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Unit II: Part-3: Projections of Planes

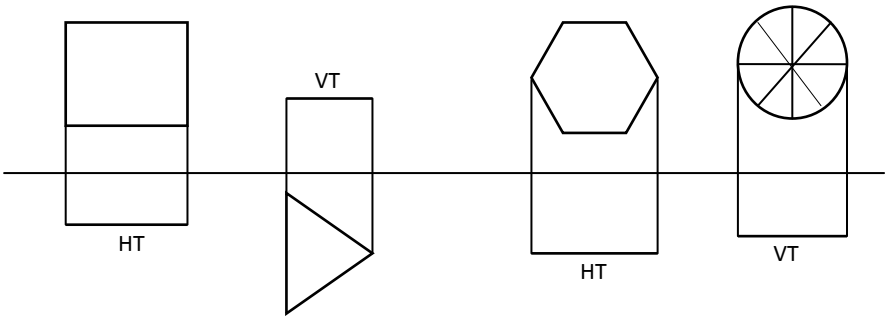
Theory Questions

1. What is meant by trace of a plane?

A. It is defined as the extension of a given plane shape to the reference plane (HP or VP) to which it is perpendicular or inclined. The plane meets the HP or VP as a line. This line is called trace of a plane.

2. Explain the terms horizontal trace (HT) and vertical trace (VT) for a plane.

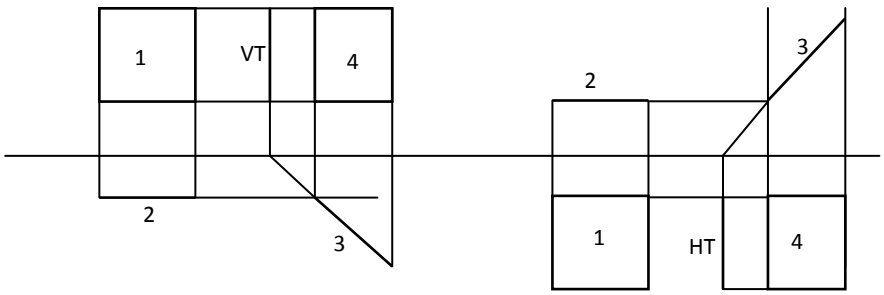
A. The line in which the plane shape meets the HP is called HT and the line in which the plane shape meets the VP is called as VT.



(Refer to article 12.1 to 12.3 from ND Bhat on projections of planes – traces and general conclusions for further details)

3. Explain the method of determining a trace of a plane with simple sketches.

A. The traces for planes inclined to one reference plane (HP/VP) are given below.



(Refer article 12.1 to 12.3 in projection of planes for more examples)

4. When does a plane have no traces?

A. When a plane is parallel to a plane, it has no trace on that plane.

5. Define oblique plane & auxiliary plane.

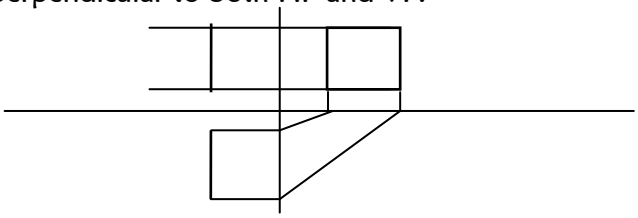
A. Oblique planes are planes which are inclined to both HP and VP. Auxiliary planes are planes parallel to section plane or cutting plane onto which the true shape of the cut section can be seen.

6. Explain oblique planes & their uses.

A. Oblique planes are the planes which are inclined to both HP and VP. With the help of these planes, we can find the orientation of a plane in its final position and also its approximate shape.

7. Describe the conditions necessary for a plane whose projections on to HP, VP & its traces are identical.

A. The plane is perpendicular to both HP and VP.



8. When a plane is perpendicular to a reference plane, what is the projection on that plane?

A. When a plane is perpendicular to a reference plane, its projection on that plane is a straight line.

9. When a plane is parallel to a reference plane, what is the projection on that plane?

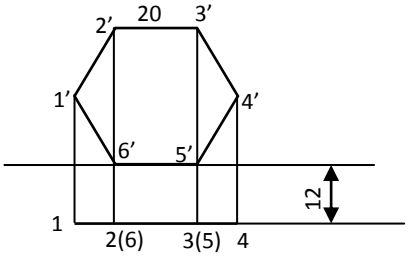
A. When a plane is parallel to a reference plane, its projection on that plane will be its true shape and size.

Problems:

Short Answer Questions (1 stage and 2 stage problems)

10. A regular hexagonal lamina of 20 mm side rests on one of its sides on HP. It is parallel to and 12 mm away from VP and it is in first quadrant. Draw its projections.

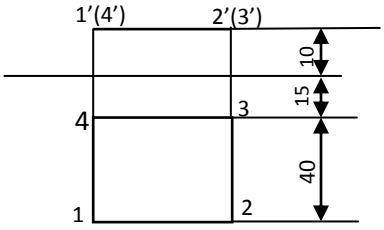
A. As the plane is parallel to VP, the true shape is seen in the Front view. As side is on HP, it is to be drawn parallel to xy.



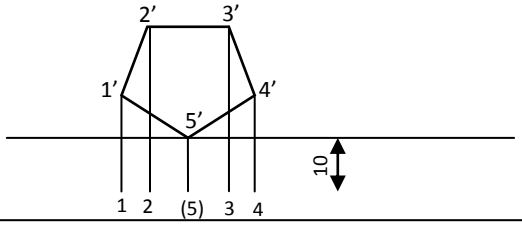
11. Draw the projections of a square lamina having side 40 mm long which is 15 mm in front of VP and 10 mm above HP.

A. As the orientation of the plane is not given, it can be assumed to be parallel to HP or VP.

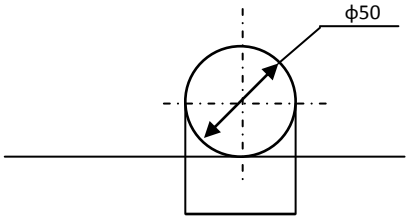
Assuming it to be parallel to HP, we get the true shape in the top view.



12. A regular pentagon ABCDE 25 mm side has a corner A in HP and the side CD parallel to the HP. Draw its projections when its plane is parallel to and 10 mm away from the VP. Also draw its traces.

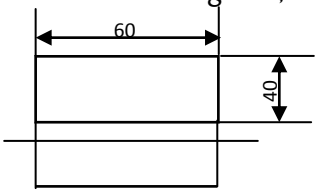


13. Draw the projections of a circle of diameter 50 mm resting on one of its ends of the diameter on the HP.



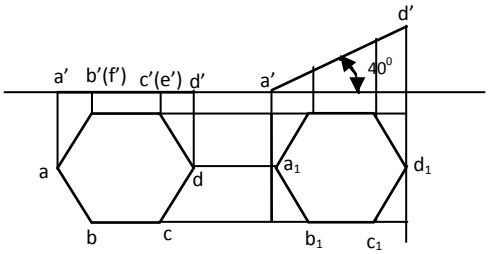
14. Top view of a rectangle is a line of 60 mm & parallel to xy. Draw its front view if its width is given as 40 mm.

A. As the top view length is 60 and the width is 40, the rectangle dimensions are 60x40. As top view is a line, the front view gives the true shape which means that the plane is parallel to VP. As distances from HP and VP are not given, they can be conveniently assumed.



15. A regular hexagon of 25 mm side has its one edge on the HP. The surface of the plane is perpendicular to the VP and inclined at 40^0 to the HP. Draw the three views of the plane and locate the traces. (2 stage problem as plane is inclined to HP)

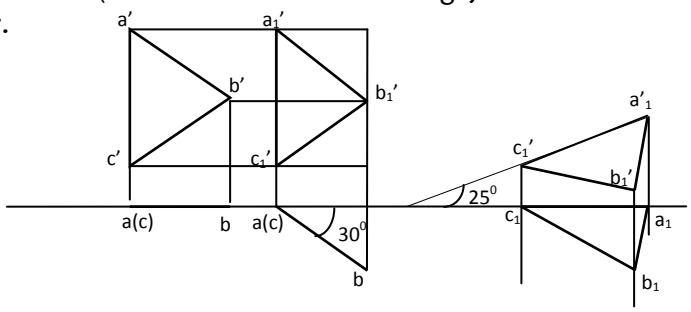
A. The plane is inclined to HP and hence the reduced shape of the plane will be seen in the top view. Moreover as the edge is on HP, the starting side of the polygon will be vertical (it will be ⊥ w.r.t xy). So the problem is to be solved in two stages. (ab=bc=25 mm)



Long Answer Questions (3 stage problems)
Data involves plane angle and side/diagonal angle
(For detailed analysis of these concepts, refer to the notes enclosed)

16. A triangle with its sides 30, 40 and 50 mm respectively is resting with its 50 mm side in VP and inclined to HP at 25°. The plane of the triangle is inclined at 30° to VP. Draw its projections.

A. Given data: shape→ triangle; Plane angle→ 30^0 to VP (Shape seen in front view, 2 stages) Side angle→ 25^0 to HP (data to be used for 3rd stage). 50 mm Side in the VP means side is to be taken ⊥ to xy.



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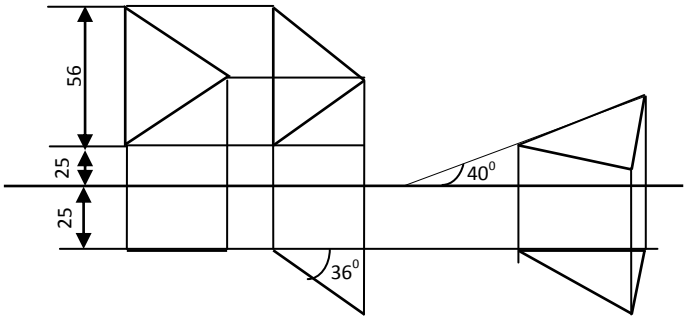
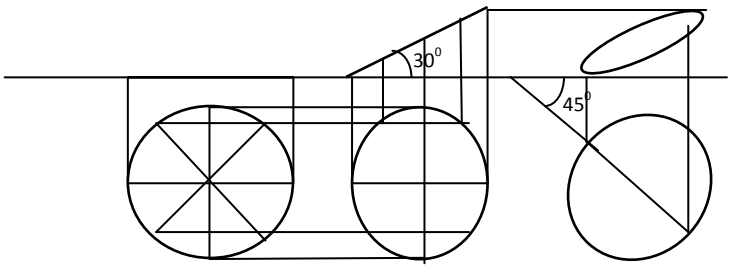
17. An equilateral triangle sheet of metal, of 56 mm side and negligible thickness. Draw the front and top views of the sheet when its plane is vertical and inclined at 36^0 to VP. Given that the corner nearest to HP is 25 mm from both the HP and VP and a side containing the corner making an angle of 40^0 to the HP.

A. The problem can be solved similar to the above problem (prob.no 16) (labelling as per above examples to be followed)

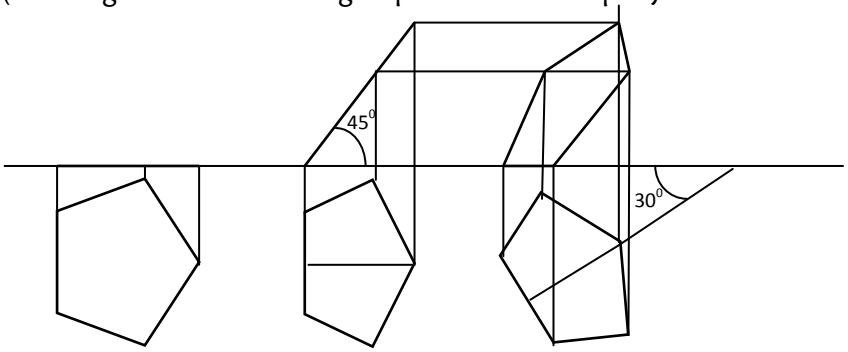


18. A circular lamina of 65mm diameter rests on the ground such that the surface of the lamina is inclined at 30° to the ground. The diameter through the point on which the lamina is resting on the ground appears to be inclined at 45° to the V.P., in the top view. Draw its projections.



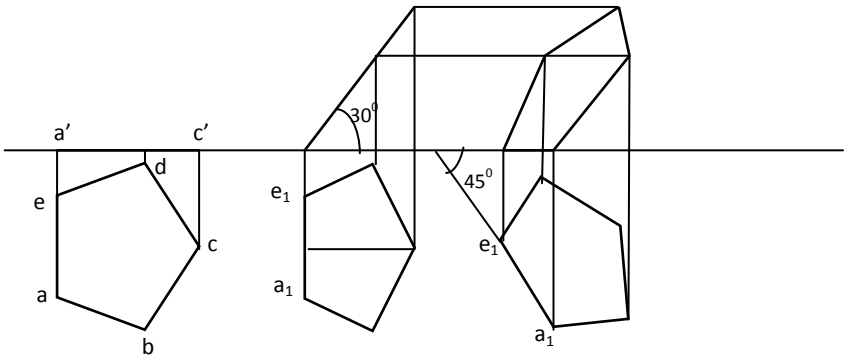
19. Draw the projections of a pentagonal plane, side 25 mm resting on the H.P on one of its edges. The plane of the pentagon is inclined at 45° to the H.P. and the perpendicular drawn from the midpoint of the resting edge makes an angle of 30° with the V.P.

A. Refer solutions. (labelling and dimensioning as per above examples)



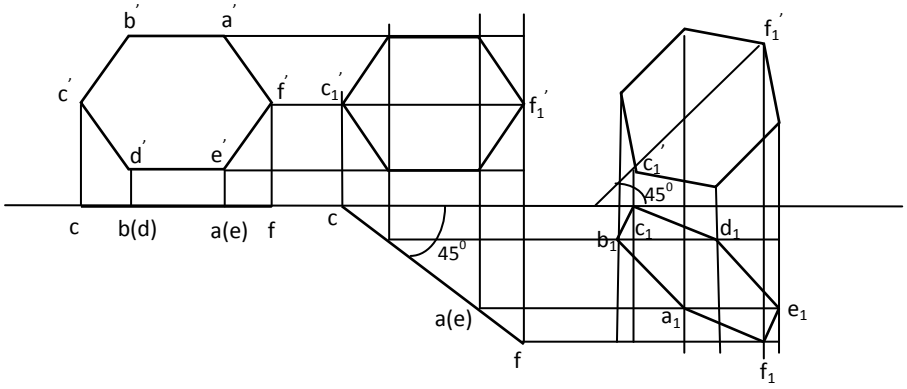
20. A regular pentagonal lamina of 25 mm side, rests on HP on one of its sides such that it is inclined to the HP at *30° (plane is inclined)* and the side on which it rests, inclined at *40°* to the VP. Draw its projections in the first angle.

A. Solution is similar to the above problem (Prob No 19). Only difference is that in the 3rd stage, the side ae should be turned by 40^0 with respect to xy and redrawn.



21. A regular hexagon ABCDEF 30 mm side has its plane inclined at 45^0 to the VP and its diagonal FC parallel to the VP and inclined at 45^0 to the HP. Draw the projections when its side DE is nearest to the VP and 10 mm in front of it.

A. Plane angle→ VP; hence true shape in Front view. So start in the front view in the first stage. In the starting position, the diagonal FC should be parallel (which means side ab should also be parallel to xy). In the 2nd stage, plane angle is 45^0 VP and in the third stage, the diagonal fc is inclined at 45^0 to HP (also means side ab is inclined at 45^0 to HP)



Long Answer questions-3-stage problems; Model -2.

(Data involving the true shape and reduced shape positions; plane angle to be found out)

22. A circular plate of negligible thickness & 50 mm diameter appears as an ellipse in the front view, having its major axis 50 mm long & minor axis 30 mm long. Draw its top view when the major axis of the ellipse is horizontal. Refer solutions.
23. Draw a rhombus of diagonals 100 mm & 60 mm, with the longer diagonal horizontal. The figure is the top view of a square of 100 mm long diagonals with a corner on the ground. Draw its front view & determine the angle which its surface makes with the ground. Refer solutions.
24. Draw the projections of a rhombus, having diagonals 120 mm and 60 mm long, the smaller diagonal of which is parallel to both the principal planes, while the other is inclined at 30° to H.P. Refer solutions.

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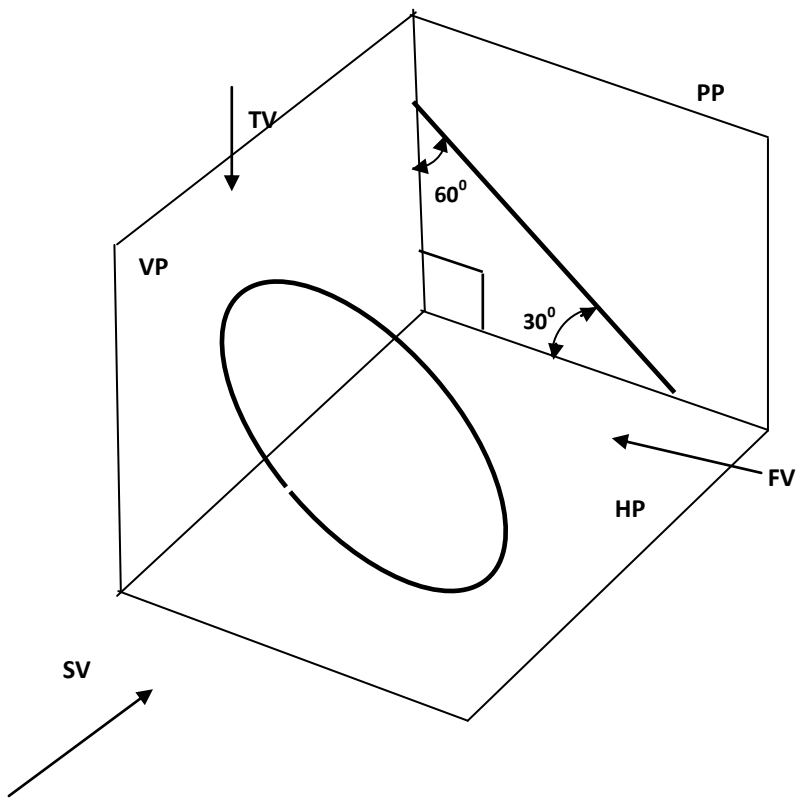
25. Draw projections of a circle of 80mm diameter having the end A of diameter AB in HP, the end B in VP and the plane of the circle inclined at 35^0 to the HP and at 60^0 to the VP.

A. In the exam, the above data was given. A correction is needed in data here. Sum of angles cannot be more than 90^0 whenever one end is in HP and other end is in VP because it is like a ladder resting on a wall and ground. Their angles are always complementary (90^0).
Hence, change the angle w.r.t. HP as 30^0 and solve the problem.
(For answer, refer to solutions in side view based last problem in planes: when sum of angles is 90^0, side view gives the true shape).

3-D representation of the plane resting on both HP and VP



The final three views of the plane surface are shown in solutions.