SECTIONING A SOLID.

An object (here a solid) is cut by some imaginary cutting plane to understand internal details of that object.

The action of cutting is called SECTIONING a solid

&

The plane of cutting is called SECTION PLANE.

Two cutting actions means section planes are recommended.

A) Section Plane perpendicular to Vp and inclined to Hp.
(This is a definition of an Aux. Inclined Plane i.e. A.I.P.)
NOTE:- This section plane appears as a straight line in FV.

B) Section Plane perpendicular to Hp and inclined to Vp.
(This is a definition of an Aux. Vertical Plane i.e. A.V.P.)
NOTE:- This section plane appears as a straight line in TV.

Remember:-

1. After launching a section plane either in FV or TV, the part towards observer is assumed to be removed.
2. As far as possible the smaller part is assumed to be removed.

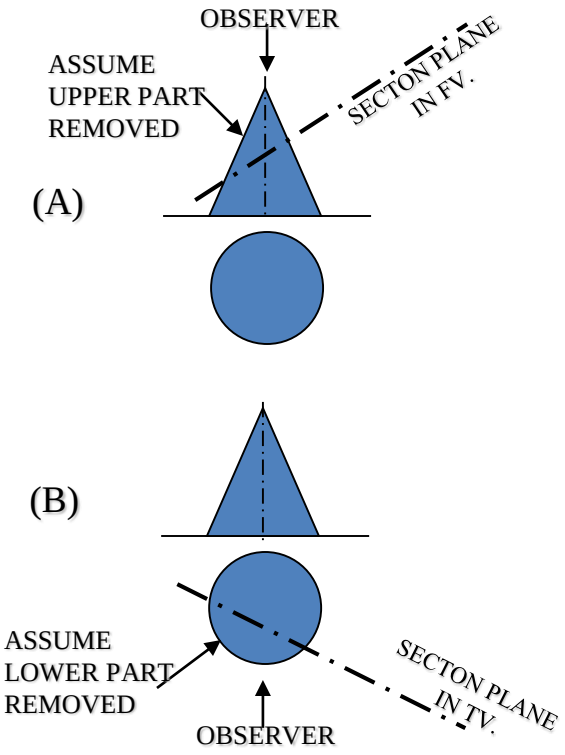
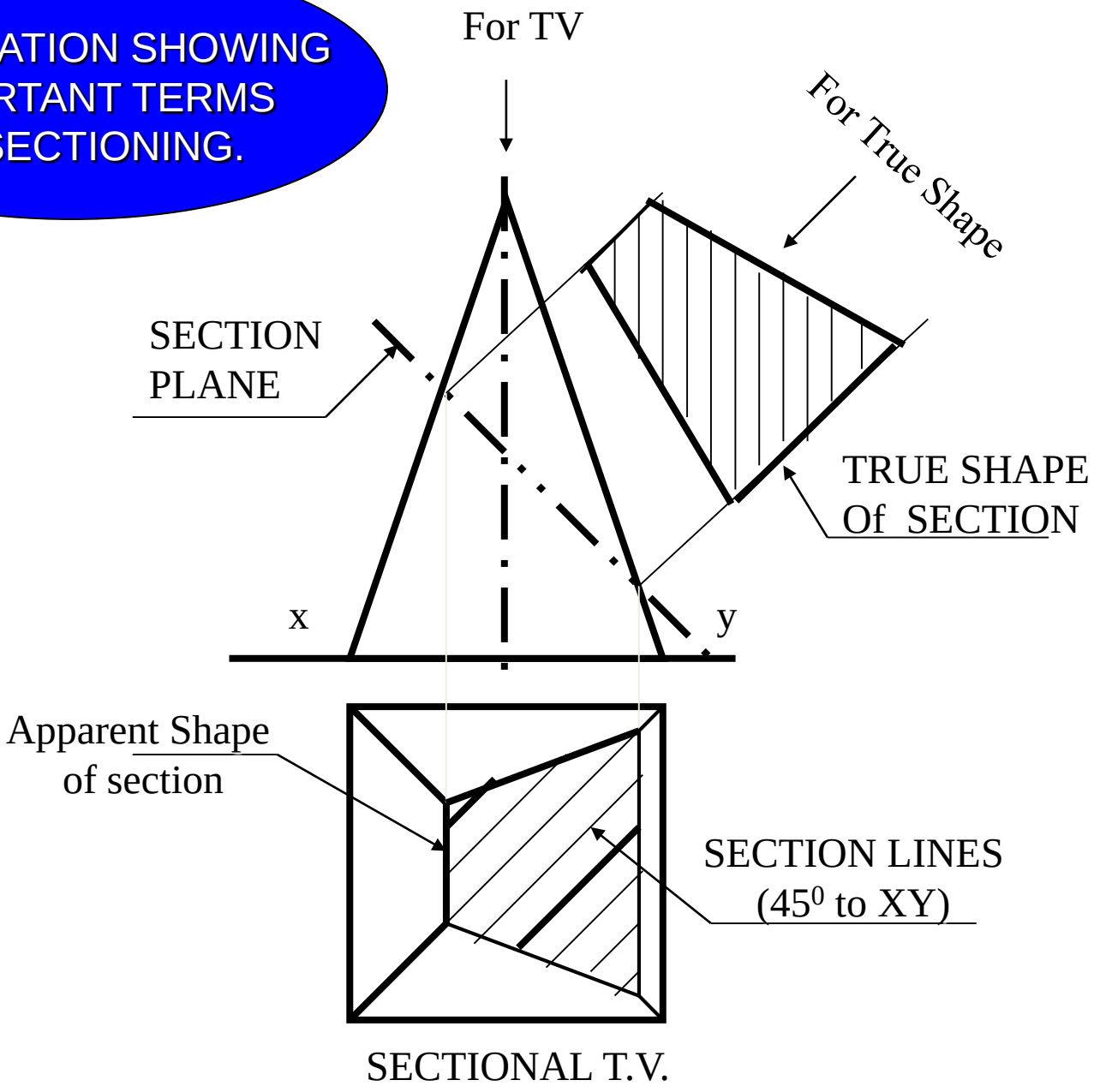
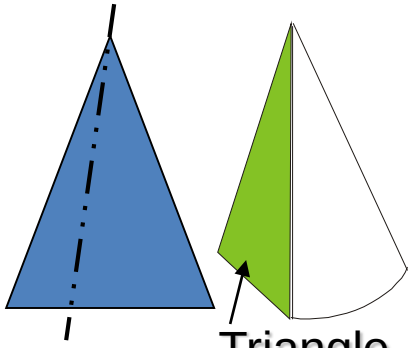


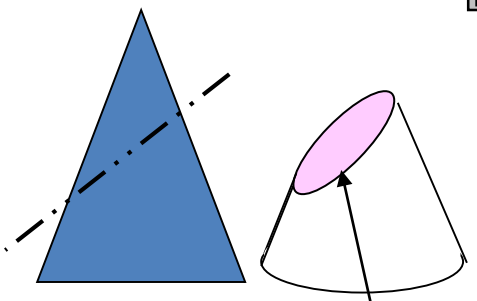
ILLUSTRATION SHOWING IMPORTANT TERMS IN SECTIONING.



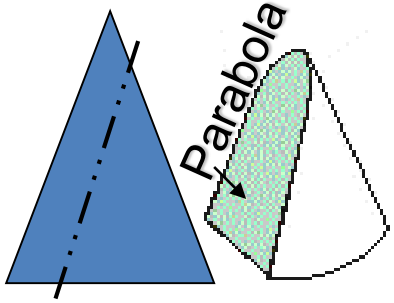
Typical Section Planes
&
Typical Shapes
Of
Sections.



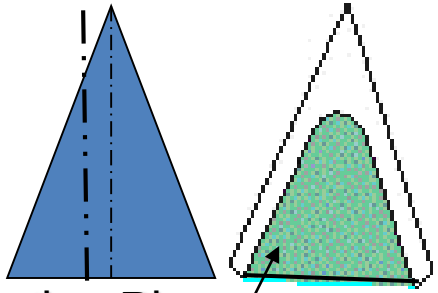
Section Plane
Through Apex



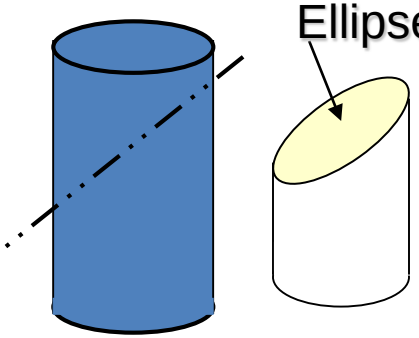
Section Plane
Through Generators



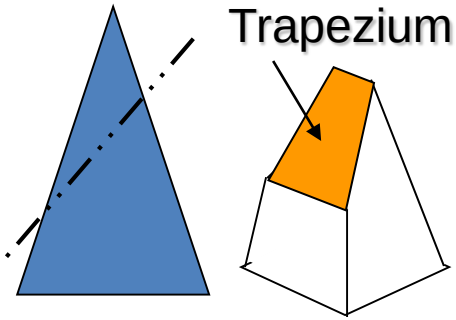
Section Plane Parallel
to end generator.



Section Plane
Parallel to Axis.



Cylinder through
generators.



Sq. Pyramid through
all slant edges

DEVELOPMENT OF SURFACES OF SOLIDS.

MEANING:-

ASSUME OBJECT HOLLOW AND MADE-UP OF THIN SHEET. CUT OPEN IT FROM ONE SIDE AND UNFOLD THE SHEET COMPLETELY. THEN THE SHAPE OF THAT UNFOLDED SHEET IS CALLED DEVELOPMENT OF LATERLAL SUEFACES OF THAT OBJECT OR SOLID.

LATERLAL SURFACE IS THE SURFACE EXCLUDING SOLID'S TOP & BASE.

ENGINEERING APLICATION:

THERE ARE SO MANY PRODUCTS OR OBJECTS WHICH ARE DIFFICULT TO MANUFACTURE BY CONVENTIONAL MANUFACTURING PROCESSES, BECAUSE OF THEIR SHAPES AND SIZES. THOSE ARE FABRICATED IN SHEET METAL INDUSTRY BY USING DEVELOPMENT TECHNIQUE. THERE IS A VAST RANGE OF SUCH OBJECTS.

EXAMPLES:-

Boiler Shells & chimneys, Pressure Vessels, Shovels, Trays, Boxes & Cartons, Feeding Hoppers, Large Pipe sections, Body & Parts of automotives, Ships, Aeroplanes and many more.

WHAT IS OUR OBJECTIVE IN THIS TOPIC ?

To learn methods of development of surfaces of different solids, their sections and frustums.

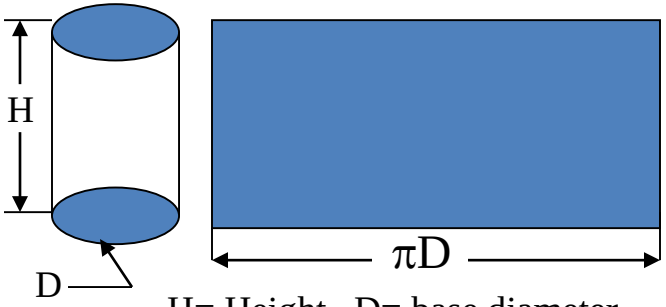
But before going ahead, note following Important points.

1. Development is different drawing than PROJECTIONS.
2. It is a shape showing AREA, means it's a 2-D plain drawing.
3. Hence all dimensions of it must be TRUE dimensions.
4. As it is representing shape of an un-folded sheet, no edges can remain hidden And hence DOTTED LINES are never shown on development.

Study illustrations given on next page carefully.

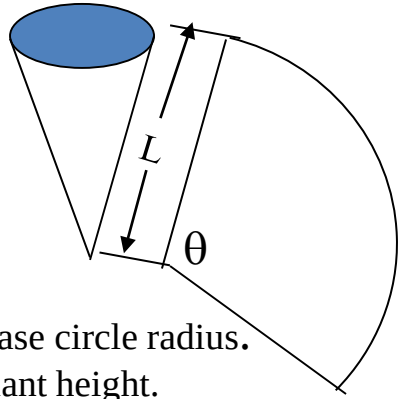
Development of lateral surfaces of different solids.
(Lateral surface is the surface excluding top & base)

Cylinder: A Rectangle



H= Height D= base diameter

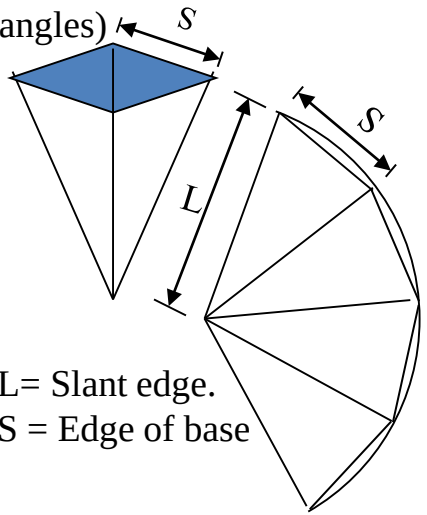
Cone: (Sector of circle)



R=Base circle radius.
L=Slant height.

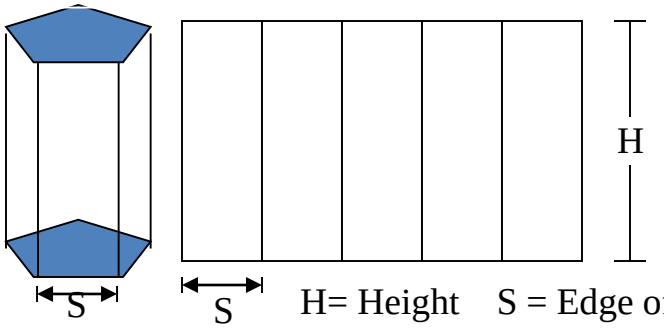
$$\theta = \frac{R}{L} \times 360^0$$

Pyramids: (No.of triangles)



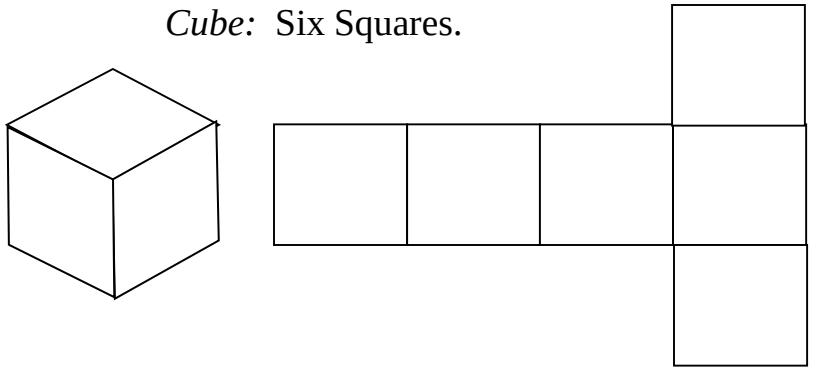
L= Slant edge.
S = Edge of base

Prisms: No.of Rectangles

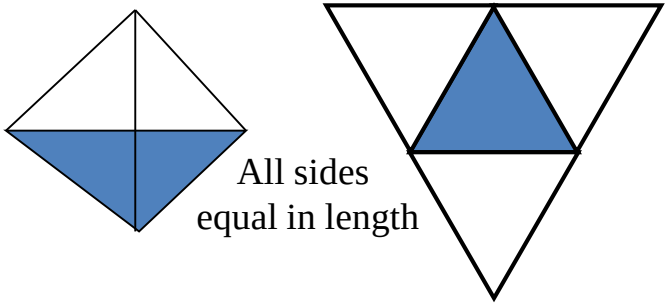


H= Height S = Edge of base

Cube: Six Squares.



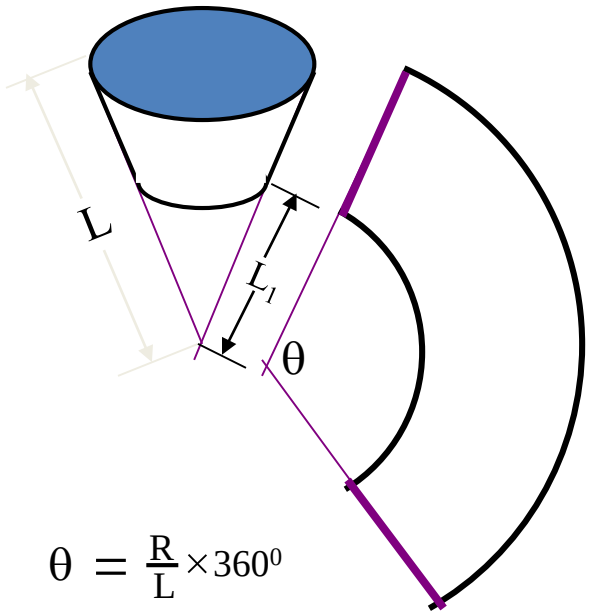
Tetrahedron: Four Equilateral Triangles



All sides equal in length

FRUSTUMS

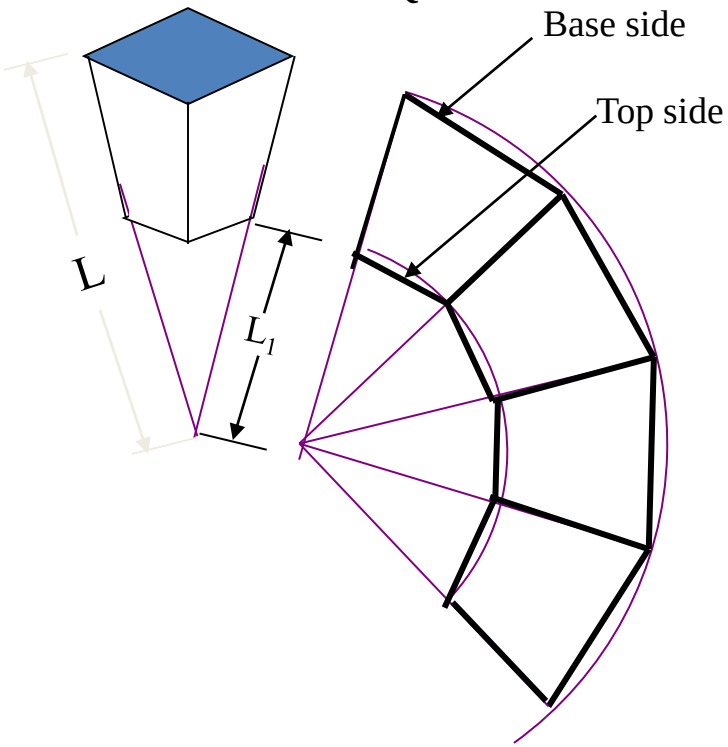
DEVELOPMENT OF FRUSTUM OF CONE



$$\theta = \frac{R}{L} \times 360^0$$

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

DEVELOPMENT OF FRUSTUM OF SQUARE PYRAMID

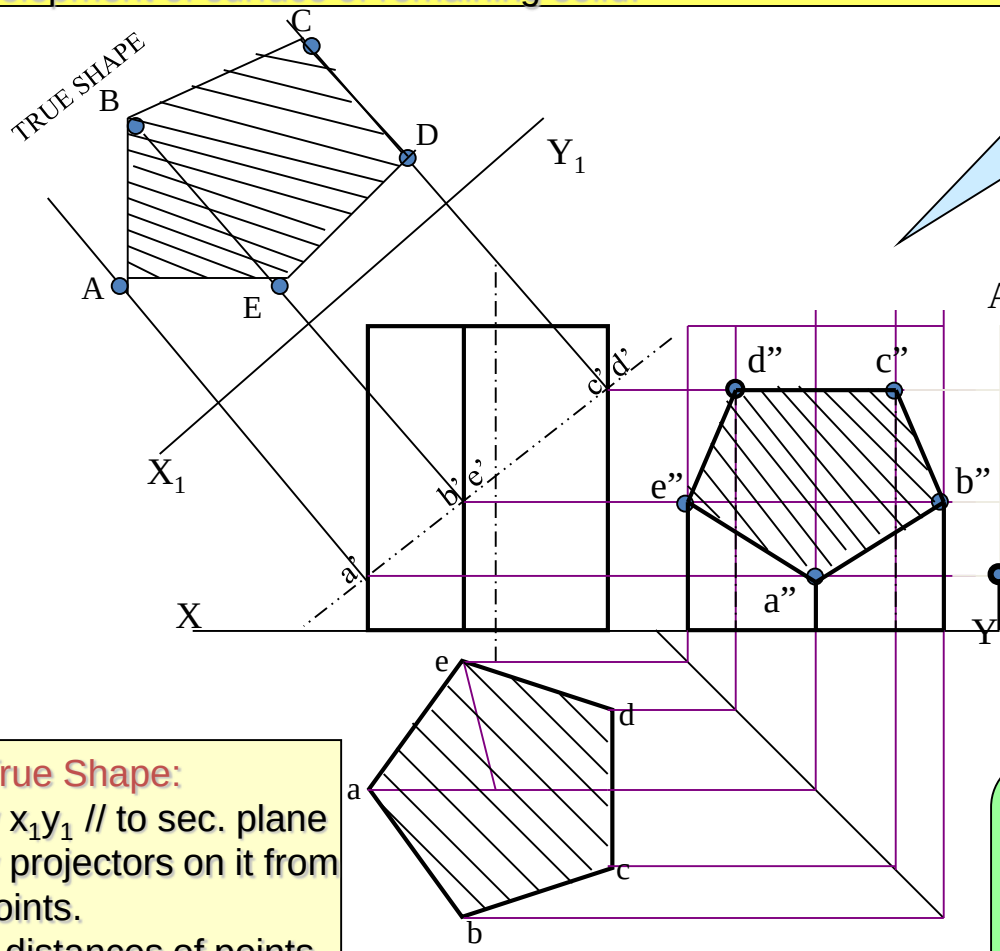


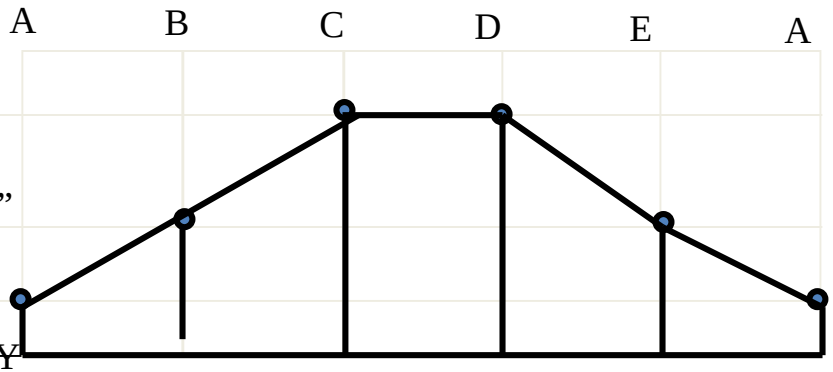
L= Slant edge of pyramid
L_1 = Slant edge of cut part.

STUDY NEXT *NINE* PROBLEMS OF SECTIONS & DEVELOPMENT

Problem 1: A pentagonal prism , 30 mm base side & 50 mm axis is standing on Hp on it's base whose one side is perpendicular to Vp. It is cut by a section plane 45^0 inclined to 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.

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.





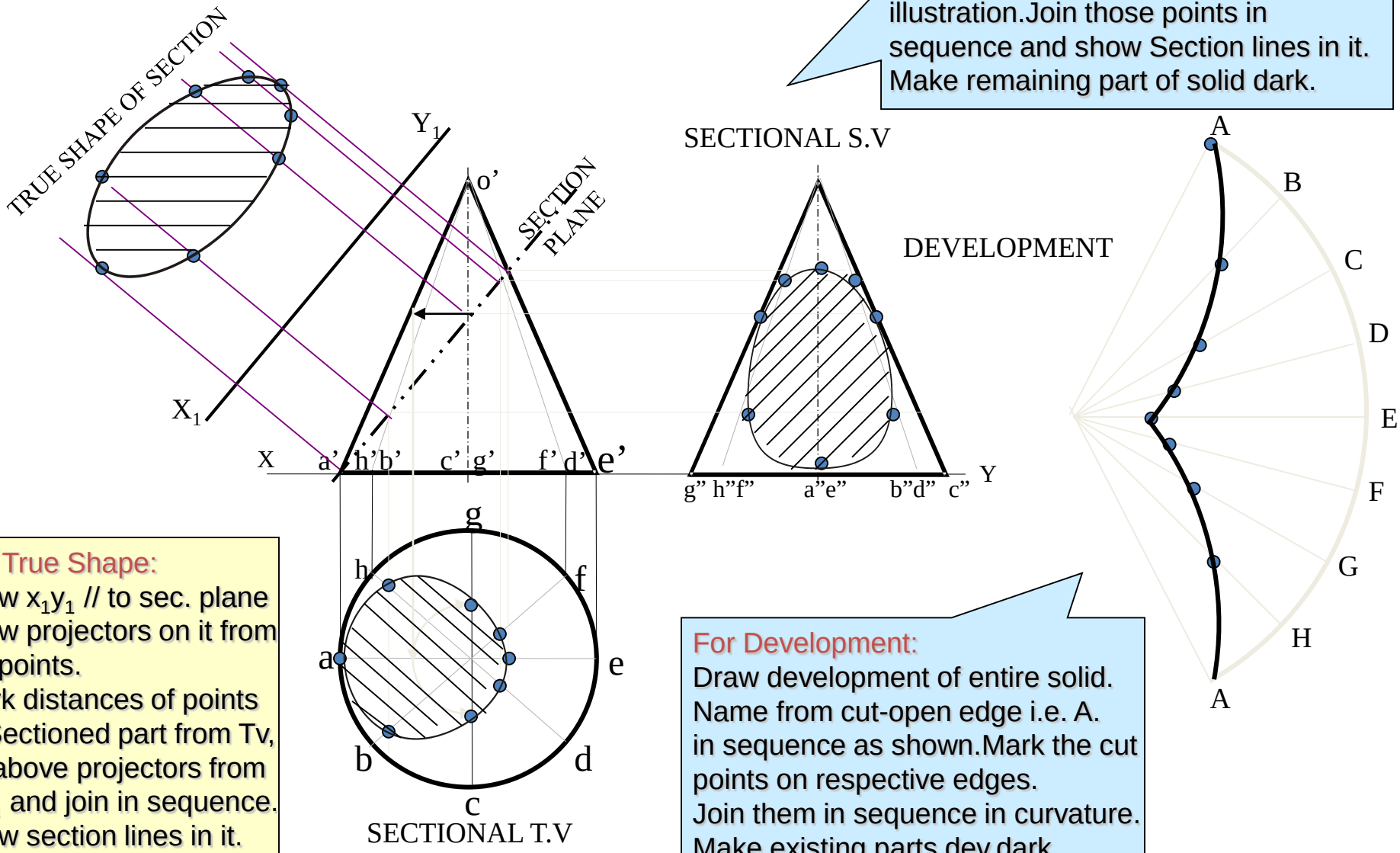
DEVELOPMENT

For True Shape:
Draw x_1y_1 // 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.

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 it's base on Hp. It cut by a section plane 45^0 inclined to Hp through base end of end generator.Draw projections, sectional views, true shape of section and development of surfaces of remaining solid.

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.

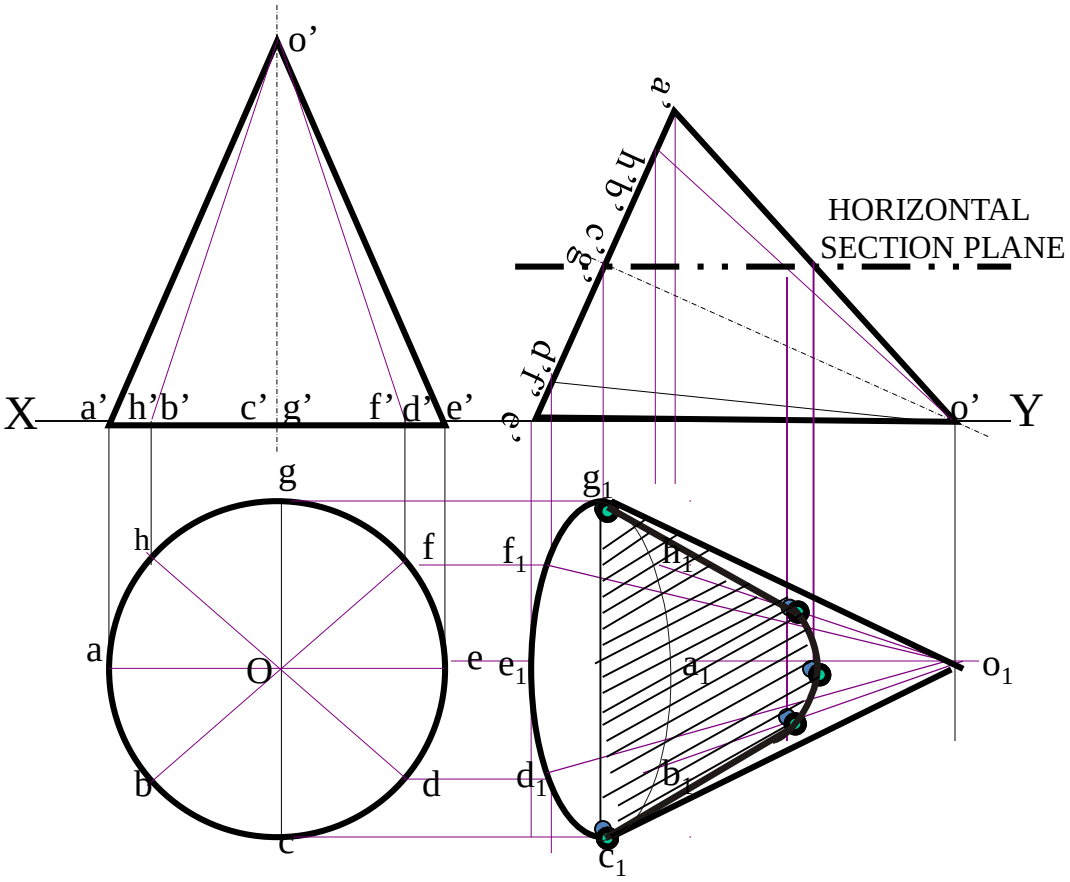


For True Shape:
Draw x_1y_1 // to sec. plane
Draw projectors on it from cut points.
Mark distances of points of Sectioned part from Tv, on above projectors from x_1y_1 and join in sequence.
Draw section lines in it.
It is required true shape.

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.

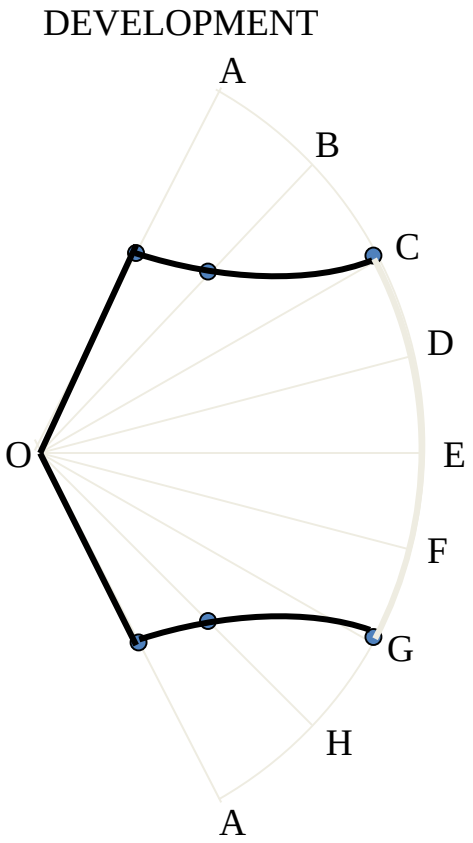
Problem 3: A cone 40mm diameter and 50 mm axis is resting on one generator on Hp(lying on Hp) which is // to Vp.. Draw it's projections.It is cut by a horizontal section plane through it's base center. Draw sectional TV, development of the surface of the remaining part of cone.

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



SECTIONAL T.V

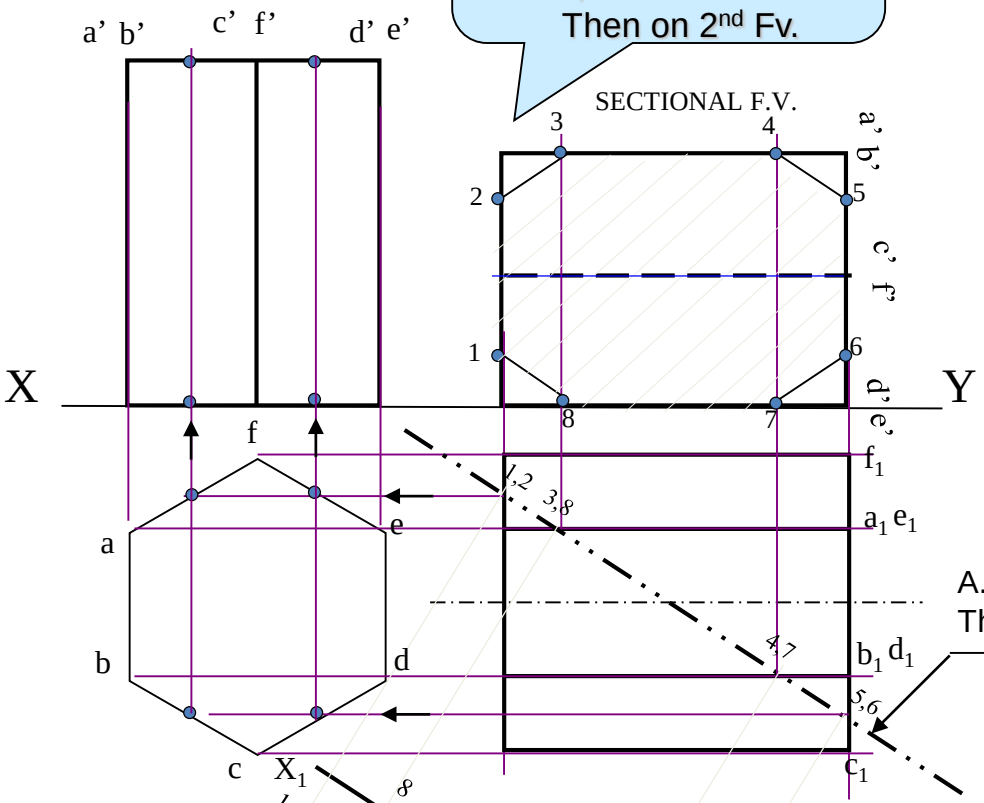
(SHOWING TRUE SHAPE OF SECTION)

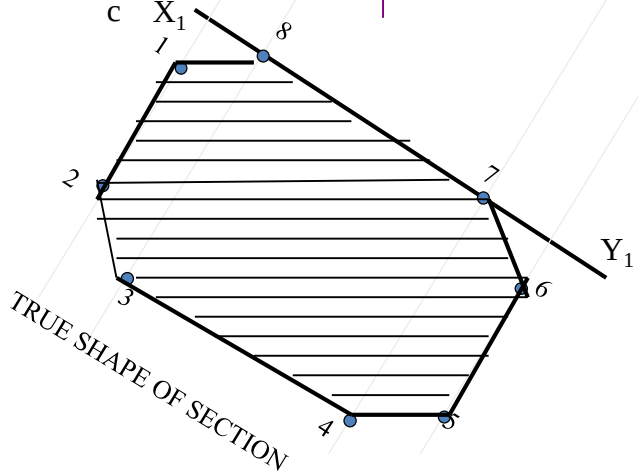


Note the steps to locate Points 1, 2 , 5, 6 in sec.Fv: Those are transferred to 1st TV, then to 1st Fv and Then on 2nd Fv.

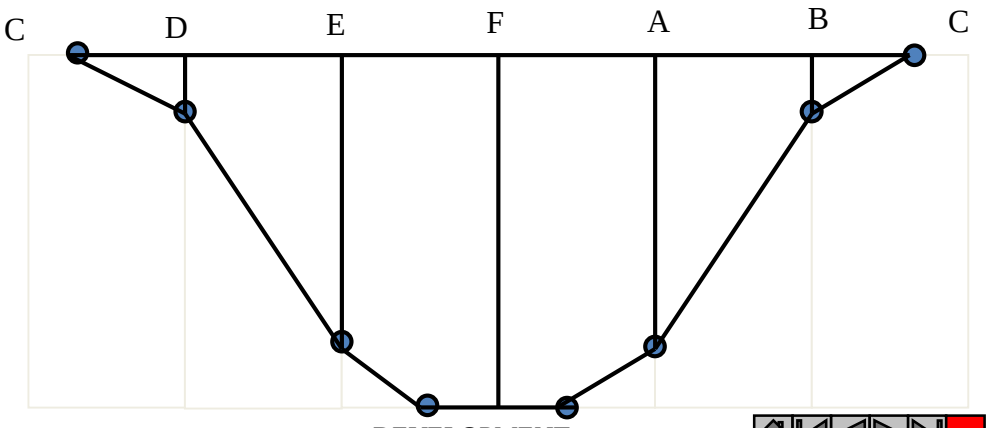
Problem 4: A hexagonal prism. 30 mm base side & 55 mm axis is lying on Hp on it's rect.face with axis // to Vp. It is cut by a section plane normal to Hp and 30^0 inclined to Vp bisecting axis.
Draw sec. Views, true shape & development.

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.



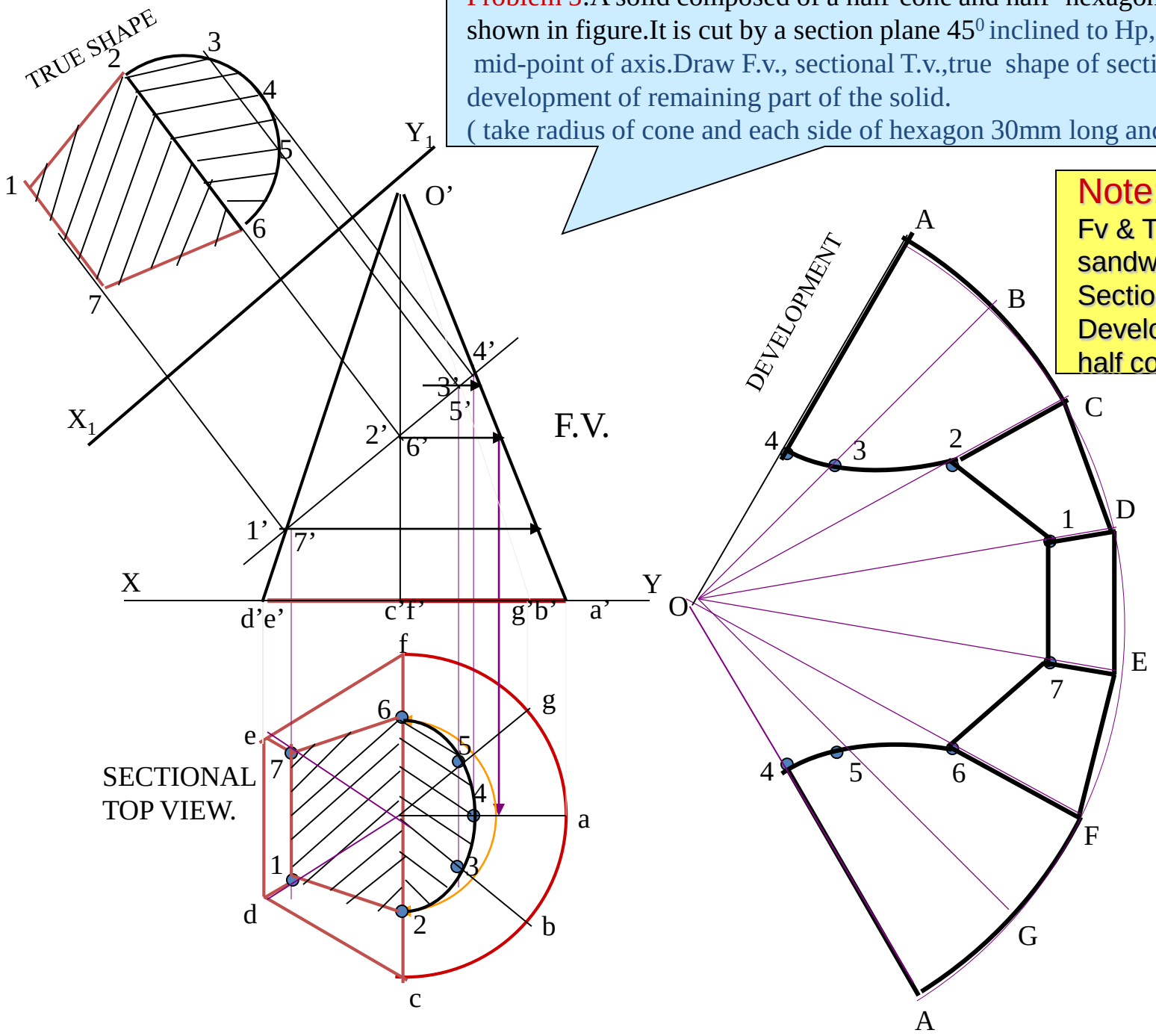


AS SECTION PLANE IS IN T.V.,
CUT OPEN FROM BOUNDRY EDGE C_1 FOR DEVELOPMENT.



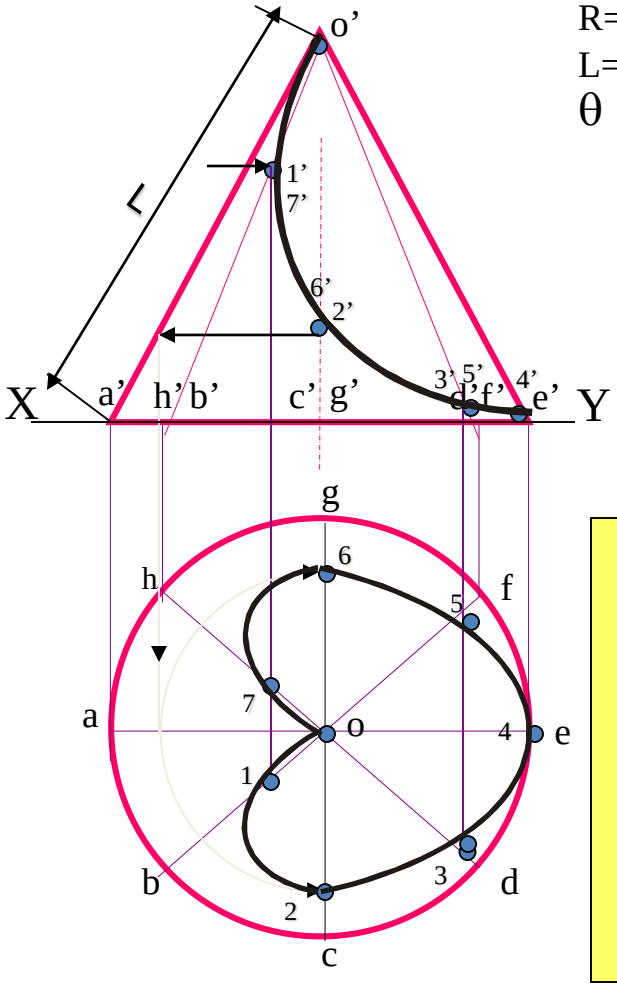
Problem 5:A solid composed of a half-cone and half- hexagonal pyramid is shown in figure.It is cut by a section plane 45^0 inclined to Hp, passing through mid-point of axis.Draw F.v., sectional T.v.,true shape of section and development of remaining part of the solid.
(take radius of cone and each side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

Note:
Fv & TV 8f two solids sandwiched
Section lines style in both:
Development of
half cone & half pyramid:



Problem 6: Draw a semicircle 0f 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.

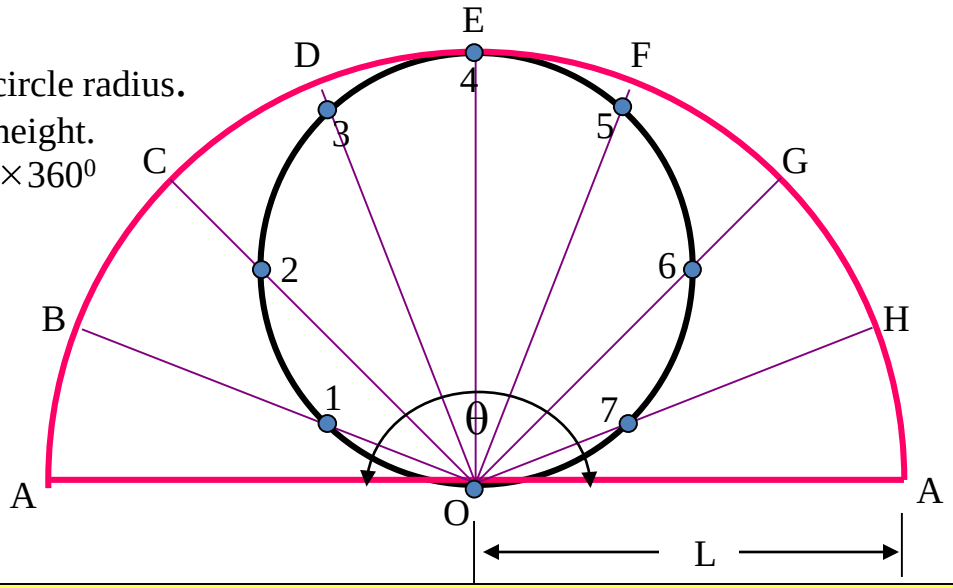
TO DRAW PRINCIPAL VIEWS FROM GIVEN DEVELOPMENT.



R=Base circle radius.

L=Slant height.

$$\theta = \frac{R}{L} \times 360^0$$



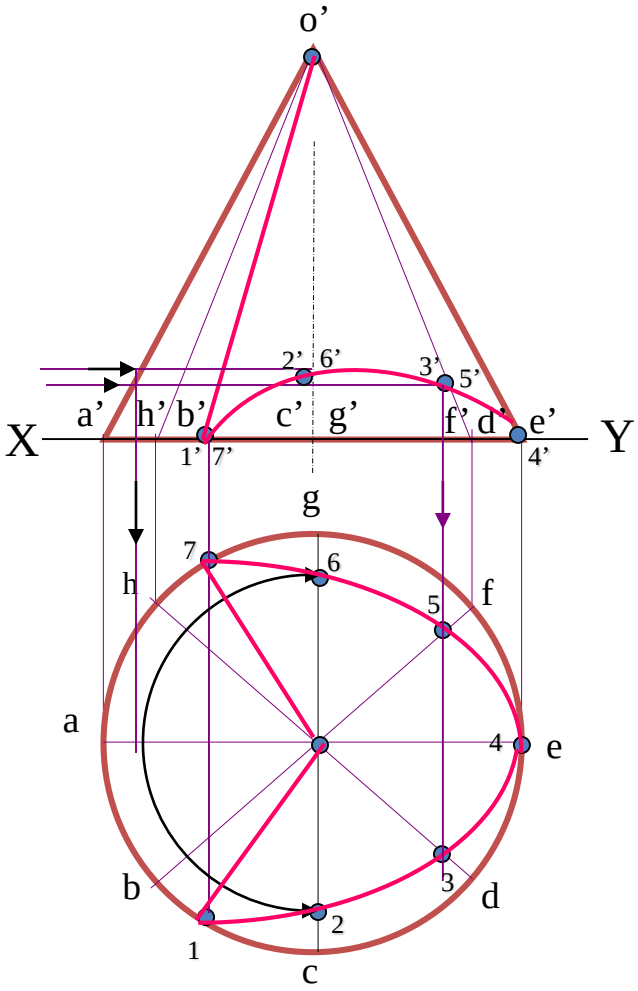
Solution Steps:

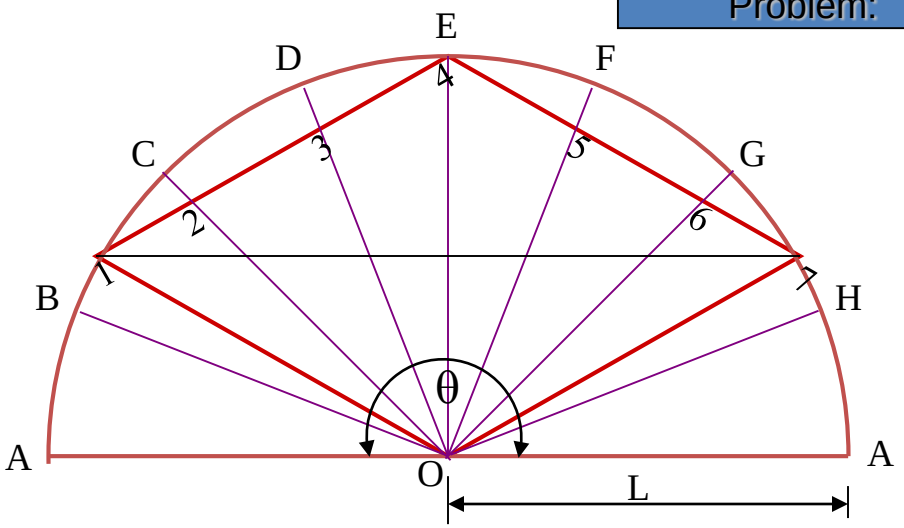
Draw semicircle of given diameter, divide it in 8 Parts and inscribe in it a largest circle as shown.Name intersecting points 1, 2, 3 etc.
Semicircle being dev.of a cone it's radius is slant height of cone.(L)
Then using above formula find R of base of cone. Using this data draw Fv & Tv of cone and form 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 7:Draw a semicircle 0f 100 mm diameter and inscribe in it a largest rhombus.If the semicircle is development of a cone and rhombus is some curve on it, then draw the projections of cone showing that curve.

TO DRAW PRINCIPAL VIEWS FROM GIVEN DEVELOPMENT.

Solution Steps:
Similar to previous Problem:





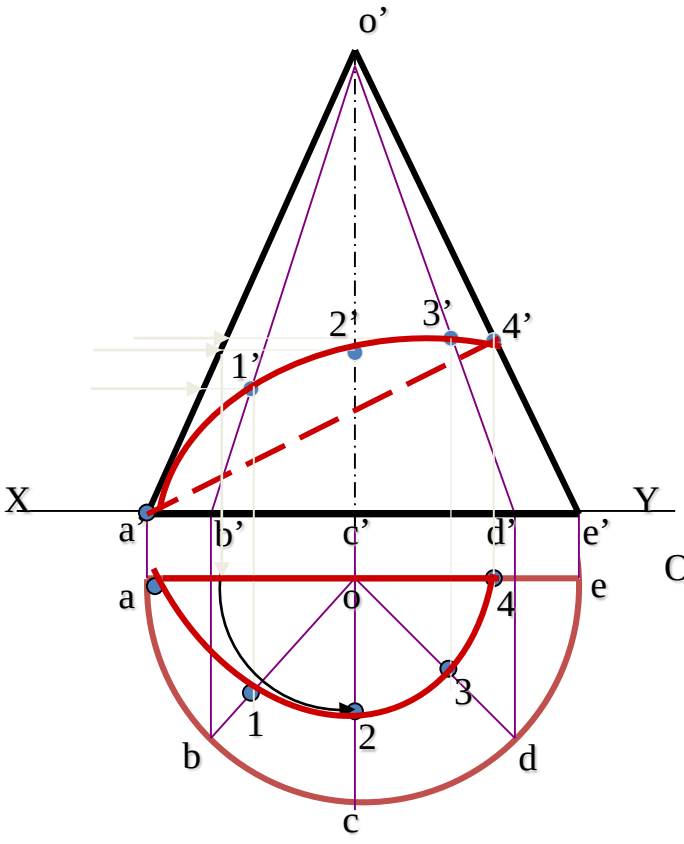
R=Base circle radius.

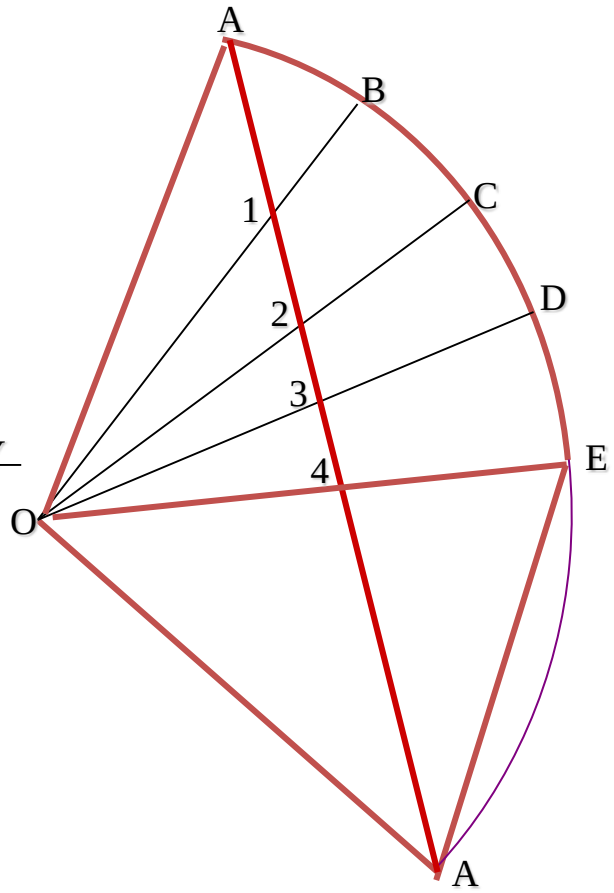
L=Slant height.

$$\theta = \frac{R}{L} \times 360^0$$

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.



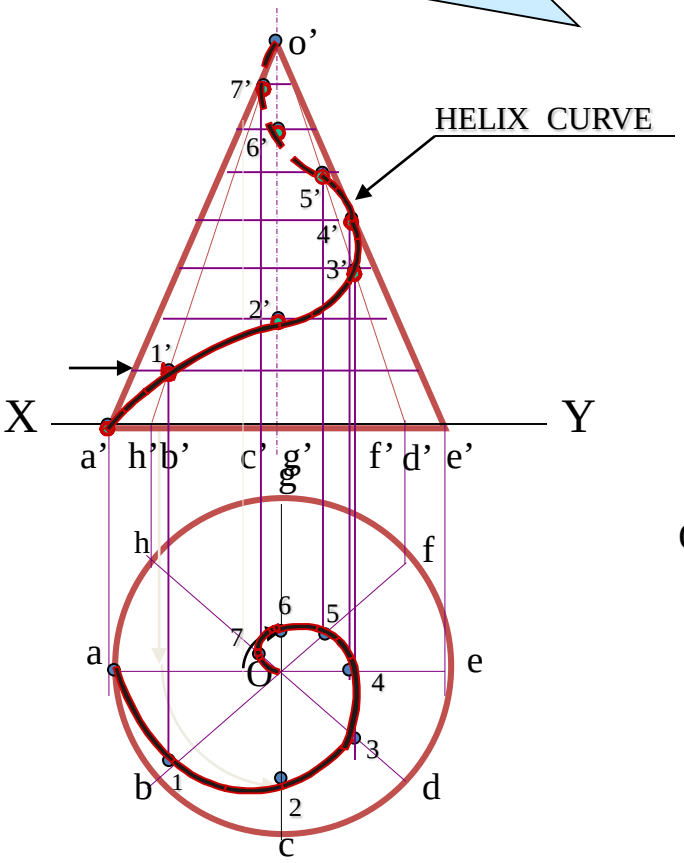


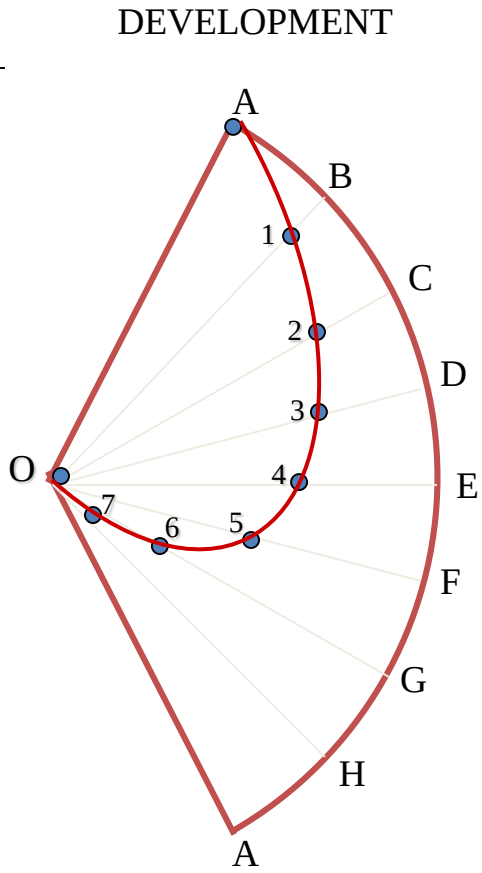
Concept: A string wound from a point up to the same Point, of shortest length Must appear st. line on it's Development.

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 it's 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.