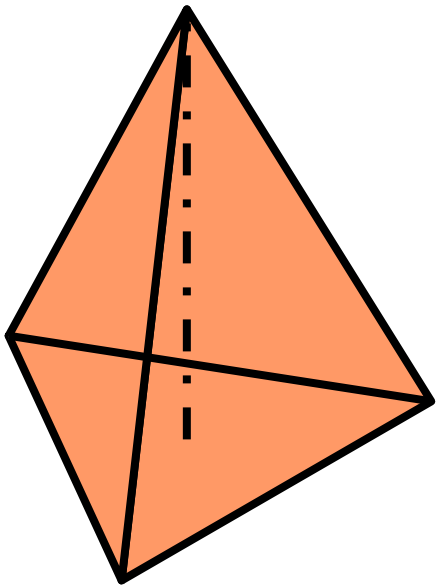
This is a polyhedra having plane surface as a base and a number of triangular faces meeting at a point called the *Vertex* or *Apex*.

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

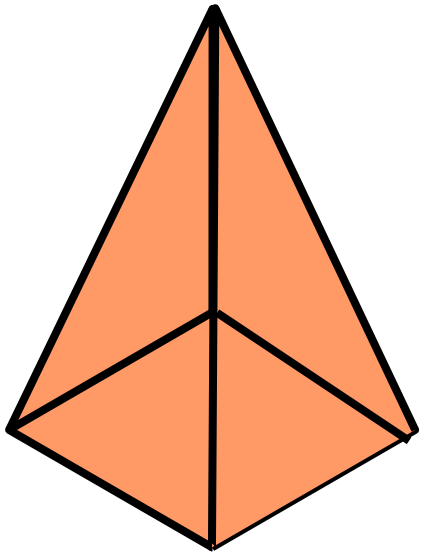


According to the shape of its base, pyramid can be sub classified into following types:

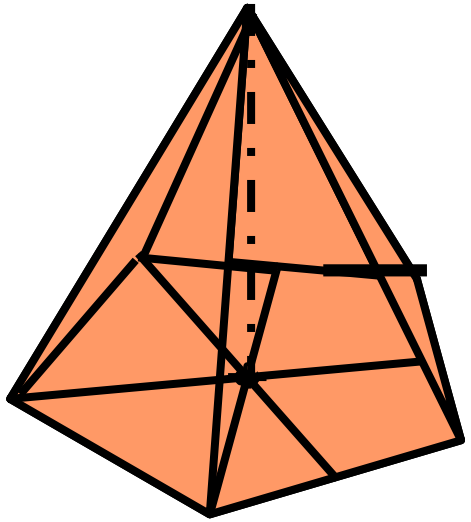
(a) Triangular Pyramid:



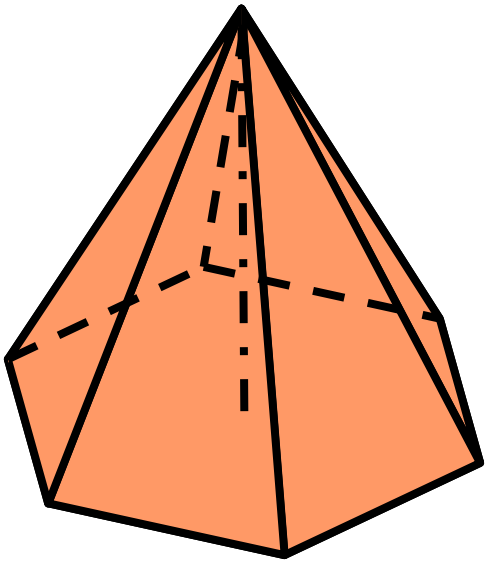
(b) Square Pyramid:



(c) Pentagonal Pyramid:



(d) Hexagonal Pyramid:

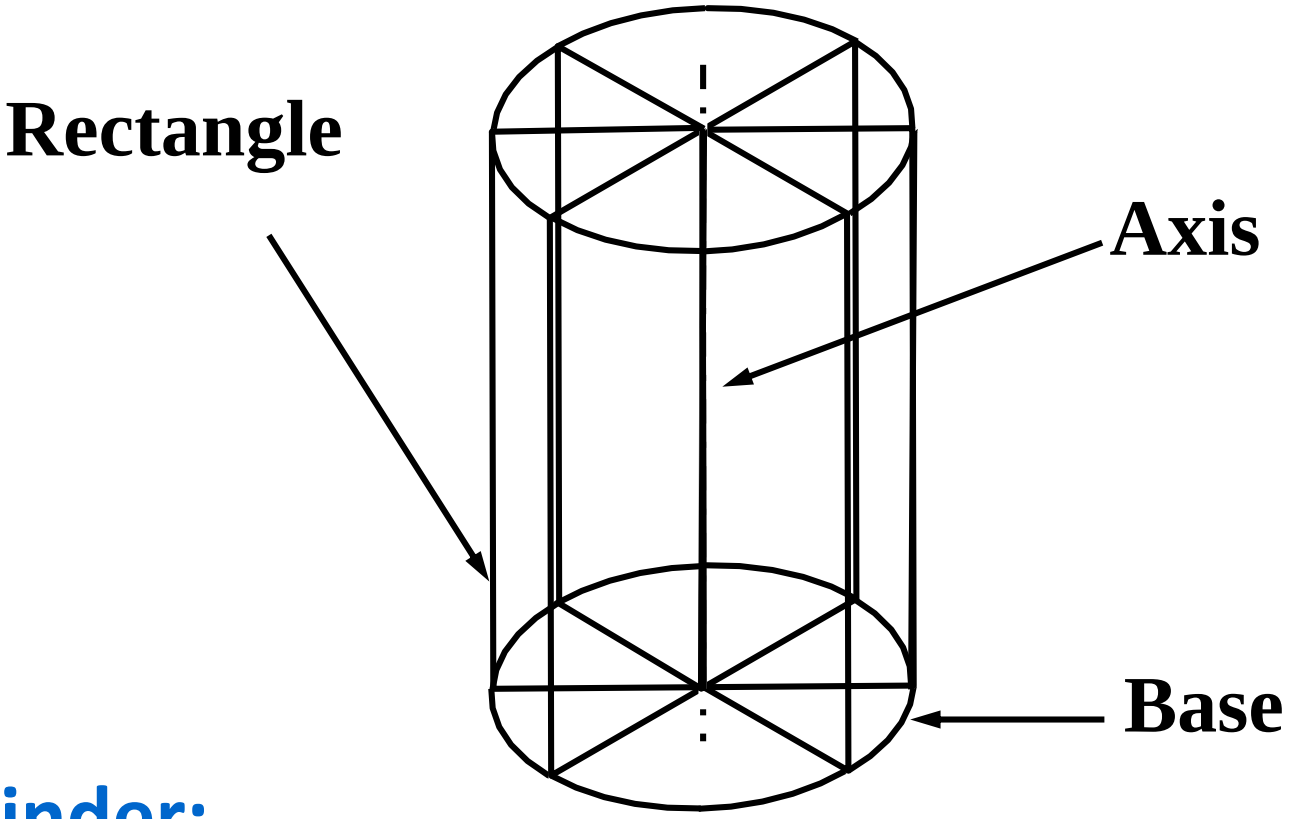


(B) Solids of Revolutions:

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*.

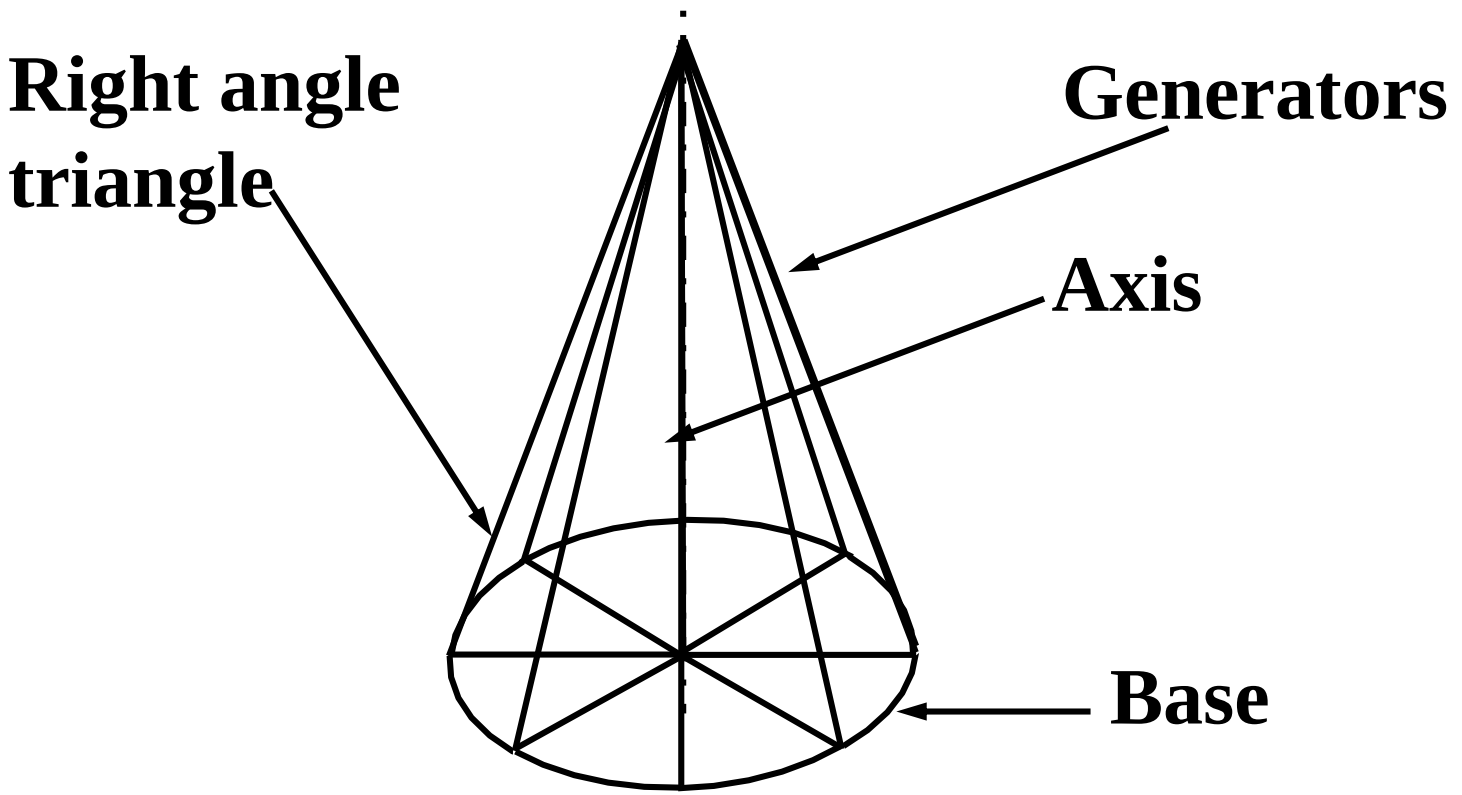
Solids of revolutions may be of following types;

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



(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:

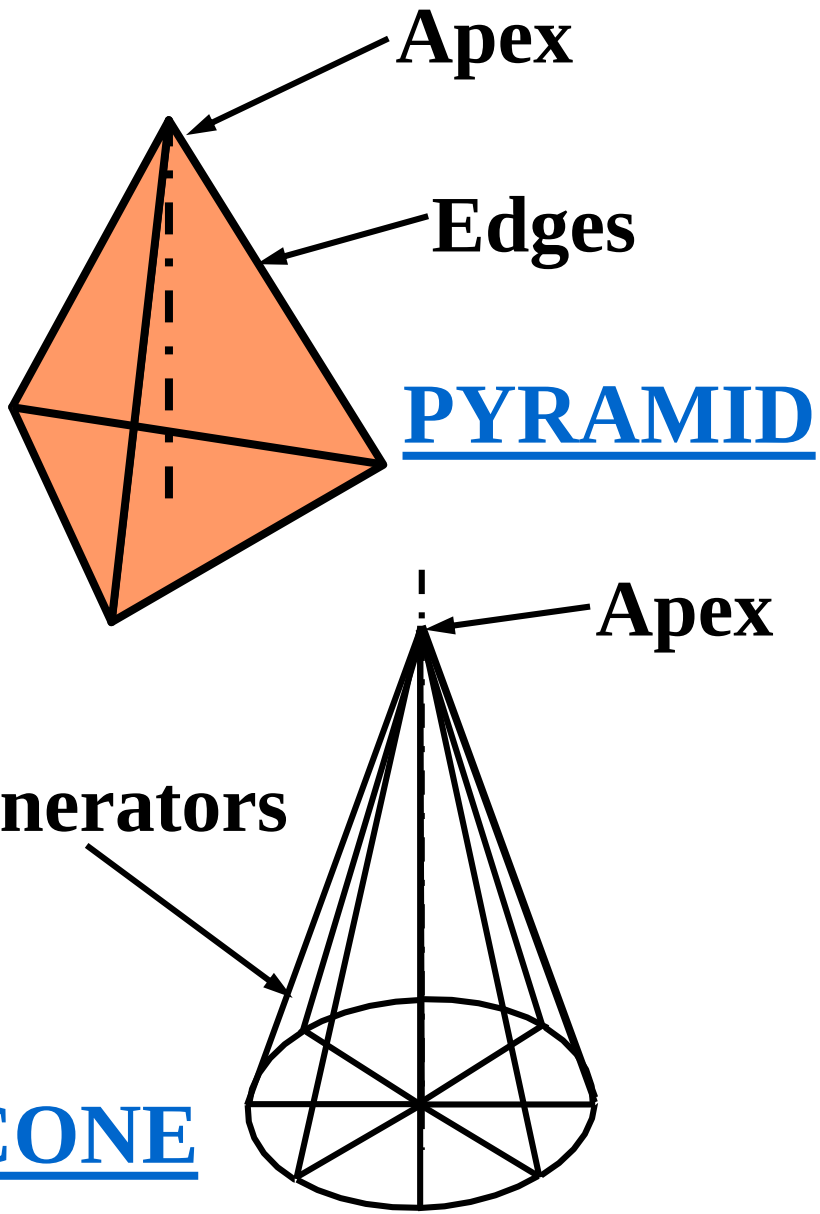
For *Pyramids* & *Prisms*, edges are the lines separating the triangular faces or rectangular faces from each other.

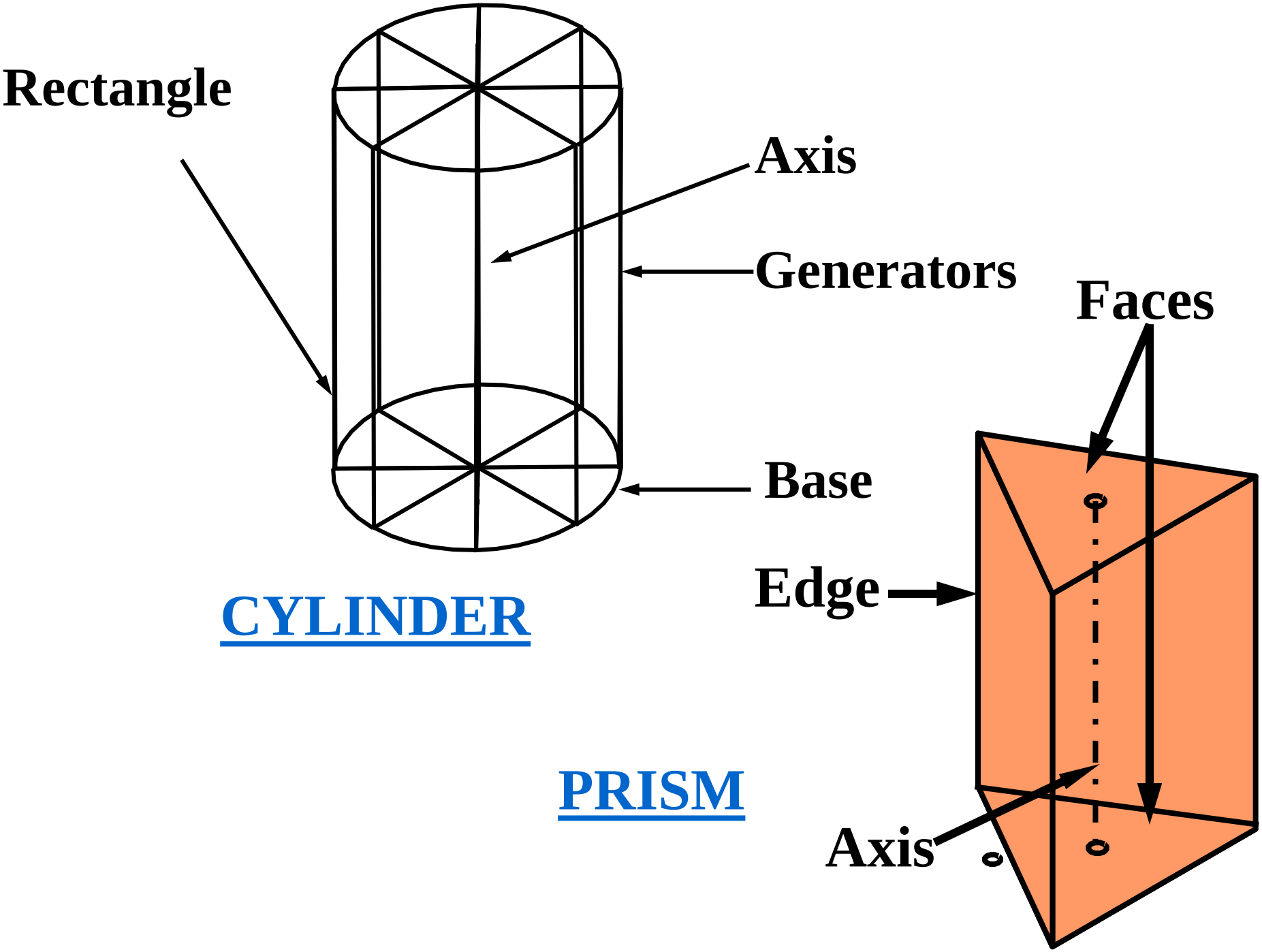
For *Cylinder*, generators are the straight lines joining different points on the circumference of the bases with each other

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
CYLINDER
Faces
Edge
PRISM
Axis

Important Terms Used in Projections of Solids:

(3) Axis of Solid:

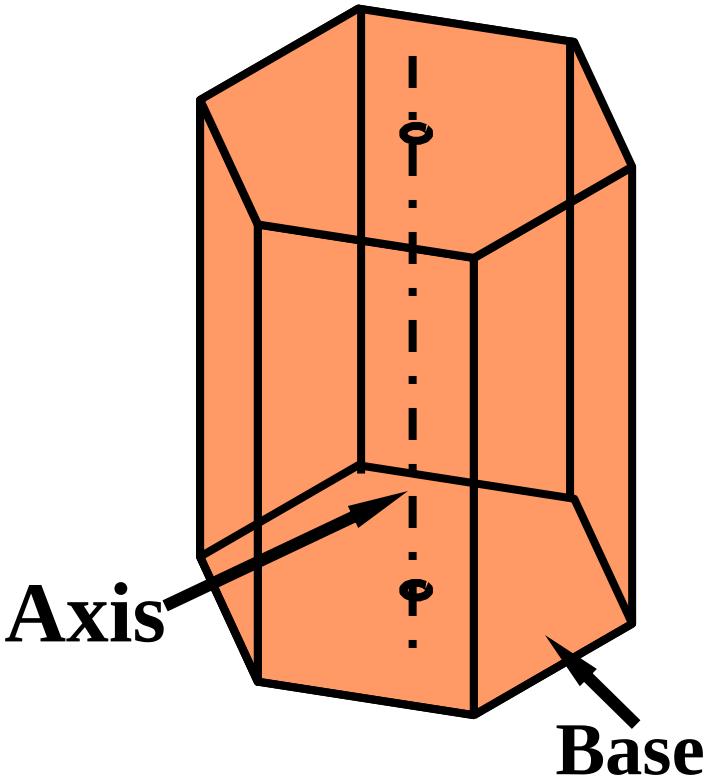
For *Cone and Pyramids*, Axis is an imaginary *line joining centre of the base to the Apex*.

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:

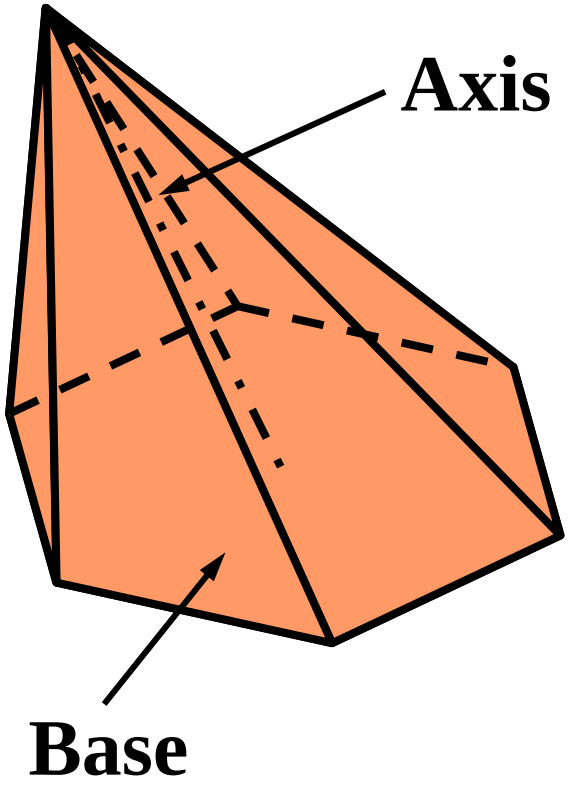
A solid is said to be a *Right Solid* if its <u>axis is perpendicular to its base.</u>



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.

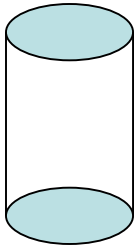


SOLIDS

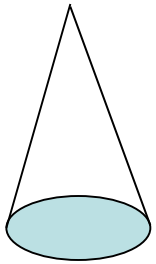
To understand and remember various solids in this subject properly, those are classified & arranged in to two major groups.

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.

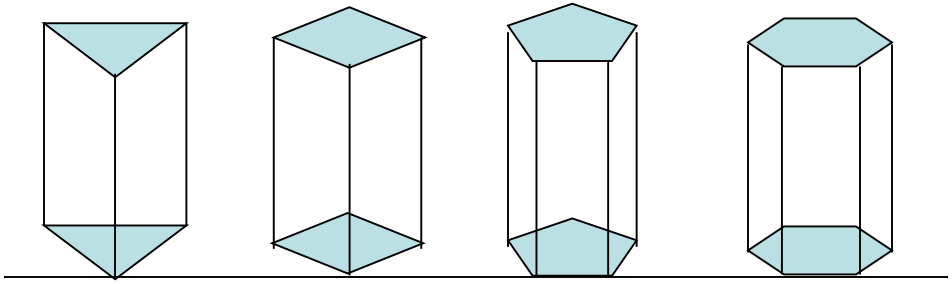
Cylinder



Cone

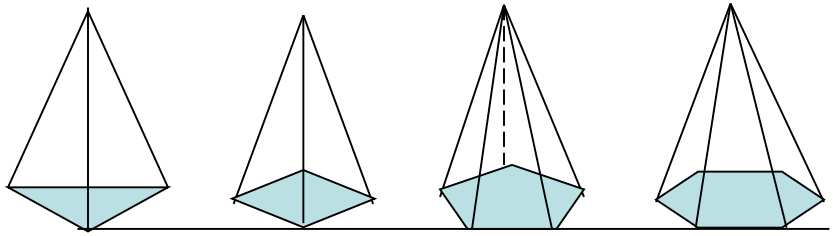


Prisms



Triangular Square Pentagonal Hexagonal

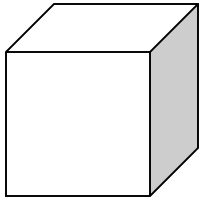
Pyramids



Triangular Square Pentagonal Hexagonal

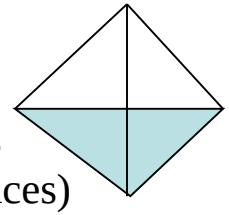
Cube

(A solid having six square faces)



Tetrahedron

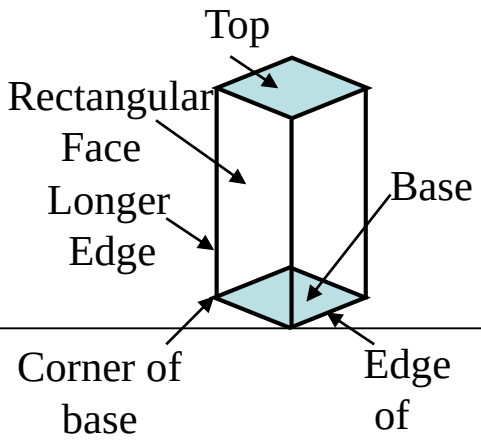
(A solid having Four triangular faces)



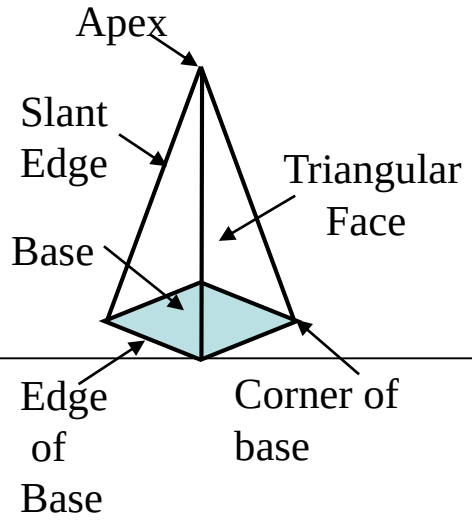
SOLIDS

Dimensional parameters of different solids.

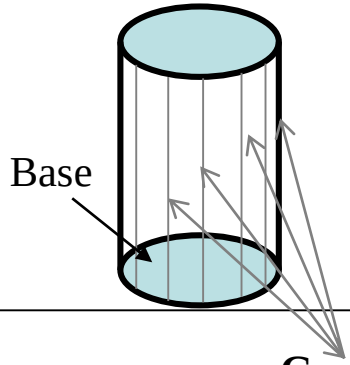
Square Prism



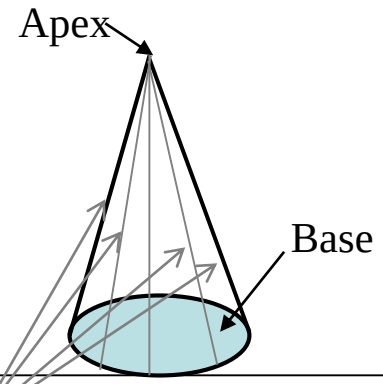
Square Pyramid



Cylinder

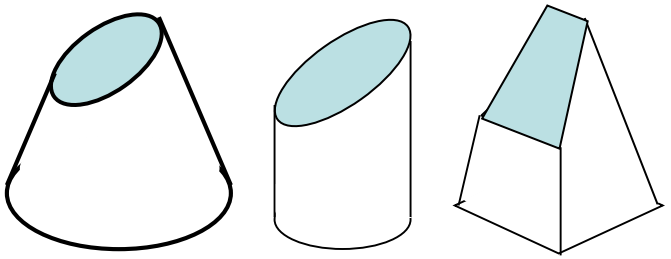


Cone

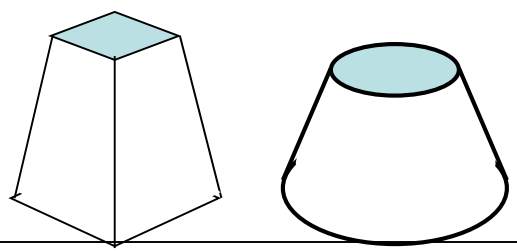


Generators

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)

Important Terms Used in Projections of Solids:

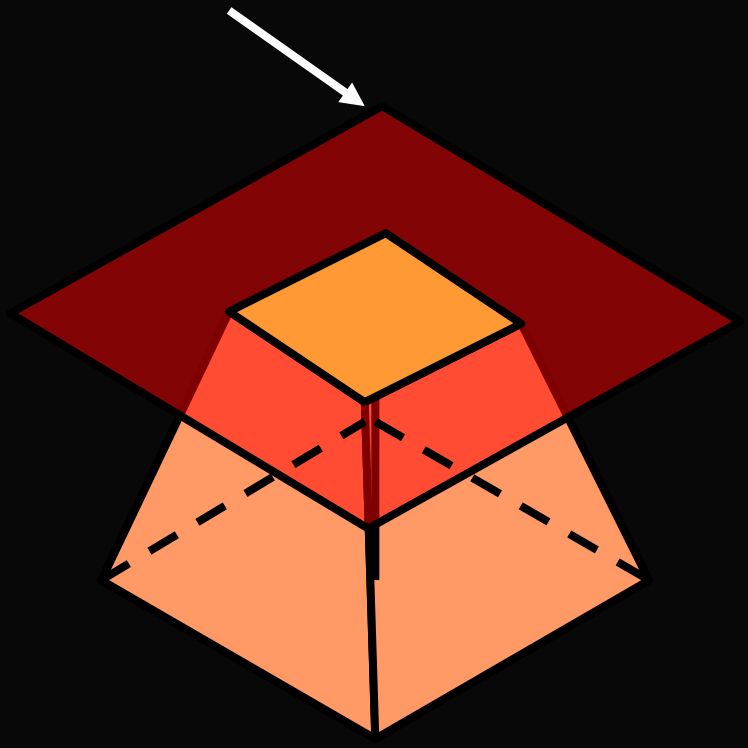
(6) Regular Solid:

A solid is said to be a *Regular Solid* if all the edges of the base or the end faces of a solid are equal in length and form regular plane figures

Important Terms Used in Projections of Solids:

(7) Frustum of Solid:

When a *Pyramid* or a *Cone* is cut by a <u>Plane</u> <u>parallel to its base</u>, thus removing the top portion, the <u>remaining</u> <u>*lower portion*</u> is called its frustum.



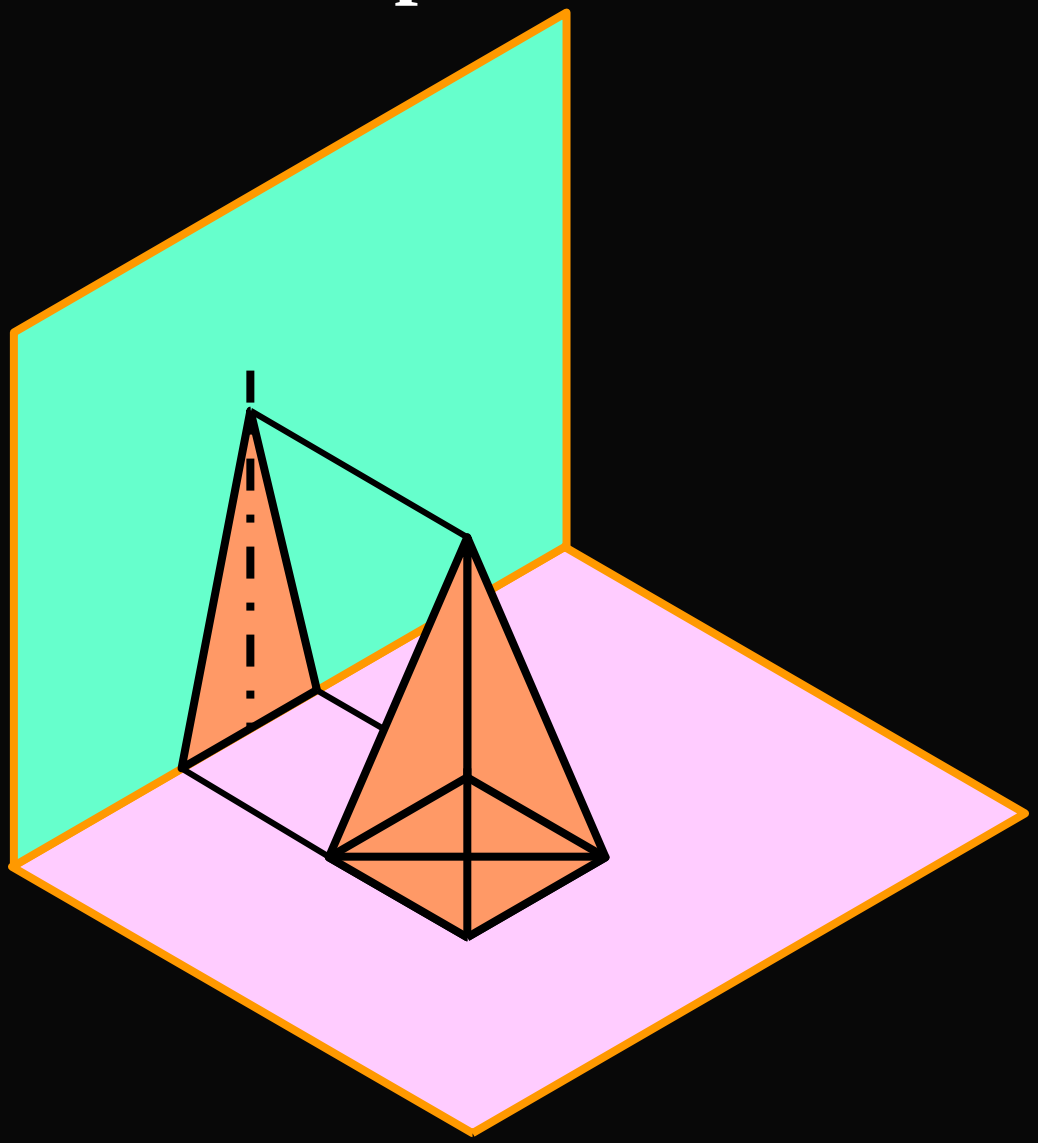
FRUSTUM OF A PYRAMID

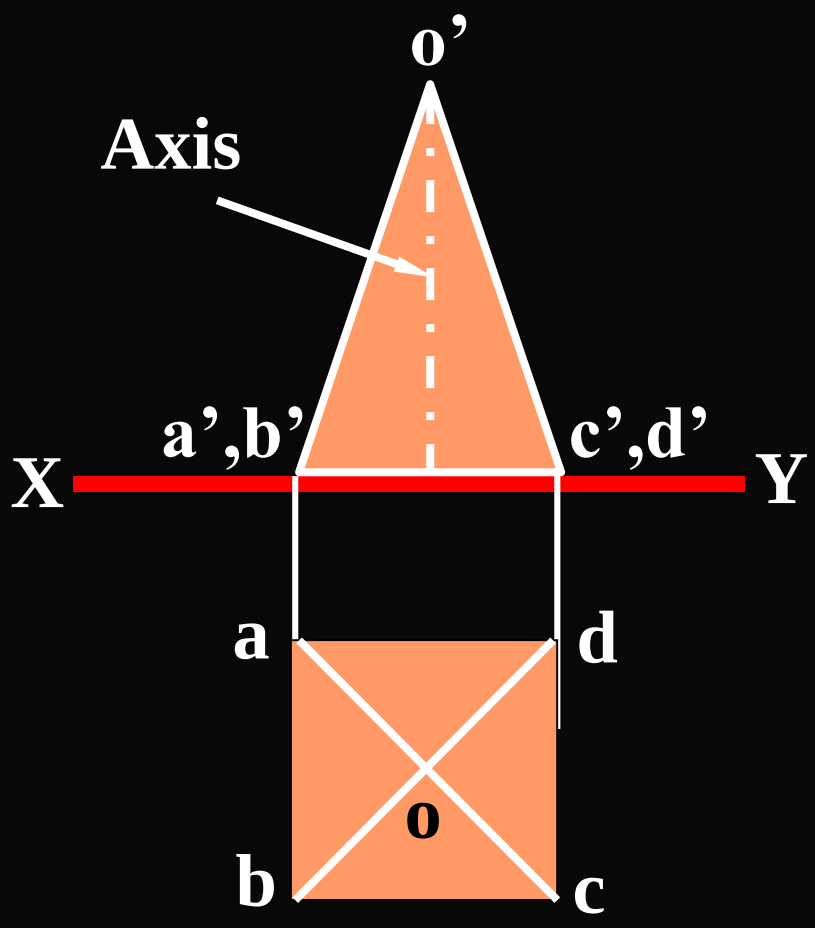
Important Terms Used in Projections of Solids:

(8) Truncated Solid :

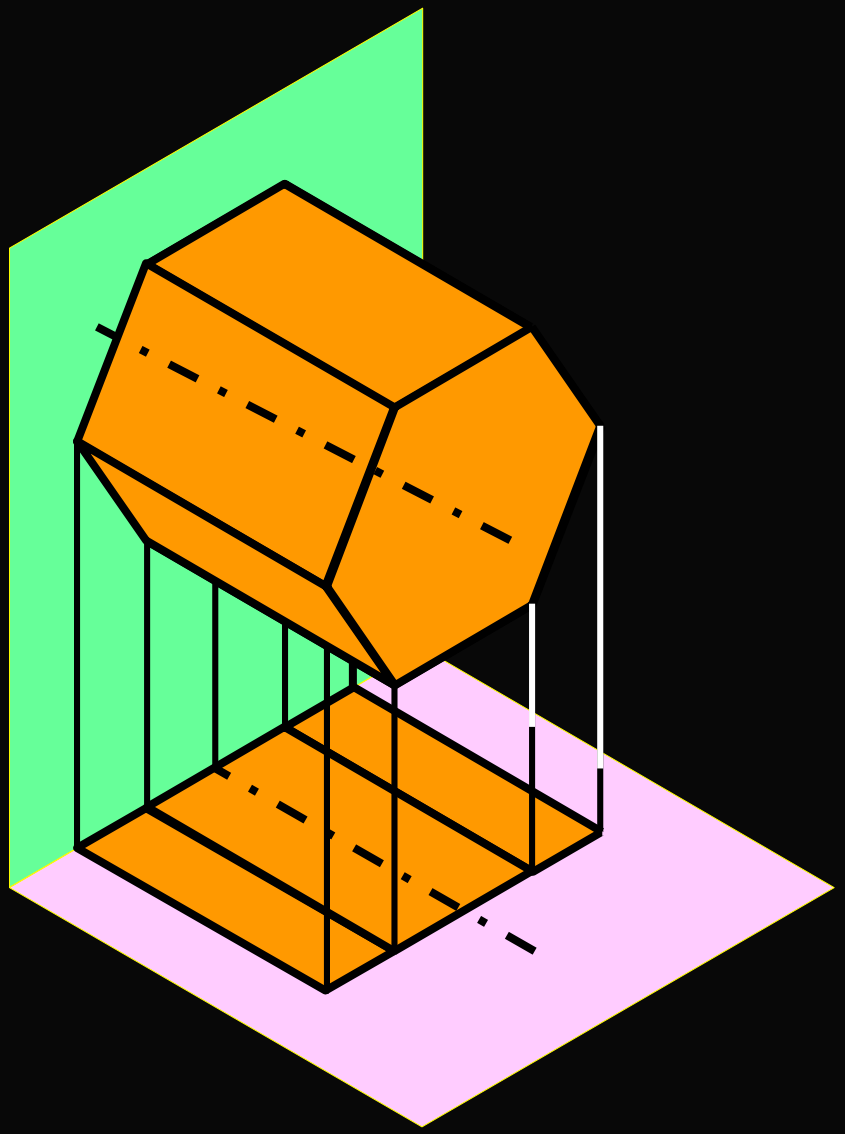
When a *Pyramid* or a *Cone* is cut by a Plane inclined to its base, thus removing the top portion, the remaining *lower portion* is said to be truncated.

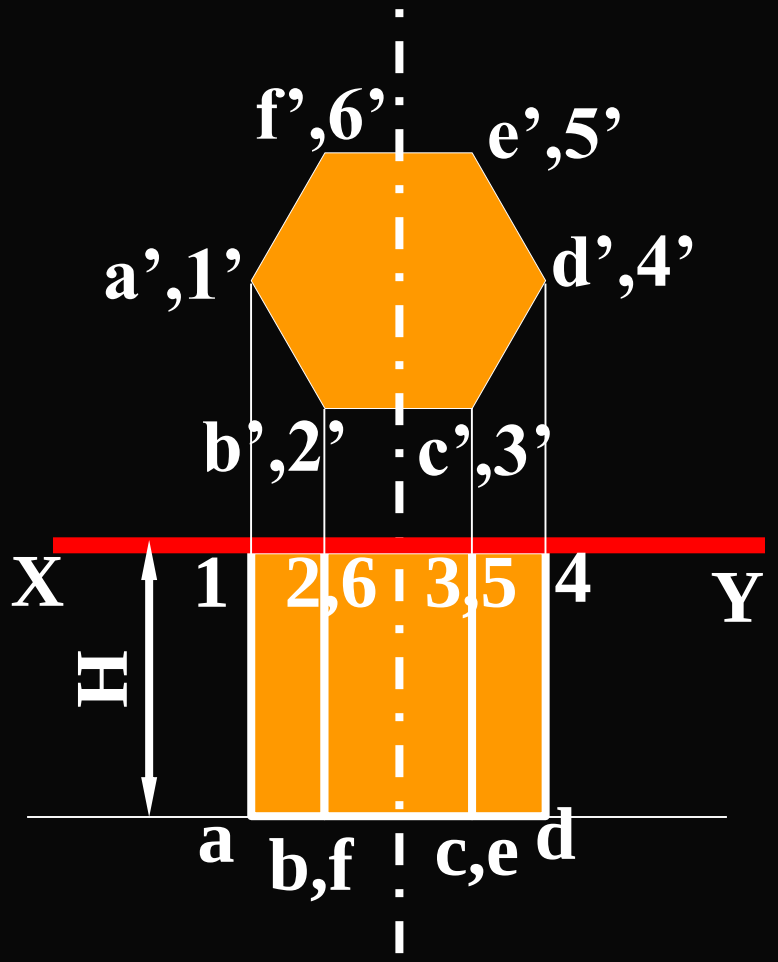
Class A(1): Axis perpendicular to H. P. and hence parallel to both V.P. & P.P.



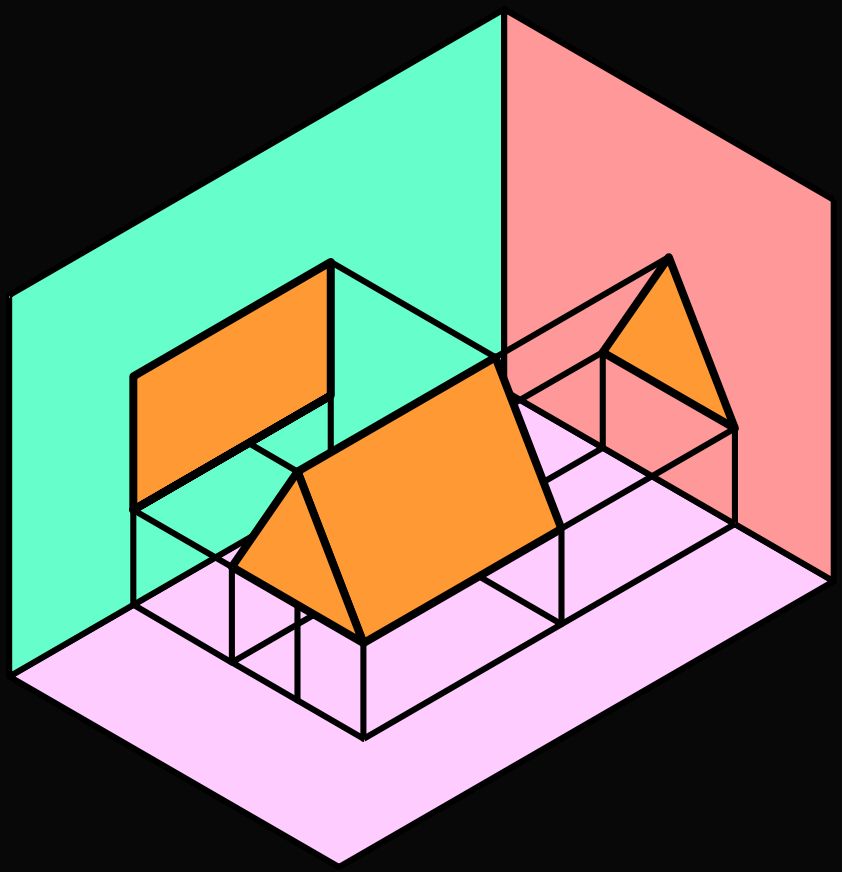


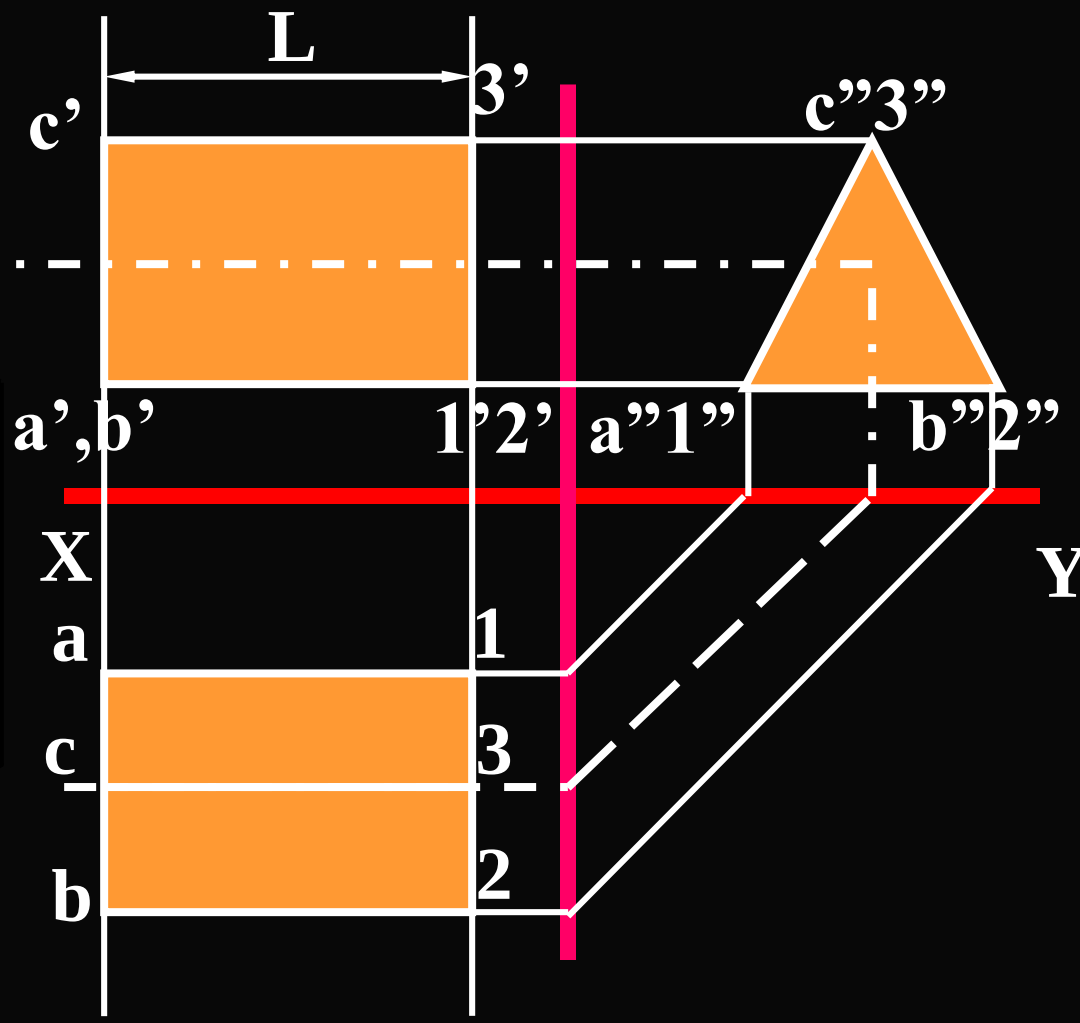
Class A(2): Axis perpendicular to V.P. and hence parallel to both H.P. & P.P.





Class A(3): Axis perpendicular to P.P. and hence parallel to both H.P. & V.P.

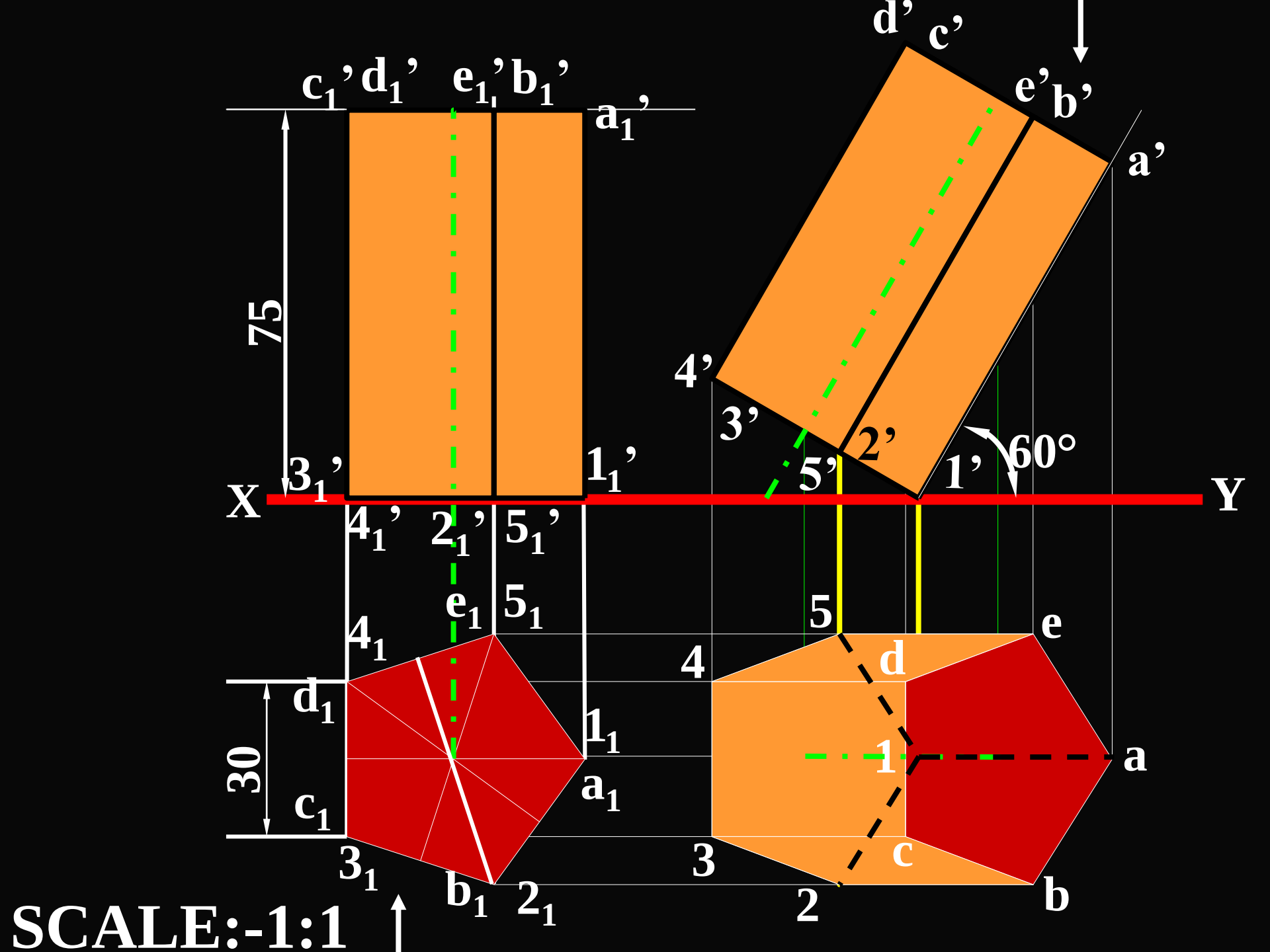


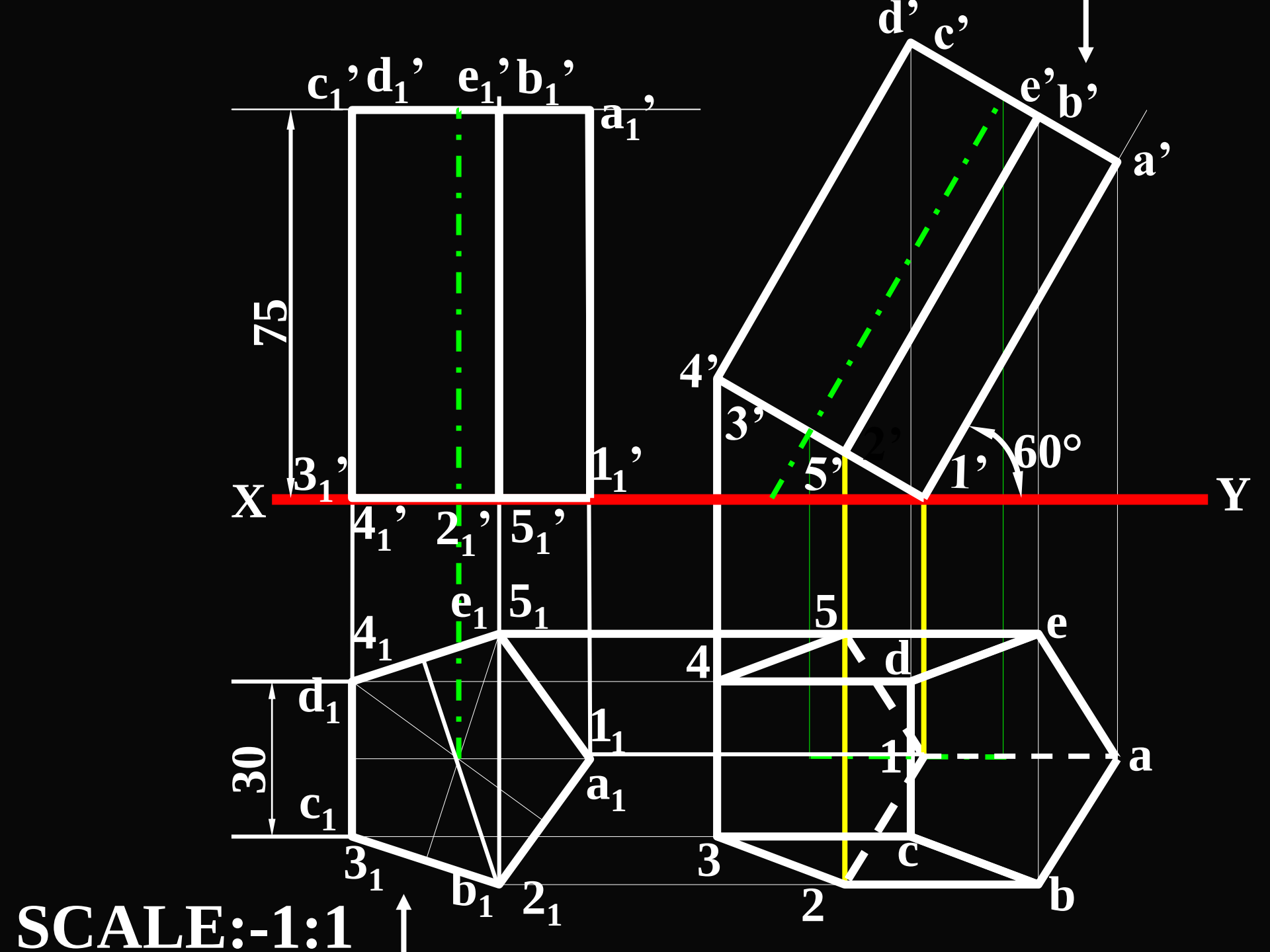


Class B(1): Axis parallel to V.P. and inclined to H.P. by θ & also inclined to P.P.

Exercise 1 :

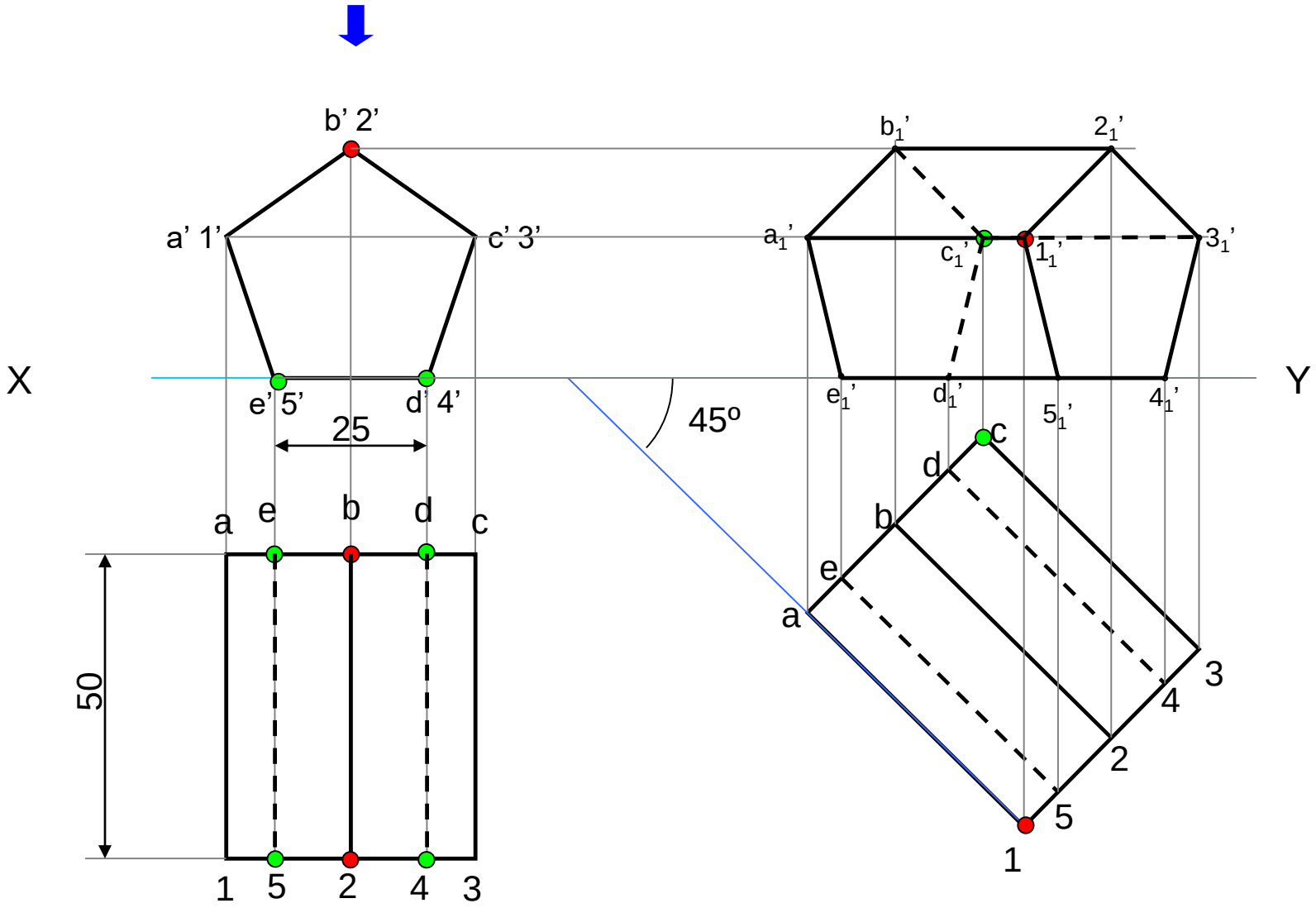
A right regular pentagonal prism, side of base 30 mm and height of axis as 75mm rests on HP on one of its base corners such that its long edge containing the corner is inclined to the HP at 60°. Draw its projections.


d’
c’
e’
b’
a’
c_1’ d_1’ e_1’ b_1’
a_1’
75
4’
3’
2’
1’
5’
60°
X
Y
3_1’
1_1’
4_1’ 2_1’ 5_1’
e_1
5_1
4_1
5
e
4
d
d_1
1_1
1
a
30
c_1
a_1
c
3_1
3
b_1
2_1
2
b
SCALE:-1:1


d’
c’
e’
b’
a’
c1’ d1’ e1’ b1’
a1’
75
4’
3’
2’
5’
1’
60°
X
Y
3 1’
1 1’
4 1’
2 1’
5 1’
e1
5 1
5
e
4 1
4
d
d1
1 1
1
a
30
a1
c1
c
3 1
3
b1
2 1
2
b
SCALE:-1:1

Q Draw the projections of a pentagonal prism , base 25 mm side and axis 50 mm long, resting on one of its rectangular faces on the H.P. with the axis inclined at 45º to the V.P.

As the axis is to be inclined with the VP, in the first view it must be kept perpendicular to the VP i.e. true shape of the base will be drawn in the FV with one side on XY line



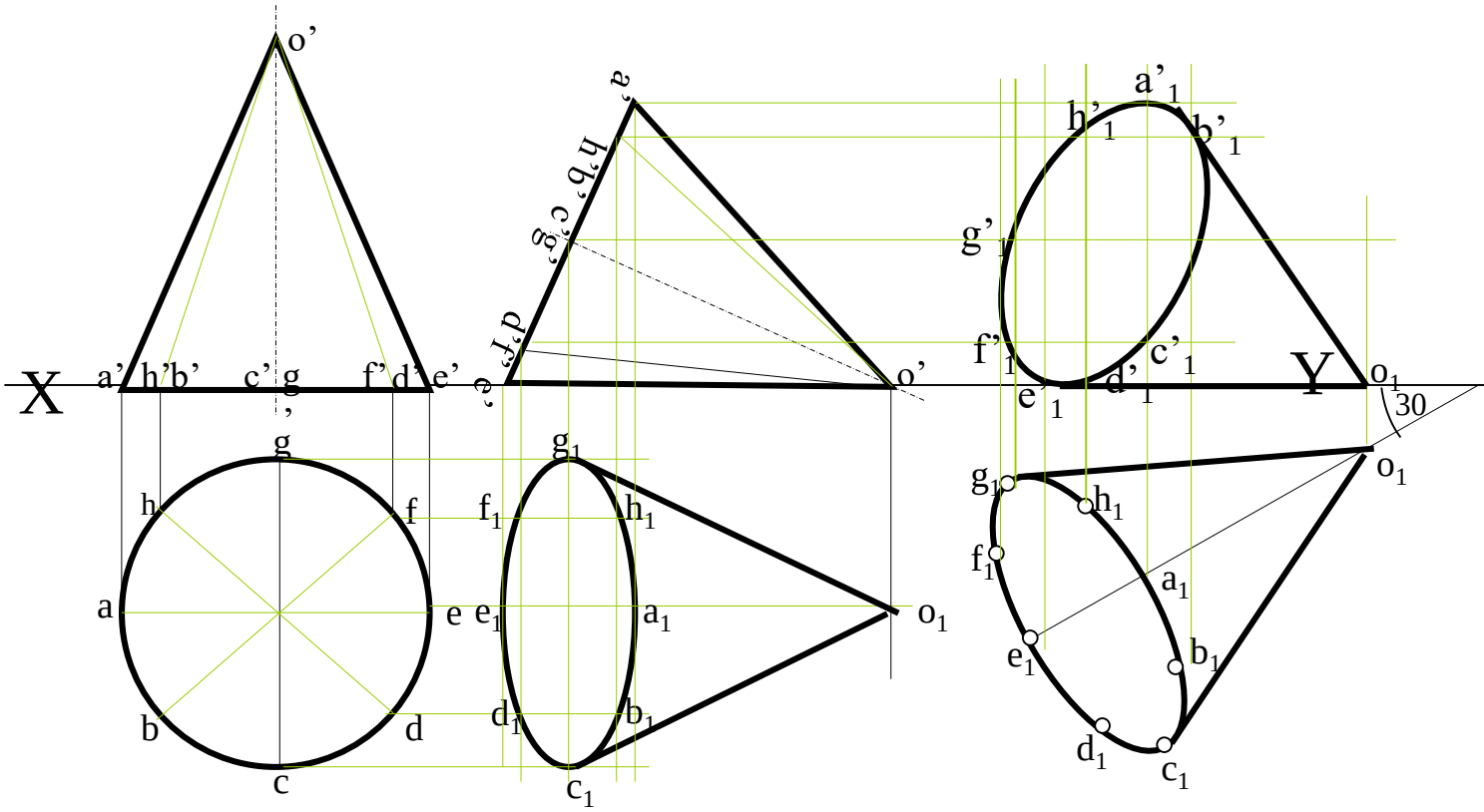
Problem 2:

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.

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.



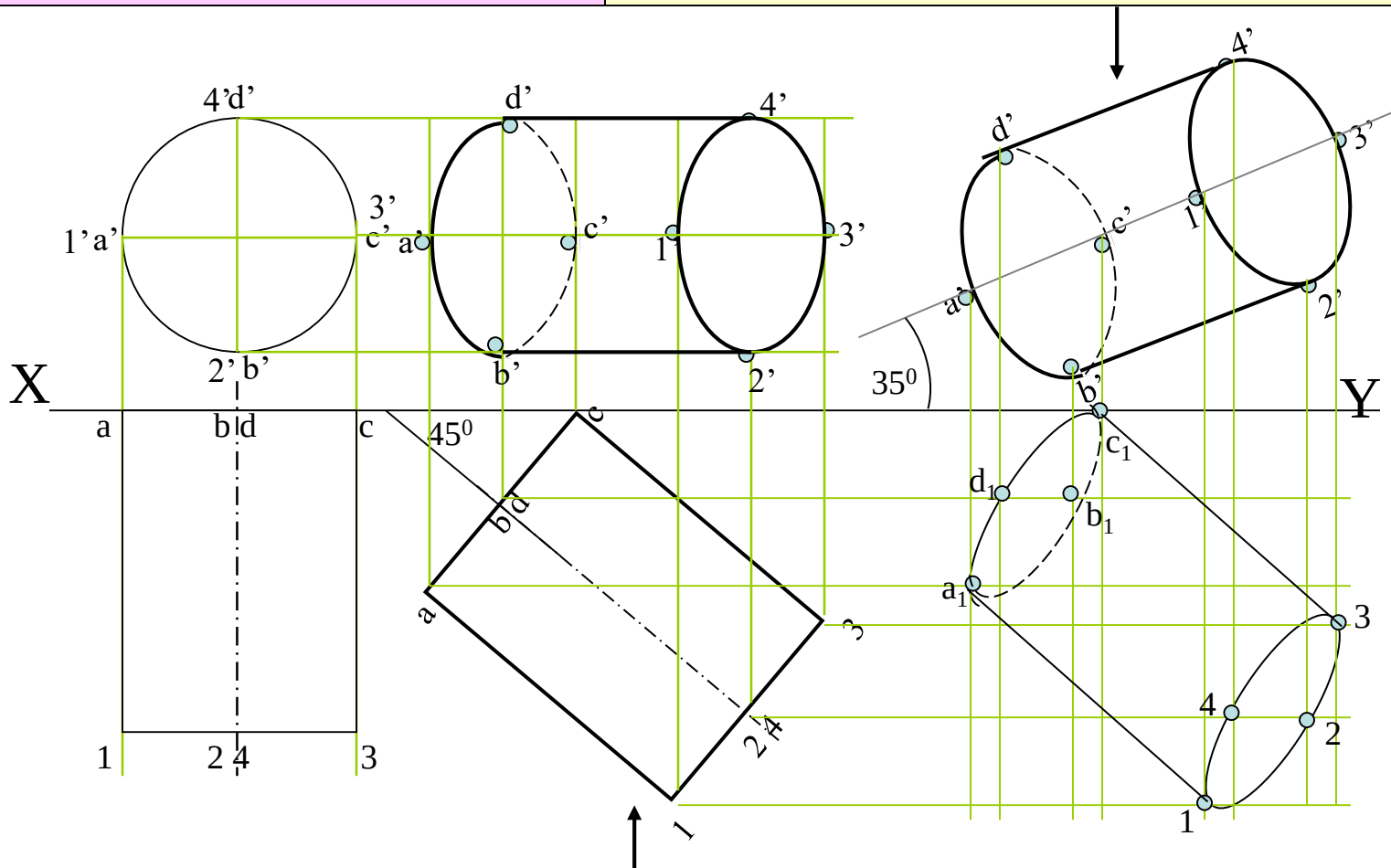
Problem 3:

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

Solution Steps:

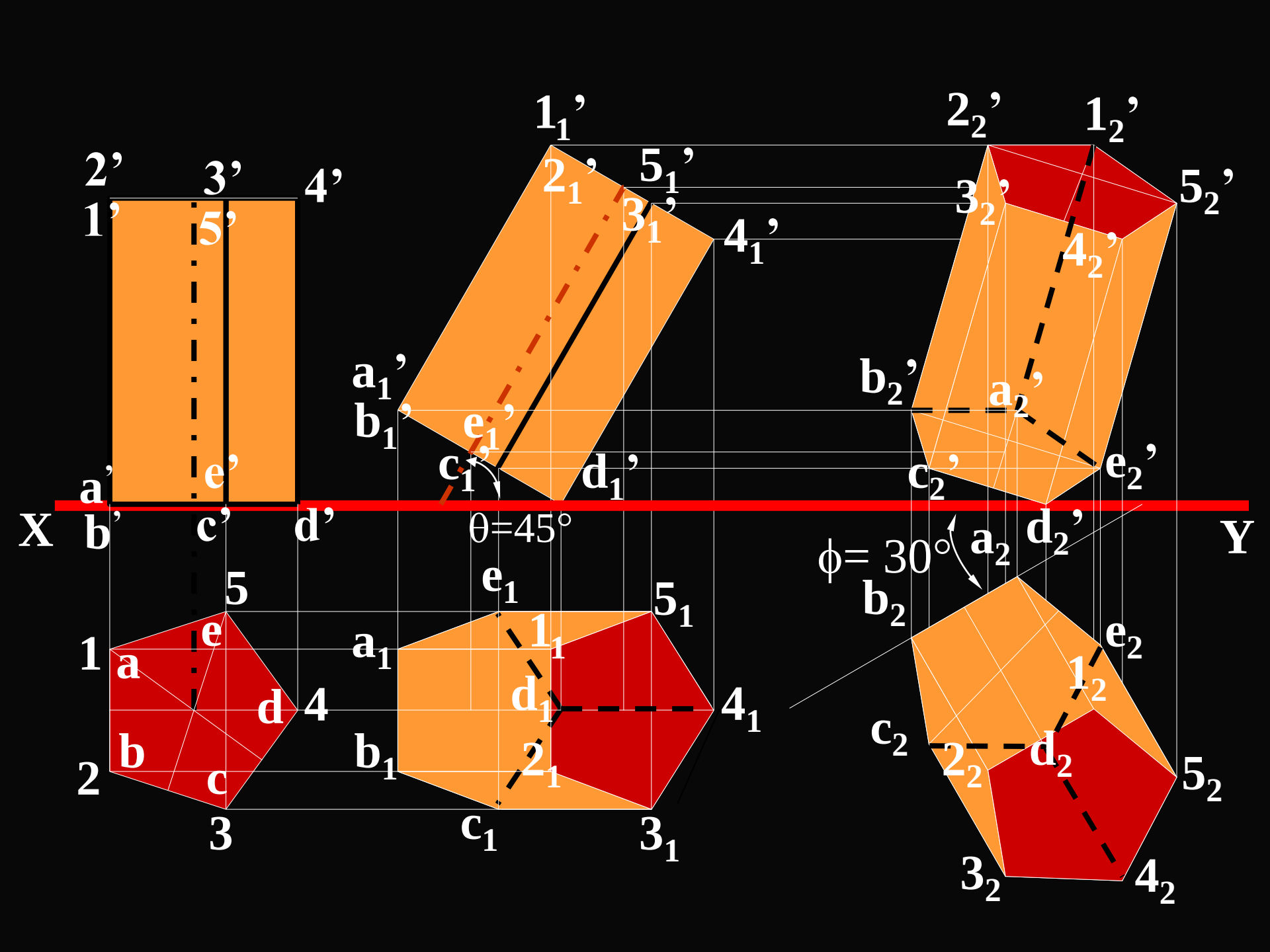
Resting on Vp on one point of base, means inclined to Vp:

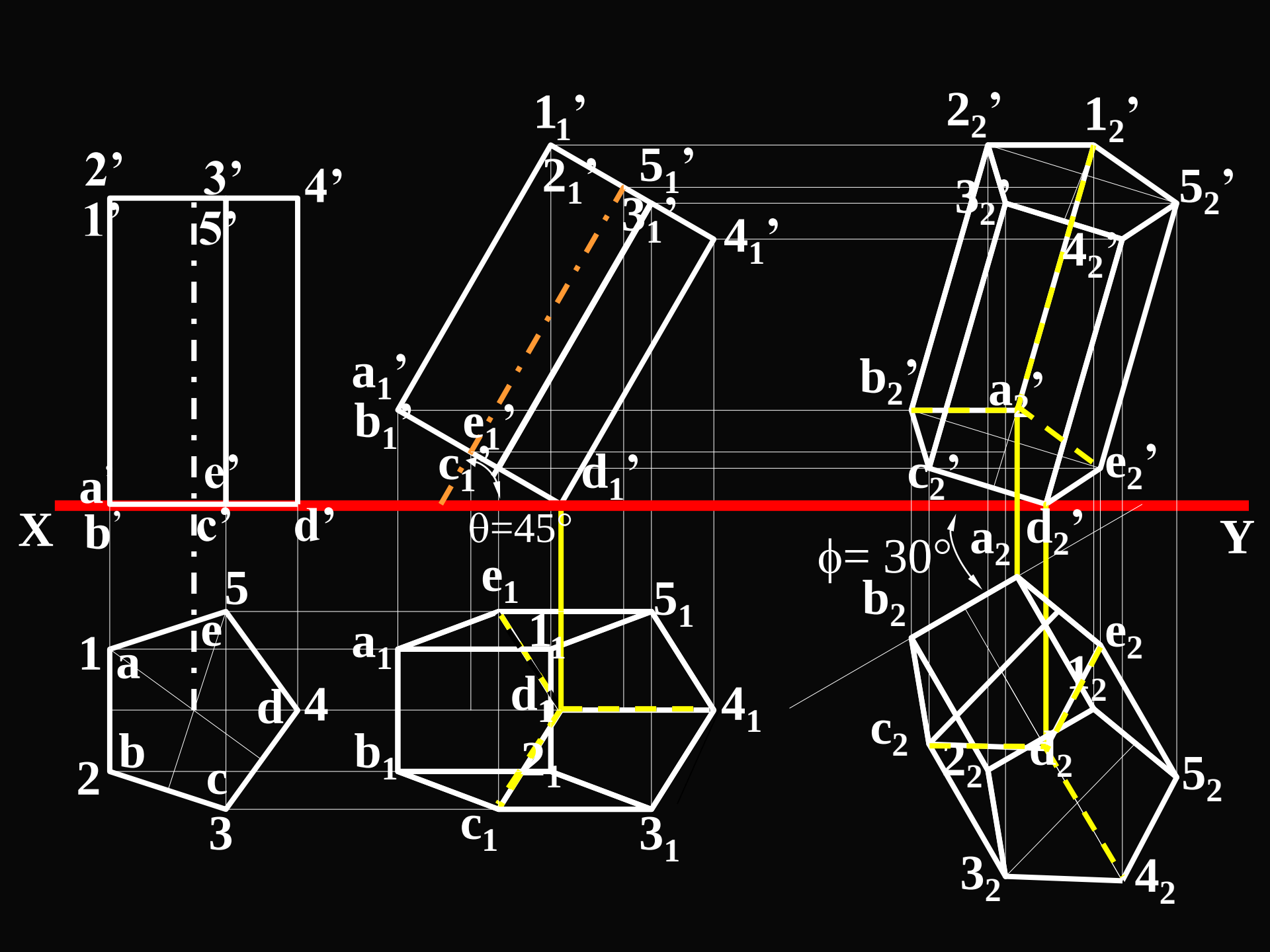
1. Assume it standing on Vp
2. It's Fv will show True Shape of base & top(circle)
3. Draw 40mm dia. Circle as Fv & taking 50 mm axis project Tv. (a Rectangle)
4. Name all points as shown in illustration.
5. Draw 2nd Tv making axis 45^0 to xy And project it's Fv above xy.
6. Make visible lines dark and 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.



Exercise 4 :

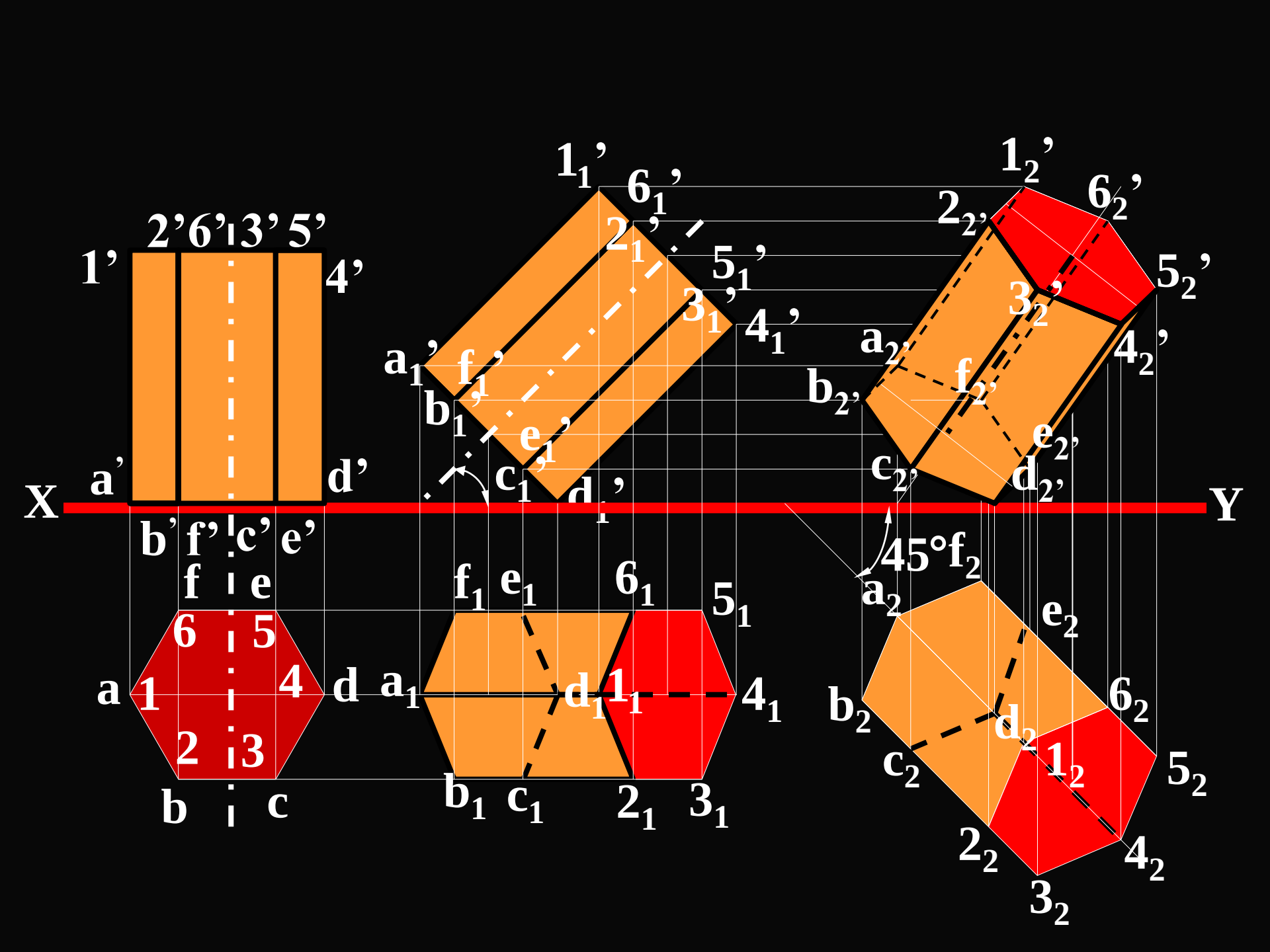
A regular pentagonal prism of 25mm long edges and axis 70mm long rests on HP on one of its corner of the base. The slant edge passing through corner makes 45° with HP and the side opposite to the same corner makes 30° with VP. Draw its projections.


2’
3’
4’
1’
5’
e’
a’
b’
c’
d’
X
Y
1₁’
2₁’
5₁’
3₁’
4₁’
a₁’
b₁’
e₁’
c₁’
d₁’
θ=45°
2₂’
1₂’
3₂’
5₂’
4₂’
b₂’
a₂’
c₂’
e₂’
d₂’
ϕ= 30°
5
e
1
a
d
4
b
2
c
3
e₁
5₁
1₁
a₁
d₁
4₁
b₁
2₁
c₁
3₁
a₂
b₂
e₂
1₂
c₂
2₂
d₂
5₂
3₂
4₂


2’
3’
4’
1’
5’
e’
a’
b’
c’
d’
X
1$_1$’
2$_1$’
5$_1$’
3$_1$’
4$_1$’
a$_1$’
b$_1$’
e$_1$’
c$_1$’
d$_1$’
θ=45°
2$_2$’
1$_2$’
5$_2$’
3$_2$’
4$_2$’
b$_2$’
a$_2$’
c$_2$’
e$_2$’
d$_2$’
Y
ϕ= 30°
5
e
1
a
d
4
b
2
c
3
e$_1$
5$_1$
1$_1$
a$_1$
d$_1$
4$_1$
b$_1$
2$_1$
c$_1$
3$_1$
a$_2$
b$_2$
e$_2$
1$_2$
c$_2$
2$_2$
d$_2$
5$_2$
3$_2$
4$_2$

Exercise 5 :

A regular hexagonal prism of 30mm sides and axis 80mm long is resting on HP on one of its corners of the base. The axis makes 30° with HP and plan of the axis makes 45° with the VP. Draw its projections.


1’ 2’6’3’ 5’ 4’ a’ d’ b’ f’ c’ e’
X Y
f e 6 5 a 1 4 d 2 3 b c
1_1’ 6_1’ 2_1’ 5_1’ 3_1’ 4_1’ a_1’ f_1’ b_1’ e_1’ c_1 d_1’
f_1 e_1 6_1 5_1 a_1 d_1 1_1 4_1 b_1 c_1 2_1 3_1
1_2’ 6_2’ 2_2’ 5_2’ 3_2’ 4_2’ a_2’ f_2’ b_2’ e_2’ c_2’ d_2’
45° f_2 a_2 e_2 b_2 6_2 d_2 1_2 5_2 c_2 2_2 4_2 3_2

Exercise 6 :

A square pyramid, side of base 50mm and height 64mm, is freely suspended from one of the corners of the base. Draw its projections when vertical plane containing axis makes an angle of 45° with the VP.