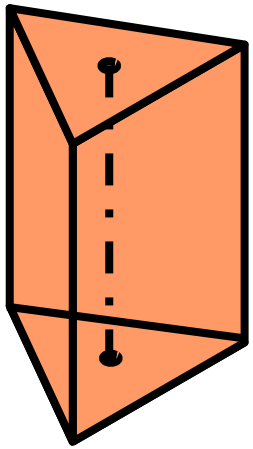
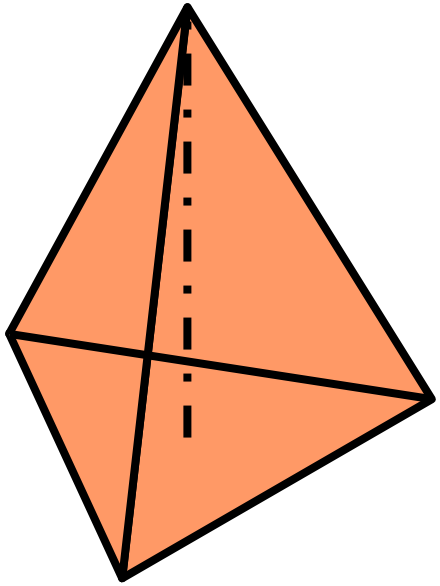
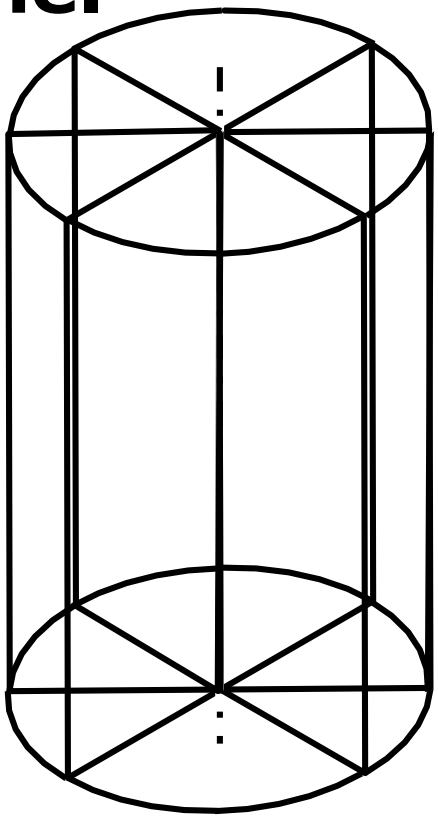
PROJECTIONS OF SOLIDS

What is a 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.







PROJECTIONS OF SOLIDS

-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: Eight equal equilateral triangles as faces

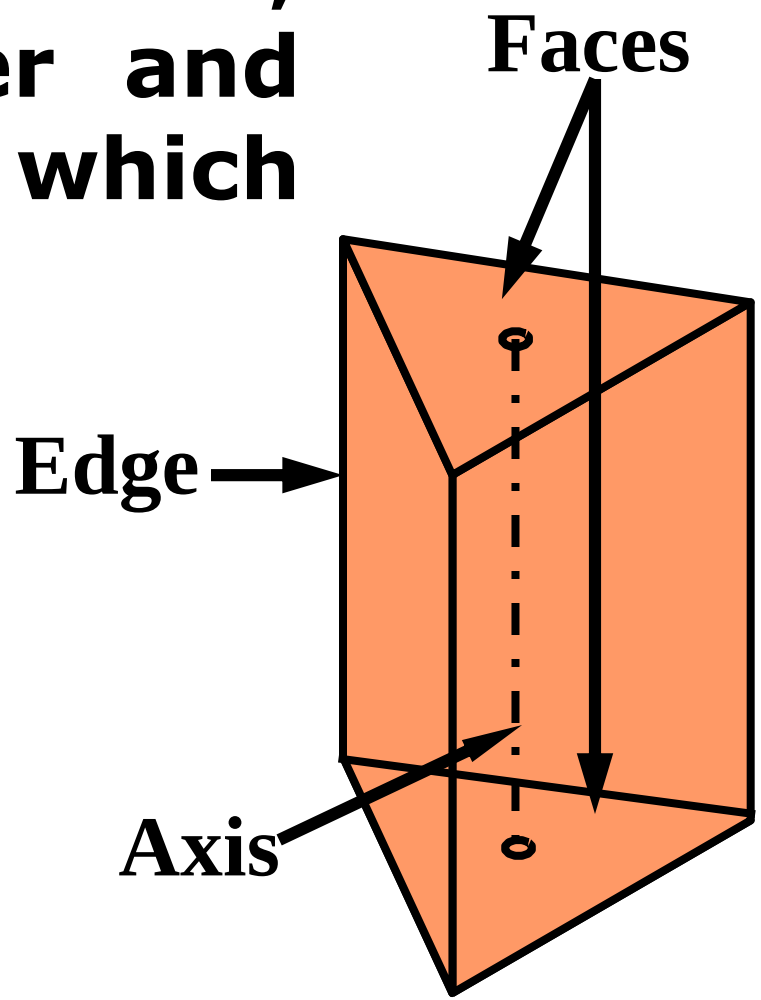
(6) Dodecahedron: Twelve equal and regular pentagons as faces

(7) Icosahedron: Twenty faces all equal equilateral triangles

(1) Prism:

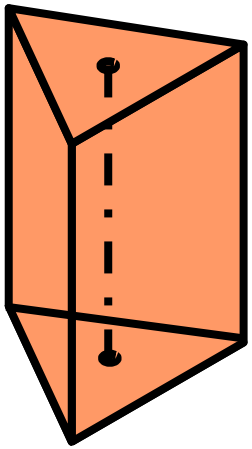
It is a polyhedra having *two equal and similar faces* called its ends or bases, parallel to each other and joined by other faces which are *rectangles*.

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

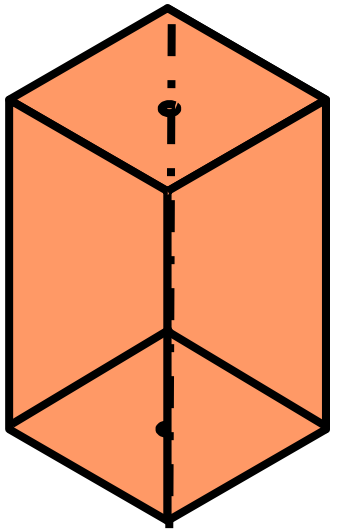


According to the shape of its base, prism can be sub classified into following types:

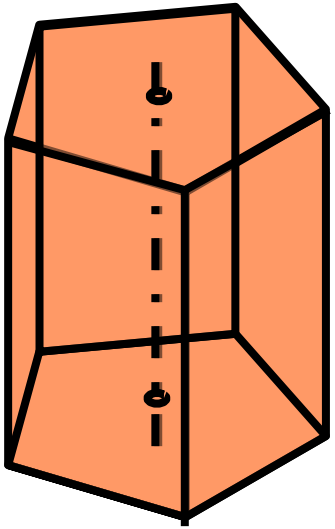
(a) Triangular Prism:



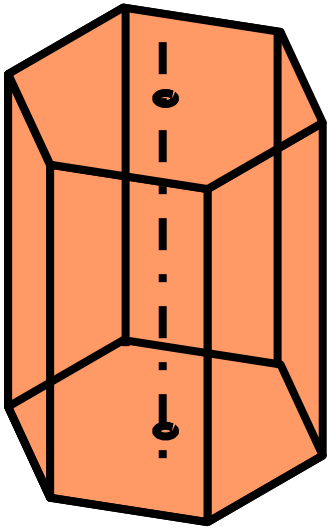
(b) Square Prism:



(c) Pentagonal Prism:



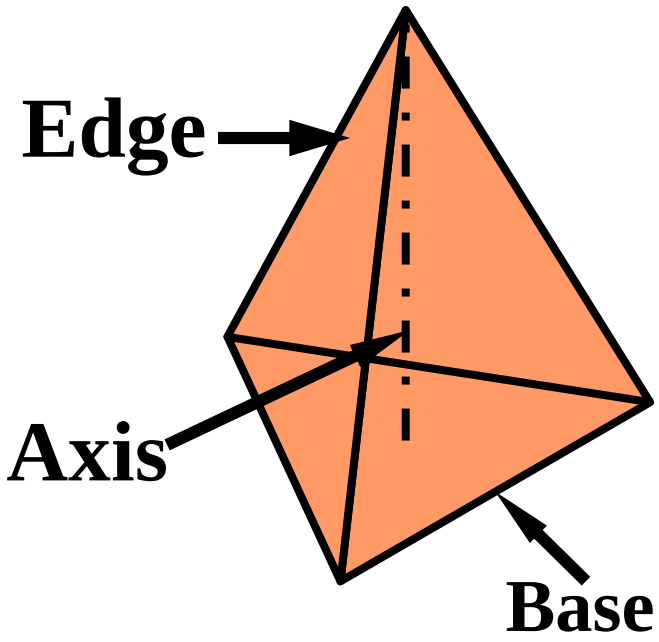
(d) Hexagonal Prism:



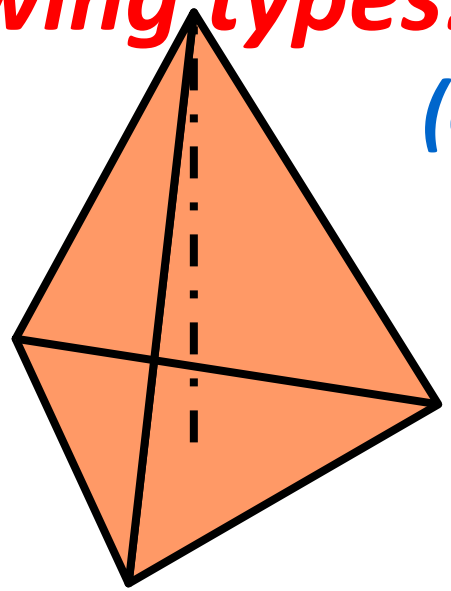
(2) Pyramid:

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.

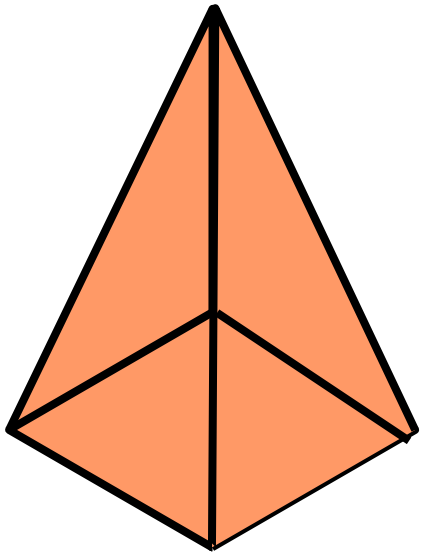


According to the shape of its base, pyramid can be sub classified into following types:

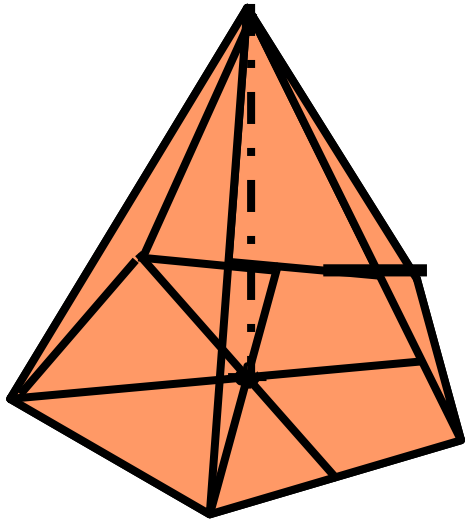


(a) Triangular Pyramid:

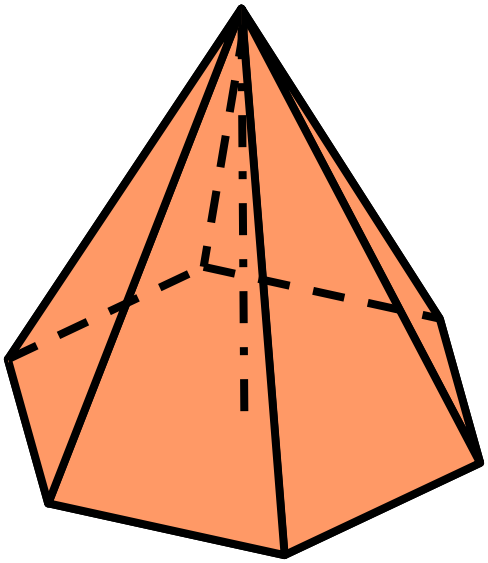
(b) Square Pyramid:



(c) Pentagonal Pyramid:



(d) Hexagonal Pyramid:



(B) Solids of Revolutions:

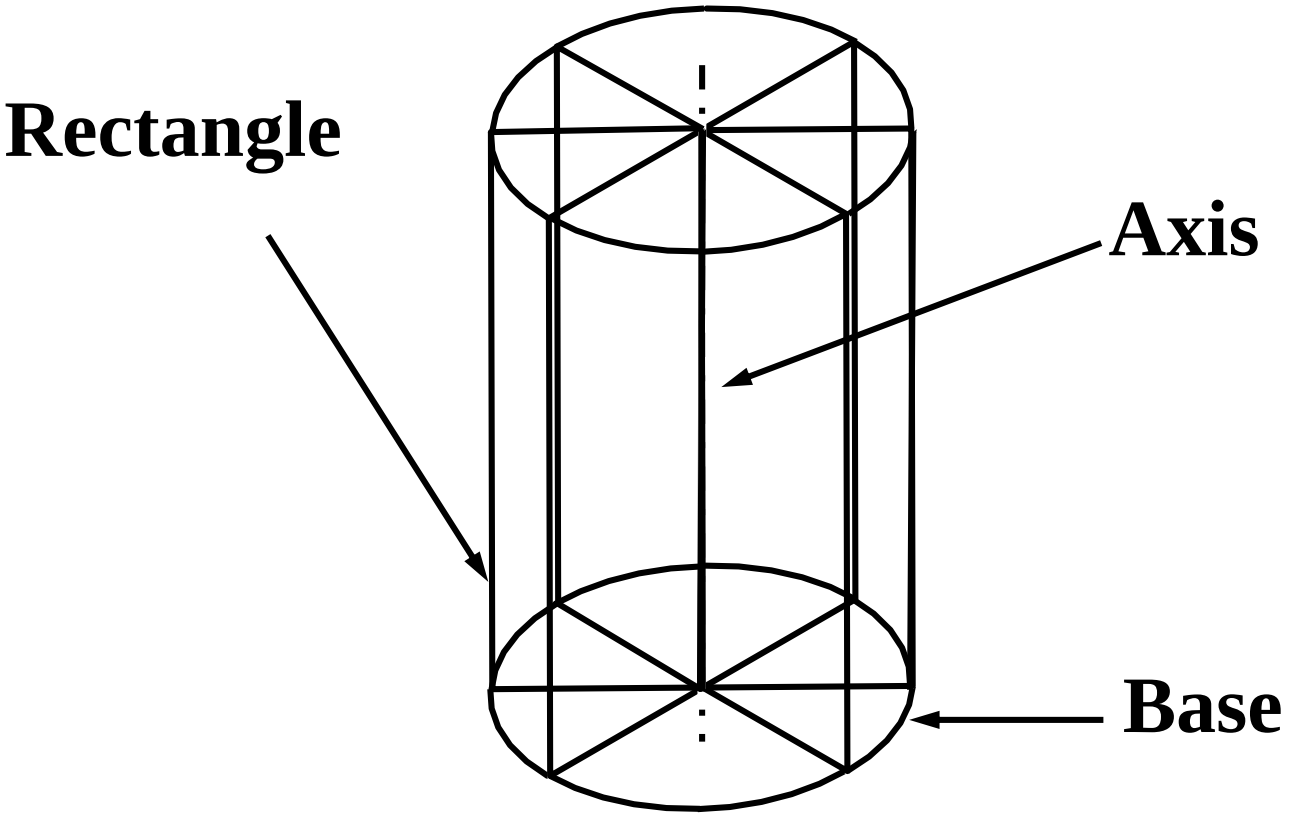
When a solid is generated by revolutions of a plane figure about a fixed line (Axis) then such solids are named as *solids of revolution*.

Solids of revolutions may be of following types;

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

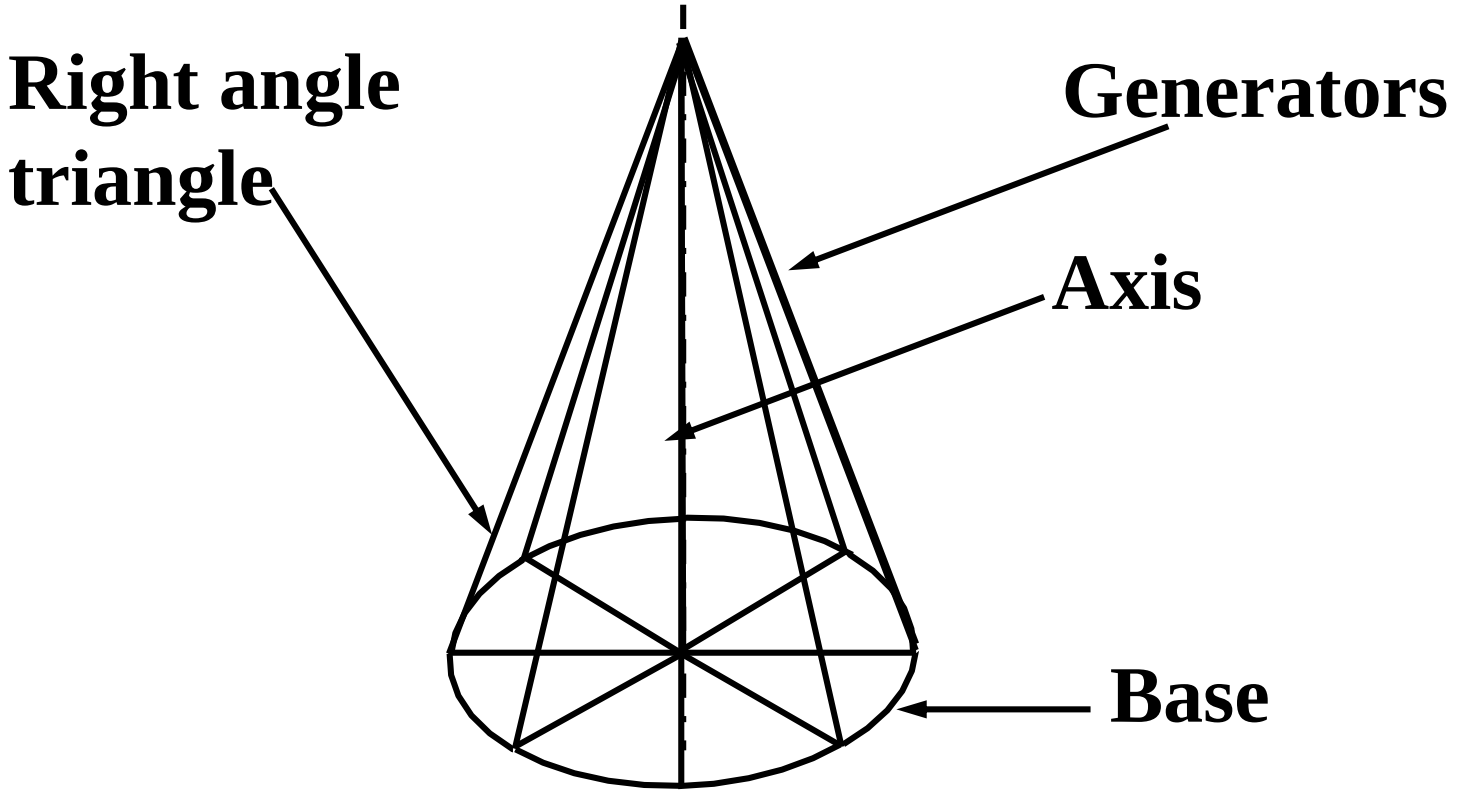
(1) Cylinder:

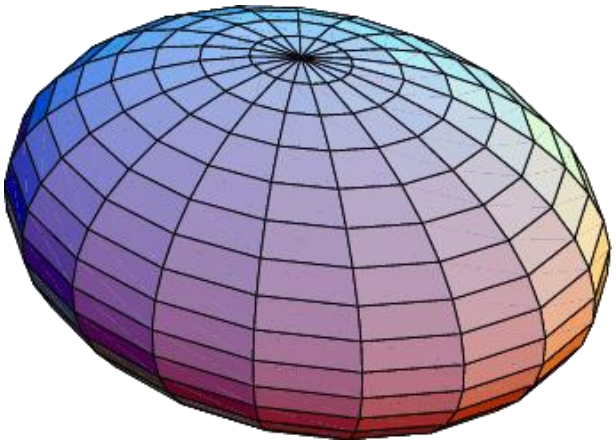
A right circular cylinder is a solid generated by the revolution of a rectangle about its vertical side which remains fixed.



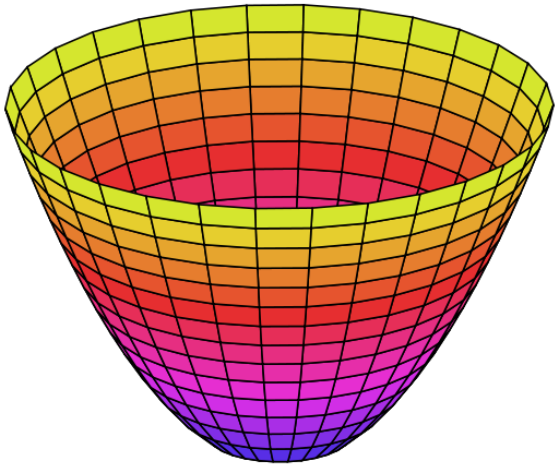
(2) Cone:

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

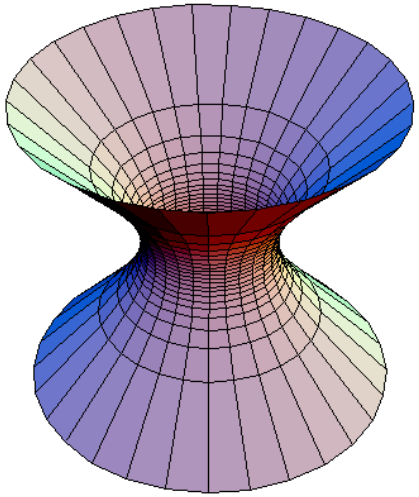




Ellipsoid



Paraboloid



Hyperboloid

Important Terms Used in Projections of Solids:

(1) Edge or generator:

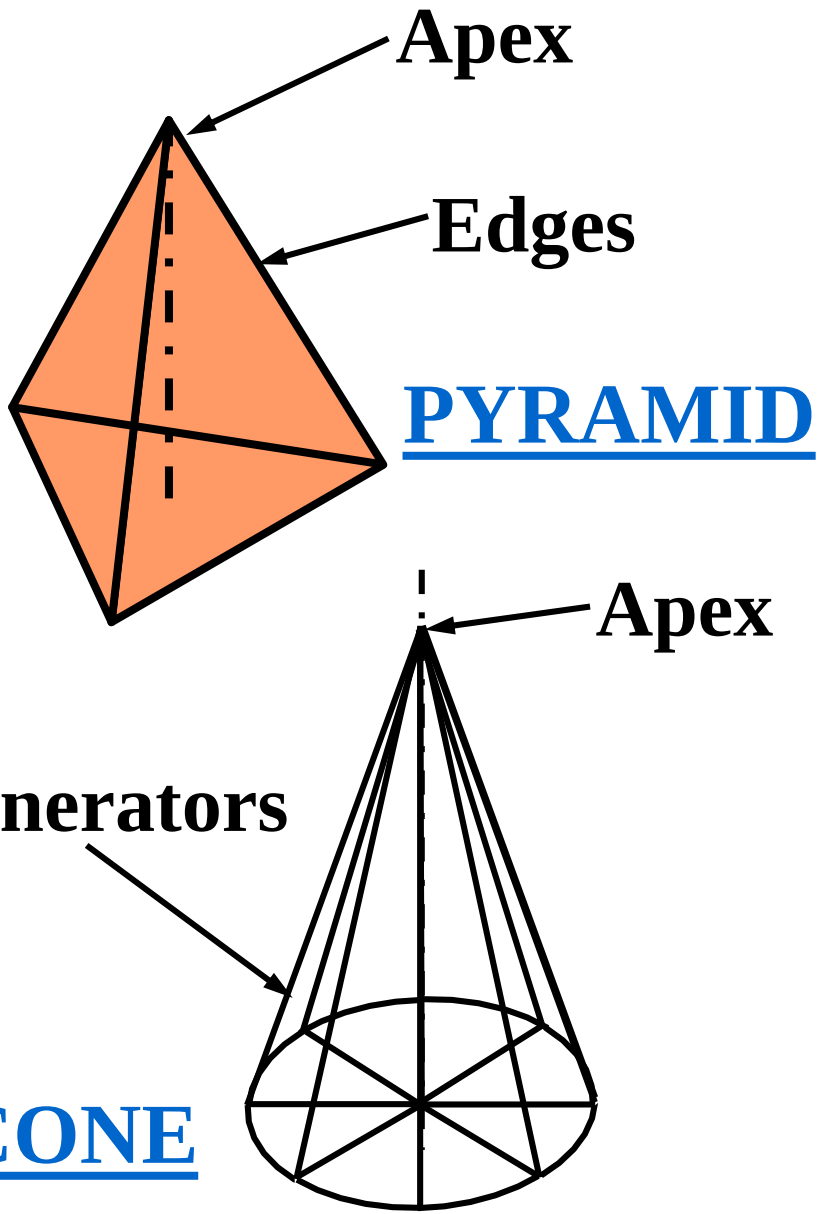
For *Pyramids* & *Prisms*, edges are the lines separating the triangular faces or rectangular faces from each other.

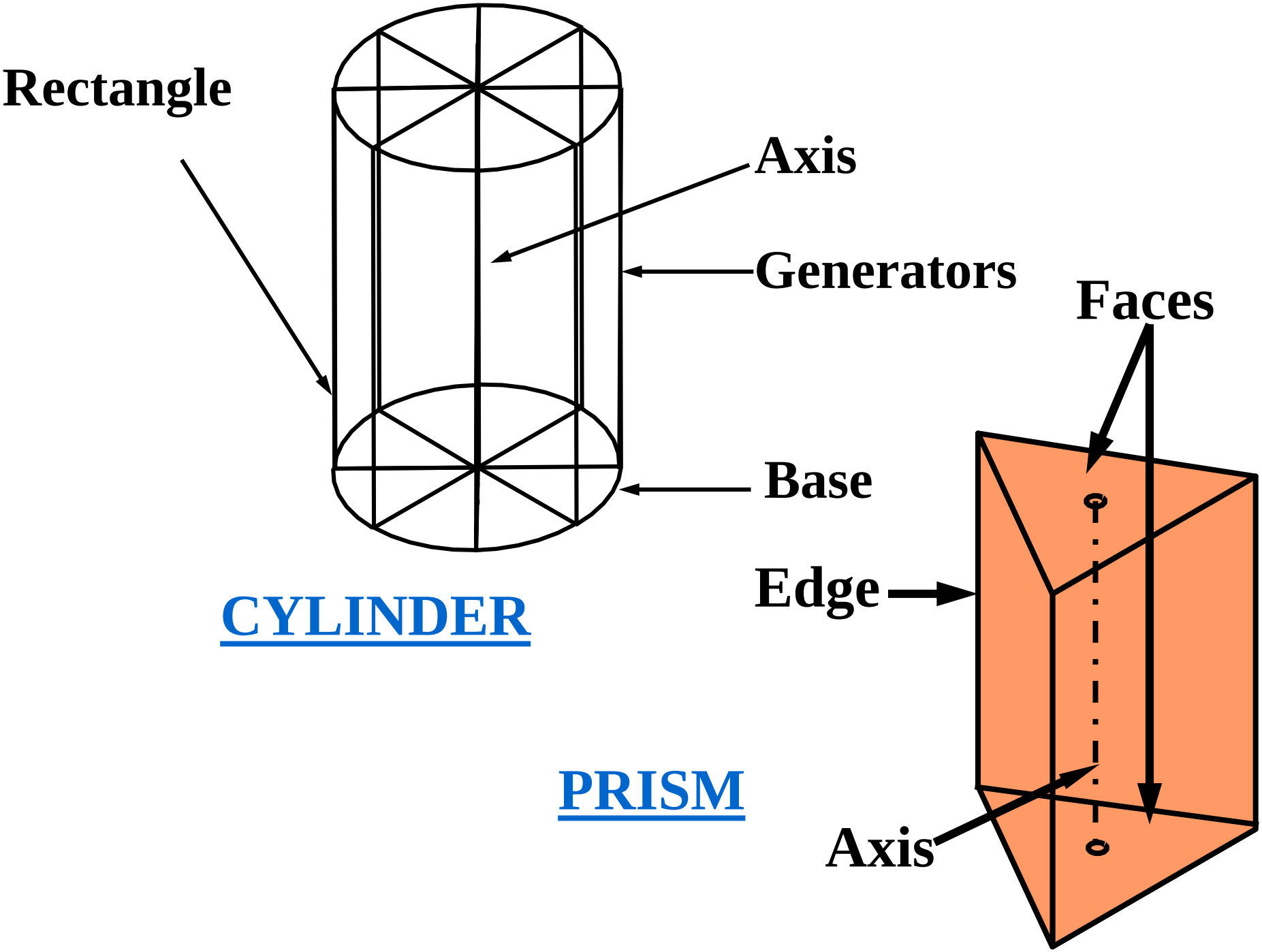
For *Cylinder*, generators are the straight lines joining different points on the circumference of the bases with each other

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:

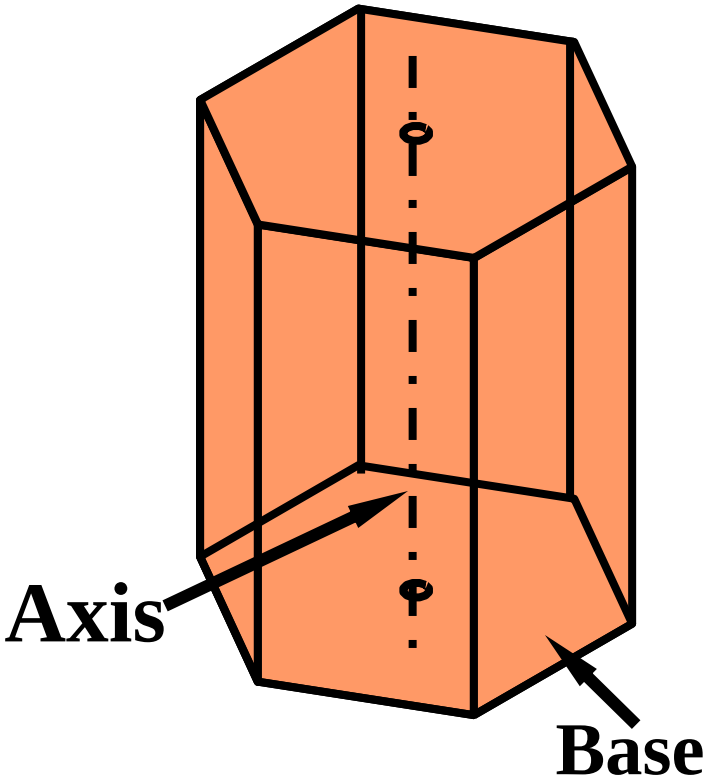
For *Cone and Pyramids*, Axis is an imaginary *line joining centre of the base to the Apex*.

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:

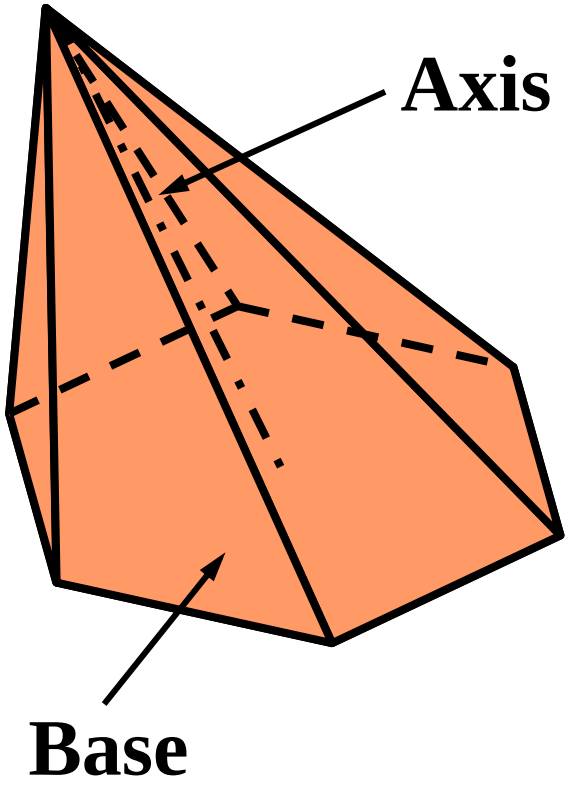
A solid is said to be a *Right Solid* if its <u>axis is perpendicular to its base.</u>



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.



Important Terms Used in Projections of Solids:

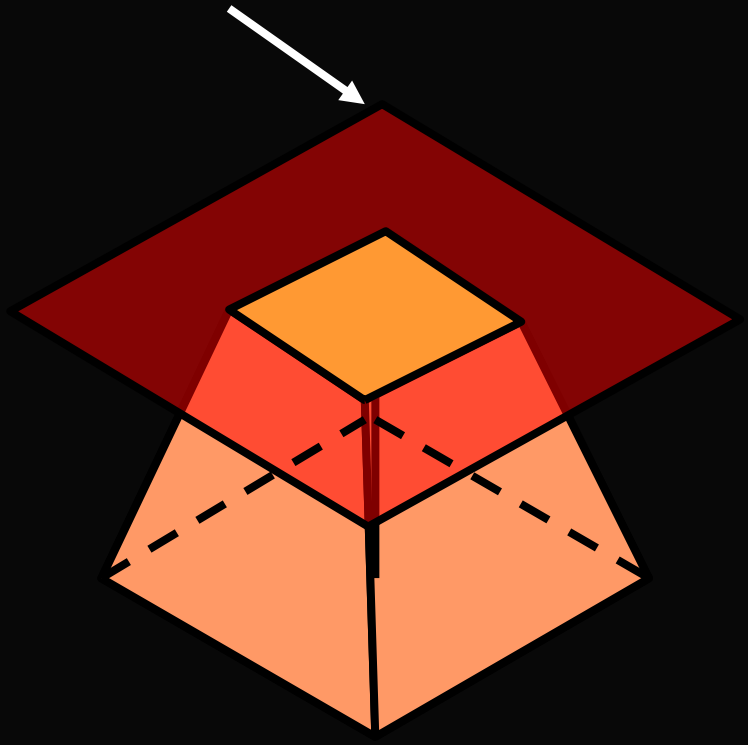
(6) Regular Solid:

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:

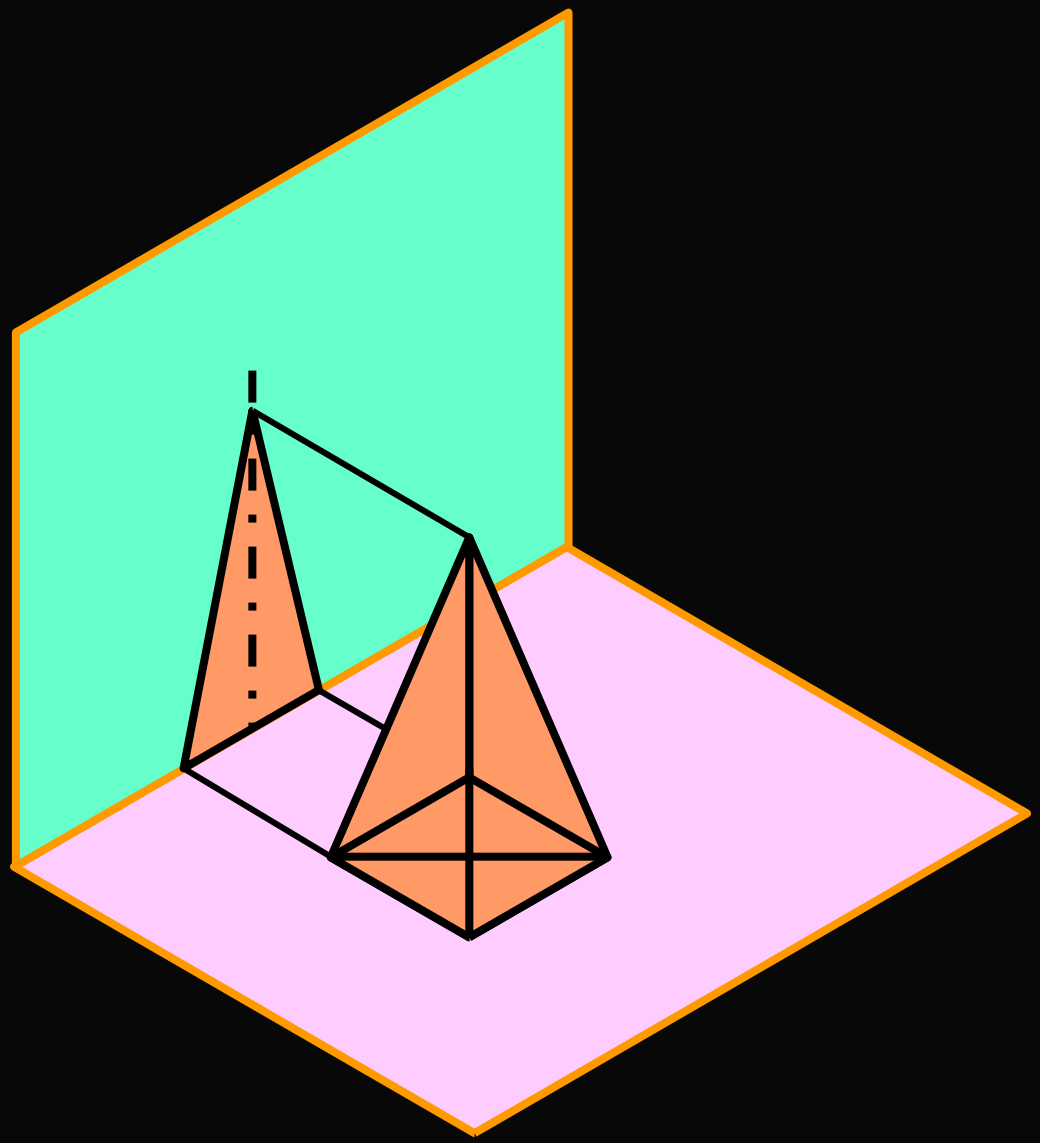
(8) Truncated Solid :

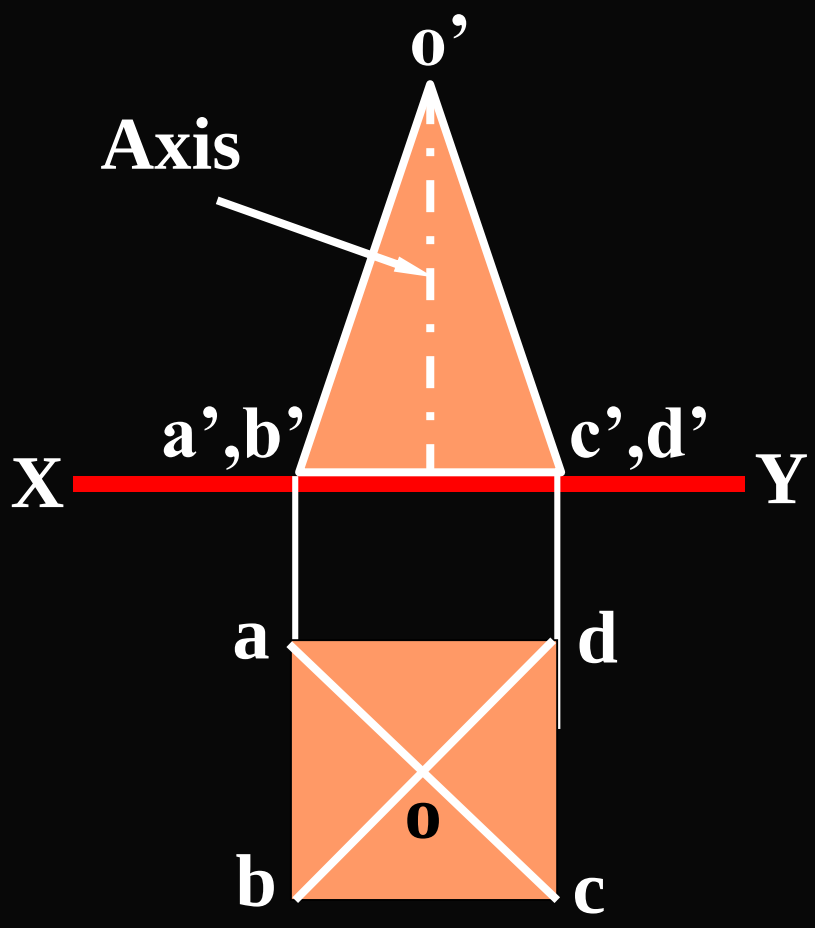
When a *Pyramid* or a *Cone* is cut by a Plane inclined to its base, thus removing the top portion, the remaining *lower portion* is said to be truncated.

Projection of Solid in Simple Position

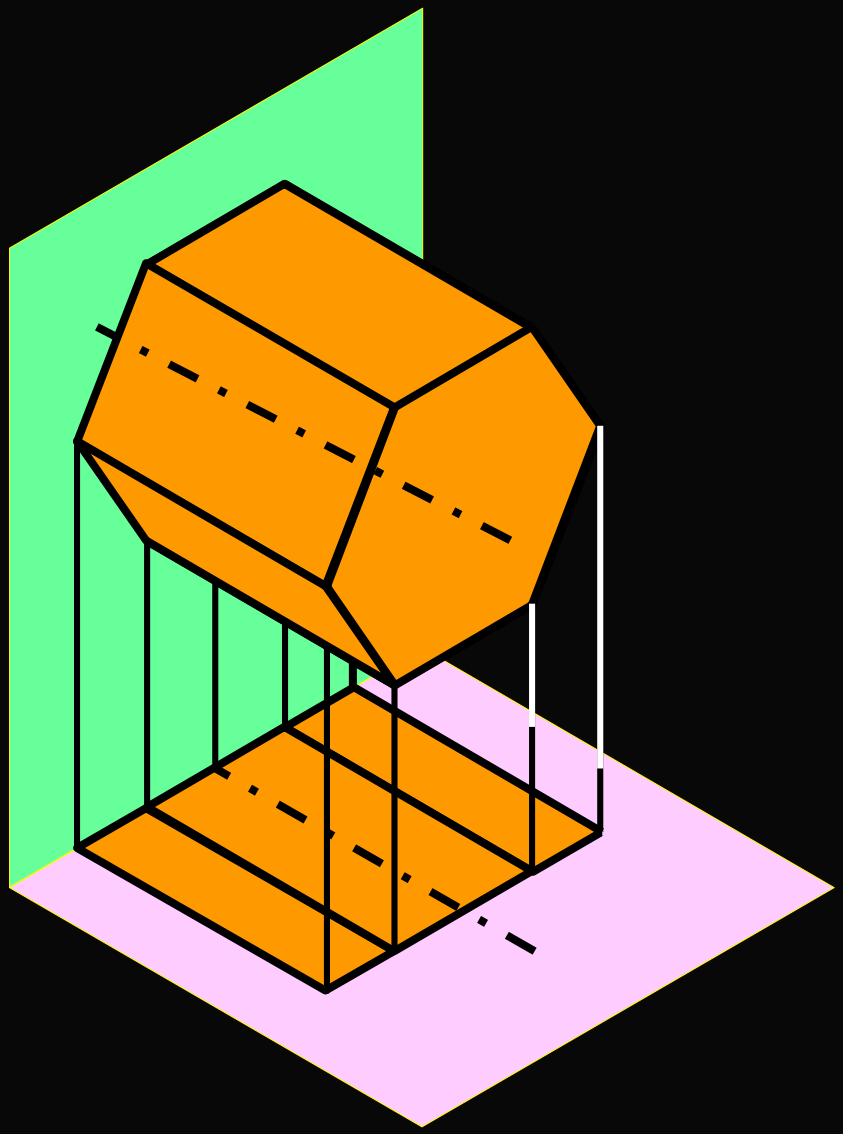
- A solid in simple position may have its axis perpendicular to one reference plane or parallel to both
  - When the axis is perpendicular to H.P., the top view should be drawn first and the front view projected from it
  - When the axis is perpendicular to V.P., the front view should be drawn first and the top view projected from it
- When the axis is parallel to both H.P. and V.P., neither the top view nor the front view will show the actual shape of the base
  - The side view drawn first. Then the front view and top view are then projected from the side view

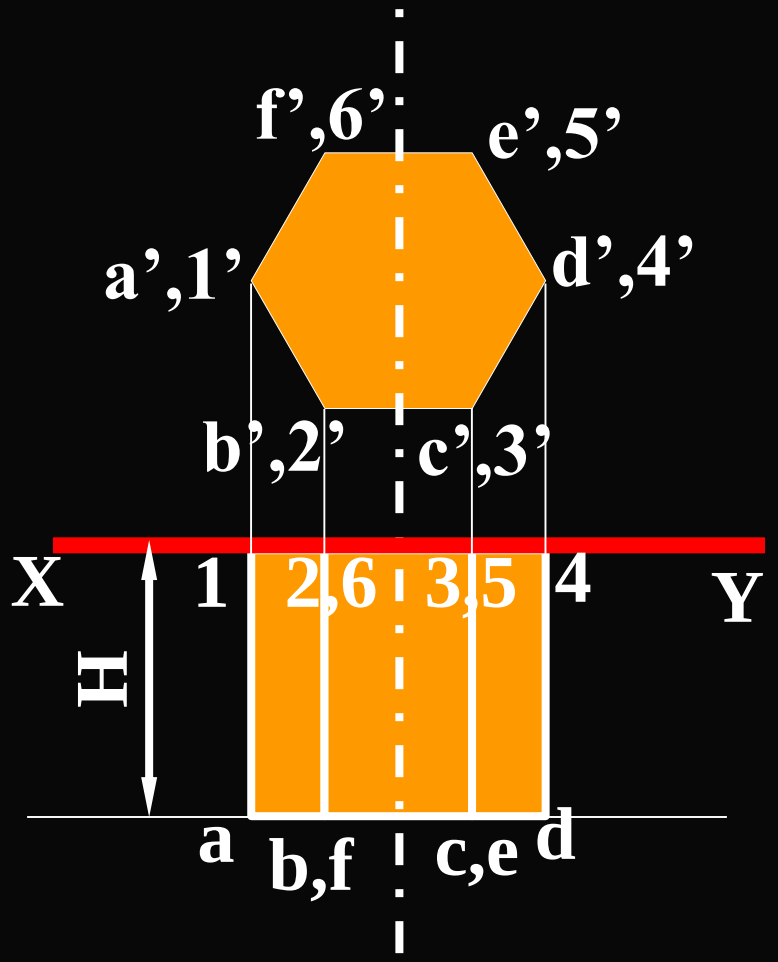
Axis perpendicular to H. P. and hence parallel to both V.P. & P.P.



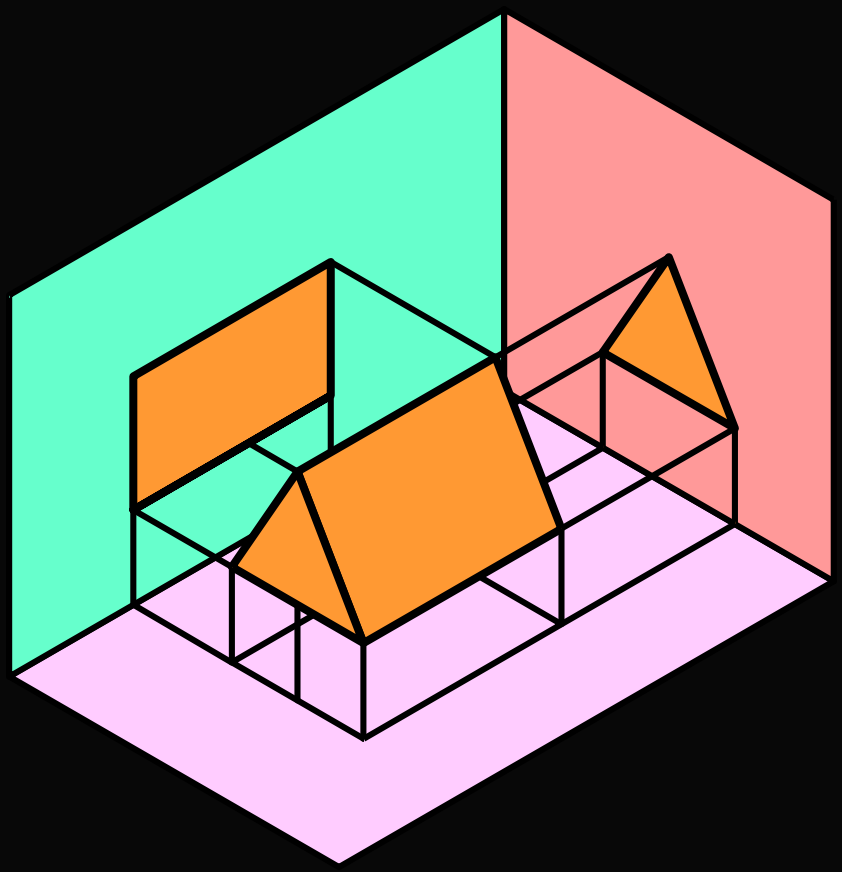


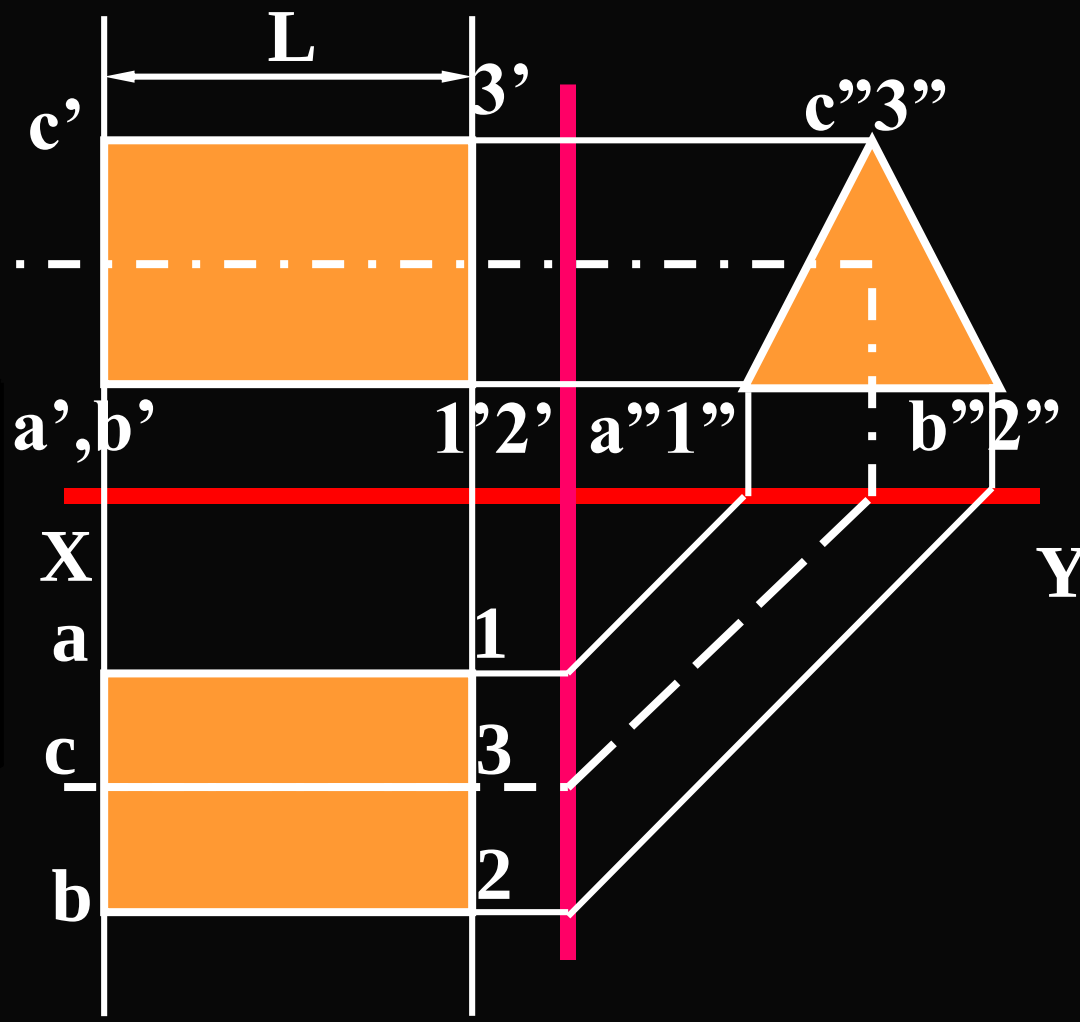
Axis perpendicular to V.P. and hence parallel to both H.P. & P.P.





Axis perpendicular to P.P. and hence parallel to both H.P. & V.P.

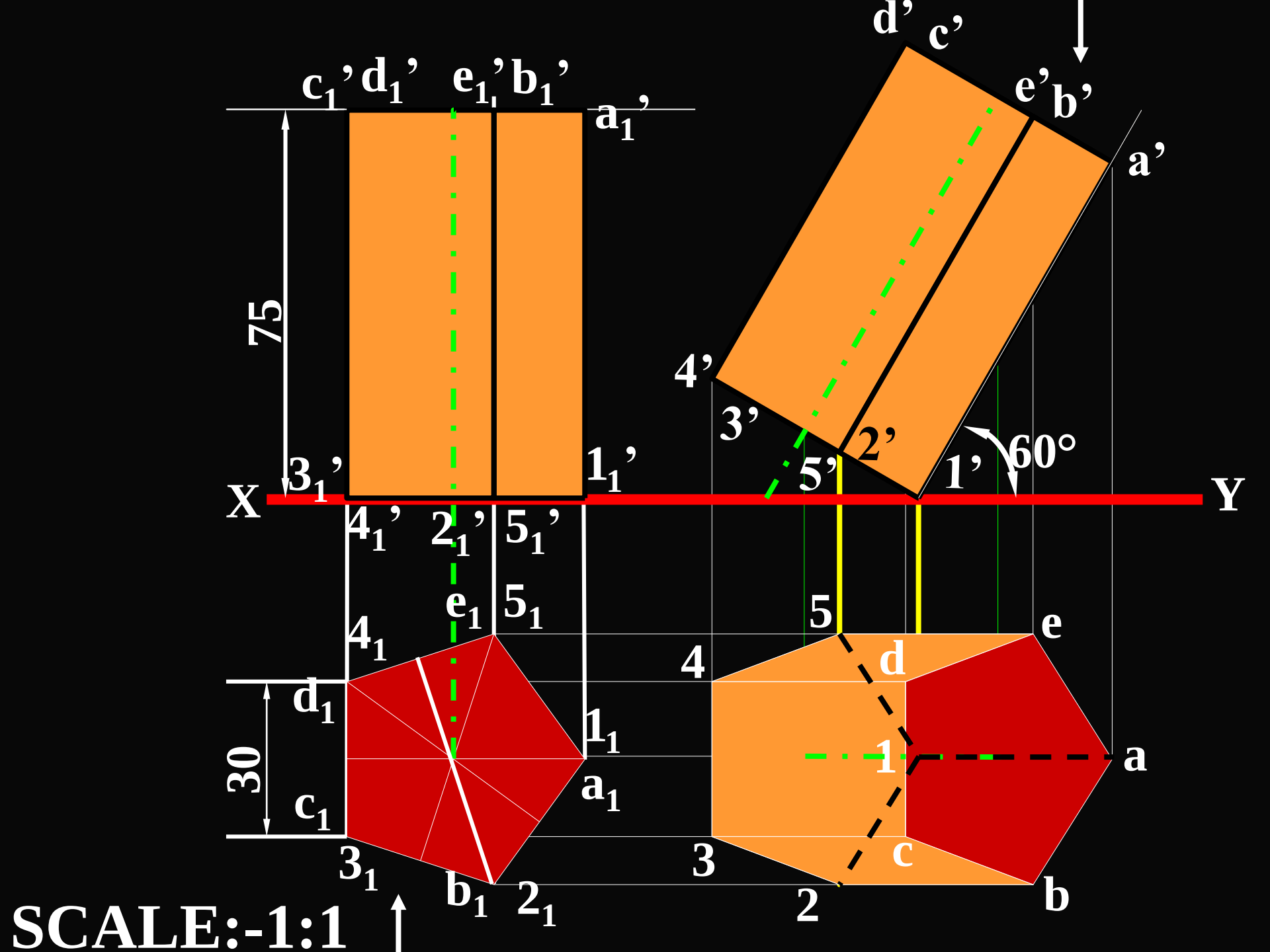


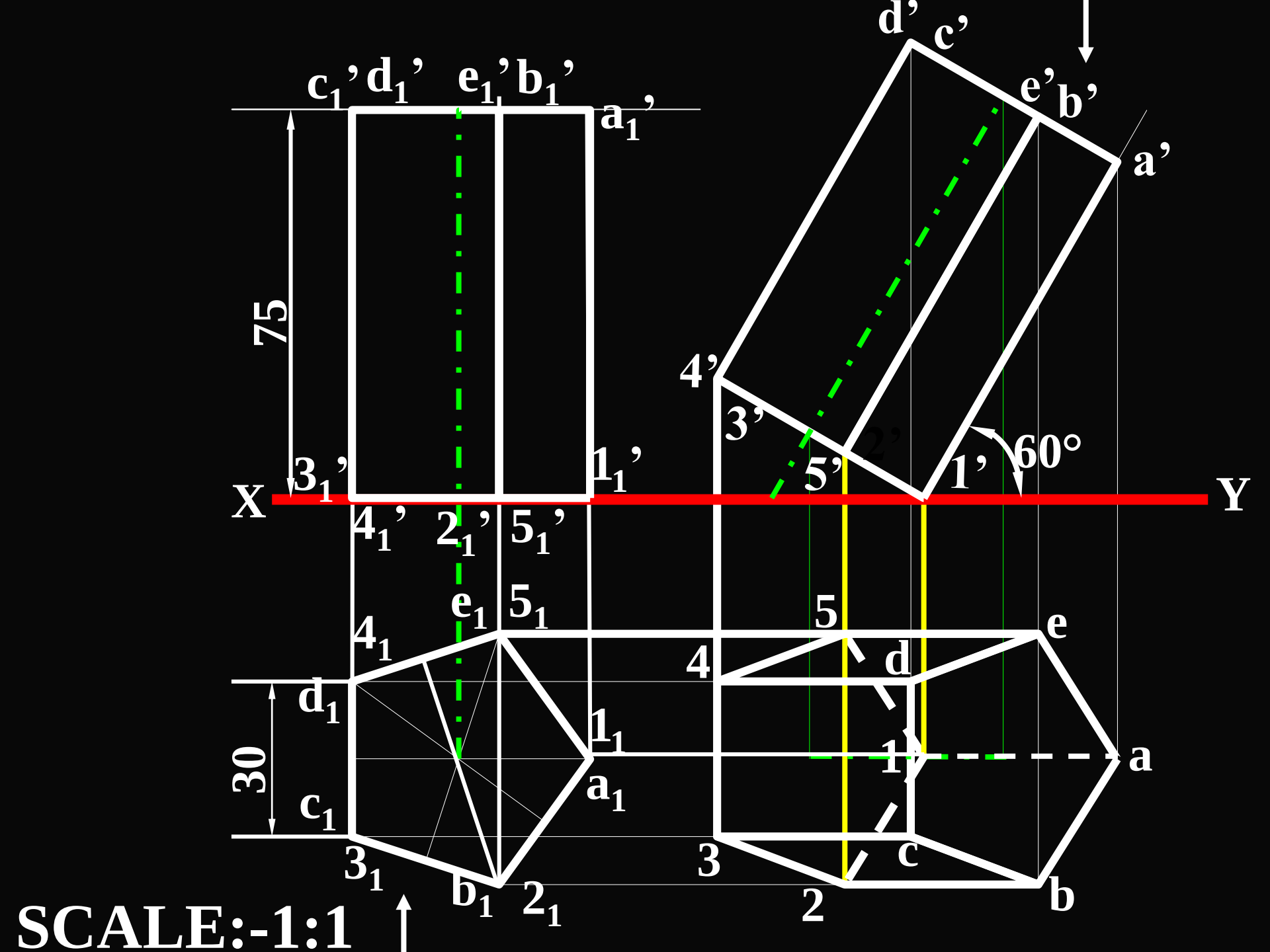


Axis parallel to V.P. and inclined to H.P. by θ & also inclined to P.P.

EXAMPLE 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.

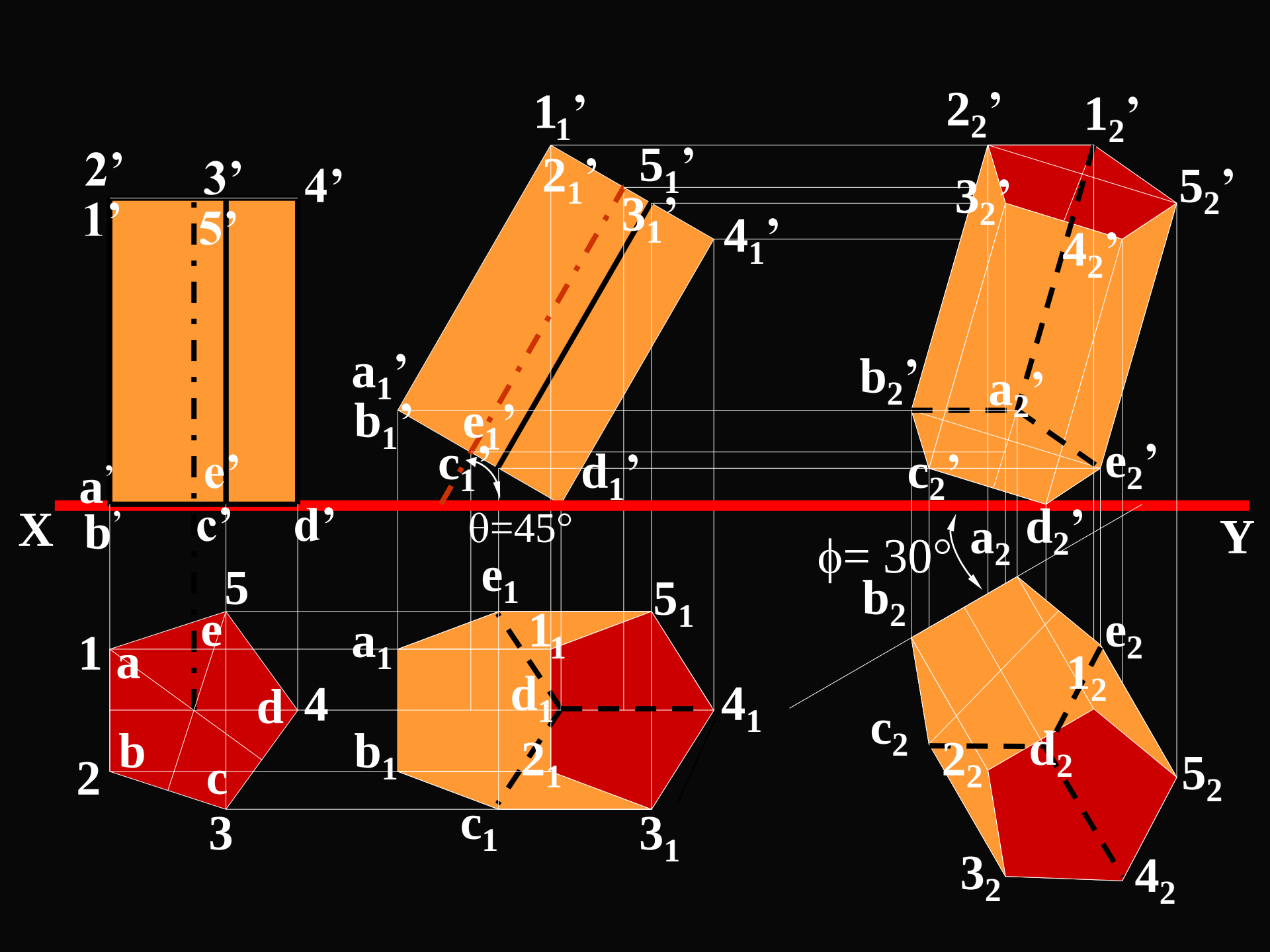

d’
c’
e’
b’
a’
c_1’ d_1’ e_1’ b_1’
a_1’
75
4’
3’
2’
5’
1’
60°
X
Y
3_1’
1_1’
4_1’ 2_1’ 5_1’
e_1
5_1
4_1
5
e
4
d
d_1
1_1
1
a
30
c_1
a_1
c
3_1
3
b_1 2_1
2
b
SCALE:-1:1

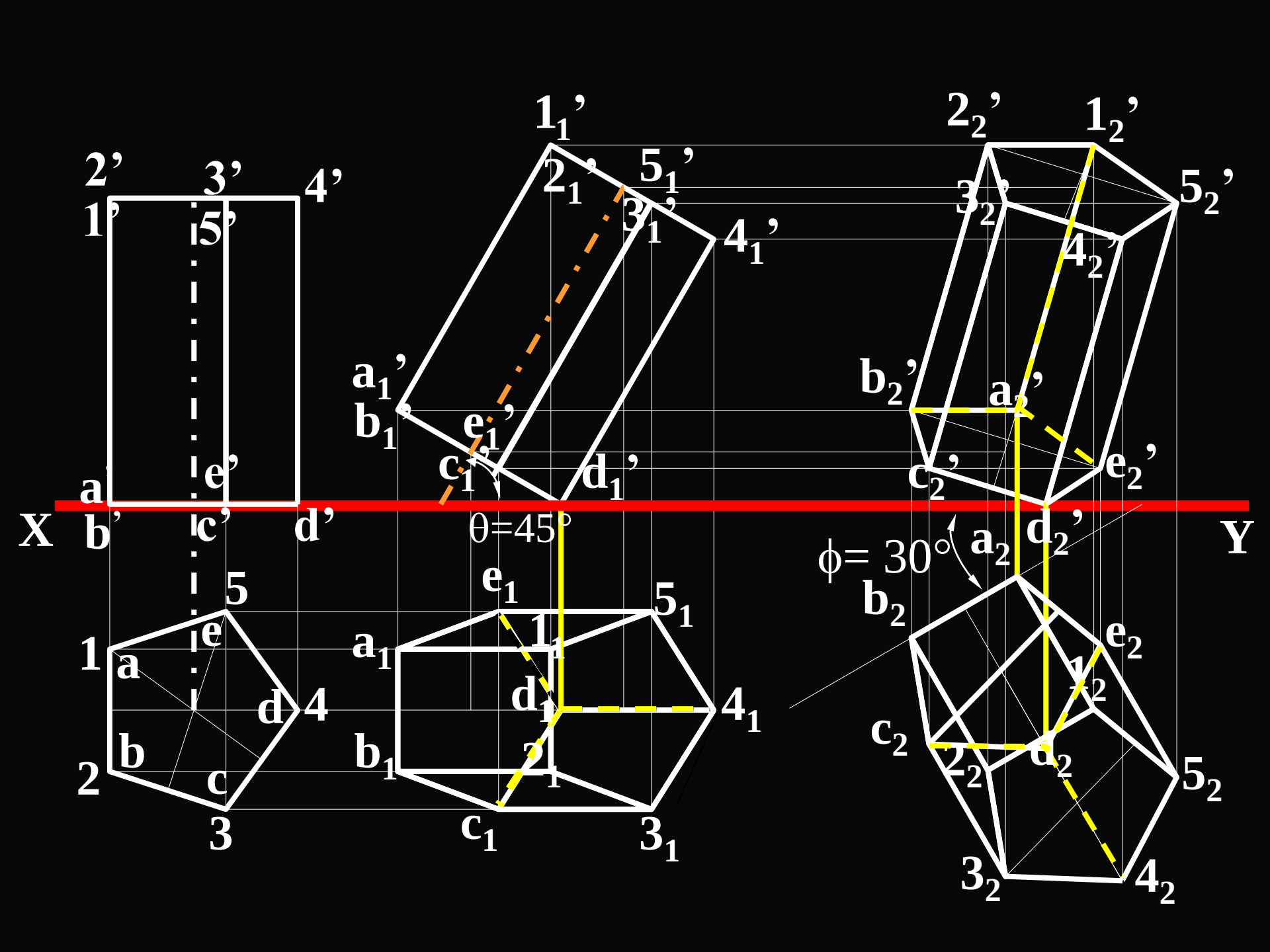

c1' d1' e1' b1'
a1'
75
3'
1'
X
Y
4'
3'
2'
5'
1'
60°
d'
c'
e'
b'
a'
4'1 2'1 5'1
e1
5'1
4'1
d1
30
c1
1'1
a1
3'1
b1
2'1
5
e
4
d
1
a
3
c
2
b

SCALE:-1:1

Example 2 :

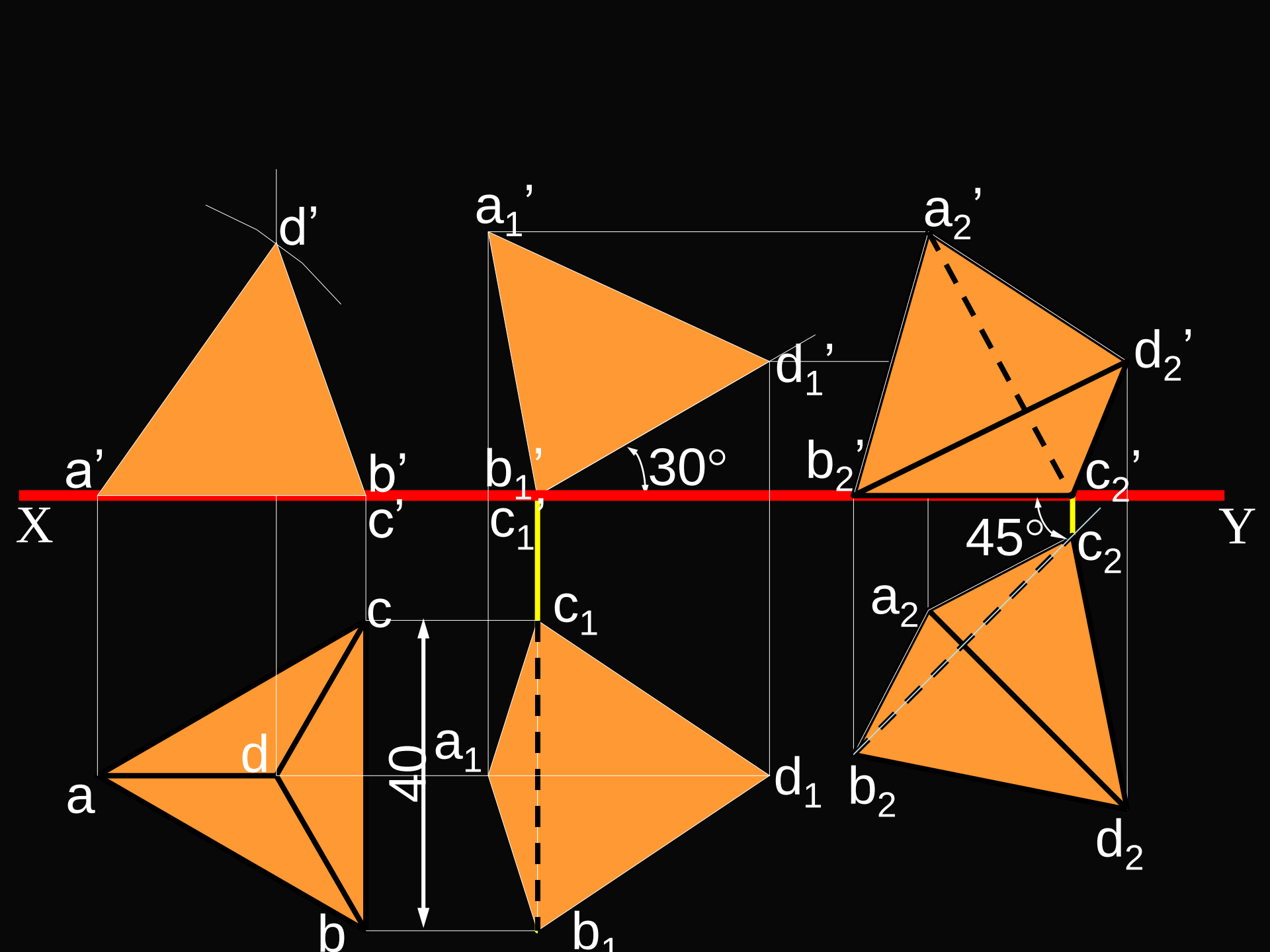
A regular pentagonal prism of 25mm long edges and axis 70mm long rests on HP on one of its corner of the base. The slant edge passing through corner makes 45° with HP and the side opposite to the same corner makes 30° with VP. Draw its projections.

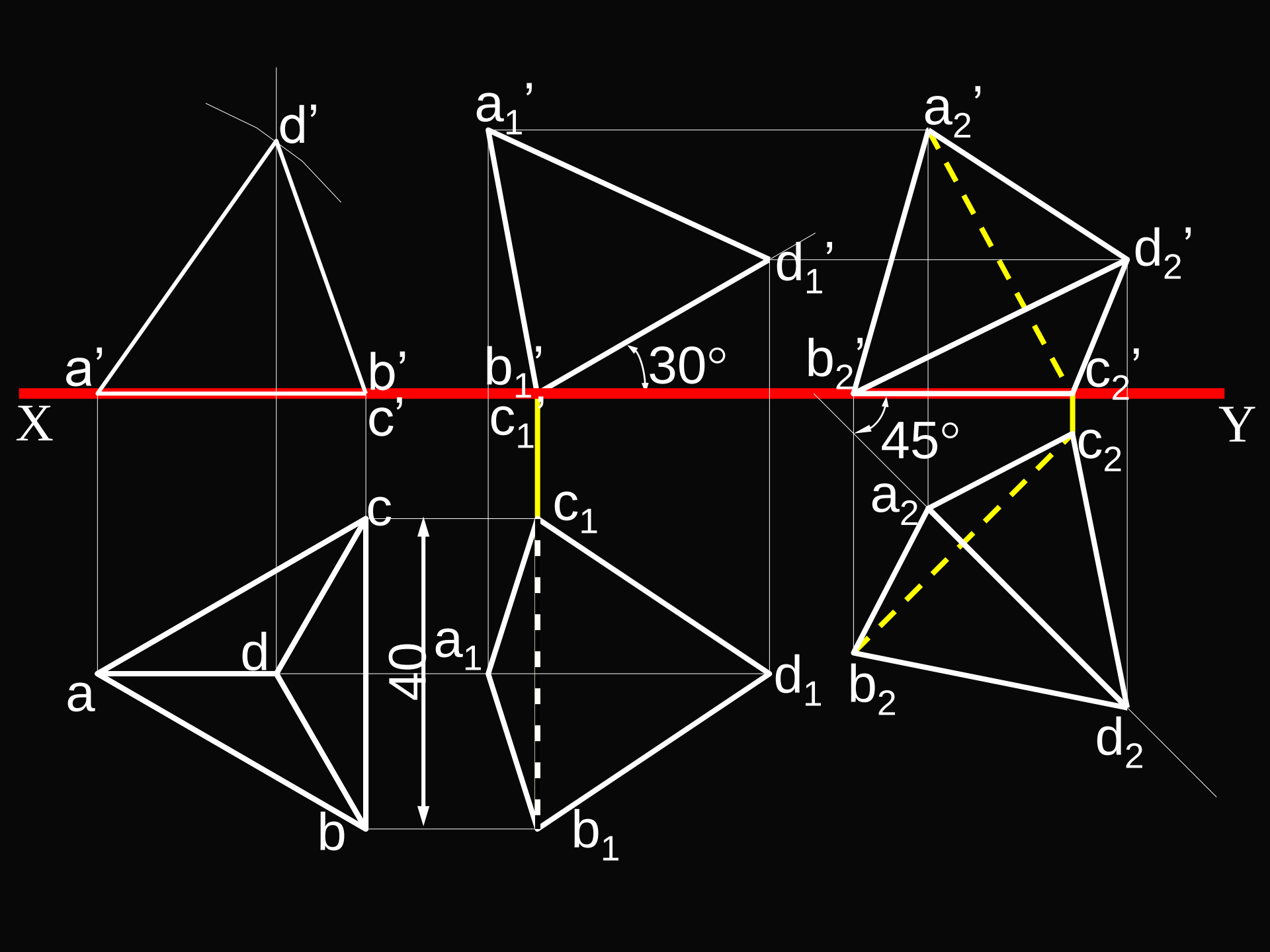

2’
3’
4’
1’
5’
a’
e’
b’
c’
d’
X
Y
θ=45°
ϕ= 30°
1
2
3
4
5
a
b
c
d
e
1_1’
2_1’
3_1’
4_1’
5_1’
a_1’
b_1’
c_1’
d_1’
e_1’
2_2’
1_2’
3_2’
4_2’
5_2’
b_2’
a_2’
c_2’
e_2’
d_2’
a_1
b_1
c_1
d_1
e_1
1_1
2_1
3_1
4_1
5_1
b_2
a_2
c_2
d_2
e_2
1_2
2_2
3_2
4_2
5_2


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

Example 3 :

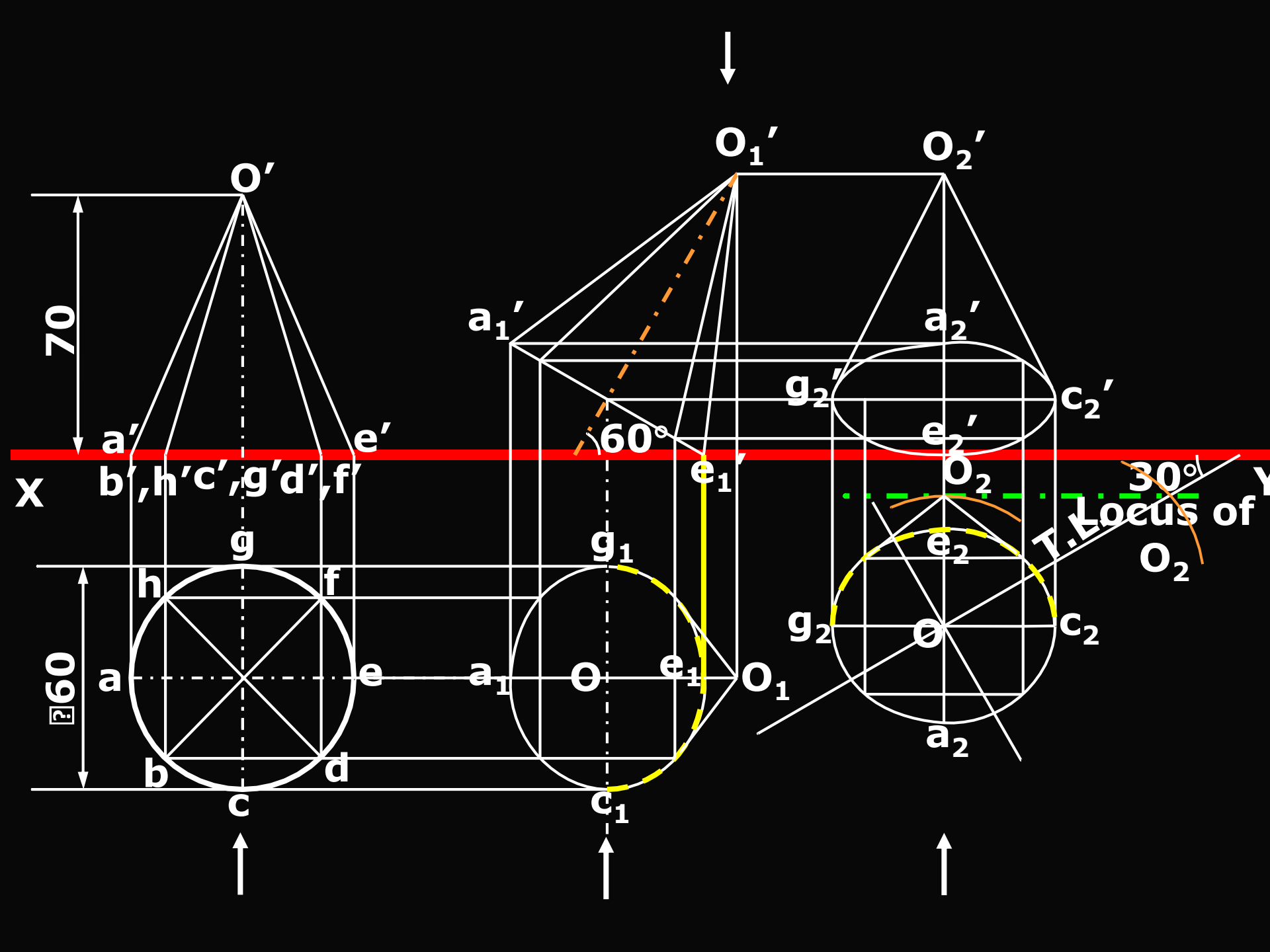
A tetrahedron of 40 mm long edges, rests on HP on one of its edges such that the face containing that edge is inclined to HP at 30° and the same edge is inclined at 45° to VP. Draw the projections of the solid.


d'
a1'
a2'
d1'
d2'
a'
b'
b1'
30°
b2'
c2'
X
c'
c1'
45°
Y
c2
c
c1
a2
d
a1
40
a
d1
b2
d2
b
b1


d'
a1'
a2'
d1'
d2'
a'
b'
b1'
30°
b2'
c2'
X
c'
c1'
45°
Y
c2
c
c1
a2
d
a1
40
a
d1
b2
d2
b
b1

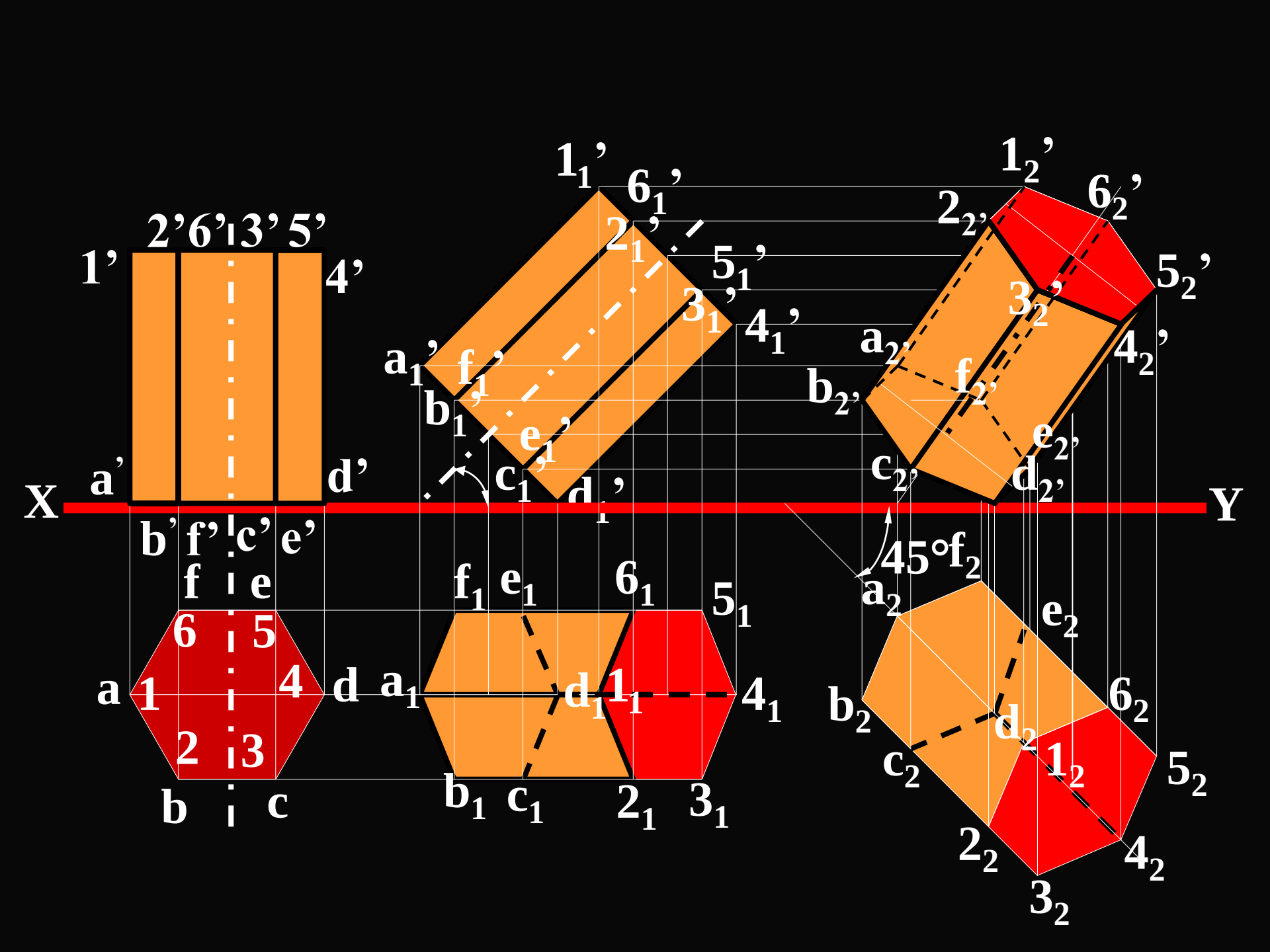
Example 4 :

A cone, diameter of base 60mm and height 70mm, is resting on HP on the point of periphery of the base. Axis of the cone makes 60° with HP and 30° with the VP. Draw the projections of the cone, when the apex is nearer to the VP.


O′
70
a′
e′
b′,h′c′,g′d′,f′
X
g
h
f
a
e
b
d
c
60
O1′
O2′
a1′
a2′
g2′
c2′
e2′
60°
e1′
O2
30°
Y
T.L
Locus of
O2
g1
e2
g2
O
c2
a1
O
e1
O1
a2
c1

Example 5 :

A regular hexagonal prism of 30 mm sides and axis 80 mm 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
1₁’ 6₁’ 2₁’ 5₁’ 3₁’ 4₁’ a₁’ f₁’ b₁’ e₁’ c₁’ d₁’
f₁ e₁ 6₁ 5₁ a₁ d₁ 1₁ 4₁ b₁ c₁ 2₁ 3₁
1₂’ 6₂’ 2₂’ 5₂’ 3₂’ 4₂’ a₂’ f₂’ b₂’ e₂’ c₂’ d₂’
45° f₂
a₂ e₂ b₂ 6₂ d₂ c₂ 1₂ 5₂ 2₂ 4₂ 3₂