

ME119: **Engineering Drawing & Graphics**

A photograph of a helicopter's cockpit area. A pilot wearing a flight helmet and goggles is visible through the window, looking out. The helicopter is white with some dark markings. The background shows a clear blue sky.

9. Intersection of Surfaces

**Department of Mechanical Engineering
Indian Institute of Technology Bombay**

Outline

- Feedback
- Intersection of Surfaces
- Conclusions

Intersection of Surfaces

Intersection of Surfaces

- If $\bar{p}(u_1, v_1)$ and $\bar{q}(u_2, v_2)$ are two surfaces, then, their intersection will be obtained from $\bar{p}(u_1, v_1) = \bar{q}(u_2, v_2)$.
- While $\bar{p}(u_1, v_1)$ and $\bar{q}(u_2, v_2)$ are surfaces (defined by 2 parameters), their intersection will be a curve (defined by 1 parameters).
- Example:

A cylinder $\rightarrow \bar{p}(u_1, v_1) = [r \cos u_1, r \sin u_1, v_1] \quad u_1 \in (0, 2\pi) \quad v_1 \in (0, h)$

A plane $\rightarrow \bar{q}(u_2, v_2) = [u_2, v_2, 10] \quad u_2 \in (-\infty, +\infty) \quad v_2 \in (-\infty, +\infty)$

Intersection $\rightarrow \bar{r}(u_1) = [r \cos u_1, r \sin u_1, 10] \quad u_1 \in (0, 2\pi)$

Intersection of Prisms

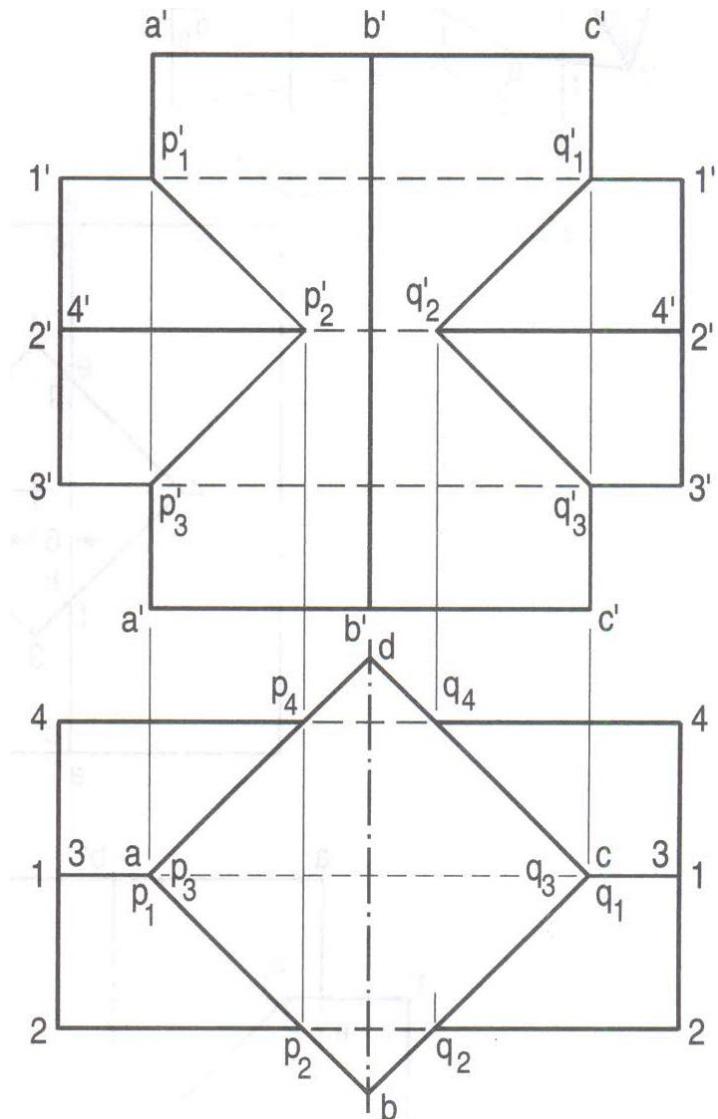
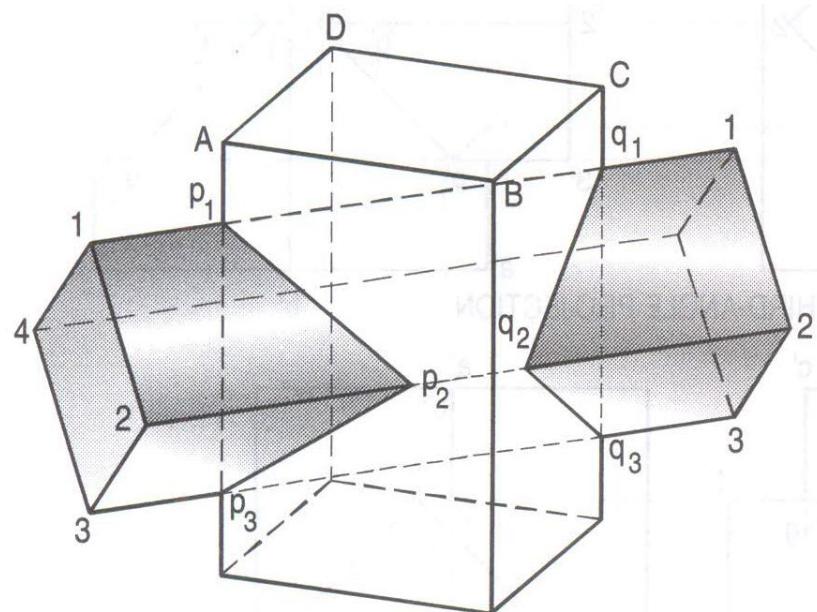
Intersection of Surfaces

Example-1 (Solved Pb. 16-1, pp. 383)

A vertical square prism base, 50 mm side, is completely penetrated by horizontal square prism, base 35 mm side, so that their axes intersect. The axis of the horizontal prism is parallel to the V.P., while the faces of the two prisms are equally inclined to the V.P. Draw the projections of the solids, showing lines of intersection. Assume suitable lengths for the prisms.

Intersection of Surfaces

Example-1 (Solved Pb. 16-1, pp. 383) ...



Intersection of Surfaces

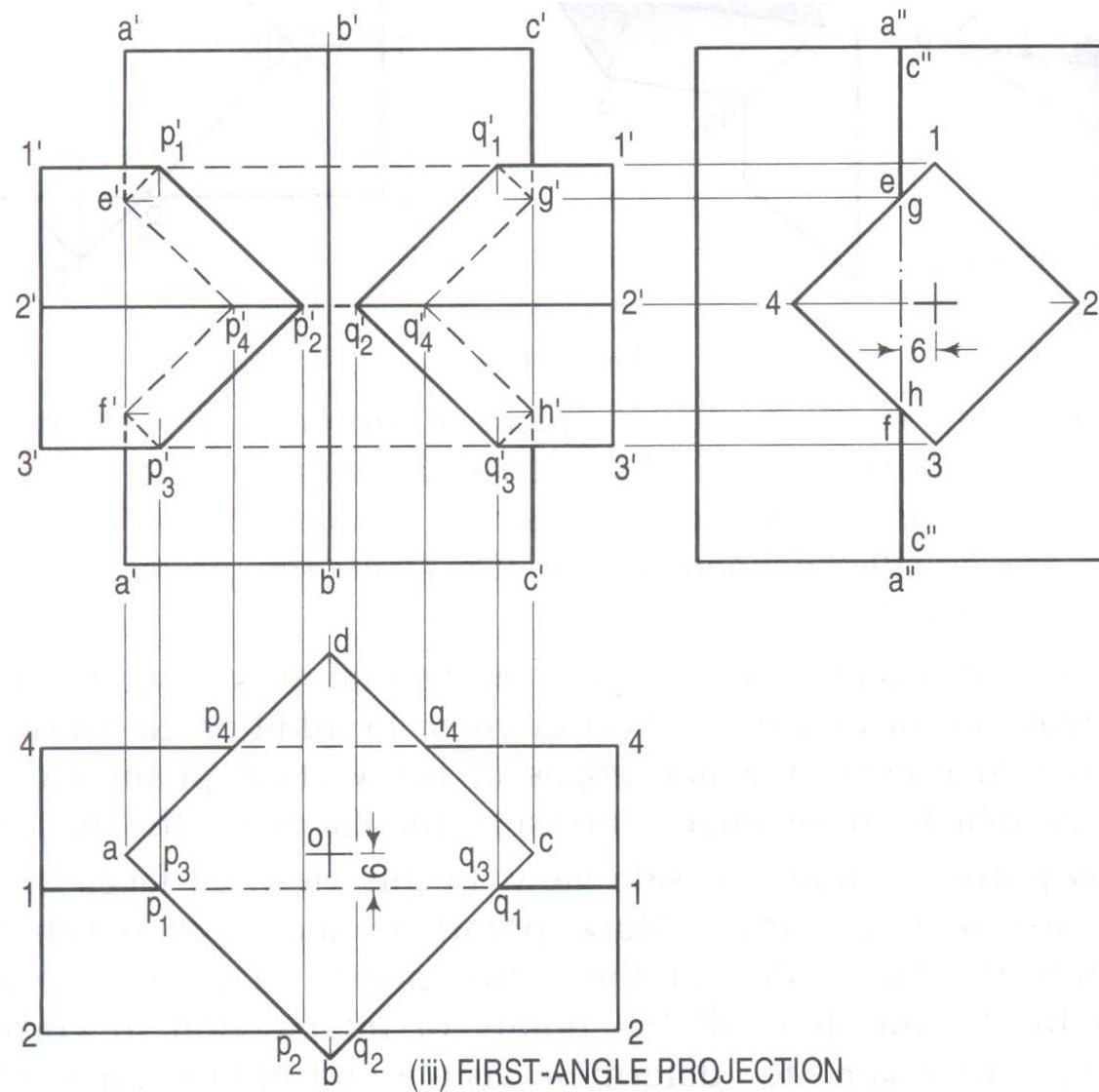
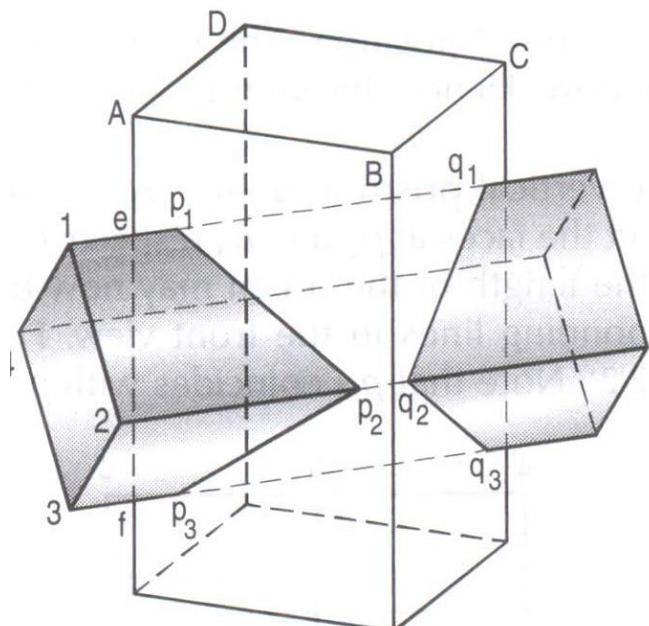
Example-2 (Solved Pb. 16-2, pp. 383)

A vertical square prism, base 50 mm side is completely penetrated by a horizontal square prism, base 35 mm side so that their axes are 6 mm apart. The axis of the horizontal prism is parallel to the V.P. Draw the projection of the prisms showing lines of intersection.

Statement missing in the book: The faces of the two prisms are equally inclined to the V.P.

Intersection of Surfaces

Example-2 (Solved Pb. 16-2, pp. 383) ...



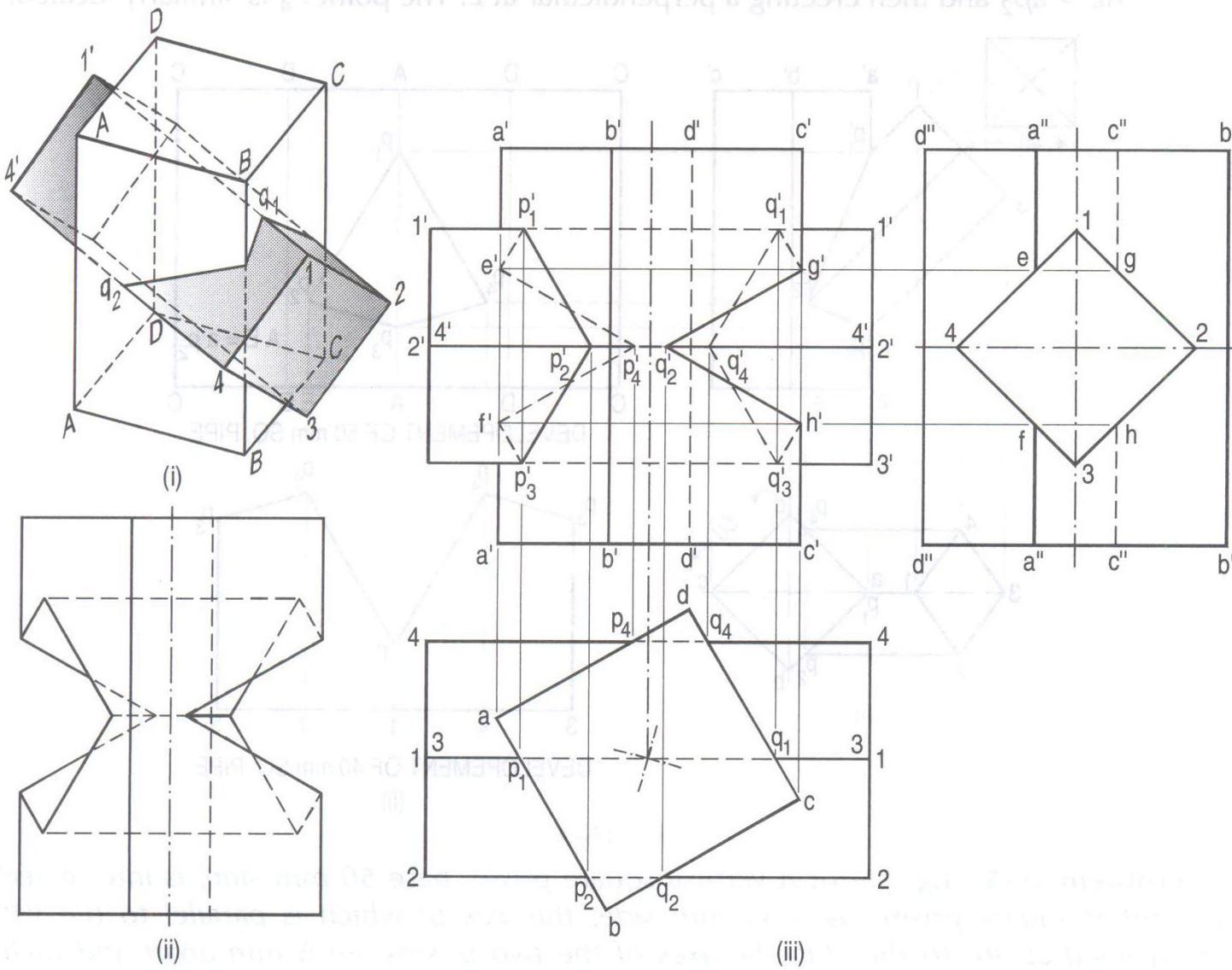
Intersection of Surfaces

Example-3 (Solved Pb. 16-3, pp. 385)

A vertical square prism, base 50 mm side and height 90 mm has a face inclined at 30° to the V.P. It is completely penetrated by another square prism, base 38 mm side and axis 100 mm long, faces of which are equally inclined to the V.P. and bisect each other at right angles. Draw the projections showing lines of intersection.

Intersection of Surfaces

Example-3 (Solved Pb. 16-3, pp. 385) ...



Intersection of Surfaces

Example-4 (Solved Pb. 16-4, pp. 386)

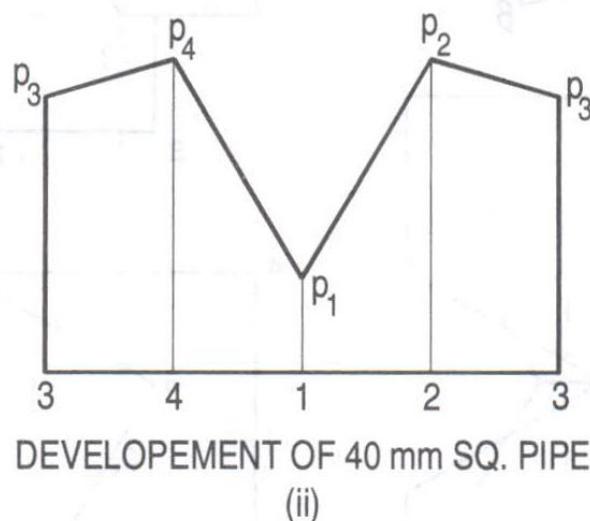
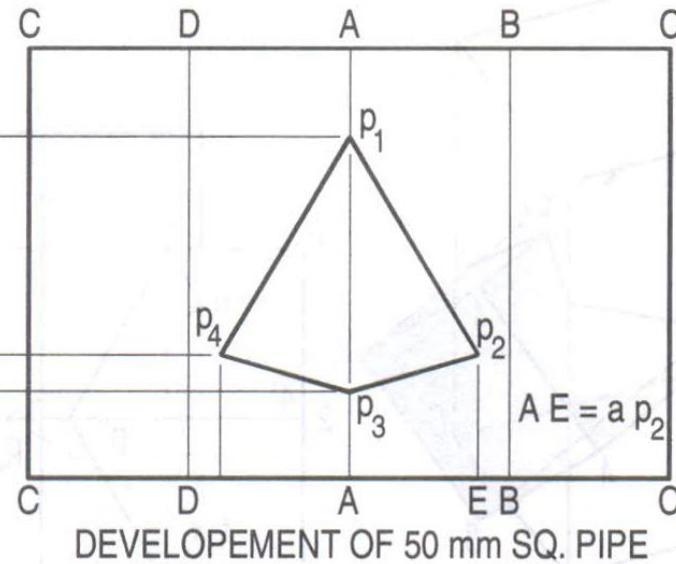
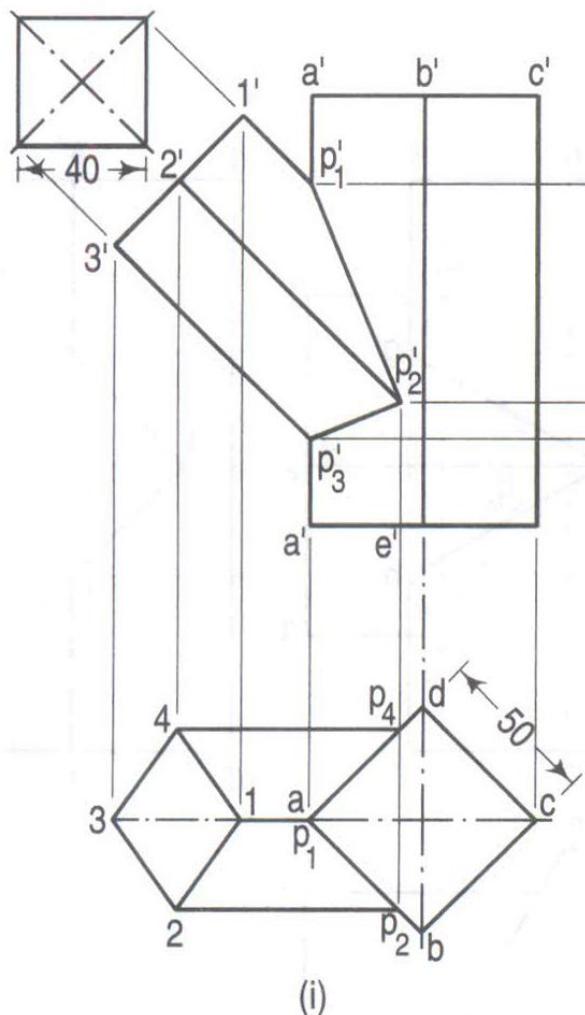
A square pipe of 50 mm side has a *similar branch* of 40 mm side. The axis of the main pipe is vertical and is intersected by the axis of the branch at an angle of 45° . All the faces of both the pipes are equally inclined to V.P. Draw the projections of the pipes, showing lines of intersection. Also develop the surfaces of both the pipes.

Similar branch means: similar orientation

Assume lengths.

Intersection of Surfaces

Example-4 (Solved Pb. 16-4, pp. 386) ...



Intersection of Surfaces

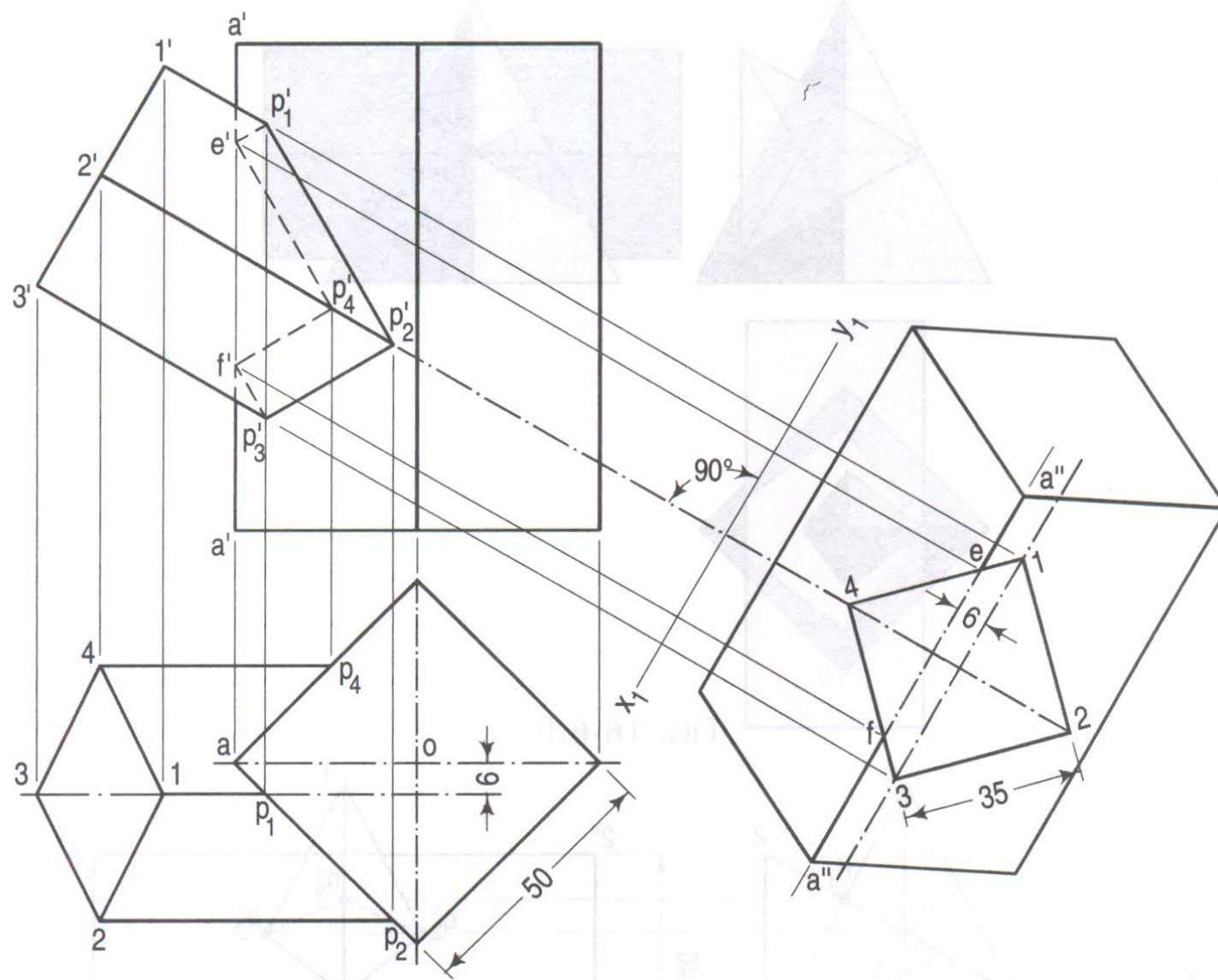
Example-5 (Solved Pb. 16-5, pp. 386)

A vertical square prism, base 50 mm side, is intersected by another square prism, base 35 mm side, the axis of which is parallel to the V.P. and inclined at 30° to the H.P. The axes of the two prisms are 6 mm apart and their faces are equally inclined to the V.P. Draw the projections showing the line of intersection.

There is ambiguity about exit at the other end. Assume it buried at right end and ignore projections of that end.

Intersection of Surfaces

Example-5 (Solved Pb. 16-5, pp. 386) ...



Intersection of Prism and Pyramid

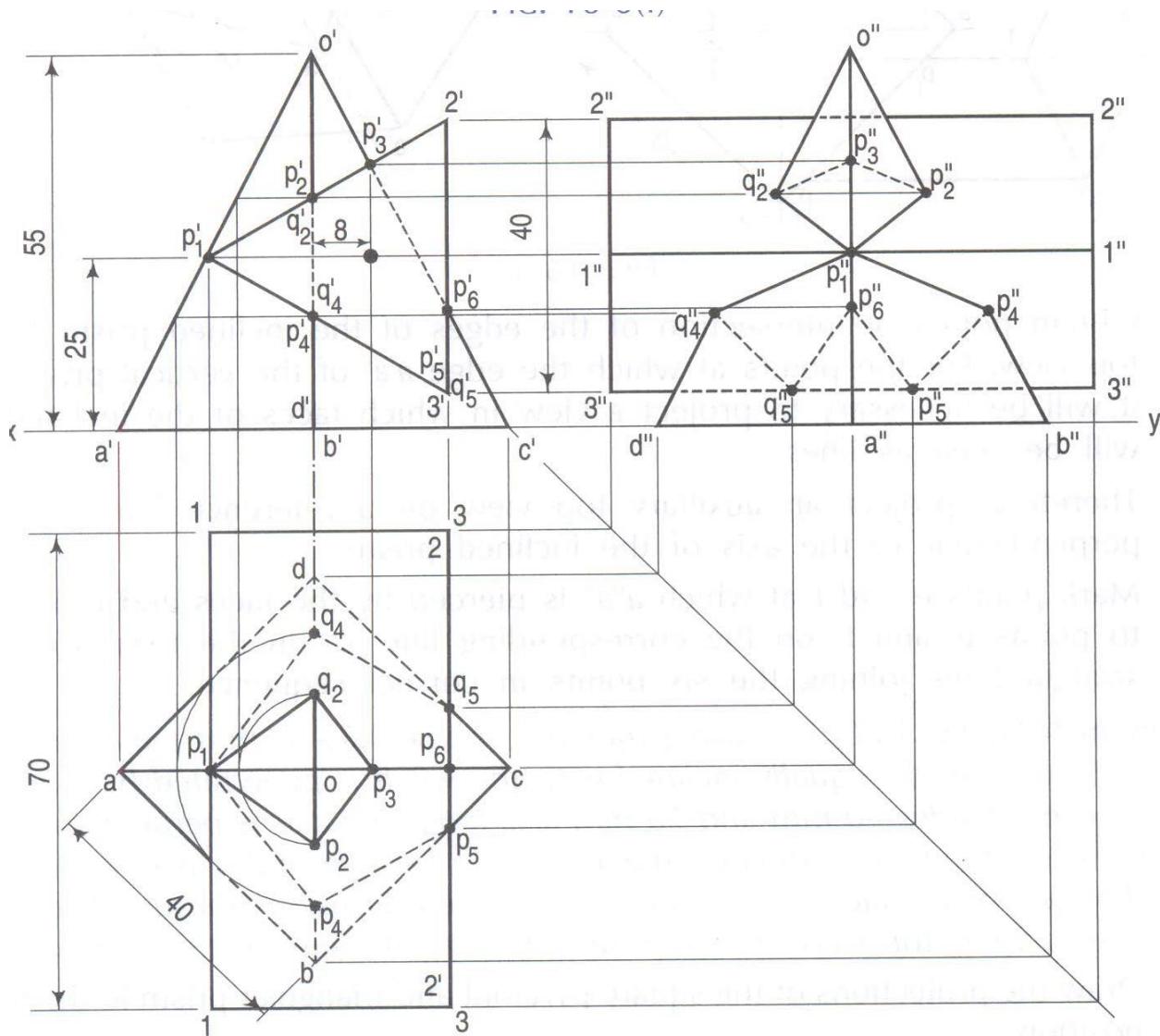
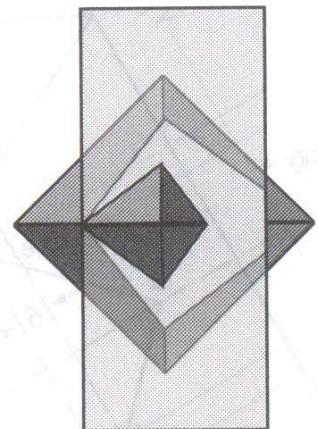
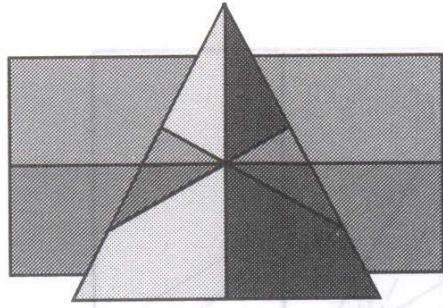
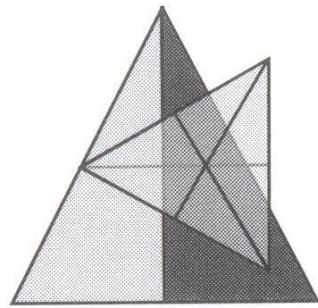
Intersection of Surfaces

Example-6 (Solved Pb. 16-6, pp. 387)

A square pyramid is of base sides 40 mm and height 55 mm. The sides of the base are equally inclined with the V.P. It is penetrated by a horizontal triangular prism of sides 40 mm and 70 mm axis long. The axis is perpendicular to the V.P. 25 mm above the base of the pyramid and 8 mm away from the axis of the pyramid. Assume that one of the faces of the prism is vertical and passes through the pyramid. Draw the front view, top view and side-view showing the intersection curve.

Intersection of Surfaces

Example-6 (Solved Pb. 16-6, pp. 387) ...



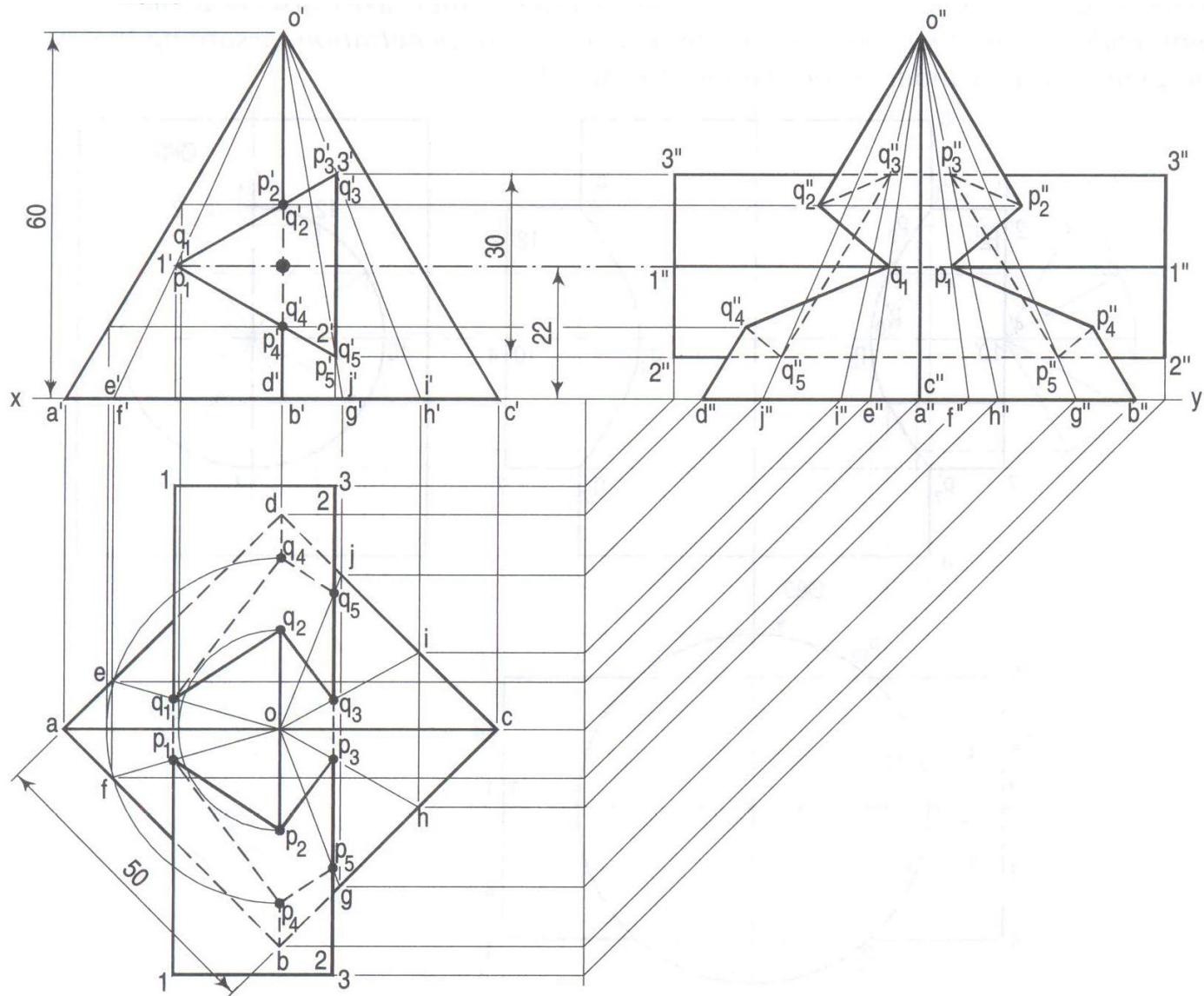
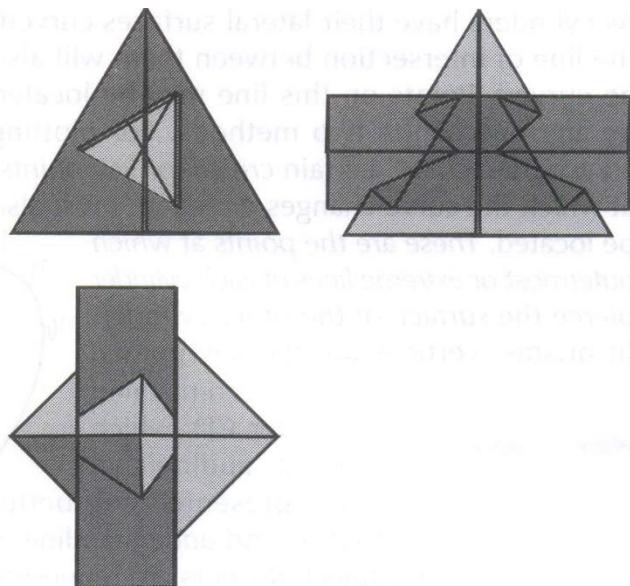
Intersection of Surfaces

Example-7 (Solved Pb. 16-7, pp. 388)

A square pyramid of base sides 50 mm and height 60 mm. The sides of base are equally inclined with the V.P. It is penetrated by a horizontal triangular prism of sides 30 mm and 80 mm axis long. The axes of both solids are intersecting each other. The axis of triangular prism is 22 mm above H.P. and perpendicular to the V.P. One of the faces of triangular prism is perpendicular to the V.P. Draw the top view, front view and side view showing the curve of the penetration.

Intersection of Surfaces

Example-7 (Solved Pb. 16-7, pp. 388) ...



Intersection of Cylinders

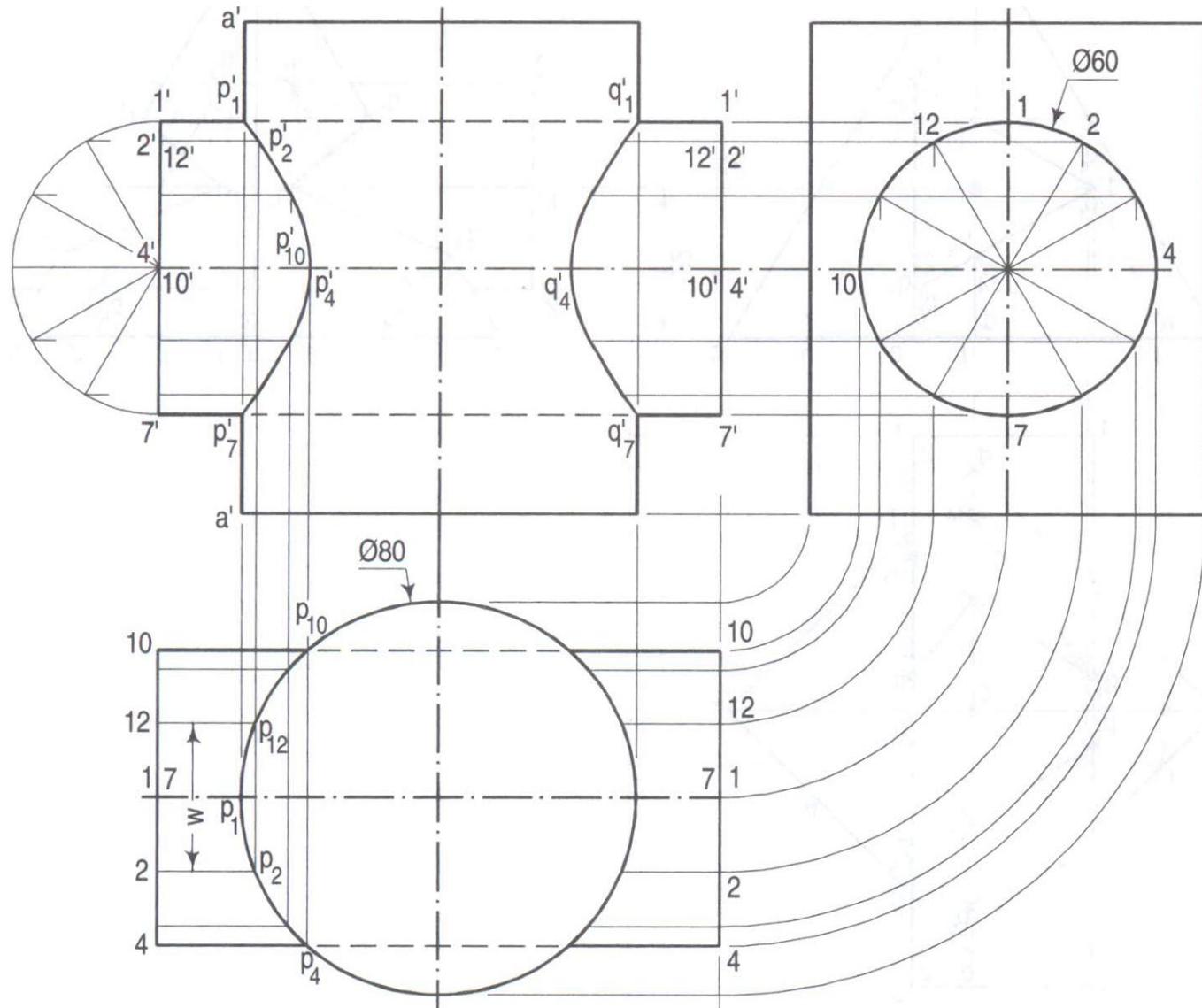
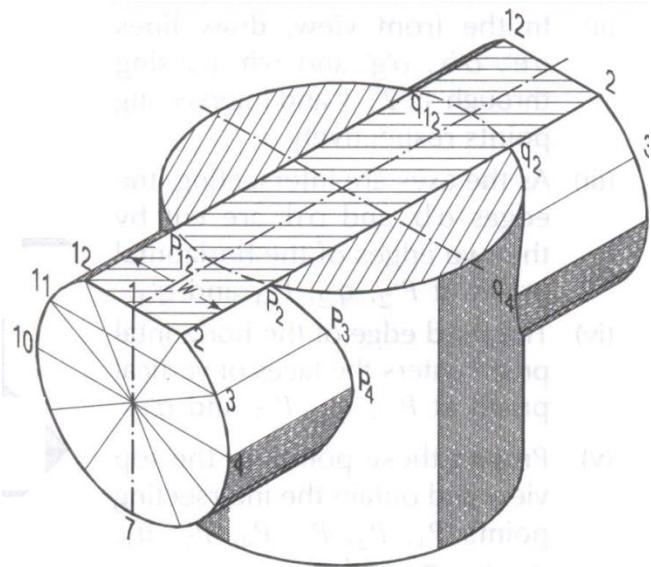
Intersection of Surfaces

Example-8 (Solved Pb. 16-8, pp. 390)

A vertical cylinder of 80 mm diameter is completely penetrated by another cylinder of 60 mm diameter, their axes bisecting each other at right angles. Draw their projections showing curves of penetration, assuming the axis of the penetrating cylinder to be parallel to the V.P.

Intersection of Surfaces

Example-8 (Solved Pb. 16-8, pp. 390) ...



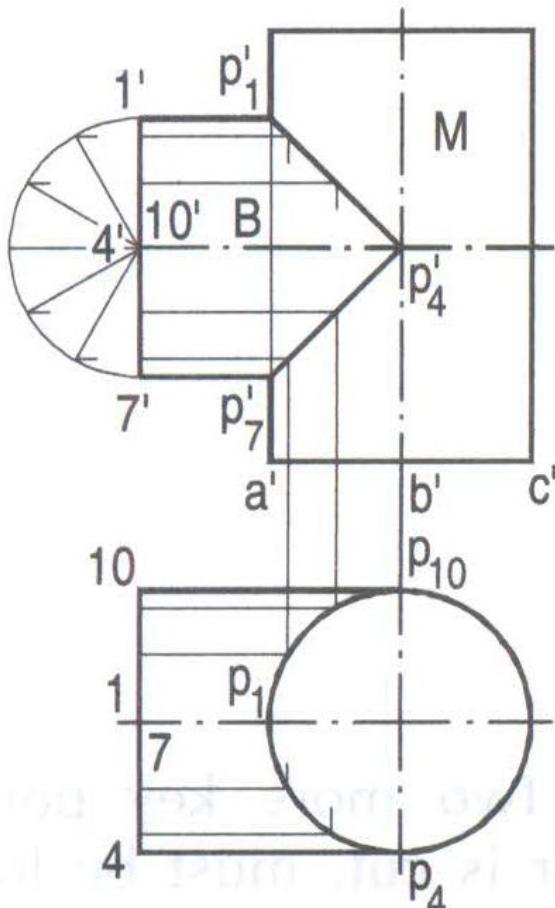
Intersection of Surfaces

Example-9 (Solved Pb. 16-9, pp. 391)

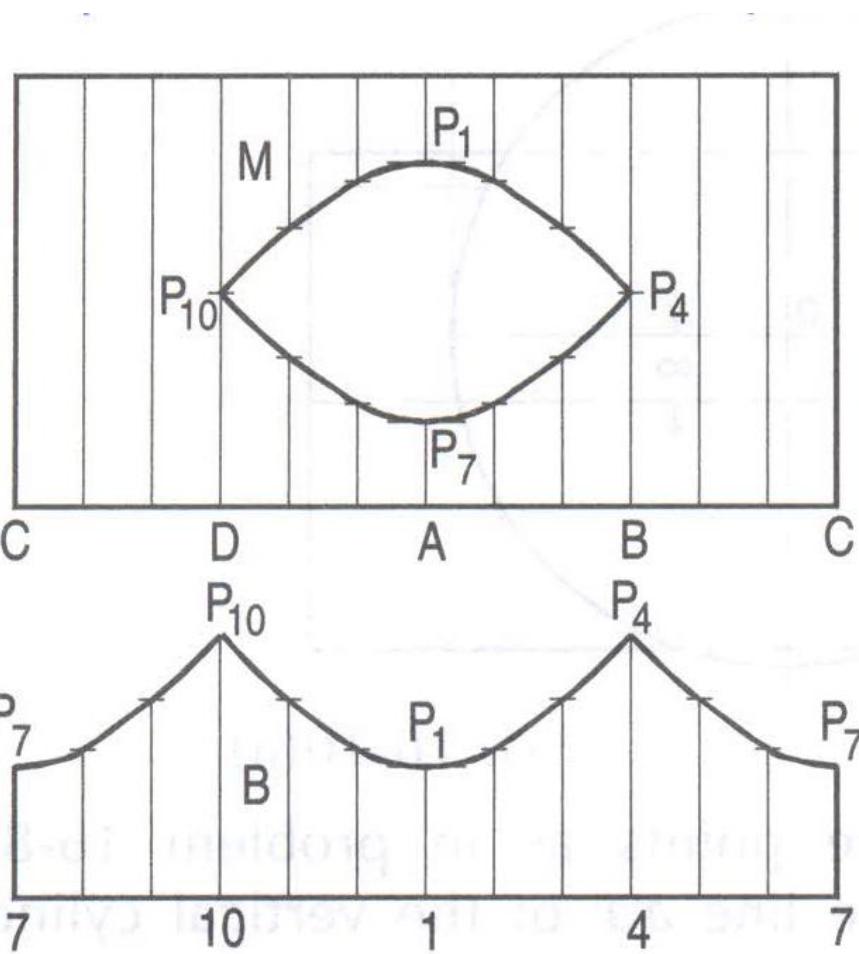
A cylindrical pipe of 30 mm diameter has a similar branch of the same size. The axis of the main pipe is vertical and is intersected by that of the branch at right-angles. Draw the projections of the pipes, assuming suitable lengths, when the two axes lie in a plane parallel to the V.P. Develop the surfaces of the two pipes.

Intersection of Surfaces

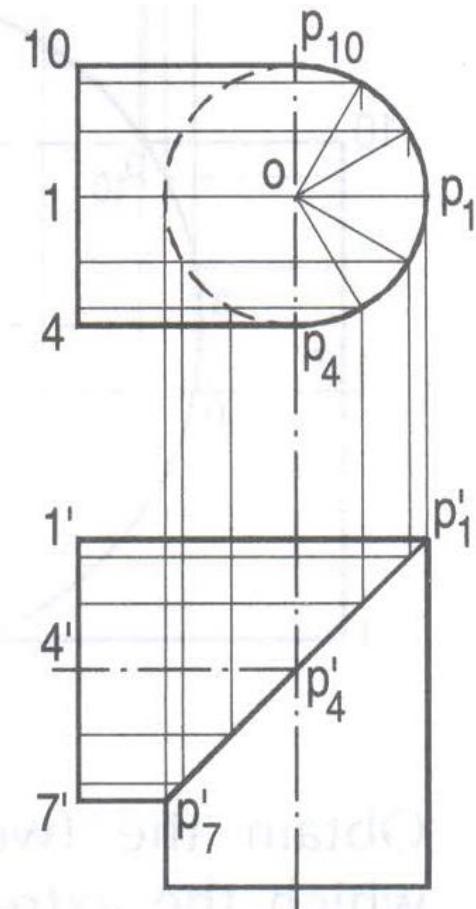
Example-9 (Solved Pb. 16-9, pp. 391) ...



(i)



(ii)



(iii)

Intersection of Surfaces

Example-10 (Solved Pb. 16-10, pp. 392)

A vertical cylinder of 80 mm diameter is penetrated by another cylinder of 60 mm diameter, the axis of which is parallel to both the H.P. and the V.P. The two axes are 8 mm apart. Draw the projections showing curves of intersection.

Intersection of Surfaces

Example-10 (Solved Pb. 16-10, pp. 392) ...

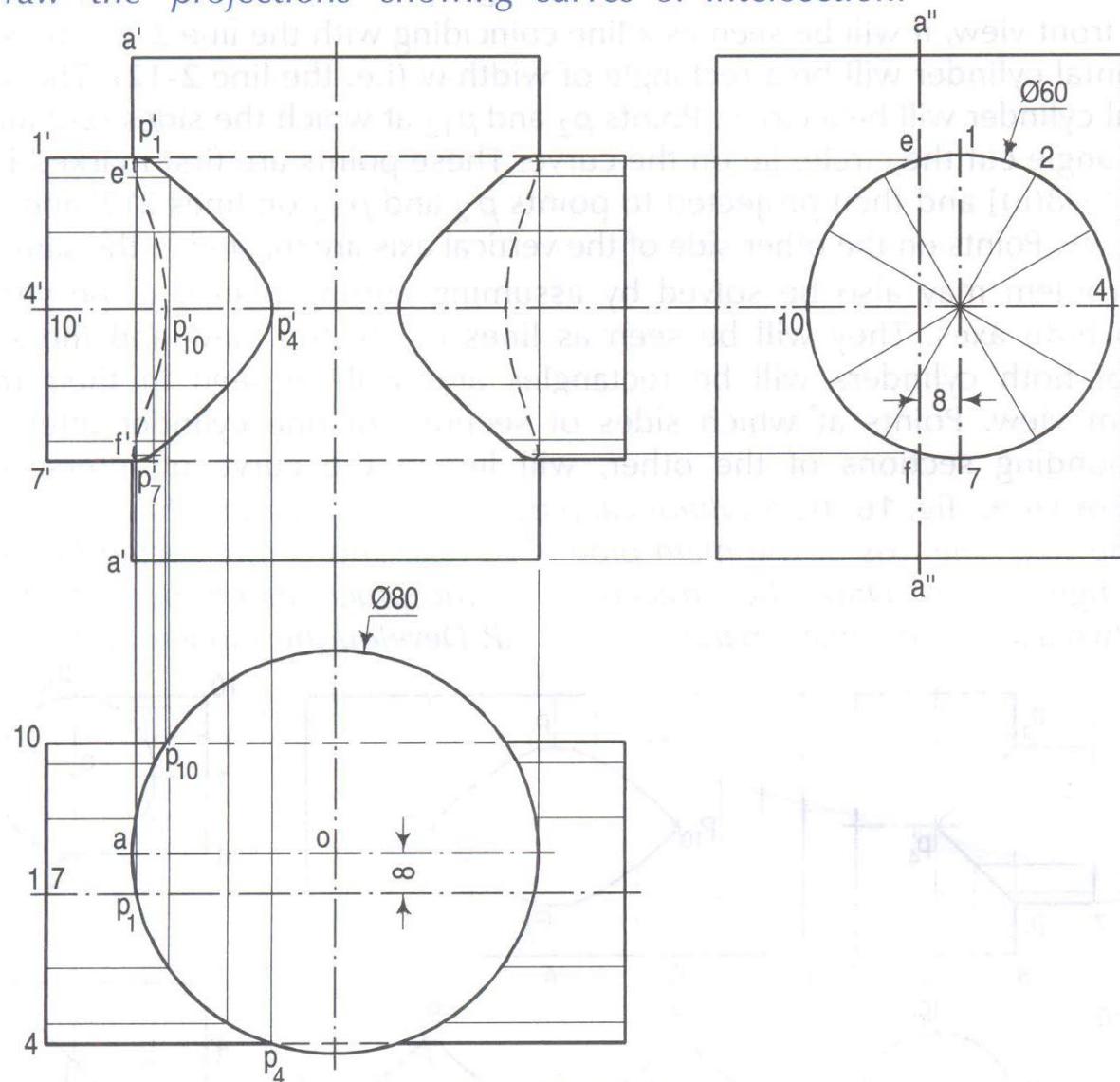
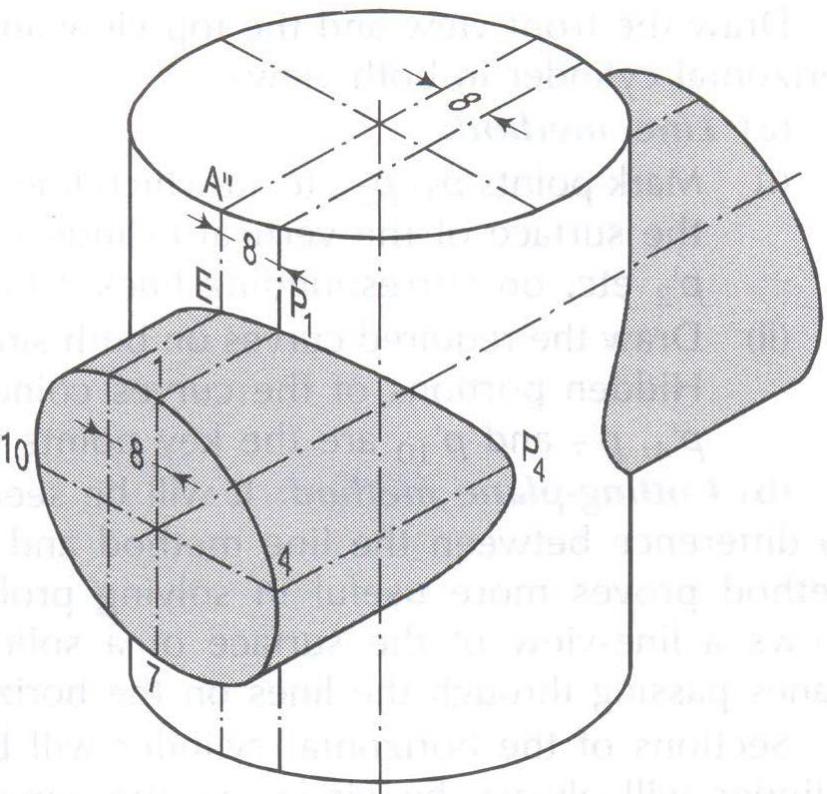


Fig. 16-10 (ii)

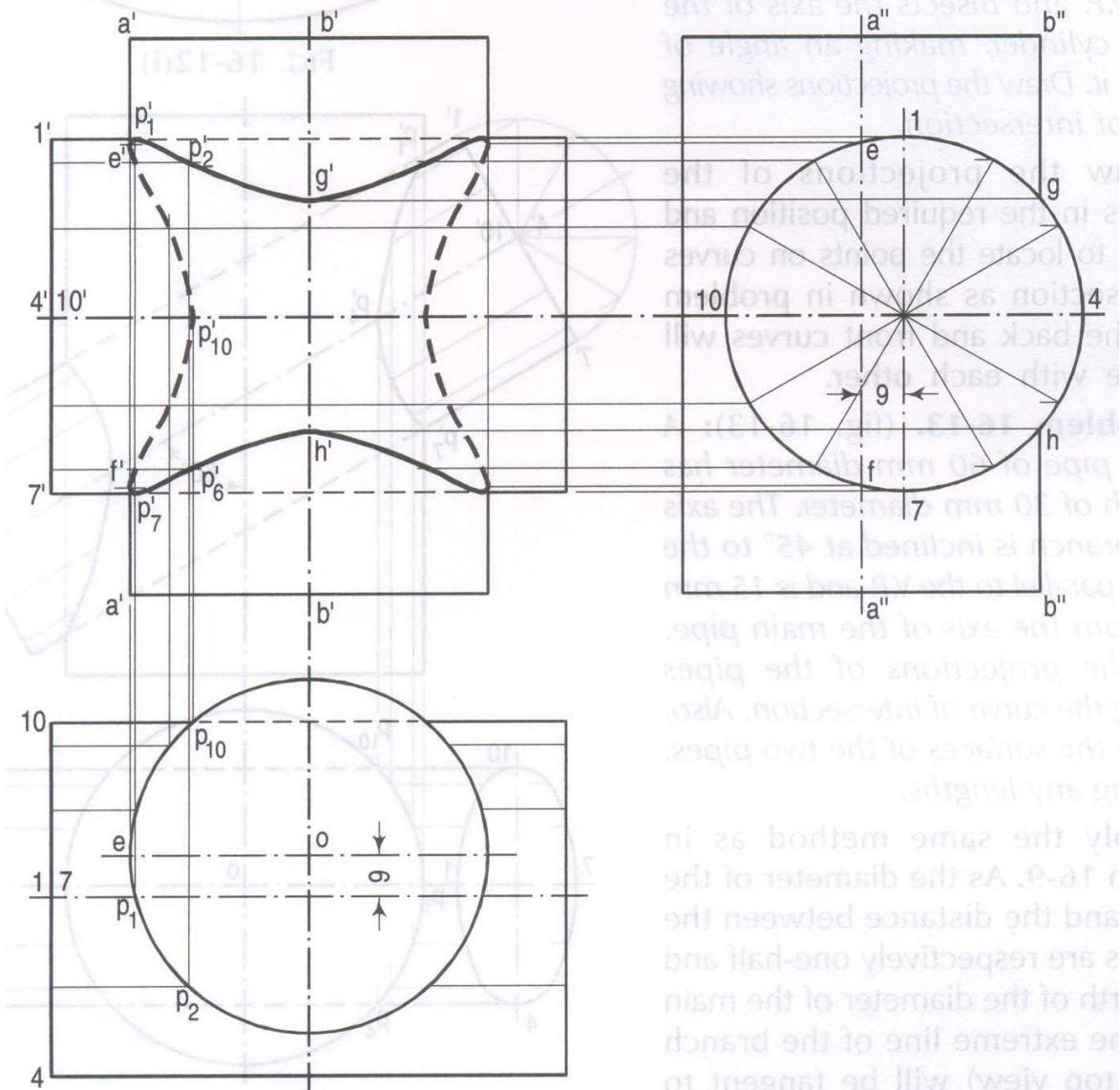
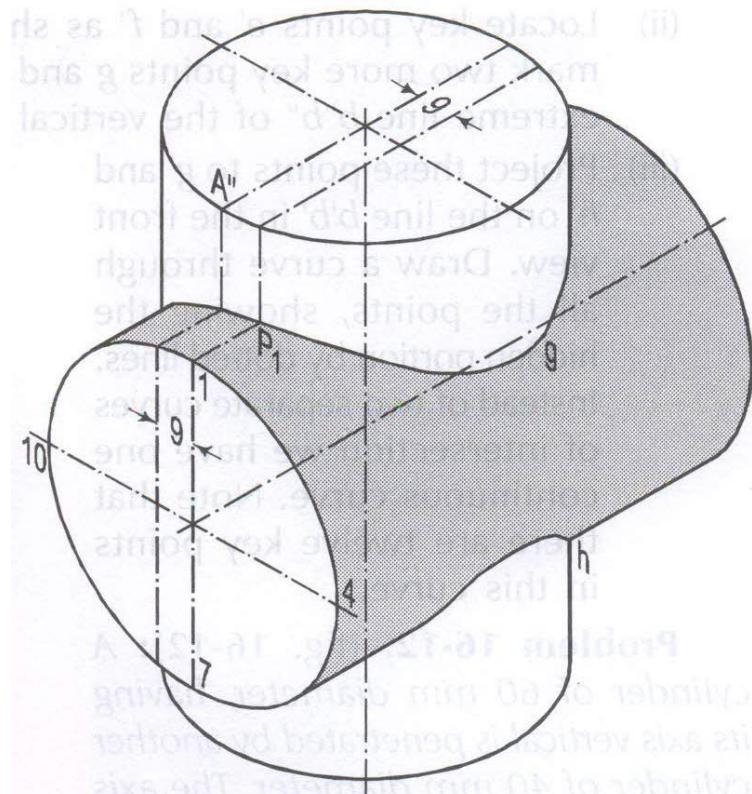
Intersection of Surfaces

Example-11 (Solved Pb. 16-11, pp. 393)

A vertical cylinder of 75 mm diameter is penetrated by another cylinder of the same size. The axis of the penetrating cylinder is parallel to both the H.P. and the V.P. and is 9 mm away from the axis of the vertical cylinder. Draw the projections showing curves of intersection.

Intersection of Surfaces

Example-11 (Solved Pb. 16-11, pp. 393) ...



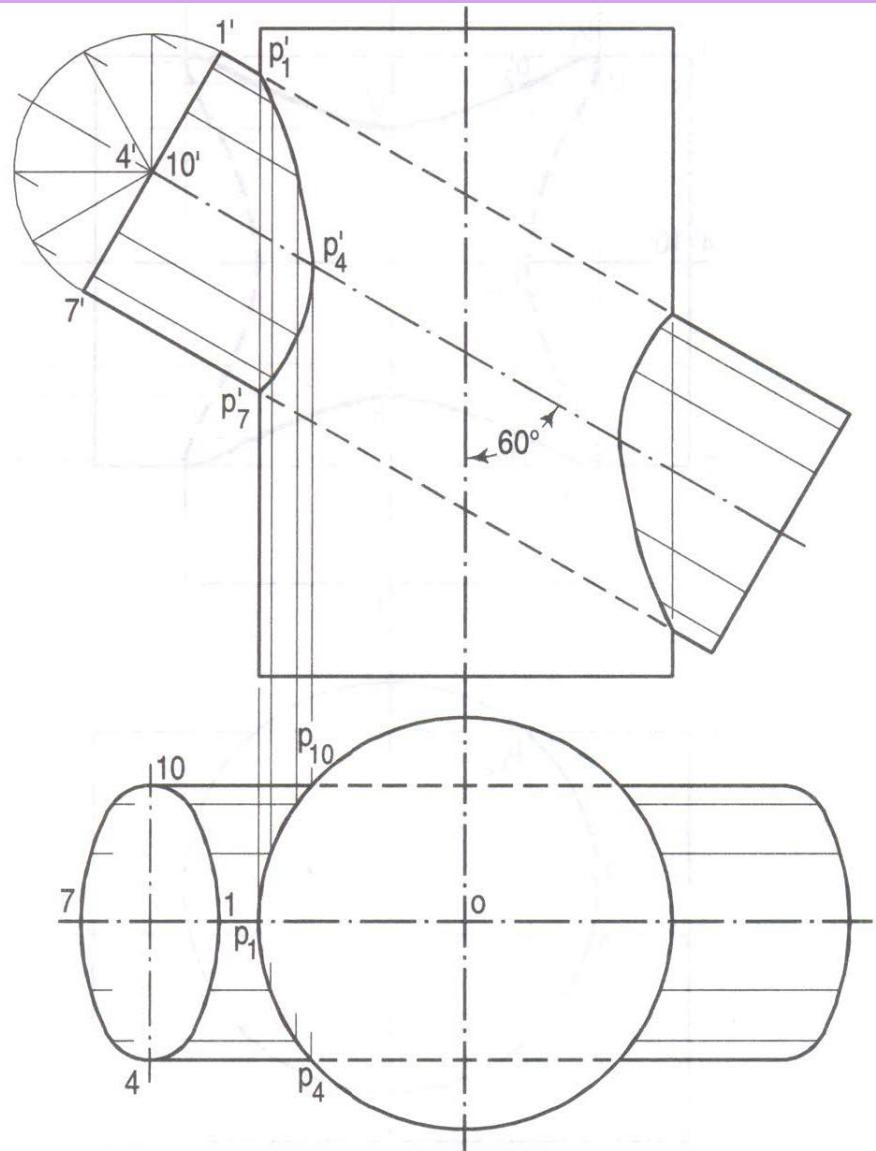
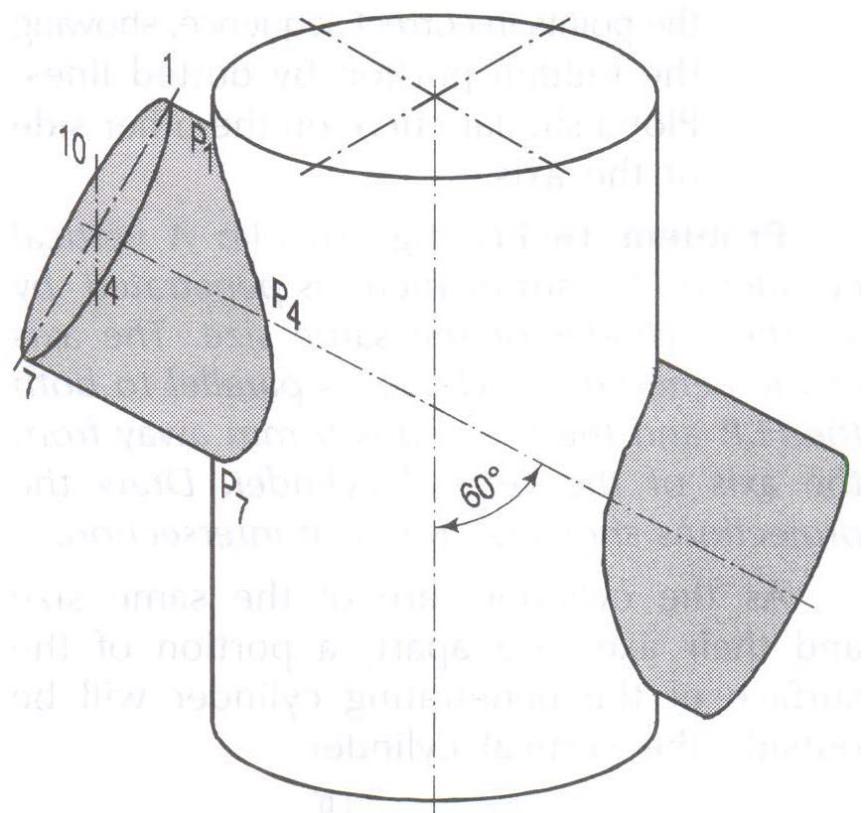
Intersection of Surfaces

Example-12 (Solved Pb. 16-12, pp. 394)

A cylinder of 60 mm diameter, having its axis vertical is penetrated by another cylinder of 40 mm diameter. The axis of the penetrating cylinder is parallel to the V.P. and bisects the axis of the vertical cylinder, making an angle of 60° with it. Draw the projections showing curves of intersection.

Intersection of Surfaces

Example-12 (Solved Pb. 16-12, pp. 394) ...



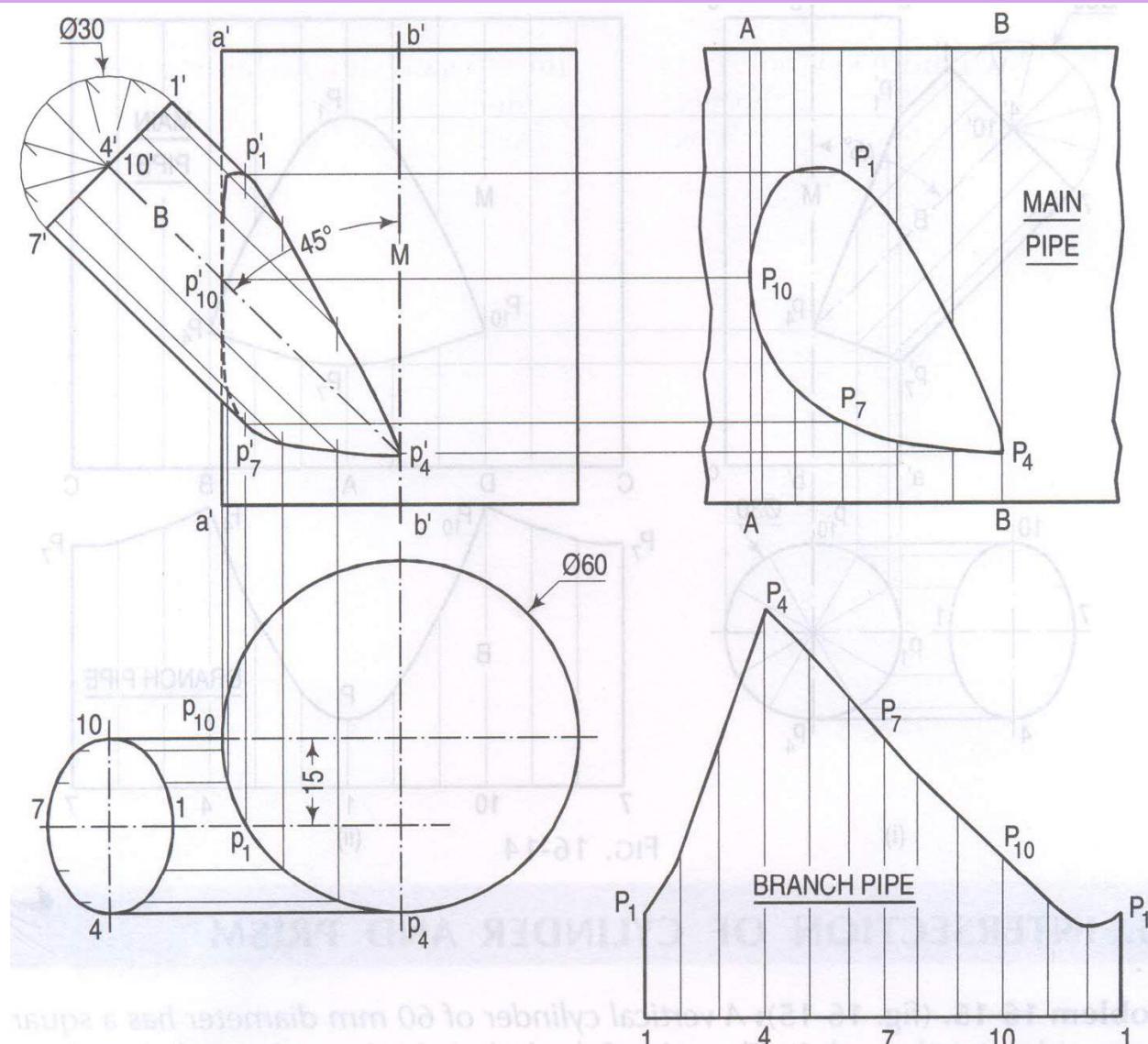
Intersection of Surfaces

Example-13 (Solved Pb. 16-13, pp. 394)

A vertical pipe of 60 mm diameter has a branch of 30 mm diameter. The axis of the branch is inclined at 45° to the ground parallel to the V.P. and is 15 mm away from the axis of the main pipe. Draw the projections of the pipes showing the curves of intersection. Also, develop the surfaces of the two pipes, assuming any lengths.

Intersection of Surfaces

Example-13 (Solved Pb. 16-13, pp. 394) ...



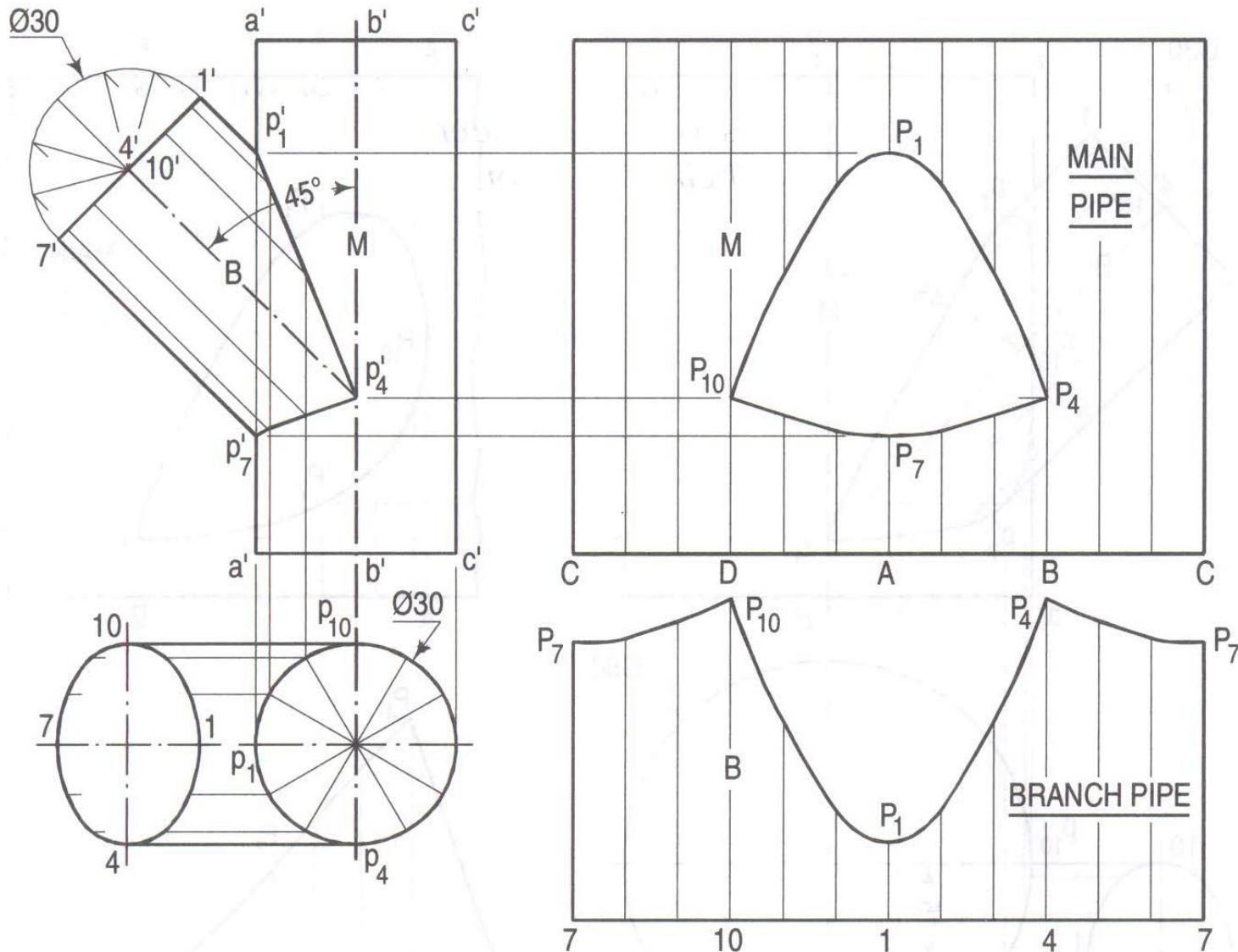
Intersection of Surfaces

Example-14 (Solved Pb. 16-14, pp. 395)

A cylindrical pipe of 30 mm diameter has a similar branch of the same size. The axis of the branch intersects that of the main pipe at an angle of 45° . Draw the projections, when the two axes lie in a plane parallel to the V.P., and the axis of the main pipe is vertical. Also, develop the surfaces of the two pipes, assuming suitable lengths.

Intersection of Surfaces

Example-14 (Solved Pb. 16-14, pp. 395) ...



Intersection of Cylinder and Prism

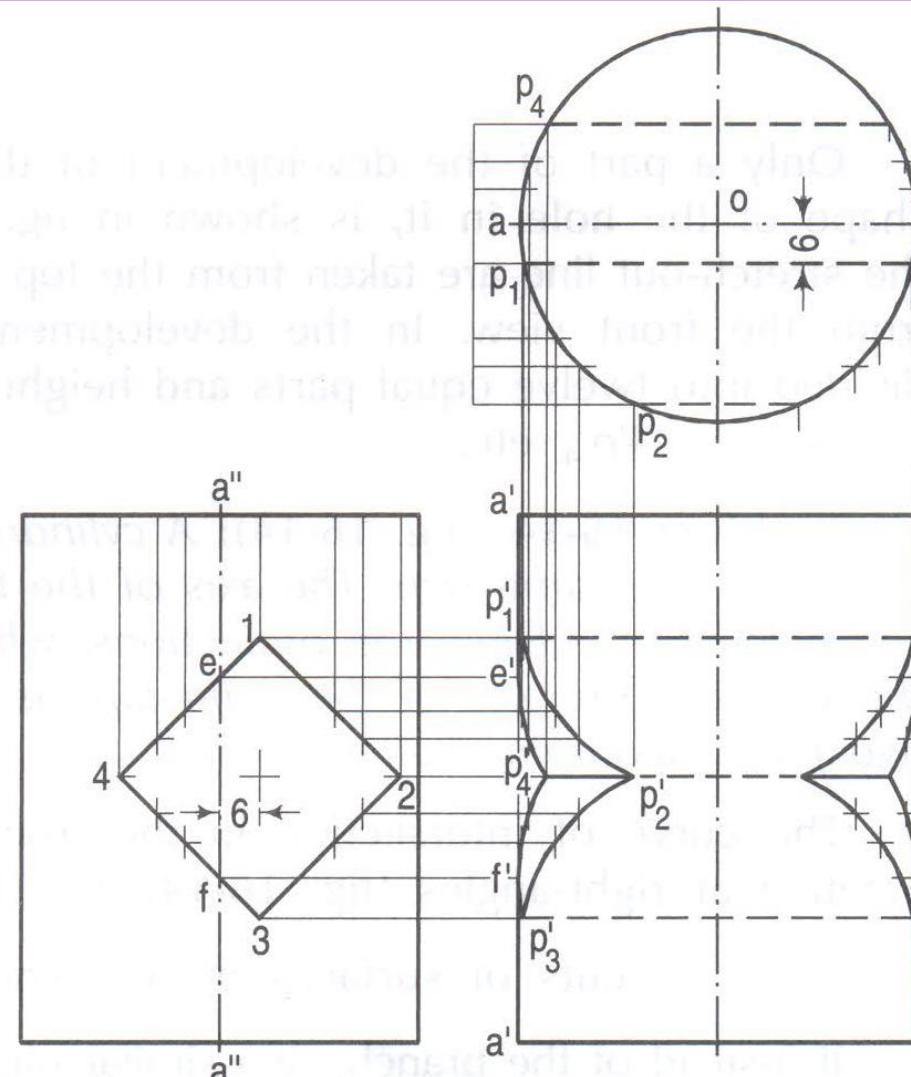
Intersection of Surfaces

Example-15 (Solved Pb. 16-15, pp. 396)

A vertical cylinder of 60 mm diameter has a square hole of 30 mm sides cut through it. The axis of the hole is horizontal, parallel to the V.P. and 6 mm away from the axis of the cylinder. The faces of the hole are equally inclined to the H.P. and the V.P. Draw the projections of the cylinder showing the hole in it.

Intersection of Surfaces

Example-15 (Solved Pb. 16-15, pp. 396) ...



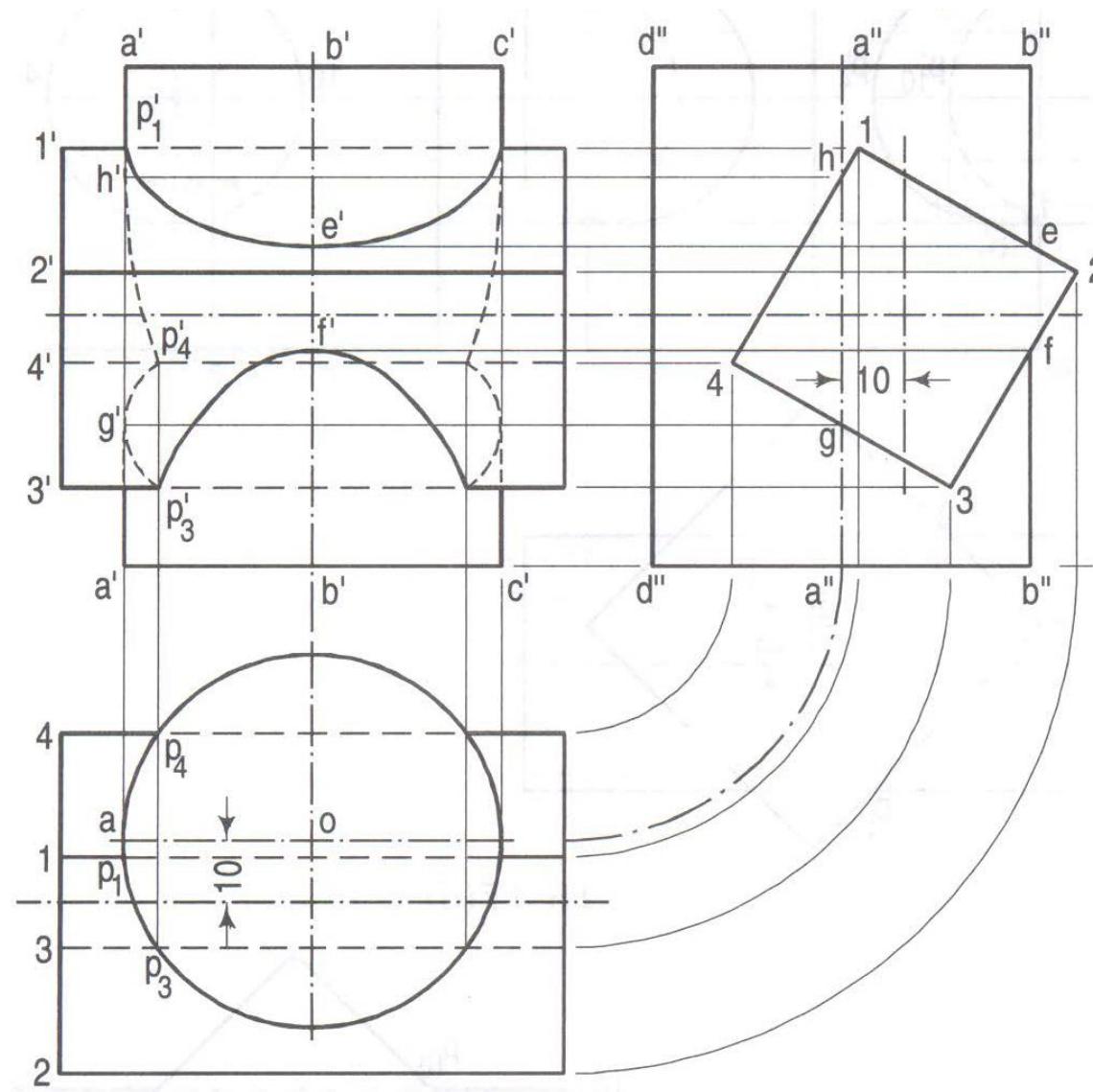
Intersection of Surfaces

Example-16 (Solved Pb. 16-16, pp. 397)

A vertical cylinder of 60 mm diameter is penetrated by a horizontal square prism, base 40 mm side, the axis of which is parallel to the VP and 10 mm away from the axis of the cylinder. A face of the prism makes an angle of 30° with the H.P. Draw their projections, showing curves of intersection.

Intersection of Surfaces

Example-16 (Solved Pb. 16-16, pp. 397) ...



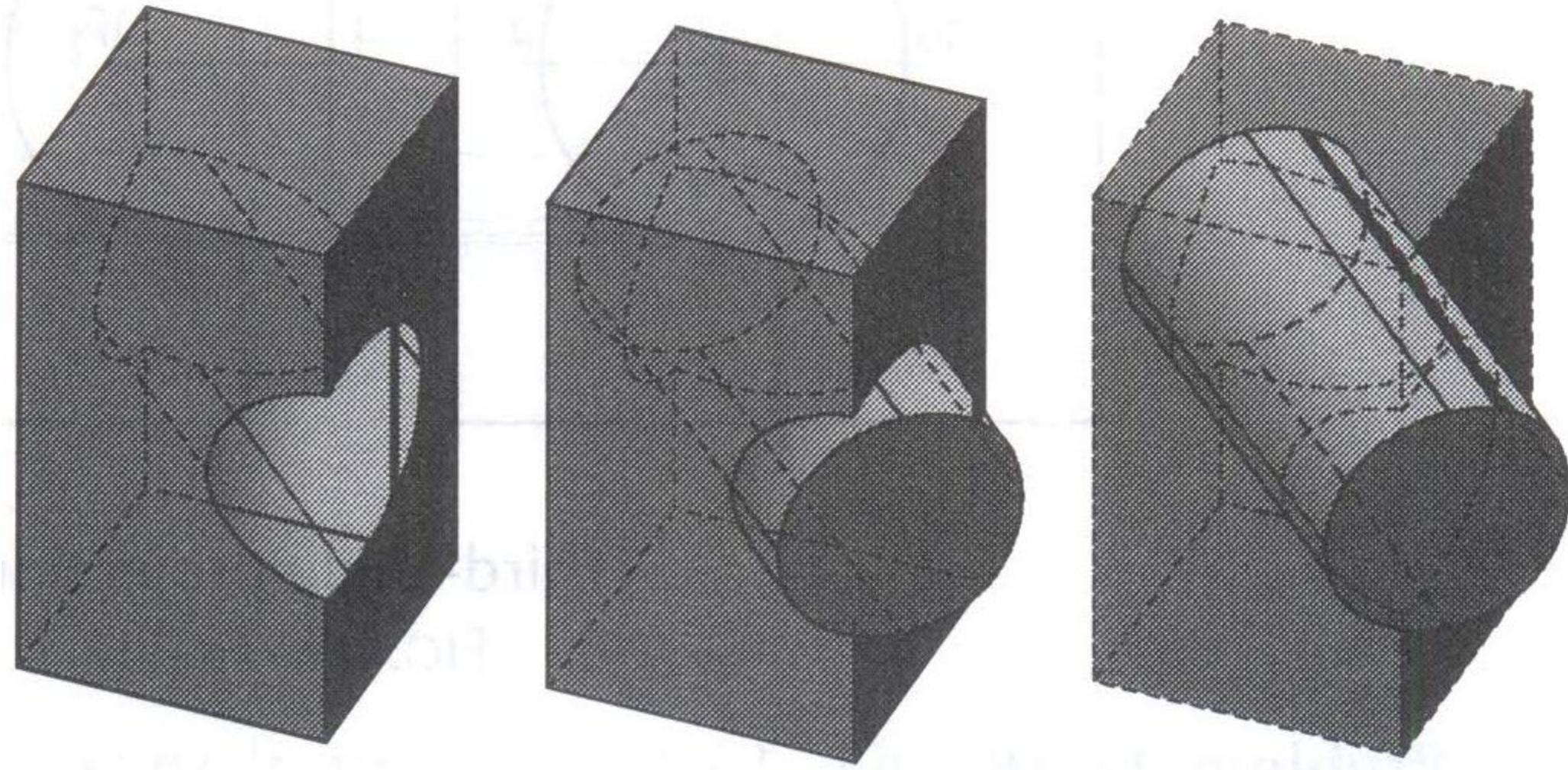
Intersection of Surfaces

Example-17 (Solved Pb. 16-17, pp. 397)

A vertical square prism having its faces equally inclined to the V.P. is completely penetrated by a horizontal cylinder, the axis of which is parallel to the V.P. and 6 mm away from that of the prism. Draw the projections of the solids showing curves of intersections. The length of the sides of the base of the prism is 50 mm and the diameter of the cylinder is 40 mm.

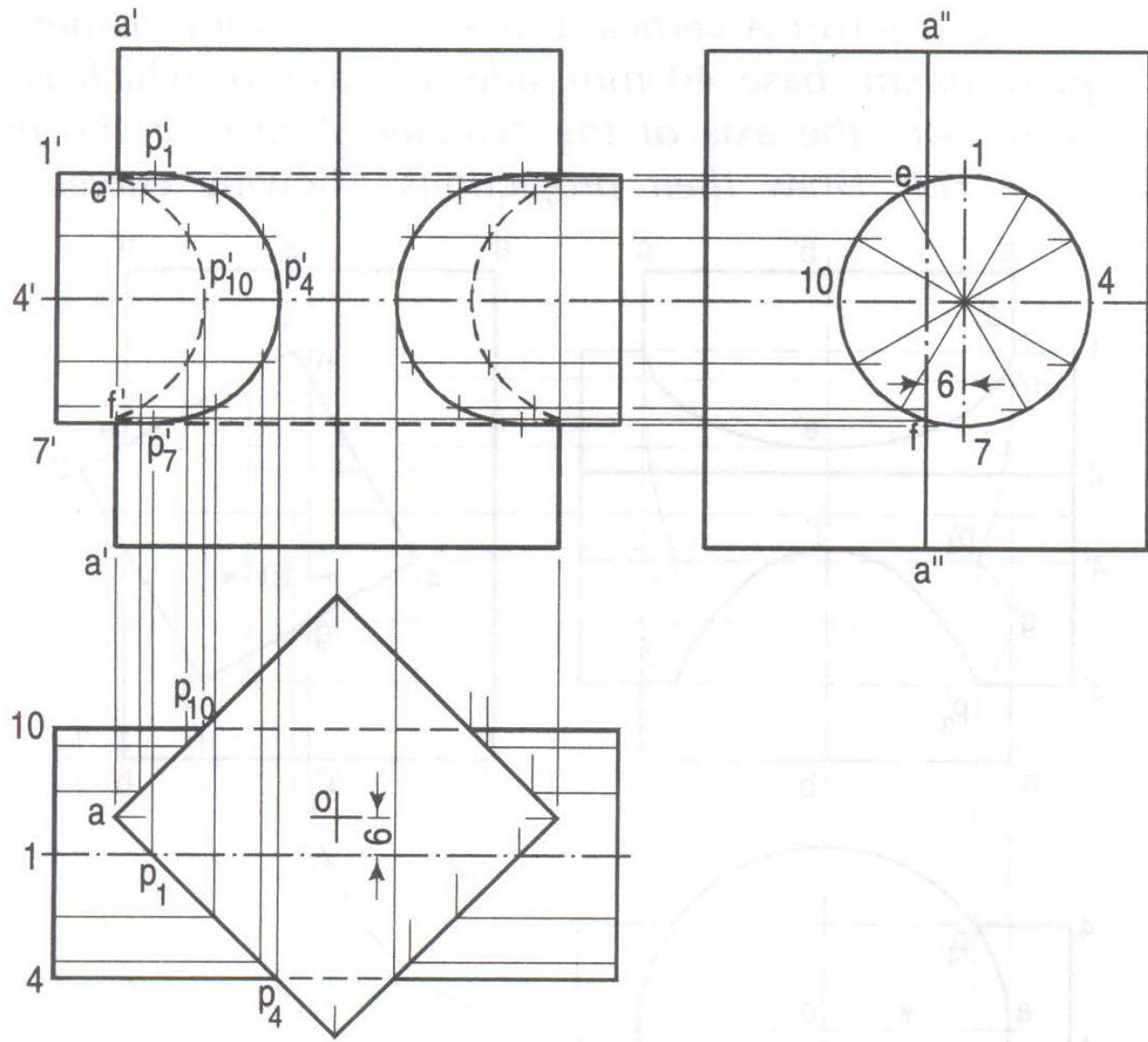
Intersection of Surfaces

Example-17 (Solved Pb. 16-17, pp. 397) ...



Intersection of Surfaces

Example-17 (Solved Pb. 16-17, pp. 397) ...



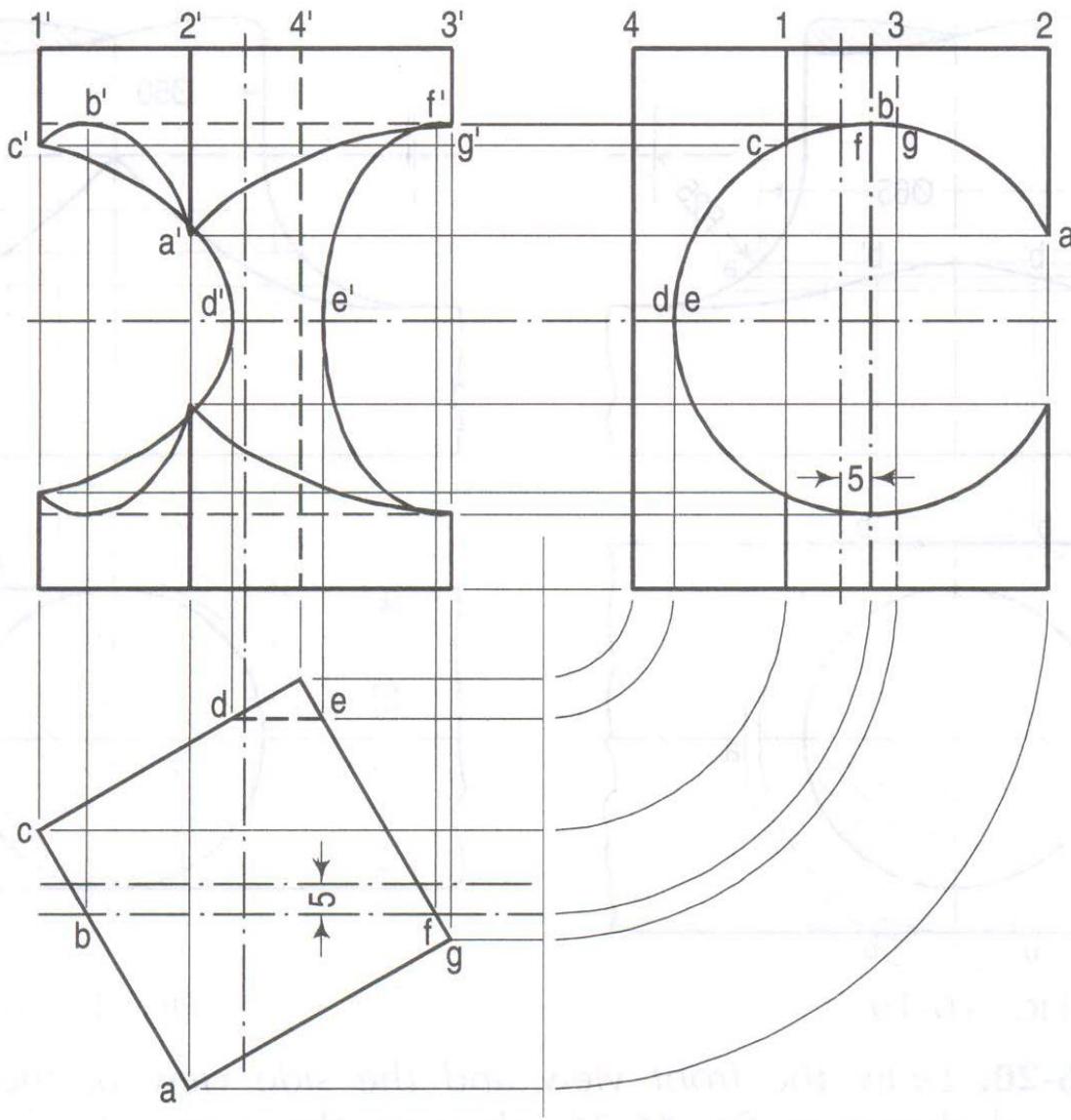
Intersection of Surfaces

Example-18 (Solved Pb. 16-18, pp. 398)

A vertical square prism, base 50 mm side, has a face inclined at 30° to the V.P. It has a hole of 65 mm diameter drilled through it. The centre line of the hole is parallel to both the H.P. and the V.P. and is 5 mm away from the axis of the prism. Draw the projections of the prism.

Intersection of Surfaces

Example-18 (Solved Pb. 16-18, pp. 398) ...



Intersection of Cylinder and Cone

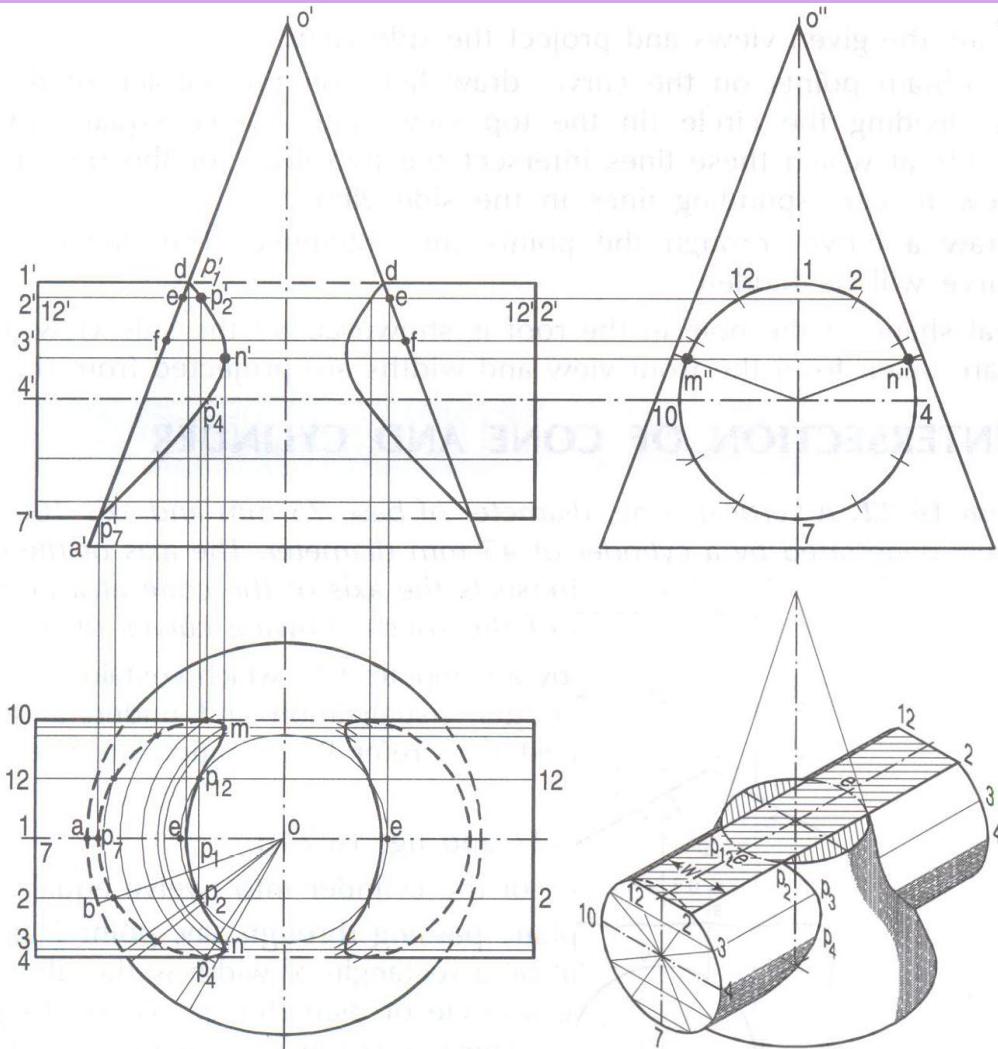
Intersection of Surfaces

Example-22 (Solved Pb. 16-22, pp. 401)

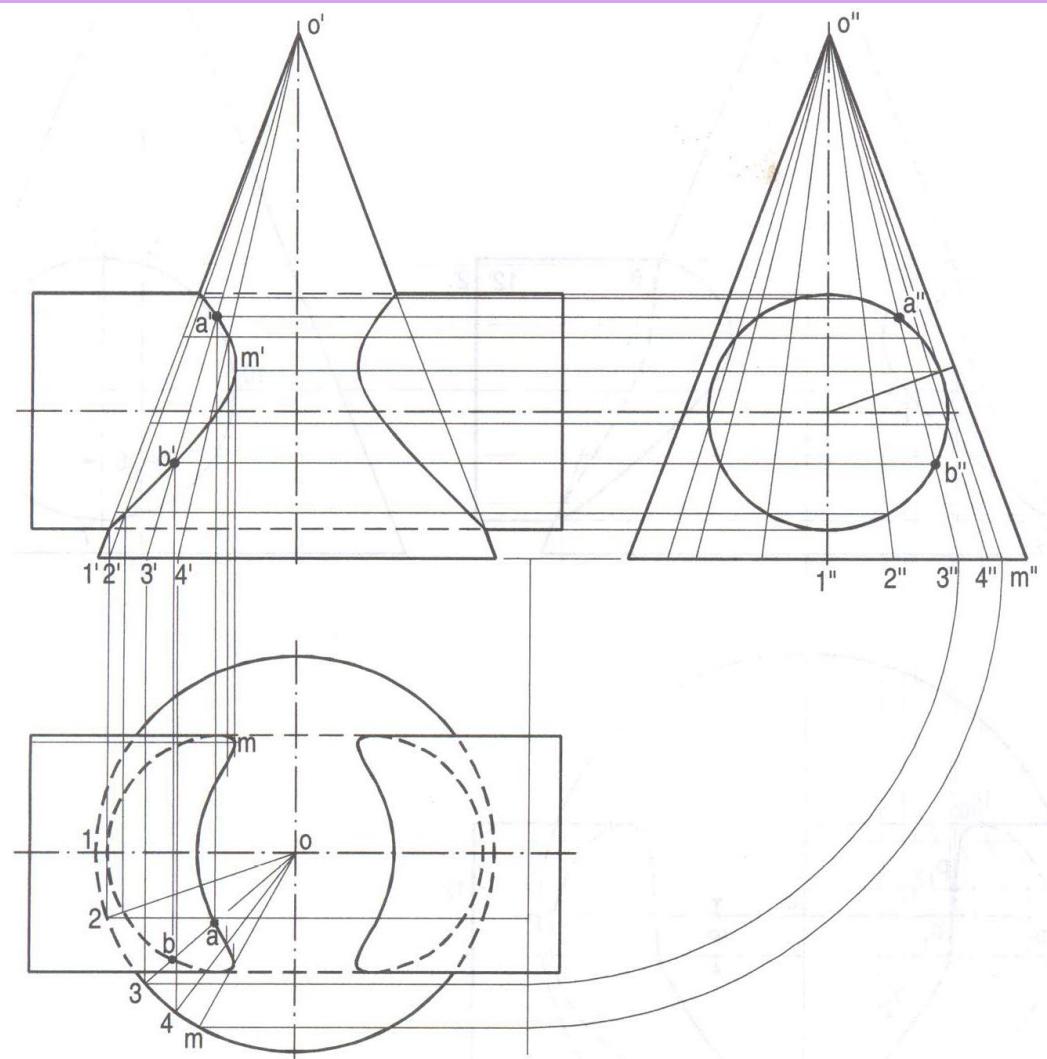
A vertical cone, diameter of base 75 mm and axis 100 mm long, is completely penetrated by a cylinder of 45 mm diameter. The axis of the cylinder is parallel to the H.P. and the V.P. and intersects the axis of the cone at a point 28 mm above the base. Draw the projections of solid showing curves of intersection.

Intersection of Surfaces

Example-22 (Solved Pb. 16-22, pp. 401) ...



Cutting plane method



Line method

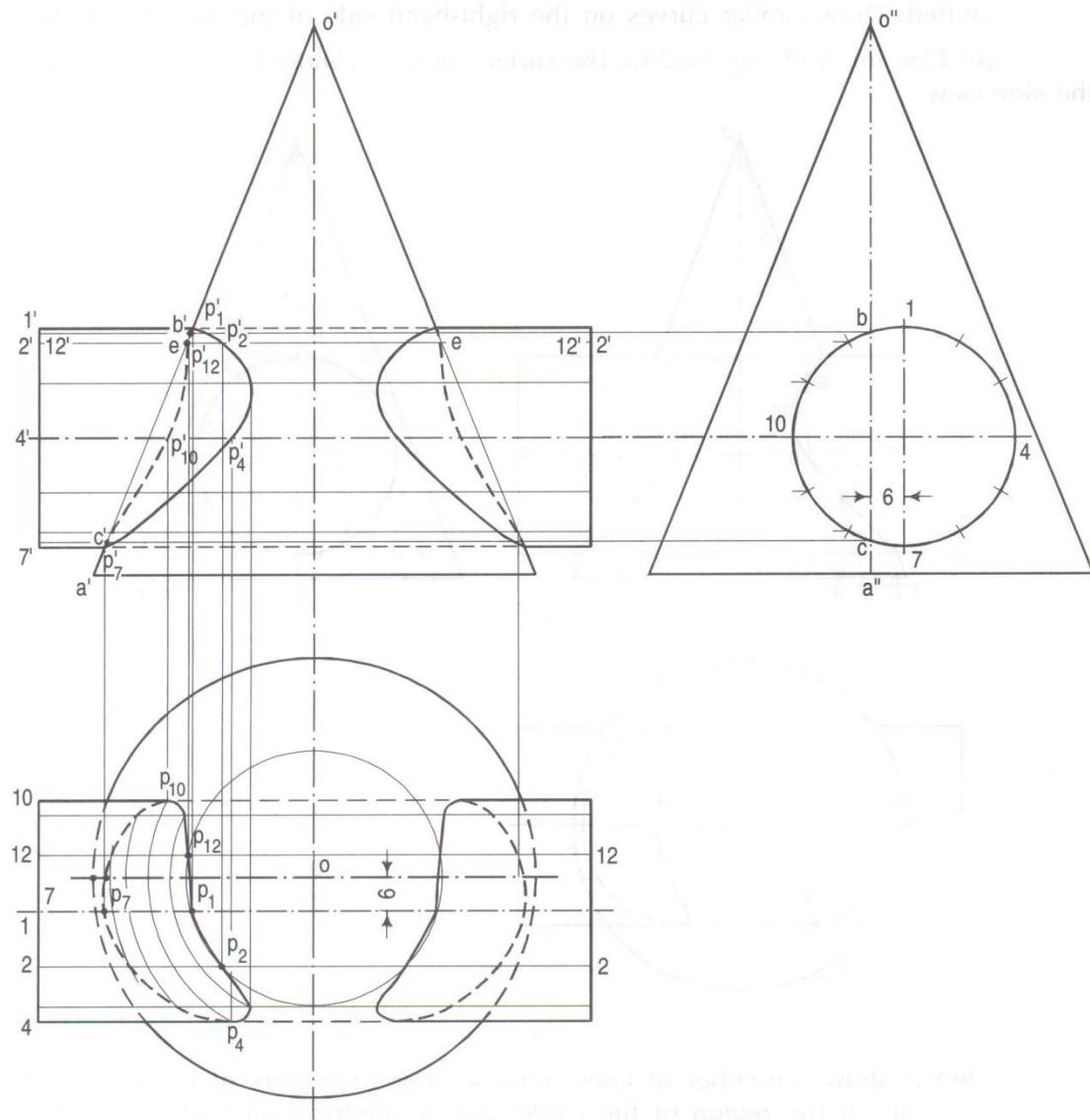
Intersection of Surfaces

Example-23 (Solved Pb. 16-23, pp. 404)

A vertical cone, base 80 mm diameter and axis 100 mm long, is penetrated by a horizontal cylinder of 40 mm diameter, the axis of which is 25 mm above the base of the cone, parallel to the V.P. and 6 mm away from the axis of the cone. Draw the projections, showing curves of intersection.

Intersection of Surfaces

Example-23 (Solved Pb. 16-23, pp. 404) ...



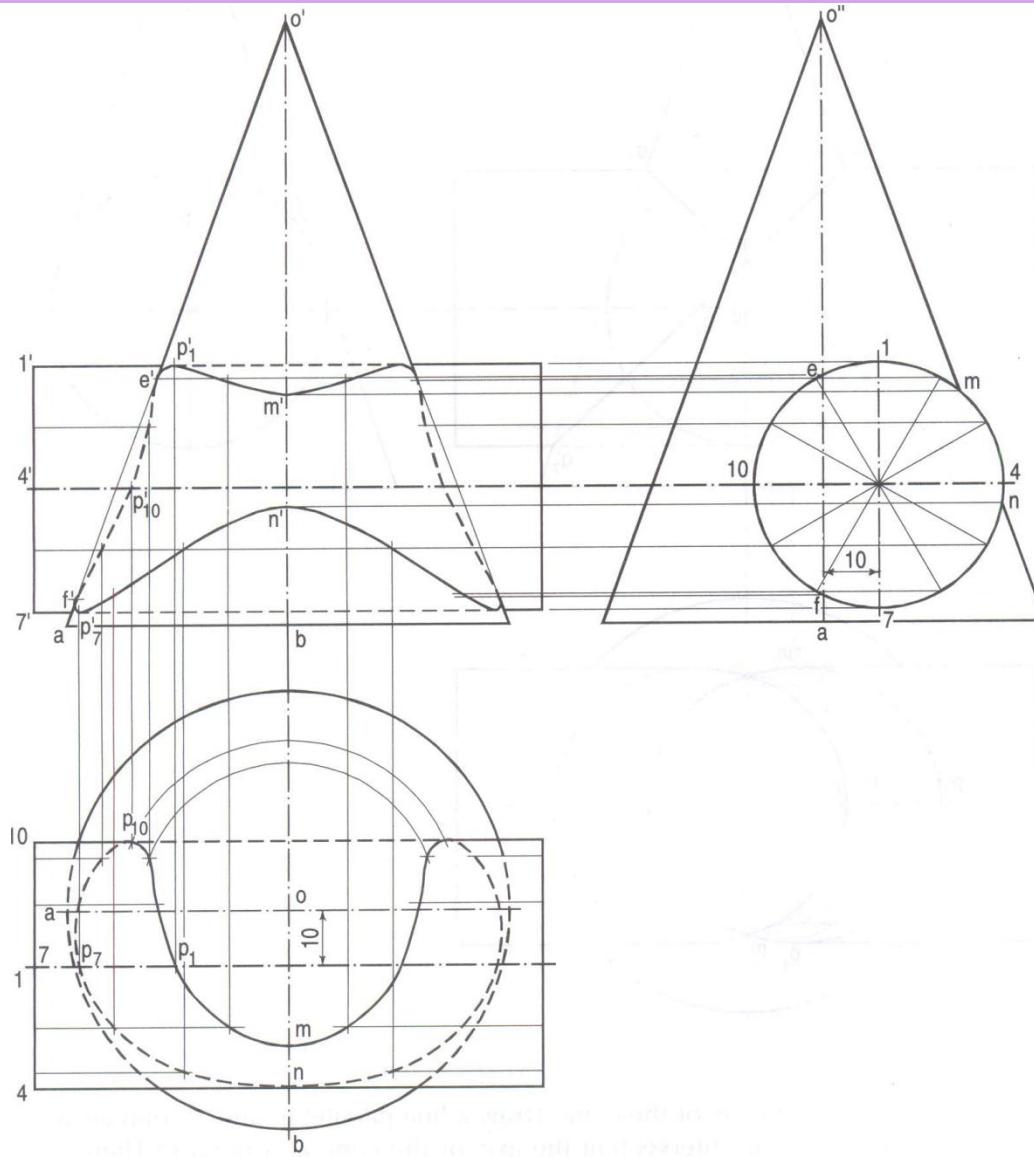
Intersection of Surfaces

Example-24 (Solved Pb. 16-24, pp. 405)

A vertical cone, base 80 mm diameter and axis 110 mm long is penetrated by a horizontal cylinder, 45 mm diameter. The axis of the cylinder is 25 mm above the base of the cone, is parallel to the V.P. and is 10 mm away from the axis of the cone. Draw the projections of the solid showing curves of intersections.

Intersection of Surfaces

Example-24 (Solved Pb. 16-24, pp. 405) ...



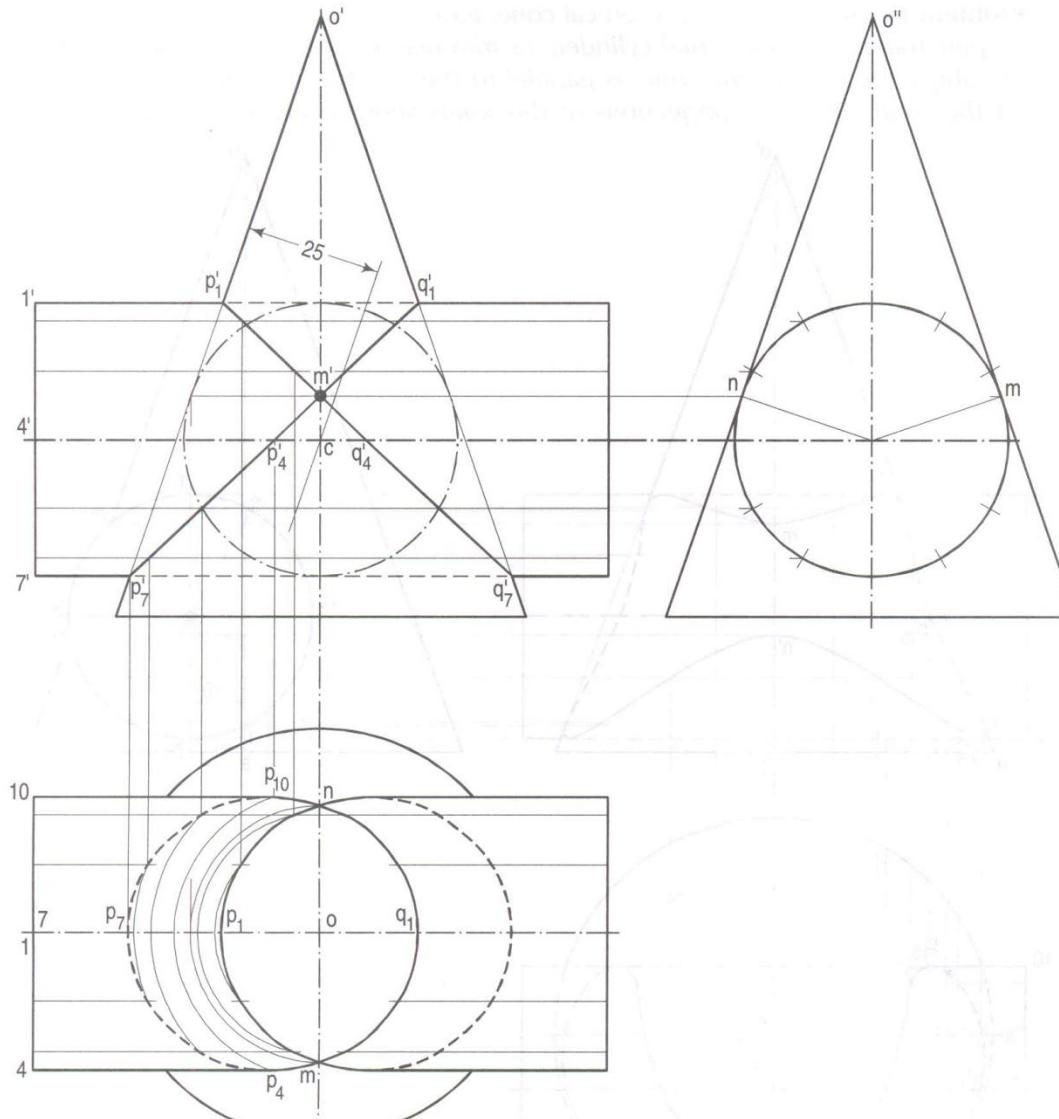
Intersection of Surfaces

Example-25 (Solved Pb. 16-25, pp. 405)

A vertical cone, base 75 mm diameter and axis 110 mm long is penetrated by horizontal cylinder of 50 mm diameter in such a way that both the solids envelope an imaginary common sphere and their axis intersect each other. Draw the projections of solid when their axes lie in a plane parallel to the V.P.

Intersection of Surfaces

Example-25 (Solved Pb. 16-25, pp. 405) ...



Intersection of Cone and Prism

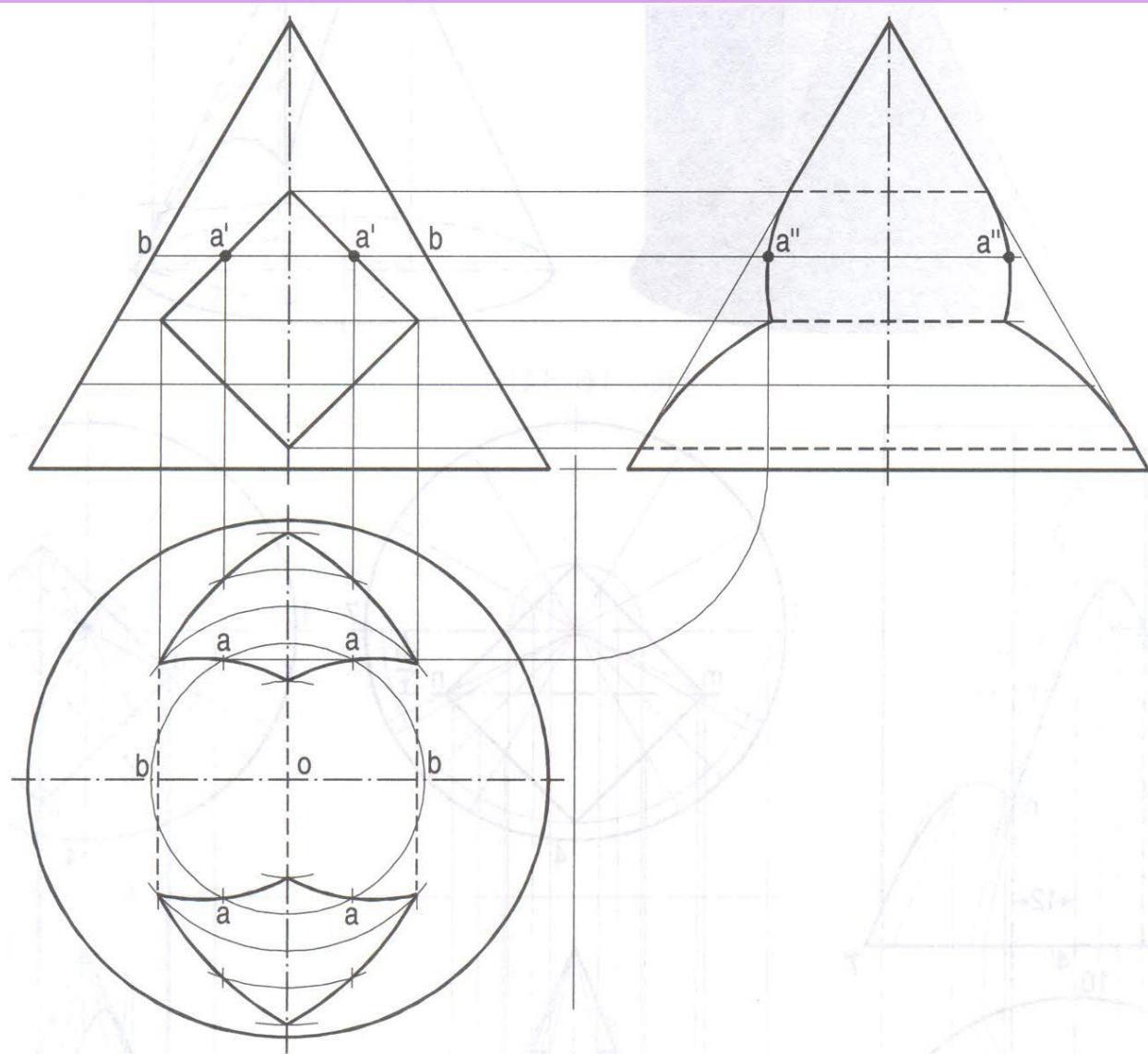
Intersection of Surfaces

Example-29 (Solved Pb. 16-29, pp. 409)

Draw an equilateral triangle of 100 mm side with one side horizontal. Draw a square of 35 mm side in its centre with its side inclined at 45° to the base of the triangle. The figure shows the front view of a cone standing on its base on the ground and having a square hole cut through it. Draw three views of the cone.

Intersection of Surfaces

Example-29 (Solved Pb. 16-29, pp. 409) ...



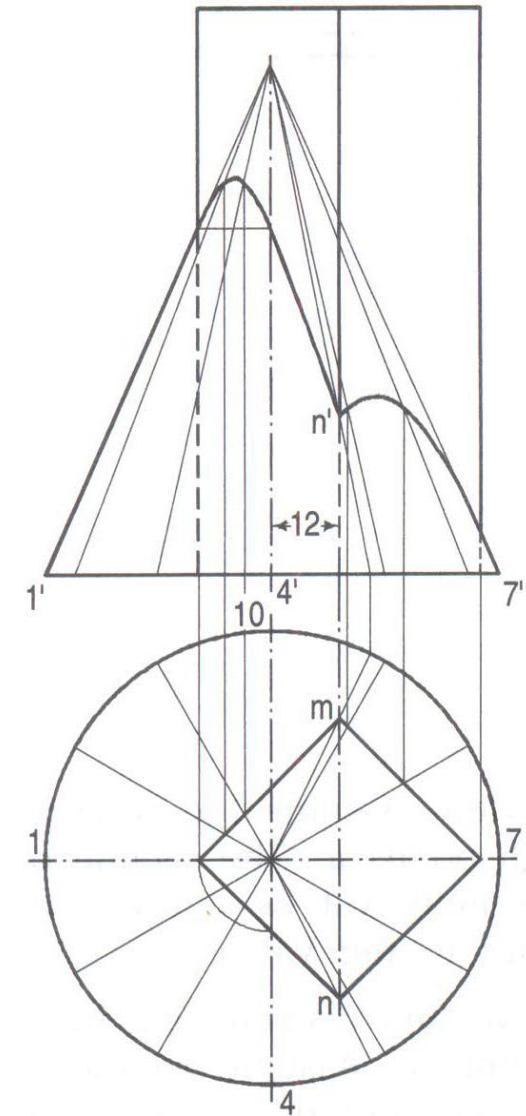
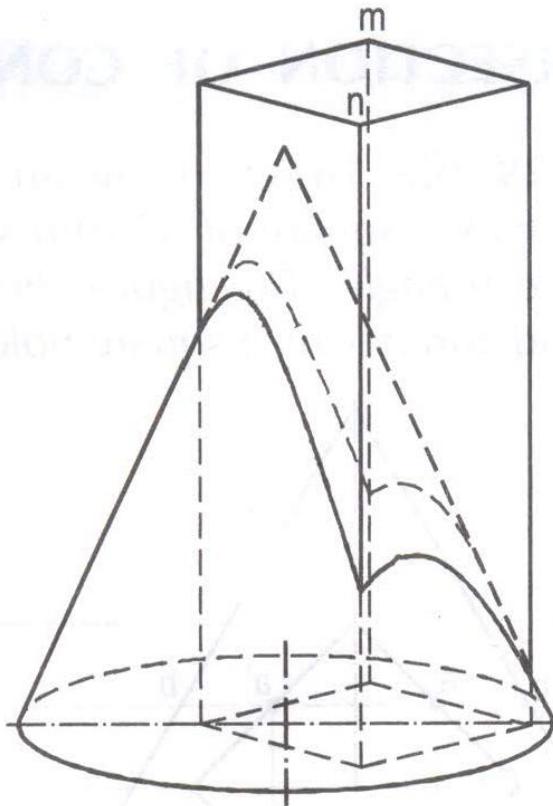
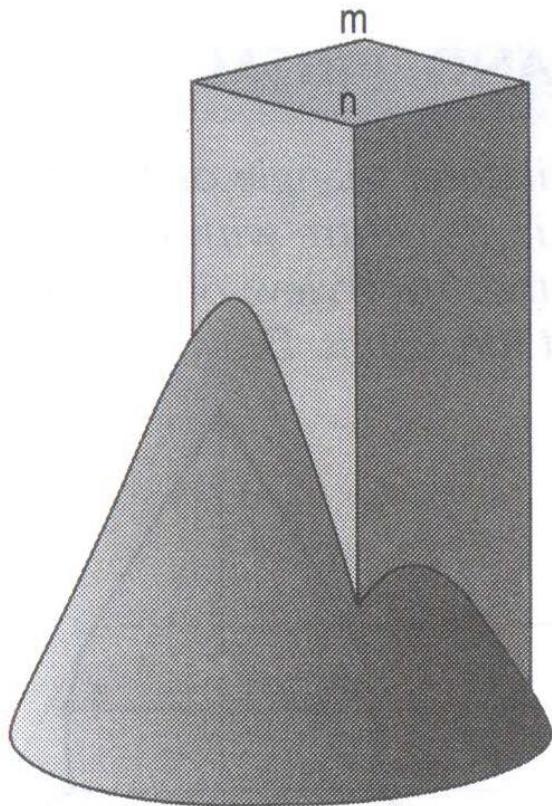
Intersection of Surfaces

Example-30 (Solved Pb. 16-30, pp. 409)

A vertical cone, base 80 mm diameter an axis 90 mm long, is penetrated by a square prism of base 35 mm side. The axis of the prism is parallel to and 12 mm away from that of cone. Draw the projections when the plane containing two axes is parallel two the V.P. and the faces of the prism are equally inclined to the V.P.

Intersection of Surfaces

Example-30 (Solved Pb. 16-30, pp. 409) ...



Intersection of Cone and Cone

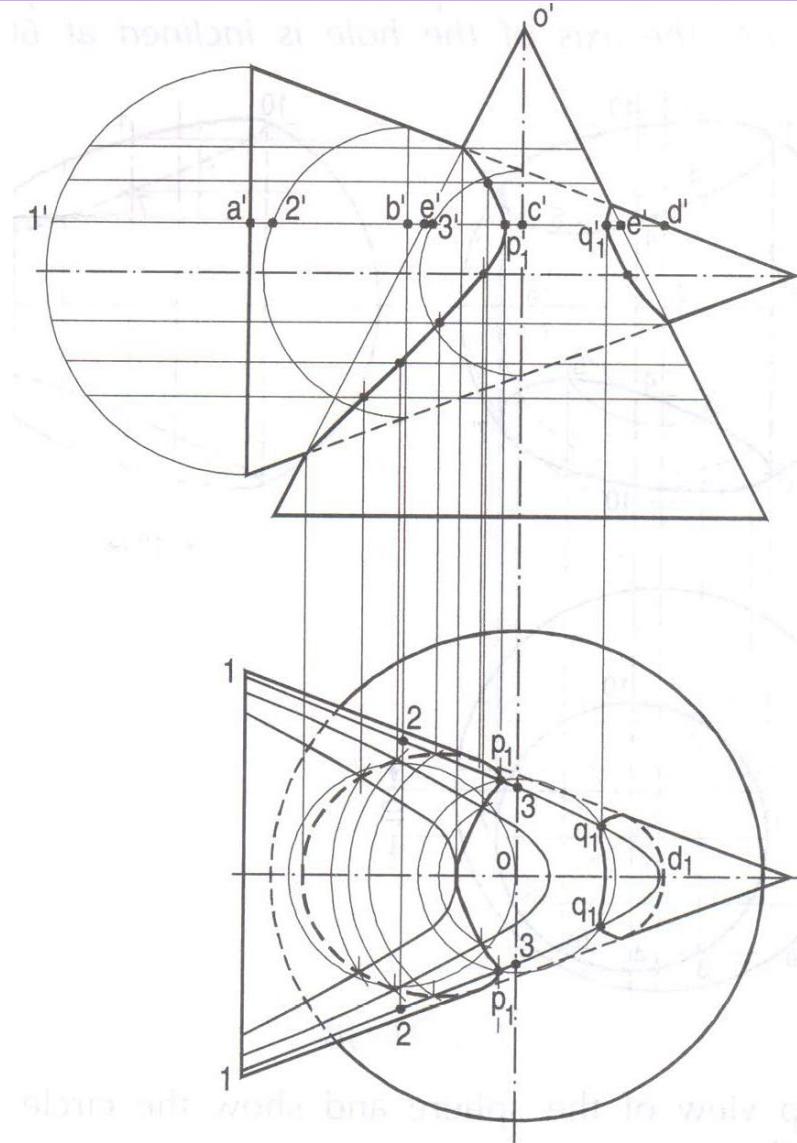
Intersection of Surfaces

Example-31 (Solved Pb. 16-31, pp. 411)

A vertical cone, base 90 mm diameter and axis 90 mm long, is penetrated by another cone of base 75mm diameter and height 100 mm. The axes of the two cones bisect each other at right-angles. Draw the front view showing curves of intersection, when the axis of the penetrated cone is parallel to the V.P.

Intersection of Surfaces

Example-31 (Solved Pb. 16-31, pp. 411) ...



Intersection of with Sphere

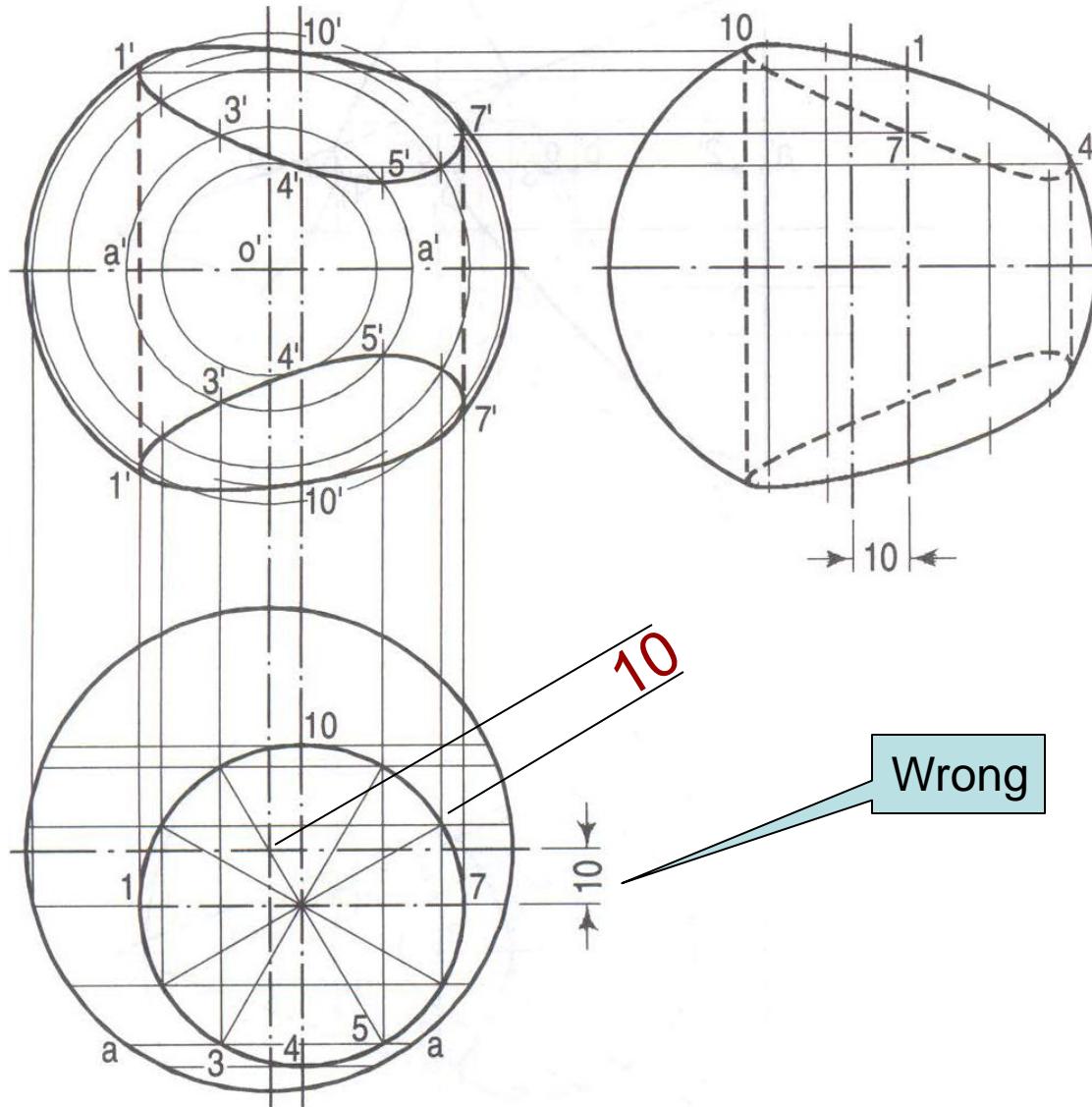
Intersection of Surfaces

Example-32 (Solved Pb. 16-32, pp. 412)

A hole of 50 mm diameter is drilled through a sphere of 75mm diameter. The axis of the hole is 10 mm away from the centre of the sphere. Draw three views of the sphere when a vertical plane containing the centre of the sphere and the axis of the hole is inclined at 60° to the V.P.

Intersection of Surfaces

Example-32 (Solved Pb. 16-32, pp. 412) ...



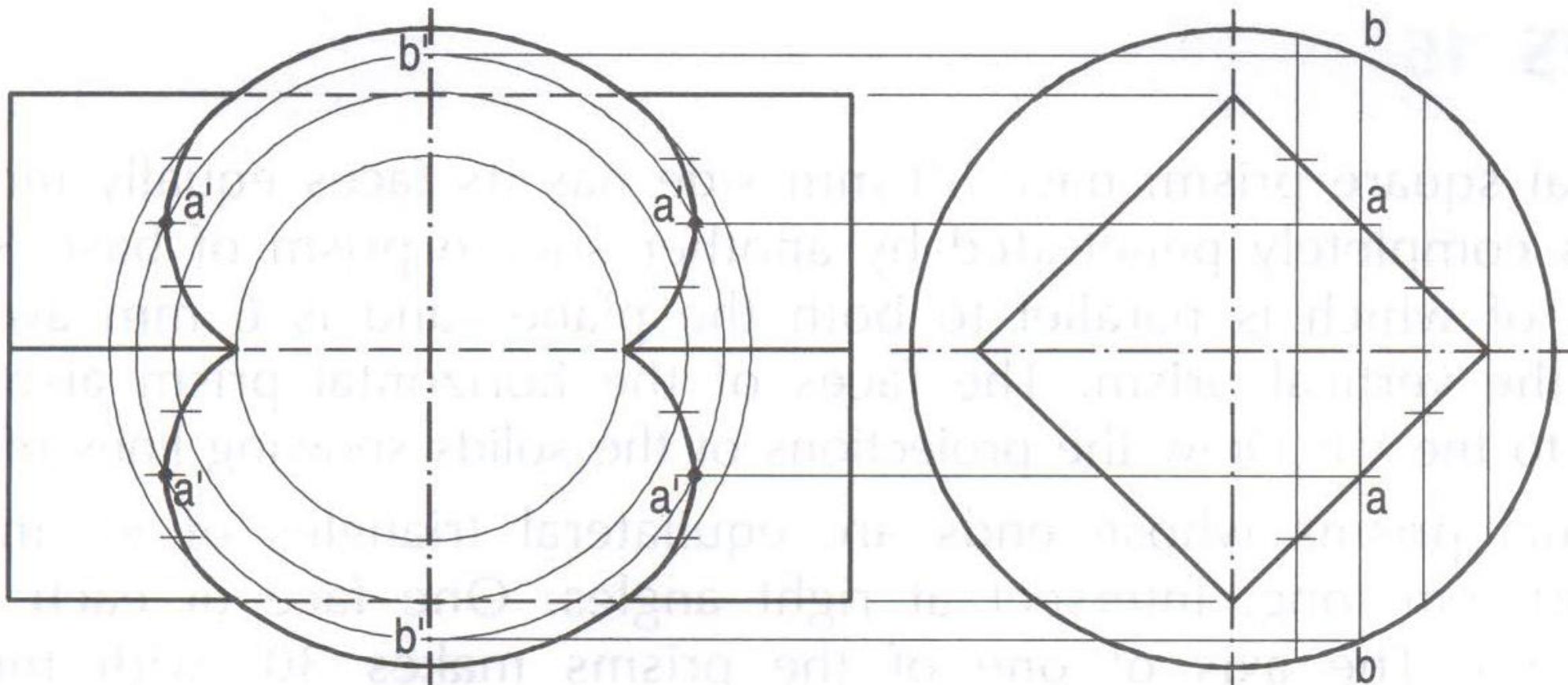
Intersection of Surfaces

Example-33 (Solved Pb. 16-33, pp. 412)

A sphere of 80 mm diameter is penetrated by a square prism, base 45 mm side, the axis of which passes through its centre. Draw the front view of the solids showing curves of intersection when the axis of the prism is parallel to both H.P. and V.P. and the faces are equally inclined to the V.P.

Intersection of Surfaces

Example-33 (Solved Pb. 16-33, pp. 412) ...



Conclusions

- Roughly work out all the problems given to you. Only if you come prepared, you will be able to complete all problems of the sheet in the drawing session.



Thank You!