

Unit-4, Part-1: Sections of solidsTheory Questions

1. Define sectional plane, section and sectional view (sectional top view, sectional front view and sectional side view).

A. Section plane: It is the cutting plane that cuts the solid at different orientations to generate a section of the solid. The section plane can be oriented w.r.t HP and VP like parallel to, perpendicular to, inclined to, etc. Section planes are referred to by their traces.

If a section plane is inclined to HP, it is referred to as the VT makes angle with xy.

If a section plane is inclined to VP, it is referred to as the HT makes angle with xy.

Section: It is the cut portion of the solid obtained after cutting the solid by the sectional plane.

Sectional View: It is the portion of the solid shown along with the section part in one of the views.

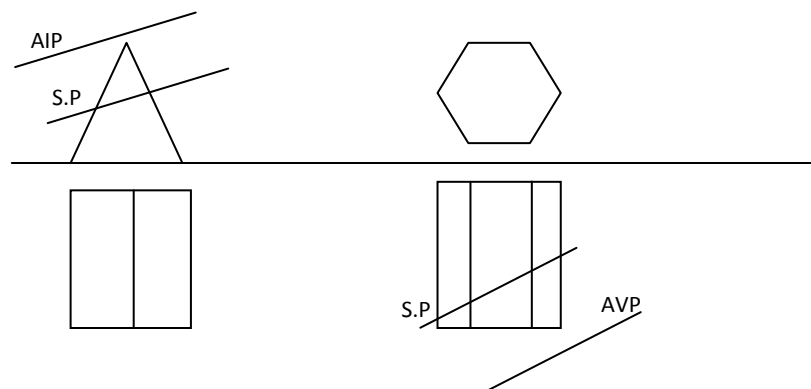
If the section is shown along with the top view, it is called as sectional top view.

If the section is shown along with the front view, it is called sectional front view.

If the section is shown along with the side view, it is called sectional side view.

2. What is meant by auxiliary plane? What is its use in sections of solids?

A. An auxiliary plane is a reference plane drawn parallel to the section plane. Its use in sections of solids is that whenever the section plane is inclined to HP or VP, the true shape of the section is shown on these auxiliary planes.



3. What is meant by AVP and AIP? What is drawn on AVP and AIP? (Auxiliary Vertical Plane and Auxiliary Inclined plane)

A. AVP: It is auxiliary vertical plane. It is the auxiliary plane drawn parallel to the section plane which is inclined to VP. The true shape is drawn on AVP when the section plane is inclined to VP.

AIP: It is the auxiliary plane drawn parallel to the section plane which is inclined to HP. The true shape is drawn on AHP (or AIP) when the section plane is inclined to the HP.

4. When will the sectional front view (SFV) show the true shape of the section?

A. When the section plane is parallel to VP, the SFV will show the true shape of the section.

5. When does the sectional top view (STV) provide the true shape of a section?

A. When the section plane is parallel to HP, the STV will show the true shape of the section.

6. When does the sectional side view (SSV) provide the true shape of a section?

A. When the section plane is parallel to the profile plane (perpendicular to both HP and VP), the SSV will show the true shape of the section.

7. Discuss the importance of sectional views.

A. Sectional views are the views in which the cut portion of the solid is shown along with the solid's view. It helps in analysing the shape of the solid when cut by the planes. These concepts find applications in analysis of machine components when they are cut in different positions.

8. Explain the formation of different conic sections with reference to sectional planes cutting a cone (i.e., Explain how different conic sections are formed by cutting a cone)

A. The following are the various sections obtained by cutting a cone in different positions:

Circle: It is obtained when a cone is cut by a section plane parallel to the base.

Ellipse: It is obtained when a cone is cut by a section plane cutting both the extreme generators.

Parabola: It is obtained when a cone is cut by a section plane which is parallel to one of the generators and the section plane cuts the base of the cone too.

Hyperbola: It is obtained when a cone is cut by a section plane at an angle greater than the angle between the base and the generator.

9. Explain the method of obtaining the true shape of a section.

A. If the section plane is parallel to the HP or VP, the sectional view itself is sufficient to get the true shape.

When the section plane is inclined to HP or VP, an AIP or AVP is to be drawn and the cutting points of the section plane (intersection points between section plane and the solid) is to be projected on to this AVP or AIP. Then the distances of the cutting points in the sectional views w.r.t.  $xy$  are to be measured and these distances are to be marked from the AIP or AVP line to get the true shape.

10. Define frustum and truncated solid with reference to pyramids and cones.

A. When a solid is cut by a section plane parallel to the base, the left over portion is called as frustum of the solids.

When a solid is cut by a section plane inclined to the base, the left over portion is called as truncated solid.

11. A section plane is cutting all the generators of the cone. What is the shape of the section obtained? (A: if parallel to base-- circle; if inclined to the base- ellipse)

12. A cone is cut by a plane whose VT is parallel to the extreme generator. What is the true shape of the section? (A: VT  $\rightarrow$  w.r.t. HP; parallel to generator  $\rightarrow$  inclined to HP and parallel to generator  $\rightarrow$  parabola)

13. Distinguish between generator method & circle method in drawing the sections of cones.

A. In the generator method, the cutting points are selected based on the distance on the generators. In circle method, circles are drawn in the top view (usually) based on the section plane cutting the cone at different positions and then the circles are used to obtain the points of section. Refer article 14.4 in sections of cones.

14. If VT of section plane makes an angle  $\alpha$  (e.g.  $30^\circ$ ) with  $xy$ , the section plane is inclined to \_\_\_. (Ans: HP)

15. If HT of a section plane makes an angle  $\alpha$  (e.g.  $30^\circ$ ) with  $xy$ , the section plane is inclined to \_\_\_. (Ans: VP)

Problems:

16. A triangular prism, base 30 mm side & axis 50 mm long is lying on the ground on one of its rectangular faces with the axis inclined at  $30^{\circ}$  to the VP. It is cut by a horizontal plane at a distance of 15 mm above the ground. Draw its front view & sectional top view.
17. A triangular prism, side of base 40 mm and length of axis 70 mm, is lying on one of its rectangular faces in HP. Its axis is parallel to both HP and VP. It is cut by section plane parallel to and at a distance of 20 mm from the HP. Draw its front view and sectional top view.
18. A square prism of base 50 mm sides and axis 100 mm long is resting on its edge of HP such that its axis is parallel to VP and its faces are equally inclined to VP. The prism is cut by an AIP passing through the midpoint of the axis, normal to the HP and inclined at  $30^{\circ}$  to the VP (also stated as- The HT of the plane makes  $45^{\circ}$  to the xy). Draw the sectional front view, top view and the true shape of the section.
19. A square pyramid side of base 40 mm and axis height 75 mm long has its base in HP with all the base edges equally inclined to the VP. It is cut by a section plane perpendicular to the VP and the VT of which is inclined at  $45^{\circ}$  to xy and bisects the axis. Draw its sectional top view, sectional side view and true shape of the section. (hint: VT  $\rightarrow$  angle to HP).
20. A pentagonal pyramid of base 30 mm side and height 50 mm stands with its base on HP such that an edge of its base is parallel to VP. It is cut by a plane, normal to VP, the VT of which makes  $45^{\circ}$  to the xy, passing through a point on the axis, 30 mm above the base. Draw its sectional top view, sectional side view and true shape of the section.  
(Hint: VT  $\rightarrow$  Angle is w.r.t HP)
21. A pentagonal prism with side of its base 50 mm and length 100 mm has a rectangular face on the HP and the axis parallel to VP. It is cut by a section plane normal to VP and makes an angle  $30^{\circ}$  with the horizontal and bisects the axis of the prism. Draw the sectional front view, top view and the true shape of the section.
22. A hexagonal pyramid, side of base 25 mm axis 50 mm long is resting on its base on HP, with an edge of the base parallel to VP. A section plane perpendicular to both HP and VP cuts the solid, 5 mm away from the axis. Draw the sectional side view of the cut solid.
23. A hexagonal pyramid, base 30 mm sides and axis 65 mm long is resting on one of its triangular faces on the HP with its axis parallel to the VP. A horizontal section plane bisects the axis of the solid. Draw the projections and sectional views.
24. A hexagonal pyramid, base 30 mm side and axis 65 mm long is resting on its base on the HP with two edges parallel to VP. It is cut by a sectional plane perpendicular to the VP, inclined at  $45^{\circ}$  to the HP and intersecting the axis at a point 25 mm above the base (also stated as- The VT of the plane makes  $45^{\circ}$  to the xy). Draw the front view, sectional top view, sectional side view and true shape of the section.
25. A hexagonal prism of base 30 mm and axis 50 mm has a rectangular face on the HP and its axis makes an angle of  $60^{\circ}$  with the VP. It is cut by a vertical plane, the HT of which makes an angle of  $45^{\circ}$  to the xy line, bisecting the axis. Draw the sectional front view and true shape of the section. (Hint: HT angle  $\rightarrow$  angle w.r.t VP)
26. A cylinder of base 40 mm diameter & 60 mm height, having its axis vertical is cut by a plane perpendicular to VP and inclined at  $45^{\circ}$  to the HP, intersecting the axis 30 mm above the base. Draw the sectional side view, sectional top view and obtain the true shape of the section.
27. A cylinder of diameter 50 mm and axis 75 mm long rests on one of the points of the base in HP and its axis parallel to VP and inclined to HP at  $30^{\circ}$ . A horizontal section plane cuts the cylinder at a distance 45 mm above the HP. Draw the sectional plan and elevation and the true shape of the section. (plan  $\rightarrow$  TV; Elevation  $\rightarrow$  FV)
28. A cone of base 50 mm diameter & axis 80 mm long is lying on one of its generators with the axis parallel to the VP. A horizontal section plane bisects the axis of the solid. Draw the projections showing its sectional top view.

29. A cone, base 65 mm diameter & axis 75 mm long is lying on the HP on one of its generators with the axis parallel to the VP. A section plane which is parallel to the VP cuts the cone 6 mm away from the axis. Draw the sectional front view & development of the surface of the remaining portion of the cone.
30. A cone of base 45 mm diameter & axis 55 mm long is resting on the HP on its base. It is cut by a section plane, perpendicular to both HP & VP & 6 mm away from the axis. Draw its front view, top view & sectional side view. (refer prob no 14.26 in text book)
31. A cube of 65 mm long edges has its vertical faces equally inclined to the VP. It is cut by a section plane, perpendicular to the VP, so that the true shape is a regular hexagon. Determine the inclination of the cutting plane with the HP & draw the sectional top view & the true shape of the section.
32. A cylindrical prism of 50 mm diameter and 70 mm long has its axis parallel to H.P, and inclined at  $30^\circ$  with V.P. It is cut by a vertical section plane such that the true shape of the section is an ellipse with major axis of 60 mm long. Draw its sectional front view and true shape of the section. (try as an assignment problem)