UNIT V

SECTIONING OF SOLIDS, ISOMETRIC PROJECTIONS

5.1 INTRODUCTION TO ISOMETRIC PROJECTIONS

- Two or more principle views are shown in orthographic projection.
- Though exact dimensions given in orthographic projections, one of the views consist of few dimensions
- It makes difficult to visualize actual object or to visualize one should have keen knowledge of orthographic projections.
- The part which is not clear in orthographic projections, can be easily visualize with the help of pictorial Drawing.
- Pictorial drawings are commonly used in catalogues, piping diagrams, furniture industries etc.

5.2 ISOMETRIC VIEW

1. **In this Pictorial Drawing Method,**

- Three mutually perpendicular edges of cube make equal inclination with plane of projection.
- The projected edges will be foreshortened to the same length i.e. OX = OY = OZ.
- Angles between them is same i.e. $\alpha = \beta = \gamma$
- The view drawn with true or natural scale.

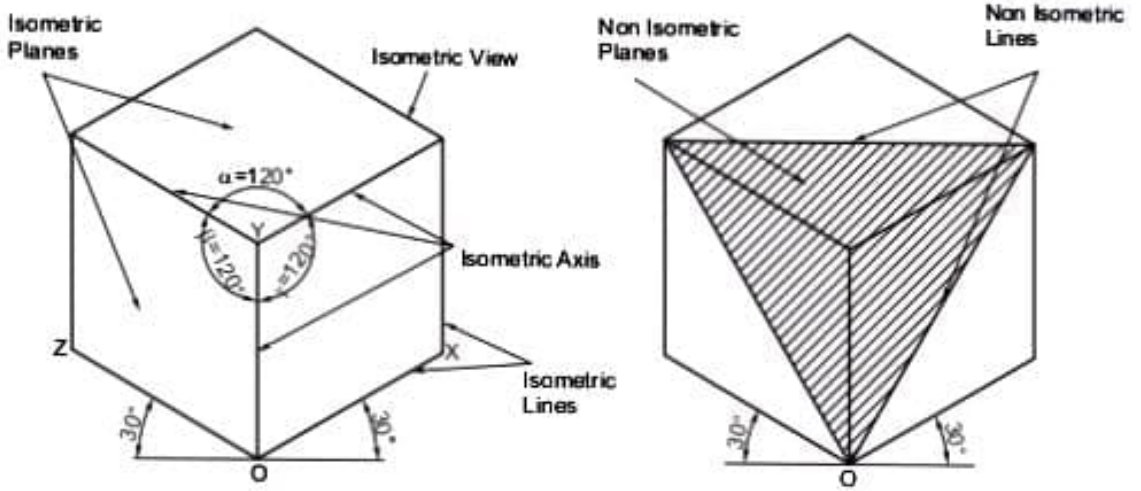


Fig. 5.1

2. **Isometric Axis:** - OX, OY and OZ three mutually perpendicular edges of the cube are called as Isometric Axis.
3. **Isometric Lines:** - The lines which are parallel to isometric axis (i.e. OX/OY/OZ) are called Isometric lines.
4. **Non Isometric Lines** :- The lines which are not parallel to the isometric axes are called Non-isometric Lines.
5. **Isometric Planes** are formed by using Isometric lines.
6. **Non Isometric Planes** are formed by using Non Isometric Lines.

5.3 STEPS TO DRAW ISOMETRIC DRAWINGS

Figure shows front view and end view of a bracket. Draw isometric view and show overall dimensions.

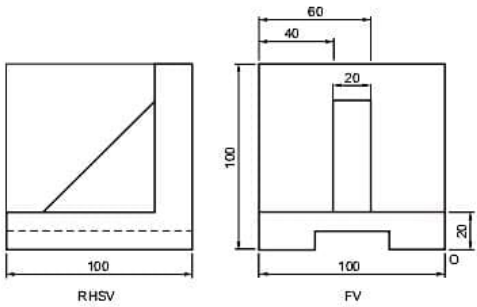


Fig. 5.2

Step 1: First complete the required frame or box by calculating L, B & H from given Orthographic Views.

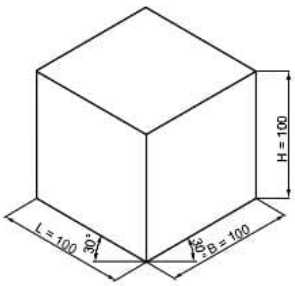


Fig. 5.3

Step 2: Find base part from given orthographic views & draw it in given view with light construction.

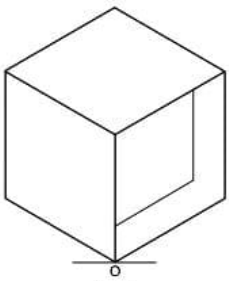


Fig. 5.4

Step 3: Project base part up to the last surface.

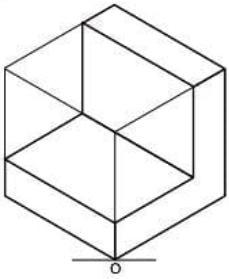


Fig. 5.5

Step 4: Add features one by one on base part

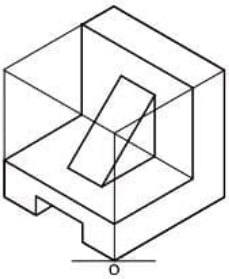


Fig. 5.6

Step 5: Darken the required lines.

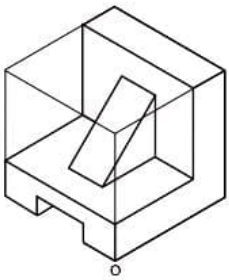


Fig. 5.7

5.4 CONSTRUCTION OF ISOMETRIC PLANE

1. Draw Isometric View of Hexagonal Plane

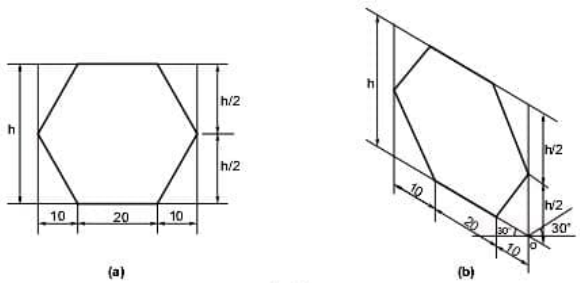


Fig. 5.8

2. Draw Isometric View of Circular Plane

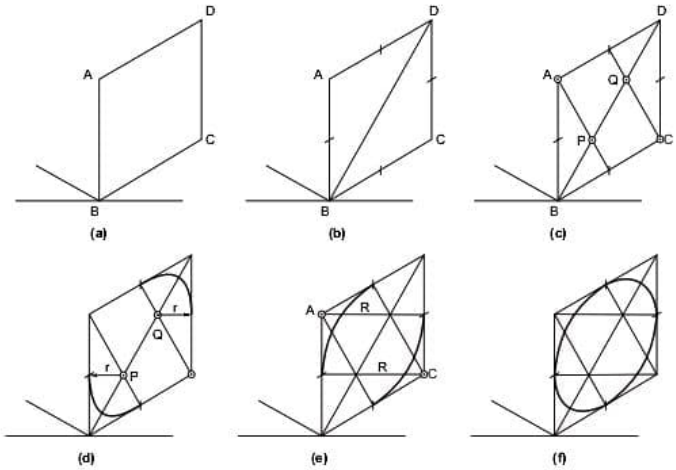


Fig. 5.9

3. Isometric Circle on Three Isometric Plane

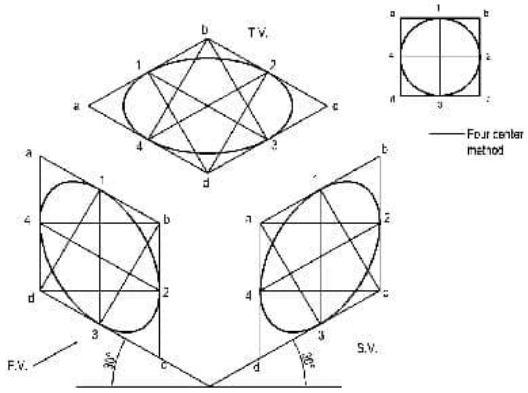


Fig. 5.10

5.5 CONSTRUCTION OF ISOMETRIC SOLID

1. Draw Isometric View of Pentagonal Prism

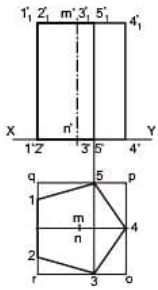


Fig. 5.11

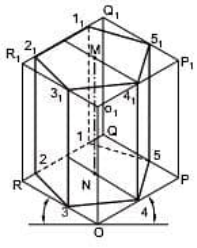


Fig. 5.12

2. Draw Isometric View of Square Pyramid

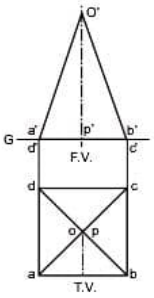


Fig. 5.13

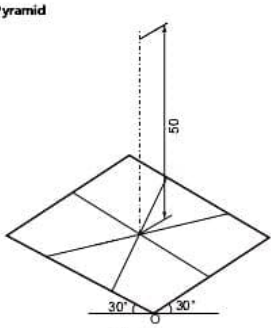


Fig. 5.14

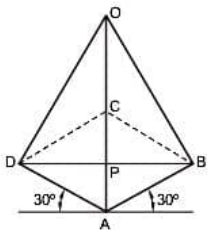
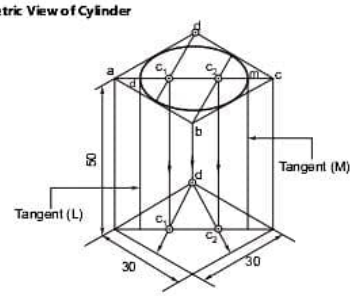
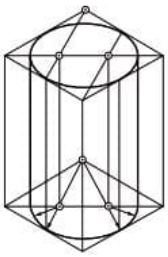


Fig. 5.15

3. Draw Isometric View of Cylinder



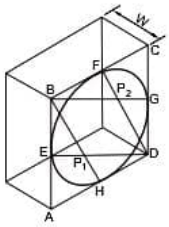
(a)



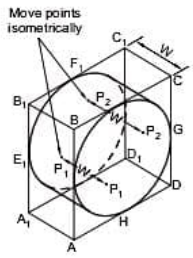
(b)

Fig. 5.16

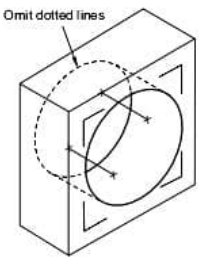
4. Draw Isometric View of Shaft and Holes



Step 1



Final For shaft



Final For hole

Fig. 5.17

5. Draw Isometric View of Semi Circular Plate

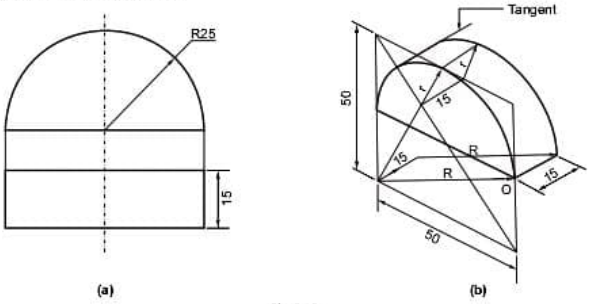


Fig. 5.18

6. Draw Isometric View of Rounded Ends (Quarter Circle)

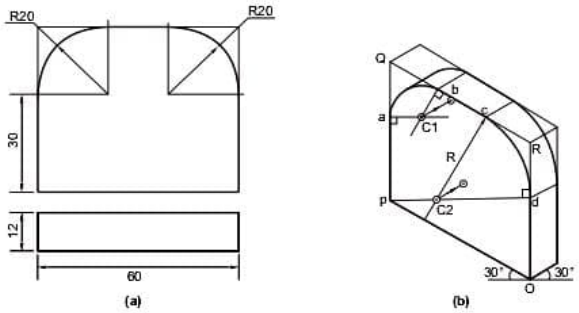


Fig. 5.19

7. Draw Isometric View of Sphere

Step 1 : Measure radius of Sphere on isometric scale

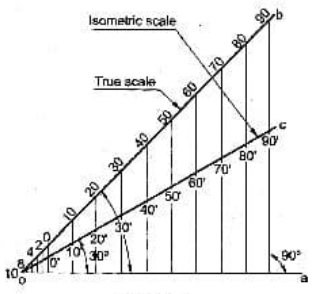


Fig. 5.20 (a)

Step 2 : Draw OC on vertical Axis with radius measured on isometric scale

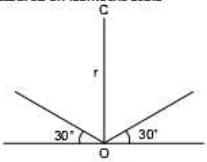


Fig. 5.20 (b)

Step 3 : Draw a circle with center as C, which represents required Sphere

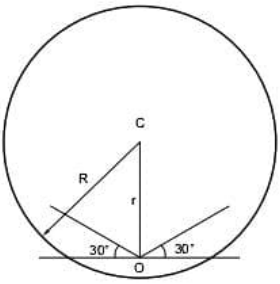


Fig. 5.20 (c)

5.6 TAPERS IN ISOMETRIC

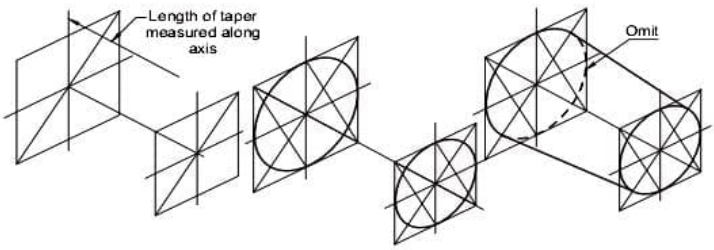


Fig. 5.21

5.7 TO CONSTRUCT AND ISOMETRIC VIEW OF A CONE

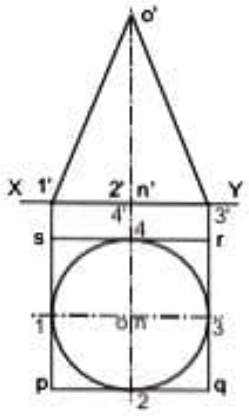


Fig. 5.22

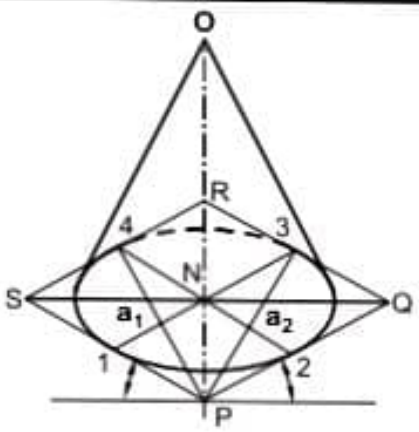


Fig. 5.23

SOLVED PROBLEMS

Problem 5.1 : Figure shows front view and end view of a bracket. Draw isometric view and show overall dimensions.

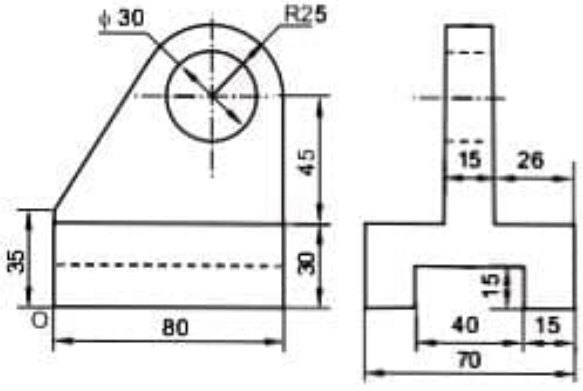


Fig. 5.24 (a)

Solution :

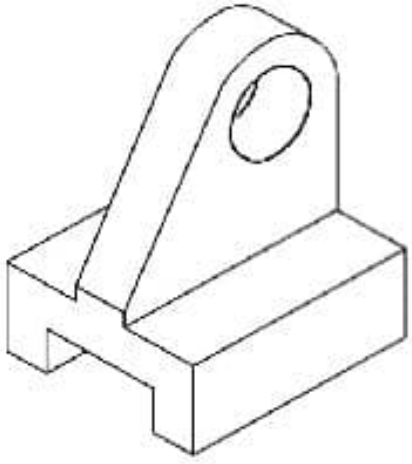


Fig. 5.24 (b)

Problem 5.2 : *Figure shows front view and top view of a bracket. Draw isometric view and show overall dimensions.*

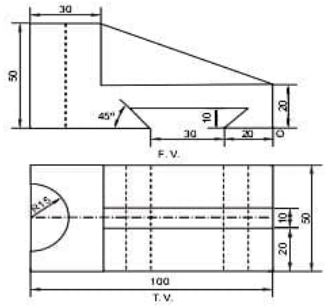


Fig. 5.25 (a)

Solution :

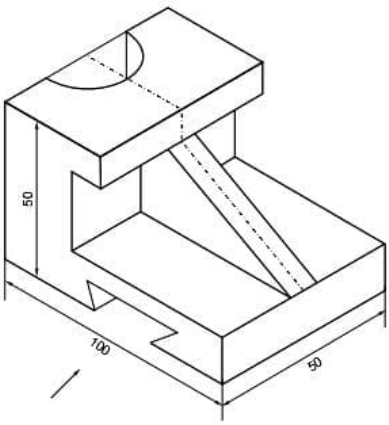


Fig. 5.25 (b)

Problem 5.3 : *Figure shows front view and end view of a bracket. Draw isometric view and show overall dimensions.*

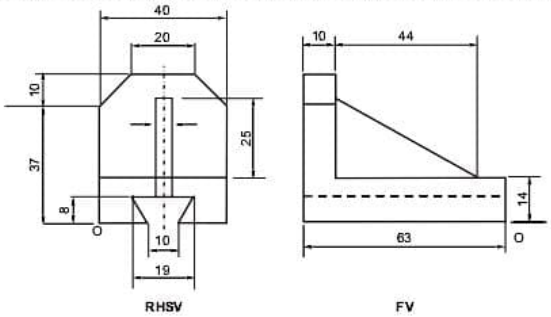


Fig. 5.26 (a)

Solution:

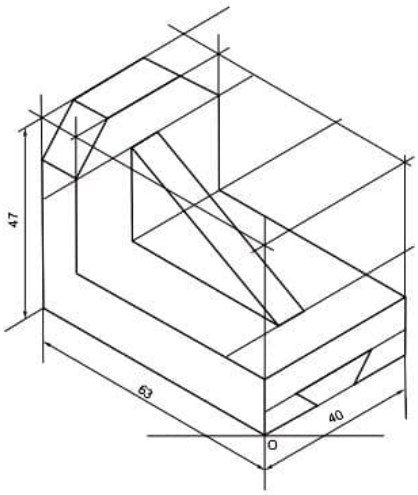


Fig. 5.26 (b)

Problem 5.4 : Fig. 5.28 (a) shows front view & end view of a bracket. Draw isometric view and show overall dimensions.

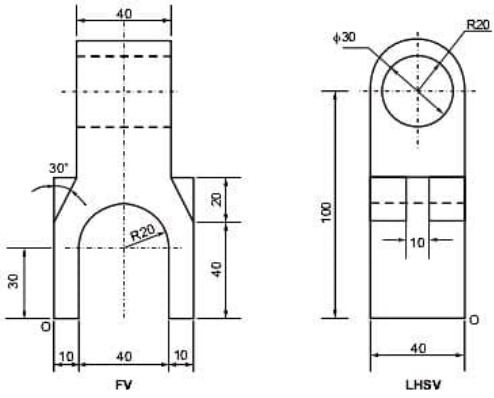


Fig. 5.27 (a)

Solution:

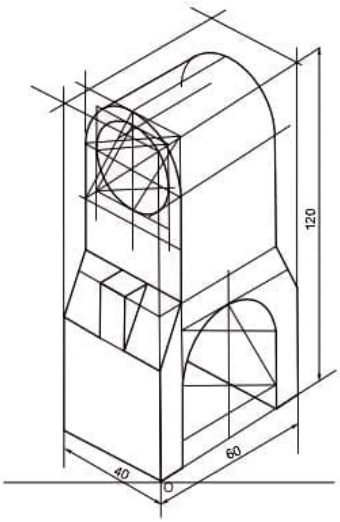


Fig. 5.27 (b)

Problem 5.5 : Fig. 5.29 (a) shows front view and end view of a bracket. Draw isometric view and show overall dimensions

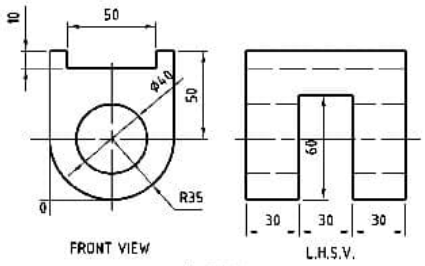


Fig. 5.28 (a)

Solution:

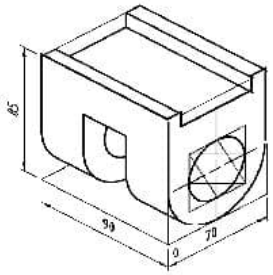


Fig. 5.28 (b)

Problem 5.6 : Figure shows front view and end view of an object. Draw isometric view and show overall dimensions.

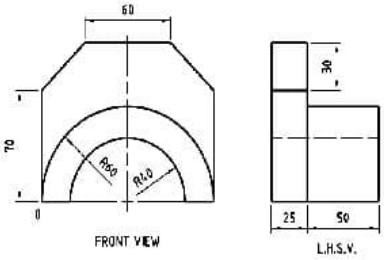


Fig. 5.29 (a)

Solution :

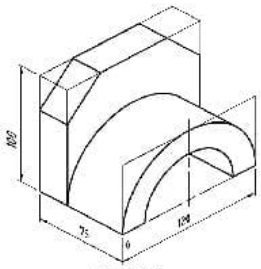


Fig. 5.29 (b)

Problem 5.7 : Figure shows front view, top view and end view of a bracket. Draw isometric view and show overall dimensions.

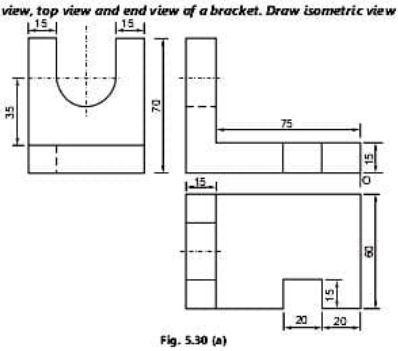


Fig. 5.30 (a)

Solution :

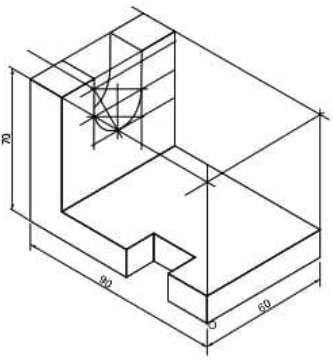


Fig. 5.30 (b)

Problem 5.8 : *Fig. 5.31 (a) shows front view and end view of an object. Draw isometric view and show overall dimensions.*

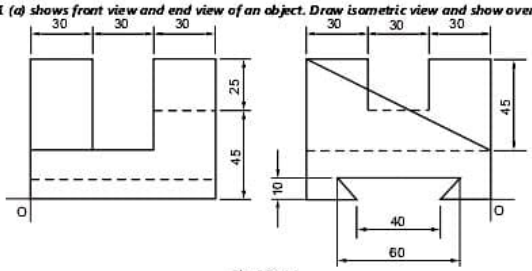


Fig. 5.31 (a)

Solution

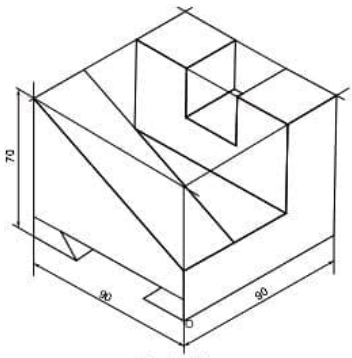


Fig. 5.31 (b)

Problem 5.9 : *Figure shows front view and end view of a bracket. Draw isometric view and show overall dimensions.*

Solution:

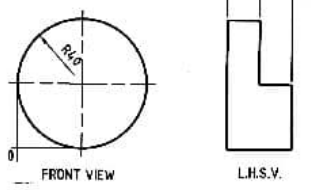


Fig. 5.32 (a)

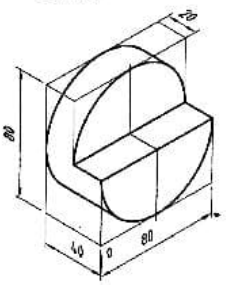


Fig. 5.32 (b)

Problem 5.10 : Figure shows front view and end view of a bracket. Draw isometric view and show overall dimensions.

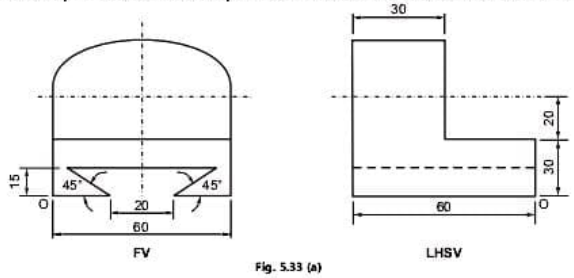


Fig. 5.33 (a)

Solution :

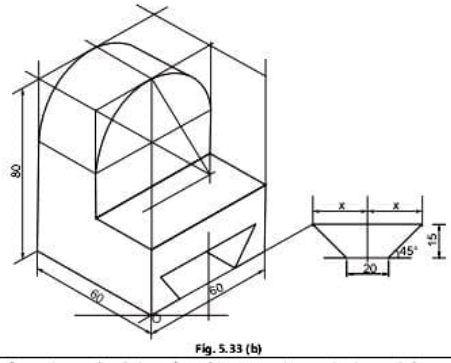


Fig. 5.33 (b)

Problem 5.11 : Figure shows front view and end view of an object. Draw isometric view and show overall dimensions.

Solution:

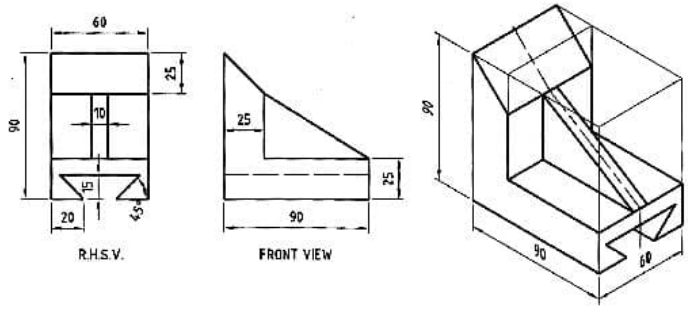


Fig. 5.34 (a) Fig. 5.34 (b)

Problem 5.12 : Figure shows front view and end view of an object. Draw isometric view and show overall dimensions.

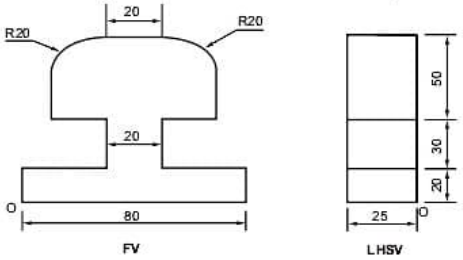


Fig. 5.35 (a)

Solution :

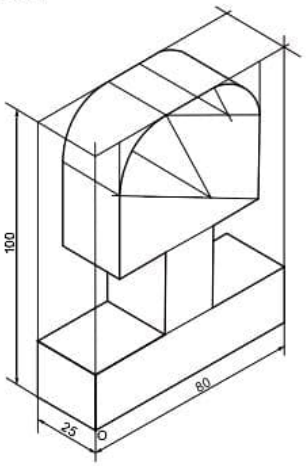


Fig. 5.35 (b)

Problem 5.13 : Figure shows Front View and Top View of an object. Draw Isometric View and show overall dimensions.

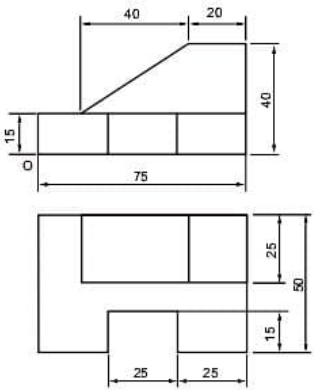


Fig. 5.36 (a)

Solution :

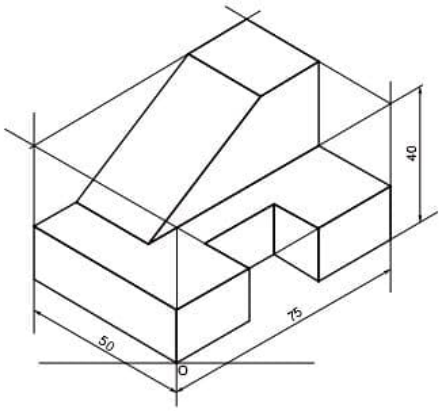


Fig. 5.36 (b)

Problem 5.14 : *Figure shows Front View, Top view and End View of a bracket. Draw Isometric View and show overall dimensions*

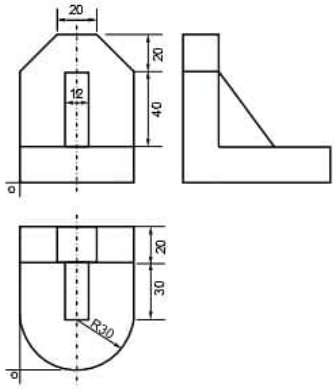


Fig. 5.37

Solution:

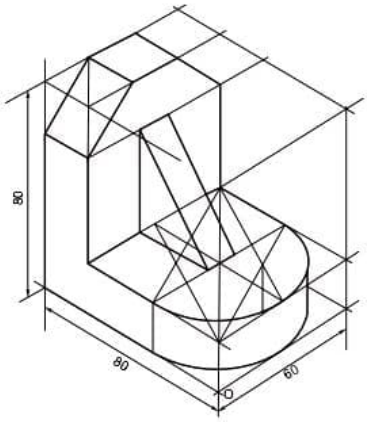


Fig. 5.38

SOLVED PROBLEMS FOR PRACTICE

Two orthographic views are given. Draw the isometric view using natural scale. Take O as origin.

Problem 5.15 : **Solution**

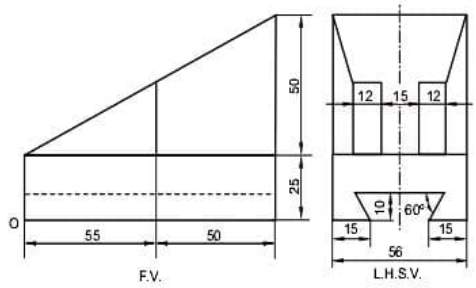


Fig. 5.39 (a)

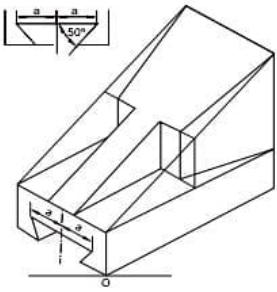


Fig. 5.39 (b)

Problem 5.16 :

Solution

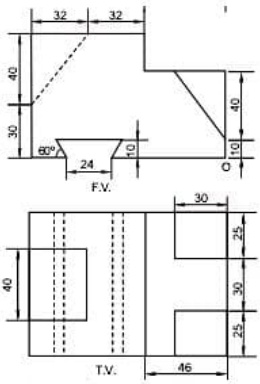


Fig. 5.40 (a)

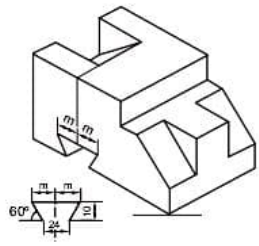


Fig. 5.40 (b)

Problem 5.17:

Solution

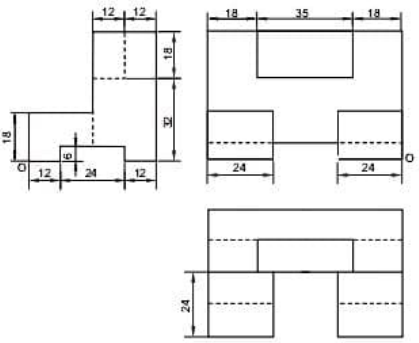


Fig. 5.41 (a)

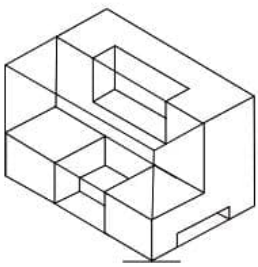


Fig. 5.41 (b)

Problem 5.18 :

Solution

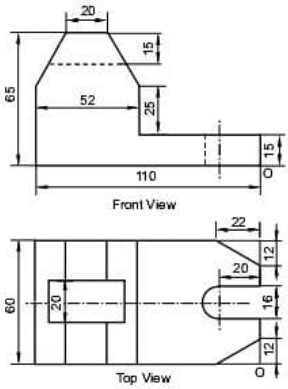


Fig. 5.42 (a)

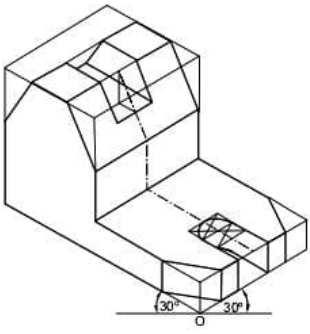


Fig. 5.42 (b)

Problem 5.19 :

Solution

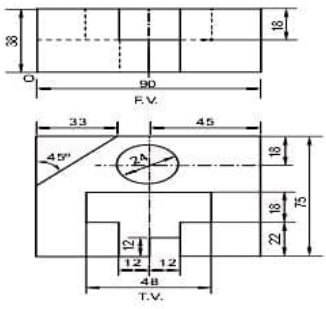


Fig. 5.43 (a)

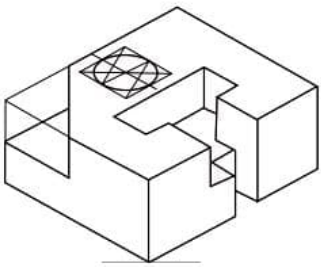


Fig. 5.43 (b)

Problem 5.20:

Solution

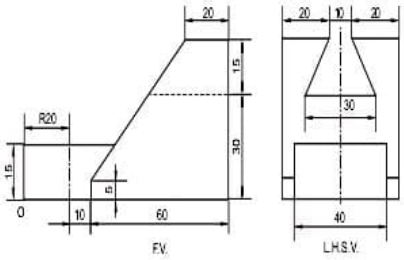


Fig. 5.44 (a)

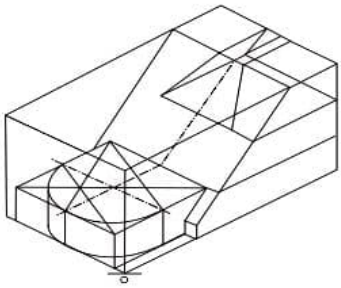


Fig. 5.44 (b)

Problem 5.21 :

Solution

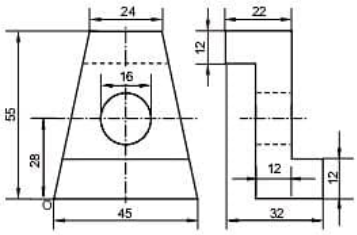


Fig. 5.45 (a)

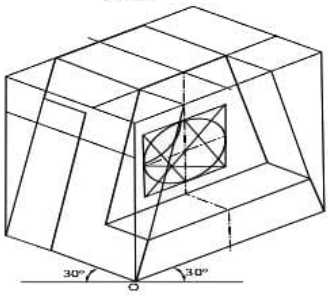


Fig. 5.45 (b)

Problem 5.22 :

Solution

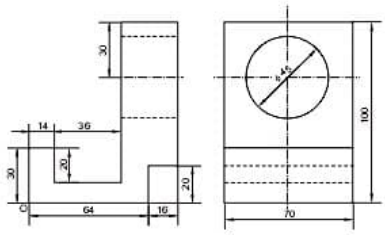


Fig. 5.46 (a)

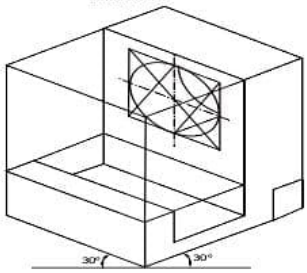


Fig. 5.46 (b)

Problem 5.23 :

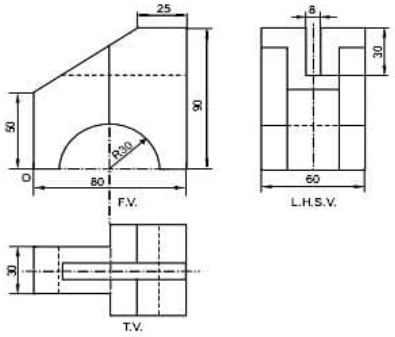


Fig. 5.47 (a)

Solution

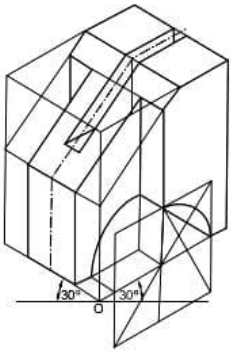


Fig. 5.47 (b)

Problem 5.24 :

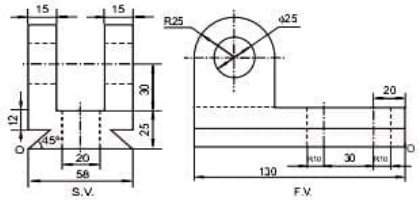


Fig. 5.48 (a)

Solution

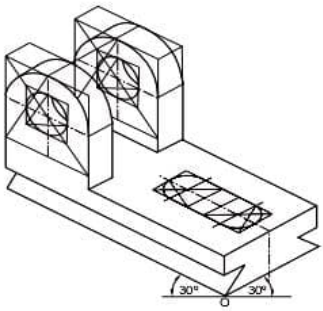


Fig. 5.48 (b)

Problem 5.25 :

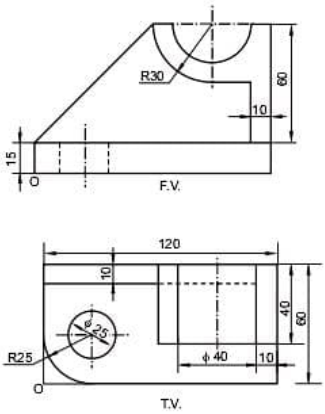


Fig. 5.49 (a)

Solution

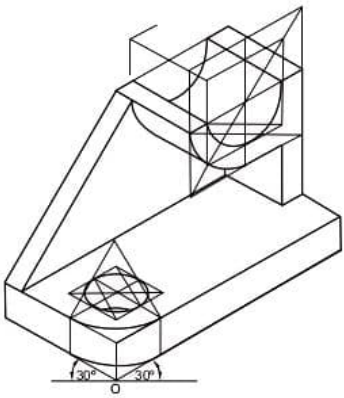


Fig. 5.49 (b)

Problem 5.26 ;

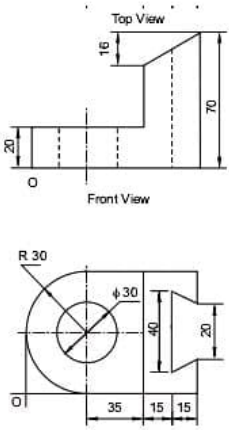


Fig. 5.50 (a)

Solution

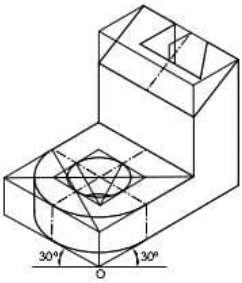


Fig. 5.50 (b)

Problem 5.27 :

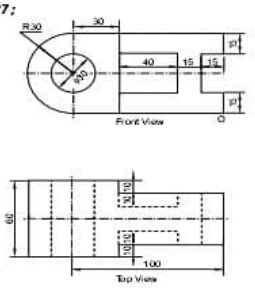


Fig. 5.51 (a)

Solution

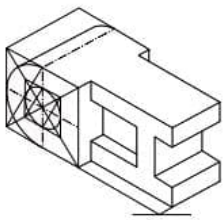


Fig. 5.51 (b)

Problem 5.28 :

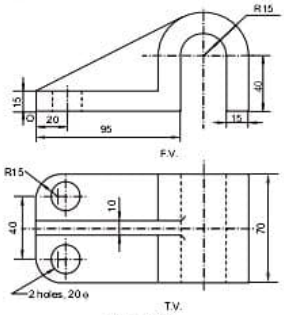


Fig. 5.52 (a)

Solution

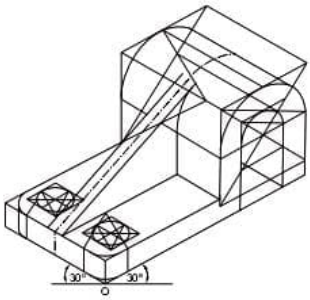


Fig. 5.52 (b)

Problem 5.29 :

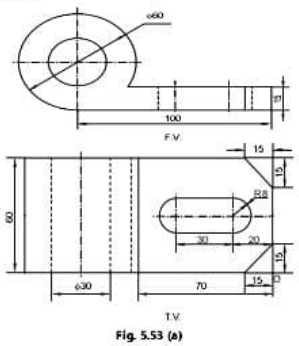


Fig. 5.53 (a)

Solution

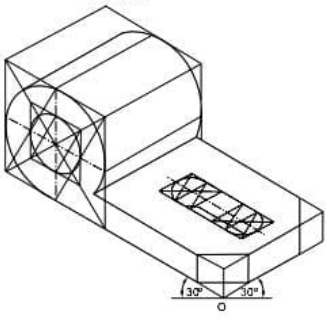


Fig. 5.53 (b)

Problem 5.30 :

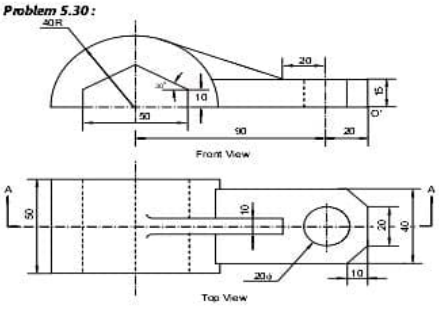


Fig. 5.54 (a)

Solution

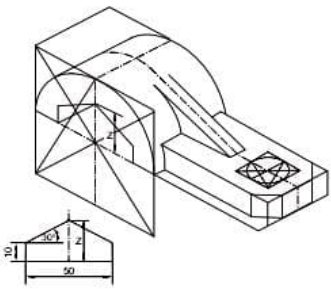


Fig. 5.54 (b)

Problem 5.31 :

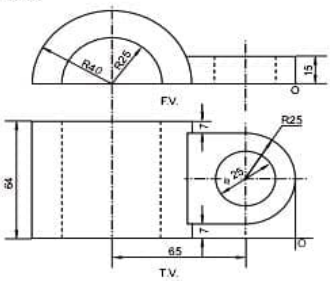


Fig. 5.55 (a)

Solution

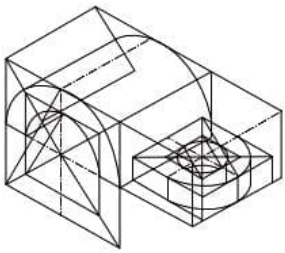


Fig. 5.55 (b)

Problem 5.32 :

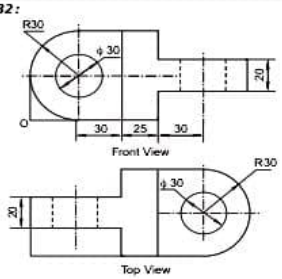


Fig. 5.56 (a)

Solution

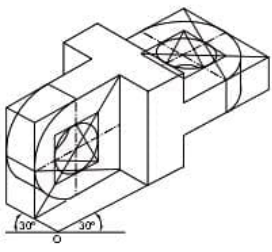


Fig. 5.56 (b)

Problem 5.33 :

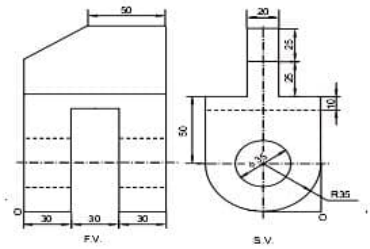


Fig. 5.57 (a)

Solution

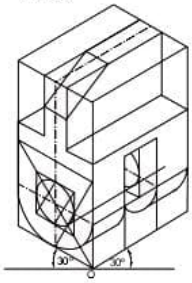


Fig. 5.57 (b)

Problem 5.34 :

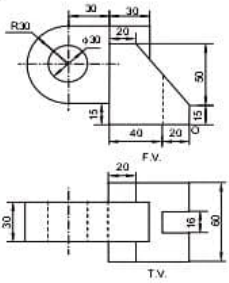


Fig. 5.58 (a)

Solution

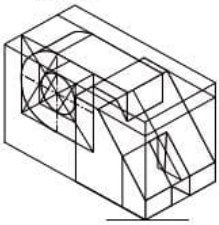


Fig. 5.58 (b)

Problem 5.35 :

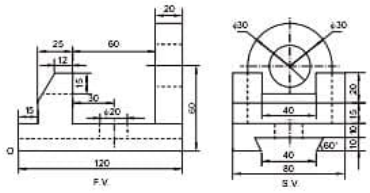


Fig. 5.59 (a)

Solution

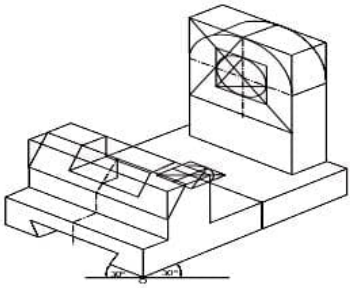


Fig. 5.59 (b)

PROBLEMS FOR PRACTICE

Problem 1

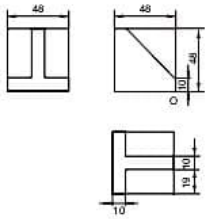


Fig. 5.60

Problem 2

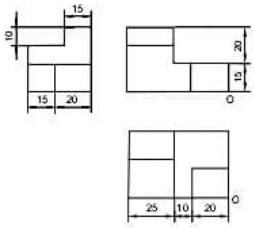


Fig. 5.61

Problem 3

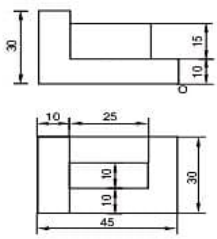


Fig. 5.62

Problem 4

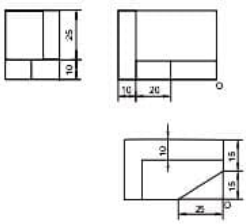


Fig. 5.63

Problem 5

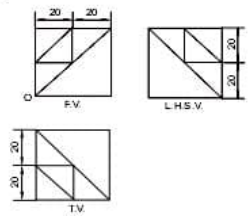


Fig. 5.64

Problem 6

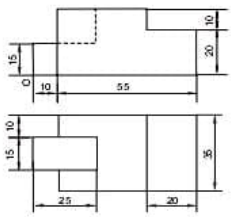


Fig. 5.65

Problem 7

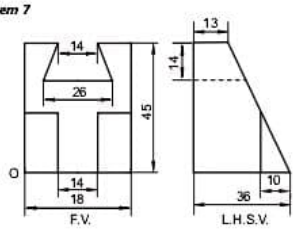


Fig. 5.66

Problem 8

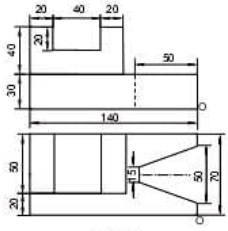


Fig. 5.67

Problem 9

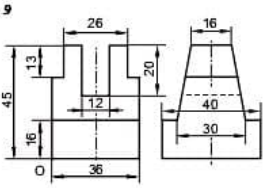


Fig. 5.68

Problem 10

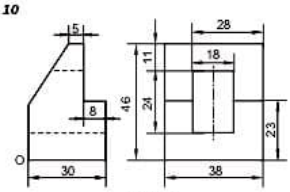


Fig. 5.69

Problem 11

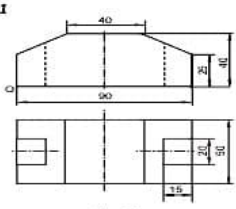


Fig. 5.70

Problem 12

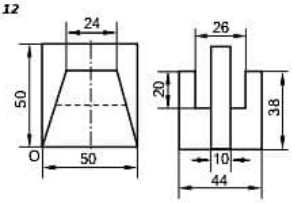


Fig. 5.71

Problem 13

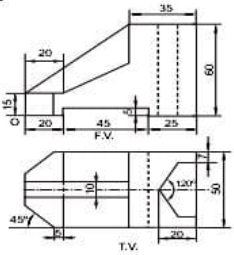


Fig. 5.72

Problem 14

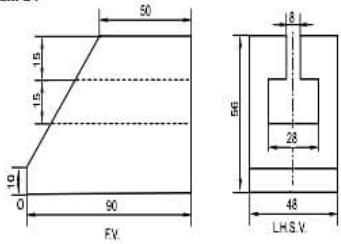


Fig. 5.73

Problem 15

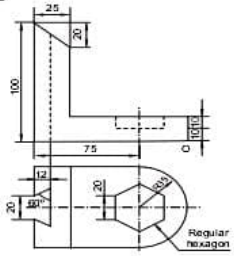


Fig. 5.74

Problem 16

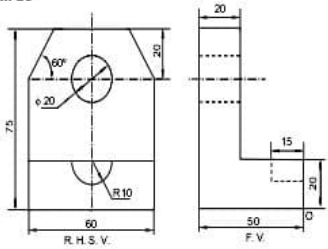


Fig. 5.75

Problem 17

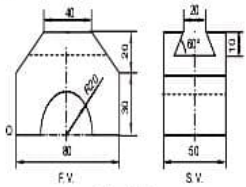


Fig. 5.76

Problem 18

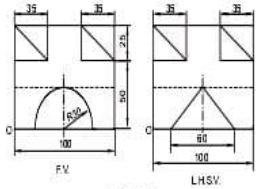


Fig. 5.77

Problem 19

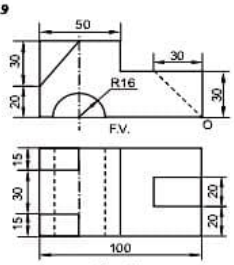


Fig. 5.78

Problem 20

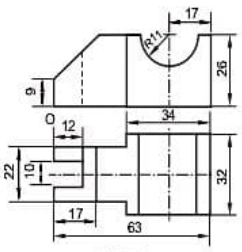


Fig. 5.79

Problem 21

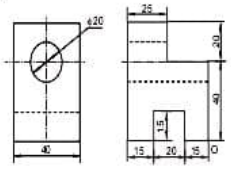


Fig. 5.80

Problem 22

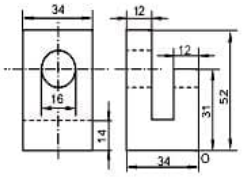


Fig. 5.81

Problem 23

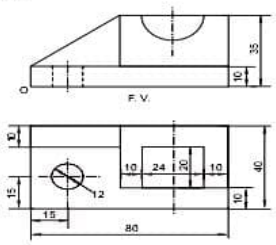


Fig. 5.82

Problem 24

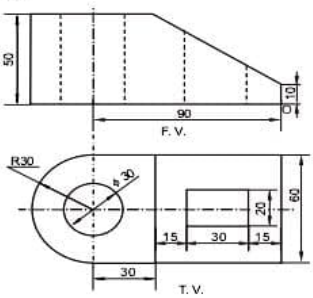


Fig. 5.83

Problem 25

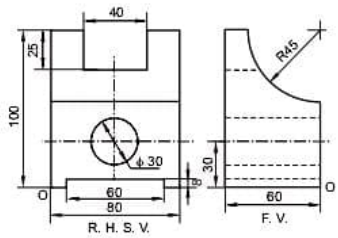


Fig. 5.84

Problem 26

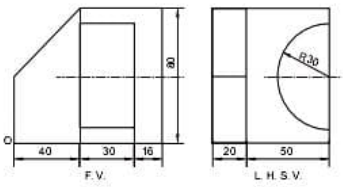


Fig. 5.85

Problem 27

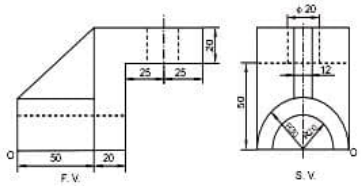


Fig. 5.86

Problem 28

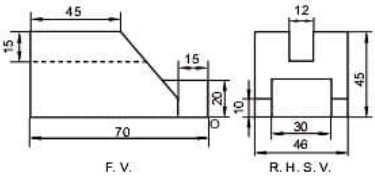


Fig. 5.87

Problem 29

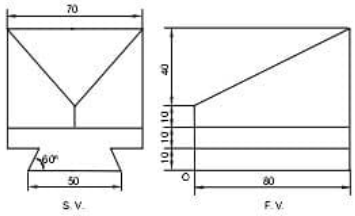


Fig. 5.88

Problem 30

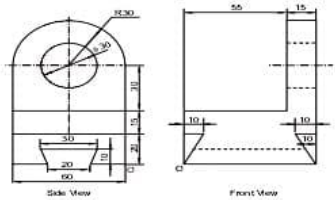


Fig. 5.89

Problem 31

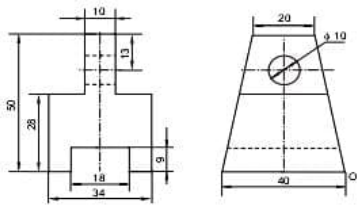


Fig. 5.90

Problem 32

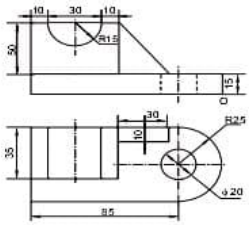


Fig. 5.91

5.8 SECTIONING OF SOLIDS

In engineering industries, when an object is having complicated internal structure, it is very much difficult to visualize the object from its orthographic views since there will be several hidden lines.

In such case, the internal details are shown by sectional views.

Sectional views are an important aspect of design and documentation since it is used to improve clarity and reveal interior features of parts.

After reading this chapter, you will be able to

- Identify sections and sectional views of solids
- Draw sectional views of cut surfaces of solids such as prisms, pyramids, cylinders and cones
- Draw the true shape of the cut surfaces of simple solids
- Locate the position of the cutting plane if the true shape of a section is known.

Some Typical Shapes Sections of Solids

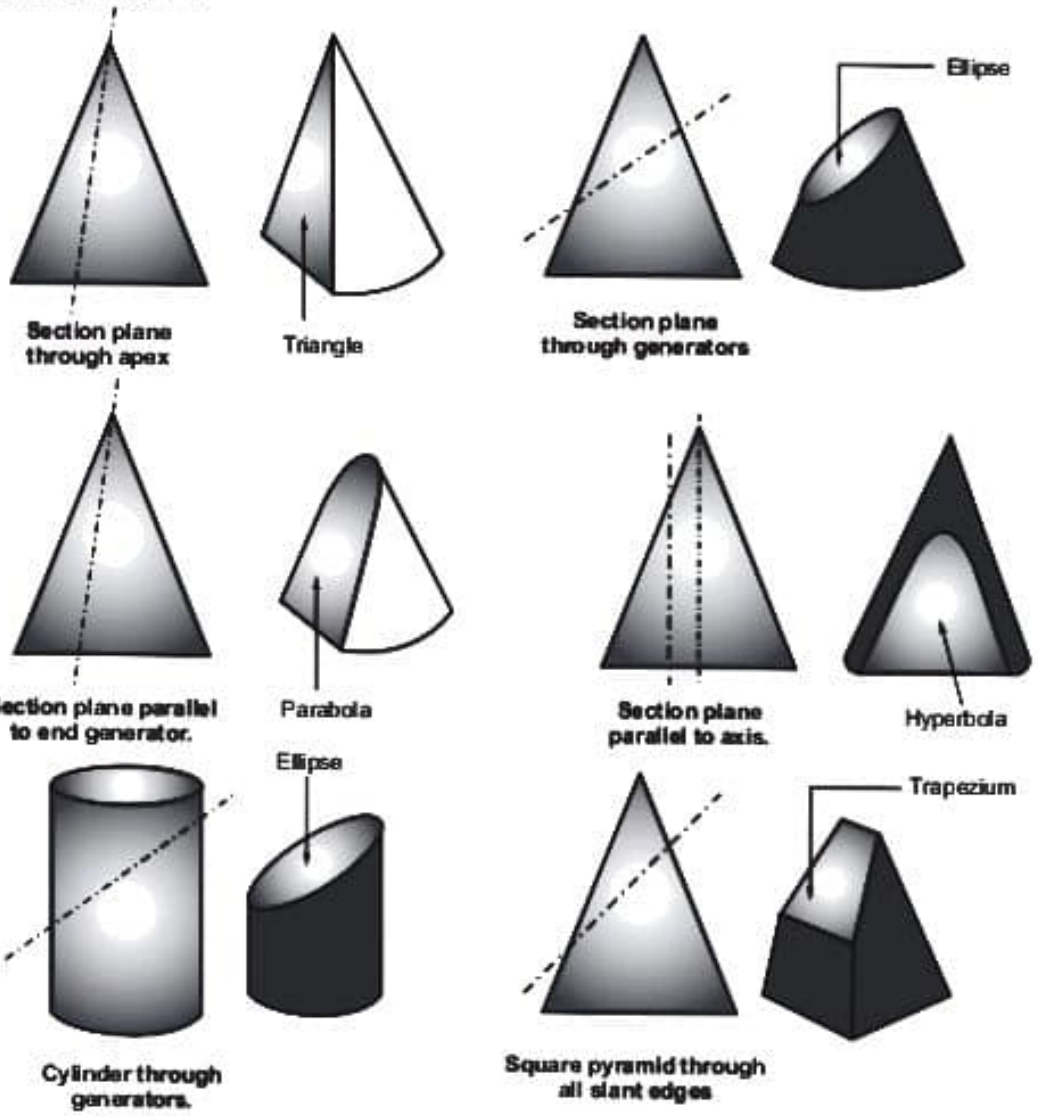


Fig. 5.92

Problem Based on Prism

Problem 5.36 : A square prism edge of base 40 mm and axis 60 mm long is resting on ground on one of its bases with all vertical faces equally inclined to V.P. It is cut by a section plane parallel to V.P. and 10 mm from axis and away from V.P. Draw its top view and sectional front view.

Solution :

(1) Draw T.V. first. In T.V. all edges of base of prism are equally inclined to V.P. Project F.V. from it.

(2) Since section plane is parallel to V.P. as shown in Fig. 5.93, in the top view its H.T. will be a straight line parallel to xy, 10 mm from axis.

(3) The section plane cuts the edges ab, bc, 1-2 and 2-3 in r, s and p, q. These are key points.

(4) Project these key points in the front view on the corresponding edges. Join points to get sectional F.V.

(5) pqrs is the true shape of section, since the cutting plane is parallel to V.P.

(6) Show the views by dark but thin lines. Cut portion is shown by faint lines. Draw section lines at 45° to horizontal in the rectangle p' q' r' s' for section.

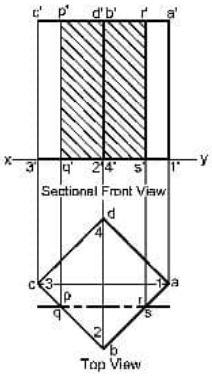


Fig. 5.93

Problem 5.37 : A square prism base 40 mm side, axis 80 mm long has its base on the H.P. and faces equally inclined to V.P. It is cut by a plane perpendicular to V.P. inclined at 60° to H.P. and passing through a point on the axis 60 mm above the H.P. Draw front view, sectional top view and true shape of section.

Solution :

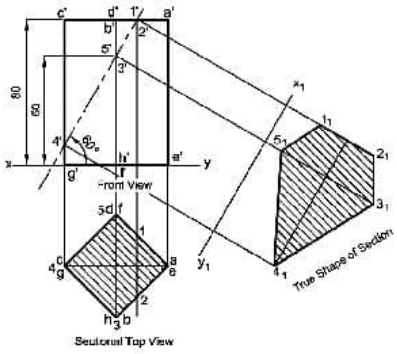


Fig. 5.94

(1) Draw F.V. and T.V. of prism. Locate section plane which coincides with V.T. in F.V. inclined at 60° to xy and passing through a point 60 mm above the base, along the axis.

(2) Locate key points in F.V. where section plane cuts the vertical edges and face of prism in 1-2-3-4-5.

(3) From these key points draw projectors to cut in T.V. Join 1-2-3-4-5 in T.V. which shows apparent shape of section as cutting plane is inclined to H.P.

(4) To find true shape of section, draw perpendicular projectors from key points to cutting plane.

(5) Measure distances of section points 1-2-3-4-5 in T.V. from xy line and along respective projectors. Transfer these distances from x_1y_1 line which is drawn parallel to cutting plane.

(6) Join 1, 2, 3, 4, 5, which is true shape of section.

Problem 5.38 : A square prism, base 40 mm side and axis 80 mm long is resting on H.P. on its base with all vertical faces equally inclined to V.P. It is cut by a plane perpendicular to V.P. and inclined to H.P. by 60° passing through a point on axis 55 mm above H.P. Draw :

(1) Front view.

(2) Sectional top view.

(3) True shape of section.

Solution :

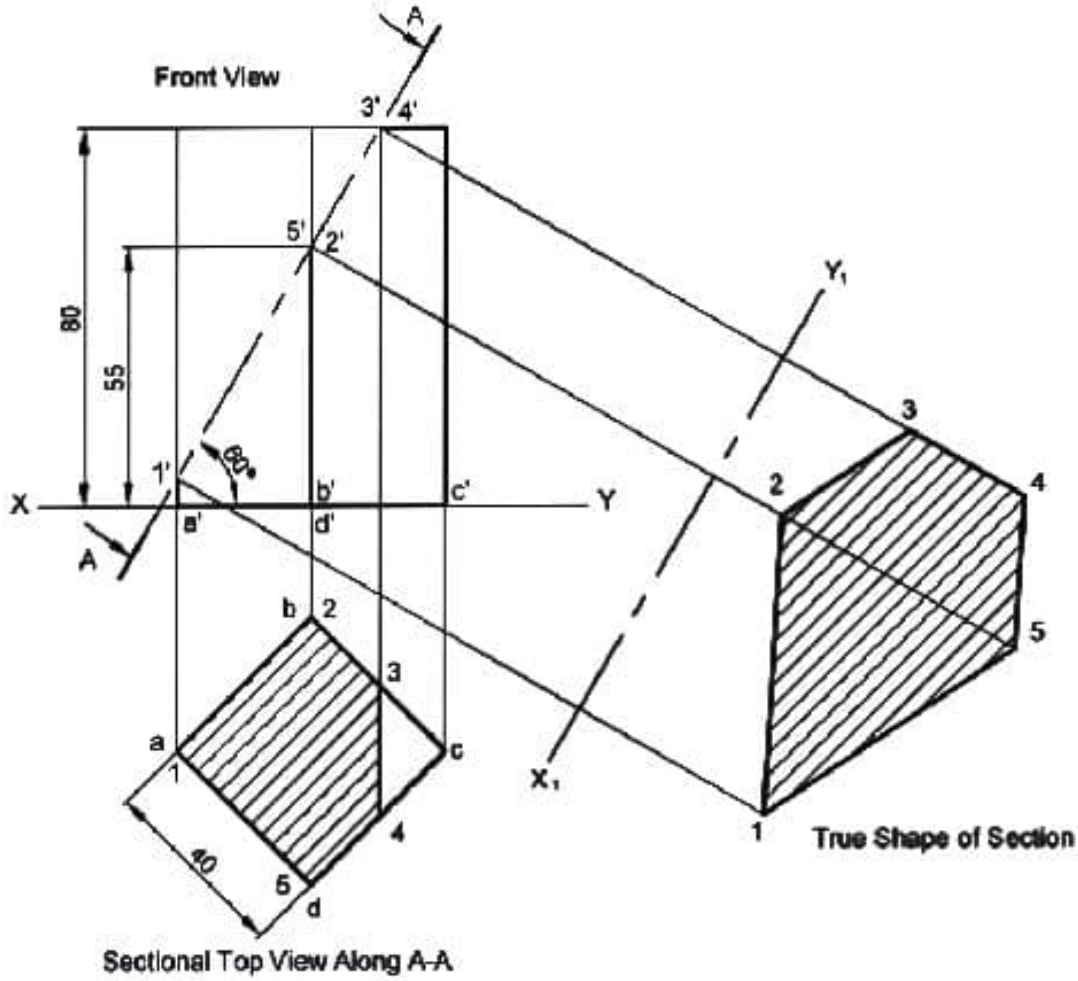


Fig. 5.95

Problem 5.39 : A hexagonal prism of 35 mm side of end faces and 80 mm height is resting on one of its ends in H.P. with two opposite rectangular faces parallel to V.P. A cutting plane perpendicular to V.P. and inclined to H.P. Cut its half with true shape of section being the largest rectangle. Draw :

(i) Front view.

(ii) section T.V.

(iii) True shape of the section.

Solution :

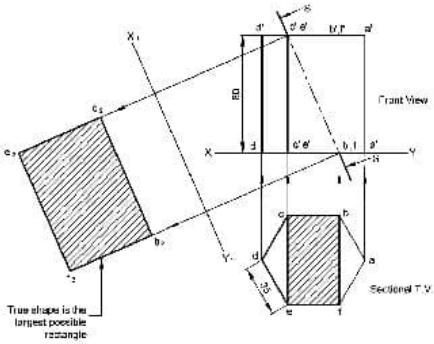


Fig. 5.96

Problem Based on Pyramid

Problem 5.40 : A square pyramid base 40 mm side and axis 70 mm long, has its base on the H.P. and all the edges of the base equally inclined to V.P. It is cut by a section plane perpendicular to V.P., inclined at 45° to H.P. and bisecting the axis. Draw its sectional top view, sectional side view and true shape of section.

Solution :

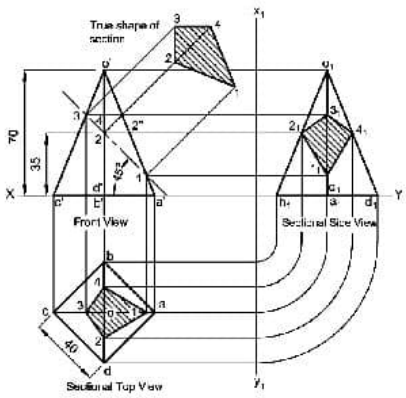


Fig. 5.97

(1) Draw F.V., T.V. and S.V. of pyramid in the required position. Locate section plane, which is V.T. a line passing through mid-point of axis and inclined at 45° to H.P. (xy).

(2) Name the key points 1, 2, 3 and 4 to the edges in the correct sequence for the edges cut, in FV.

(3) Project these key points in T.V. for points 2 and 4. They are not directly cut. So, draw parallel 2-2° from 2 to cut end generator at 2°. Take radius 2-2° and with centre 0, draw a semicircle to cut ob and od in T.V. at 2 and 4.

(4) For sectional S.V. draw horizontals from 1, 2, 3, 4 to cut respective edges to cut in 1_1 2_1 3_1 and 4_1. Join them to get sectional S.V.

(5) For true shape of section, draw perpendiculars from key points to cutting plane. Measure distance of T.V. point 1, 2, 3, 4 from xy line and transfer them from cutting plane line along respective projectors. Join them to get true shape of section.

Problem 5.41 : A pentagonal pyramid has its base on the H.P. and the edge of base nearer the V.P. parallel to it. A vertical section plane inclined at 45° to V.P. cuts the pyramid at a distance of 10 mm from the axis. Draw top view, sectional F.V. and true shape of section. Base of pyramid 40 mm side and axis 75 mm long.

Solution :

(1) Draw T.V. and F.V. of pyramid with an edge of base i.e. one side of base nearer from xy parallel to it.

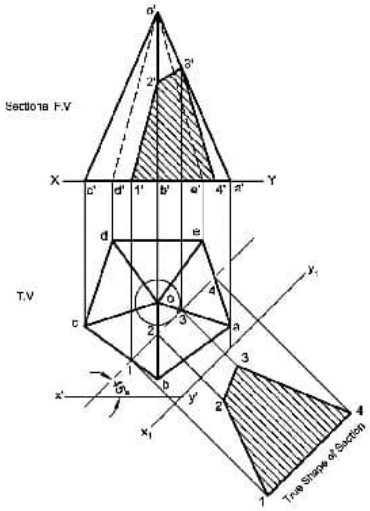


Fig. 5.98

(2) With centre 0, draw a circle of 10 mm radius. Locate section plane which will appear in T.V. as a line coinciding with HT and inclined at 45° to V.P.

Draw a line tangent to this 10 mm circle and at 45° to xy nearer to observer.

(3) The portion between observer and cutting plane is to be removed. Mark key points 1, 2, 3, 4, where section plane cuts the edges of pyramid.

(4) Project these key points in front view on respective edges to mark section points 1, 2, 3, 4. Join them in order to get section.

(5) To get true shape of section from key points in T.V. draw projectors perpendicular to cutting plane. Take a new plane x_1y_1 parallel to cutting plane.

(6) Measure distances of section points in front view from xy line and along corresponding projectors transfer them from x_1y_1 line.

(7) Join the points to get true shape of section.

Problem 5.42 : A pentagonal pyramid side of base 50 mm and axis 100 mm long is resting on its base on the H.P. such that one edge of the base is parallel to V.P. It is cut by a sectional plane perpendicular to V.P. and inclined at 60° to H.P. and passing through a point on the axis 55 mm from the base. Draw (i) Front view (ii) Sectional top view (iii) True shape of section.

Solution :

(1) Draw T.V. a pentagon with a side parallel to xy (V.P.) project F.V.

(2) Locate section plane a straight line in F.V. which is V.T. inclined at 60° to xy and passing through a point on the axis 55 mm from the base.

(3) Mark key points a, b, c, ... Project them in F.V. on respective edges. Join in order to get section F.V.

(4) Draw true shape in the usual manner.

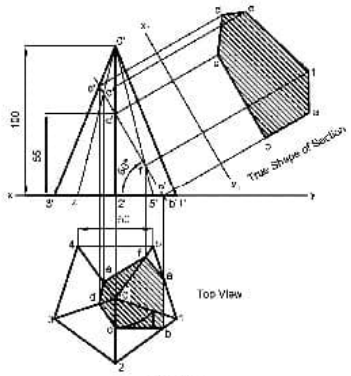


Fig. 5.99

Problem 5.43 : A square pyramid, base 30 mm side and axis 50 mm long stands vertically on the ground with the edges of base equally inclined to V.P. It is cut by a section on the axis 20 mm from the apex section plane is inclined to H.P. by 45° and perpendicular to V.P.

Draw : (i) Front view, (ii) Sectional top view, (iii) True shape of the section.

Solution :

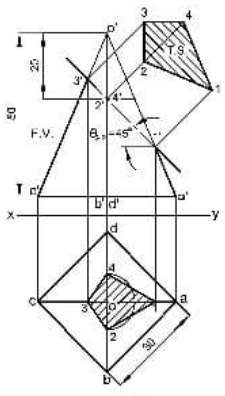


Fig. 5.100

Problem 5.44 : A square pyramid base 40 mm side and axis 70 mm long has its base on the H.P. and all the edges of the base equally inclined to V.P. It is cut by a section plane perpendicular to V.P. inclined at 45° to H.P. and bisecting the axis. Draw (i) Sectional top view, (ii) Front view, (iii) True shape of section.

Solution :

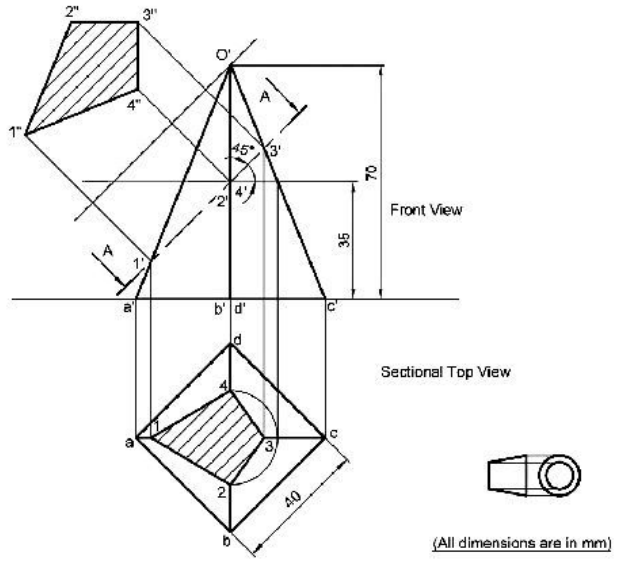


Fig. 5.101

Problem Based on Cone

Problem 5.45 : A cone base 70 mm diameter and axis 75 mm long is resting on its base on the H.P. It is cut by a section plane perpendicular to V.P. inclined at 45° to H.P. and cutting the axis at a point 30 mm from the apex. Draw front view, sectional top view, sectional side view and true shape of section.

Solution : In this problem, generator method will be explained which is easy to follow.

(1) Draw T.V., F.V. and S.V. Divide T.V. circle into 12 equal parts. Draw generators in T.V. Project them in F.V. and S.V.

(2) Locate section plane which is a straight line in F.V. coinciding with V.T. inclined at 45° and 30 mm from apex along the axis.

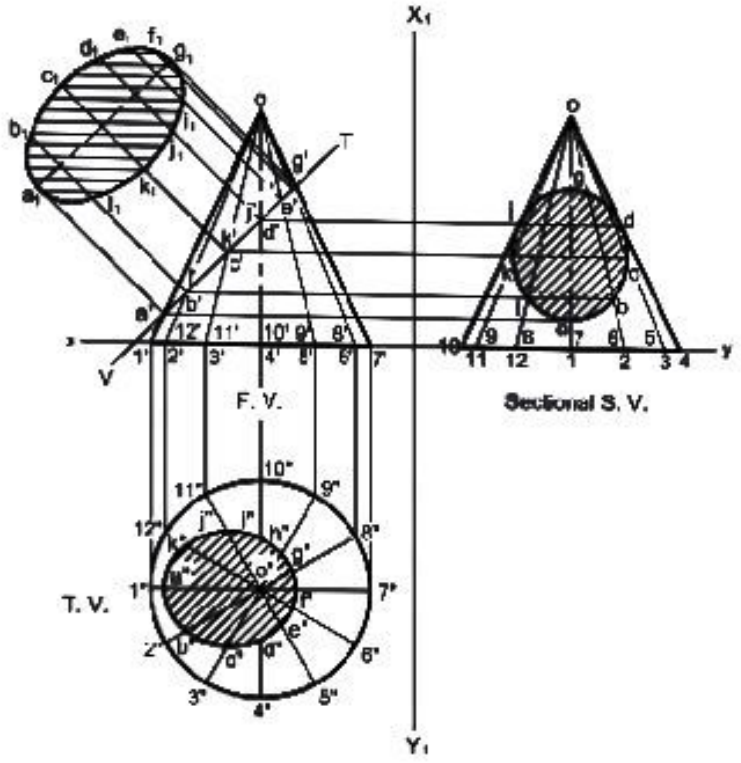


Fig. 5.102

(3) Note the key points in F.V. naming them as a, b, c, d etc. These are points of intersection of generators with section plane.

(4) Project key points in T.V. and S.V. For generator 0-4 and 0-10 no intersection is obtained. So, produce point d to cut end generator and with that radius, draw semi-circle to cut 0-4 and 0-10 in T.V.

(5) The true shape of section is drawn in usual fashion as will be clear from Fig. 5.102. It is an ellipse.

Problem 5.46 : A cone base 70 mm diameter of base and axis 75 mm long is resting on its base on H.P. It is cut by a section plane perpendicular to V.P. and parallel to and 12 mm away from one of its end generators. Draw front view, sectional top view and true shape of section.

Solution :

(1) Draw T.V. and F.V. Divide T.V. in 12 parts. Project generators in F.V.

(2) Draw a section plane in F.V. parallel to end generator and at a distance of 12 mm from it.

(3) All the generators except 0'-1', 0'-2' and 0'-12' are cut by section plane. Project these key points on respective generators in the top view.

(4) The base cut by section plane, will be projected by a line a"j". Draw a curve a"-b"-c" ... etc. The curve in T.V. is apparent section.

(5) The true shape will be obtained in the usual manner. It is a parabola.

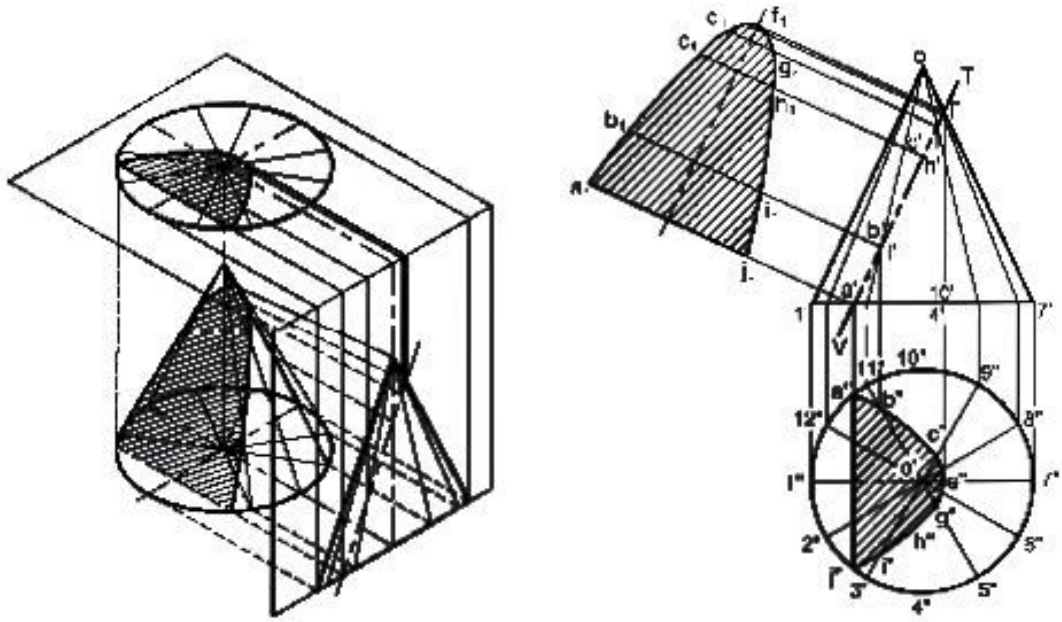
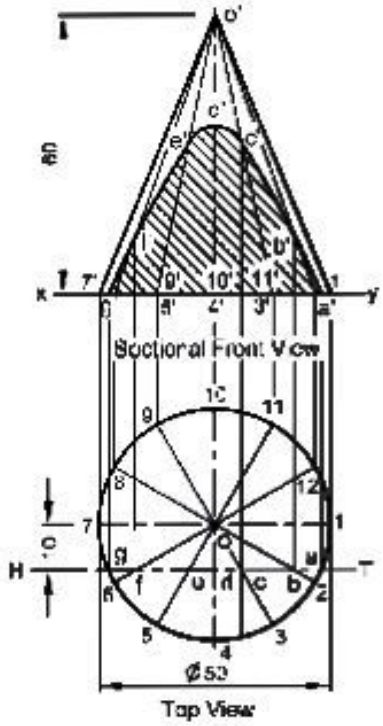


Fig. 5.103

Problem 5.47 : A cone base with 50 mm diameter, axis 60 mm long and resting on its base on the H.P. is cut by a vertical section plane parallel to V.P. and 10 mm away from the top view of the axis. Draw top view and sectional front view.

Solution :



1. T.V. and F.V. is drawn. Divide top view in 12 equal parts. Mark the generators in F.V.
2. Locate section plane, which is H.T. in T.V. 10 mm away from 0 in T.V.
3. Mark the key points in T.V. as a, b, c, d, and e. Project them in F.V. to cut respective generators. a and e are point of base. Join them in order to get sectional view which is also true shape of section.

Fig. 5.104

Problem 5.48 : A cone with diameter of base 60 mm and axis 60 mm long is resting on its base on the ground. It is cut by a section plane perpendicular to V.P., inclined at 75° to H.P. and passing through the apex. Draw its front view, sectional top view and true shape of section.

Solution : When section plane is inclined to H.P. and passes through apex, the true shape is a triangle.

(1) Draw T.V. and F.V. Show section plane which is V.T. 75° to xy and passing through 0.

(2) Take number of horizontal section plane in F.V. say 4. Draw semi-circle in T.V. and project the key points from F.V. in T.V. to get section. Point 4' of base will give a straight line in T.V. Other points of section will lie on a straight line.

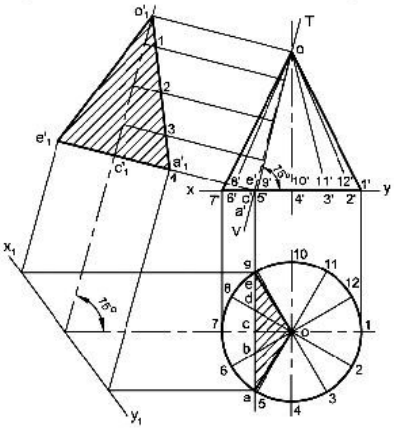


Fig. 5.105

(3) Project true shape in the usual manner. It is an isosceles triangle, the base of which is equal to length of cord on base circle and altitude is equal to length of section plane within the cone.

Problem 5.49 : A cone base 60 mm diameter and height 70 mm, is resting on the base in H.P. It is cut by vertical section plane inclined at 30° to V.P. and 12 mm in front of the axis.

Draw : (i) Sectional front view, (ii) Top view, (iii) True shape of section.

Solution :

(1) Complete T.V. and F.V. of cone.

(2) In T.V. draw a circle of 12 mm radius.

(3) Draw a tangent to circle and at 30° to V.P. (xy).

(4) Note the cutting points of base and generators.

(5) Project them in usual manner in F.V. to get sectional F.V.

(6) For true shape, draw projectors perpendicular to section plane.

(7) Transfer the distances of section points in F.V., along corresponding projectors to get true shape.

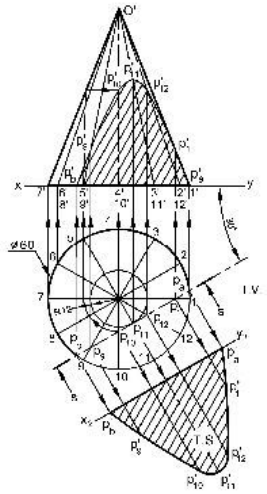


Fig. 5.106

Problem 5.50 : A cone with base 60 mm diameter and axis 75 mm long has its base on the H.P. It is cut by a section plane, perpendicular to V.P., inclined at 75°to H.P. and passing through its apex.

Draw : (i) Sectional top view, (ii) Front view, (iii) True shape of section.

Solution :

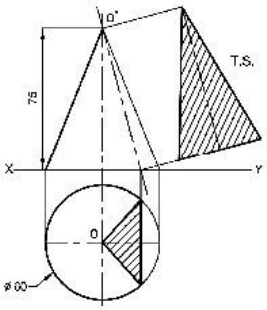


Fig. 5.107

Problem 5.51 : A right circular cone of 50 mm base diameter and axis 80 mm long is resting on its base on H.P. It is cut by a section plane inclined at 60°to H.P. and perpendicular to V.P. bisecting the axis. Draw (i) Front view. (ii) Sectional T.V. (iii) True shape of section.

Solution :

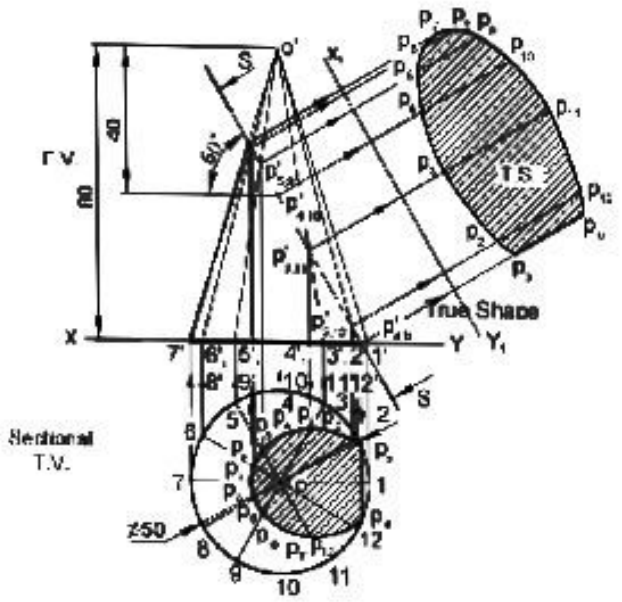


Fig. 5.108

Problem Based on Cylinder

Problem 5.52 : A cylinder of 55 mm diameter and 70 mm high has its axis vertical. It is cut by a section plane perpendicular to V.P., inclined at 45° to H.P. and intersecting the axis 40 mm above the base. Draw front view, sectional top view, sectional side view and true shape of section.

Solution :

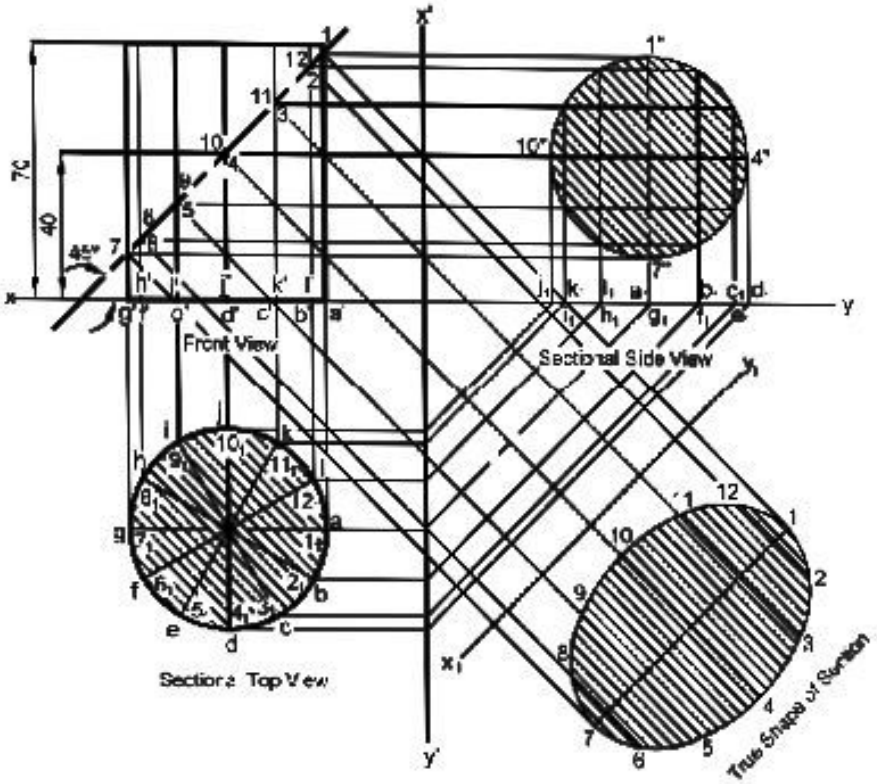


Fig. 5.109

(1) This problem is solved by following way. Draw F.V., T.V. and L.H.S.V.

(2) Locate section plane in F.V. passing through 40 mm above base 40° to H.P. (xy).

(3) Complete T.V. will be in section as all the edges are cut.

(4) Mark the key points in F.V. 1, 2, 3 ... 12.

(5) For sectional S.V. project key points to respective generators. Join them in order to get sectional S.V.

(6) For true shape, the projectors are drawn to opposite side of section plane and by usual procedure, points of section from T.V. are transferred. Join them in order to get true shape.

Problem 5.53 : A cylinder of 40 mm diameter rests on the H.P. on one of its ends. It is cut by auxiliary vertical plane in such a way that true shape of section is a rectangle of 30 mm x 55 mm. Draw T.V., sectional F.V., true shape of section and find inclination of plane with V.P.

Solution : (Refer Fig. 5.110).

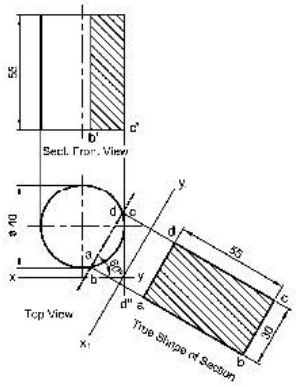


Fig. 5.110

(1) Draw T.V. and project F.V. T.V. is a circle of 40 mm diameter. Since true shape is a rectangle of 30 mm × 55 mm it means the height of cylinder is 55 mm.

(2) In the top view, adjust 30 mm as shown in the Fig. 5.56. so that it gives one side of rectangle. The other side of rectangle is height of rectangle i.e. 55 mm.

(3) Draw sectional F.V. Measure inclination of section plane with V.P. which is $\phi = 60°$.

Problem 5.54 : A cylinder base diameter 40 mm and axis length 60 mm is lying on H.P. on its curved surface such that axis is parallel to V.P. It is cut by section plane perpendicular to V.P. and inclined to H.P. and cuts the axis at a distance of 20 mm from one end.

Draw : (i) Front view, (ii) Sectional top view, (iii) True shape of section.

Solution :

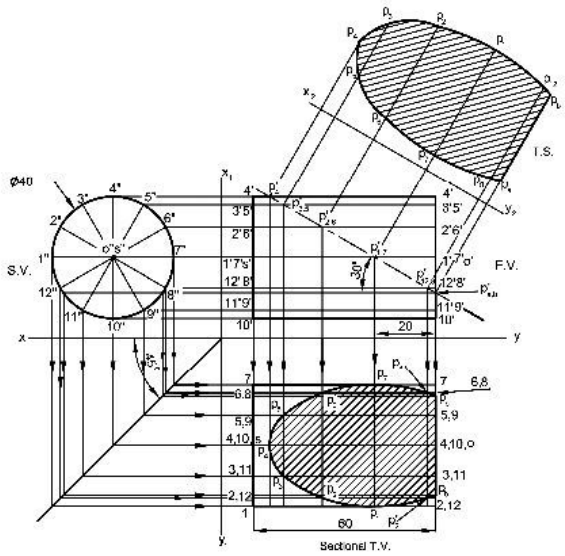


Fig. 5.111

Problem 5.55: *A right circular cylinder, base 60 mm diameter and height 120 mm stands vertically on the ground. It is cut by a section plane, perpendicular to V.P. and inclined to H.P. such that true shape of the section is an ellipse with major axis 80 mm long. Draw its front view, sectional top view, and true shape of the section. Determine the inclination of the section plane with H.P.*

Solution :

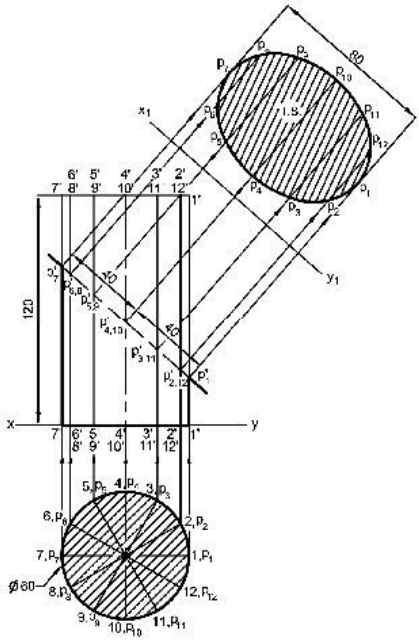


Fig. 5.112

Problem 5.56 : A cylinder of 55 mm diameter and 70 mm high has its axis vertical. It is cut by a section plane perpendicular to V.P. inclined at 45° to H.P. and intersecting the axis 40 mm above the base. Draw :

(i) Front view.

(ii) Sectional top view.

(iii) True shape of section.

Solution :

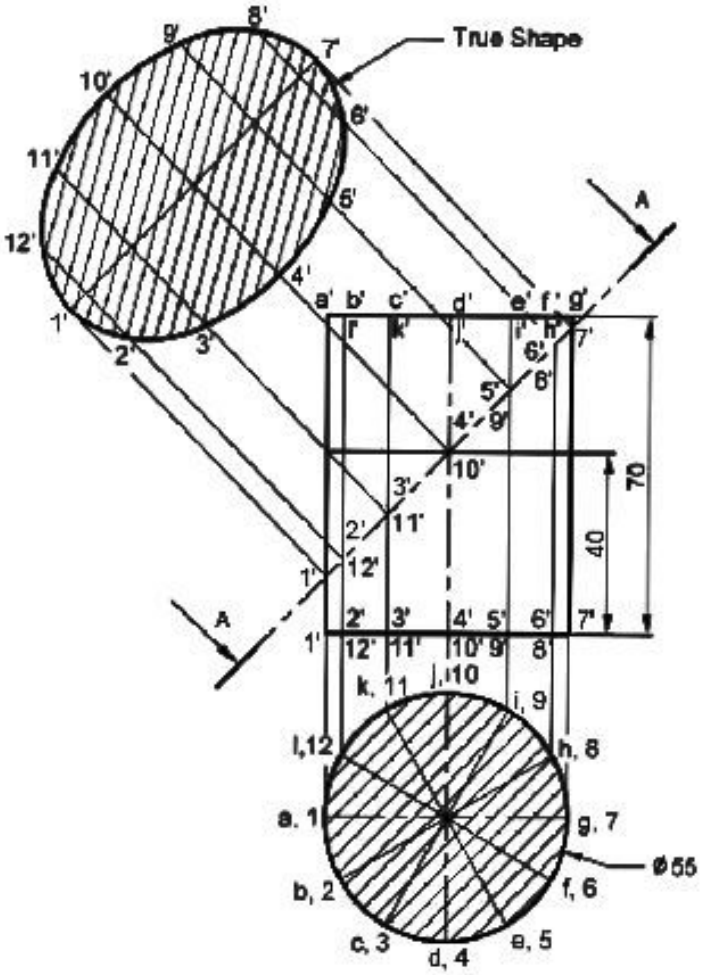


Fig. 5.113

Problem 5.57 : A right circular cylinder of 60 mm diameter and axis 80 mm long is resting on its base on H.P. It is cut by a cutting plane, perpendicular to V.P. and inclined at 45° to H.P., passing through the mid-point of axis.

Draw

(1) Front view.

(2) Sectional top view.

(3) True shape of section.

Solution :

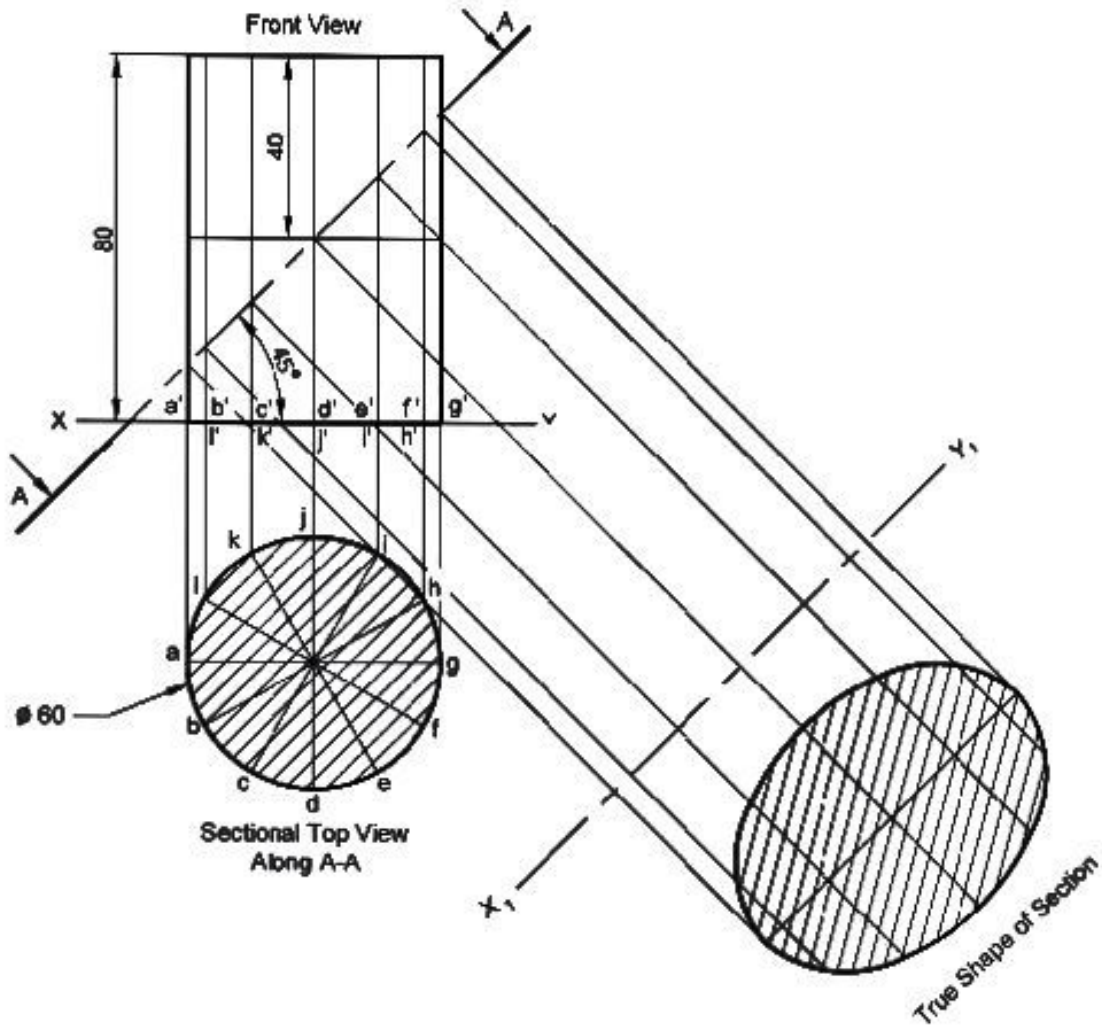


Fig. 5.114

Problem Based on Cube

Problem 5.58 : A cube of 60 mm long edges has its vertical faces equally inclined to V.P. It is cut by a section plane, perpendicular to V.P. so that the true shape of section is a regular hexagon. Determine the inclination of cutting plane with H.P. and draw sectional top view and true shape of section.

Solution :

(1) Draw T.V. a square of 60 mm side with all sides 45° to xy. Project F.V.

(2) To obtain true shape of section as a regular hexagon, the cutting plane must pass through mid-points of lower and upper two sides each and two vertical sides. So, mark cutting plane passing through mid-points as shown in F.V.

(3) Project key points in T.V. to obtain sectional T.V.

(4) Obtain true shape in usual manner. It is a regular hexagon.

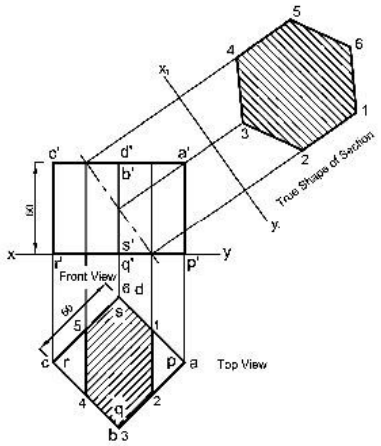


Fig. 5.115

Problem Based on Tetrahedron

Problem 5.59 : A tetrahedron of 65 mm long edges is lying on the H.P. on one of its faces, with an edge perpendicular to V.P. It is cut by a section plane perpendicular to V.P. So that the true shape of section is an isosceles triangle of base 50 mm long and altitude 45 mm Find the inclination of section plane with H.P. and draw front view, sectional top view and true shape of section.

Solution :

(1) Draw T.V. as equilateral triangle with one side ab perpendicular to xy.

(2) Project a'b'c' in F.V. with c' as centre and radius as 65 mm. Cut projector of 0 in 0' to get apex in F.V.

(3) In T.V. divide 50 mm symmetrically as 1-2. Project 1-2 in F.V. with 1' as centre and 45 mm as radius. Cut other side oc in F.V. Join 1-3 which is the section plane.

(4) Project 3' in T.V. as 3. Join 1-2-3 to get sectional T.V.

(5) Draw true shape of section in the usual manner which is an isosceles triangle of length 50 mm and altitude 45 mm.

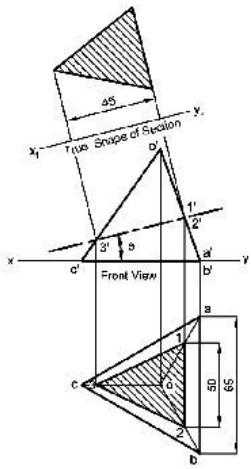


Fig. 5.116

Problem 5.60 : A tetrahedron of side 70 mm is kept on the H.P. of one of its triangular faces with an edge of that triangular face perpendicular to V.P. It is cut by an AIP in such a way that the true shape of section is a square.

Draw : (i) Front view, (ii) Sectional T.V., (iii) True shape of section.

Solution :

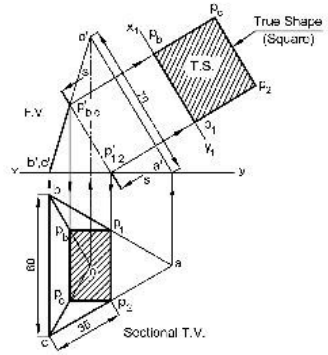


Fig. 5.117

(1) Draw tetrahedron of side 70 mm with one side perpendicular to V.P.

(2) Complete F.V.

(3) In the T.V. locate P_1P_2 equal to Pb, Pc.

(4) Project key points in F.V. as shown.

(5) Draw true slope of section which will be a square.

Problem 5.61 : A tetrahedron of 65 mm long edges is lying on the H.P. on one of its faces, with an edge perpendicular to V.P. It is cut by a section plane perpendicular to V.P. so that the true shape of section is an isosceles triangle of base 50 mm long and altitude 45 mm. Find the inclination of section plane with H.P. and draw front view, sectional top view and true shape of section.

Solution :

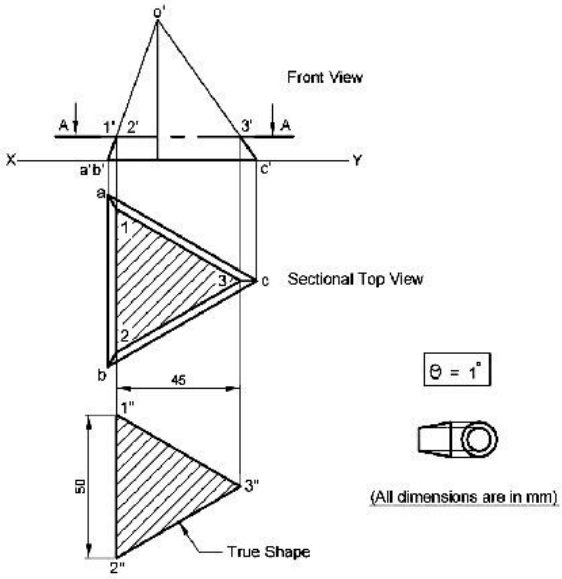


Fig. 5.118

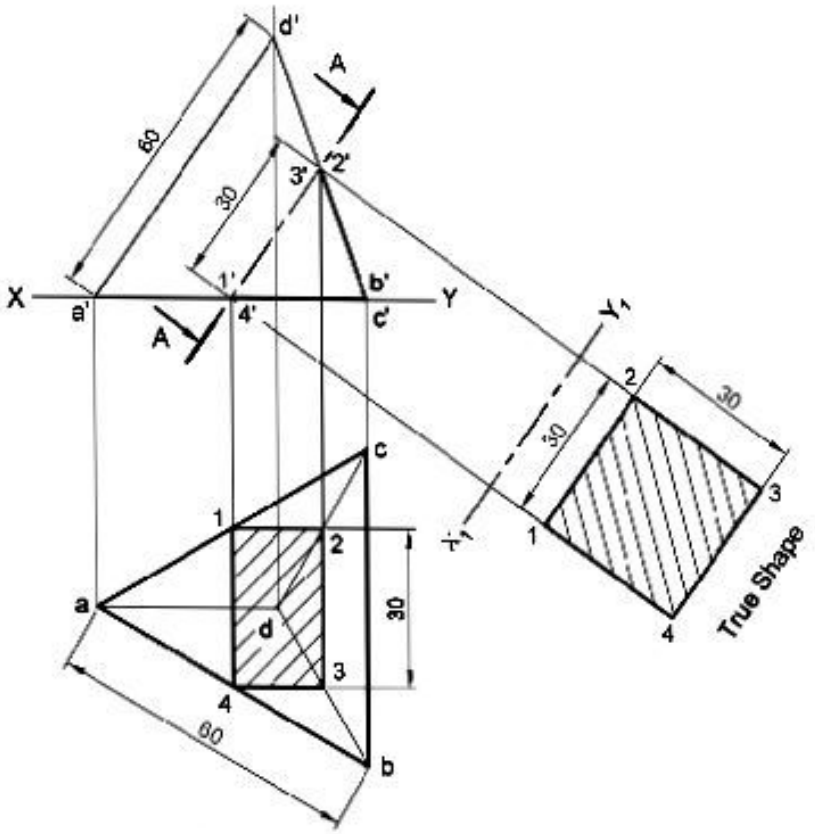
Problem 5.62 : A tetrahedron of 60 mm long edges is lying on H.P. on one of its faces; with an edge perpendicular to V.P. It is cut by a cutting plane perpendicular to V.P. and inclined to H.P. in such a way that true shape of section obtained is square of 30 mm side. Draw.

(1) Front view.

(2) Sectional top view.

(3) True shape of section.

Solution :



Sectional Top View Along A-A

Fig. 5.119

PROBLEMS FOR PRACTICE

1. A square prism of 50 mm side of base and 80 mm in height is resting on its base on H.P. with all sides of base making equal angle with V.P. It is cut by a section plane normal to V.P. which passes through the left bottom corner and right top corner of elevation. Draw the following views : (1) The elevation, (2) The sectional plan, (3) The true shape of section.
2. A square prism is resting on its base on H.P. So that all vertical faces are equally inclined to V.P. It is cut by an auxiliary inclined plane in such a way that true shape of section is a rhombus of maximum diagonal length 100 mm and minimum diagonal length 50 mm. Draw front view, sectional top view and the shape of section. Determine the side and height of prism.
3. A pentagonal prism, base edge 25 mm and length of axis 70 mm is resting on its base on the H.P. with one of the rectangular surfaces perpendicular to V.P. It is cut by a section plane, perpendicular to V.P. and inclined at 45° to H.P., bisecting the axis. Draw the three views.
4. A hexagonal prism end surface edge 25 mm and length of axis 70 mm is resting on its base on the H.P. with one of the rectangular surface parallel to V.P. It is cut by a section plane perpendicular to V.P. and inclined at 50° to H.P. and passing through left top corner of the prism. Draw (1) Sectional elevation, (2) Sectional plan and (3) True shape of the section.
5. A hexagonal prism has a face on the H.P. and the axis is parallel to the V.P. and H.P. It is cut by a section plane inclined at 45° to V.P. and perpendicular to H.P. and it cuts the axis at a point 15 mm from one of its ends. Draw its (1) Sectional front view, (2) Sectional top view, (3) True shape of the section. Side of base 25 mm long and length of axis is 70 mm.
6. A pentagonal pyramid, base edge 30 mm and slant edge 60 mm is resting on its base on the H.P. with one of the slant edge parallel to V.P. It is cut by an inclined plane perpendicular to V.P. and at an angle of 60° to H.P. and bisecting the axis. Draw (1) Sectional elevation, (2) Sectional plan and (3) True shape of the section.
7. A square pyramid base edge 50 mm and length of axis 80 mm is resting on its base on the H.P. with all the base edges equally inclined with V.P. It is cut by plane perpendicular to V.P. and inclined at 50° to H.P. and passing through extreme left base corner of the pyramid. Draw (1) Sectional Front View, (2) Sectional Top View and (3) True shape of the section.
8. A hexagonal pyramid, base edge 25 mm and length of axis 70 mm is resting on its base on the H.P. with two parallel base edges perpendicular to V.P. It is cut by a plane perpendicular to H.P. and inclined at 45° with V.P. and passing through a point 10 mm from the apex. Draw (1) Sectional Top View, (2) Sectional Front View and (3) True shape of the section.

9. A square pyramid base edge 40 mm and length of axis 70 mm is resting on its base on the H.P. with one of the base edge making an angle of 25° with V.P. It is cut by a plane perpendicular to V.P. and inclined at 45° with H.P. and passing through a point at 40 mm from the base along the axis. Draw the three views.
10. A hexagonal pyramid side of base 25 mm and axis 70 mm long is resting on its base on the H.P. such that four edges of base are inclined at 30° with V.P. It is cut by a section plane perpendicular to V.P. inclined at 60° with H.P. and passing through a point on the axis 15 mm from the base. Draw : (i) Sectional top view, (ii) Front view, (iii) Sectional side view, (iv) True shape of section.
11. A hexagonal pyramid with base 30 mm side and axis 65 mm long has its base on the ground with as edge of base parallel to V.P. A section plane perpendicular to H.P., inclined at 45° to V.P. cuts the pyramid at a distance of 10 mm from its axis. Draw - (i) Top view, (ii) Sectional front view, (iii) True shape of section.
12. A square pyramid of 60 mm edges of base and 80 mm height is resting on its base with one of the edges of base perpendicular to V.P. It is cut by an auxiliary inclined plane in such a way that true shape of section is a trapezium. Whose parallel sides measure 50 mm and 30 mm Draw F.V., sectional top view and true shape of section.
13. A cone of 60 mm diameter of base and 70 mm height of axis, rests on its base on the ground. It is cut by an auxiliary inclined plane such that true shape of section is an parabola of base 40 mm. Draw : (i) Front view, (ii) Sectional top view, (iii) True shape of section, (iv) Find inclination of plane with H.P.
14. A cone 60 mm, diameter of base and 70 mm height is standing on its base in H.P. It is cut by a plane perpendicular to both H.P. and V.P. and 5 mm away from the axis of cone. Draw : (i) Plan, (ii) Elevation, (iii) Sectional end view.
15. A cone base 50 mm diameter and axis 60 mm long and resting on its base on H.P. It is cut by a vertical section plane parallel to V.P. and 10 mm away from the top view of axis. Draw top view and sectional front view.
16. A cone diameter of base 60 mm and axis 65 mm long is resting on its base on H.P. It is cut by a plane perpendicular to V.P. so that true shape of section is a parabola having base 46 mm Draw front view, sectional top view and true shape of section.
17. A cone diameter of base 60 mm and axis 65 mm long is resting on its base on H.P. It is cut by a plane perpendicular to V.P. so that the true shape of section is a parabola having 46 mm base. Draw front view, sectional top view and true shape of section.
18. A cone, base diameter 60 mm and length of axis 80 mm stands on its base on the H.P. It is cut by a plane which is perpendicular to V.P. and inclined at 45° with H.P. Draw (1) Sectional Front View, (2) Sectional Top View and (3) True shape of the section if the section plane passes through the point 30 mm from the apex along the axis.
19. A cone base diameter 70 mm and the slant length 70 mm rests on the H.P. on its base. It is cut by a section plane passing through the extreme left base corner of the cone and bisecting the axis. Draw the three views.
20. A cone base diameter 70 mm, length of axis 80 mm is resting on its base on the H.P. It is cut by a section plane, passing through the midpoint of the axis. The section plane is perpendicular to V.P. and inclined at 60° to H.P. Draw (1) Sectional Front View, (2) Sectional Top View and (3) True shape of the section.
21. A cone base diameter 70 mm, length of axis 80 mm is resting on its base on H.P. It is cut by a vertical section plane inclined at 45° with V.P. and at a distance of 20 mm from the apex and nearer to observer. Draw (1) Sectional Front View, (2) Sectional Top View and (3) True shape of the section.
22. A cone base diameter 70 mm, length of axis 80 mm rests on H.P. It is cut by inclined plane which passes through the apex and it is inclined at 75° with H.P. and perpendicular to V.P. Draw sectional elevation, sectional top view and true shape of the section.
23. A cylinder, base diameter 50 mm and length of axis 70 mm is resting on its base on the H.P. It is cut by a plane inclined to H.P. and perpendicular to V.P. and passing through the extreme left bottom base corner and extreme right top surface corner. Draw (1) Sectional elevation, (2) Sectional plan and (3) True shape of the section. Find the inclination of the cutting plane with the H.P.
24. A cylinder, base diameter 50 mm and length of axis 80 mm is resting on its base on H.P. It is cut by a plane inclined at 50° with H.P. and perpendicular to V.P. and passing through a point 20 mm from the top surface along the axis. Draw the three views.
25. A cylinder, base diameter 55 mm and length of axis 80 mm is lying on its curved surface on the H.P. with the axis parallel to V.P. It is cut by a vertical plane inclined at 30° to V.P. and passing through the mid-point of the axis. Draw the (1) Sectional Top View and (2) Sectional Front View and (3) True shape of the section.
26. A cylinder with 50 mm diameter and 80 mm height has its circular base on H.P. A square slot of 15 mm side is cut through the cylinder axially such that all faces of the slots are at 45° to V.P.
    A section plane perpendicular to V.P. and inclined at 60° to H.P. cut the cylinder through a point on the axis at 40 mm, from the base. Draw (i) Front view, (ii) Sectional top view, (iii) Sectional side view.
27. A cube of 50 mm long edges is resting on H.P. on one of its face with vertical faces equally inclined to V.P. It is cut by an auxiliary inclined plane so that true shape of section is a trapezium with two parallel sides of 20 mm and 60 mm Draw front view, sectional top view and true shape of section.
28. A cube 50 mm side is resting on one of its square surfaces on the H.P. with the base edge inclined at 30° with V.P. It is cut by a plane inclined at 45° to H.P. and perpendicular to V.P. and passing through the top end of the axis. Draw (1) Sectional elevation, (2) Sectional plan and (3) True shape of the section.