5.3 A fixed point is 90 mm from a fixed straight line. Draw the locus of a point P moving in such a way that its distance from the fixed straight line is twice its distance from the fixed point. Name the curve. Draw a tangent and a normal at a point 40 mm away from the fixed point.

ELLIPSE

5.20 Draw the locus of a point which moves in such a manner that its distance from a fixed point is equal to its distance from a fixed straight line. Consider the distance between the fixed point and the fixed line as 60 mm. name the curve.

ELLIPSE

5.30 Draw the hyperbola when its vertex and its focus are at a distance of 15 mm and 40 mm respectively from the directrix. Plot at least six points.

HYPERBOLA

6.25 An elastic string of length 150 mm has its one end attached to the circumference of a circular disc of diameter 40 mm. Draw the curve traced out by the other end of the string when it is completely wound around the disc, keeping the string always tight.

INVOLUTE CURVES

6.27 Draw an Archimedean spiral for one convolution with a shortest distance of 15 mm and radial increment of 5 mm for each 30°.

SPIRAL

9.15 A line PQ measures 100 mm. The projectors through its V.T. and the end P are 40 mm apart. The end P is 30 mm above H.P. and 20 mm in front of V.P. The V.T. is 10 mm below the H.P. Draw the projections of the line and determine H.T. and inclinations of line with the reference planes.

PROJECTION OF STRAIGHT LINES

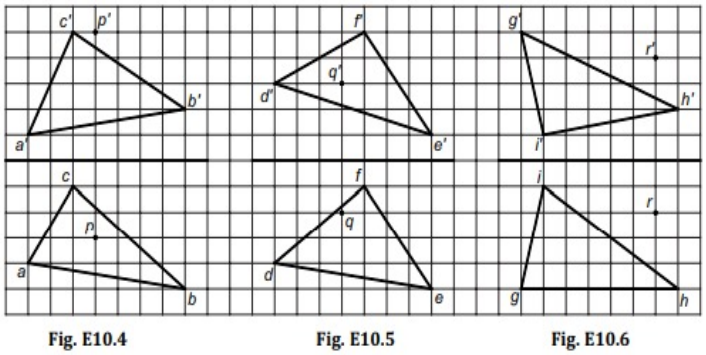

Fig. E10.4 Fig. E10.5 Fig. E10.6

10.16 Figures E10.4 to E10.6 are drawn on a 10 mm grid. They show the front and the top views of planes *ABC*, *DEF* and *GHI*. The figure also shows the projections of points *P*, *Q* an *R*. Determine the distance of the point *P*, *Q* and *R* from planes *ABC*, *DEF* and *GHI*, respectively.

PROJECTION OF PLANES

11.22 A hexagonal pyramid of base edge 30 mm and slant edge 75 mm is resting on an edge of base on the ground in such a way that the edge of the base on which it rests is inclined at 45° to the V.P. and the base itself is inclined at 60° to the H.P. Draw its projections.

PROJECTIONS OF SOLIDS

Problem 12.3 *A pentagonal pyramid of base side 30 mm and axis 60 mm is resting on its base in the H.P. with an edge of the base parallel to the V.P. A horizontal section plane cuts the pyramid bisecting the axis. Draw its front view and sectional top view.*

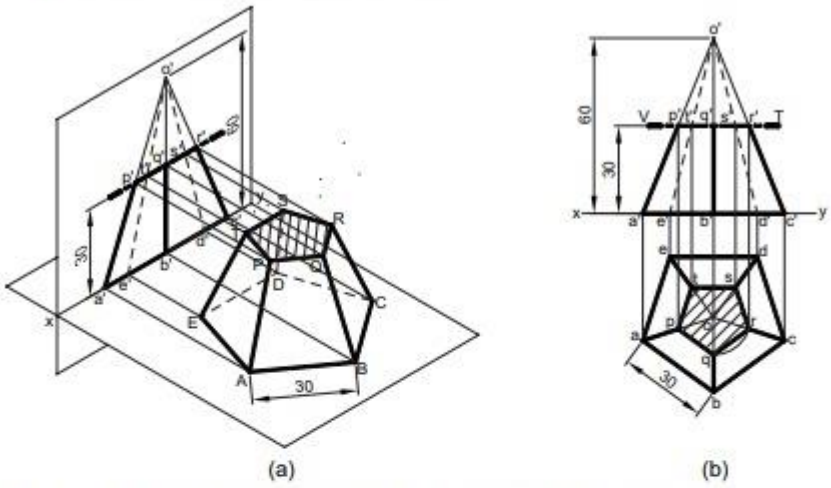

Fig. 12.8 *Section of pyramid by horizontal plane* **(a)** *Pictorial view* **(b)** *Orthographic view*

Figure 12.8(a) shows the pictorial view of a pentagonal pyramid kept on its base on H.P. which is cut by a horizontal section plane.

Construction Refer to Fig. 12.8(b).

1. **Projections** Draw a pentagon *abcde* keeping side de parallel to *xy*. Join all the corners of the pentagon with centroid *o*. This is the top view. Project all the corners and obtain *a'c'o'* as the front view.
2. **Cutting plane** Draw V.T. of the section plane parallel to and 30 mm above *xy*. Let V.T. cut the slant edges *o'a'* at *p'*, *o'b'* at *q'*, *o'c'* at *r'*, *o'd'* at *s'* and *o'e'* at *t'*.
3. **Sectional top view** Project *p'*, *r'*, *s'* and *t'* on their respective edges *oa*, *oc*, *od* and *oe* and obtain points *p*, *r*, *s* and *t*. Point *q'* cannot be projected directly on *ob*. However, it is known that the sectional top view should be a regular pentagon. Therefore, draw an arc with centre *o* and radius *ro* to meet *ob* at point *q*. Join *pqrst* and hatch the enclosed portion.
   As the section plane is parallel to the H.P., *pqrst* represents the true shape of the section.

Problem 13.3 *A hexagonal prism of base side 30 mm and axis 70 mm is resting on its base on the ground with a side of base inclined at 45° to the V.P. It is cut by an auxiliary inclined plane inclined at 45° to the H.P. and passes through a point 15 mm below the top end of the axis. Draw the development of the lateral surface of the truncated prism.*

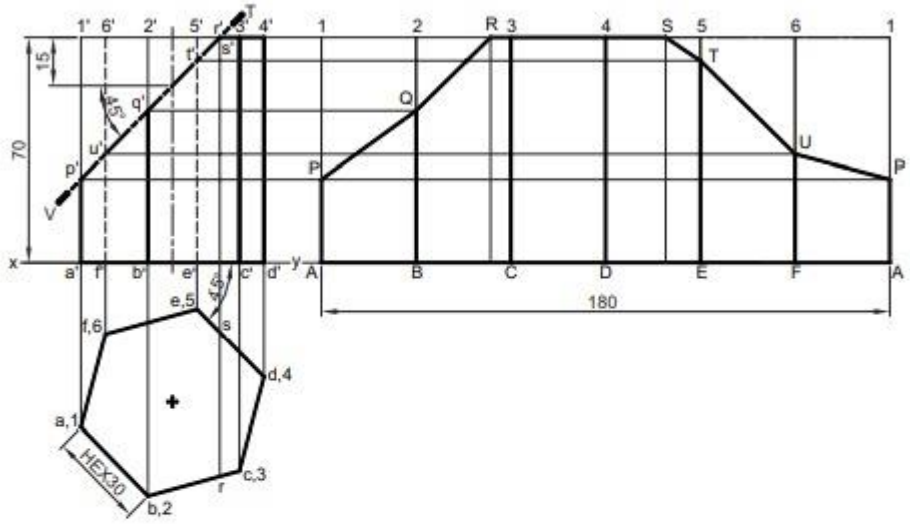

Fig. 13.4

Construction Refer to Fig. 13.4.

1. **Projections** Draw a hexagon *abcdef* keeping *ed* inclined at 45° with *xy* to represent the top view. Project all points to obtain $a'd'4'1'$ as the front view.
2. **Cutting plane** Draw V.T. of the cutting plane inclined at 45° to *xy* such that it passes through a point 15 mm below the top end of the axis. Let V.T. cut the edges $a'1'$ at p', $b'2'$ at q', $2'3'$ at r', $4'5'$ at s', $e'5'$ at t' and $f'6'$ at u'.
3. **Development** Consider seam at $a'1'$. Stretch out lines 1-1 and A-A from the front view equal to the perimeter of the base (180 mm). Divide 1-1 and A-A in six equal parts and name their intermediate points as 2, 3, 4, 5, 6 and *B*, *C*, *D*, *E*, *F* respectively. Join 1*A*, 2*B*, 3*C*, 4*D*, 5*E* and 6*F* in the development.
4. Draw horizontal lines from points p', q', t' and u' to meet their corresponding edges *A*1, *B*2, *E*5, *F*6 at points *P*, *Q*, *T*, *U*, respectively.
5. Project $r's'$ to meet the corresponding edges in the top view at points *r* and *s* respectively. Mark points *R* and *S* on the development such that distance $2R = 2r$, and $4S = 4s$. Join each of *PQ*, *QR*, *RS*, *ST*, *TU* and *UP* with straight lines.
6. Dark the portion of the development that is retained after truncating the prism.

Problem 14.3 *A square prism of base side 60 mm is resting on its base on H.P. with a face inclined at 30° to V.P. It is completely penetrated by another square prism of base side 45 mm and faces of which are equally inclined to V.P. The axes of both the prisms intersect each other at right angles. Draw the projections of the combination and show lines of intersection.*

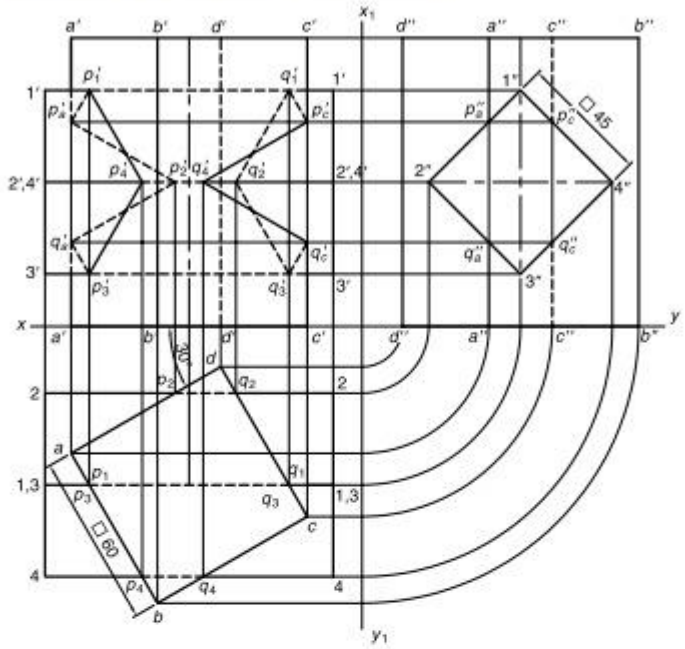

Fig. 14.4

Construction Refer to Fig. 14.4.

1. Draw a square *abcd* to represent TV of the vertical prism. Assuming its suitable height (say 100 mm), project FV and SV and label them as shown.
2. Draw another square 1″2″3″4″ keeping centre at the mid-point of the axis of the vertical prism to represent the SV of the horizontal prism. Assuming its suitable length (say 100 mm), project FV and TV and label them as shown.
3. The faces of the vertical prism are seen as lines in the TV. First locate the points of intersection in the TV of the edges 1-1, 2-2, 3-3 and 4-4 of the horizontal prism with the faces of the vertical prism on left side as p_1, p_2, p_3 and p_4 and on right side as q_1, q_2, q_3 and q_4.
4. Project points p_1, p_2, p_3 and p_4 to FV to meet their corresponding edges 1′1′, 2′2′, 3′3′ and 4′4′ at points p_1', p_2', p_3' and p_4'. Similarly, project q_1, q_2, q_3 and q_4 to FV and obtain points q_1', q_2', q_3' and q_4'.

5. In the SV, the vertical edges $a''a''$ and $c''c''$ intersect with the faces 1″2″, 2″3″, 1″4″ and 3″4″ of the horizontal prism at p_a'', q_a'', p_c'' and q_c''. Project these points to FV up to vertical edges $a'a'$ and $c'c'$.
6. Join lines $p_1'p_a'p_2'q_a'p_3'$ and $p_c'q_1'q_2'q_3'q_c'$ by dotted lines and then $p_1'p_4'p_3'$ and $p_c'q_4'q_c'$ by full lines as shown. These lines show the line of intersection.
7. Show the portion of horizontal prism which is inside the vertical prism by dotted lines in both the FV and TV.

Problem 7.4 *Pictorial view of an object is shown in Fig. 7.16(a). Using first angle projection, draw its (a) front view from the X-direction, (b) top view and (c) left-hand side view.*

Looking at Fig. 7.16(a) it can be observed that the basic feature of the object lies in the plane parallel to H.P. Therefore, it is convenient to first draw the top view which is the true replica of this feature. Now project all the points from the top view and obtain the front and side views as shown in Fig. 7.16(b).

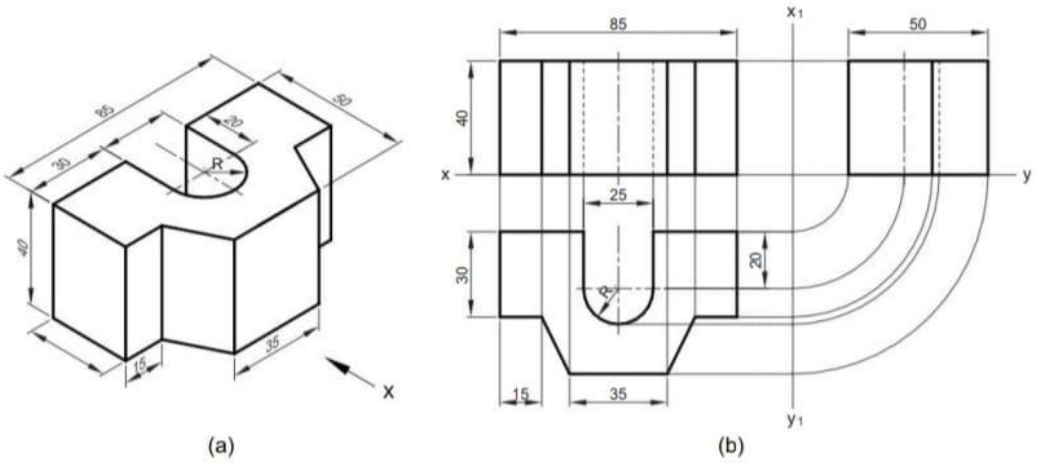

Fig. 7.16 **(a)** *Pictorial view* **(b)** *Orthographic views*

Problem 7.31 *Pictorial view of an object is shown in Fig. 7.53(a). Using first-angle projection, draw its (a) sectional front view at A–A and (b) top view.*

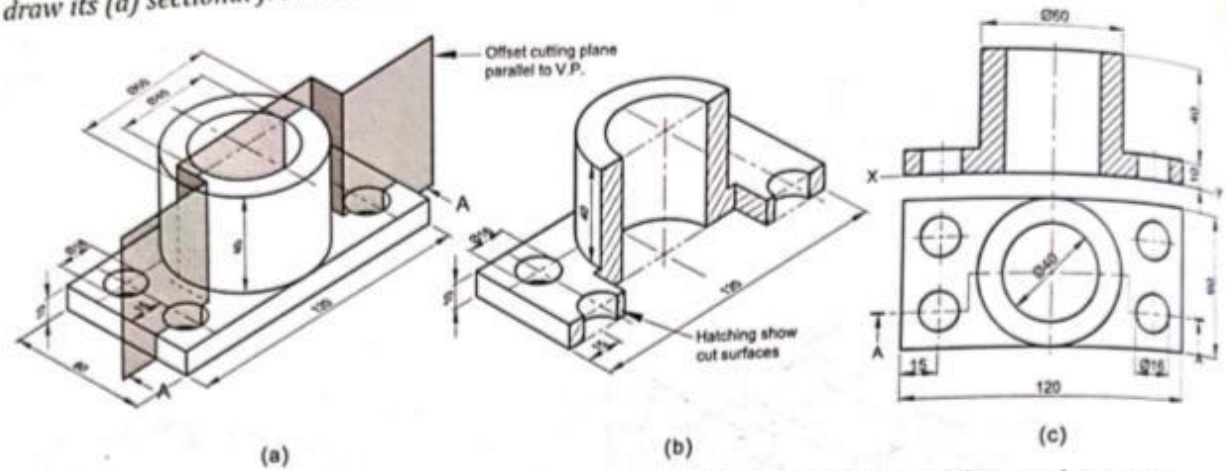

Fig. 7.53 *Object (a) Pictorial view; (b) Cut by offset sectional plane and (c) Sectional front and top views*