

DEVELOPMENT OF SURFACES

A layout of the complete surface of a 3D object on a plane is called the development of the surface. The solid is opening the surface should be determined first. Every edges used in making the development must represent the true length of the edge on the object.

In engineering practice, a large number of products like hoppers, funnels, trays, boiler shells, duct of air conditioners, etc.,

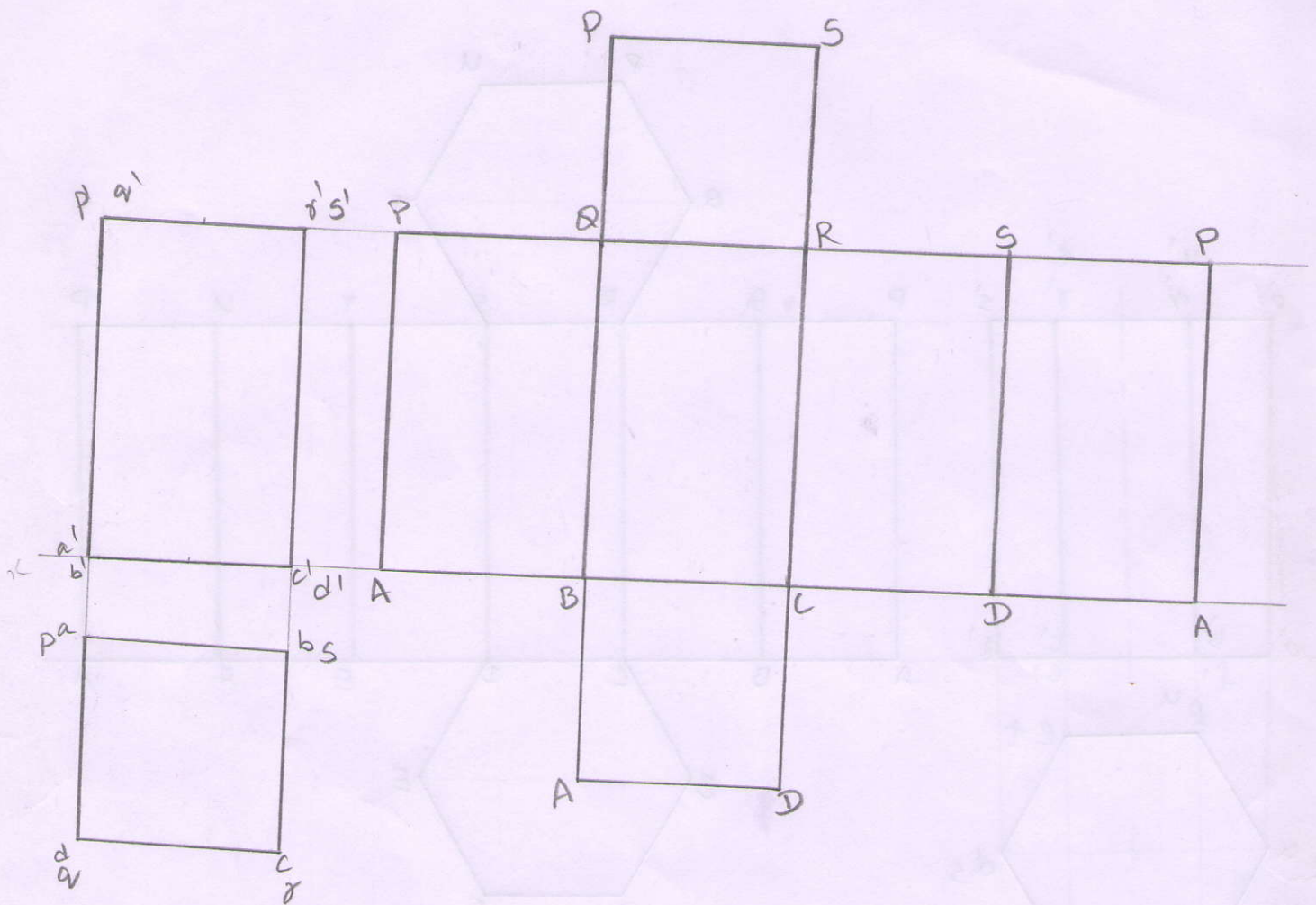
methods of Development :-

The following two methods are mainly employed to obtain the development of surfaces.

- ① parallel line method :- It is used for developing the prisms and single curved surfaces like cylinders in which all the edges/generators of lateral surfaces are parallel to each other.
- ② Radial line ~~method~~ method :- It is used for ~~para~~ developing the pyramids and single curved surfaces like cones in which the apex is taken as centre and the slant edges or generators as radius for its development.

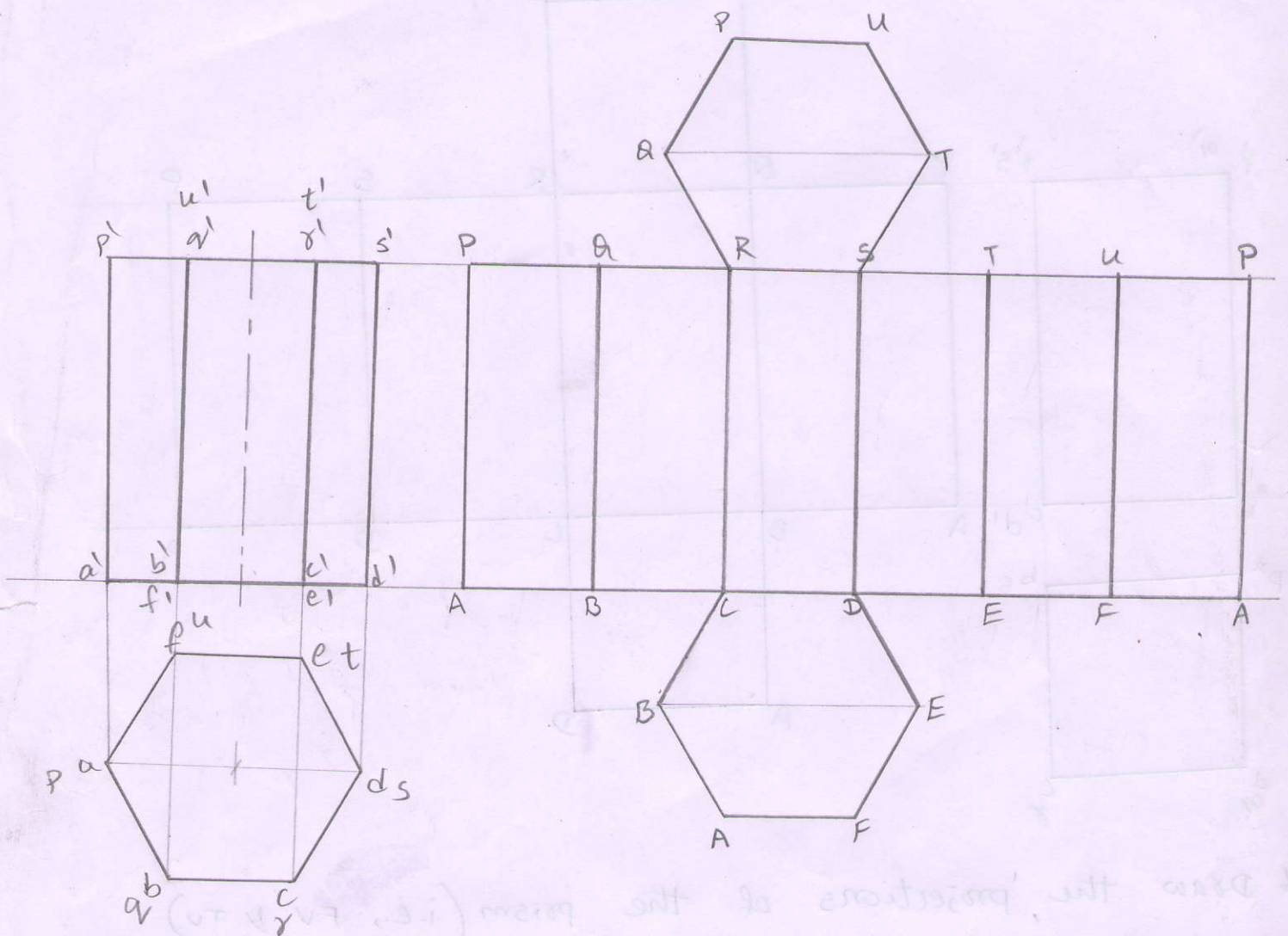
ILLUSTRATIVE PROBLEMS

Problem: 1) Draw the development of a square prism, with side of base 30 and axis 50 long, is resting on its base on HP.



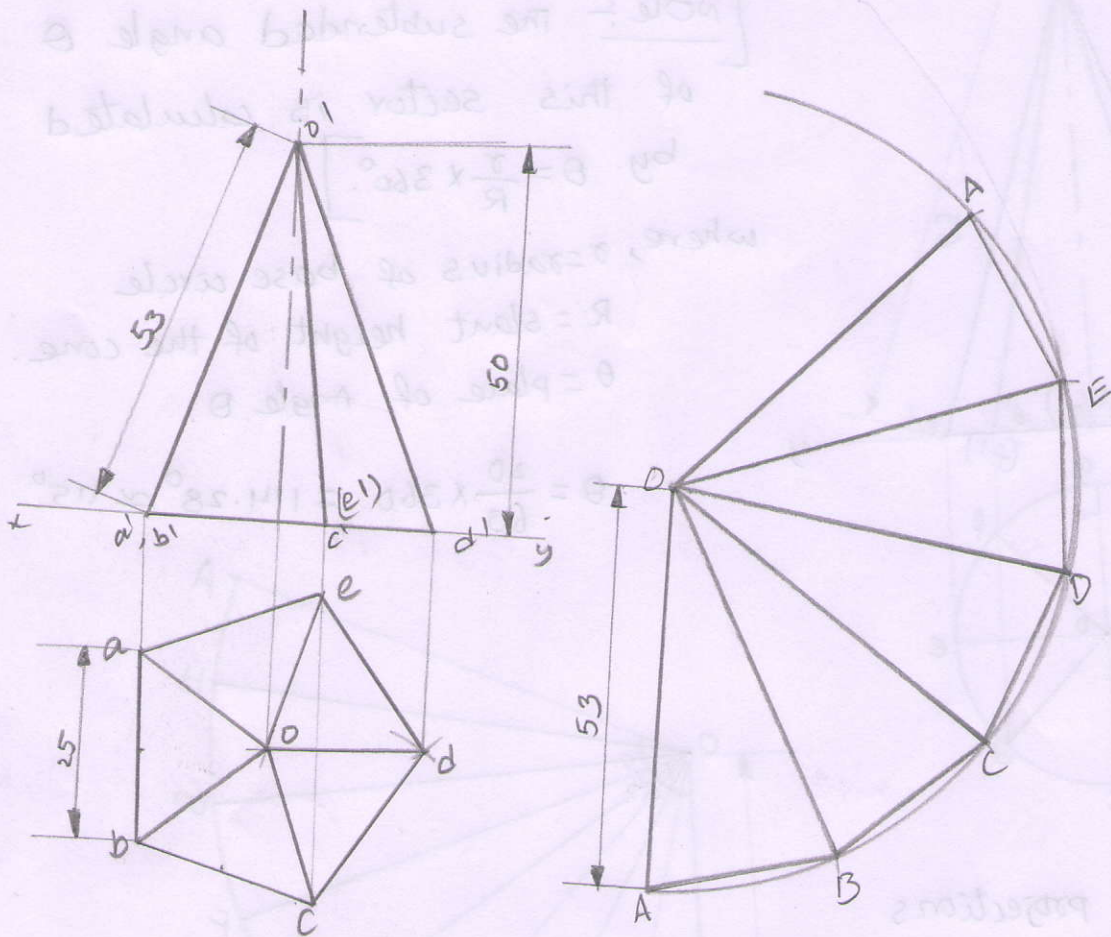
- * Draw the projections of the prism (i.e., FV & TV)
- * stretch out lines P-P and A-A from the FV.
- * Divide P-P and A-A in four equal parts. The intermediate points as Q, R, S and B, C, D respectively.
- * Attach the squares PARS and ABCD to BC and QR respectively.

problem: 2) Draw the development of a hexagonal prism, with side of base 20 mm and axis 50 long, is resting on its base on HP.



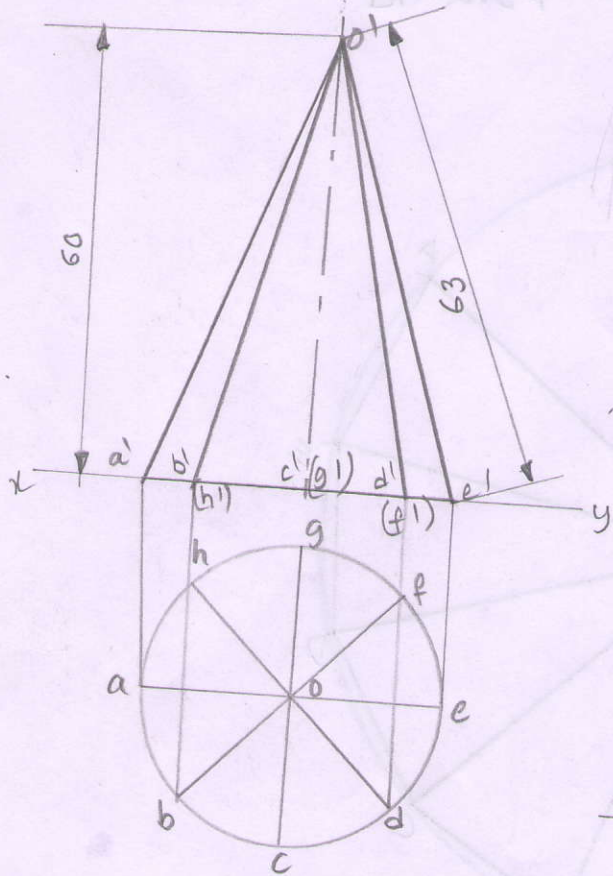
- * Draw the projections of the prism (i.e., FV & TV)
- * stretch out lines P-P and A-A from the FV
- * Divide P-P and A-A in six equal parts. The intermediate points are Q, R, S, T, U and B, C, D, E, F respectively.
- * Attach the hexagonal to CD and RS respectively.

problem: 3) A pentagonal pyramid of side 25mm and axis 50mm long is kept on its ~~ground~~ the ground on its base. Draw the ~~the~~ development of the pyramid.



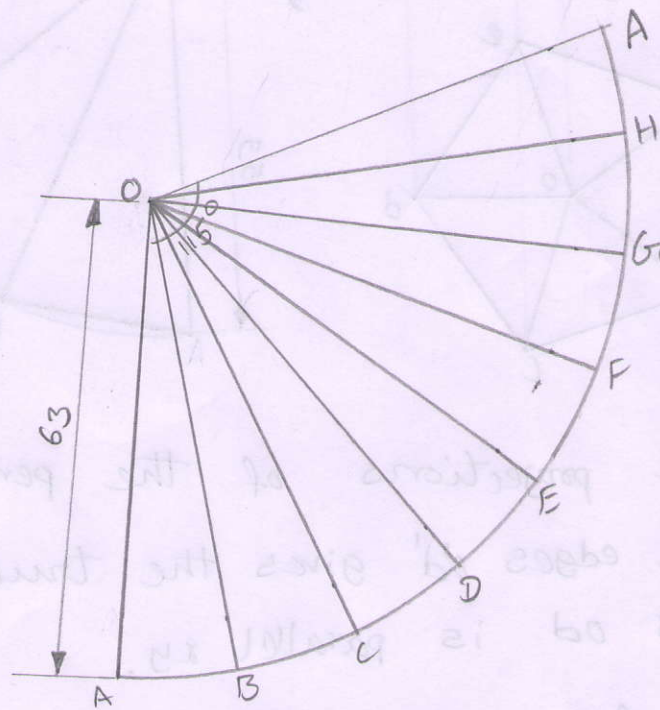
- * Draw the projections of the pentagonal pyramid.
- * The slant edges $o'd'$ gives the true length because its top views od is parallel xy .
- * Draw an Arc A-A with O as centre and radius OA
- * step off the arc A-A into 5 equal divisions.
- * Join Base edges and slant edges. i.e., AB, BC, CD, ~~DE~~ DE, EA is the base edges, OA, OB, OC, OD, OE is the slant edges.
- * This is the required development of pyramid.

problem: 4) Draw the development of lateral surface of the cone with 40mm base diameter and 60mm long axis. The cone is resting on H.P. on its base.



[note:- The subtended angle θ of this sector is calculated by $\theta = \frac{r}{R} \times 360^\circ$]
 where, r = radius of base circle
 R = slant height of the cone.
 θ = plane of angle θ .

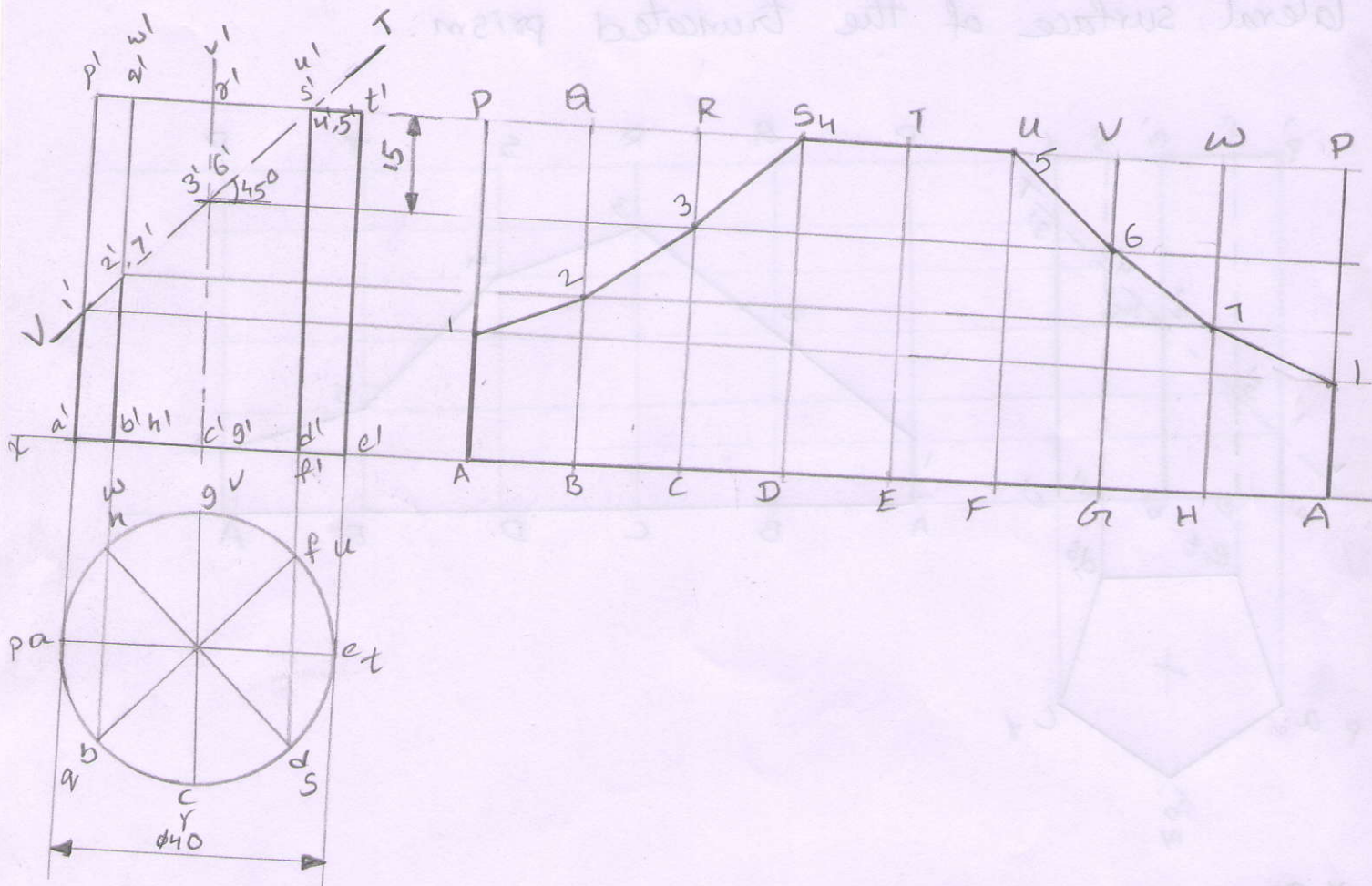
$$\theta = \frac{20}{63} \times 360 = 114.28^\circ \approx 115^\circ$$



- * Draw the projections of the cone.
- * The generator $o'e'$ is the true length because its TV oe is parallel to xy .

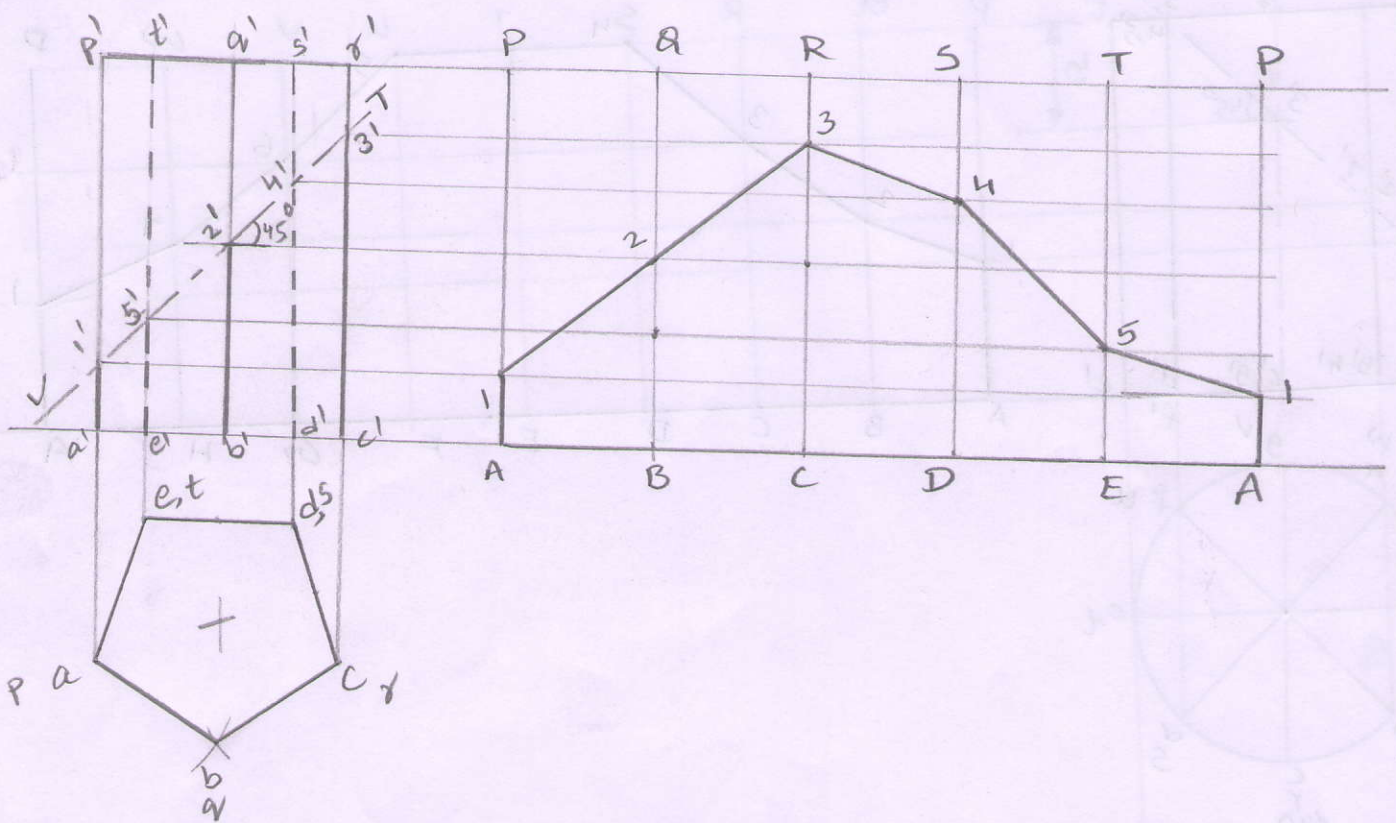
- * Determine the ~~sector~~ subtended angle θ of the development
- * Draw an Arc AA with O as centre and radius OA
- * step off the arc AA into 8 equal parts.
- * This is the required development of the cone.

problem: 5) A cylinder of diameter of base 40 mm and axis 50 mm long, is resting on its base on HP. It is cut by a section plane perpendicular to VP and inclined at 45° to HP. The section plane is passing through a point 15 mm below the top end of the axis. Draw the development of the lateral surface of cylinder.



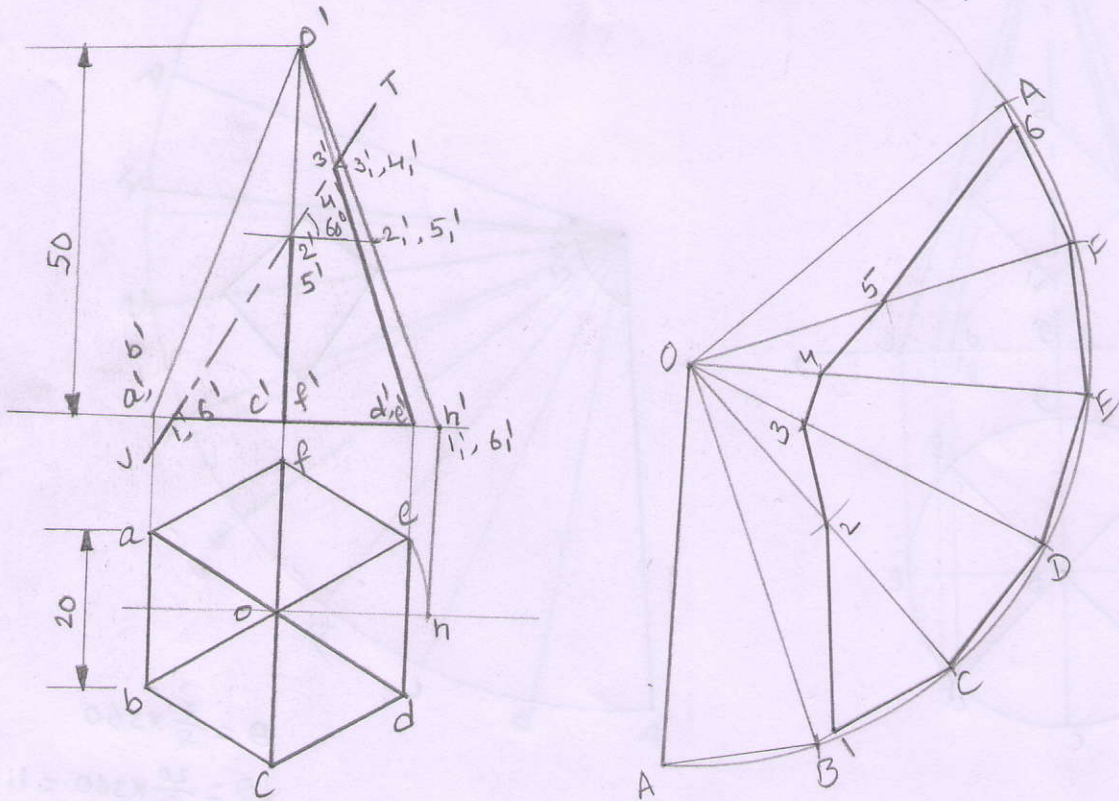
- * Draw the projections of the cylinder
- * stretch out lines P-P and A-A.
- * The perimeter of the cylinder divided into 8 equal parts.
- * Draw the cutting plane VT inclined at 45° to xy. The point is Below the top end of the axis.
- * Thus VT cuts the generators. The intersection points is 1 to 7.
- * Draw the horizontal lines from 1 to 7.
- * Join all the points in the development with a continuous smooth curve.

problem: 6) A pentagonal prism, having a base with 20mm side and 50mm long axis, is resting base on HP. such that the rectangular faces is parallel to VP. It is cut by a section plane perpendicular to VP and inclined at 45° to HP. and passing through the mid point of axis. Draw the development of the lateral surface of the truncated prism.



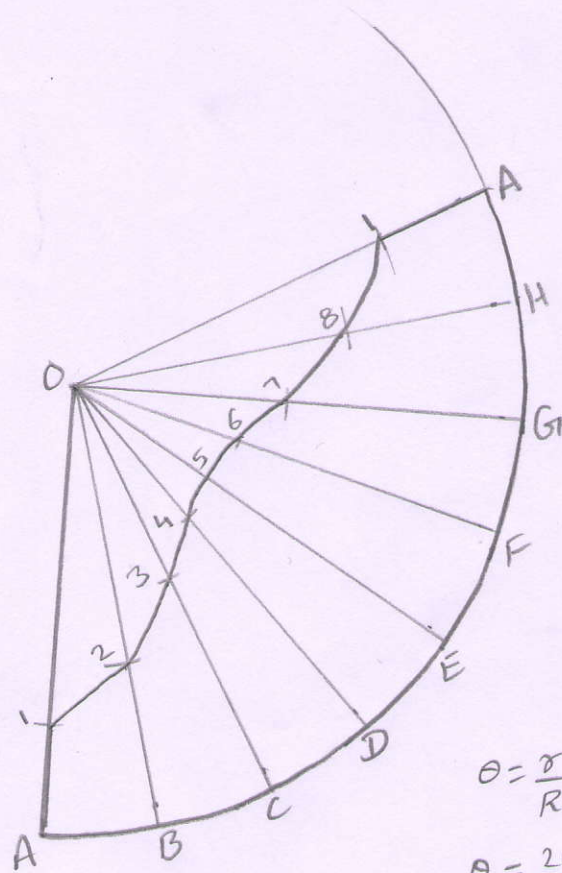
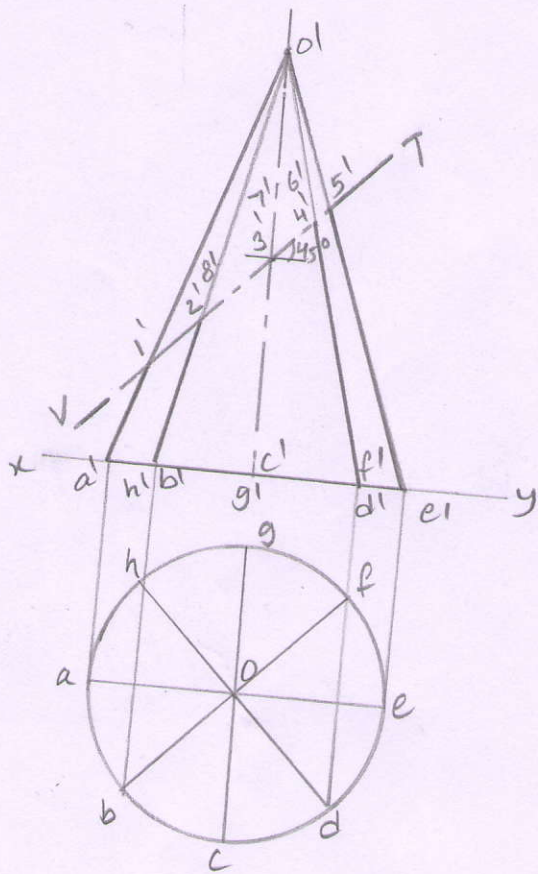
- * Draw FV and TV as shown.
- * mark points $1', 2', 3', 4', 5'$ at the intersections of the AIP with vertical edges of the prism.
- * stretch out lines A-A and P-P.
- * Divide A-A and P-P in 5 equal parts.
- * project points $1', 2', 3', 4', 5'$ from front view to corresponding edges. in development. and mark points $1, 2, 3, 4, 5$.
- * Join all the points.

problem: 7) Draw the development of lateral surface of a hexagonal pyramid with 20mm base and 50mm long axis, when it is resting on its base in the HP, such that an edge of the base is perpendicular to VP. It is cut by a section plane perpendicular to and inclined at an angle of 60° to HP. bisects the axis.



- * Draw the projections of the hexagonal pyramid.
- * The slant edges $o'h'$ gives the true length because its TV oh is parallel to xy .
- * Draw an Arc A-A with O as centre and radius OA .
- * Step off the arc A-A into 6 equal divisions.
- * Join the base edges and slant edges.
- * Draw the cutting plane VT inclined at 60° to xy . through the midpoint of axis.
- * Thus VT cut the slant edges.
- * Draw the horizontal lines from $1'$ to 1_1 , $2'$ to 2_1 upto $6'$ to 6_1 to meet oh line.
- * Transfer the points 1_1 to 6_1 in the development.
- * Join all the points in the development with a continuous smooth curve. (8)

problem: 8) A cone of base diameter 40mm and slant height 60mm is kept on the ground on its base. It is cut by a section plane perpendicular to VP and inclined at an angle 45° to HP through the midpoint of the axis. Draw the development.



$$\theta = \frac{\pi}{R} \times 360$$

$$\theta = \frac{20}{60} \times 360 = 120^\circ$$

- * Draw the projections of the cone
- * The slant edge $o'e'$ gives the true length
- * Draw an Arc A-A with O as centre and radius OA
- * Step off the arc A-A into 8 equal parts.
- * Join the base edges and slant edges
- * Draw the cutting plane VT inclined at 45° to XY through the midpoint of axis
- * Thus VT cut the slant edges
- * Transfer the points ~~1-8~~ from FV to developing surface.
- * Join all the points in the development with a continuous smooth curve.