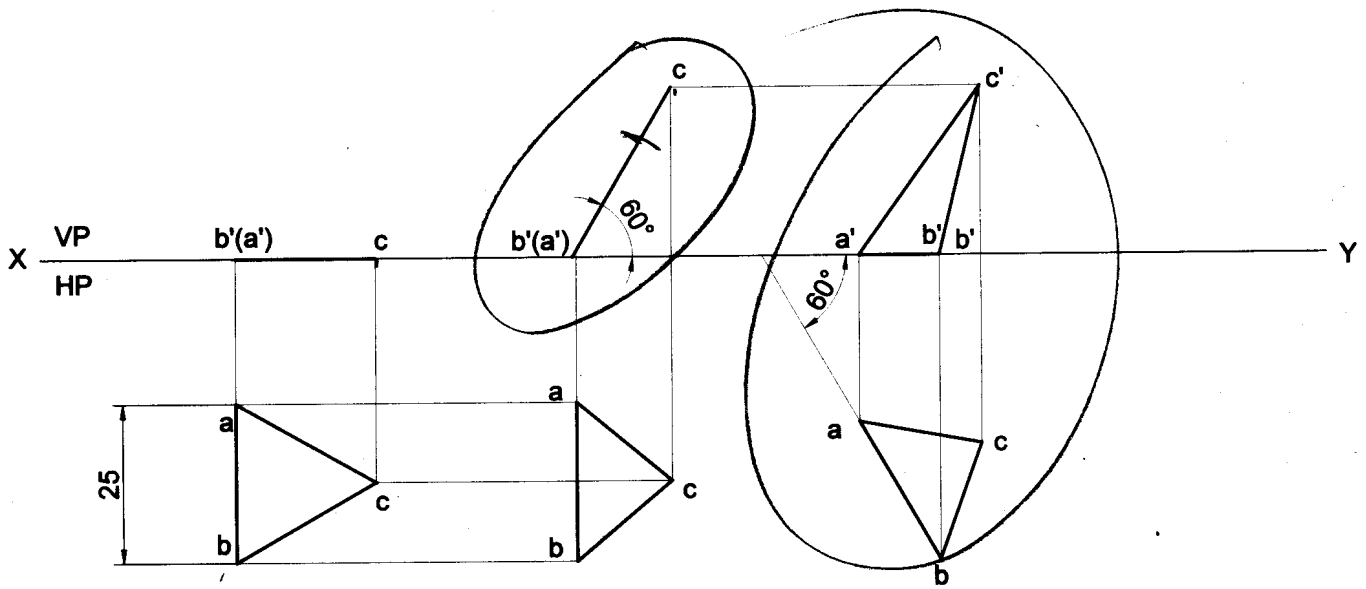
CHAPTER 3

PROJECTIONS OF PLANE SURFACES

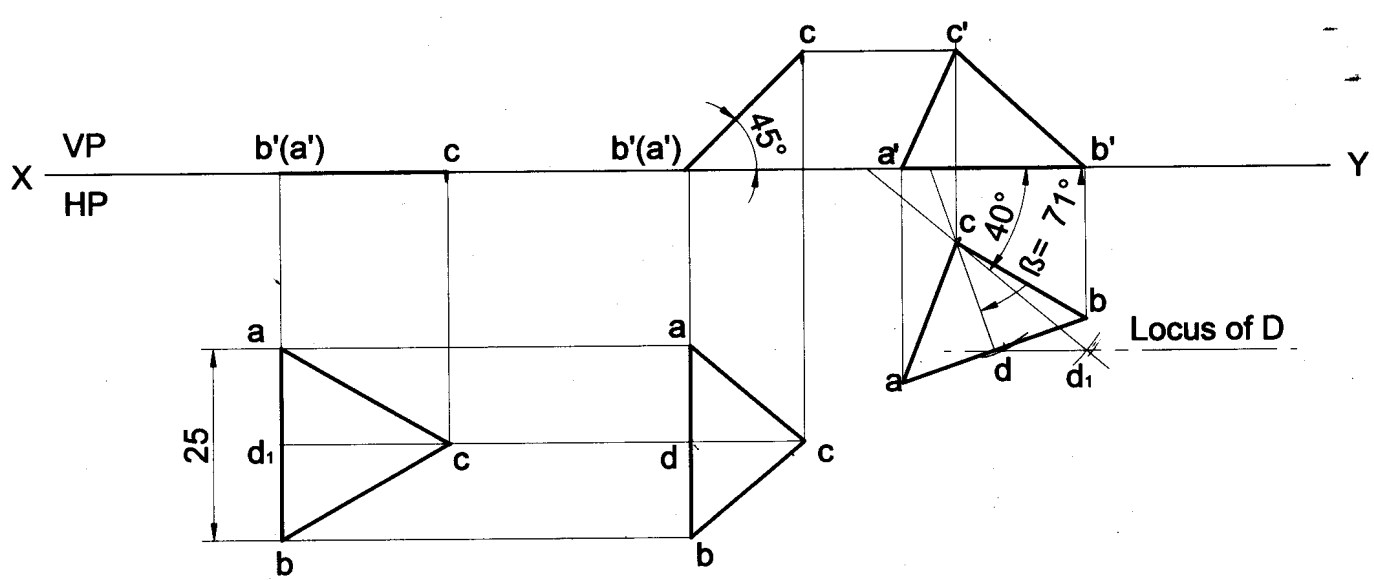
Problem 1 An equilateral triangular lamina of 25mm side lies with one of its edges on HP such that the surface of the lamina is inclined to HP at 60°. The edge on which it rests is inclined to VP at 60°. Draw the projections.

Solution



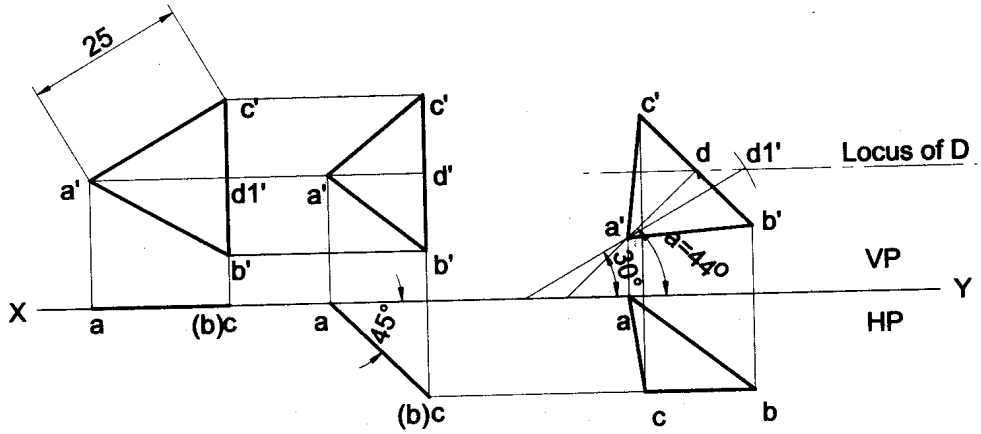
Problem 2 An equilateral triangular lamia of 25mm side lies on one of its sides on HP. The lamina makes 45° with HP and one of its medians is inclined at 40° to VP. Draw its projections.

Solution



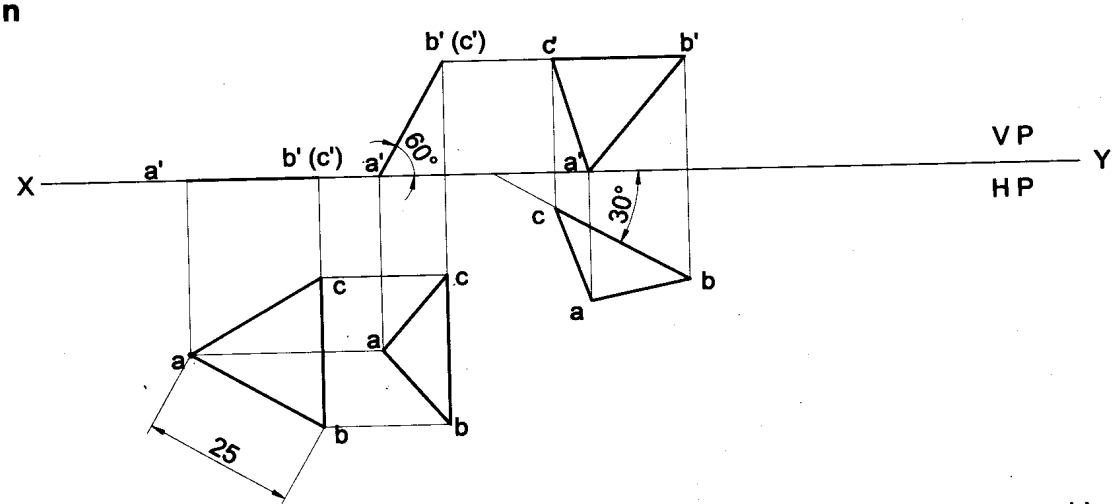
Problem 3 A triangular lamina of 25mm sides rests on one of its corners on VP such that the median passing through the corner on which it rests is inclined at 30° to HP and 45° to VP. Draw its projections.

Solution



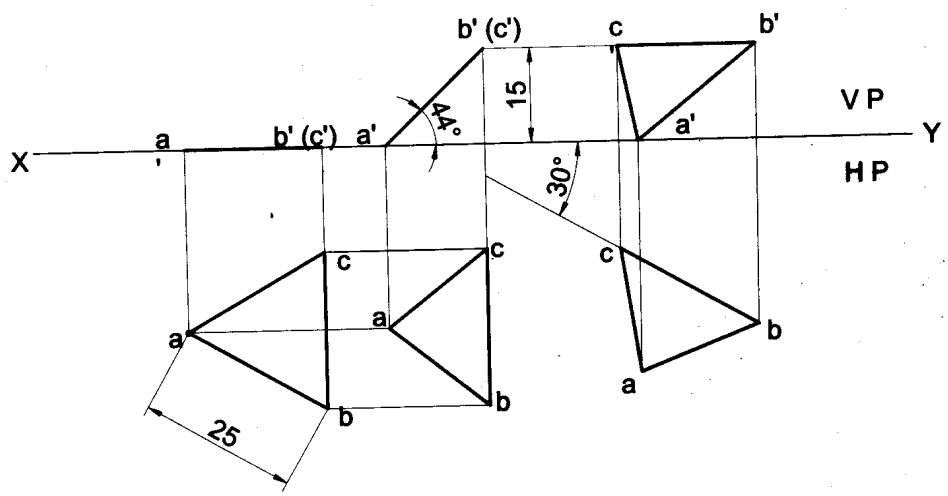
Problem 4 A triangular plane figure of sides 25mm is resting on HP with one of its corners, such that the surface of the lamina makes an angle of 60° with HP. If the side opposite to the corner on which the lamina rests makes an angle of 30° with VP, draw the top and front views in this position.

Solution



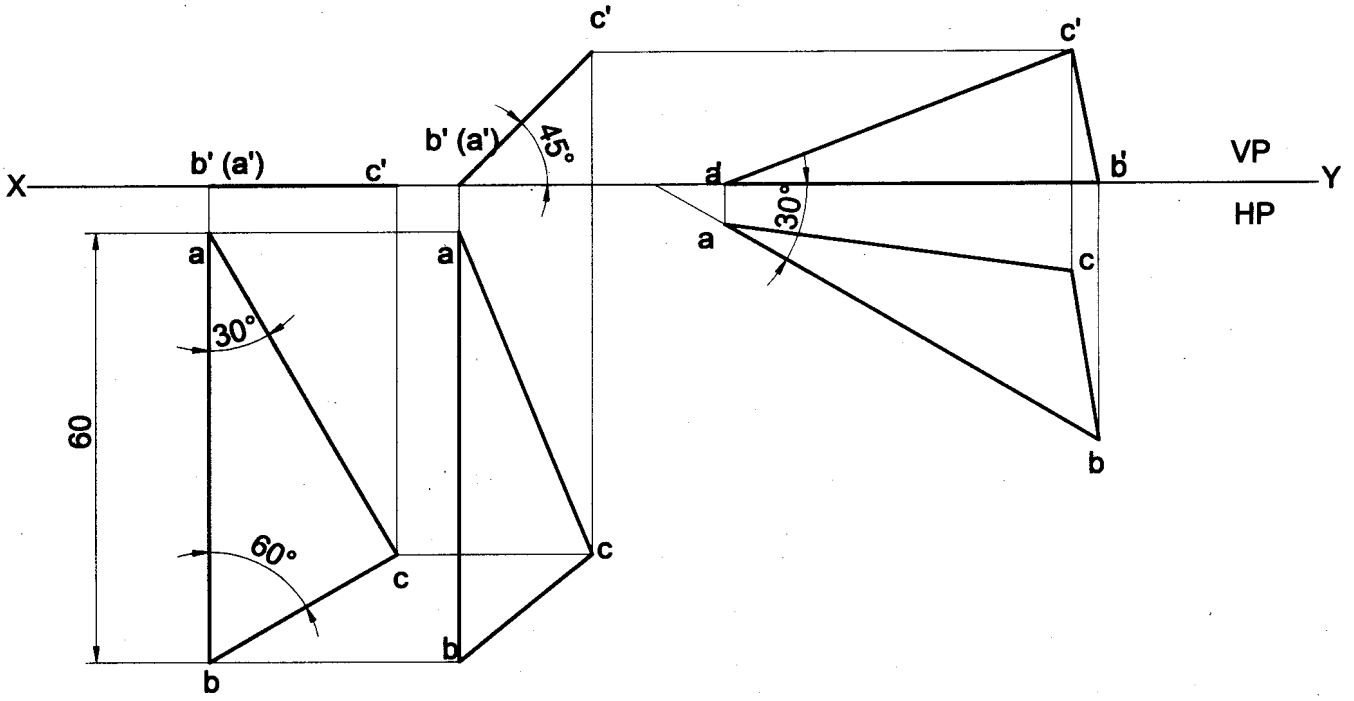
Problem 5 A triangular plane lamina of sides 25mm is resting on HP with one of its corners touching it, such that the side opposite to the corner on which it rests is 15mm above HP and makes an angle of 30° with VP. Draw the top and front views in this position. Also determine the inclination of the lamina to the reference plane.

Solution



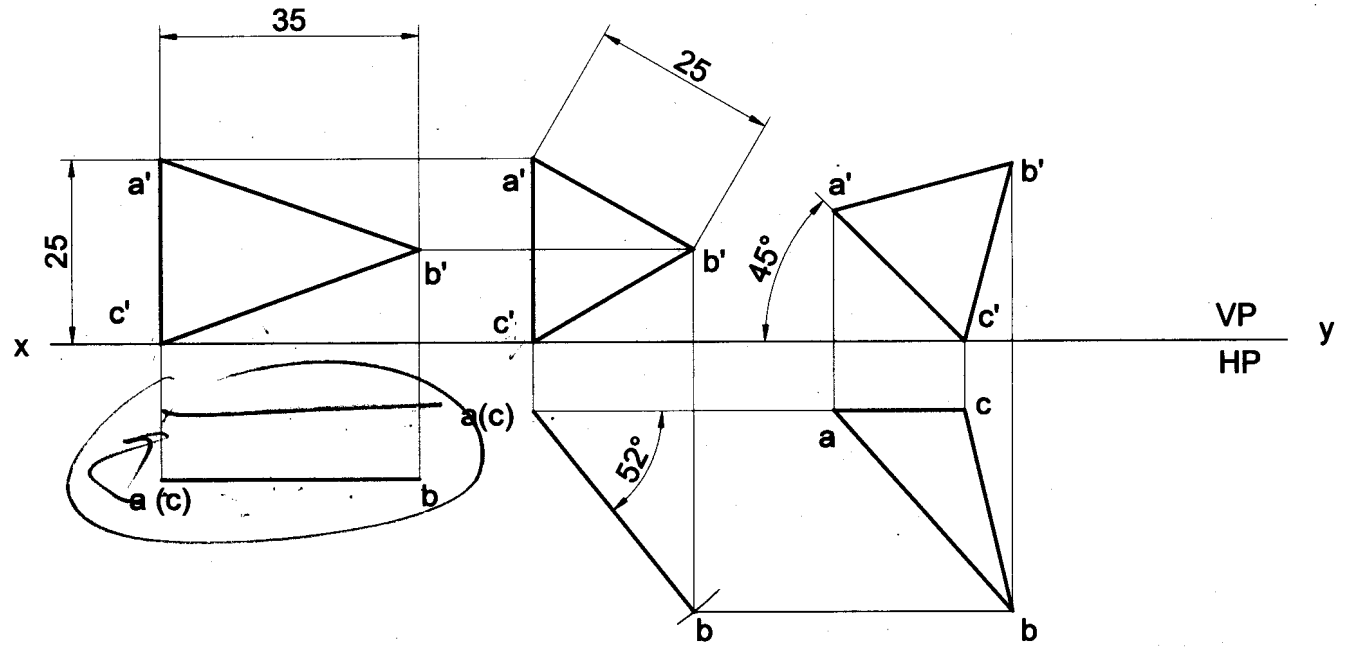
Problem 6 A 30°-60° setsquare of 60mm longest side is so kept such that the longest side is in HP, making an angle of 30° with VP. The set square itself is inclined at 45° to HP. Draw the projections of the setsquare.

Solution



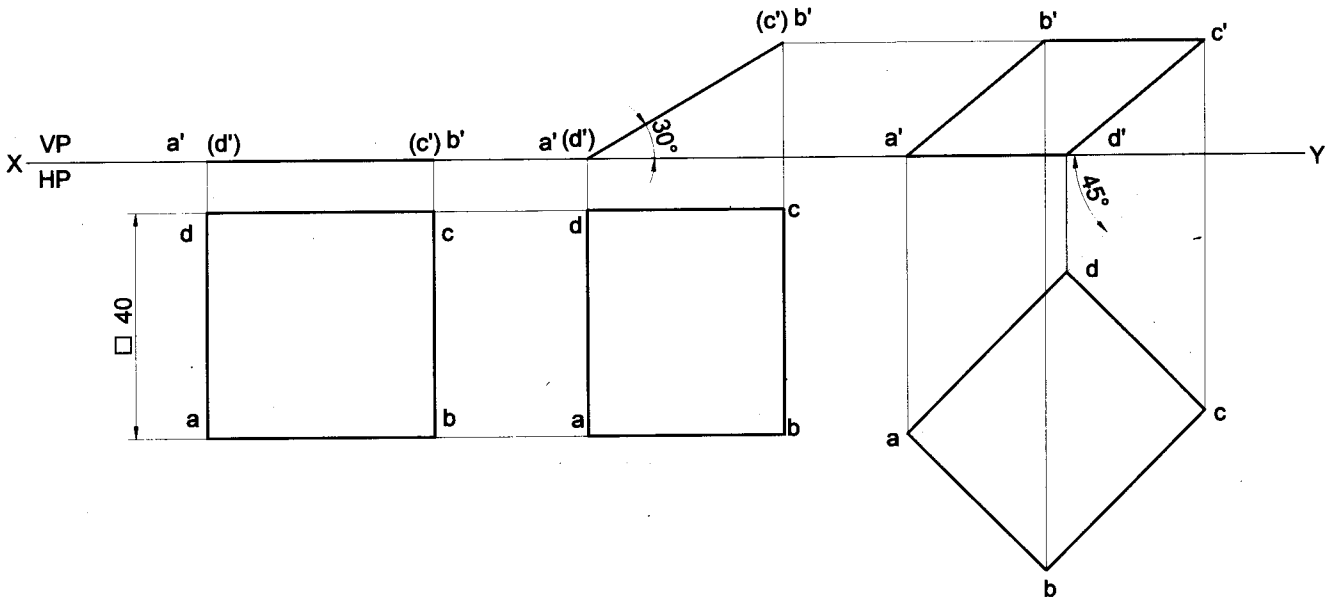
Problem 7 An isosceles triangular plate of negligible thickness has base 25mm long and altitude 35mm. It is so placed on HP such that in the front view it is seen as an equilateral triangle of 25mm sides with the side that is parallel to VP is inclined at 45° to HP. Draw its top and front views. Also determine the inclination of the plate with the reference plane.

Solution



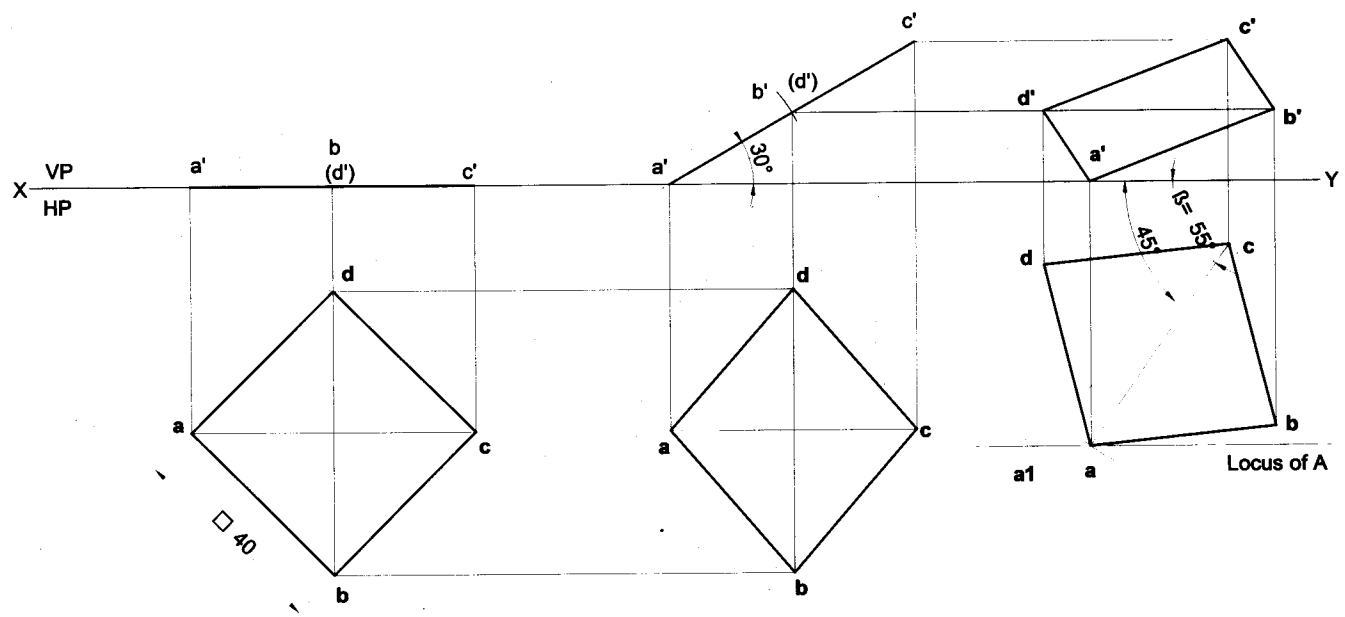
Problem 8 A square lamina of 40mm side rests on one of its sides on HP. The lamina makes 30° to HP and the side on which it rests makes 45° to VP. Draw its projections.

Solution



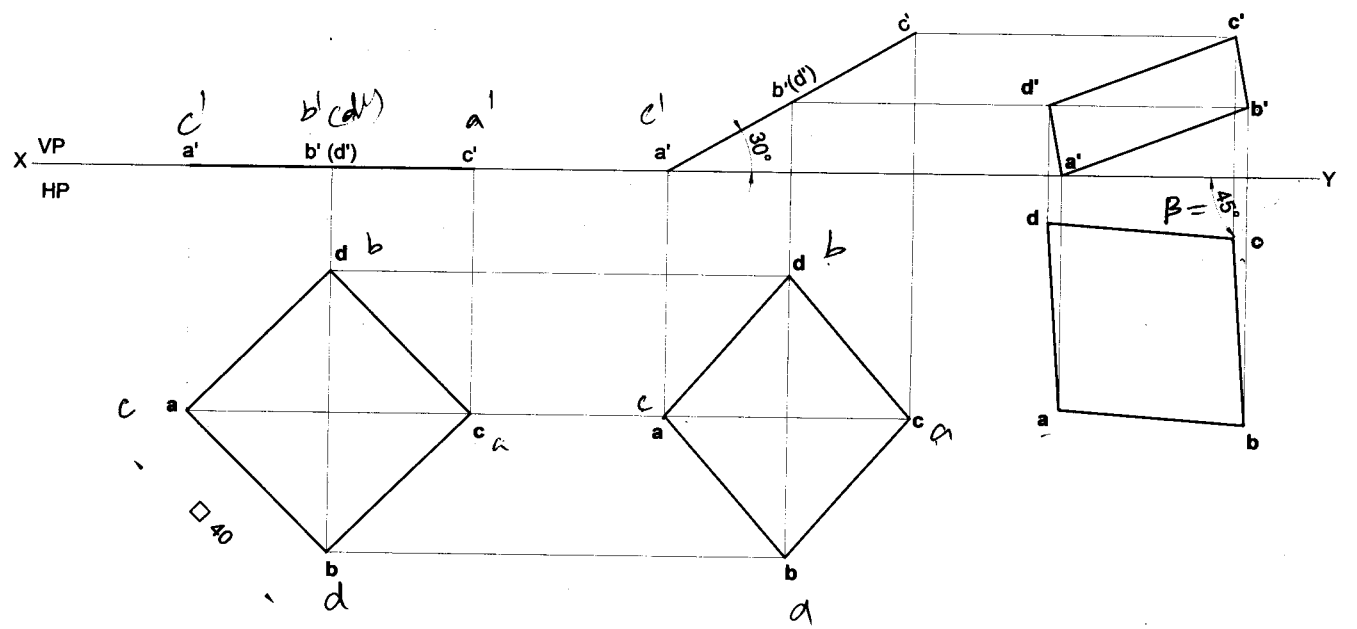
Problem 9 A square plate of 30mm sides rests on HP such that one of the diagonals is inclined at 30°to HP and 45° to VP. Draw its projections.

Solution



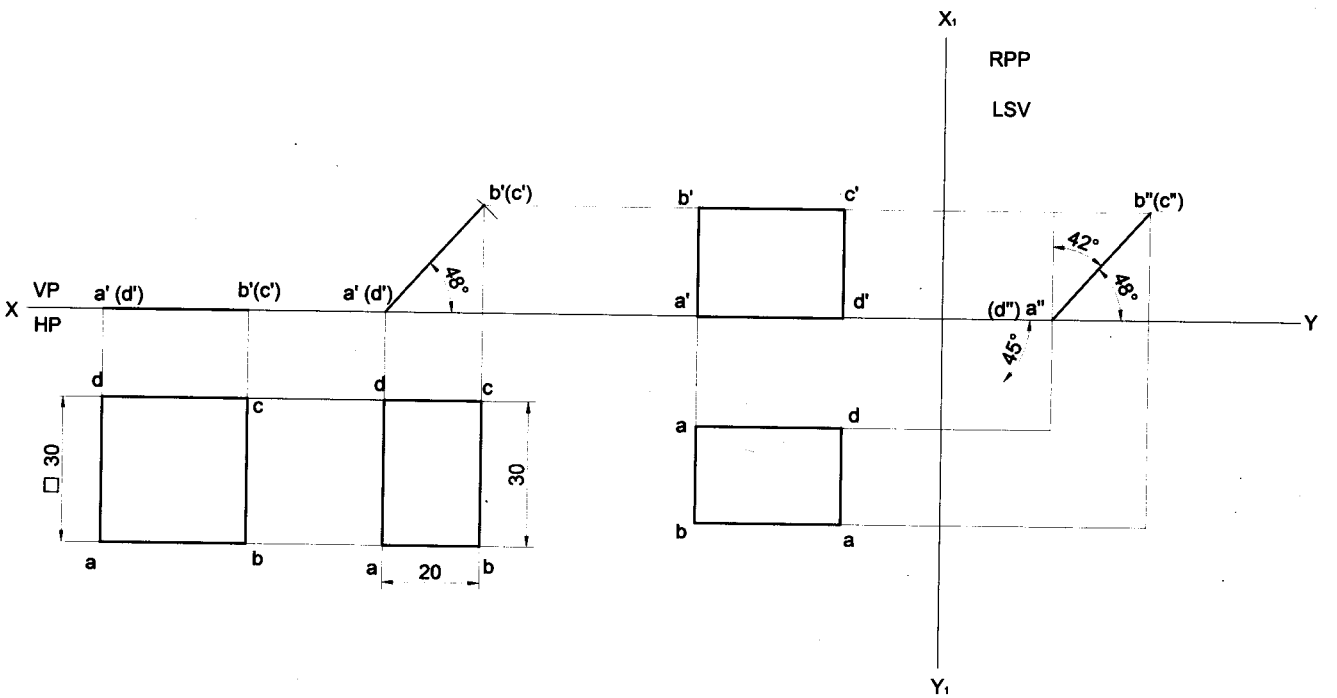
Problem 10 A square lamia ABCD of 40mm side rests on corner C such that the diagonal AC appears to be at 45°to VP. The two sides BC and CD containing the corner C make equal inclinations with HP. The surface of the lamina makes 30° with HP. Draw its top and front views.

Solution



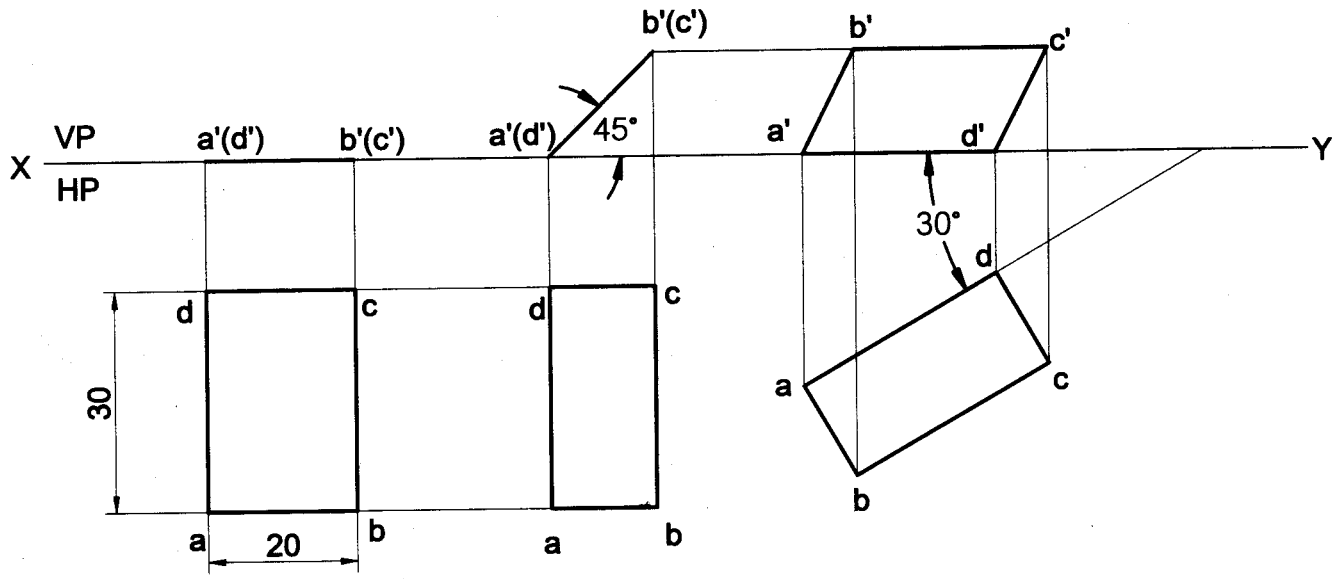
Problem 11 The top view of a square lamia of side 30mm is a rectangle of sides 30mm x 20mm with the longer side of the rectangle being parallel to both HP and VP. Draw the top and front views of the square lamina. What is the inclination of the surface of the lamina with HP and VP?

Solution



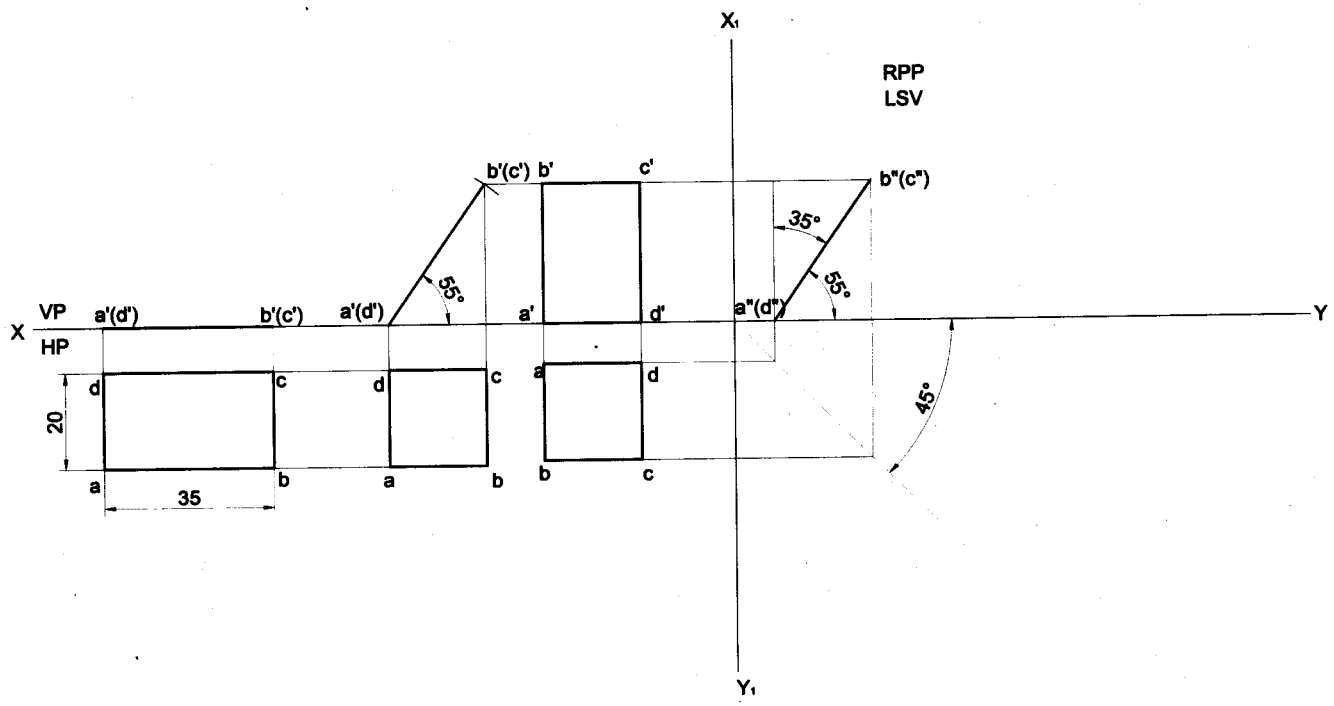
Problem 12 A rectangular lamina of sides 20mm x 30mm rests on HP on one of its longer edges. The lamina is tilted about the edge on which it rests till its plane surface is inclined t HP at 45°. The edge on which it rests is inclined at 30° to VP. Draw the projections of the lamina.

Solution



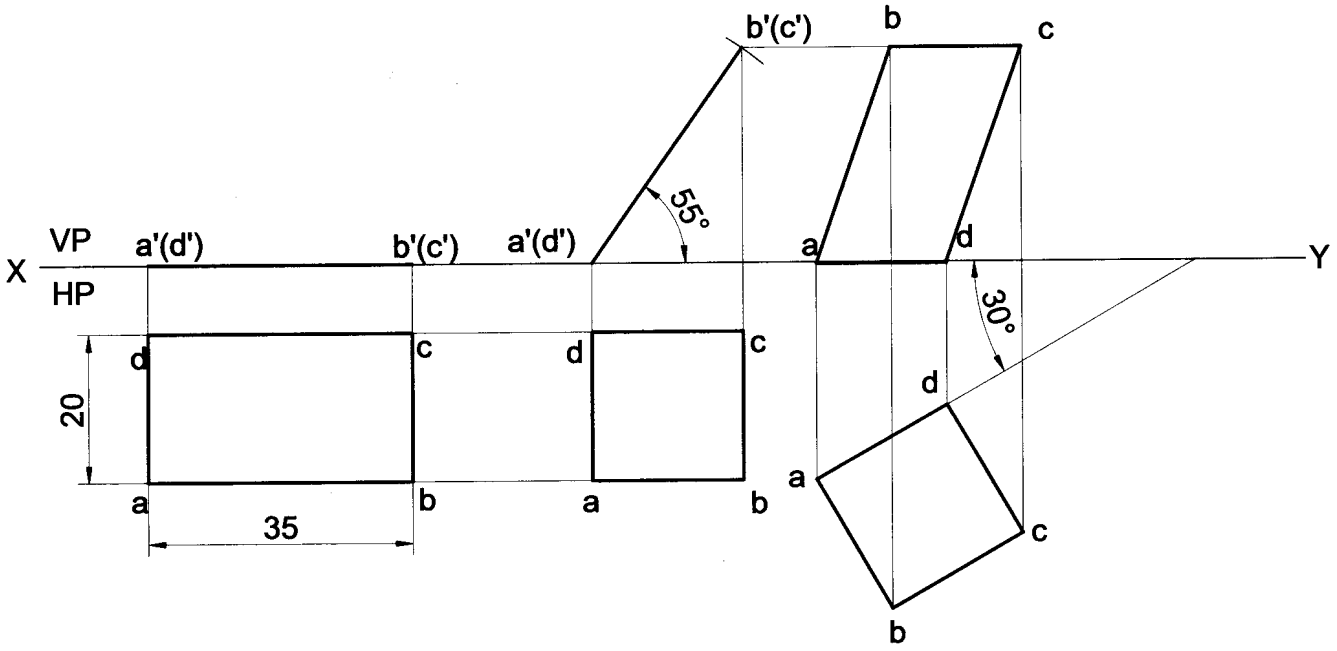
Problem 13 A rectangular lamina of 35mm x 20mm rests on HP on one of its shorter edges. The lamina is rotated about the edge on which it rests till it appears as a square in the top view. The edge on which the lamina rests being parallel to both HP and VP. Draw its projections and find its inclinations to HP and VP.

Solution



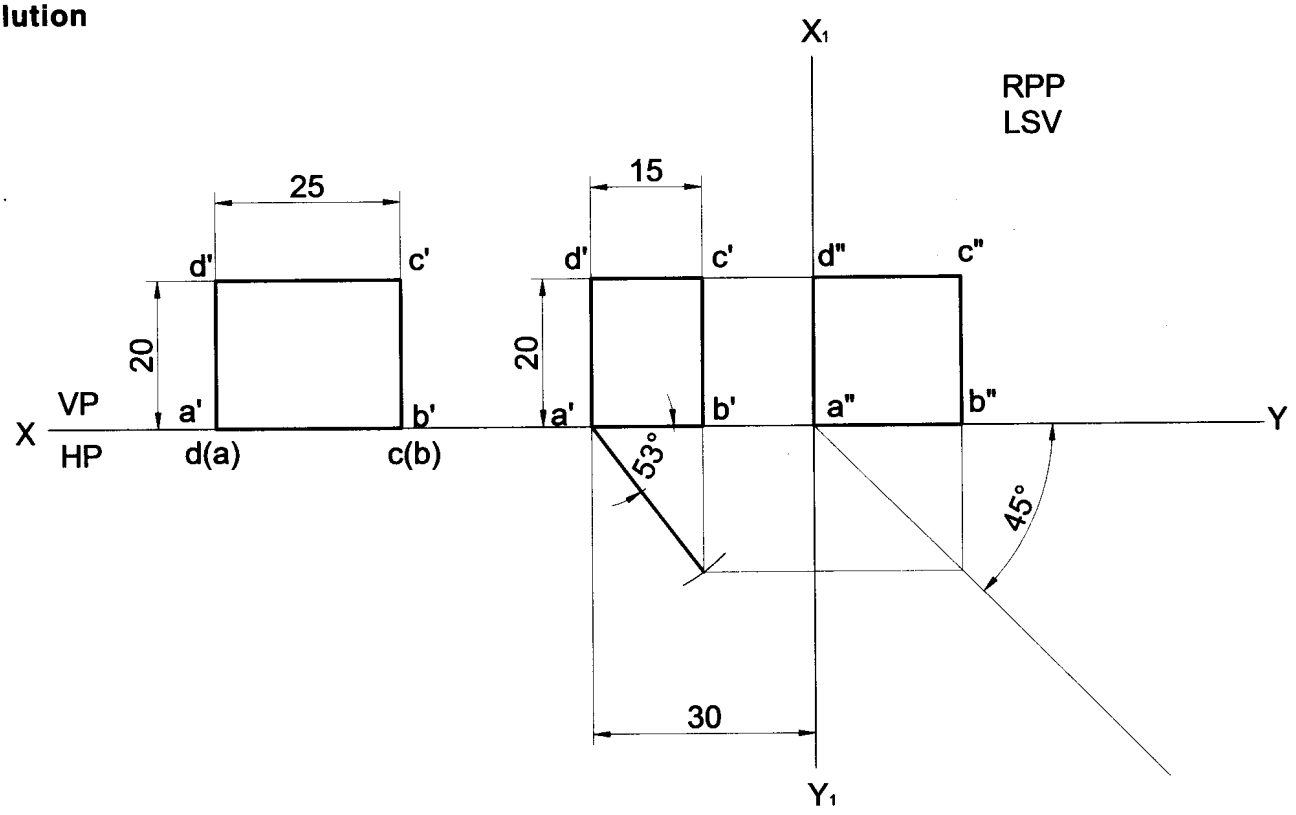
Problem 14 A rectangular lamina of 35mm x 20mm rests on HP on one of its shorter edges. The lamina is rotated about the edge on which it rests till it appears as a square in the top view. The edge on which the lamina rests is inclined 30° to VP. Draw its projections and find its inclination to HP.

Solution



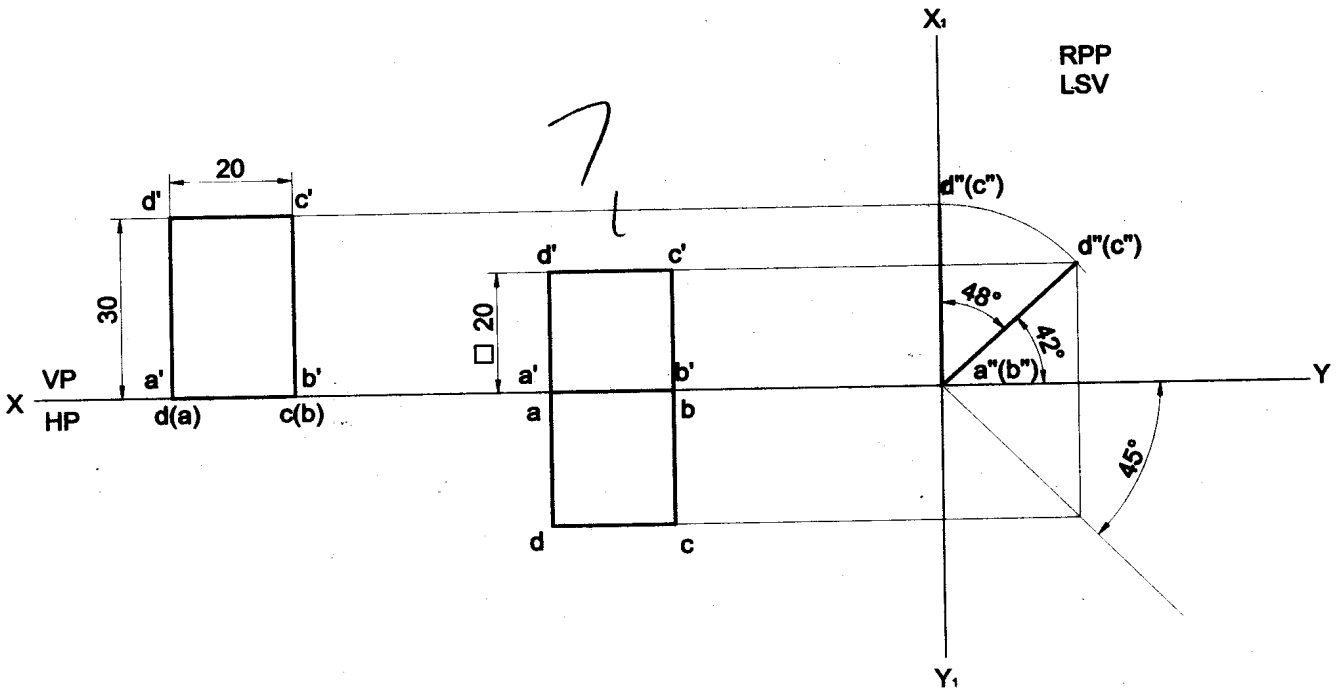
Problem 15 A rectangular lamina of sides 20mm x 25mm has an edge in HP and adjoining edge in VP, is tilted such that the front view appears as a rectangle of 20mm x 15mm. The edge, which is in VP, is 30mm from the right profile plane. (a) Draw the top view, front view and the left profile view in this position. (b) Find its inclinations with the corresponding principal planes.

Solution



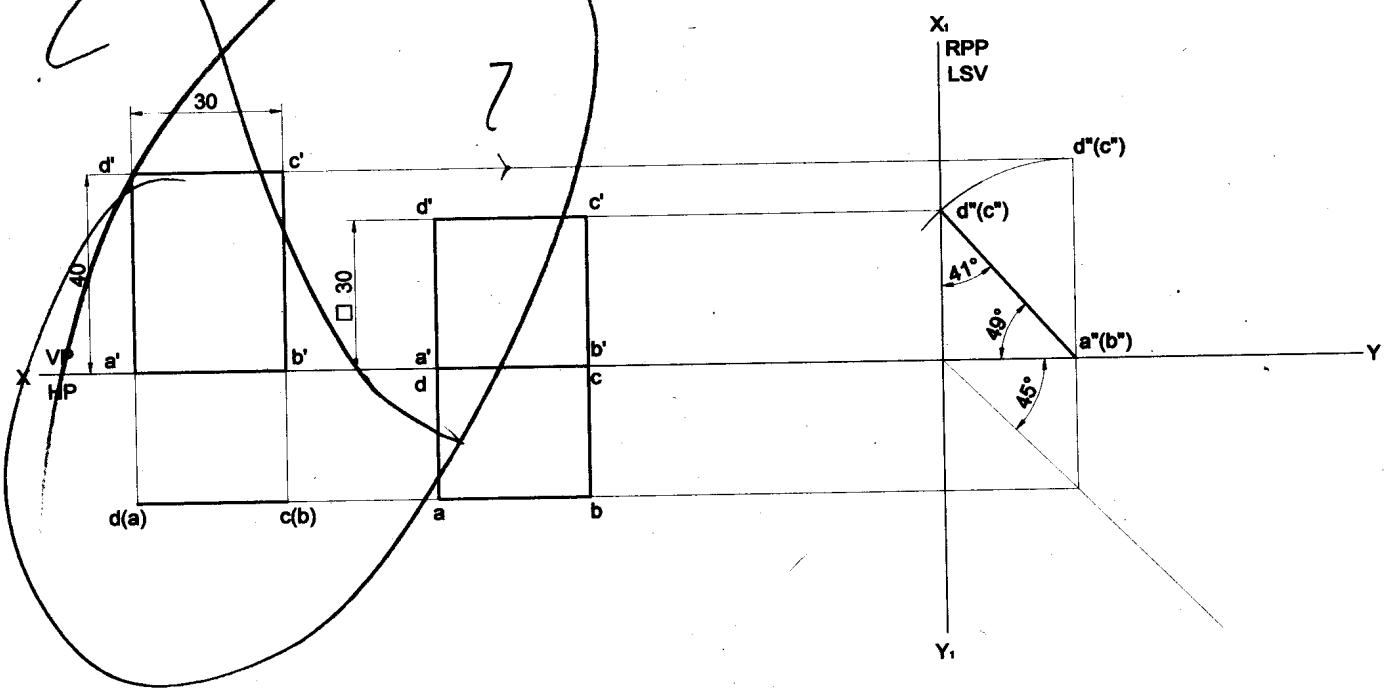
Problem 16 The front view of a rectangular lamina of sides 30mm x 20mm is square of 20mm sides. Draw the projections and determine the inclinations of the surface of the lamina with HP and VP.

Solution



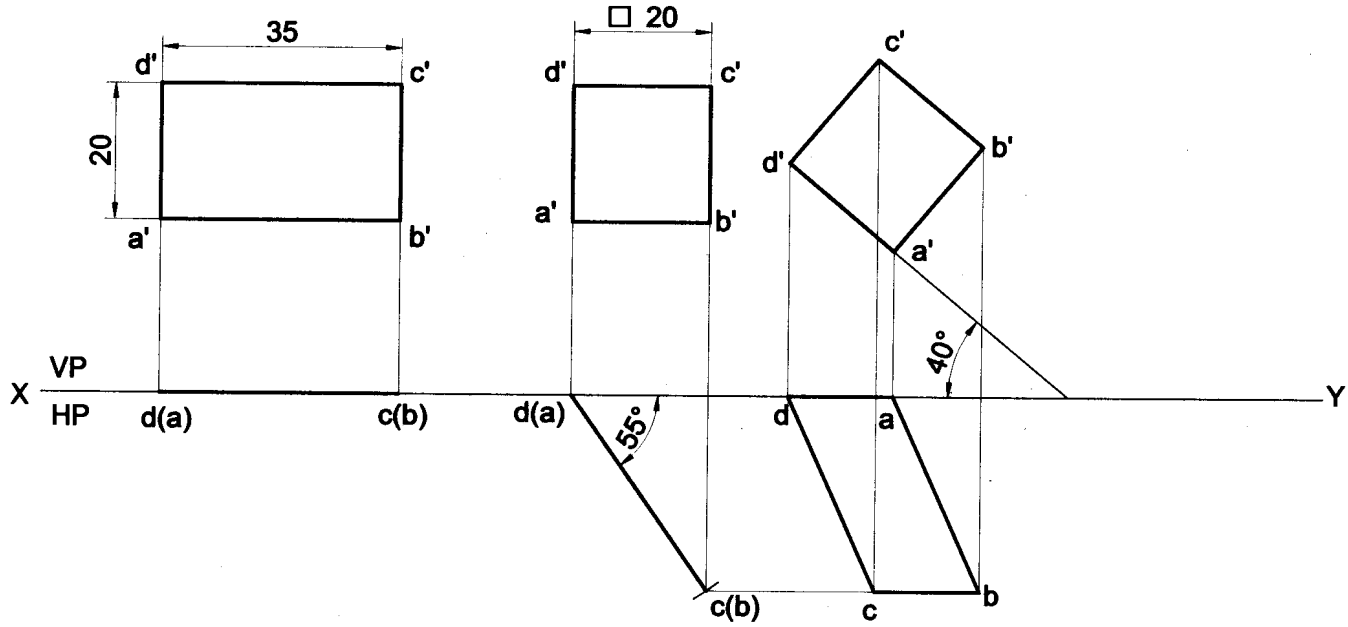
Problem 17 A mirror 30mm x 40mm is inclined to the wall such that its front view is a square of 30mm side. The longer sides of the mirror appear perpendicular to both HP and VP. Find the inclination of the mirror with the wall.

Solution



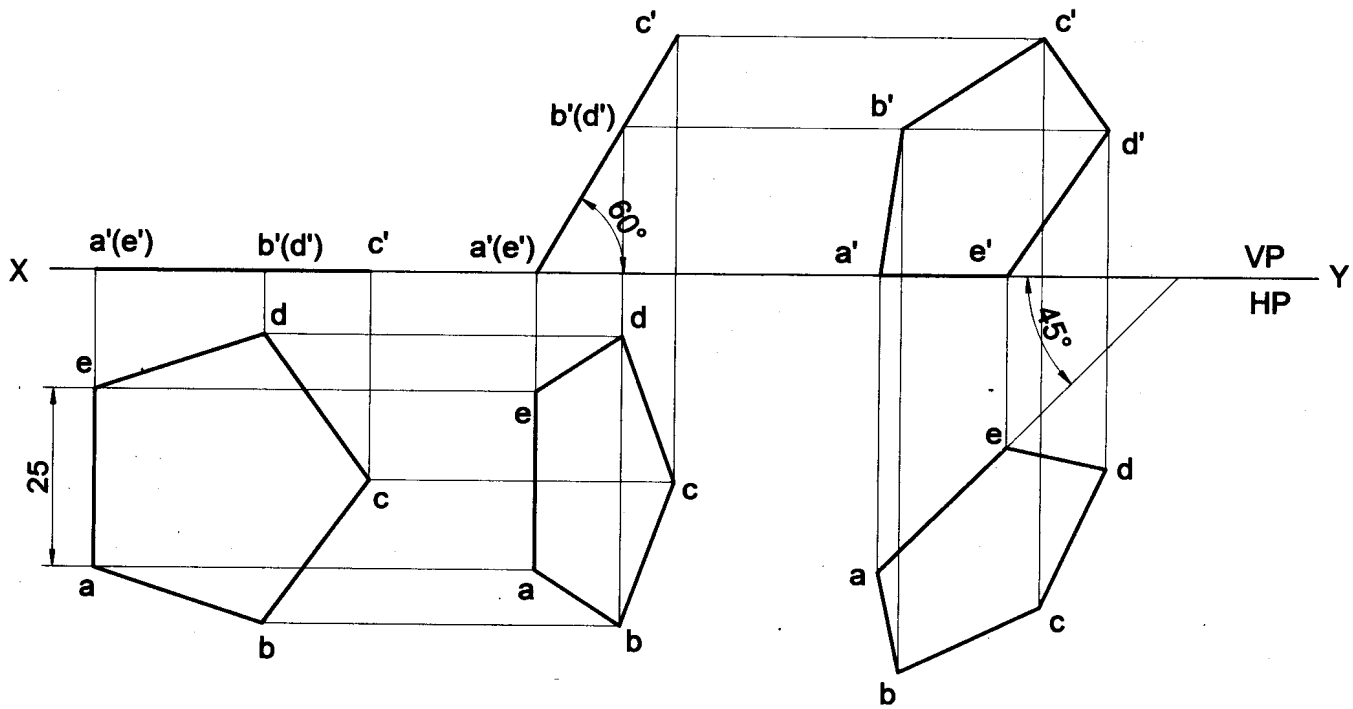
Problem 18 A rectangular plate of negligible thickness of size 35x20mm has one of its shorter edges in VP with that edge inclined at 40° to HP. Draw the top view if its front view is a square of side 20mm.

Solution



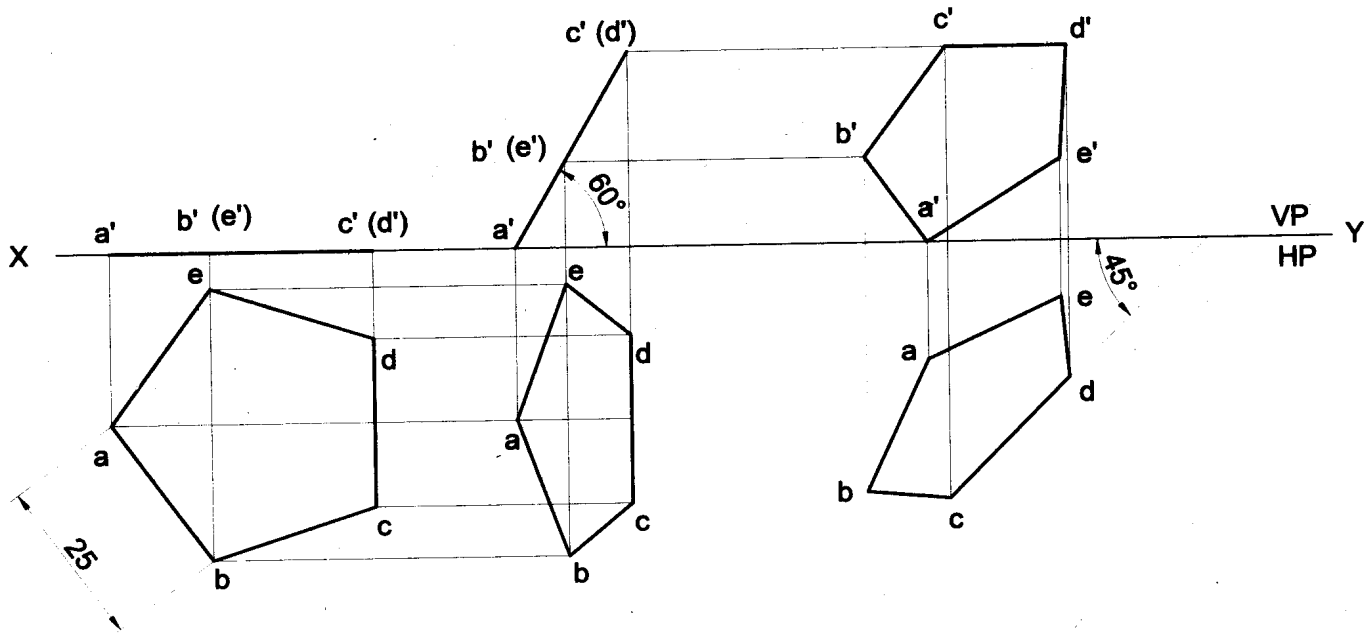
Problem 19 A pentagonal lamina of edges 25mm is resting on HP with one of its sides such that the surface makes an angle of 60° with HP. The edge on which it rests is inclined at 45° to VP. Draw its projections.

Solution



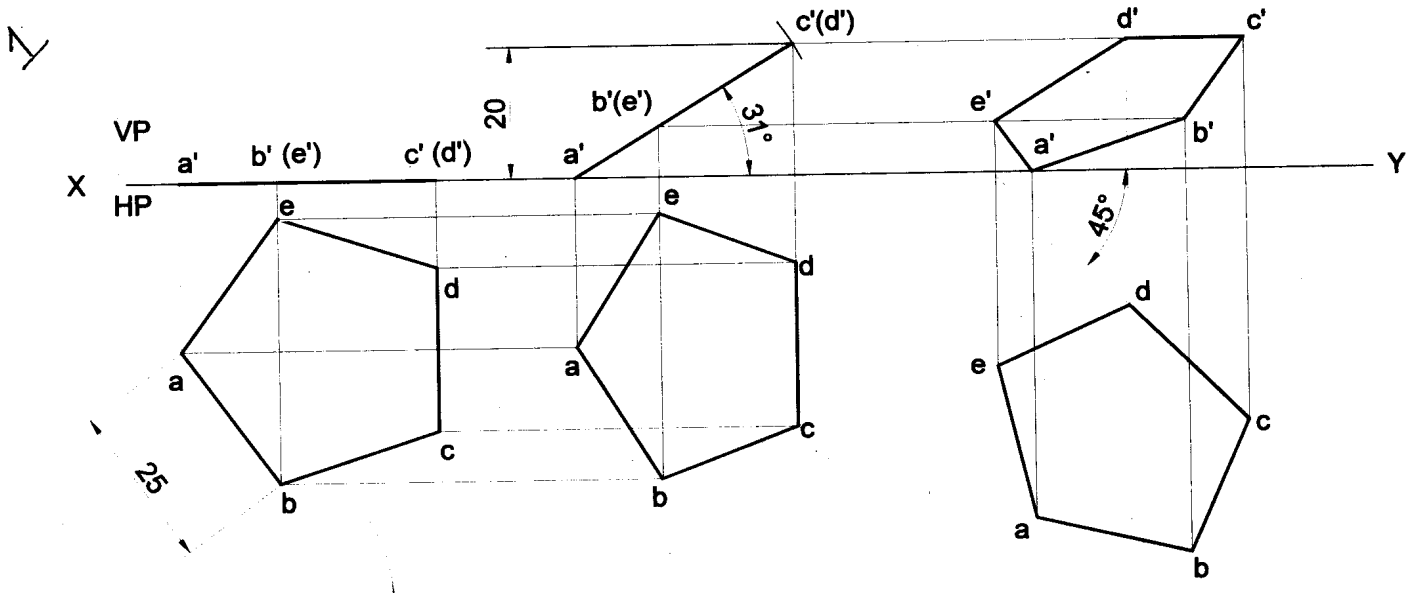
Problem 20 A pentagonal lamina of edges 25mm is resting on HP with one of its corners such that the plane surface makes an angle of 60° with HP. The two of the edges containing the corner on which the lamia rests make equal inclinations with HP. When the edge opposite to this corner make an angle of 45° with VP and nearer to the observer, draw the top and front views of the plane lamina in this position.

Solution



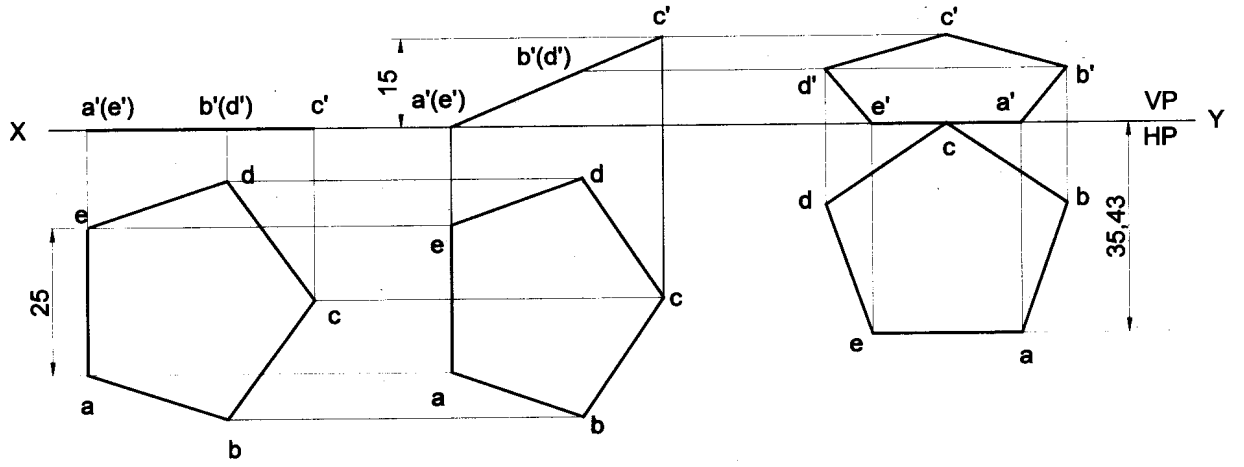
Problem 21 A pentagonal lamina of edges 25mm is resting on HP with one of its corners such that the edge opposite to this corner is 20mm above HP & makes an angle of 45° with VP. Draw the top and front views of the plane lamina in this position. Determine the inclination of the lamina with HP.

Solution



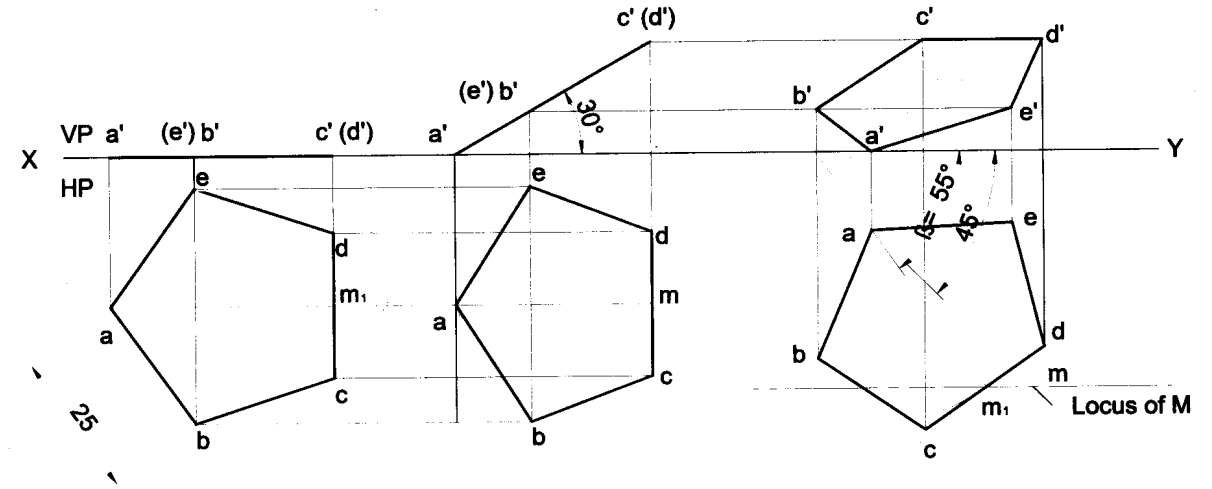
Problem 22 A pentagonal lamina of sides 25mm is resting on one of its edges on HP with the corner opposite to that edge touching VP. This edge is parallel to VP and the corner, which touches VP, is at a height of 15mm above HP. Draw the projections of the lamina and determine the inclinations of the lamina with HP and VP and the distance at which the parallel edge lies from VP.

Solution



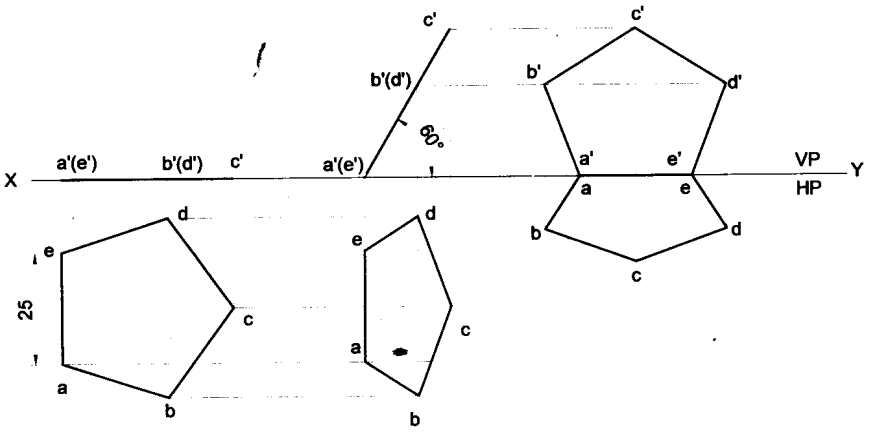
Problem 23 A pentagonal lamina having edges 25mm is placed on one of its corners on HP such that the perpendicular bisector of the edge passing through the corner on which the lamina rests is inclined at 30° to HP and 45° VP. Draw the top and front views of the lamina.

Solution



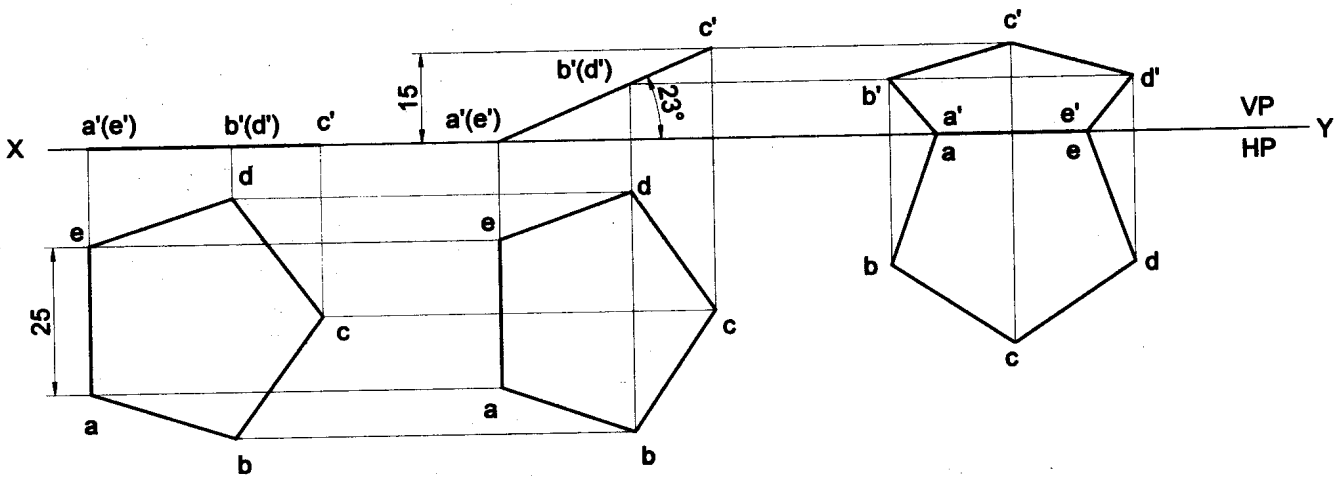
Problem 24 A pentagonal lamina of sides 25mm is having a side both on HP and VP. The corner opposite to the side on which it rests is 15mm above HP. Draw the top and front views of the lamina.

Solution



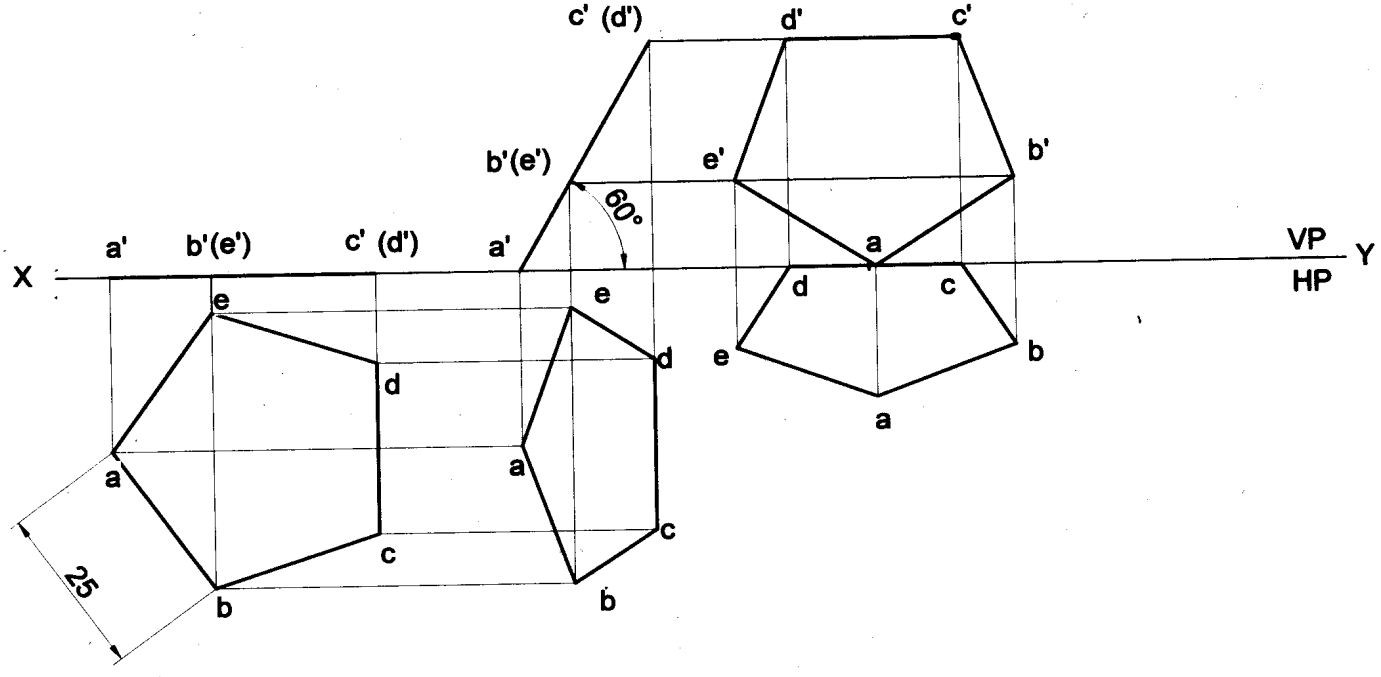
Problem 25 A pentagonal lamina of sides 25mm is having a side both on HP and VP. The surface of the lamina is inclined at an angle of 60° with HP. Draw the top and front views of the lamina.

Solution



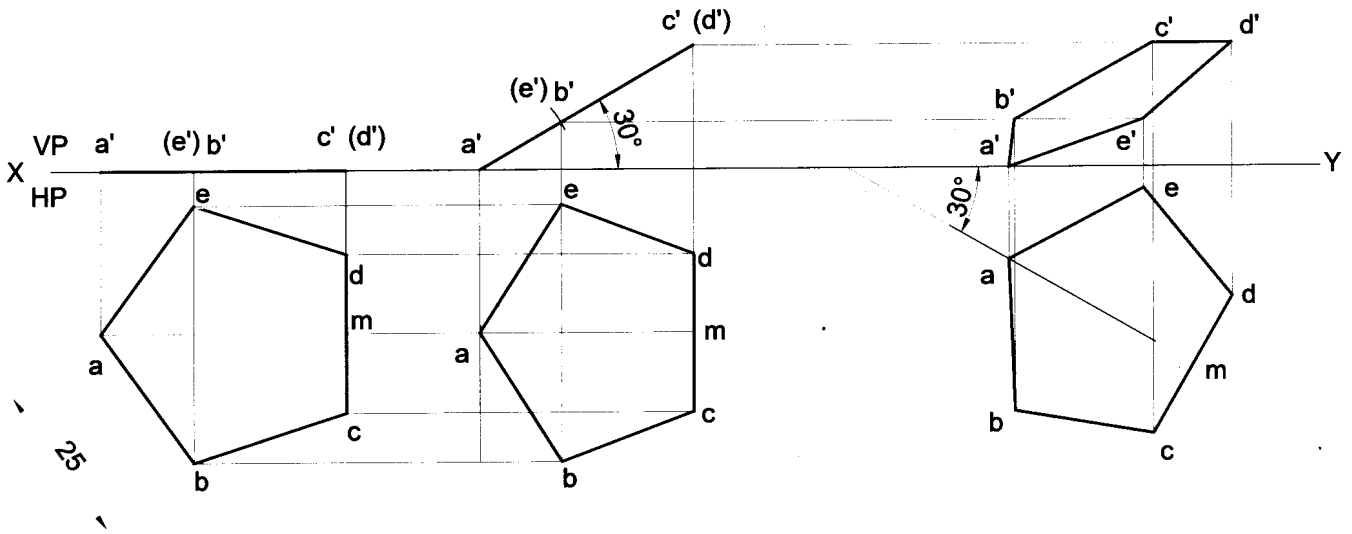
Problem 26 A regular pentagonal lamina of 25mm side is resting on one of its corners on HP while the side opposite to this corner touches VP. If the lamina makes an angle of 60° with HP and 30° with VP, draw the projections of the lamina.

Solution



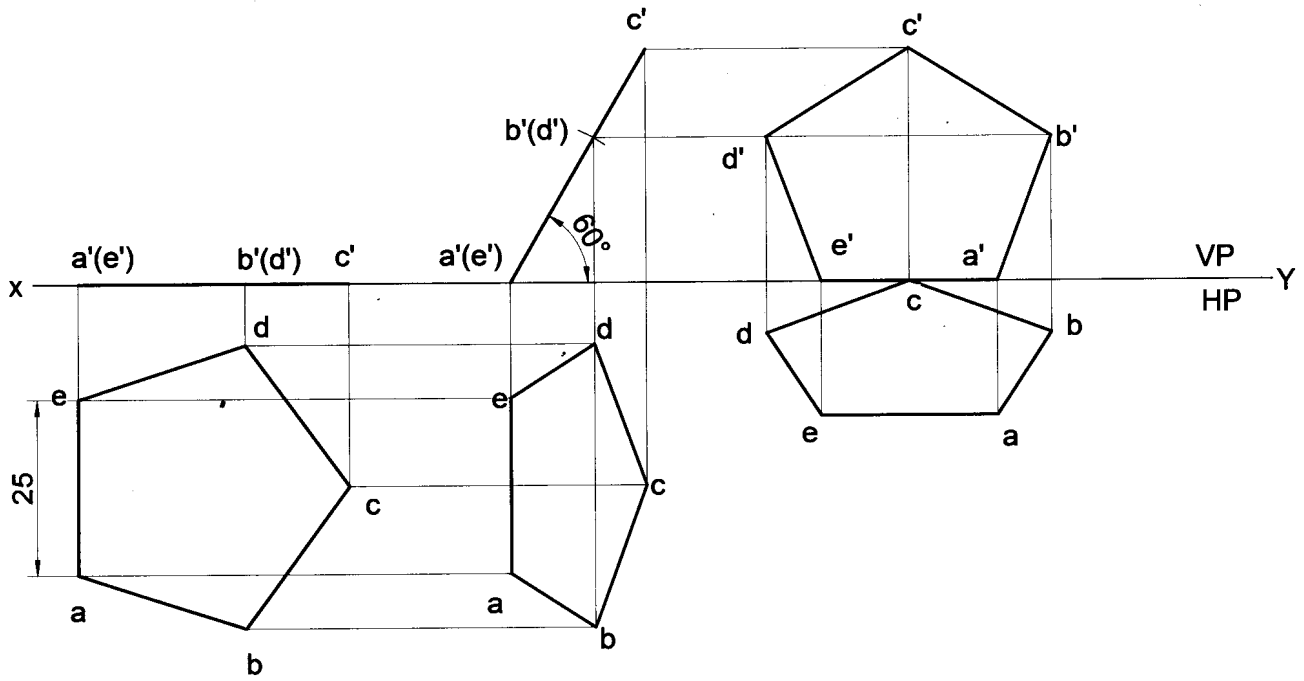
Problem 27 A pentagonal lamina having edges 25mm is placed on one of its corners on HP such that the surface makes an angle 30° with HP and perpendicular bisector of the edge passing through the corner on which the lamina rests appears to be inclined at 30° to VP. Draw the top and front views of the lamina.

Solution



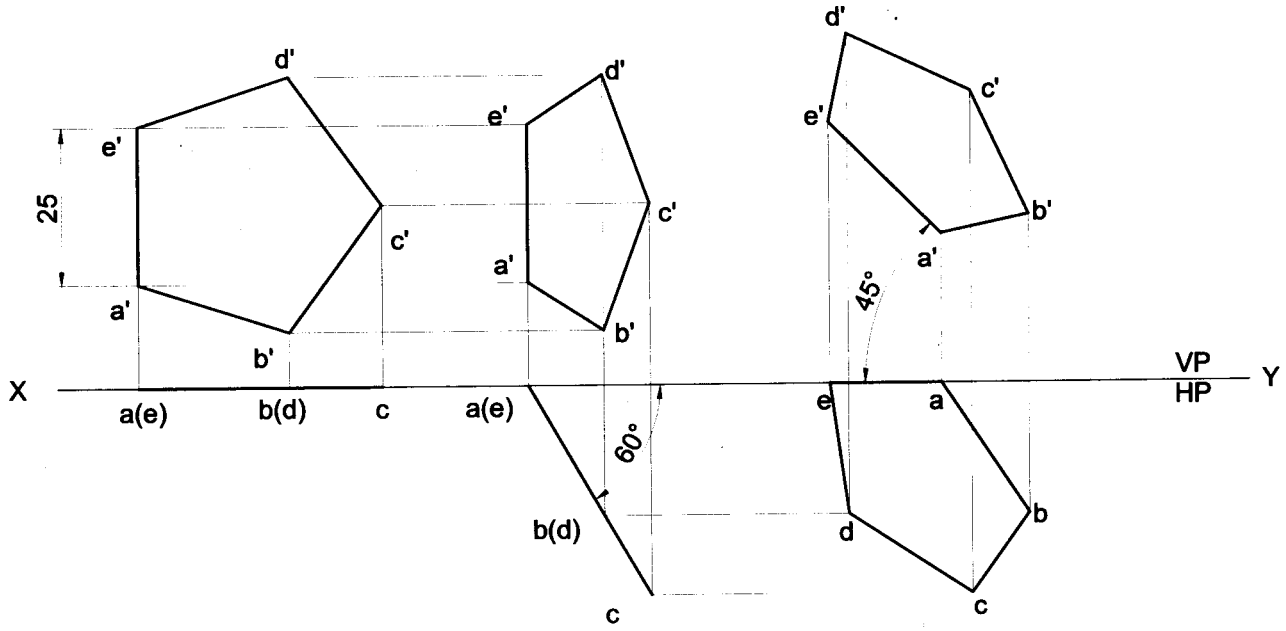
Problem 28 A regular pentagonal lamina of 25mm side is resting on one of its sides on HP while the corner opposite to this side touches VP. If the lamina makes an angle of 60° with HP and 30° with VP, draw the projections of the lamina.

Solution



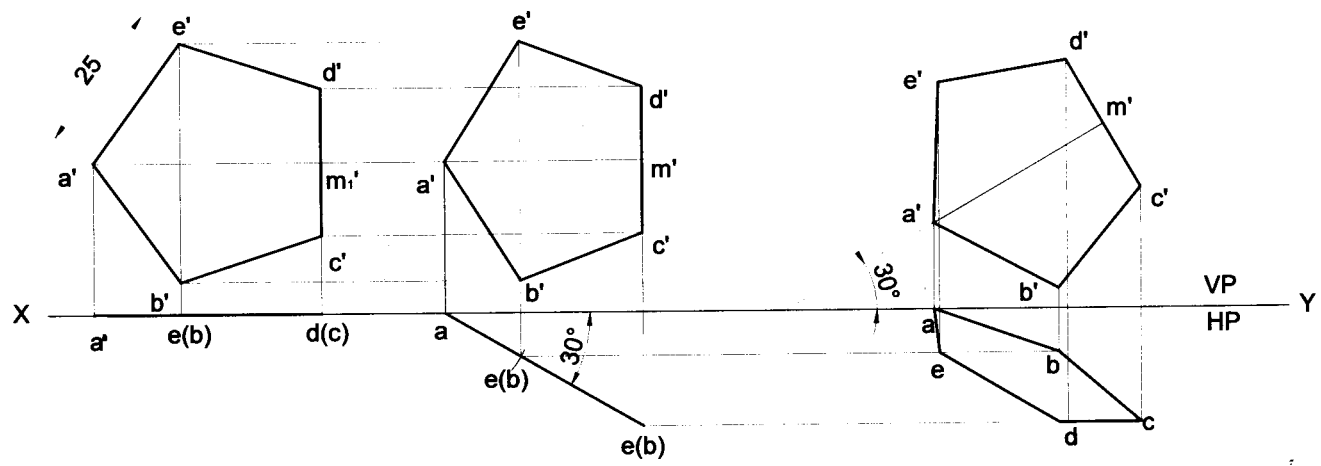
Problem 29 A pentagonal lamina of edges 25mm is resting on VP with one of its sides such that the surface makes an angle of 60° with VP. The edge on which it rests is inclined at 45° to HP. Draw its projections.

Solution



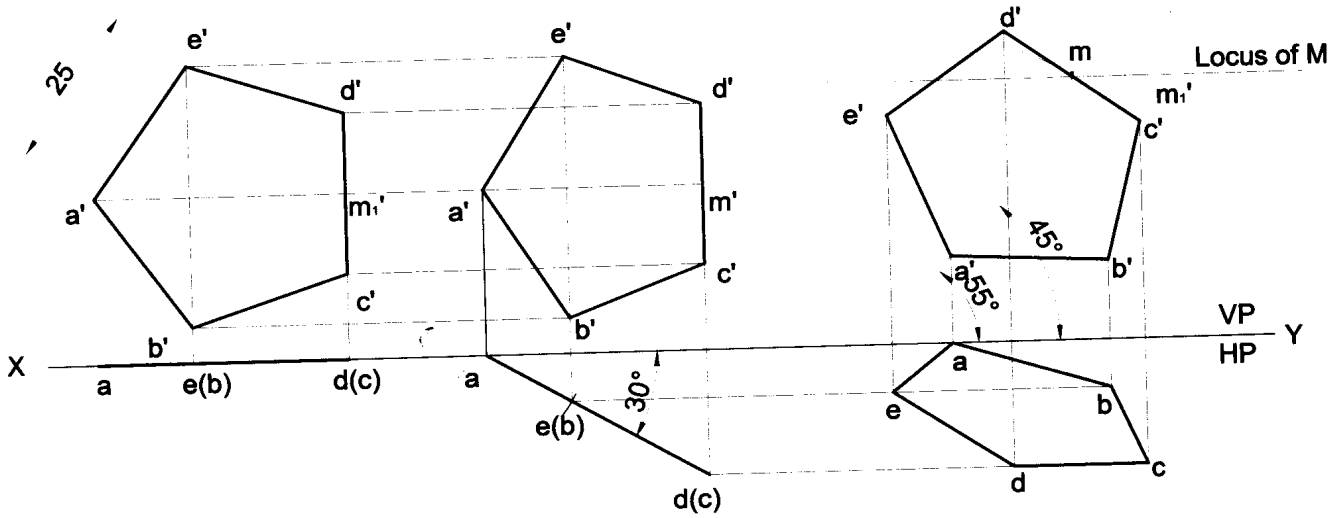
Problem 30 A pentagonal lamina having edges 25mm is placed on one of its corners on VP such that the surface makes an angle 30° with VP and perpendicular bisector of the edge passing through the corner on which the lamina rests appears to be inclined at 30° to HP. Draw the top and front views of the lamina.

Solution



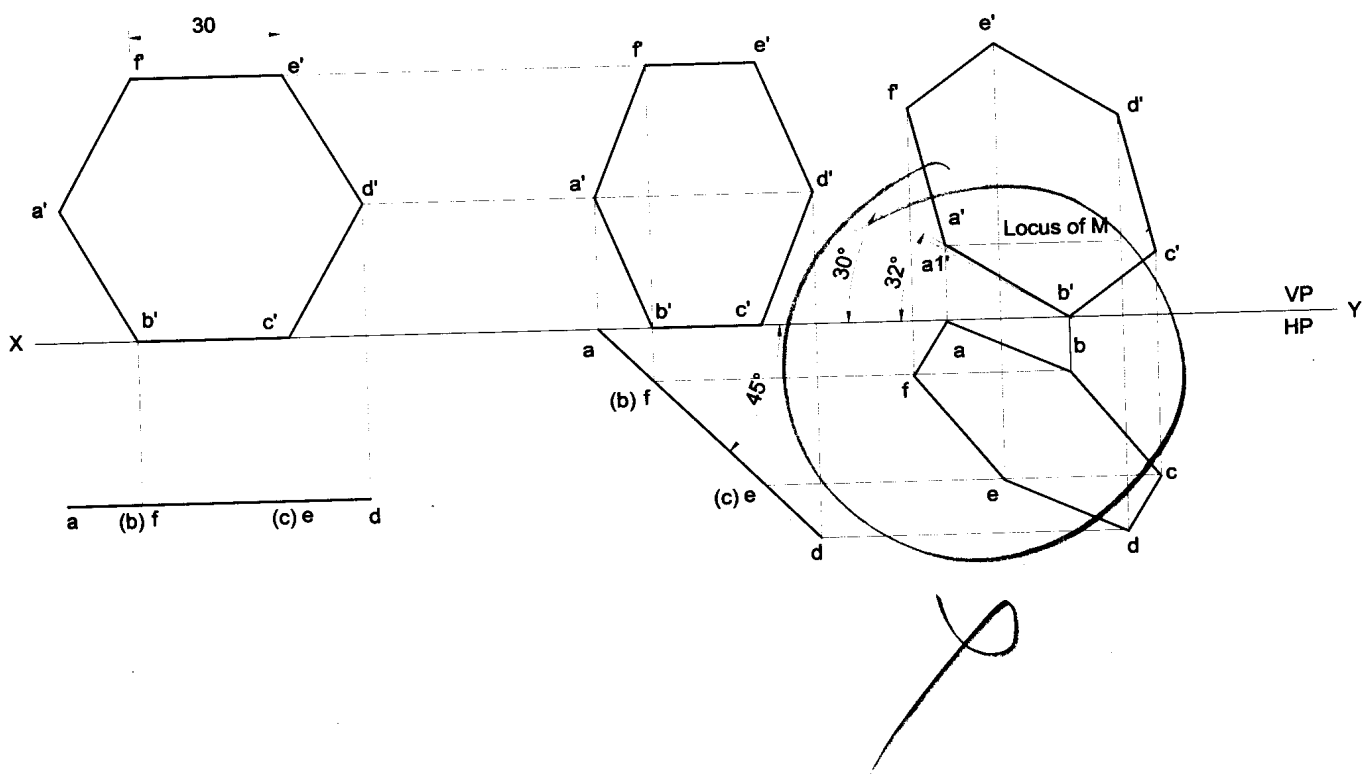
Problem 31 A pentagonal lamina having edges 25mm is placed on one of its corners on VP such that the surface makes an angle 30° with VP and perpendicular bisector of the edge passing through the corner on which the lamina rests is inclined at 45° to HP. Draw the top and front views of the lamina.

Solution



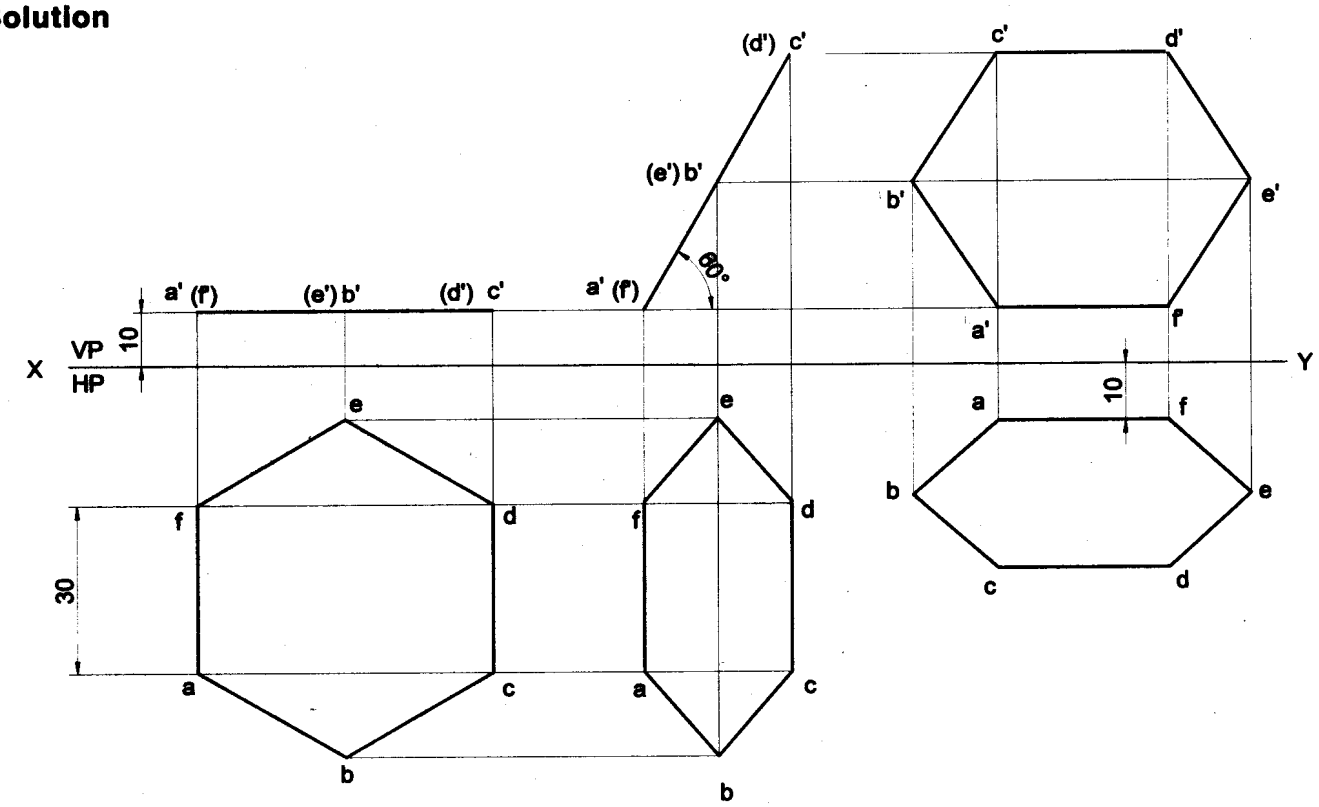
Problem 32 A hexagonal lamina of 30mm sides rests on HP with one of its corners touching VP and surface inclined at 45° to it. One of its edges is inclined to HP at 30°. Draw the front and top views of the lamina in its final position.

Solution



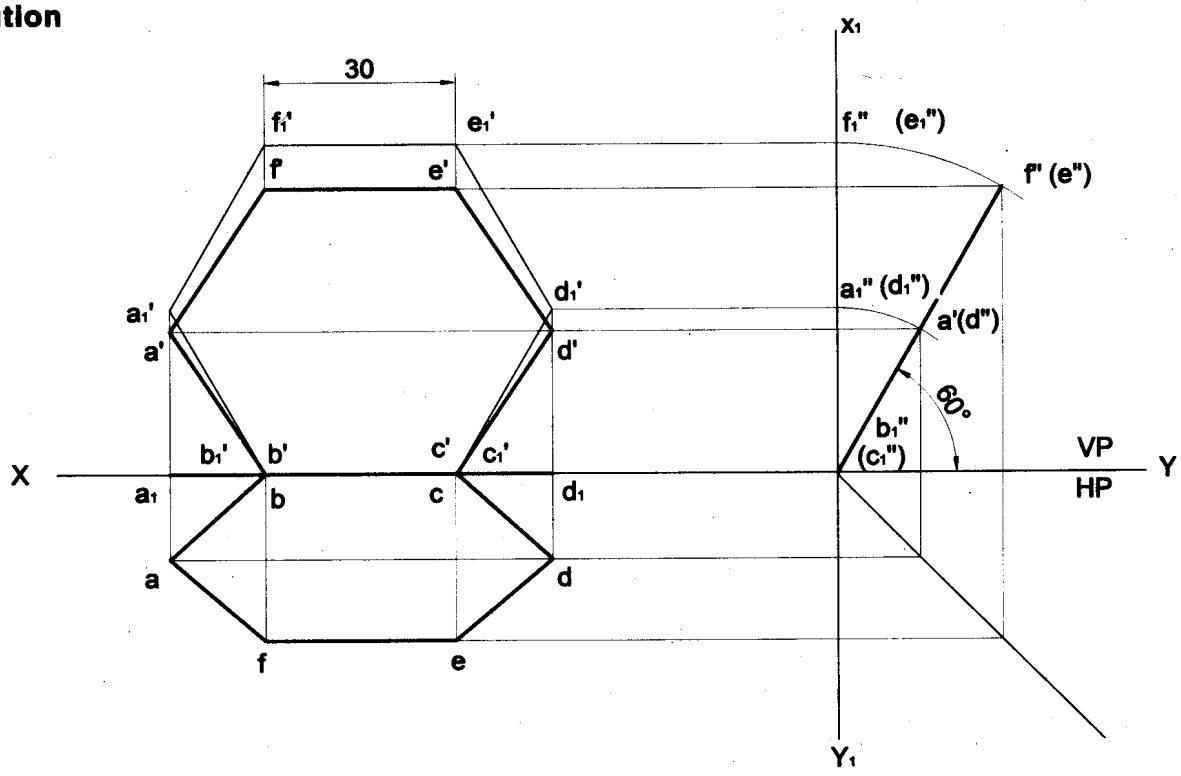
Problem 33 Draw the top and front views of a hexagonal lamina of 30mm sides having two of its edges parallel to both vertical and horizontal planes and one of its edges is 10mm from each of the planes of projection. The surface of the lamina is inclined at an angle of 60° to the HP.

Solution



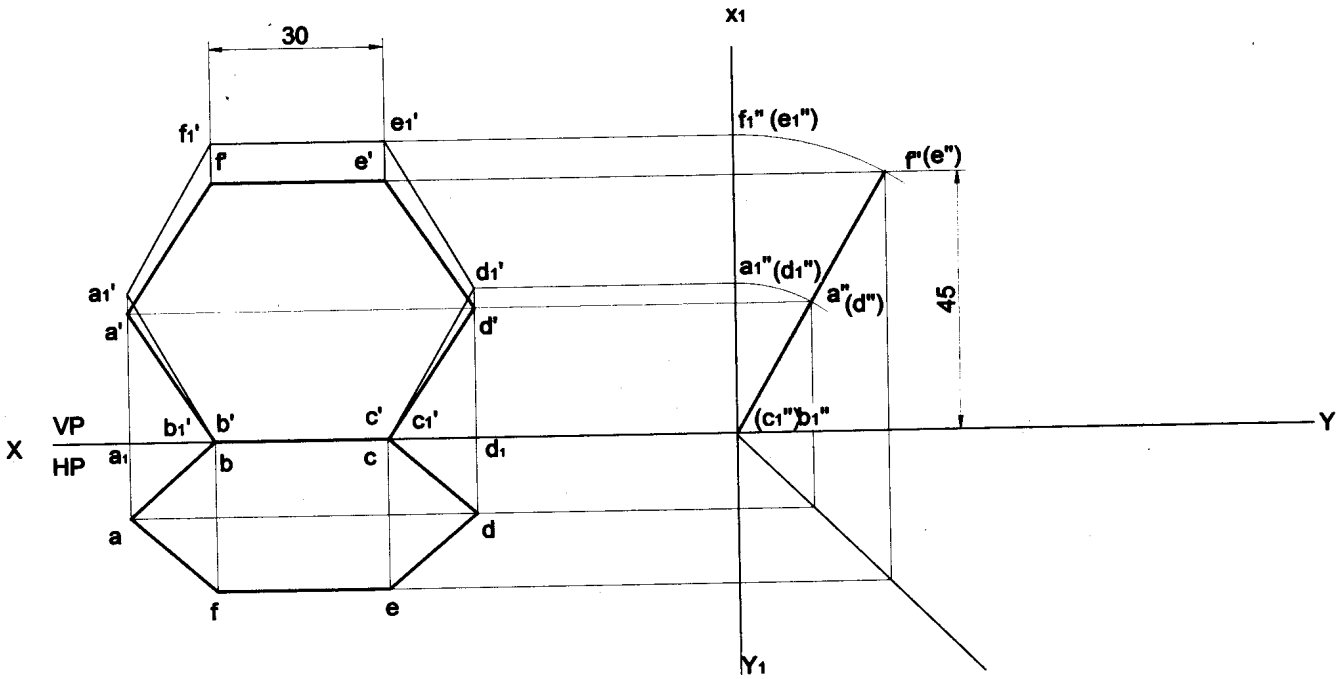
Problem 34 A regular hexagonal lamina of sides 30mm is lying in such a way that one of its sides touches both the reference planes. If the lamina makes 60° with HP, draw the projections of the lamina.

Solution



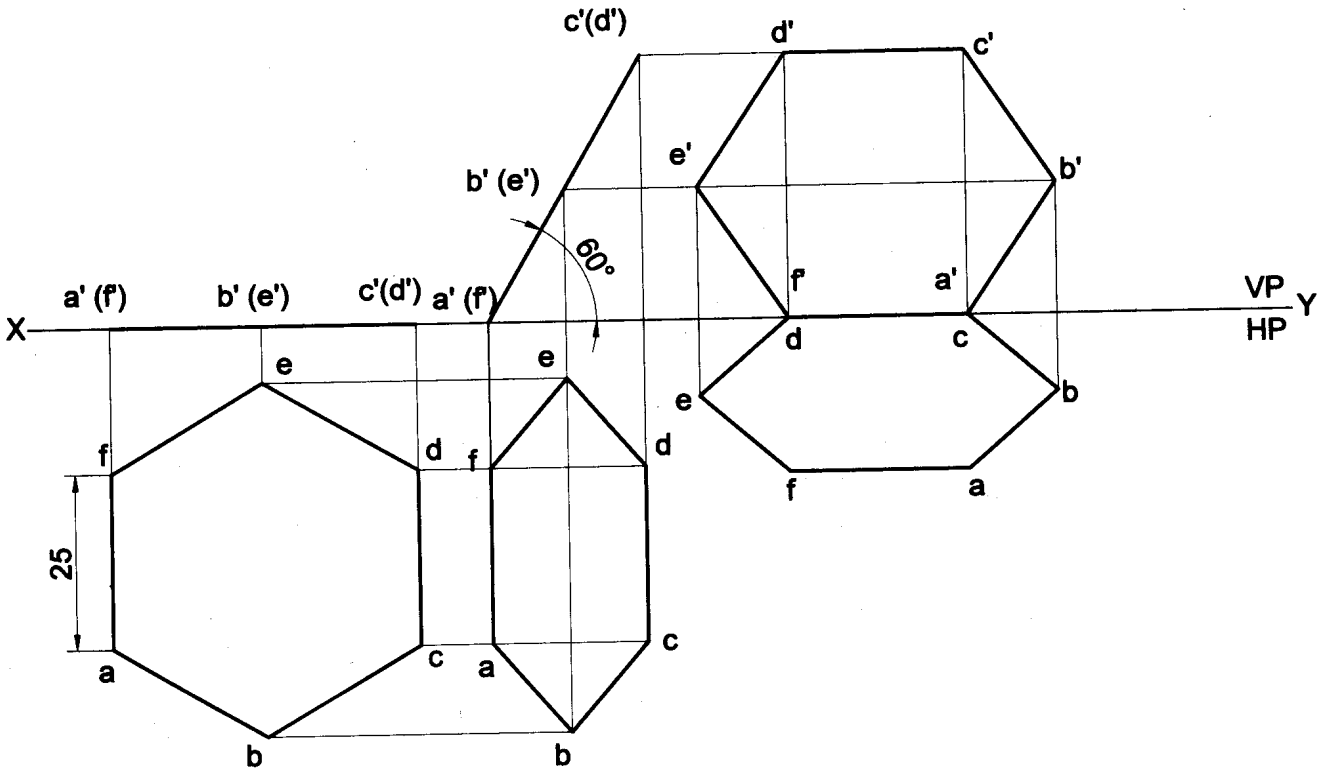
Problem 35 A regular hexagonal lamina of side 30mm is lying in such a way that one of its sides touches both the reference planes. If the side opposite to the side on which it rests is 45mm above HP, draw the projections of the lamina.

Solution



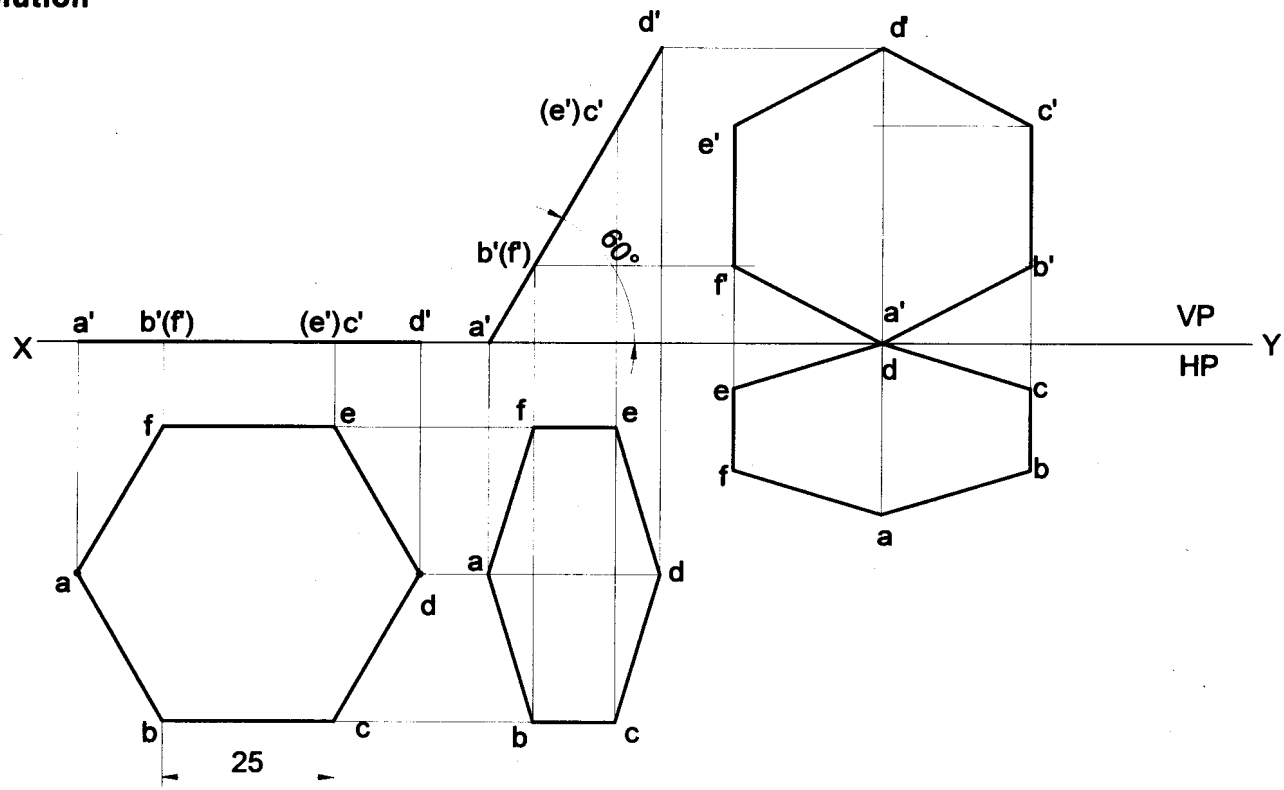
Problem 36 A regular hexagonal lamina of sides 25mm is lying in such a way that one of its sides on HP while the side opposite to the side on which it rests is on VP. If the lamina makes 60° to HP, Draw the projections of the lamina.

Solution



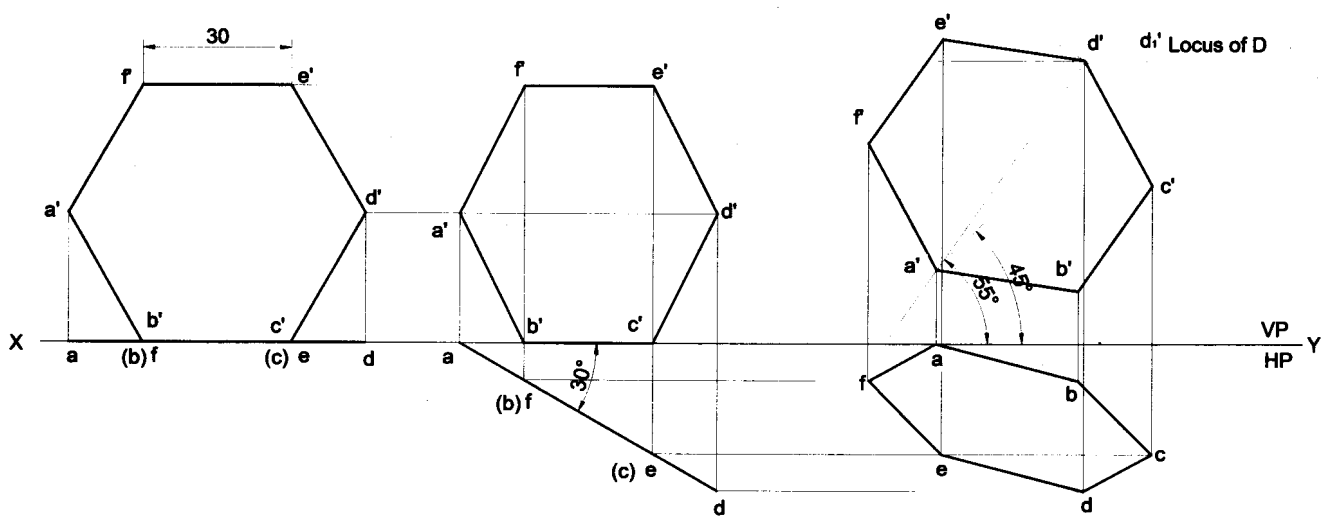
Problem 37 A regular hexagonal lamina of side 25mm is lying in such a way that one of its corners on HP while the corner opposite to the corner on which it rests is on VP. If the lamina makes 60° to HP, Draw the projections of the lamina.

Solution



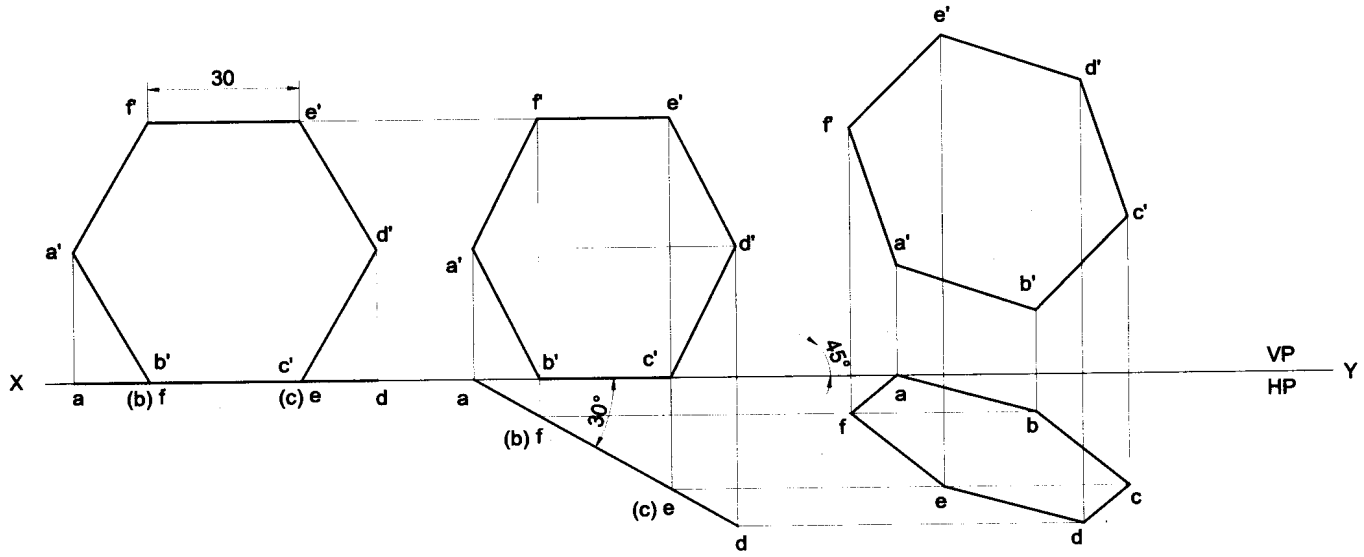
Problem 38 A hexagonal lamina of sides 30mm is resting on HP with one of its corners in VP and its surface inclined at an angle of 30° with VP. The diagonal passing through that corner which is in VP is inclined at 45° to HP. Draw the projections of the lamina.

Solution



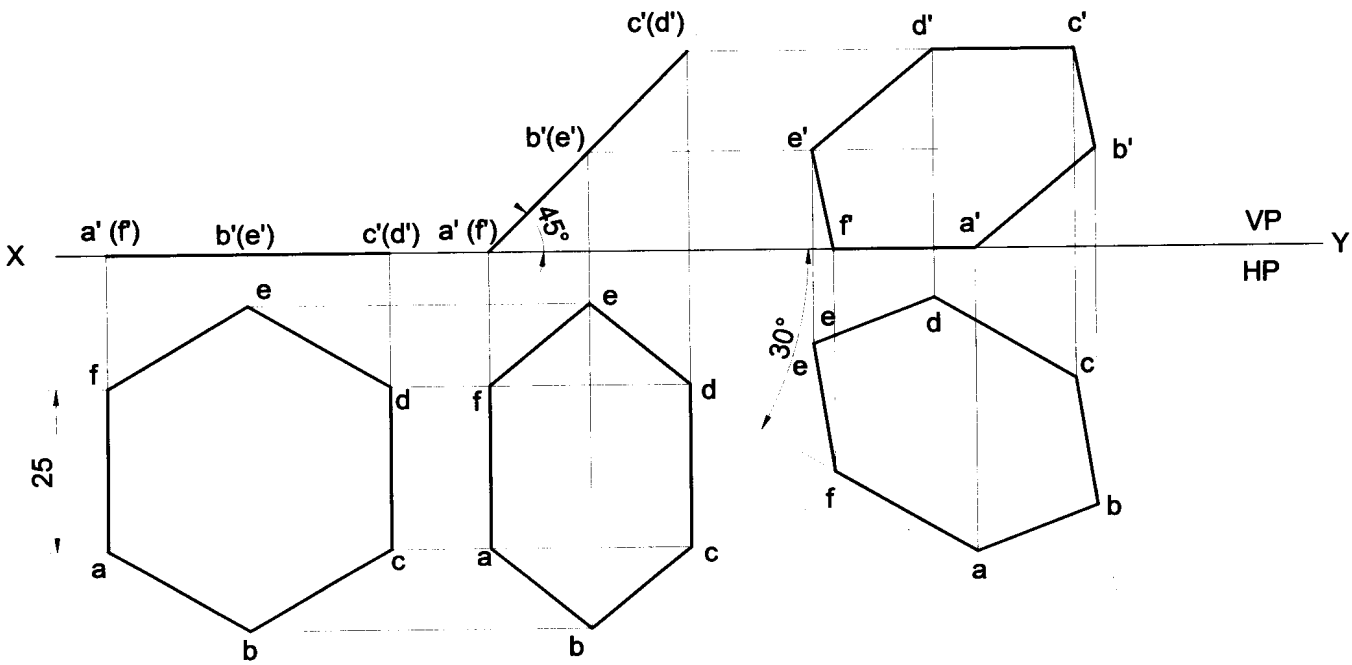
Problem 39 A hexagonal lamina of sides 30mm is resting on HP with one of its corners in VP and its surface inclined at an angle of 30° with VP. The diagonal passing through that corner which is in VP appears to be inclined at 40° to HP. Draw the projections of the lamina.

Solution



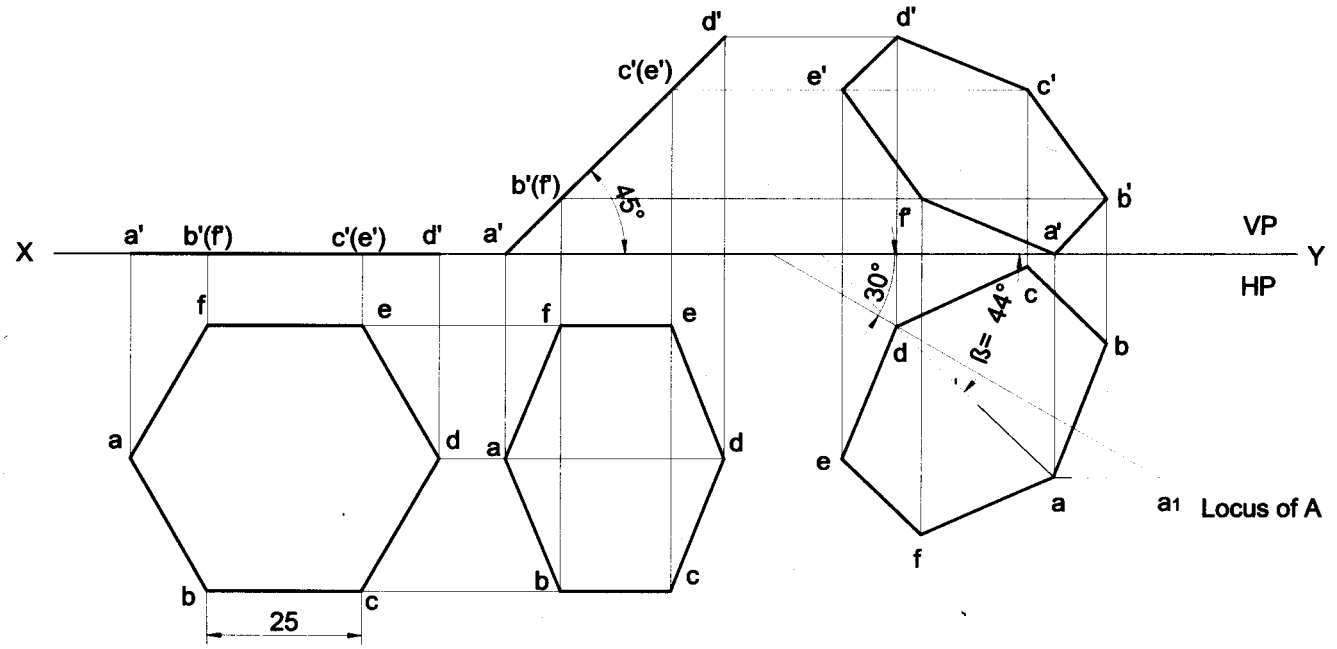
Problem 40 A hexagonal lamina of sides 25mm rests on one of its sides on HP. The lamina makes 45° to HP and the side on which it rests makes 30° to VP. Draw its projections.

Solution



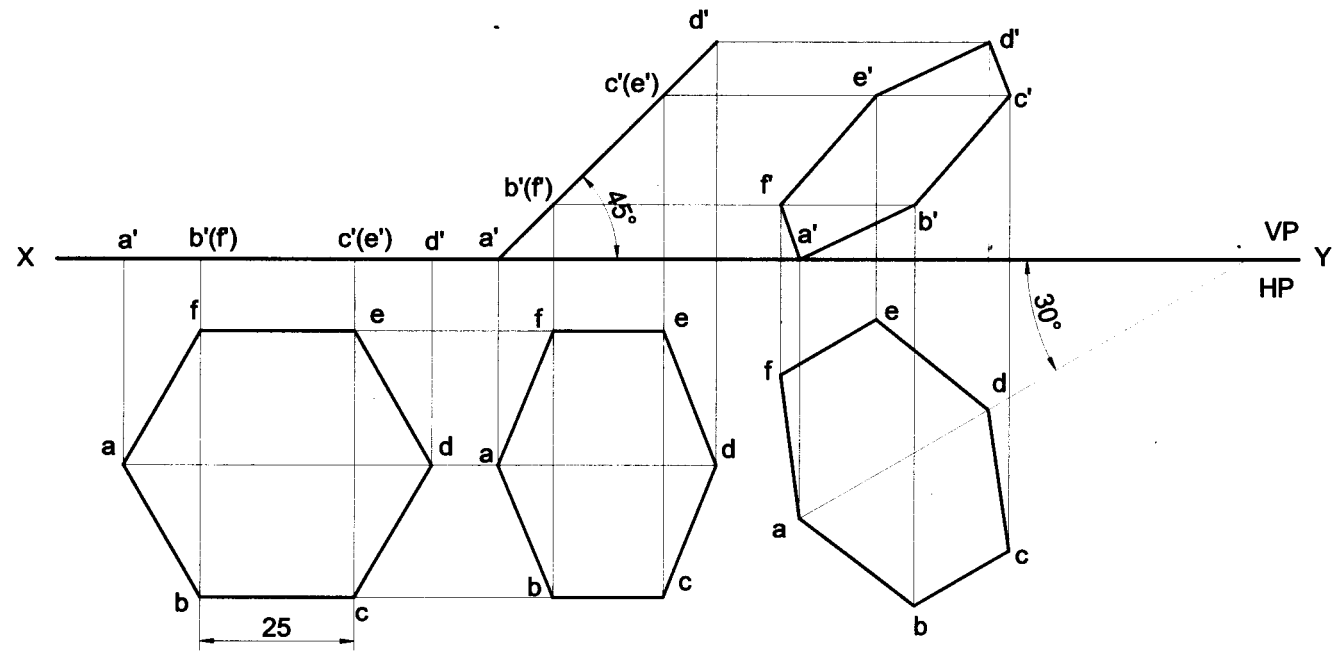
Problem 41 A hexagonal lamina of sides 25mm rests on one of its corners on HP. The lamina makes 45° to HP and the diagonal passing through the corner on which it rests is inclined at 30° to VP. Draw its projections.

Solution



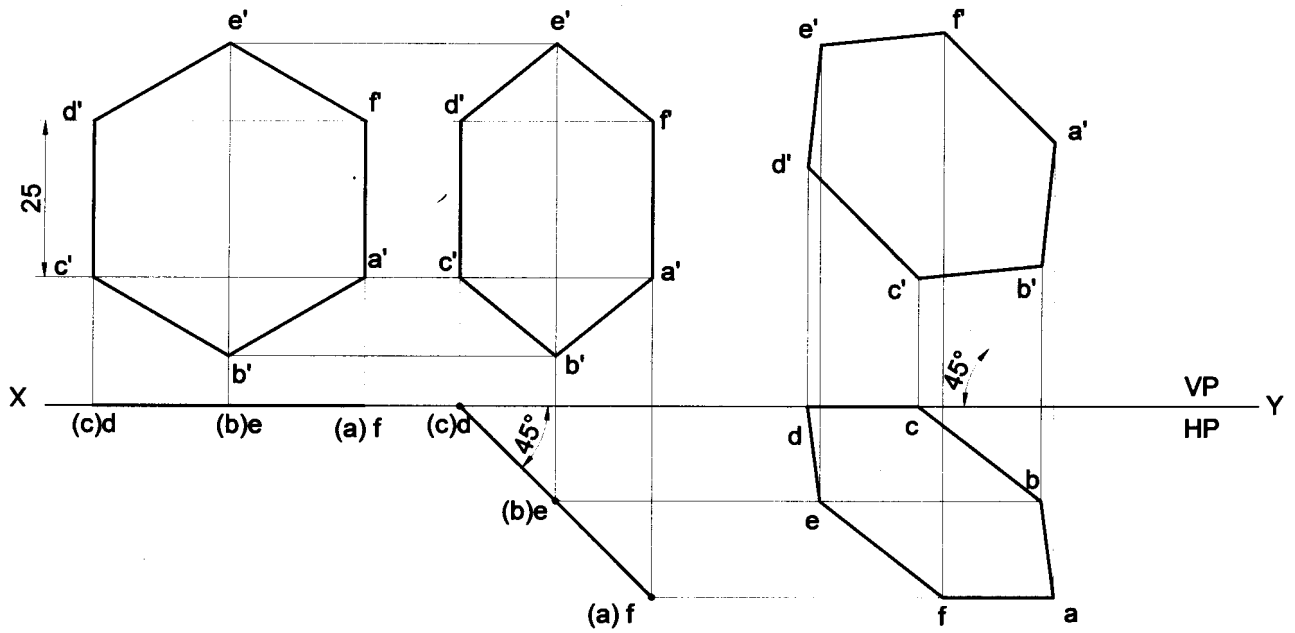
Problem 42 A hexagonal lamina of sides 25mm rests on one of its corners on HP. The lamina makes 45° to HP and the diagonal passing through the corner on which it rests appears to be inclined at 30° to VP. Draw its projections.

Solution



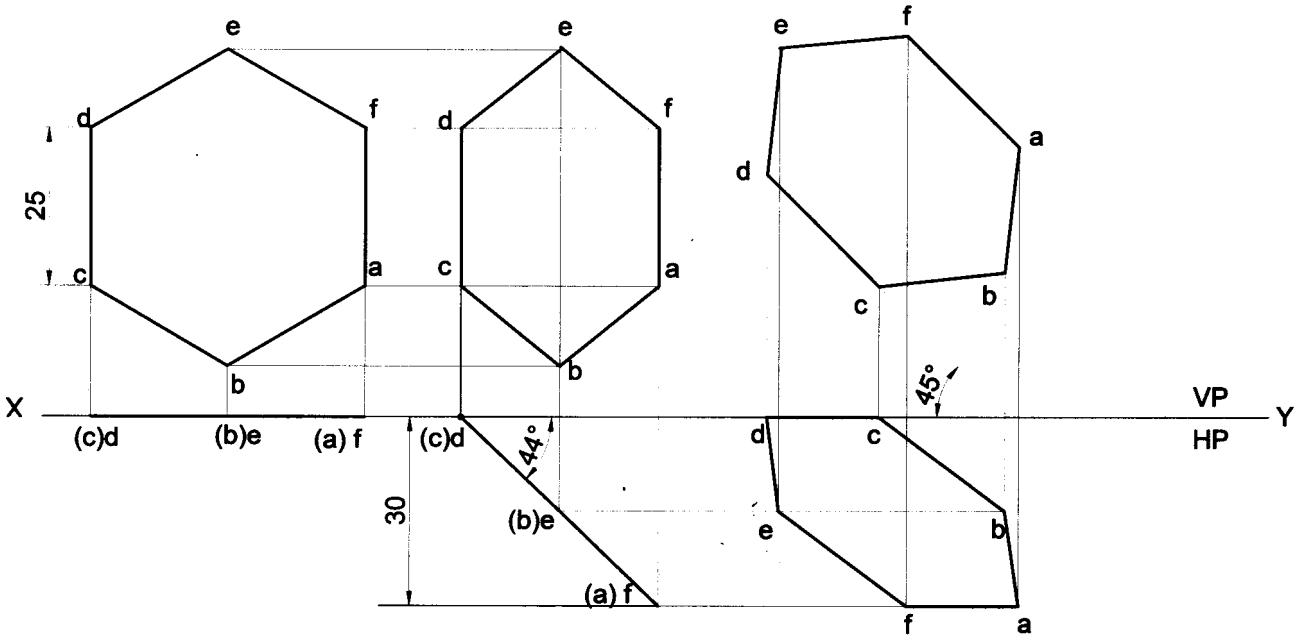
Problem 43 A hexagonal lamina of sides 25mm rests on one of its sides on VP. The lamina makes 45° to VP and the side on which it rests makes 45° to HP. Draw its projections.

Solution



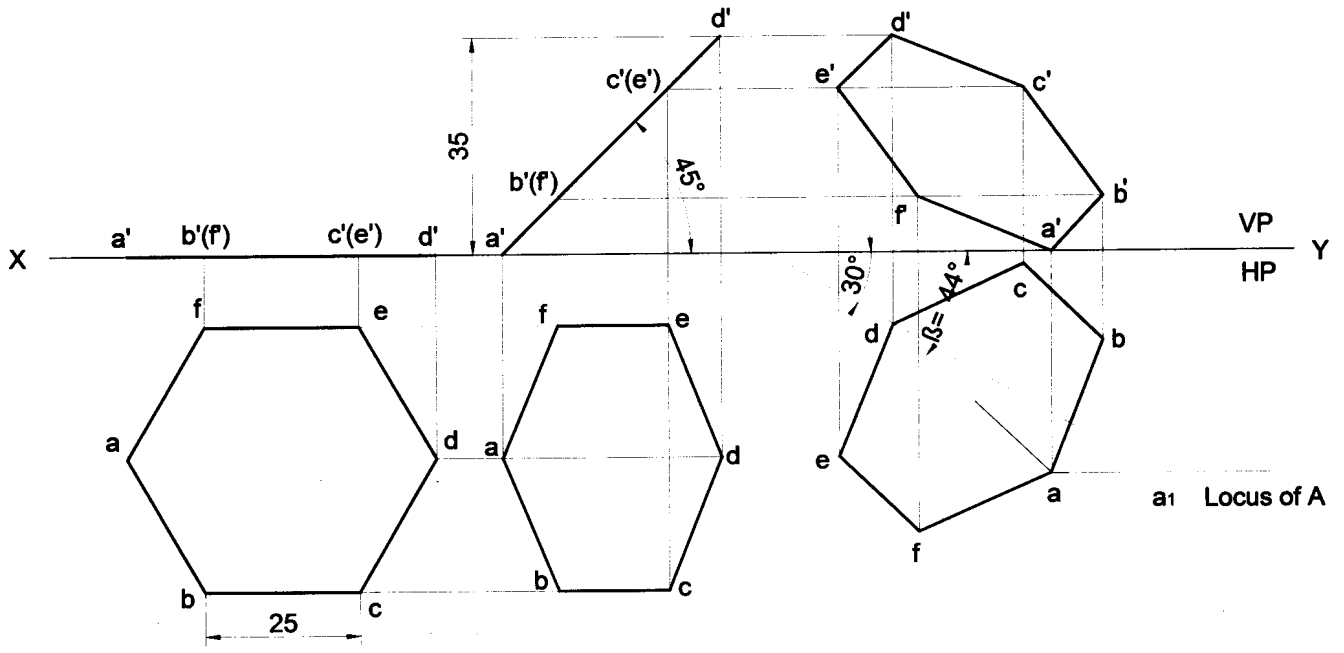
Problem 44 A hexagonal lamina of sides 25mm rests on one of its sides on VP. The side opposite to the side on which it rests is 30mm infront of VP & the side on which it rests makes 45° to HP. Draw its projections. Also determine the inclination of the lamina with the reference plane.

Solution



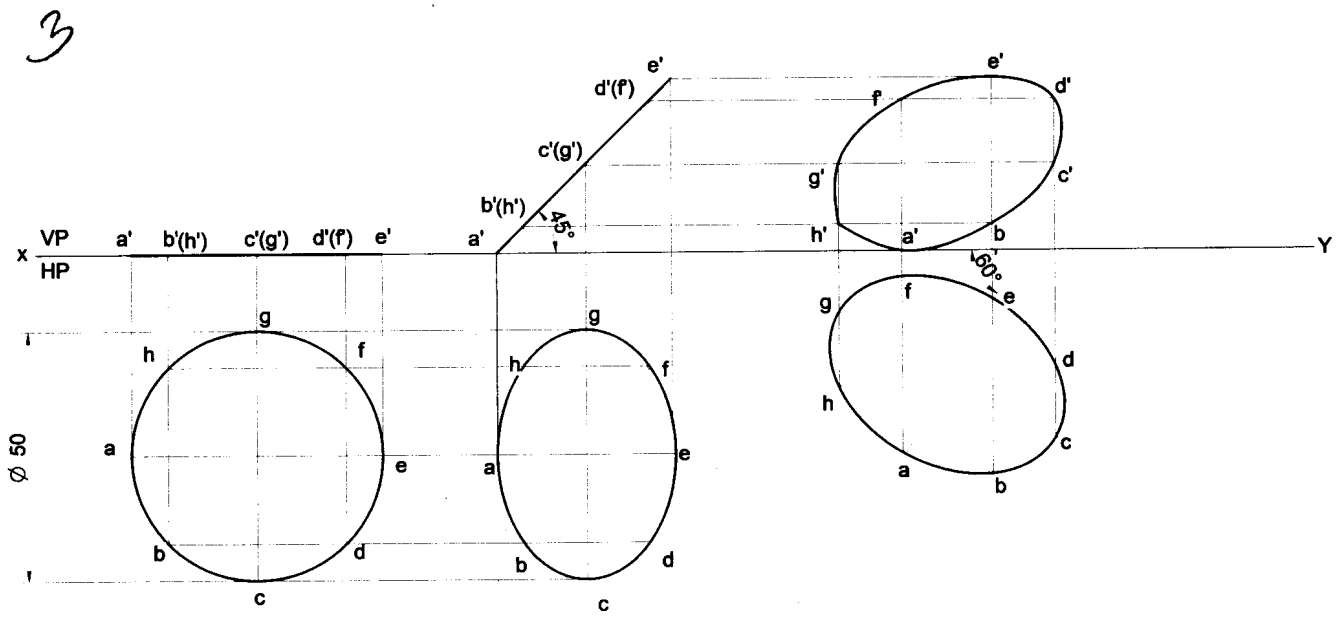
Problem 45 A hexagonal lamina of sides 25mm rests on one of its corners on HP. The corner opposite to the corner on which it rests is 35mm above HP and the diagonal passing through the corner on which it rests is inclined at 30° to VP. Draw its projections. Find the inclination of the surface with HP.

Solution



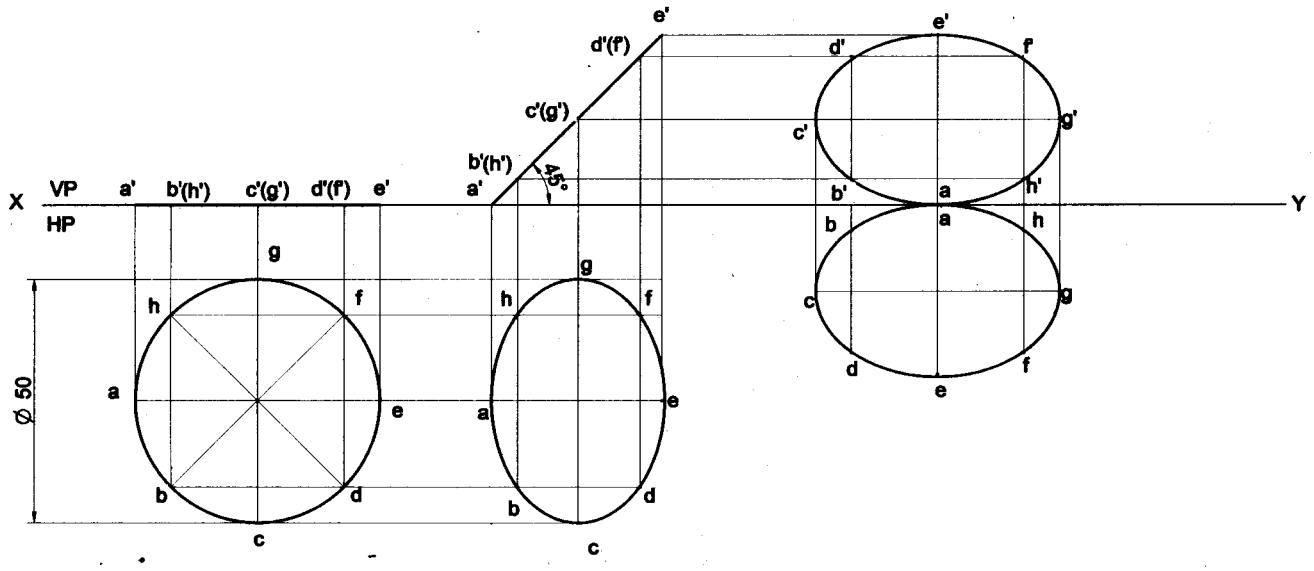
Problem 46 Draw the projections of a circular plate of negligible thickness of 50mm diameter resting on HP on a point A on the circumference, with its plane inclined at 45° to HP and the top view of the diameter passing through the resting point makes 60° with VP.

Solution



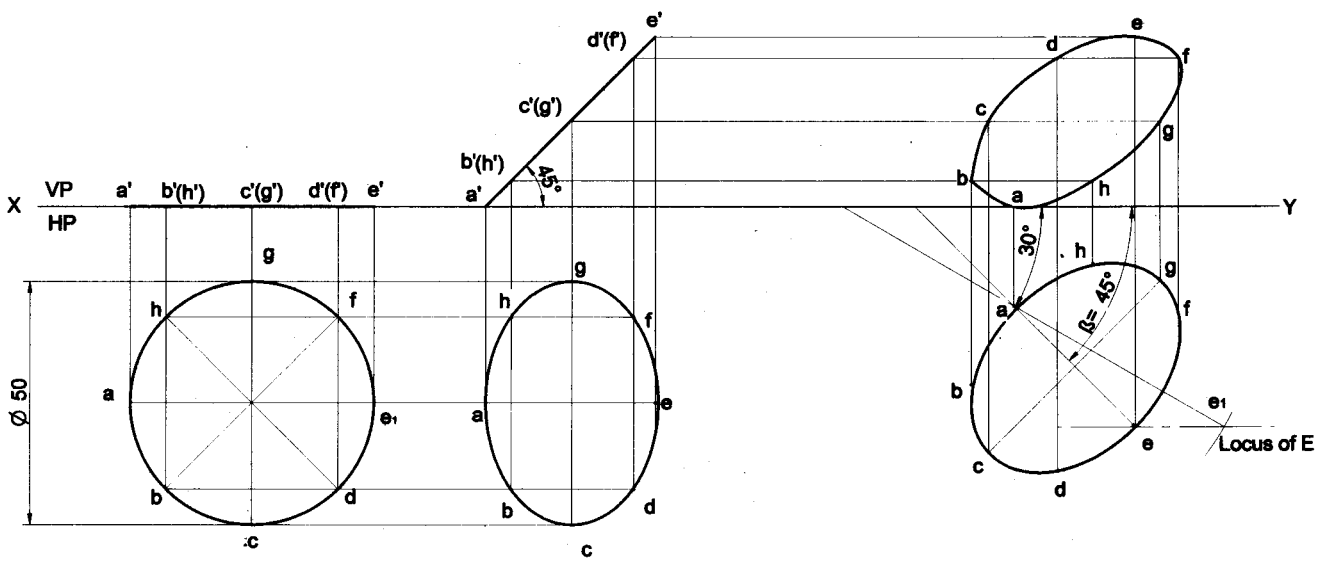
Problem 47 A circular lamina of 50mm diameter is standing with one of its points on the rim on HP and the lamina inclined at 45° to HP. The diameter at right angles to the diameter which is passing through the point on which the lamina rests is parallel to VP. Draw its projections.

Solution



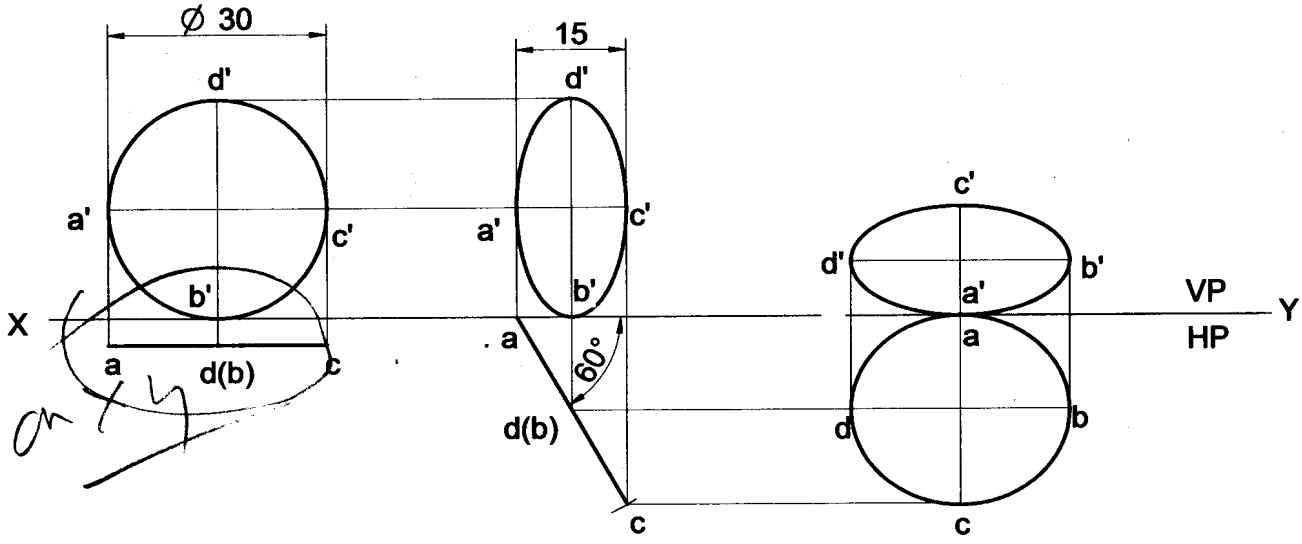
Problem 48 A circular lamina of 50mm diameter rests on HP such that one of its diameters is inclined at 30° to VP and 45° to HP. Draw its top and front views in this position.

Solution



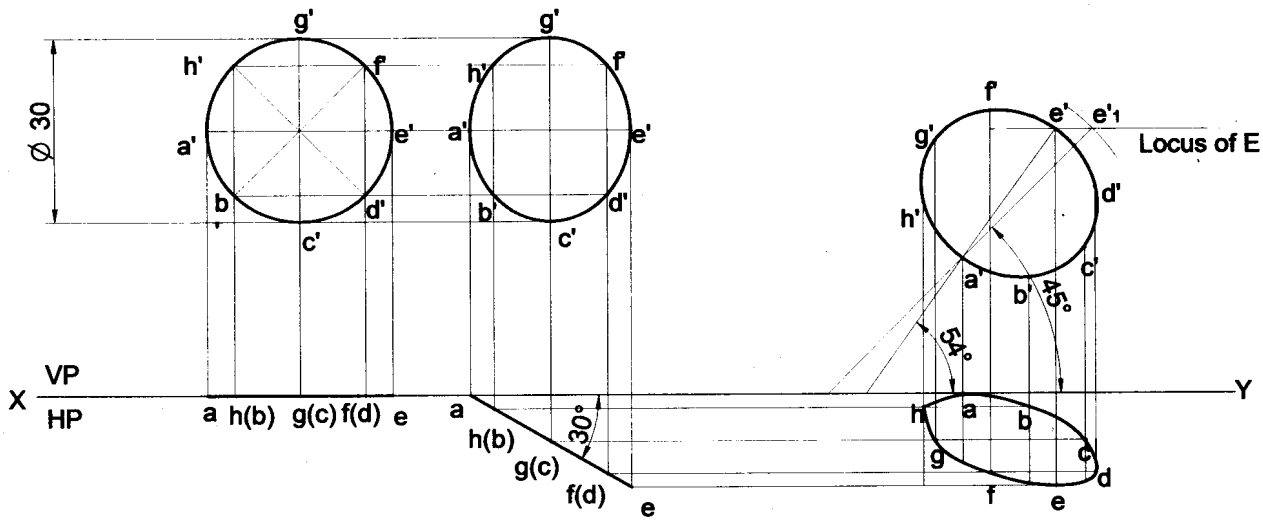
Problem 49 A circular lamina inclined to the VP appears in the front view as an ellipse of major axis 30mm and minor axis 15mm. The major axis is parallel to both HP and VP. One end of the minor axis is in both the HP and VP. Draw the projections of the lamina and determine the inclination of the lamina with the VP.

Solution



Problem 50 A circular lamina of 30mm diameter rests on VP such that one of its diameters is inclined at 30° to VP and 45° to HP. Draw its top and front views in this position.

Solution



MODULE-2

ORTHOGRAPHIC PROJECTIONS

OBJECTIVES:

1) To understand the basic concept of orthographic projection
2) To understand projection of points in all quadrant
3) To understand projection of Lines and Planes in 1st quadrant

LESSON CONTENT:

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes (No application problems). Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only (No problems on punched plates and composite plates).

2.1 Theory of Projections

Projection theory

In engineering, 3-dimensonal objects and structures are represented graphically on a 2-dimensional media. The act of obtaining the image of an object is termed "projection". The image obtained by projection is known as a "view". A simple projection system is shown in figure 1.

All projection theory are based on two variables:

- Line of sight
- Plane of projection.

Plane of Projection

A plane of projection (i.e, an image or picture plane) is an imaginary flat plane upon which the image created by the line of sight is projected. The image is produced by connecting the points where the lines of sight pierce the projection plane. In effect, 3-D object is transformed into a 2-D representation, also called projections. The paper or computer screen on which a drawing is created is a plane of projection.

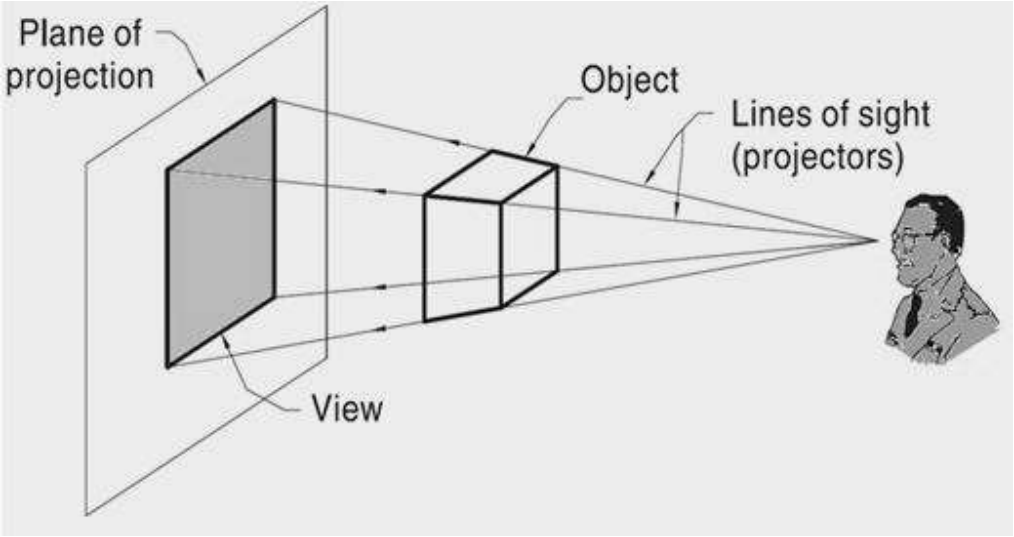


Figure 1 : A simple Projection system

Projection Methods

Projection methods are very important techniques in engineering drawing.

Two projection methods used are:

- Perspective and
- Parallel

Figure 2 shows a photograph of a series of building and this view represents a perspective projection on to the camera. The observer is assumed to be stationed at finite distance from the object. The height of the buildings appears to be reducing as we move away from the observer. In perspective projection, all lines of sight start at a single point and is schematically shown in figure 3. .

Figure 2. Photographic image of a series of buildings.

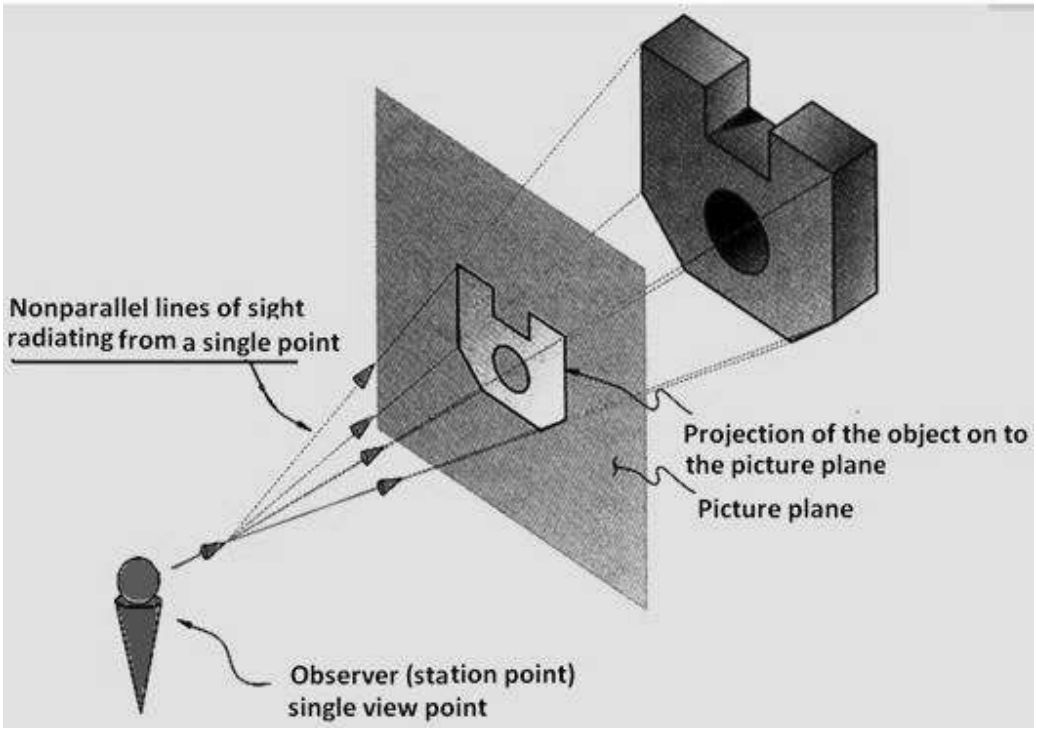


Figure 3. A schematic representation of a Perspective projection

In parallel projection, all lines of sight are parallel and is schematically represented in figure. 4. The observer is assumed to be stationed at infinite distance from the object.

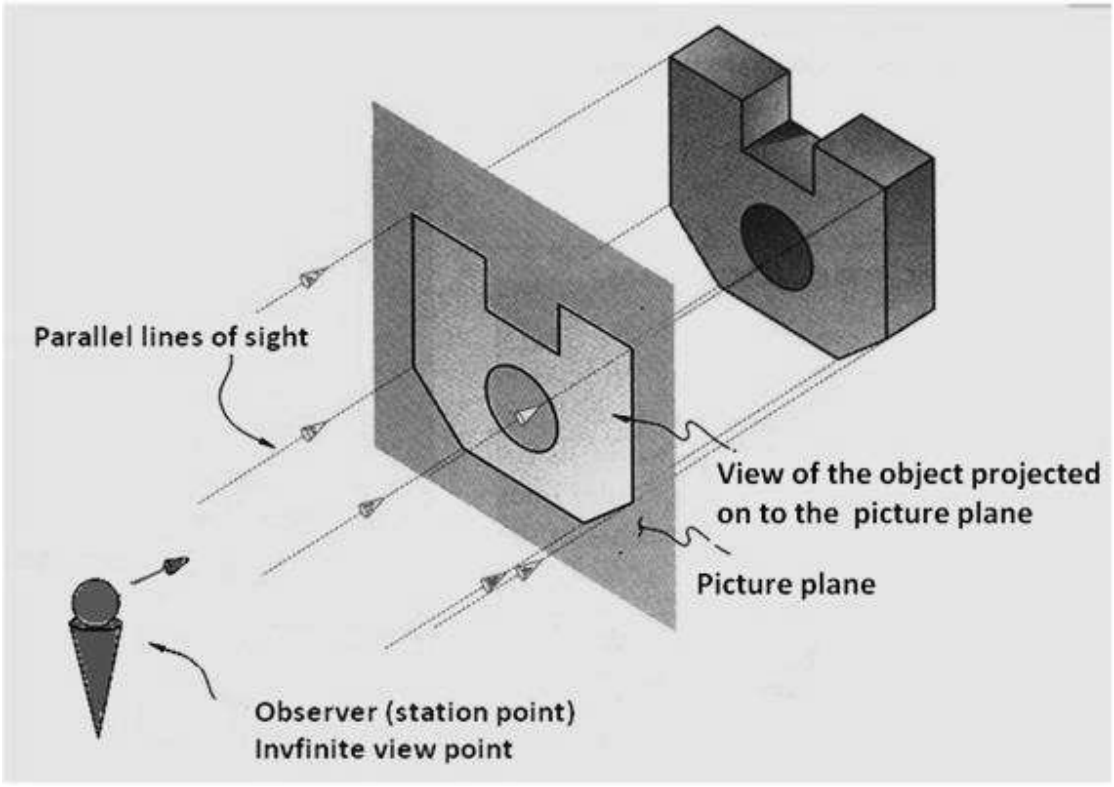


Figure 4. A schematic representation of a Parallel projection

Parallel vs Perspective Projection

Parallel projection

√ Distance from the observer to the object is infinite projection lines are parallel – object is positioned at infinity.

√ Less realistic but easier to draw.

Perspective projection

- Distance from the observer to the object is finite and the object is viewed from a single point – projectors are not parallel.
- Perspective projections mimic what the human eyes see, however, they are difficult to draw.

Orthographic Projection

Orthographic projection is a parallel projection technique in which the plane of projection is perpendicular to the parallel line of sight. Orthographic projection technique can produce either pictorial drawings that show all three dimensions of an object in one view or multi-views that show only two dimensions of an object in a single view. These views are shown in figure 5.

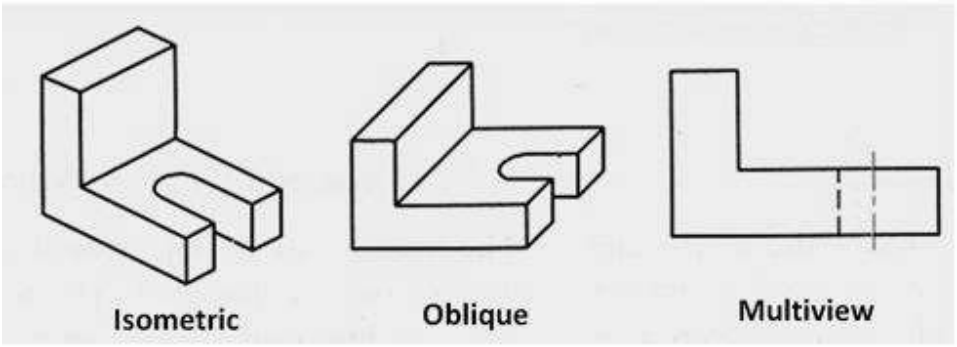


Figure 5. Orthographic projections of a solid showing isometric, oblique and multi-view drawings.

2.2 Projection Methods

Universally either the 1st angle projection or the third angle projection methods is followed for obtaining engineering drawings. The principal projection planes and quadrants used to create drawings are shown in figure 16. The object can be considered to be in any of the four quadrant.

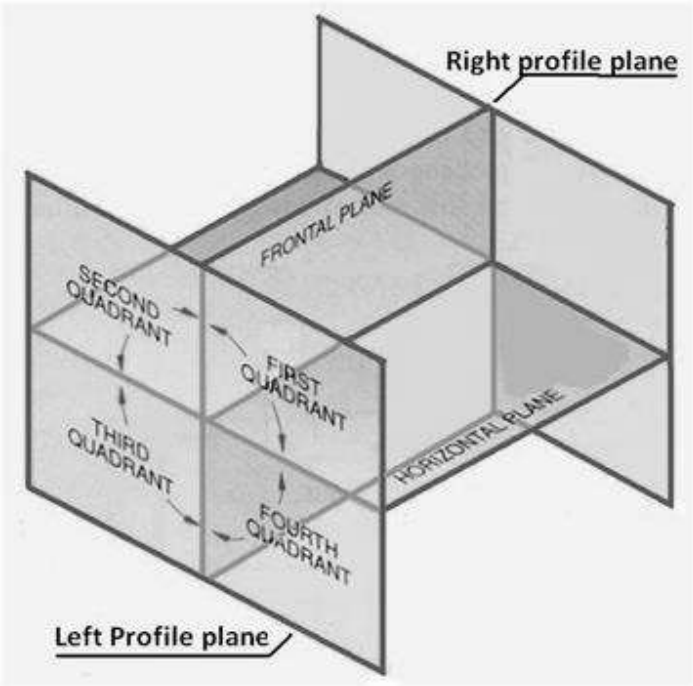


Figure 16. The principal projection planes and quadrants for creation of drawings.

First Angle Projection

In this the object in assumed to be positioned in the first quadrant and is shown in figure 17 The object is assumed to be positioned in between the projection planes and the observer. The views are obtained by

projecting the images on the respective planes. Note that the right hand side view is projected on the plane placed at the left of the object. After projecting on to the respective planes, the bottom plane and left plane is unfolded on to the front view plane. i.e. the left plane is unfolded towards the left side to obtain the Right hand side view on the left side of the Front view and aligned with the Front view. The bottom plane is unfolded towards the bottom to obtain the Top view below the Front view and aligned with the Front View.

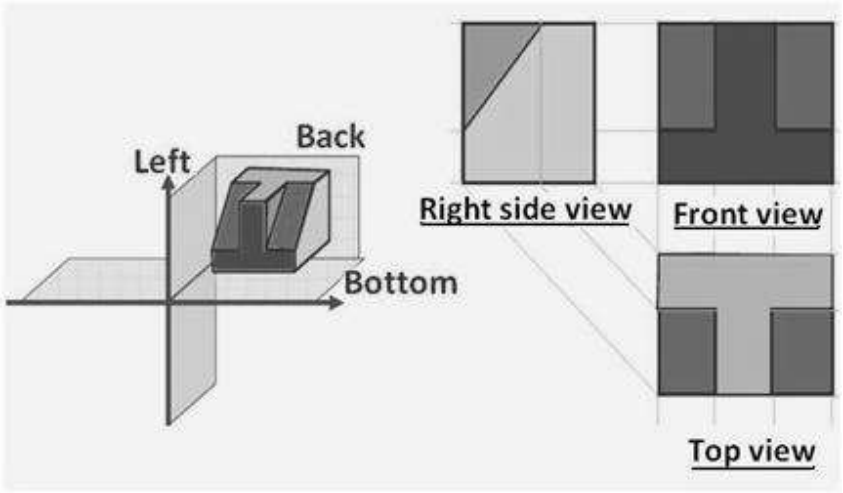


Figure 17. Illustrating the views obtained using first angle projection technique.

Third Angle Projection

In the third angle projection method, the object is assumed to be in the third quadrant. i.e. the object behind vertical plane and below the horizontal plane. In this projection technique, Placing the object in the third quadrant puts the projection planes between the viewer and the object and is shown in figure 18.

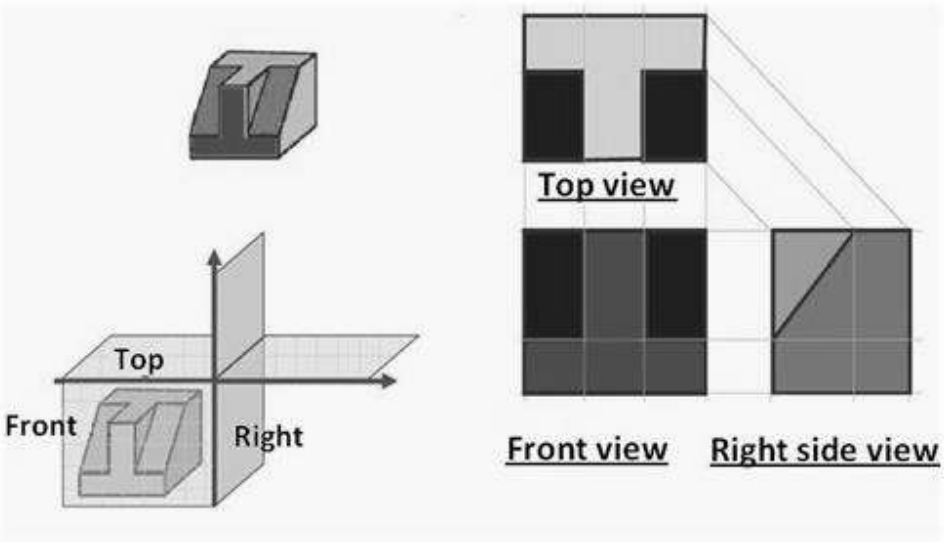


Figure 18. Illustrating the views obtained using first angle projection technique

Figure 19 illustrates the difference between the 1st angle and 3rd angle projection techniques. A summary of the difference between 1st and 3rd angle projections is shown if Table 1.

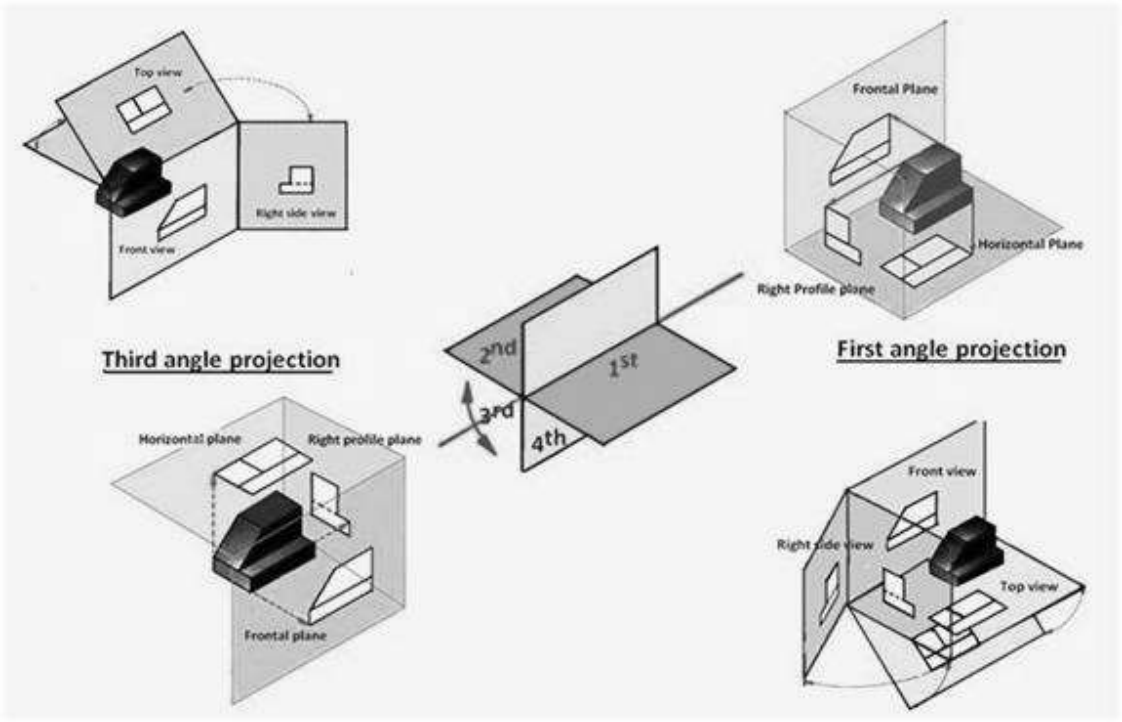


Figure 19 Differentiating between the 1st angle and 3rd angle projection techniques.

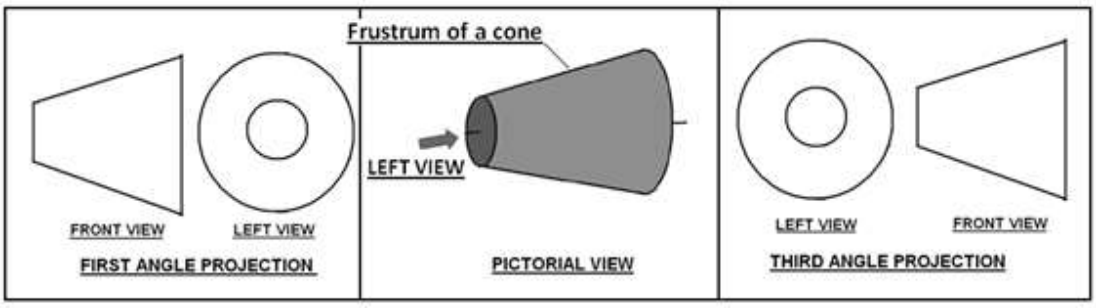
Table 1. Difference between first- and third-angle projections

First angle projection	Third-angle projection
Object is kept in the first quadrant.	Object is assumed to be kept in the third quadrant.
Object lies between observer and the plane of projection.	Plane of projection lies between the observer and the object.
The plane of projection is assumed to be non-transparent.	The plane of projection is assumed to be transparent.
Front (elevation) view is drawn above the XY line	Front (elevation) view is drawn below the XY line
Top (plan) view is drawn below the XY line	Top (plan) view is drawn above the XY line
Left view is projected on the right plane and vice versa	Left view is projected on the left plane itself.
Followed in India, European countries	Followed in USA

Either first angle projection or third angle projection are used for engineering drawing. Second angle projection and fourth angle projections are not used since the drawing becomes complicated. This is being explained with illustrations in the lecture on Projections of points (lecture 18).

Symbol of projection

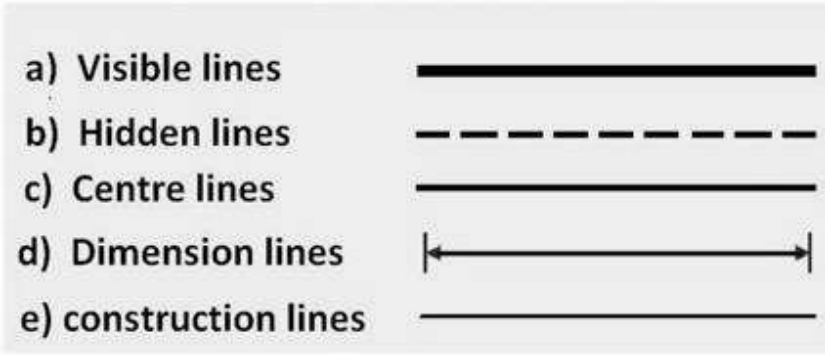
The type of projection obtained should be indicated symbolically in the space provided for the purpose in the title box of the drawing sheet. The symbol recommended by BIS is to draw the two sides of a frustum of a cone placed with its axis horizontal The left view is drawn.



2.3 Orthographic Projections

Lines are used to construct a drawing. Various type of lines are used to construct meaningful drawings. Each line in a drawing is used to convey some specific information. The types of lines generally used in engineerign drawing is shown in Table-1.

Table -1. Types of lines generally used in drawings



All visible edges are to be represented by visible lines. This includes the boundary of the object and intersection between two planes. All hidden edges and features should be represented by dashed lines. Figure 1 shows the orthographic front view (line of sight in the direction of arrow)of an object. The external boundary of the object is a rectangle and is shown by visible lines. In Figure-1(a), the step part of the object is hidden and hence shown as dashed lines while for the position of the object shown in figure-1(b) , the step part is directly visible and hence shown by the two solid lines.

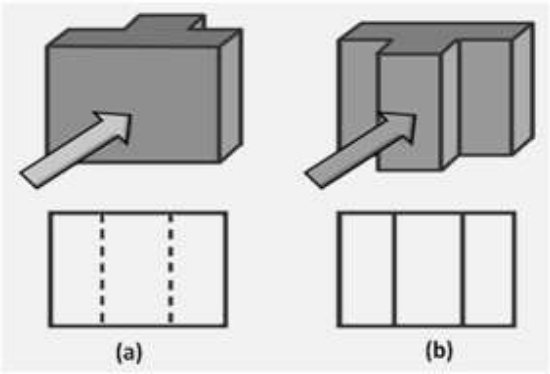


Figure 1 shows the pictorial view and front view of the object when the middle stepped region is (a) hidden and (b) visible.

Projection of Points

A POINT

The position of a point in engineering drawing is defined with respect to its distance from the three principle planes i.e., with respect to the VP, HP, & PP.

The point is assumed to be in the respective quadrant shown in figure 1(a). The point at which the line of sight (line of sight is normal to the respective plane of projection) intersects the three planes are obtained. The horizontal plane and the side planes are rotated so such that they lie on the plane containing the vertical plane. The direction of rotation of the horizontal plane is shown in figure 1 (b).

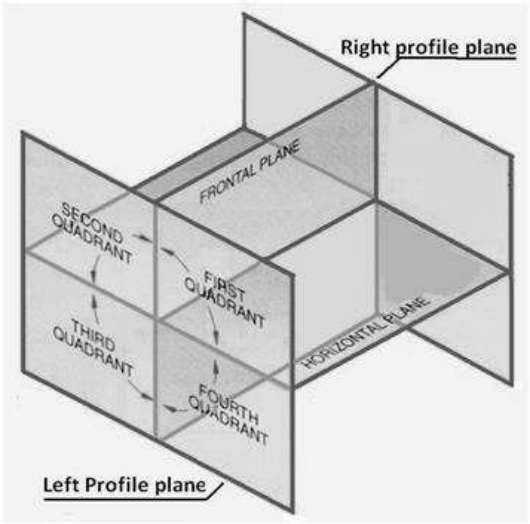


Figure 1(a). The relative positions of projection planes and the quadrants

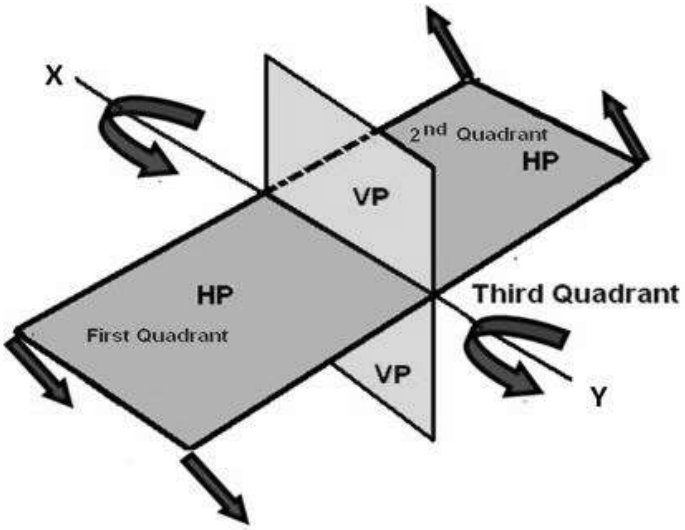


Figure 1(b). The direction of rotation of the Horizontal plane.

Conventions used while drawing the projections of points

With respect to the 1st angle projection of point "P' shown in figure 2,

- Top views are represented by only small letters eg. p .
- Their front views are conventionally represented by small letters with dashes eg. p'
- Profile or side views are represented by small letters with double dashes eg. p''
- Projectors are shown as thin lines.
- The line of intersection of HP and VP is denoted as X-Y.
- The line of intersection of VP and PP is denoted as X1-Y1

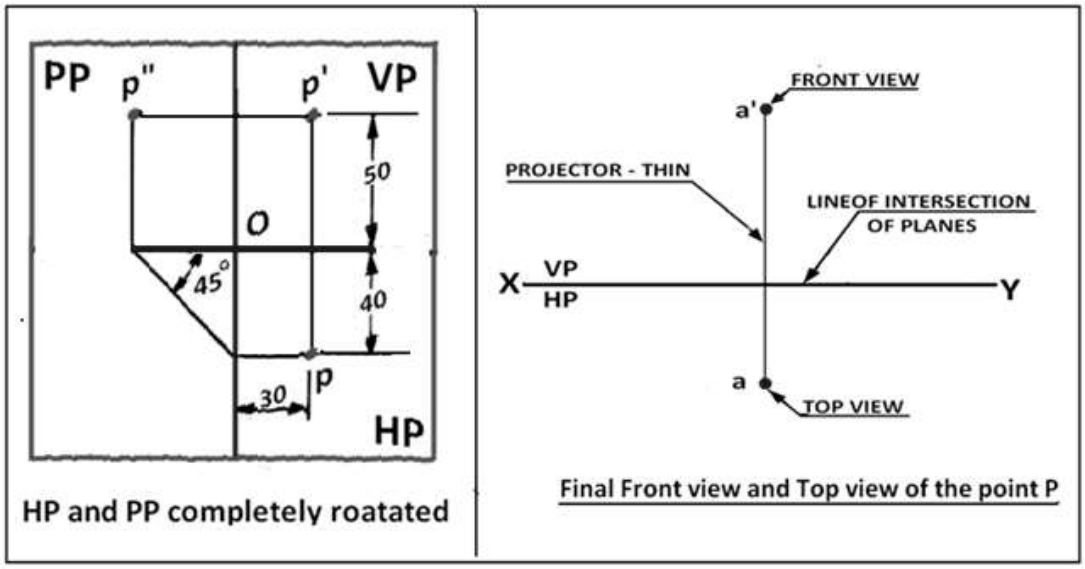


Figure 2. Showing the three planes and the projectionof the point P after the planes have been rotated on to the vertical plane.

Point in the First quadrant

Figure 3 shown the projections of a point P which is 40 mm in front of VP, 50 mm above HP, 30 mm in front of left profile plane (PP)

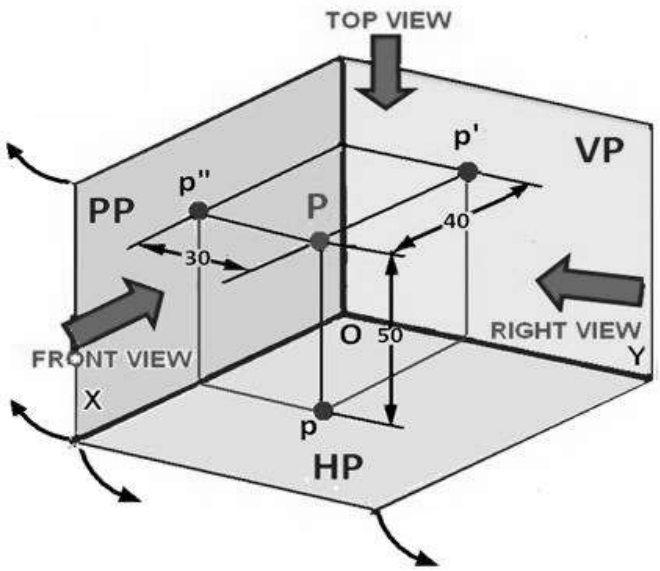


Figure 3. Projection of the point "P" on to the three projection planes before the planes are rotated.

Figure 4 shows the planes and the position of the points when the planes are partially rotated. The arrows indicate the direction of rotation of the planes. The three views after complete rotation of the planes is shown in figure 2.

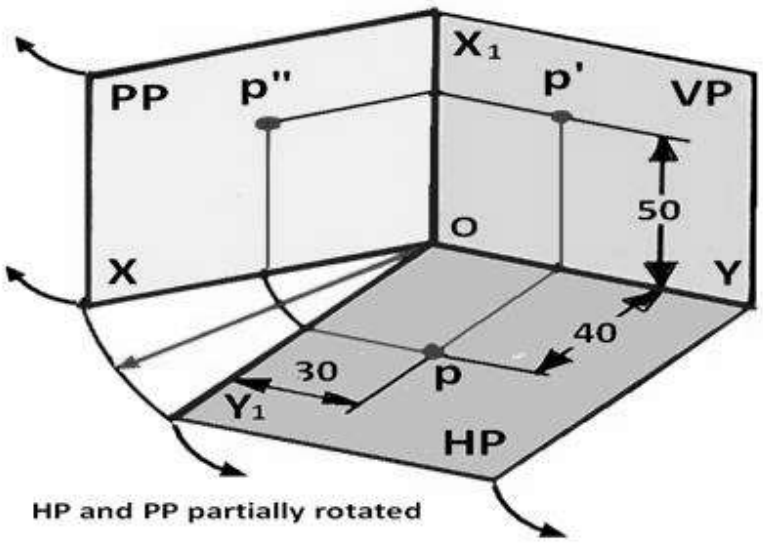


Figure 4. Projection of the point "P" on to the three projection planes after the planes are partially rotated.

The procedure of drawing the three views of the point "P" is shown in figure-4.

- Draw a thin horizontal line, XY, to represent the line of intersection of HP and VP.
- Draw X_1Y_1 line to represent the line of intersection of VP and PP.

- Draw the Top View (p).
- Draw the projector line
- Draw the Front View (p′) .
- To project the right view on the left PP, draw a horizontal projector through p to intersect the 45 degree line at m. Through m draw a vertical projector to intersect the horizontal projector drawn through p′ at p′′.
- p ′′ is the right view of point P

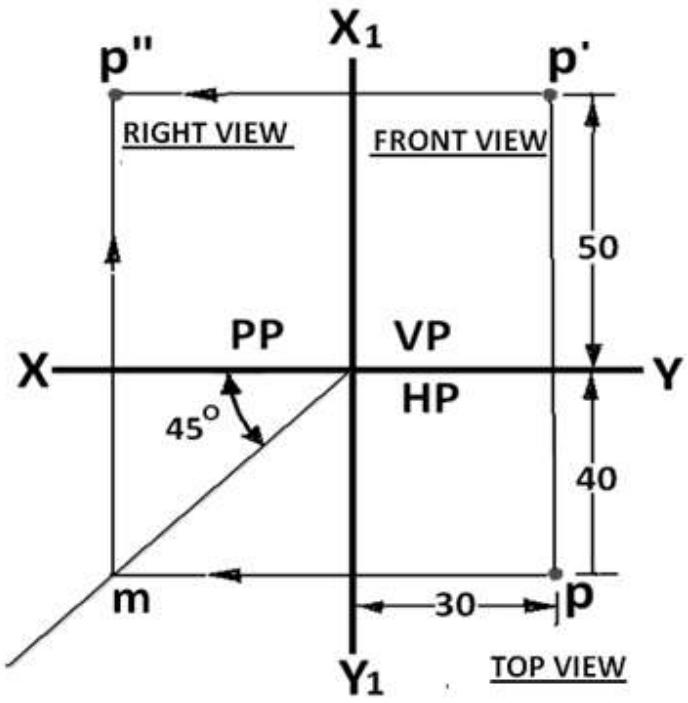


Figure 5 First angle multi-view drawing of the point "P"

Point in the Second quadrant

Point P is 30 mm above HP, 50 mm behind VP and 45 mm in front of left PP. Since point P is located behind VP, the VP is assumed transparent. The position of the point w.r.t the three planes are shown in Figure 1. The direction of viewing are shown by arrows. After projecting the point on to the three planes, the HP and PP are rotated such that they lie along the VP. The direction of rotation of the HP and PP is shown in figure 2. As shown in figure 3, after rotation of the PP and HP, it is found that the VP and HP is overlapping. The multiview drawing for the point P lying in the second quadrant is shown in figure 4. Though for the projection of a single point, this may not be a problem, the multiview drawing of solids, where a number of lines are to be drawn, will be very complicated. Hence second angle projection technic is not followed anywhere for engineering drawing.

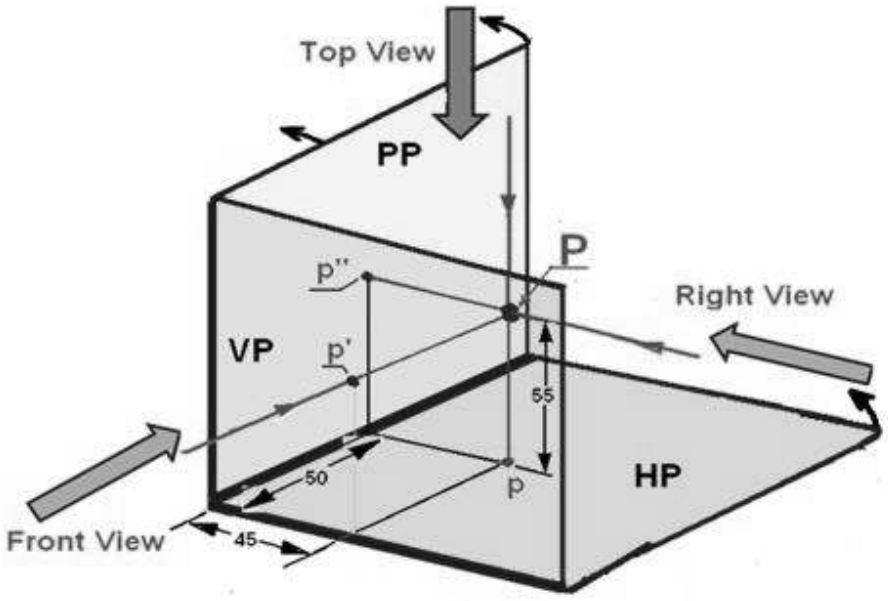


Figure 1. The projection of point P on to the three projection planes.

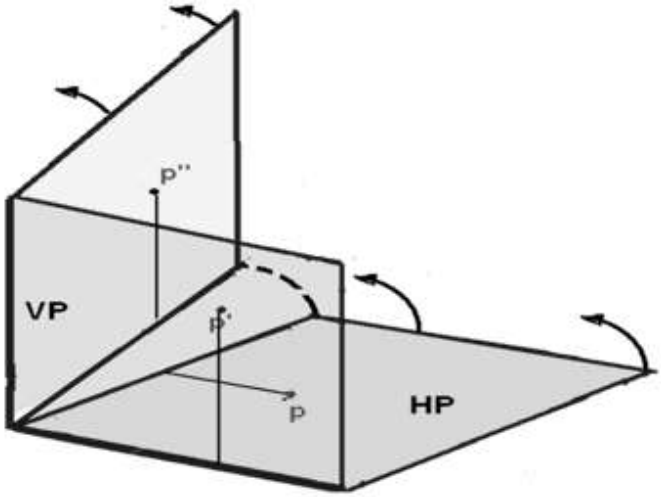


Figure 2. The direction of rotation of HP.

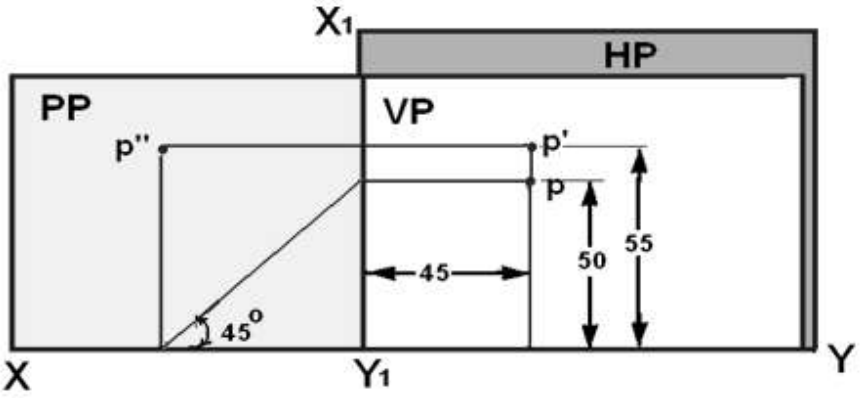


Figure 3. The projection of point P after complete rotation of the HP and PP.

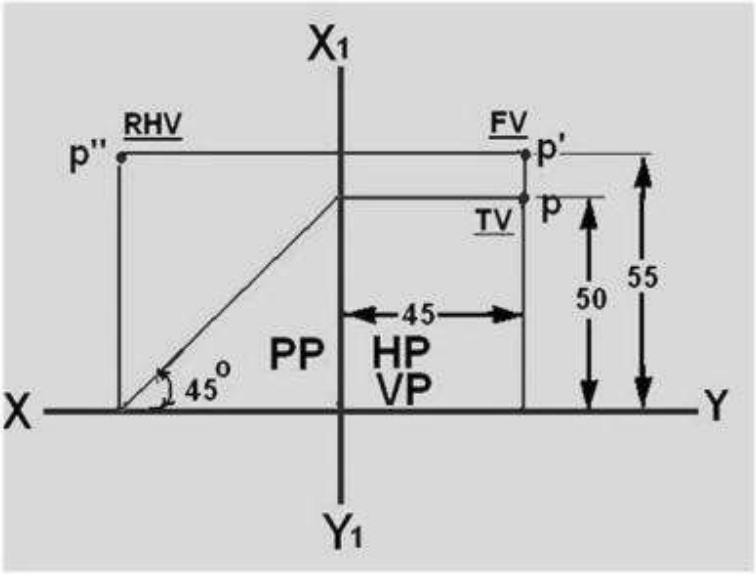


Figure 4. The multiview drawing of the point P lying in the second quadrant.

Point in the Third quadrant

Projection of a point P in the third quadrant where P is 40 mm behind VP, 50 mm below HP and 30 mm behind the right PP is shown in figure 5.

Since the three planes of projections lie in between the observer and the point P, they are assumed as transparent planes. After the point P is projected on to the three planes, the HP and VP are rotated along the direction shown in figure 6, such that the HP and PP is in plane with the VP. The orthographic projection of the point P lying in the third quadrant is shown in figure 7.

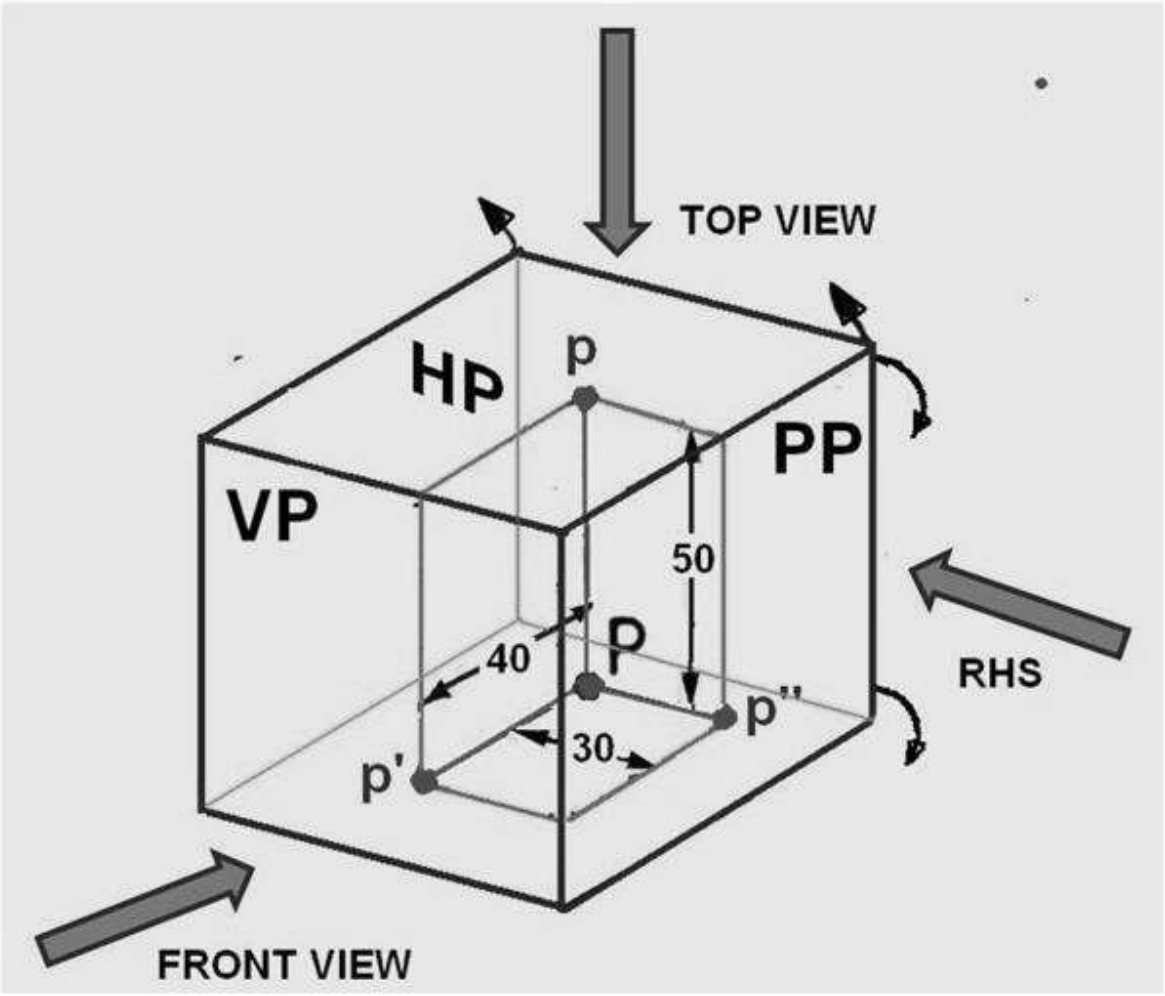


Figure 5. Projection of a point P placed in the third quadrant

In the third angle projection, the Top view is always above the front view and the Right side view will be towards the right of the Front view.

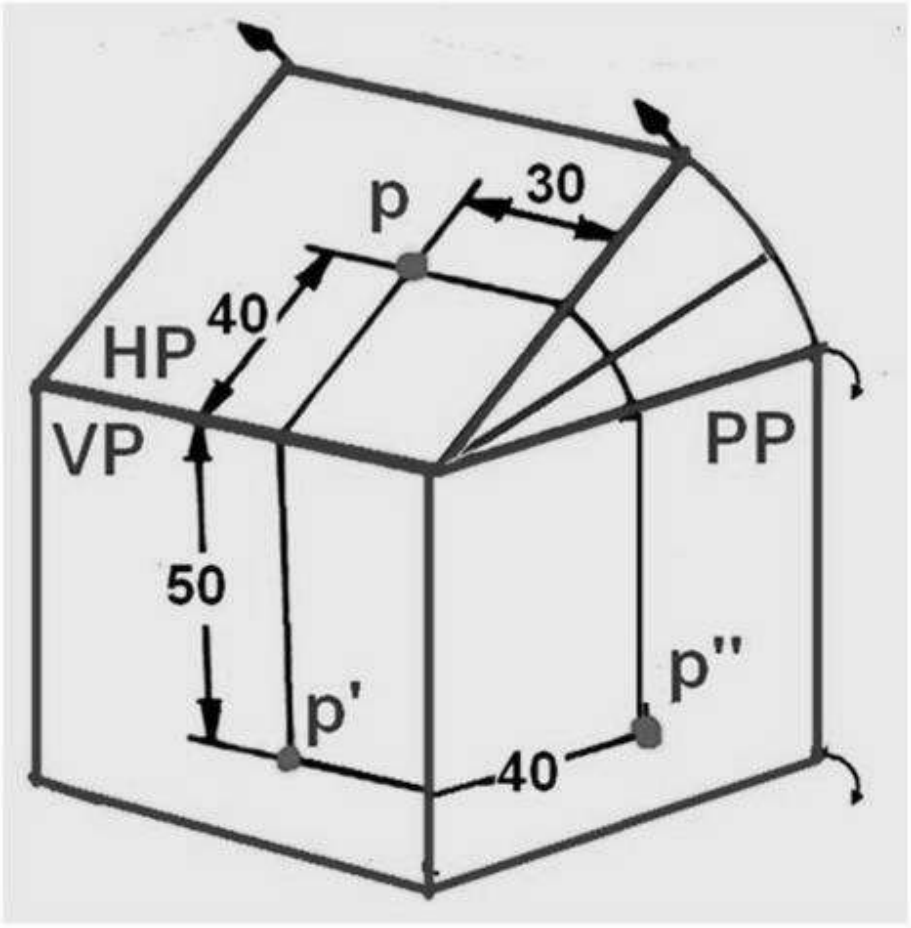


Figure 6. shows the sense of direction of rotation of PP and HP.

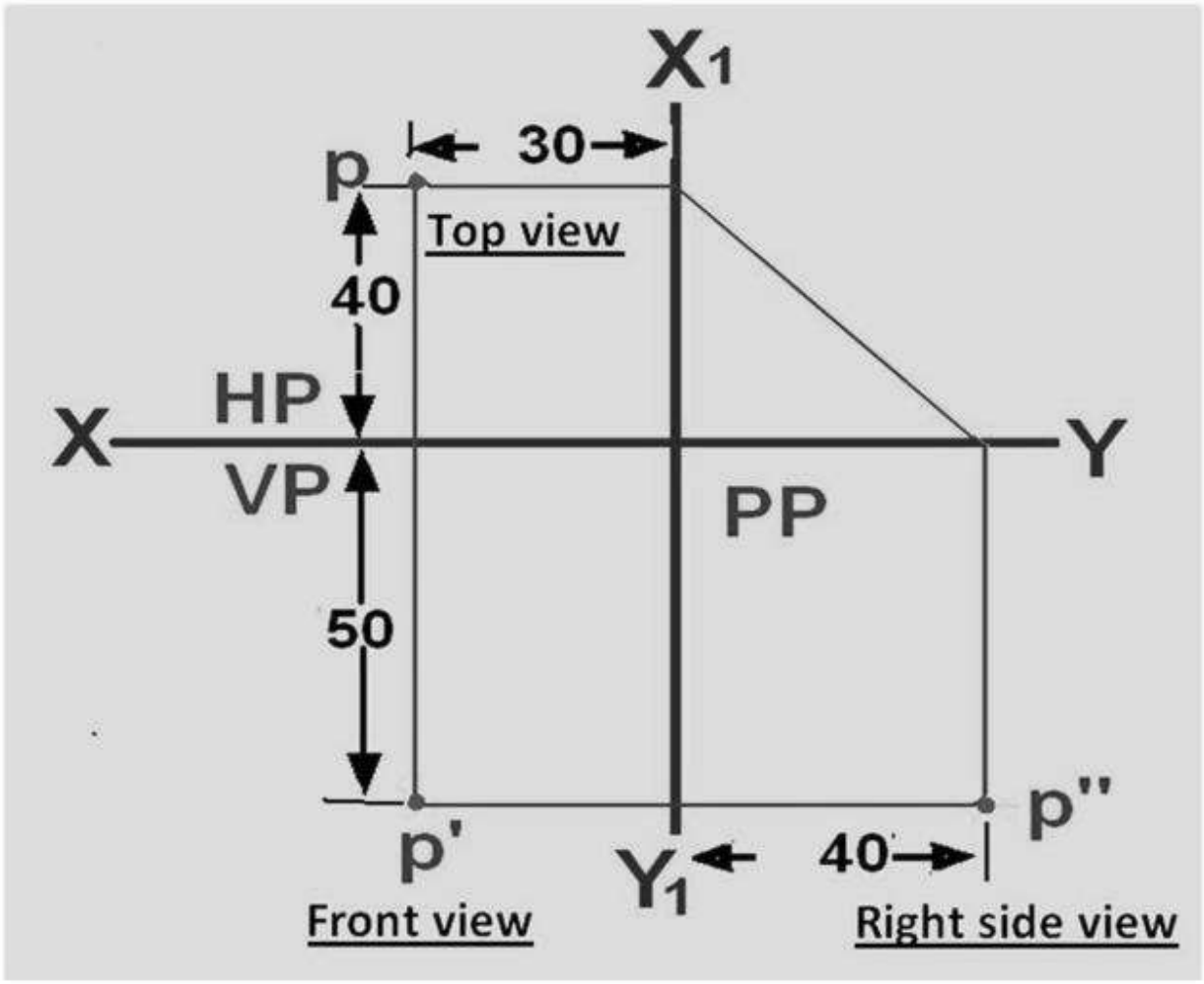


Figure 7. Multi-view drawing of the point lying in the third quadrant.

In the third angle projection, the Top view is always above the front view and the Right side view will be towards the right of the Front view.

Point in the Fourth quadrant

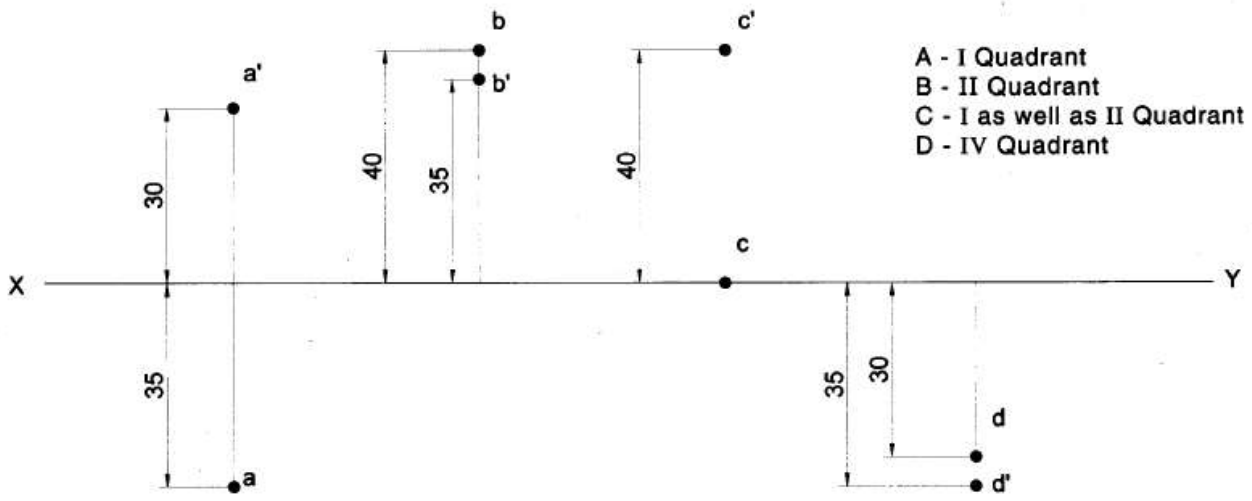
If A point is lying in the fourth quadrant, the point will be below the HP and infront of the VP. The point is projected on to the respective projection planes. After rotation of the HP and PP on to the VP, it will be observed that that the HP and VP are overlapping, similar to the second angle projection. The multi-view drawing of objects in such case would be very confusing and hence fourth angle projection technique is not followed by engineers.

Worked Examples- Projection of Points

Problem 1 Draw the projections of the following Points on the same XY line, keeping convenient distance between each projectors. Name the Quadrants in which they lie.

A – 30 mm above HP & 35 mm in front of VP.
B – 35 mm above HP & 40 mm behind VP.
C – 40 mm above HP & on VP.
D – 35 mm below HP & 30 mm in front of VP.

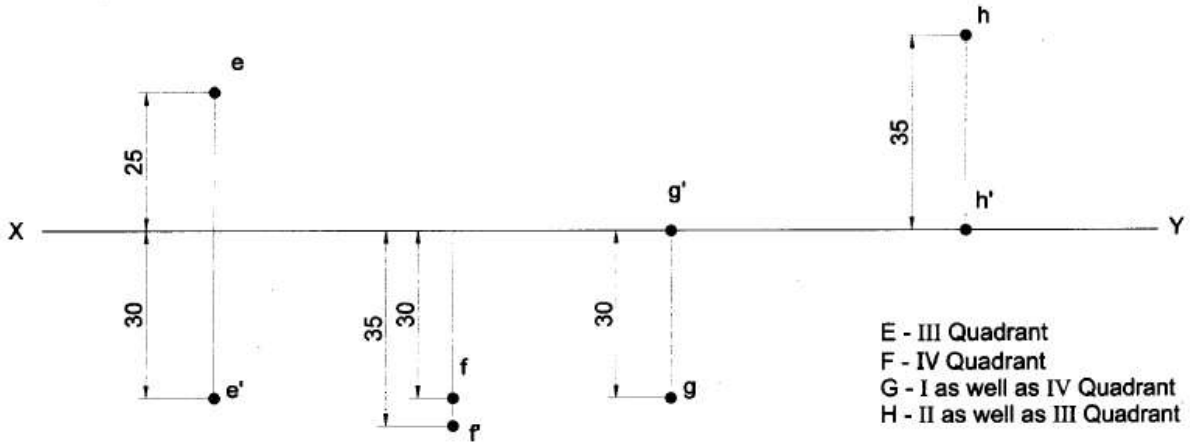
Solution



Problem 2 Draw the projections of the following Points on the same XY line,Keeping convenient distance between each projectors. Name the Quadrants in which they lie.

E – 30 mm below HP & 25 mm behind VP.
F – 35 mm below HP & 30 mm in front of VP.
G – On HP & 30 mm in front of VP.
H - On HP & 35 mm behind VP.

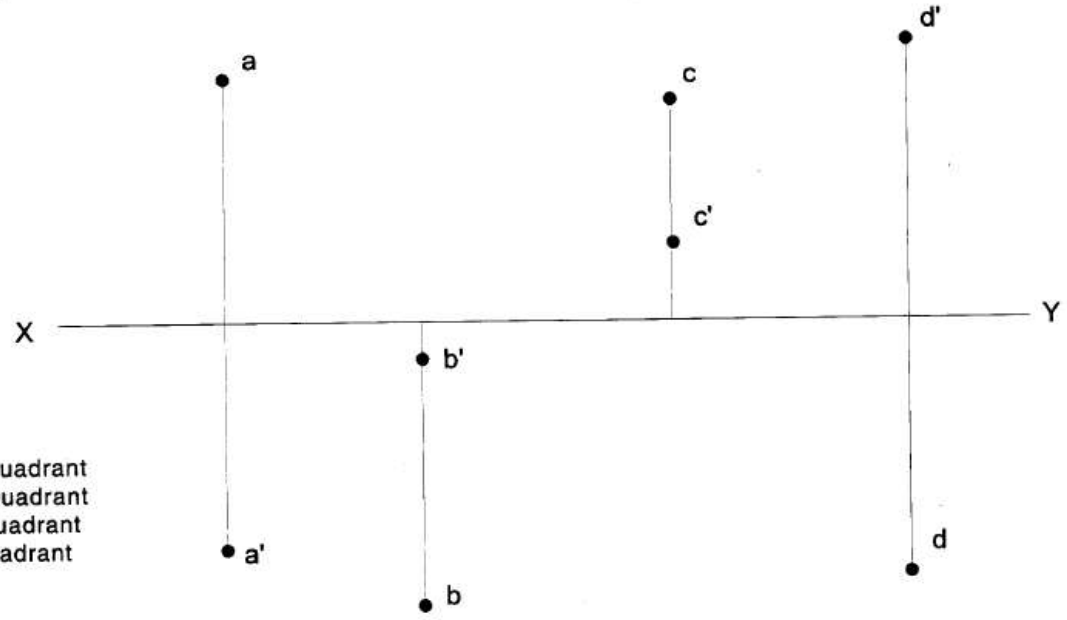
Solution



Problem 3 Draw and state the quadrants in which the following Points are located. Assume any distances.

A – Front view below XY line & Top view above XY line.
B – Front and Top views are below XY line.
C – Front and top views are above XY line.
D – Front view above XY line & top view below XY line.

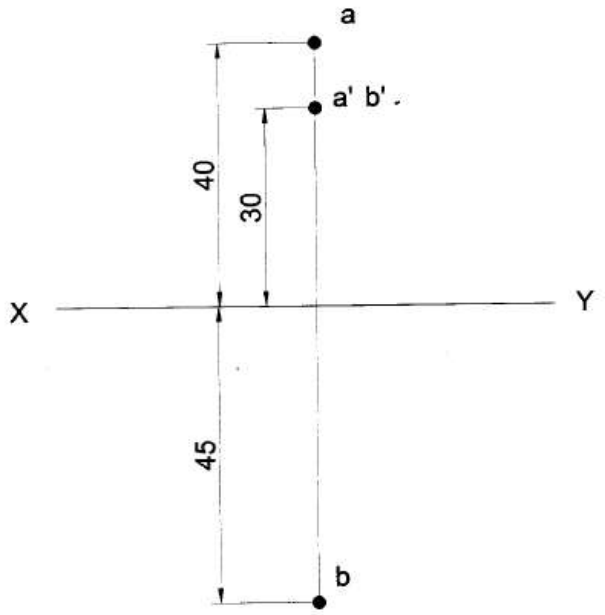
Solution



A - III Quadrant
B - IV Quadrant
C - II Quadrant
D - I Quadrant

Problem 4 A point 30mm above XY line is the front view of two points A&B .The top view of A is 40 mm behind VP & The top view of B is 45 mmin front of VP. Draw The projections of the points & state the quadrants in which the points are situated.

Solution

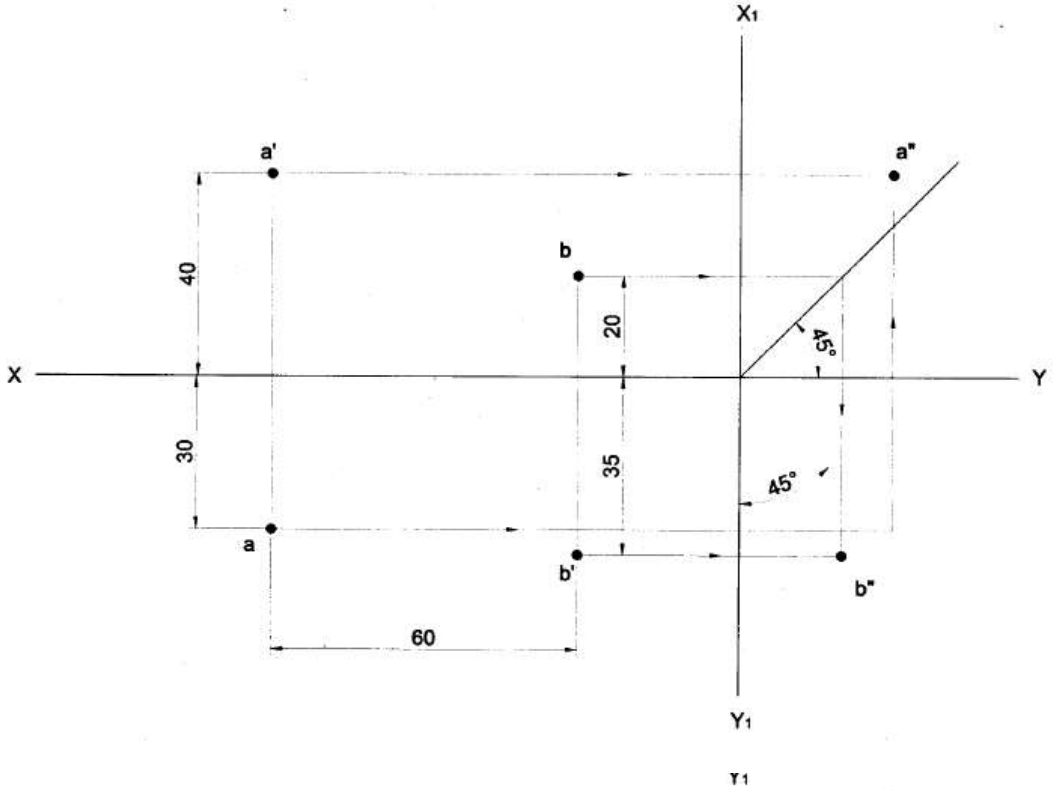


ANSWERS : **A is in II Q**

B is in I Q

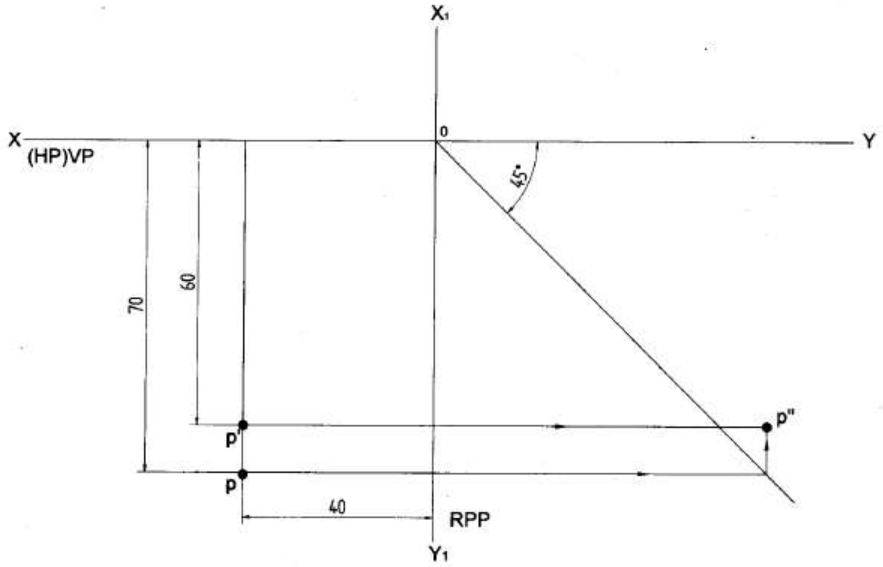
Problem 5 A point 'A' is 30 mm in front of VP and 40mm above HP. Another point B is 20 mm behind VP & 35 mm below HP. The horizontal distance between the points measured parallel to XY line is 60 mm . Draw the three projections of the points. Join their front and top views.

Solution



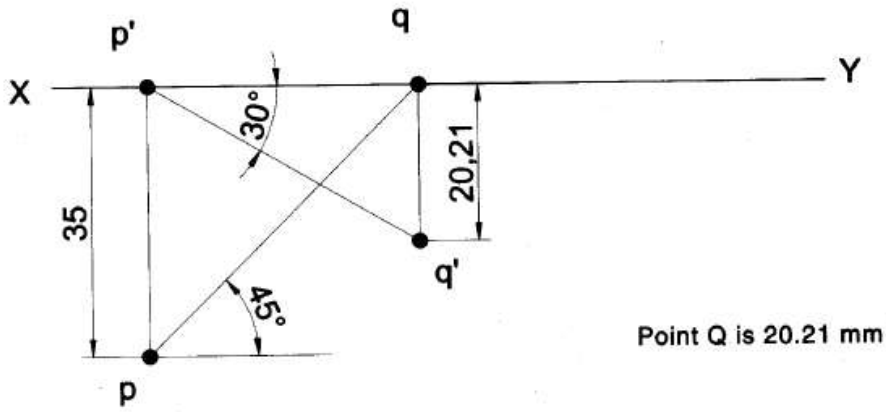
Problem 6 Draw all the three views of a point P lying 60 mm below HP, 70 mm infront of VP and 40 mm from the RPP. Also state the quadrant in which it lies.

Solution



Problem 7 A point P is on HP and 35 mm in front of VP. Another Point Q is on VP and below HP. The line Joining their front views makes an angle of 30 deg to XY line , while the line joining their top views makes an angle of 45 deg with XY line.Find the distance of the point Q from HP.

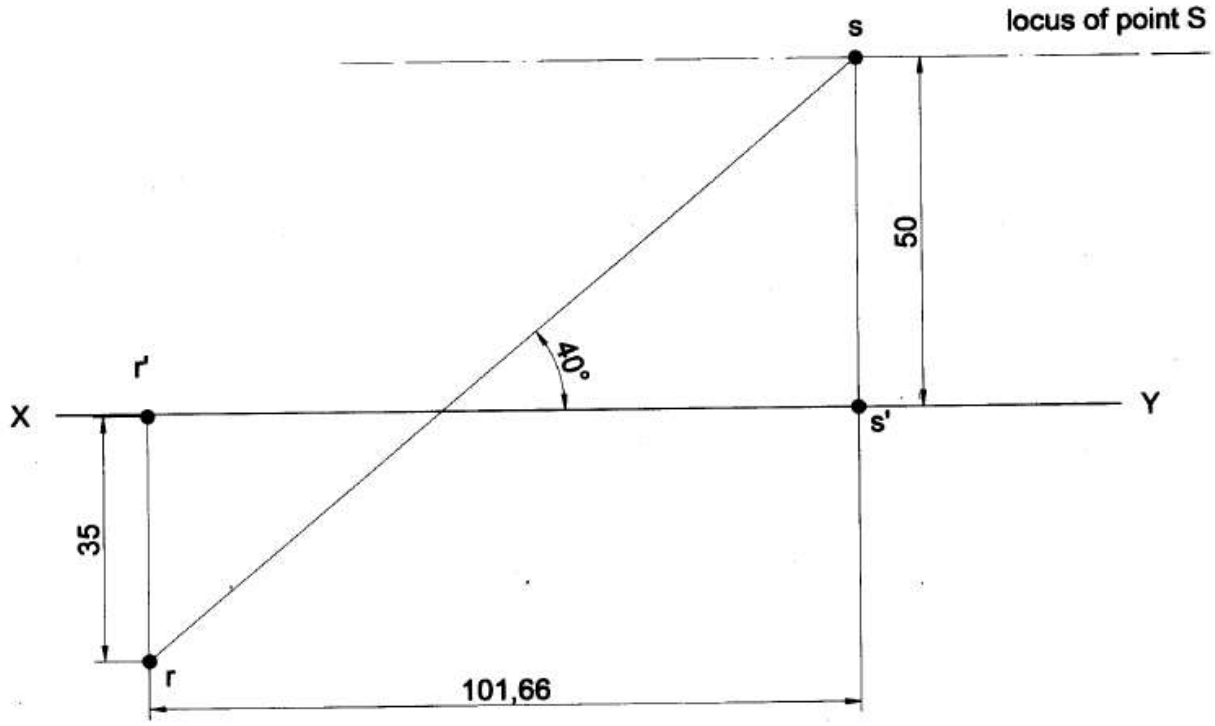
Solution



Point Q is 20.21 mm below HP

Problem 8 Two Points R and S are on HP. The point R is 35 mm in front of VP, while S is 50mm behind VP .The line joining their top views makes an angle of 40deg with XY. Find the horizontal distance between the two projectors.

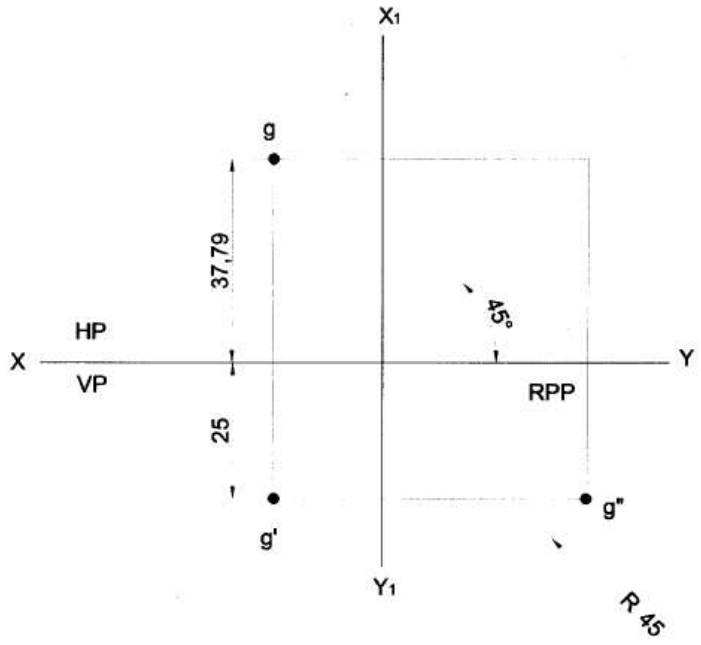
Solution



ANSWER : Distance b/w two projectors is 101.66 mm.

Problem 9 A point G is 25 mm below HP & is situated in the third quadrant. Its shortest distance from the intersection of XY and X1Y1 is 45 mm . Draw its projections and find its distance from VP.

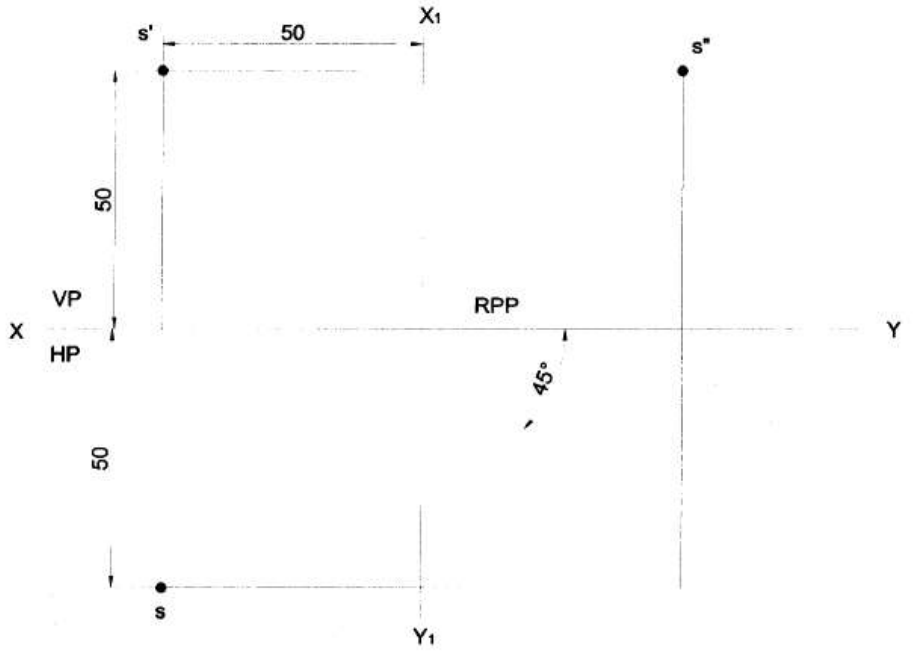
Solution



Point G is 37.79 mm behind VP

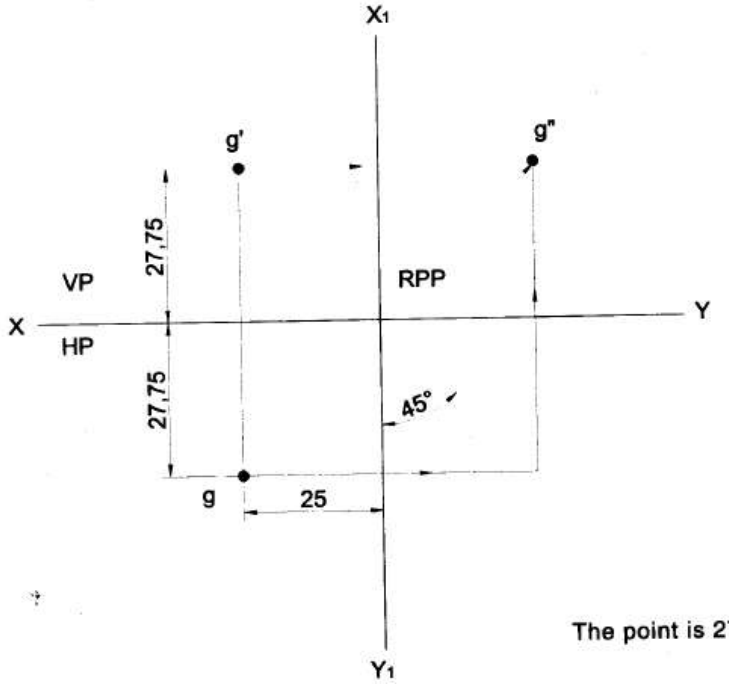
Problem 10 A point S is in the first quadrant and equidistant of 50 mm from all the three principal planes. Draw the projections of the point. Draw all the three views of the point.

Solution



Problem 11 Draw the projections of point G which is in first quadrant such that it is equidistant from HP & VP. The point is 25 mm from RPP. Determine its distances from HP&VP.

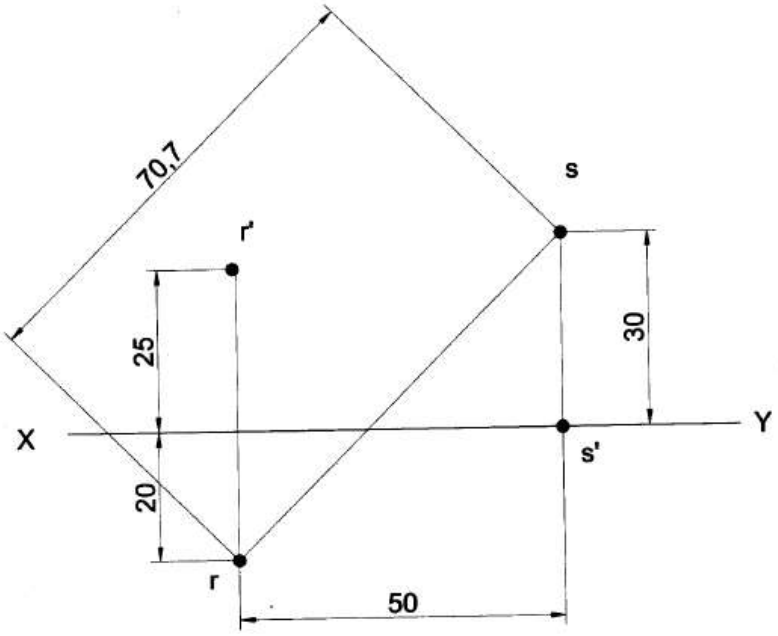
Solution



The point is 27.75 mm from VP and HP

Problem 12 A point R is 25 mm above HP & 20 mm in front of VP. Another point S is on HP and 30 mm behind VP. The distance between their projectors measured parallel to the line of intersection of VP and HP is 50mm. Find the distance between the top views of points R and S.

Solution



The Distance Between TVs of R and S is 70.7 mm

Projections of lines

Straight line

A line is a geometric primitive that has length and direction, but no thickness. Straight line is the Locus of a point, which moves linearly. Straight line is also the shortest distance between any two given points.

The location of a line in projection quadrants is described by specifying the distances of its end points from the VP, HP and PP. A line may be:

- Parallel to both the planes.
- Parallel to one plane and perpendicular to the other.
- Parallel to one plane and inclined to the other.
- Inclined to both the planes.

Projection of a line

The projection of a line can be obtained by projecting its end points on planes of projections and then connecting the points of projections. The projected length and inclination of a line, can be different compared to its true length and inclination.

Case 1. Line parallel to a plane

When a line is parallel to a plane, the projection of the line on to that plane will be its true length. The projection of line **AB** lying parallel to the Vertical plane (VP) is shown in figure 1 as **a'b'.**

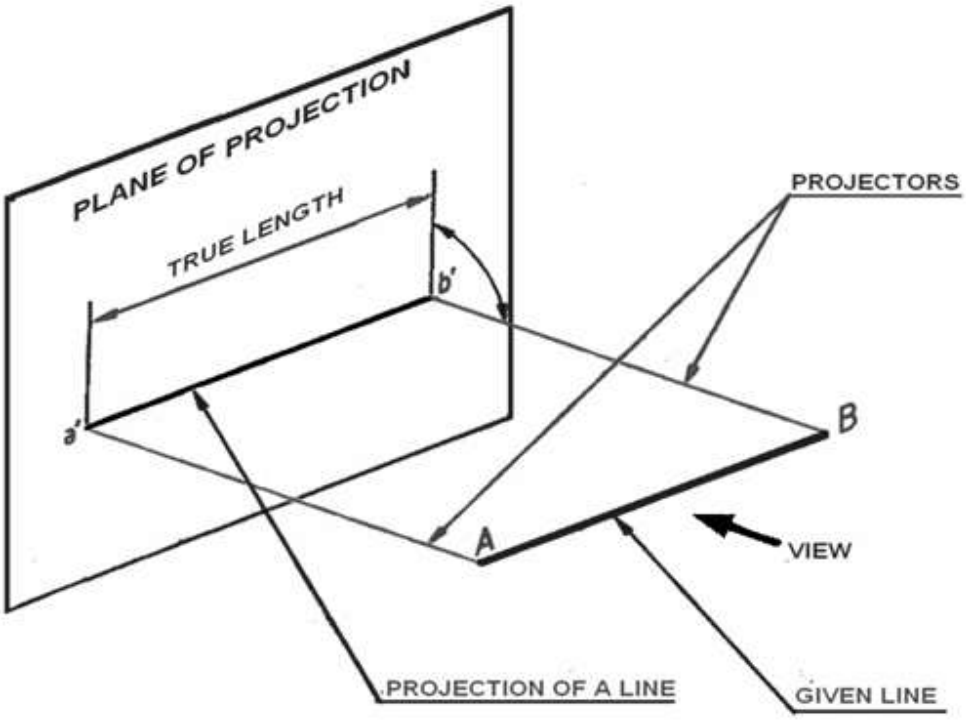


Figure 1. Projection of line on VP. Line AB is parallel to VP.

Case 2. Line inclined to a plane

When a line is parallel to one plane and inclined to the other, The projection of the line on the plane to which it is parallel will show its true length. The projected length on the plane to which it is inclined will always be shorter than the true length. In figure 2, the line AB is parallel to VP and is inclined to HP. The angle of inclination of AB with HP is being θ degrees. Projection of line AB on VP is a'b' and is the true length of AB. The projection of line AB on HP is indicated as line ab. Length ab is shorter than the true length AB of the line.

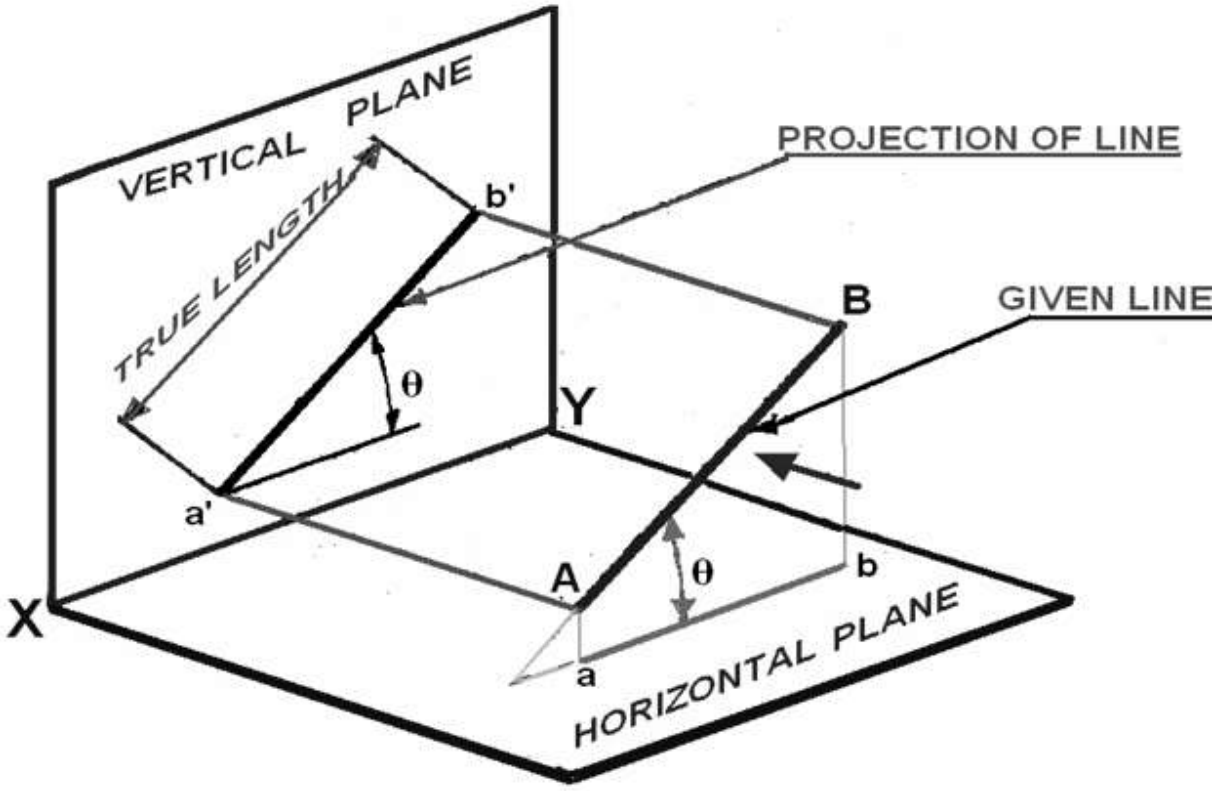


Figure 2. Projection of line AB parallel to VO and inclined to HP.

Case 3. Projection of a line parallel to both HP and VP

A line AB having length 80 mm is parallel to both HP and VP. The line is 70 mm above HP, 60 mm in front of VP. End B is 30 mm in front of right PP. To draw the projection of line AB, assume the line in the first quadrant. The projection points of AB on the vertical plane VP, horizontal plane HP and Right Profile plane PP is shown in figure 3(a). Since the line is parallel to both HP and VP, both the front view a'b' and the top view ab are in true lengths. Since the line is perpendicular to the right PP, the left side view of the line will be a point a'' (b''). After projection on to the projection planes, the planes are rotated such that all the three projection planes lie in the same planes. The multi-view drawing of line AB is shown in Figure 3(b).

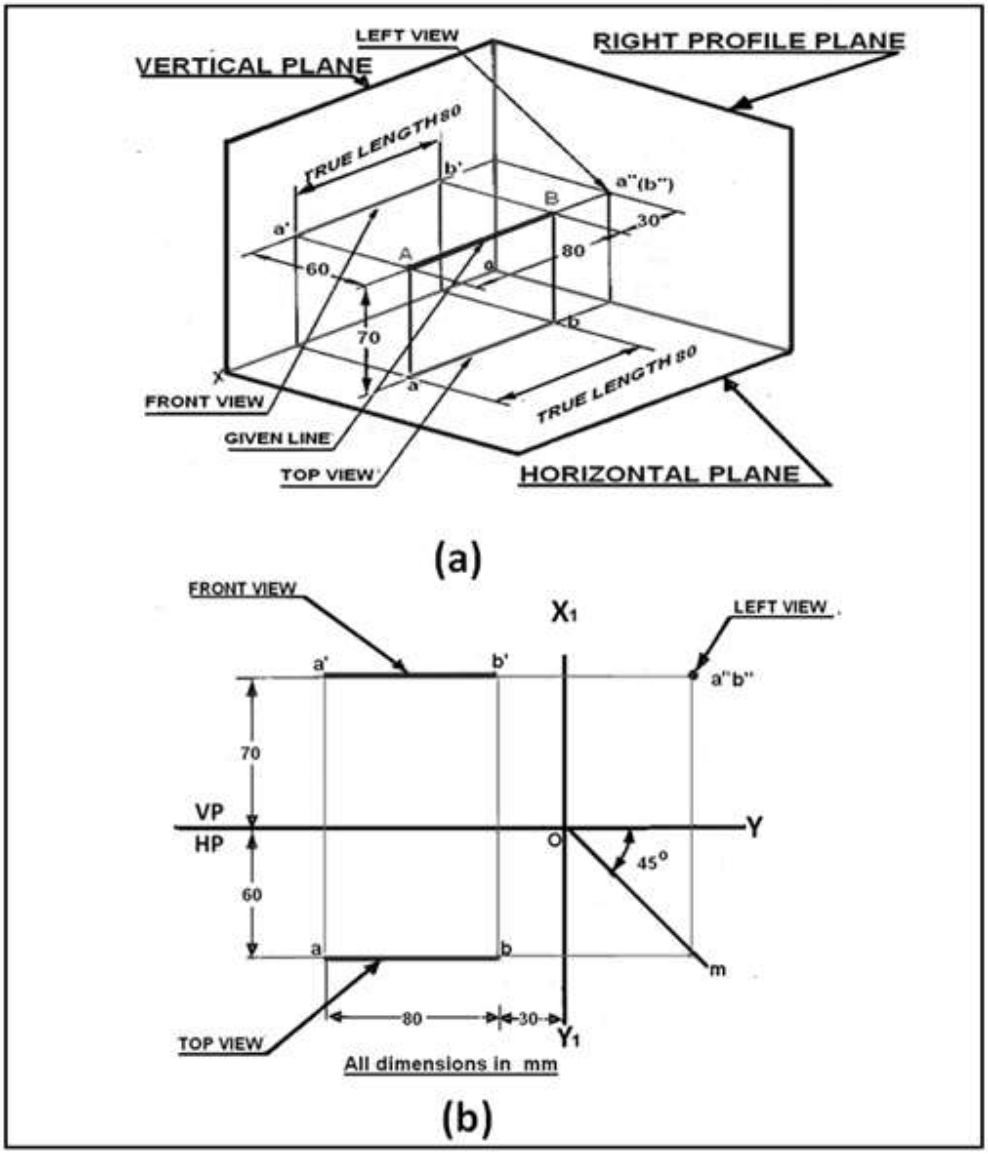


Figure 3. Projection of line parallel to both HP and VP.

Case 4. Line perpendicular to HP & parallel to VP

A line AB of length 80 mm is parallel to VP and perpendicular to HP. The line is 80 mm in front of VP and 80 mm in front of right PP. The lower end of the line is 30 mm above HP. The projections of line AB shown in figure 4 can be obtained by the following method.

Draw a line XY which is the intersection between VP and HP. Draw the front view a'b' = 80 mm perpendicular to the XY line, with the lower end b' lying 30 mm above the XY line. Project the top view of the line which will be a point a(b) at a distance of 60 mm below XY line. Since the line is 70 mm in front of the right PP draw the X_1Y_1 line at a distance of 70 mm on the right- side of the front view.

Through O the point of intersection of XY and X_1Y_1, lines draw a 45° line. Draw the horizontal projector through a(b) to cut the 45 degree line at m. Draw the horizontal projectors through a' and b' to intersect the vertical projector drawn through m at a ′ ′ and b ′ ′. a ′ ′b ′ ′ is the left view of the line AB.

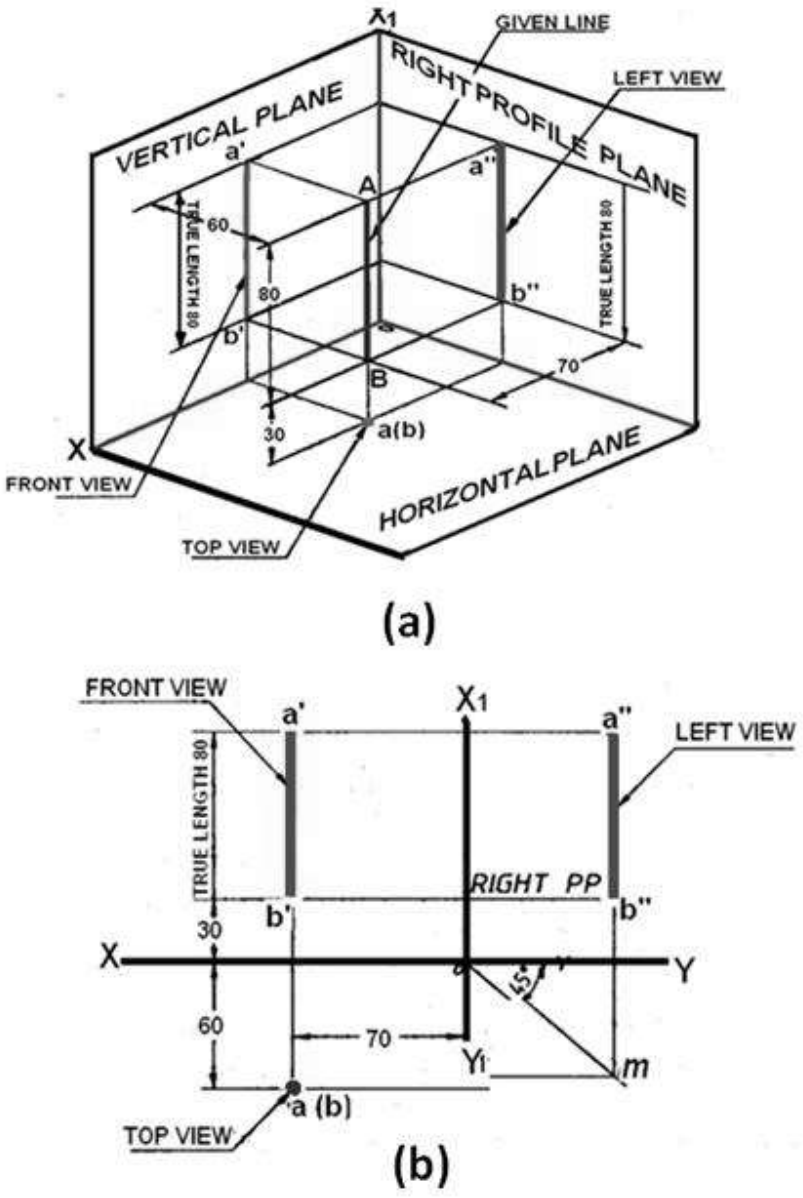


Figure 4. Projections of a line AB perpendicular to HP and parallel to VP.

Line parallel to one plane and inclined to the other

Case 5. Line parallel to VP and inclined to HP

A line AB, 90 mm long is inclined at 30° to HP and parallel to VP. The line is 80 mm in front of VP. The lower end A is 30 mm above HP. The upper end B is 50 mm in front of the right PP. The projections of line AB shown in figure 5 can be obtained in the following manner. Mark a', the front view of the end A, 30 mm above HP. Draw the front view a'b' = 90 mm inclined at 30° to XY line.

Project the top view **ab** parallel to XY line. The top view is 80 mm in front of VP. Draw the X_1Y_1 line at a distance of 50 mm from **b'**. Draw a 45° line through **O**. Draw the horizontal projector through the top view **ab** to cut the 45 ° line at **m**. Draw a vertical projector through **m**. Draw the horizontal projectors through **a'** and **b'** to intersect the vertical projector drawn through m at **a"** and **b"**. Connect a''b'' which is the left side view.

Case 6. Line inclined to HP and VP

When a line is inclined to both HP and VP, the apparent inclination of the line to both the projection planes will be different from the actual inclinations. Similarly the projected length of the lines on to the planes will not be the same as the true length f the line. The following notation will be used for the inclinations and length of the lines for this entire lecture series:

Actual inclinations are θ degrees to HP and φ degrees to VP.
Apparent Inclinations are a and b to HP and VP respectively.
The Apparent Lengths of line AB are ab and a'b' in the top view and front view respectively.

Example: Draw the projections of a line AB inclined to both HP and VP, whose true length and true inclinations and locations of one of the end points, say A are given.

The projections of the line AB are illustrated in figure 1. Since the line AB is inclined at θ to HP and φ to VP – its top view ab and the front view a'b' are not in true lengths and they are also not inclined at angles θ to HP and φ to VP in the Front view and top view respectively. Figure 2 illustrates the projections of the line AB when the line is rotated about A and made parallel to VP and HP respectively. A clear understanding of these can be understood if the procedure followed in the subsequent sub-sections are followed:

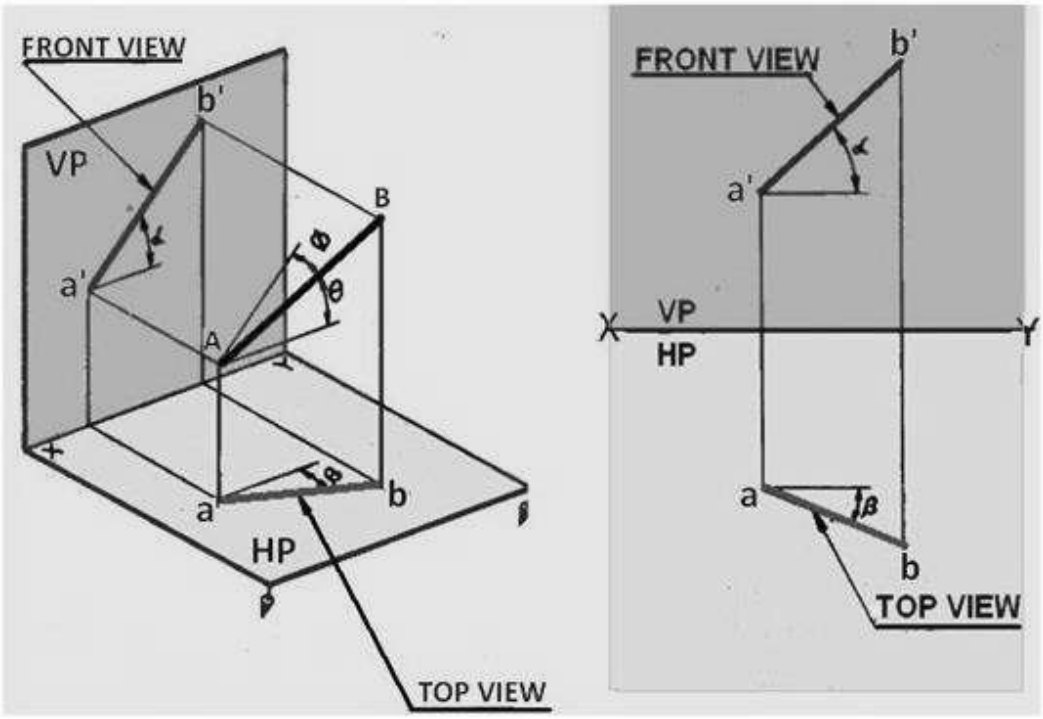
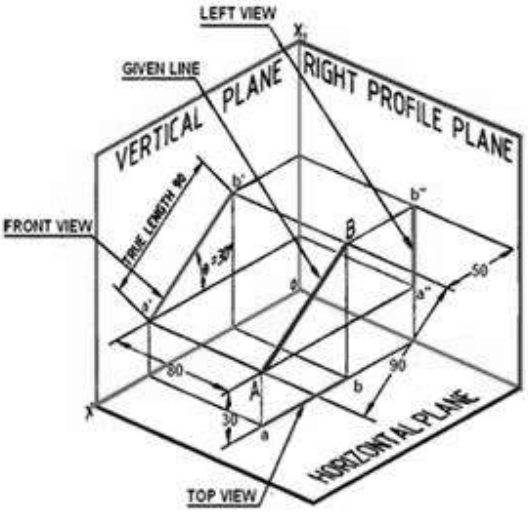
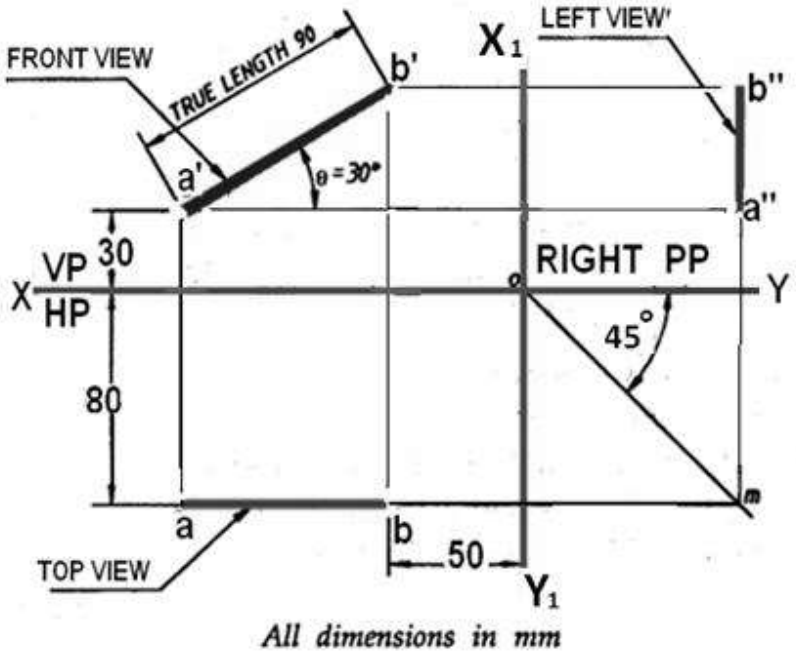


Figure 1: The projections of a line inclined to both HP and VP



(a)



(b)

Figure 5. Projections of line AB parallel to VP and inclined to HP.

Step 1: Rotate the line AB to make it parallel to VP.

Rotate the line AB about the end A, keeping θ, the inclination of AB with HP constant till it becomes parallel to VP. This rotation of the line will bring the end B to the new position B1. AB_1 is the new position of the line AB when it is inclined at q to HP and parallel to VP. Project AB_1 on VP and HP. Since AB_1 is parallel to VP, $a'b_1'$, the projection of AB1 on VP is in true length inclined at q to the XY line, and ab1, the projection of AB_1 on HP is parallel to the XY line. Now the line is rotated back to its original position AB.

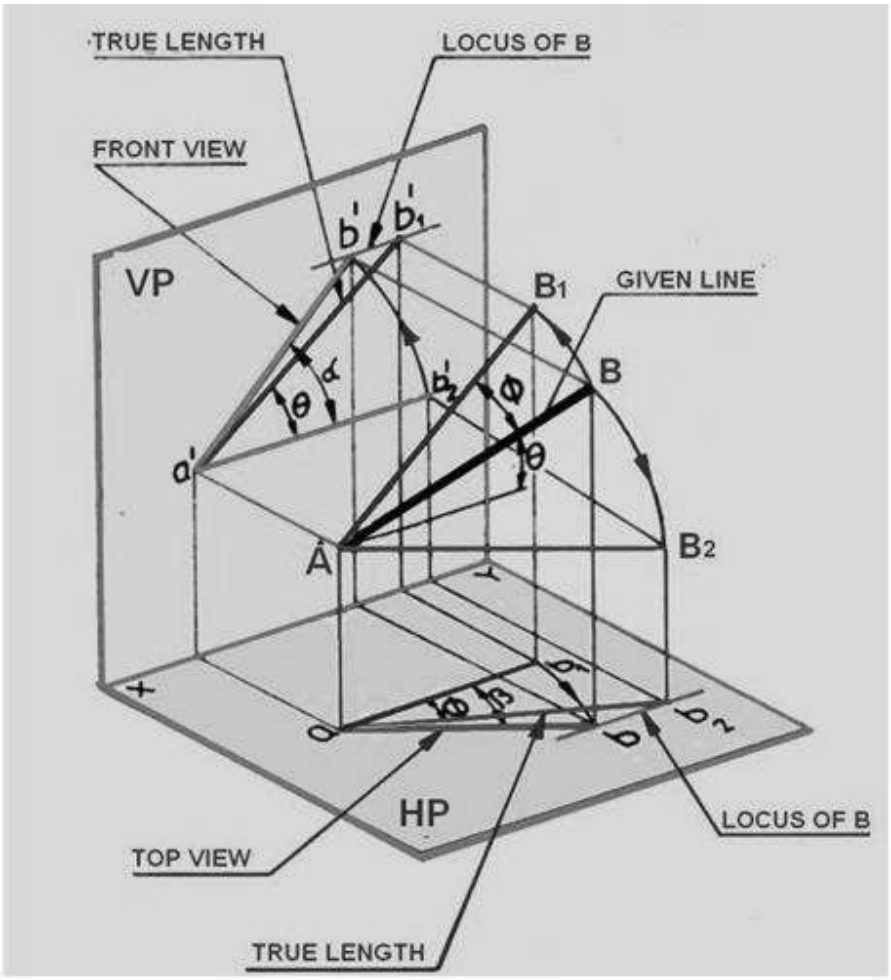


Figure 2. Illustrates the locus of end B of the line AB when the line is rotated about end A

Step 2: Rotate the line AB to make it parallel to HP.

Rotate the line AB about the end A keeping φ the inclination of AB with VP constant, till it becomes parallel to HP as shown in figure 2. This rotation of the line will bring the end B to the second new Position B_2. AB_2 is the new position of the line AB, when it is inclined at f to VP and parallel to HP. Project AB_2 on HP and VP. Since AB_2 is parallel to HP, ab_2, the projection of AB_2 on HP is in true length inclined at f to XY line, and $a'b_2'$ the projection of AB_2 on VP is parallel to XY line. Now the line is rotated back to its original position AB.

Step 3: Locus of end B in the front view

Referring to figure 2, when the line AB is swept around about the end A by one complete rotation, while keeping θ the inclination of the line with the HP constant, the end B will always be at the same vertical height above HP, and the locus of the end B will be a circle which appears in the front view as a horizontal line passing through b'.

As long as the line is inclined at θ to HP, whatever may be the position of the line (i.e., whatever may be the inclination of the line with VP) the length of the top view will always be equal to ab1 and in the front view the projection of the end B lies on the locus line passing through b1'.

Thus ab_1, the top view of the line when it is inclined at θ to HP and parallel to VP will be equal to ab and $b^{'}$, the projection of the end B in the front view will lie on the locus line passing through $b_1{}^{'}$.

Step 4: Locus of end B in the top view

It is evident from figure 2, that when the line AB is swept around about the end A by one complete rotation, keeping f the inclination of the line with the VP constant, the end B will always be at the same distance in front of VP and the locus of the end B will be a circle which appears in the top view as a line, parallel to XY, passing through b.

As long as the line is inclined at φ to VP, whatever may be the position of the line (i.e., whatever may be the inclination of the line with HP), the length of the front view will always be equal to $a'b_2'$ and in the top view the projection of the end B lies on the locus line passing through b_2.

Thus $a^{'}b_2{}^{'}$ the front view of the line when it is inclined at f to VP and parallel to HP, will be equal to a'b' and also b, the projection of the end B in the top view lies on the locus line passing through b_2.

Step 5: To obtain the top and front views of AB

From the above two cases of rotation it can be said that

(i)the length of the line AB in top and front views will be equal to ab_1 and $a'b_2'$ respectively and

(ii) The projections of the end B, (i.e., b and b‵) should lie along the locus line passing through $b_2$and $b_1{}^{'}$ respectively.
With center a, and radius ab_2 draw an arc to intersect the locus line through b_2 at b. Connect ab the top view of the line AB.
Similarly with center a', and radius $a'b_2'$ draw an arc to intersect the locus line through b_1' at $b^{'}$. Connect a'b' the front view of the line AB.

Orthographic projections
As the location of one of the end points (i.e. A) with respect to HP and VP, is given, mark a and $a^{'}$, the top and the front views of point A.
If the line AB is assumed to be made parallel to VP and inclined at θ to HP. The front view of the line will be equal to the true length and true inclination of the line with HP. Draw $a'b_1'$ passing through a' at θ to XY line and equal to the true length of AB. $a'b_1'$ is projected down to get ab_1, the top view parallel to the XY line. This is illustrated in figure 3.

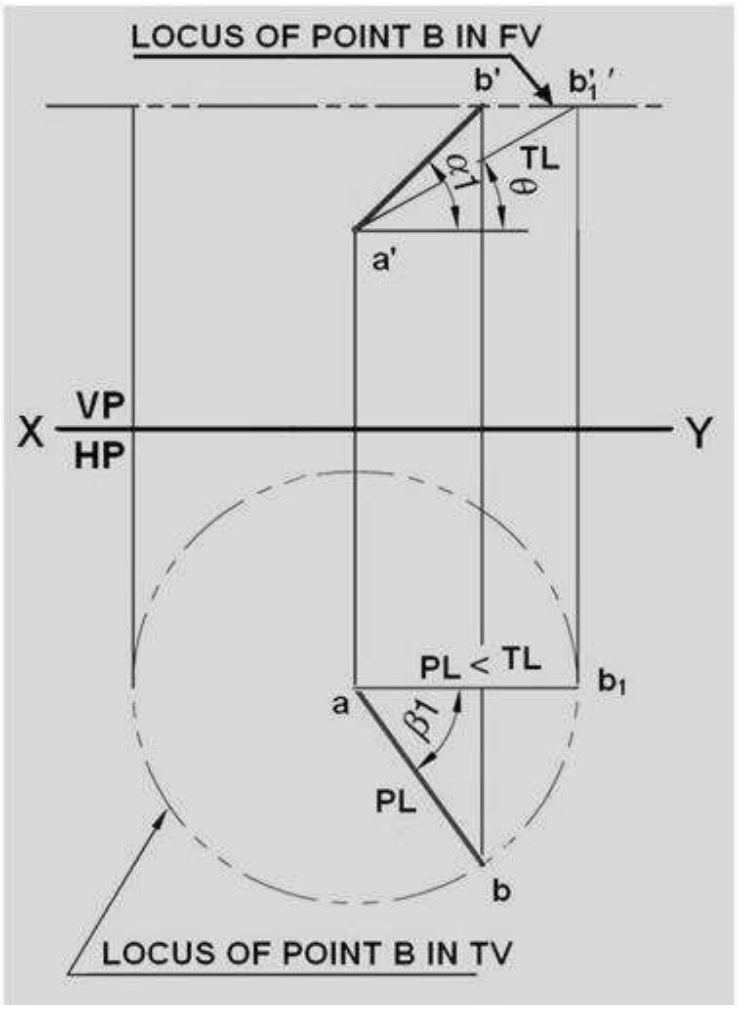


Figure 3. Illustrates the true length and true inclination of the line when it is made parallel to VP.

Now the line AB is assumed to be made parallel to HP and inclined at φ to VP. This is shown in figure 4. The top view of the line will be equal to the true length of the line and also φ, the inclination of the line with VP is seen in the top view. For this, draw ab_2 passing through a and incline at φ to the XY line. The length ab_2 is equal to the true length of AB. The end points a and b_2 are projected on to a line parallel to XY line and passing through a' to get $a'b_2'$ which is the front view of the line when it is parallel to HP and inclined to VP. Draw the horizontal locus lines through b_2, and b_1'. With center a and radius ab1, draw an arc to cut the locus line drawn through b_2 at b. Connect ab, the top view of the line AB. With center a' and radius $a'b_2'$, draw an arc to cut the locus line drawn through b_1' at b'. Connect a'b', the front view of the line AB. Orthographic projections of line AB inclined to both VP and HP, illustrating the projected length, true lengths apparent inclinations and true inclinations are shown in figure 5.

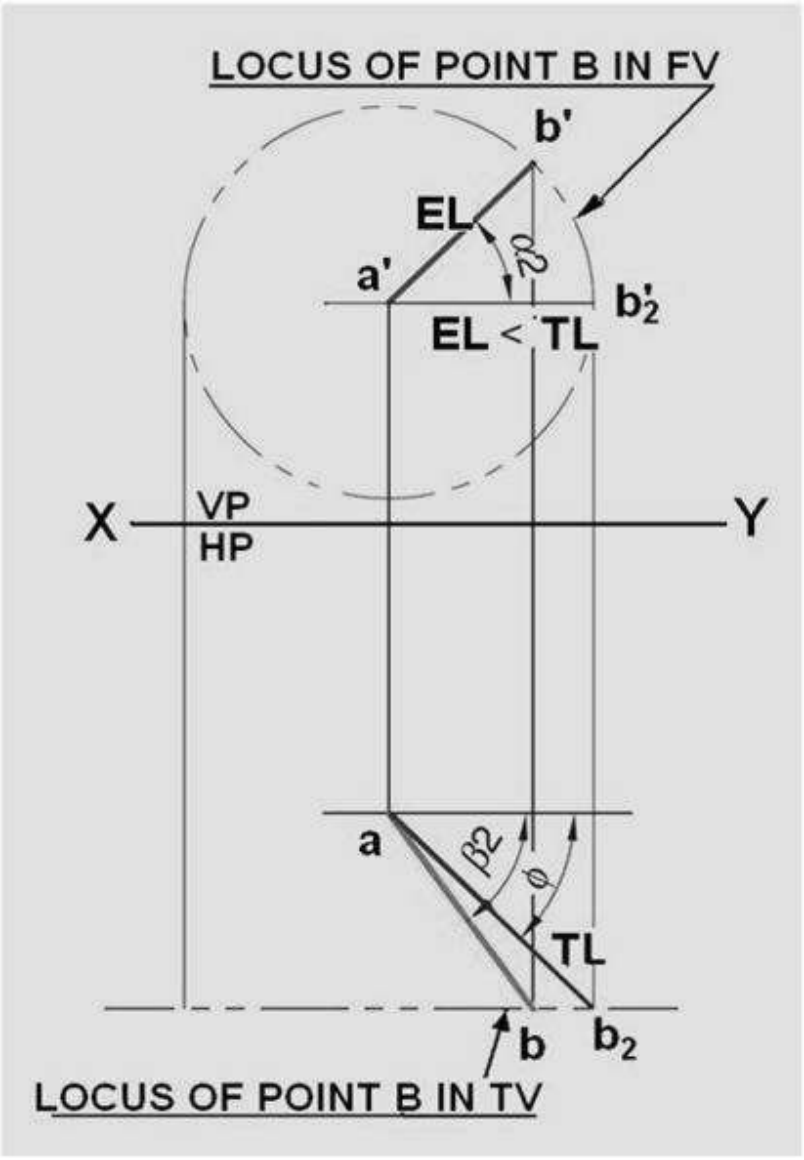


Figure 4. Illustrates the true length and true inclination of the line when it is made parallel to HP.

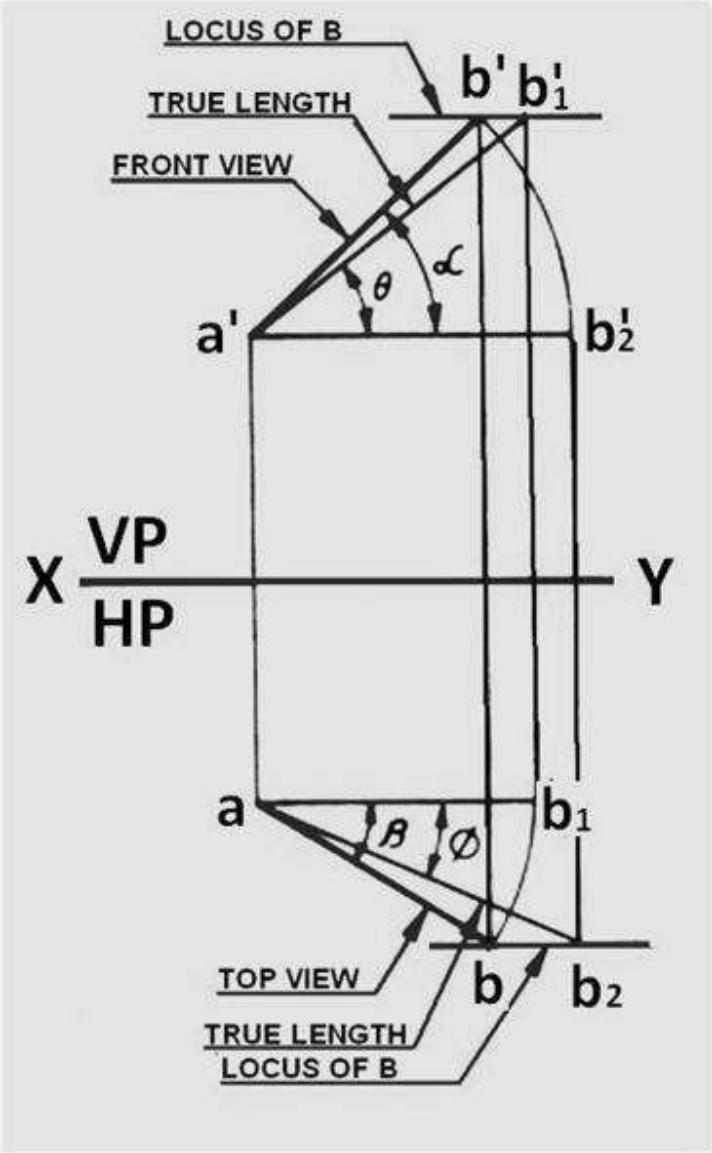


Figure 5. Illustrates the true length, apparent lengths, tue inclination and apparent inclination of the line AB inclined to HP and VP..

To Find True length and true inclinations of a line

Many times if the top and front views of a line are given, the true length and true inclinations of a line is required to be determined.

The top and front views of the object can be drawn from if any of the following data are available:

(a) Distance between the end projectors,

(b) Distance of one or both the end points from HP and VP and

(c) Apparent inclinations of the line.

The problems may be solved by

(i) Rotating line method or
(ii) Rotating trapezoidal plane method or
(iii) Auxiliary plane method.

Rotating line method

The method of obtaining the top and front views of a line, when its true length and true inclinations are given.
When a view of a line is parallel to the XY line, its other view will be in true length and at true inclination.
By following the procedure mentioned previously, in the reverse order, the true length and true inclinations of a line from the given set of top and front views can be found. The step by step procedure is shown below in figure 1.

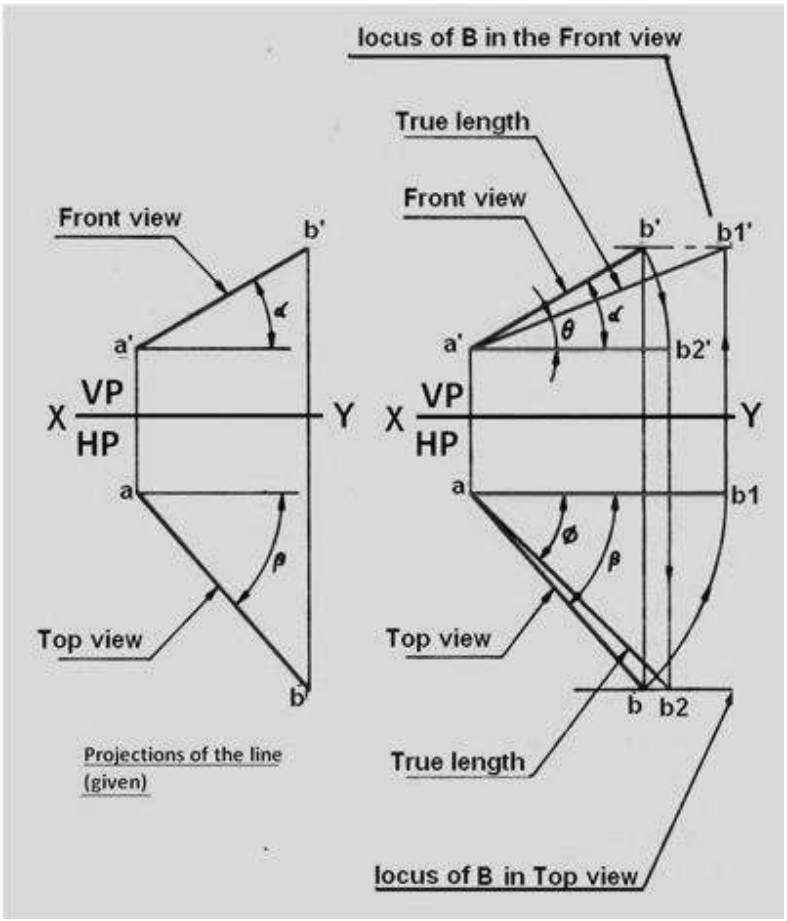


Figure 1. determinationof ture length and true inclinations of a line.

- Draw the top view ab and the front view a'b' as given
- Rotation of the top view: With center a and radius abrotate the top view to the new position ab1 to make it parallel to the XY line. Since ab1 is parallel to the XY line, its corresponding front view will be in true length and at true inclination.

- Rotation of the front view: With center a' and radius a'b' rotate the front view to the new position a'b2' parallel to the XYline. Since a'b2' is parallel to the XY line, its corresponding top view will be in true length and at true inclination. In this position, the line will be parallel to HP and inclined at fto VP. Through b draw the locus of B in the top view. Project b2' to get b2, in the top view. Connect ab2 which will be in true length and true inclination f which the given line AB makes with VP.

Traces of a line

- The trace of a line is defined as a point at which the given line, if produced, meets or intersects a plane.
- When a line meets HP, (or if necessary on the extended portion-of HP), the point at which the line meets or intersects the horizontal plane, is called horizontal trace (HT)of the line and denoted by the letter H.
- When a line meets VP (or if necessary on the extended portion of VP), the point at which the line meets or intersects the vertical plane, is called vertical trace (VT) of the line and denoted by the letter V.
- When the line is parallel to both HP and VP, there will be no traces on the said planes. Therefore the traces of lines are determined in the following positions of the lines.

Trace of a line perpendicular to one plane and parallel to the other
Since the line is perpendicular to one plane and parallel to the other, the trace of the line is obtained only on the plane to which it is perpendicular, and no trace of the line is obtained on the other plane to which it is parallel. Figures 2 and 3 illustrates the trace of a line parallel tp0VP and perpendicular to HP and parallel to HP and perpendicular to VP respectively.

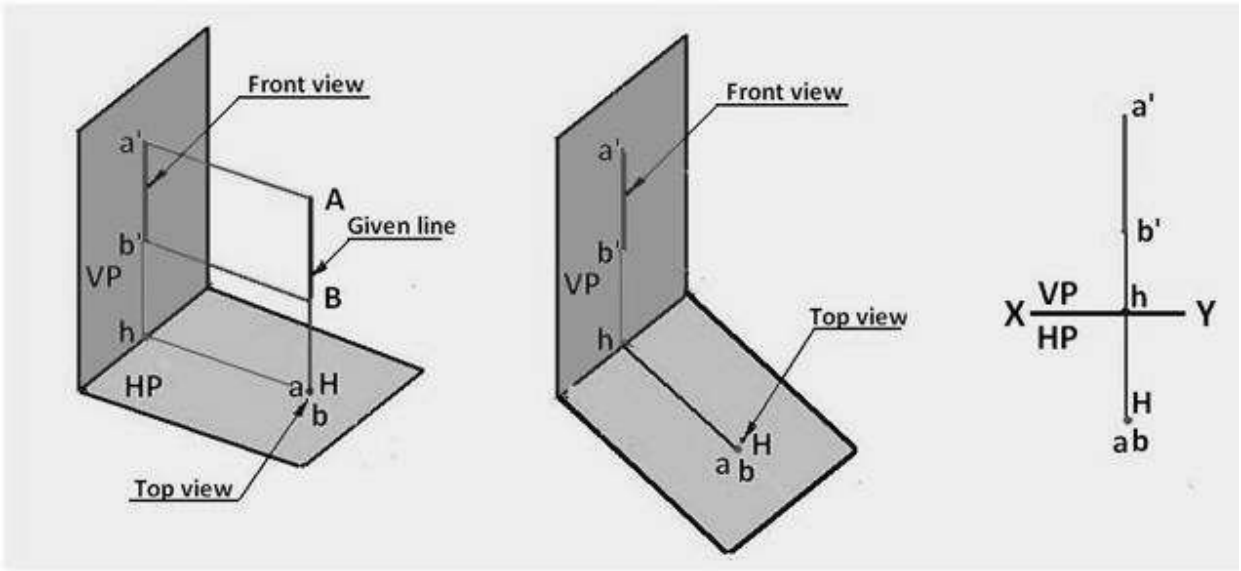


Figure 2. Trace of line parallel to VP and perpendicular to HP

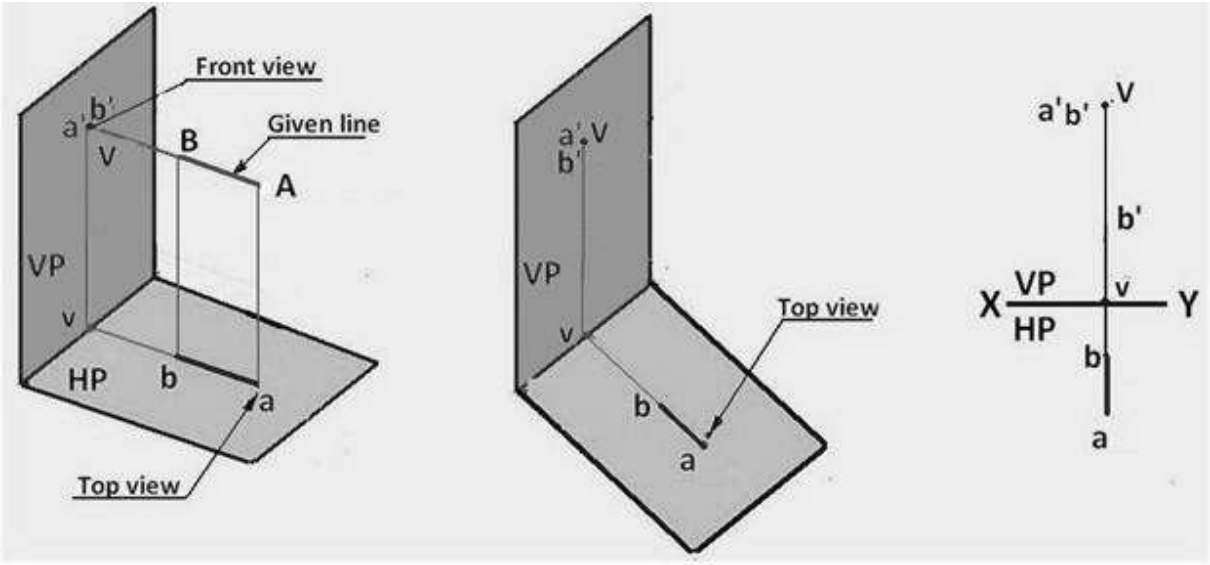


Figure 3. Trace of a line perpendicular to the VP and parallel to HP

Traces of a line inclined to one plane and parallel to the other
When the line is inclined to one plane and parallel to the other, the trace of the line is obtained only on the plane to which it is inclined, and no trace is obtained on the plane to which it is parallel. Figure 4 shows the horizontal trace of line AB which is in lined HP and parallel to VP

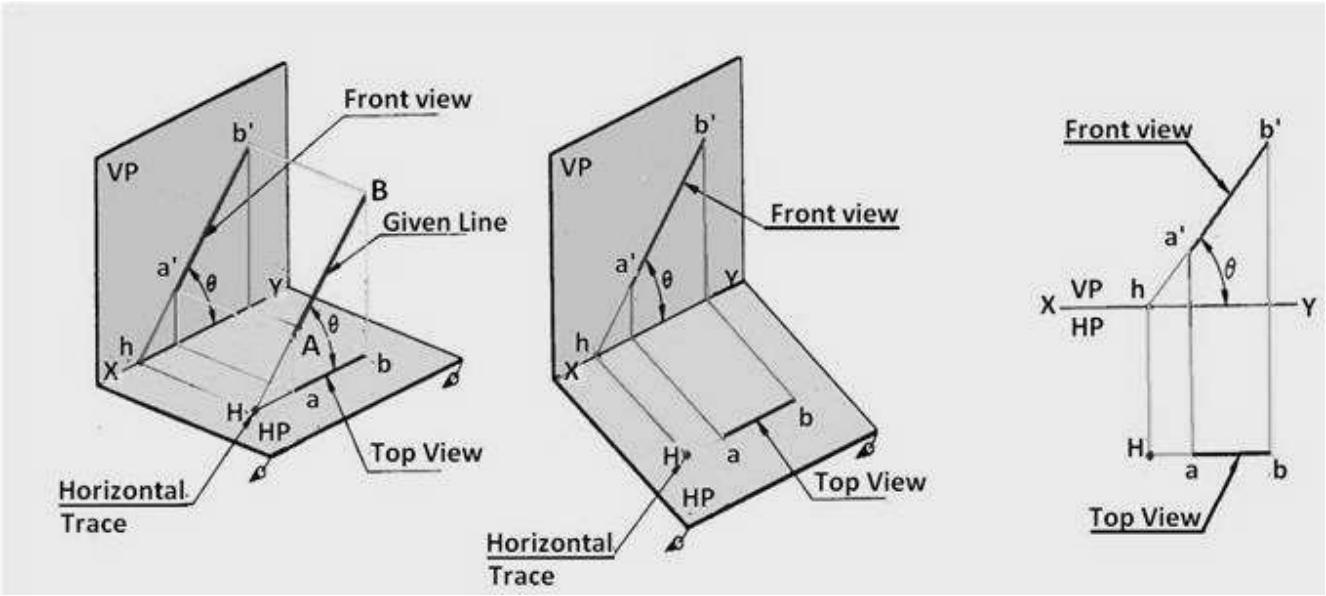


Figure 4 Horizontal trace of line AB

Figure 5 shows the vertical trace of line AB which is inclined to VP and parallel to HP

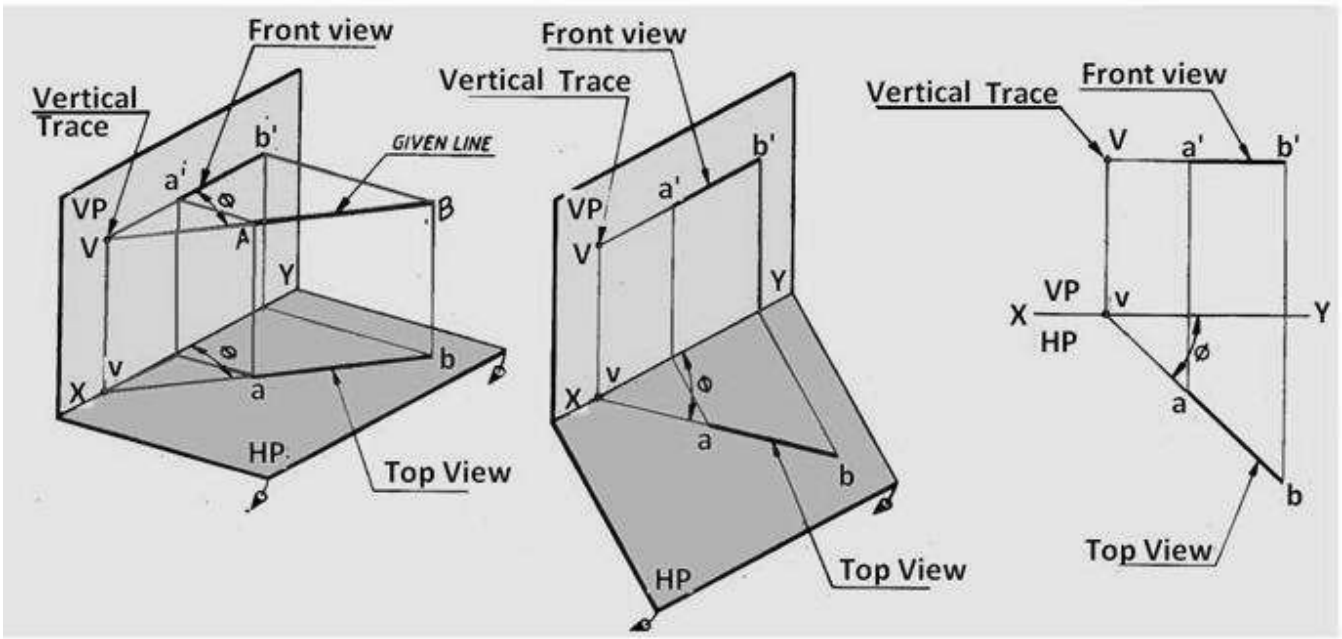


Figure 5 Vertical trace of line AB

Traces of a line inclined to both the planes

Figure 6 shows the Vertical trace (V) and Horizontal Trace (H) of Line AB inclined at q to HP and Φ to VP.

The line when extended intersects HP at H, the horizontal trace, but will never intersect the portion of VP above XY line, i.e. within the portion of the VP in the 1st quadrant. Therefore VP is extended below HP such that when the line AB is produced it will intersect in the extended portion of VP at V, the vertical trace.

In this case both horizontal trace (H) and Vertical Trace (V) of the line AB lie below XY line.

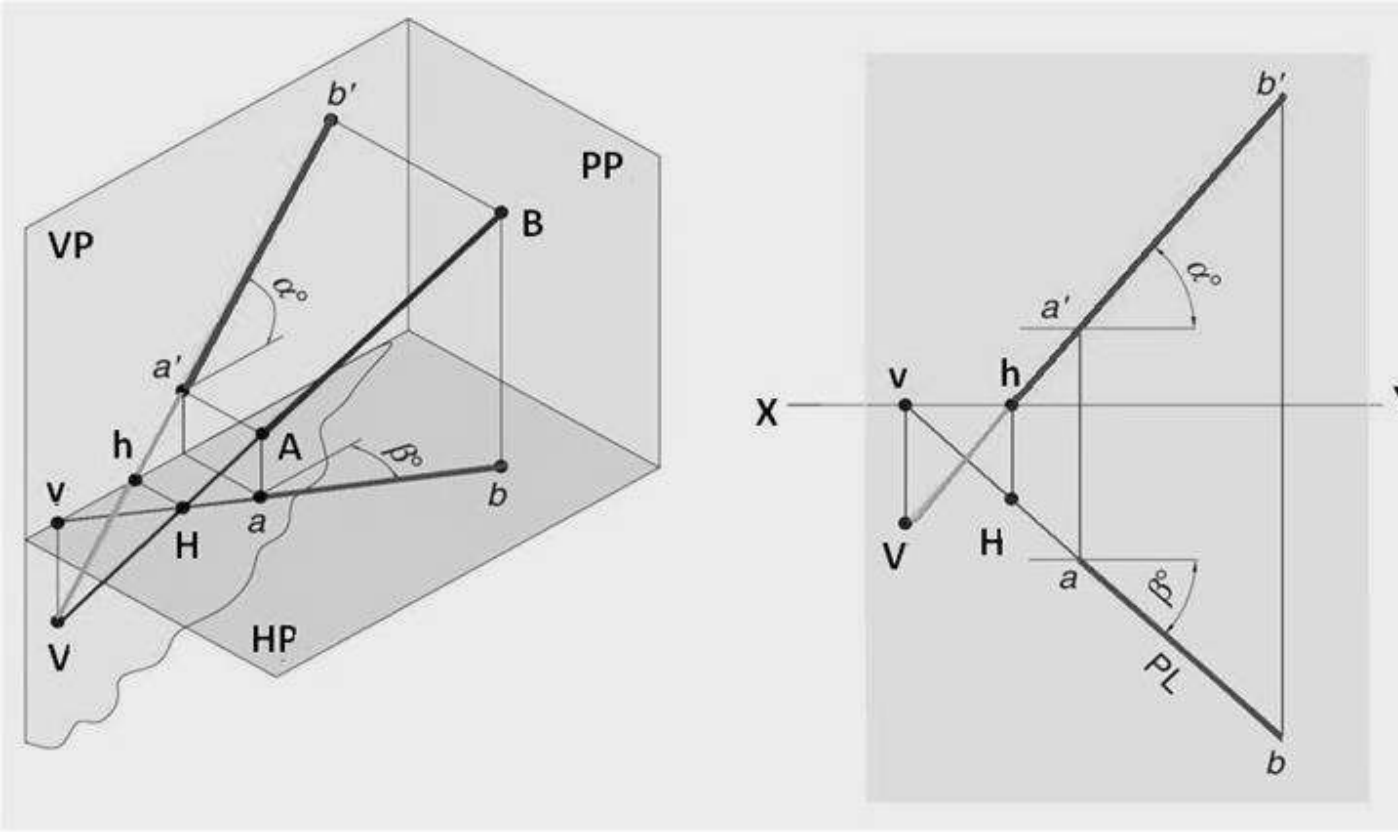


Figure 6 Vertical trace and horizontal trace of line AB which is inclined to both vertical plane and horizontal plane.

Projections of lines (Drawing practice)

Problem -1

A straight line AB of true length 100 mm has its end A 20 mm above HP and 30 mm in front of VP. The top view of the line is 80 mm and front view is 70 mm. Draw the projections (TV and FV) of the line AB and obtain the true inclinations of the line AB with HP and VP.

Solution: The solution to the problem is shown in figure 1. The step wise procedure for the solution is discussed below:

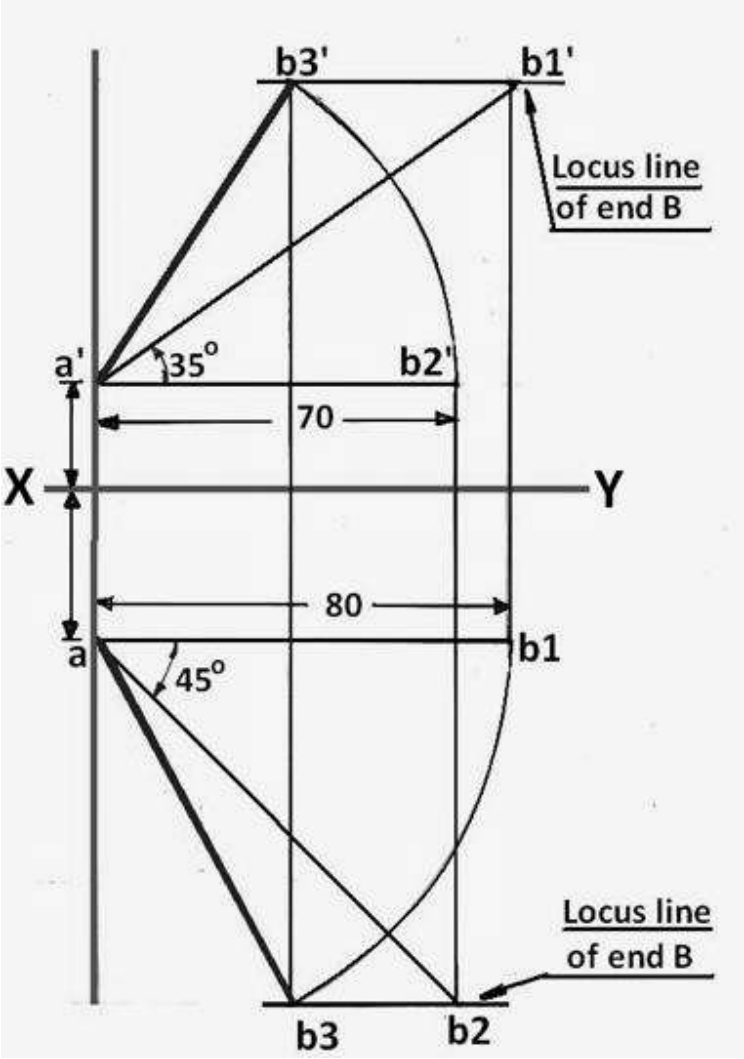


Figure 1. The projections of line AB in problem 1.

- Draw XY line and mark points **a'** (20 mm above XY line) and **a** (30mm below XY line) as given in the question.
- Let us assume that the line is parallel to HP and Inclined to VP.
- Draw a horizontal line from **a'** and mark distance equal to 70 mm on it. The end point is **b2'**. i.e., **a' b2'** = 70 mm.
- In this condition, the FV is parallel to XY line. TV can be obtained considering the following points:
- TV of point B will be along the vertical projector drawn from B2'.
- TV of line AB will be the true length = 100mm .
- The true inclination of the line with VP can also be obtained.

- Draw a projector downwards from **b2'**. It is clear that if TL of AB is drawn from **a** with the required inclination with the VP, it will give the distance **a' b2'**. Therefore, with radius equal to TL= 100mm and with centre **a**, cut an arc on the downward projector from **b2'**. Let this be **ab2**. Inclination of **ab2** with horizontal will give true inclination of line AB with VP.
- Locus of point B is marked as a horizontal line at **b2**.

- Let us no assume that the line is parallel to VP and inclined to HP.
- In this condition, the TV is parallel to XY line. FV can be obtained considering the following points:
- FV of point B will be along the vertical projector drawn from B2'.
- FV of line AB will be the true length = 100mm .
- The true inclination of the line with HP can also be obtained.

- Draw a horizontal line from **a** and mark distance equal to 80 mm on it. The end point is **b1**. **a b1** = 80 mm.
- Draw a projector upwards from **b1**. It is clear that if TL of AB is drawn from **a'** with the required inclination with the HP, it will give the distance **ab1**. Therefore, with radius equal to TL= 100mm and with centre **a'**, cut an arc on the upward projector from **b1**. Let this be **a'b1'**. Inclination of **a'b1'** with horizontal will give true inclination of line AB with HP.
- Locus of point B is marked as a horizontal line at **b1'**. (1)

Drawing the top view and front view of line AB

1. The plan of AB (**ab**) is obtained as follows: With a as centre and radius equal to **ab1**, cut an arc on the locus line drawn at **b2**.
2. The elevation of AB (**a'b'**) is obtained as follows: With **a'** as centre and radius equal to **a'b2'**, cut an arc on the locus line drawn at **b1'**.

The required inclinations are:
Angle of inclination with HP = 350
Angle of inclination with VP = 450

Problem **-2**
Straight line AB is 40 mm long. End A is 10mm above HP and 15 mm in front of VP. FV of the line is inclined at 45° and TV is inclined at 60° to XY line. Draw the projections of line AB (FV and TV) and obtain the true inclination of line AB with HP and VP.

Solution: The solution for problem 2 is shown in figure 2. The step wise procedure for the solution is discussed below:

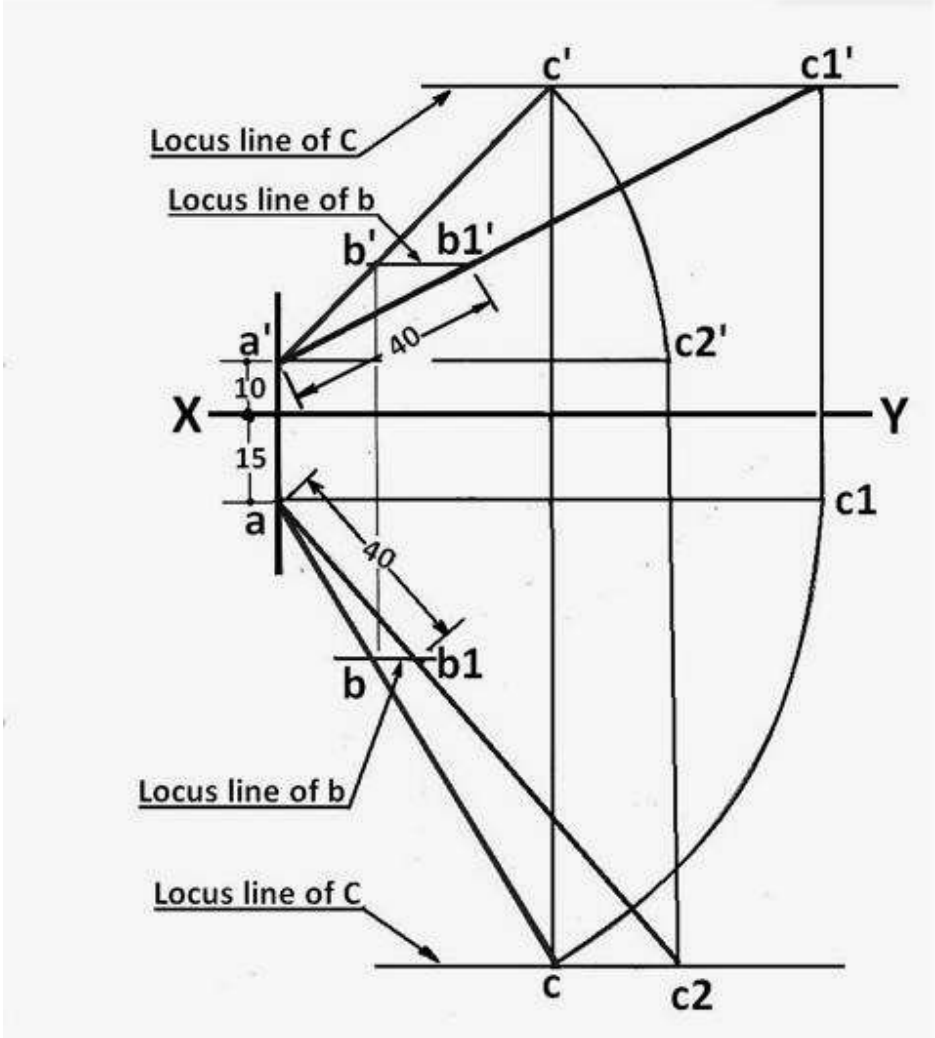


Figure 2. shows the solution of Problem 2.

- Mark the points **a'** and **a** according to the given data (i.e., 10 mm above and 15 mm below XY line, respectively).
- Since we don't know the exact position of point B in the FV, let us arbitrarily assume a point **C** on the line **AB** extended. Then the projections of points A, B, and C should line on the same line in all orientations. i.e the point corresponding to point **b'** will lie on line **a'c'**.
  - Draw a line at 45° to horizontal from **a'** and mark any point **c'** on it.
  - Under this situation, **b'** would lie on **a'c'**.
- From **a** draw a line at 60° to horizontal from **a**.
- Drop a projector from **c'** downwards to obtain the point **c** on 60° line.
- Draw horizontal lines at **c** and **c'** to denote the locus of point C.
- With **a** as centre and radius equal to **ac**, draw an arc to meet the horizontal through **a** at **c1**.
- Draw a projector upwards from **c1** to meet the horizontal locus line at **c'**. Let this meeting point be **c1'. a'c1'** would then represent the TL and true inclination of AC with HP.
- On **a'c1'** mark **b1'** such that **a'b1'** is equal to TL of AB = 40mm.

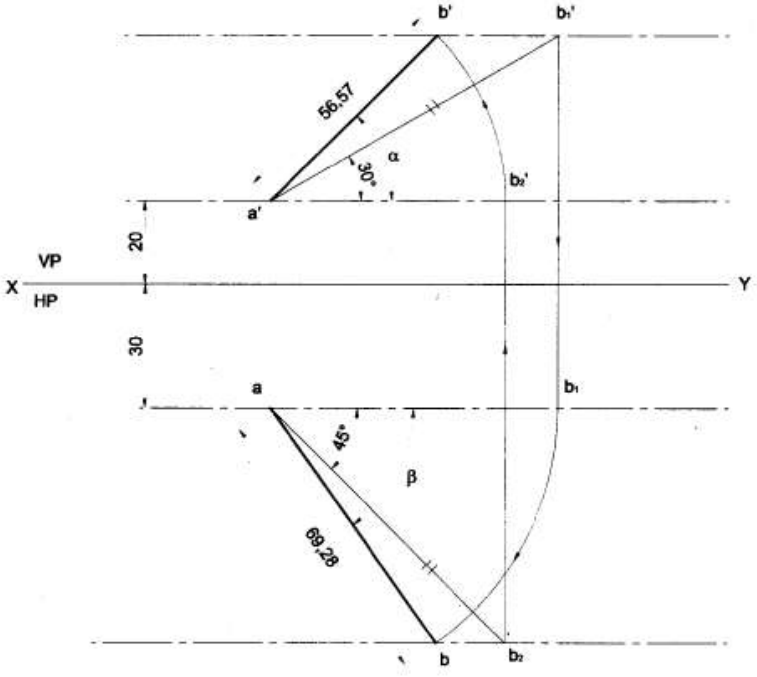
- Draw horizontal locus line through **b1'** to meet **a'c'** at **b'**.
- **a'b'** is the required FV of AB. Drop projector downwards from **b'** and obtain TV **ab**.
- Similarly, with **a'** as centre and radius equal to **a'c'**, draw an arc to meet the horizontal through **a'** at **c2'**.
- Draw the projector downwards to meet the locus line at **c** at **c2**. **ac2** would then represent the TL and true inclination of AC with VP.
- On **ac2**, mar b1 such that TL of AB (i.e. **ab1**) = 40 mm.
- Draw the locus line passing through **b1** to line **ac** at **b**.
- **ab** is the required TV of line AB.
- The vertical projector through **b'** should pass through **b**.

The required inclinations of line AB are:
Angle of inclination with HP ≈ 270
Angle of inclination with VP ≈ 500

Worked Examples- Projection of Lines

Problem 1 A line AB 80 mm long has its end A 20 mm above the HP and 30 mm infront of VP. It is inclined at 30° to HP and 45° to VP. Draw the projections of the line and find apparent lengths and apparent inclinations.

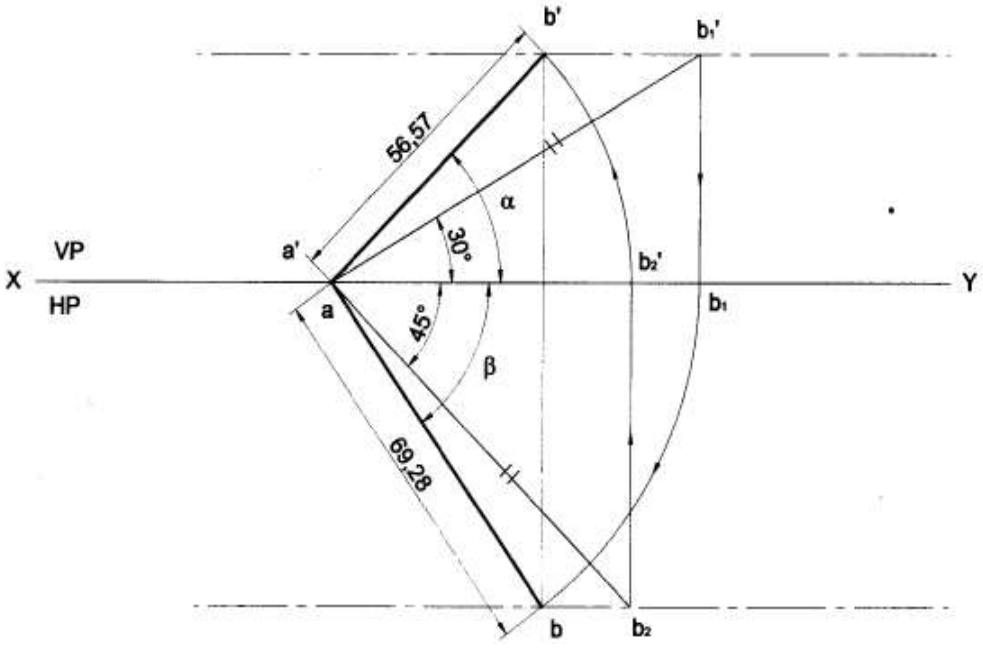
Solution



ANSWERS :
β = 55°
a'b' = 57
ab = 69

Problem 2 A line AB 80 mm long is inclined to HP at 30° and inclined to VP at 45°. Draw front and top views of line and determine their lengths. Also measure the perpendicular distance of end B from both HP and VP.

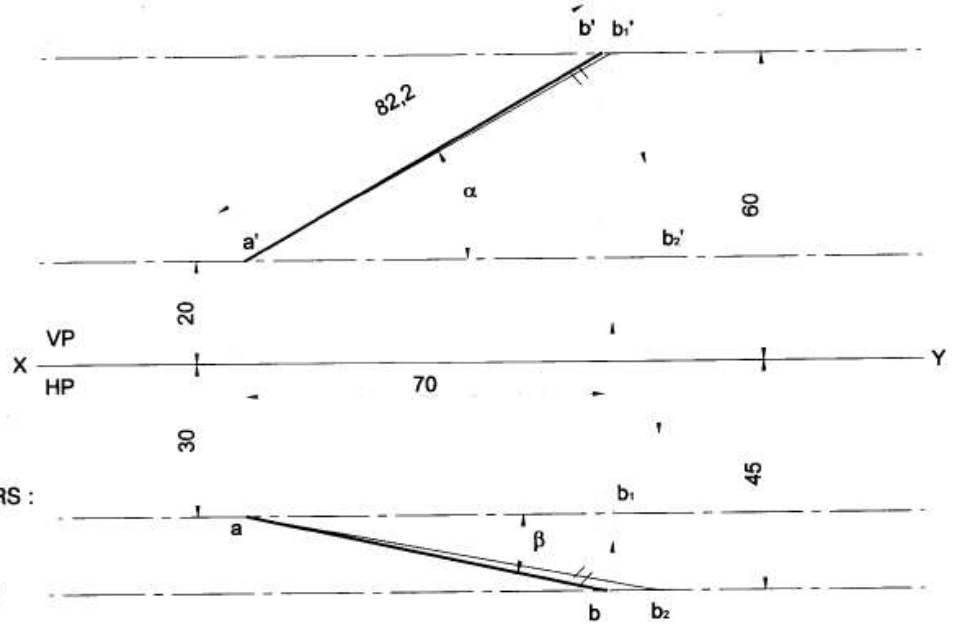
Solution



ANSWERS :
α = 45°
β = 55°
a'b' = 57
ab = 69

Problem 3 A line AB has its end A 20 mm above the HP and 30 mm infront of the VP. The other end B is 60 mm above the HP. The distance between end projectors is 70 mm. draw its projections. Determine the true length and apparent inclinations.

Solution



ANSWERS :

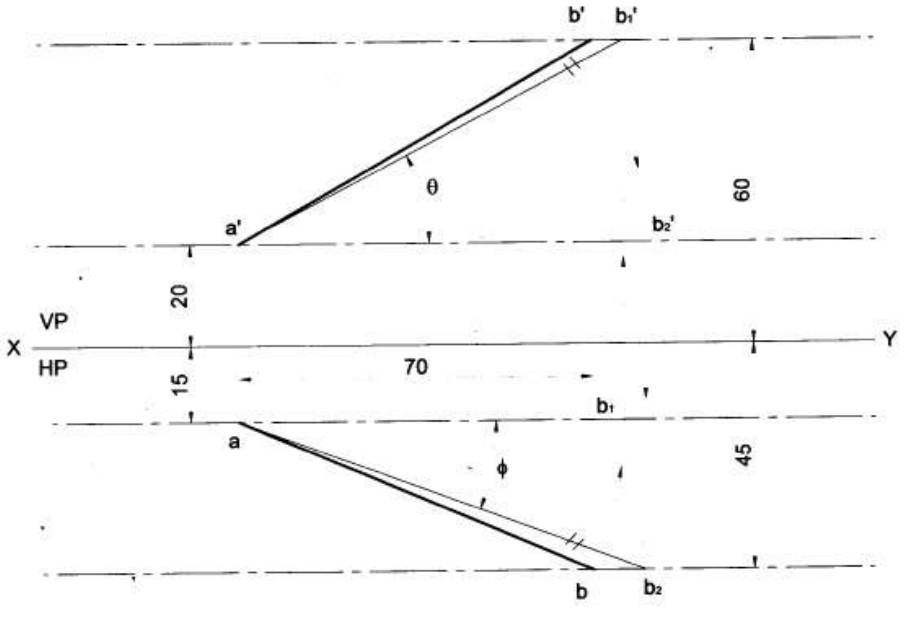
$\alpha = 30^0$

$\beta = 12^0$

a'b' = 82

Problem 4 A line AB has its end A 20 mm above the HP and 15 mm infront of the VP. The other end B is 60 mm above the HP. The distance between end projectors is 70 mm. draw its projections. Determine the apparent lengths and true inclinations.

Solution



ANSWERS :

$\theta = 28^0$

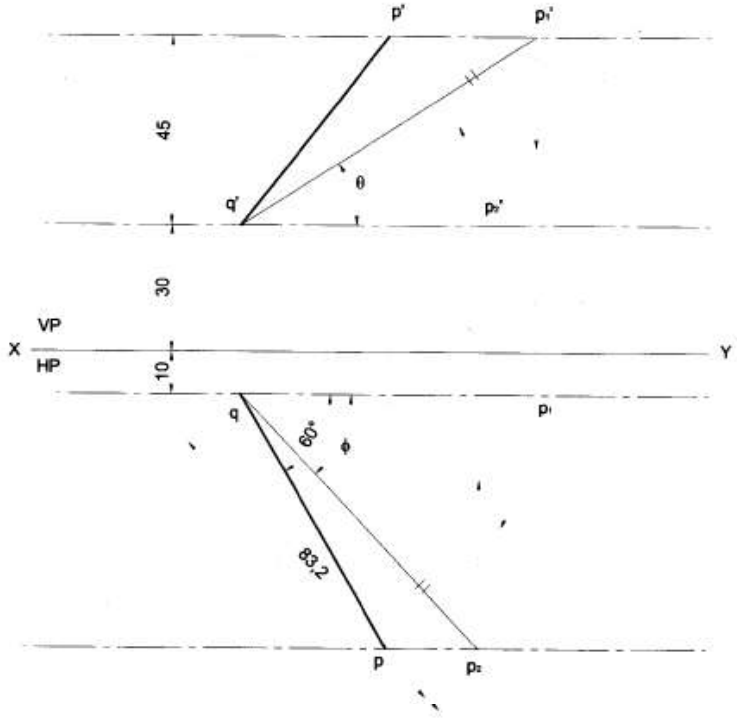
$\phi = 20^0$

a'b' = 81

ab = 76

Problem 5 The top view PQ of a straight line is 70 mm and makes an angle of 60° with XY line. The end Q is 10 mm infront of VP and 30 mm above the HP. The difference between the distances of P and Q above the HP is 45 mm. draw the projections. Determine its true length and true inclinations with HP and VP.

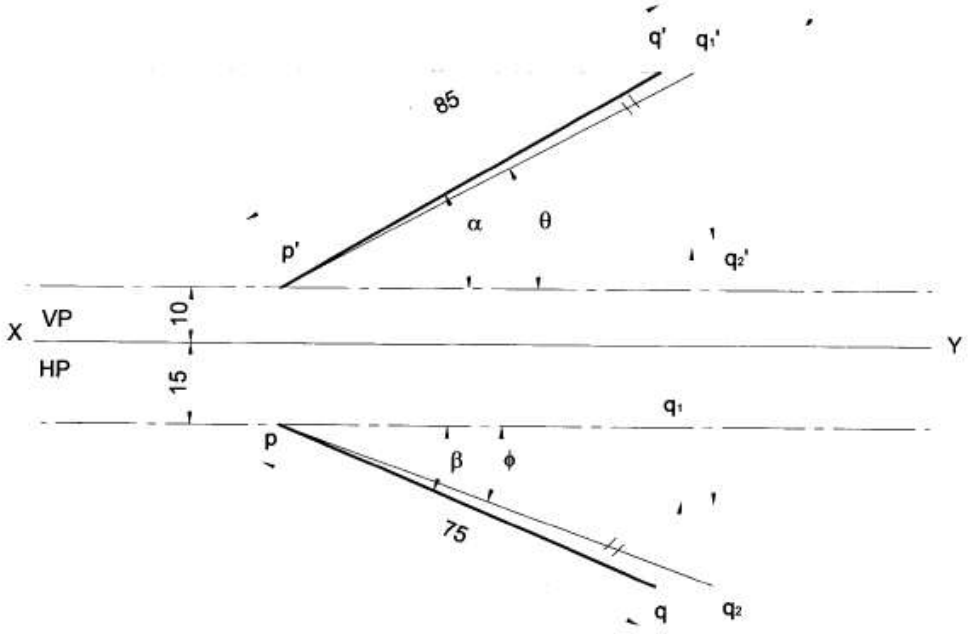
Solution



ANSWERS :
$\theta = 33^0$
$\phi = 47^0$
$qp_2 = 83$

Problem 6 A line PQ 85 mm long has its end P 10 mm above the HP and 15 mm infront of the VP. The top view and front view of line PQ are 75 mm and 80 mm respectively. Draw its projections. Also determine the true and apparent inclinations of the line.

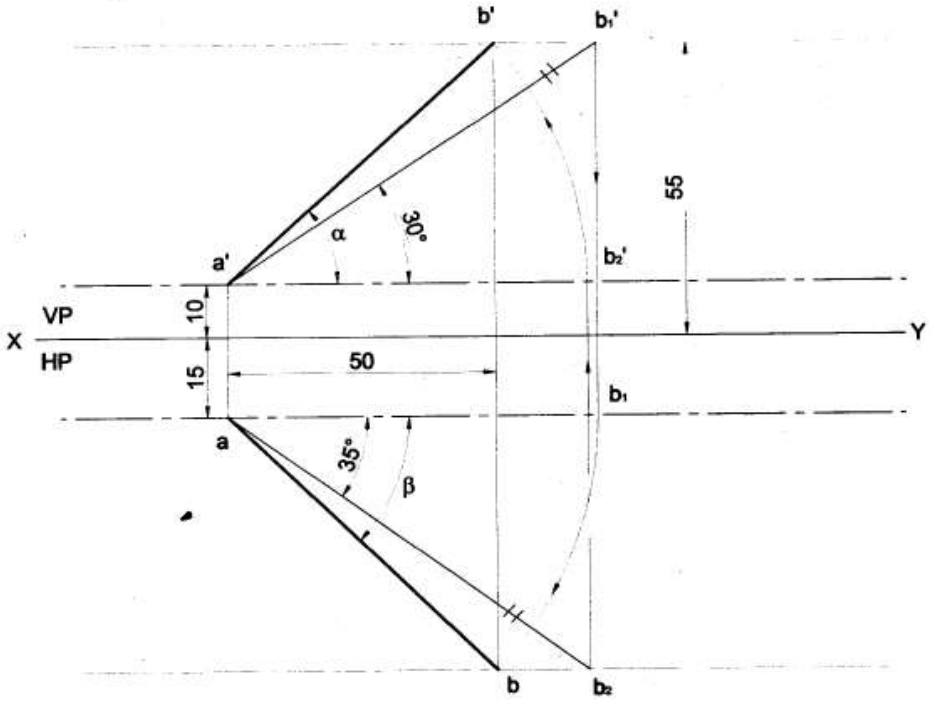
Solution



ANSWERS :
$\theta = 28^0$
$\phi = 20^0$
$\alpha = 30^0$
$\beta = 23^0$

Problem 7 A line has its end A 10 mm above HP and 15 mm infront of VP. The end B is 55 mm above HP and line is inclined at 30° to HP and 35° to VP. The distance between the end projectors is 50 mm. draw the projections of the line. Determine the true length of the line and its inclination with VP.

Solution



ANSWERS :

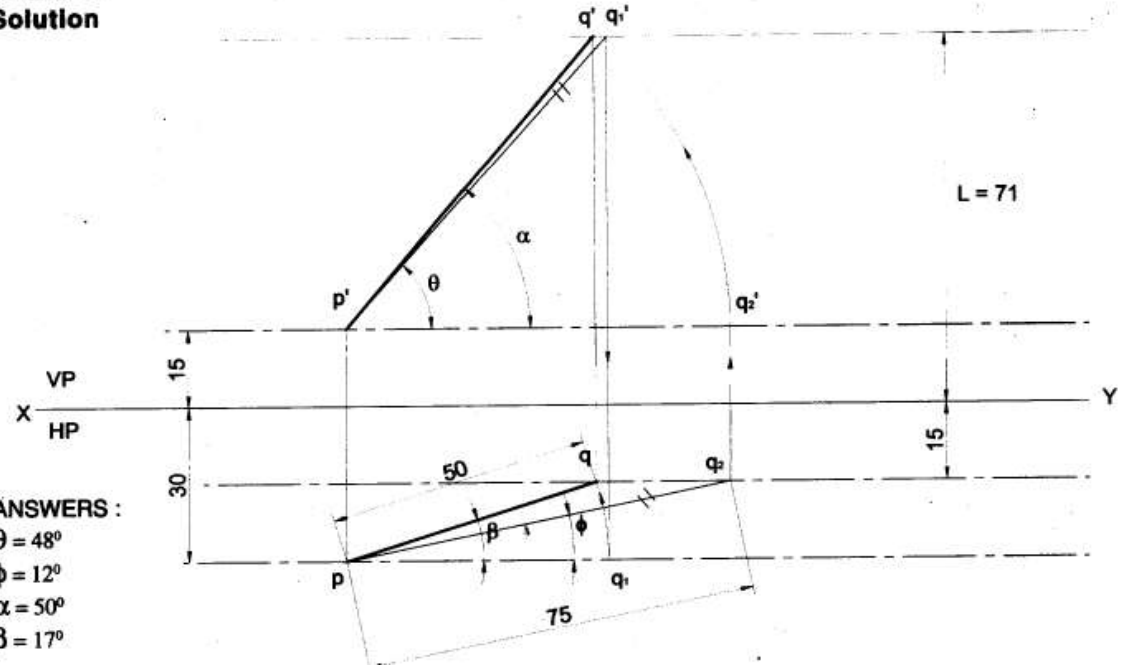
$\alpha = 42^0$

$\beta = 44^0$

TL = 80

Problem 8 The top view of a line 75 mm long measures 50 mm. the end P is 30 mm infront of VP and 15 mm above HP. The end Q is 15 mm infront of VP and above HP. Draw the projections of the line and find its true inclinations with HP and VP.

Solution



ANSWERS :

$\theta = 48^0$

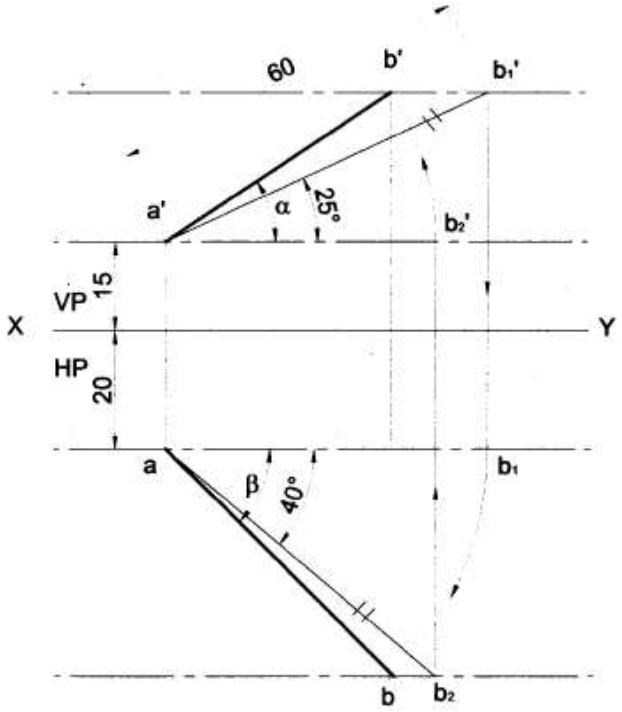
$\phi = 12^0$

$\alpha = 50^0$

$\beta = 17^0$

Problem 9 A line AB 60 mm long has one of its extremities 20 mm infornt of VP and 15 mm above HP. The lin inclined at 25° to HP and 40° to VP. Draw its top and front views.

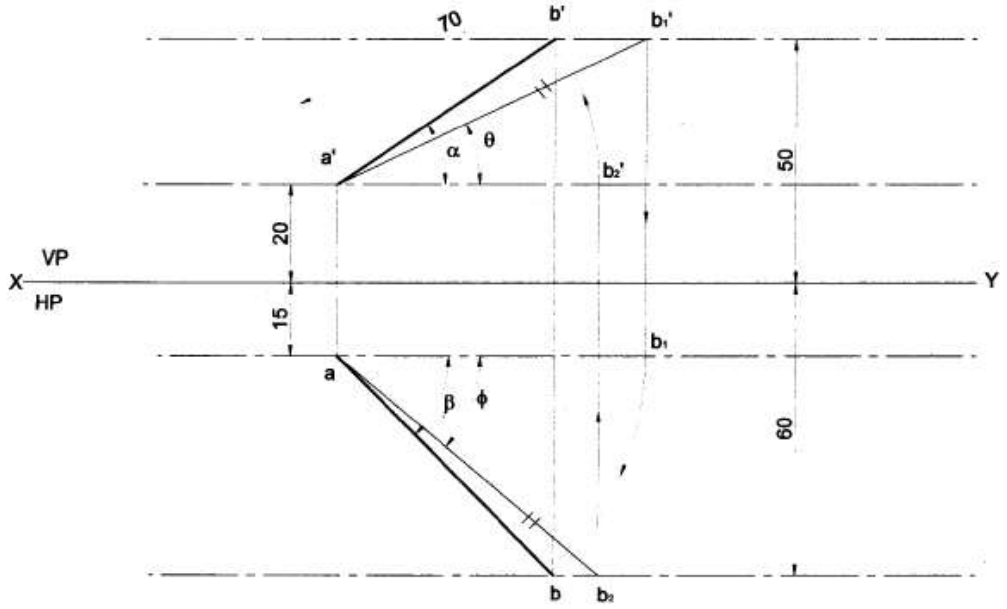
Solution



ANSWERS
$\alpha = 34^0$
$\beta = 45^0$
a'b' = 46
ab = 56

Problem 10 A line AB measuring 70 mm has its end A 15 infront of VP and 20 mm above HP and the other end B is 60 infront of VP and 50 mm above HP. Draw the projections of the line and find the inclinations of the line with both the reference planes of projection.

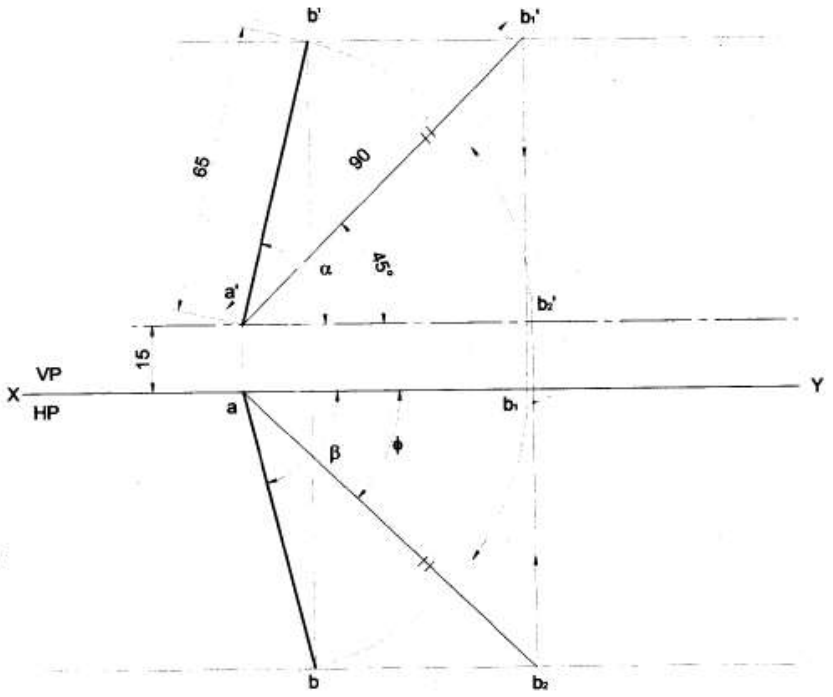
Solution



ANSWERS :
$\theta = 25^0$
$\phi = 40^0$
$\alpha = 34^0$
$\beta = 45^0$

Problem 11 The front view of a 90 mm long line which is inclined at 45° to the XY line, measures 65 mm. End A is 15 mm above the XY line and is in VP. Draw the projections of the line and find is inclinations with HP and VP.

Solution



ANSWERS :

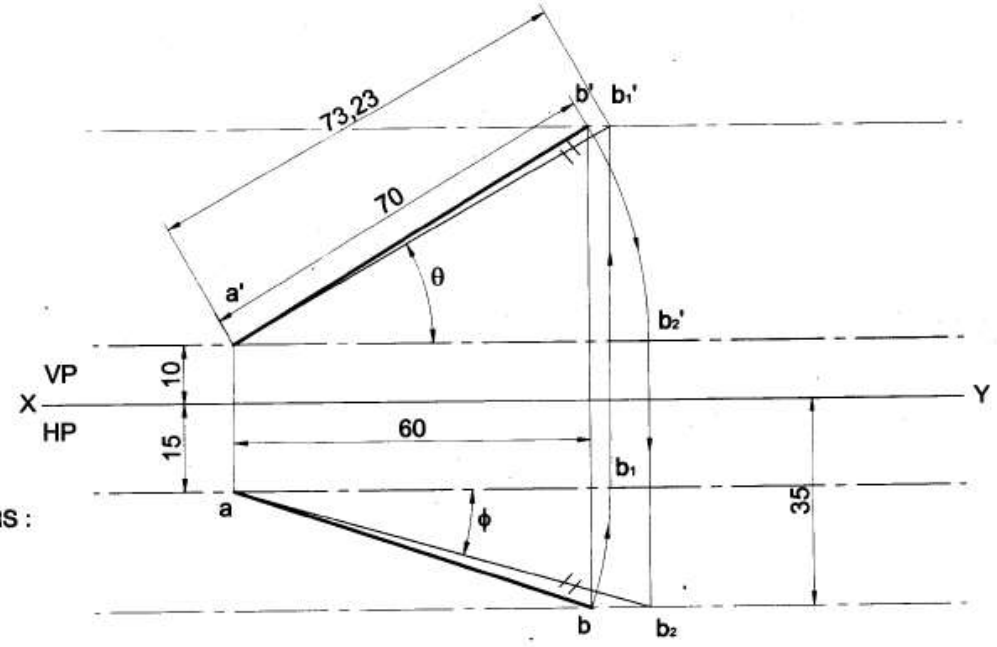
$\phi = 43^0$

$\alpha = 76^0$

$\beta = 76^0$

Problem 12 The distance between the end projectors through the end points of a line AB is 60 mm. The end A is 10 mm above HP and 15 mm infront of VP. The end B is 35 mm infront of VP. The line AB appears 70 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.

Solution



ANSWERS :

$\theta = 29^0$

$\phi = 16^0$

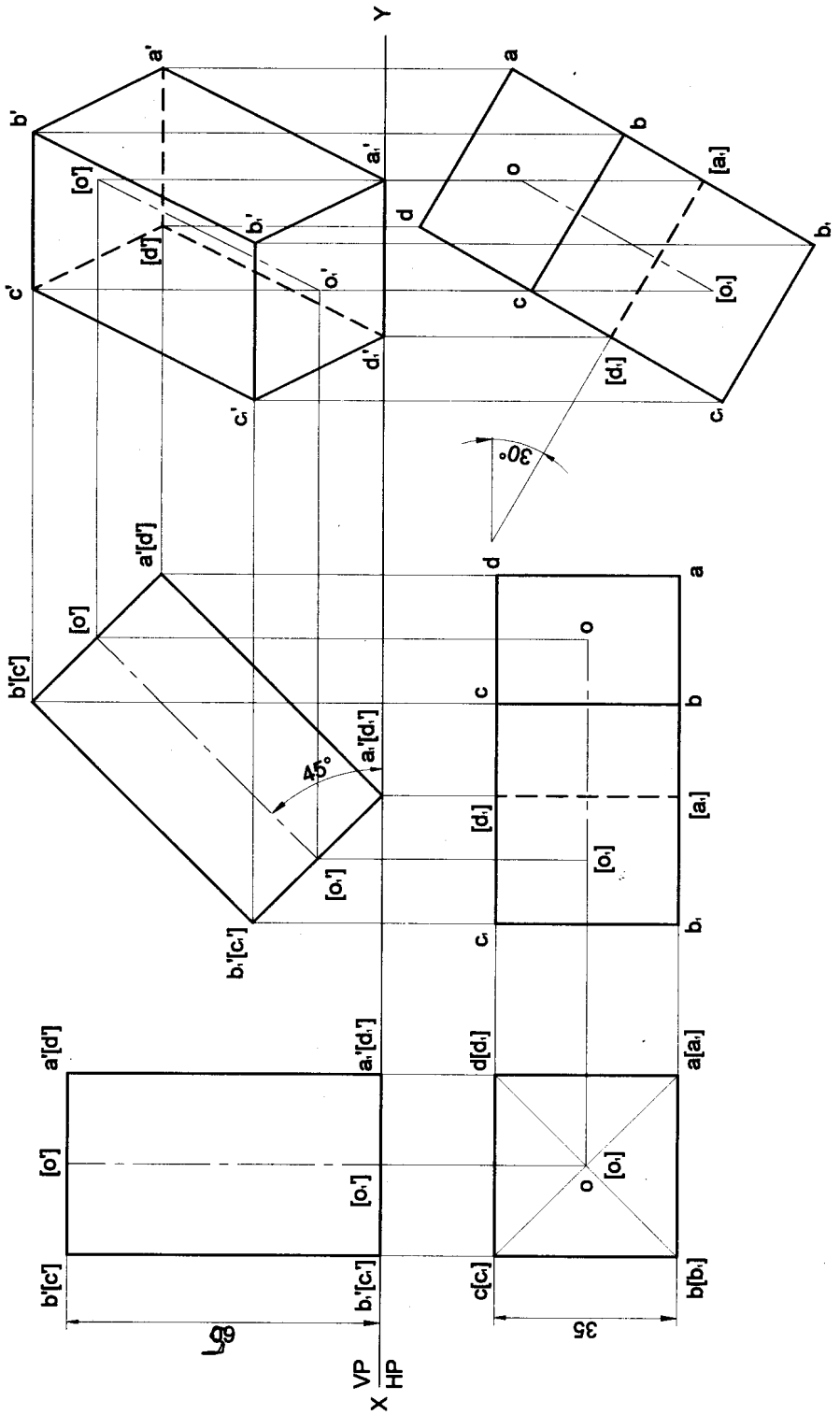
TL = 73

CHAPTER 4

PROJECTIONS OF SOLIDS

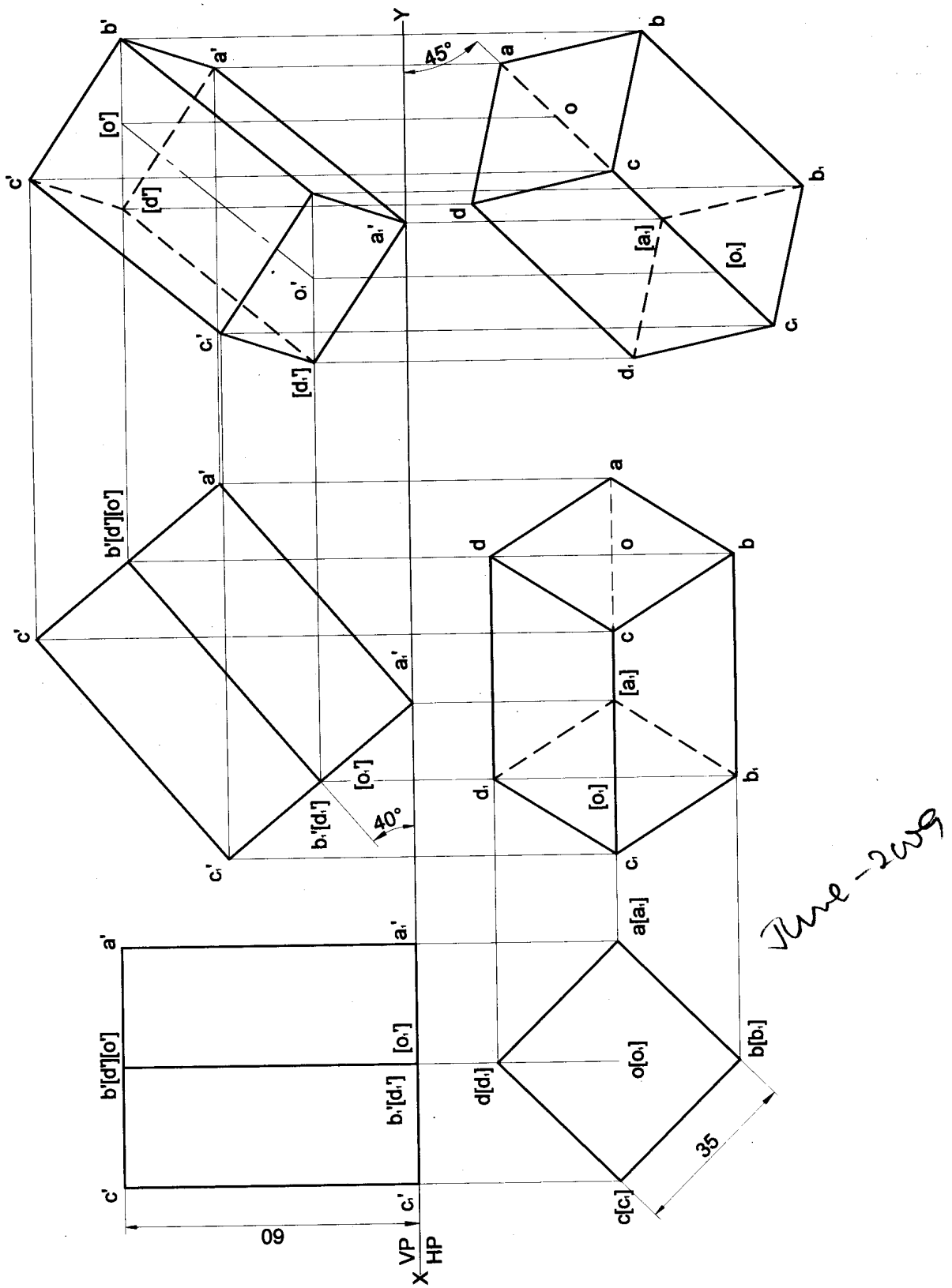
Problem 1 A square prism 35 mm sides of base and 65 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the prism when the axis is inclined to HP at 45º.

Solution



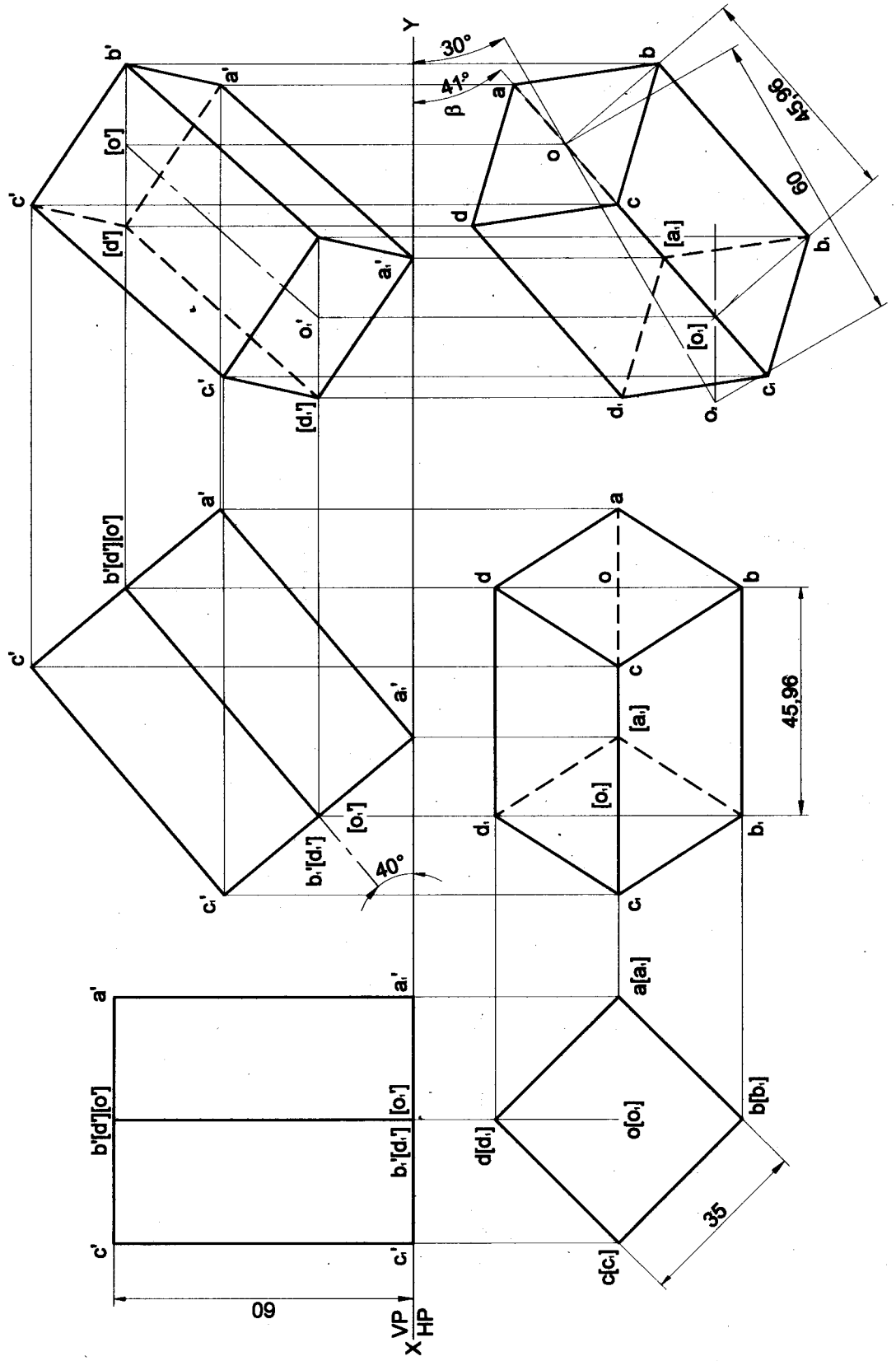
Problem 2 A square prism 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



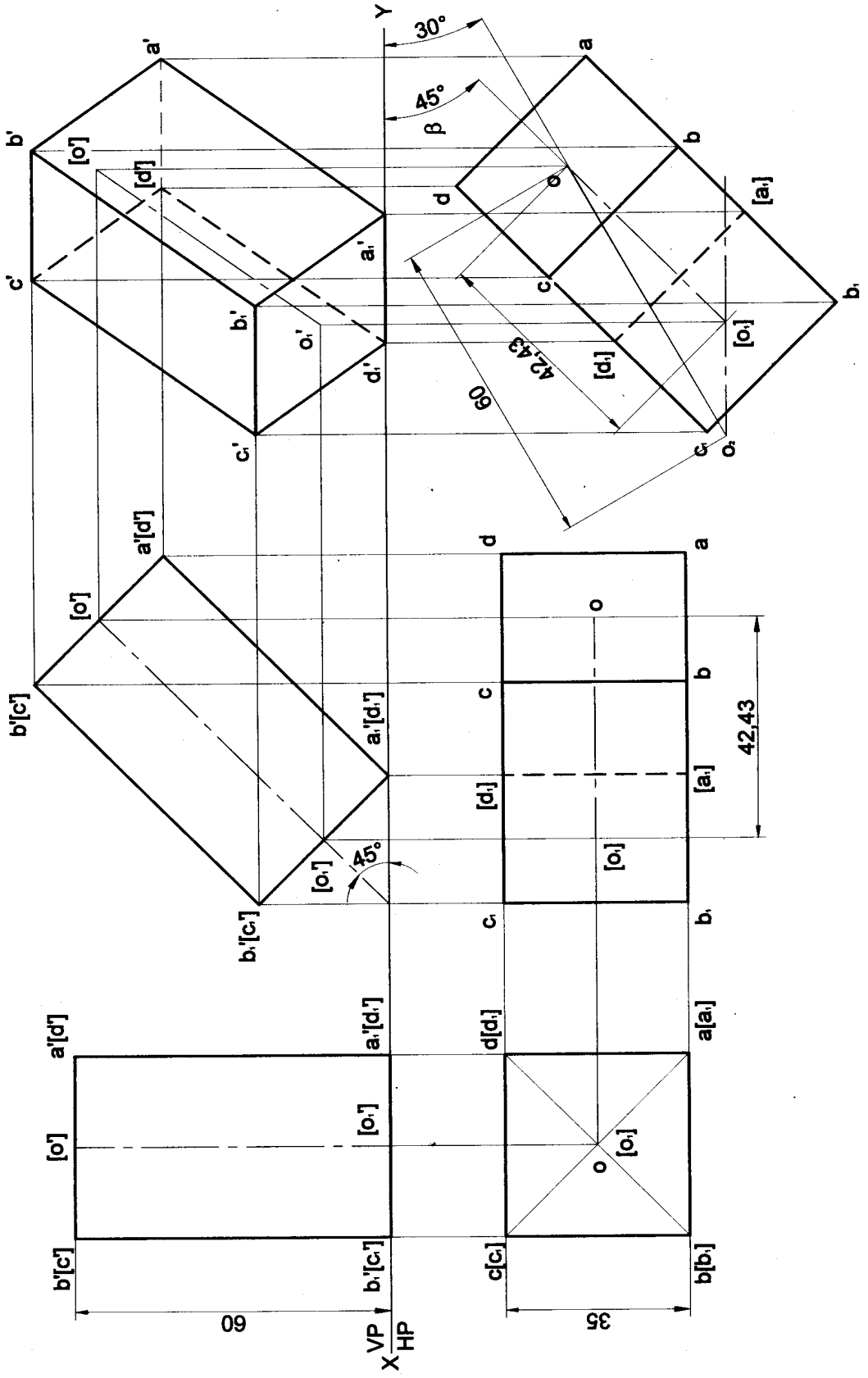
Problem 3 A square prism 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and to VP at 30º.

Solution



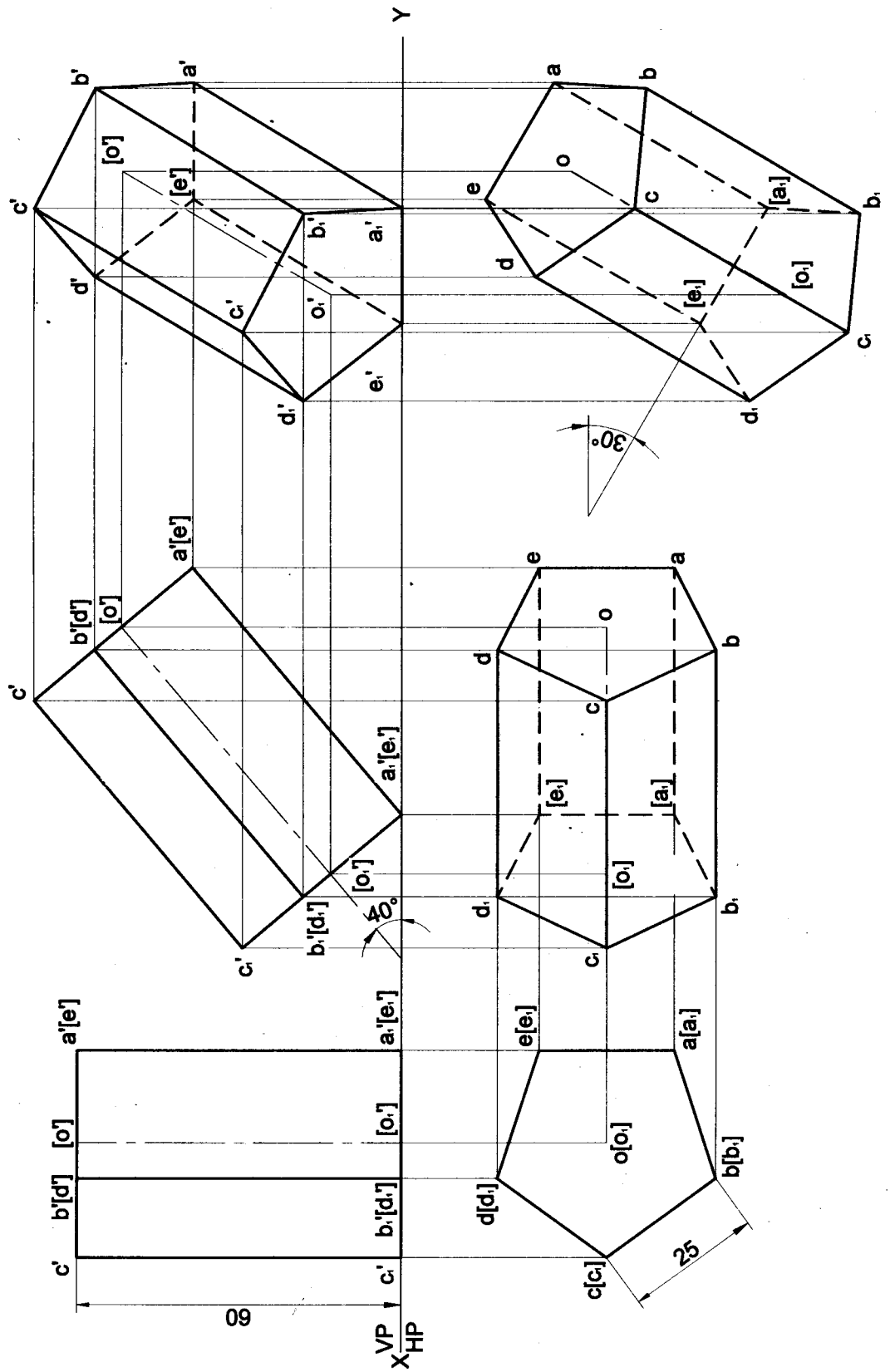
Problem 4 A square prism 35 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 45º and VP at 30º.

Solution



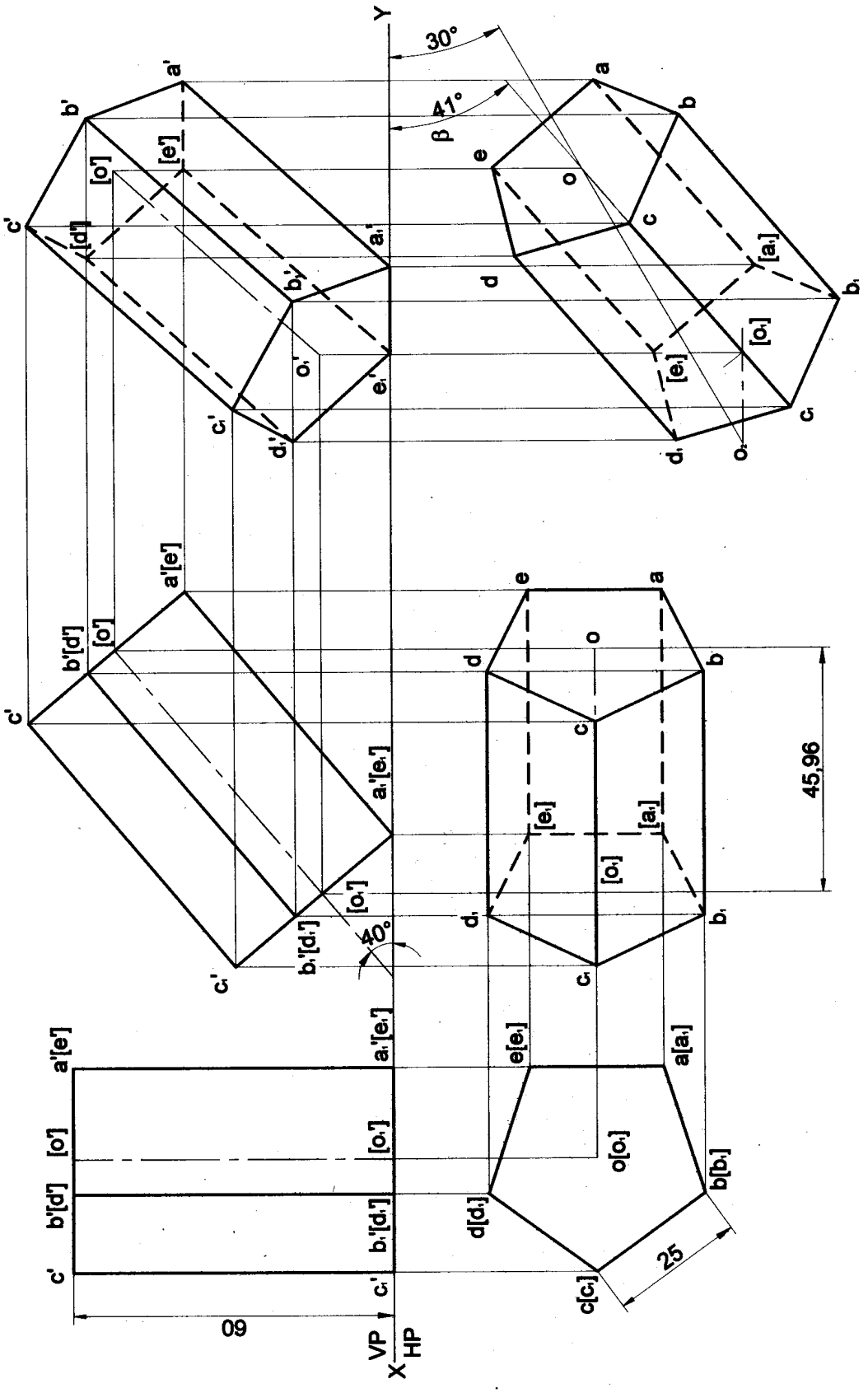
Problem 5 A pentagonal prism 25 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the prism when the axis is inclined to HP at 40º.

Solution



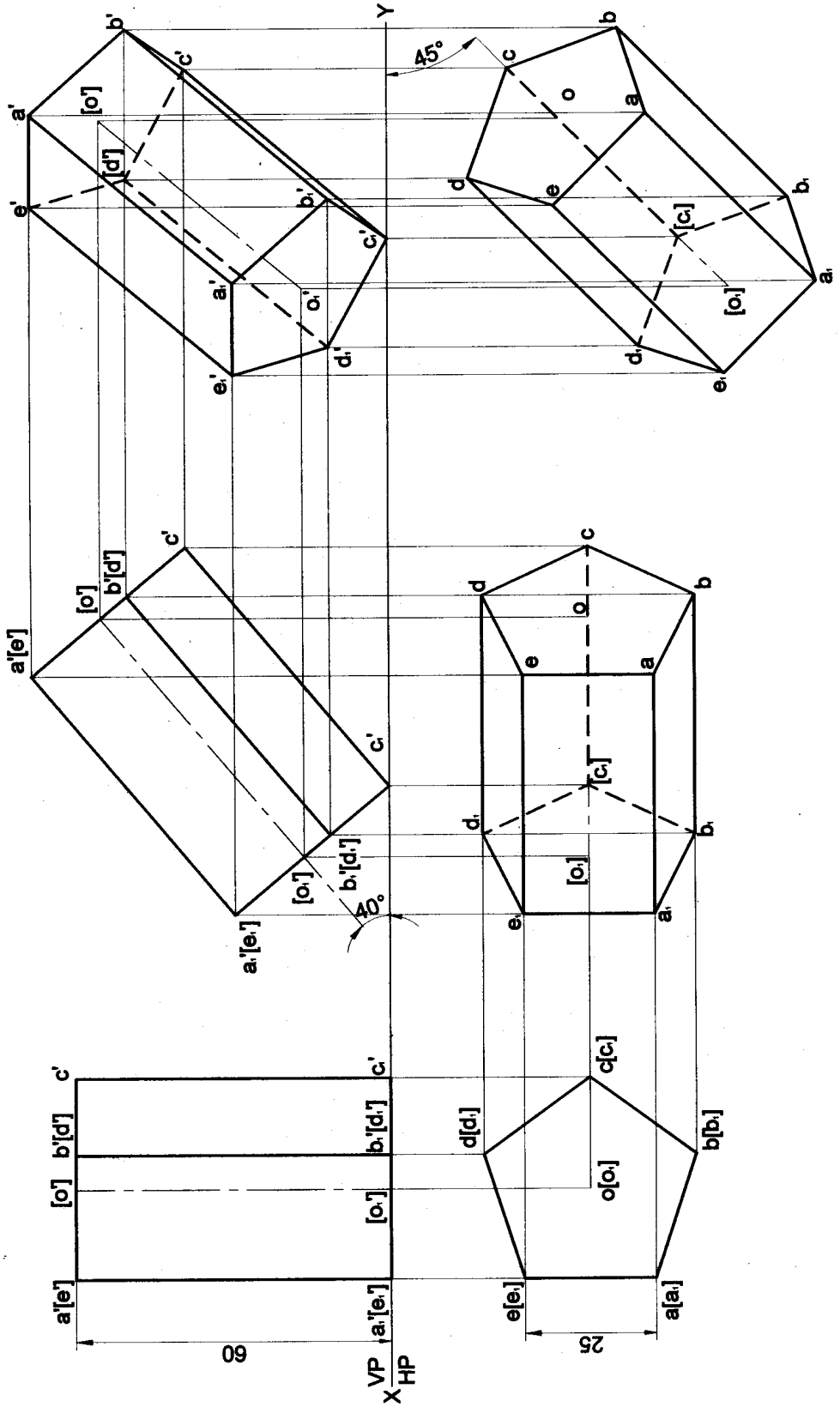
Problem 6 A pentagonal prism 25 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 40º and VP at 30º.

Solution



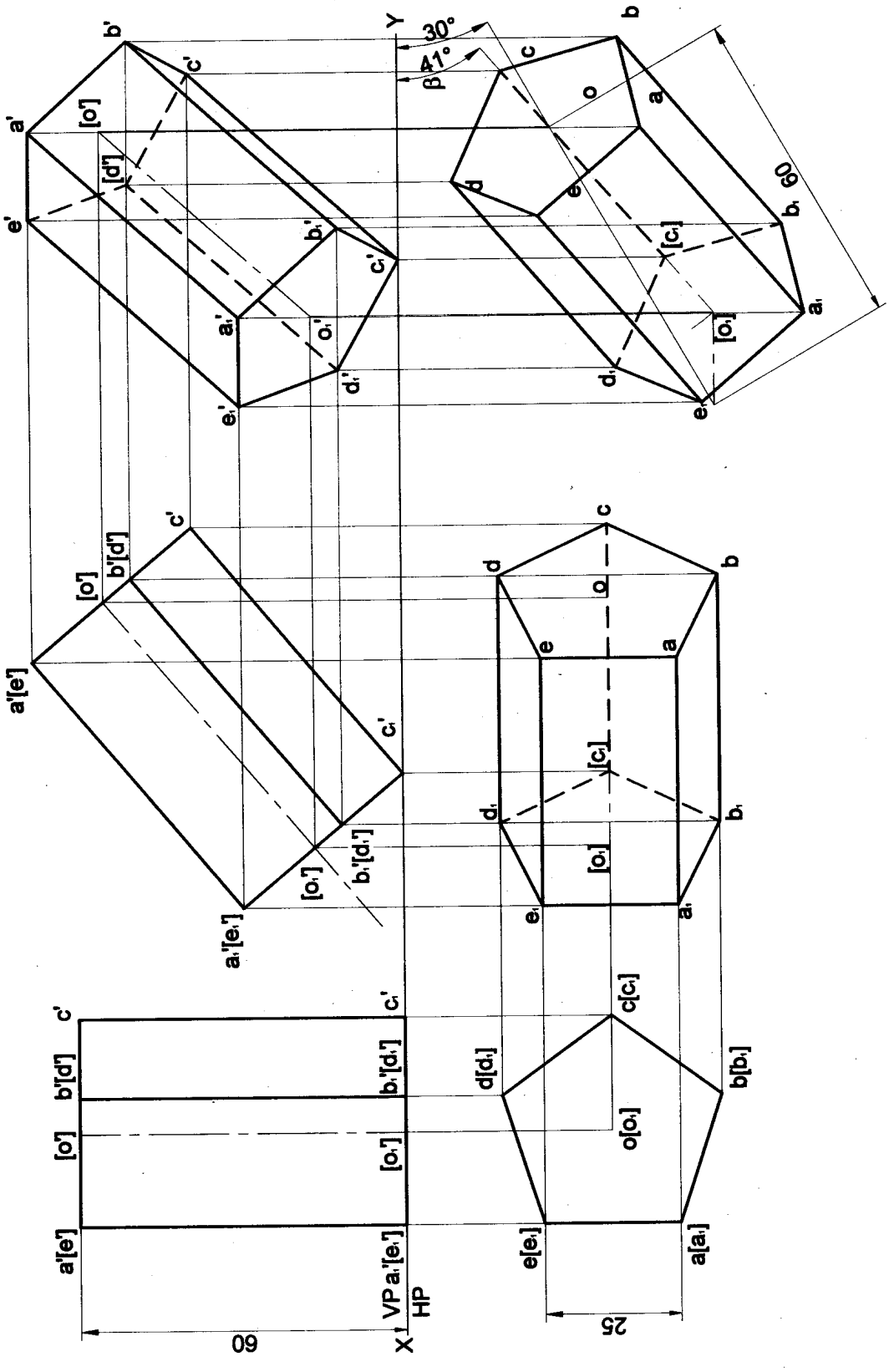
Problem 7 A pentagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



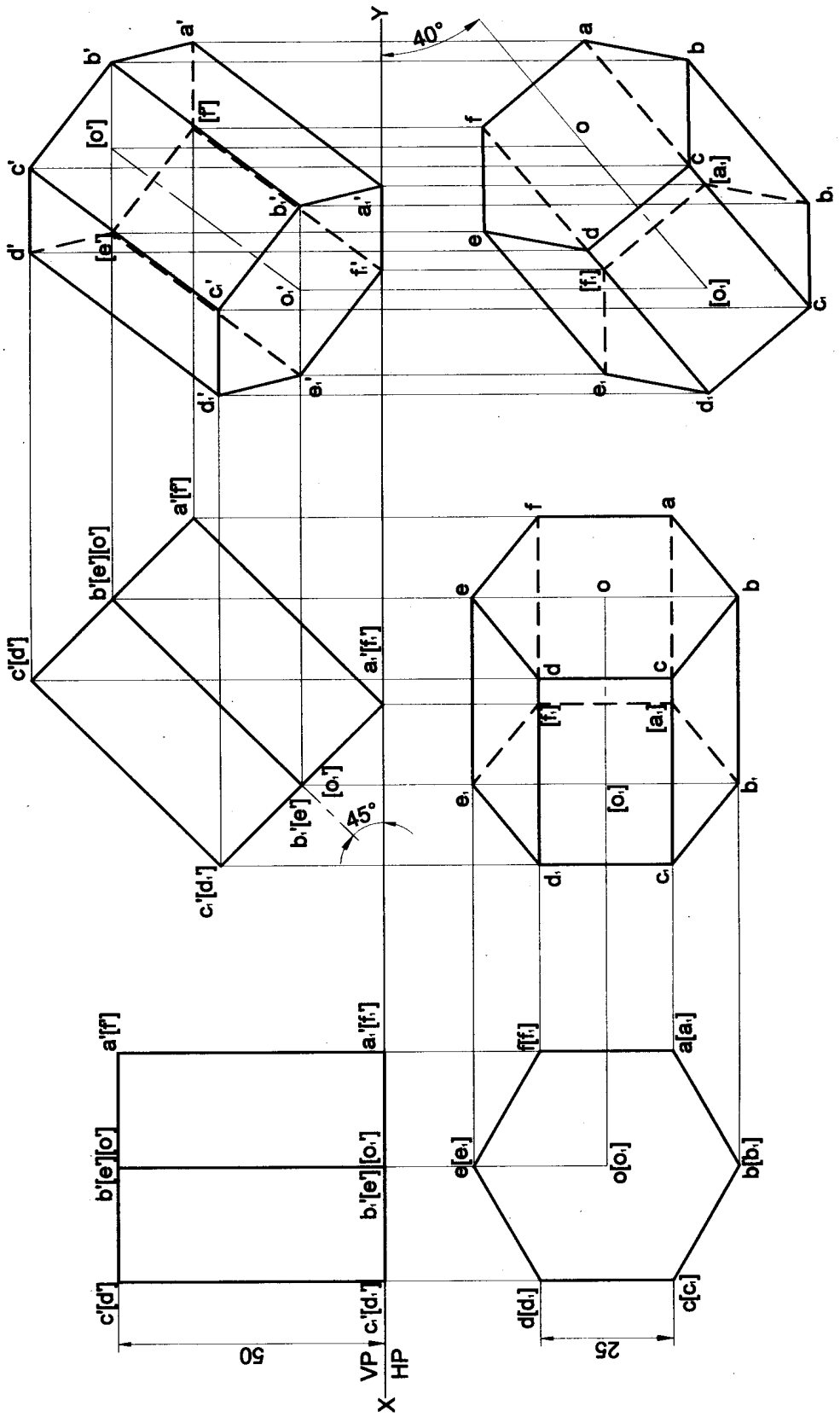
Problem 8 A pentagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and to VP at 30º.

Solution



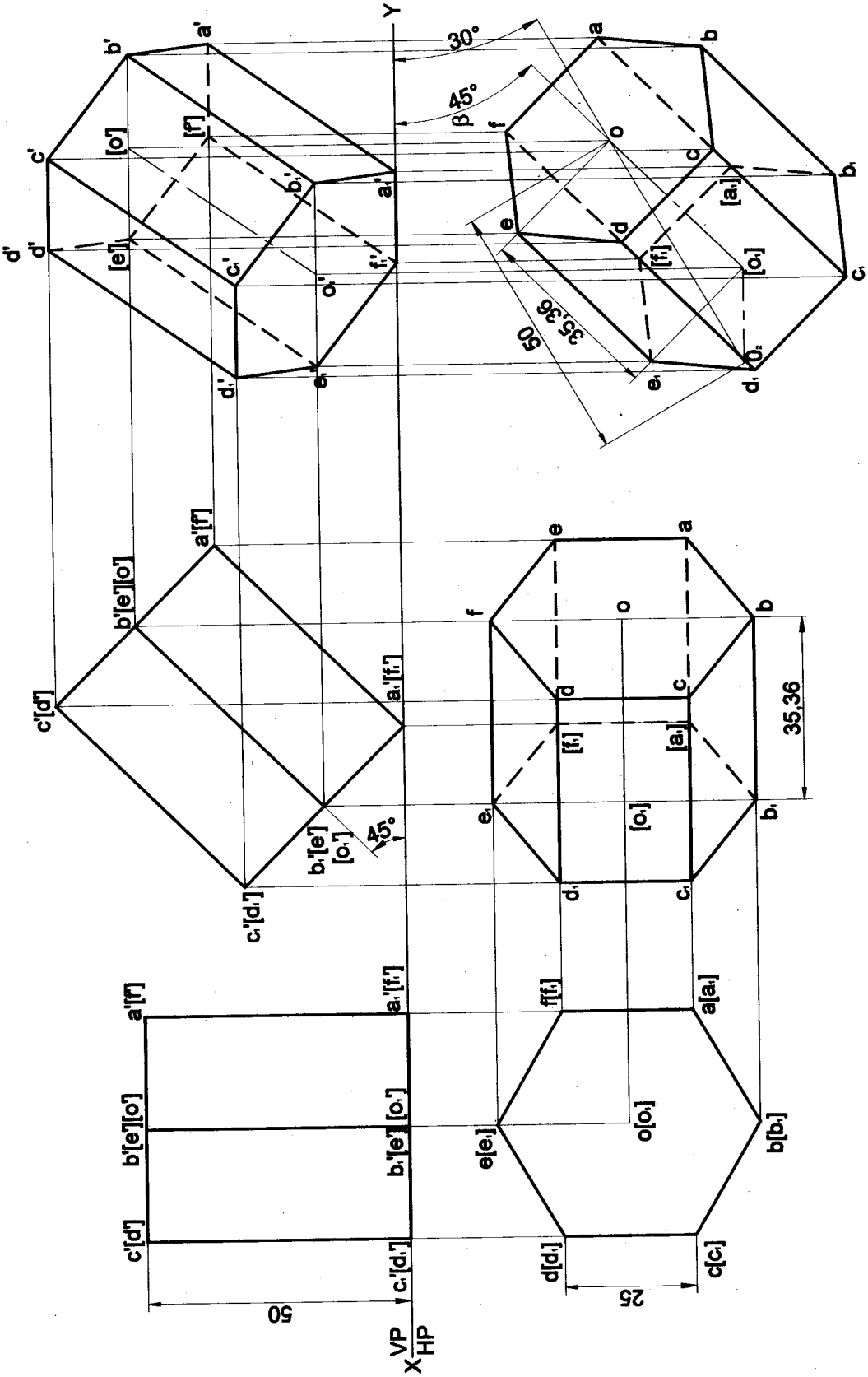
Problem 9 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its edges. Draw the projections of the prism when the axis is inclined to HP at 45º and appears to be inclined to VP 40º.

Solution



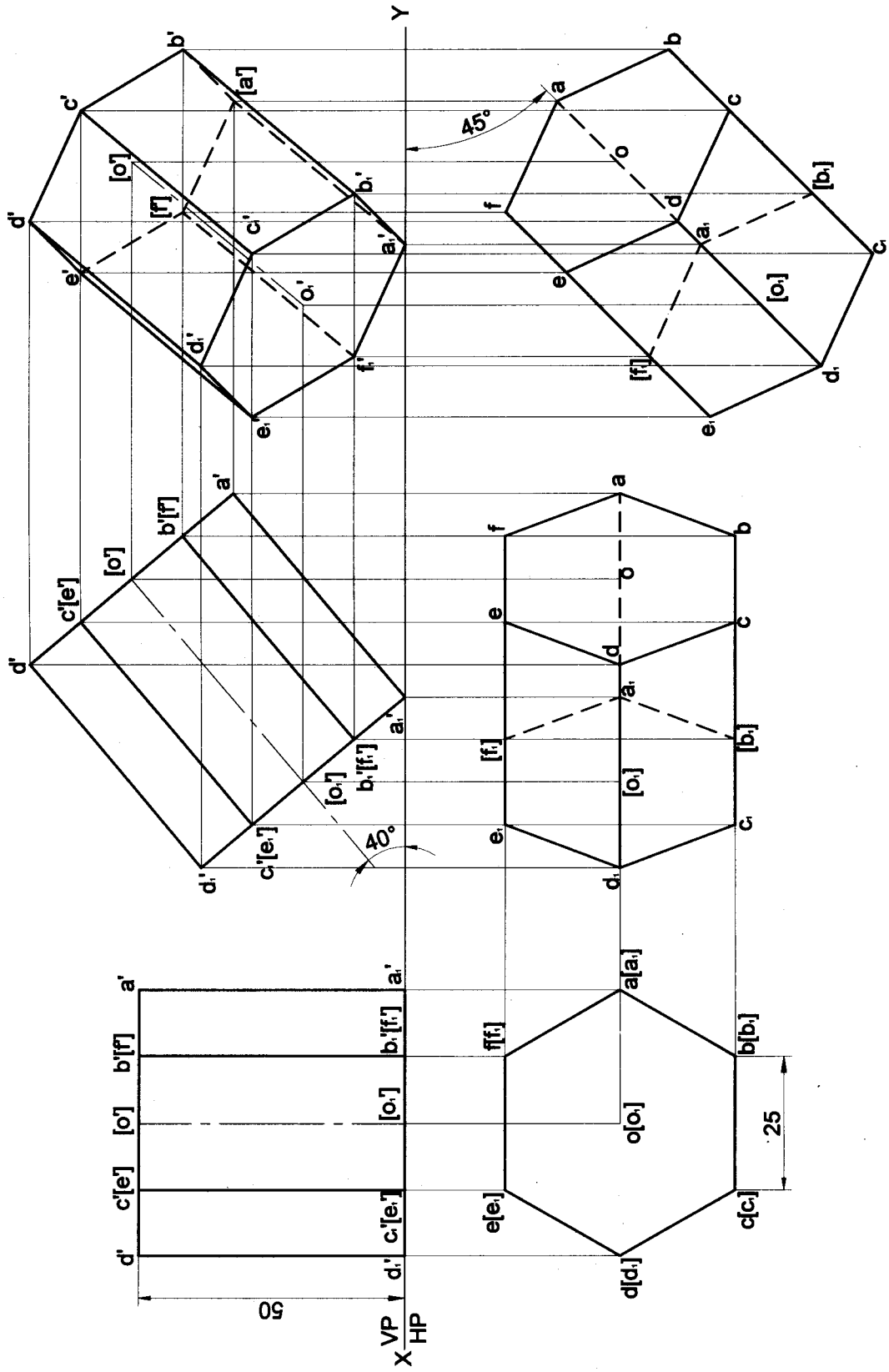
Problem 10 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 45º and VP at 30º.

Solution



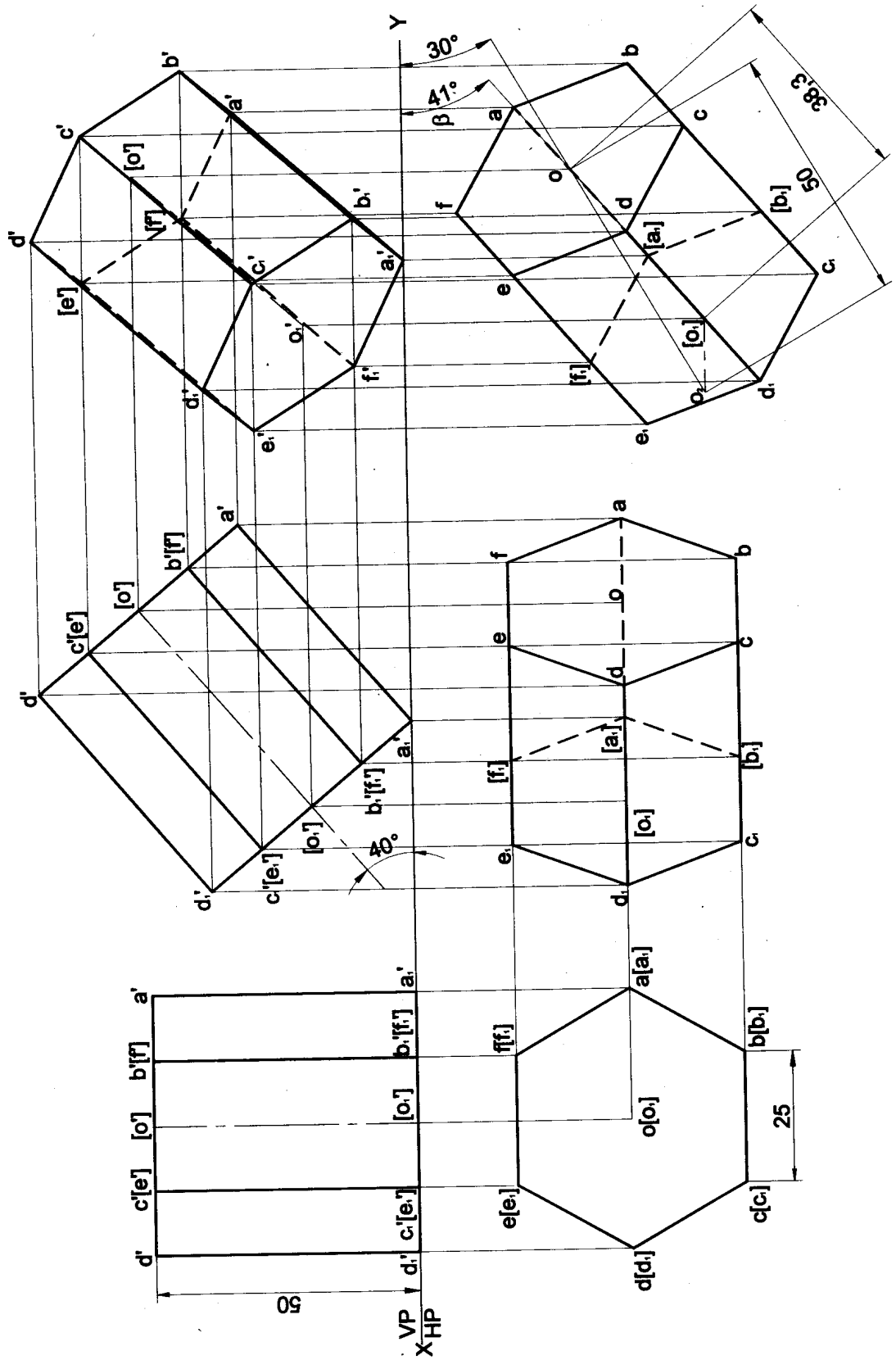
Problem 11 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



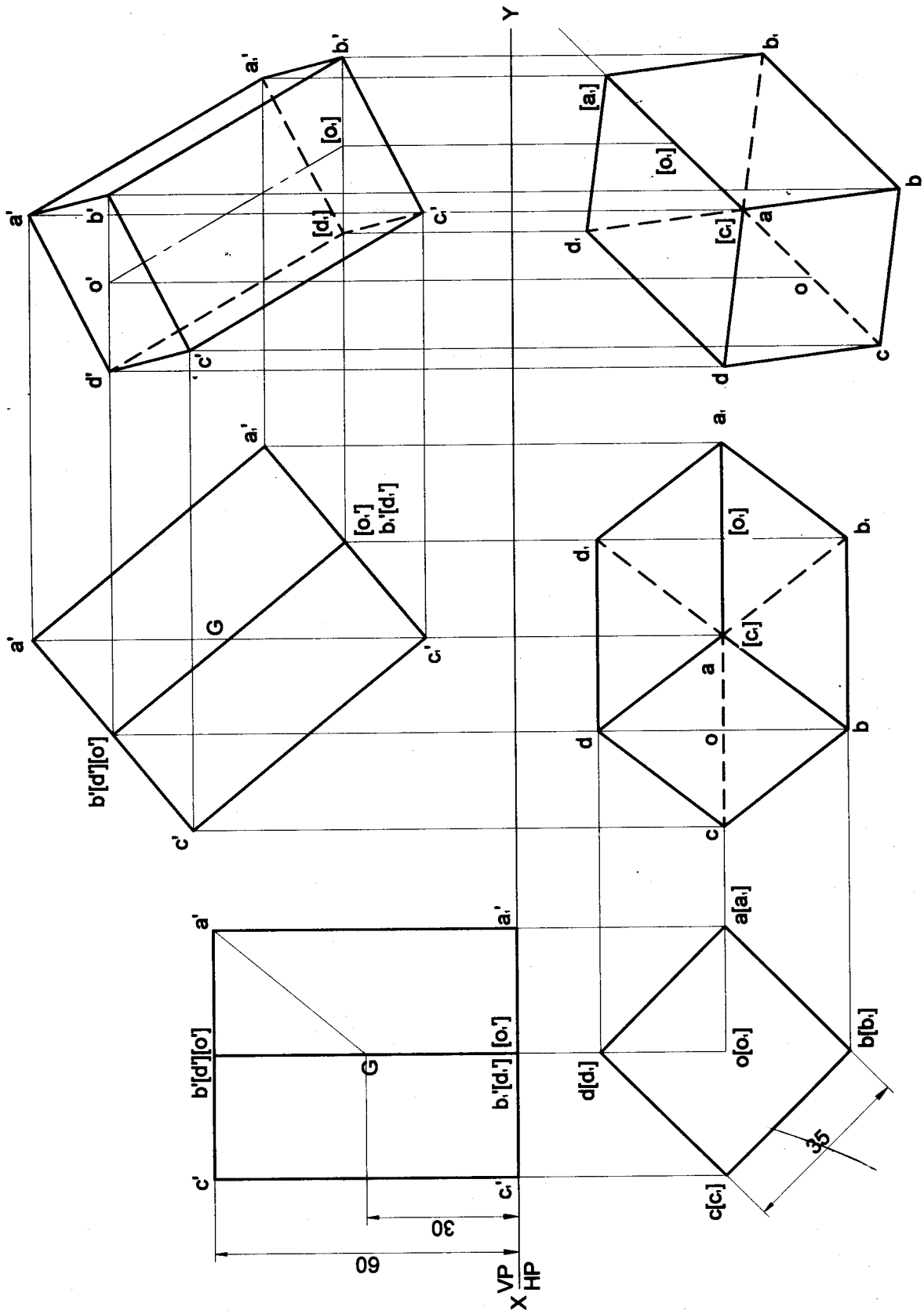
Problem 12 A hexagonal prism 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the prism when the axis of the prism is inclined to HP at 40º and to VP at 30º.

Solution



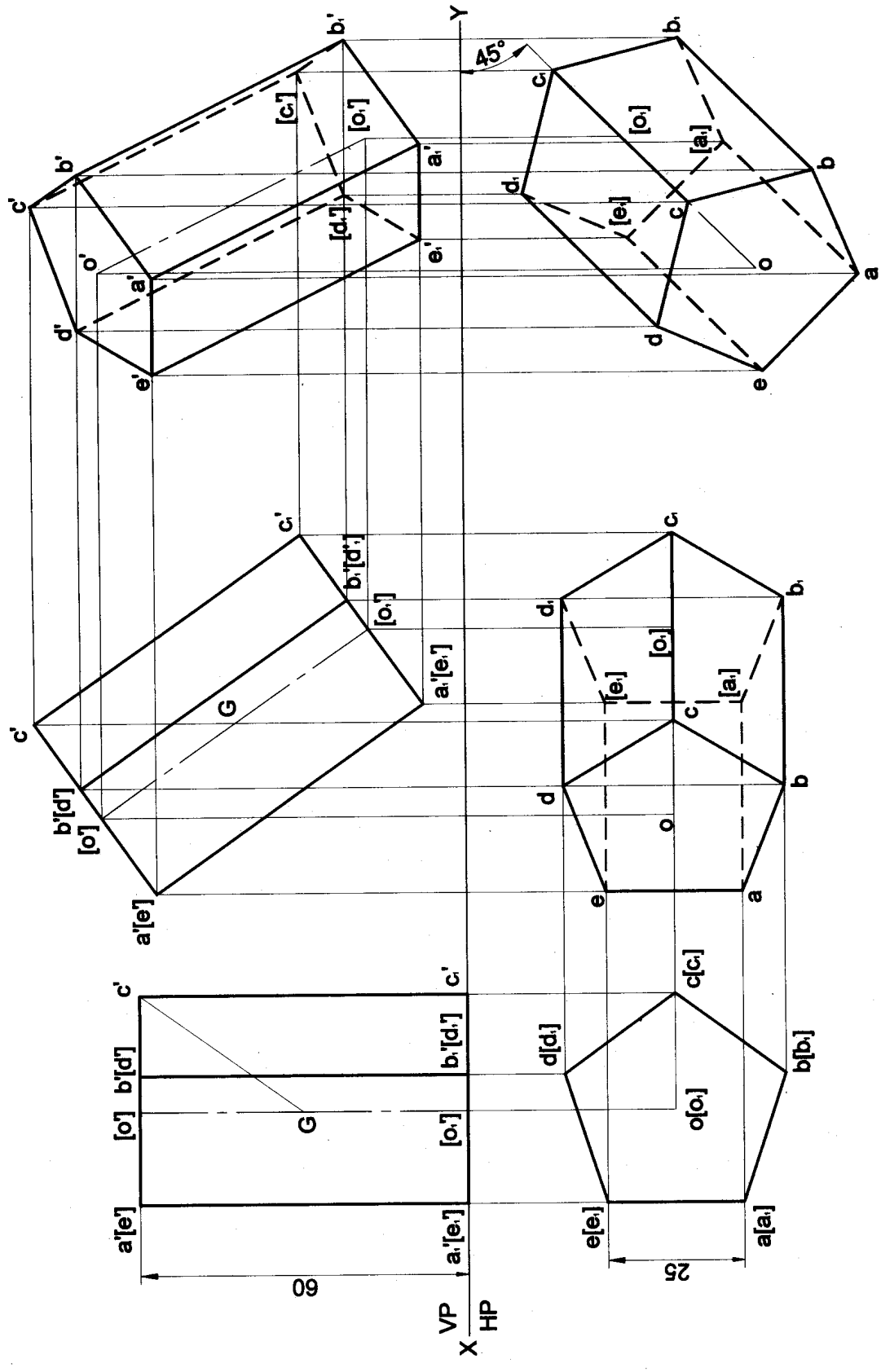
Problem 13 A square prism 35 mm sides of base and 60 mm axis length is suspended freely from a corner of its base. Draw the projections of the prism when the axis appears to be inclined to VP at 45º.

Solution



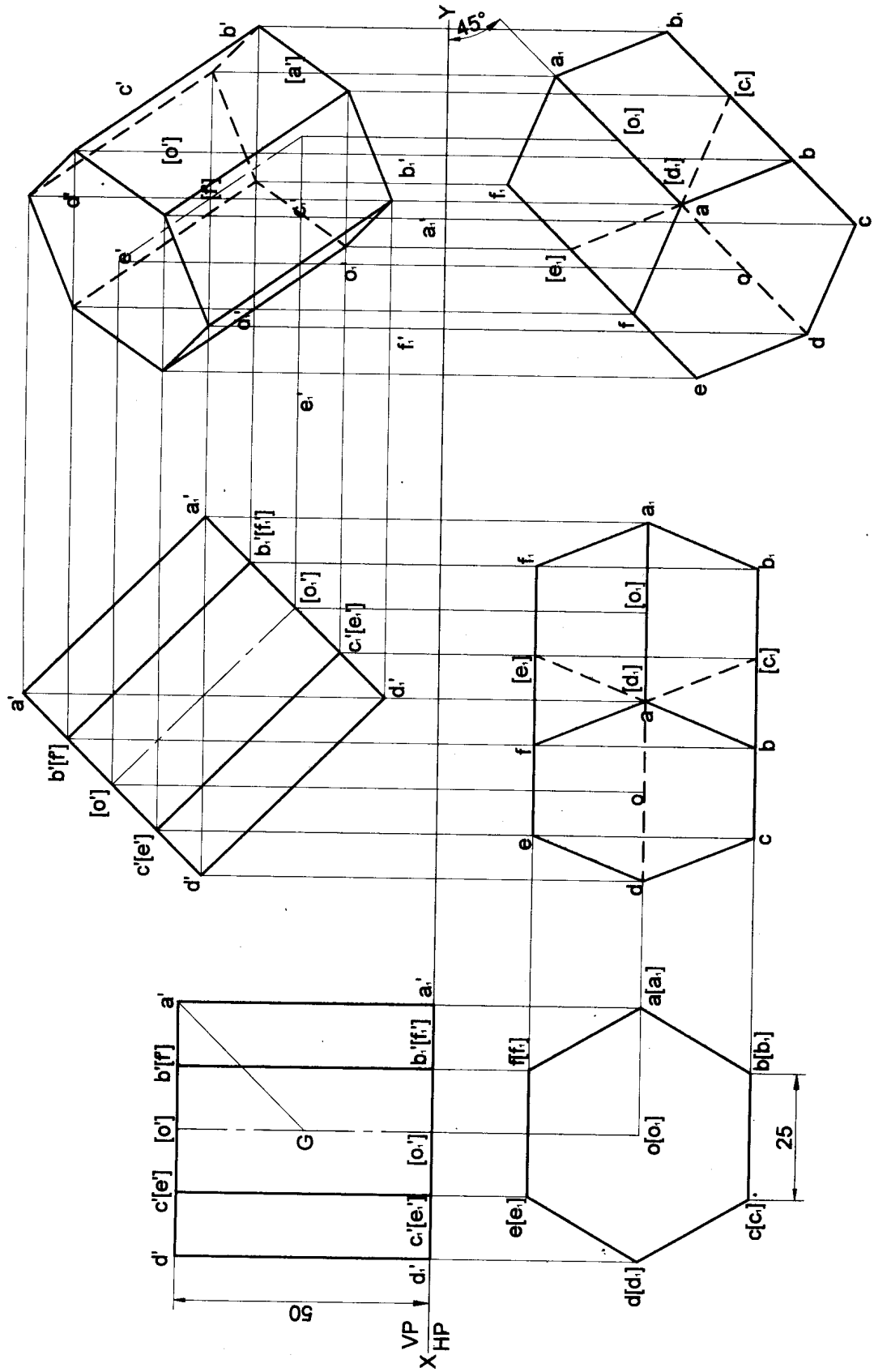
Problem 14 A pentagonal prism 25 mm sides of base and 50 mm axis length is suspended freely from a corner of its base. Draw the projections of the prism when the axis appears to be inclined to VP at 45º.

Solution



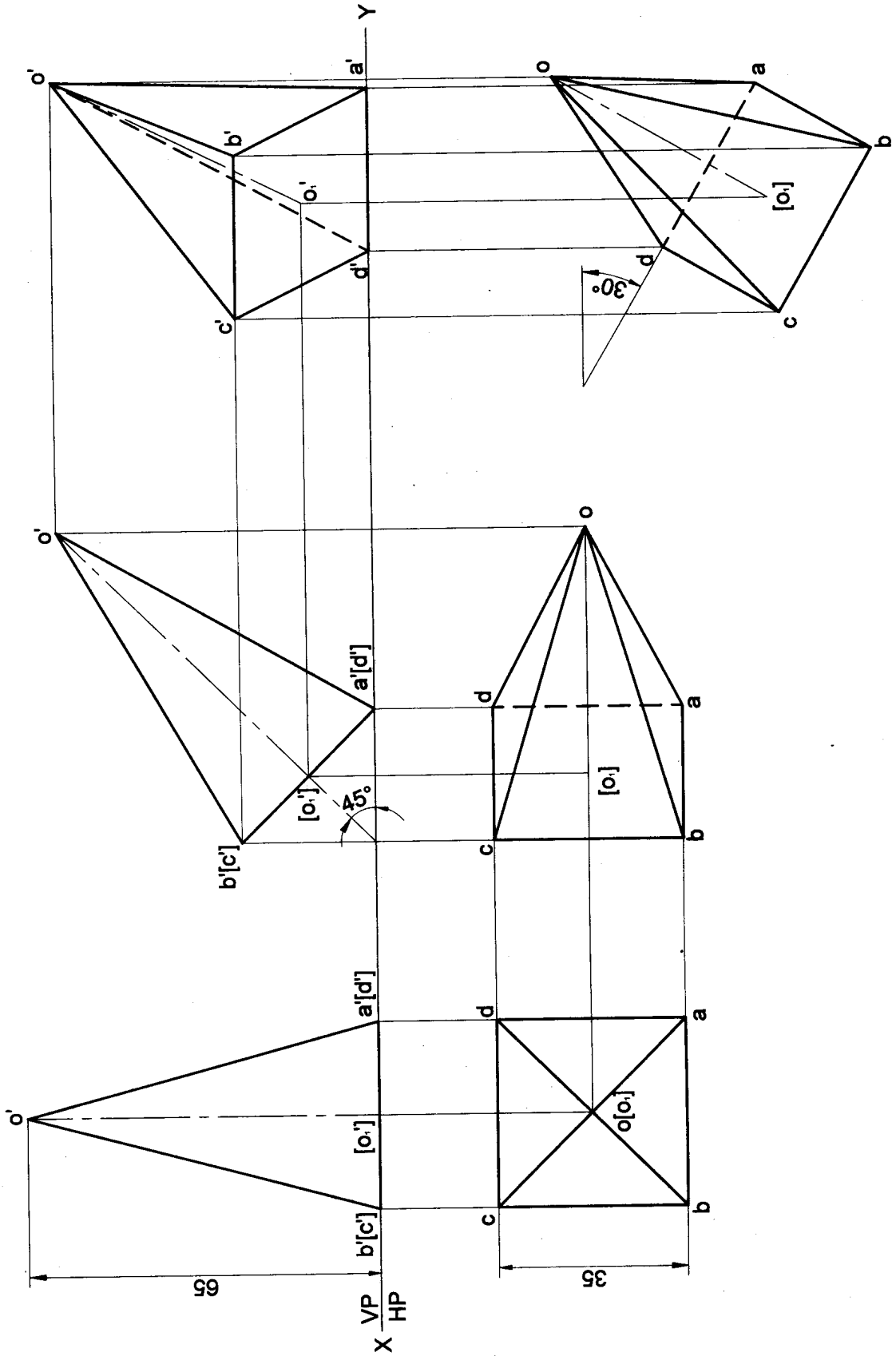
Problem 15 A hexagonal prism 25 mm sides of base and 50 mm axis length is suspended freely from a corner of its base. Draw the projections of the prism when the axis appears to be inclined to VP at 45º.

Solution



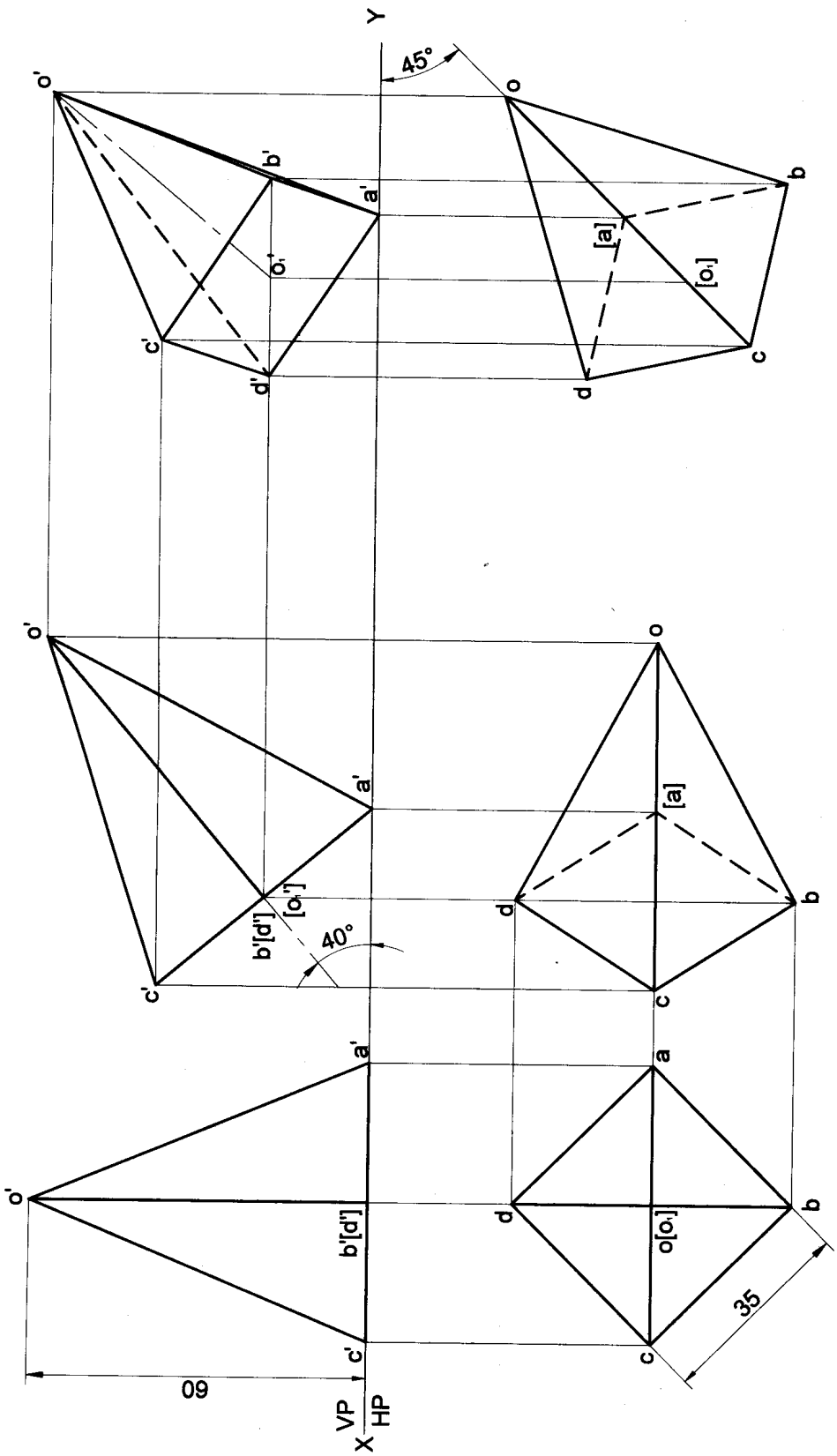
Problem 16 A square pyramid 35 mm sides of base and 65 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the pyramid when the axis is inclined to HP at 45º.

Solution



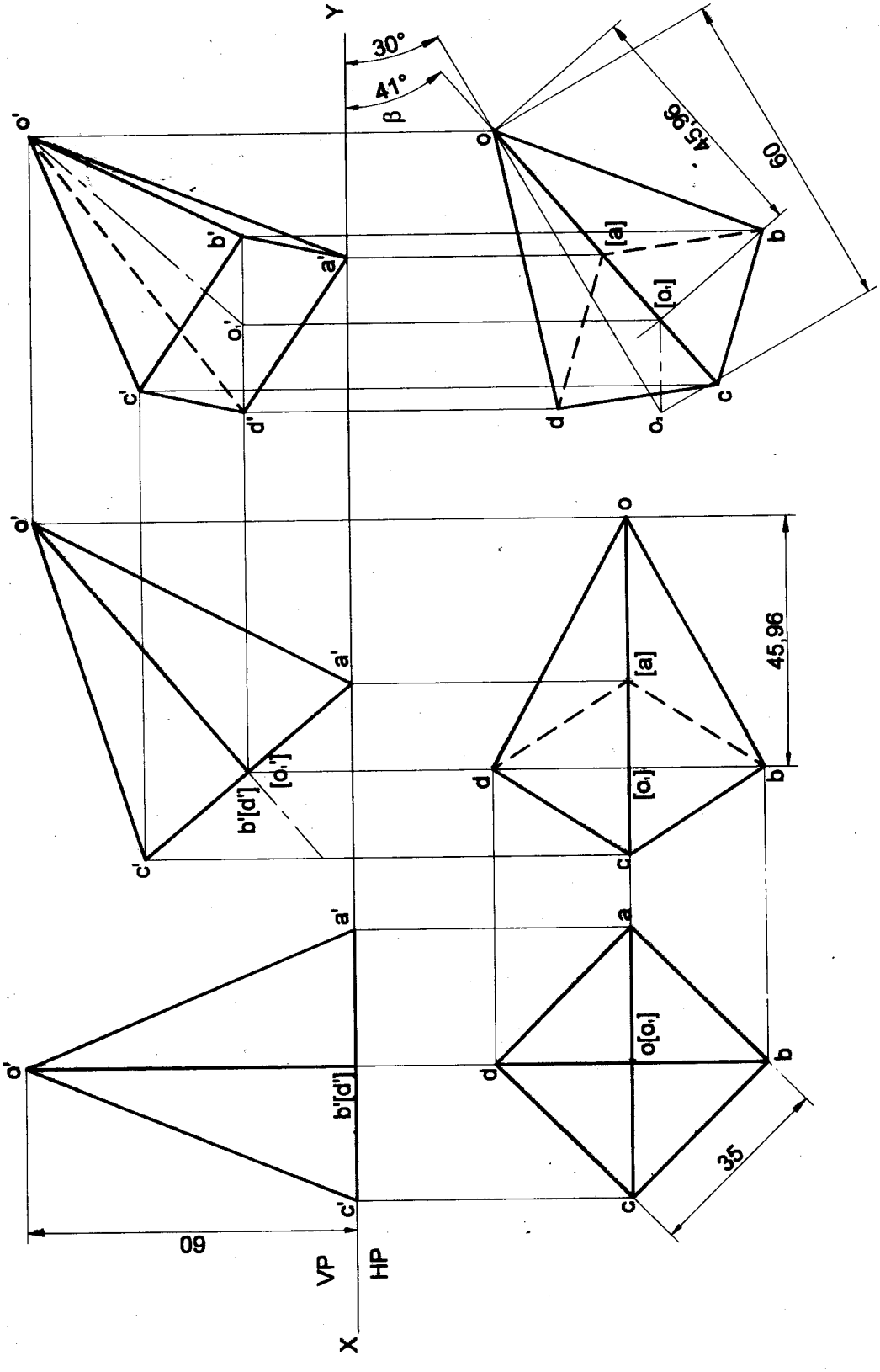
Problem 17 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



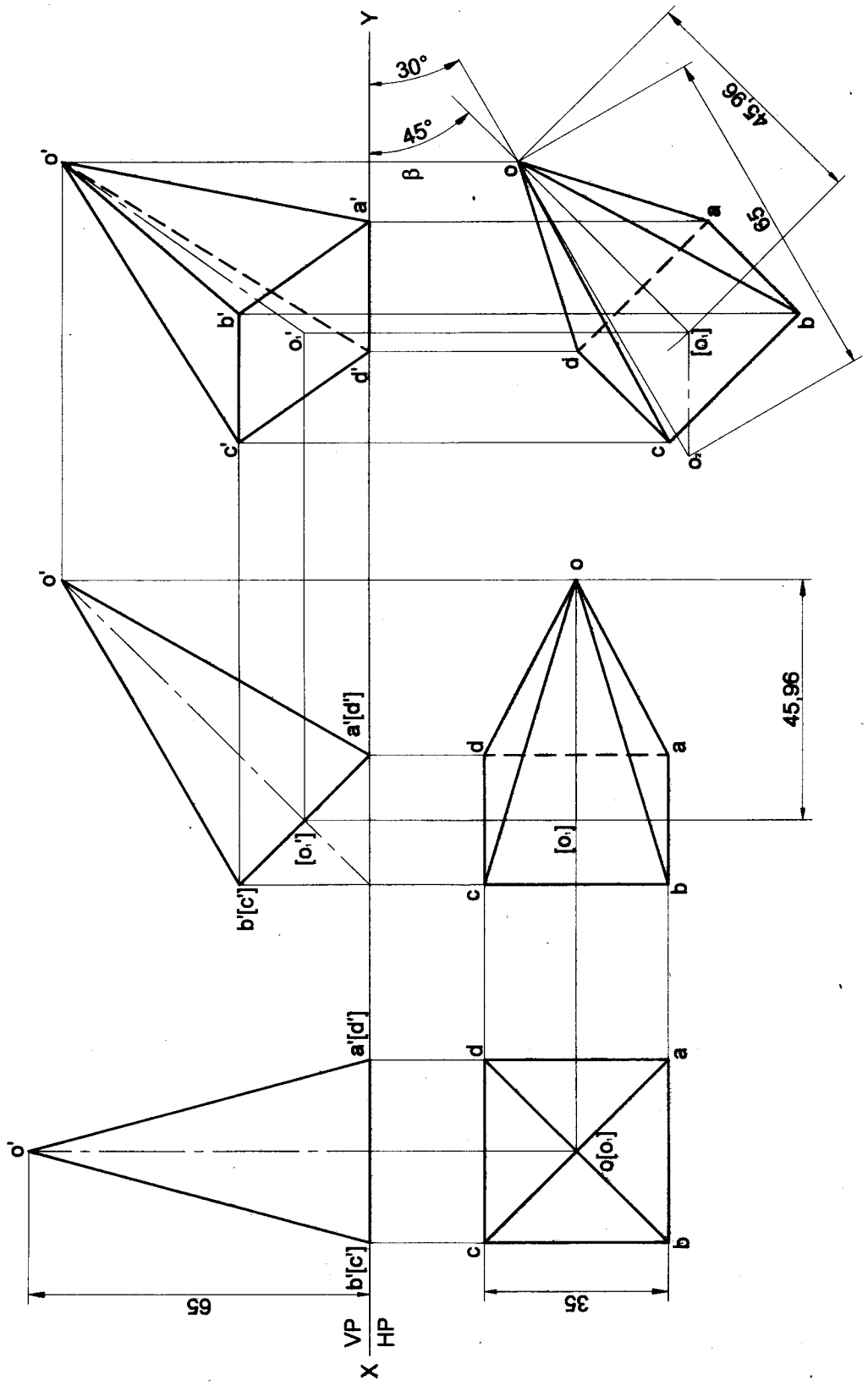
Problem 18 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and to VP at 30º.

Solution



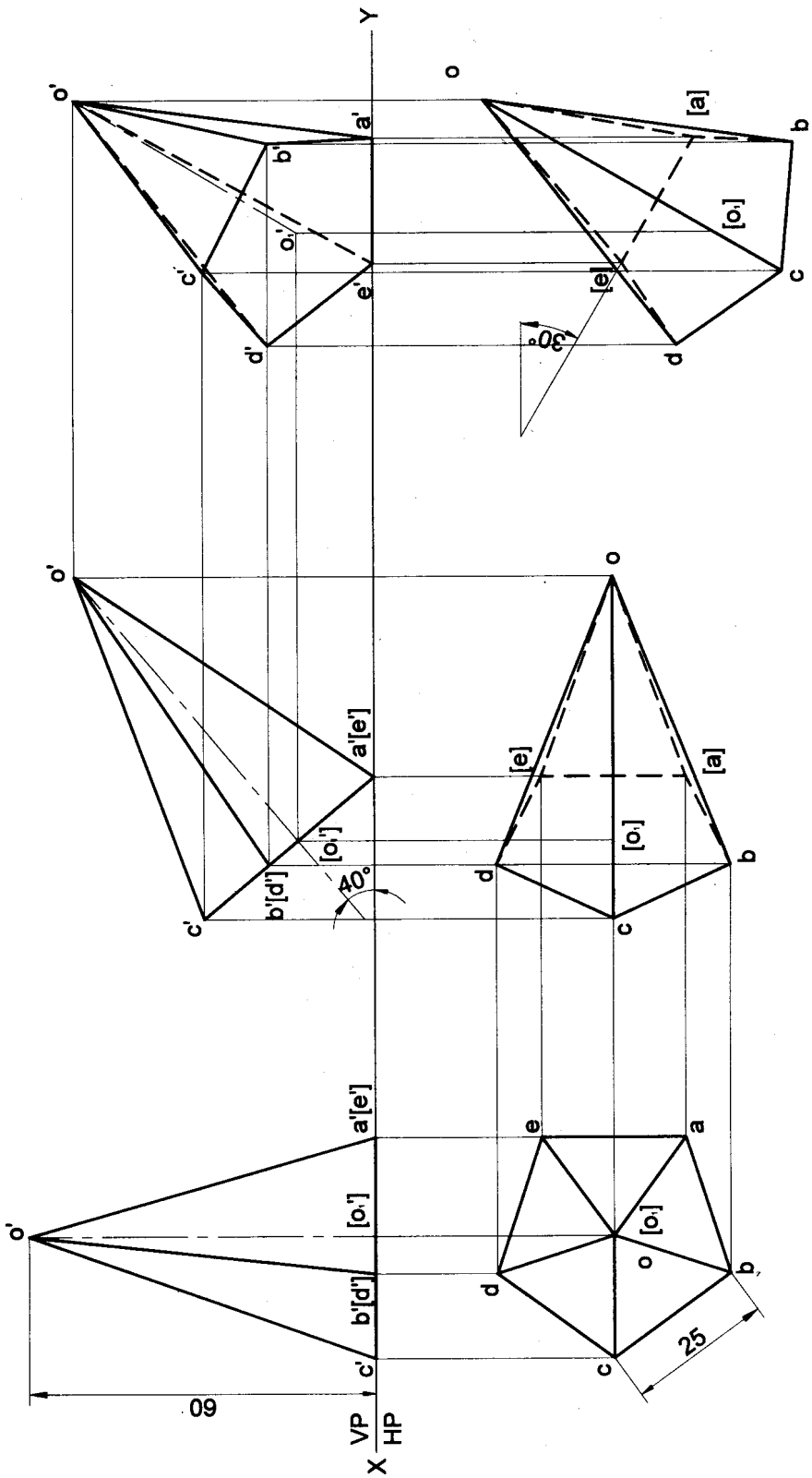
Problem 19 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45º and VP at 30º.

Solution



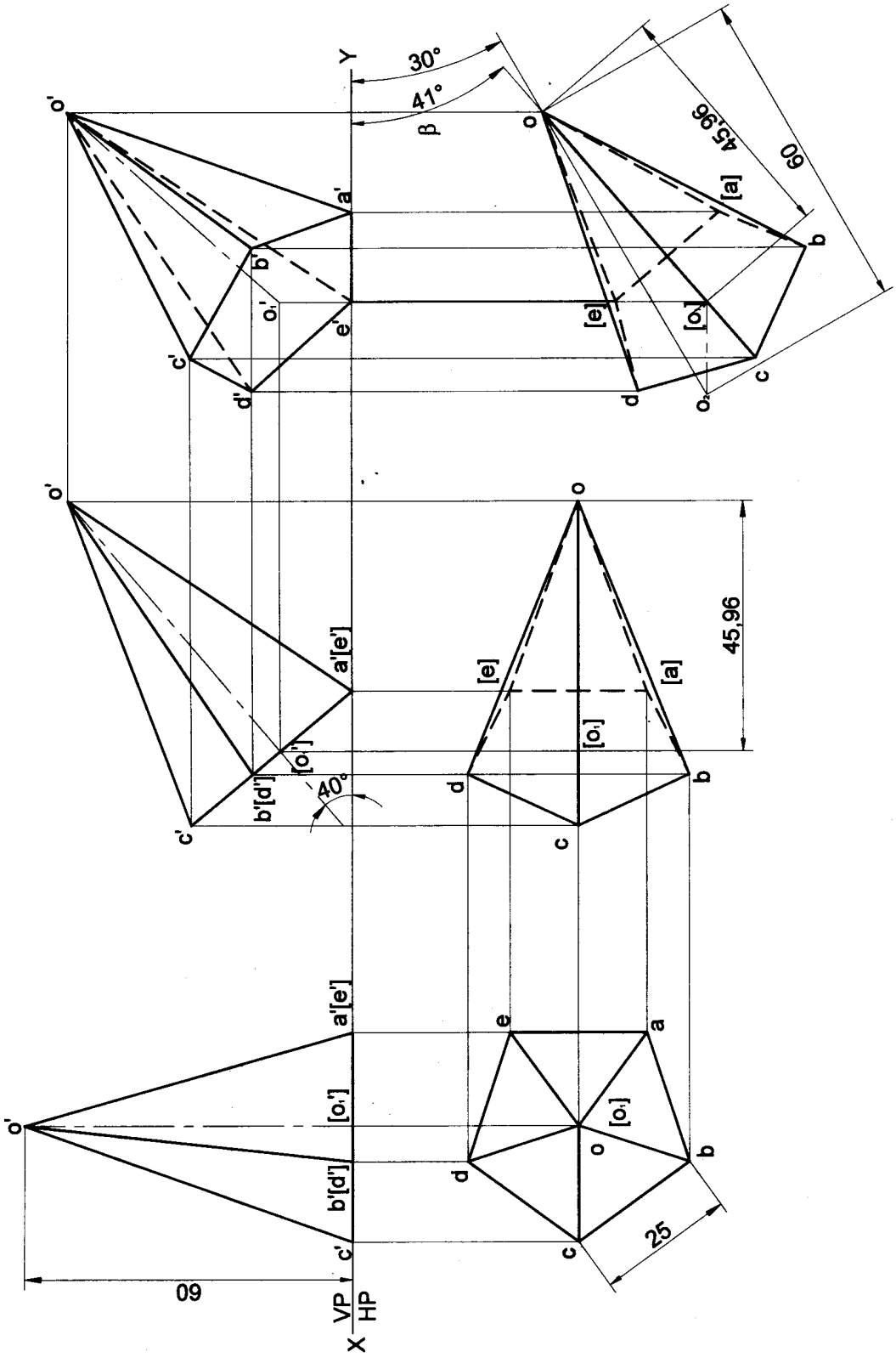
Problem 20 A pentagonal pyramid 25 mm sides of base and 60 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the pyramid when the axis is inclined to HP at 40º.

Solution



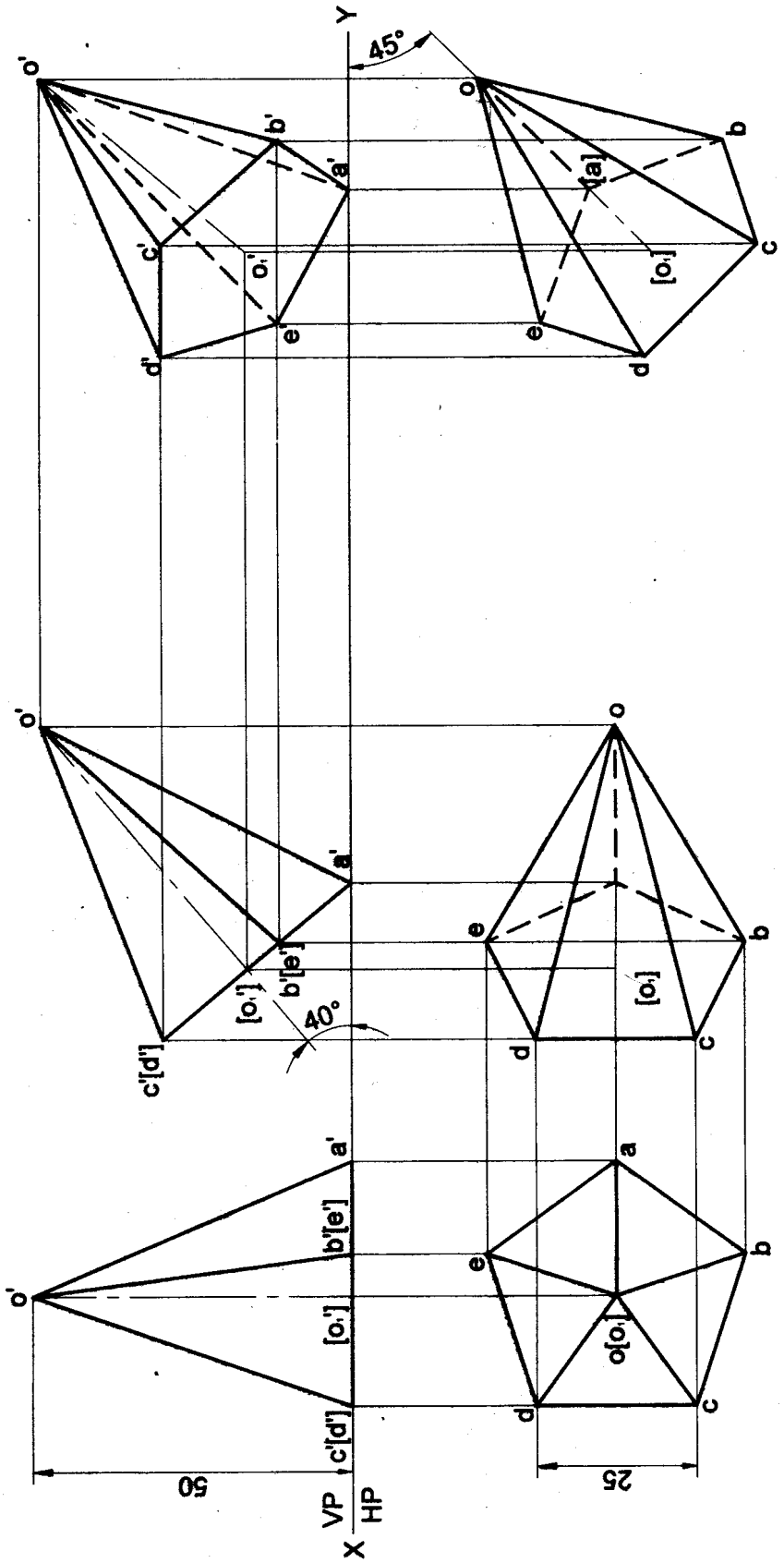
Problem 21 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45º and VP at 30º.

Solution



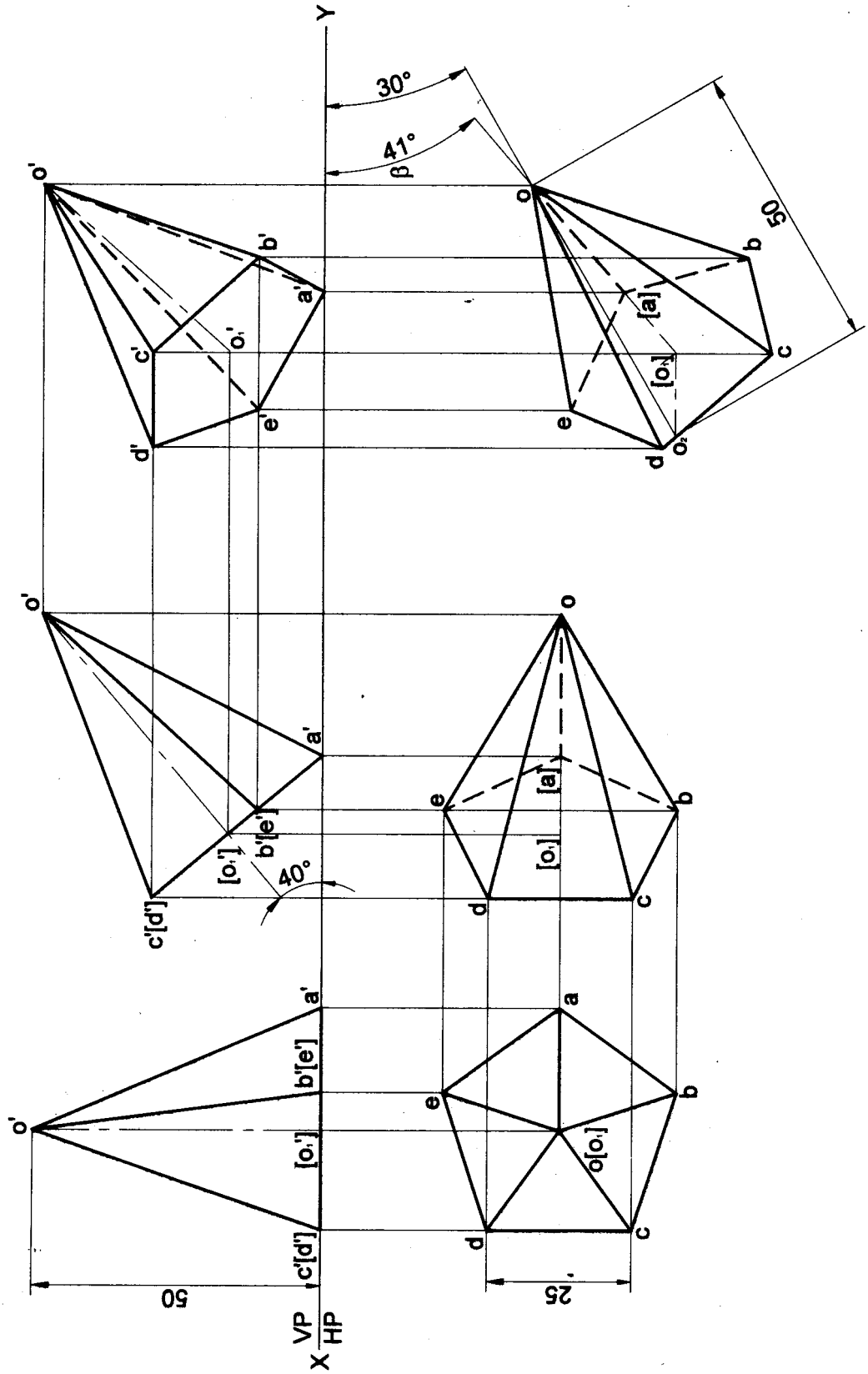
Problem 22 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



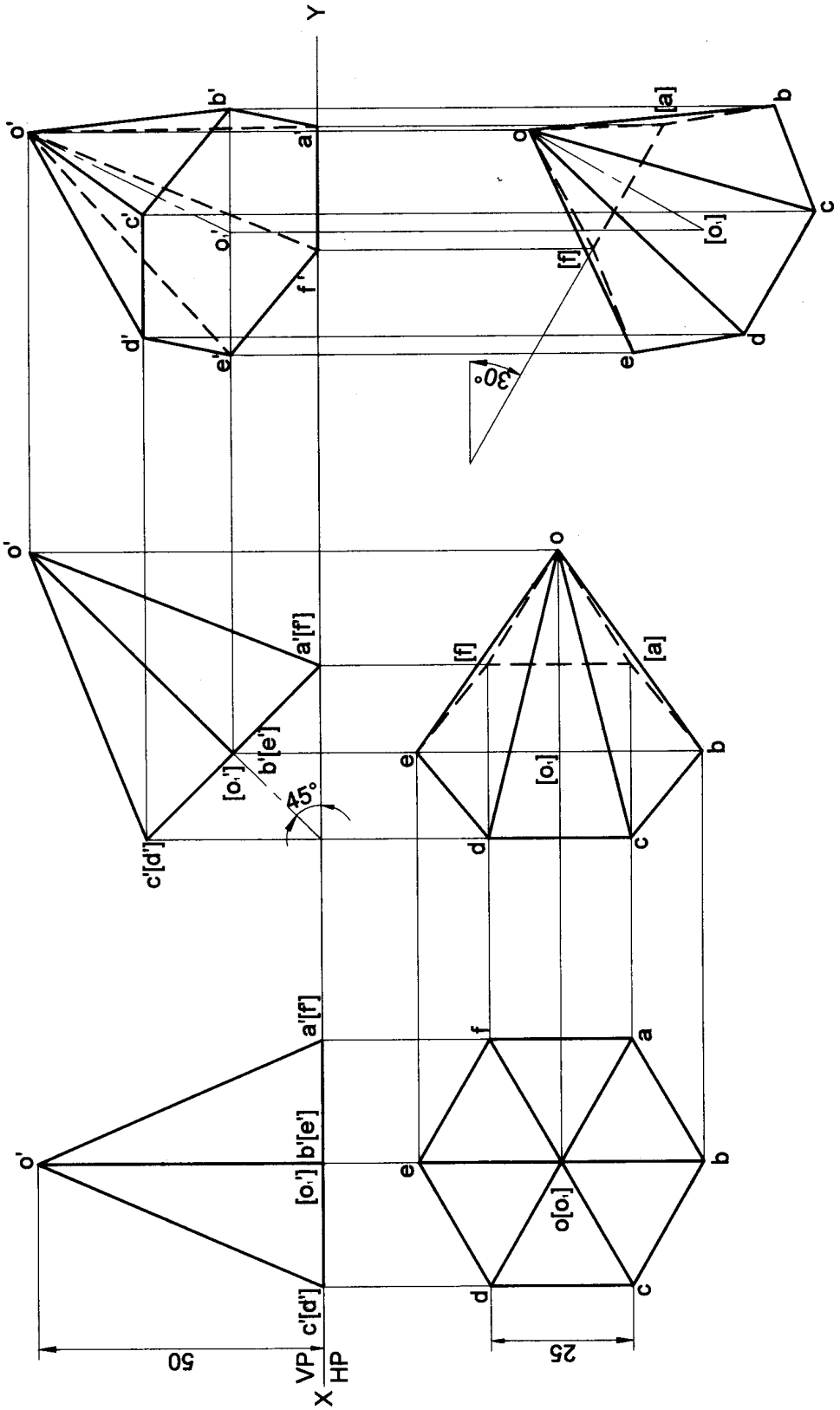
Problem 23 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and to VP at 30º.

Solution



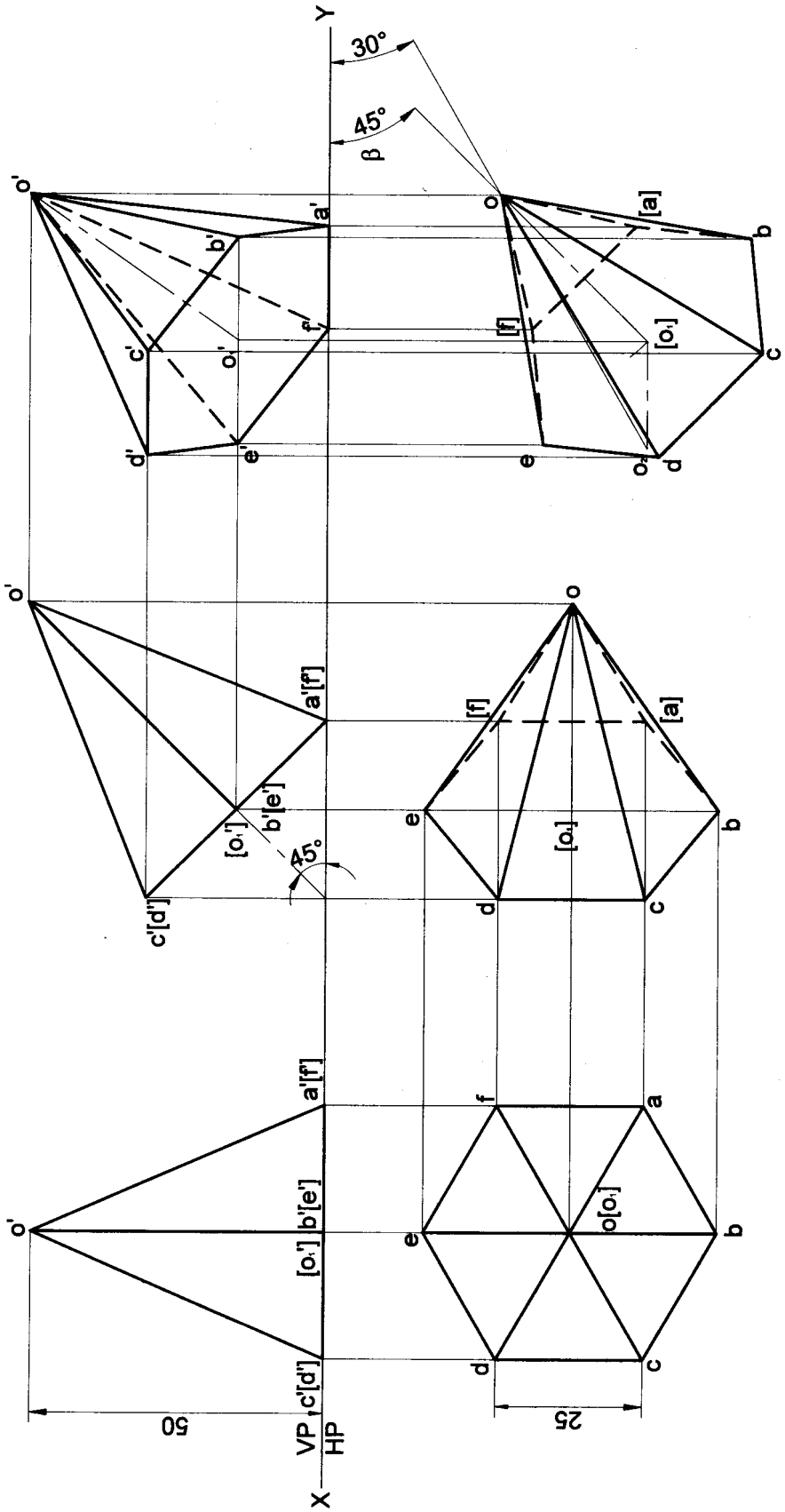
Problem 24 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the pyramid when the axis is inclined to HP at 45º.

Solution



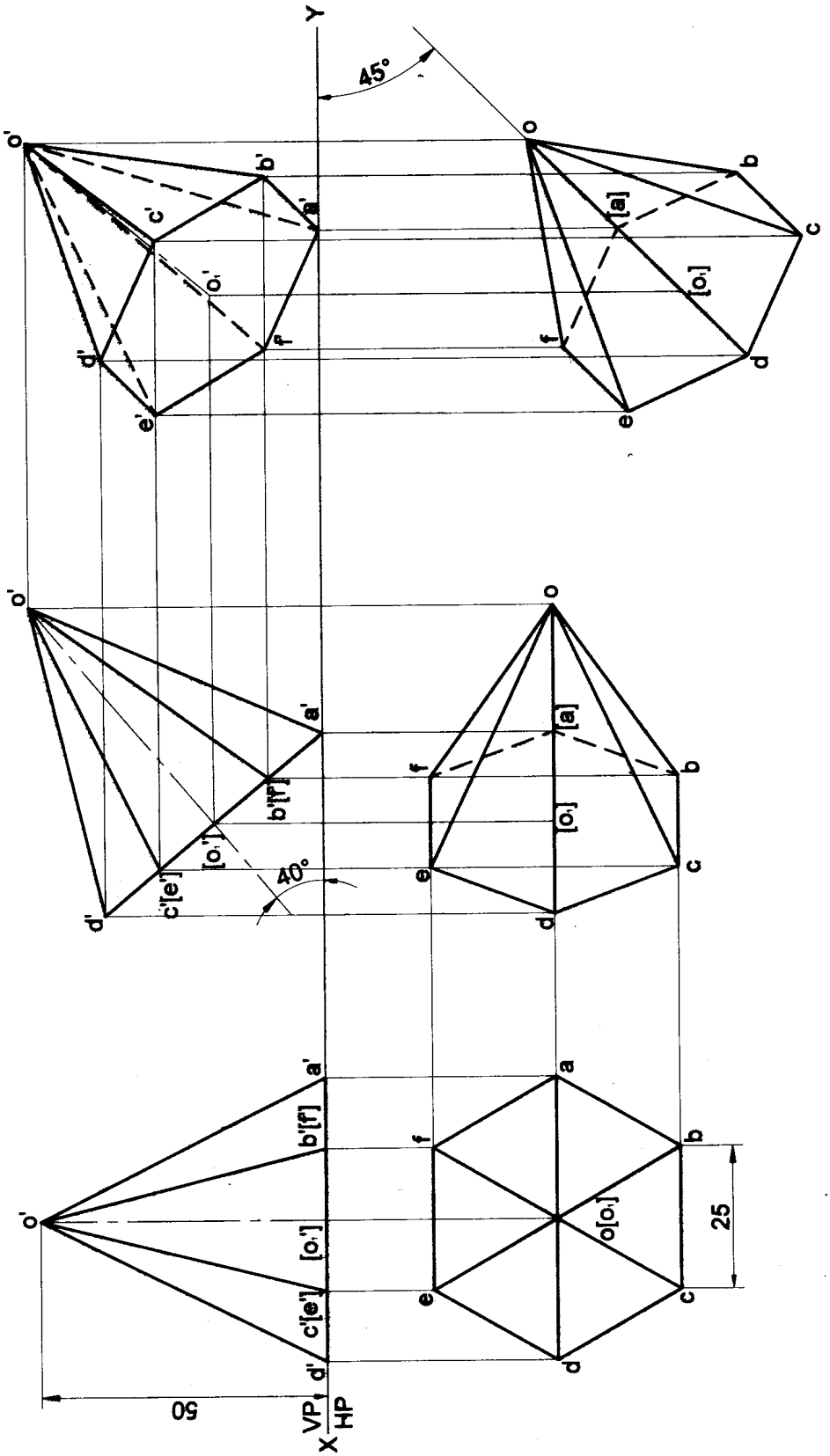
Problem 25 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its edges of the base. Draw the projections of the pyramid when the axis is inclined to HP at 45º and VP at 30º.

Solution



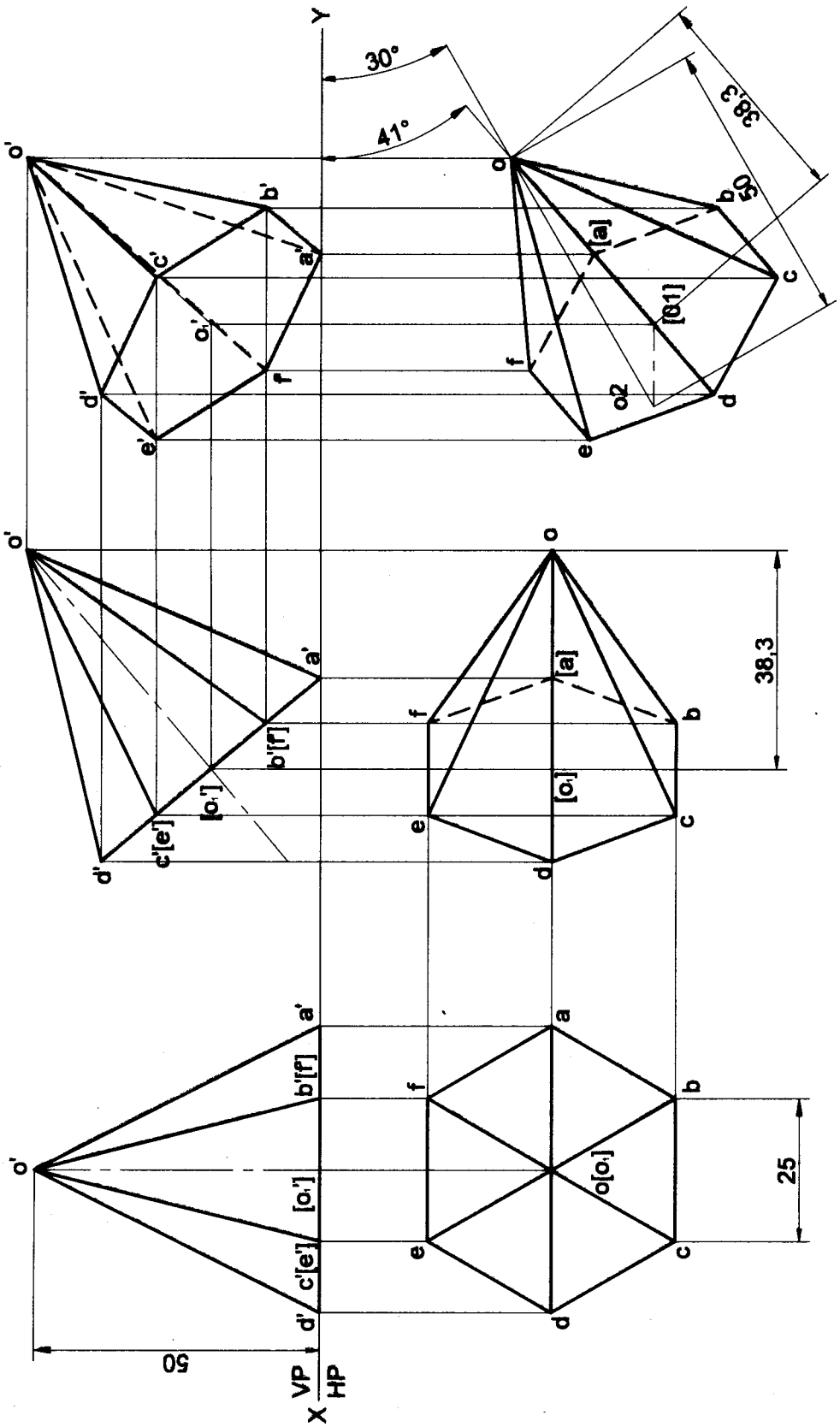
Problem 26 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and appears to be inclined to VP at 45º.

Solution



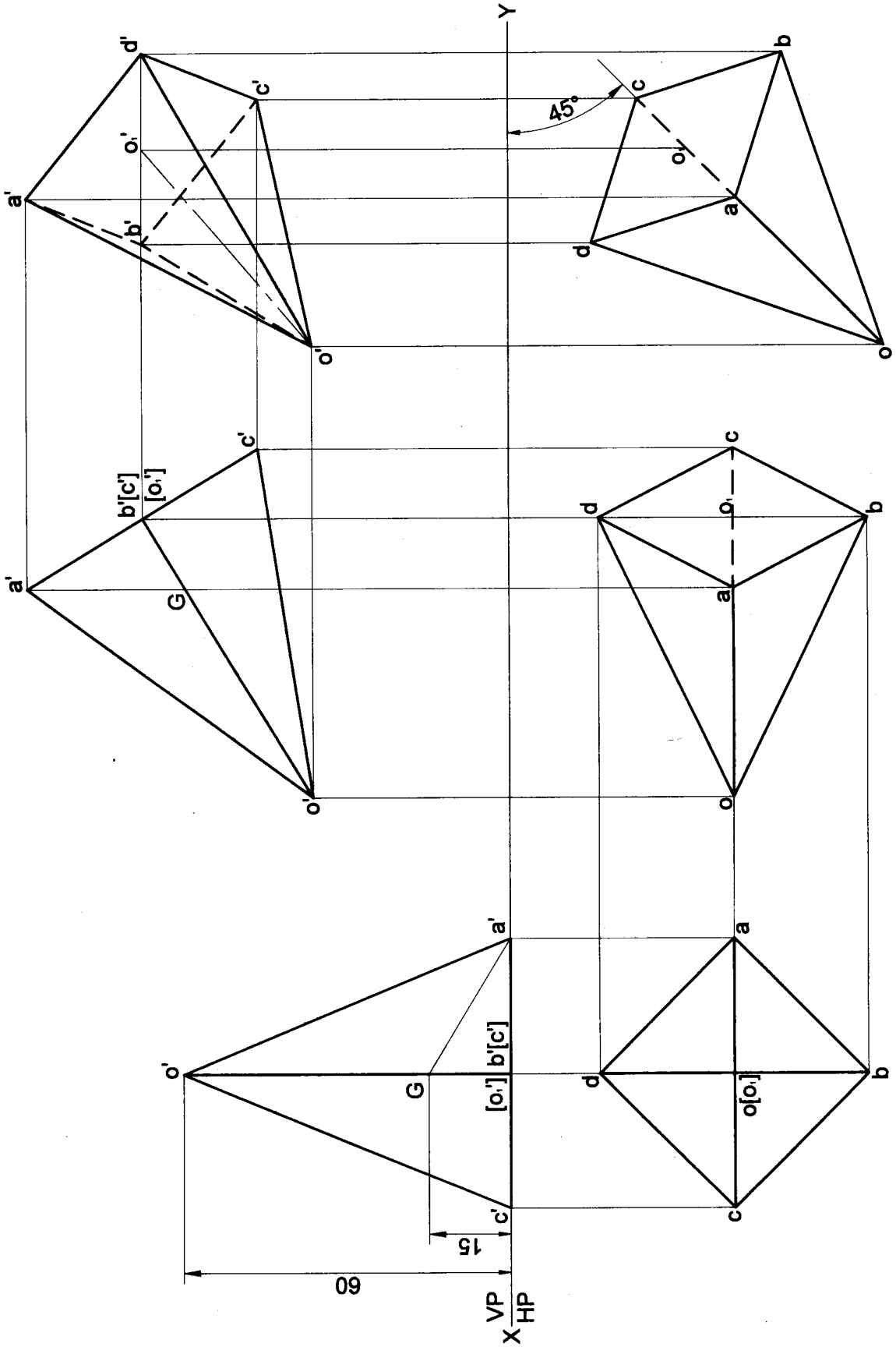
Problem 27 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its corners of the base such that the two base edges containing the corner on which it rests make equal inclinations with HP. Draw the projections of the pyramid when the axis of the pyramid is inclined to HP at 40º and to VP at 30º.

Solution



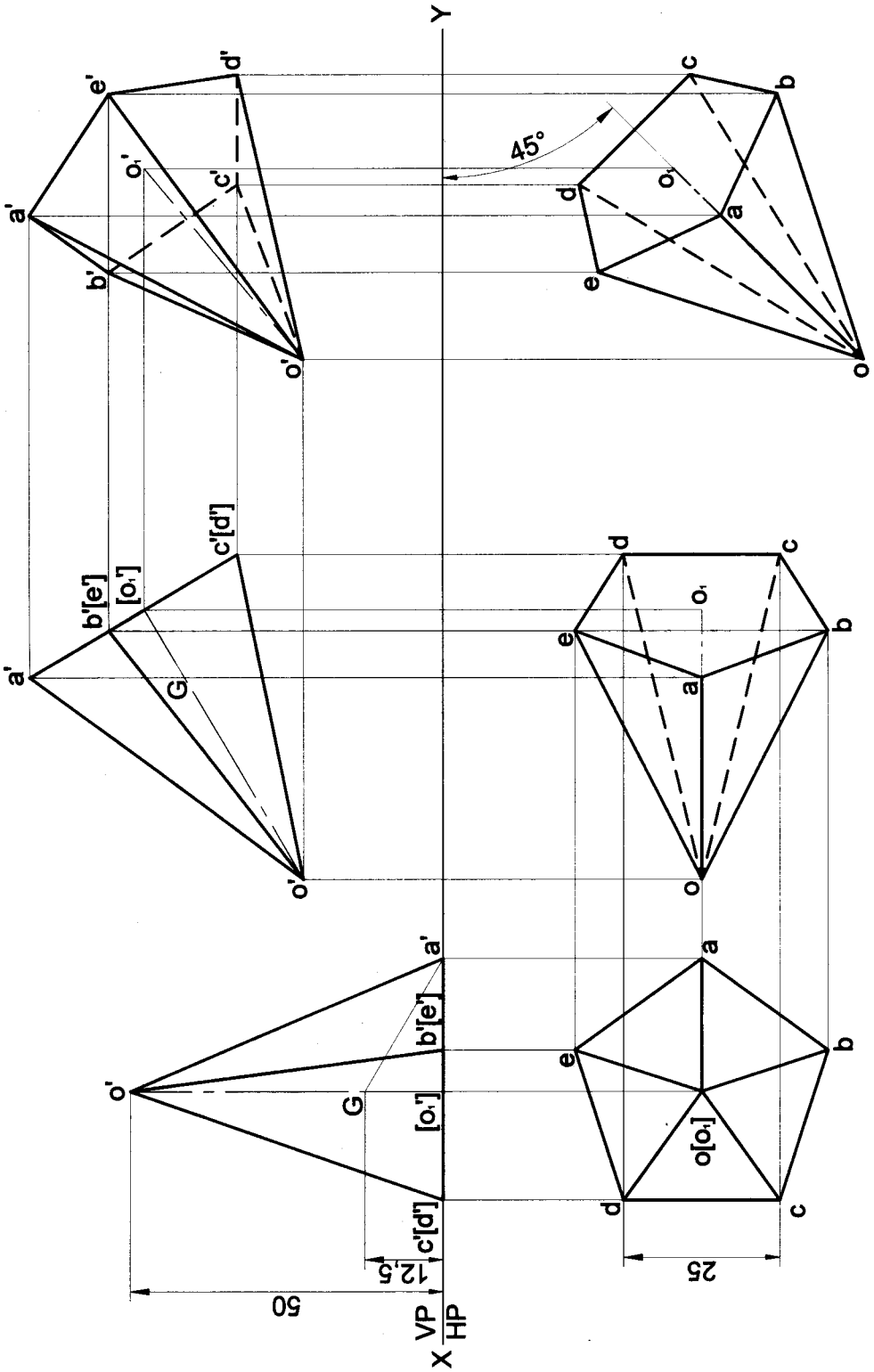
Problem 28 A square pyramid 35 mm sides of base and 60 mm axis length is suspended freely from a corner of its base. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



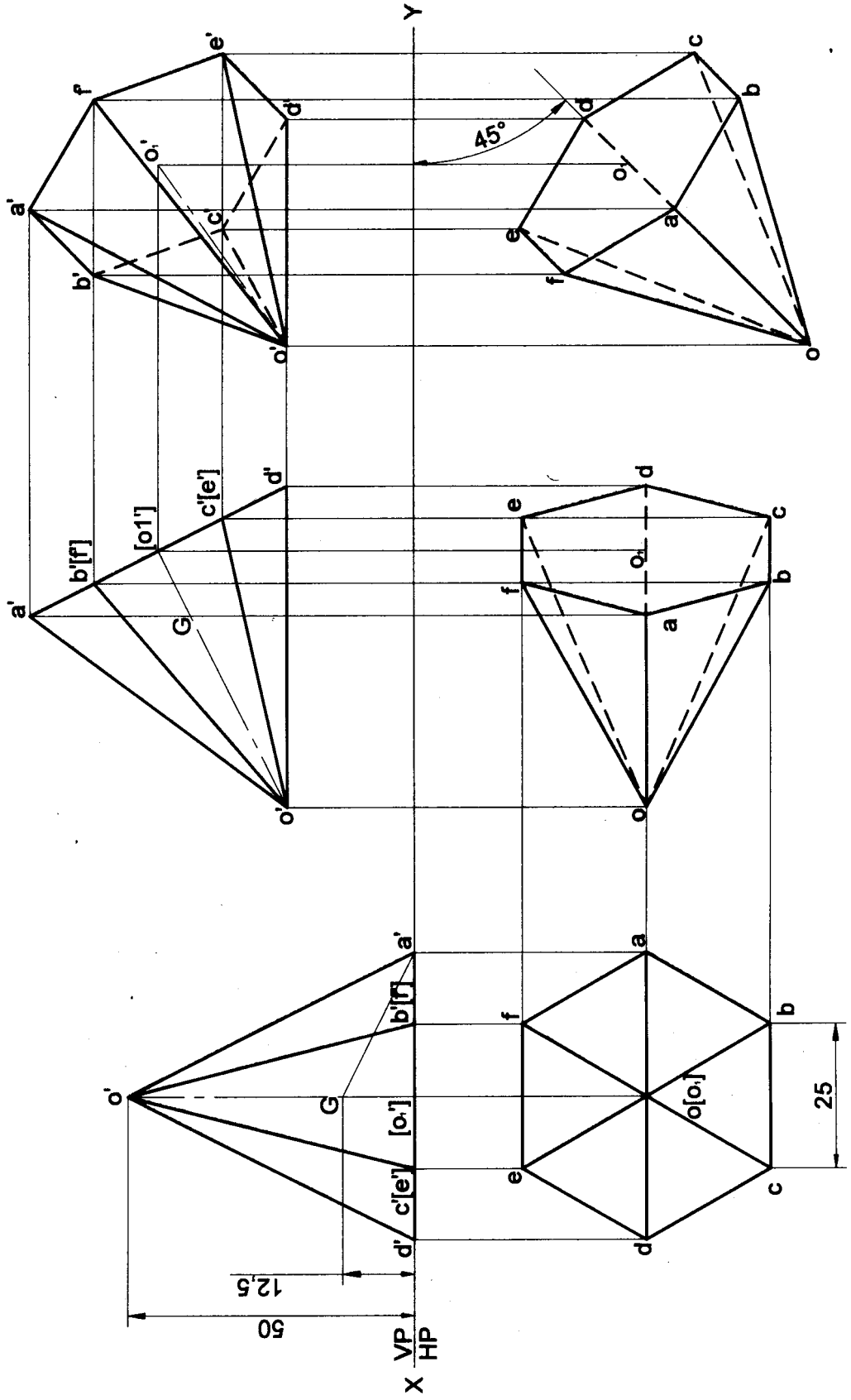
Problem 29 A pentagonal pyramid 25 mm sides of base and 50 mm axis length is suspended freely from a corner o its base. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



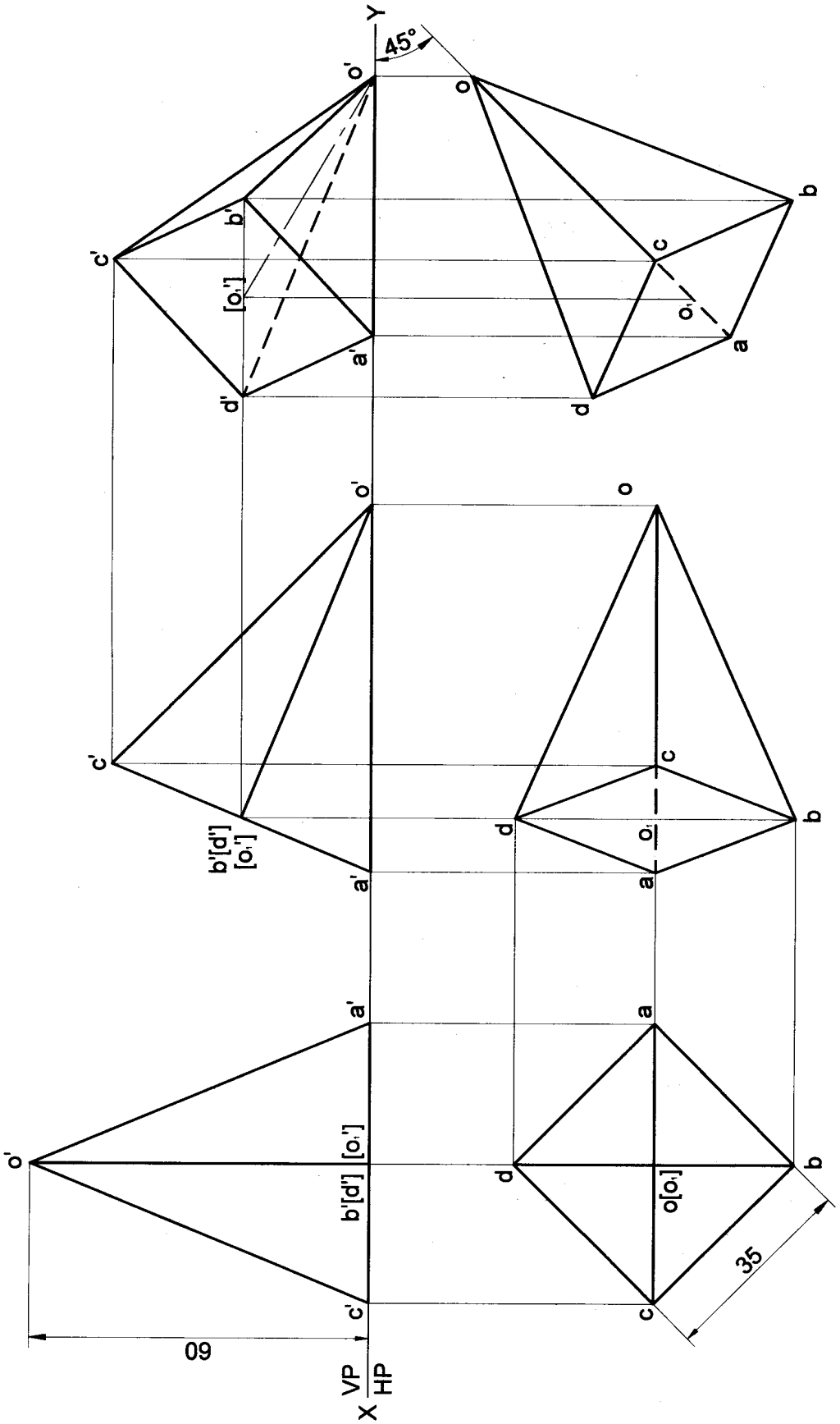
Problem 30 A hexagonal pyramid 25 mm sides of base and 50 mm axis length is suspended freely from a corner of its base. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



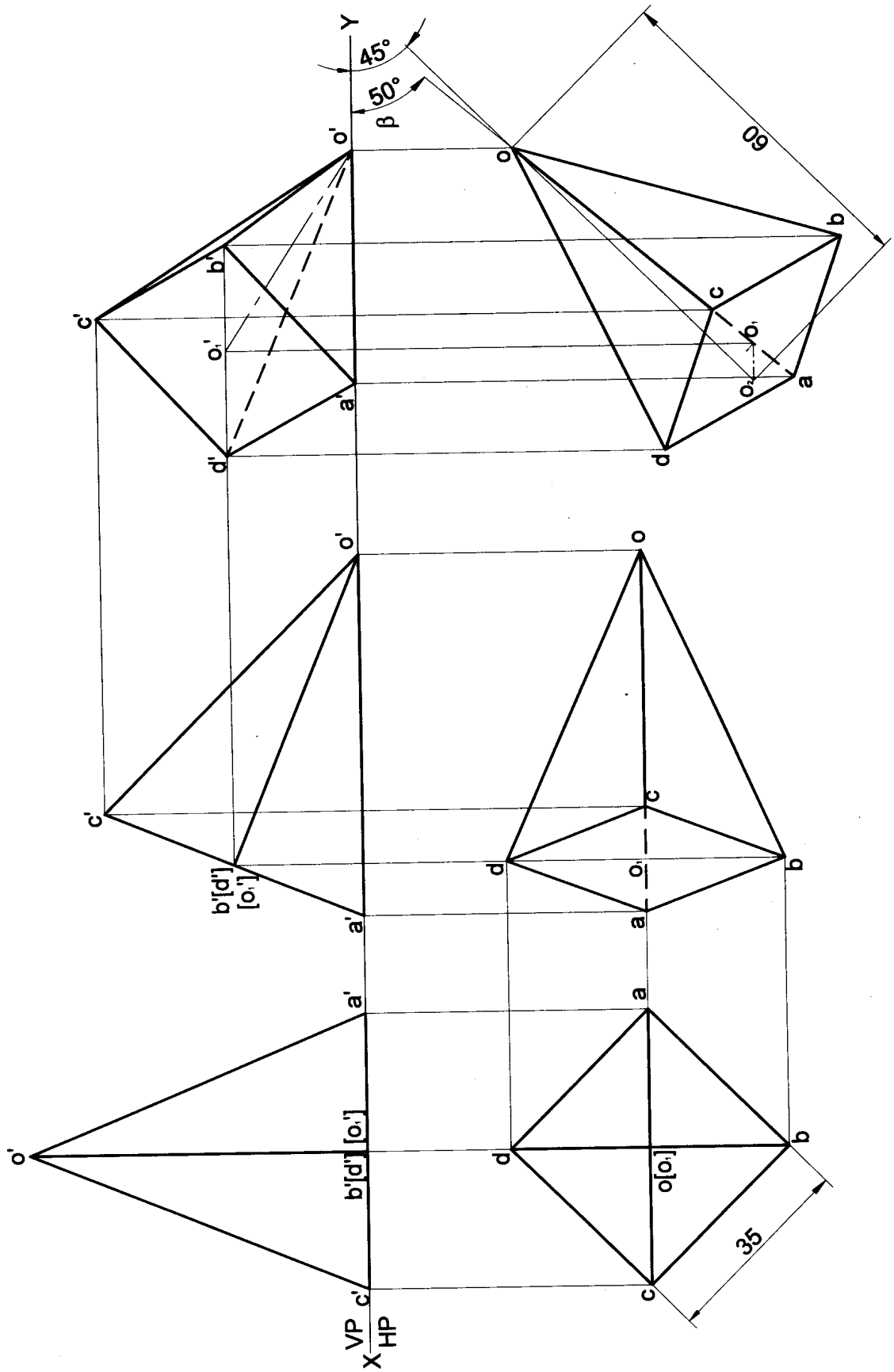
Problem 31 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



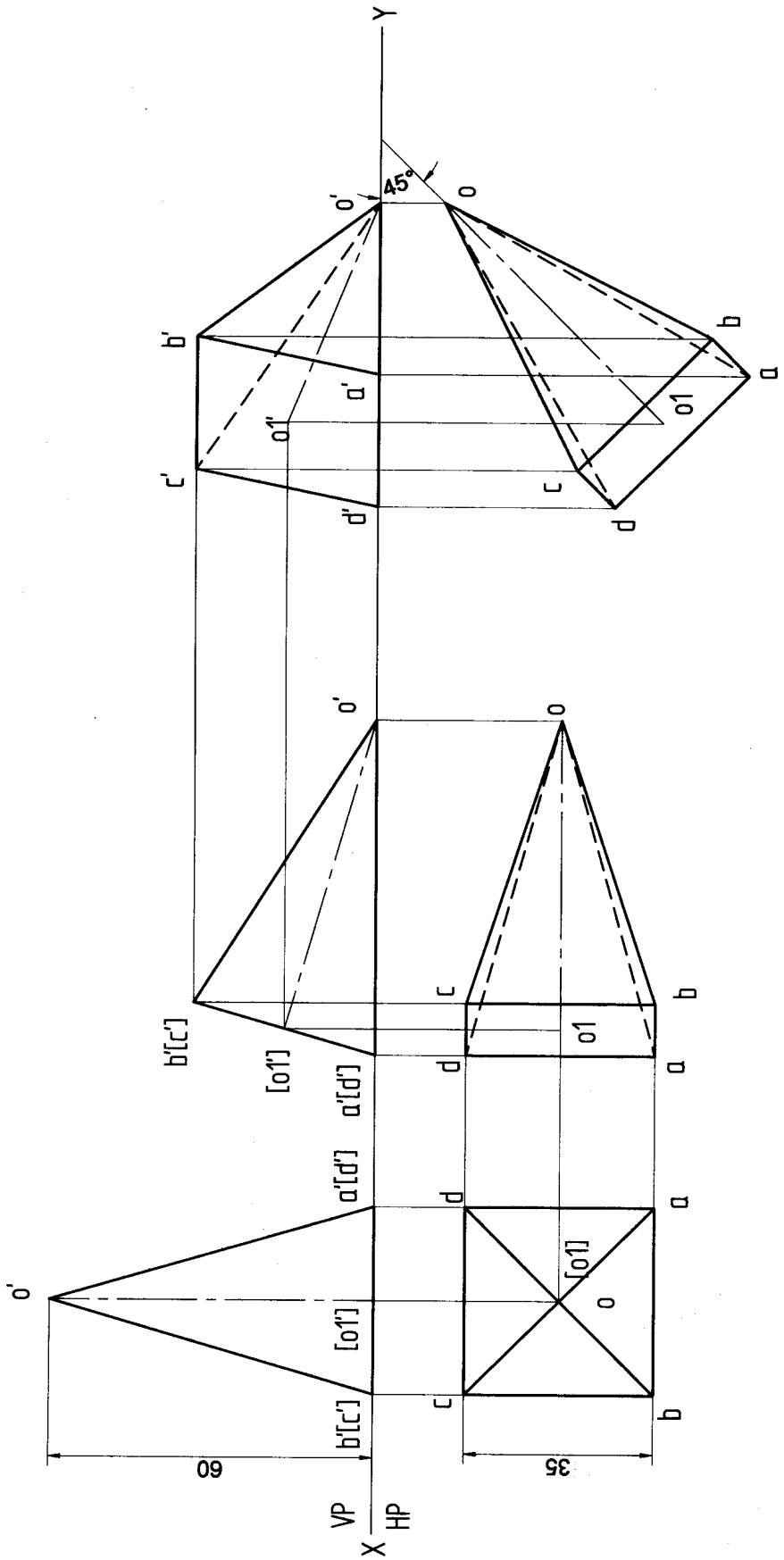
Problem 32 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



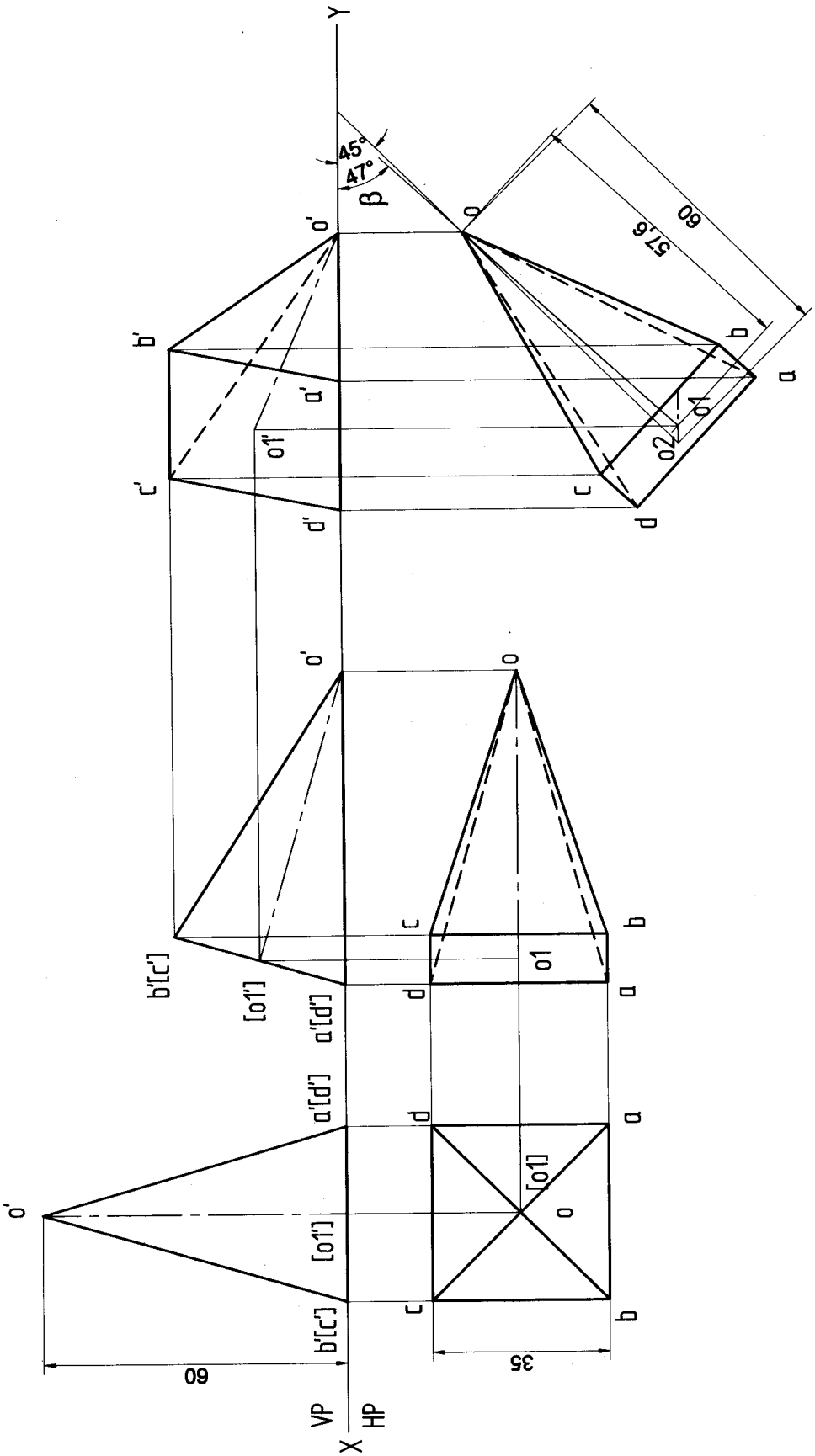
Problem 33 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



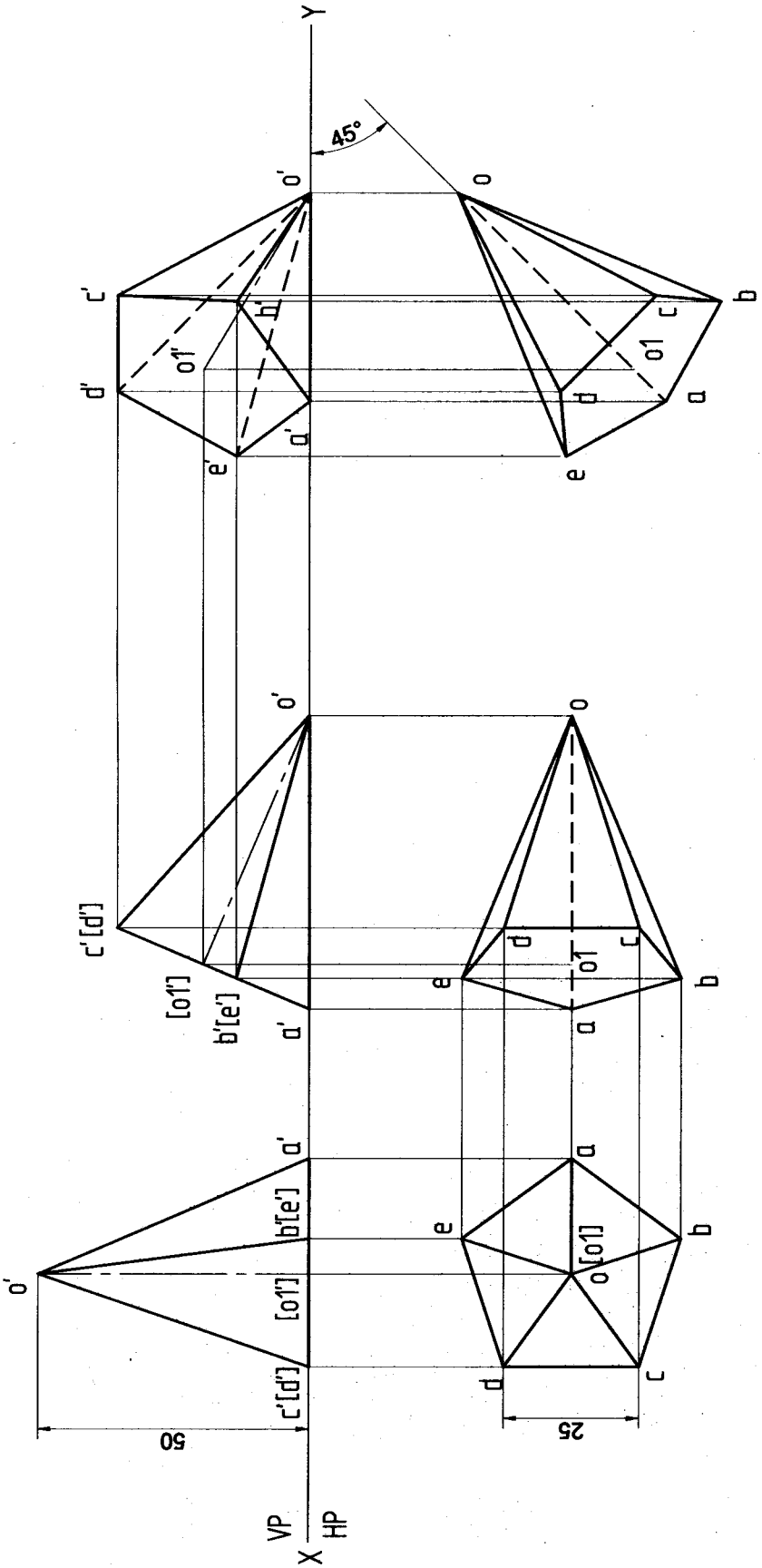
Problem 34 A square pyramid 35 mm sides of base and 60 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



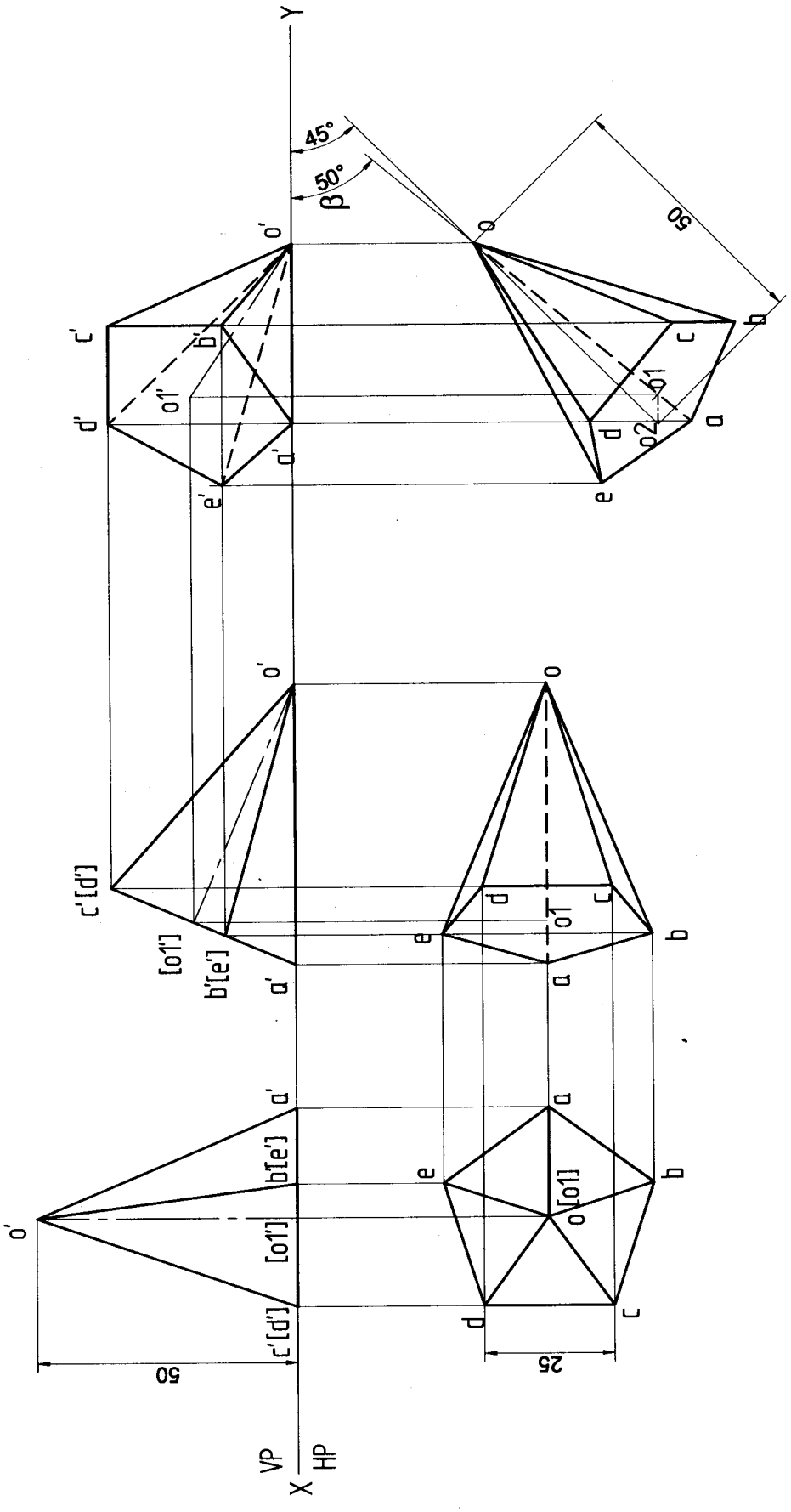
Problem 35 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



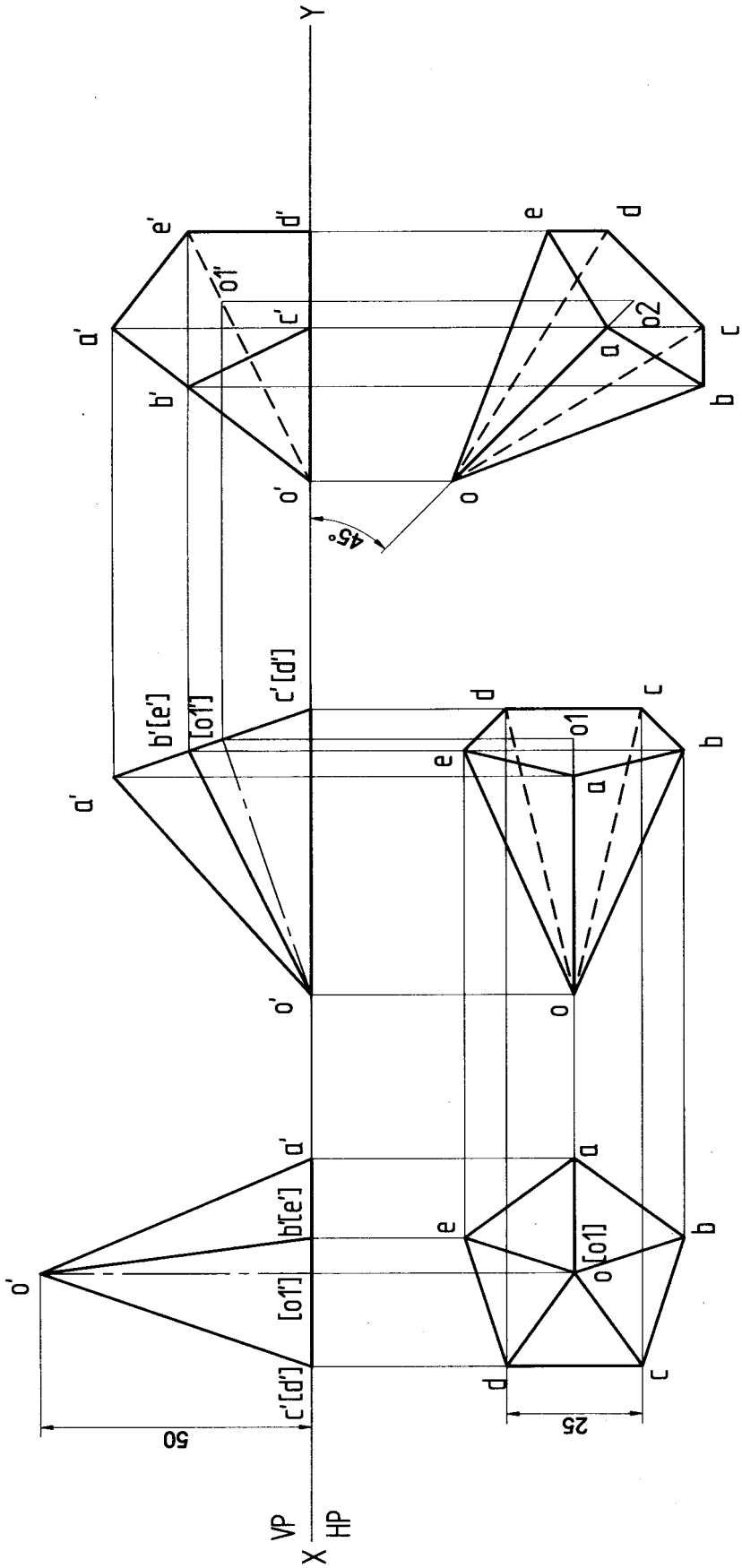
Problem 36 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



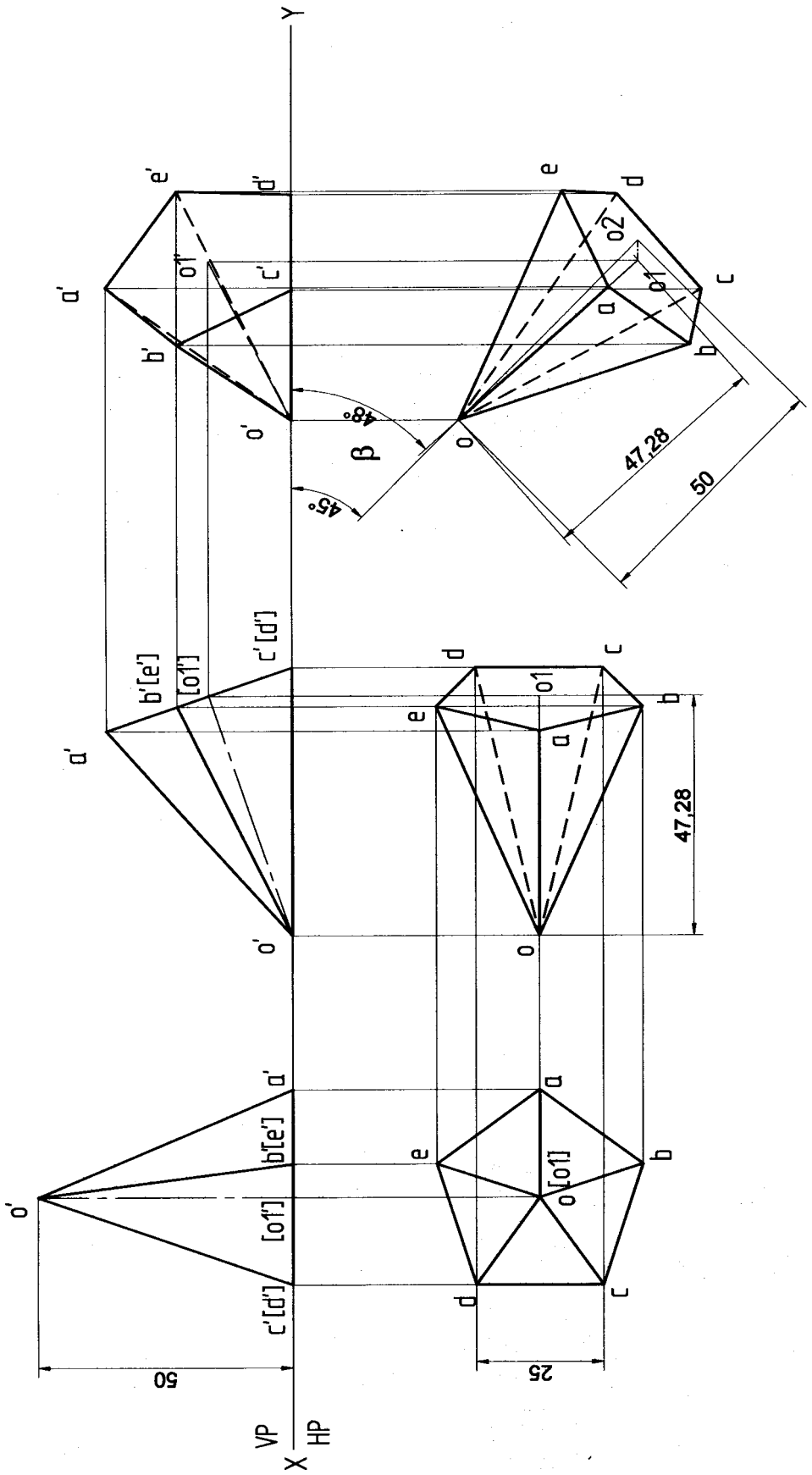
Problem 37 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



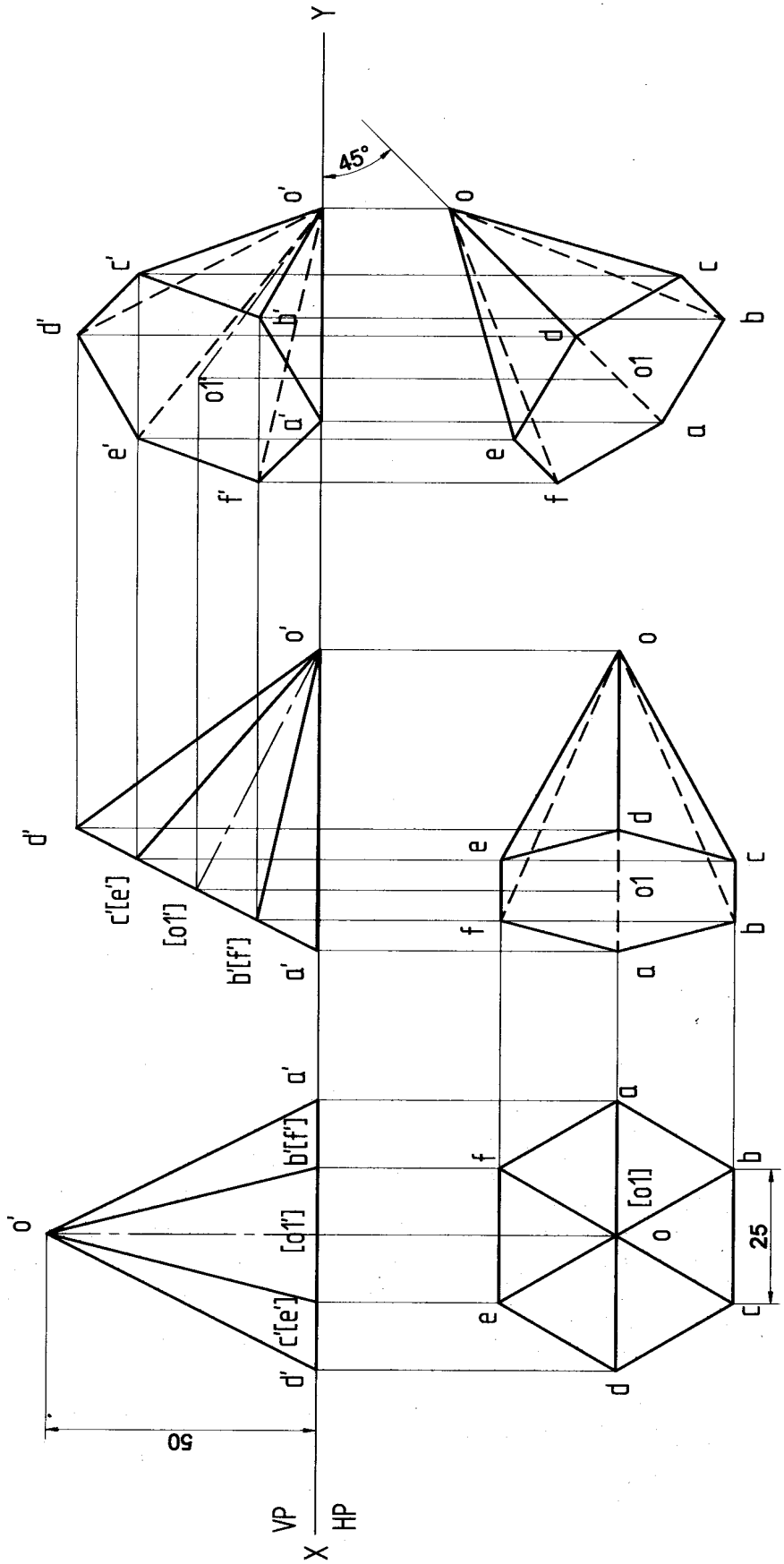
Problem 38 A pentagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



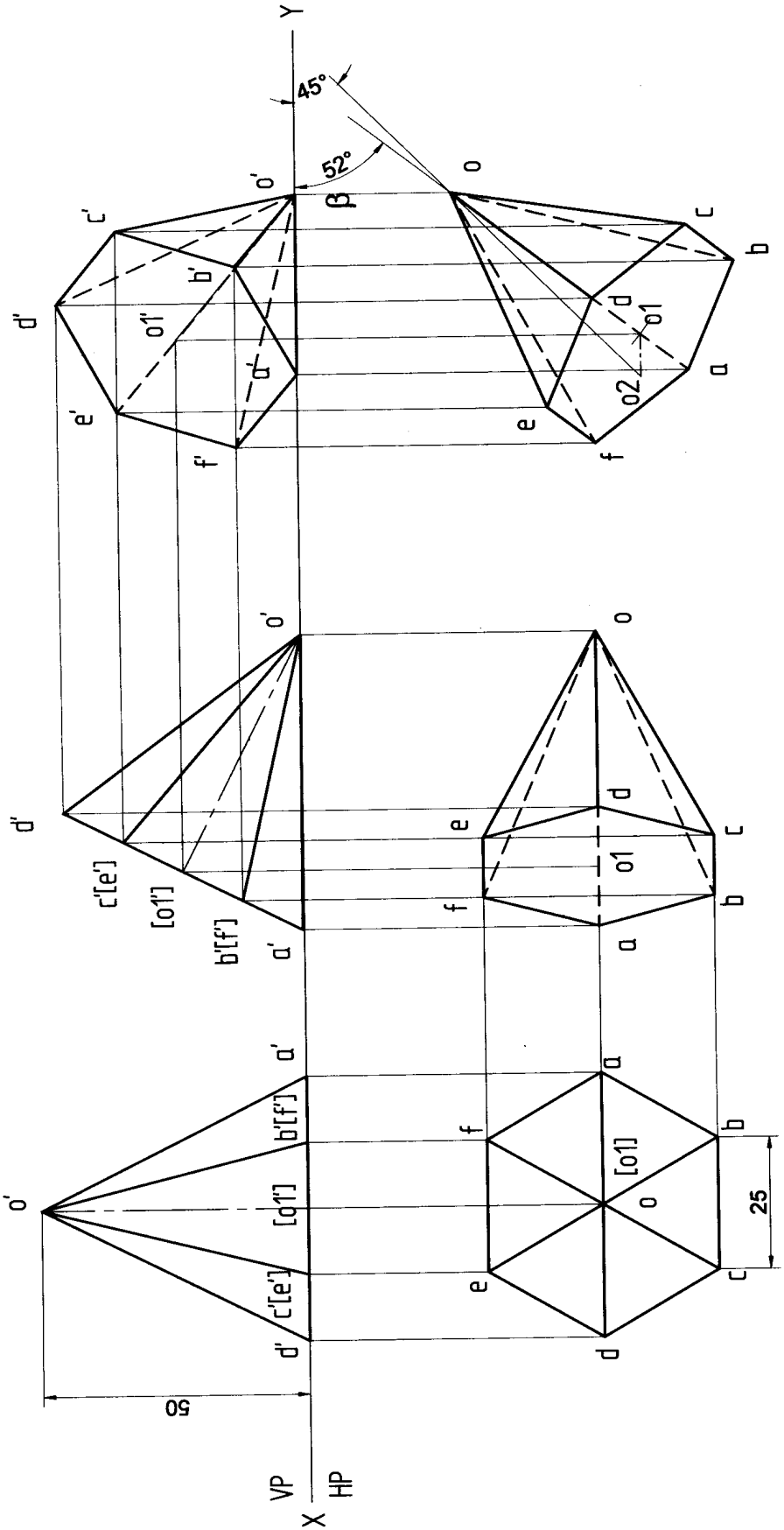
Problem 39 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



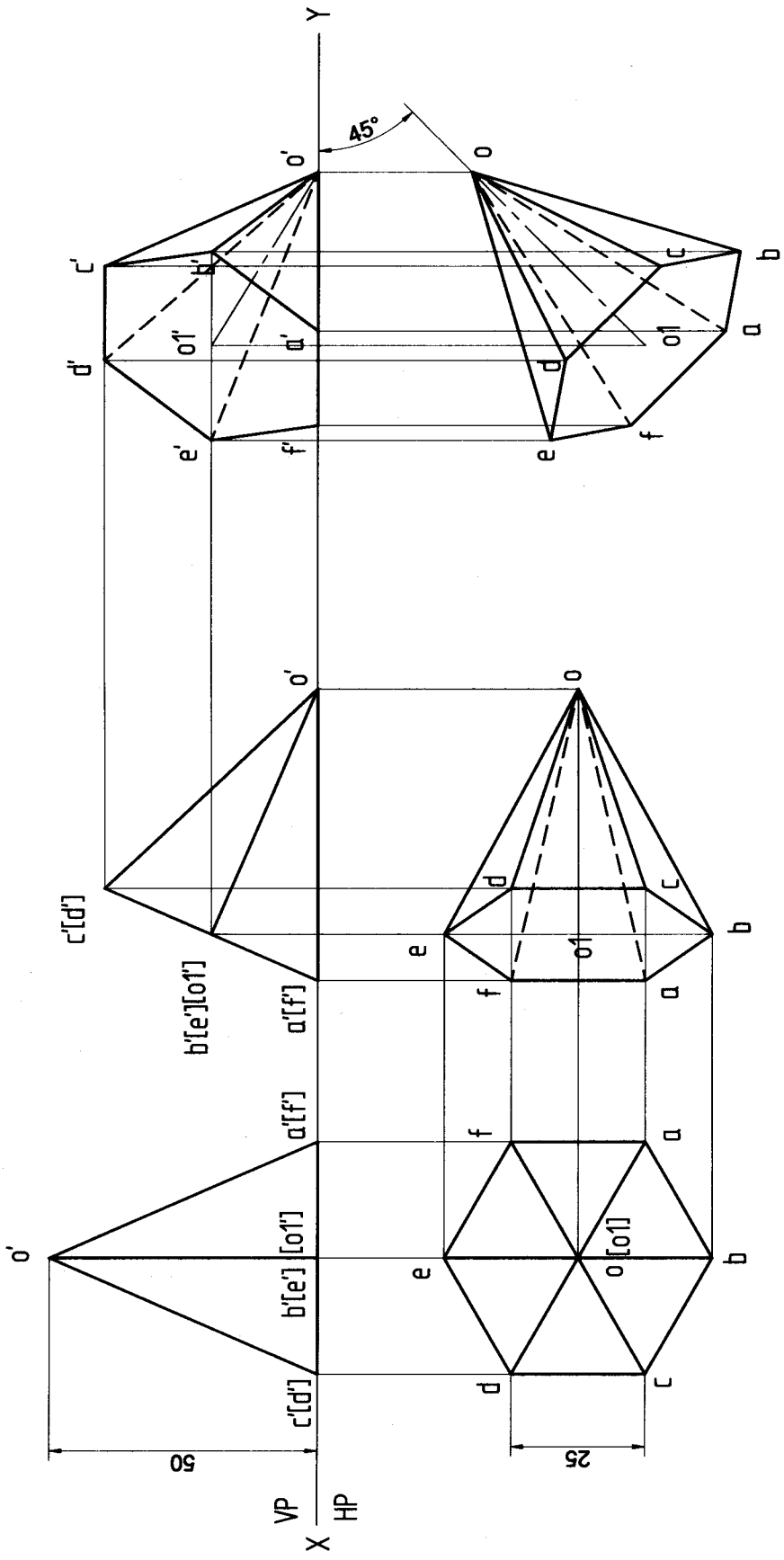
Problem 40 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant edges. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



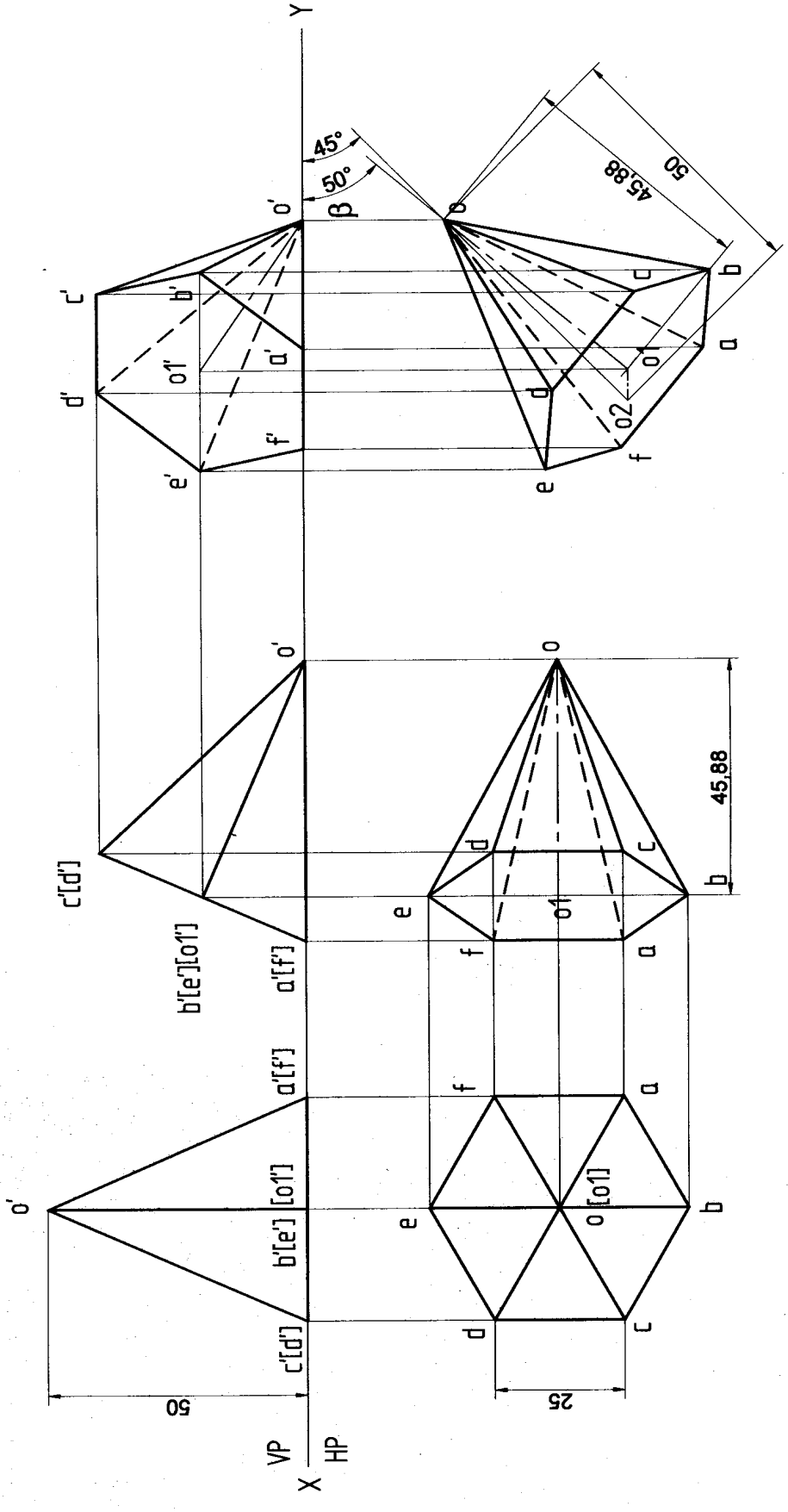
Problem 41 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis appears to be inclined to VP at 45º.

Solution



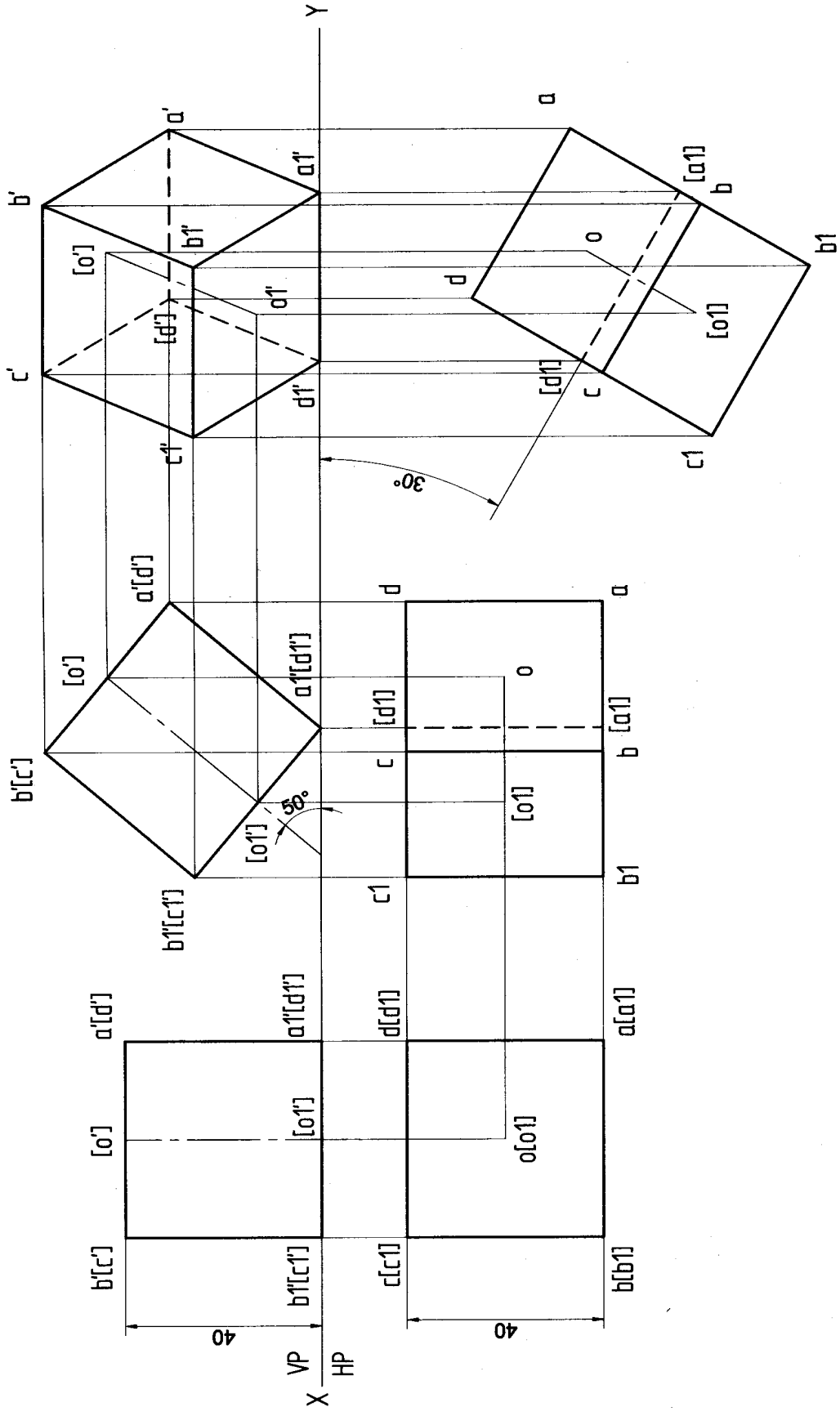
Problem 42 A hexagonal pyramid 25 mm sides of base and 50 mm axis length rests on HP on one of its slant triangular faces. Draw the projections of the pyramid when the axis is inclined to VP at 45º.

Solution



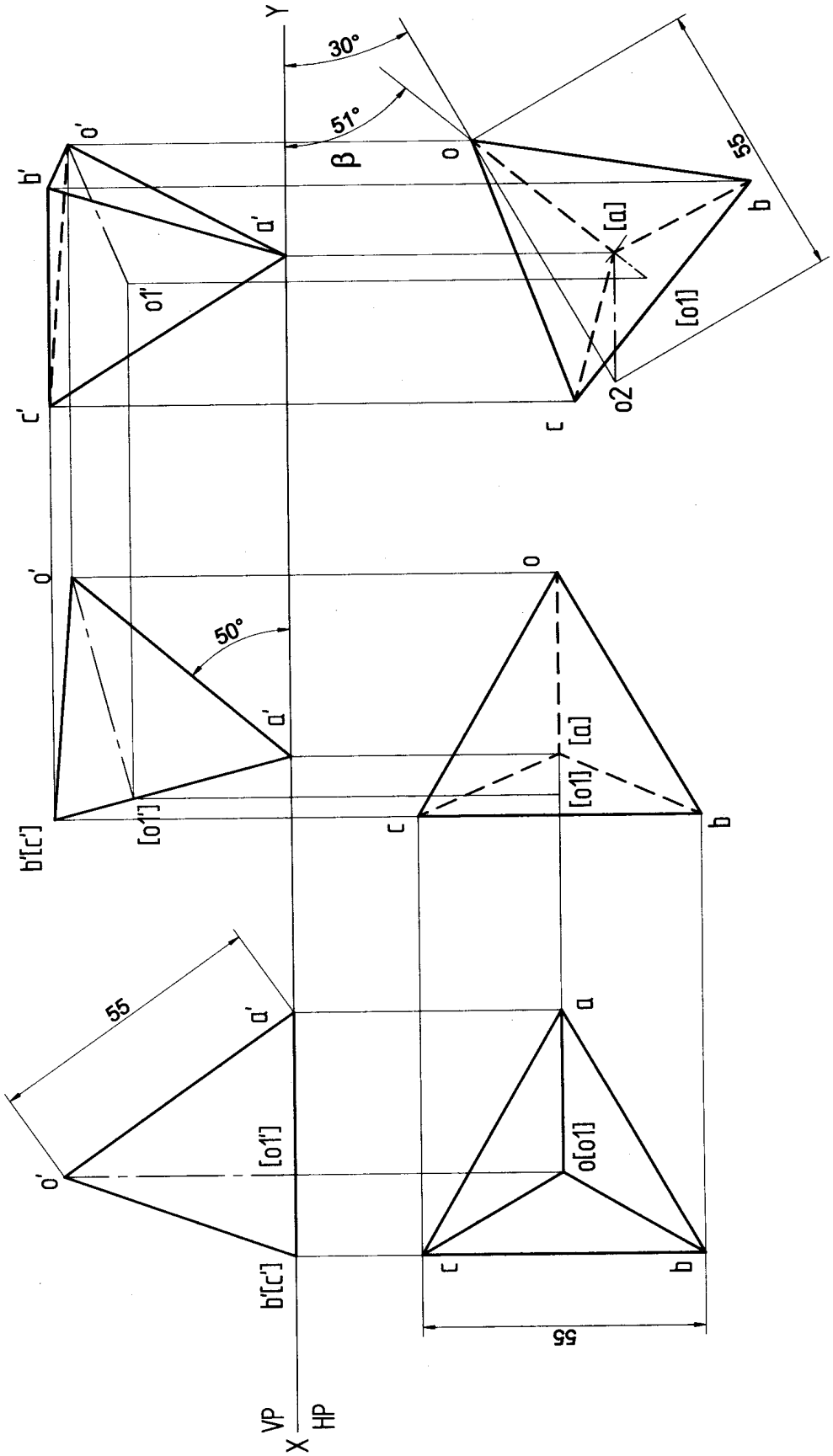
Problem 43 A cube of 40 mm sides rests on HP on an edge which is inclined to VP at 30º. Draw the projections when the lateral square face containing the edge on which it rests makes an angle of 50º to HP.

Solution



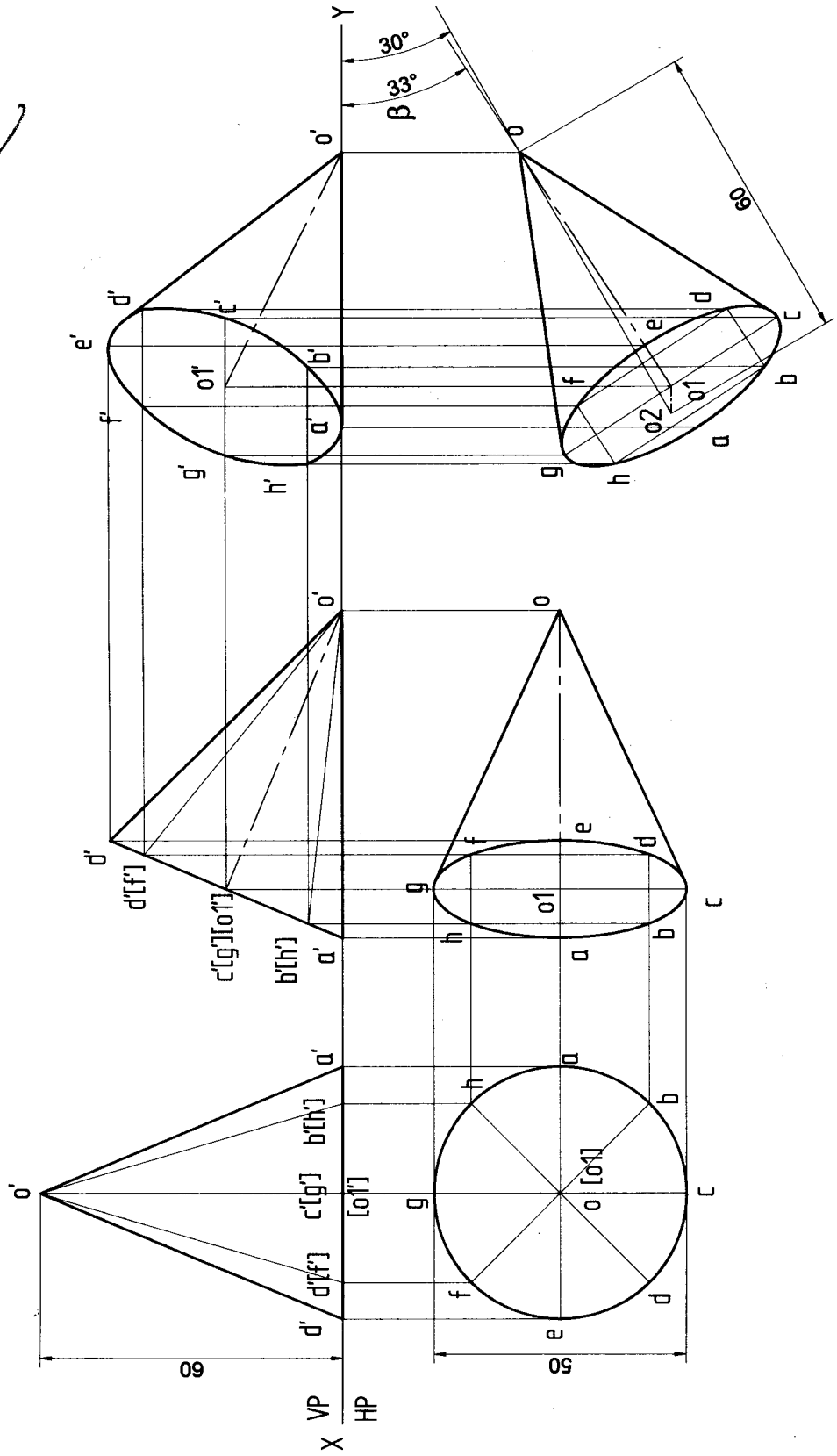
Problem 44 A tetrahedron of 55 mm sides rests on one of its corners such that an edge containing that corner is inclined to HP at 50º and VP at 30º. Draw its projections.

Solution



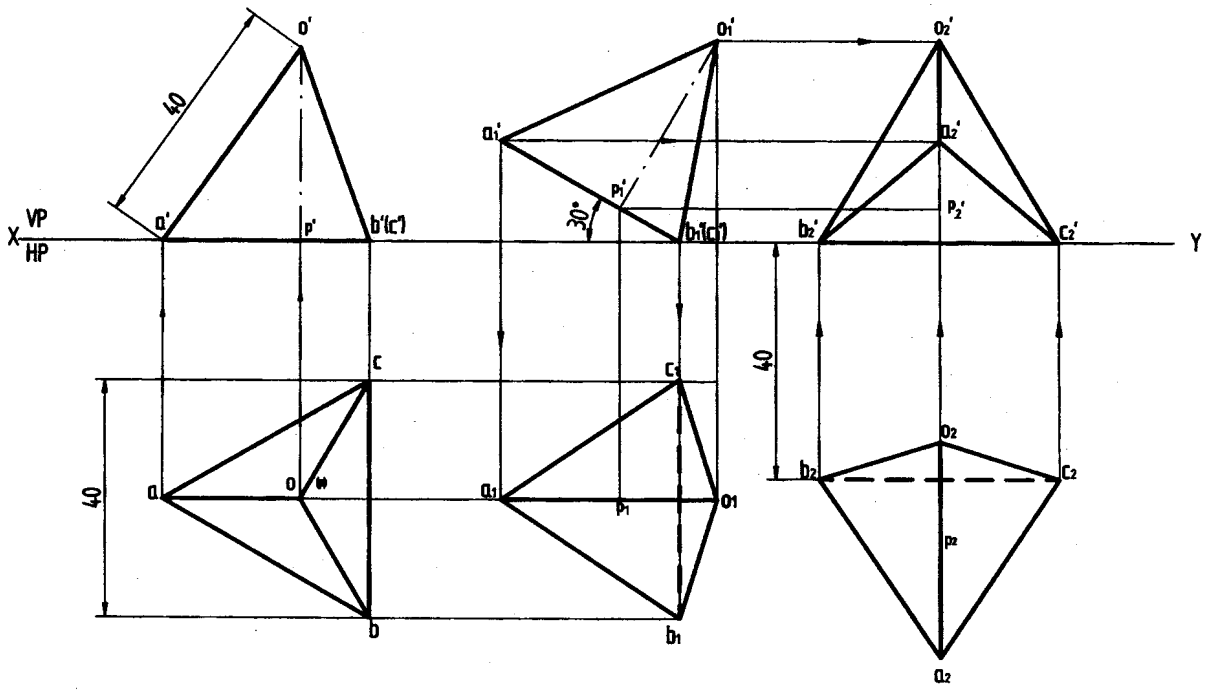
Problem 45 A cone of 50 mm base diameter and 60 mm axis length rests on HP on one of its generators. Draw its projections when the axis is inclined to VP at 30º.

Solution



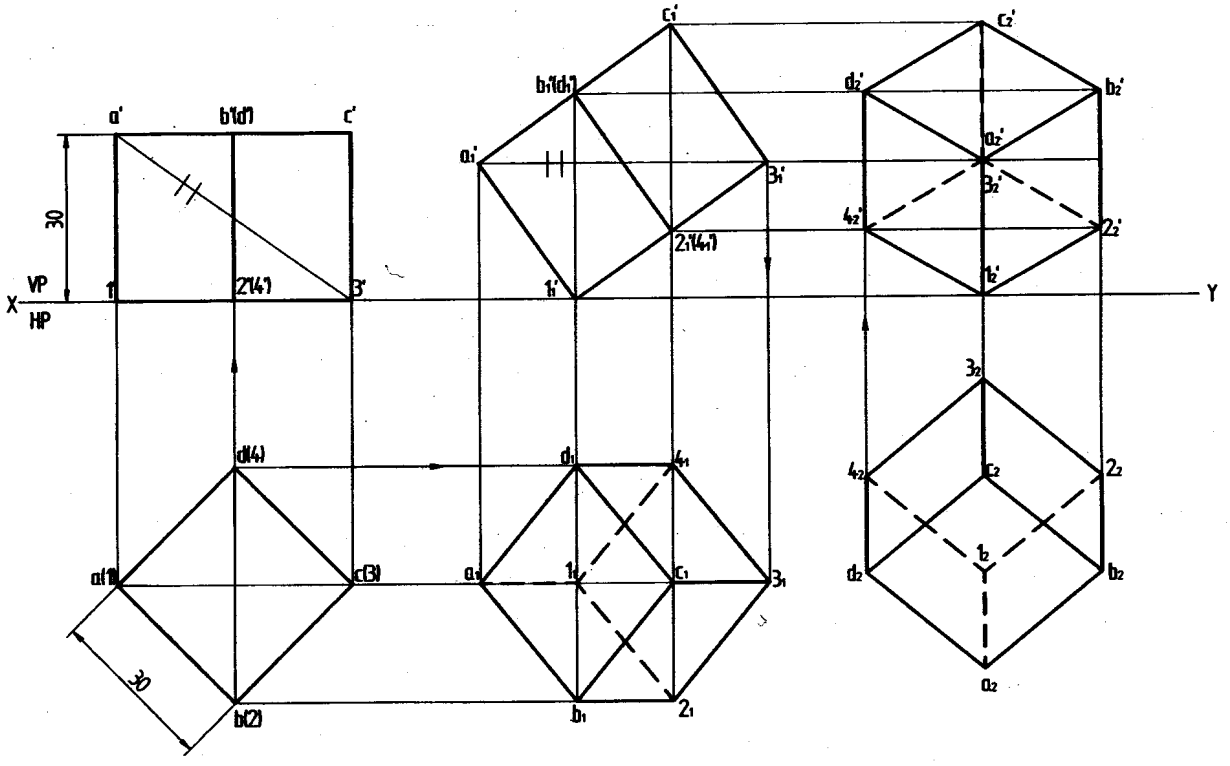
Problem 46 A tetrahedron of sides 40 mm is resting on one of its sides on HP. This side is parallel to VP and 40 mm away from it. It is tilted about resting side such that the base containing this edge is inclined at 30° to HP. Draw the projections of the solid.

Solution



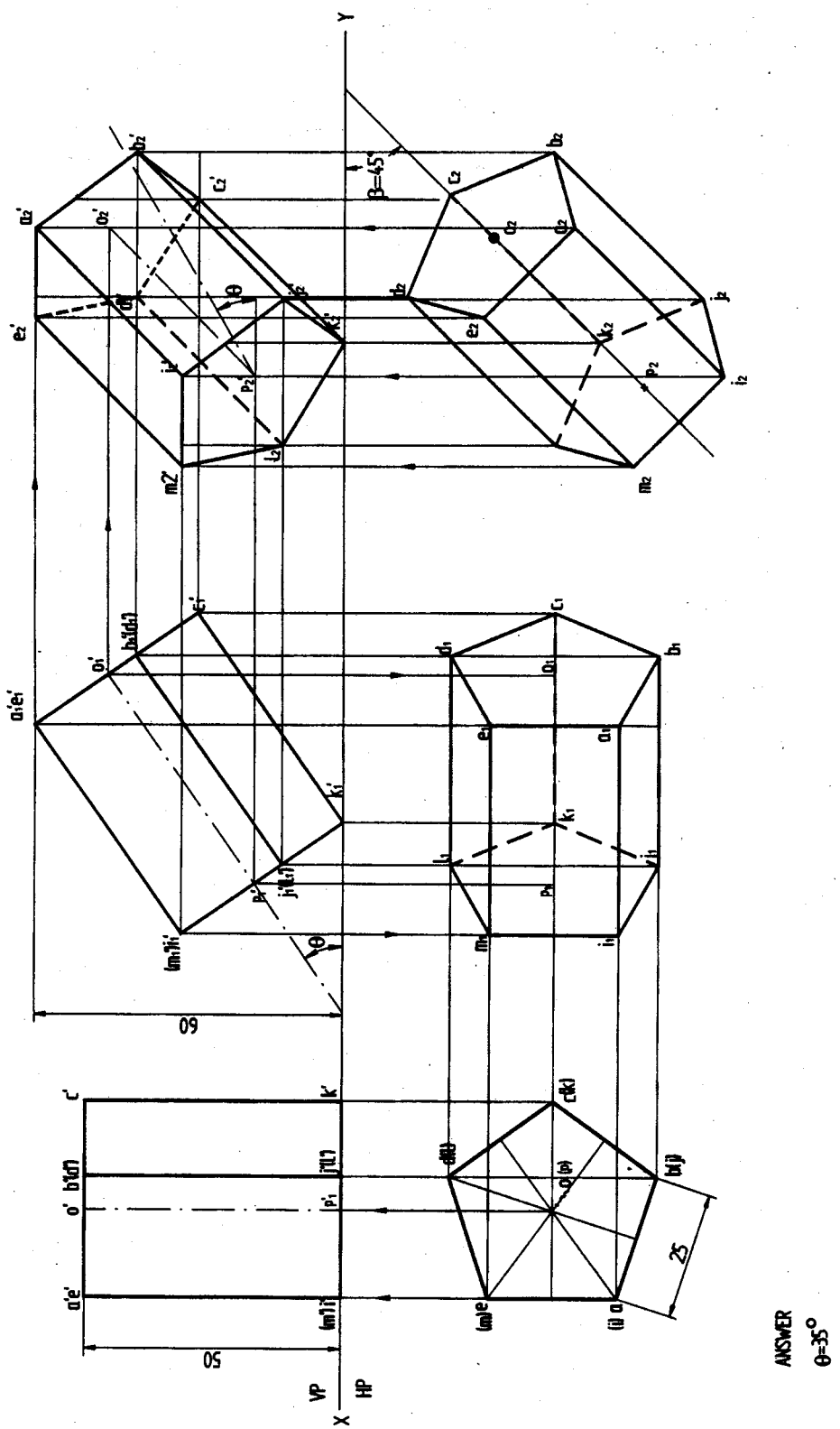
Problem 47 A Hexahedron of 30 mm sides is resting on one of its corners on HP such that one of its solid diagonals is perpendicular to VP. Draw the projections of the solid.

Solution



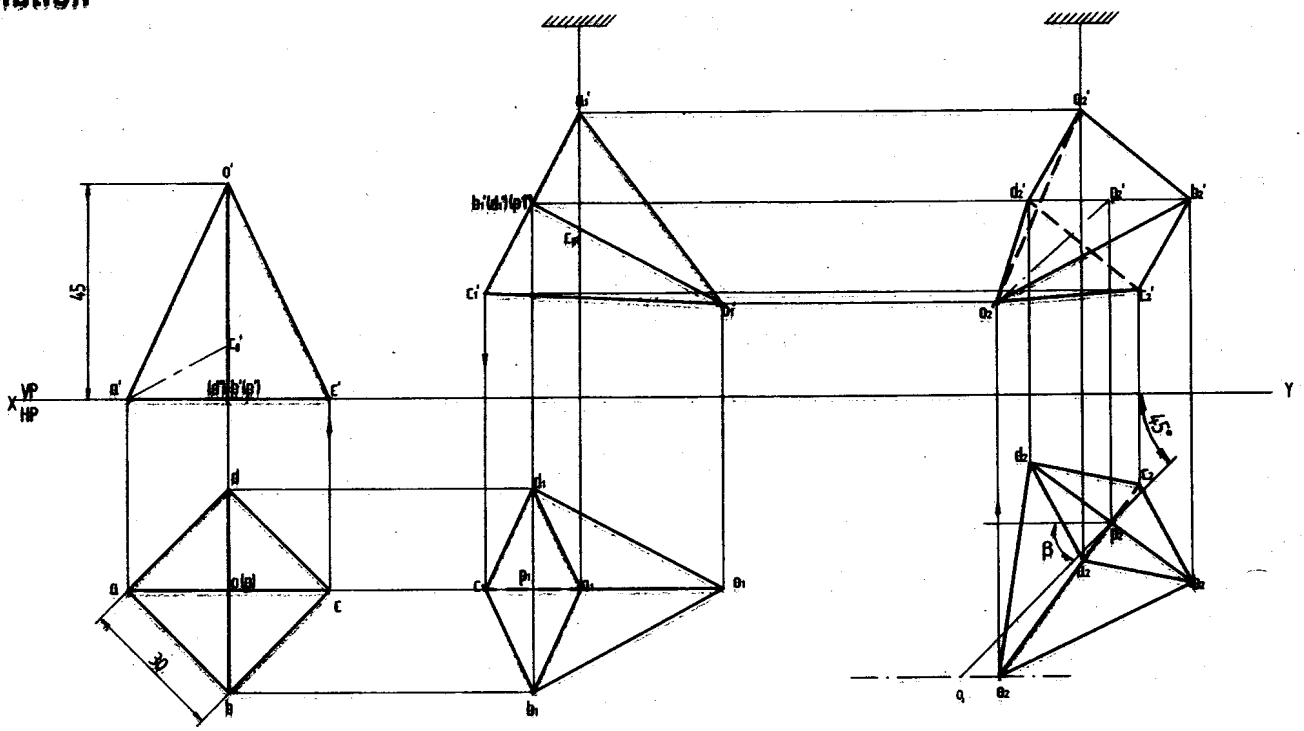
Problem 48 A pentagonal prism of base side 25 mm and height 50 mm is resting on HP on one of its base corners such that the top most edge is at a distance of 60 mm above HP. Draw its projections, when its top view of the axis is inclined at 45° to VP. Also, determine the inclination of the longer edge of the prism to HP which contains the resting corner.

Solution



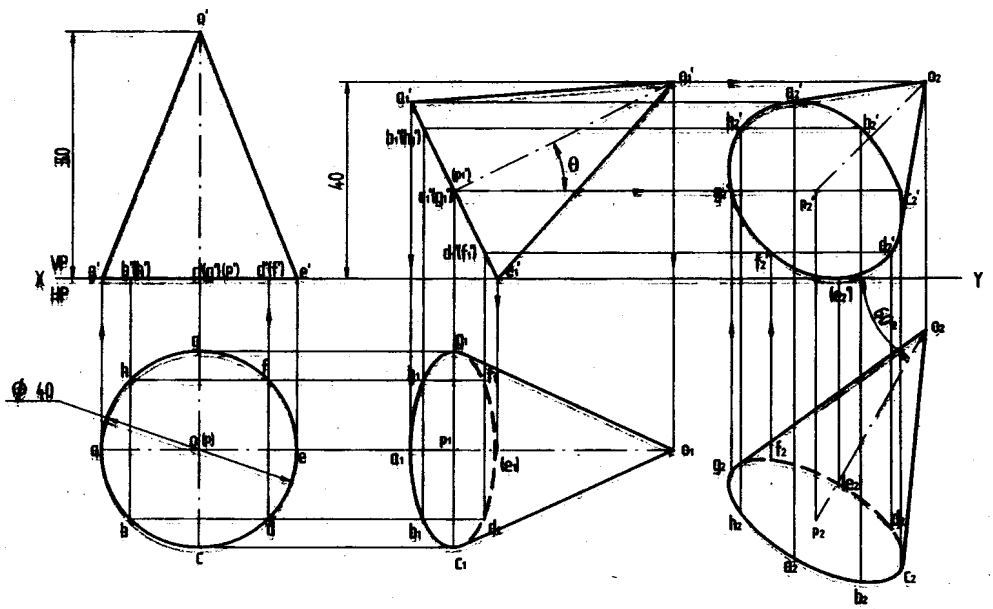
Problem 49 A square pyramid of base sides 30 mm and height 60 mm is suspended by a thread tied to one of the corners of its base. It is then tilted such that the axis makes an angle of 45° with respect to the VP. Considering the apex of the solid to be nearer to the observer, draw the projections of the solid.

Solution



Problem 50 A cone of base dia. 40 mm and axis length 50 mm is resting on HP on a point on the circumference of its base such that its apex is at 40 mm above the HP and its top view of the axis is inclined at 60° to VP. Draw the top and front views of the solid. Also, determine the inclinations of the axis when the base is nearer to the observer.

Solution



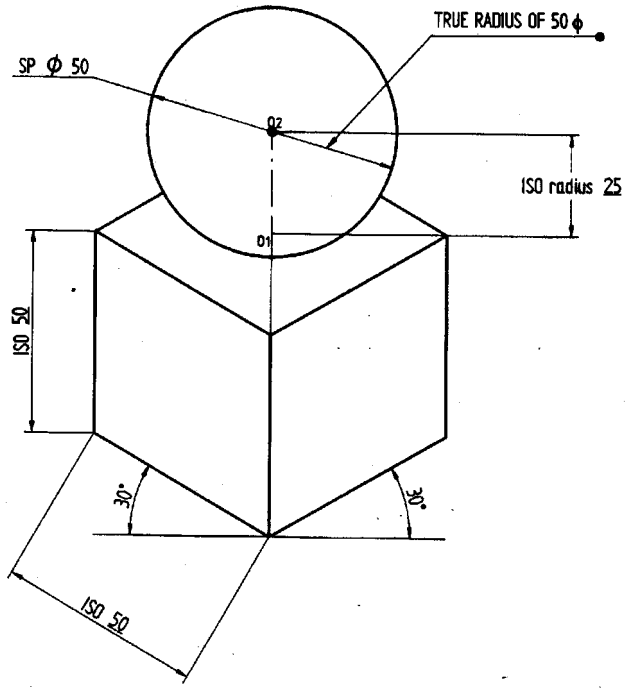
ANSWERS θ =26°
ϕ =51°

CHAPTER 6

ISOMETRIC PROJECTION

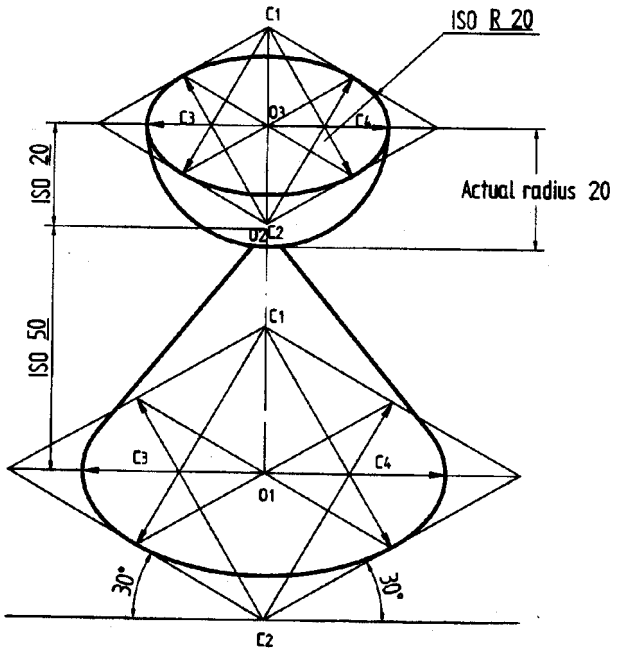
Problem 1 A sphere of diameter 50 mm rests centrally on top of a cube of sides 50 mm. Draw the Isometric projections of the combination of solids.

Solution



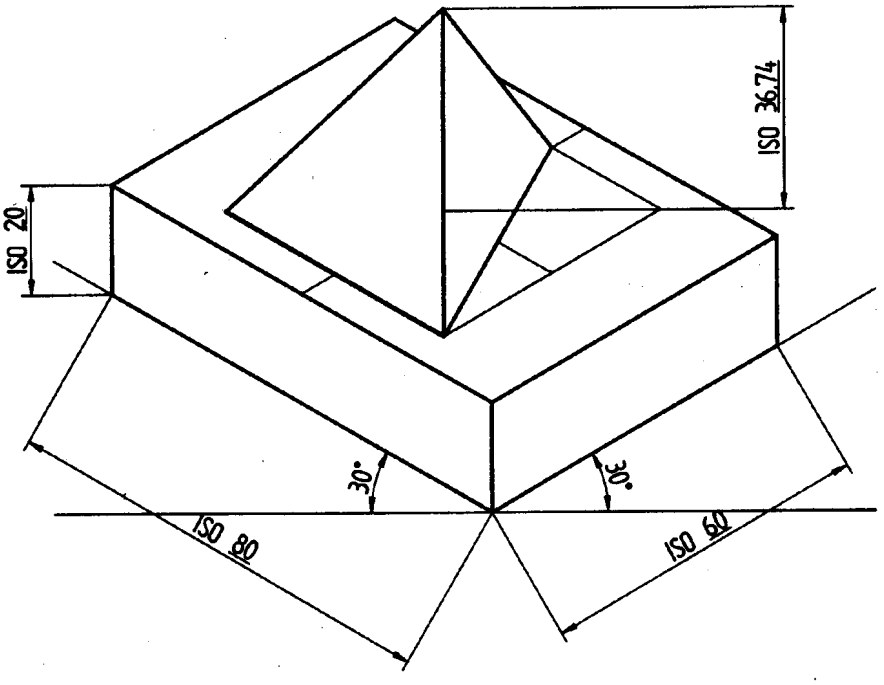
Problem 2 A hemisphere of 40 mm diameter is supported co-axially on the vertex of a cone of base dia. 60 mm and axis length 50 mm. The flat circular face of the hemisphere is facing upside. Draw the isometric projection of the combination of solids.

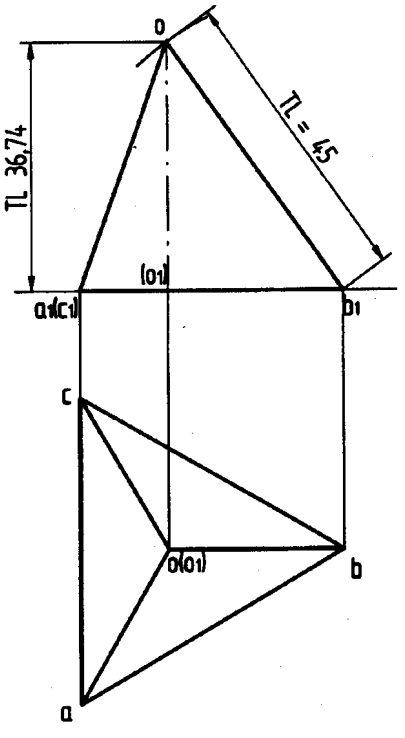
Solution



Problem 3 Draw the Isometric projection of a rectangular prism of 60 x 80 x 20 mm thick surmounting a tetrahedron of sides 45 mm such that the axes of the solids are collinear and at least one of the edges of both the solids are parallel to VP. Solved examples 6.1 p140, 6.2 p143, 6.3 p146, 6.4 p150 and 6.5 p156 of primer

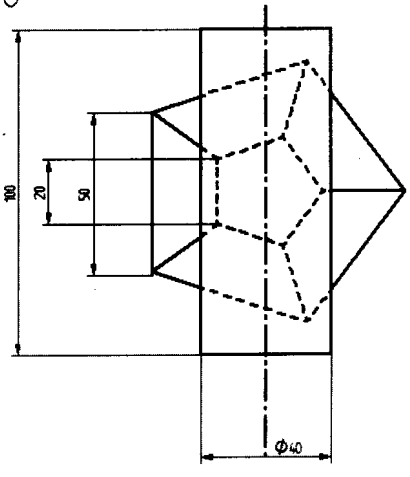
Solution

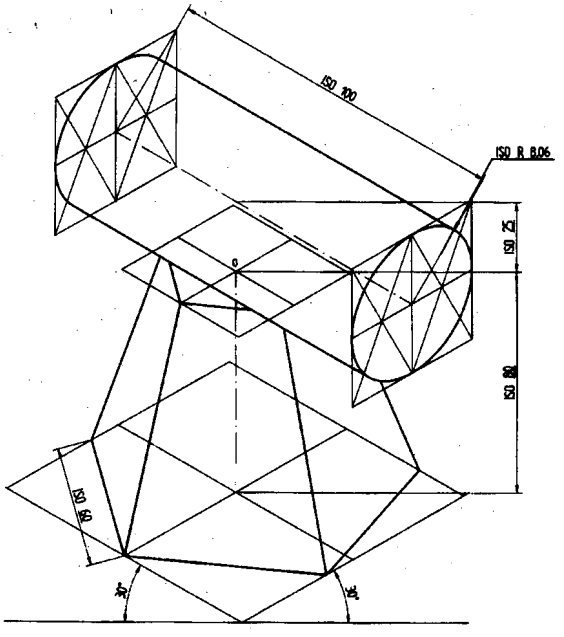




Problem 4 Following figure shows the top view of a cylinder which is centrally mounted on a frustum of a pentagonal pyramid of 60 mm height. Draw the Isometric projection of the combination of solids.

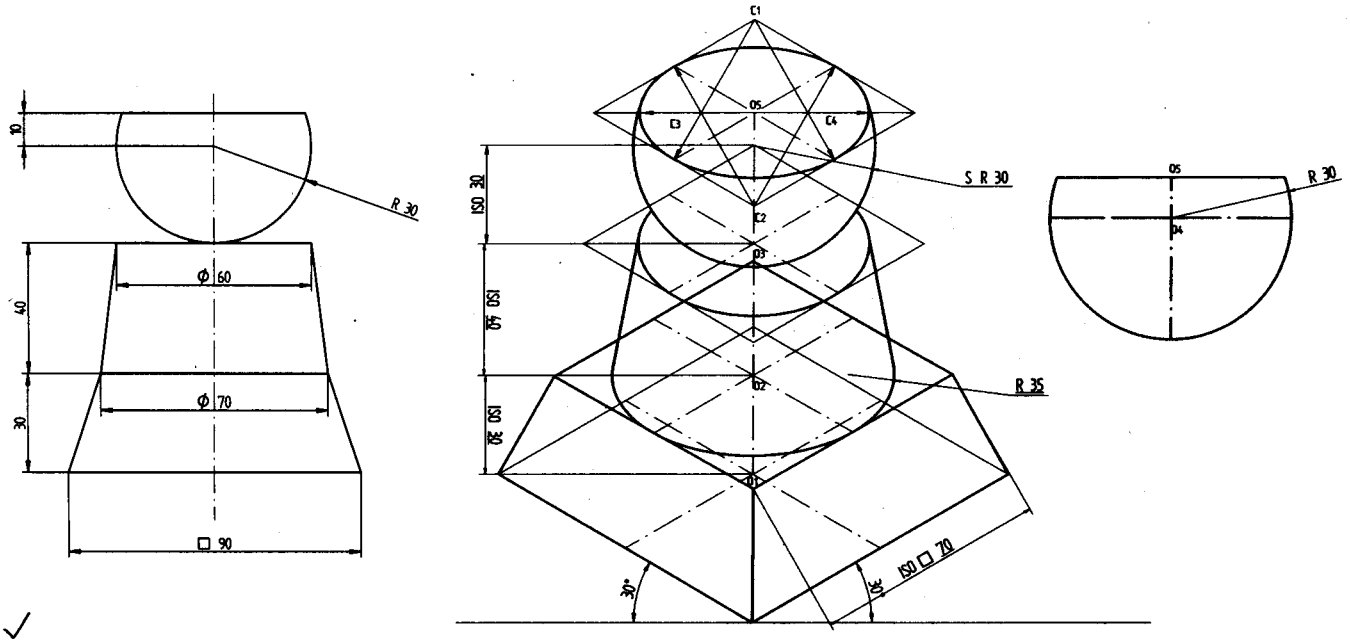
Solution





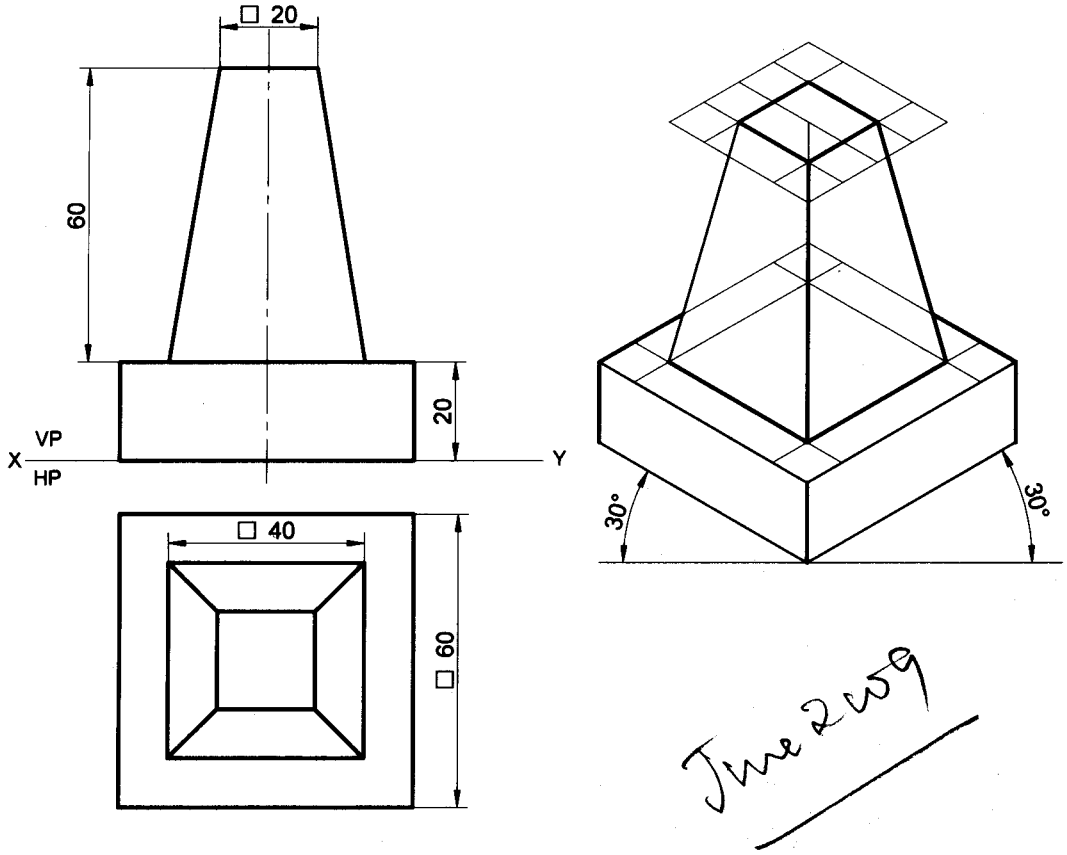
Problem 5 Following figure shows the front view of combination of solids consisting a cut sphere and frustums of a cone and a square pyramid. Draw the Isometric projection of the combination of solids.

Solution



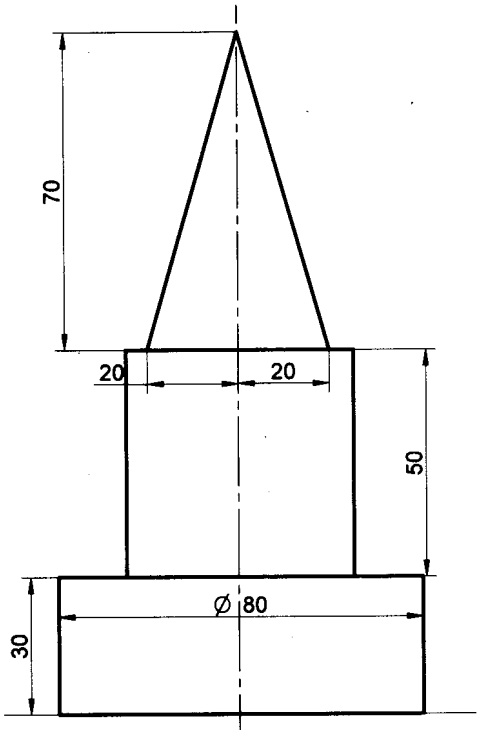
Problem 6 The frustum of a square pyramid of sides 40mm and height 60mm rest on the centre of the top of a square block of side 60mm and height 20mm. The base edges of the pyramid are parallel to the top edges of the square block. Draw the isometric projection of the combination of the solids.

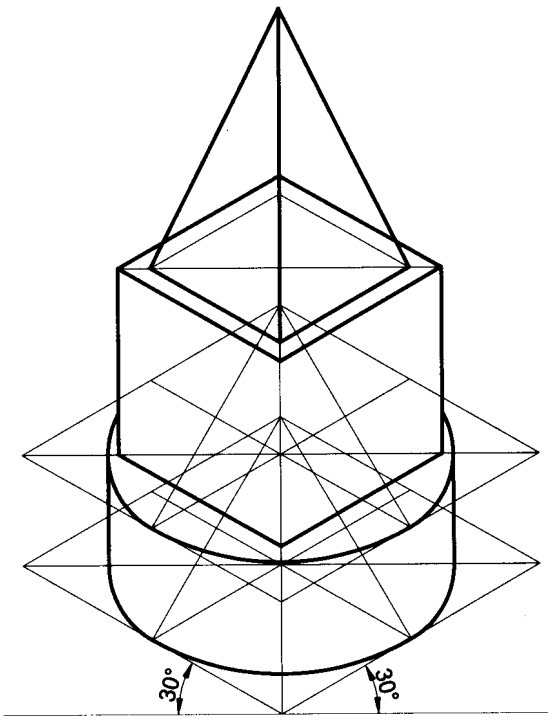
Solution



Problem 7 A square pyramid of base side 40mm and height 70mm rests symmetrically on a cube of edge 50mm, which itself is placed on a cylinder of diameter 80mm and thickness 30mm. Draw the isometric projection of the solids, if the axes of the three solids are in common line.

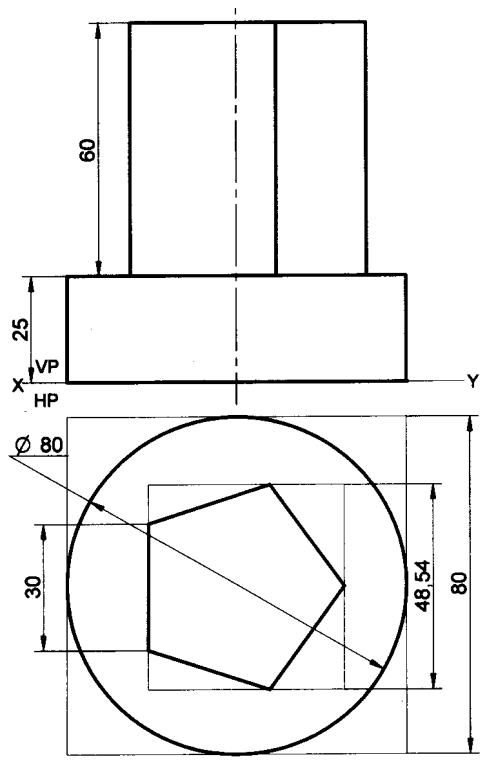
Solution

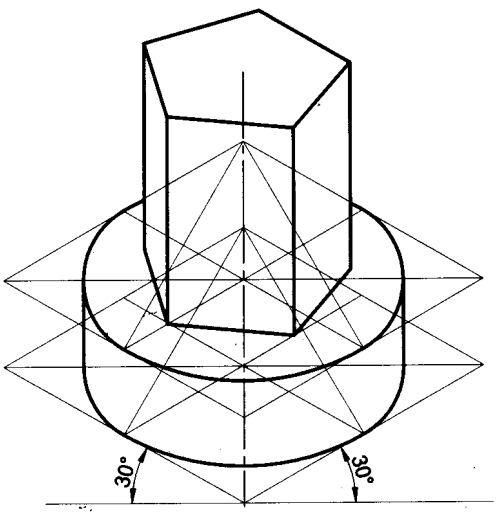




Problem 8 A regular pentagonal prism of base edge 30mm and axis 60mm is mounted centrally over a cylindrical block of 80mm diameter and 25mm thick. Draw isometric projection of the combined solids.

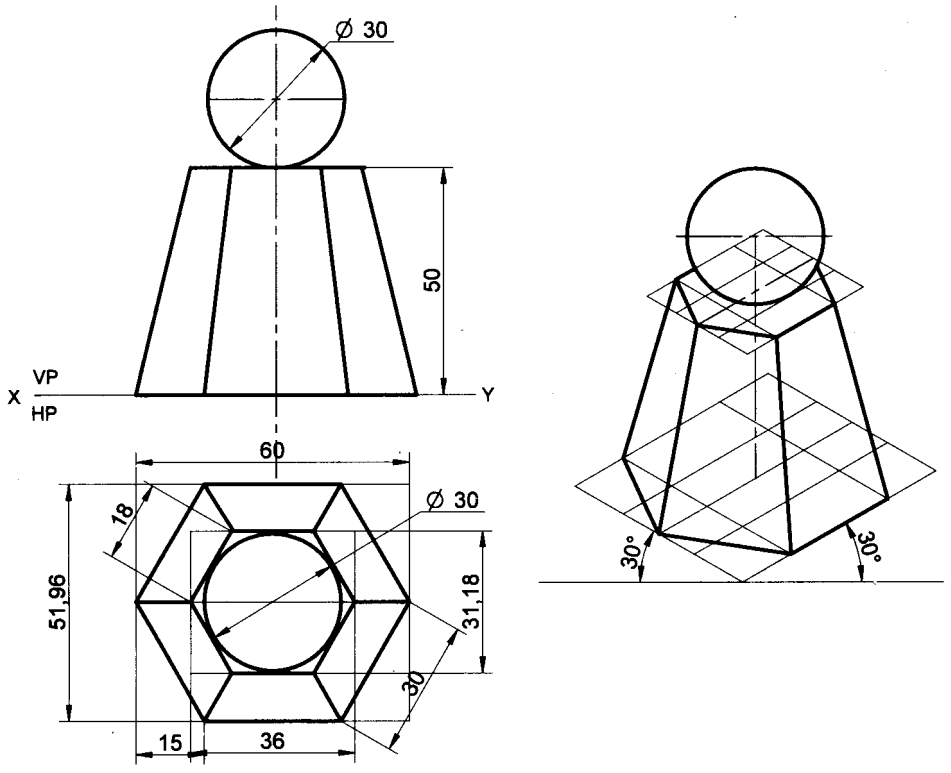
Solution





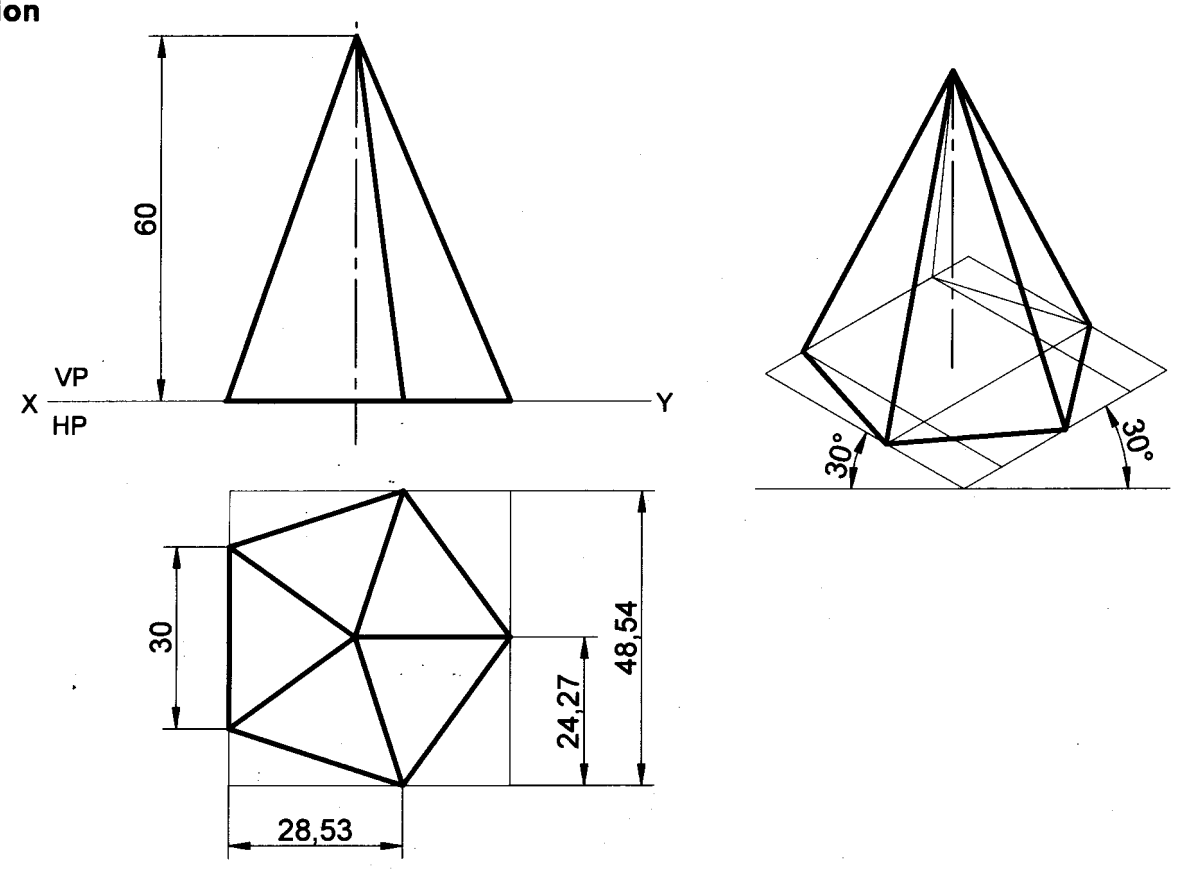
Problem 9 A sphere of diameter 30mm rests on the frustum of a hexagonal pyramid base 30mm, top face 18mm side and height 50mm, such that their axes coincide. Draw the isometric projection of the combined solids.

Solution



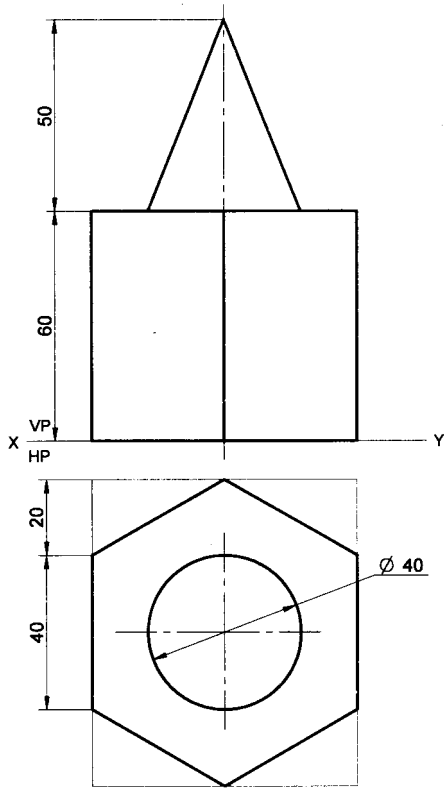
Problem 10 A pentagonal pyramid of base side 30mm and axis length 60mm is resting on HP on its base with a side of base perpendicular to VP. Draw its isometric projections

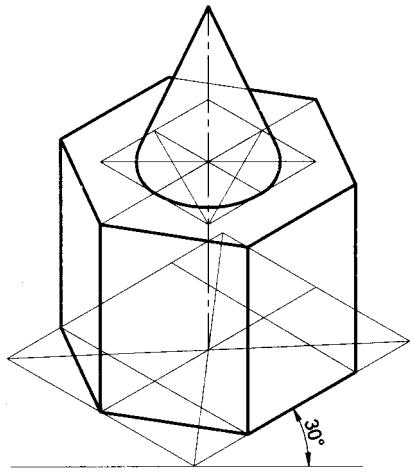
Solution



Problem 11 Draw isometric projection of a hexagonal prism of side of base 40mm and height 60mm with a right circular cone of base 40mm as diameter and altitude 50mm, resting on its top such that the axes of both the solids are collinear.

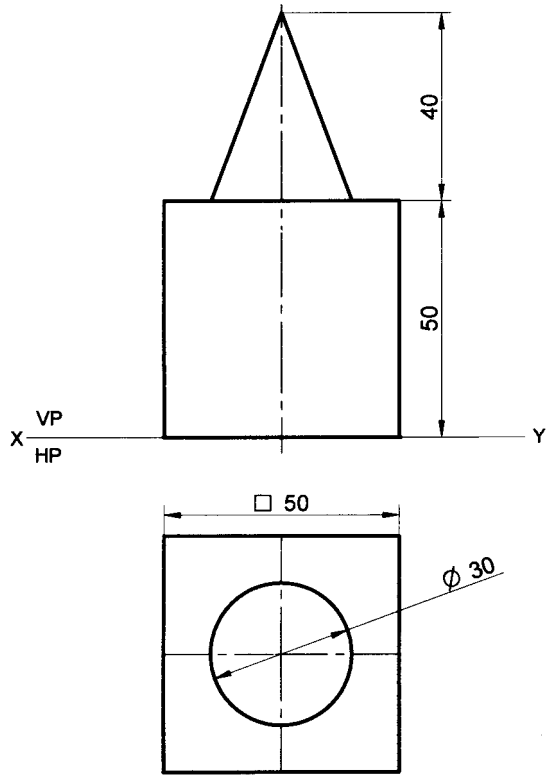
Solution

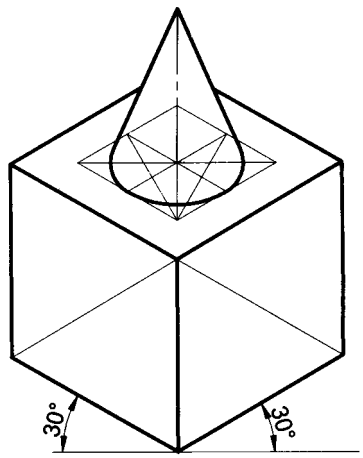




Problem 12 A cone of base diameter 30mm and height 40mm rests centrally over a cube of side 50mm. Draw the isometric projection of the combination of solids

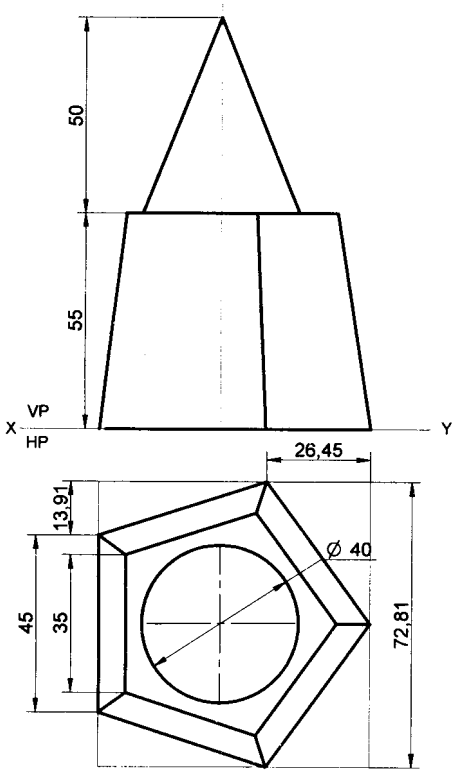
Solution

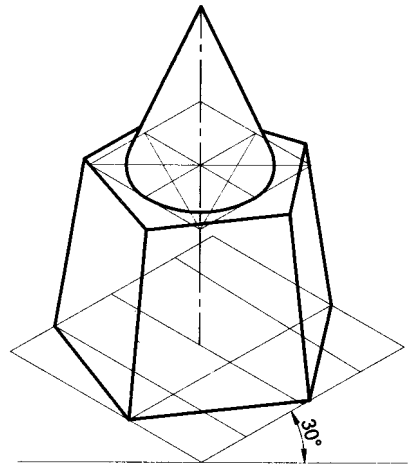




Problem 13 A cone of base diameter 40mm and height 50mm rests centrally over a frustum of a pentagonal pyramid of base side 45mm and top side 35mm and height 55mm. Draw isometric projections of the solids.

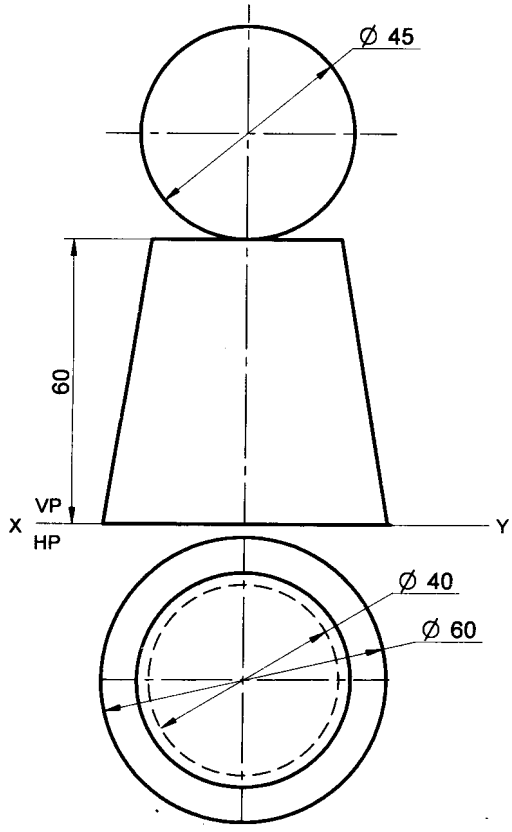
Solution

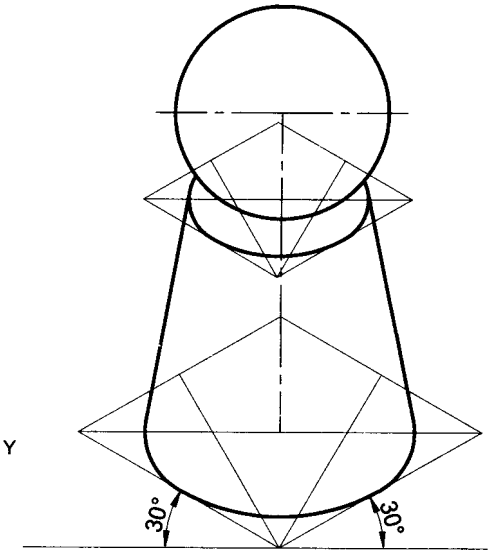




Problem 14 A sphere of diameter 45mm rests centrally over a frustum of cone of base diameter 60mm, top diameter 40mm and height 60mm. Draw its isometric projections.

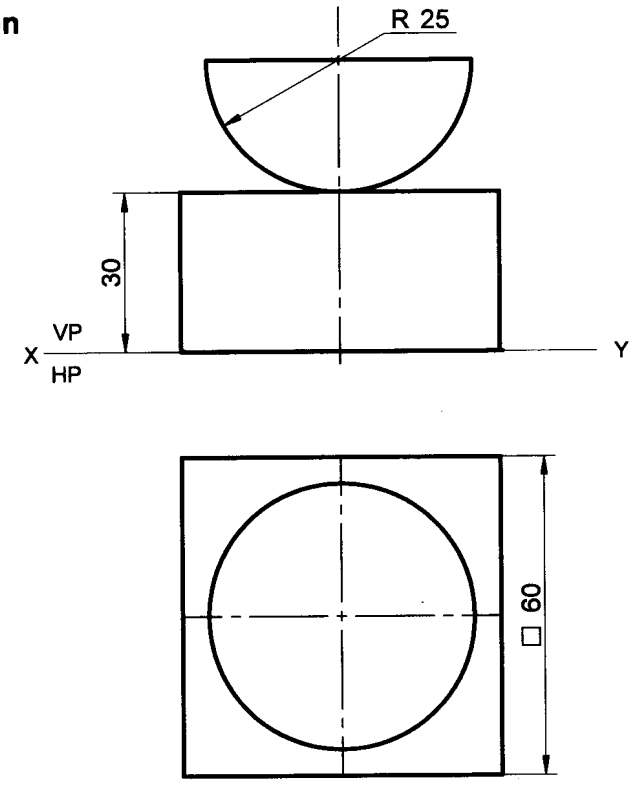
Solution

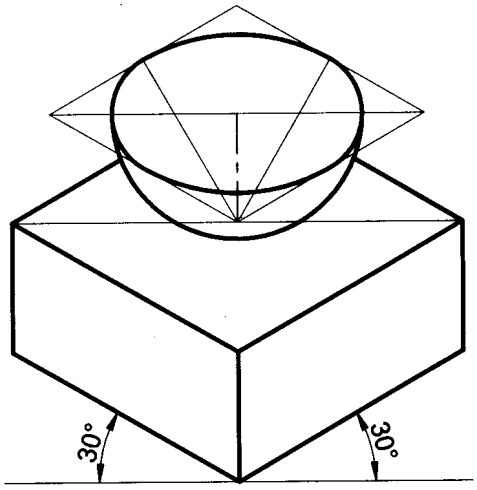




Problem 15 A hemisphere of diameter 50mm is centrally resting on top of a square prism of base side 60mm and height 30mm such that the curved surface of hemisphere is touching the top face of the prism. Draw its isometric projections

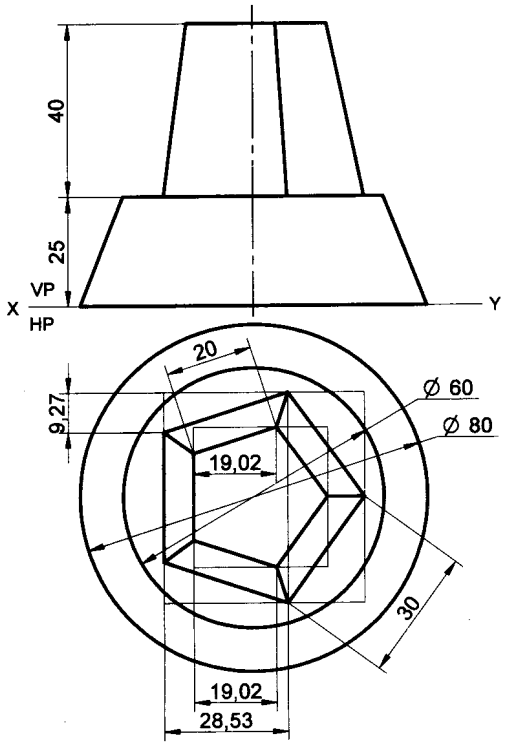
Solution

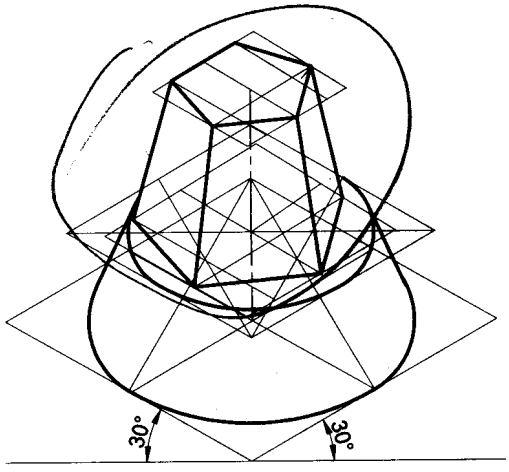




Problem 16 Draw the isometric projection of the combination of solids formed by a frustum of cone and co-axial frustum of pentagonal pyramid. The lower frustum of cone is of 80mm base diameter, 60mm top diameter and height 25mm. the upper frustum of pyramid is of 30mm side of base, 20mm side of top face and height 40mm.

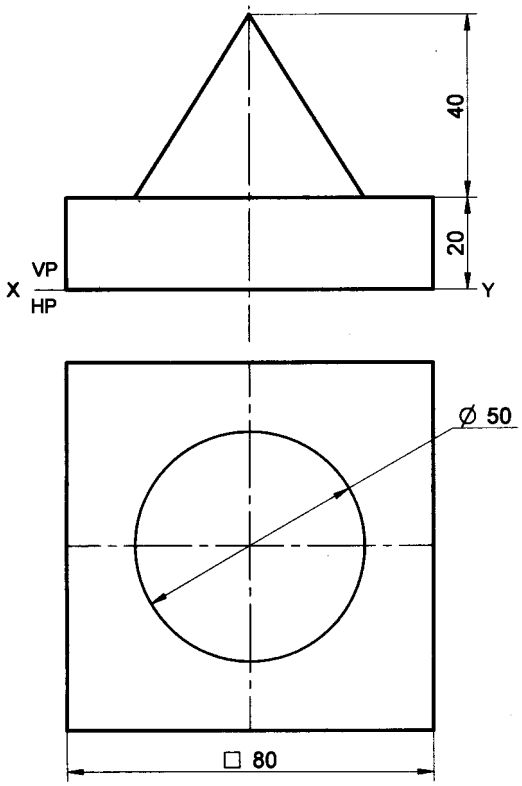
Solution

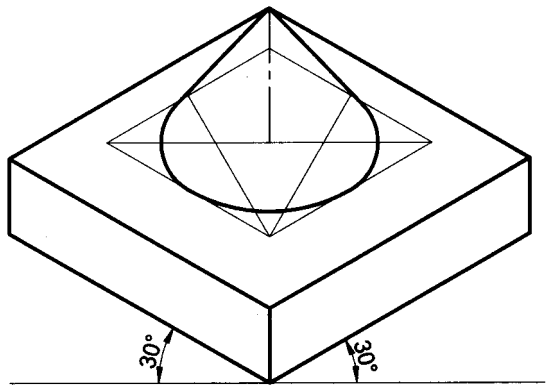




Problem 17 A cone of base diameter 50mm and height 40mm is placed centrally on the top face of a square slab side-80mm and height20mm. Draw the isometric projection of the combination

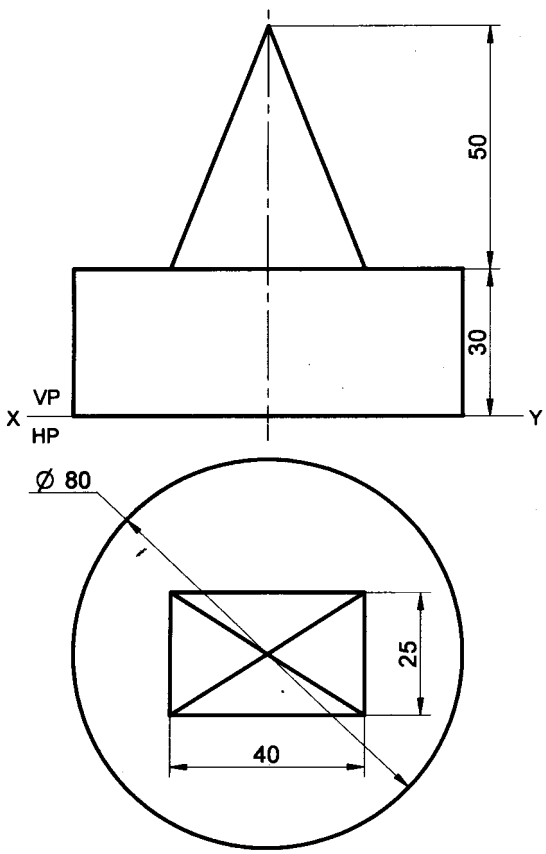
Solution

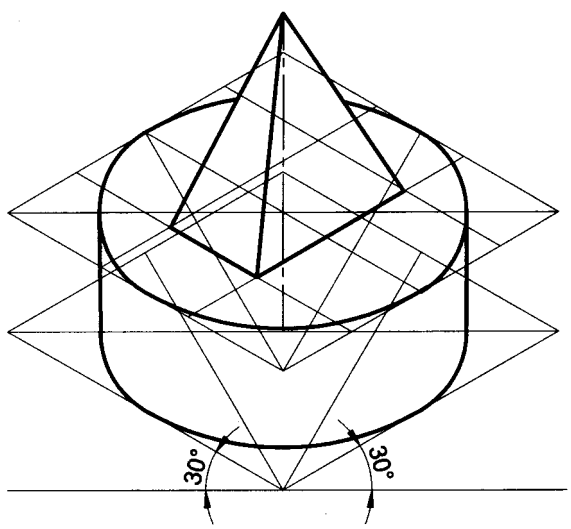




Problem 18 A rectangular pyramid of base-40mmx25mm and height 50mm is placed centrally on a cylindrical slab of diameter 100mm and thickness-30mm. Draw the isometric projection of the combination

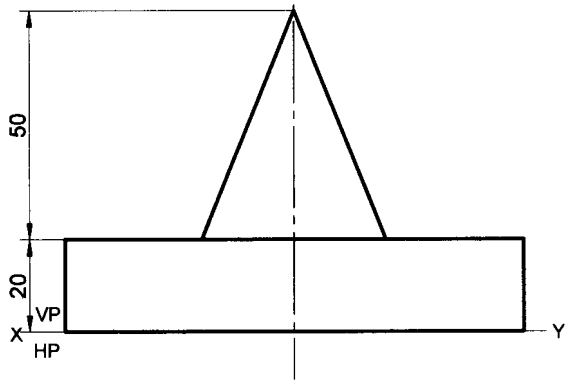
Solution

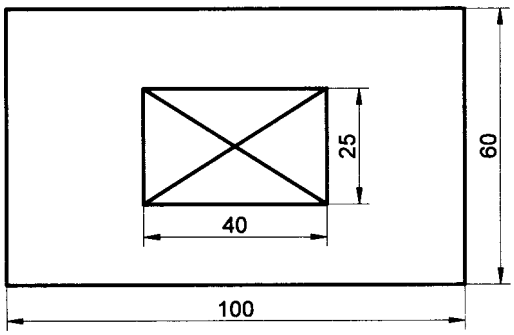


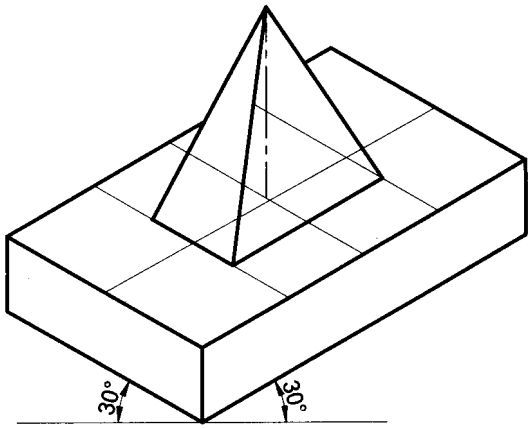


Problem 19 A rectangular pyramid of base-40mmx25mm and height50mm is placed centrally on a rectangular slab sides-100mmx60mm and thickness-20mm. Draw the isometric projection of the combination

Solution

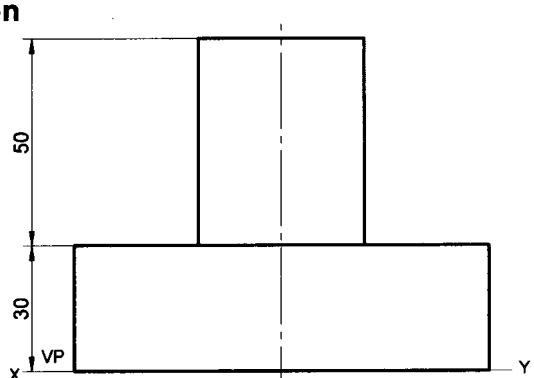


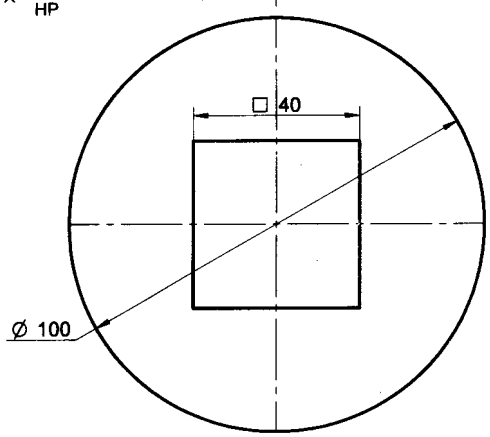


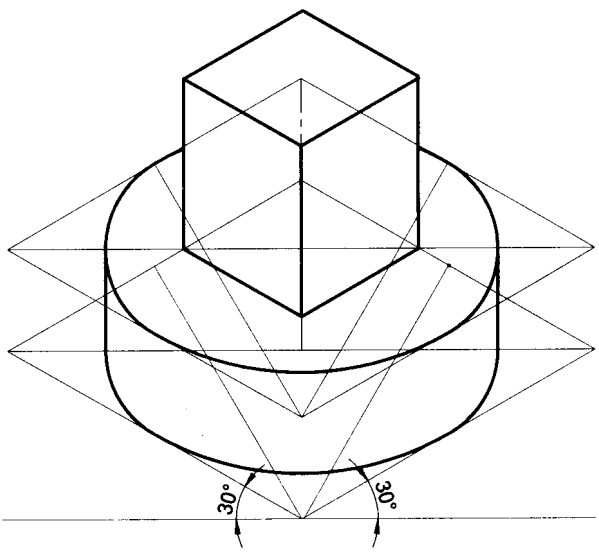


Problem 20 A square prism base side-40mm, height50mm is placed centrally on a cylindrical slab of diameter 100mm and thickness-30mm. Draw the isometric projection of the combination

Solution

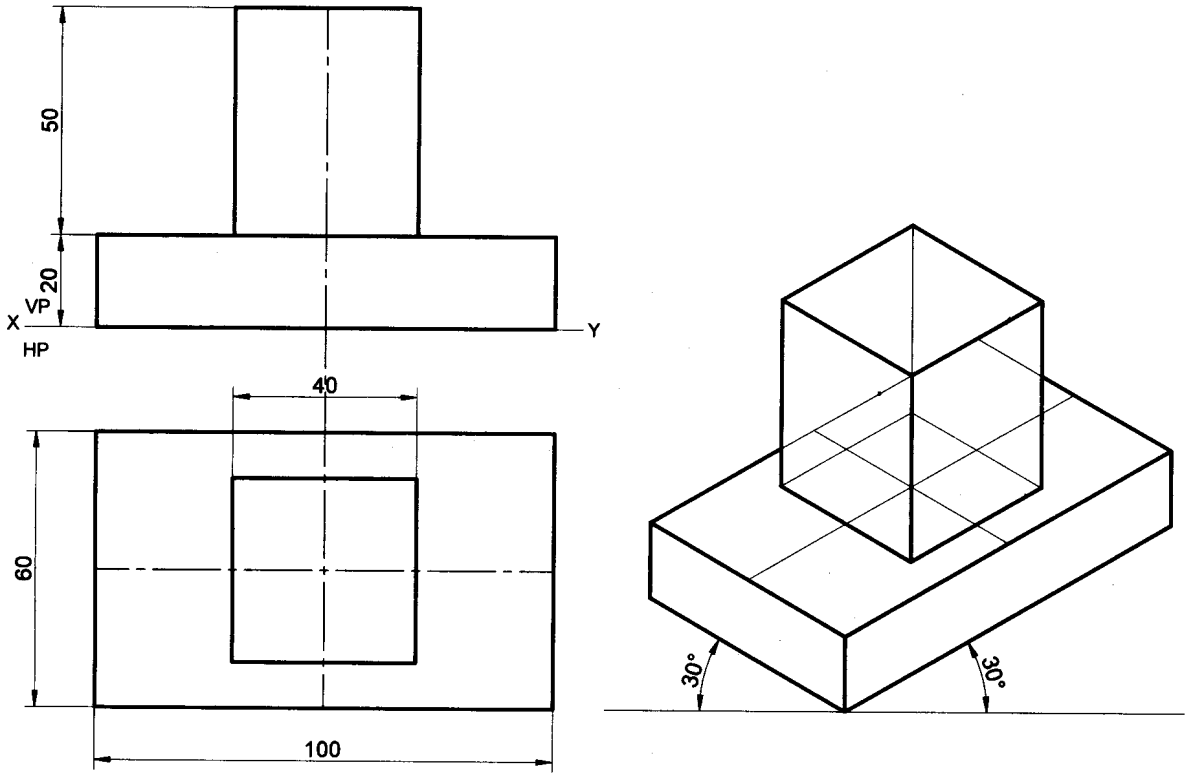






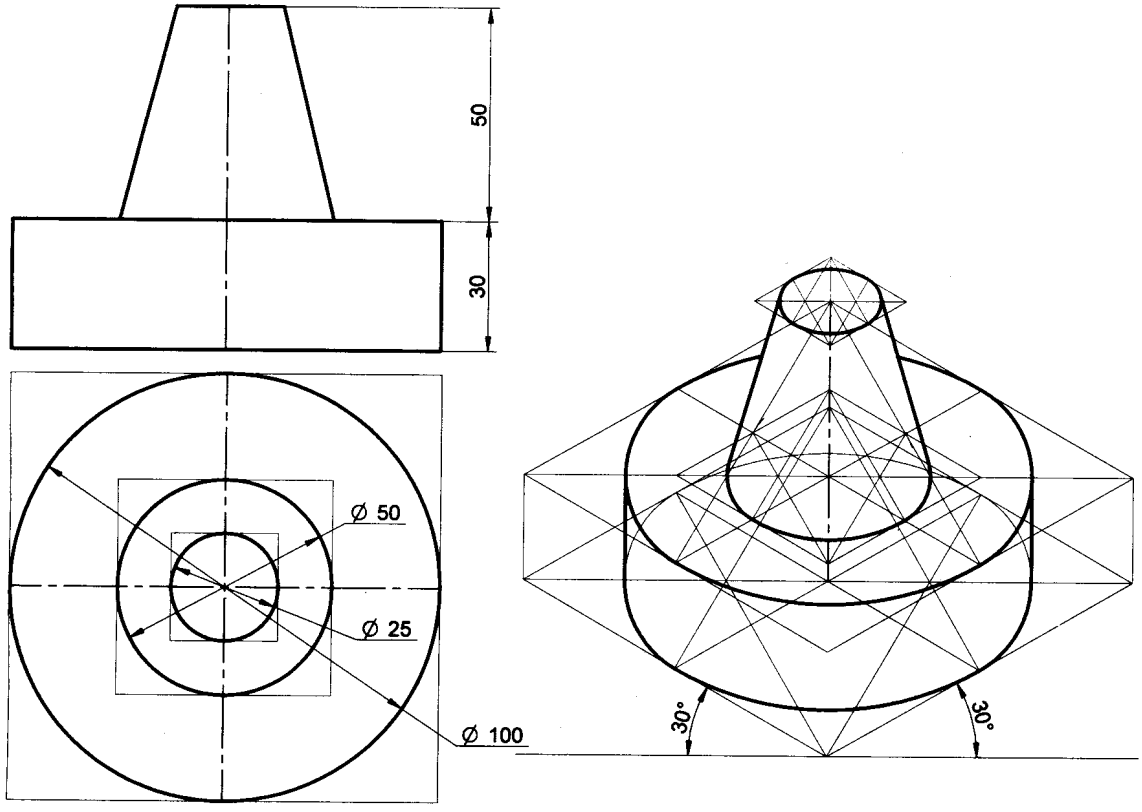
Problem 21 A square prism base side-40mm, height50mm is placed centrally on a rectangular slab sides-100mmx60mm and thickness-20mm. Draw the isometric projection of the combination

Solution



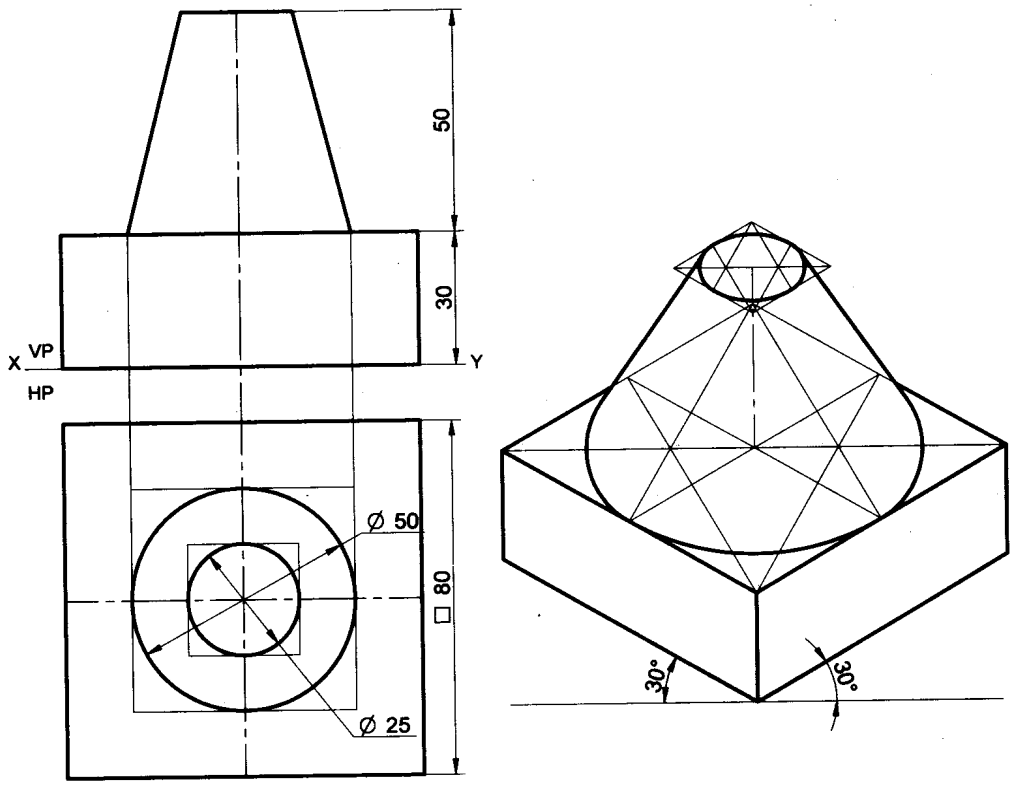
Problem 22 A frustum of cone base diameter 50mm, top diameter 25mm and height50mm is placed centrally on a cylindrical slab of diameter 100mm and thickness-30mm. Draw the isometric projection of the combination

Solution



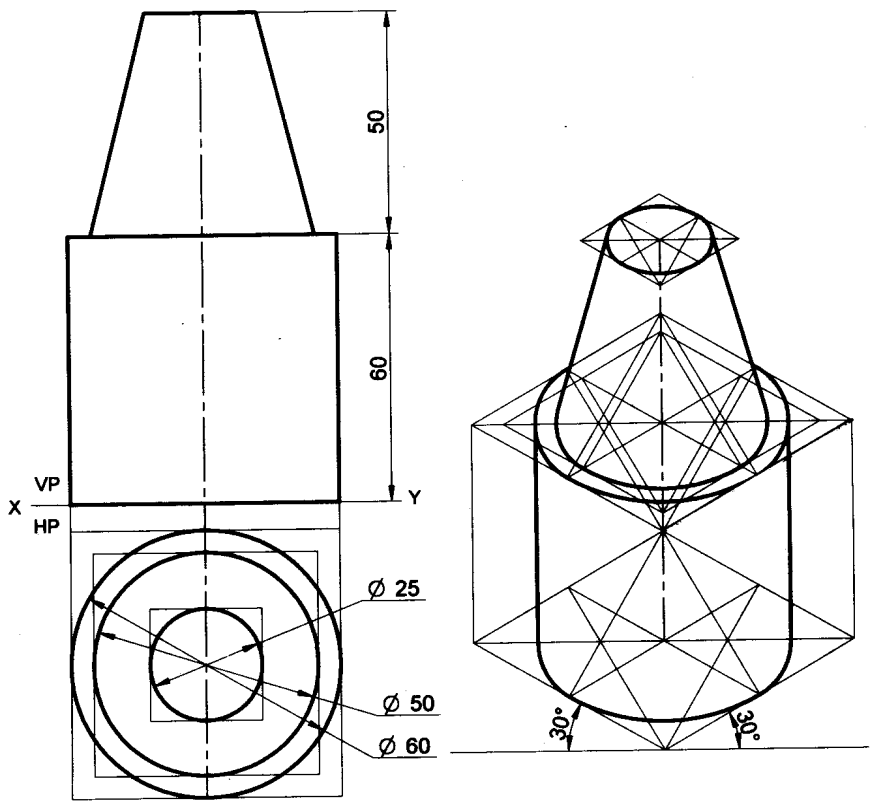
Problem 23 A frustum of cone base diameter 50mm, top diameter 25mm and height 50mm is placed centrally on a square slab side-80mm and thickness-30mm. Draw the isometric projection of the combination.

Solution



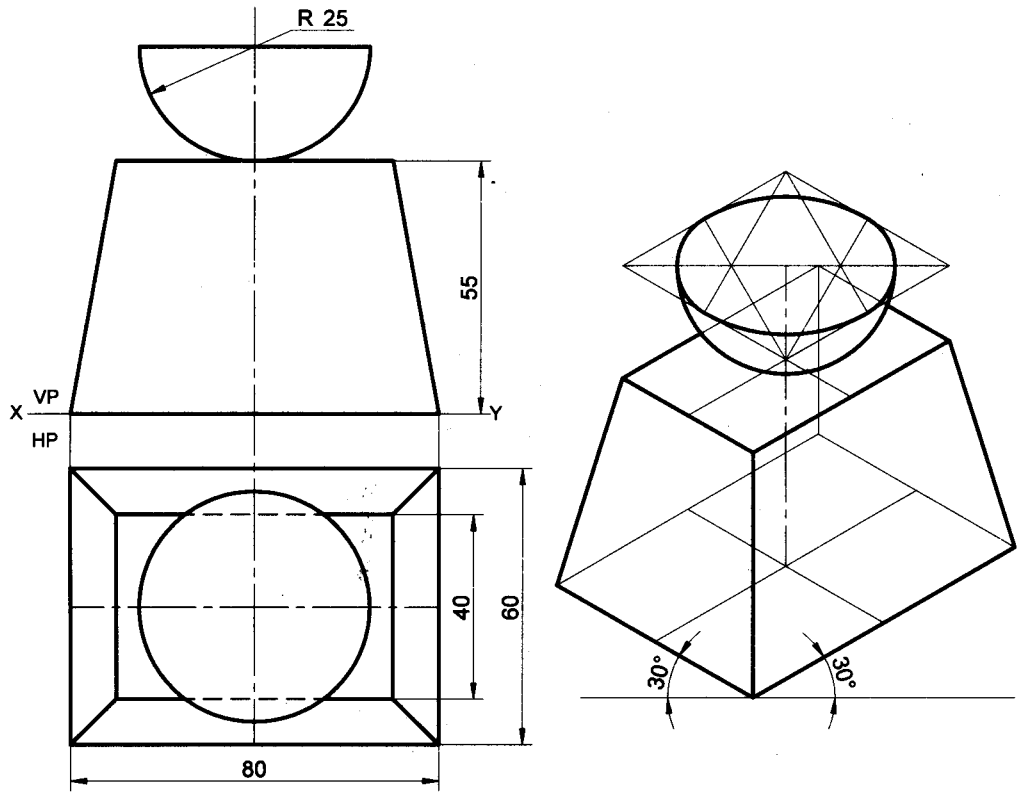
Problem 24 A frustum of cone base diameter 50mm, top diameter 25mm and height 50mm is placed centrally on the top face of a cylinder diameter 60mm and height 60mm. Draw the isometric projection of the combination

Solution



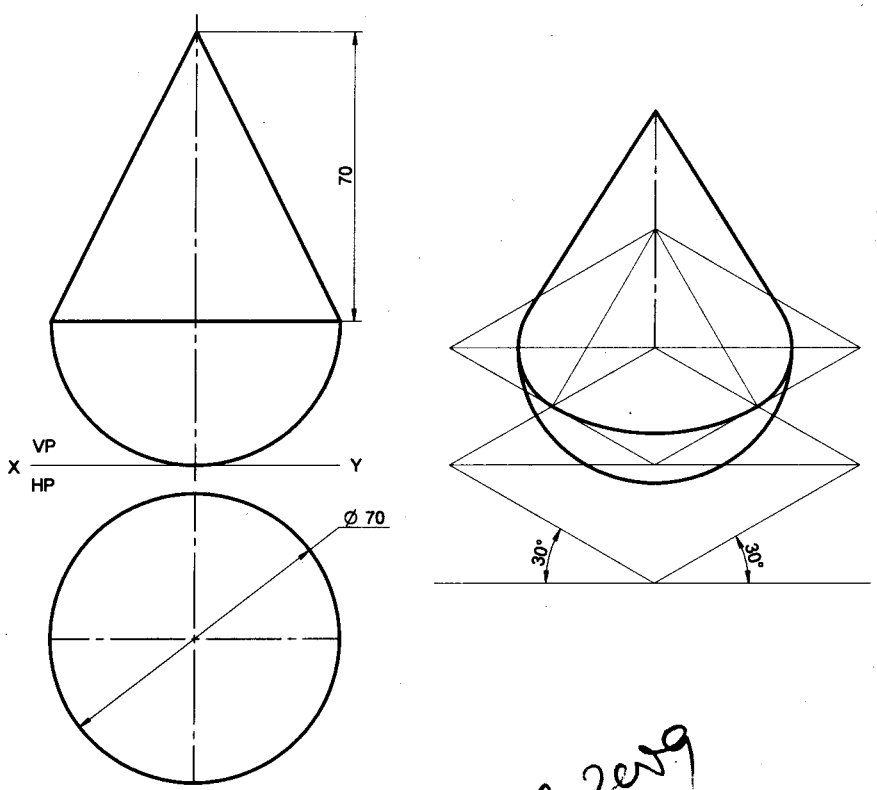
Problem 25 A hemisphere diameter 50mm is resting on its curved surface centrally on the top face of frustum of a rectangular pyramid base-80mmx60mm and top-60mmx40mm, height 55mm. Draw the isometric projection of the combination

Solution



Problem 26 A hemisphere diameter 70mm is placed on the ground on its curved surface. A cone base diameter 70mm and height 70mm is placed centrally on it. Draw the isometric projection of the combination

Solution



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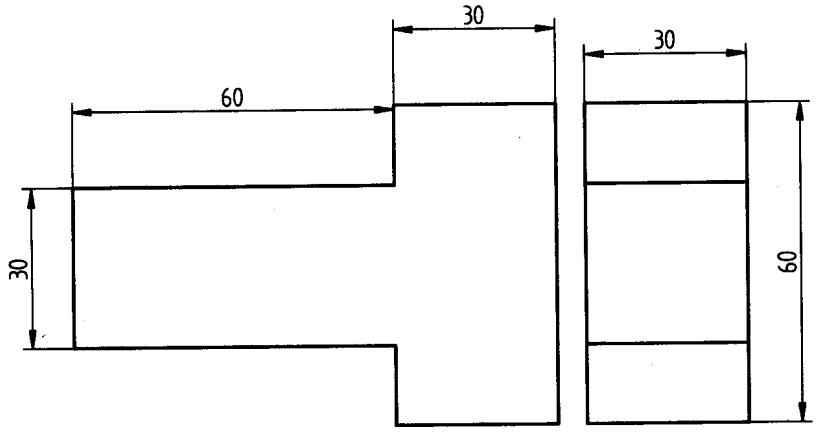
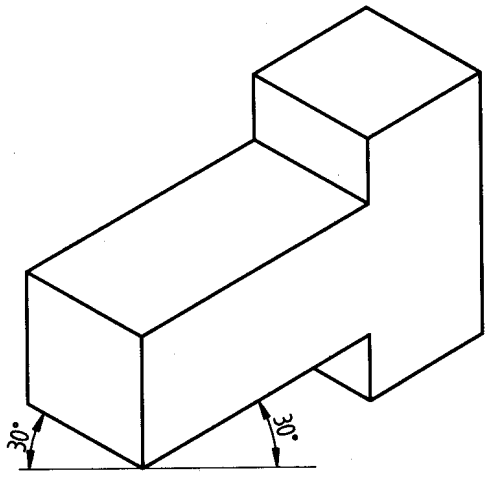
Problem 27 Following figure shows the front and side views of solid. Draw the Isometric projection of the solid.

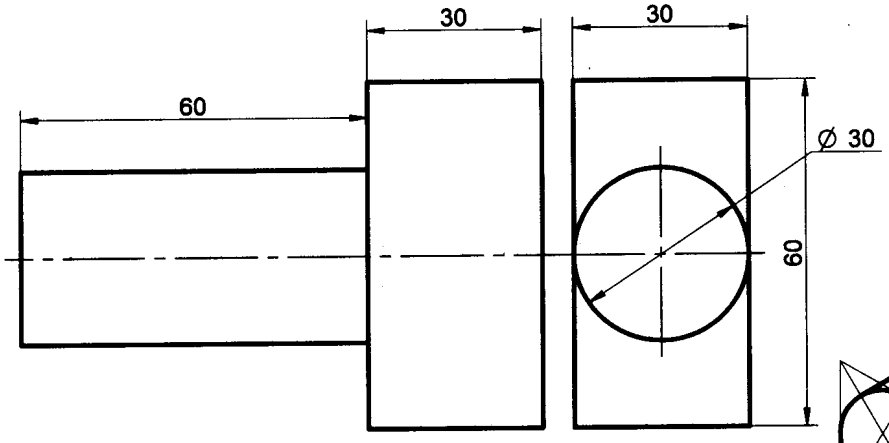
Solution

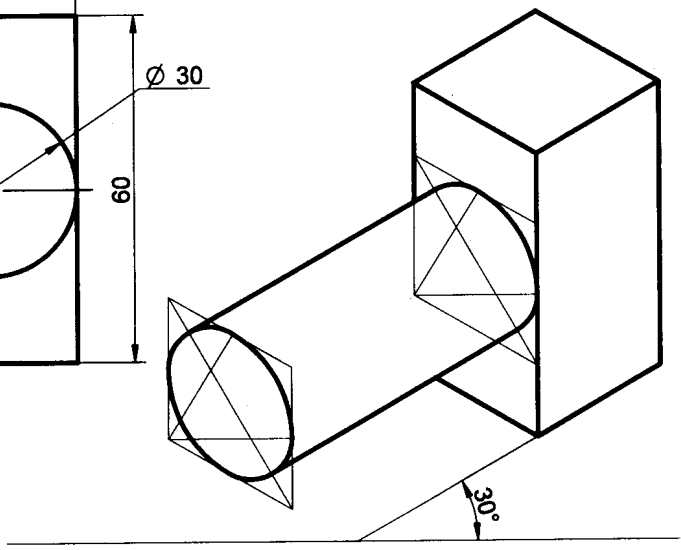




Problem 28 Following figure shows the front and side views of solid. Draw the Isometric projection of the solid.

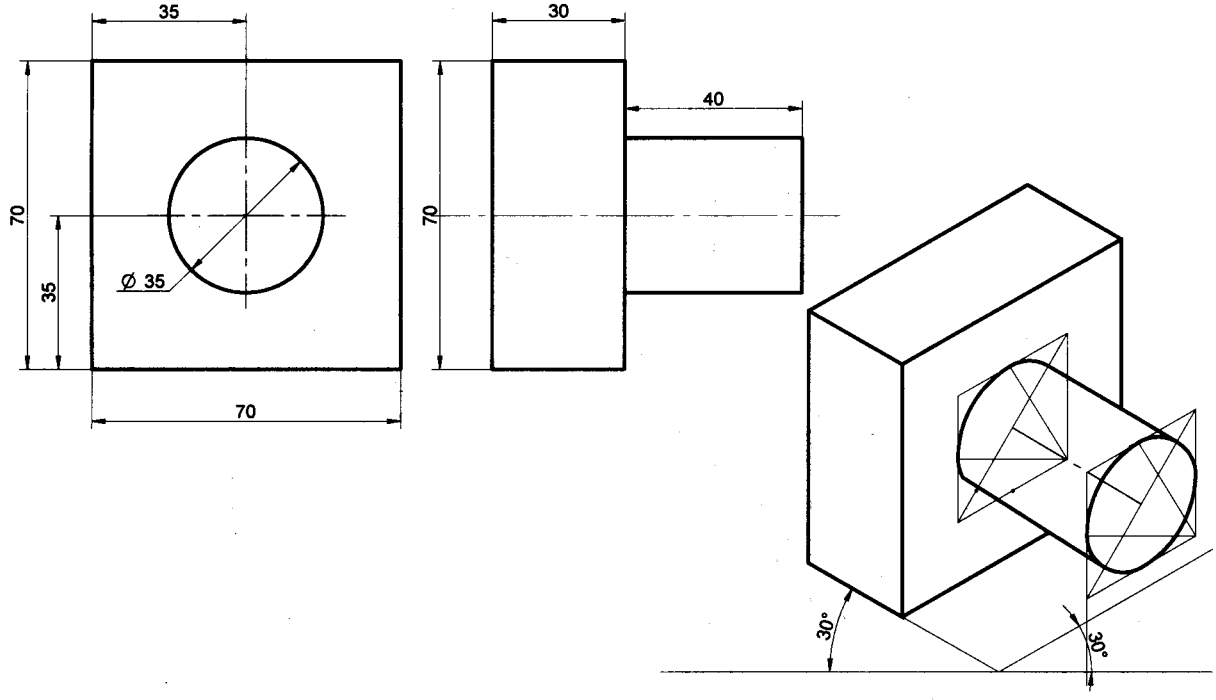
Solution





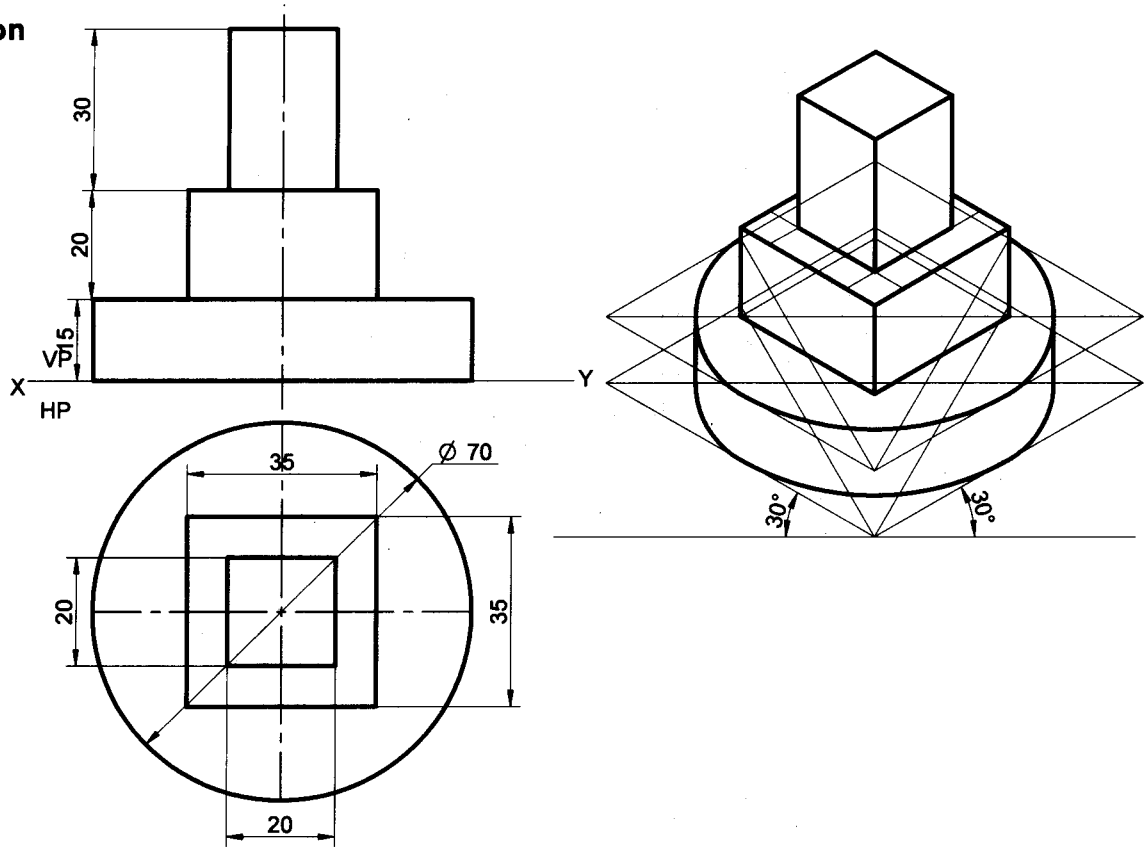
Problem 29 Following figure shows the front and side views of solid. Draw the Isometric projection of the solid.

Solution



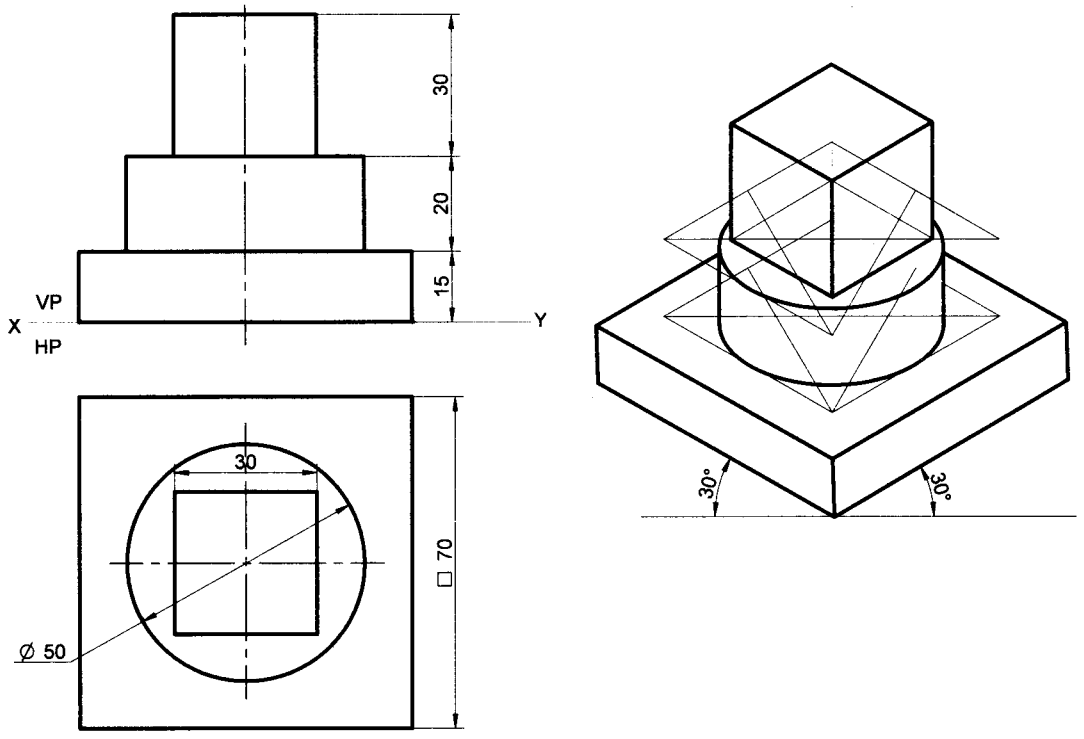
Problem 30 Following figure shows the front and top views of solid. Draw the Isometric projection of the solid.

Solution



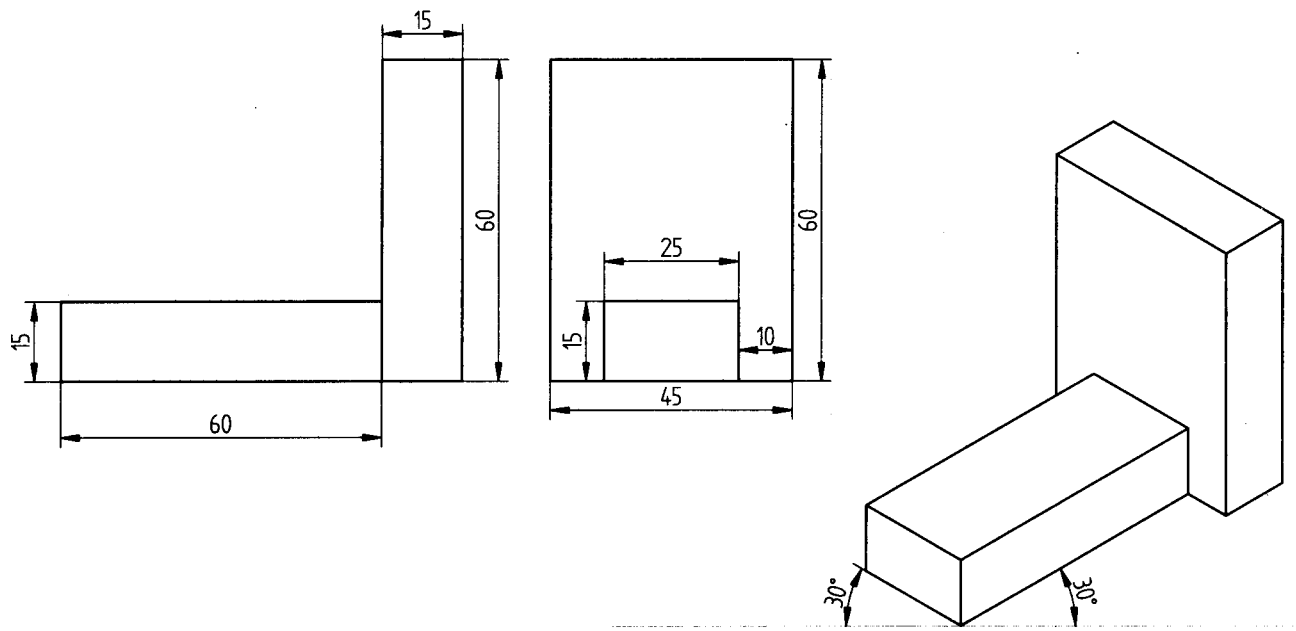
Problem 31 Following figure shows the front and top views of solid. Draw the Isometric projection of the solid.

Solution



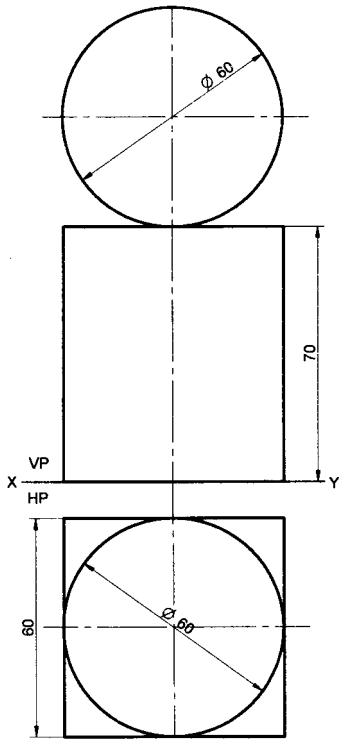
Problem 32 Following figure shows the front and side views of solid. Draw the Isometric projection of the solid.

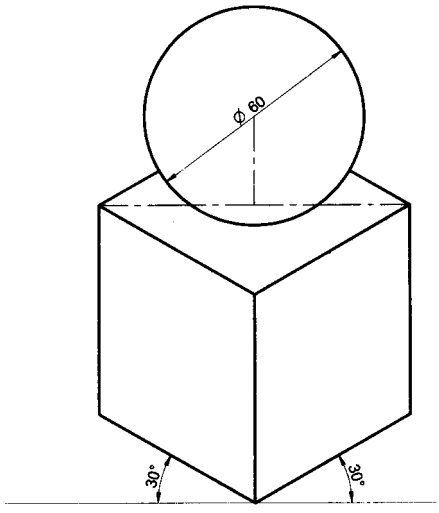
Solution



Problem 33 A sphere diameter 60mm is placed centrally on the top face of a square prism side-60mm and height 70mm. Draw the isometric projection of the combination

Solution

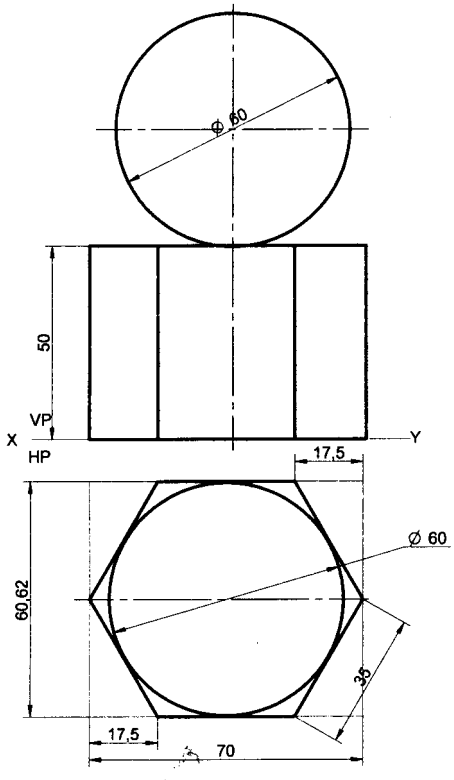


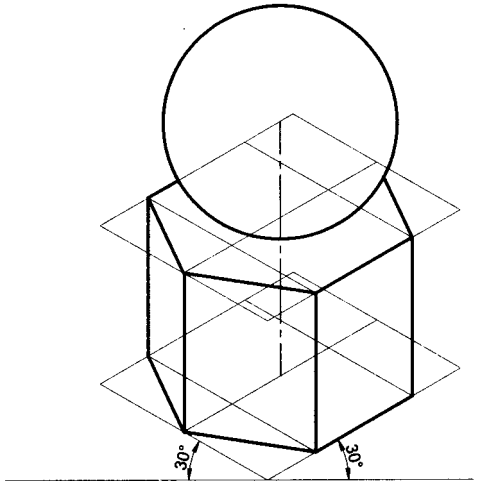


Problem 34 A sphere f60mm is placed centrally on the top face of a hexagonal prism side-35mm and height 50mm. Draw the isometric projection of the combination

Solution

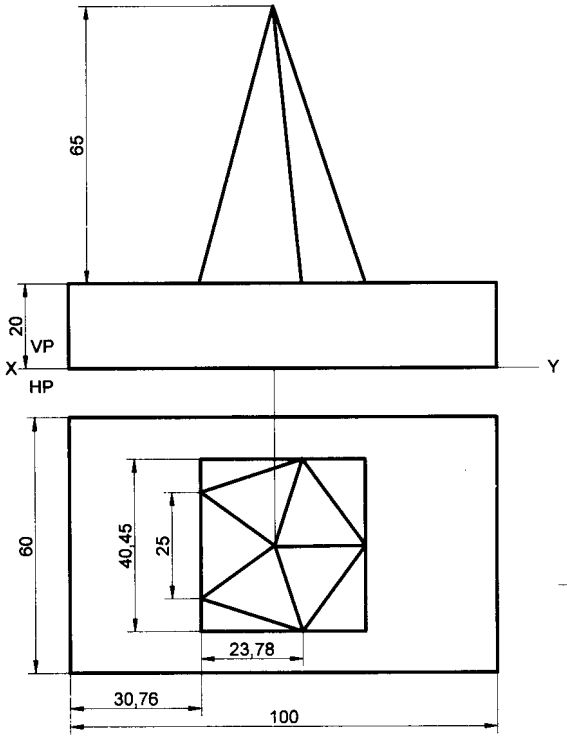
2

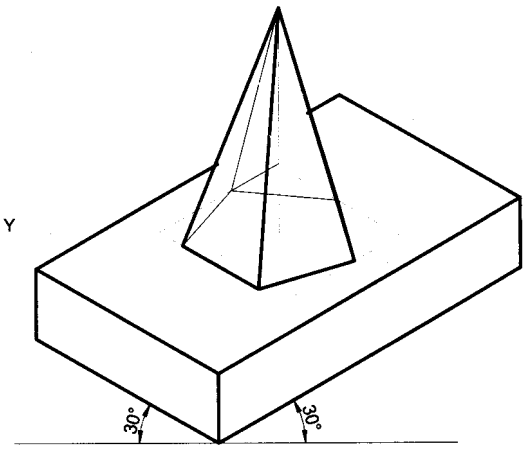




Problem 35 A pentagonal pyramid base side-25mm and height 65mm is placed centrally on a rectangular slab 100mmx60mm and 20mm-thick. Draw the isometric projection of the combination.

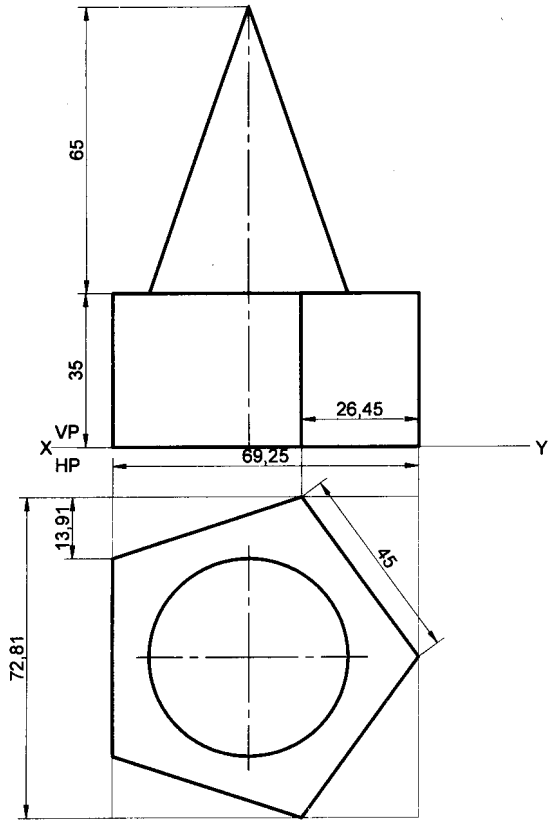
Solution

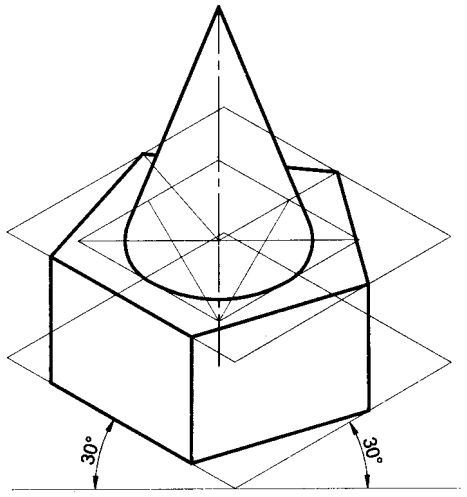




Problem 36 A cone base diameter 45mm and height 65mm is placed centrally on the top face of a pentagonal prism side-45mm and height 35mm. Draw the isometric projection of the combination

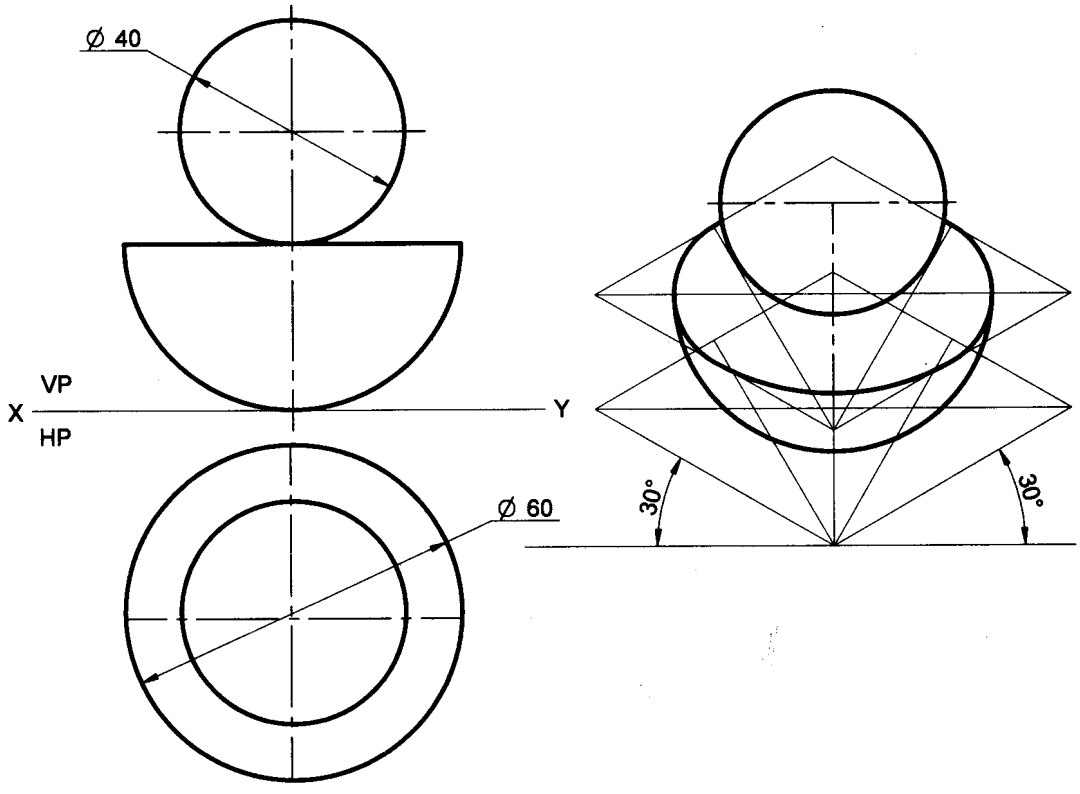
Solution





Problem 37 A sphere diameter 40mm is placed centrally on the flat face of a hemisphere diameter 60mm. Draw the isometric projection of the combination

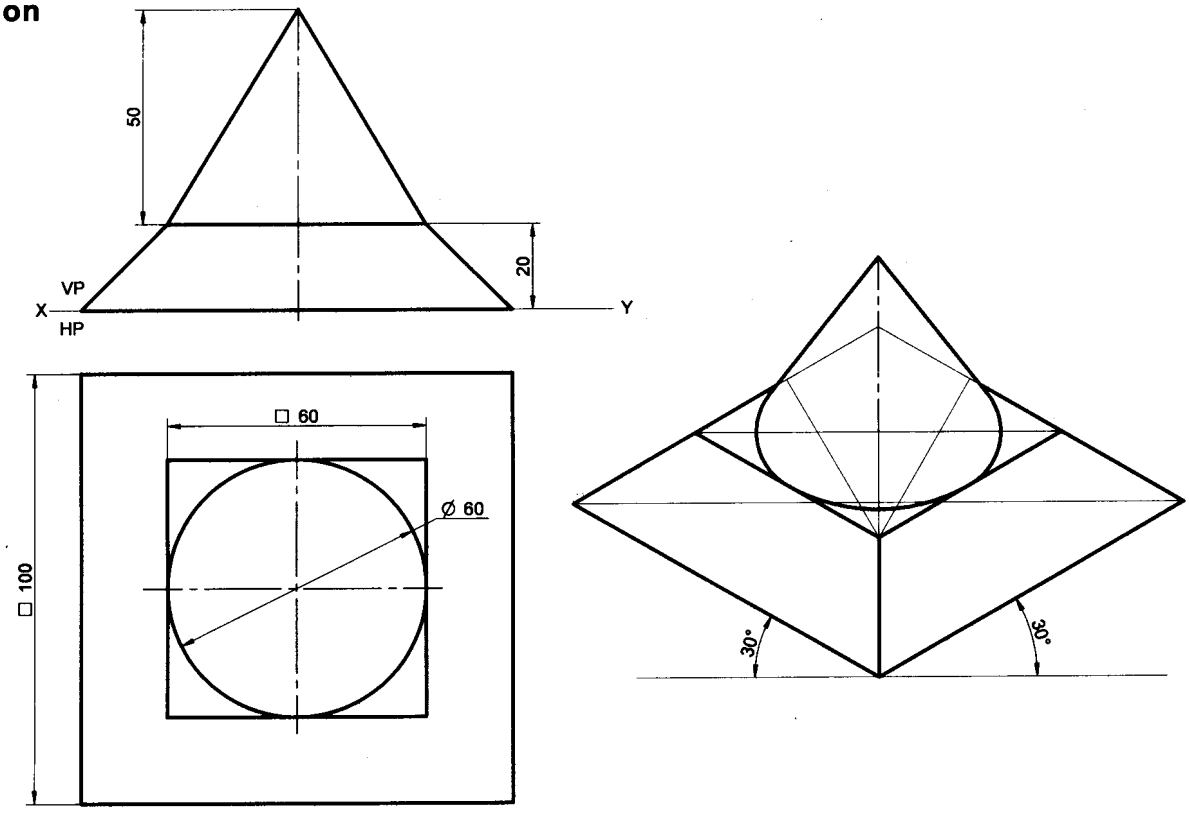
Solution



3

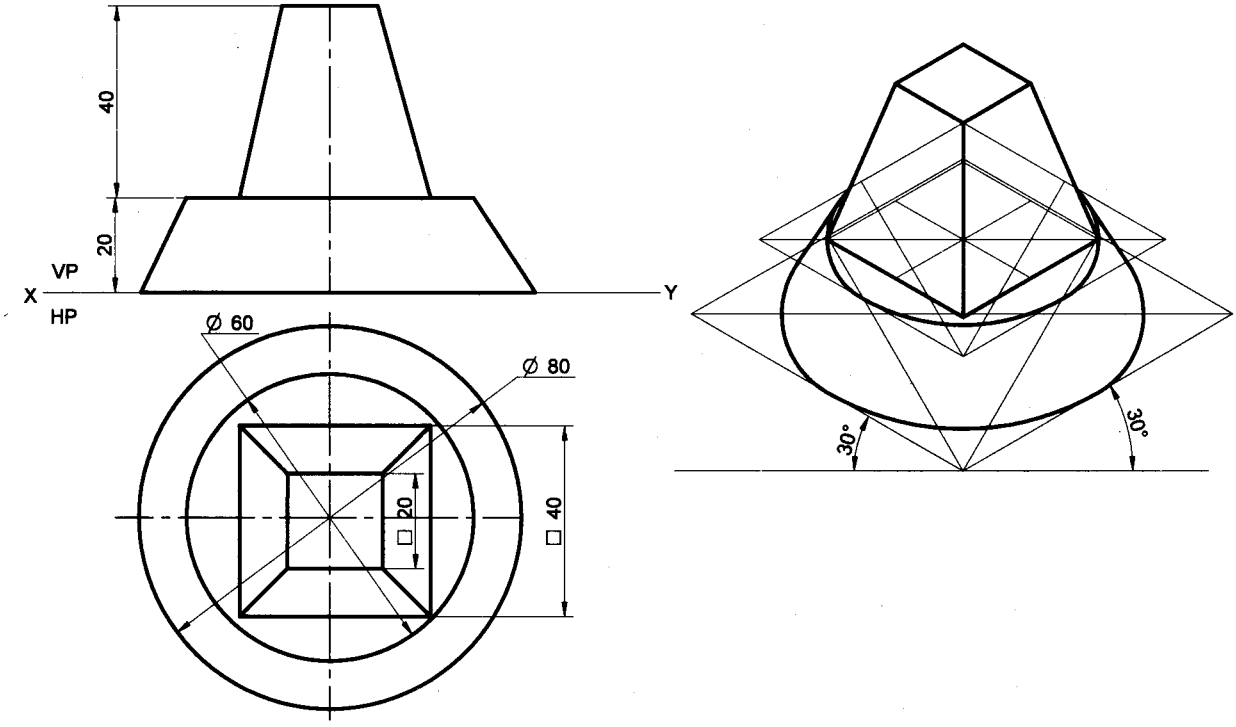
Problem 38 A cone of base diameter 60mm, top diameter 40mm and height 50mm is placed centrally on frustum of a square pyramid base side-100mm top face side-60mm and height 20mm. Draw the isometric projection of the combination

Solution



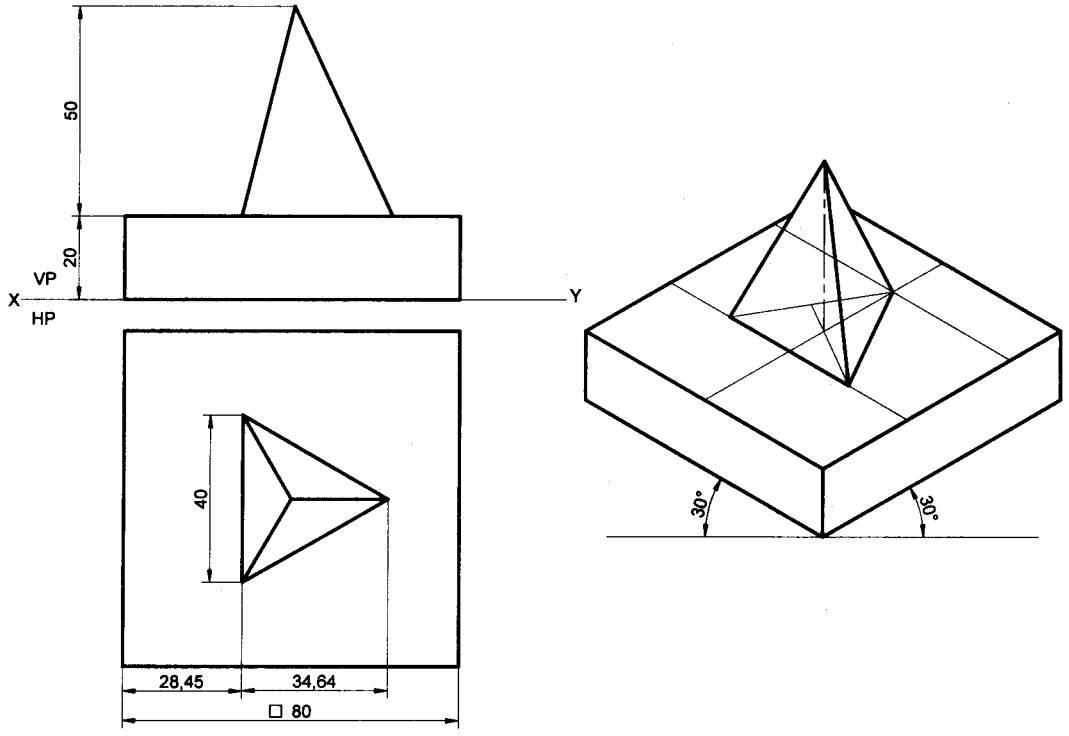
Problem 39 A frustum of a square pyramid base side-40mm, top face side-20mm and height 40mm is placed centrally on frustum of a cone base diameter 80mm, top diameter 60mm and height 20mm. Draw the isometric projection of the combination

Solution



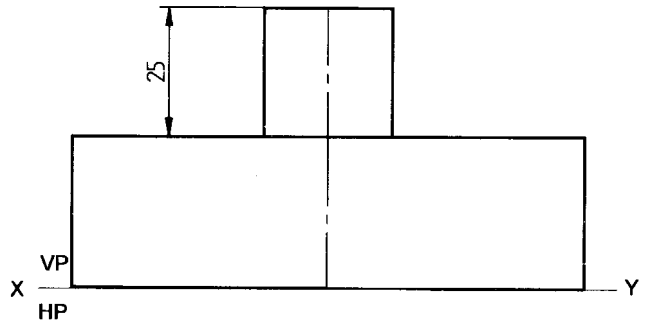
Problem 40 A triangular pyramid base side-40mm and height 50mm is placed centrally on a square slab side-80mm and 20mm-thick. Draw the isometric projection of the combination

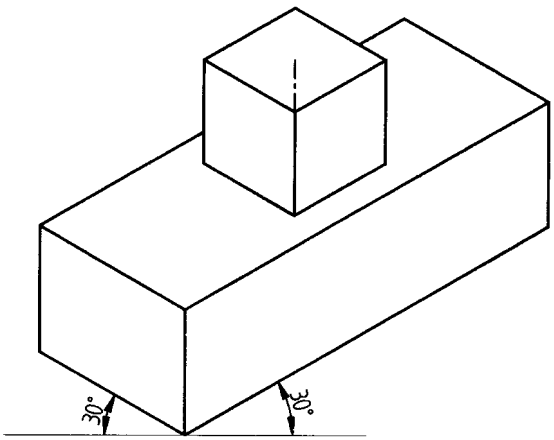
Solution

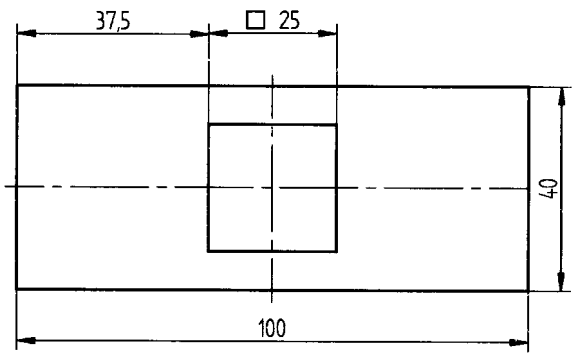


Problem 41 A cube of side-25mm is resting centrally on a rectangular slab 100mmx40mm and 30mm thick. Draw the isometric projection of the combination

Solution

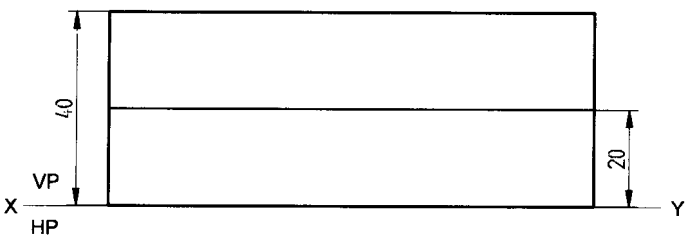


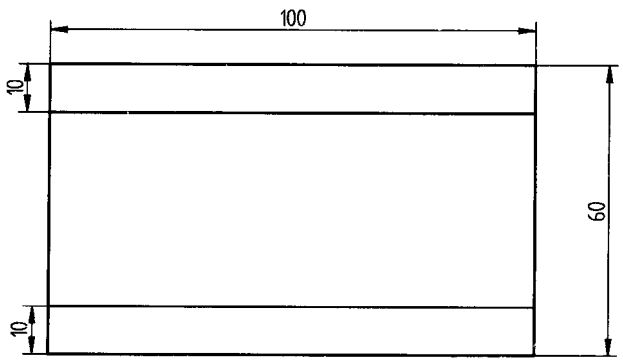


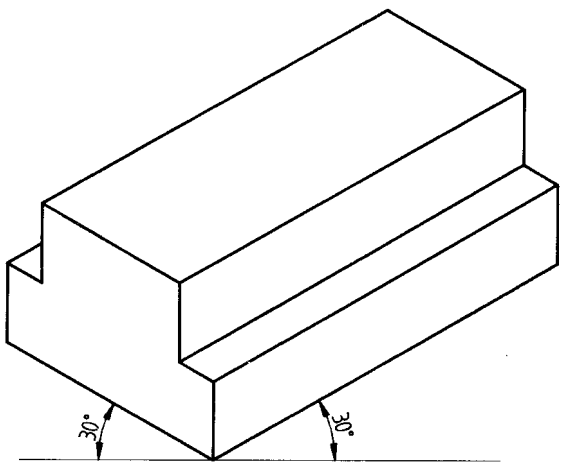


Problem 42 Two rectangular plates are placed centrally with dimensions (lxbxh)100mmx60mmx20mm and 100mmx40mmx20mm such that longer edges are parallel. Draw the isometric projection of the combination

Solution

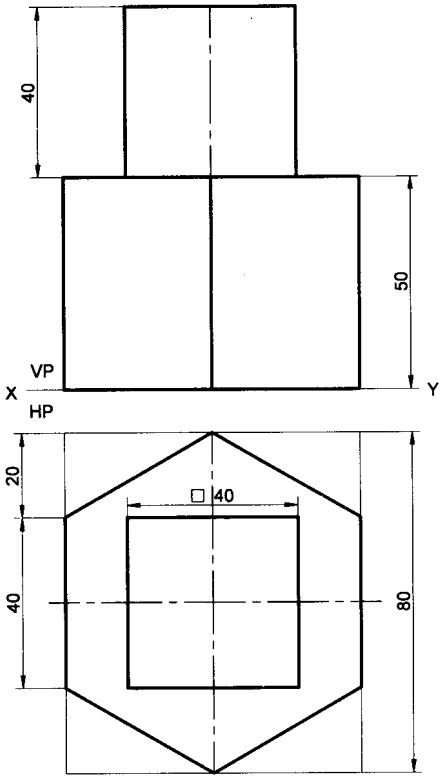


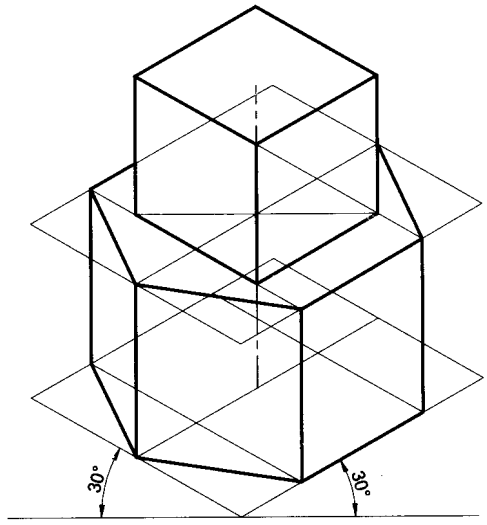




Problem 43 A cube of side-40mm is resting centrally on a hexagonal prism base side-40mm and height 50mm, such that one of the base sides of the cube is parallel to one of the sides of the top face of the prism. Draw the isometric projection of the combination.

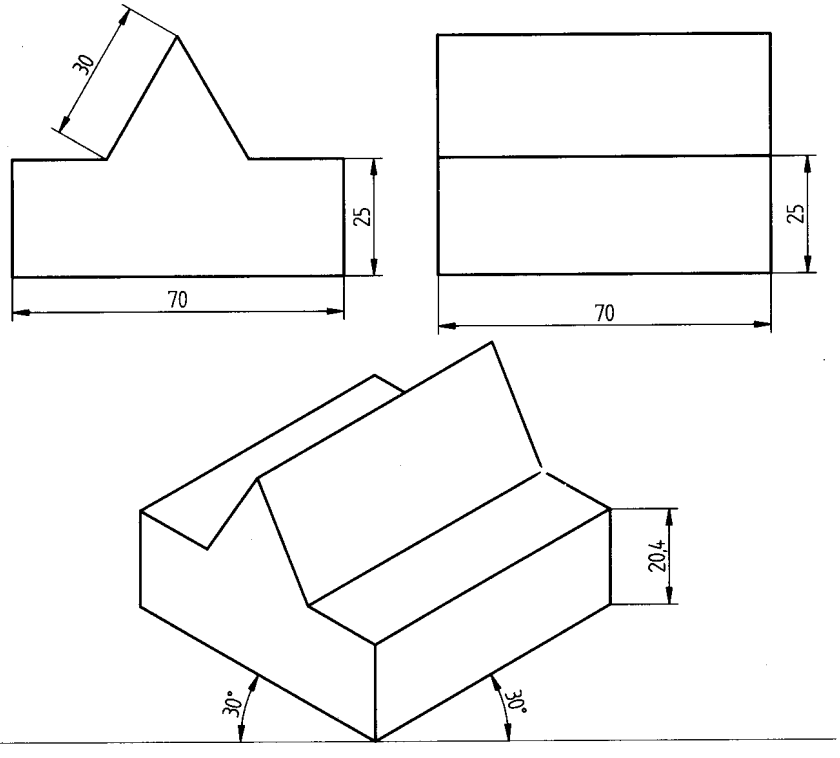
Solution





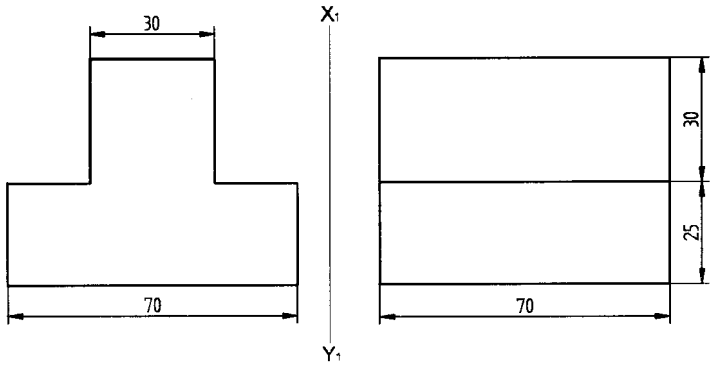
Problem 44 A triangular prism base side-30mm and length-70mm is resting on its rectangular face on top of a square slab side-70mm and 25mm-thick. Draw the isometric projection of the combination

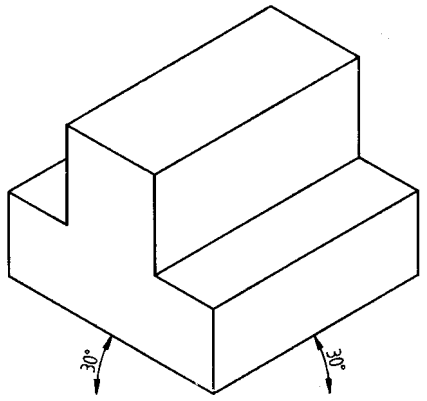
Solution



Problem 45 A square prism of base side-30mm and length-70mm, is resting on its rectangular face on top of a square slab side -70mm and 25mm-thick. Draw the isometric projection of the combination

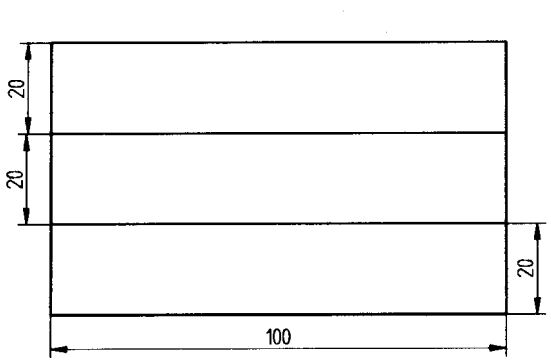
Solution

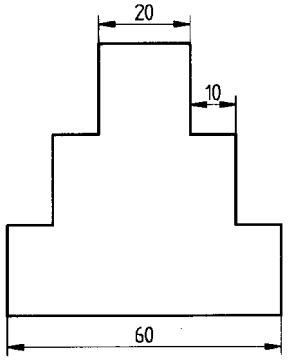


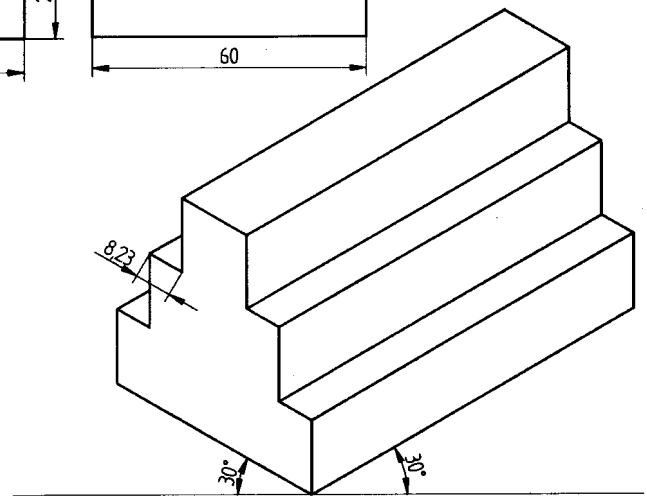


Problem 46 Three rectangular slabs (lxbxh) 100mmx60mmx20mm 100mmx40mmx20mm and 100mmx20mmx20mm are placed one above the other in the ascending order of their width-b, such that their longer axes are co-planar. Draw the isometric projection of the combination

Solution

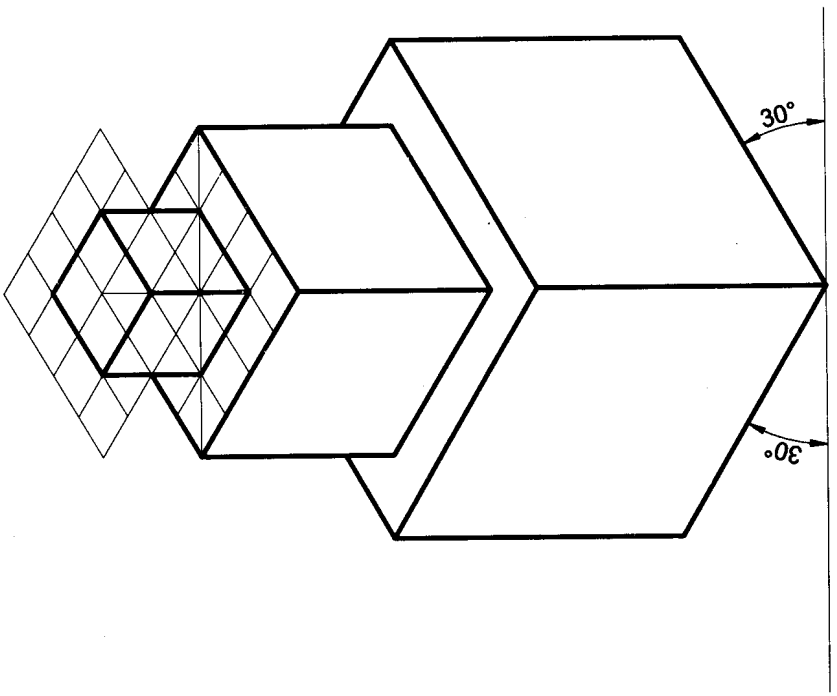


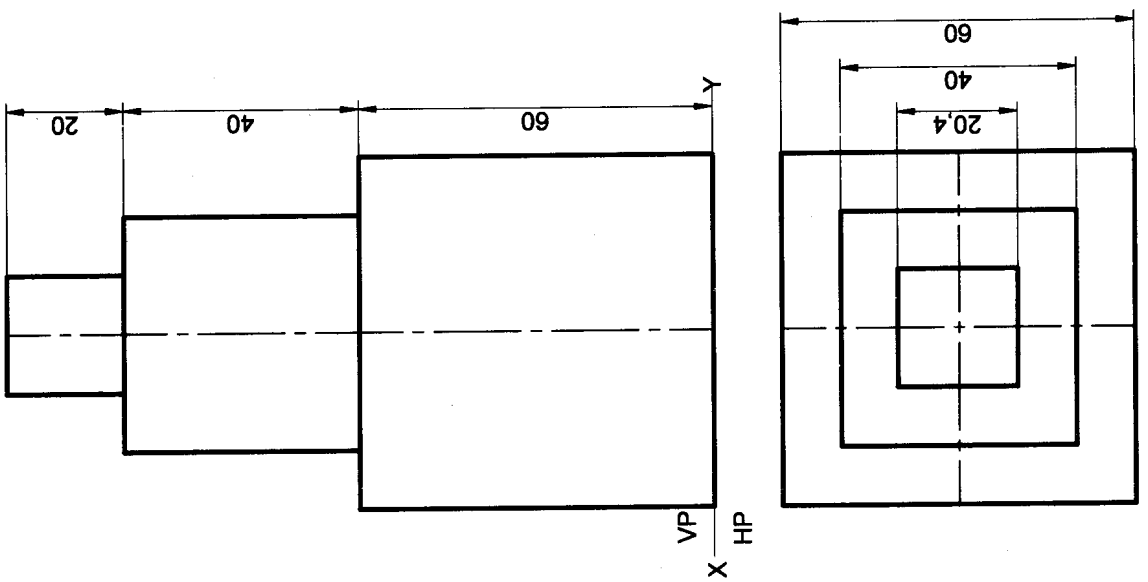




Problem 47 Three cubes of sides 60mm, 40mm and 20mm are placed centrally one above the other in the ascending order of their side. Draw the isometric projection of the combination

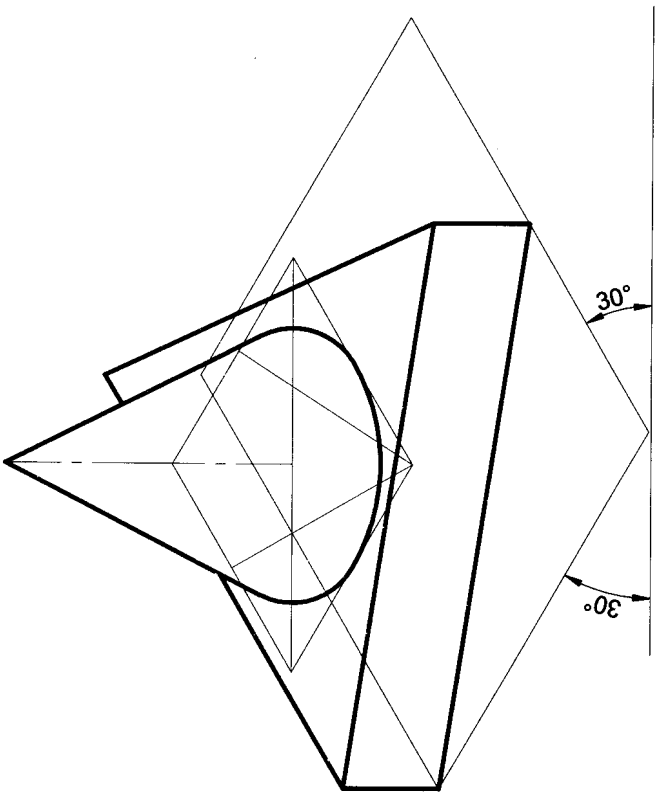
Solution

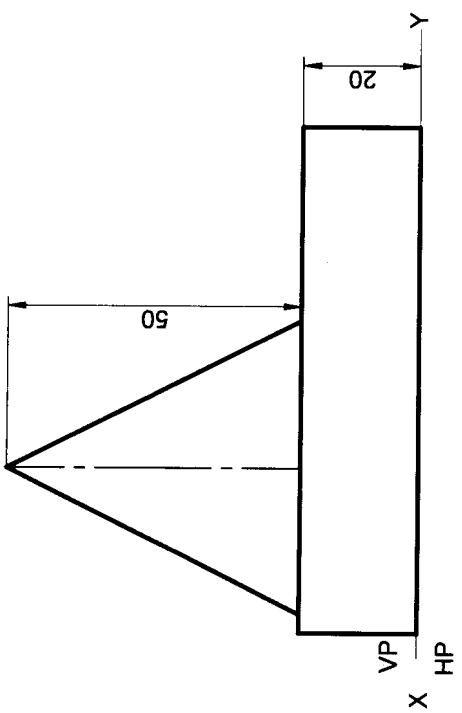


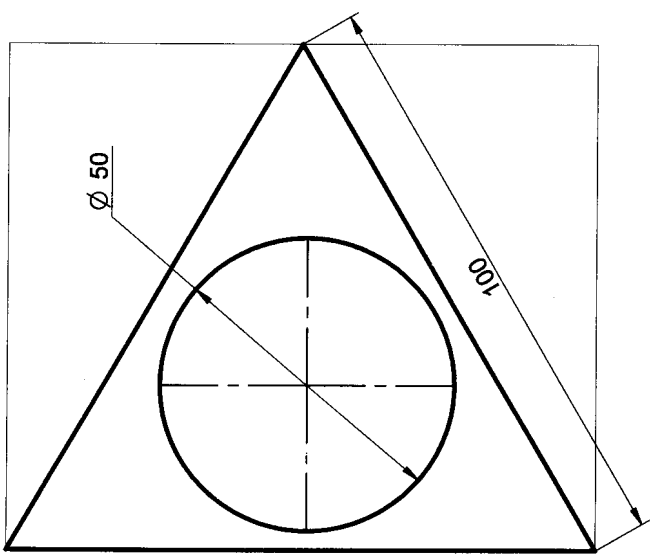


Problem 48 A cone of base diameter 50mm and height 60mm is placed centrally on an equilateral triangular prism of side-100mm and 20mm thick Draw the isometric projection of the combination

Solution

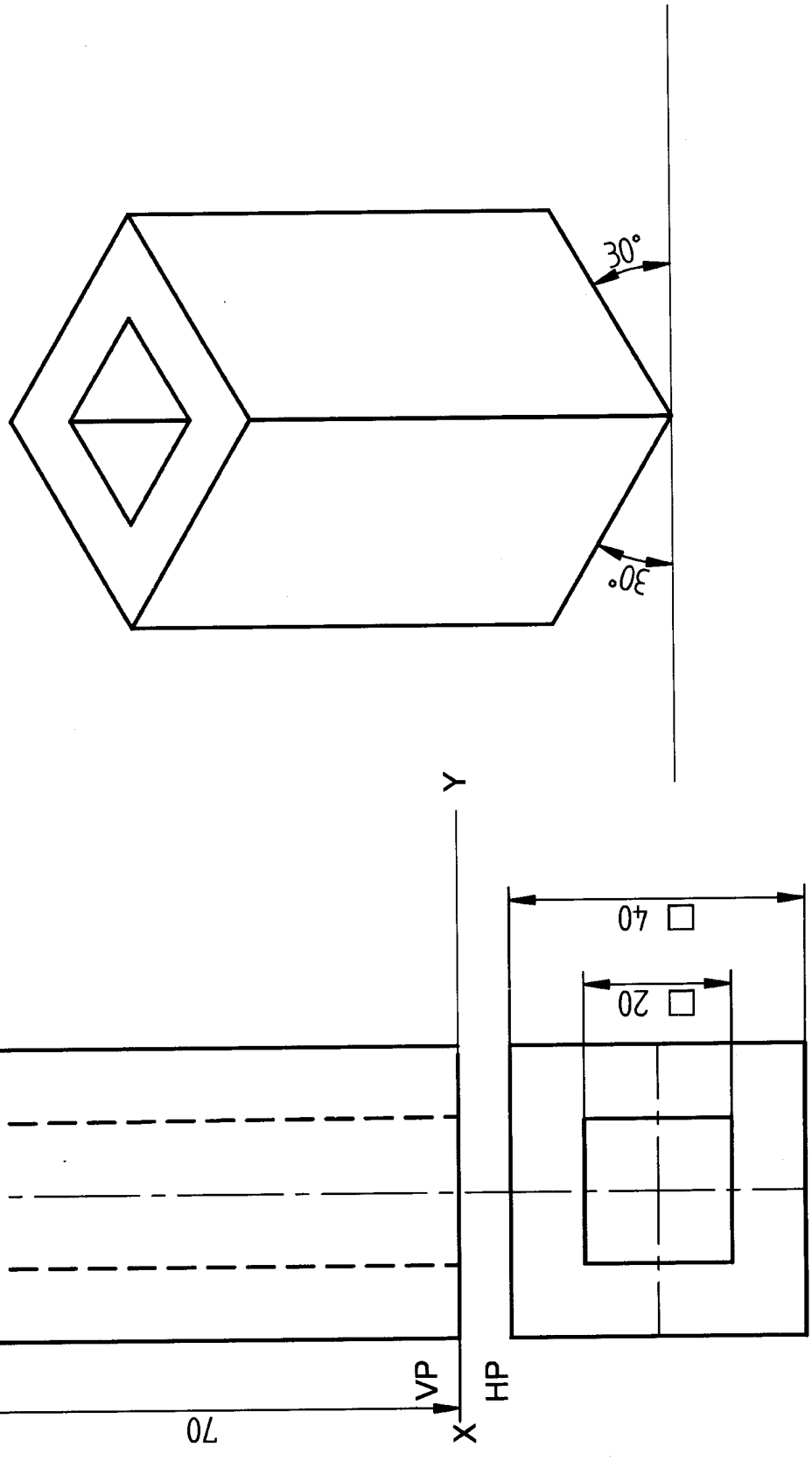






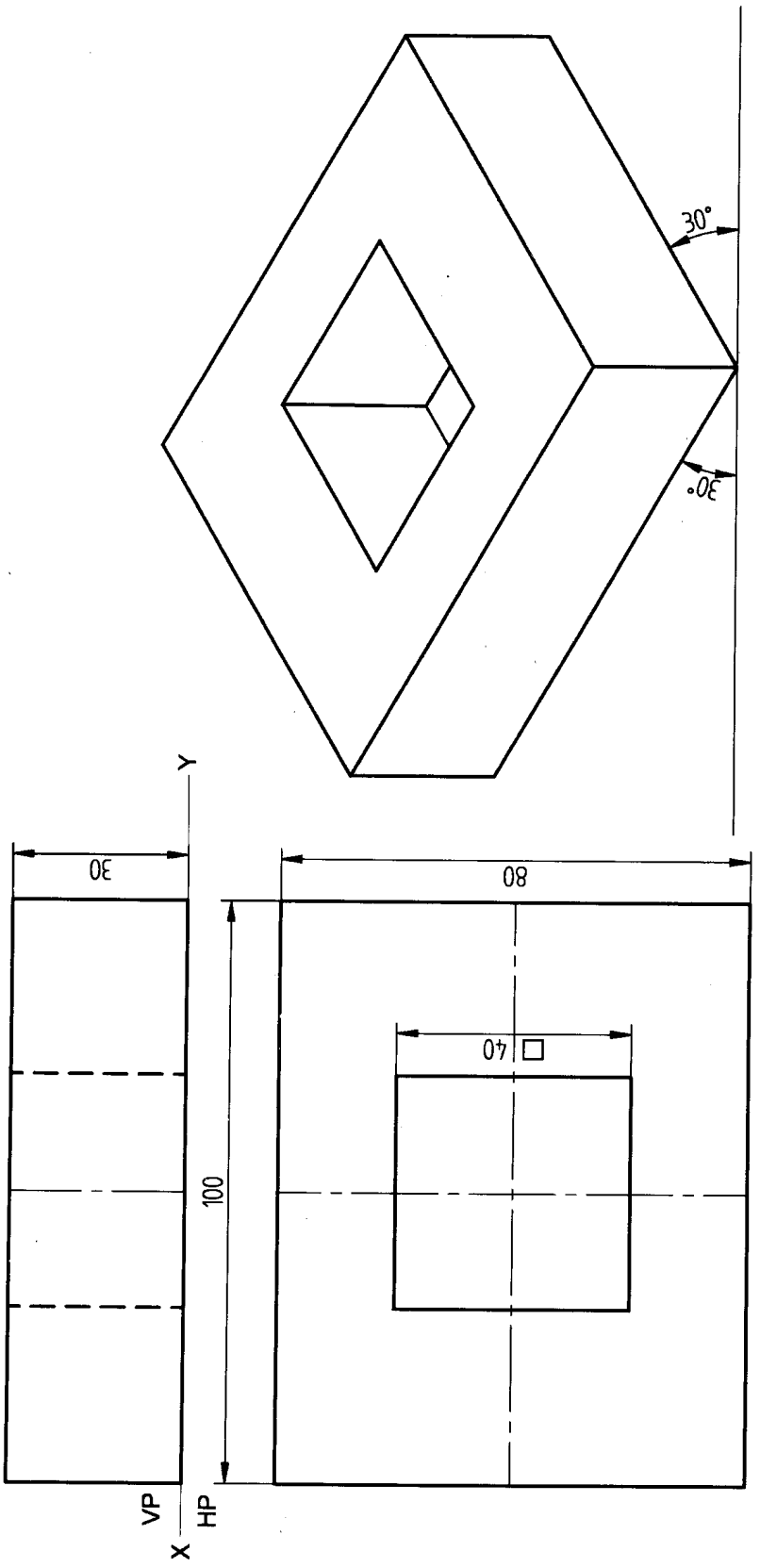
Problem 49 A square prism side-40mm and height 70mm has a full depth co-axial square hole side-20mm, such that edges of both the squares are parallel. Draw the isometric projection of the combination

Solution



Problem 50 A rectangular slab base-100mmx80mm and height 30mm has a full depth co-axial square hole side-40mm, such that one of the sides of the square is parallel to one of the sides of the rectangle. Draw the isometric projection of the combination

Solution

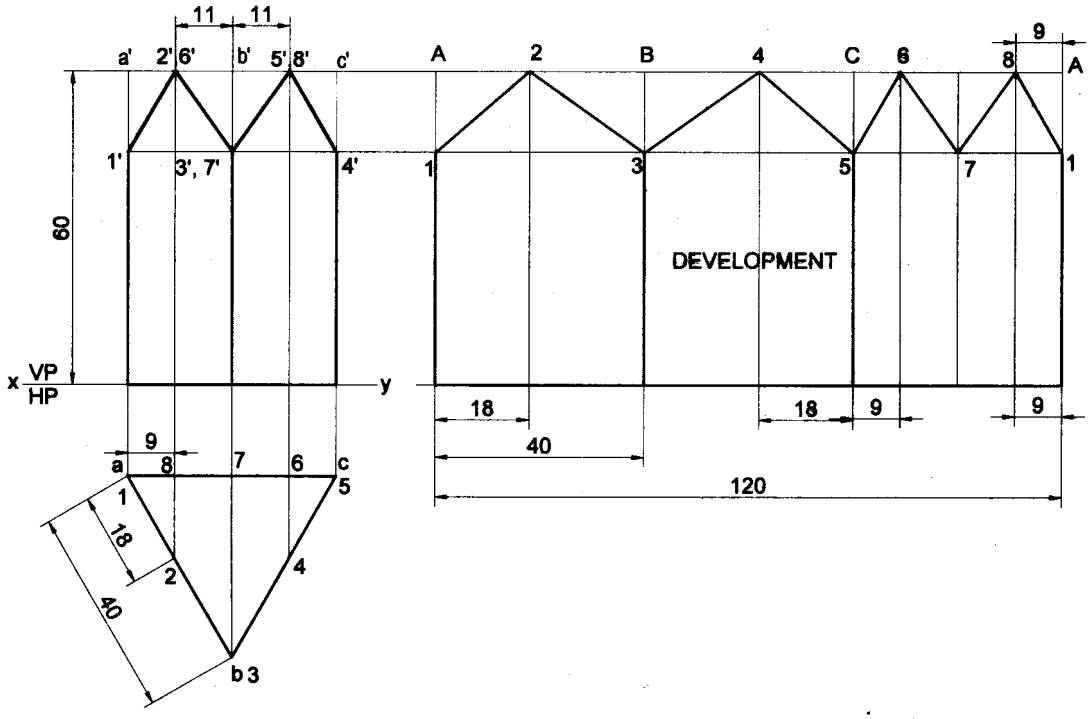


CHAPTER 5

DEVELOPMENT OF LATERAL SURFACES OF SOLIDS

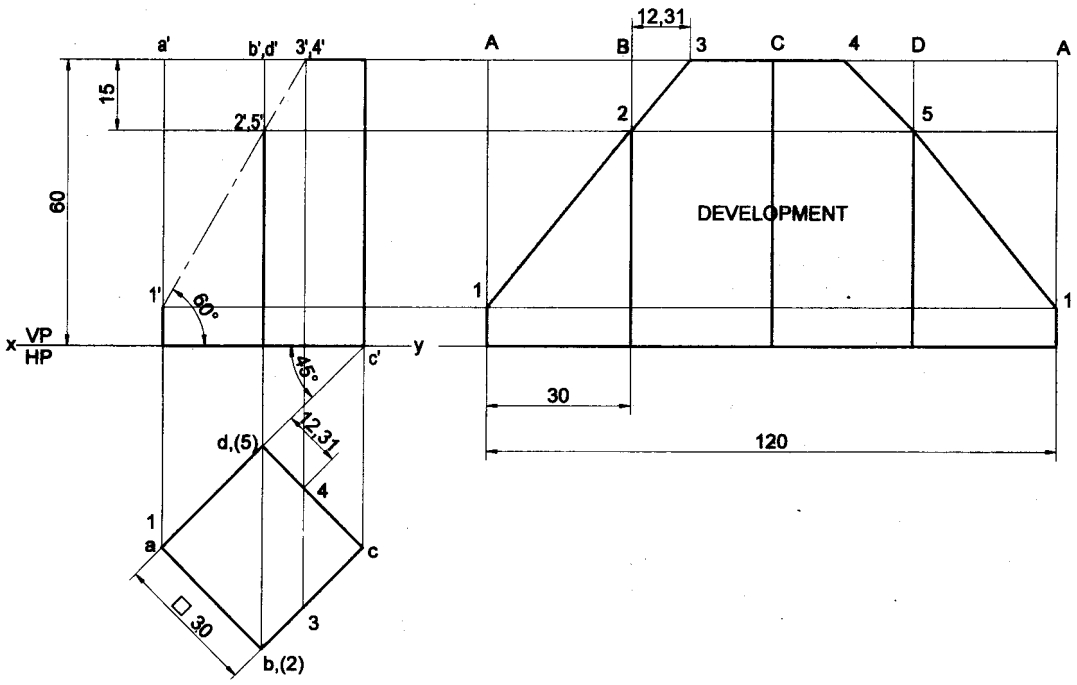
Problem 1 A triangular prism with one of its rectangular faces parallel to VP and nearer to it is cut as shown in Fig. Draw the development of the retained portions of the prism which are shown in dark lines.

Solution



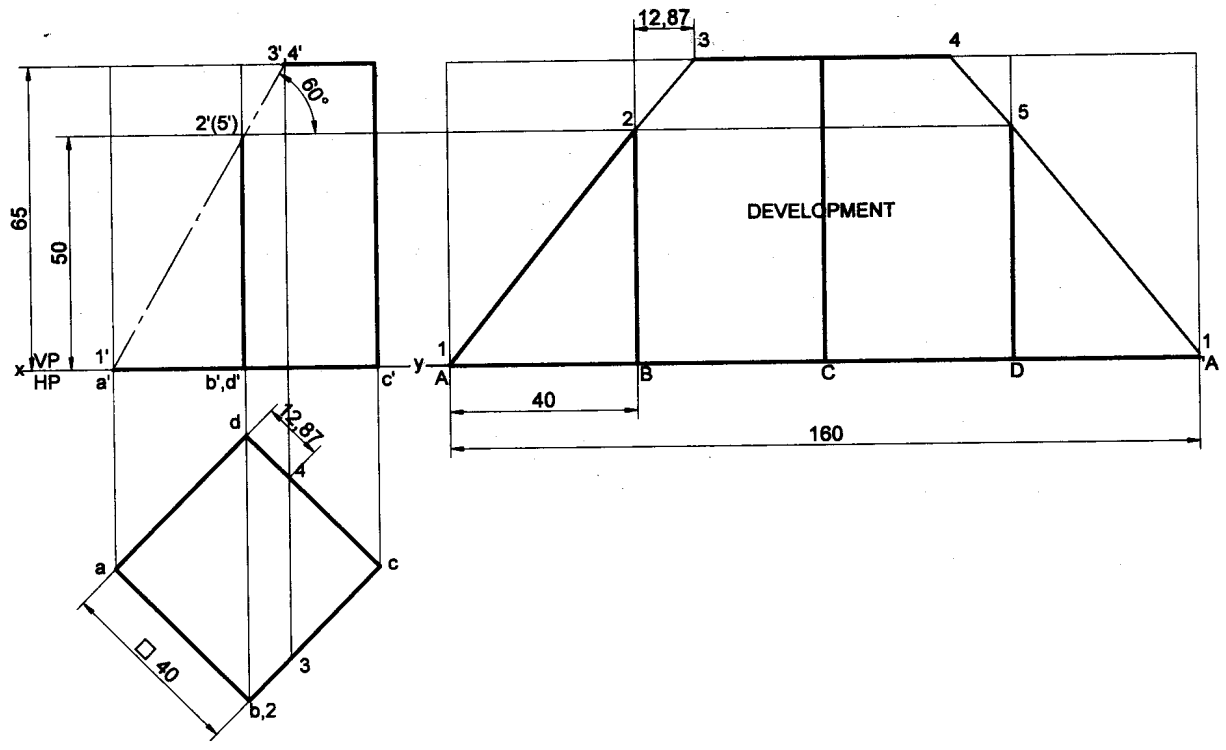
Problem 2 A square prism of base side 30 mm and axis length 60 mm is resting on HP on its base with all the vertical faces being equally inclined to VP. It is cut by an inclined plane 60° to HP and perpendicular to VP and is passing through a point on the axis at a distance 50 mm from the base. Draw the development of the lower portion of the prism.

Solution



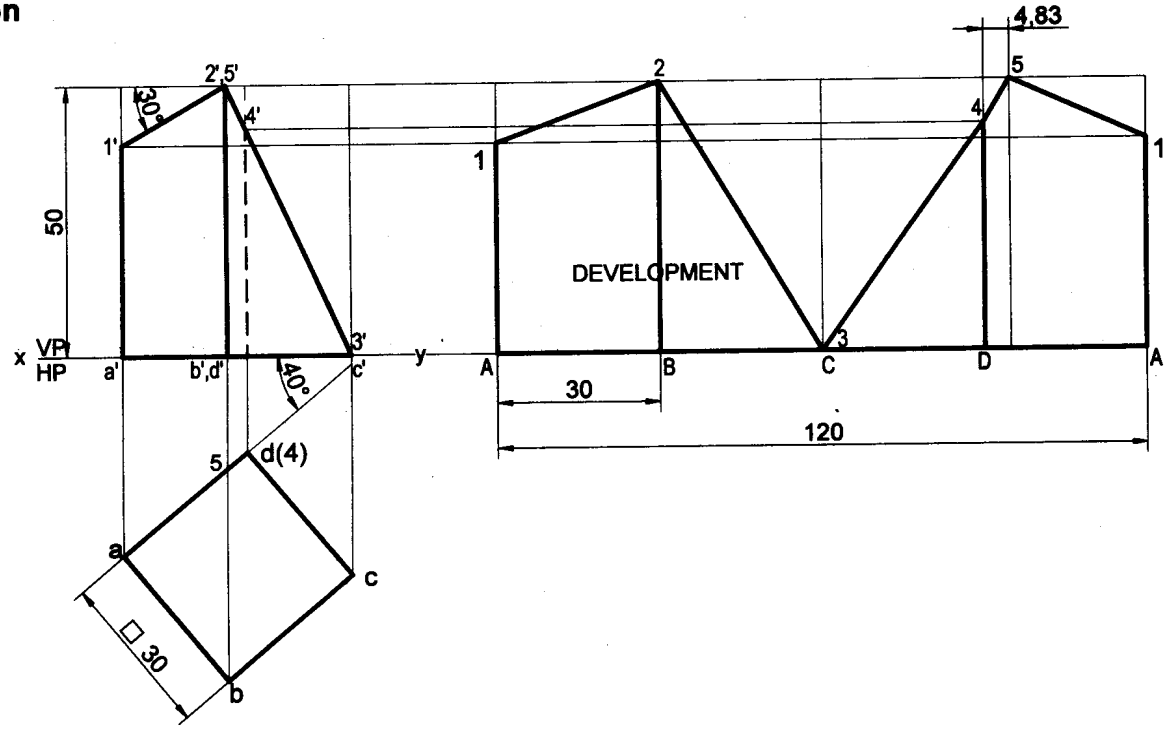
Problem 3 A square prism of base side 40mm and axis length 65mm is resting on HP on its base with all the vertical faces being equally inclined to VP. It is cut by an inclined plane 60° to HP and perpendicular to VP and is passing through a point on the axis at a distance 15mm from the top face. Draw the development of the lower portion of the prism.

Solution



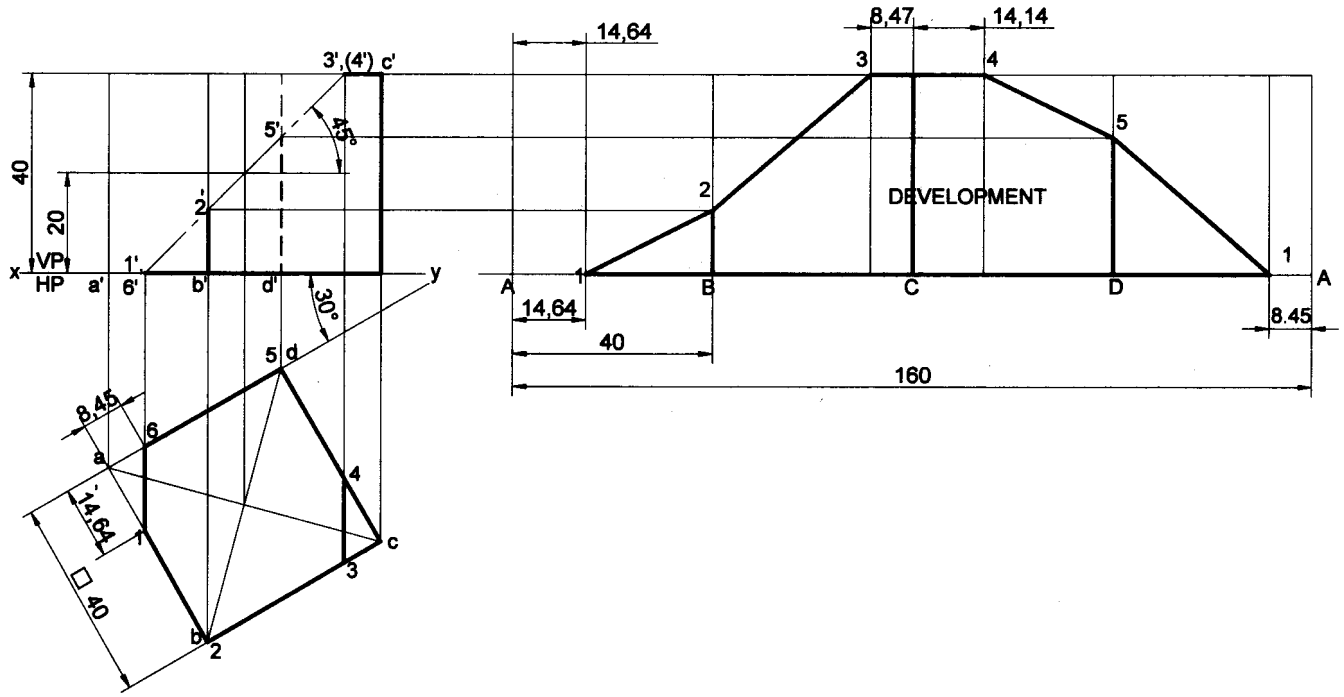
Problem 4 A square prism of 30mm side of the base and height 50mm is resting with its base on HP such that one of its vertical faces is inclined at 40° to VP. It is cut as shown in the following front view figure. Draw the development of the lateral surface of the prism.

Solution



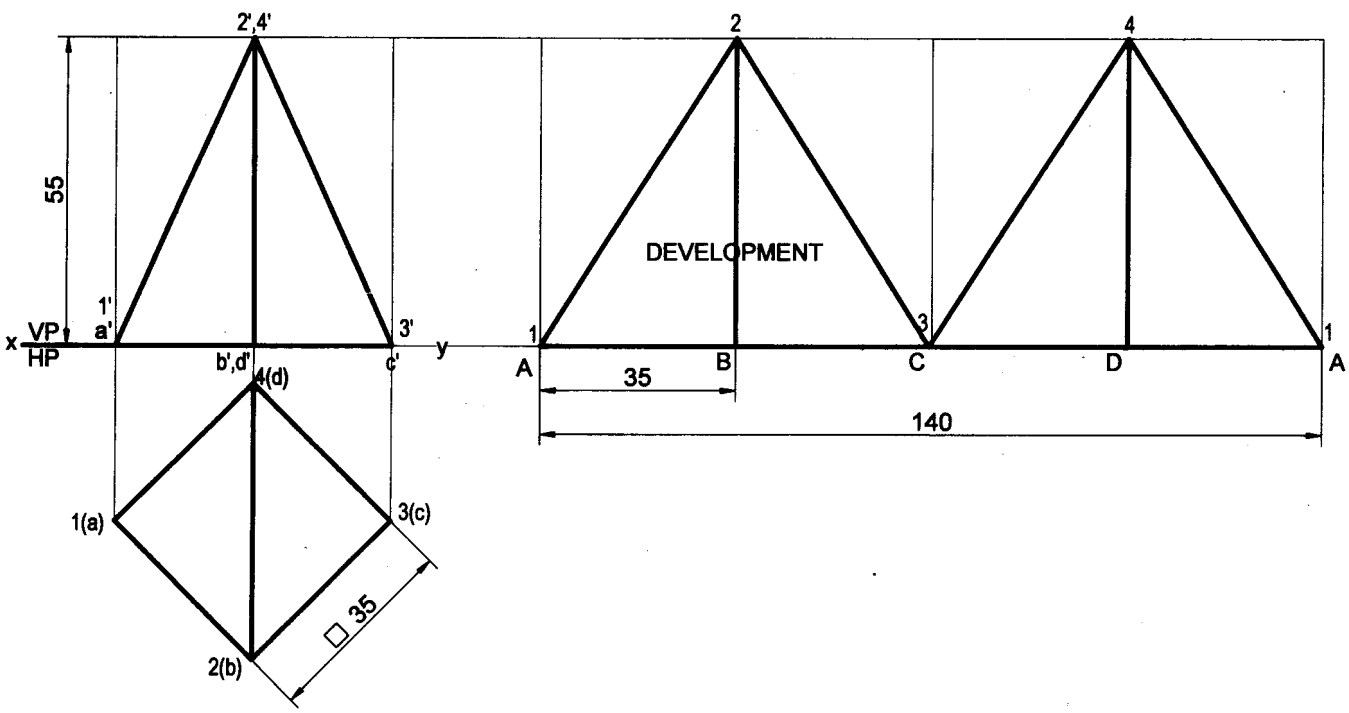
Problem 5 A cube of side 40mm is resting on HP with its base on HP such that one of its vertical faces is inclined at 30° to the VP. It is cut by a section plane perpendicular to VP, inclined to HP at an angle 45º and passes through the midpoint of the axis. Draw the development of the lower lateral surface of the cube.

Solution



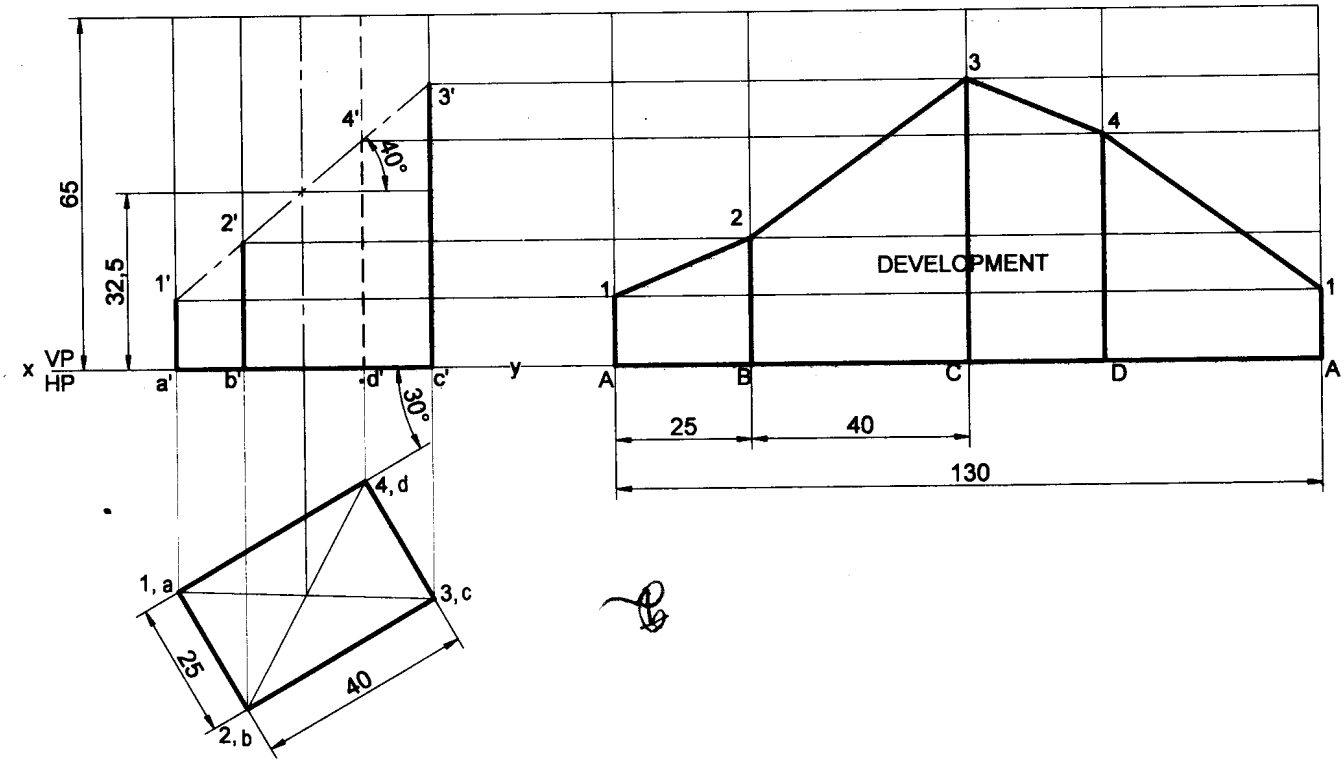
Problem 6 A square prism of base side 35mm rests with its base on HP and two faces equally inclined to VP. Draw the development of the lateral surfaces of the retained portions of the cut prism shown by dark lines in the Fig.

Solution



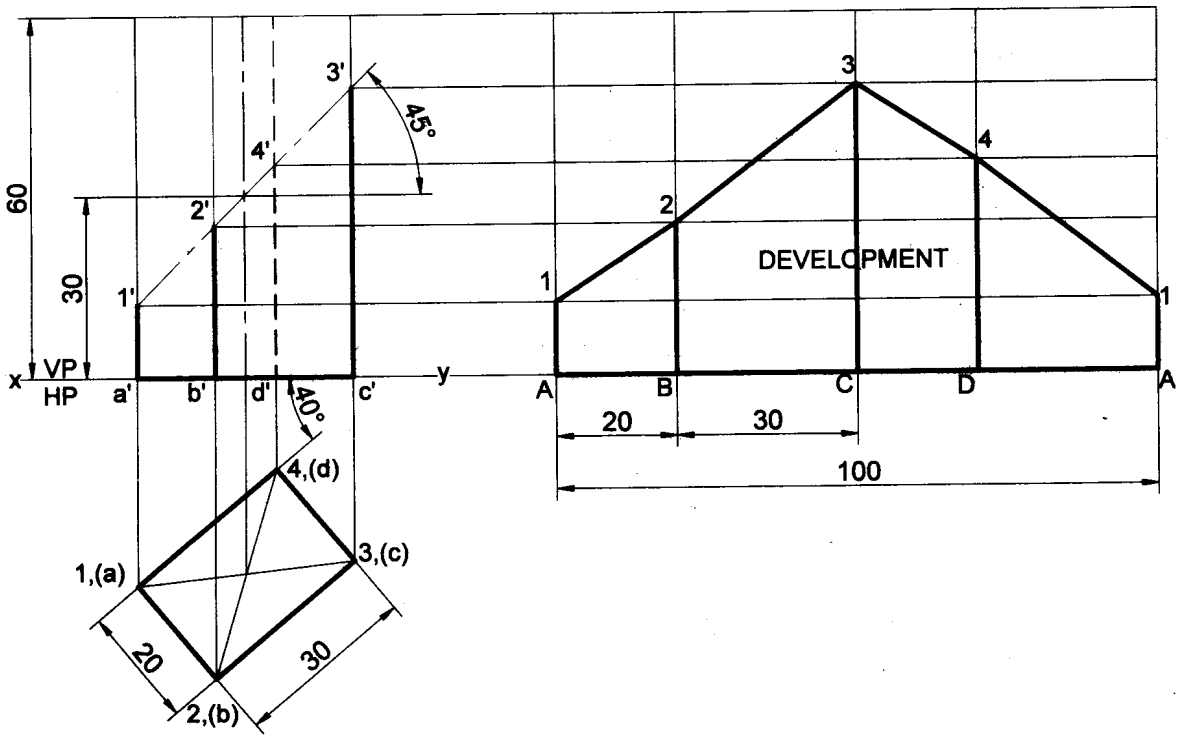
Problem 7 A rectangular prism of base 40mm x 25mm and height 65mm rests on HP on its base with the longer base side inclined at 30° to VP. It is cut by a plane inclined at 40° to HP, perpendicular to VP cuts the axis at its mid height. Draw the development of the remaining portion of the prism.

Solution



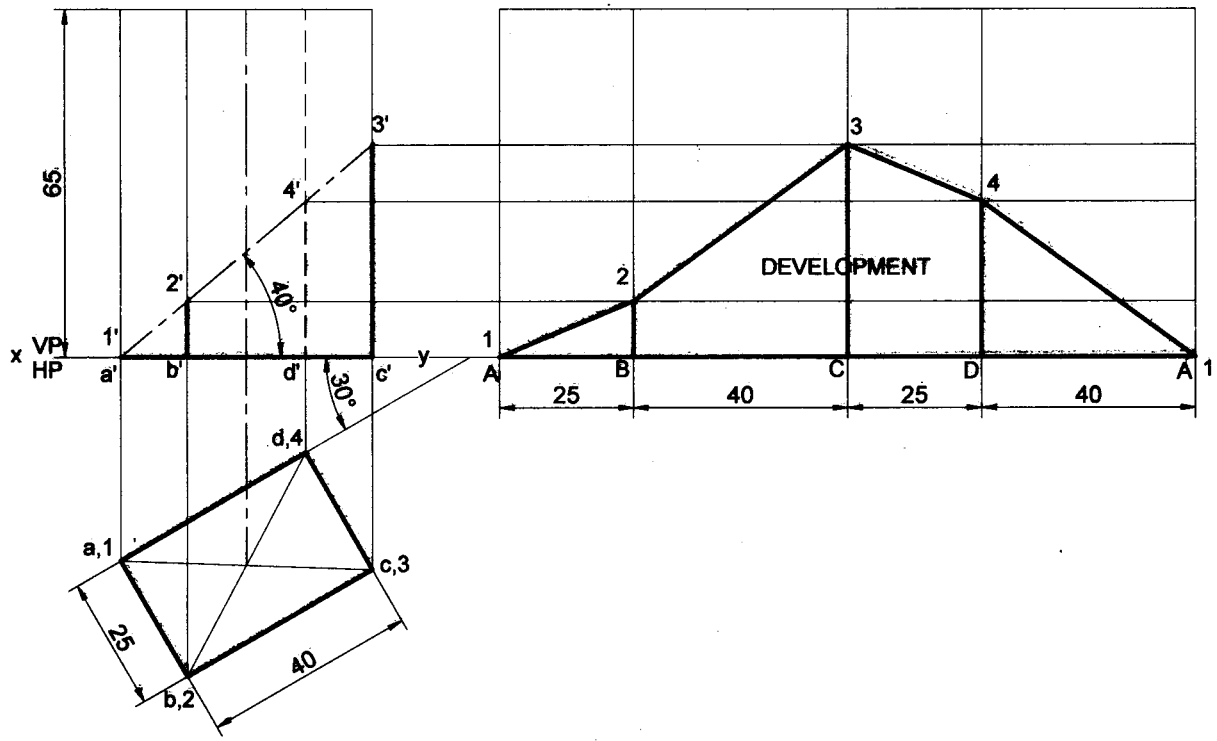
Problem 8 A rectangular prism of base 30mm x 20mm and height 60mm rests on HP on its base with the longer base side inclined at 40° to VP. It is cut by a plane inclined at 45° to HP, perpendicular to VP and bisects the axis. Draw the development of the lateral surface of the prism.

Solution



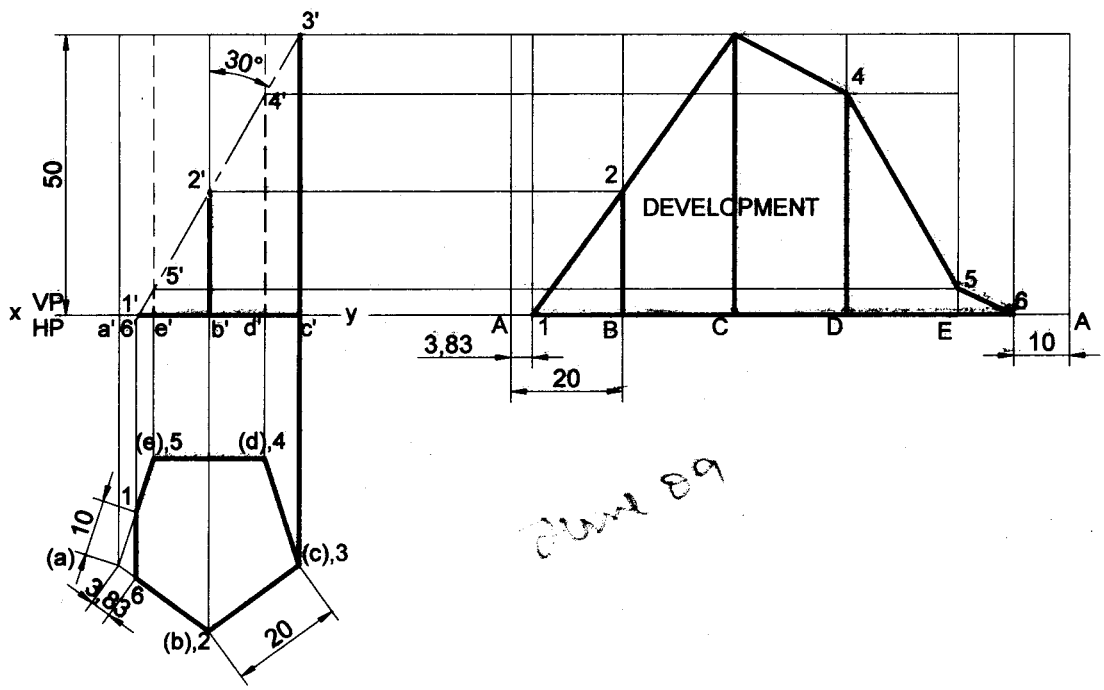
Problem 9 A rectangular prism of base size 25mmx40mm and axis length 65mm is resting on HP on its base with the longer side of base inclined at 30° to VP. It is cut by a plane inclined at 40° to HP and perpendicular to VP and passes through the extreme left corner of base. Draw the development of the lateral surface of the remaining portion of the prism.

Solution



Problem 10 Draw the development of the truncated portion of the lateral faces of a pentagonal prism of 20mm sides of base and 50mm height standing vertically with one of its rectangular faces parallel to VP and nearer to it so as to produce a one piece development. The inclined face of the truncated prism is 30° to its axis and passes through the right extreme corner of the top face of the prism.

Solution



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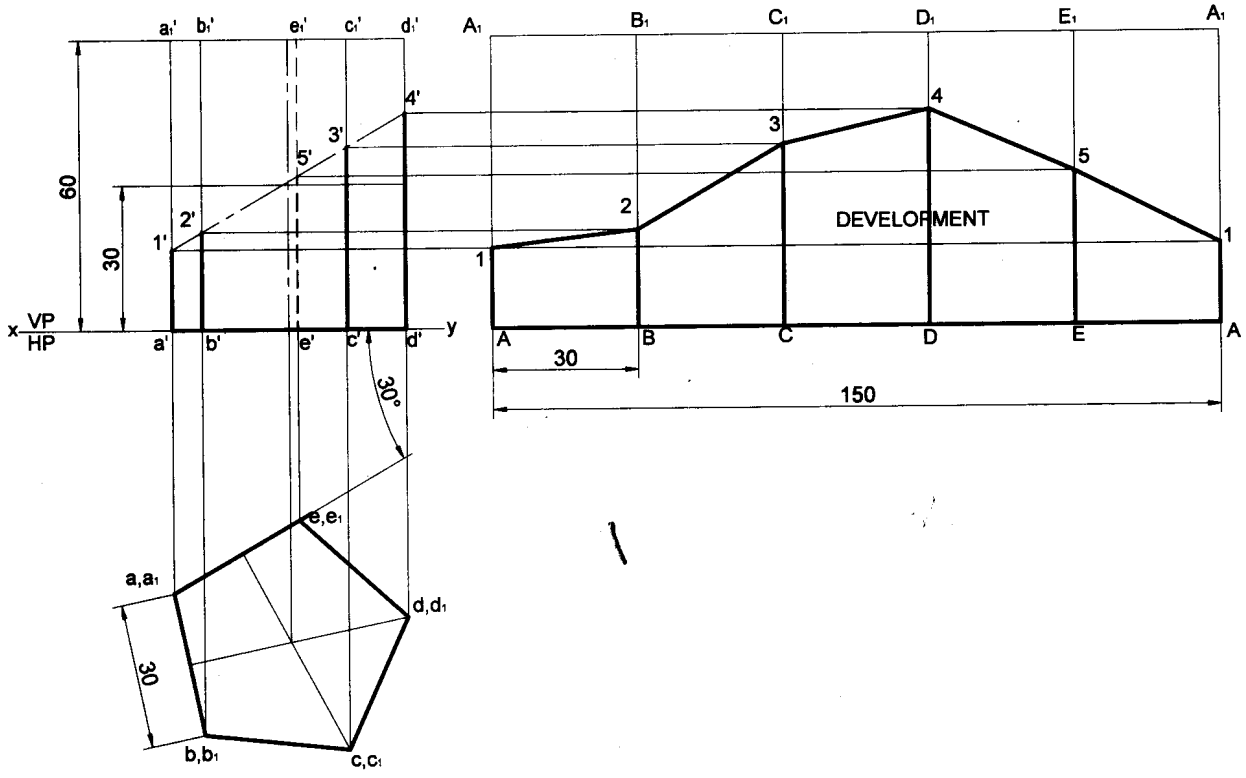
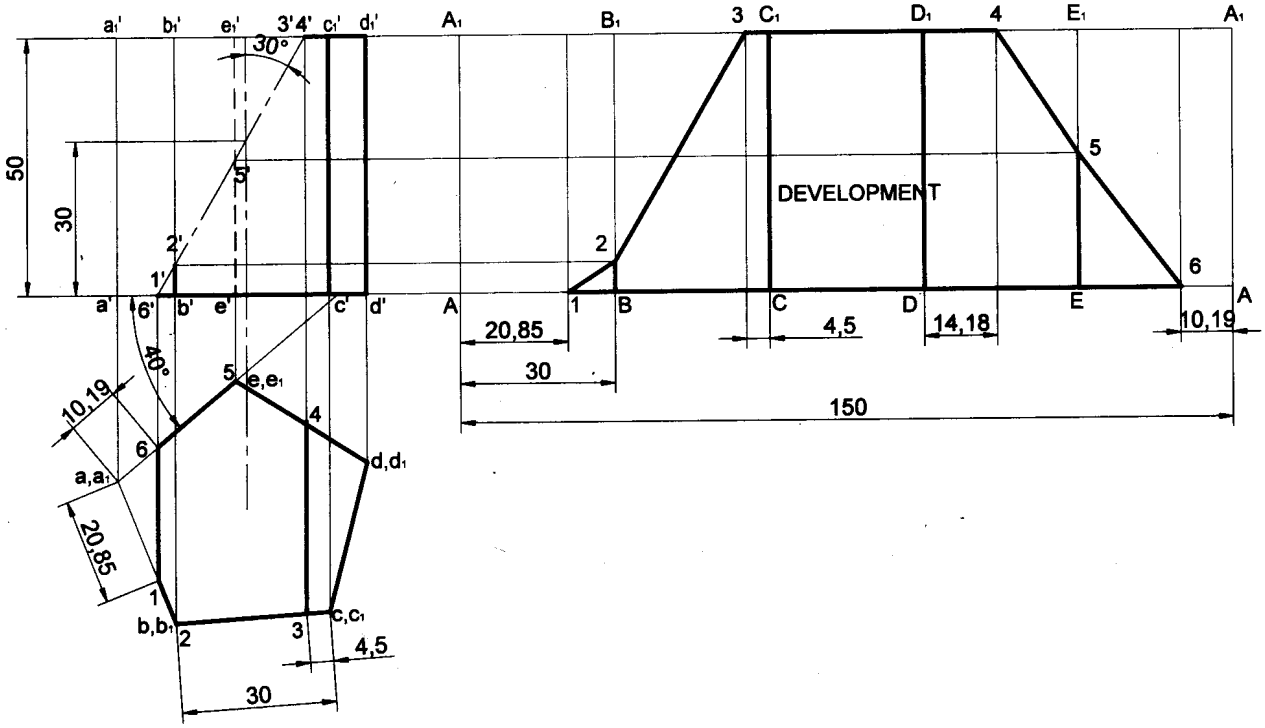
Problem 11 A regular pentagonal prism of height 60mm and base edge 30mm rests with its base on HP. The vertical face closest to VP is 30° to it. Draw the development of the truncated prism with its truncated surface inclined at 60° to its axis and bisecting it.

Solution



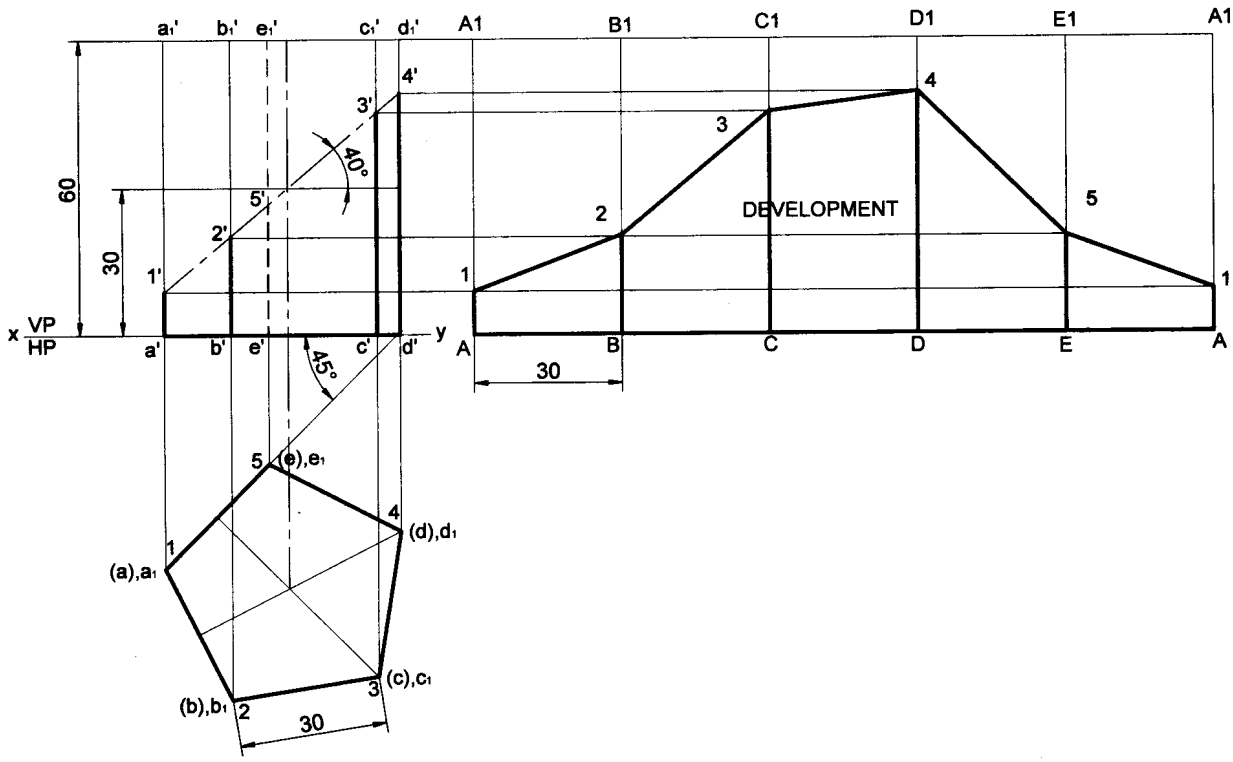
Problem 12 A pentagonal prism of 30mm side of base and height 50mm lies with its base on HP such that one of the rectangular faces is inclined at 40° to VP. It is cut to the shape of a truncated pyramid with the truncated surface inclined at 30° to the axis so as to pass through a point on it 30mm above the base. Develop the truncated portion of the prism so as to produce a one piece development.

Solution



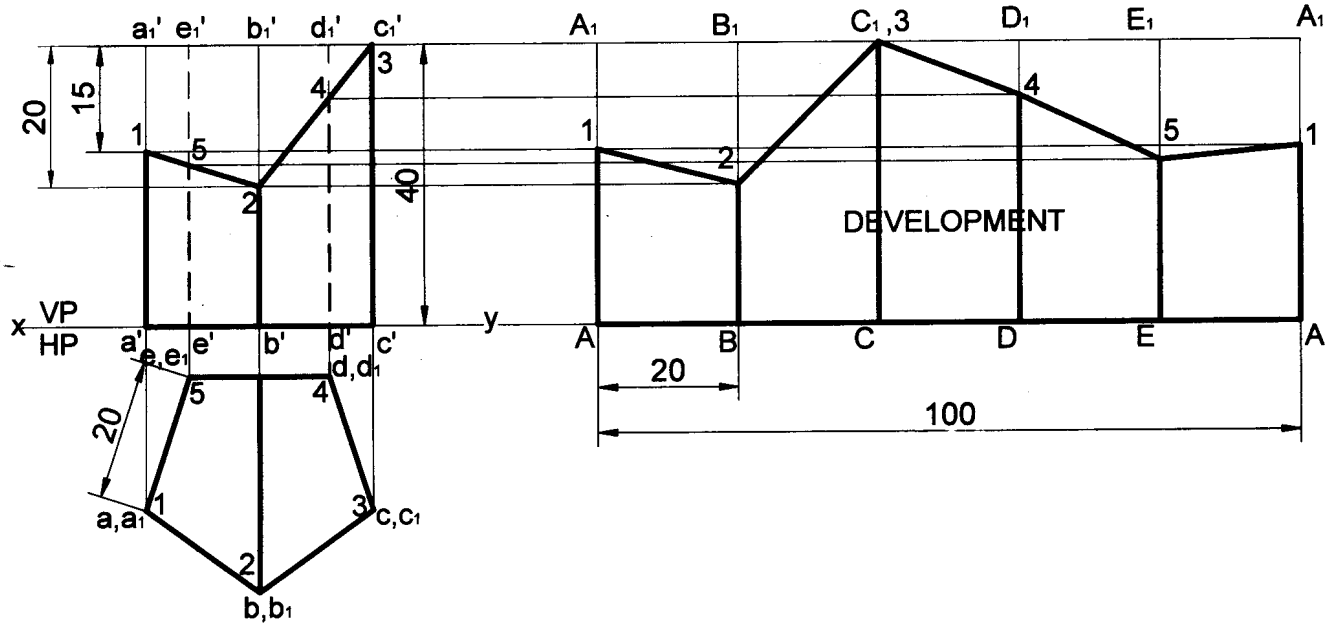
Problem 13 A pentagonal prism of base sides 30mm and axis length 60mm rests with its base on HP and an edge of the base inclined at 45° to VP. It is cut by a plane perpendicular to VP, inclined at 40° to HP and passing through a point on the axis, at a distance of 30 mm from the base. Develop the remaining surfaces of the truncated prism.

Solution



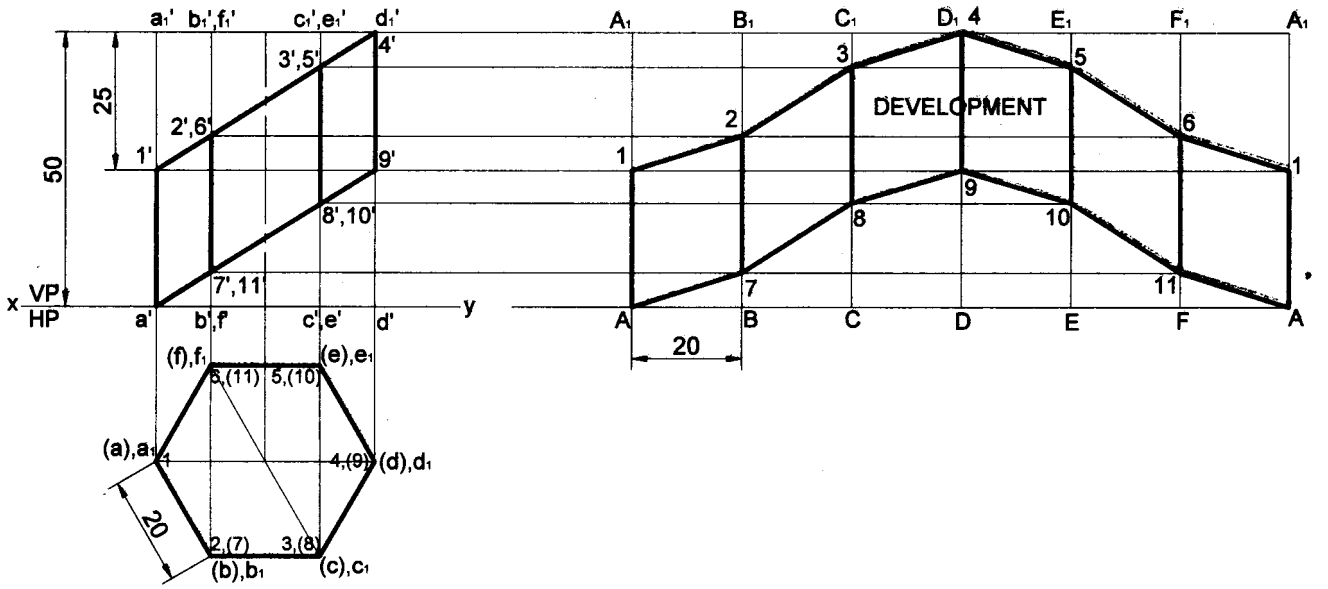
Problem 14 A pentagonal prism of base sides 20mm and height 40mm is resting with its base on HP and base edge parallel to the VP. The prism is cut as shown in the following front view. Draw the development of the lateral surface of the prism.

Solution



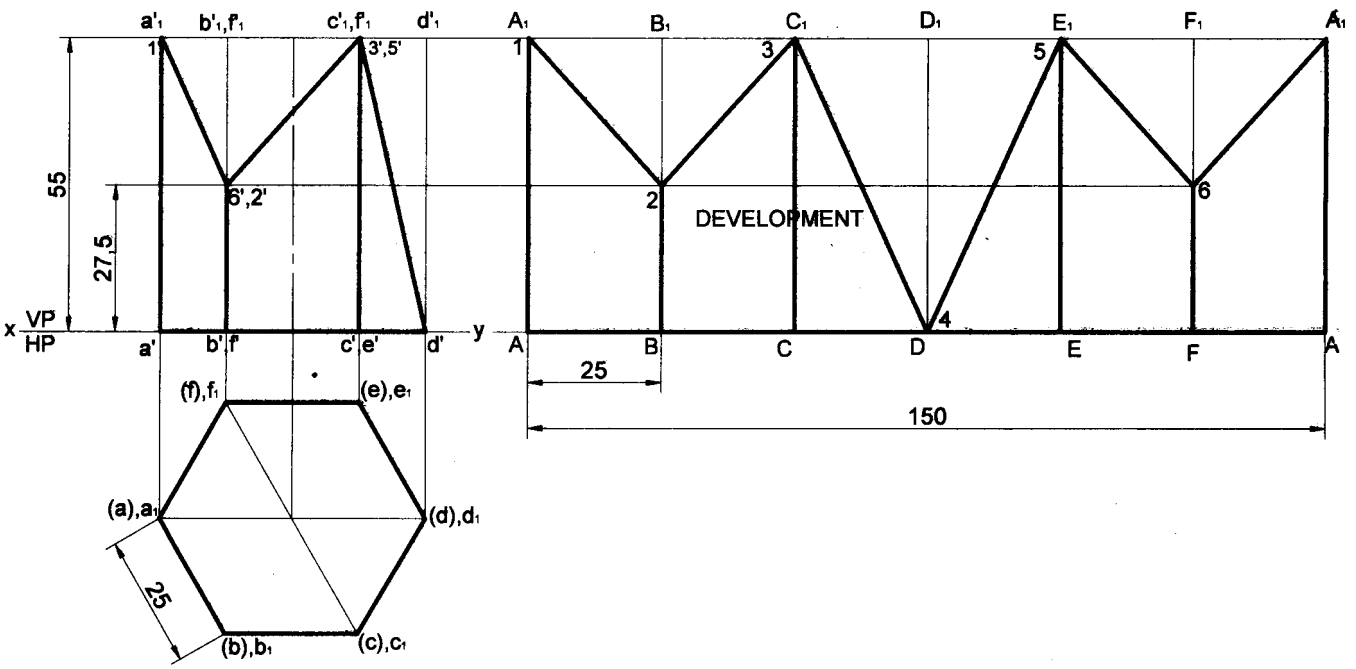
Problem 15 A hexagonal prism of base side 20mm and height 50mm is resting on HP on its base, such that one of its base edge is parallel to VP. The prism is cut in this position as shown in the following front view. Draw the development of the lateral surface of the prism.

Solution



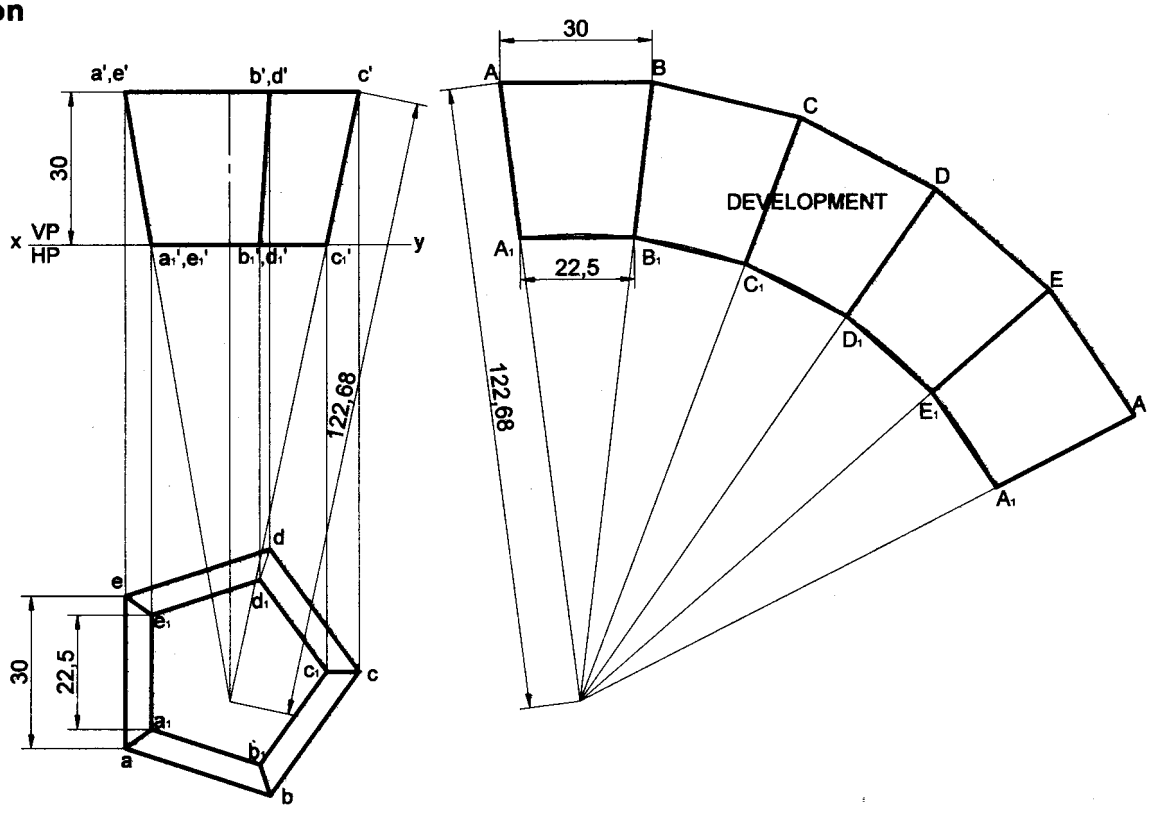
Problem 16 A hexagonal prism of base side 25mm and height 55mm is resting on HP on its base, such that one of its base edges is parallel to VP. The prism is cut in this position as shown in the following front view. Draw the development of the lateral surface of the prism.

Solution



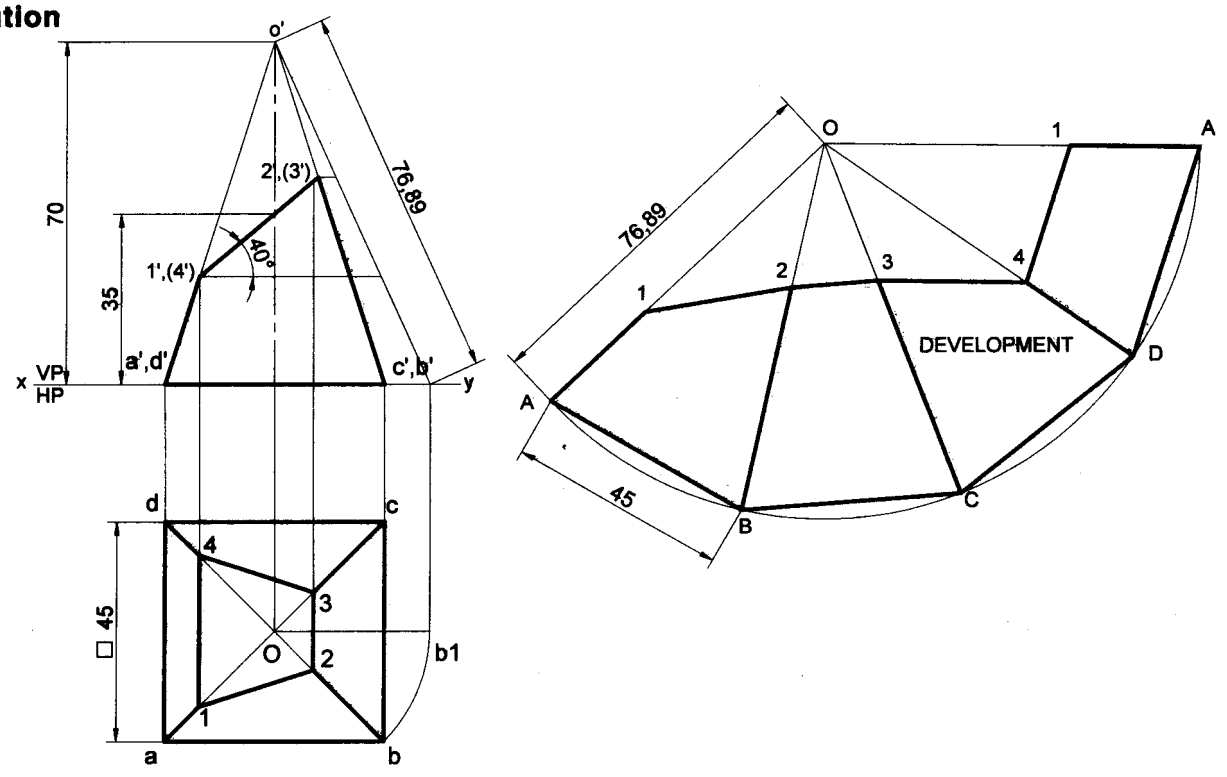
Problem 17 The inside of a hopper of a flour mill is to be lined with thin sheet. The top and bottom of the hopper are regular pentagons with each side equal to 30 mm and 22.5mm respectively. The height of the hopper is 30mm. Draw the shape of the sheet to which it is to be cut so as to fit into the hopper.

Solution



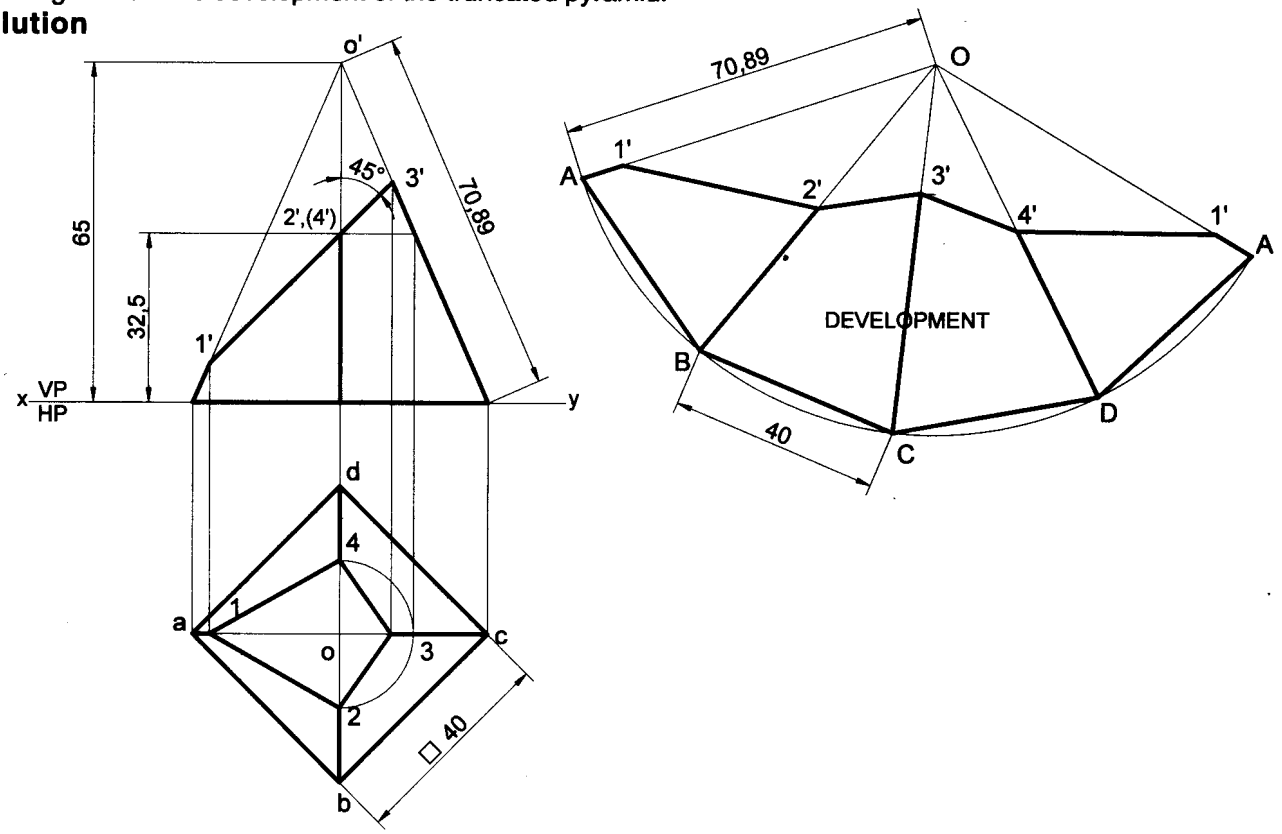
Problem 18 A square pyramid of side of base 45mm, altitude 70mm is resting with its base on HP with two sides of the base parallel to VP. The pyramid is cut by a section plane which is perpendicular to the VP and inclined at 40° to the HP. The cutting plane bisects the axis of the pyramid. Obtain the development of the lateral surfaces the truncated pyramid.

Solution



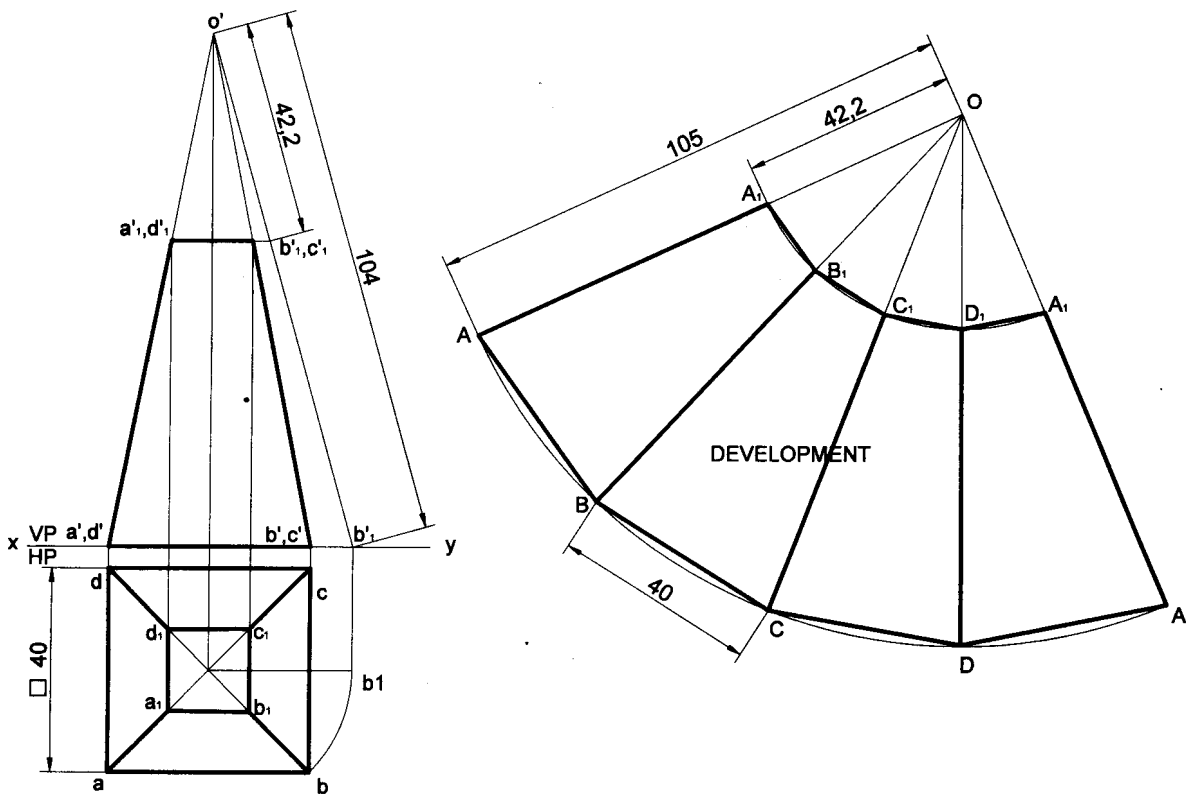
Problem 19 A square pyramid base 40mm side and axis 65mm long has its base on HP and all the edges of the base are equally inclined to VP. It is cut to with an inclined section plane so as the truncated surface at 45° to its axis, bisecting it. Draw the development of the truncated pyramid.

Solution



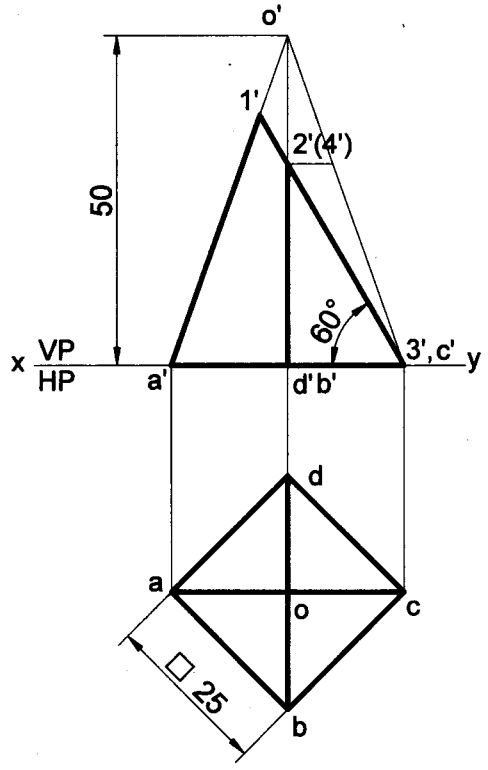
Problem 20 A frustum of a square pyramid has its base 40 mm sides, top 16 mm sides and height 60mm, its axis is vertical and a side of its base is parallel to VP. Draw the projections of the frustum and show the development of the lateral surfaces of it.

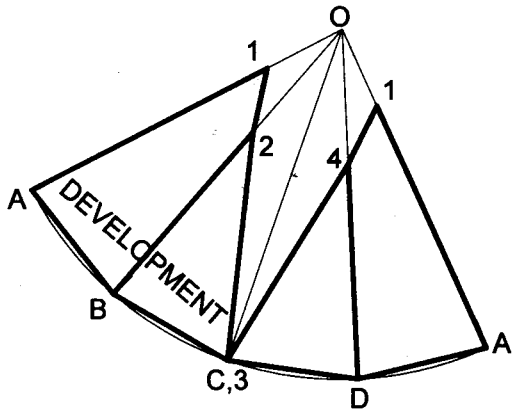
Solution



Problem 21 A square pyramid of 25mm base edge and 50mm height rests with its base on HP with all of its base edges equally inclined to VP. It is cut by a plane perpendicular to VP and inclined to HP at 60°, passing through the extreme right corner of base. Draw the development of the lateral surface of the pyramid.

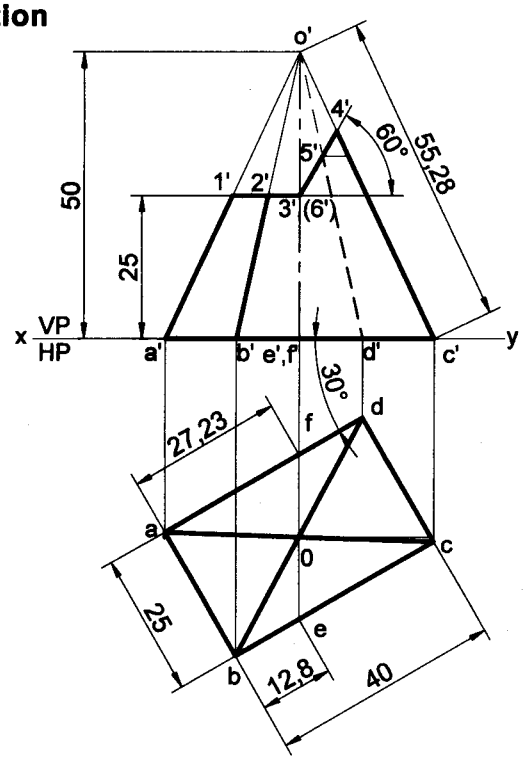
Solution

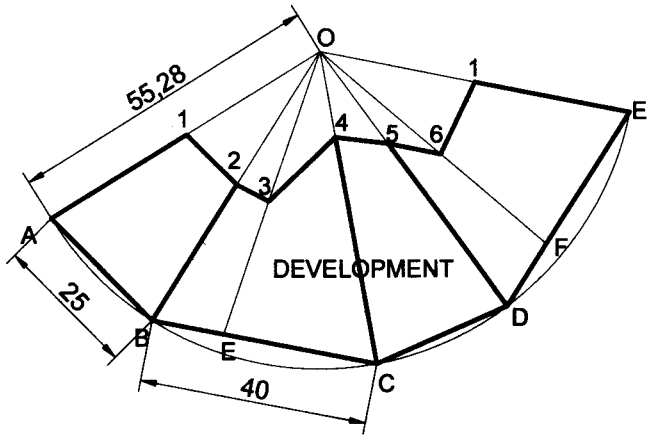




Problem 22 A rectangular pyramid, side of base 25mm x 40mm and height 50mm has one of the sides of the base is inclined at 30º to the VP. Draw the development of the lateral surface of the cut pyramid, whose front view is shown below.

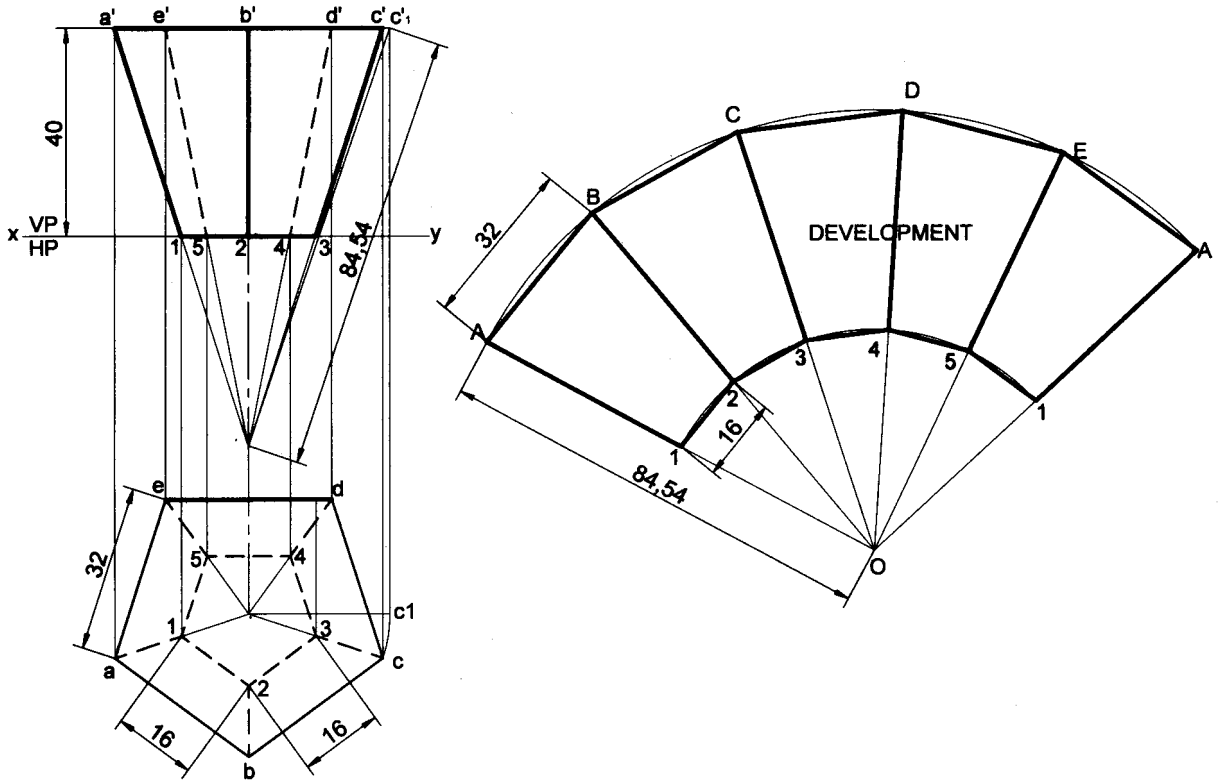
Solution





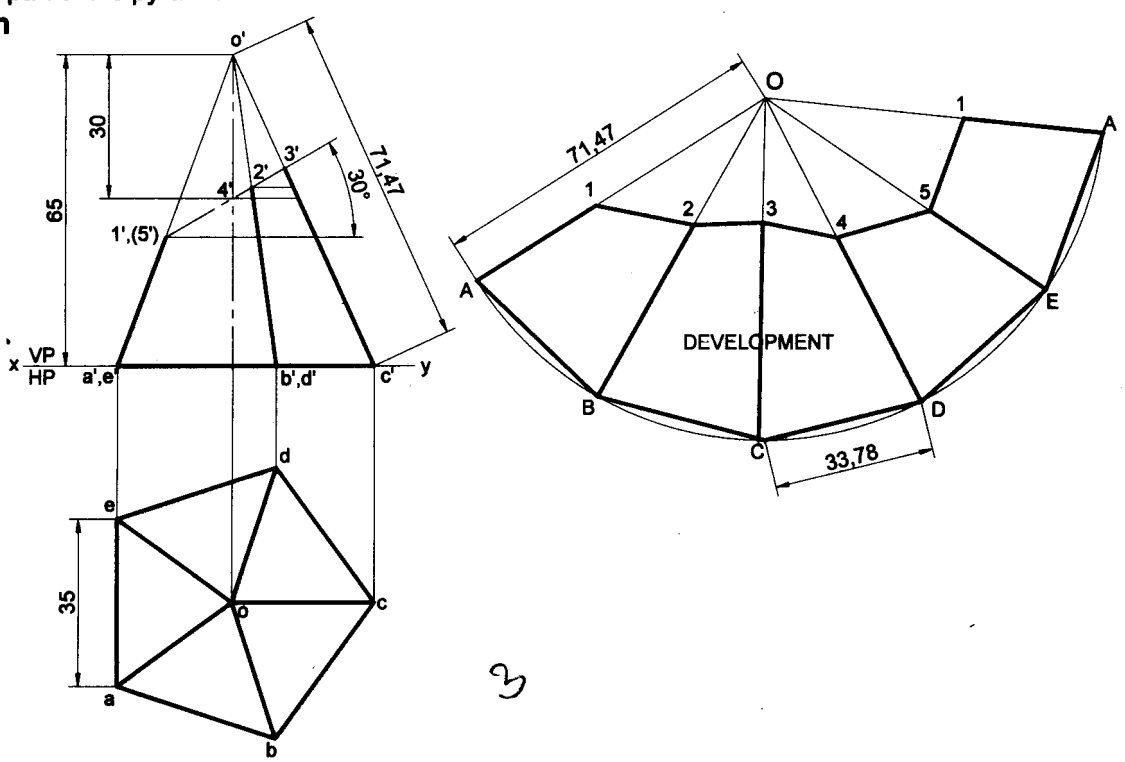
Problem 23 A frustum of a pentagonal pyramid, smaller base sides 16mm and bigger top face sides 32mm and height 40mm, is resting on the HP on its smaller base, with one of its base sides parallel to the VP. Draw the projections of the frustum and develop the lateral surface it.

Solution



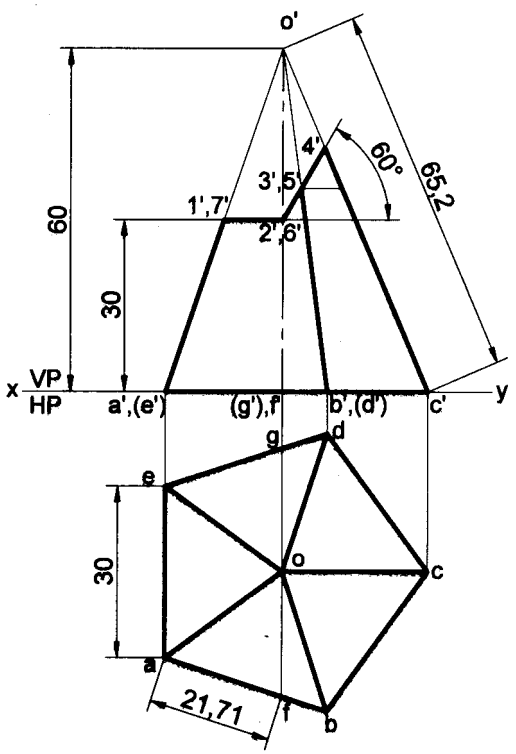
Problem 24 A regular pentagonal pyramid of side of base 35mm and altitude 65mm has its base on HP with a side of base perpendicular to VP. The pyramid is cut by a section plane which is perpendicular to the VP and inclined at 30° to HP. The cutting plane meets the axis of the pyramid at a point 30mm below the vertex. Obtain the development of the remaining part of the pyramid.

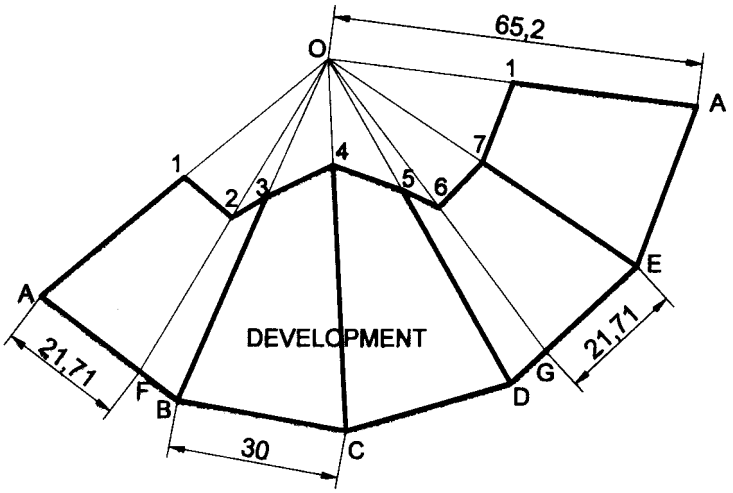
Solution



Problem 25 A pentagonal pyramid, 30mm sides, with a side of base perpendicular to VP. Draw the development of the lateral surfaces of the retained portion of the pyramid shown by the dark lines in the following figure.

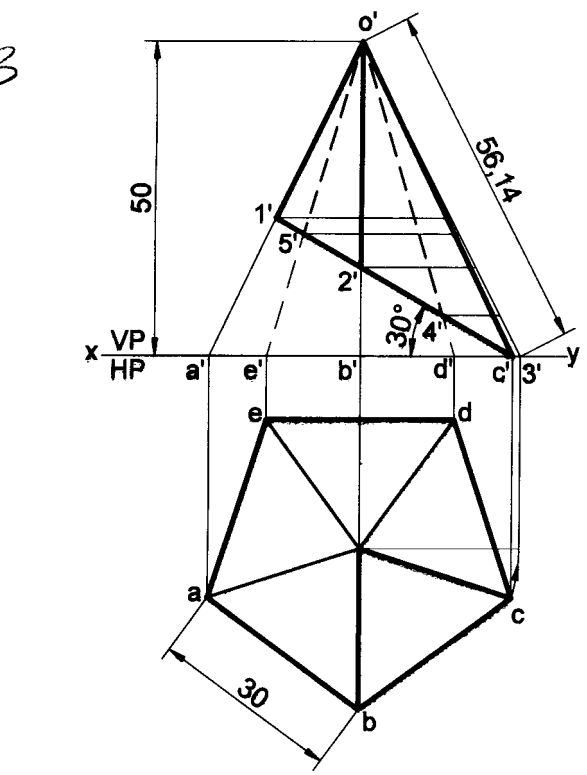
Solution

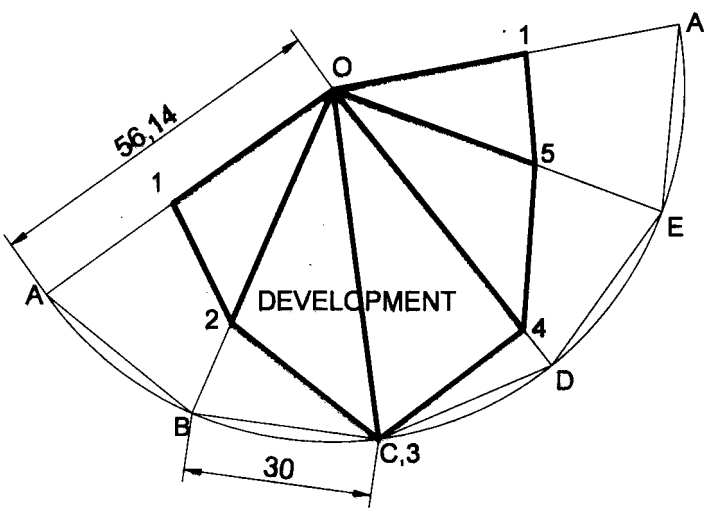




Problem 26 A pentagonal pyramid of 30mm edges of base and 50mm height rests vertically with one of its base edges parallel to VP and nearer to it. It is cut as shown in following figure. Draw the development of the lateral surfaces of the upper portion of the pyramid.

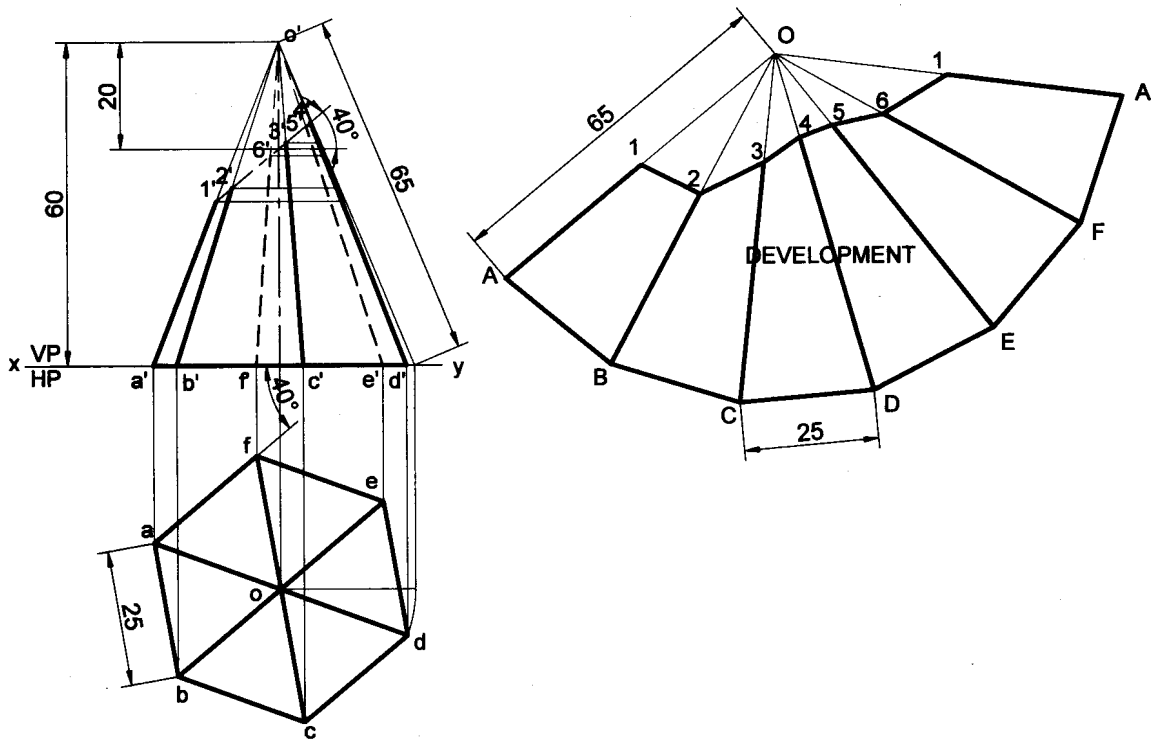
Solution





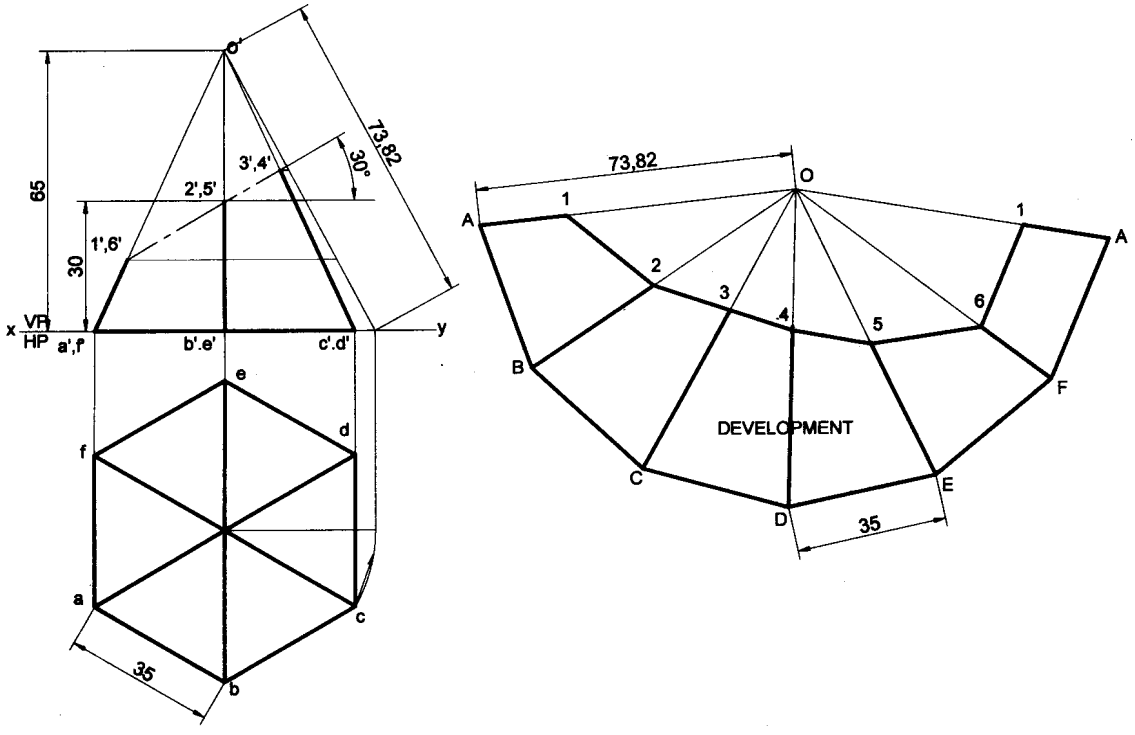
Problem 27 A hexagonal pyramid, base sides 25mm and height 60mm, is resting with its base on HP and an edge of base inclined at 40° to VP. It is cut to the shape of a truncated pyramid with the truncated surface indicated in the front view at a point on the axis 20mm from the apex and inclined at 40° to XY. Draw the projections and show the development of the lateral surface of the remaining portion of the pyramid.

Solution



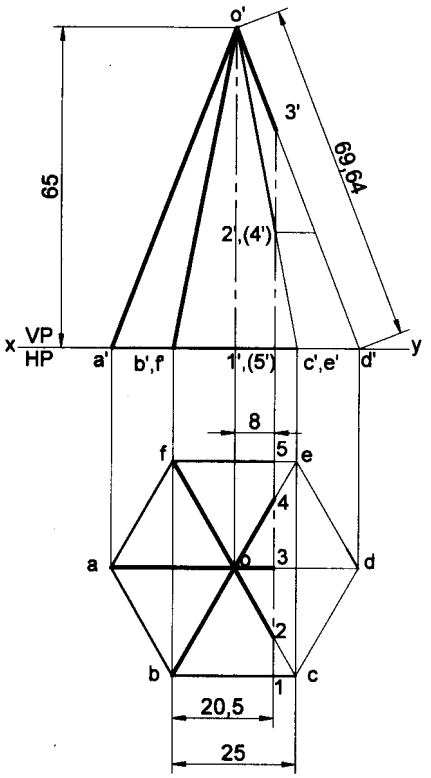
Problem 28 A hexagonal pyramid of sides 35mm and altitude 65mm is resting on HP on its base with two of the base sides perpendicular to VP. The pyramid is cut by a plane inclined at 30° to HP and perpendicular to VP and is intersecting the axis at 30mm above the base. Draw the development of the remaining portion of the pyramid.

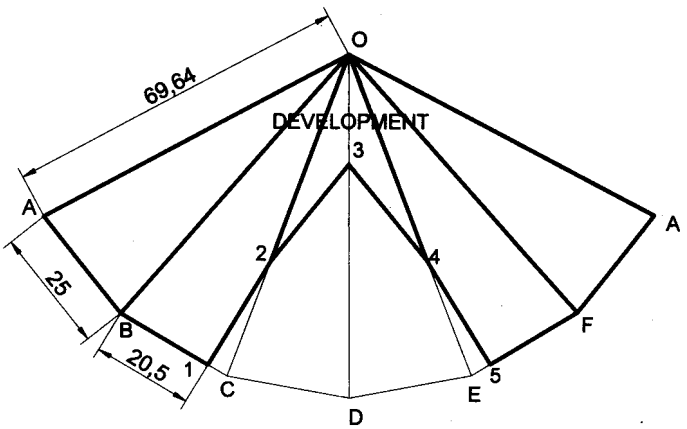
Solution



Problem 29 A hexagonal pyramid 25 mm side of base and axis 65 mm long is resting on its base on HP with one of the edges of the base parallel to VP. It is cut by a vertical section plane at a distance of 8 mm from the axis towards right side. Develop the lateral surface of the left part of the pyramid.

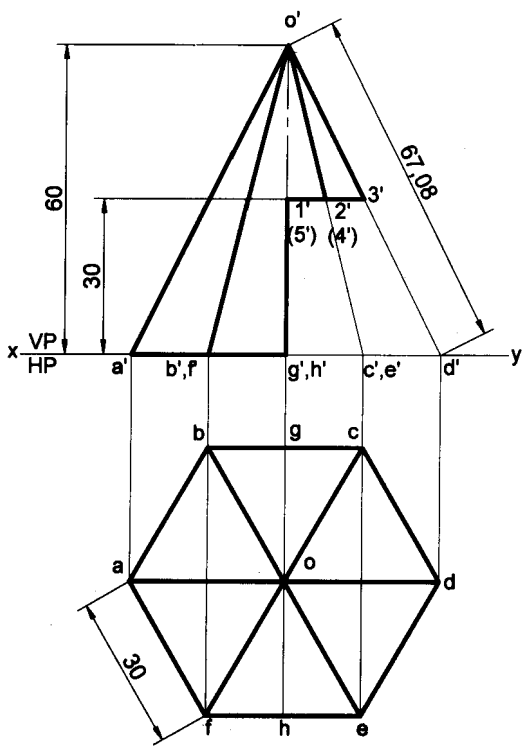
Solution

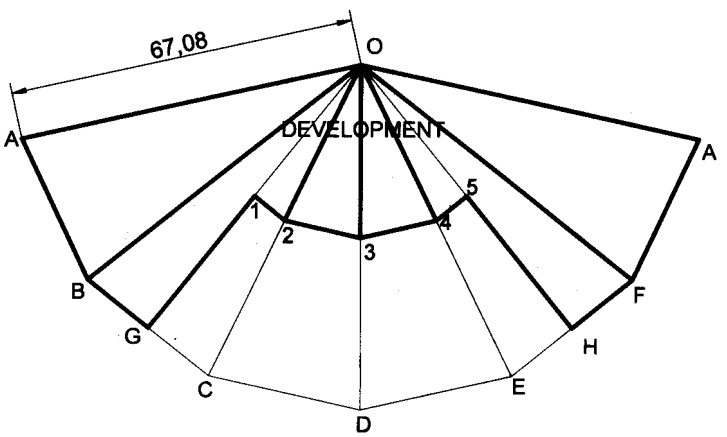




Problem 30 A hexagonal pyramid of 30mm base sides with a side of base parallel to VP. Draw the development of the lateral surfaces of the retained portions of the pyramid cut by two perpendicular planes shown by dark lines in the Fig.

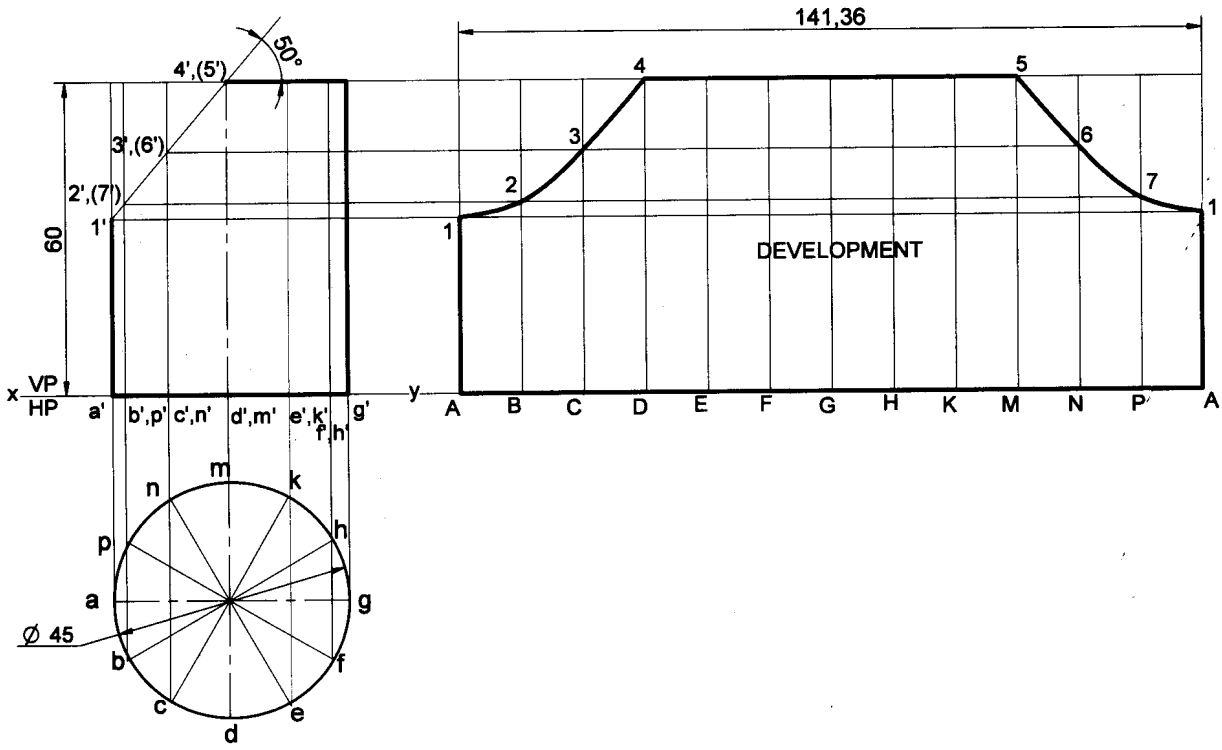
Solution





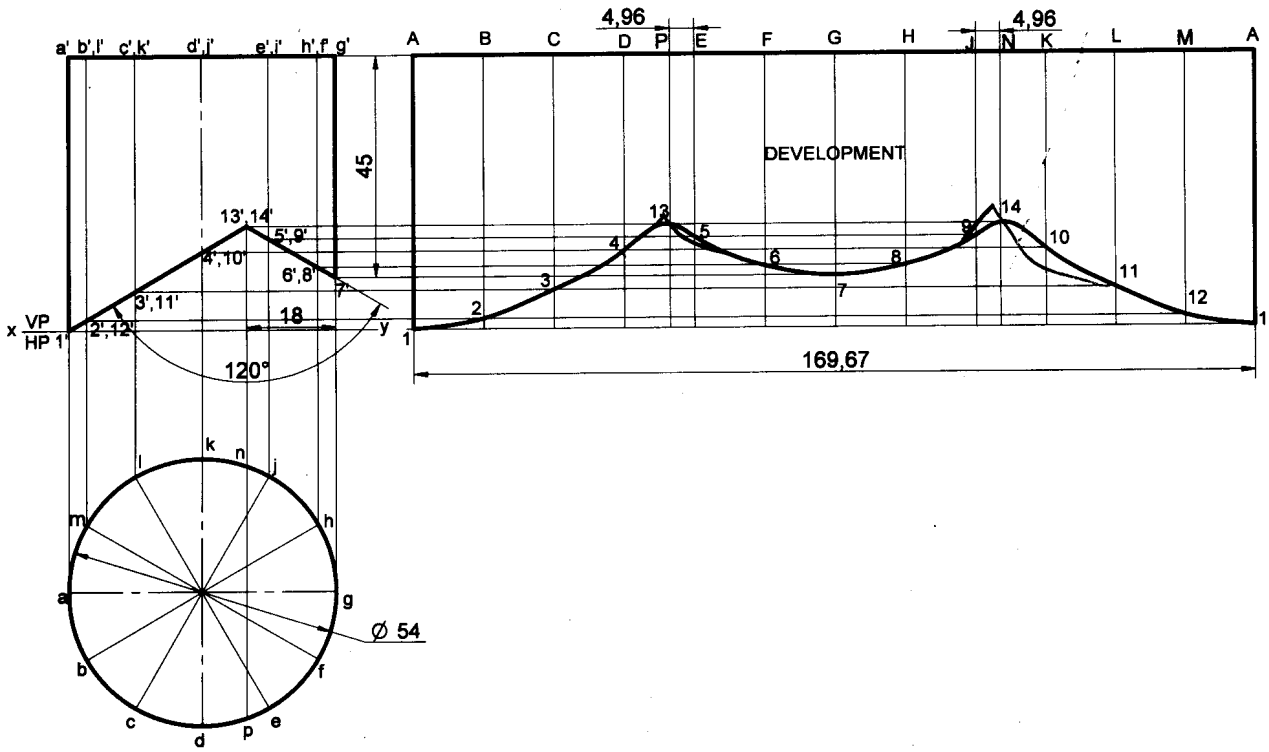
Problem 31 A vertical cylinder of base diameter 45mm and axis length 60mm is cut by a plane perpendicular to VP and inclined at 50° to HP, is passing through the centre point of the top face. Draw the development of the lateral surface of the cylinder.

Solution



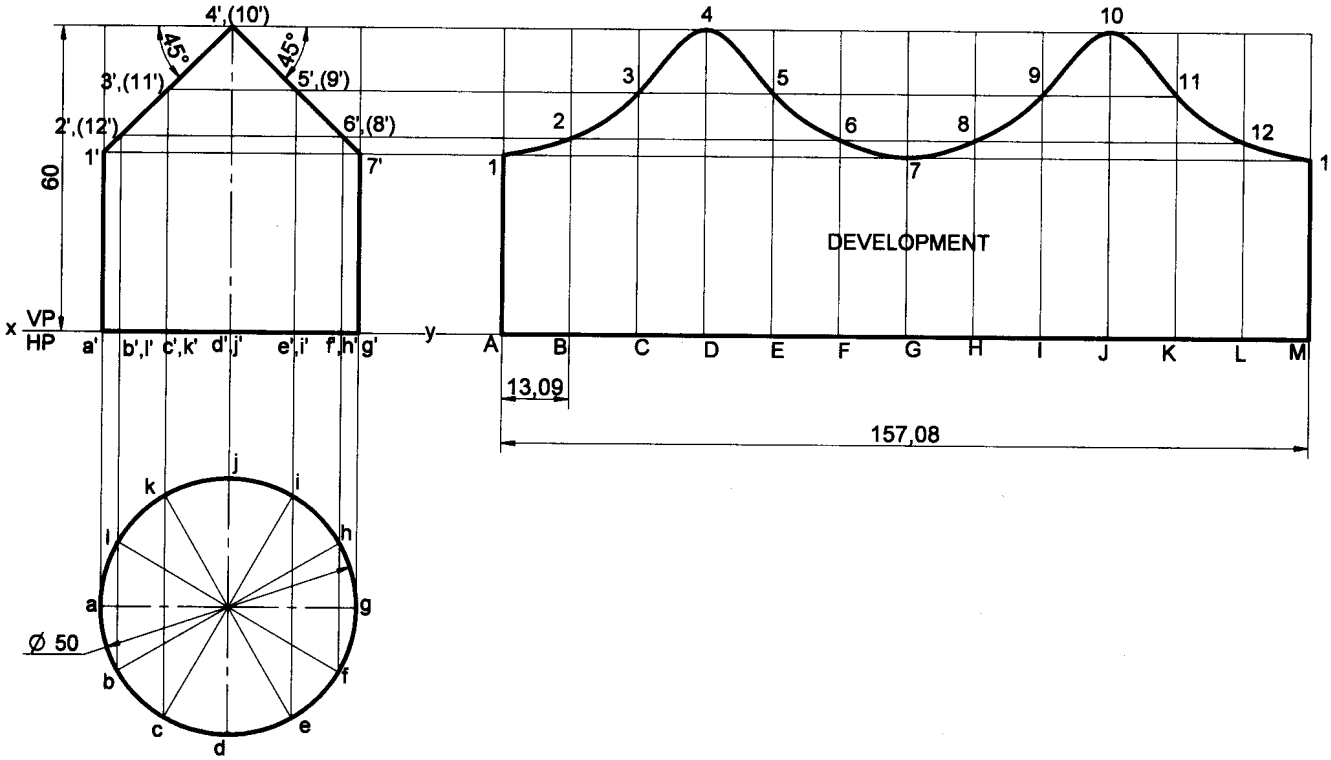
Problem 32 Following figure shows the front view of a model of a steel chimney of diameter 60mm made from a flat thin sheet metal fitted over an inclined plane roof. Develop the portion of the chimney.

Solution



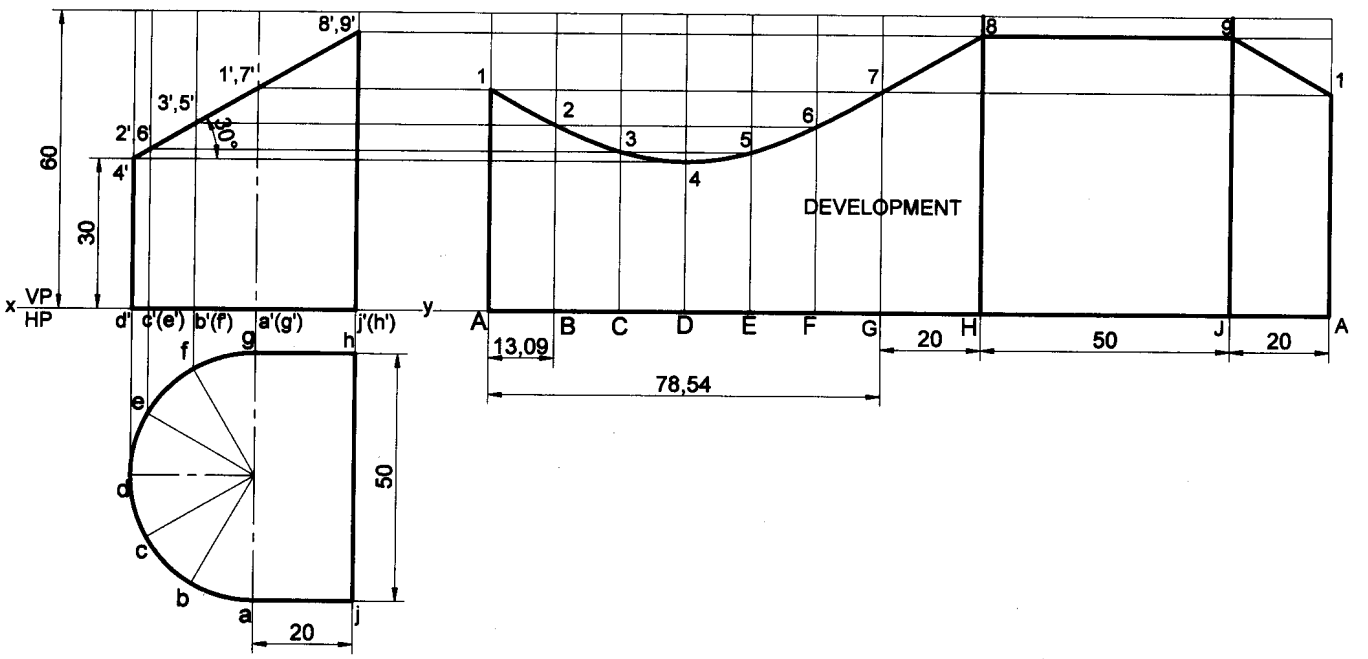
Problem 33 A vertical cylinder of base diameter 50mm and axis length 60mm is cut by a two planes which are perpendicular to VP and inclined at 45° to HP and passing through either side the centre point of the top face. Draw the development of the lateral surface of the cylinder.

Solution



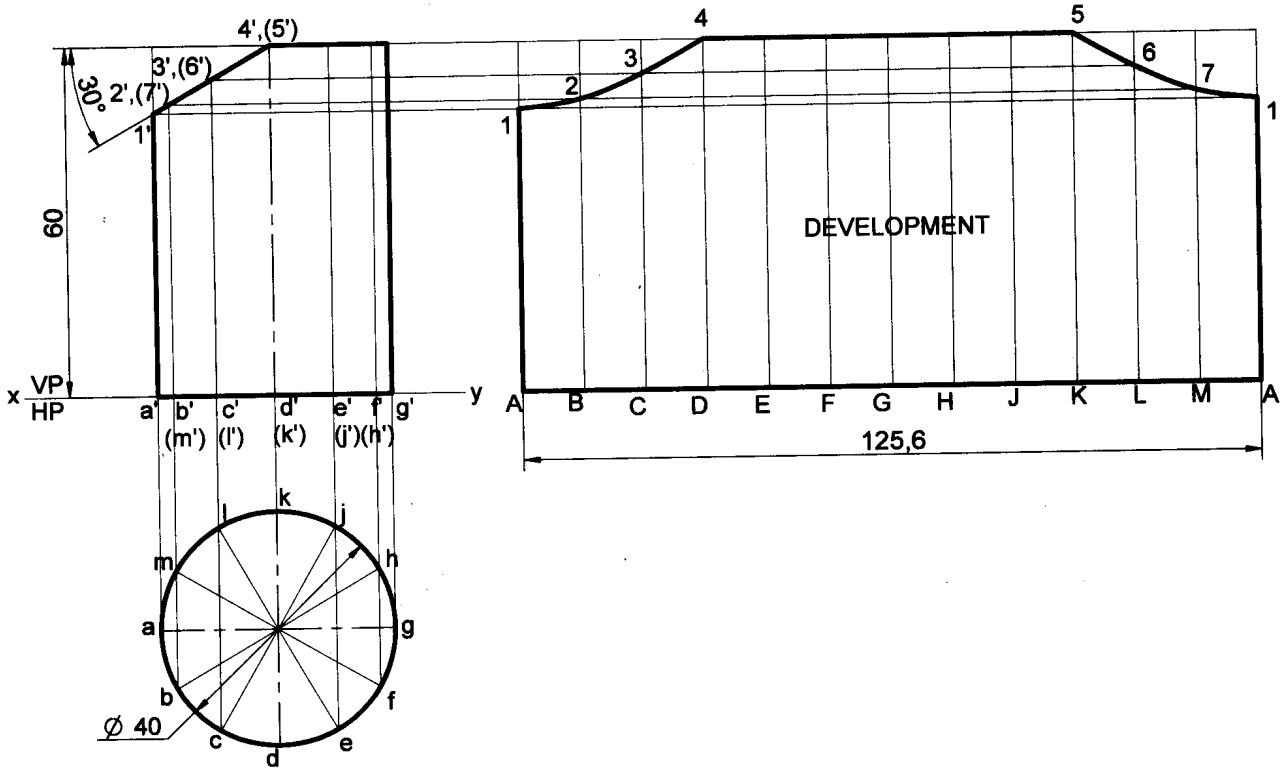
Problem 34 A pipe made of using a half tubular (circular) with a half square in shape is cut as shown in the following figure. Draw the development of the lateral surface of the object.

Solution



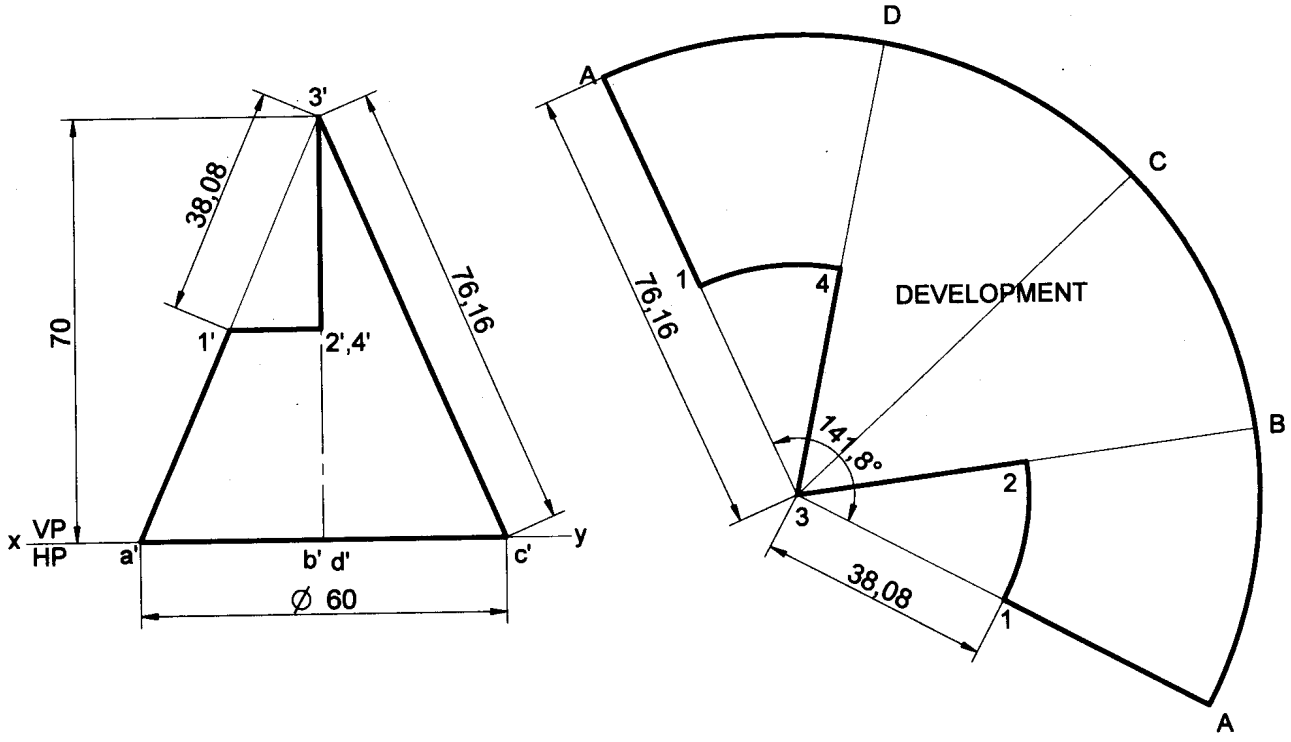
Problem 35 Develop the lateral surface of the cylinder of 40mm diameter and height 60mm which is cut in the following way.

Solution



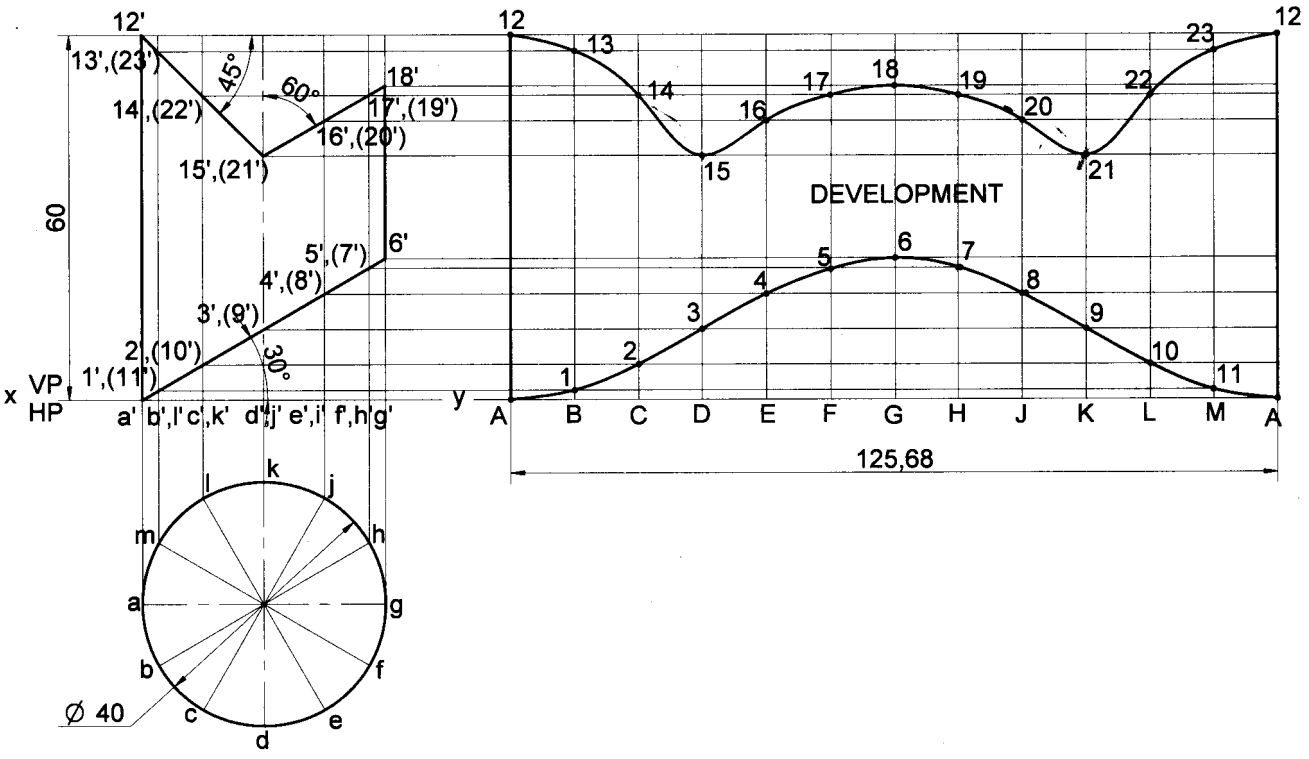
Problem 36 A cone of base diameter 60mm and height 70mm is resting on its base on HP. It is cut as shown in the following figure. Draw the development of the lateral surface of the remaining portion of the cone.

Solution



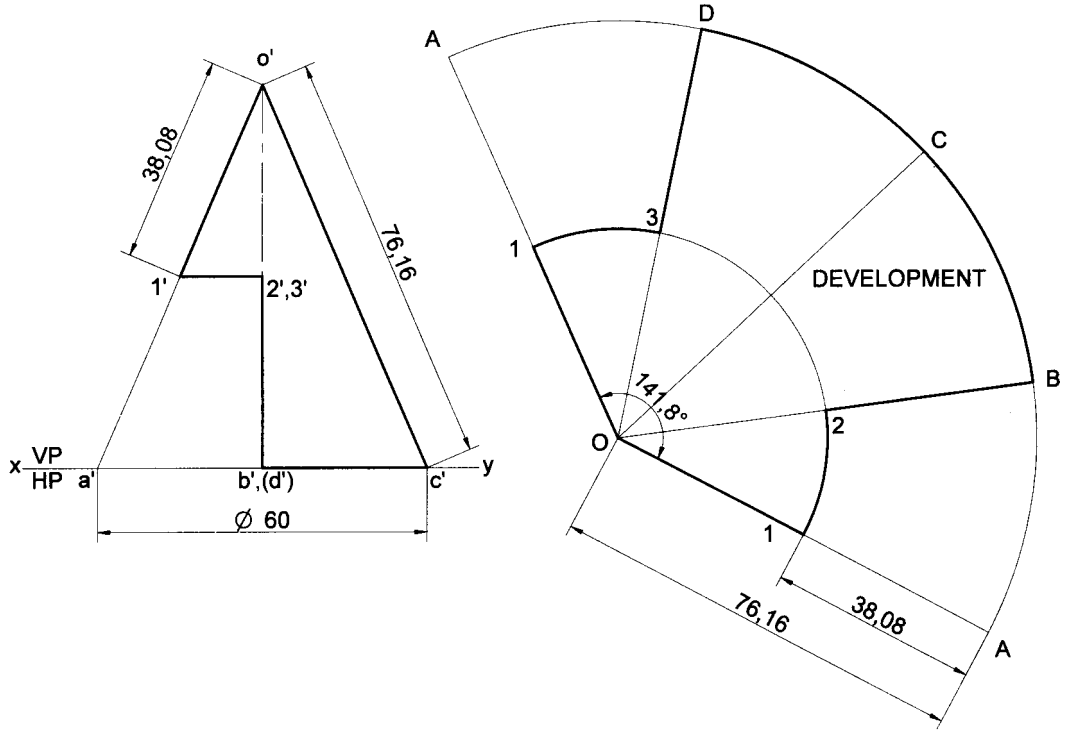
Problem 37 Develop the lateral surface of the cylinder of 40mm diameter and height 60mm which is cut in the following way.

Solution



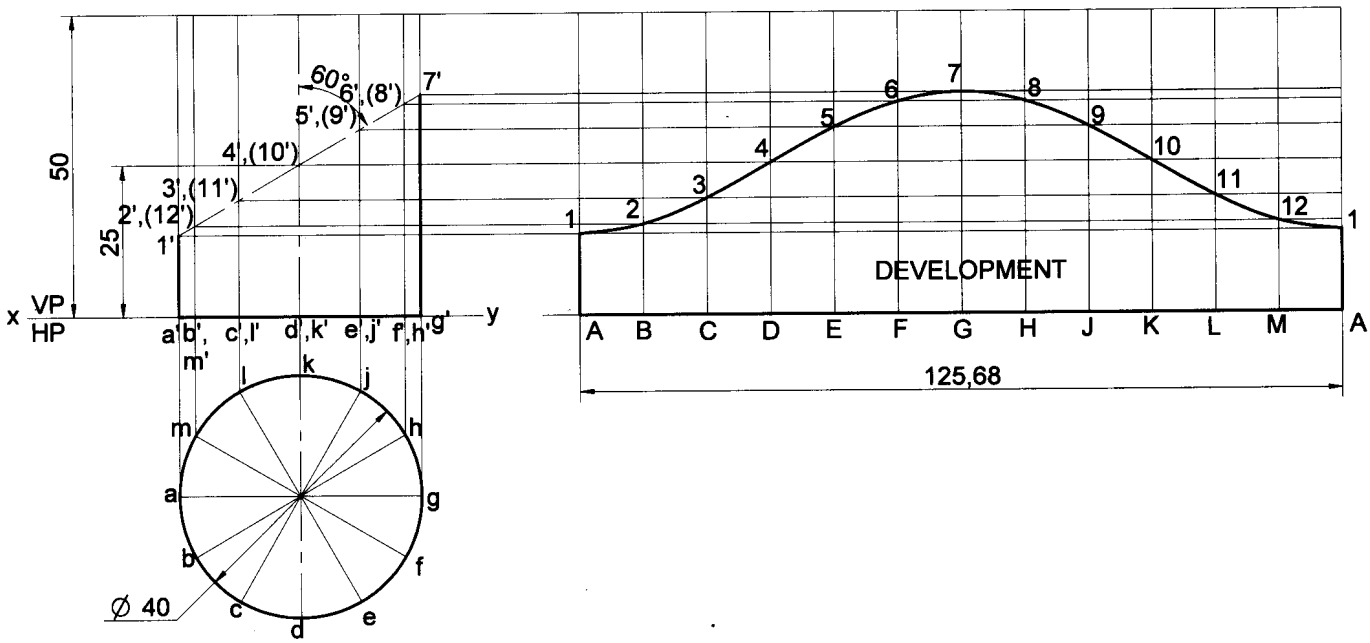
Problem 38 A cone of base diameter 60mm and height 70mm is resting on its base on HP. It is cut as shown in the following figure. Draw the development of the lateral surface of the remaining portion of the cone.

Solution



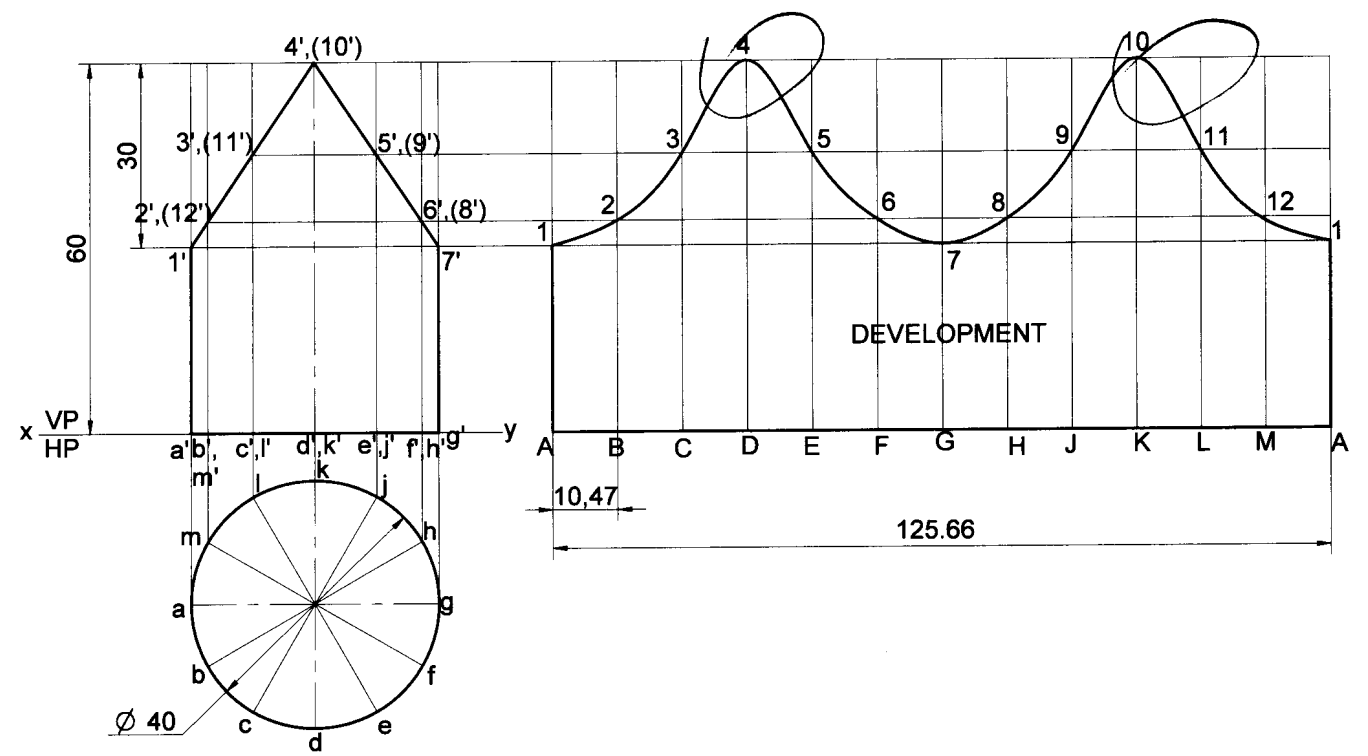
Problem 39 Draw the development of the lateral surface of a truncated vertical cylinder, 40mm diameter of base and height 50mm, the truncated flat surface of the cylinder bisects the axis at 60° to it.

Solution



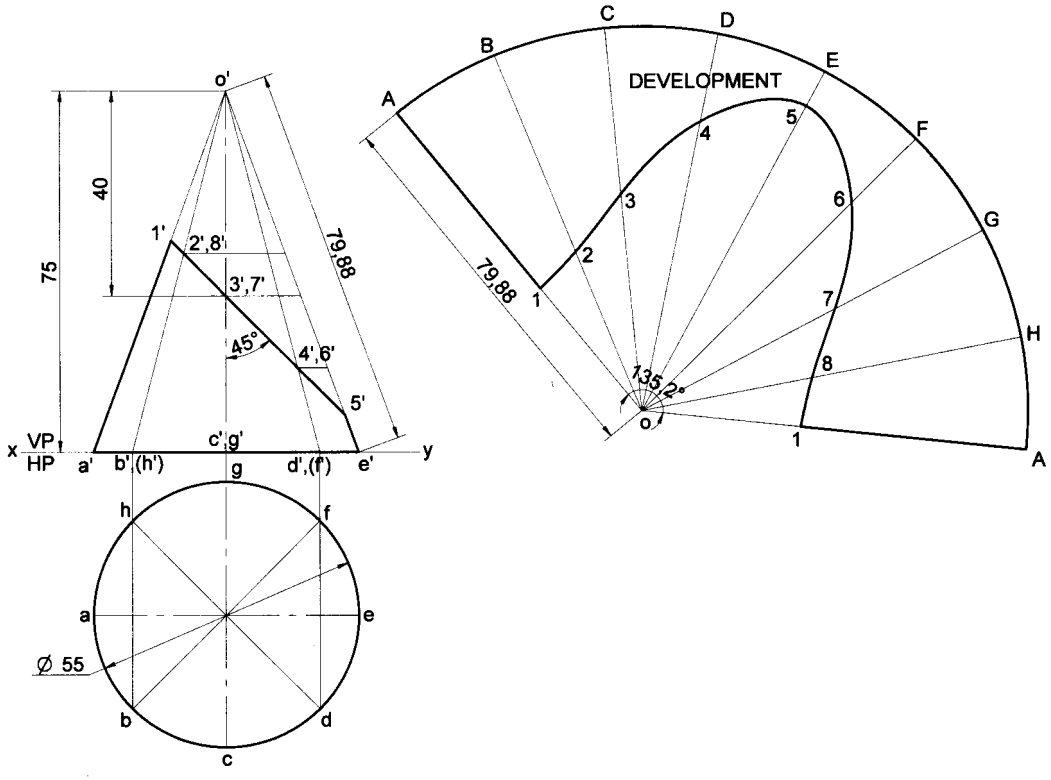
Problem 40 Develop the lateral surface of the cylinder of 40mm diameter and height 60mm cut in the following way.

Solution



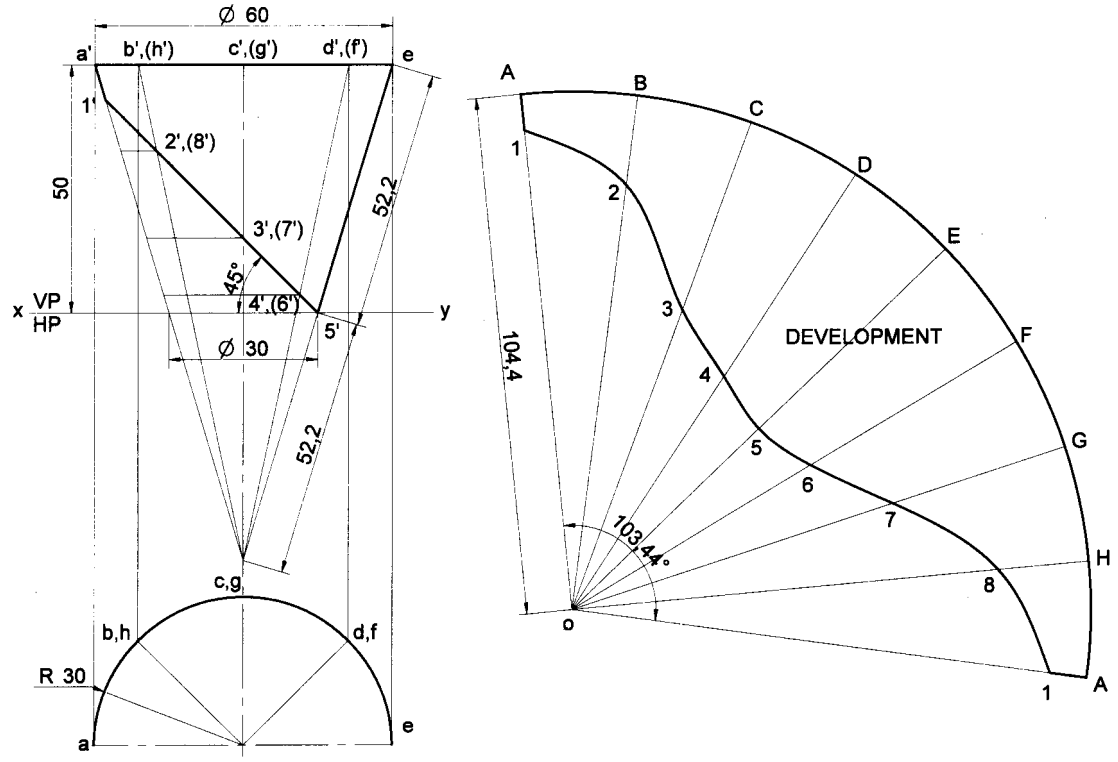
Problem 41 A right cone of 55mm diameter of base and 75mm height stands on its base on HP. It is cut to the shape of a truncated cone with its truncated surface inclined at 45° to the axis lying at a distance of 40mm from the apex of the cone. Obtain the development of the lateral surface of the truncated cone.

Solution



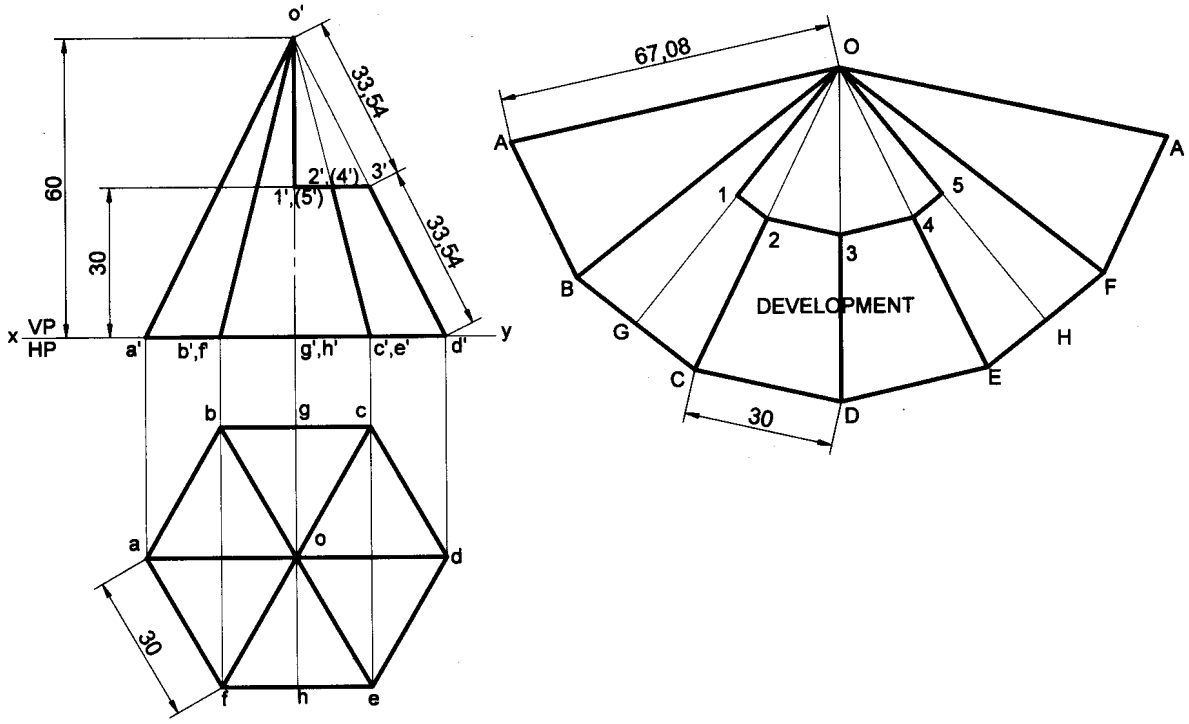
Problem 42 Draw the development of the following truncated cone.

Solution



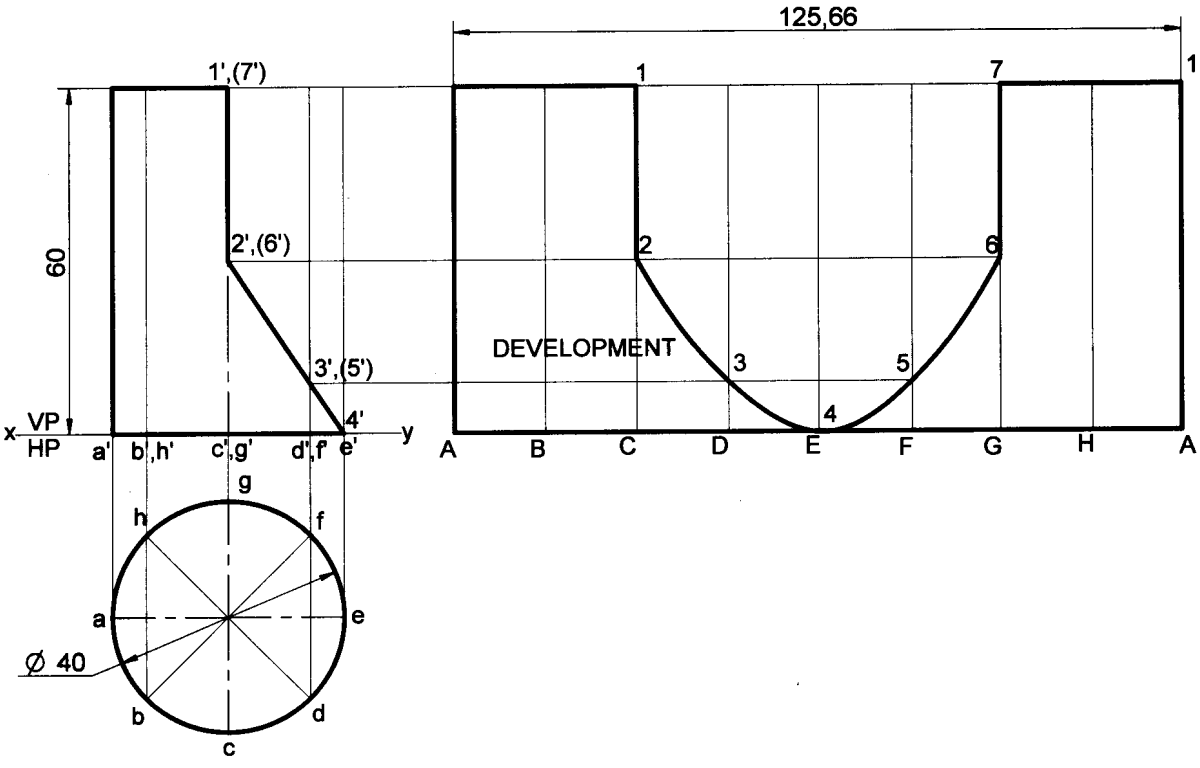
Problem 43 A hexagonal pyramid of 30mm sides of base with a side of base parallel to VP. Draw the development of the lateral surfaces of the retained portion of the pyramid which is shown by dark lines in the following figure.

Solution



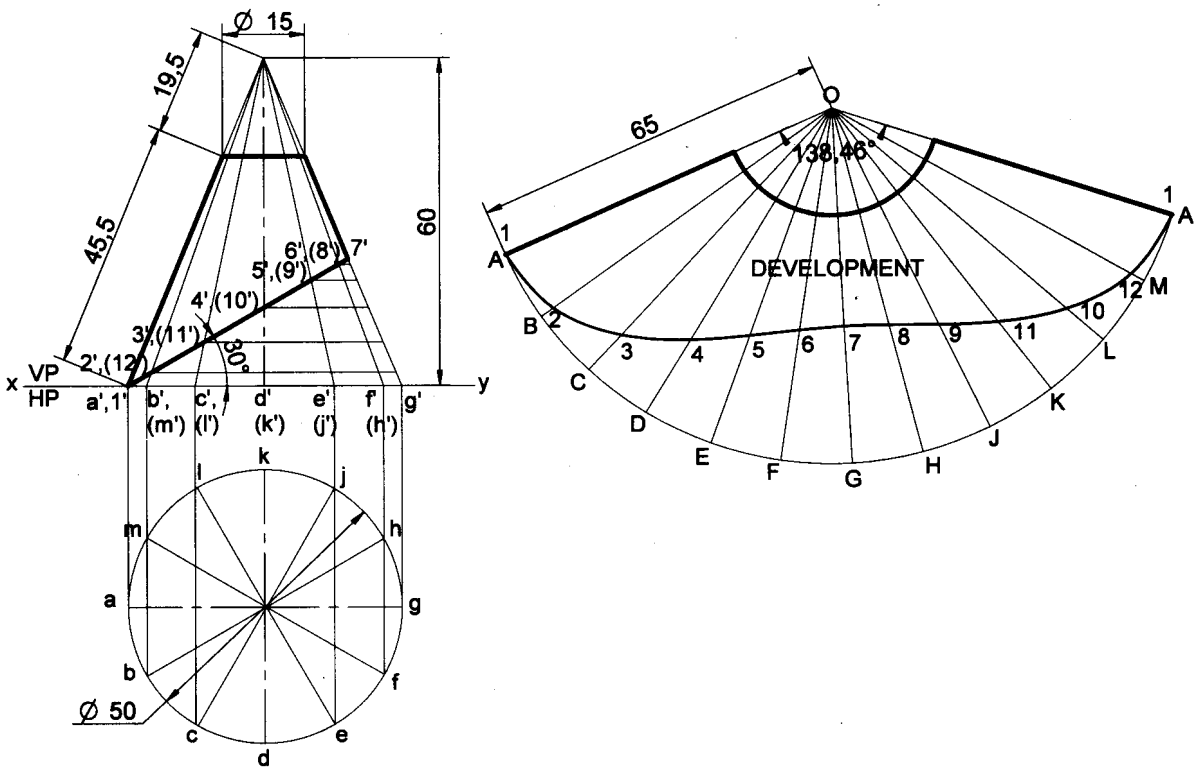
Problem 44 Develop the lateral surface of the cylinder of 40mm diameter and height 60mm which is cut in the following way.

Solution



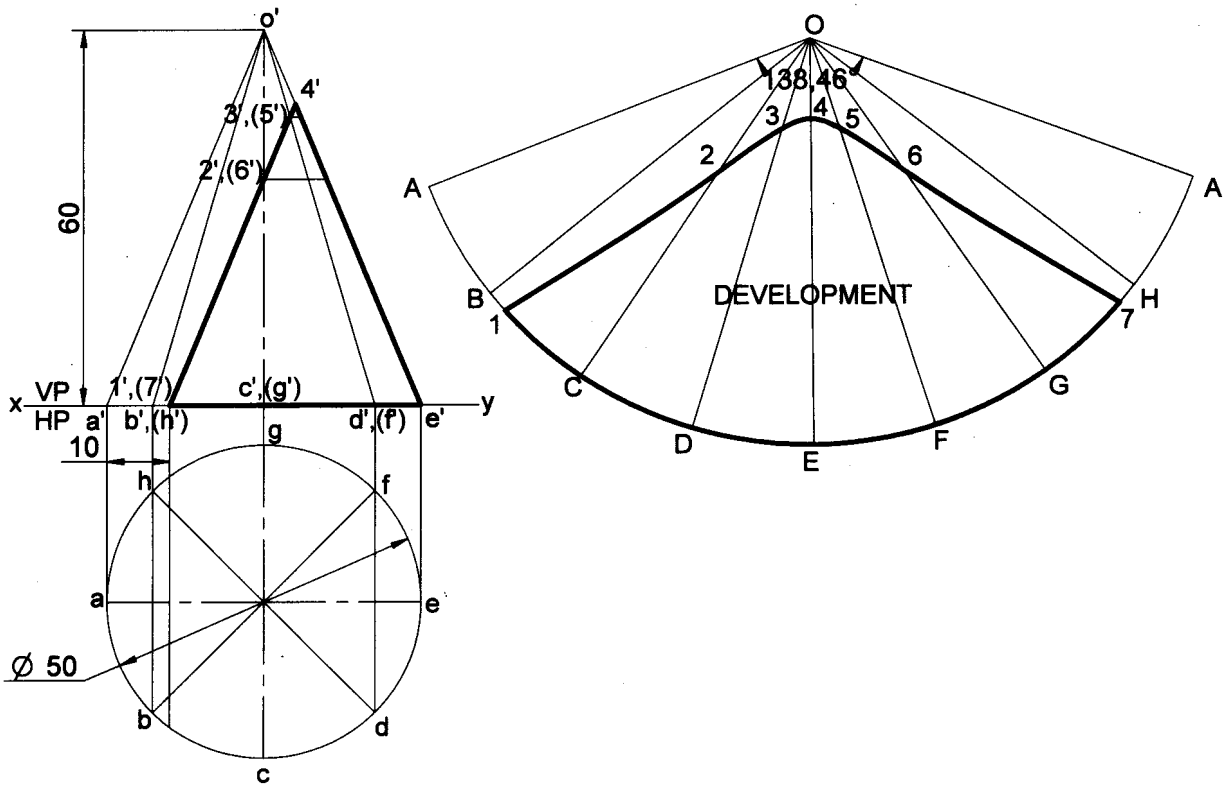
Problem 45 Draw the development of the lateral surface of the cone, whose front view is as shown in the following figure.

Solution



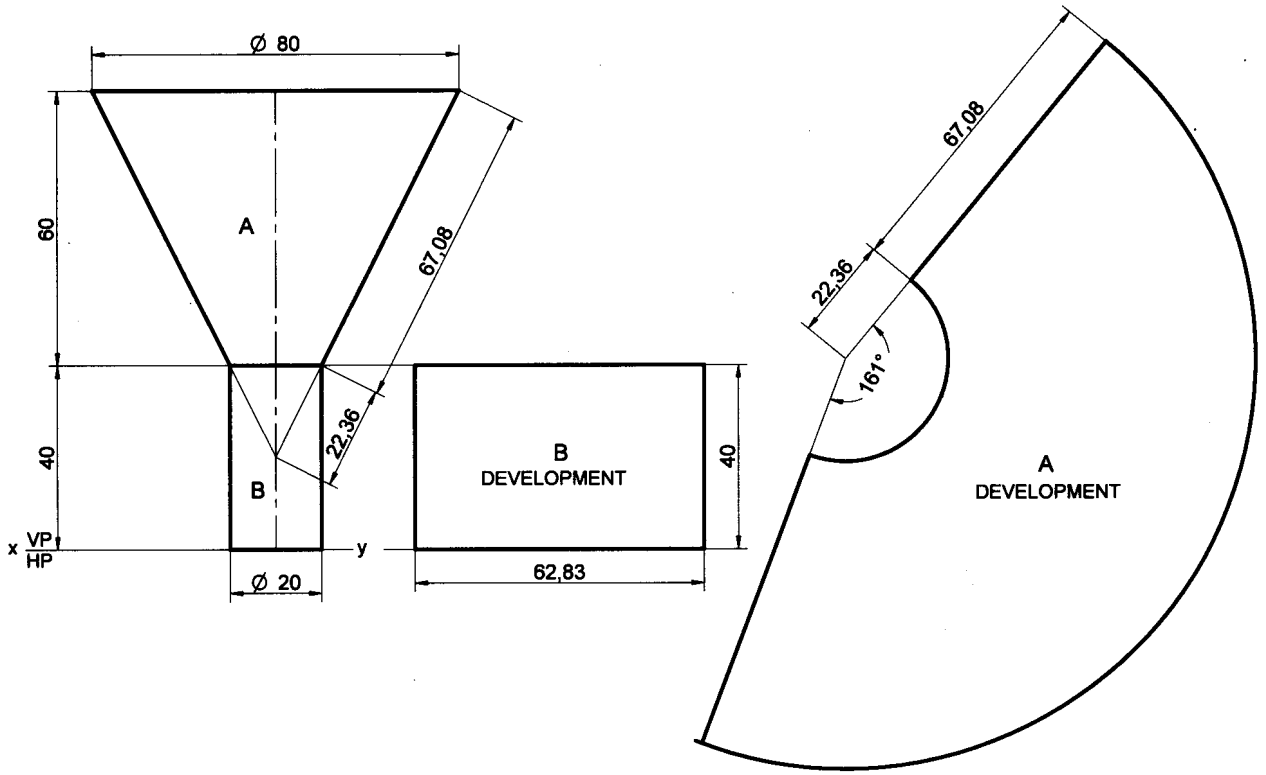
Problem 46 A cone of base diameter 50mm and height 60mm is resting with its base on HP. It is cut, as shown in the following front view of which is as shown in figure. Draw the development of the lateral surface of it.

Solution



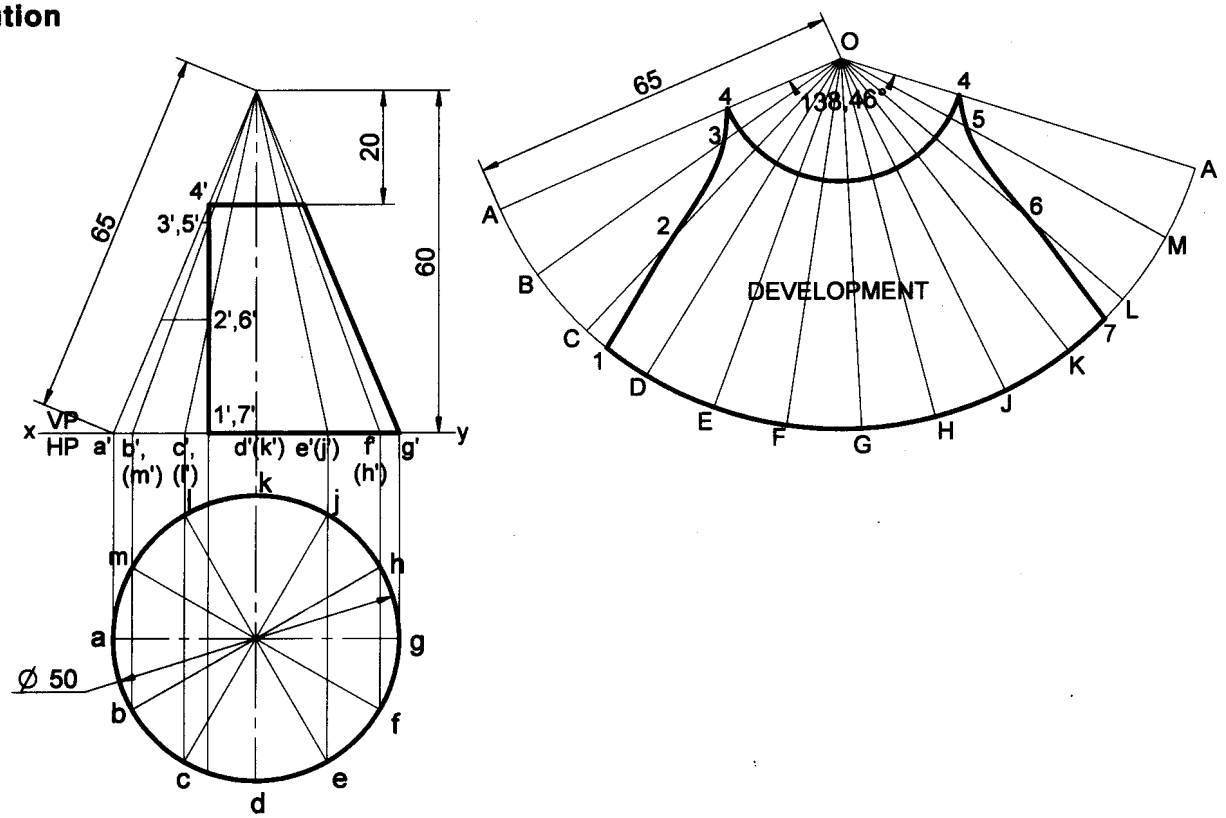
Problem 47 Draw the development of the lateral surface of a funnel consisting of a cylinder and a frustum of a cone. The diameter of the cylinder is 20mm and top face diameter of the funnel is 80mm. The height of frustum and cylinder are equal to 60mm and 40mm respectively.

Solution



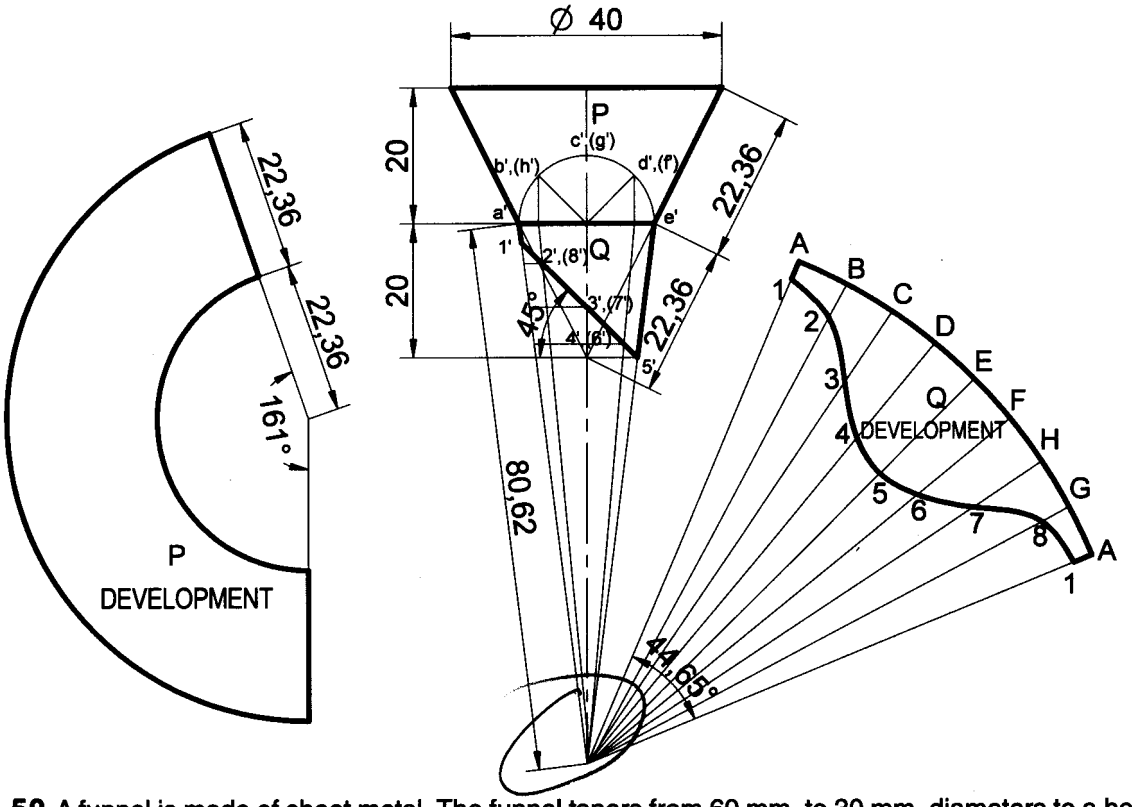
Problem 48 Draw the development of the lateral surface of the cut cone, whose front view is shown in the following figure.

Solution



Problem 49 A funnel is to be made of sheet metal. The funnel tapers from 40 mm to 20 mm diameter to a height of 20 mm and from 20 mm to 15 mm diameter, for the next 20 mm height. The bottom of the funnel is beveled off to a plane inclined at 45° to the axis. Draw the development of the funnel.

Solution



Problem 50 A funnel is made of sheet metal. The funnel tapers from 60 mm. to 30 mm. diameters to a height of 25 mm. and then forms to a cylinder with a height of 50 mm. Bottom of funnel is beveled off completely at an angle of 45° to axis Draw the development of funnel.

Solution