

DEVELOPMENT OF SURFACE



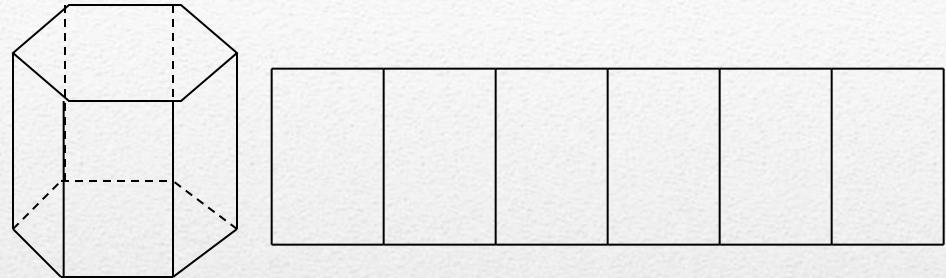
Introduction

Development is a graphical method of obtaining the area of the surfaces of a solid. When a solid is opened out and its complete surface is laid on a plane, the surface of the solid is said to be developed. The figure thus obtained is called a *development of the surfaces of the solid* or simply *development*. Development of the solid, when folded or rolled, gives the solid.

Prism – Made up of same number of rectangles as sides of the base

One side: Height of the prism

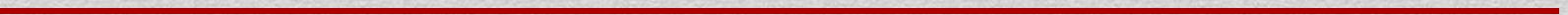
Other side: Side of the base



Cylinder – Rectangle

One side: Circumference of the base

Other side: Height of the cylinder

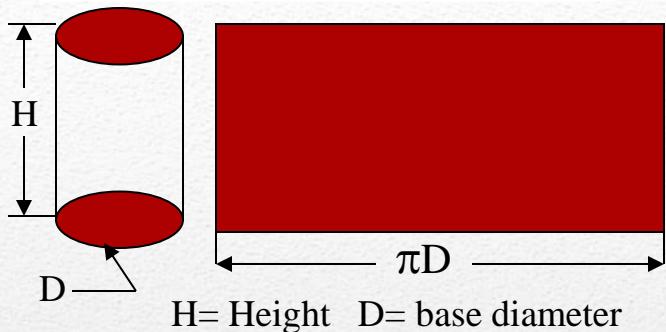


Development of lateral surfaces of different solids.

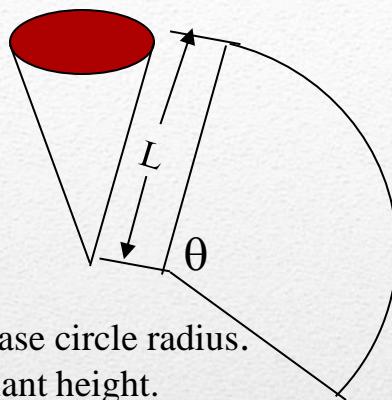
(Lateral surface is the surface excluding top & base)

Cylinder:

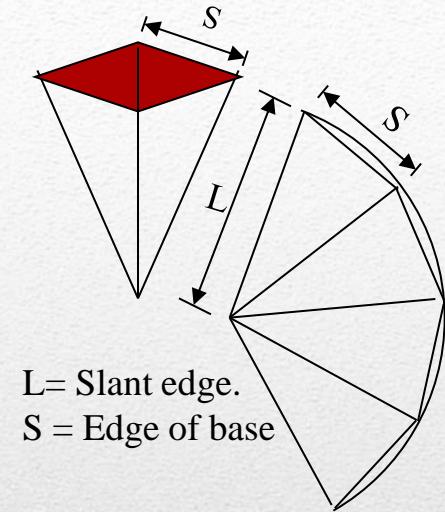
A Rectangle



Cone: (Sector of circle)

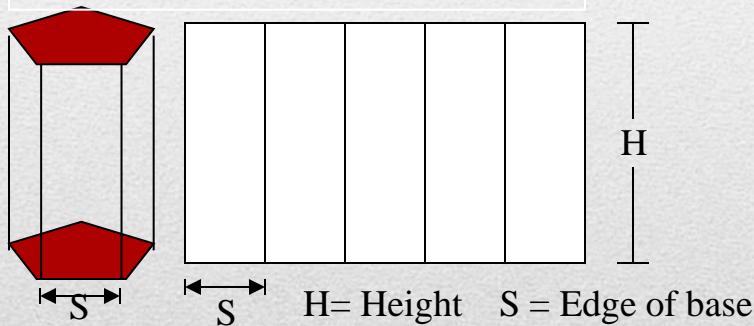


Pyramids: (No.of triangles)



Prisms:

No.of Rectangles

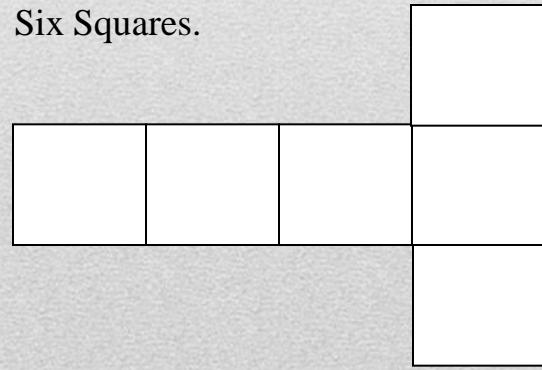


R =Base circle radius.

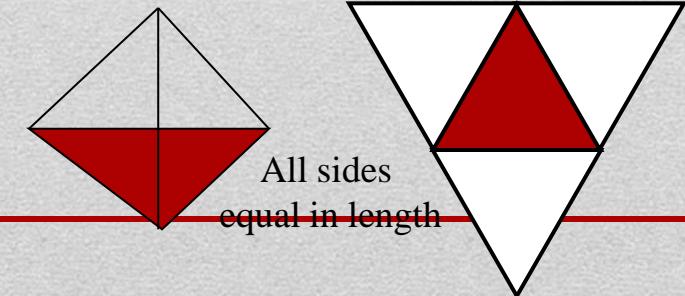
L =Slant height.

$$\theta = \frac{R}{L} \times 360^{\circ}$$

Cube: Six Squares.



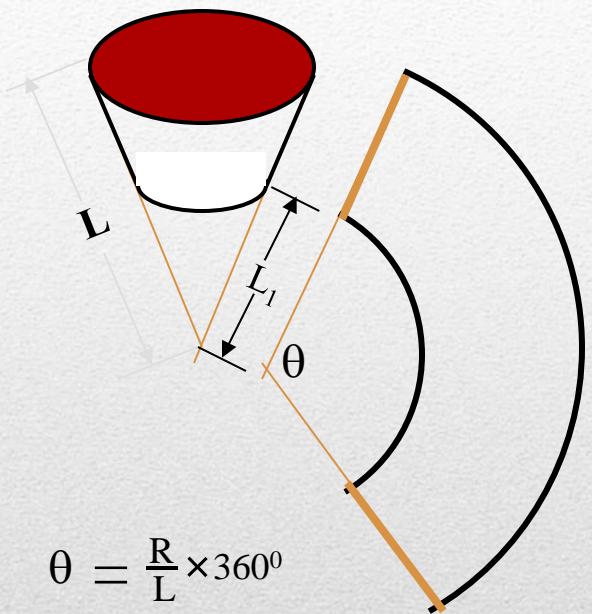
Tetrahedron: Four Equilateral Triangles



FRUSTUMS



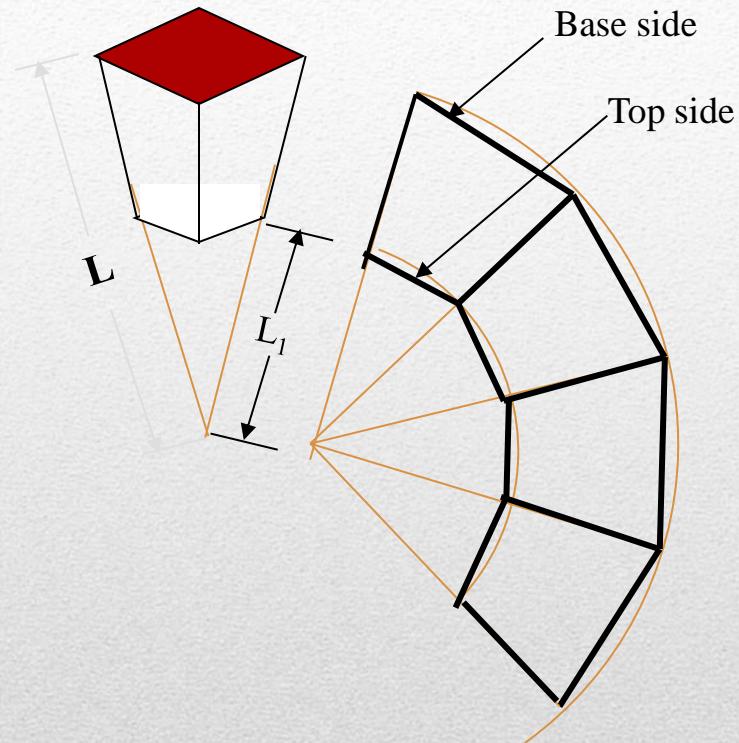
DEVELOPMENT OF FRUSTUM OF CONE



$$\theta = \frac{R}{L} \times 360^\circ$$

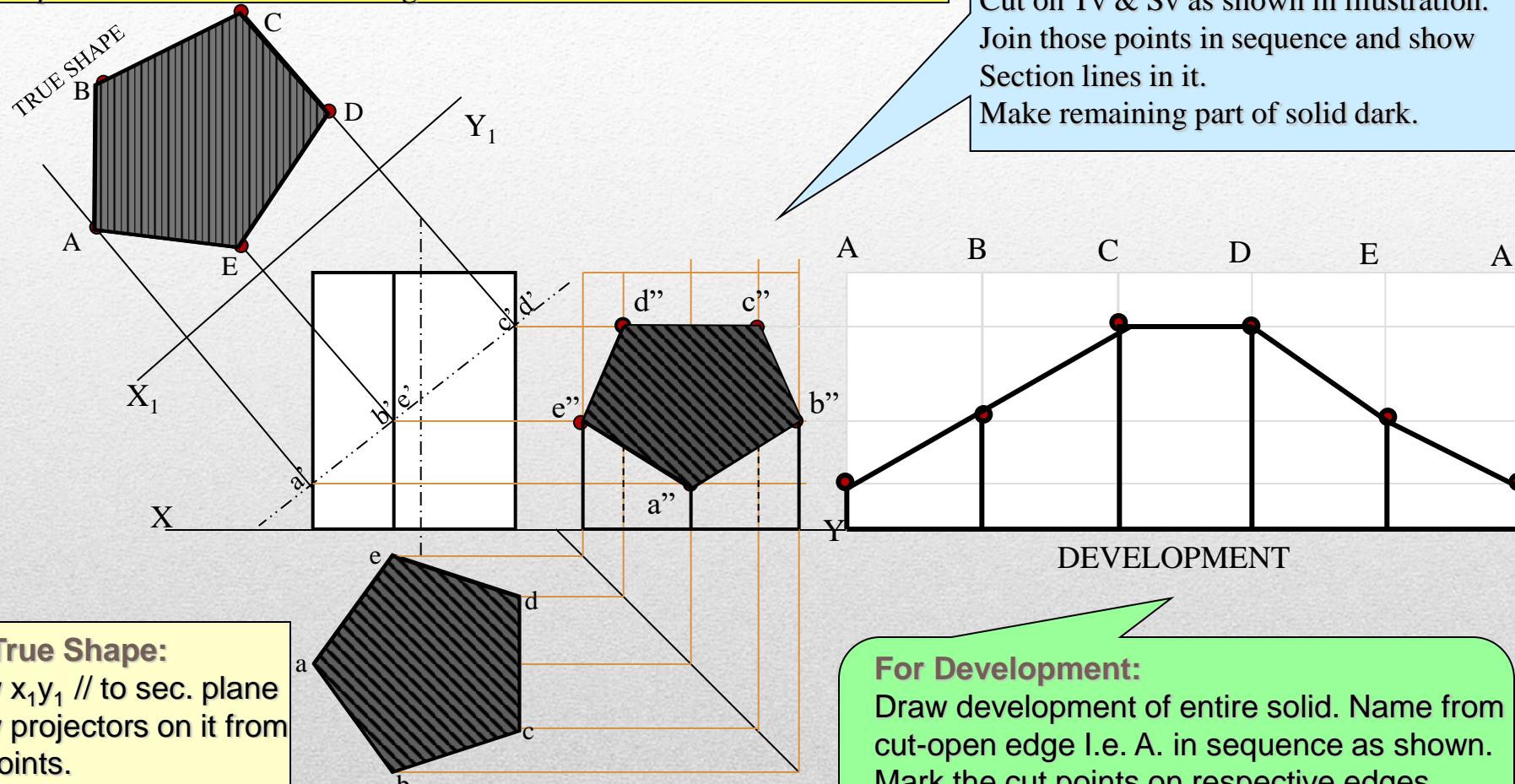
R= Base circle radius of cone
L= Slant height of cone
 L_1 = Slant height of cut part.

DEVELOPMENT OF FRUSTUM OF SQUARE PYRAMID



L= Slant edge of pyramid
 L_1 = Slant edge of cut part.

Problem 1: A pentagonal prism , 30 mm base side & 50 mm axis is standing on Hp on it's base with one side of the base perpendicular to VP. It is cut by a section plane inclined at 45° to the HP, through mid point of axis. Draw Fv, sec.Tv & sec. Side view. Also draw true shape of section and Development of surface of remaining solid.

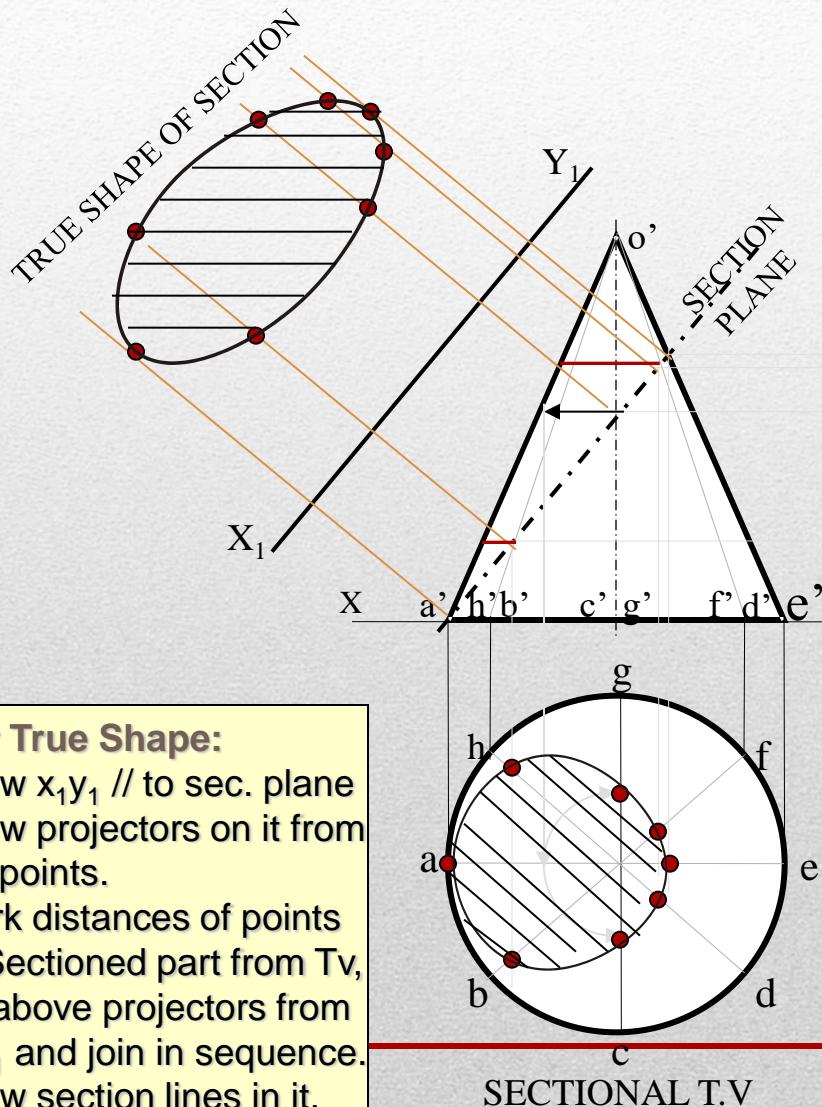


For True Shape:
Draw $x_1y_1 \parallel$ to sec. plane
Draw projectors on it from cut points.
Mark distances of points of Sectioned part from Tv, on above projectors from x_1y_1 and join in sequence.
Draw section lines in it.
It is required true shape.

Solution Steps: *for sectional views:*
Draw three views of standing prism.
Locate sec. plane in Fv as described.
Project points where edges are getting
Cut on Tv & Sv as shown in illustration.
Join those points in sequence and show
Section lines in it.
Make remaining part of solid dark.

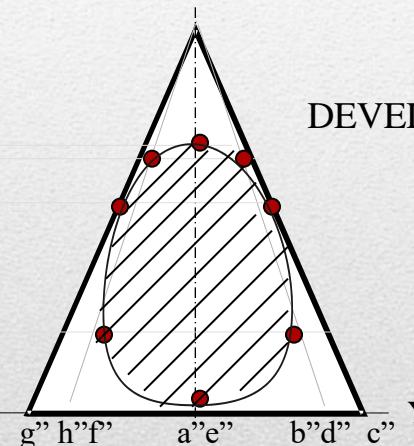
For Development:
Draw development of entire solid. Name from cut-open edge i.e. A. in sequence as shown.
Mark the cut points on respective edges.
Join them in sequence in st. lines.
Make existing parts dev.dark.

Problem 2: A cone, 50 mm base diameter and 70 mm axis is standing on its base on Hp. It is cut by a section plane 45° inclined to Hp through base end of end generator. Draw projections, sectional views, true shape of section and development of surfaces of remaining solid.

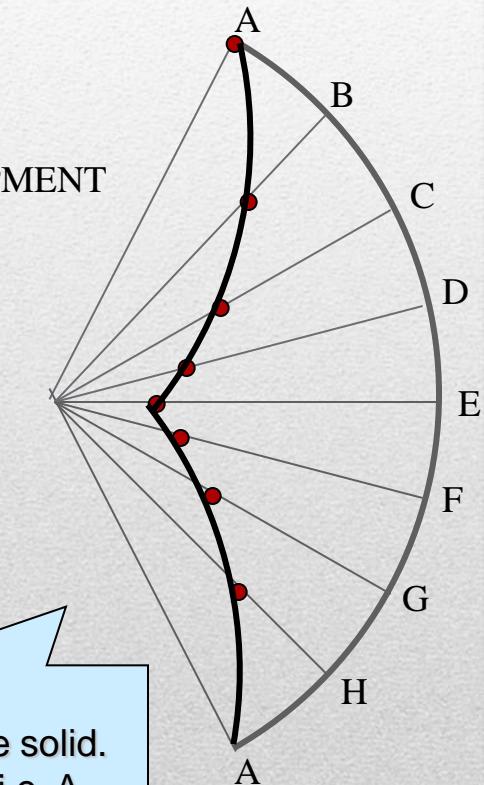


For True Shape:
Draw $x_1y_1 \parallel$ to sec. plane
Draw projectors on it from cut points.
Mark distances of points of Sectioned part from Tv, on above projectors from x_1y_1 and join in sequence.
Draw section lines in it.
It is required true shape.

SECTIONAL S.V



DEVELOPMENT



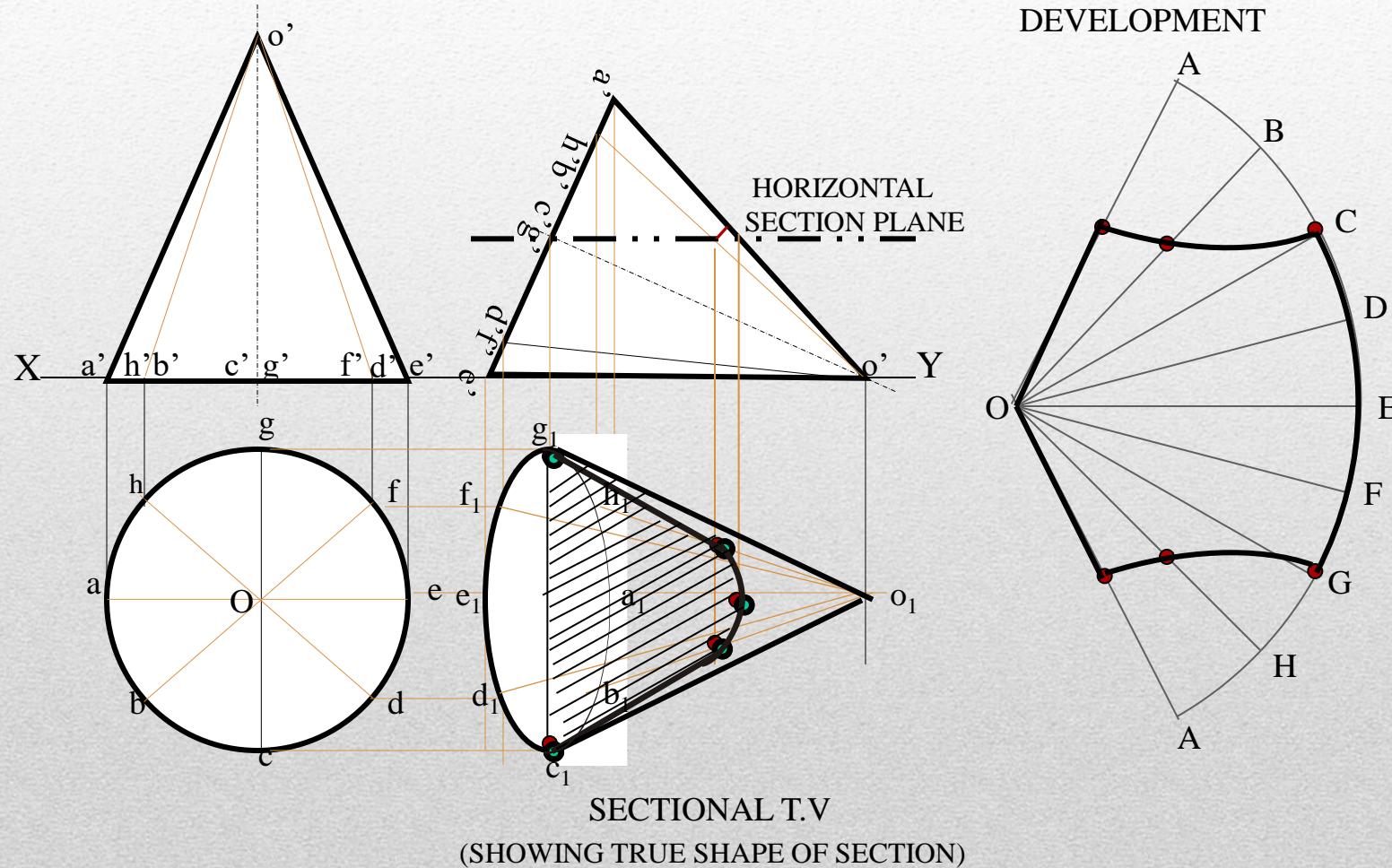
For Development:

Draw development of entire solid.
Name from cut-open edge i.e. A.
in sequence as shown. Mark the cut
points on respective edges.
Join them in sequence in curvature.
Make existing parts dev.dark.

Solution Steps: for sectional views:
Draw three views of standing cone.
Locate sec. plane in Fv as described.
Project points where generators are
getting Cut on Tv & Sv as shown in
illustration. Join those points in
sequence and show Section lines in it.
Make remaining part of solid dark.

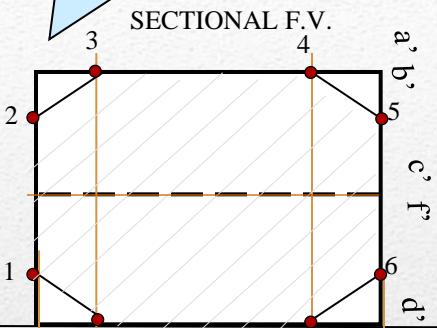
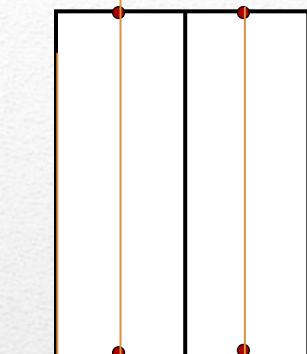
Problem 3: A cone 40mm diameter and 50 mm axis is resting on one generator on Hp(lying on Hp) which is // to Vp.. Draw it's projections. It is cut by a horizontal section plane through it's base center. Draw sectional TV, development of the surface of the remaining part of cone.

Follow similar solution steps for Sec.views - True shape – Development as per previous problem!



Note the steps to locate Points 1, 2, 5, 6 in sec.Fv:
Those are transferred to 1st TV, then to 1st Fv and Then on 2nd Fv.

a' b' c' f' d' e'



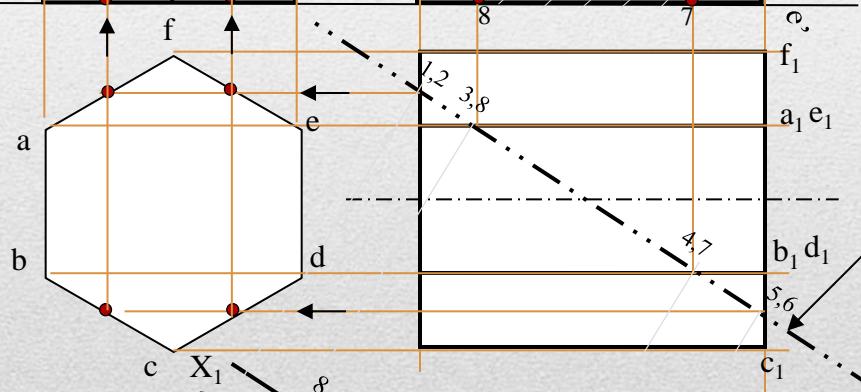
Problem 4: A hexagonal prism. 30 mm base side & 55 mm axis is lying on Hp on its rect.face with axis // to Vp. It is cut by a section plane normal to Hp and 30° inclined to Vp bisecting axis.
Draw sec. Views, true shape & development.

Use similar steps for sec.views & true shape.

NOTE: for development, always cut open object from From an edge in the boundary of the view in which sec.plane appears as a line.

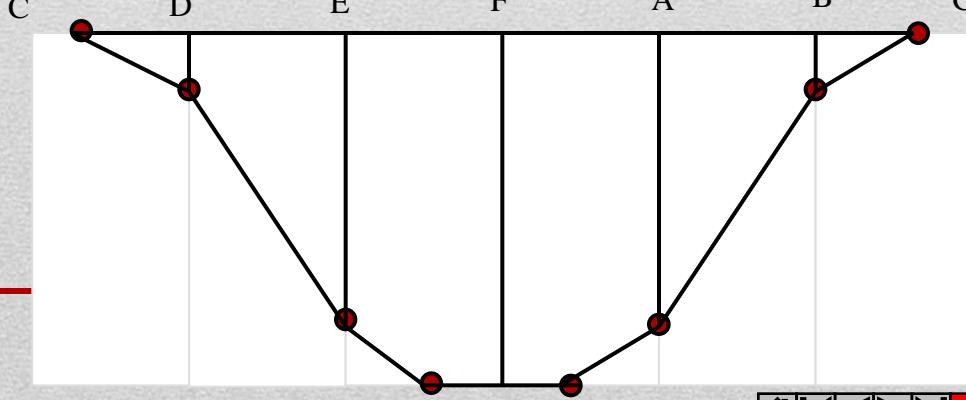
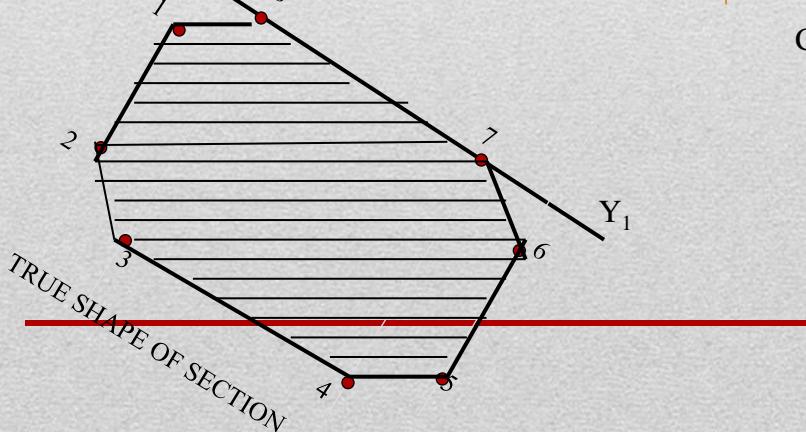
Here it is Tv and in boundary, there is c₁ edge.Hence it is opened from c and named C,D,E,F,A,B,C.

X Y

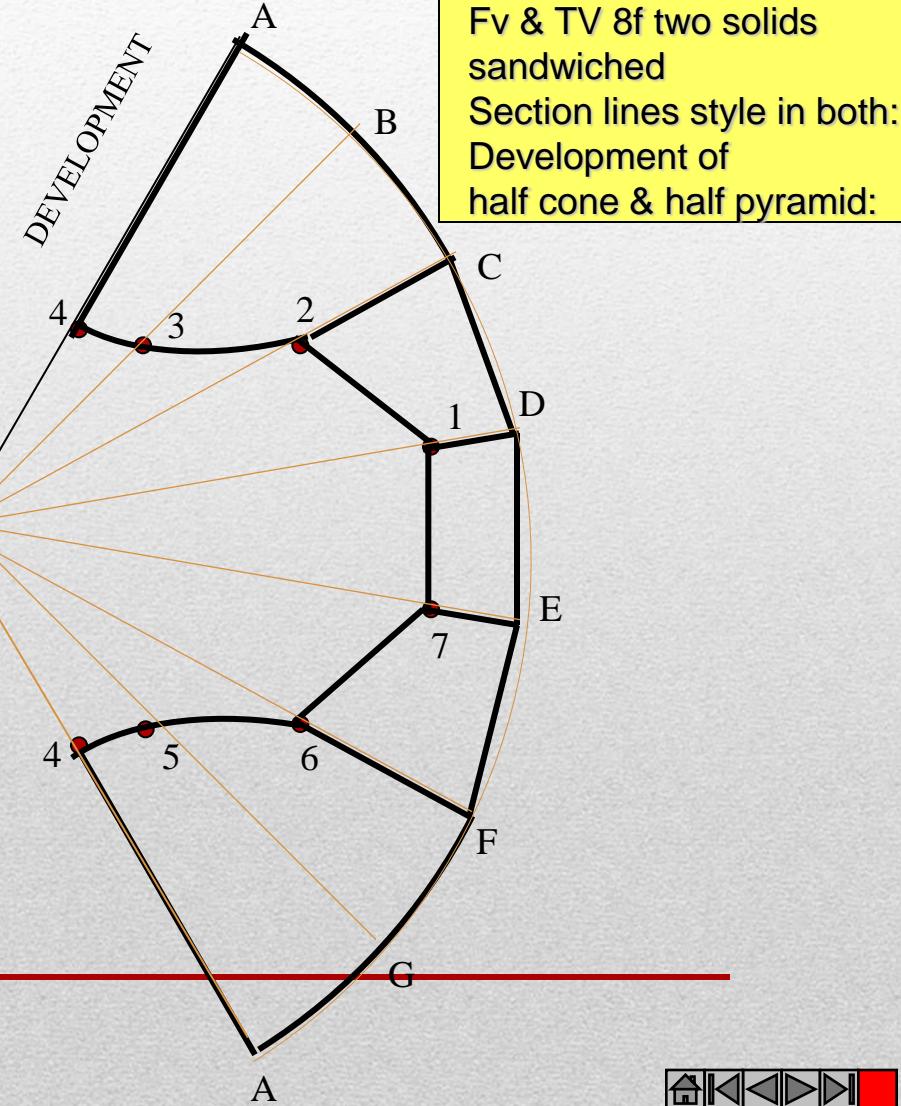
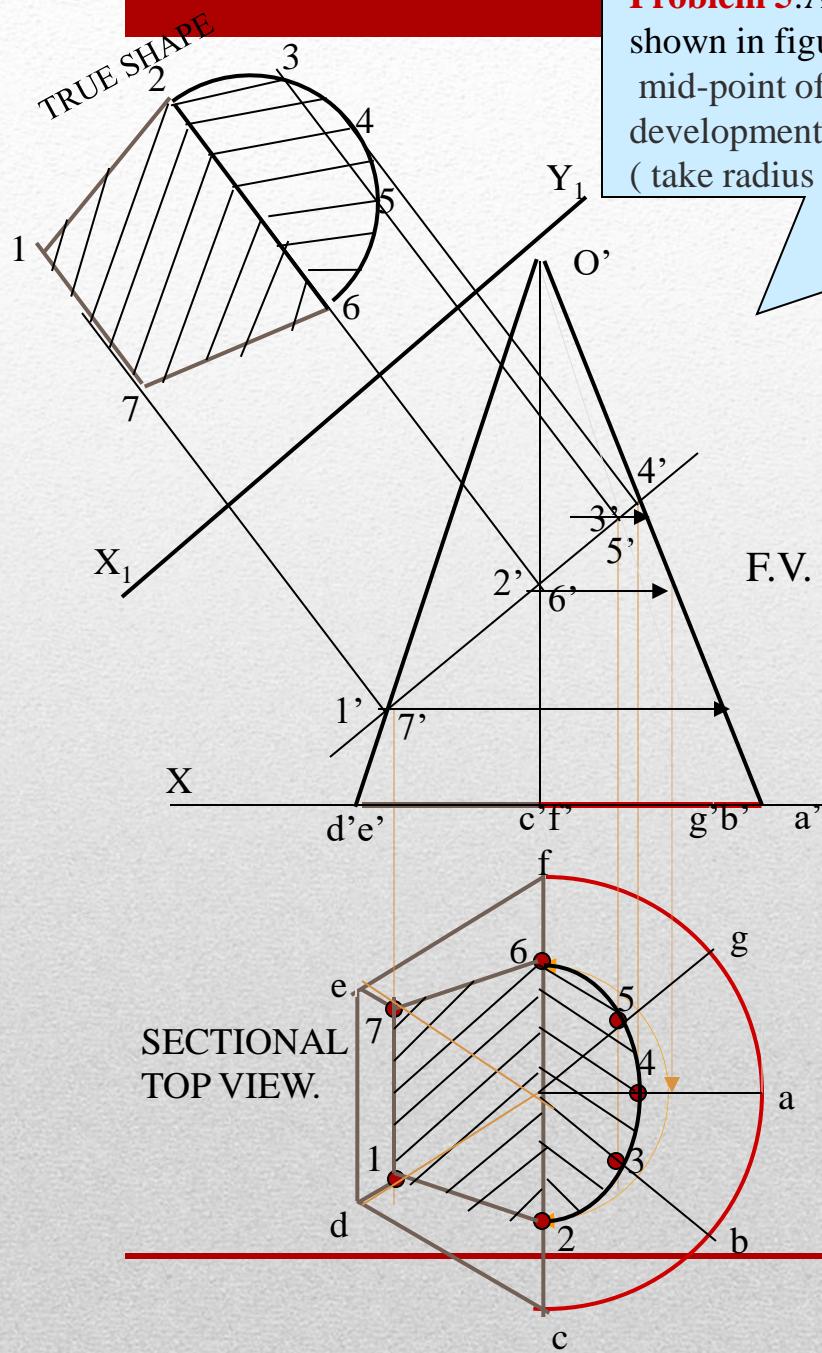


A.V.P30° inclined to Vp
Through mid-point of axis.

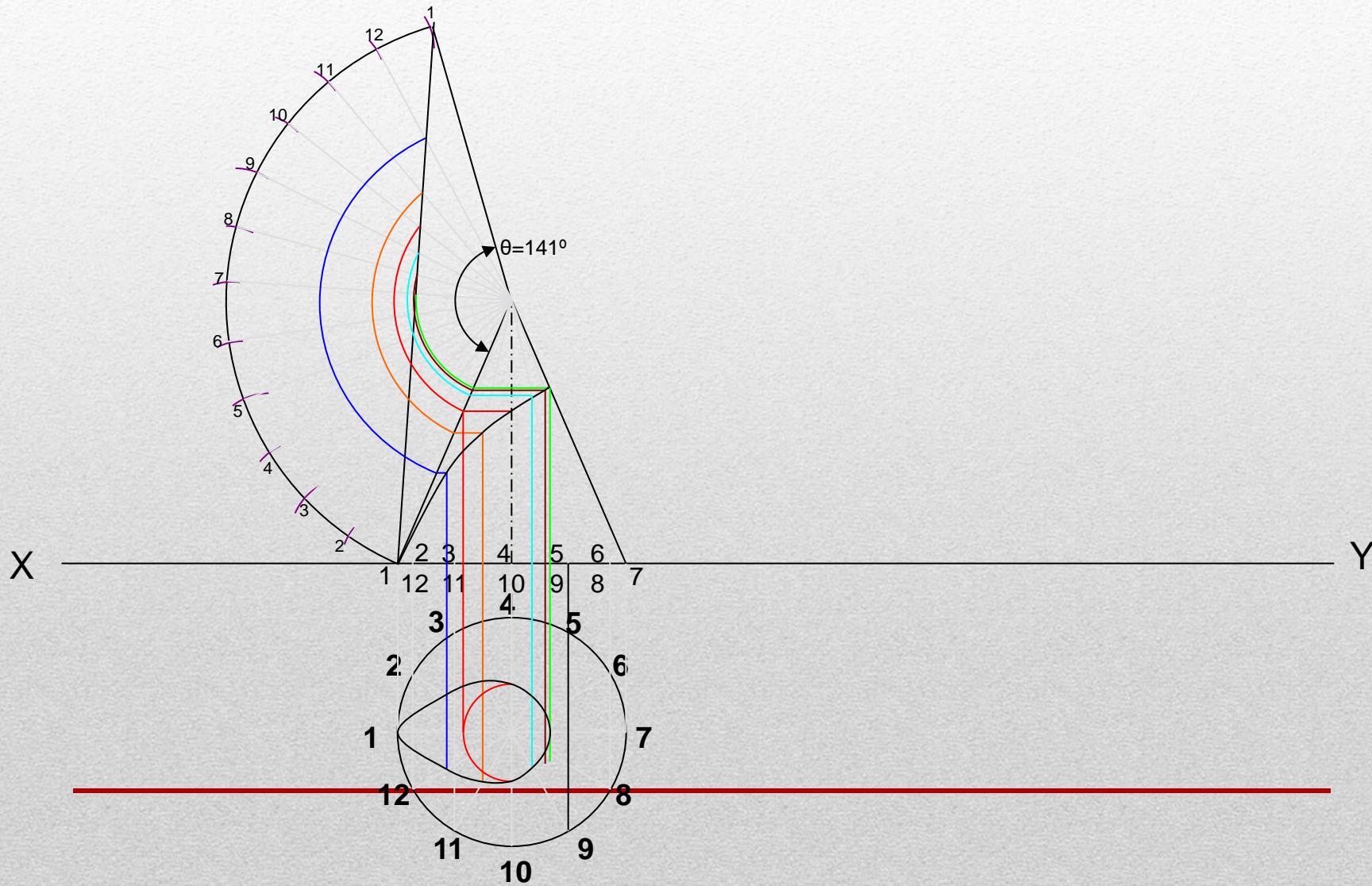
AS SECTION PLANE IS IN T.V.,
CUT OPEN FROM BOUNDARY EDGE C₁ FOR DEVELOPMENT.



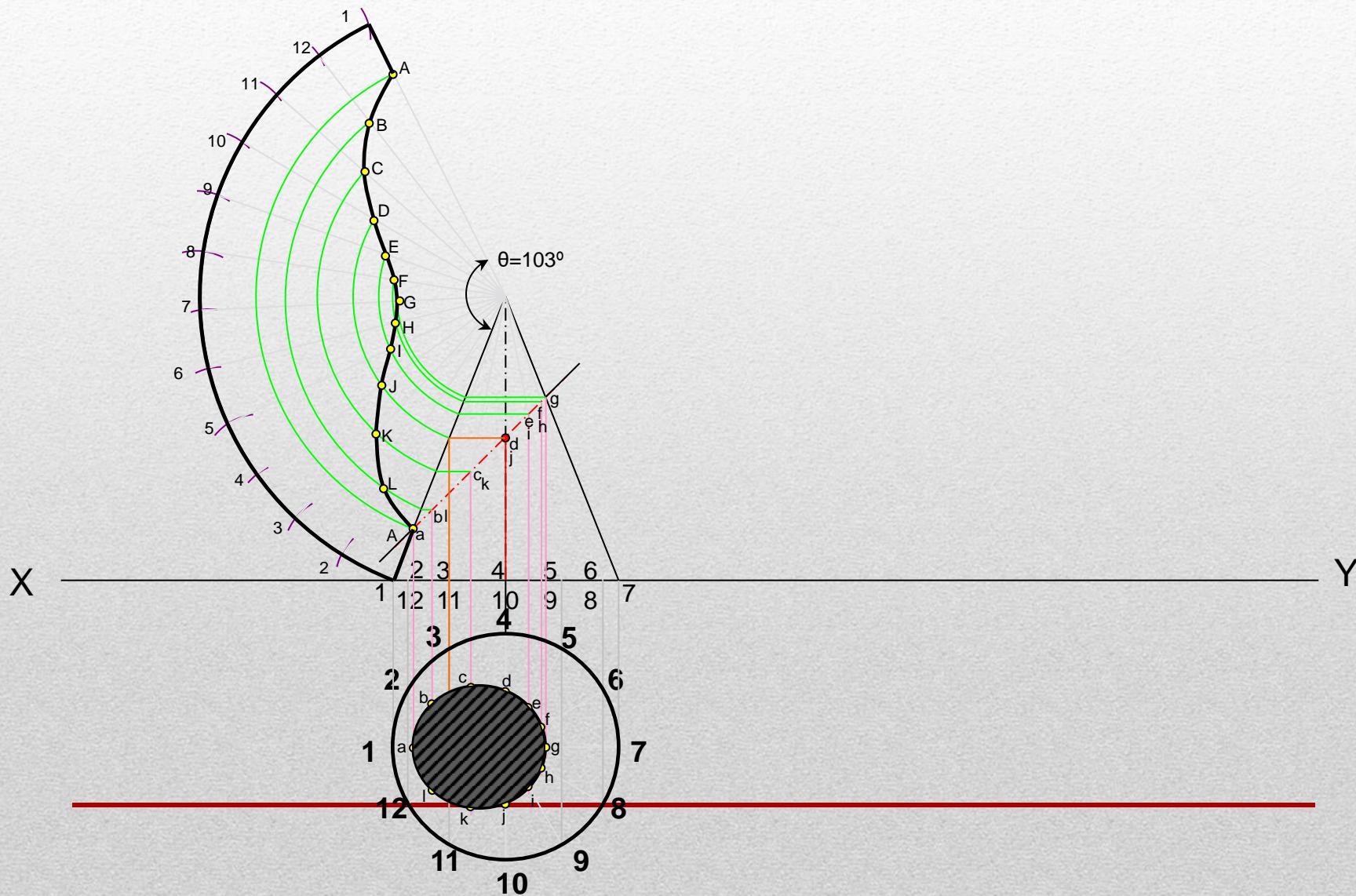
Problem 5: A solid composed of a half-cone and half-hexagonal pyramid is shown in figure. It is cut by a section plane 45^0 inclined to Hp, passing through mid-point of axis. Draw F.v., sectional T.v., true shape of section and development of remaining part of the solid.
 (take radius of cone and each side of hexagon 30mm long and axis 70mm.)



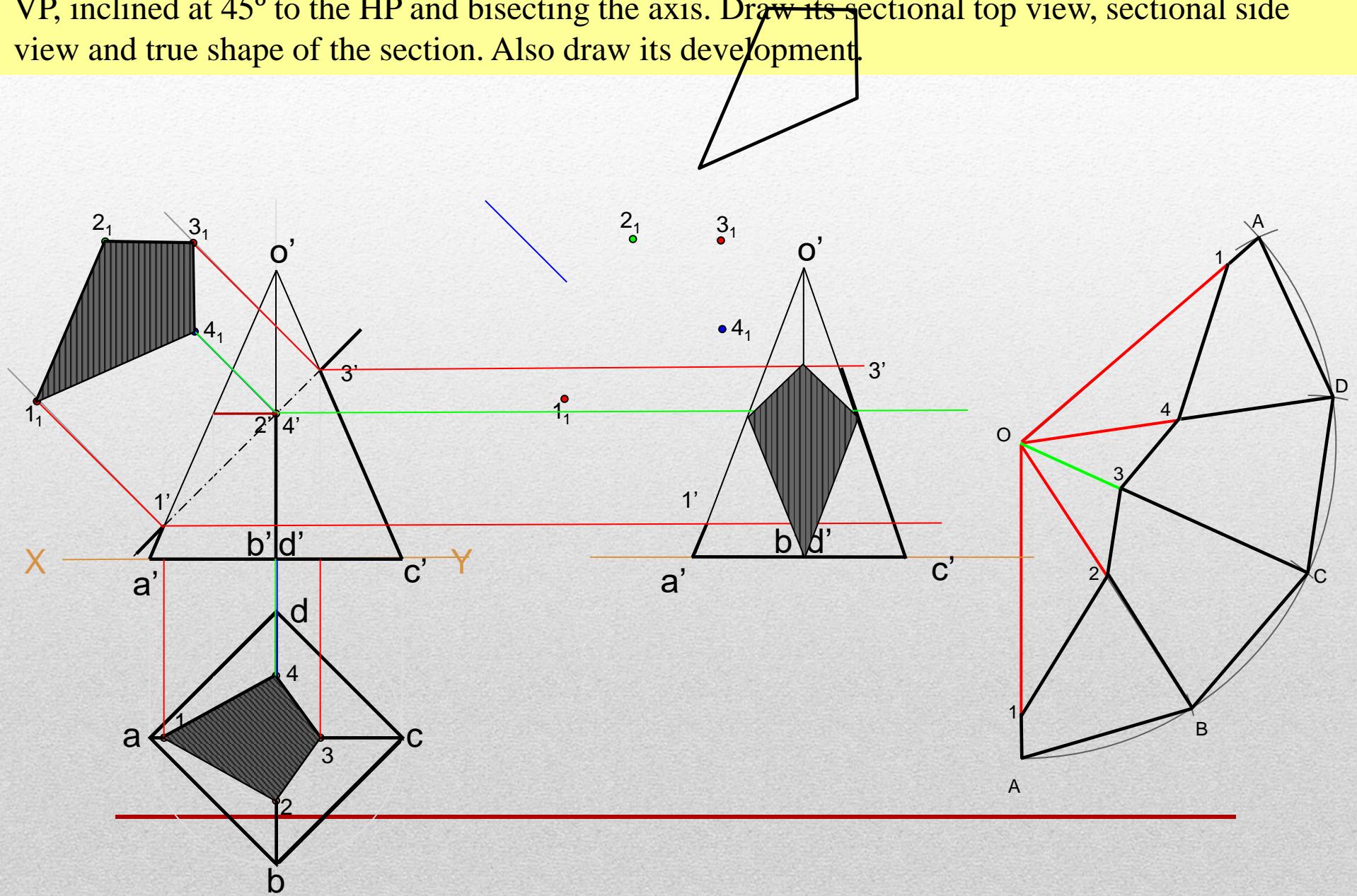
Q 15.26: draw the projections of a cone resting on the ground on its base and show on them, the shortest path by which a point P, starting from a point on the circumference of the base and moving around the cone will return to the same point. Base ofn cone 65 mm diameter ; axis 75 mm long.



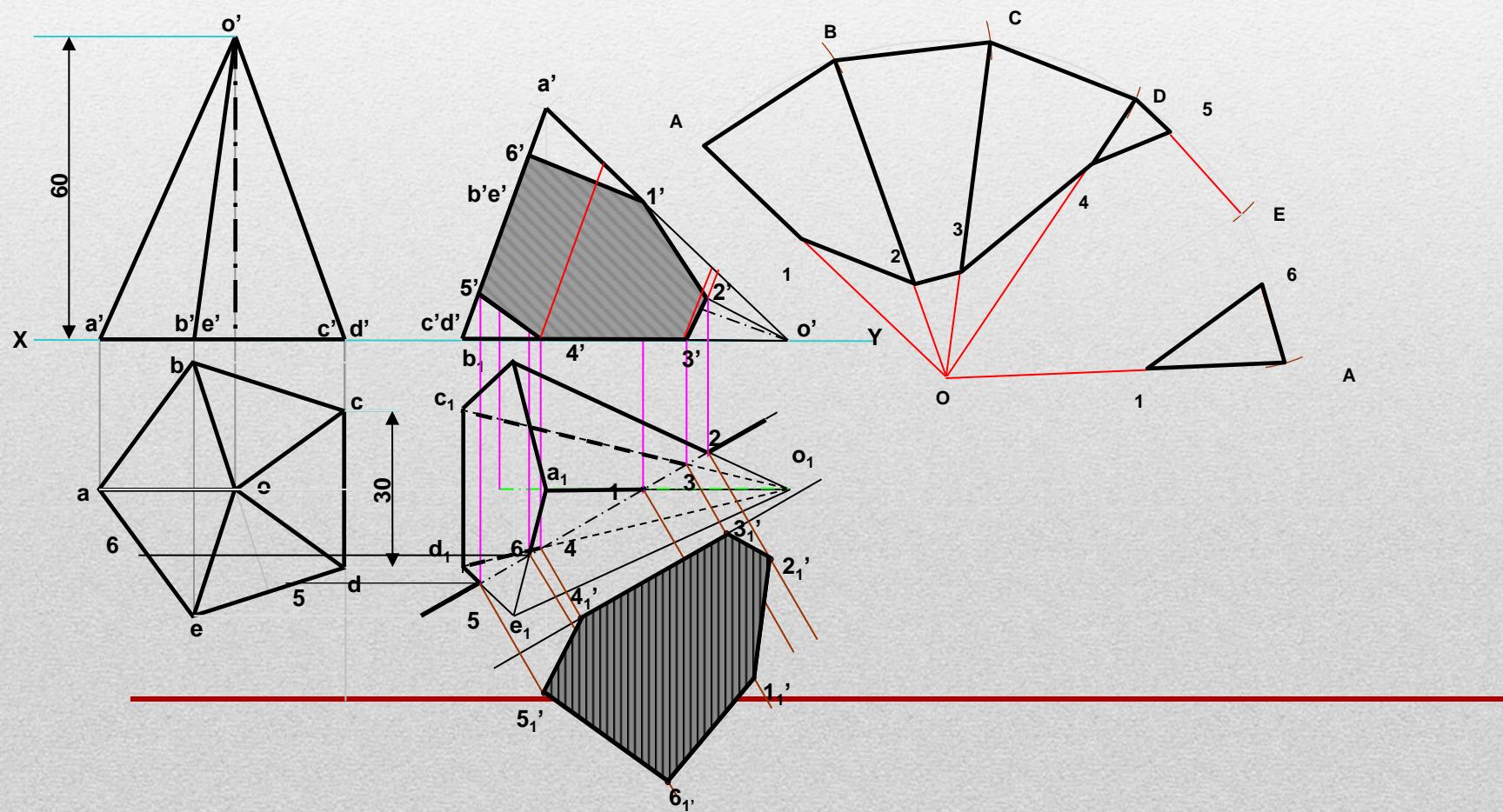
Q 15.26: A right circular cone base 30 mm side and height 50 mm rests on its base on H.P. It is cut by a section plane perpendicular to the V.P., inclined at 45° to the H.P. and bisecting the axis. Draw the projections of the truncated cone and develop its lateral surface.



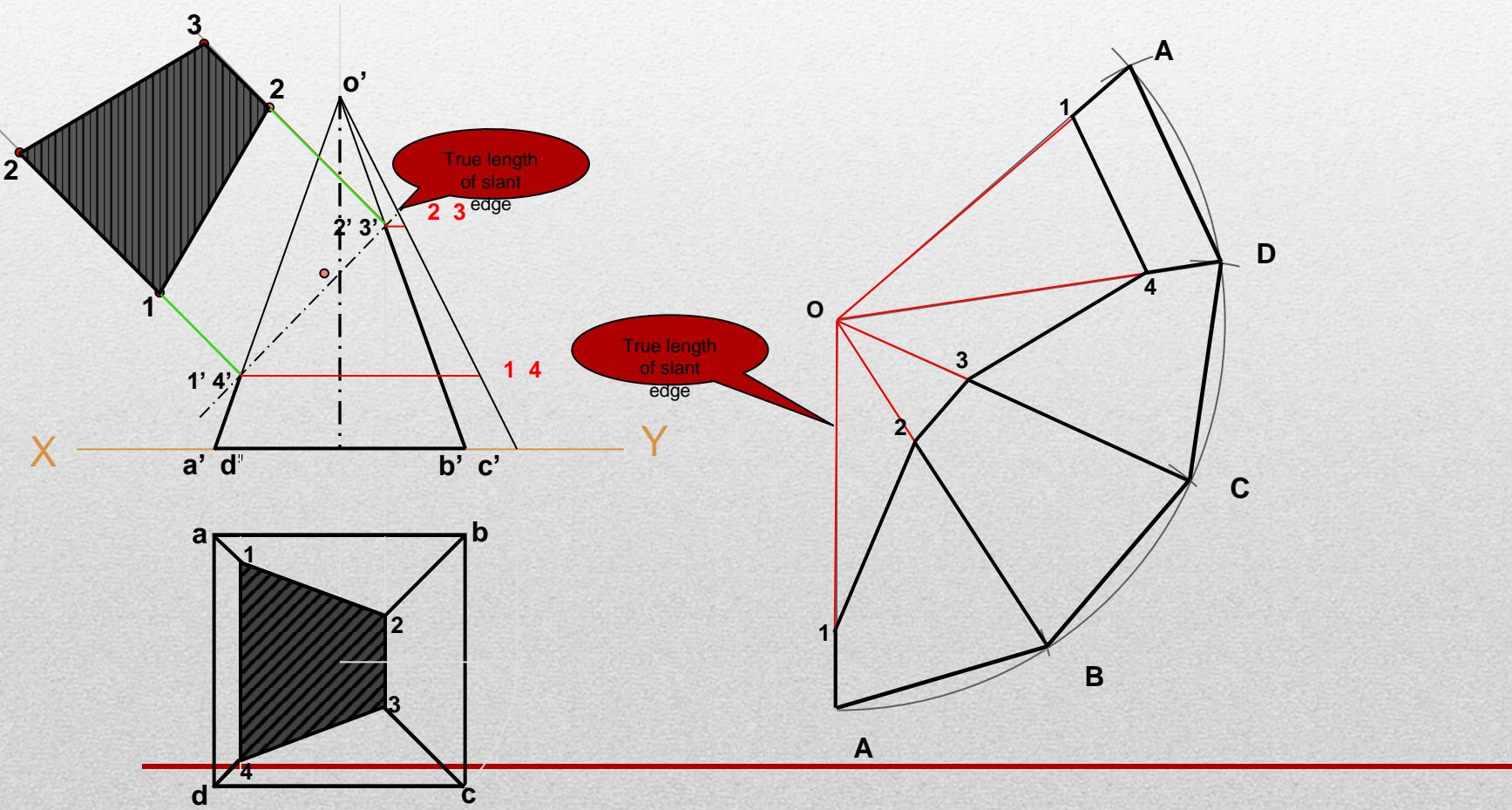
Q 14.11: A square pyramid, base 40 mm side and axis 65 mm long, has its base on the HP and all the edges of the base equally inclined to the VP. It is cut by a section plane, perpendicular to the VP, inclined at 45° to the HP and bisecting the axis. Draw its sectional top view, sectional side view and true shape of the section. Also draw its development.



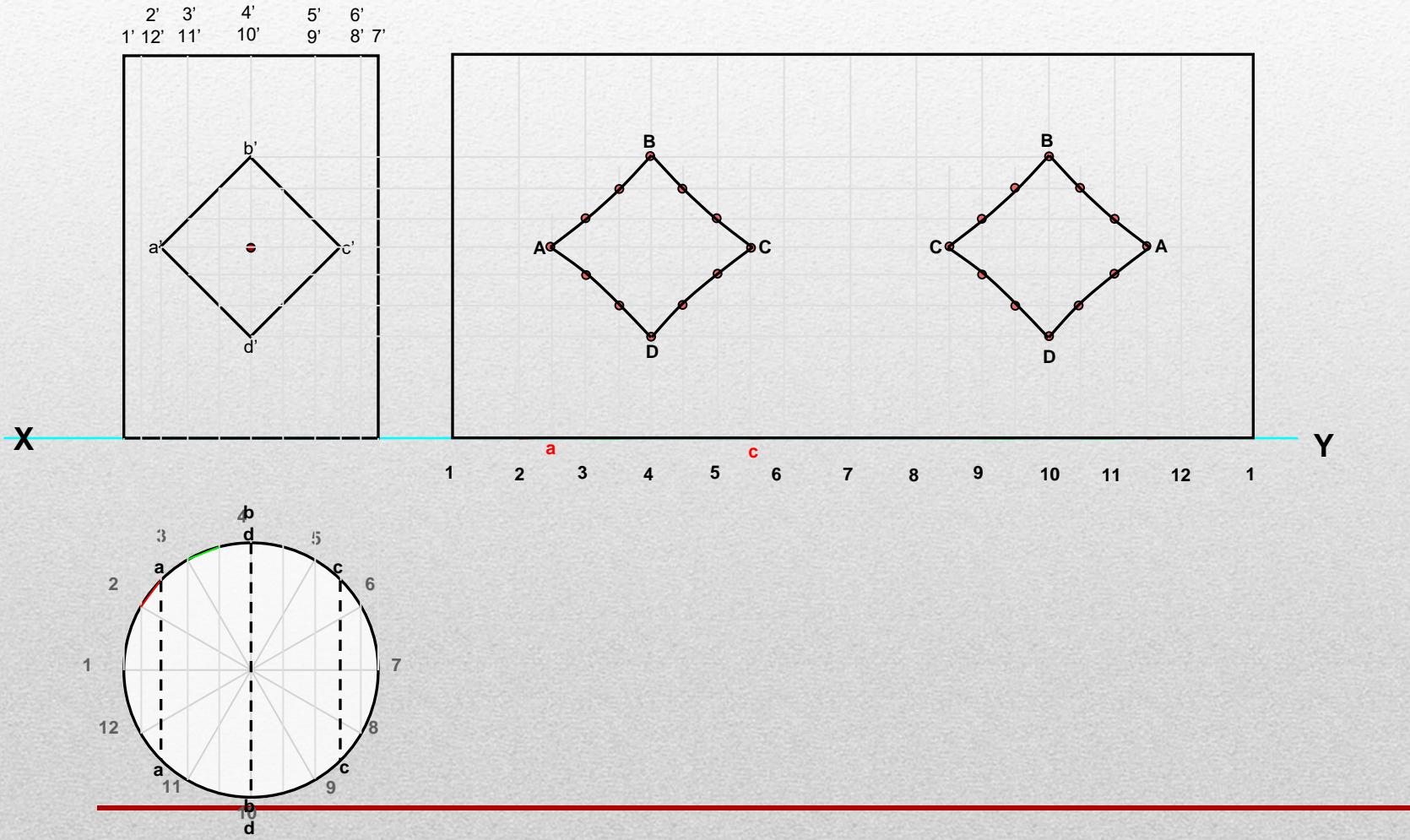
Q 14.14: A pentagonal pyramid , base 30mm side and axis 60 mm long is lying on one of its triangular faces on the HP with the axis parallel to the VP. A vertical section plane, whose HT bisects the top view of the axis and makes an angle of 30° with the reference line, cuts the pyramid removing its top part. Draw the top view, sectional front view and true shape of the section and development of the surface of the remaining portion of the pyramid.



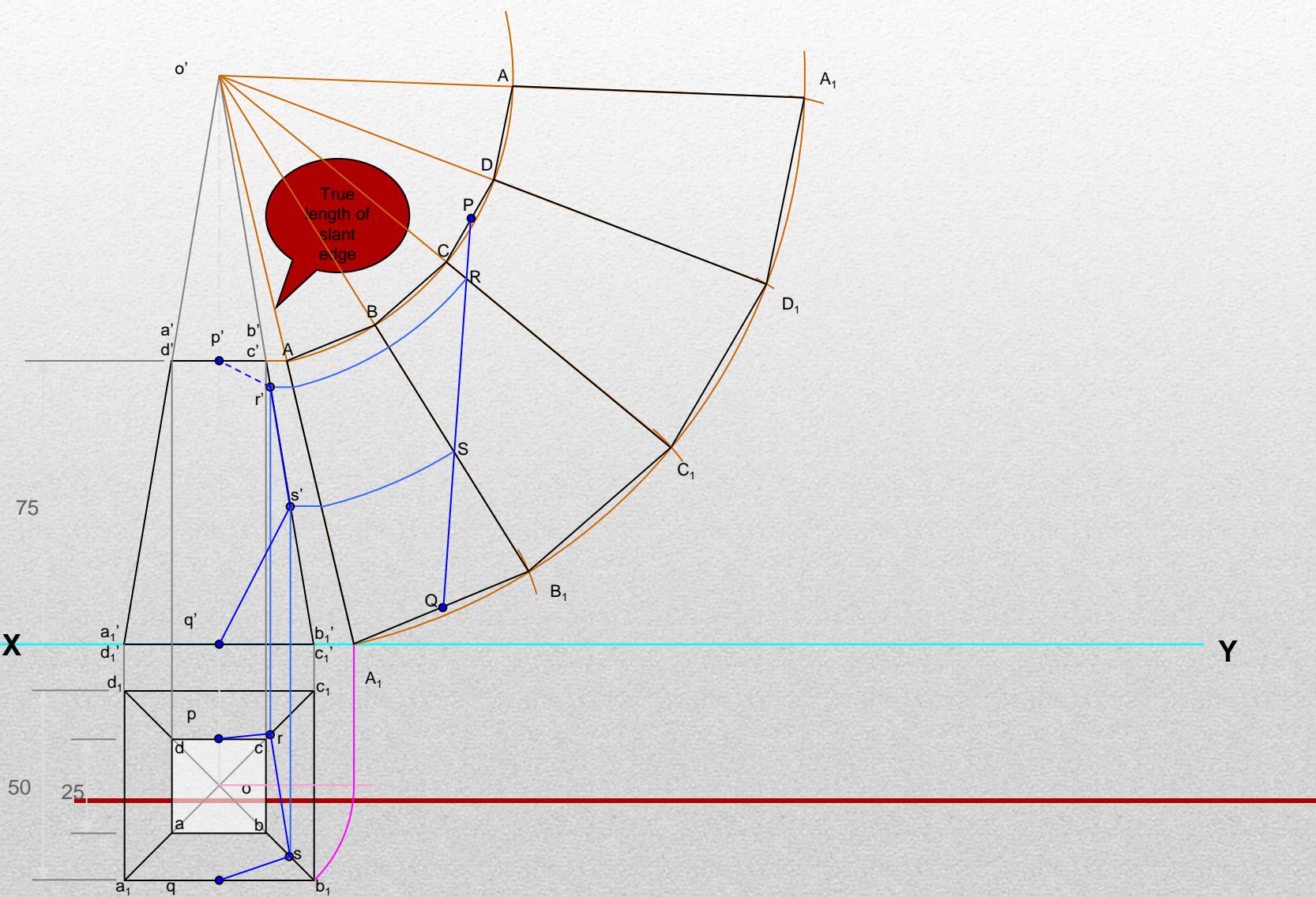
Q 14.11: A square pyramid, base 40 mm side and axis 65 mm long, has its base on the HP with two edges of the base perpendicular to the VP. It is cut by a section plane, perpendicular to the VP, inclined at 45° to the HP and bisecting the axis. Draw its sectional top view and true shape of the section. Also draw its development.



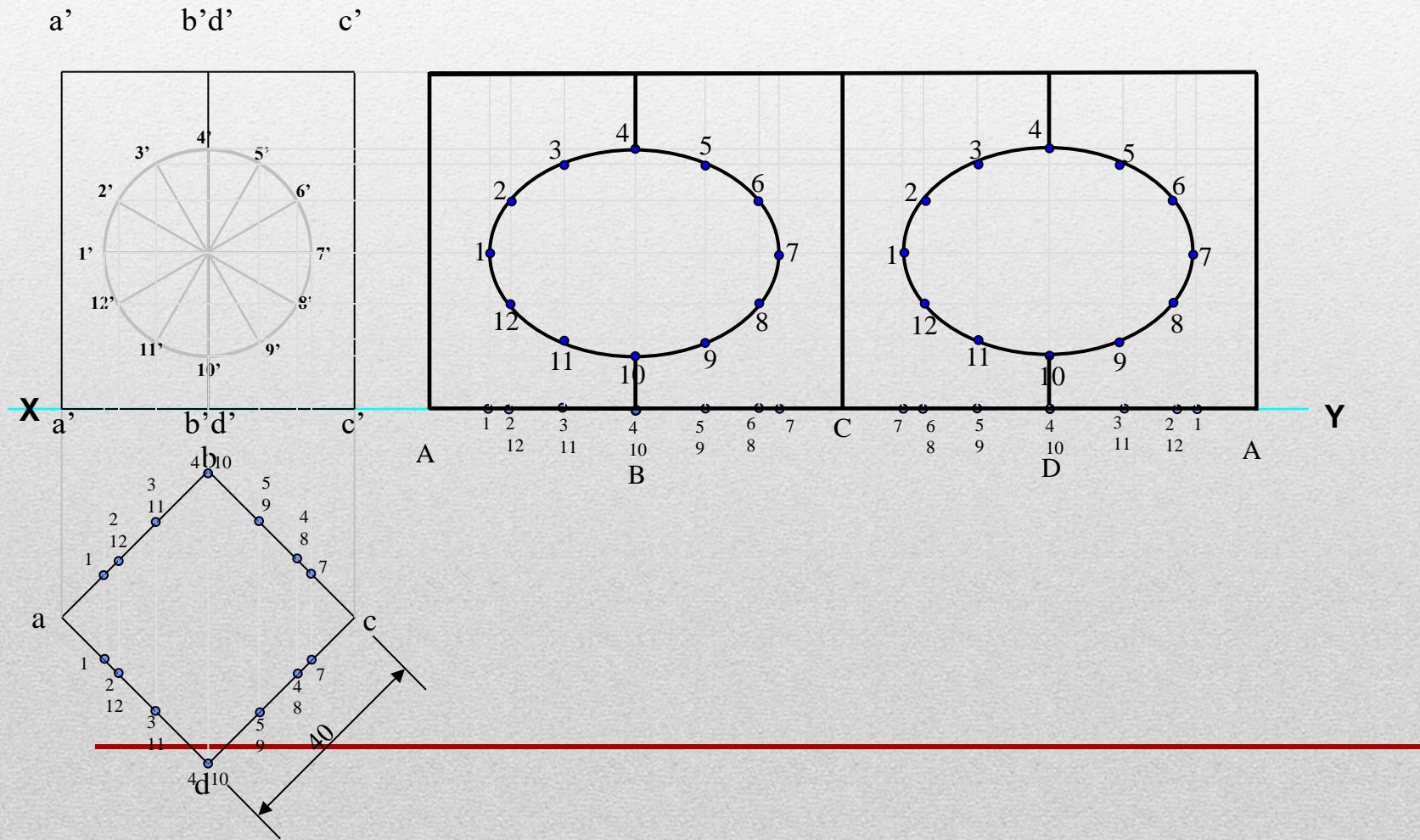
Q.15.11: A right circular cylinder, base 50 mm diameter and axis 60 mm long, is standing on HP on its base. It has a square hole of size 25 in it. The axis of the hole bisects the axis of the cylinder and is perpendicular to the VP. The faces of the square hole are equally inclined with the HP. Draw its projections and develop lateral surface of the cylinder.



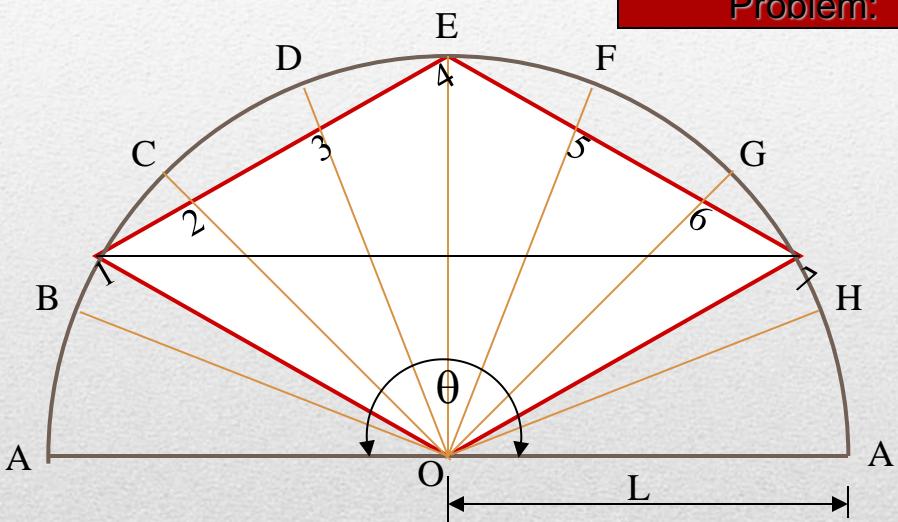
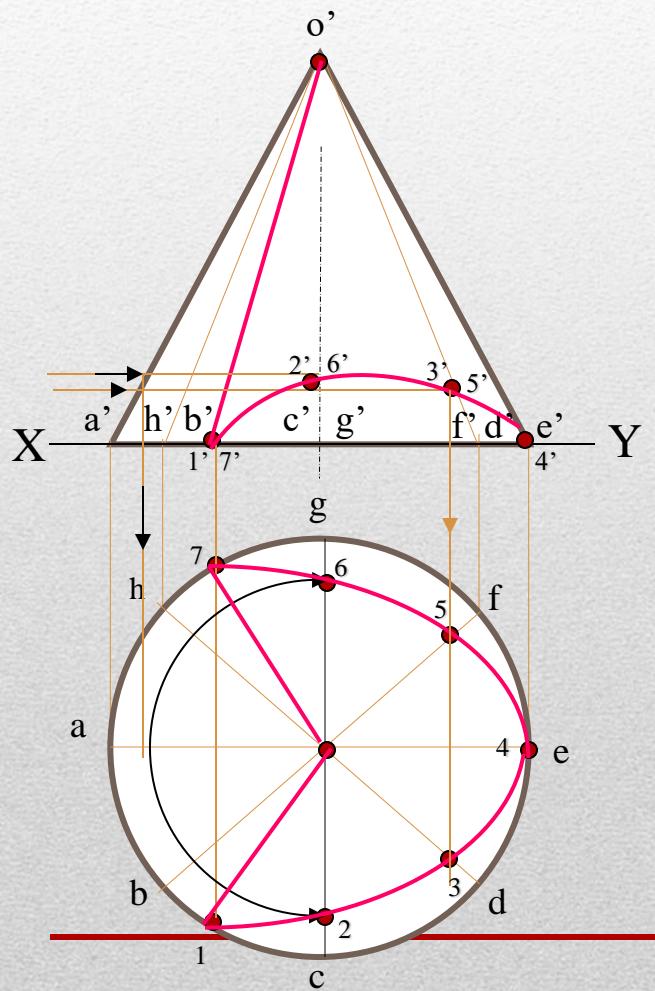
Q.15.21: A frustum of square pyramid has its base 50 mm side, top 25 mm side and axis 75 mm. Draw the development of its lateral surface. Also draw the projections of the frustum (when its axis is vertical and a side of its base is parallel to the VP), showing the line joining the mid point of a top edge of one face with the mid point of the bottom edge of the opposite face, by the shortest distance.



Q: A square prism of 40 mm edge of the base and 65 mm height stands on its base on the HP with vertical faces inclined at 45° with the VP. A horizontal hole of 40 mm diameter is drilled centrally through the prism such that the hole passes through the opposite vertical edges of the prism, draw the development of the surfaces of the prism.



TO DRAW PRINCIPAL VIEWS FROM GIVEN DEVELOPMENT.



R=Base circle radius.

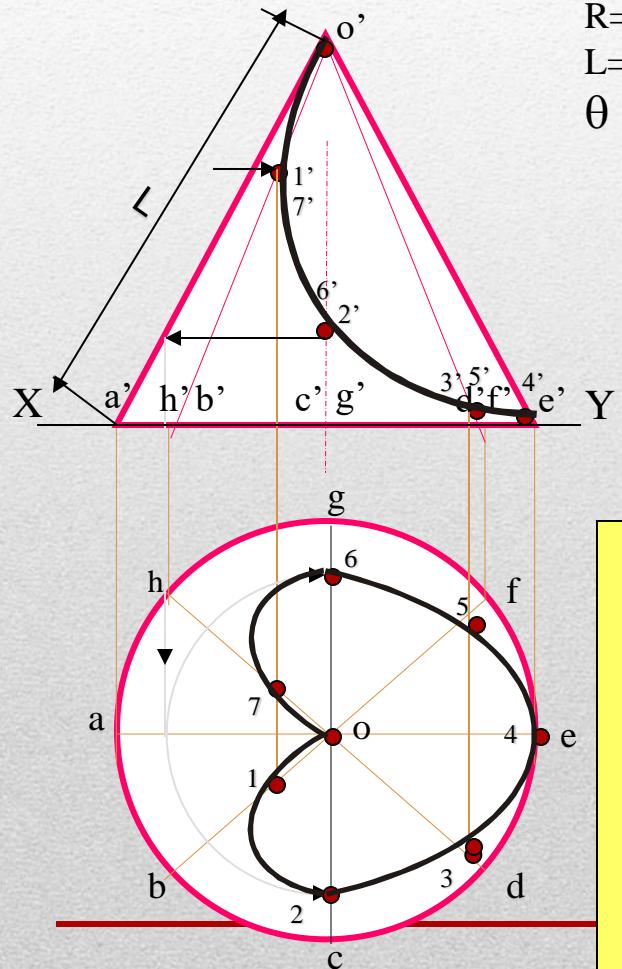
L=Slant height.

$$\theta = \frac{R}{L} \times 360^\circ$$

Solution Steps:
Similar to previous Problem:

Problem 6: Draw a semicircle of 100 mm diameter and inscribe in it a largest circle. If the semicircle is development of a cone and inscribed circle is some curve on it, then draw the projections of cone showing that curve.

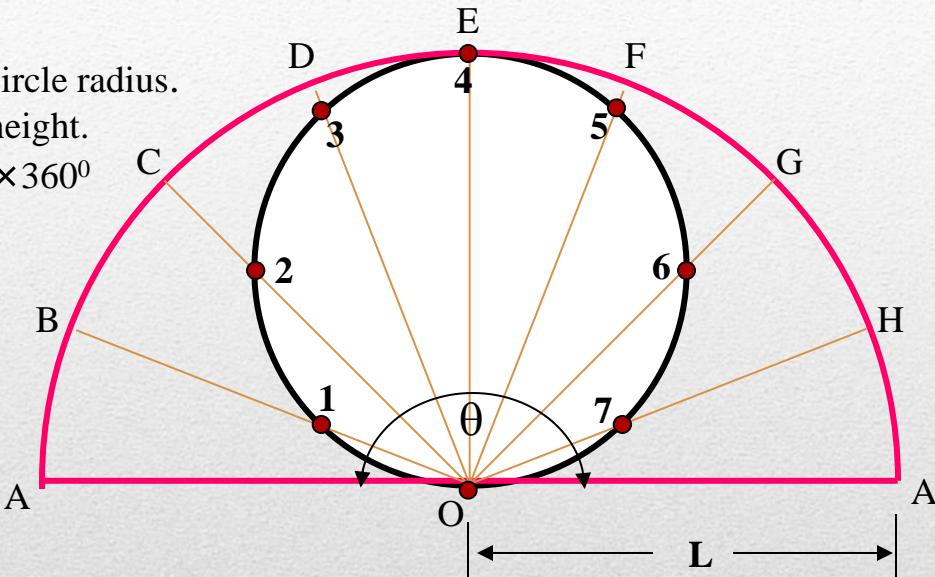
TO DRAW PRINCIPAL VIEWS FROM GIVEN DEVELOPMENT.



R=Base circle radius.

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$$\theta = \frac{R}{L} \times 360^\circ$$

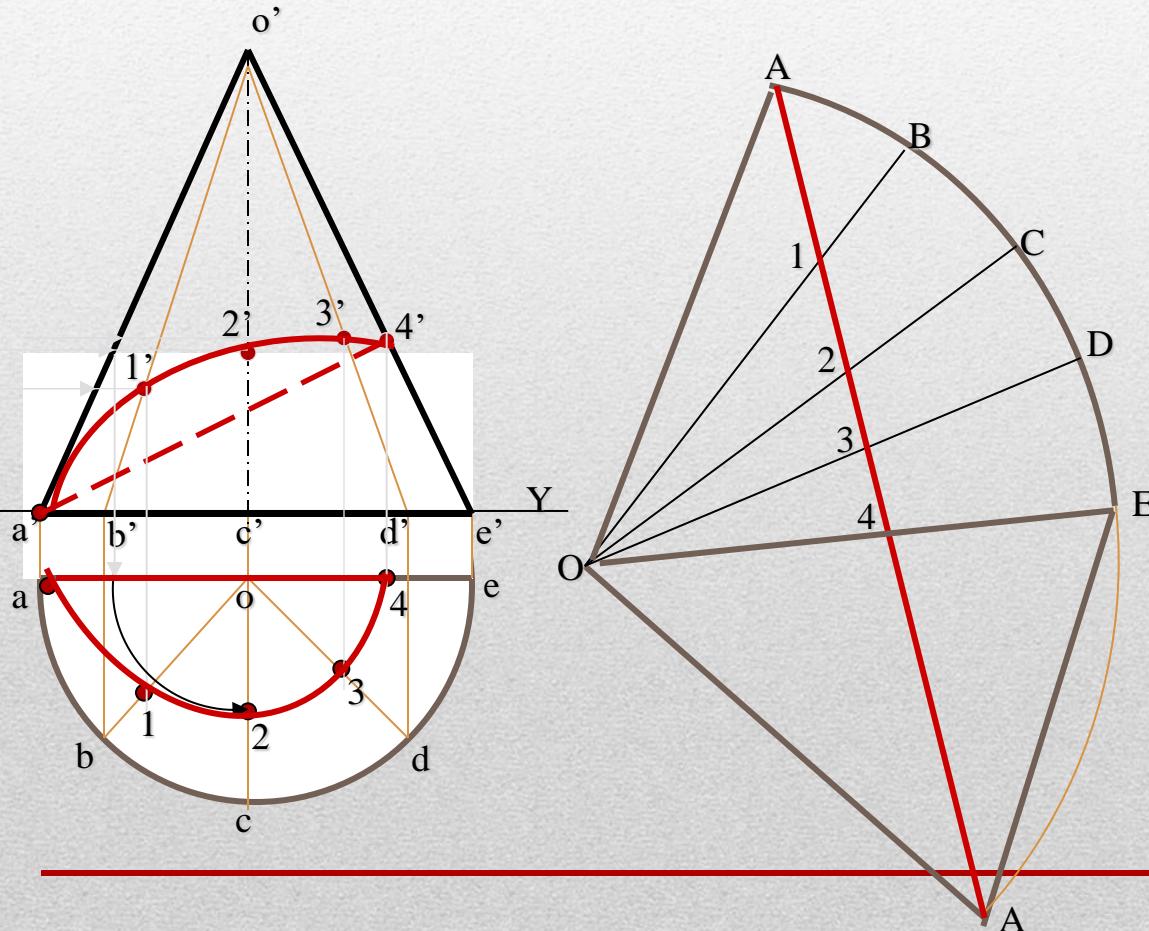


Solution Steps:

Draw semicircle of given diameter, divide it in 8 Parts and inscribe in it a largest circle as shown. Name intersecting points 1, 2, 3 etc. Semicircle being dev.of a cone it's radius is slant height of cone. (L) Then using above formula find R of base of cone. Using this data draw Fv & Tv of cone and form 8 generators and name. Take o -1 distance from dev., mark on TL i.e.o'a' on Fv & bring on o'b' and name 1' Similarly locate all points on Fv. Then project all on Tv on respective generators and join by smooth curve.

Problem 8: A half cone of 50 mm base diameter, 70 mm axis, is standing on it's half base on HP with it's flat face parallel and nearer to VP. An inextensible string is wound round it's surface from one point of base circle and brought back to the same point. If the string is of **shortest length**, find it and show it on the projections of the cone.

TO DRAW A CURVE ON PRINCIPAL VIEWS FROM DEVELOPMENT.

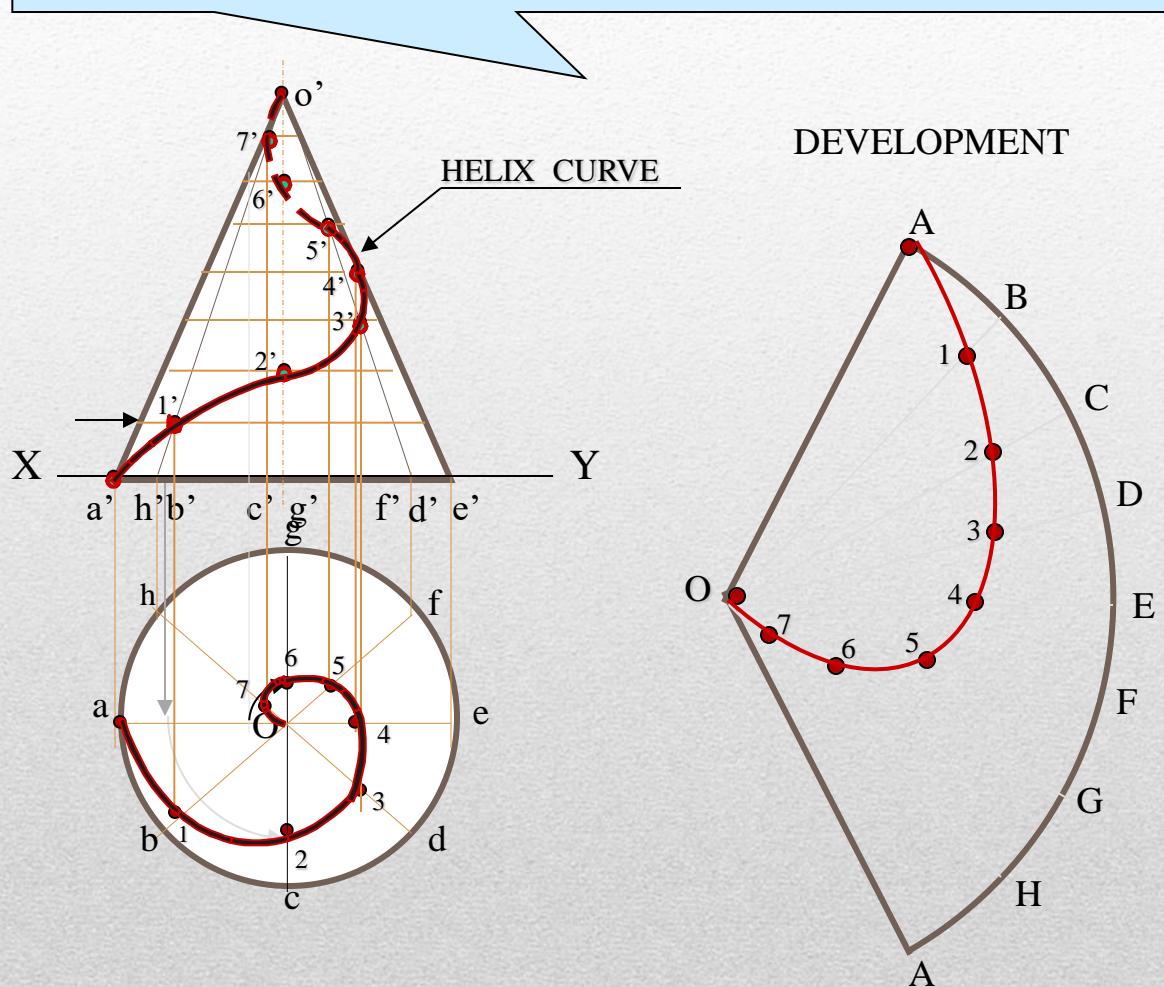


Concept: A string wound from a point up to the same Point, of shortest length
Must appear st. line on it's Development.

Solution steps:
Hence draw development,
Name it as usual and join
A to A This is shortest
Length of that string.
Further steps are as usual.
On dev. Name the points of
Intersections of this line with
Different generators.Bring
Those on Fv & Tv and join
by smooth curves.
Draw 4' a' part of string dotted
As it is on back side of cone.

Problem 9: A particle which is initially on base circle of a cone, standing on Hp, moves upwards and reaches apex in one complete turn around the cone. Draw it's path on projections of cone as well as on its development.

Take base circle diameter 50 mm and axis 70 mm long.



It's a construction of curve Helix of one turn on cone:

Draw Fv & Tv & dev.as usual
On all form generators & name.

Construction of curve Helix::

Show 8 generators on both views
Divide axis also in same parts.
Draw horizontal lines from those
points on both end generators.

1' is a point where first horizontal
Line & gen. b'o' intersect.

2' is a point where second horiz.
Line & gen. c'o' intersect.

In this way locate all points on Fv.
Project all on Tv.Join in curvature.

For Development:

Then taking each points true
Distance From resp.generator
from apex, Mark on development
& join.