GE3251 ENGINEERING GRAPHICS TOTAL: (L=30+P=60) 90 PERIODS

L T P C
2 0 4 4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 6+12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.

Practicing three dimensional modeling of simple objects by CAD Software(Not for examination)

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale —Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software(Not for examination)

Publication of Bureau of Indian Standards:

1. IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

TEXT BOOKS:

Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition,2019

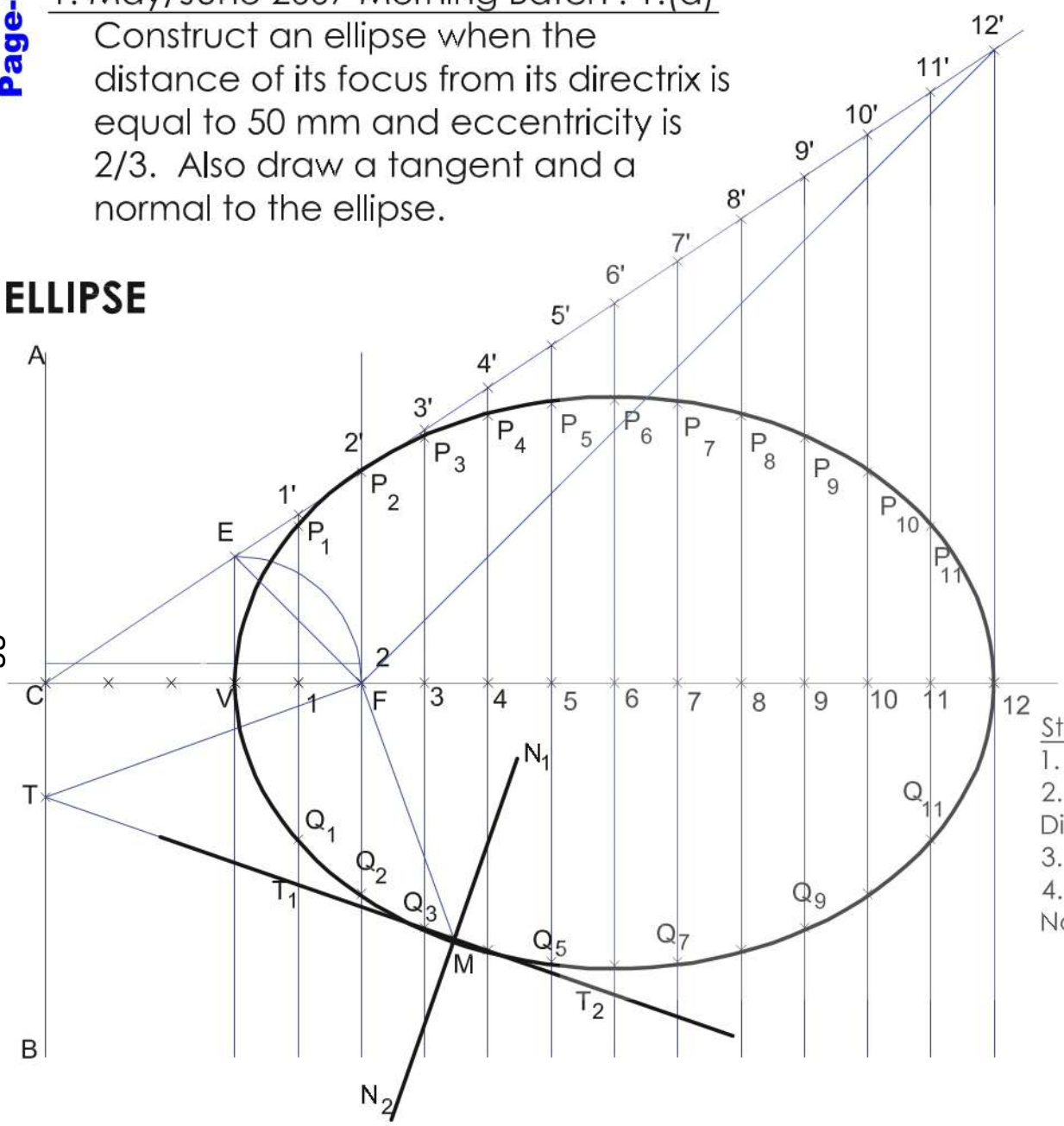
Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

1. May/June 2007 Morning Batch : 1.(a)

Construct an ellipse when the distance of its focus from its directrix is equal to 50 mm and eccentricity is 2/3. Also draw a tangent and a normal to the ellipse.

ELLIPSE



Steps for construction:

1. Draw vertical line AB(Directrix)
2. Mark a point C in the directrix
3. Draw perpendicular line at C (axis)
4. Mark Focus F on the axis from the directrix(CF =50mm)
5. Divide CF into 5 equal parts
6. Mark the Vertex V on the third division from C (Since 'e' = 2 / 3 given) CV=30mm & VF=20mm
7. At V draw perpendicular VE=VF
8. Draw line joining C and E and extend it. (tangent line)
9. Mark any point 1 on the axis
10. Draw perpendicular line at 1 on both sides of the axis, which meets the line CE at 1'
11. With F as centre and 1-1' as radius , cut two arcs at the perpendicular line on both sides of the axis and name it as P1, P1.
12. Similarly mark points 2,3,4 ….etc to find P2,P3 P4..... on both sides of the axis, with the help of 2', 3', 4'...etc.
13. Draw an ellipse, by joining these points P1,P2,P3...etc. (closed curve)

Steps to draw Tangent and Normal at Point M:

1. Draw a line joining the points M & F(Focus).
2. Draw a line FT Perpendicular to the line MF (Pt. T in Directrix).
3. Draw a line T M T , which is a tangent.
4. Draw a line N M N perpendicular to T M T , which is a Normal.

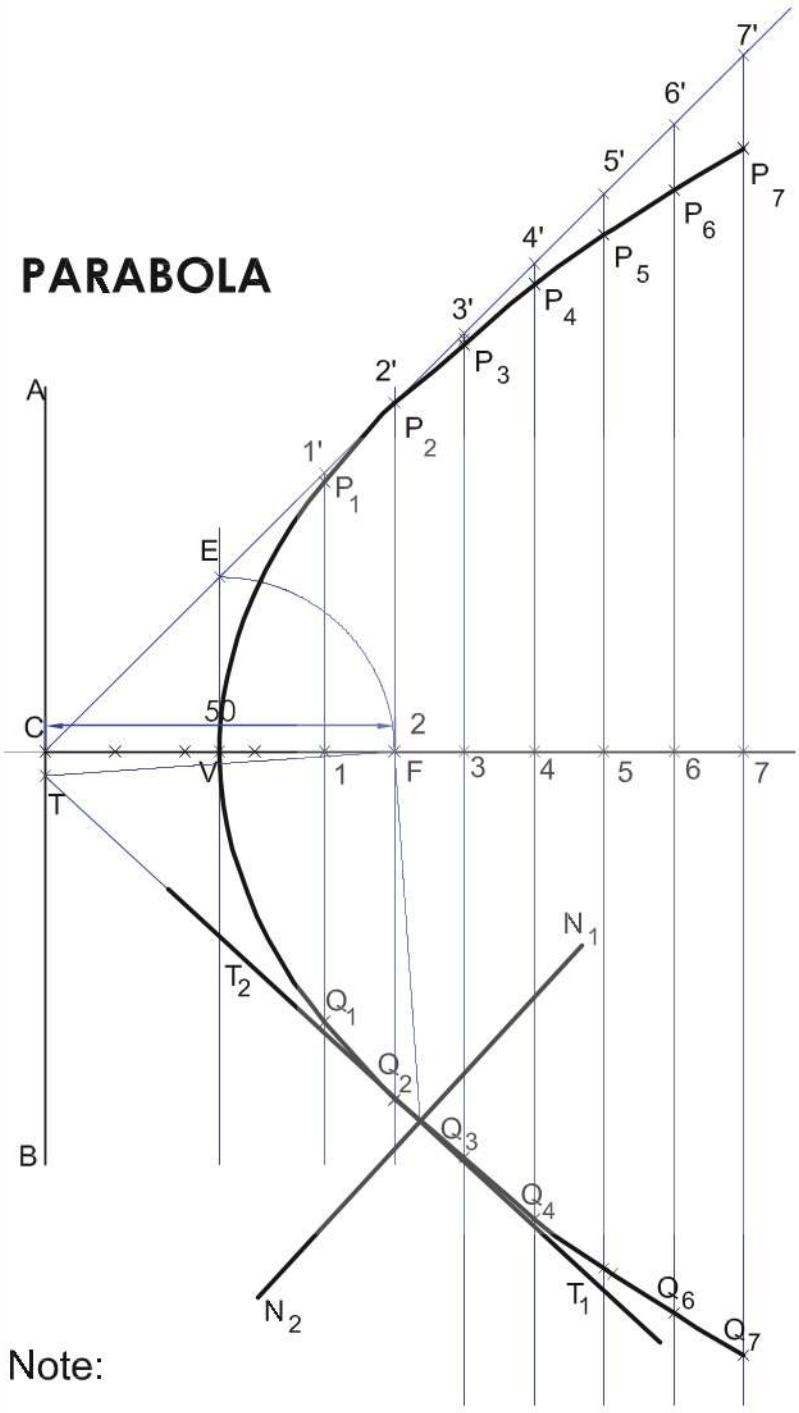
SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

Note:

V - Vertex F - Focus AB - Directrix CF = 50mm(Given) VF/VC = $\frac{2}{3}$ (Given) TT - Tangent @ P NN - Normal @ P CVF - Axis CV = 30mm VF = 20mm

2. Construct a Parabola when the distance of its focus from its directrix is equal to 50 mm. Also draw a tangent and a normal to the curve.

PARABOLA



Note:

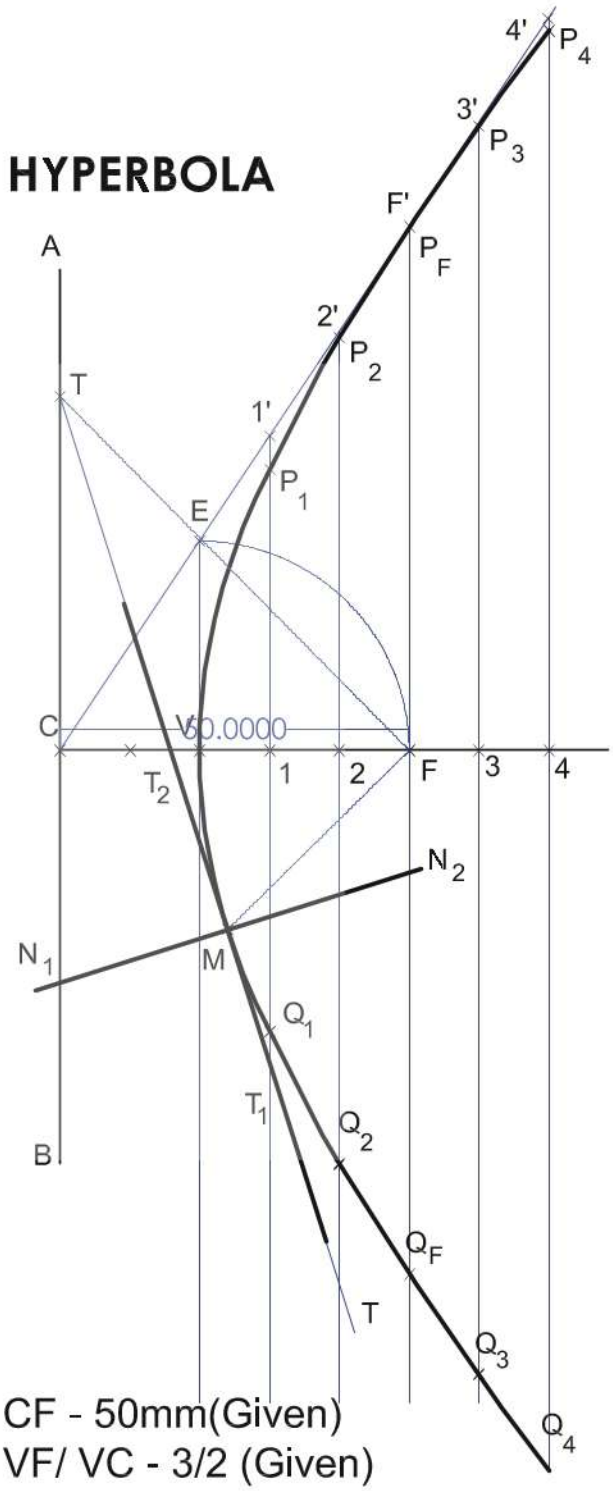
V - Vertex
F - Focus
AB - Directrix
TT - Tangent @ M
NN - Normal @ M
CVF - Axis

CF - 50mm(Given)
VF/ VC - 1 (Given)
VF = 25 mm
VC = 25 mm

SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

3. Construct a hyperbola, when the distance of its focus from its directrix is equal to 50 mm and eccentricity is 3/2. Also draw a tangent and a normal to the curve.

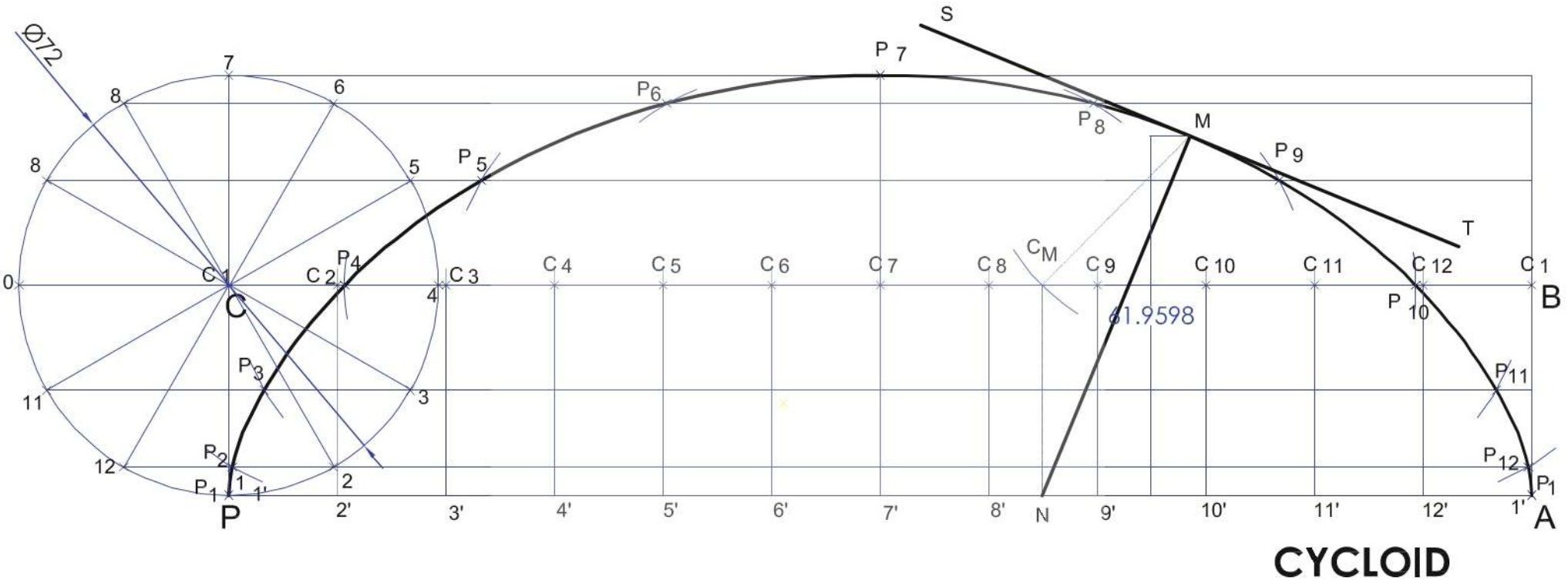
HYPERBOLA



CF - 50mm(Given)
VF/ VC - 3/2 (Given)
VF = 30 mm
VC = 20 mm

SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

4. A circle of 72mm diameter rolls along a straight line without slipping. Draw the curve traced out by a point P on the circumference, for one complete revolution of the circle. Name the curve. Draw a tangent and normal to the curve at a point N on at any point on the curve.



Steps for construction:

1. With C as centre and given radius 36 mm draw a circle.
2. Let P be the generating point on the rolling circle.
3. Draw a line PA tangential to and equal to the circumference of the circle
4. Divide the circle (1,2,3 etc) and the tangent(1',2',3' etc) into same no. of equal parts
5. Draw a line CB parallel and equal to PA
6. Draw perpendiculars at 1', 2', 3' ... etc upto the line CB and name it C1,C2,C3... etc.
7. Draw horizontal lines parallel to PA at 1 , 2 , 3 , etc.
8. With C1, C2, C3... etc as centers and radius equal to R(36mm), draw arcs cutting the lines 1,2,3..etc. at P1, P2, P3... etc.
9. Draw smooth curve joining the points P1, P2, P3 etc. which forms cycloid curve.

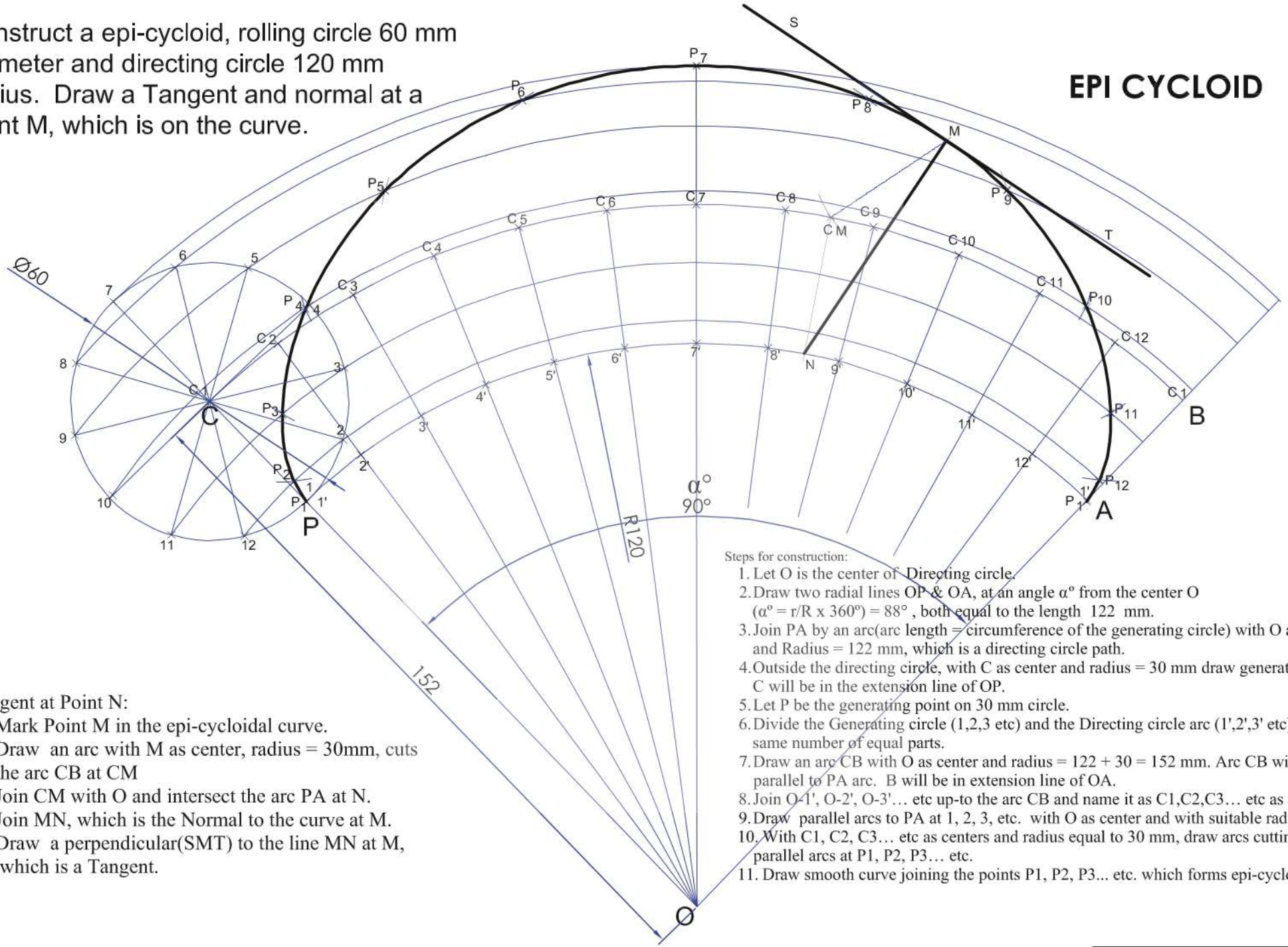
Tangent at Point N:

1. Mark Point M at any point(distance 62 mm)from the line PA.
2. Draw an arc with M as center, radius = 36mm, cuts the line CB at C_M
3. Draw a perpendicular at C_M, meets the line PA at N.
4. Join MN, which is the Normal to the curve at M.
5. Draw a perpendicular(SMT) to the line MN at M, which is a Tangent.

SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

5. Construct a epi-cycloid, rolling circle 60 mm diameter and directing circle 120 mm radius. Draw a Tangent and normal at a point M, which is on the curve.

EPI CYCLOID



Tangent at Point N:

1. Mark Point M in the epi-cycloidal curve.
2. Draw an arc with M as center, radius = 30mm, cuts the arc CB at CM
3. Join CM with O and intersect the arc PA at N.
4. Join MN, which is the Normal to the curve at M.
5. Draw a perpendicular(SMT) to the line MN at M, which is a Tangent.

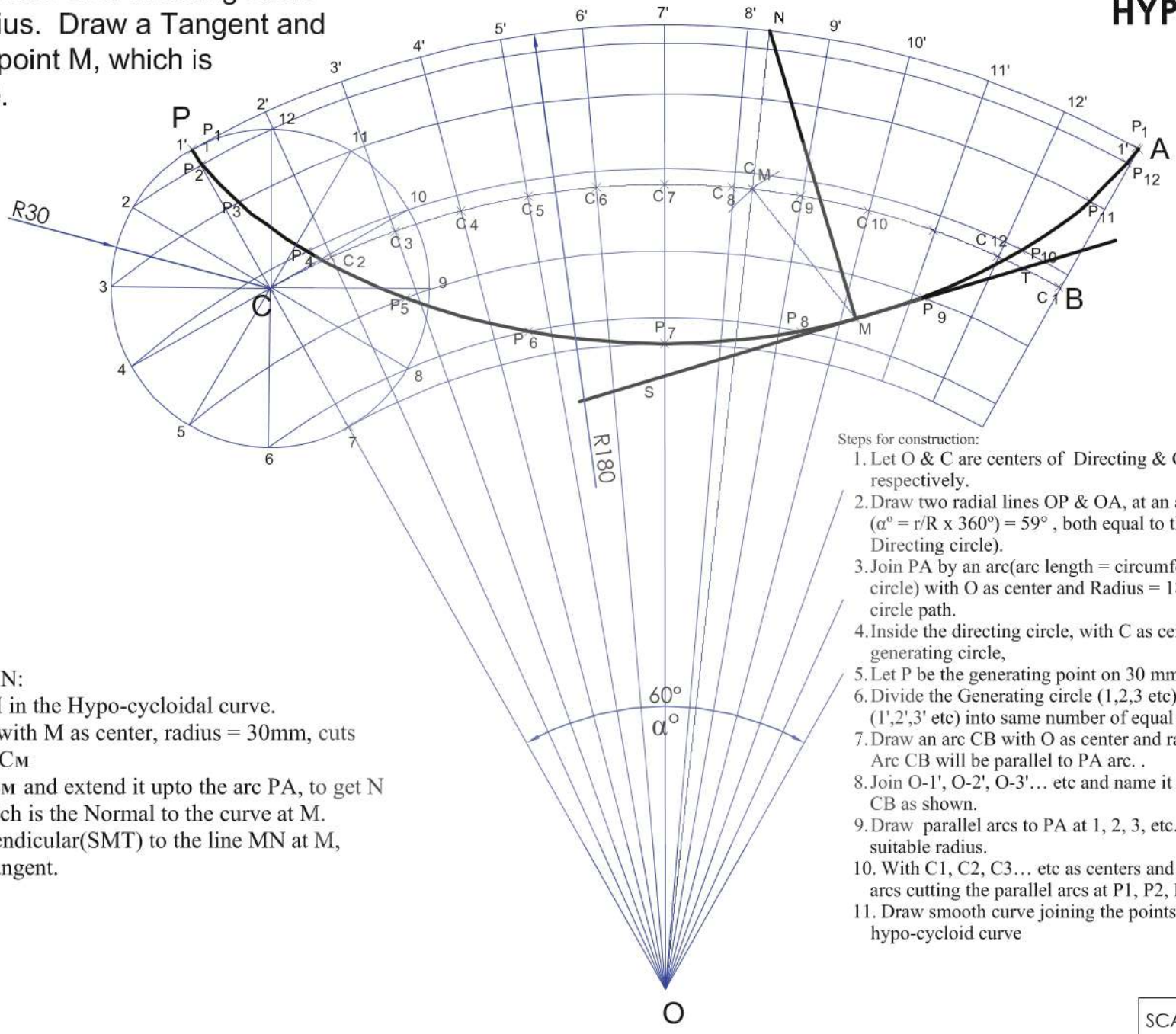
Steps for construction:

1. Let O is the center of Directing circle.
2. Draw two radial lines OP & OA, at an angle α^o from the center O ($\alpha^o = r/R \times 360^o$) = 88° , both equal to the length 122 mm.
3. Join PA by an arc(arc length = circumference of the generating circle) with O as center and Radius = 122 mm, which is a directing circle path.
4. Outside the directing circle, with C as center and radius = 30 mm draw generating circle. C will be in the extension line of OP.
5. Let P be the generating point on 30 mm circle.
6. Divide the Generating circle (1,2,3 etc) and the Directing circle arc (1',2',3' etc) into same number of equal parts.
7. Draw an arc CB with O as center and radius = 122 + 30 = 152 mm. Arc CB will be parallel to PA arc. B will be in extension line of OA.
8. Join O-1', O-2', O-3'… etc up-to the arc CB and name it as C1,C2,C3… etc as shown.
9. Draw parallel arcs to PA at 1, 2, 3, etc. with O as center and with suitable radius.
10. With C1, C2, C3… etc as centers and radius equal to 30 mm, draw arcs cutting the parallel arcs at P1, P2, P3… etc.
11. Draw smooth curve joining the points P1, P2, P3... etc. which forms epi-cycloid curve

SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

6. Construct a hypo-cycloid, rolling circle 60 mm diameter and directing circle 180 mm radius. Draw a Tangent and normal at a point M, which is on the curve.

HYPO CYCLOID



Steps for construction:

1. Let O & C are centers of Directing & Generating circles respectively.
2. Draw two radial lines OP & OA, at an angle α^o from the center O (α^o = r/R x 360º) = 59° , both equal to the length 182 mm (radius of Directing circle).
3. Join PA by an arc(arc length = circumference of the generating circle) with O as center and Radius = 182 mm, which is a directing circle path.
4. Inside the directing circle, with C as centre and radius = 30 mm draw generating circle,
5. Let P be the generating point on 30 mm circle.
6. Divide the Generating circle (1,2,3 etc) and the Directing circle arc (1',2',3' etc) into same number of equal parts.
7. Draw an arc CB with O as center and radius = 182 - 30 = 152 mm. Arc CB will be parallel to PA arc. .
8. Join O-1', O-2', O-3'… etc and name it as C1,C2,C3… etc in the arc CB as shown.
9. Draw parallel arcs to PA at 1, 2, 3, etc. with O as center and with suitable radius.
10. With C1, C2, C3… etc as centers and radius equal to 30 mm, draw arcs cutting the parallel arcs at P1, P2, P3… etc.
11. Draw smooth curve joining the points P1, P2, P3 etc. which forms hypo-cycloid curve

Tangent at Point N:

1. Mark Point M in the Hypo-cycloidal curve.
2. Draw an arc with M as center, radius = 30mm, cuts the arc CB at C_M
3. Join O with C_M and extend it upto the arc PA, to get N
4. Join MN, which is the Normal to the curve at M.
5. Draw a perpendicular(SMT) to the line MN at M, which is a Tangent.

SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

May 2007 : Que 1. (b)

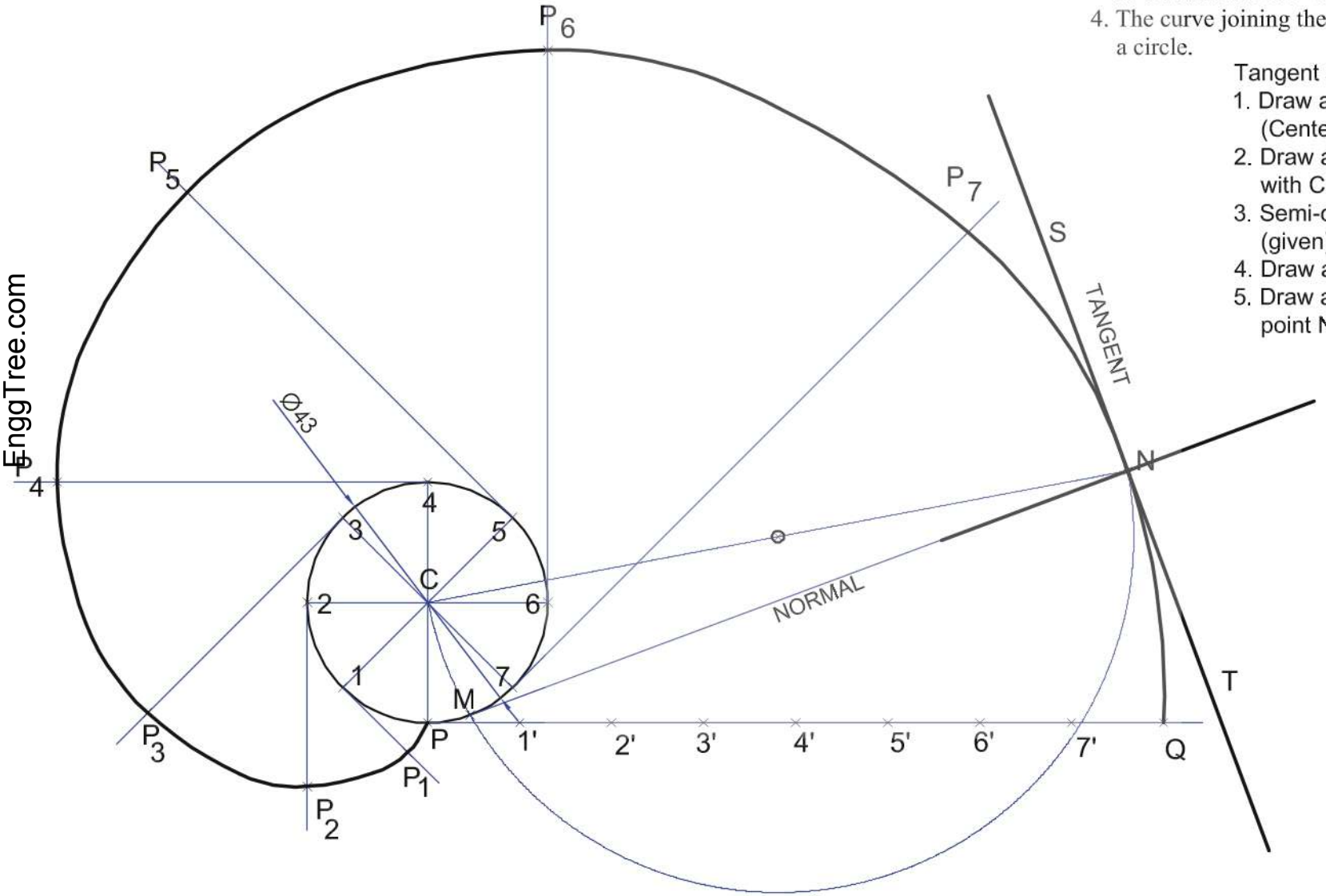
7. A coir is unwound from a drum 43 mm diameter. Draw the locus of the free end of the coir for unwinding through an angle 360°. Draw also a normal and tangent at any point on the curve.

Steps for construction:

1. Draw a line PQ, tangent to the circle and equal to the circumference of the circle
2. Divide the circle (1, 2, 3 etc) and the tangent (1', 2', 3' etc) into same number of equal parts as shown.
3. Draw tangents at 1, 2, 3, etc and mark on them points P1, P2, P3 etc such that 1P1 =P1', 2P2=P2', 3P3=P3' etc.
4. The curve joining the points P1, P2, P3, etc is involute of a circle.

Tangent at Point N:

1. Draw a line, joining the points N & C (Center of the circle) shown in dotted line.
2. Draw a semi-circle(shown in dotted line) with CN as diameter
3. Semi-circle cutting the 30 mm circle (given) at M
4. Draw a line MN, which is Normal
5. Draw a perpendiculat line to NM at the point N, which is a Tangent (SNT).

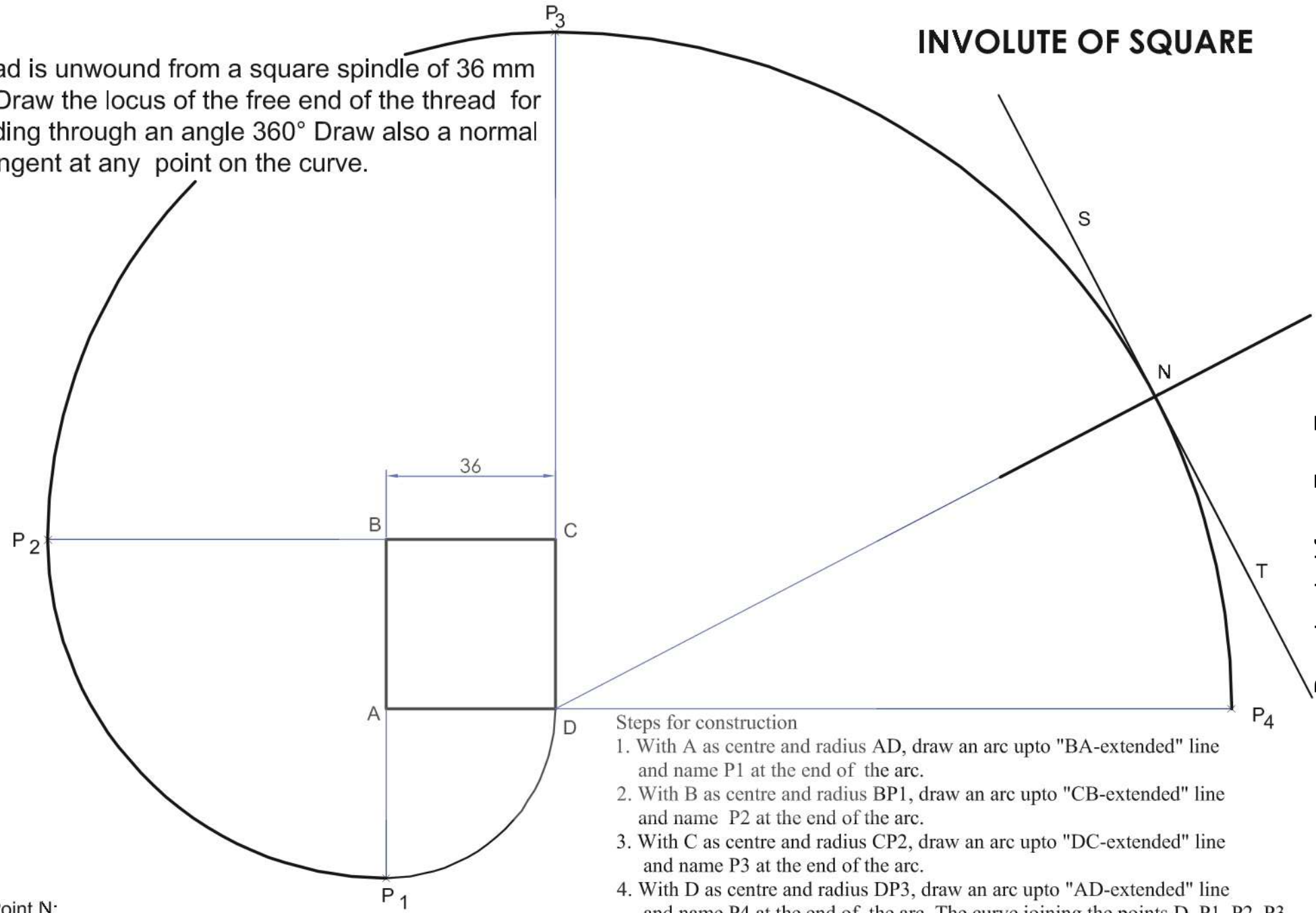


INVOLUTE OF CIRCEL

SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

INVOLUTE OF SQUARE

8. A thread is unwound from a square spindle of 36 mm side. Draw the locus of the free end of the thread for unwinding through an angle 360° Draw also a normal and tangent at any point on the curve.



Steps for construction

1. With A as centre and radius AD, draw an arc upto "BA-extended" line and name P1 at the end of the arc.
2. With B as centre and radius BP1, draw an arc upto "CB-extended" line and name P2 at the end of the arc.
3. With C as centre and radius CP2, draw an arc upto "DC-extended" line and name P3 at the end of the arc.
4. With D as centre and radius DP3, draw an arc upto "AD-extended" line and name P4 at the end of the arc. The curve joining the points D, P1, P2, P3, and P4 is involute of a square

Tangent at Point N:

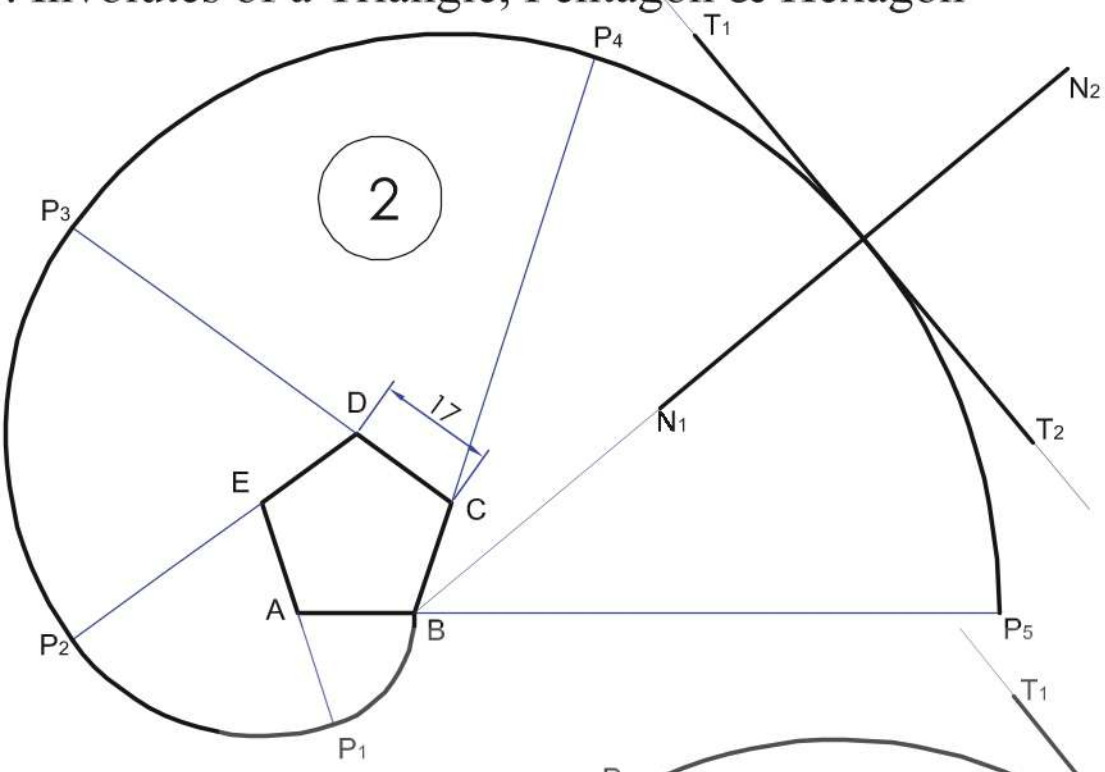
1. Draw a line, joining the points N & D (one corner of a square)
2. The line, ND is Normal
3. Draw a perpendicular(SNT) to the line ND at N, which is a Tangent.

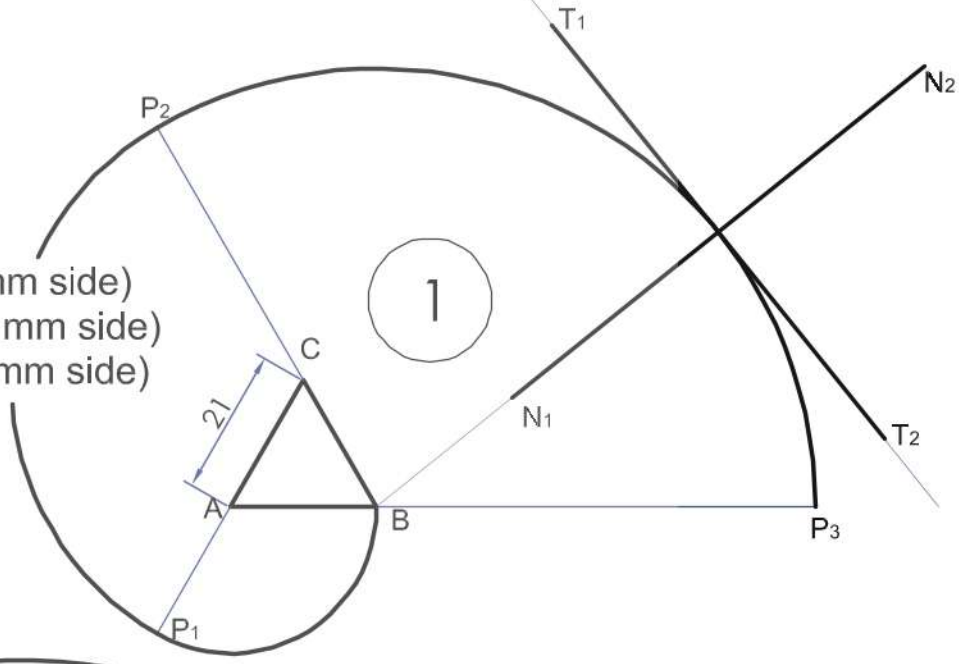
SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

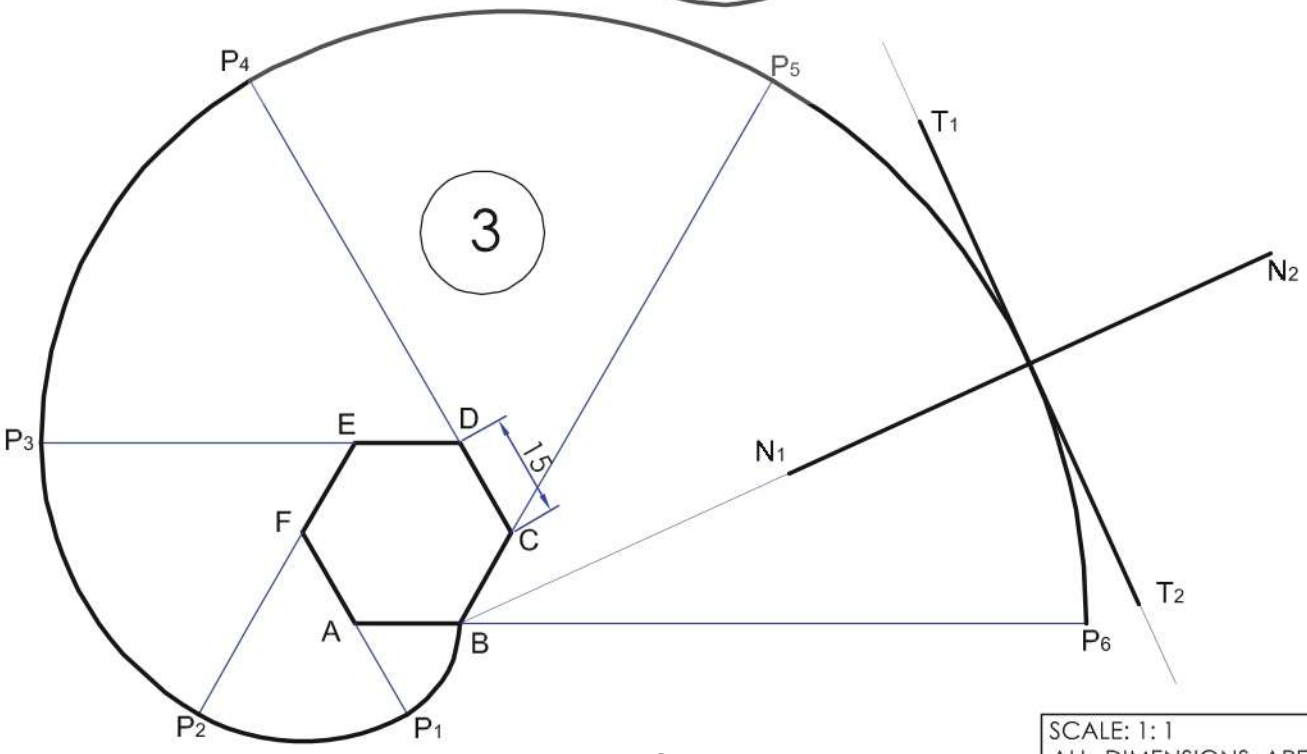
9. Involutes of a Triangle, Pentagon & Hexagon

INVOLUTES

1. Involute of a Triangle (21 mm side)
2. Involute of a Pentagon (17 mm side)
3. Involute of a Hexagon (15 mm side)







SCALE: 1: 1
ALL DIMENSIONS ARE IN MM

Projection of Points

Objectives

- To draw the projections of a point in the four quadrants.
- To identify the position of the point in different quadrants.

Notation

To obtain the projections of points in space, standard notations are followed:

1. The actual points in space are denoted by capital letters A, B, C, D, etc.,
2. The front views are denoted by the corresponding lowercase letters with dashes like a', b', c', d', etc., and their top views are denoted by the corresponding lowercase letters like a, b, c, d, etc.
3. Projectors are always drawn as continuous thin lines using a 2H pencil.
4. The visible points are drawn with a H pencil.
5. Lettering is always drawn with a HB pencil.

Quadrant system: The picture planes used for obtaining the orthographic projections are called the Principal planes of projection or reference planes or co- ordinate planes of projection.

VP: The plane in front of observer is the vertical plane. (VP) or it is also called a Frontal plane.

Front View (FV): The projection on the VP is called the Front View (FV) or Vertical Projection or front elevation or Elevation.

HP: The plane which is Horizontal and perpendicular to VP is Horizontal Plane.

Top View (TV): The projection on the HP is called the Top View (TV) or Horizontal Projection or Plan.

Note: The planes HP and VP are called **Principal Planes.**

Reference Line: The line of intersection of HP and VP is called reference line, which is denoted by X-Y.

First quadrant --- Above HP and in front of VP

Second quadrant --- Above HP and behind VP

Third quadrant --- Below HP and behind VP

Fourth quadrant --- Below HP and in front of VP

ORIENTATION OF POINT IN SPACE

(1) In quadrant I (Above H.P & In Front of V.P.)

(2) In quadrant II (Above H.P & Behind V.P.)

(3) In quadrant III (Below H.P & Behind V.P.)

(4) In quadrant IV (Below H.P & In Front of V.P.)

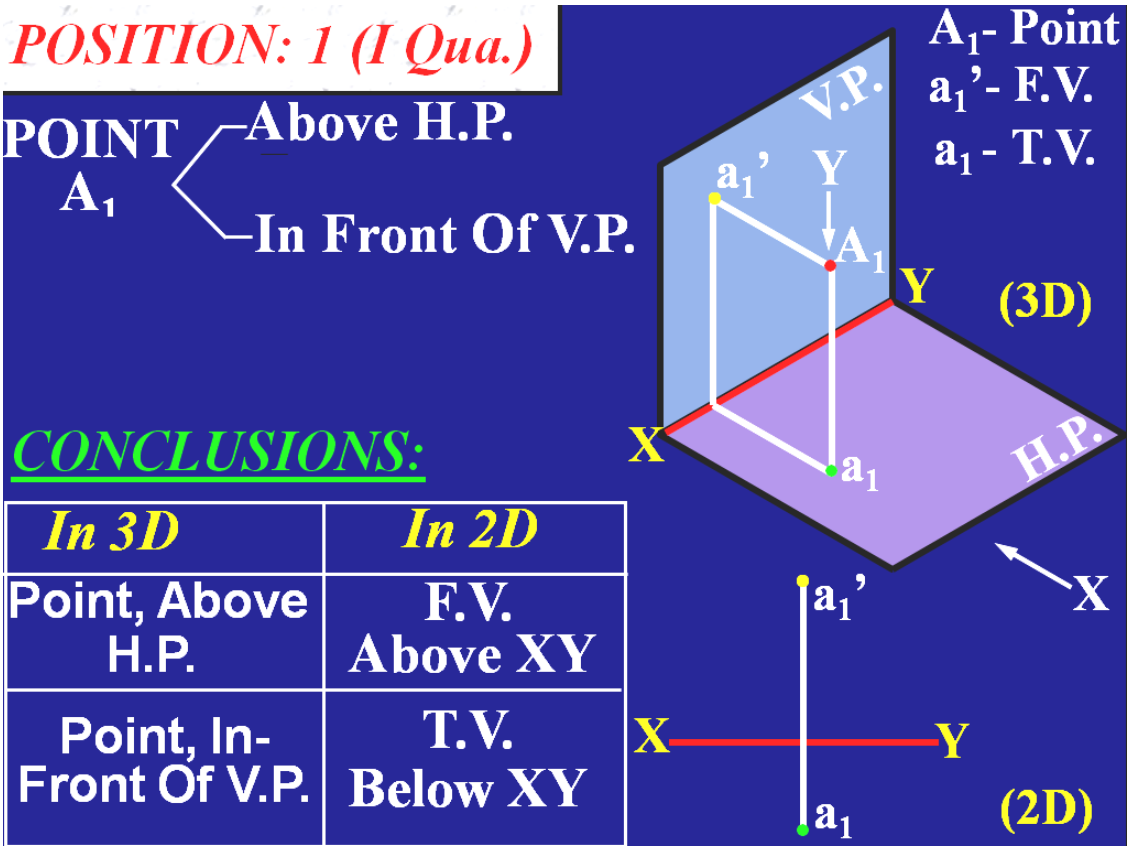
(5) In Plane (Above H.P. & In V.P.)

(6) In Plane (Below H.P. & In V.P.)

(7) In Plane (In H.P. & In front of V.P.)

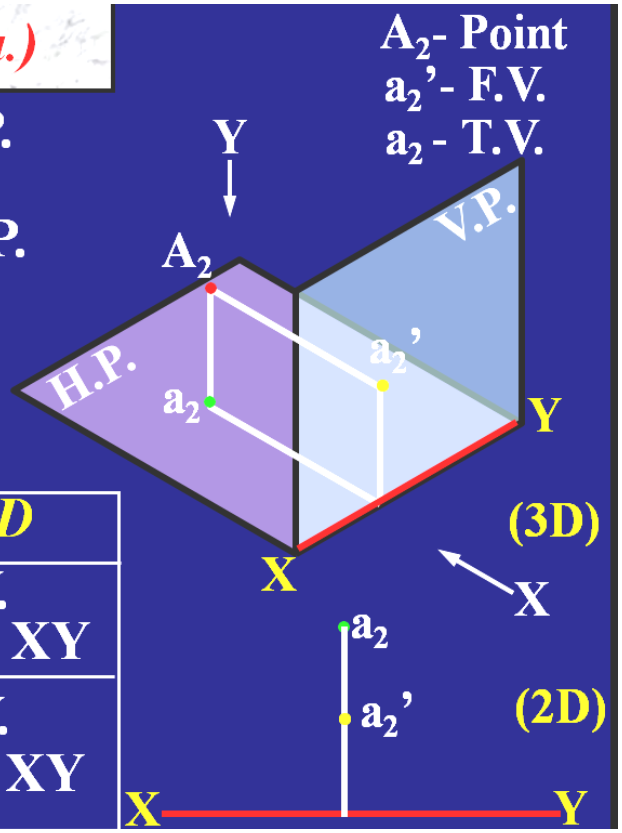
(8) In Plane (In H.P. & Behind V.P.)

(9) In Plane (In H.P. & V.P.)



POSITION:2 (II Qua.)

POINT A_2 — Above H.P. / Behind V.P.

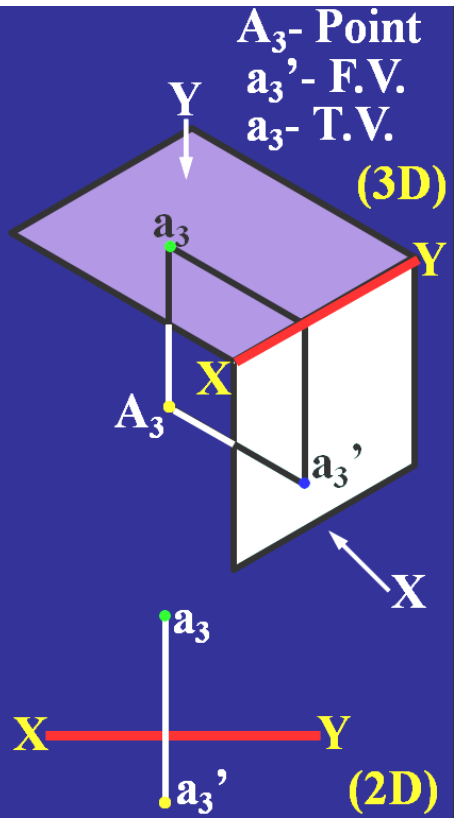


CONCLUSIONS:

In 3D	In 2D
Point, Above H.P.	F.V. Above XY
Point, Behind V.P.	T.V. Above XY

POSITION: 3 (III Qua.)

POINT A_3 — Below H.P. / Behind V.P.



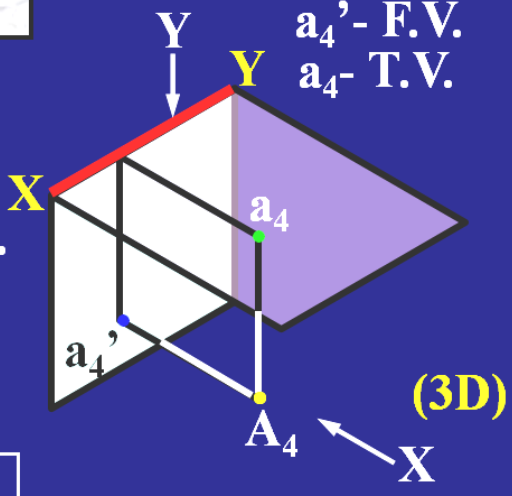
CONCLUSIONS:

In 3D	In 2D
Point, Below H.P.	F.V. Below XY
Point Behind V.P.	T.V. Above XY

POSITION: 4 (IV Qua.)

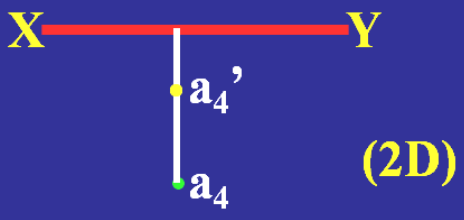
POINT A_4
- Below H.P.
- In Front of V.P.

A_4- Point
a_4'- F.V.
a_4- T.V.



CONCLUSIONS:

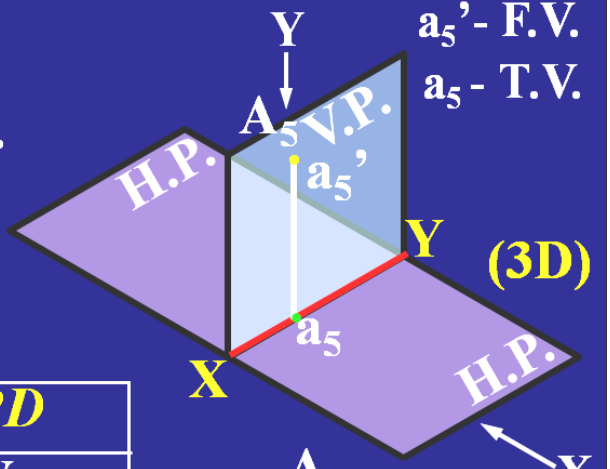
In 3D	In 2D
Point, Below H.P.	F.V. Below XY
Point, In Front Of V.P.	T.V. Below XY



POSITION: 5

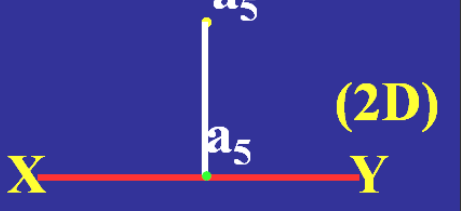
POINT A_5
- Above H.P.
- In V.P.

A_5- Point
a_5'- F.V.
a_5 - T.V.



CONCLUSIONS:

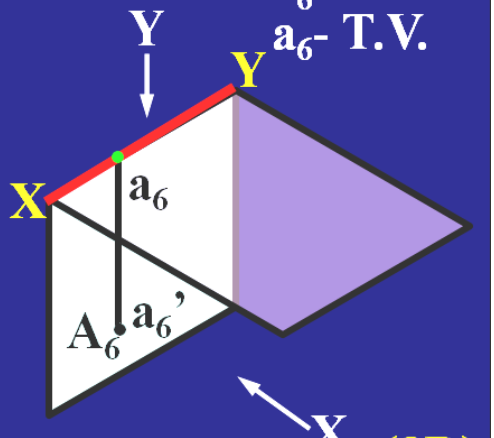
In 3D	In 2D
Point, Above H.P.	F.V. Above XY
Point, In V.P.	T.V. On XY



POSITION: 6

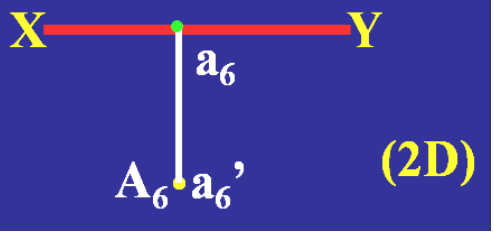
A_6- Point
a_6'- F.V.
a_6- T.V.

POINT A_6 — Below H.P.
— In V.P.



CONCLUSIONS:

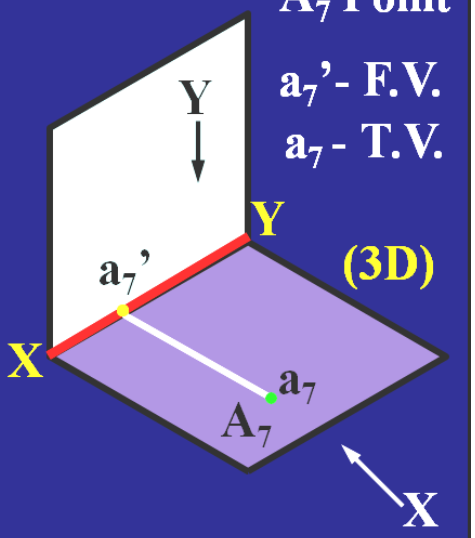
In 3D	In 2D
Point, Below H.P.	F.V. Below XY
Point In V.P.	T.V. On XY



POSITION: 7

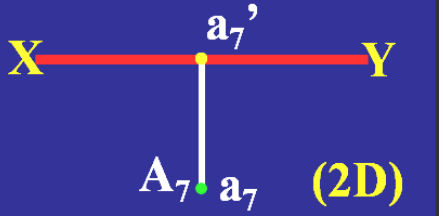
A_7 Point
a_7'- F.V.
a_7 - T.V.

POINT A_7 — In H.P.
— In Front of V.P.



CONCLUSIONS:

In 3D	In 2D
Point, In-Front Of V.P.	T.V. Below XY
Point In H.P.	F.V. On XY



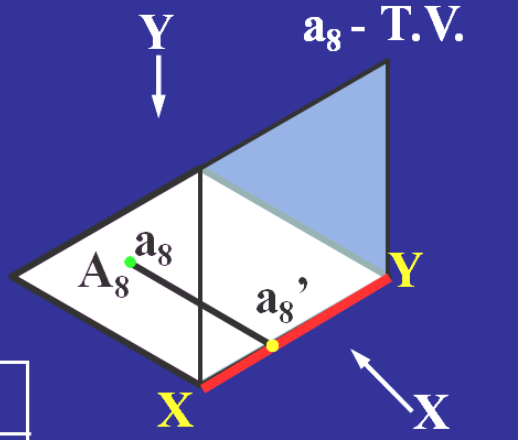
POSITION: 8

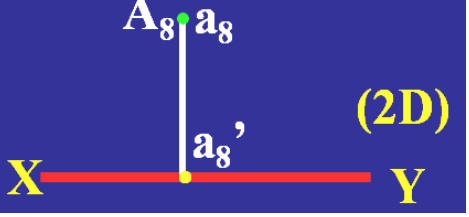
A_8- Point
a_8'- F.V.
a_8 - T.V.

POINT A_8
- In H.P.
- Behind V.P.

CONCLUSIONS:

In 3D	In 2D
Point, Behind V.P.	T.V. Above XY
Point, In H.P.	F.V. On XY





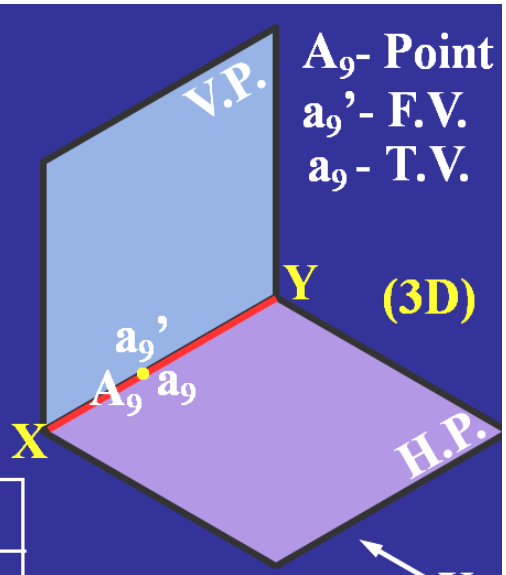
POSITION: 9

A_9- Point
a_9'- F.V.
a_9 - T.V.

POINT A_9
- In H.P
- In V.P.

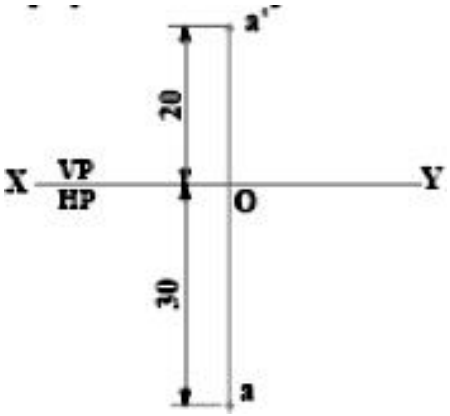
CONCLUSIONS:

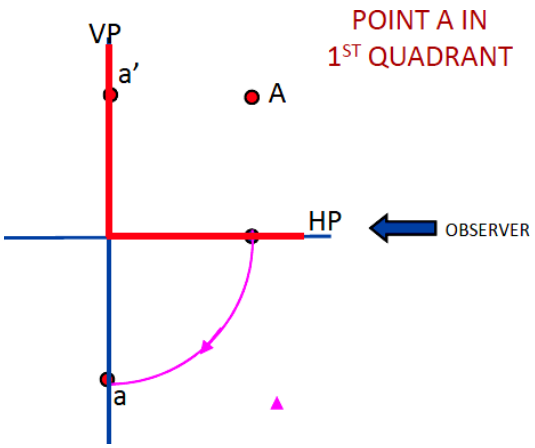
In 3D	In 2D
Point, In H.P.	F.V. On XY
Point, In V.P.	T.V. On XY



Projection of a Point in the I-Quadrant

Point A is 20 mm above the HP and 30 mm in front of the VP

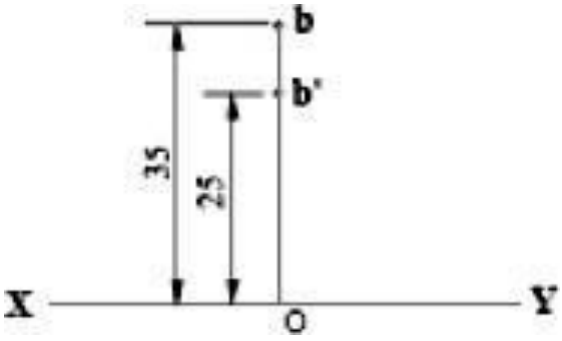


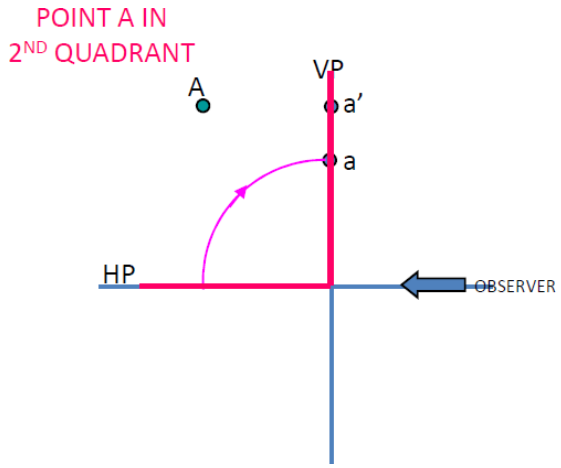


1. Draw the reference line XY and name it as VP and HP respectively above and below the XY line.
2. Draw a line perpendicular to XY.
3. On the perpendicular line mark a point a 30 mm below XY. (Top view)
4. On the perpendicular line mark a point a' 20 mm above XY. (Front view)
5. Erase the unwanted lines.
6. The points a and a' are the projections of the point A in the I- quadrant.

Projection of a Point in the II-Quadrant

Point B is 25 mm above the HP and 35mm behind the VP.



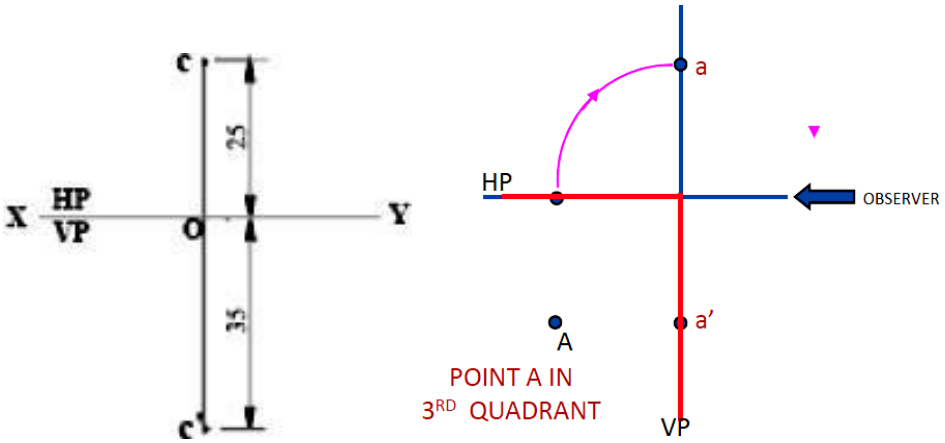


1. Draw the reference line XY and name it as VP and HP respectively above and below the XY line.
2. Draw a line perpendicular to XY.
3. On the perpendicular line mark a point b 35mm above XY.(Top view)
4. On the perpendicular line mark a point b' 25mm above XY.(Front view)
5. Erase the unwanted lines.

6. The points b' and b are the projections of the point B in the II- quadrant.

Projection of a Point in the III-Quadrant

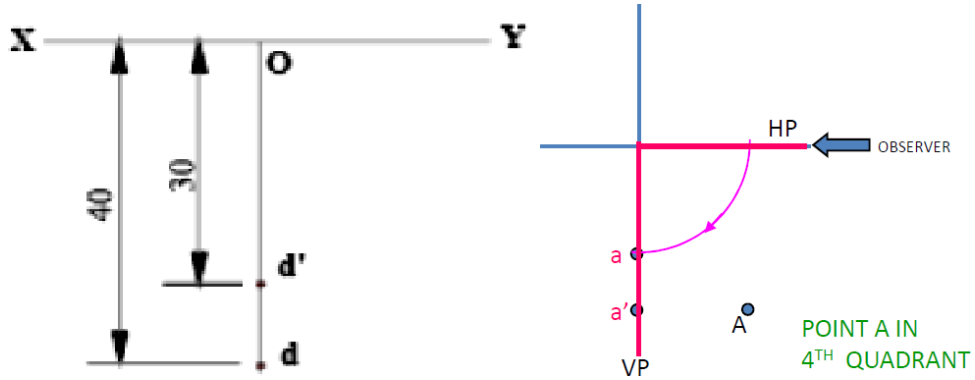
Point C 35 mm below the HP and 25 behind the VP.



1. Draw the reference line XY and name it as VP and HP respectively above and below the XY line.
2. Draw a line perpendicular to XY.
3. On the perpendicular line mark a point ‘c’ 25mm above XY. .(Top view)
4. On the perpendicular line mark a point ‘c’’ 35mm below XY. .(Front view)
5. Erase the unwanted lines.
6. The points c and c' are the projections of the point C in the III- quadrant.

Projection of a Point in the IV-Quadrant

Point D 30mm below the HP and 40 mm in front of the VP.



1. Draw the reference line XY and name it as VP and HP respectively above and below the XY line.
2. Draw a line perpendicular to XY.
3. On the perpendicular line mark a point ‘d’ 40mm below XY.(Top view)
4. On the perpendicular line mark a point ‘d’’ 30mm below XY.(Front view)

5. Erase the unwanted lines.

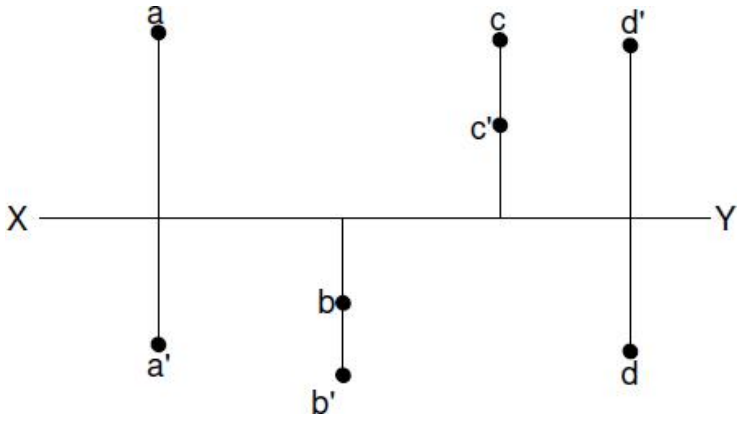
6. The points d and d' are the projections of the point D in the IV- Quadrant.

Additional problems

1. Draw and state the quadrants in which the following points are located. Assume any distances.

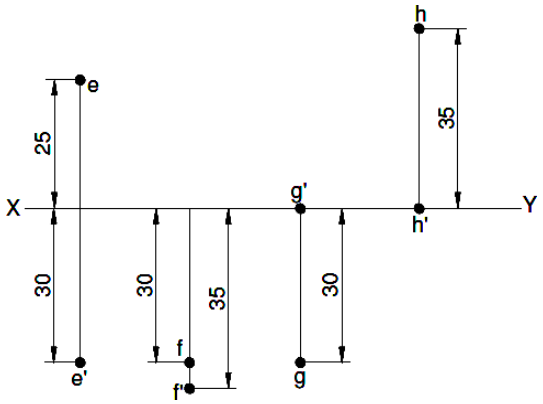
1. A - front view below XY line and Top view above XY line
2. B - Front and Top views below XY line.
3. C - Front and Top views are above XY line.
4. D - Front view above XY line and Top view below XY line.

Solution: **A lies in 3rd Quadrant** **B lies in 4th Quadrant**
C lies in 2nd Quadrant **D lies in 1st Quadrant**



2. Draw the projections of the following points on the same XY line, keeping convenient distance between each projector. Name the quadrants in which they lie.

1. E - 30 mm below HP and 25 mm behind VP.
2. F - 35 mm below HP and 30 mm in front of VP.
3. G - On HP and 30 mm in front of VP.
4. H - On HP and 35 mm behind VP.



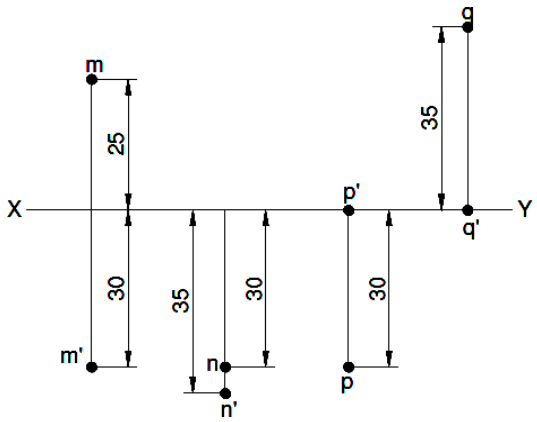
E-3rd Quadrant **F-4th Quadrant** **G-4th Quadrant** **H-3rd Quadrant**

3. Draw the projections of the following points on the same XY line, keeping convenient distance between each projectors. Name the quadrant in which they lie.

1. M - 30 mm below HP and 25 mm behind VP.
2. N - 35 mm below HP and 30 mm infront of VP.
3. P - on HP and 30 mm infront of VP.
4. Q - on HP and 35 mm behind VP.

Solution:

M - 3rd Quadrant **N - 4th Quadrant**
P - 1st as well as 4th Quadrant **Q - 2nd as well as 3rd Quadrant**

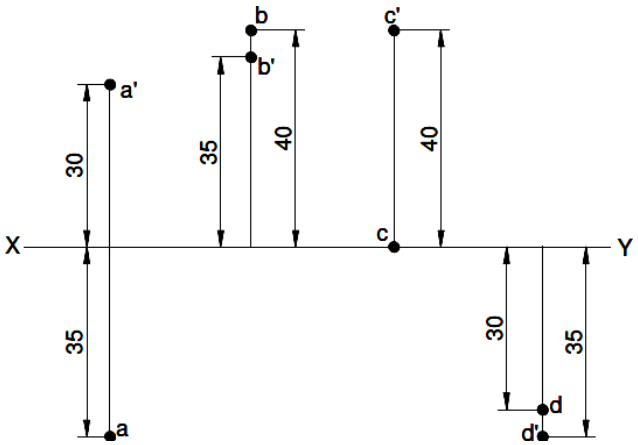


4. Draw the projections of the following points on the same XY line, keeping convenient distance between each projectors. Name the quadrants in which they lie.

1. A - 30 mm above HP and 35 mm in front of VP.
2. B - 35 mm above HP and 40 mm behind VP.
3. C - 40 mm above HP and on VP.
4. D - 35 mm below HP and 30 mm in front of VP.

Solution:

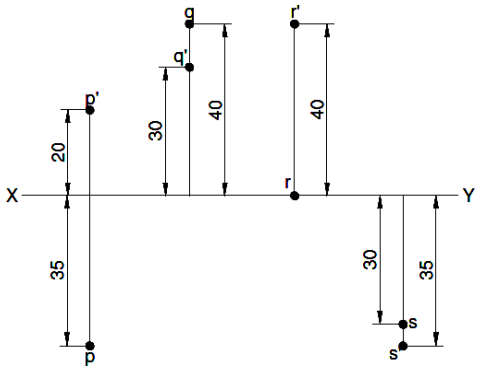
A - 1st Quadrant **B - 2nd Quadrant** **C- 1st as well as 2nd Quadrant**
D - 4th Quadrant



5. 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.

1. P - 20 mm above HP and 35 mm infront of VP.
2. Q - 30 mm above HP and 40 mm behind VP.
3. R - 40 mm above HP and on VP.
4. S - 35 mm below HP and 30 mm infront of VP.

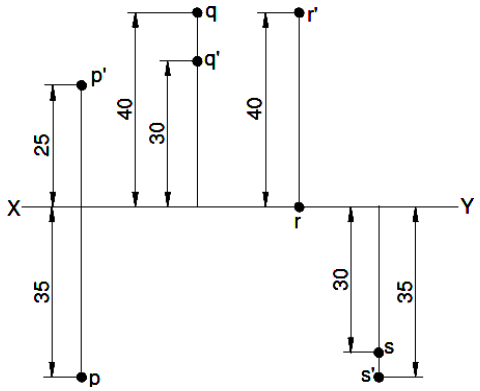
Solution: **P - 1st Quadrant** **Q - 2nd Quadrant**
R - 1st as well as 2nd Quadrant **S - 4th Quadrant**



6. Draw the projections of the following points on the same XY line, keeping convenient distance between each projectors. Also state the quadrants in which they lie.

1. P - 25 mm above HP and 35 mm infront of VP.
2. Q - 30 mm above HP and 40 mm behind VP.
3. R - 40 mm above HP and on VP. 4. S- 35 mm below HP and 30 mm in front of VP.

Solution: **P - 1st Quadrant** **Q - 2nd Quadrant** **R - 1st as well as 2nd Quad.**
S - 4th Quadrant

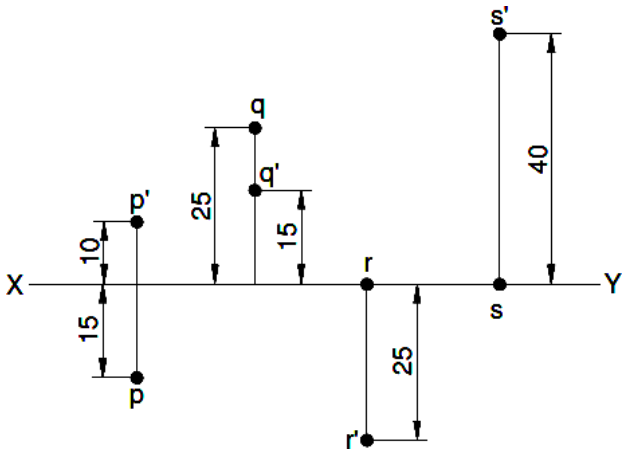


7. Draw the projections of the following points on the same XY line, keeping convenient distance between each projectors and state the quadrants in which they lie.

1. P - 10 mm above HP and 15 mm infront of VP.
2. Q - 15 mm above HP and 25 mm behind VP.
3. R - 25 mm below HP and in VP. 4.S - 40 mm above HP and in VP.

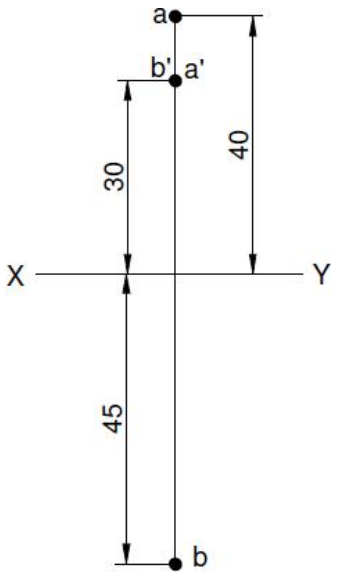
Solution: **P - 1st Quadrant** **Q - 2nd Quadrant**

R - 3rd as well as 4th Quadrant **S - 1st as well as 2nd Quadrant**



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

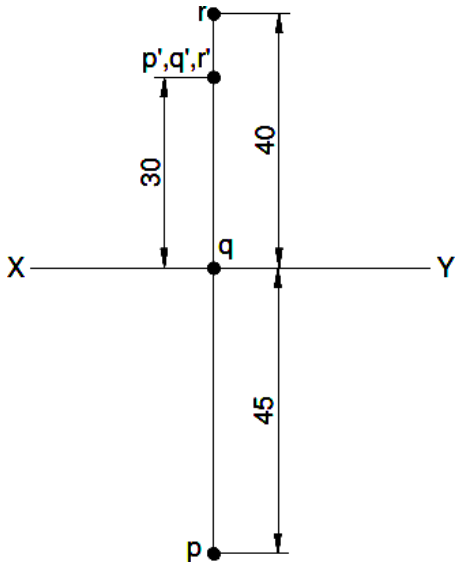
SOLUTION: **A - 2nd Quadrant** **B - 1st Quadrant**



9. A point 30 mm above XY line is the front view of 3 points P, Q and R. The top view of R is 40mm behind VP, the top view Q is on XY line and top view of point P is 45 mm in front of VP. Draw the projections of the points and state the quadrants in which the points are situated.

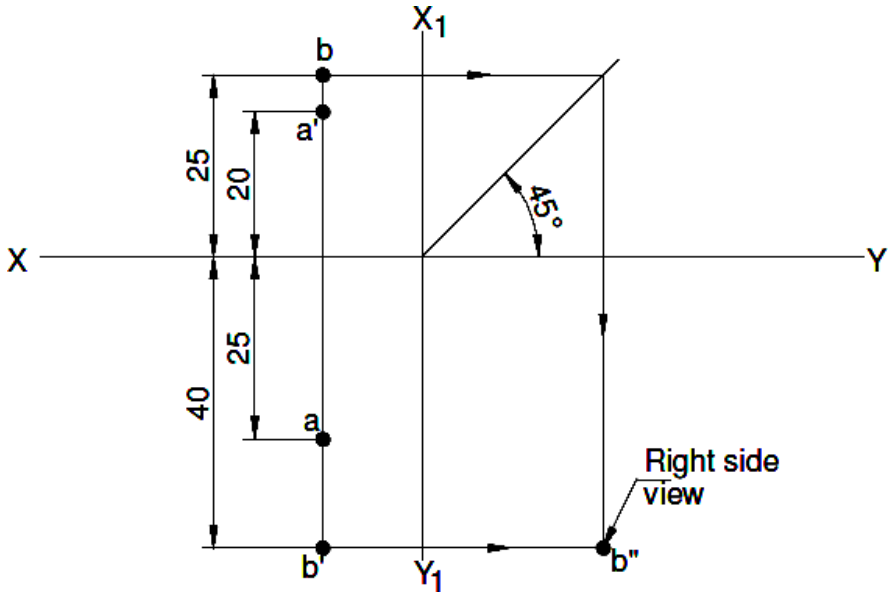
SOLUTION:

P - 1st Quadrant **R - 2nd Quadrant** **Q - 1st as well as 2nd Quadrant**



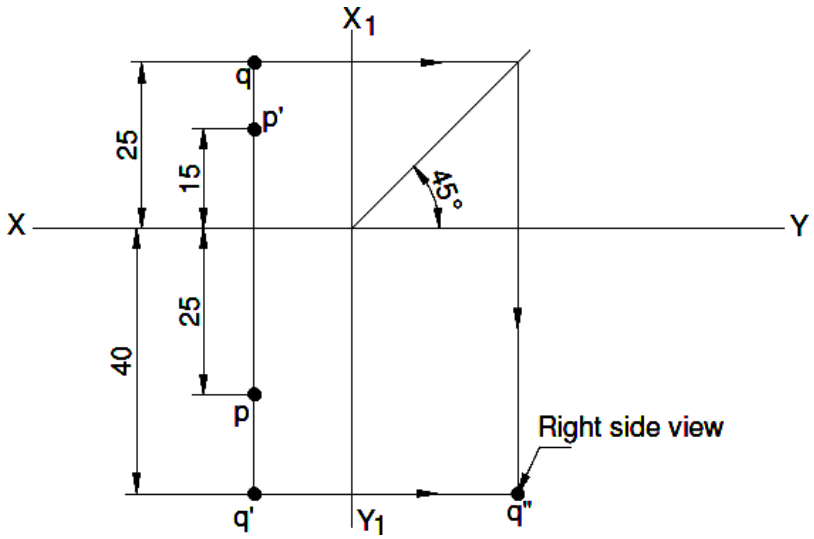
10. A point A is 20 mm above HP and 25 mm in front of VP. Another point B is 25 mm behind VP and 40 mm below HP. Draw their projections when the distance between their projectors parallel to XY line is zero mm. Add the right side view only to point B.

SOLUTION:



11. A point P is 15 mm above HP and 25 mm in front of VP. Another point Q is 25 mm behind VP and 40 mm below HP. Draw their projections when the distance between their projectors parallel to XY line is zero mm. Add the right side view only to point Q.

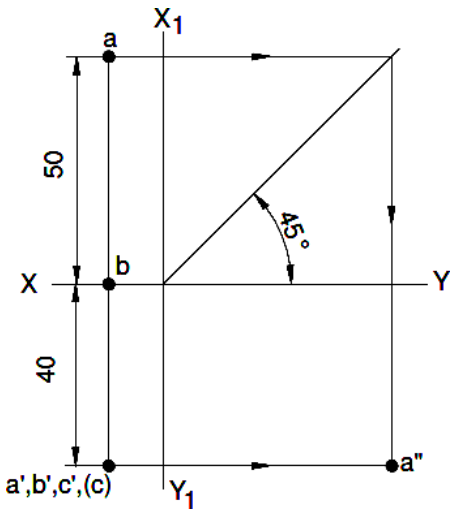
SOLUTION:



12. The common point 40 mm below XY line represents not only the front views of three points A,B and C but also the top view of point C. The top view of point B is lies on XY line and top view of point A lies 50 mm above it. Draw the projections of the points and add the right side view to the point A only. Also state in which the quadrants the points lie.

Solution:

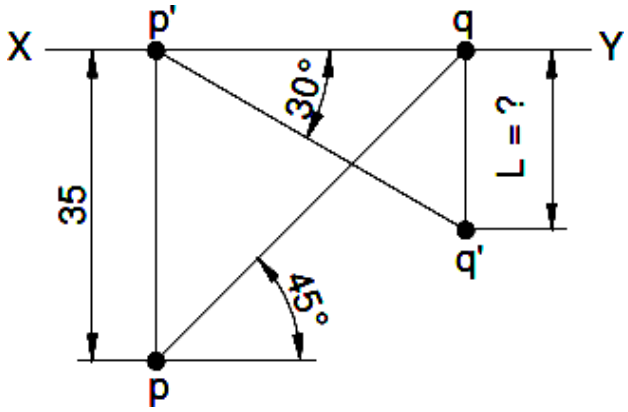
A - 3rd Quadrant **B - 3rd as well as 4th Quadrant** **C - 4th Quadrant**



13. 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:

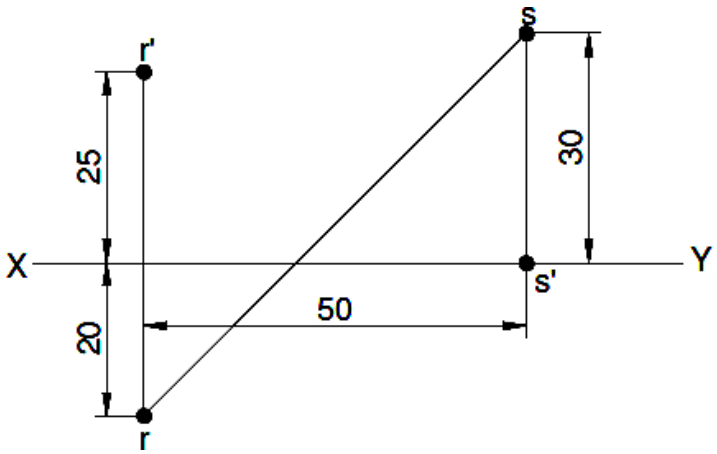
L = 20.21 mm **Q is 20.21 mm below HP**



14. A point R is 25 mm above HP and 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 VP and HP is 50 mm. Find the distance between top views of points R and S.

Solution:

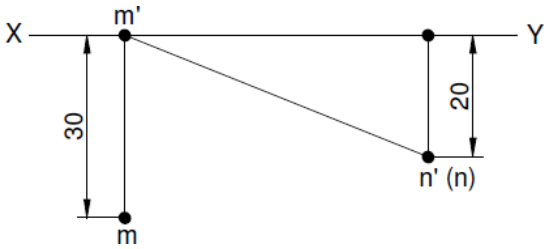
The distance between top views of points R and S is 70.71 mm



15. A point M is on HP and 30 mm in front of VP. Another point N is 20 mm below HP and 20 mm in front of VP. The distance between their projectors measured parallel to XY line is 50 mm. Find the distance between front views of the point M and N.

Solution:

The distance between front views of M and N are 53.85 mm

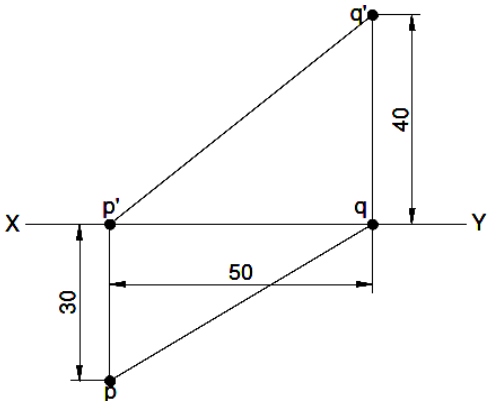


16. A point P is on HP and 30 mm in front of VP. Another point Q is on VP and 40 mm above HP. The distance between their projectors parallel to XY line is 50 mm. Find the distance between their front and top views of the points P and Q.

Solution:

Distance between their front views of P and Q is 64.03 mm

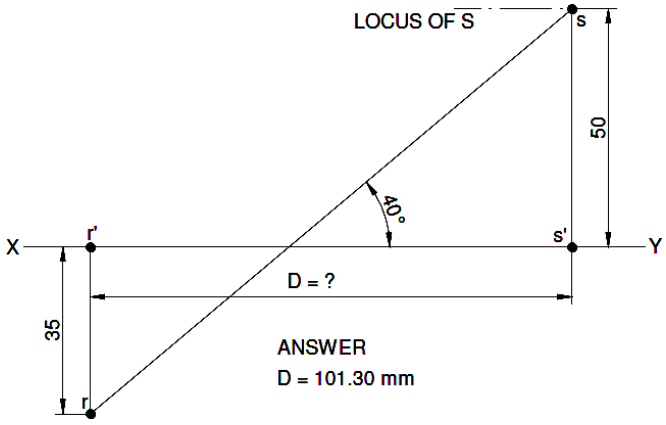
Distance between their top views of P and Q is 58.31 mm



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

Solution:

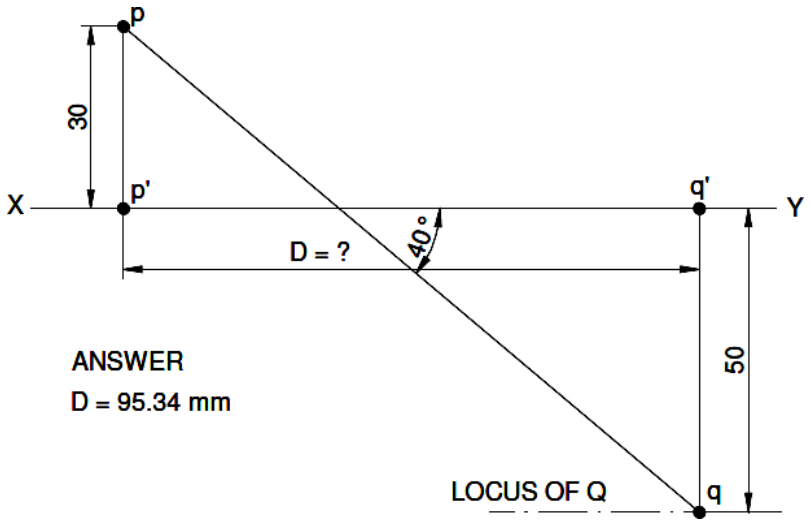
ANSWER: D = 101.3mm



18. Two points P and Q are on HP. The point P is 30 mm behind VP, while Q is 50 mm in front of VP. The line joining their top views makes an angle of 40 deg. with XY. Find the horizontal distance between their projectors parallel to XY line.

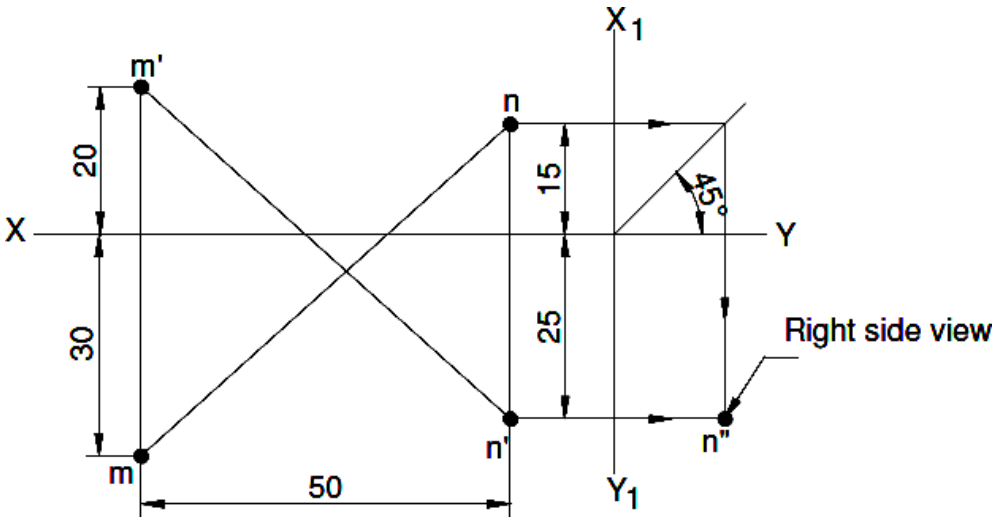
Solution:

ANSWER: D = 95.3 mm



19. A point M is 30 mm in front of VP and 20 mm above HP, another point N is 15 mm behind VP and 25 mm below HP. The horizontal distance between the points parallel to XY line is 50 mm. Draw the projections of the points M and N and join their front and top views. Draw the right side view for the point N only.

Solution:



Projections of a Straight Line

Introduction

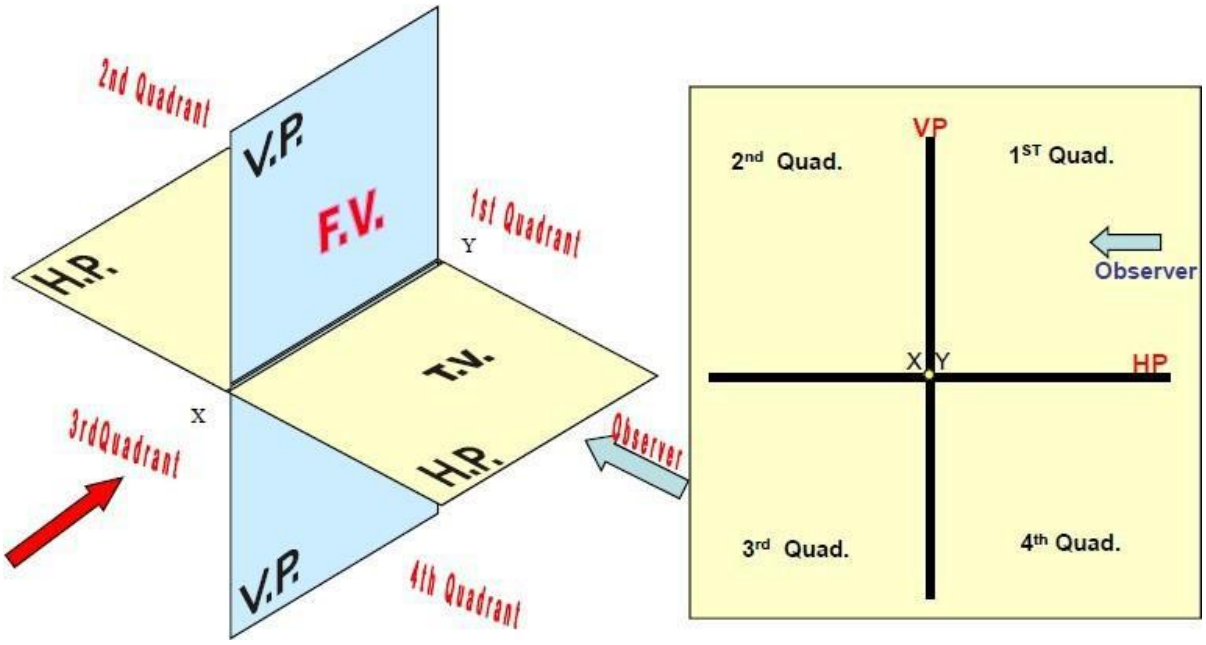
The shortest distance between any two points is called a "straight line". Different surfaces and planes form the configuration or shape of any object. Revolving or moving straight lines in different ways obtains these surfaces and planes.

Thus a straight line is the basic conceptual figure using which any object like a machine component or a structural element is represented. Thus projection of a straight line is the foundation of Engineering Drawing.

We have studied the projections of given points, Joining the respective projections of two points therefore gives the projection of the straight line joining the two points. As per ISO convention the first angle of projection is used.

Objectives

- Define straight line.
- Draw the projections of a straight line located at different positions with respect to the VP and the HP.

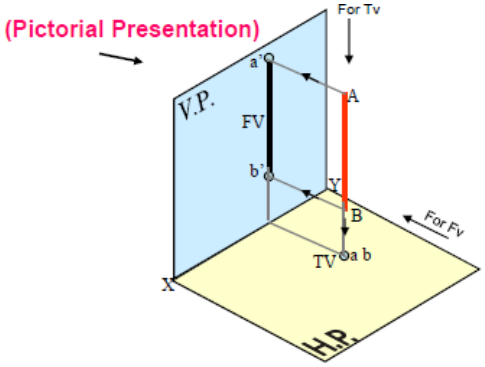


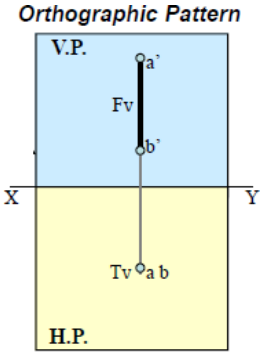
ORIENTATION OF LINE IN SPACE

The position of straight line in space can be described following

1. Lines parallel to VP and perpendicular to HP
2. Lines perpendicular to VP and parallel to HP
3. Lines parallel to both VP and HP
4. Lines parallel to VP and inclined to HP
5. Lines inclined to VP and parallel to HP
6. Lines inclined to both VP and HP

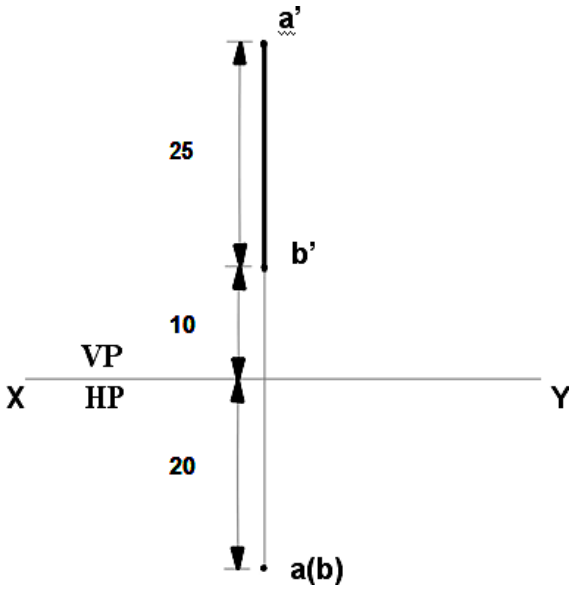
Perpendicular to the HP and Parallel to the VP



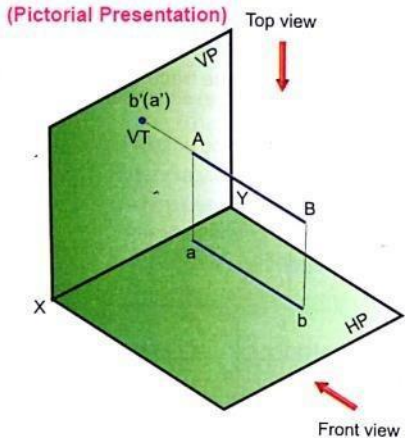


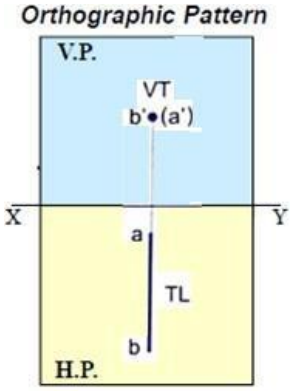
A Line AB 25mm is parallel to the VP and perpendicular to the HP 20mm in front of the and 10 mm above the HP

1. Draw the line XY.
2. Draw a line perpendicular to XY using a 2H pencil.
3. Mark b' 10mm above XY on the perpendicular line.
4. Mark a' 25mm above b'.
5. a' b' is the front view, join a', b' using a H pencil.
6. Mark a (b) 20mm below XY; a (b) is the top View.
7. Erase the unwanted Lines.



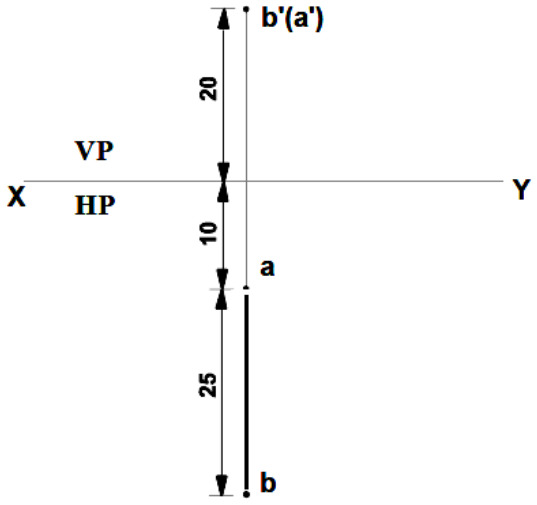
Perpendicular to the VP and Parallel to the HP





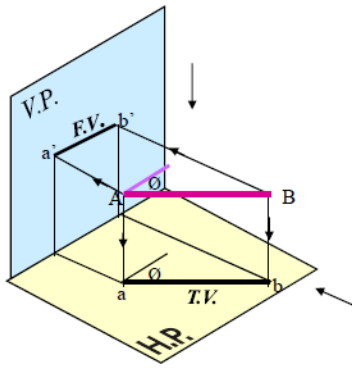
A Line AB of length 25mm is perpendicular to the VP and Parallel to the HP. The point A is 20mm above the HP and 10mm in front of the VP.

1. Draw the line XY.
2. Draw a line perpendicular to XY using a 2H pencil.
3. Mark "a" 10mm below XY on the Perpendicular line.
4. Mark "b" 25mm below "a".
5. Join "a" and "b" using an H pencil to get the top view.
6. Mark a' (b') 20mm above XY line on the Perpendicular line
7. Erase the unwanted Lines

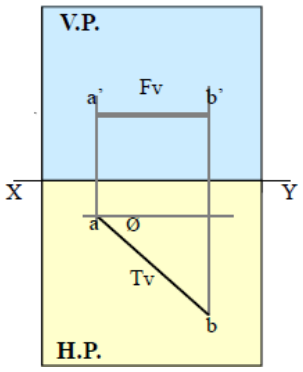


Parallel to the HP and Inclined to the VP

(Pictorial presentation)

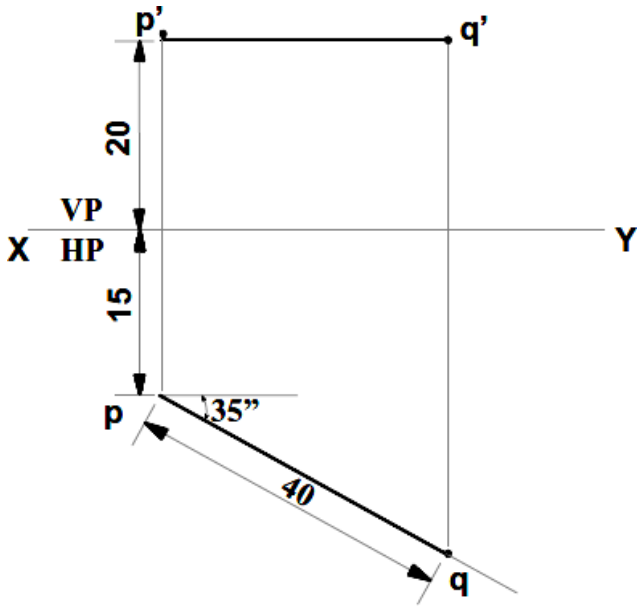


Orthographic Projections



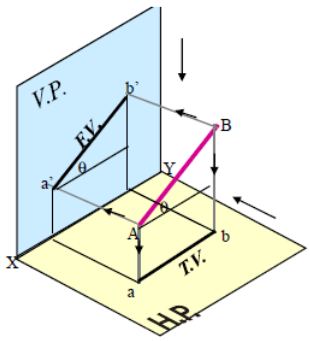
A line PQ of length 40mm is parallel to the HP and inclined at an angle of 35° to the VP. The end P is 20mm above the HP and 15mm in front of the VP.

1. Draw the line XY.
2. Draw a line perpendicular to XY using a 2H pencil
3. Mark “p'” and “p” respectively 15 mm above XY and 20mm below XY on the perpendicular line
4. From “p” draw a line at an angle of 35° to XY and mark “q” such that pq = 40mm true length.
5. pq is the top view of the given line in the I-Quadrant.
6. From “q” draw a projector (perpendicular line) to intersect the horizontal line drawn from “ p' ” at “ q' ”.
7. p' q ' is the front view.
8. Erase the unwanted line.

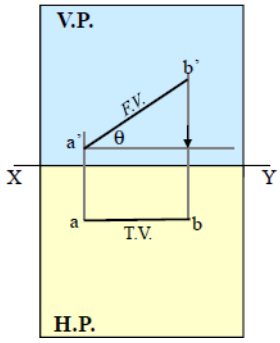


Parallel to the VP and Inclined to the HP

(Pictorial presentation)

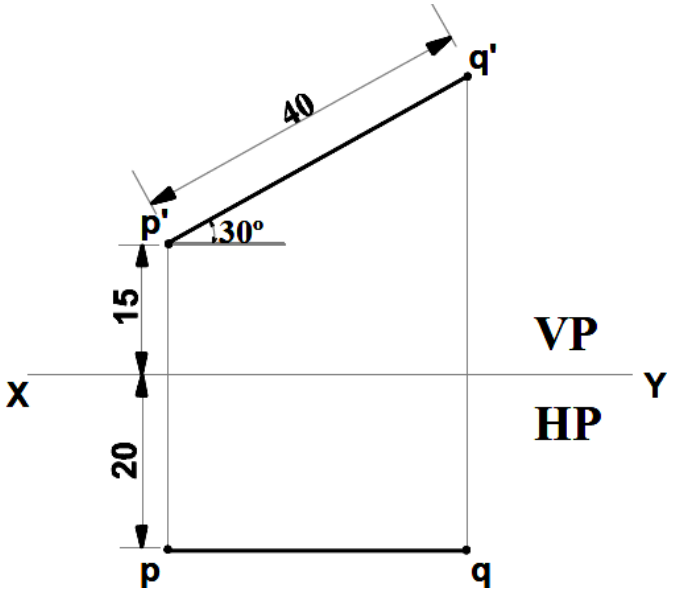


Orthographic Projections

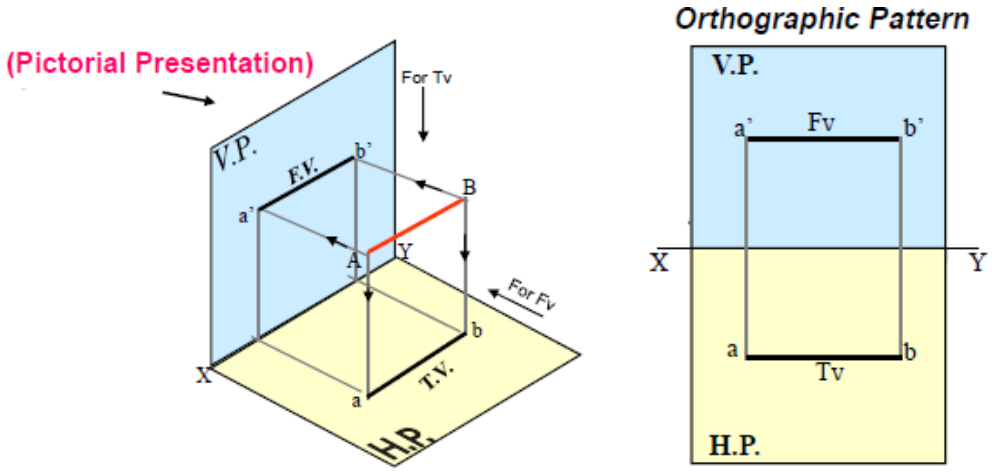


A line PQ of length 40mm is parallel to the VP and inclined at an angle of 30° to the HP. The end P is 15mm above the HP and 20mm in front of the VP.

1. Draw the line XY.
2. Draw a perpendicular line to XY using 2H pencil.
3. Mark p' & p 15mm above XY & 20mm below XY on the perpendicular line.
4. From p' draw a line at angle of 30° to XY and mark q'. such that p'q'= 40mm = True length
5. p' q' is the required Front View
6. From q' draw a projector (perpendicular line) to intersect the horizontal line draw from p at q.
7. p q is the required Top View
8. Erase the unwanted Line.

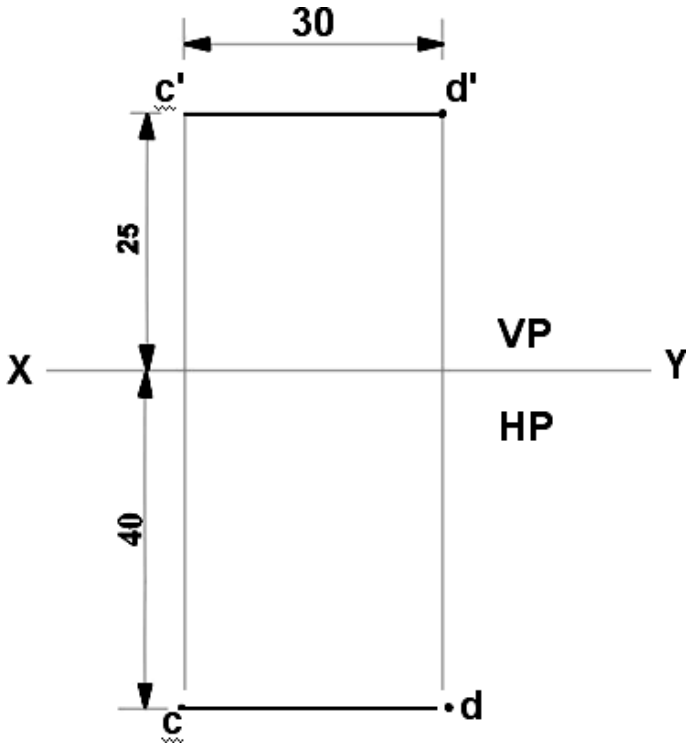


Parallel to the HP and the VP

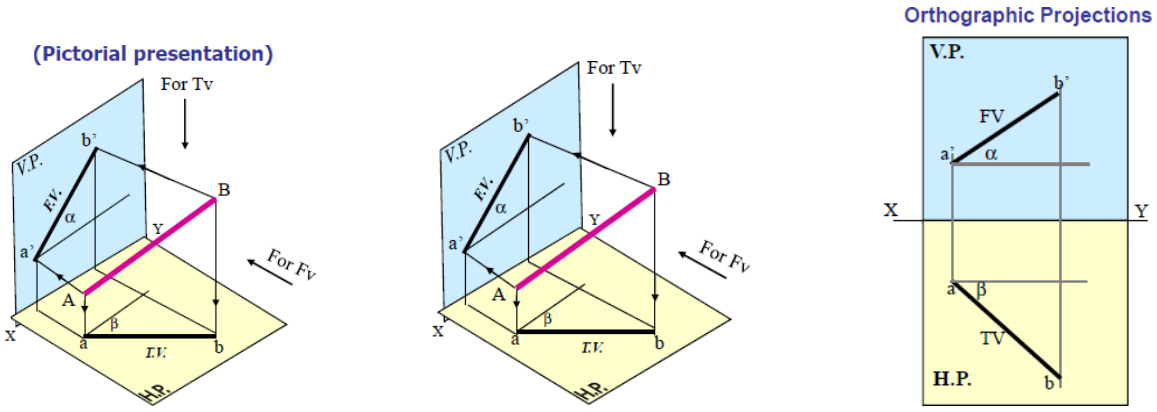


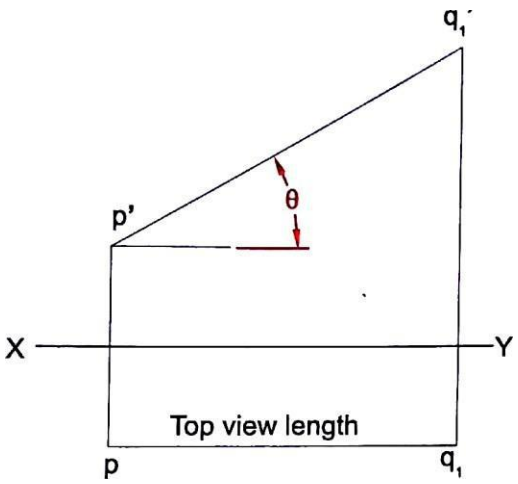
A Line CD 30mm long is parallel to both planes. The line is 40mm above the HP and 25mm in front of the VP.

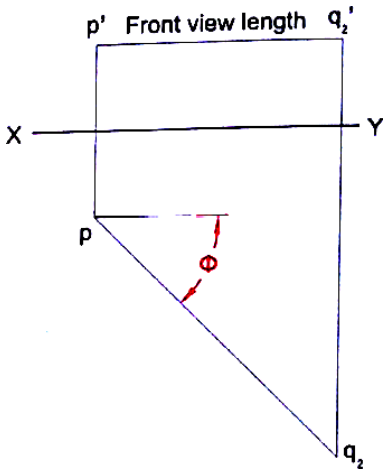
1. Draw the line XY.
2. Draw a line perpendicular to XY using a 2H pencil.
3. Draw another perpendicular line 30mm from the previous line.
4. Mark “c'” and “d' ” on the Perpendicular lines and join them to get the front view.
5. Mark “c” 25mm below line XY; join “c” and “d” to get the top view.
6. Erase the unwanted Lines.

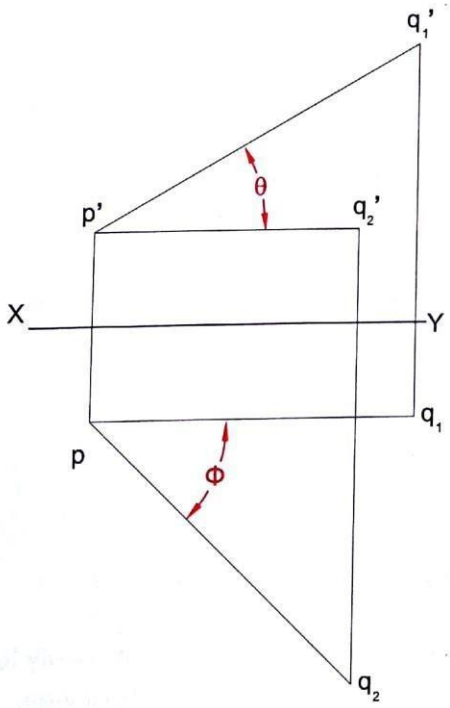


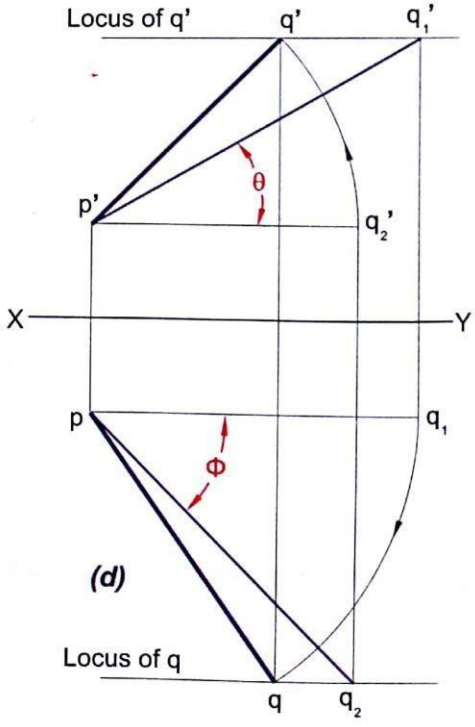
Inclined to the HP and the VP

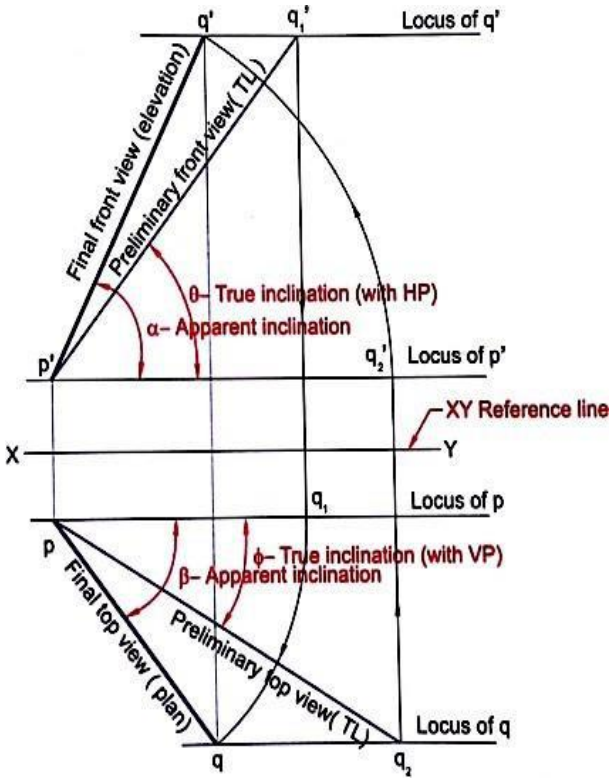


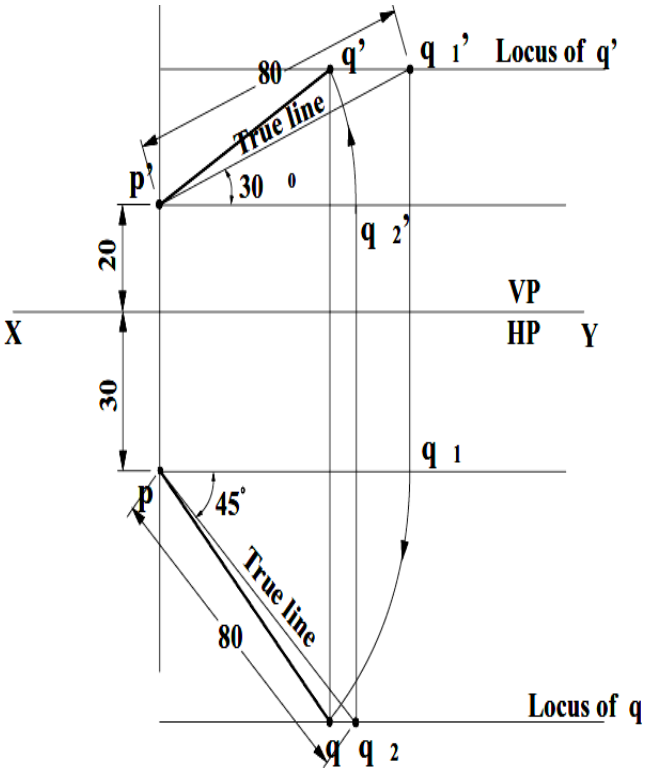












The line pq is inclined to both the VP and the HP.

A line PQ of length 80mm. is inclined at an angle of 45° to the VP and inclined at an angle of 30° to the HP. The end P is 20mm above the HP and 30mm in front of the VP.

1. Draw the line XY.
2. Mark “p” below XY line and draw 45° line and mark q_2 at 80mm
3. Mark “p’” above XY line and draw 30° line and mark “q_1' ” at 80mm
4. Draw locus of “q_1' ” and “q_2”
5. Project from “q_1' ” and “p” as centre rotate, it cuts locus of “q_2” at “q”
6. Joint “p” and “q” to get top view
7. Project from “q_2” and “p' ” as centre rotate, it cuts locus of “q_1' ” at “q' ”
8. Joint “p’” and “q’” to get front view

Finding true length of a line and its inclination with HP and VP

True length and inclination is determine from the final top and front view of the straight line by following two methods

1. Rotating method
2. Rotating trapezoidal plan method

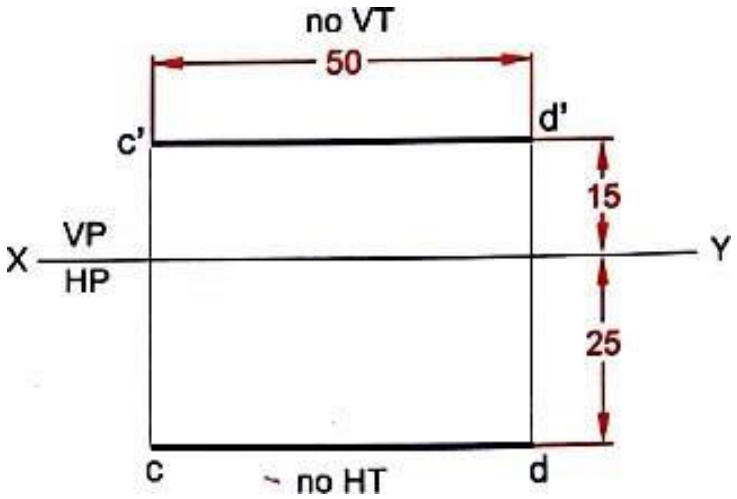
Projection of straight line on its various positions

S.No	Position of the line	Front view	Top view	Traces
1	Lines parallel to both VP and HP	True length and is parallel to XY	True length and is parallel to XY	NO TRACES
2	Lines perpendicular to VP and parallel to HP	Point	True length and is Perpendicular to XY	Only VT No HT
3	Lines parallel to VP and perpendicular to HP	True length and is Perpendicular to XY	Point	Only HT No VT
4	Lines parallel to HP and inclined to VP	Shorter than true length and is parallel to XY	Has true length and true inclination	Only VT No HT
5	Lines inclined to HP and parallel to VP	Has true length and true inclination	Shorter than true length and is parallel to XY	Only HT No VT
6	Lines inclined to both VP and HP	Shorter than true length, inclined to XY and angle is not true inclination	Shorter than true length, inclined to XY and angle is not true inclination	Has Both HT and VT

Problems- Projection of Lines

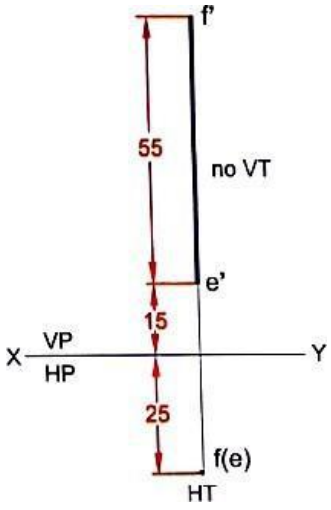
Lines parallel to both VP and HP

1.A line CD 50mm long has its end C, 15mm above the HP and 25 mm in front of the VP.The line is kept parallel to both HP and VP .draw its projections

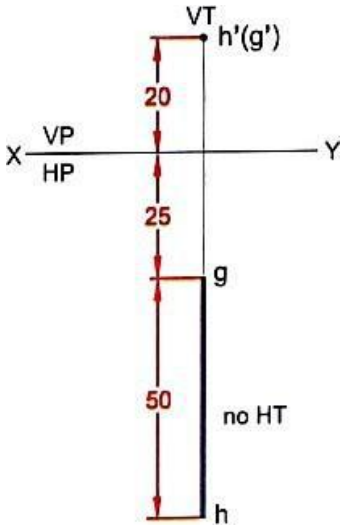


Lines perpendicular to one plane and parallel to another plane

2.A line 55 mm long has its end E 15 mm above the HP and 25 mm in front of the VP. The line is kept perpendicular to HP and parallel to VP. Draw its projections.

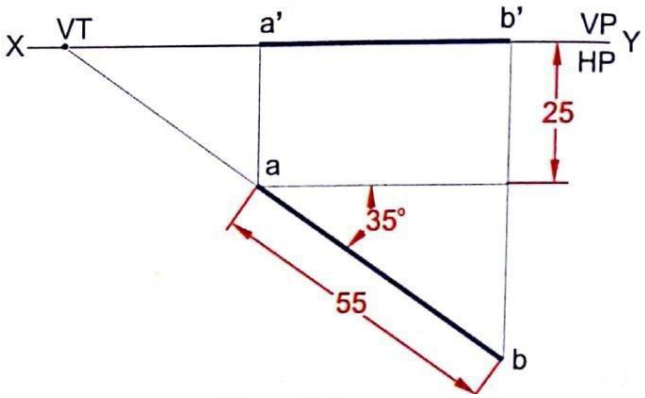


3. A line GH 50 mm long has its end G 20 mm above the HP and 25 mm in front of the VP. The line is kept perpendicular to VP and parallel to HP. Draw its projections.

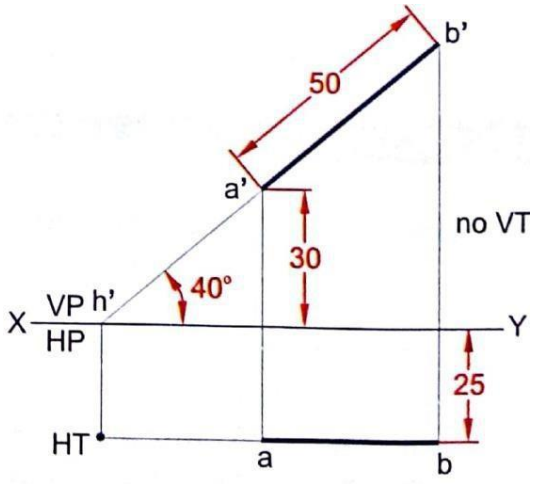


Lines inclined to one plane and parallel to another plane

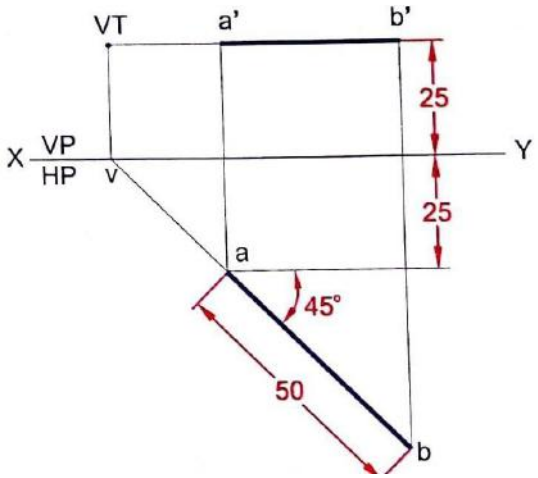
4. A line AB 55 mm long is lying on the HP and makes an angle of 35^0 with the VP. Its end A is 25mm in front of VP. Draw the projections of the line .



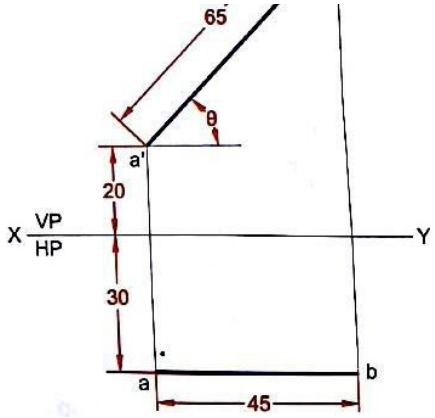
6. A line AB 50 mm long has its end A 30mm above HP and 25 mm in front of VP. The line is kept inclined at 40^0 to HP and parallel to VP. Draw its projections and make its traces.



7. A line AB 50 mm long has its end A25 mm above HP and 25 mm in front of VP. The line is inclined at 45^0 to VP and parallel to HP. Draw its projections and also make its traces.

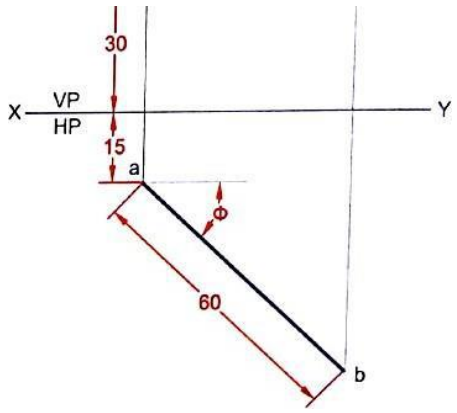


8. A line AB 65 mm long has its end A 20 mm above HP and 30 mm in front of VP. Its top view has a length of 45 mm and parallels to HP. Draw its projections and find the inclination of the line with HP.



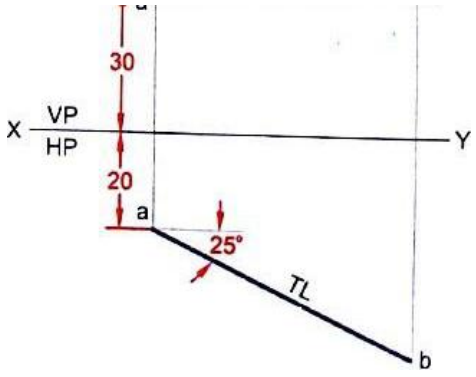
Answer: $\theta=46^0$

9. A line AB 60 mm long has its end A 30 mm above HP and 15 mm in front of VP. Its front view has a length of 45 mm and parallels to HP. Draw its projections and find the inclination of the line with VP.



Answer: θ=46^0

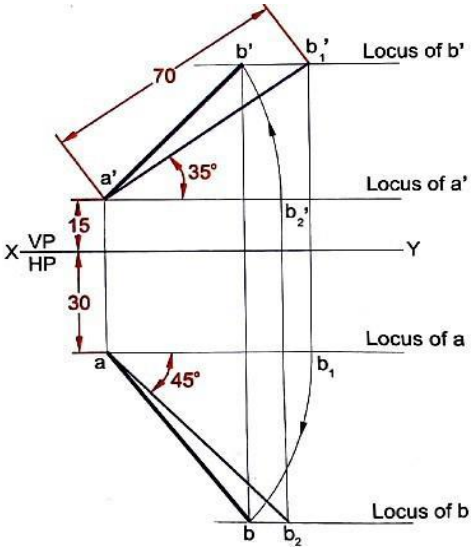
10. A line AB has its end A 30 mm above HP and 20 mm in front of VP. It is inclined at 25^{0}to the VP and parallels to HP. Draw its projections, if the distance between the end projectors to be 55 mm. Find the true length of the line also.



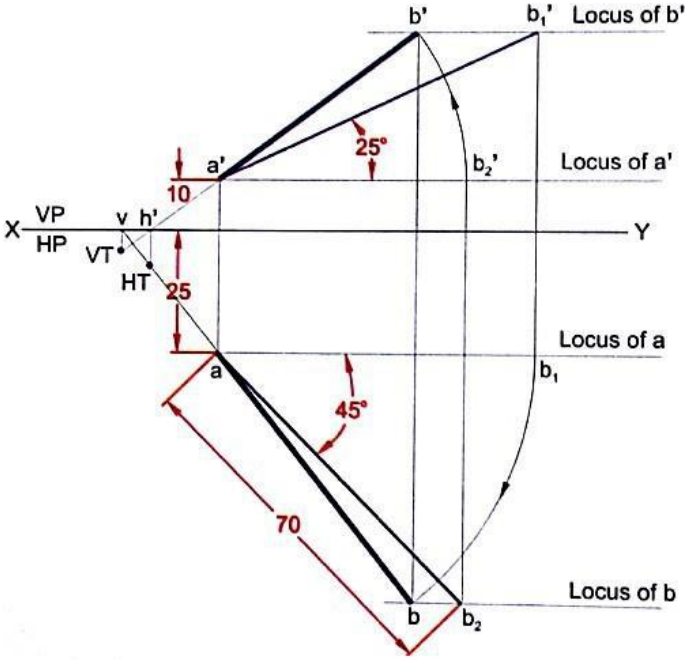
Answer: TL=60mm

Lines inclined to one plane and parallel to another plane

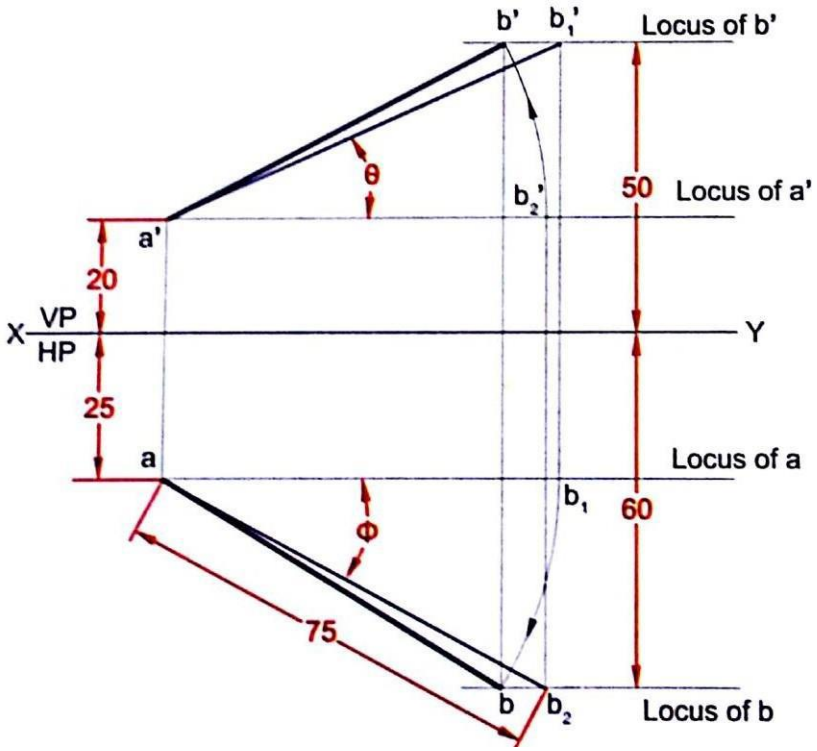
11. A line 70 mm long has one end 15 mm above HP and 30 mm in front of VP. The line is inclined at 35^{0}to the HP 45^{0}to the VP. Draw the projection of the line.



12. One end of a line AB 70 mm long, is 10 mm above HP and 25 mm in front of VP. The line is inclined at 25^{0}to the HP 45^{0}to the VP. Draw the projections and find its traces.

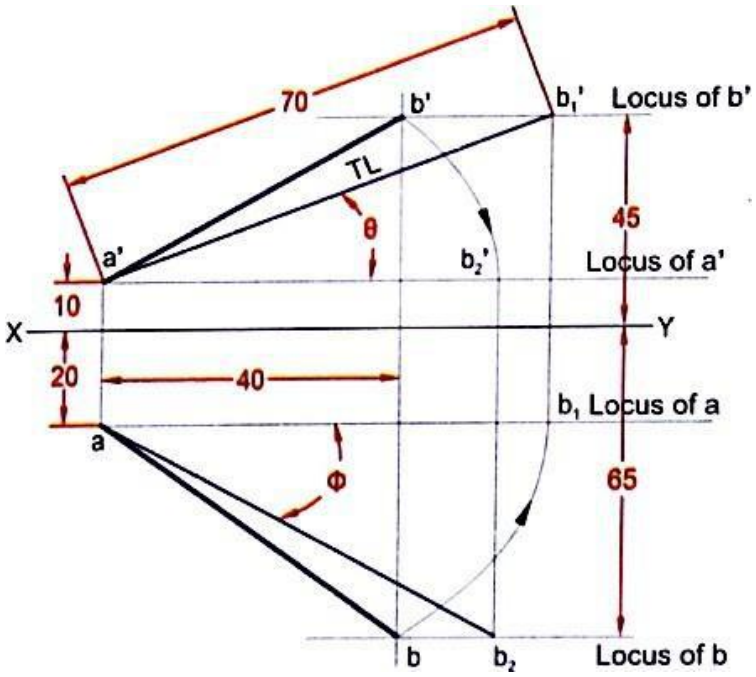


13. A line AB 75 mm long has one end A 20 mm above HP and 25 mm in front of VP. The end B is 50mm above the HP and 60 mm infront of VP. Draw the projection of the line and find its inclination with HP and VP.



Answer: **θ= 24 ^{0} ϕ = 28 ^{0}**

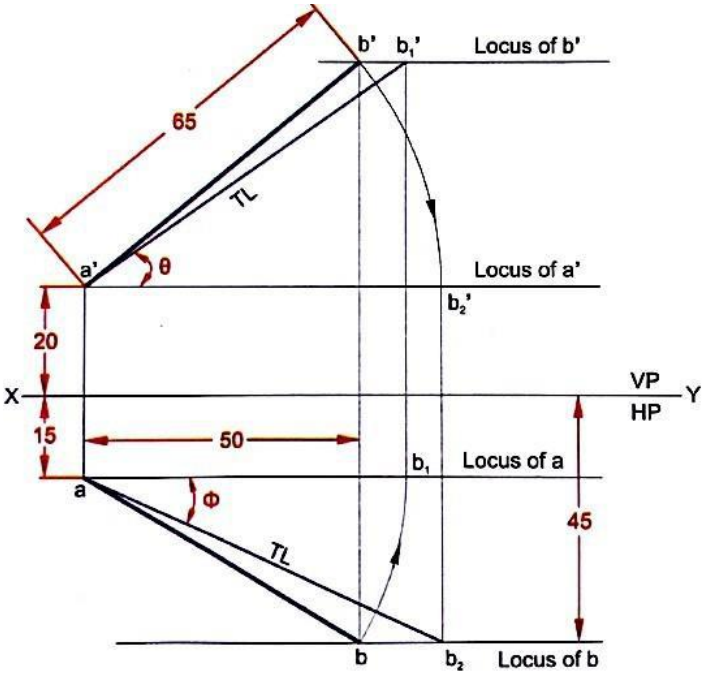
14. One end of a line AB is 10 mm above HP and 20 mm in front of VP. The other end is 45 mm above HP and 65 mm in front of VP the distance between the end projector is 40mm. Draw the projection of the line and find its inclination and length.



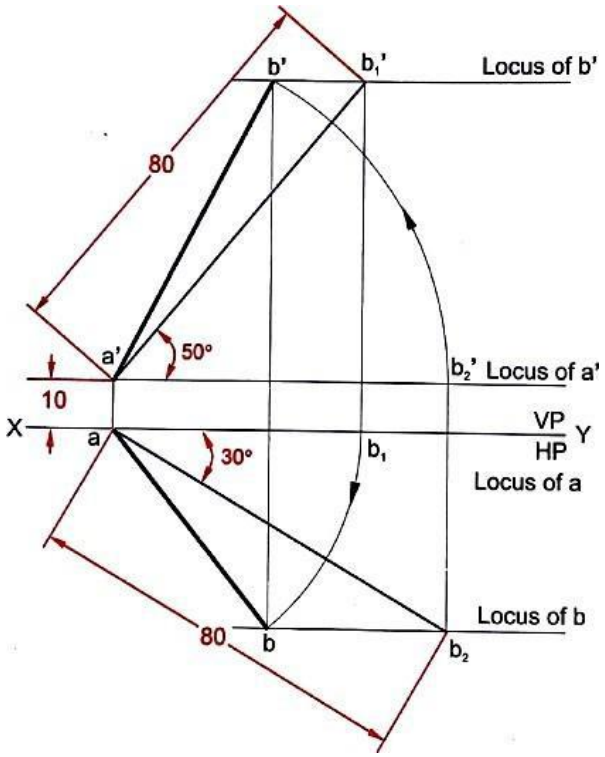
Answer: θ= 30 ^{0} ϕ = 40 ^{0} TL = 70 mm

15. A line AB 65 mm long in the front view has its end A 20 mm above HP and 15 mm in front of VP. The end B is 45 mm in front of VP. Draw the projection of the line and find its inclination with HP and VP. The distance between the ends projectors passing through the end point is 50 mm. Draw the projection of the line and find its inclination.

Answer: θ= 35 ^{0} ϕ = 25 ^{0} TL = 71 mm

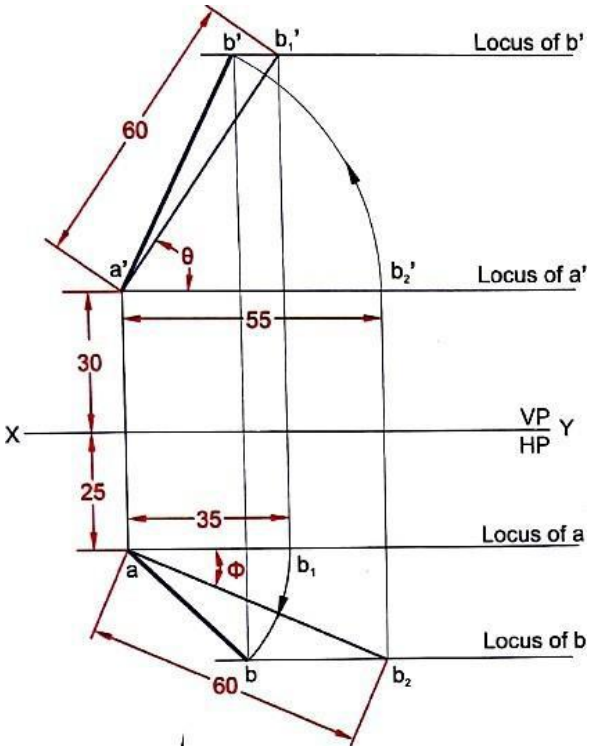


16. A line AB 80 mm long has its end A 10 mm above HP and in the VP. Draw the projection of the line makes an angle of inclined at 50^0 to the HP and 30^0 to the VP.

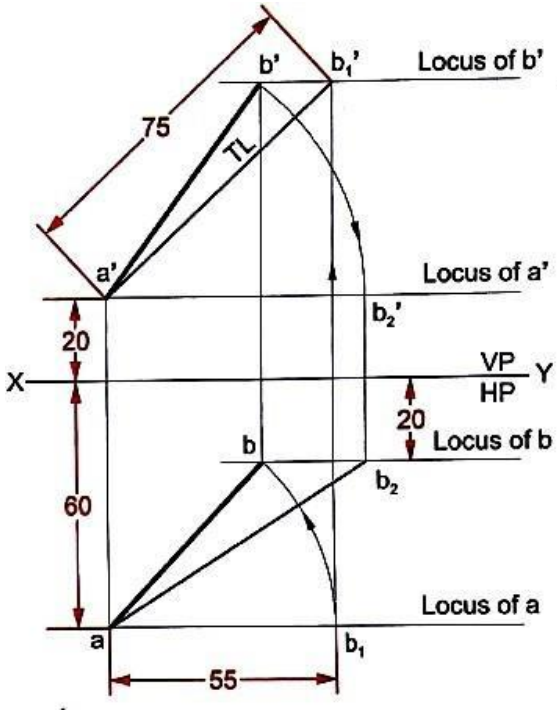


17. One end A of a line AB is 60 mm long 30 mm above HP and 25 mm in front of VP. The top and front view has a length of 35 mm and 55mm respectively. Draw the projection of the line and find its inclination.

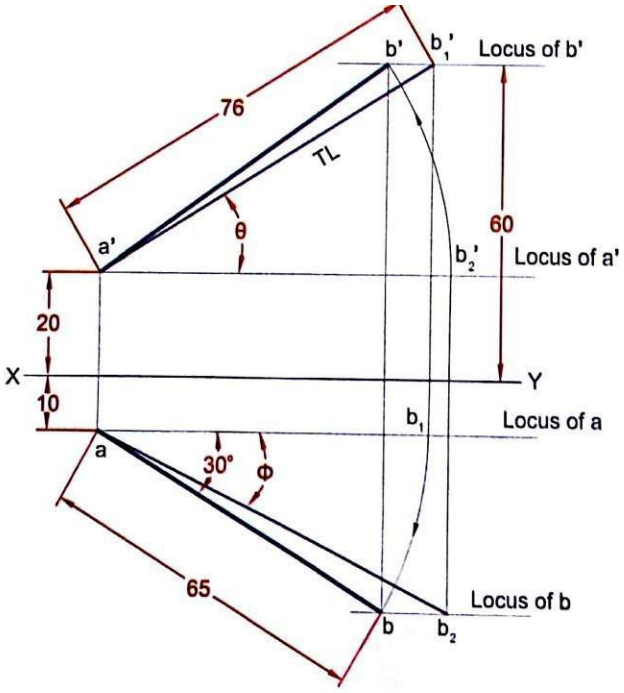
Answer: θ= 55 ^{0} ϕ = 25 ^{0}



18. A line AB 75 mm long has one of its ends 60 mm in front of the VP and 20 mm above the HP and the other end is 20 mm in front of VP and is above HP. The top view of the line is 55mm long. Draw the projection.

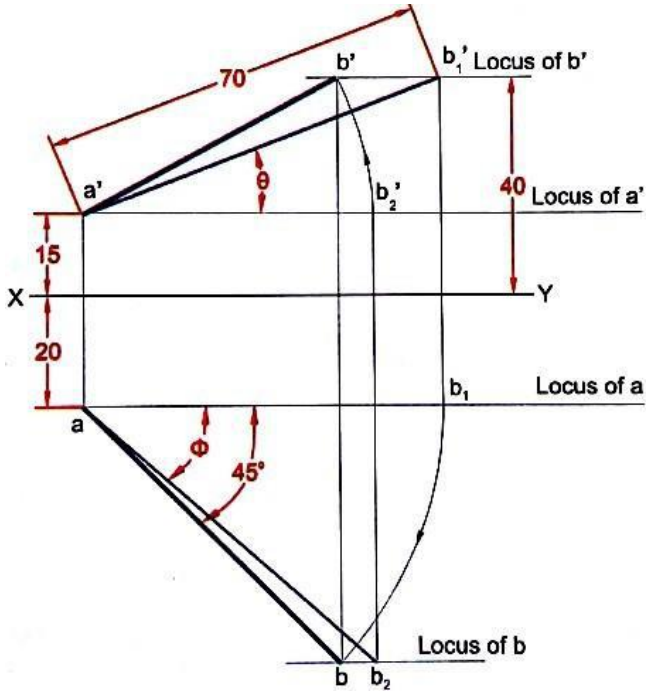


19. The top view of a line is 65mm long and is inclined at30^{0}to the reference line. One end is 20mm above the HP and 10mm in front of VP. The other end is 60mm above the HP and is front view of VP. Draw the projection of the line and find its inclination and length.



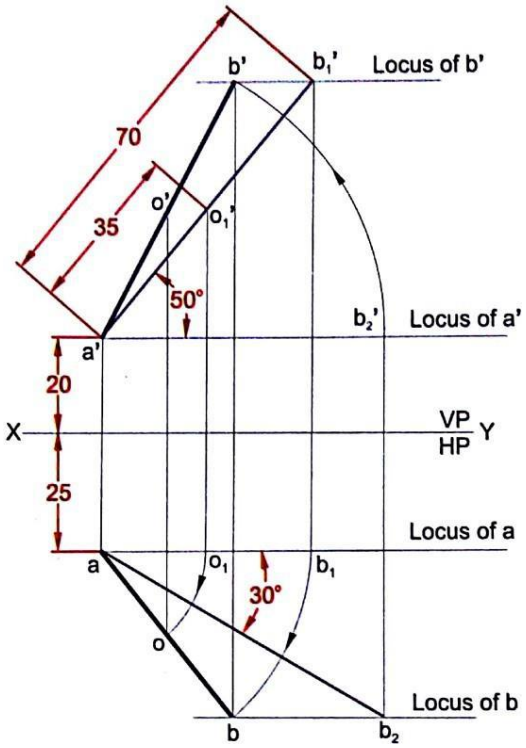
Answer: θ= 32 ^{0} ϕ = 25 ^{0} TL = 76 mm

20. One end A of a line AB is 70 mm long 15 mm above HP and 20 mm in front of VP. The top and front view has a length of 35 mm and 55mm respectively. Draw the projection of the line and find its inclination.

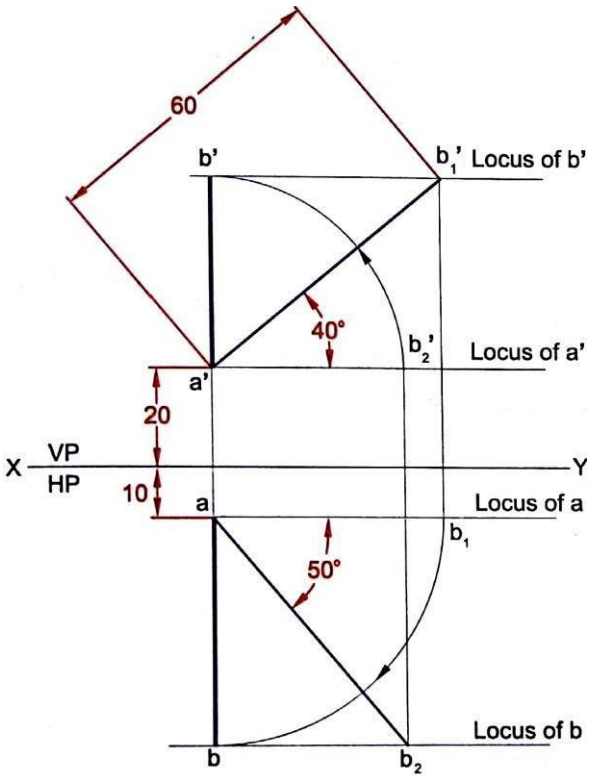


Answer: $\theta = 21^0$ $\phi = 41^0$

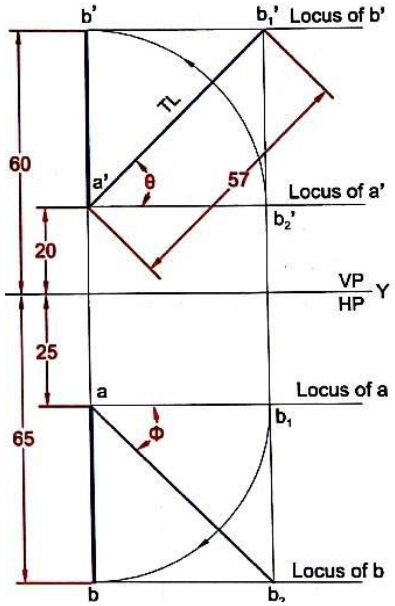
21. One end A of a line AB is 70 mm long 20 mm above HP and 25 mm in front of VP. The line inclined at $50^0$to the HP and 30^0 to the VP. Draw the projection of the line and mark the point O on it, which is 35 mm away from one end of the line.



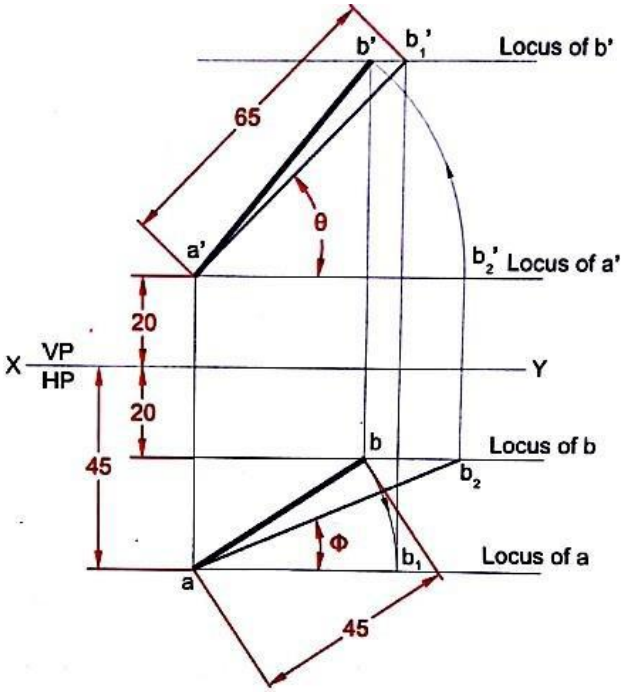
22.A line AB 60 mm long has one of its ends 10 mm in front of the VP and 20 mm above the HP. The line inclined at 40^{0}to the HP and 50^0 to the VP. Draw the projection.



23. A straight line AB has one of its ends 25 mm in front of the VP and 20 mm above the HP and the other end is 60 mm above HP and is in front of VP. The ends of the lines are on the same projector. Draw the projection and find the true length, inclinations Answer: θ= 45 ^{0} ϕ = 45 ^{0} TL = 57 mm



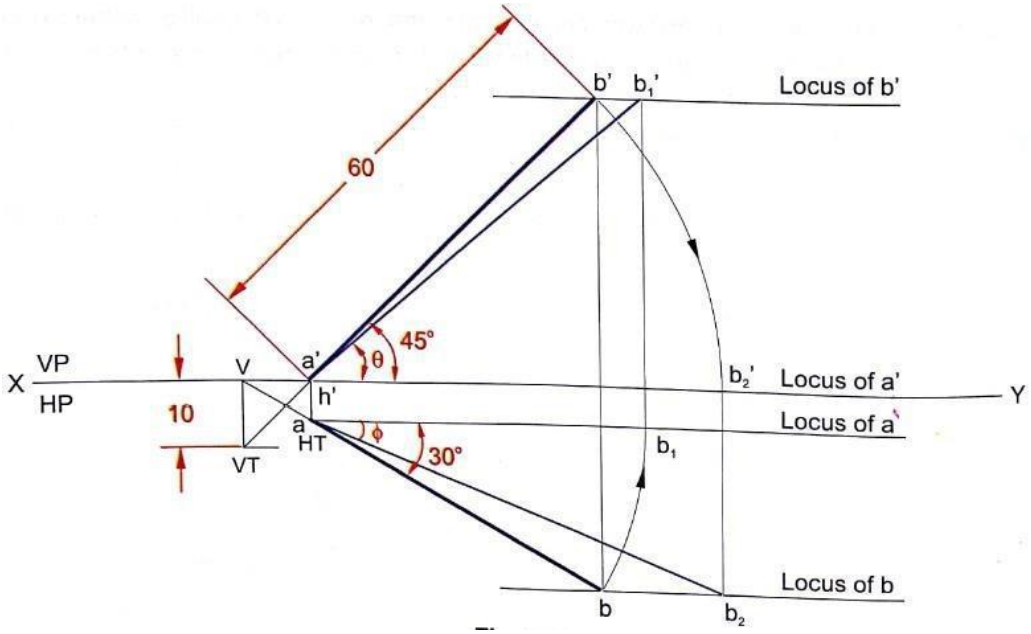
24.A line measuring 65mm long has one of its ends 45 mm in front of the VP and 20 mm above the HP.the top view of the line is45mm long. The other end is above HP and is 20mm in front of VP. The ends of the lines are on the same projector. Draw the projection and find the true length, inclinations



Answer: θ= 46 ^{0} ϕ =23 ^{0}

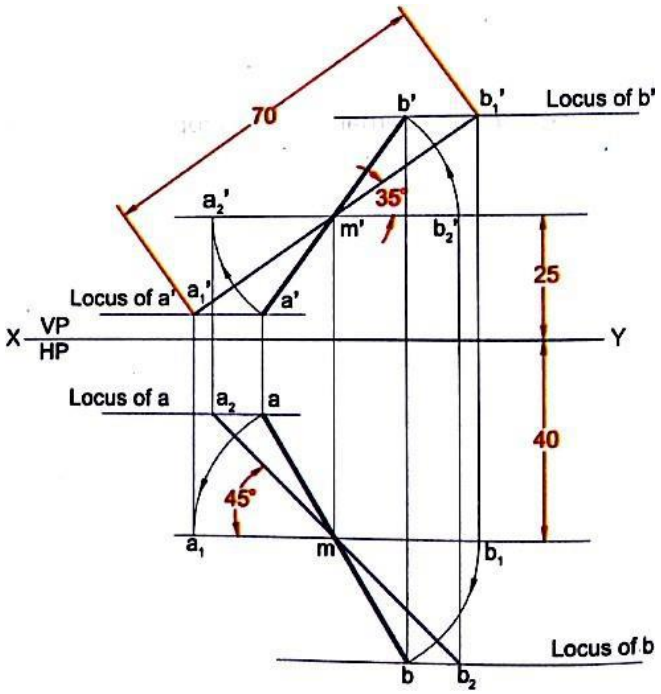
25. The front view of line AB measures 60mm and make an angle of 45^{0}with XY line. The end A is in HP. The vertical trace of the line is 10mm below XY. The top view is inclined 30^0 to XY. Draw the projections, locate its traces.

Answer: θ= 41 ^{0} ϕ =26 ^{0}

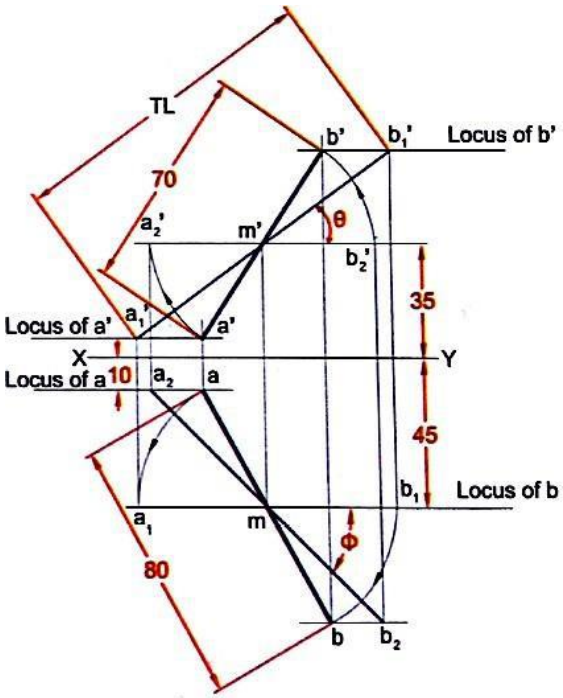


Midpoints Problems

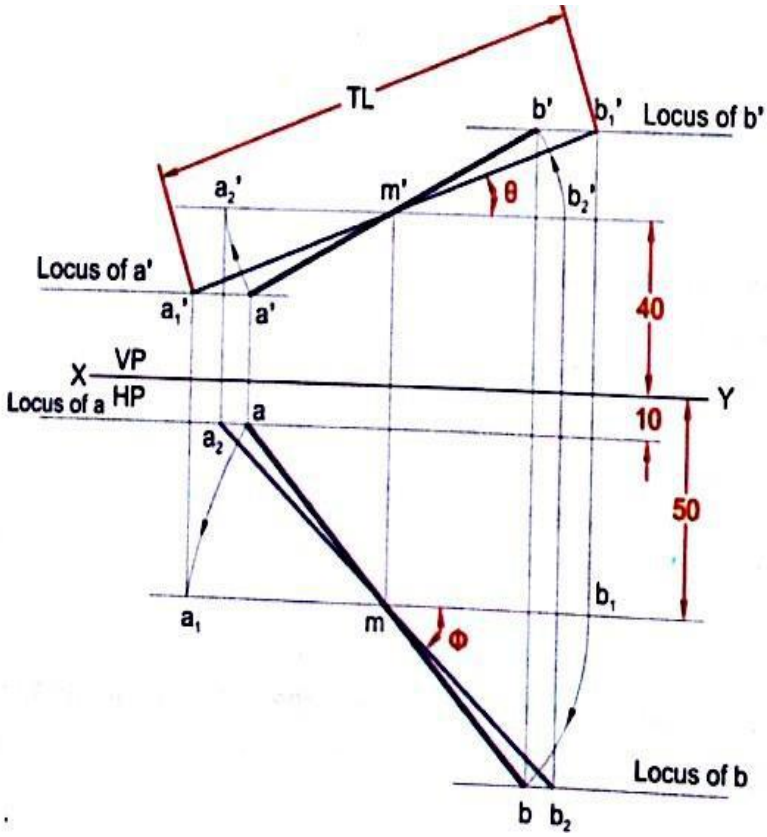
26. The midpoint of line AB 70mm long ,is 25 mm above the HP and 40mm in front ofVP. It's inclined at $35^0$to HP and 45^0 to the VP. Draw its projections



27. The projection of line measuring 80 mm in the top view and 70 mm in the front view the midpoint of the line is 45mm,in front of the VP and 35mm above HP .One end is 10 mm in front of VP and nearer to it. The other end is nearer to HP. Draw the projection and find the true length, inclinations



28.A straight line AB has one of its end A, 10 mm in front of the VP and nearer to it. the midpoint m of the line is 50mm,in front of the VP and 40 mm above the HP.the front and top view measures 90mm and 120 mm respectively. Draw the projection and find the true length, inclinations



PROJECTION OF PLANES

A plane is a two dimensional object having length and breadth only.Its thickness is always neglected .Various shapes of plane figures are considered such as square, rectangle, circle, pentagon, hexagon, etc.

TYPES OF PLANE FIGURES


SQUARE


RECTANGLE

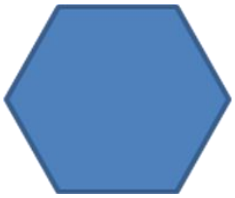

TRIANGLE


CIRCLE


TRAPEZOID


PARALLELOGRAM


PENTAGON


HEXAGON


DIAMOND

TYPES OF PLANES

PERPENDICULAR PLANES

Planes which are perpendicular to one of the principal planes of projection and inclined or parallel to the other

OBLIQUE PLANES

Planes inclined to both the reference planes

TRACE OF PLANE

HORIZONTAL TRACE

The Intersection line of the plane surface with H.P

VERTICAL TRACE

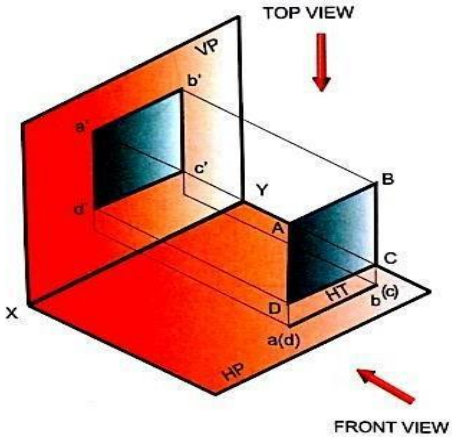
The Intersection line of the plane surface with V.P

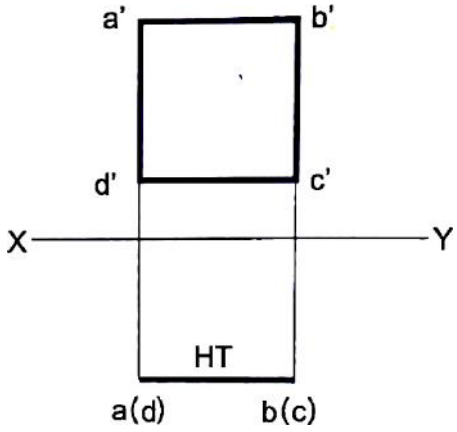
ORIENTATION OF PLANES IN SPACE

The position of Planes in space can be described following

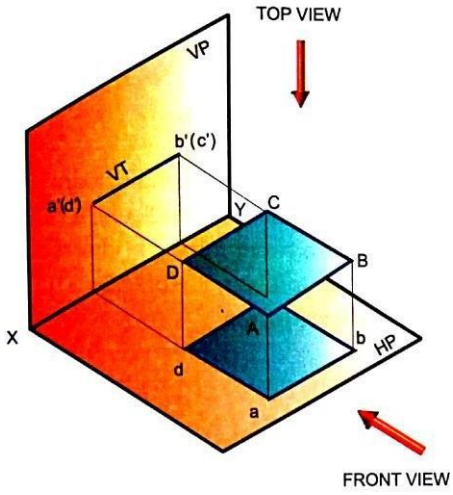
1. Planes Parallel to VP and Perpendicular to HP
2. Planes Perpendicular to VP and Parallel to HP
3. Planes Parallel to both VP and HP OR both Perpendicular VP and HP
4. Planes Perpendicular to VP and Inclined to HP
5. Planes Inclined to VP and Perpendicular to HP
6. Planes Inclined to both VP and HP

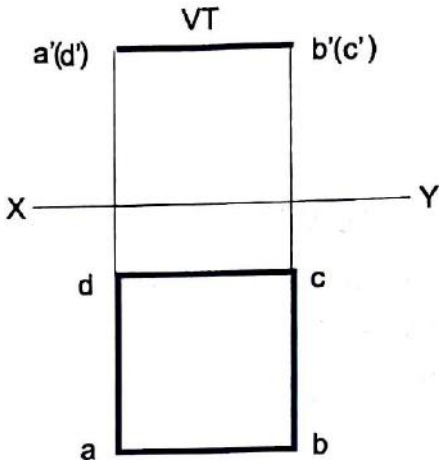
1. PLANE SURFACE PARALLEL TO VP AND PERPENDICULAR TO HP



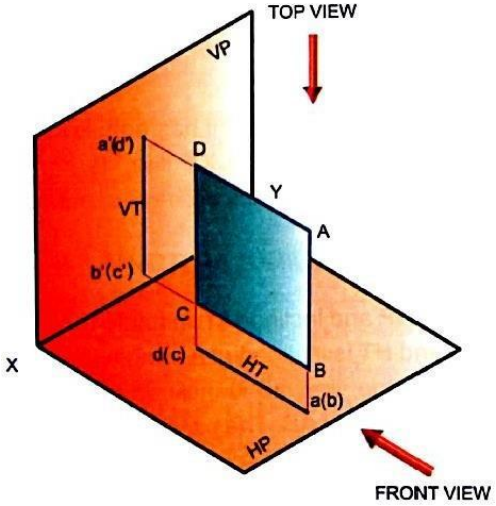


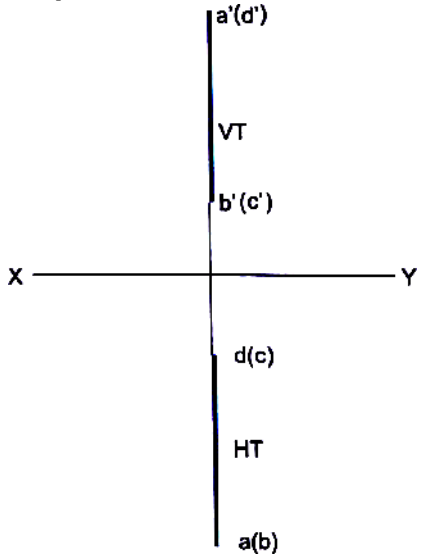
2. PLANE SURFACE PARALLEL TO HP AND PERPENDICULAR TO VP



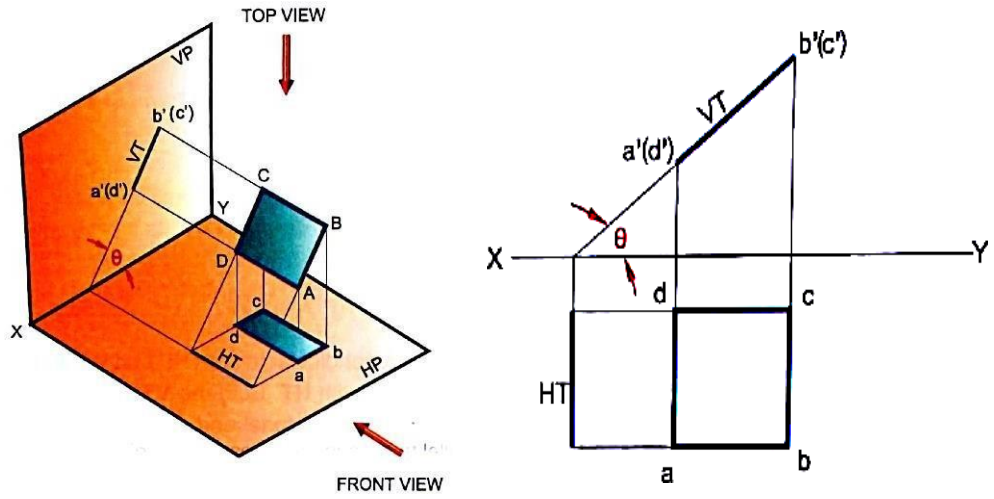


3. Planes parallel to both VP and HP / Both Perpendicular VP and HP

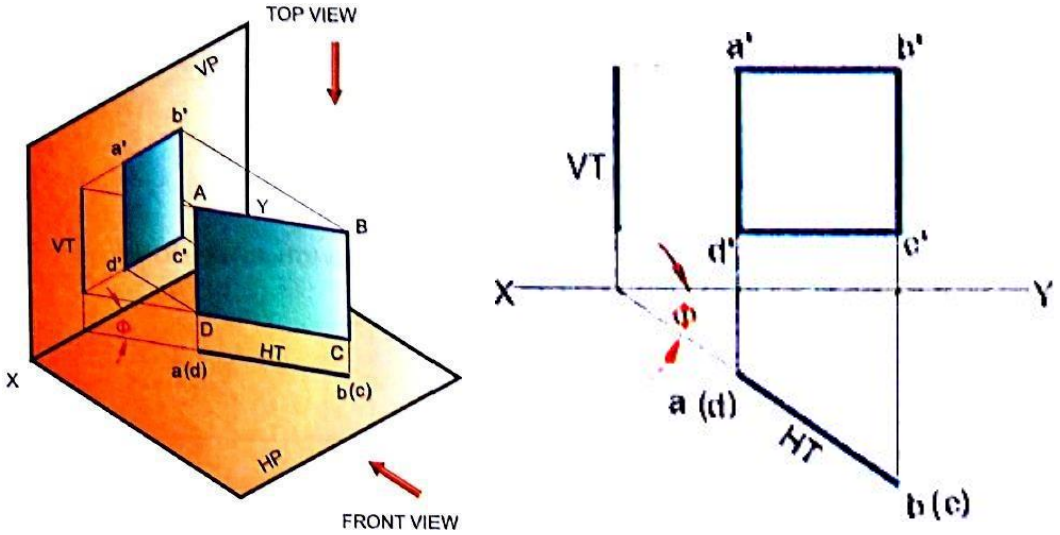




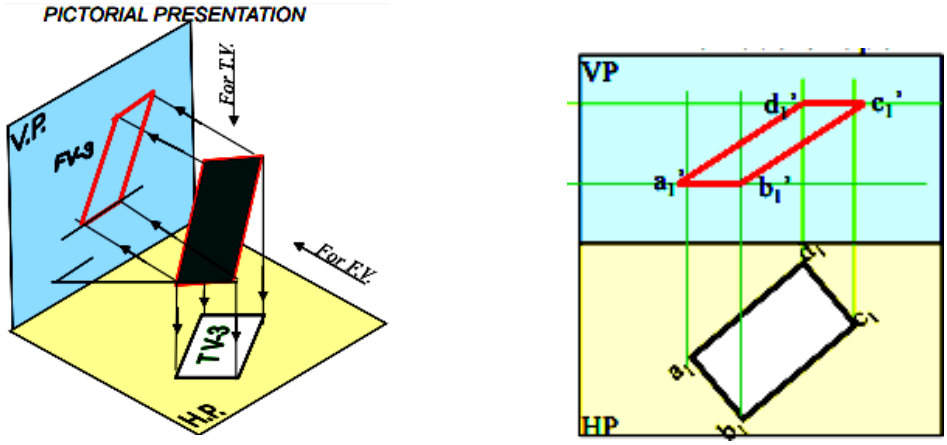
4. Planes Perpendicular to VP and inclined to HP



5. Planes Inclined to VP and Perpendicular to HP

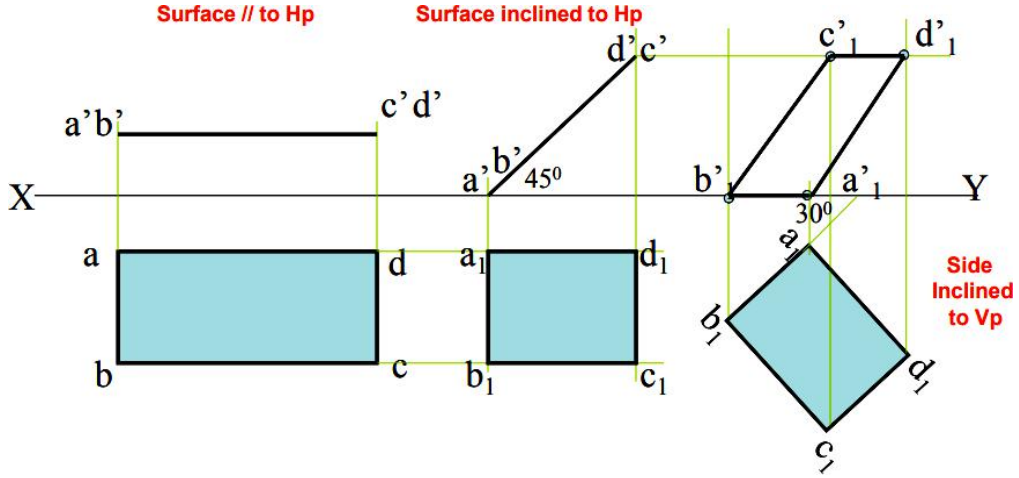


6. Planes Inclined to both VP and HP

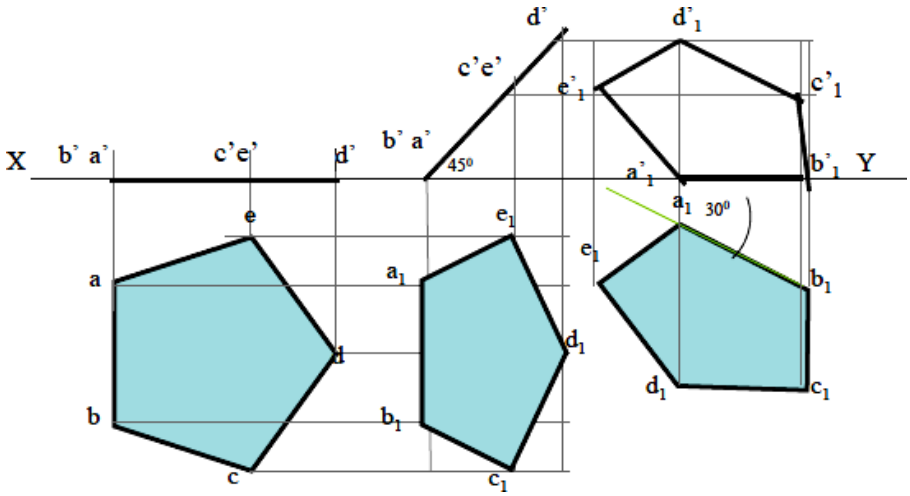


PROBLEMS IN PROJECTION OF PLANES

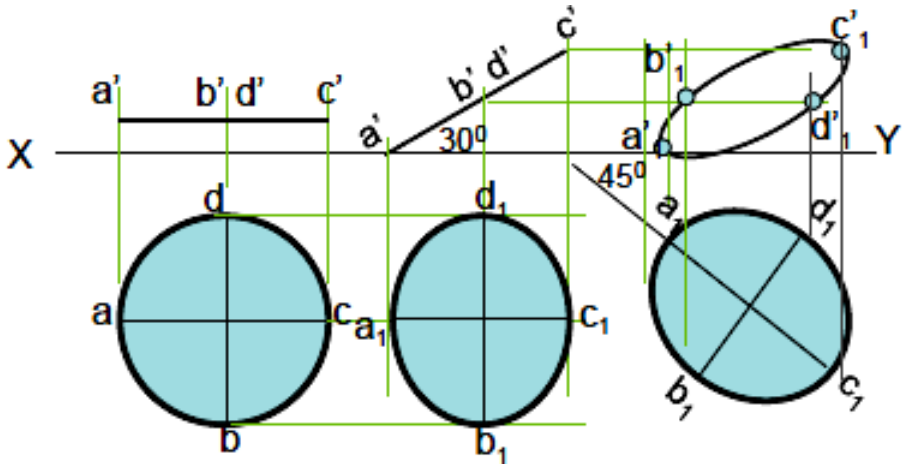
1. Rectangle 30mm and 50mm sides is resting on HP on one small side which is 30^0 Inclined to VP, While the surface of the plane makes 45^0 inclination with HP. Draw it's projections.



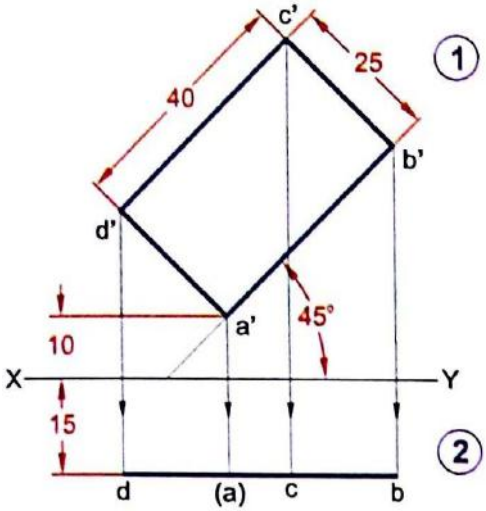
2. A regular pentagon of 30 mm sides is resting on HP on one of its sides with its surface 45^0 inclined to HP. Draw its projections when the side in HP makes 30^0 angle with VP.



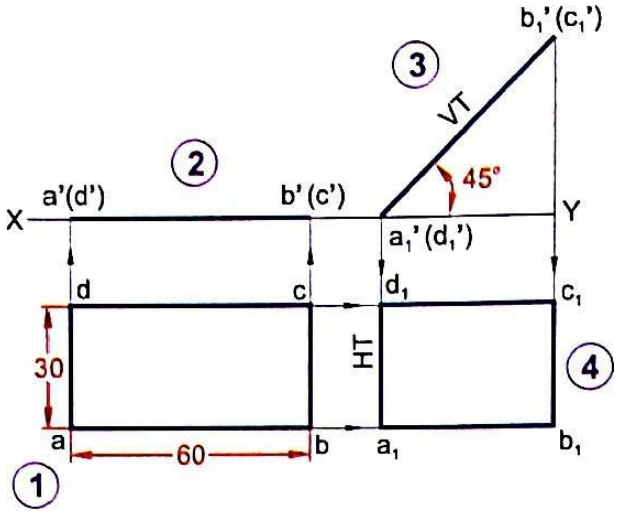
3. A circle of 50 mm diameter is resting on Hp on end A of its diameter AC which is 30^0inclined to Hp while it's TV is 45^0inclined to VP. Draw its projections.



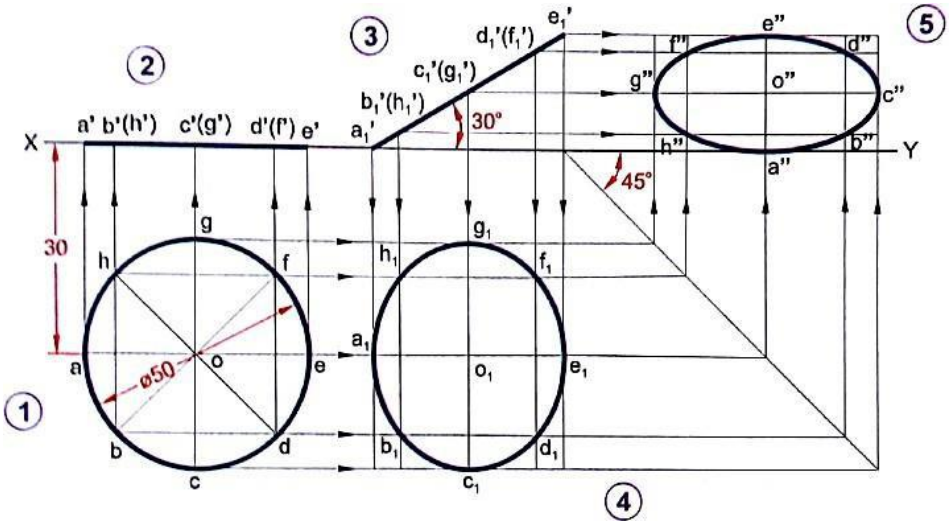
4. A rectangle ABCD of size40x25 has the corner A, 10mm above HP and 15 mm in front of VP. All the sides of the rectangle are equally inclined to HP and parallel to VP. Draw the projection of lamina.



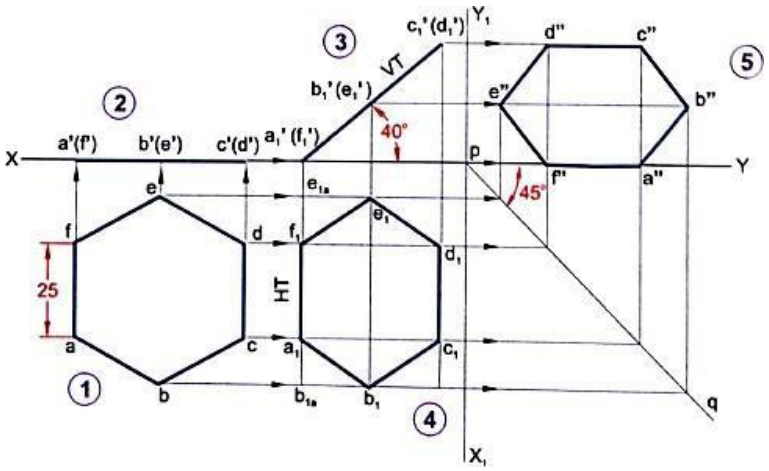
5. A rectangular lamina ABCD is perpendicular to VP and inclined at 45⁰ to the HP. Draw its projections and obtains the traces.



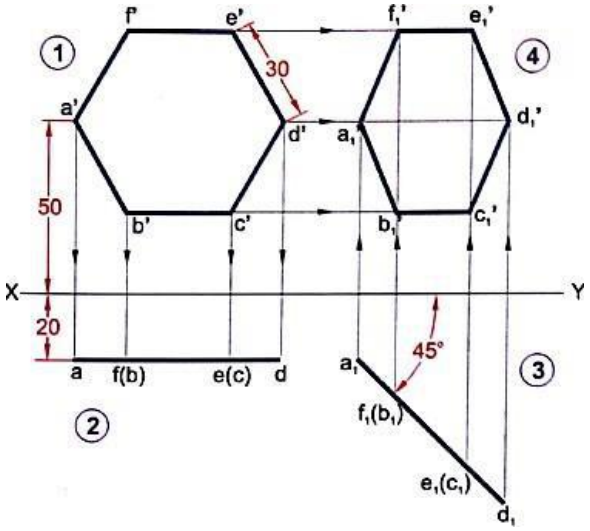
6. A circle of 50 mm diameter inclined at 30⁰ to the HP and perpendicular to VP has its centre 30 mm in front of VP. Draw its front, top and side views.



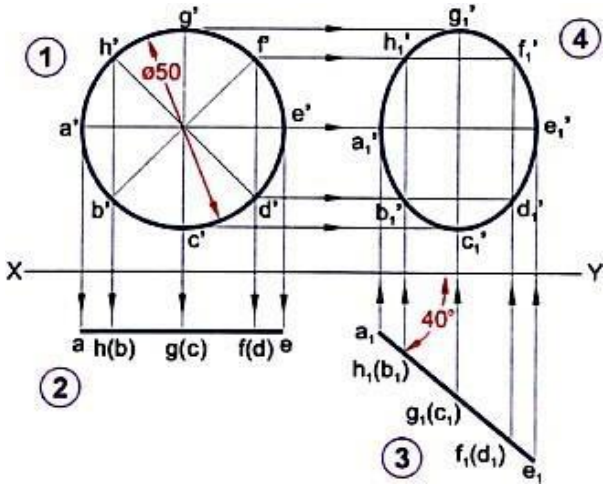
7. A regular hexagon of 25 mm side has its one edge on HP. The surface of the lamina is perpendicular to VP and inclined at 40^0 to HP. Draw the three views of the plane and locates the traces.



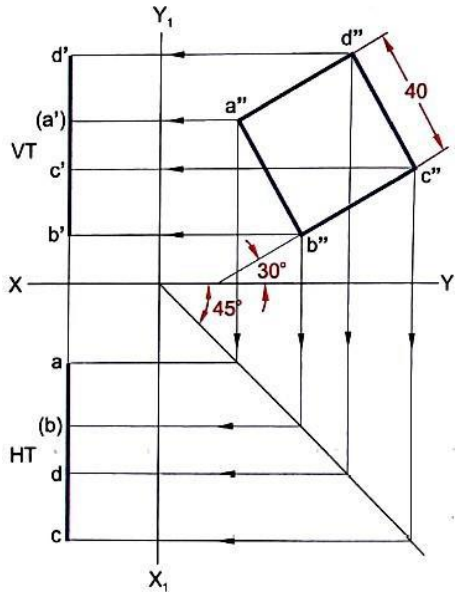
8. A hexagonal plate of 30mm side has a corner at 20 mm from VP and 50 mm from HP. Its surface is inclined at 45^0 to the VP perpendicular to HP. Draw the projections of the plate.



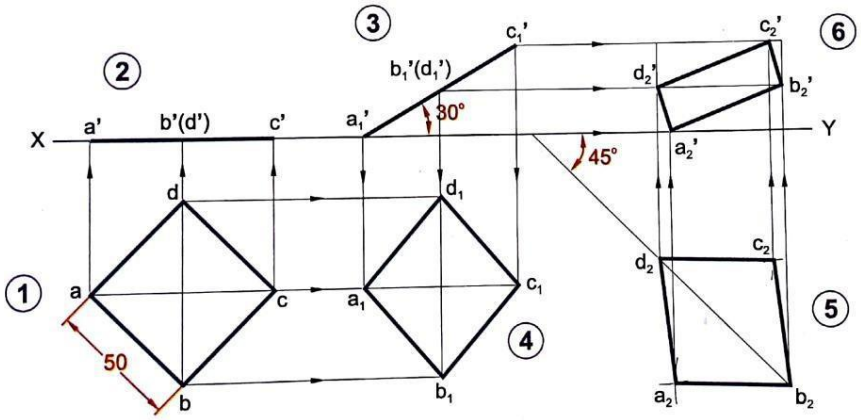
9. A circular lamina of diameter 50 mm lies in a plane inclined at 40^{0}to VP and perpendicular to HP. Draw its front and top views.



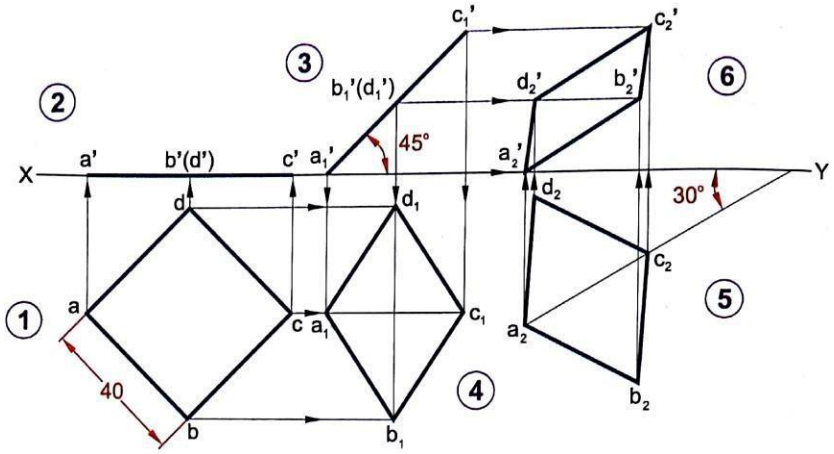
10. A square plate of side 40mm has its surface perpendicular to both HP and VP. One of the sides of the plate is inclined at 30^0 to HP. Draw its projections and also its traces.



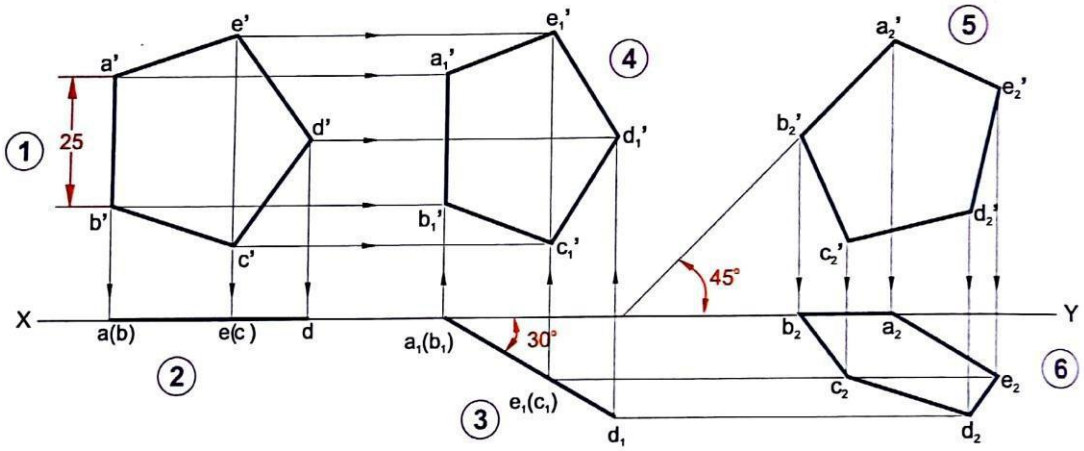
11. A square ABCD of 50 mm side has its corner A on the ground its diagonal AC inclined at 30^0 to the HP and the diagonal BD inclined at 45^{0}to the VP and parallel to the HP. Draw its projections.



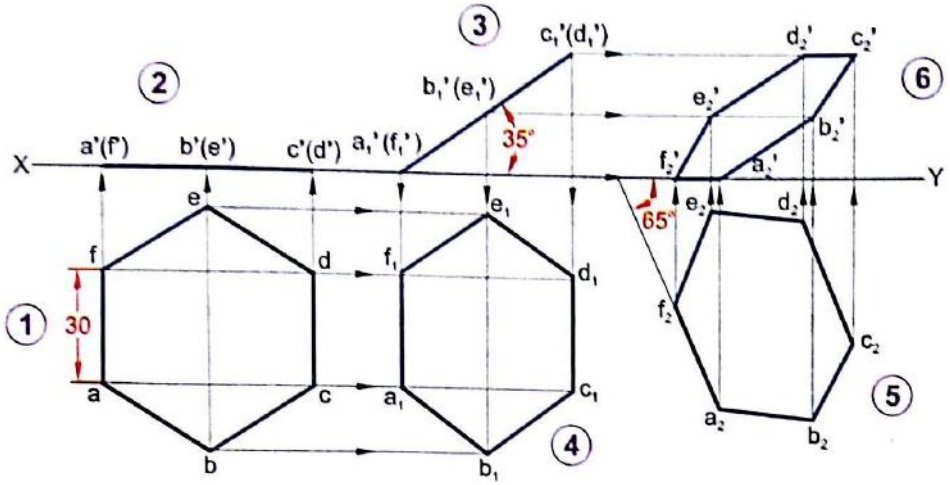
12. A square lamina ABCD of 40 mm side has its corner A on the ground its diagonal AC inclined at 45^0 to the HP and apparently inclined at 30^{0}to the VP. Draw its projections.



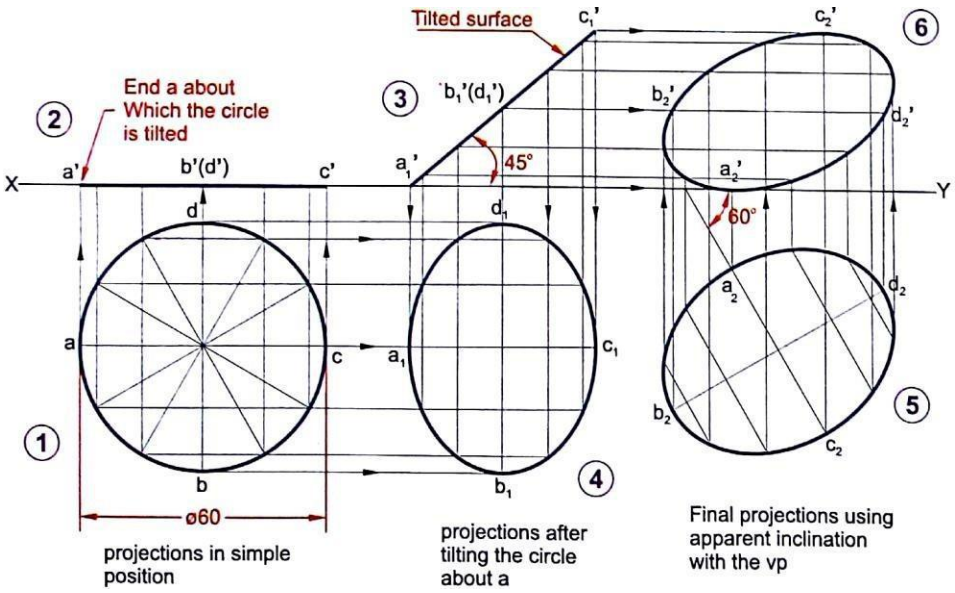
13. Draw the projection of a pentagonal sheet of 25 mm side resting on VP, having its surface inclined at 30^{0}to VP. Its one side is parallel to VP and inclined at 45^0 to HP



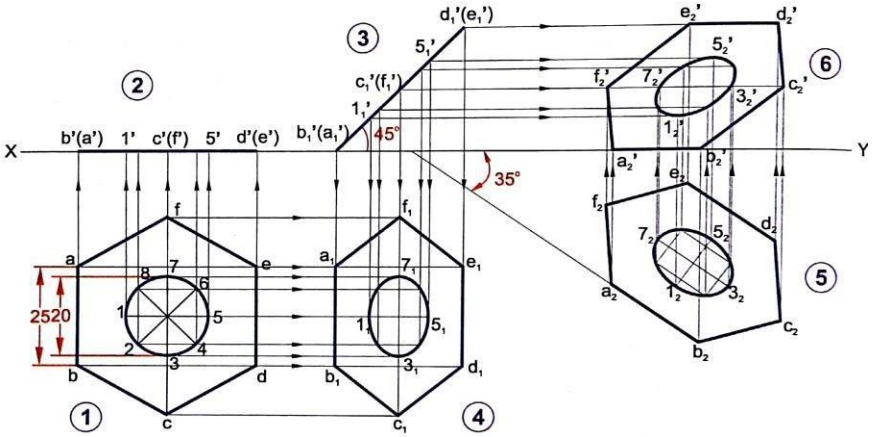
14. Draw the projection of a hexagonal of 30 mm side, having one of its side in HP and top view inclined at 65^{0}to VP. And the surface inclined at 35^0 to HP.



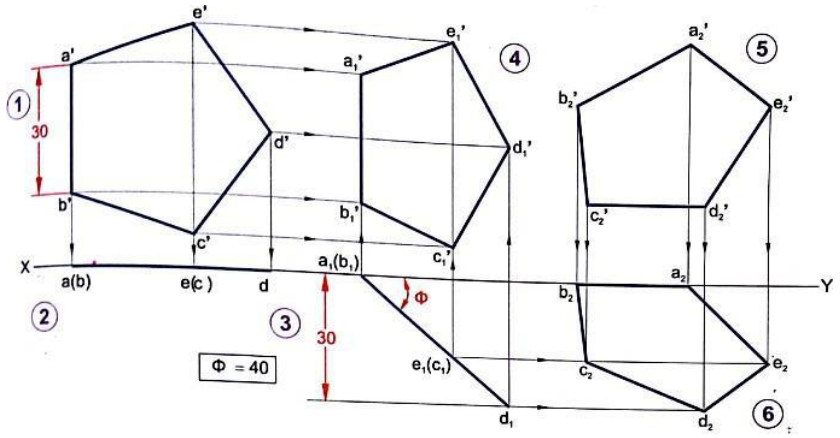
15. A circular plate of diameter 60 mm has the end A of the diameter AB in the HP and the plate is inclined at 45^0 to the HP. Draw its projections when the diameter AB appears to be inclined at 60^0 to the VP in the top view.



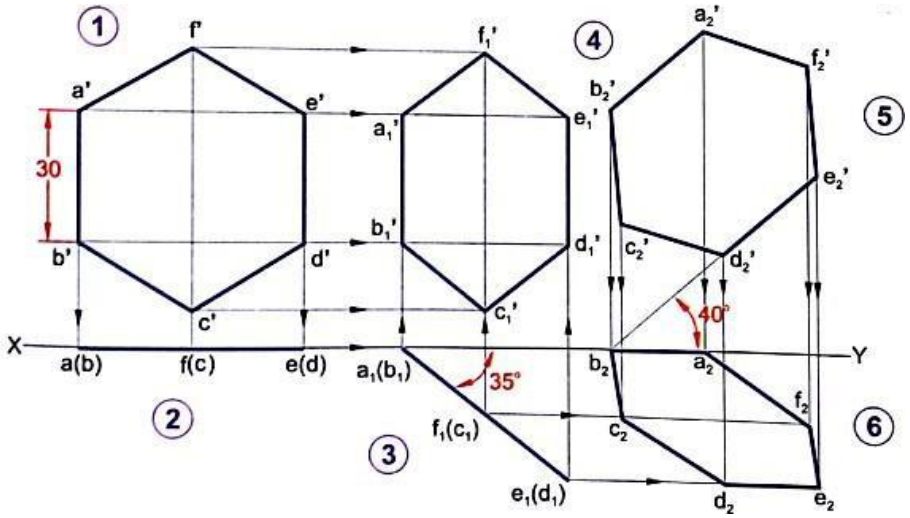
16. A regular hexagonal lamina of 25 mm side has a central square hole of 20 mm size. Draw the front and top views when the surface of the lamina is inclined at 45^0 to the HP. A side of lamina is inclined at 35^0 to VP



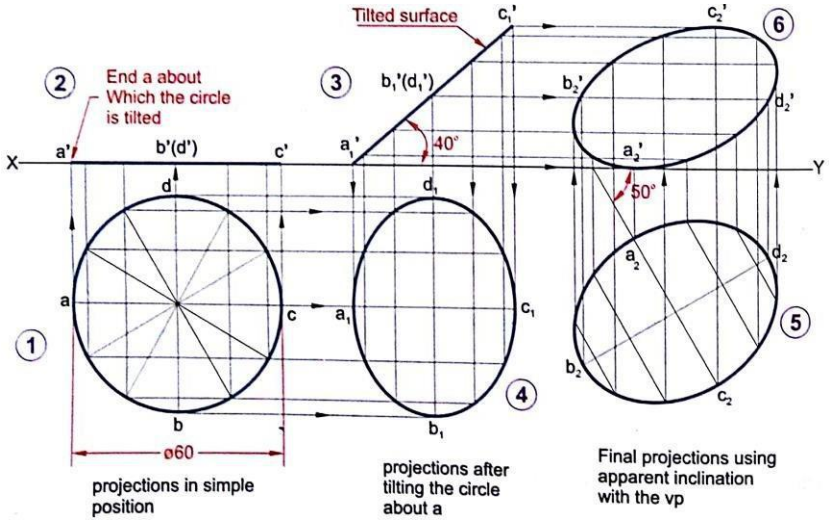
17. ABCDE is a thin pentagonal plate of 30 mm sides. The edge AB in the VP and the edge CD is parallel to the HP. The corner D is 30 mm away from the VP. Obtain the projection of the plane and find its inclinations with the reference plane



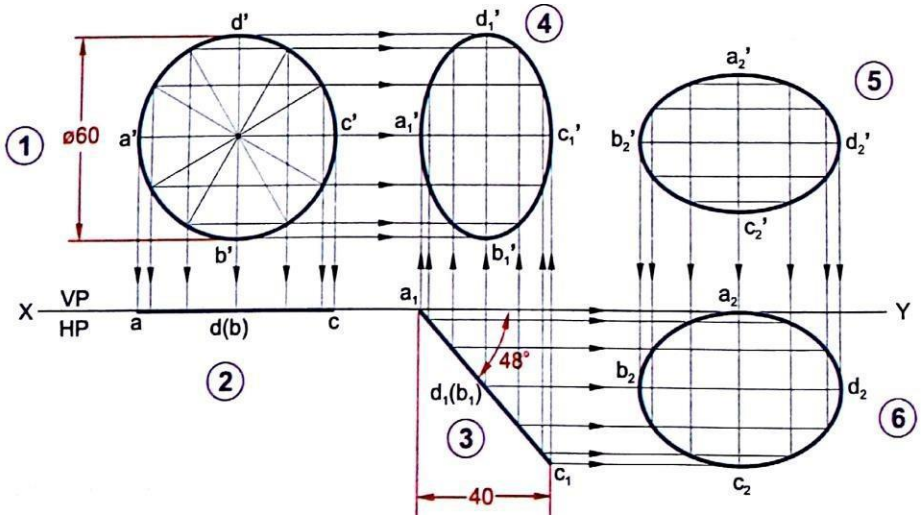
18. A hexagonal lamina of side 30 mm is resting on one of its sides and inclined at 400 to the HP. its surface is inclined at 350 to the VP. Draw the projections



19. A circular lamina of diameter 60 mm has the end A of the diameter AB in the HP and the end B on the VP. Draw its projections when the surface inclined at 40^0 to the HP and 50^0 to VP.



20. A thin circular plate with 60 mm diameter appears in the front view as an ellips of major and minor axes are 60 mm and 40 mm length respectively. Draw the projection of circular plate when one of the diameters in parallel to both the reference plane.



PROJECTIONS OF SOLIDS

Introduction

An object having three dimensions, i.e., length, breadth and height is called as solid. In orthographic projection, minimums of two views are necessary to represent a solid. Front view is used to represent length and height and the top view is used to represent length and breadth.

Sometimes the above two views are not sufficient to represent the details. So a third view called as side view either from left or from right is necessary.

Objectives

At the end of this session, you will be able to

- Classify the different types of solids
- Draw the projections of solids in various positions in the given quadrant

Classification of Solids

Solids are classified into two groups. They are

- Polyhedra
- Solids of Revolution

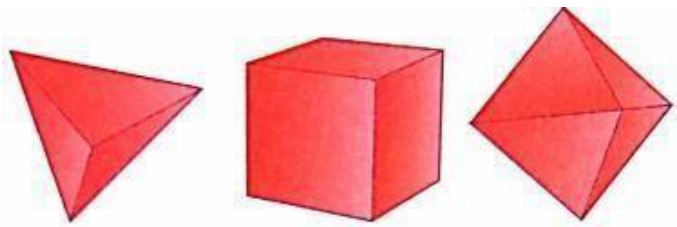
Polyhedra

A solid, which is bounded by plane surfaces or faces, is called apolyhedron. Polyhedra are classified into three sub groups; these are

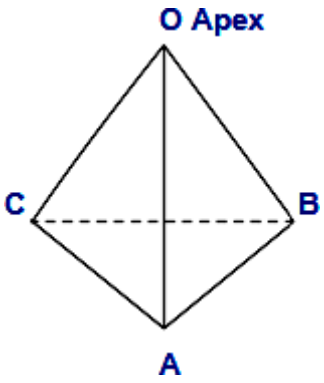
1. Regular Polyhedra
2. Prisms
3. Pyramids

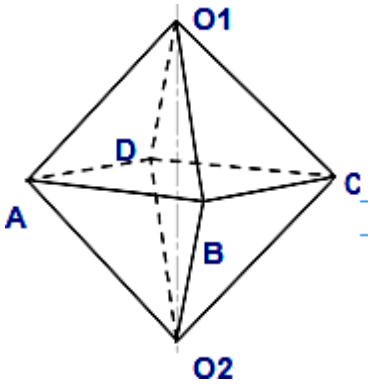
1. Regular Polyhedra

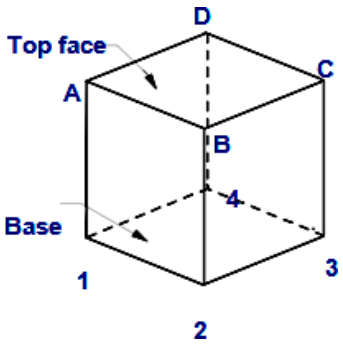
Polyhedra are regular if all their plane surfaces are regular polygons of the same shape and size. The regular plane surfaces are called "Faces" and the lines connecting adjacent faces are called "edges".



Tetrahedran **Octahedran** **Hexahedran**

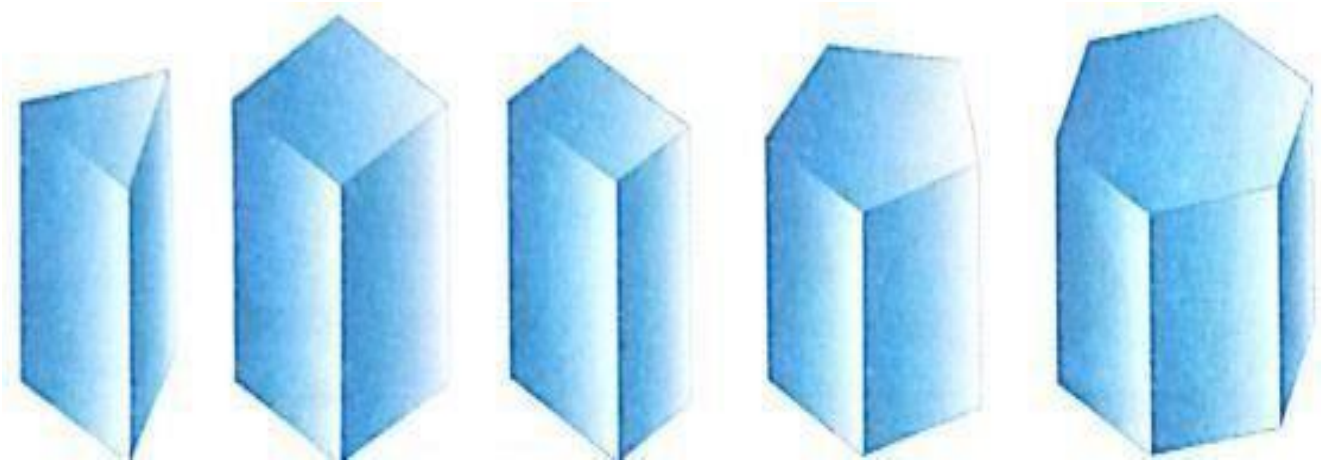




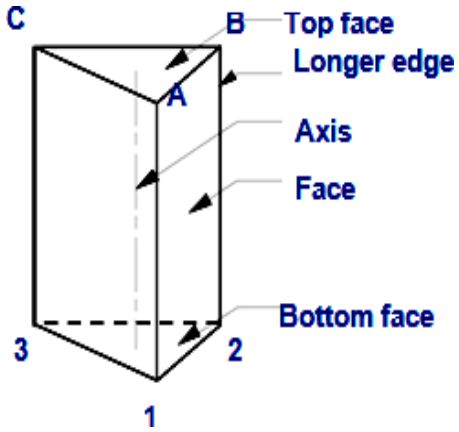


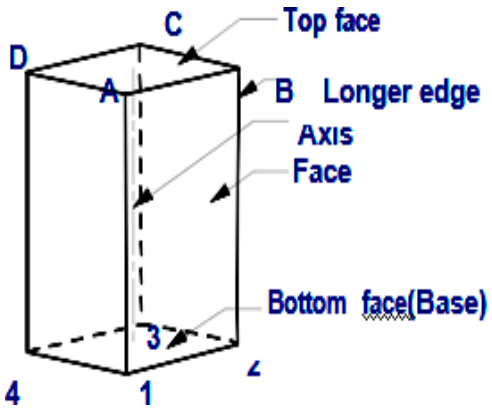
2. Prisms:

A prism has two equal and similar end faces called the top face and the bottom face or (base) joined by the other faces, which may be rectangles or parallelograms.

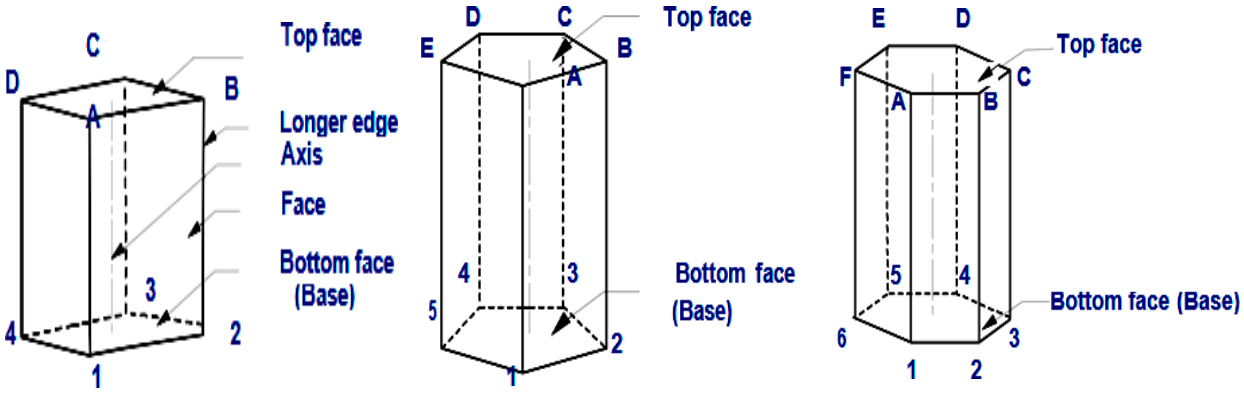


Triangular prism **Square Prism**



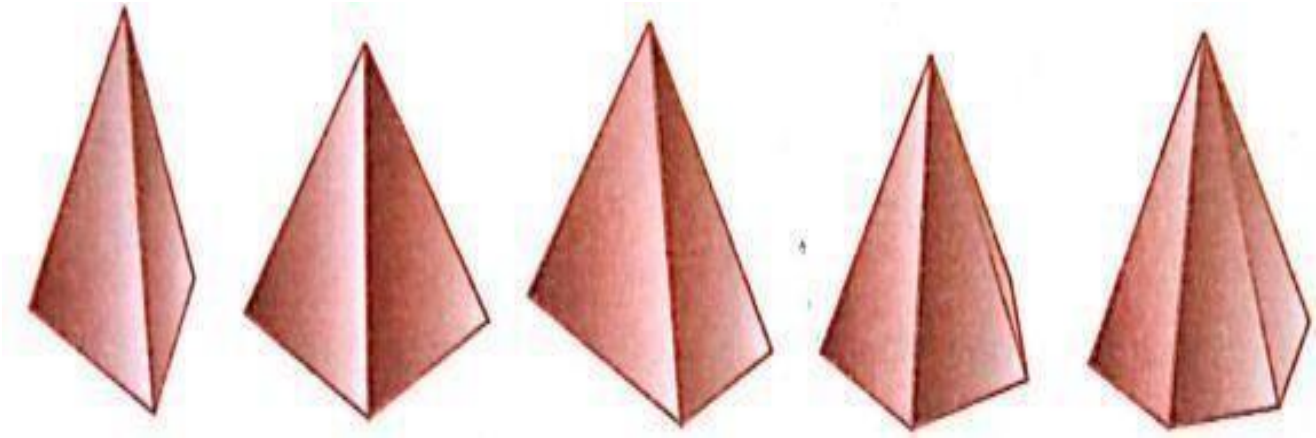


Rectangular Prism **Pentagonal Prism** **Hexagonal Prism**

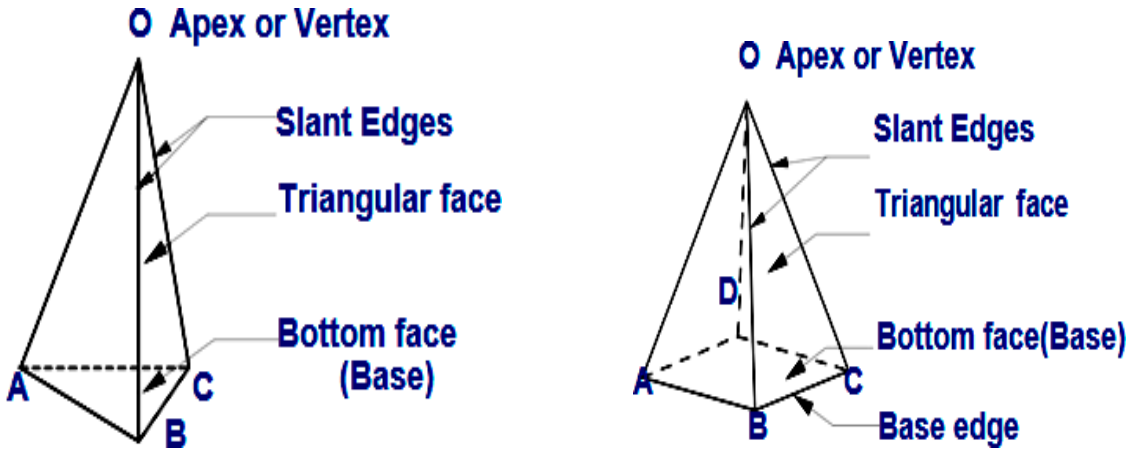


3. Pyramids:

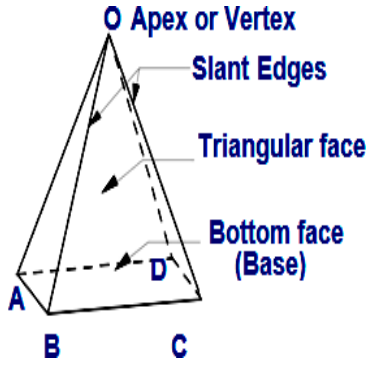
A pyramid has a plane figure as at its base and an equal number of isosceles triangular faces that meet at a common point called the "vertex" or "apex". The line joining the apex and a corner of its base is called the slant edge. Pyramids are named according to the shapes of their bases.

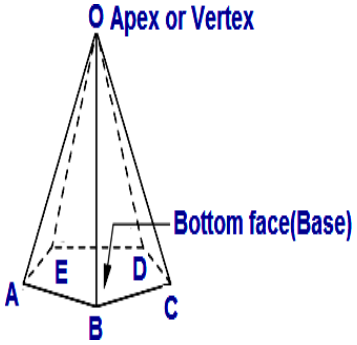


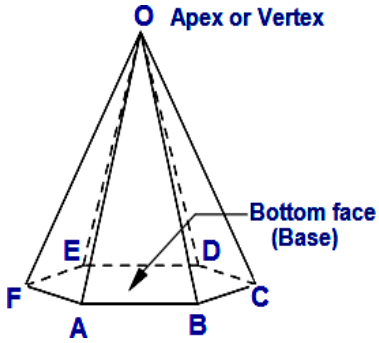
Triangular Pyramid **Square Pyramid**



Rectangular Pyramid **Pentagonal Pyramid** **Hexagonal Pyramid**

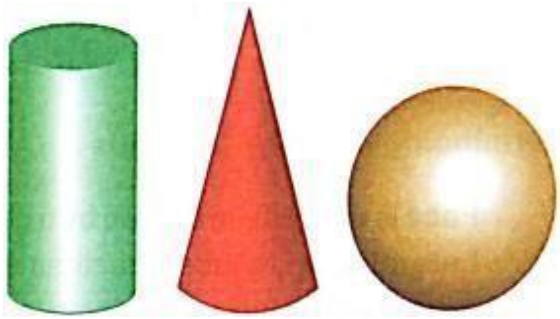






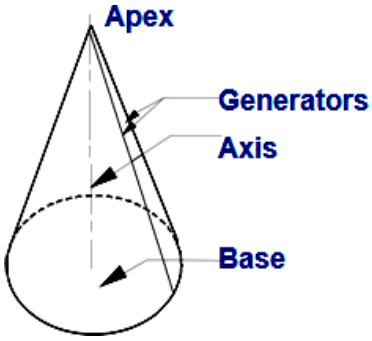
Solids of Revolution:

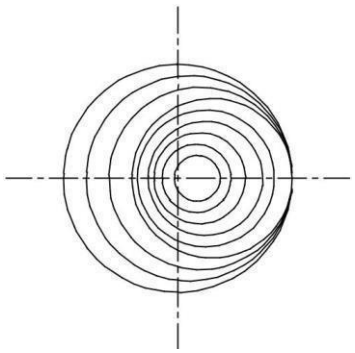
If a plane surface is revolved about one of its edges, the solid generated is called a Solid ofRevolution.

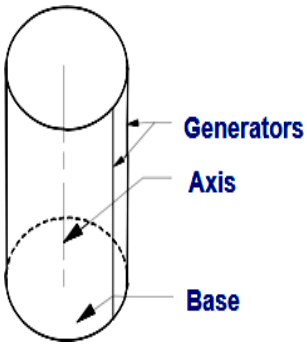


Cone

A cone can be generated by the revolution of a right-angled triangle about one of its perpendicular sides, which remains fixed. A cone has a circular base and an apex. Theline joining apex and the centre of the base is called the “Axis” of the cone.







Sphere

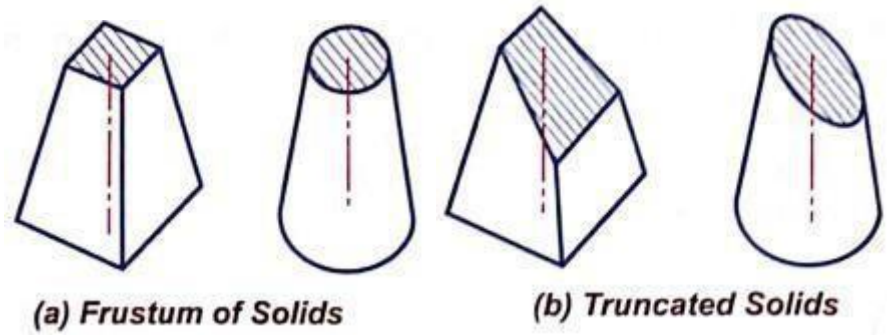
A sphere can be generated by the revolution of a semi-circle about its diameter that remains fixed.

Cylinder

A right circular cylinder is a solid generated by the revolution of a rectangular surface aboutone of its sides, which remains fixed. It has two circular faces. The line joining the centres of the top and the bottom faces is called “Axis”.

FRUSTUMS AND TRUNCATED SOLIDS

When a solid is cut by a plane parallel to its base, thus removing the top portion, the remaining lower portion is called **frustum**. When a solid is cut by a plane inclined to its base, thus removing the top cut portion, the remaining lower portion of the solid is called **truncated.**



(a) Frustum of Solids *(b) Truncated Solids*

Terms used in solids

Face - The surface formed by closed figure.

Lateral face - A face other than end face or base

Axis - A imaginary line joining the centres of ends or base and apex

Base -The resting face of solid

Corners -The intersection of edges

Apex/vertex - The point at which the lateral edge meet**Edge** - The line of intersection of faces **Regular solid** - Solid which has equal faces

Oblique solid - Solid which has its axis inclined to the base

Generators - An imaginary edge on the lateral surfaces of cylinder/cone

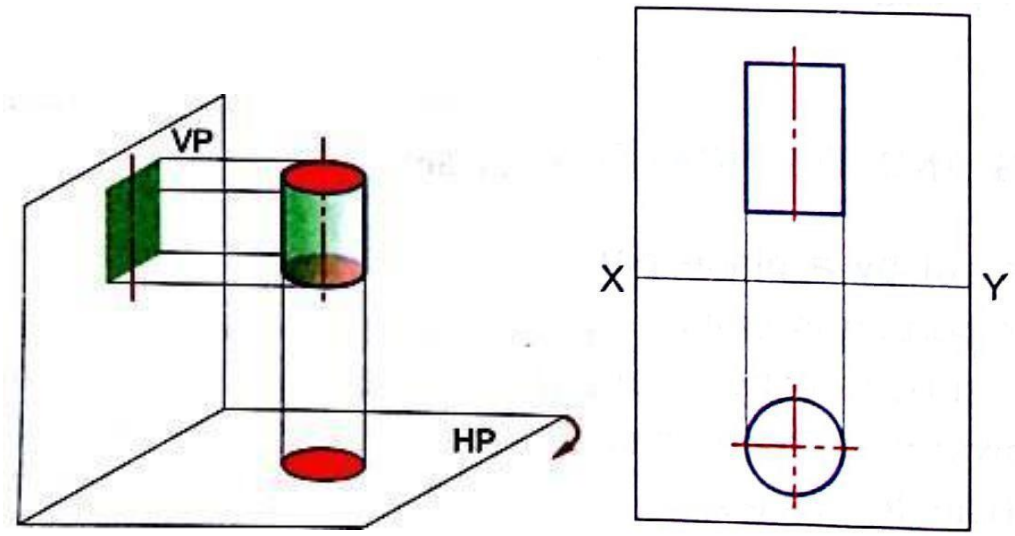
Slant edge - The edge joining apex and corner

Frustum - Solid is cut parallel to the base and removing the top portion

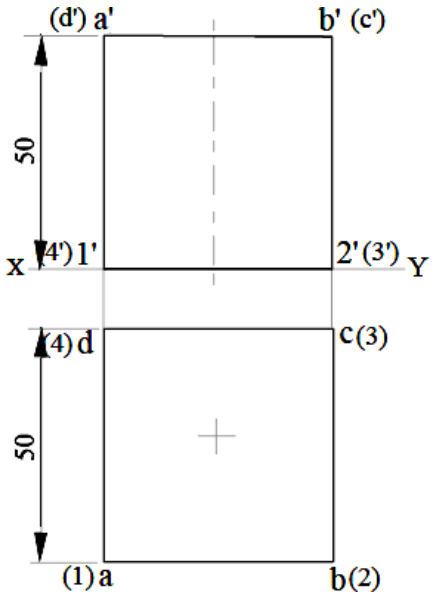
Truncated - Solid is cut inclined to the base and removing the top cut portion

Projections of Solids

Perpendicular to the HP

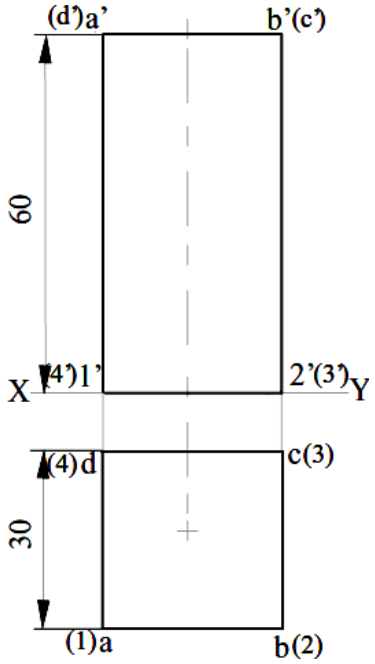


1. A cube of 50mm side is resting with one of its square faces on the HP.
   1. Draw the line XY.
   2. Draw the top view as a square (Side 50 mm) and name its corners.
   3. Draw projectors at each corner of the top view through line XY.
   4. Draw the front view as a square (Side 50 mm) and name its corners.
   5. Dimension the completed drawing.

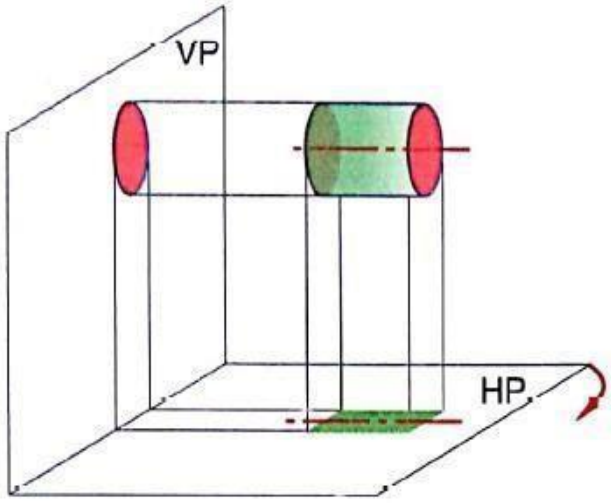


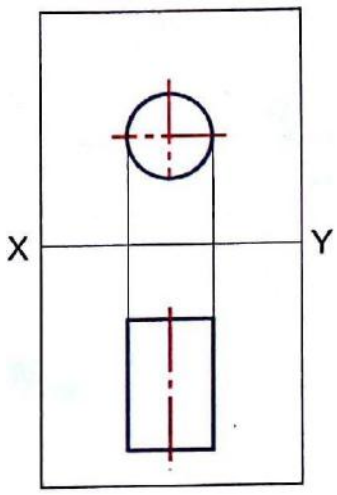
2. A square prism of base 30mm and height 60mm is resting with its base on the HP and one of its vertical faces perpendicular to the VP.

1. Draw the line XY
2. Draw the top view as square and name its corners.
3. Draw projectors from each corner of the top view through XY.
4. Draw the front view as shown and name its corners.
5. Dimension the completed drawing.

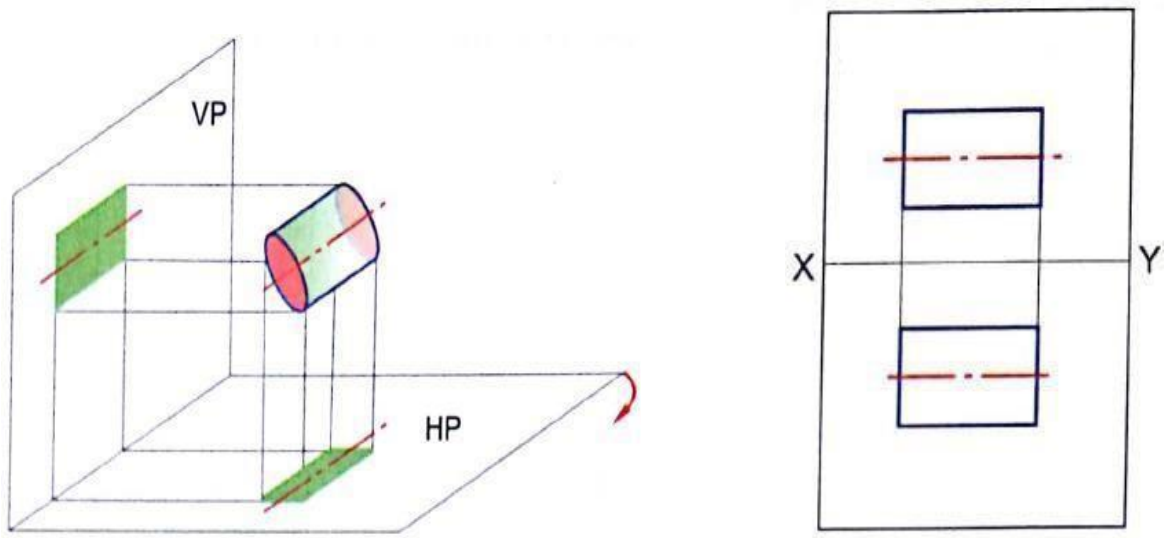


Perpendicular to the VP



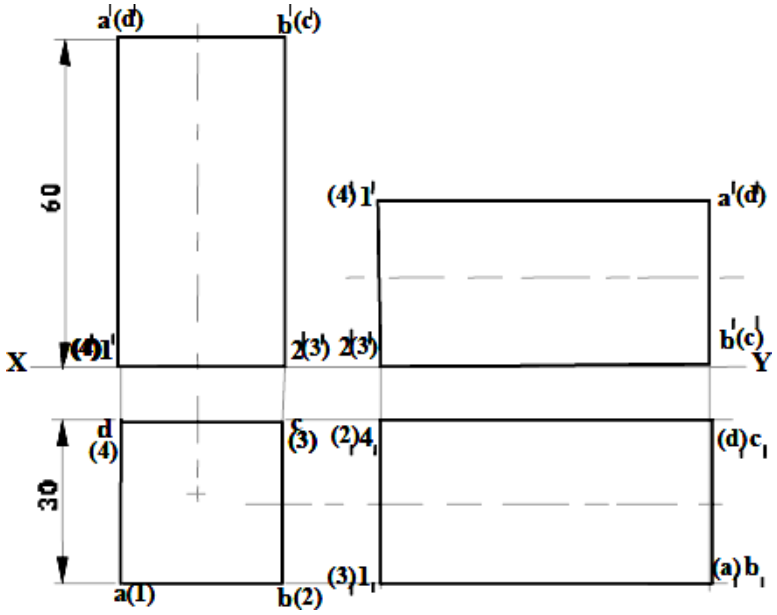


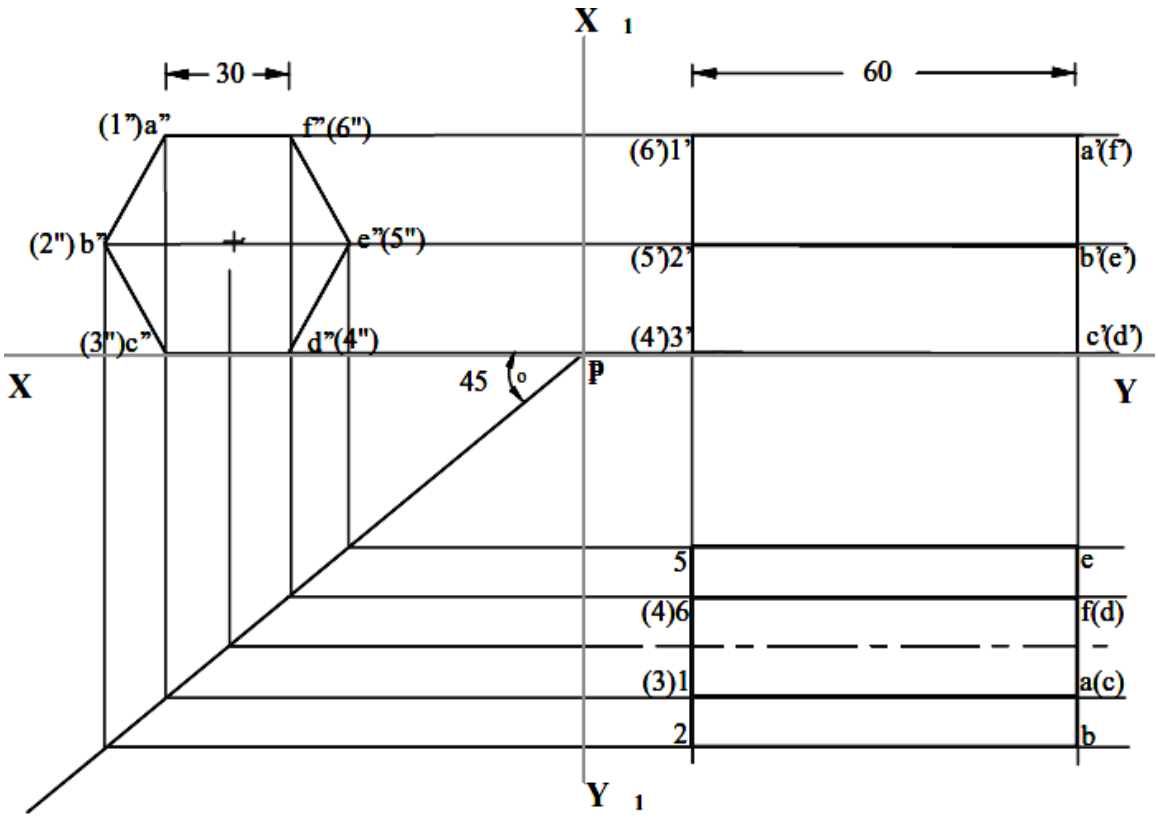
Parallel to the HP and the VP



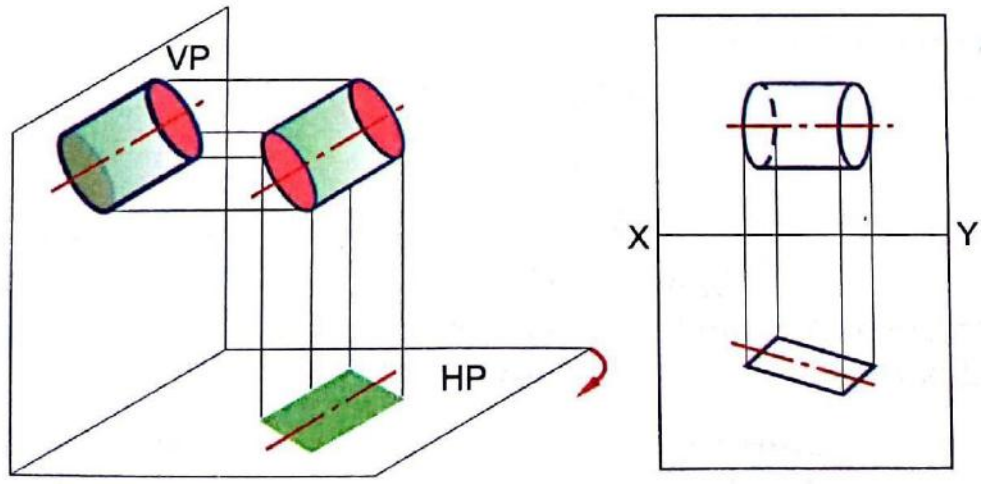
1. A square prism of base 30mm and axis 60mm long lies on the HP, such that its axis is parallel to both the HP and the VP.

1. Draw the line XY.
2. Draw the projections (top and front views) of the solid in simple position (an edge ofits base is perpendicular to the VP).
3. Rotate the front view through 90°.
4. Draw projectors from the rotated front view and the initial top view and name the pointsof intersection.
5. Join the points correspondingly to get the final top view.



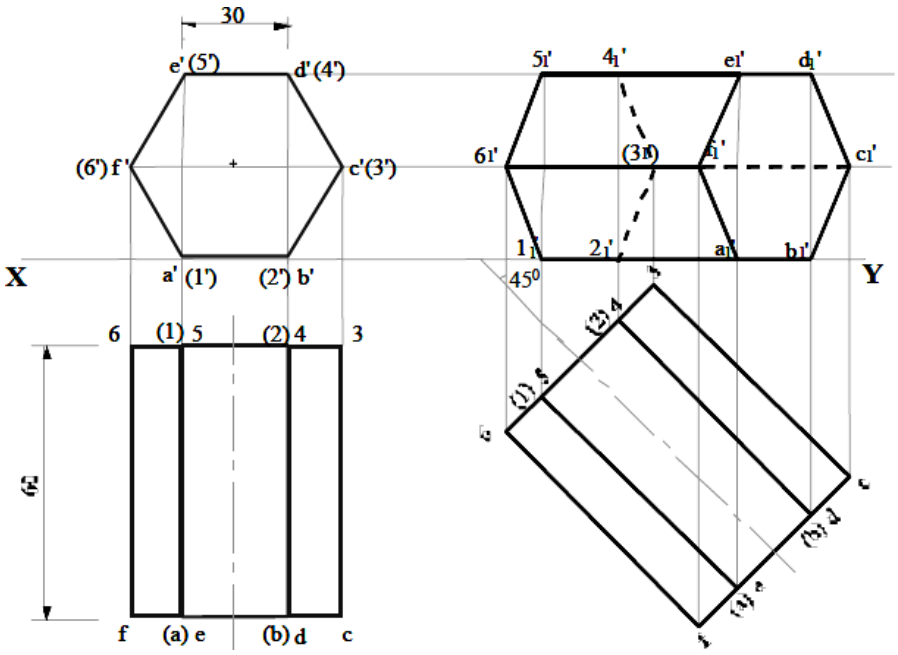


Parallel to the HP and Inclined to the VP

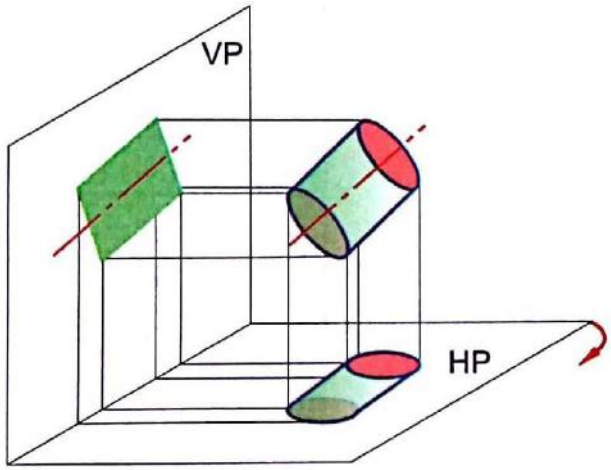


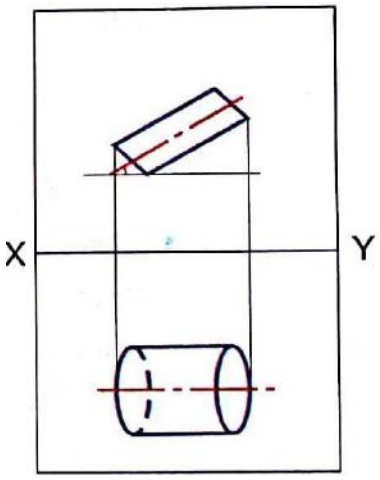
1. A hexagonal prism of base 30mm and height 60mm lies on one of its rectangular faces lies on the HP, such that its axis is inclined at 45° to the VP.

1. Draw the line XY.
2. Draw the projections of the prism in simple position.
3. Rotate the axis of the top view through 45° with respect to XY.
4. Draw projectors from the rotated top view and the initial front view and name the points of intersection..
5. Join all the points correspondingly to get the final front view.



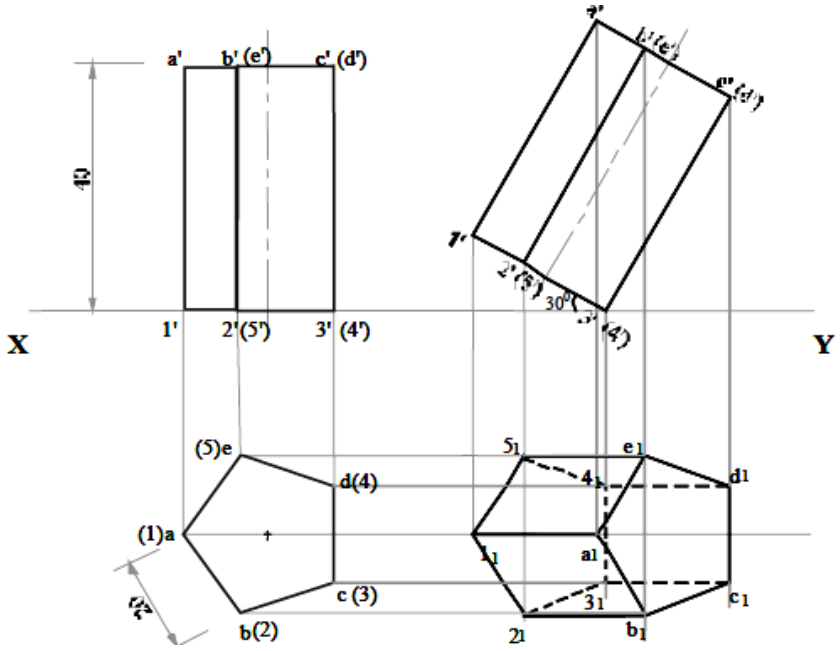
Parallel to the VP and Inclined to the HP





(3',4') rests on the HP.

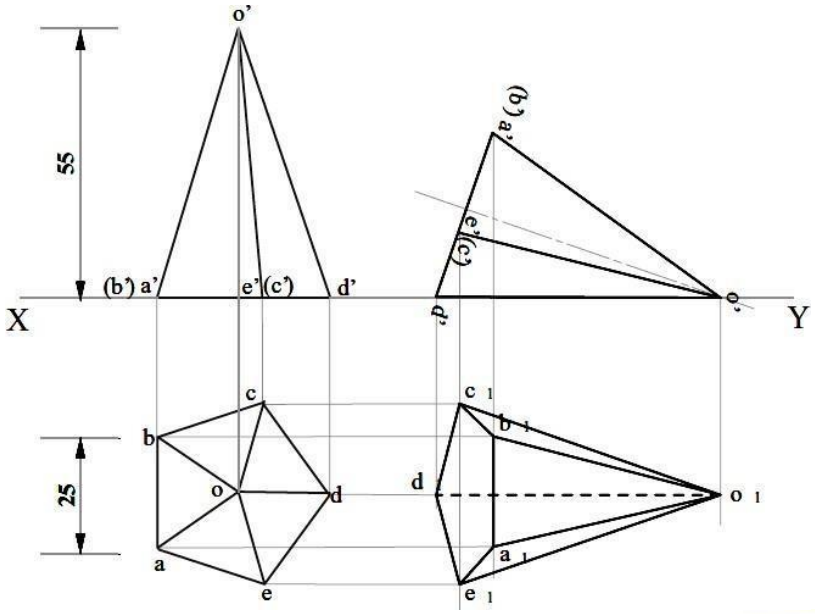
4. Draw projectors from the rotated front view and the initial top view and name the points of intersections.
5. Join the points correspondingly to get the final top view.

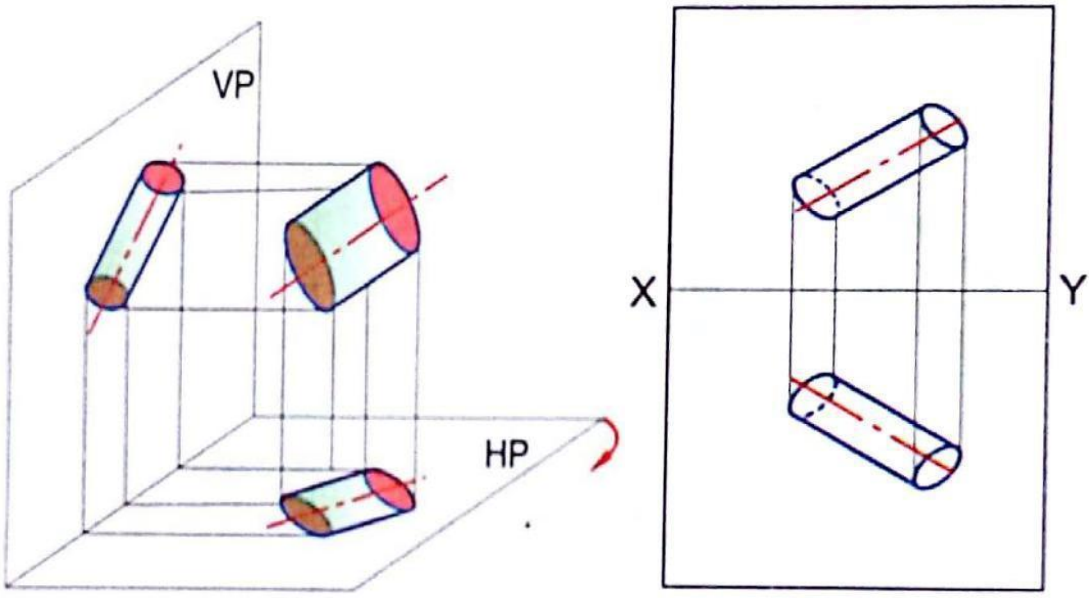


2. A pentagonal pyramid of base 25mm and axis 55mm long lies on one of its longer edgeson the HP and its axis is parallel to the VP.

1. Draw the line XY.
2. Draw the projection of solid in simple position.
3. Rotate the Front view such that one of the slant edge o'd' will lie on XY Line.
4. Draw projectors from the rotated front view and the initial top view and name it.
5. Join the points correspondingly to get the final top view.

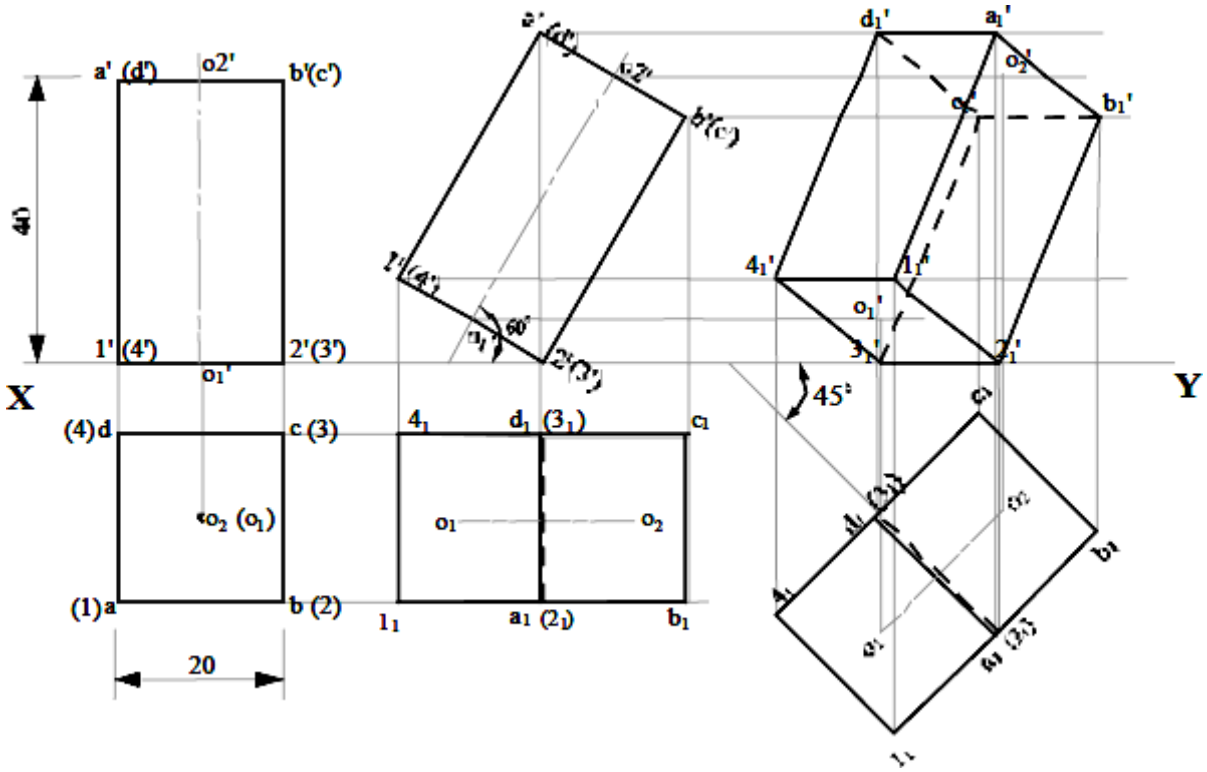
Inclined to the VP and the HP





1. A square prism of base 20mm and axis 40mm long has its axis inclined at 60° tothe HP and an edge of its base is inclined at 45° to the VP.

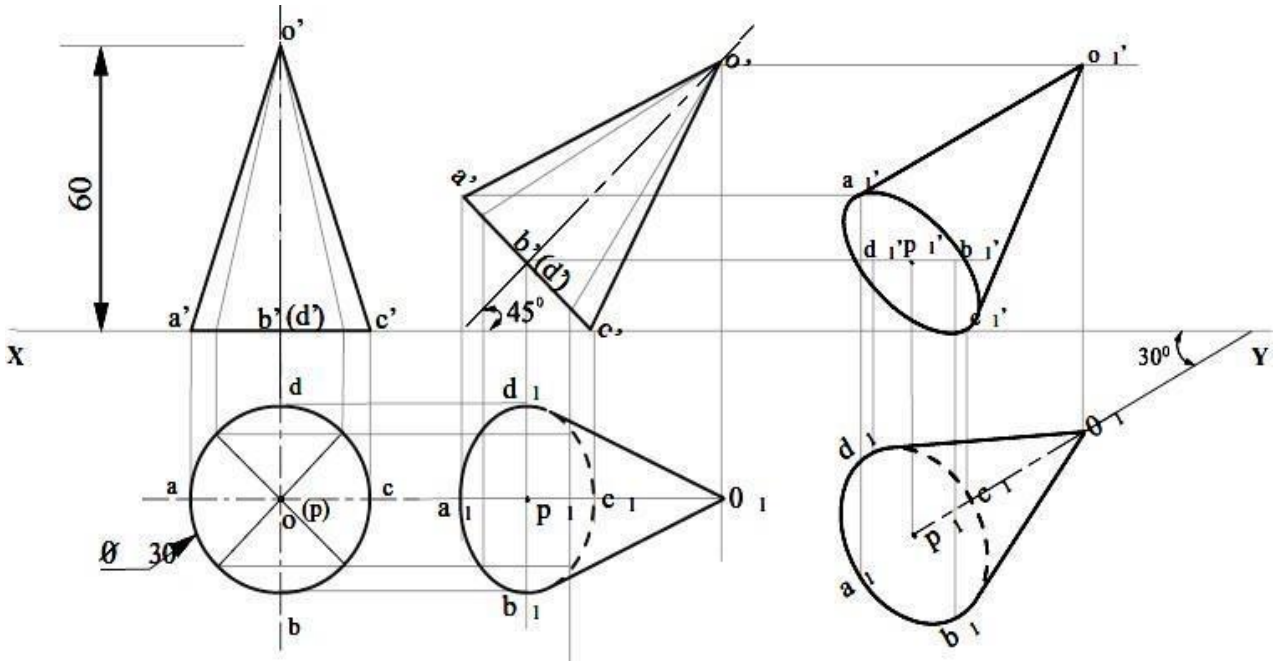
1. Draw the line XY.
2. Draw the projection of the prism placed in the simple position.
3. Rotate the front view axis through 60°.
4. Draw projectors from the rotated front view and the initial top view and name the points of intersection.
8. Join all the points correspondingly to get the final front view.

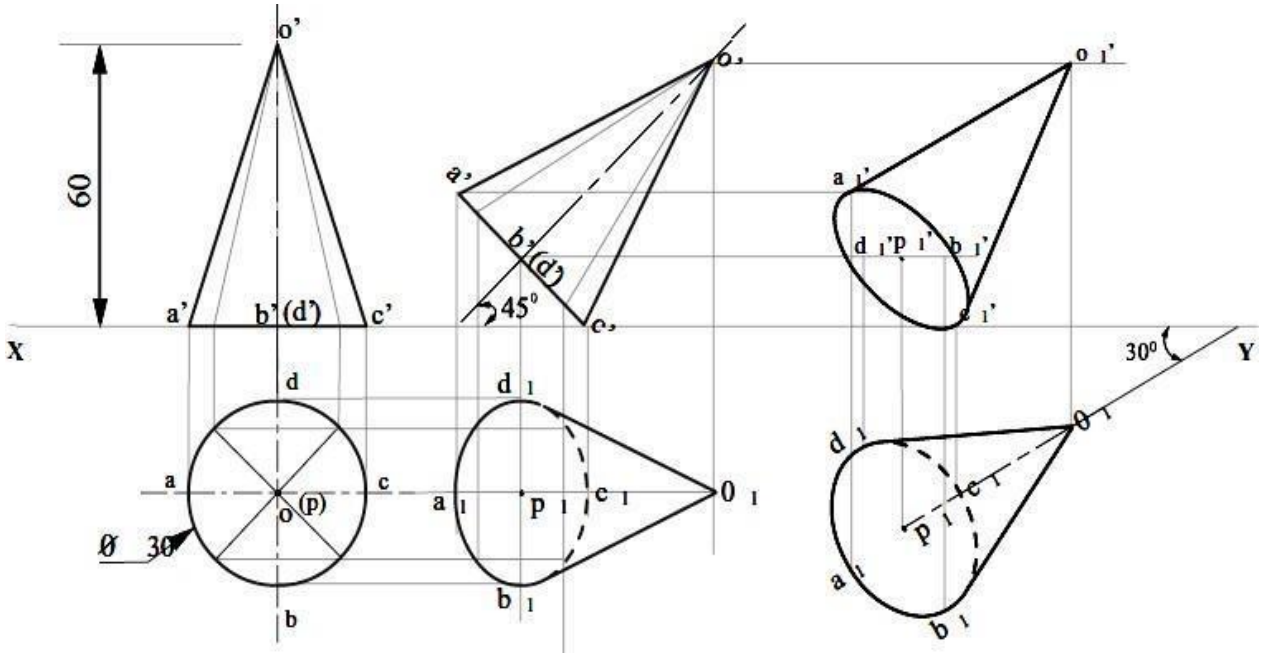


2. A cone of base 30mm diameter and axis 60mm long has its axis inclined at 45° tothe HP and 30° to the VP.

1. Draw the line XY.
2. Draw the projections of the cone placed in the simple position.
3. Rotate the axis of the front view through 45°.
4. Draw projectors from the rotated front view and the initial top view and name the points of intersection.

5. Join the points correspondingly to get the top view.
6. Rotate the axis of the rotated top view through 30°.
7. Draw projectors from the rotated top view and the rotated front view and name the points of intersection.
8. Join all the points correspondingly to get the final front view.





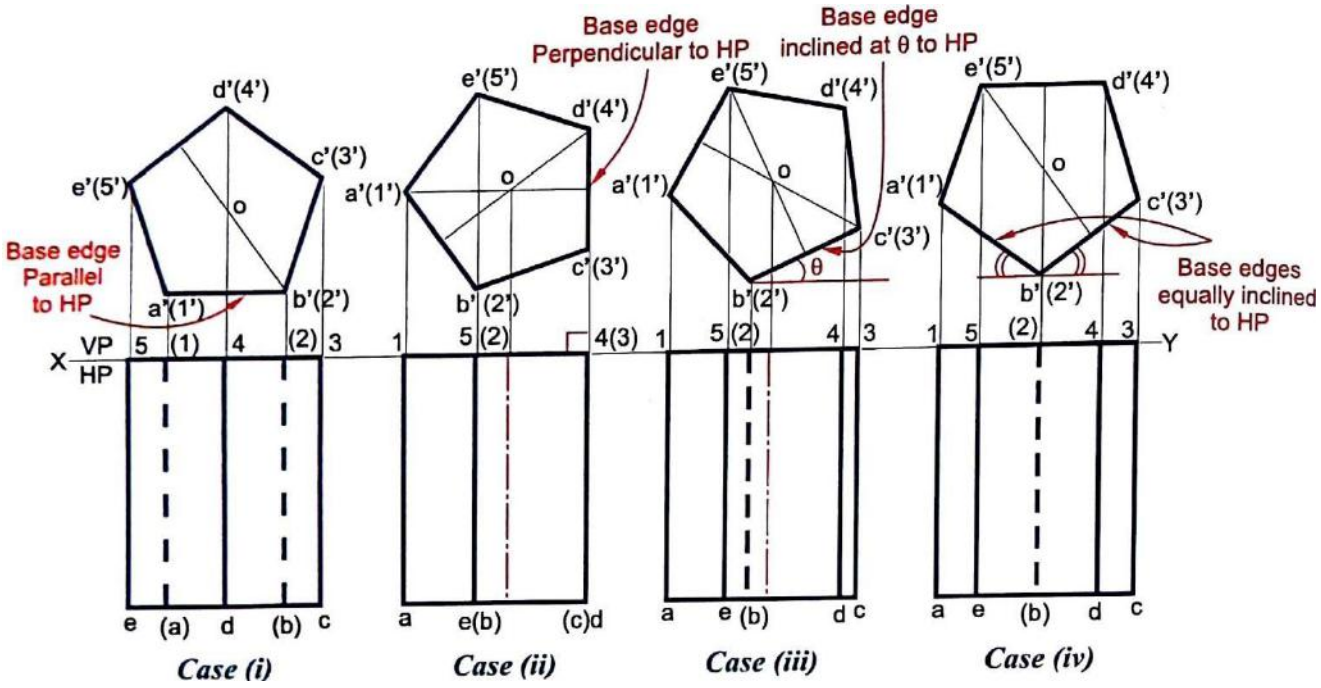
Positions of solids with respect to reference plane

S.No	Positions of solids	Step -1	Step -2	Step -3
1	Axis of the solid perpendicular to HP and parallel to VP	Draw plan first	Draw elevation next	--
2	Axis of the solid perpendicular to VP and parallel to HP	Draw elevation first	Draw plan next	---
3	Axis parallel to both VP and HP	Side view	Elevation	Plan
4	Axis of the solid inclined to VP and parallel to HP	Draw elevation axis perpendicular to VP	Tilt the plan	Get final elevation
5	Axis of the solid inclined to HP and parallel to VP	Draw plan axis perpendicular to HP	Tilt the elevation	Get final elevation
6	Axis of the solid inclined to both HP and VP	Draw plan , edge perpendicular to VP		Tilt the plan get elevation

Axis of the solid perpendicular to VP and parallel to HP

Case (i) : Base edge parallel to HP **Case (ii) : Base edge perpendicular to HP**

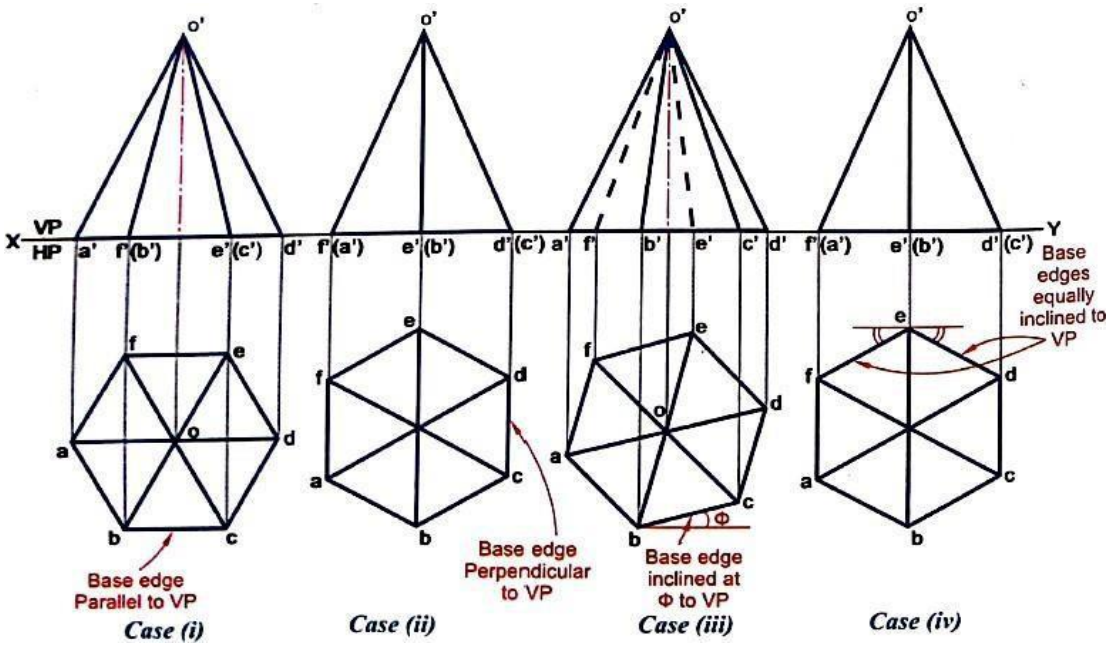
Case (iii): Base edge inclined to HP **Case (iv) : Base edges equally inclined to HP**



Axis of the solid perpendicular to HP and parallel to VP

Case (i) : Base edge parallel to VP **Case (ii) : Base edge perpendicular to VP**

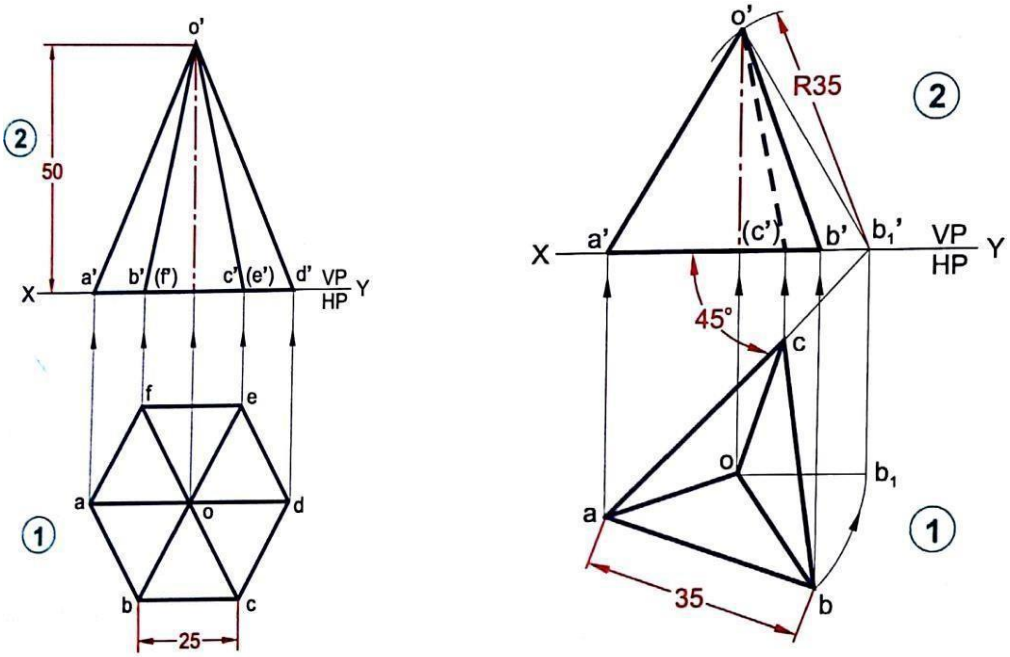
Case (iii): Base edge inclined to VP **Case (iv): Base edges equally inclined to VP**



Axis perpendicular to HP and parallel to VP:

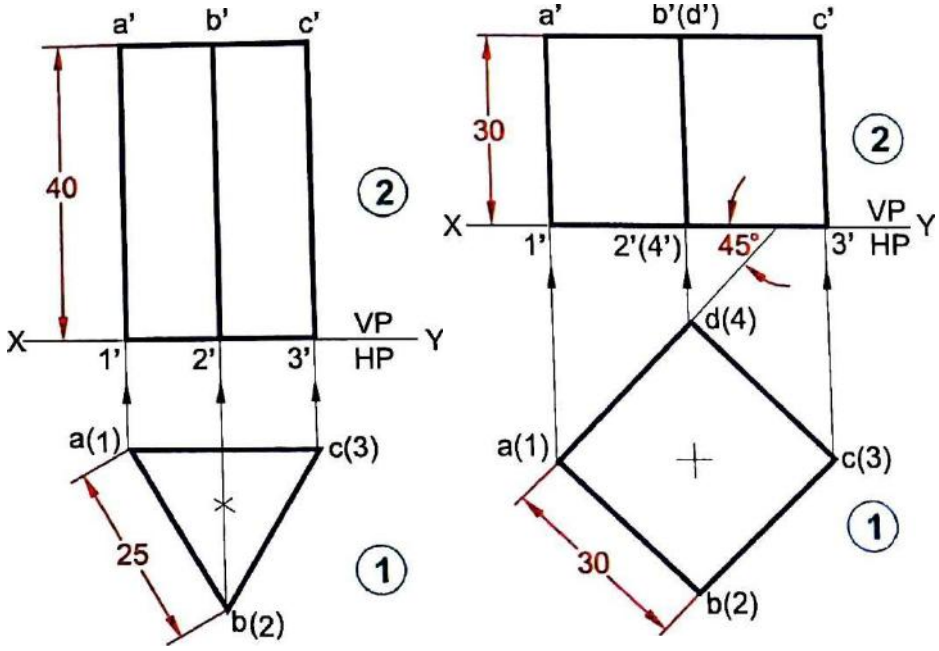
1.(a) A hexagonal pyramid of base side 25mm and height 50 mm is resting on its base on HP. Draw the projections when one base edge is parallel to VP.

(b) A tetrahedron of side 35 mm rests on the ground on one of its faces with an edge of that face making 45^0 with the VP. Draw its projections.



2.(a) A triangular prism of base side 25 mm and height 40 mm is resting on its base on HP. Draw the projections of solid when one of the rectangular face is parallel to VP

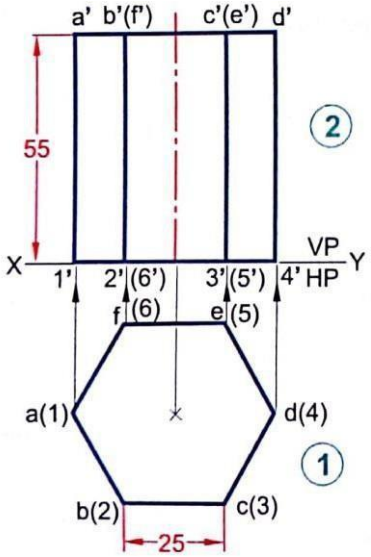
(b)A cube of side 30 mm rests on one of its faces with the vertical faces equally inclined to VP. Draw the projection of the solid.

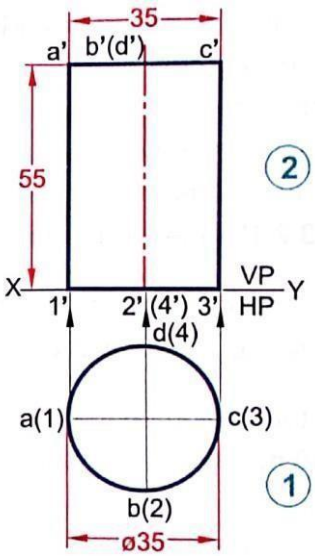


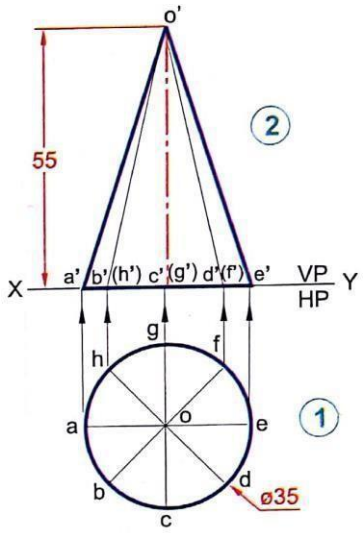
3.(a) A hexagonal prism of side 25 mm and height 55 mm is resting on its base onthe HP with one rectangular face is parallel to VP. Draw its projections.

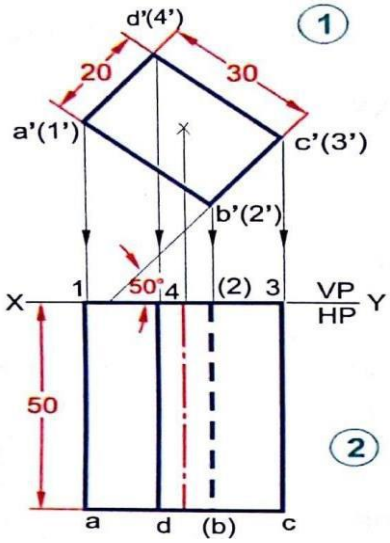
(b) draw the projection of right circular cylinder of base diameter 35 mm and axis 55mm when it rests on its base.

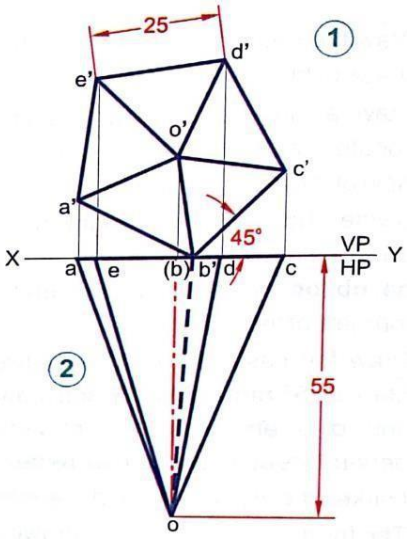
(c) draw the projections of a right circular cone of the base 35 mm diameter andheight 55 mm when resting with its base on the HP





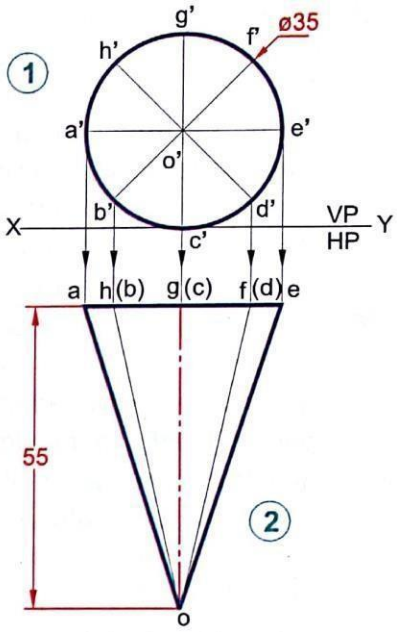


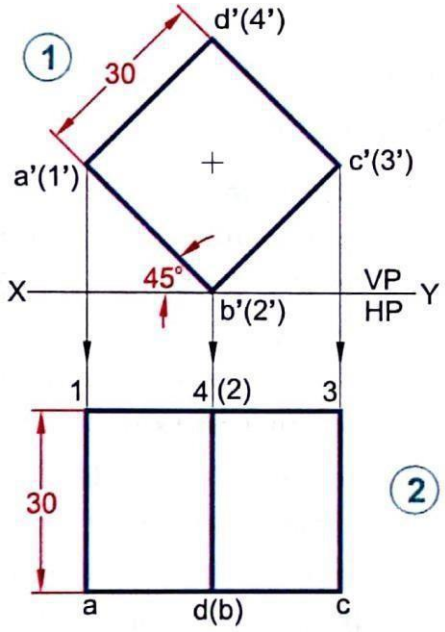




5.(a) A cone of base diameter 35 mm and height 55 mm rests on HP on a point of its base circle. Draw its plan and elevation when the base is kept parallel to the VP and its apex is away from the VP

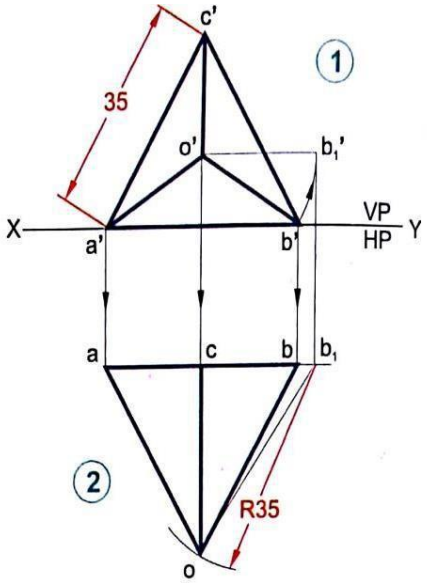
(b) A cube of side 30 mm is resting on the HP on one its edges with the faces containing the resting edge are equally inclined to HP and vertical faces parallel to VP. Draw its projections.

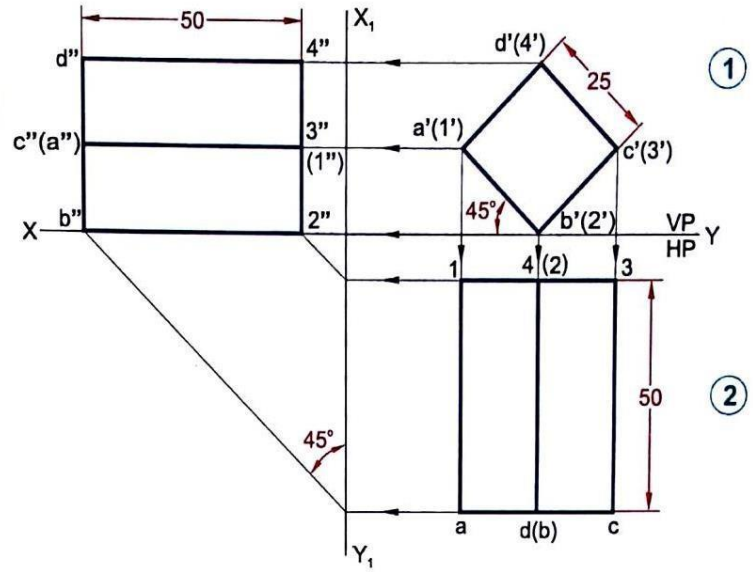


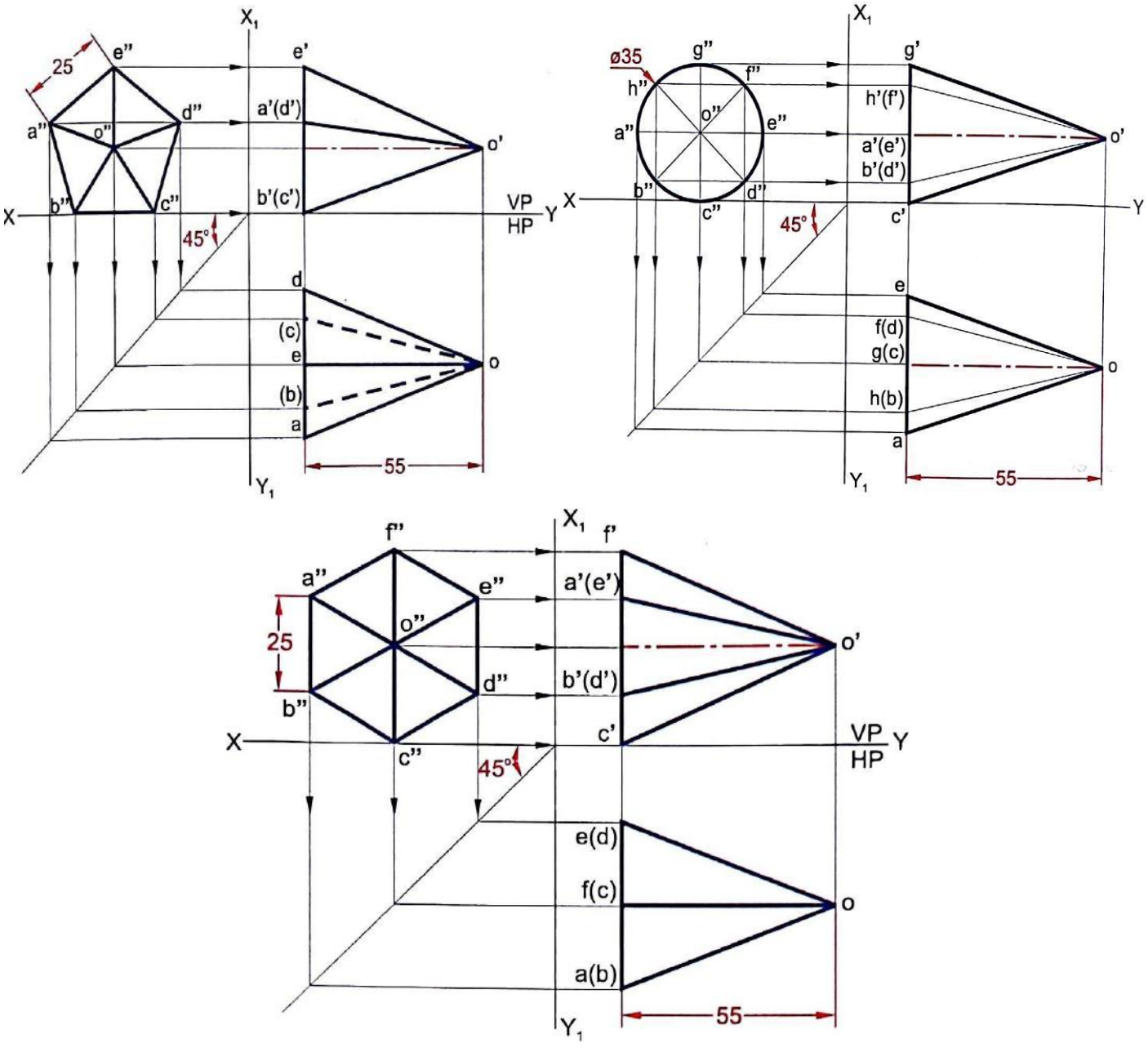


6.(a) A tetrahedron of side 35 mm is placed with a face parallel to VP with a side of the face parallel to HP. Draw its projections.

(b) draw the projections of a square prism of base 25 mm side and axis 50 mm height, when it is lying on the ground on one of its longer edges, such that the lateral faces are equally inclined to HP and the axis is perpendicular to VP. Alsodraw the right side view.







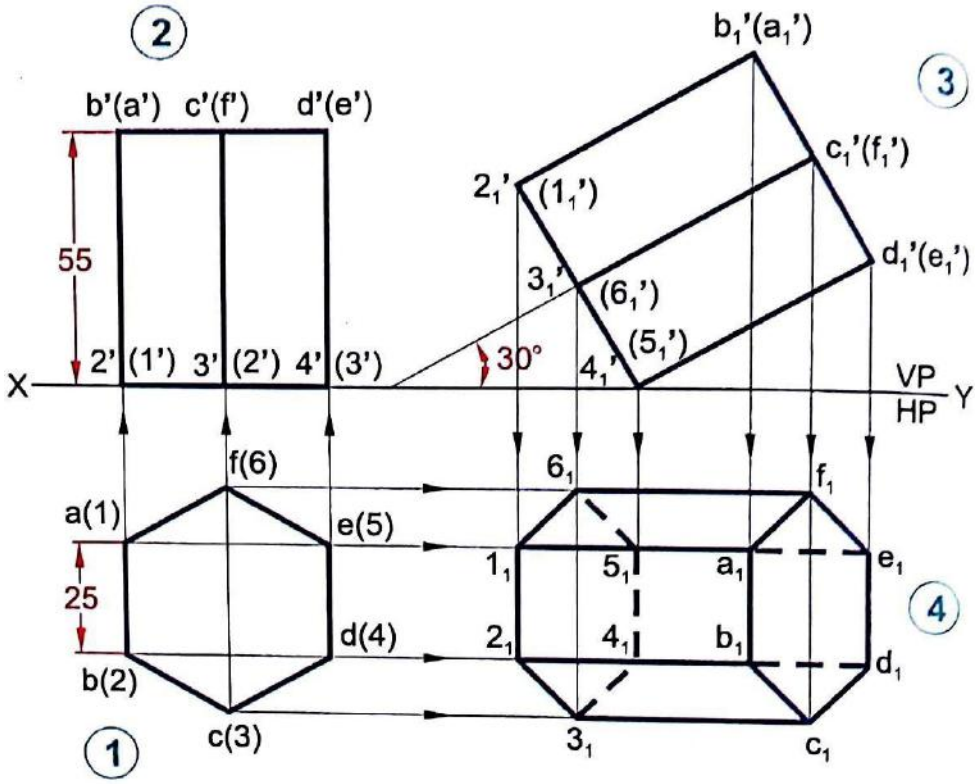
Axis parallel to VP and inclined to HP:

Axis inclined to one of the principal planes and parallel to the other. When the axis of a solid is inclined to any plane, the projections are obtained in two stages. In the first stage, the axis of the solid is assumed to be perpendicular to the plane to which it is actually inclined and the projections are drawn. In second stage, the position of one of the projections is altered to satisfy the given condition and the other view is projected from it. This method of obtaining the projections is known as **the change of position method**.

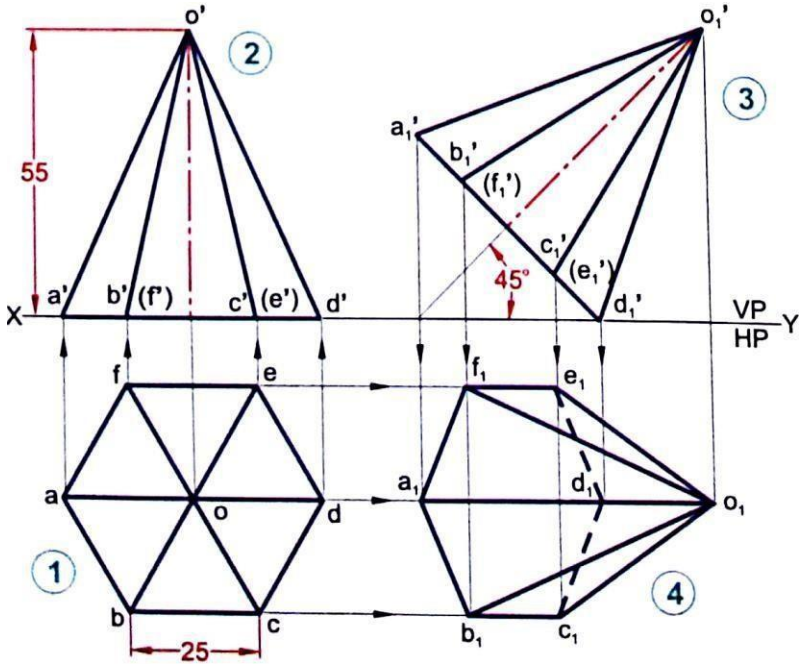
In the **change of reference line method, or auxiliary plan method** an auxiliary plane is introduced as stipulated and the required final front view is projected on it. This means that a new reference line is to be drawn to represent the auxiliary plane and the required projection drawn

Axis parallel to VP and inclined to HP - Problems:

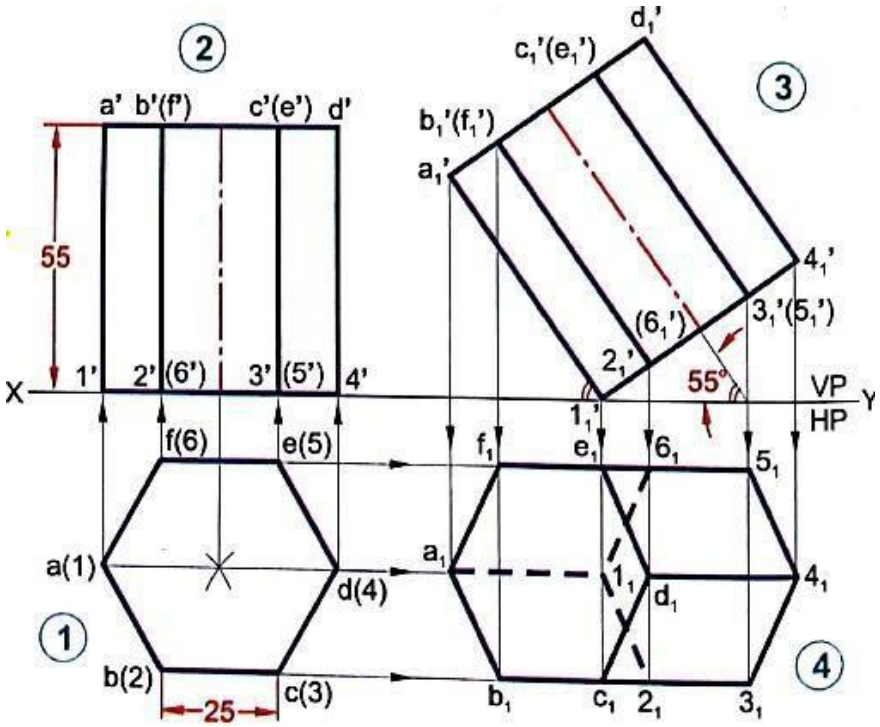
8 .A hexagonal prism of base side 25 mm and axis height 55 mm resting on HP with one of its base edges, such that the axis is inclined at $30^0$to the HP and parallel to VP. Draw the projections of the prism.



9. A hexagonal pyramid of base side 25 mm and axis height 55 mm is resting on HP with one of its base corners, such that the axis is inclined at 45^0 to HP and parallel to VP. Draw the projections of the pyramid.

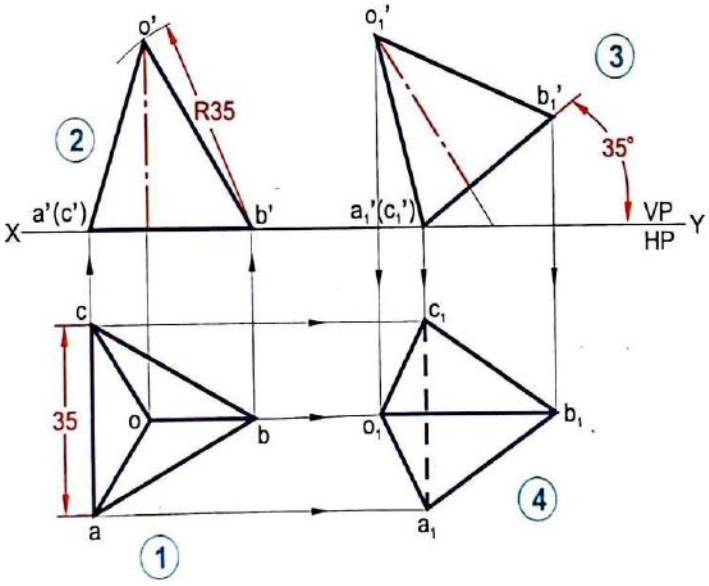


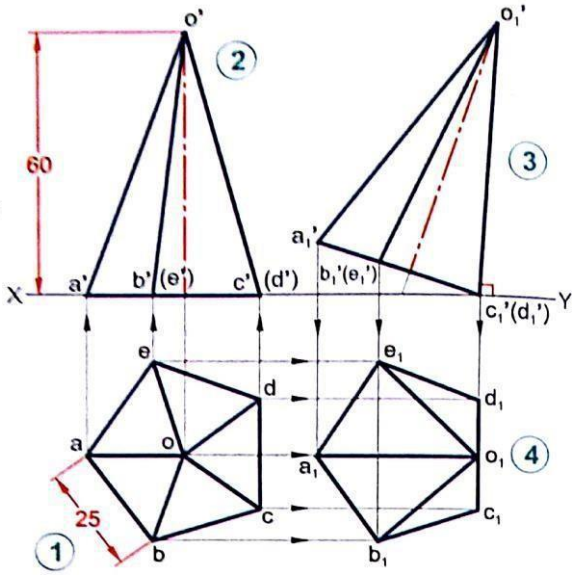
10. A hexagonal prism of base side 25 mm and axis height 55 mm resting on HP with one of its base corners, such that the axis is inclined at $55^0$to the HP and parallel to VP. Draw the projections of the solid.

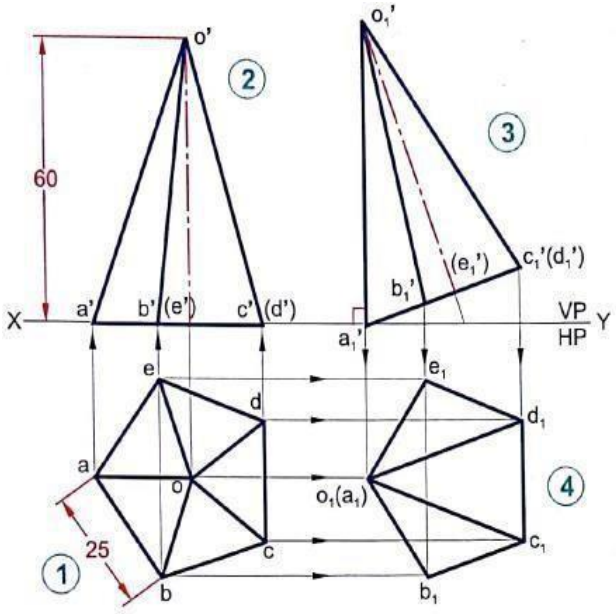


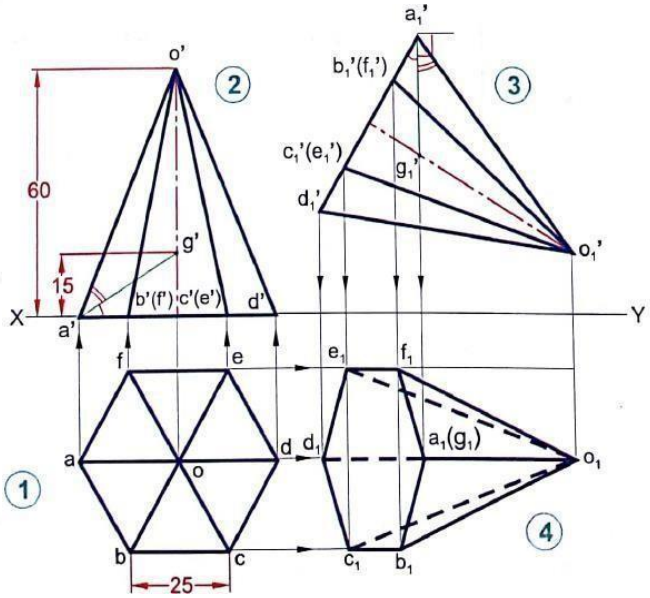
11.(a) Draw the projections of tetrahedron of side 35 mm kept such that a face is inclined at 350 to HP and perpendicular to VP with one of its edge on HP.

(b) Draw the projections of a pentagonal pyramid of base side 25 mm and axisheight 60 mm with a triangular face perpendicular to HP and VP

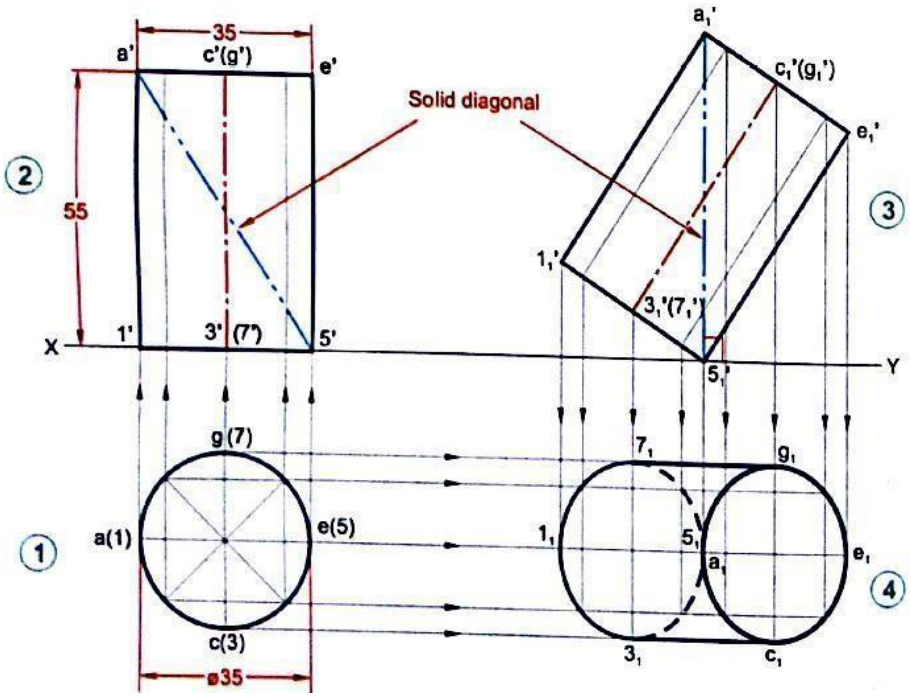


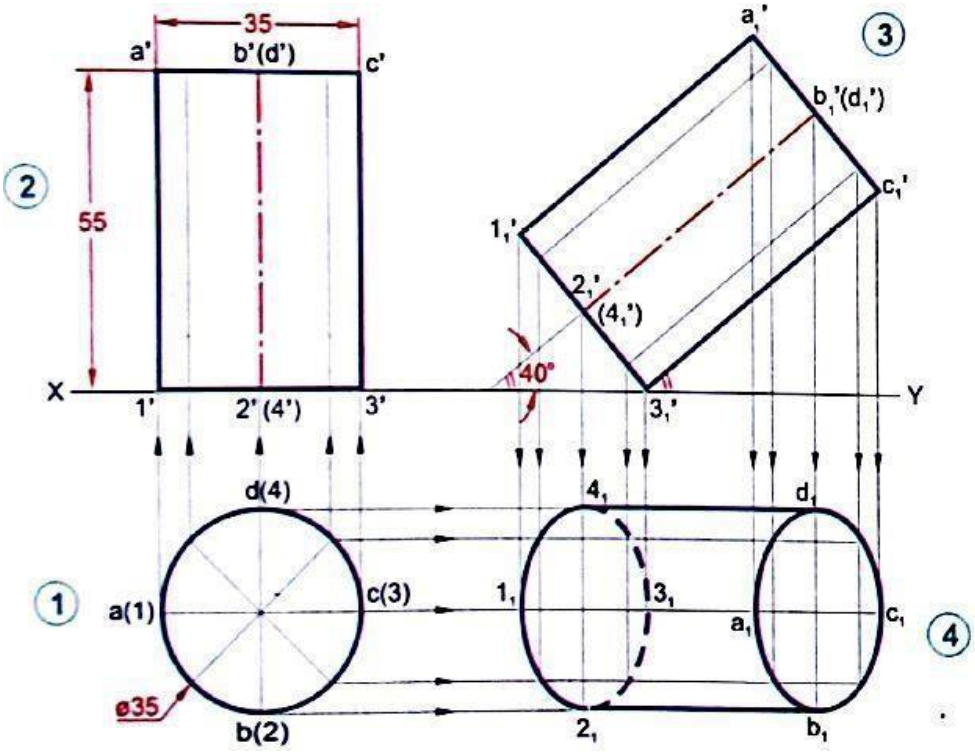




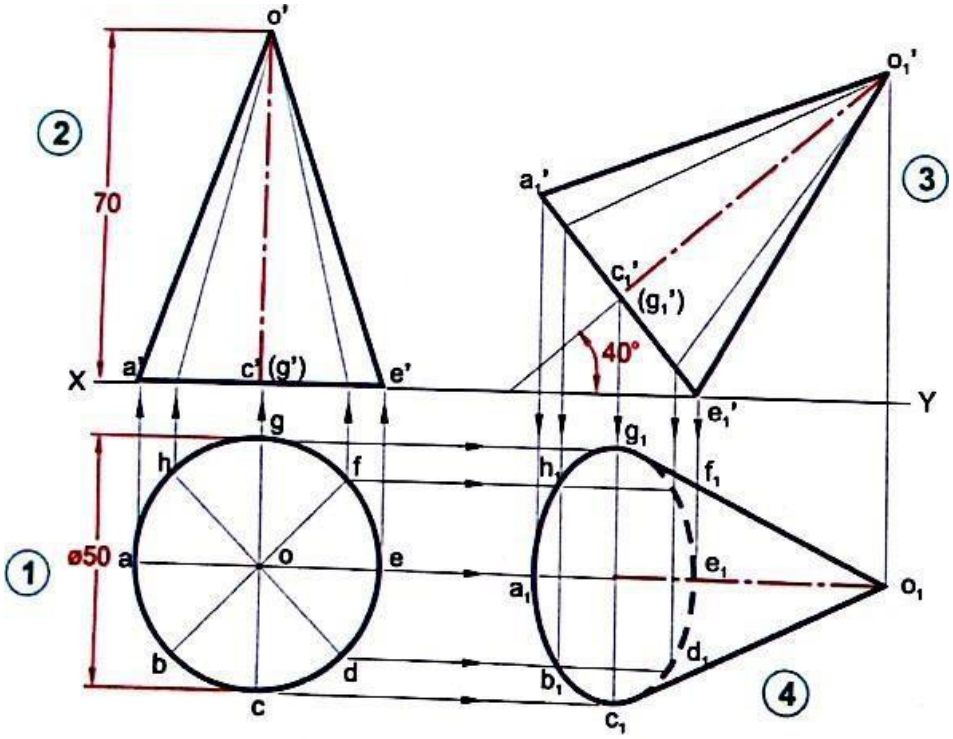


13.(a) A cylinder of diameter 35 mm and axis height 55 mm is resting on the groundon its base. It is then tilted such that a solid diagonal is vertical.Draw its projections.

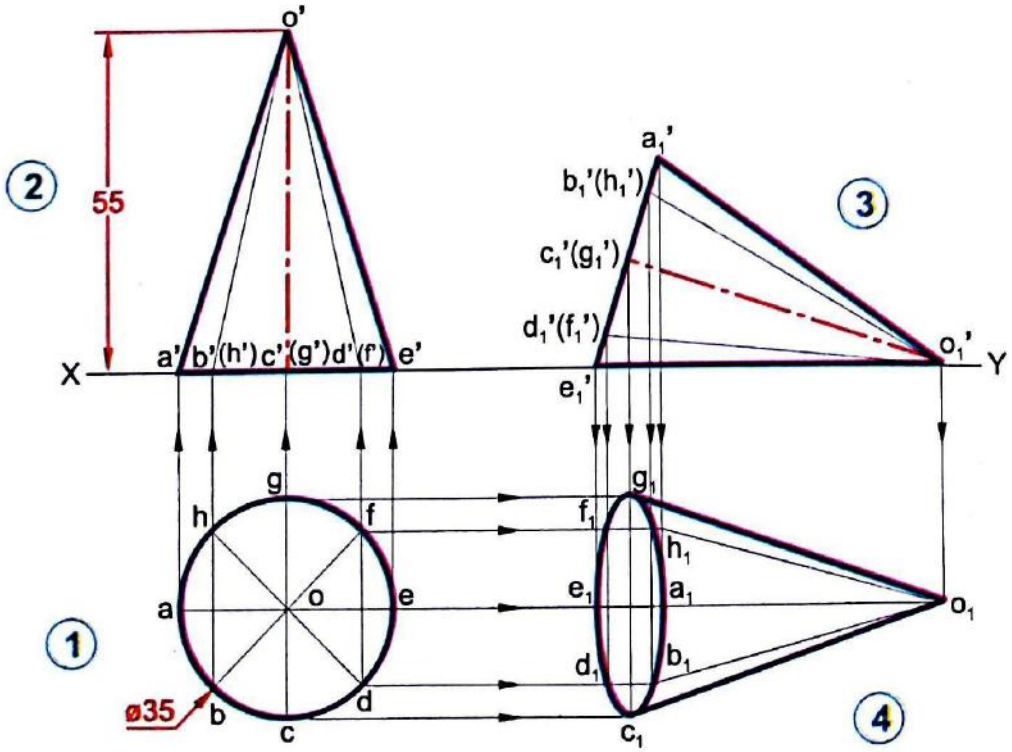




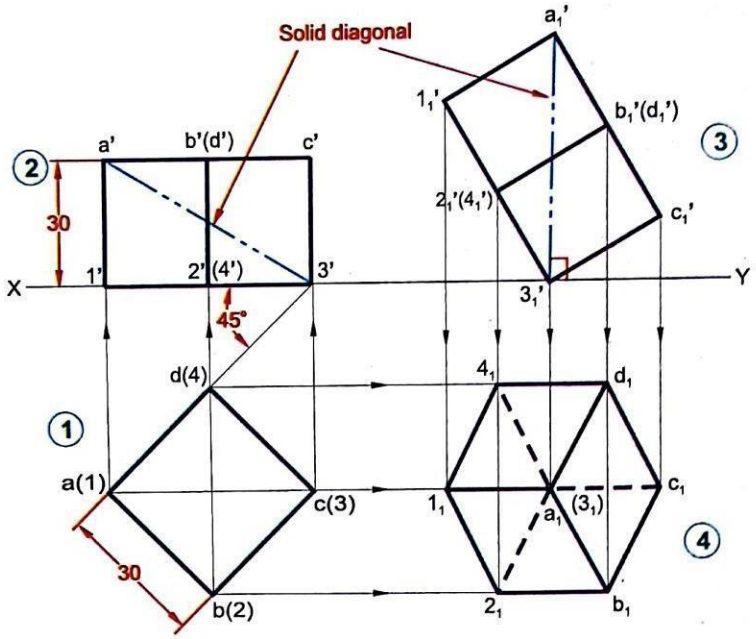
14(a) A cone of diameter 50 mm axis height 70 mm is lying on HP on one of its base point with its axis inclined at 40^0 to HP and parallel to VP. Draw the projections.



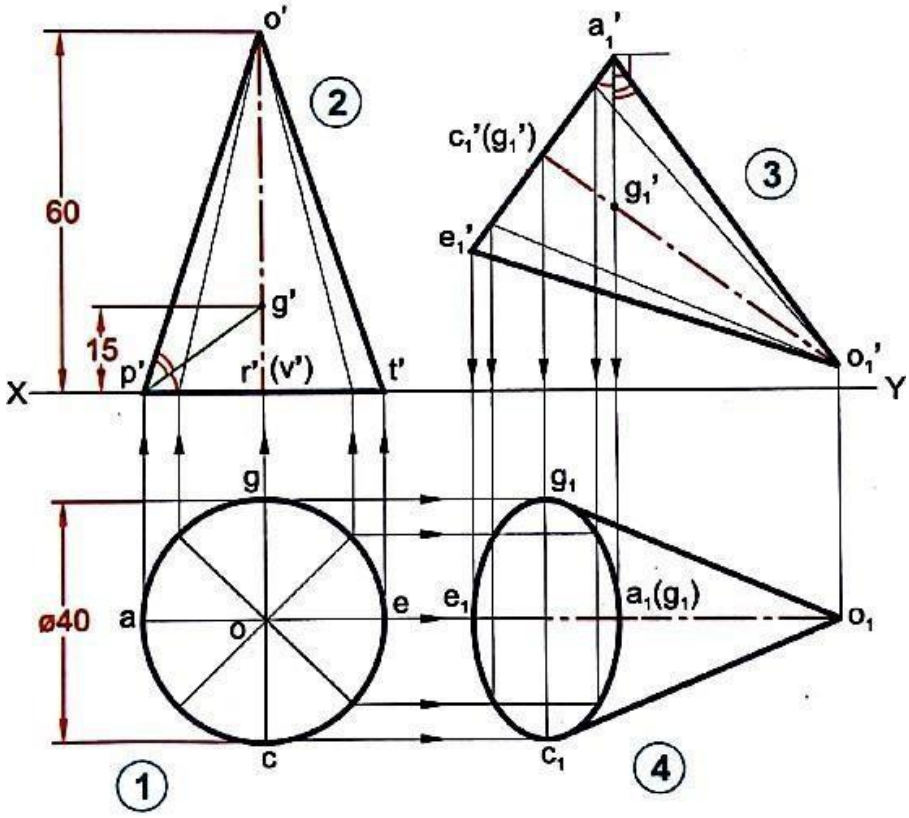
(b) A cone of diameter 35 mm axis height 55 mm is lying on ground with one of itsgenerators parallel to VP and on the HP. Draw its projections.



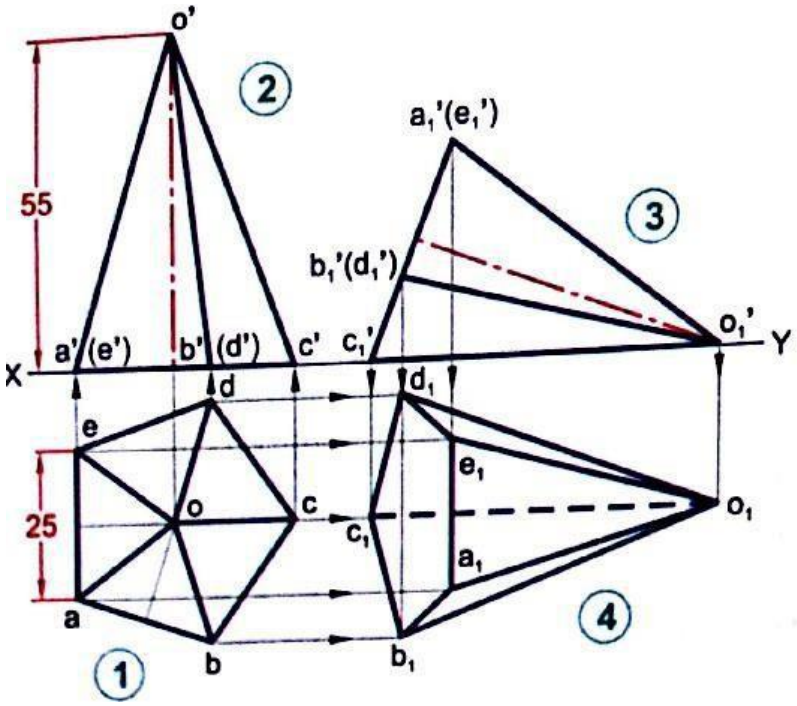
15 (a). Draw the projections of a cube of side 30 mm when its rests on one of itscorners with a diagonal of the solid vertical.



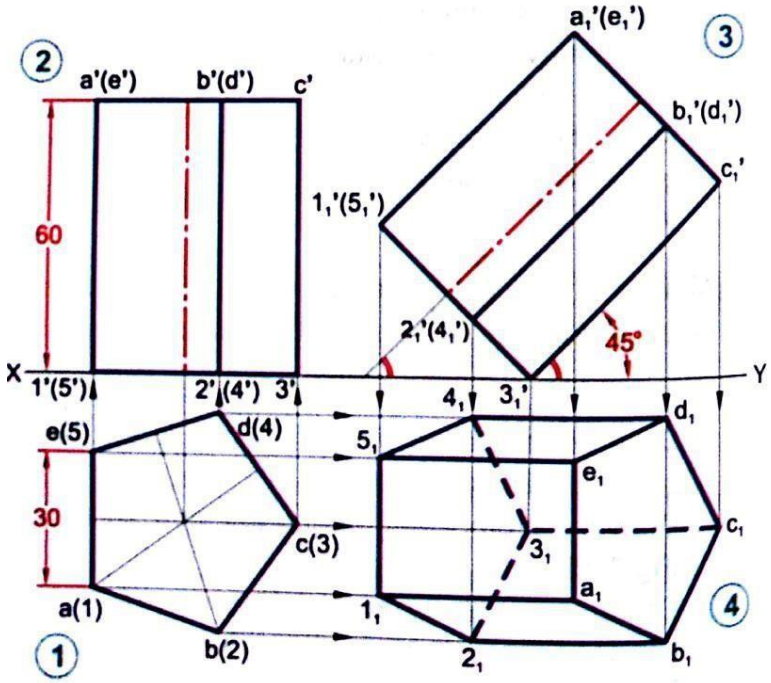
(b) A cone of diameter 40 mm and axis height 60 mm is freely suspended from oneof its base points, such that the axis is parallel to VP. Draw the projections



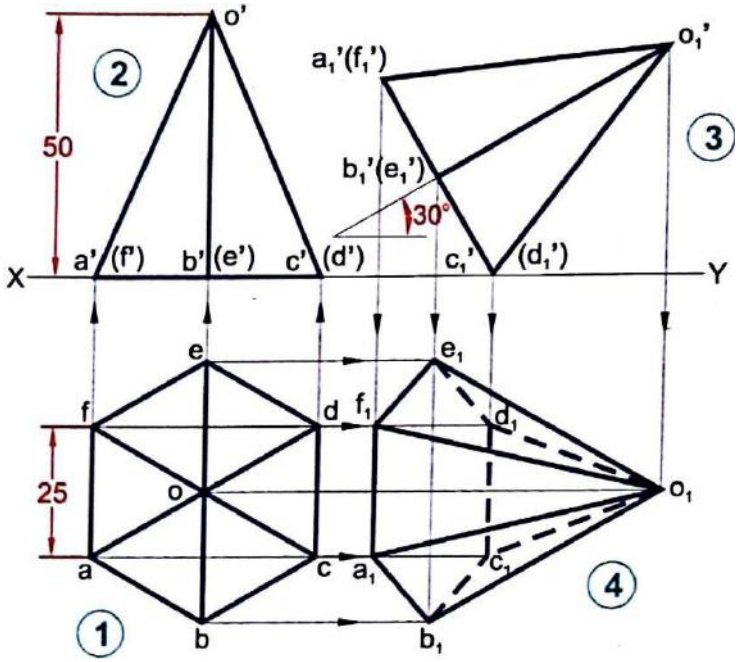
16(a) A pentagonal pyramid of base side 25 mm and axis 55 mm long lies with one ofits slant edges on HP such that its axis is parallel to VP. Draw its projections.



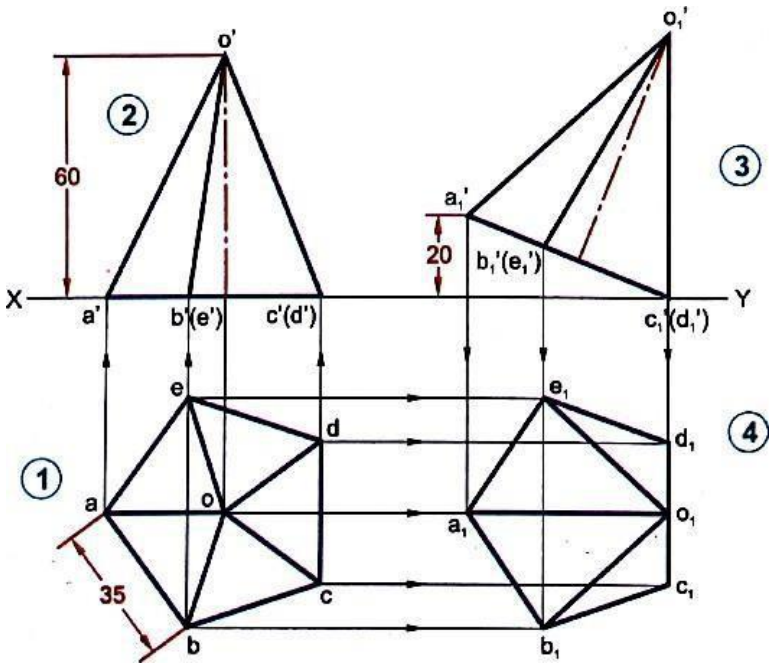
(b) A pentagonal prism of base side 30 mm and axis length 60 mm rests on the HP on one of the base corners with the base edges containing it being equally inclined to HP. The axis is inclined at 45^0 to the HP and parallel to the VP. Draw the projections.



17(a) A hexagonal pyramid side of base 25 mm and axis 50 mm long, rests with one of its base on the HP and its axis is inclined at $30^0$to the HP and parallel to VP. Draw its projections

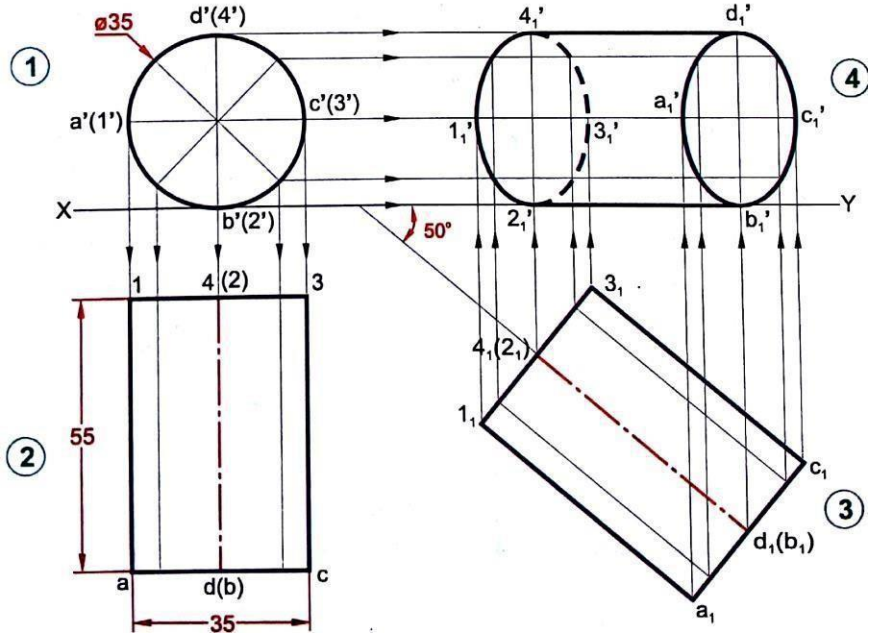


(b) A right pentagonal pyramid of base side 35 mm and attitude 60 mm rest on oneof its base edge in HP, the base being lifted up until the highest corner in it is 20 mm above HP. Draw its projections when the edge on which it rests is made perpendicular to VP.

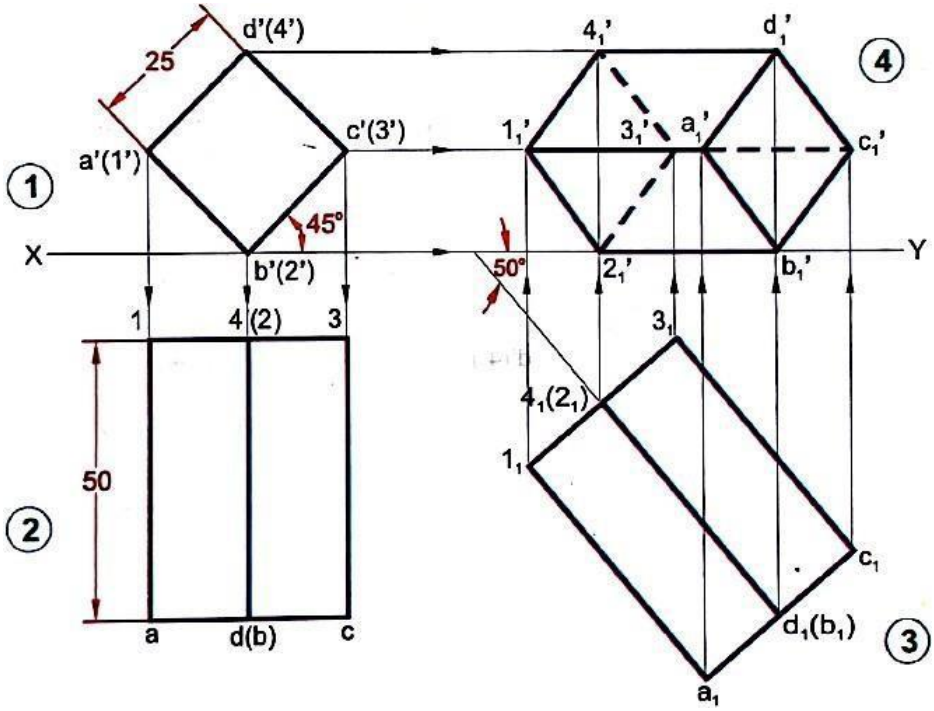


Axis parallel to HP and inclined to VP - Problems:

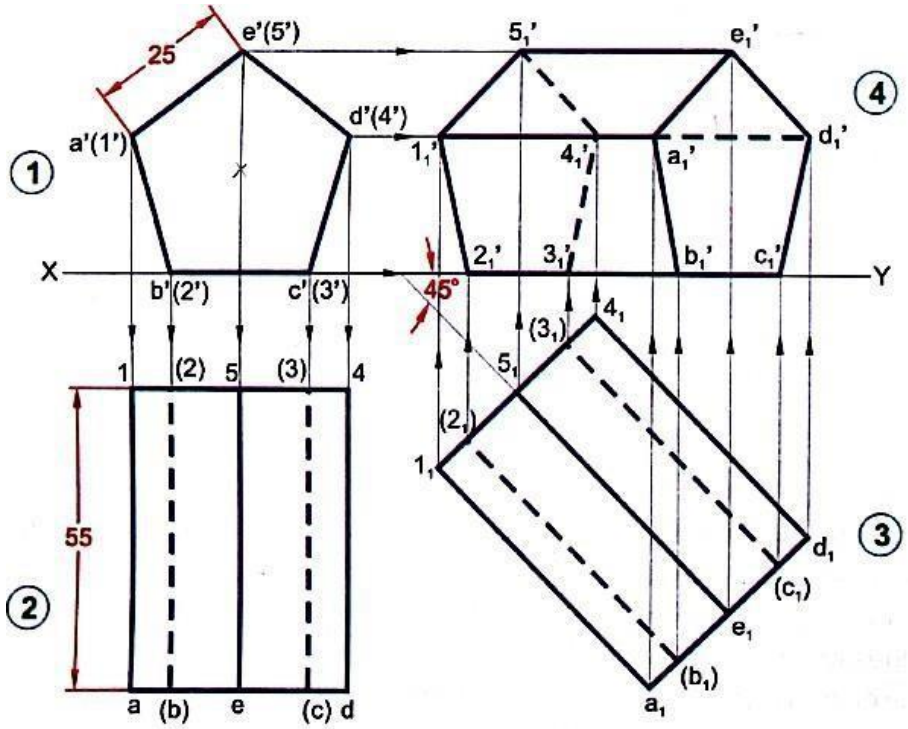
18(a) Draw the projections of a cylinder of diameter 35 mm and axis 55 mm long is resting on HP on one of its generators with its axis inclined at 50^0 to VP. Draw its projections



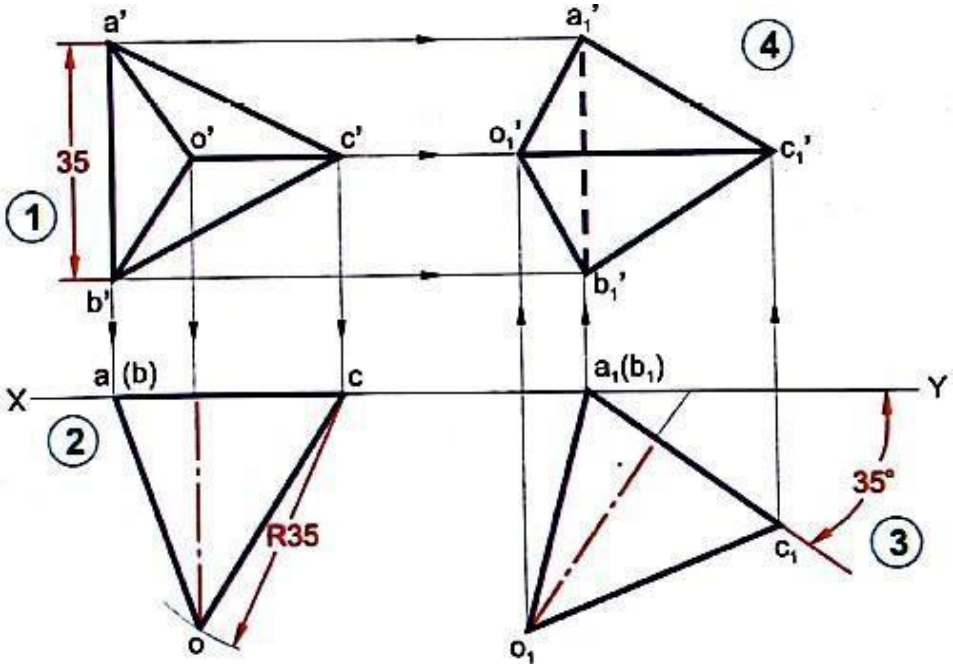
(b) A square prism of base side 25mm and axis length 50 mm lies on HP on one its longer edges with its faces equally inclined to the HP. Draw its projections when its axis is inclined at 50^0 to the VP



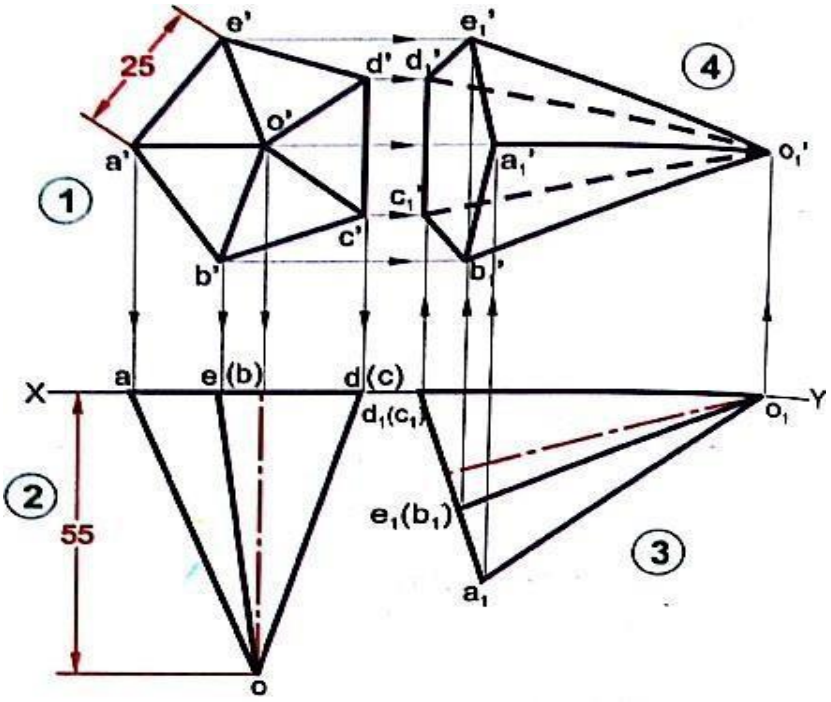
19 (a) A pentagonal prism of base side 25 mm and axis length 55 mm resting on HP on one of its rectangular faces with its axis inclined to 45^0 to VP. Draw its projections.



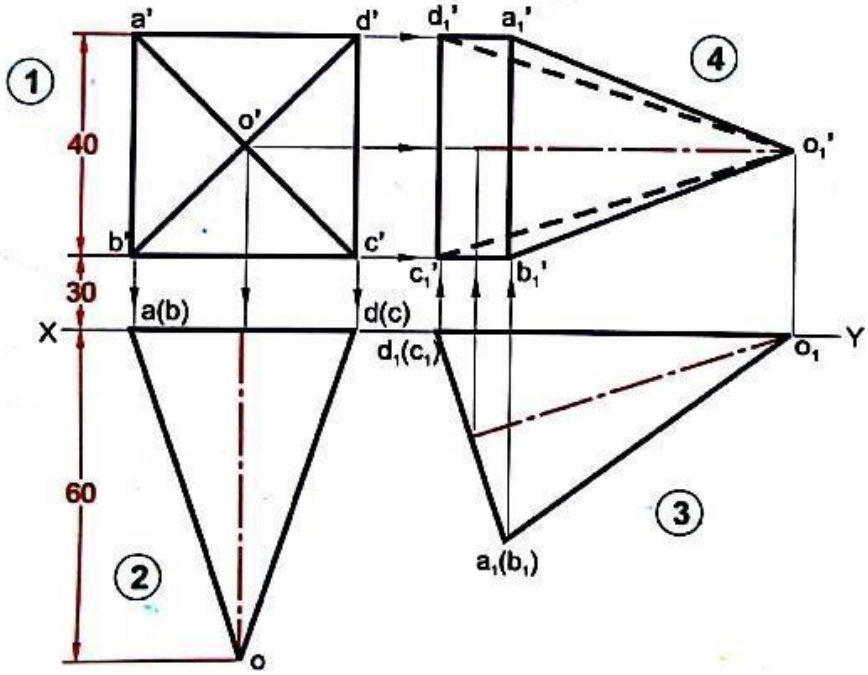
(b) A tetrahedron of edges 35 mm rests on one of its edges on the VP. The resting edge is perpendicular to HP and one of the triangular faces containing the resting is inclined at 35^0 to the VP. Draw its projections.



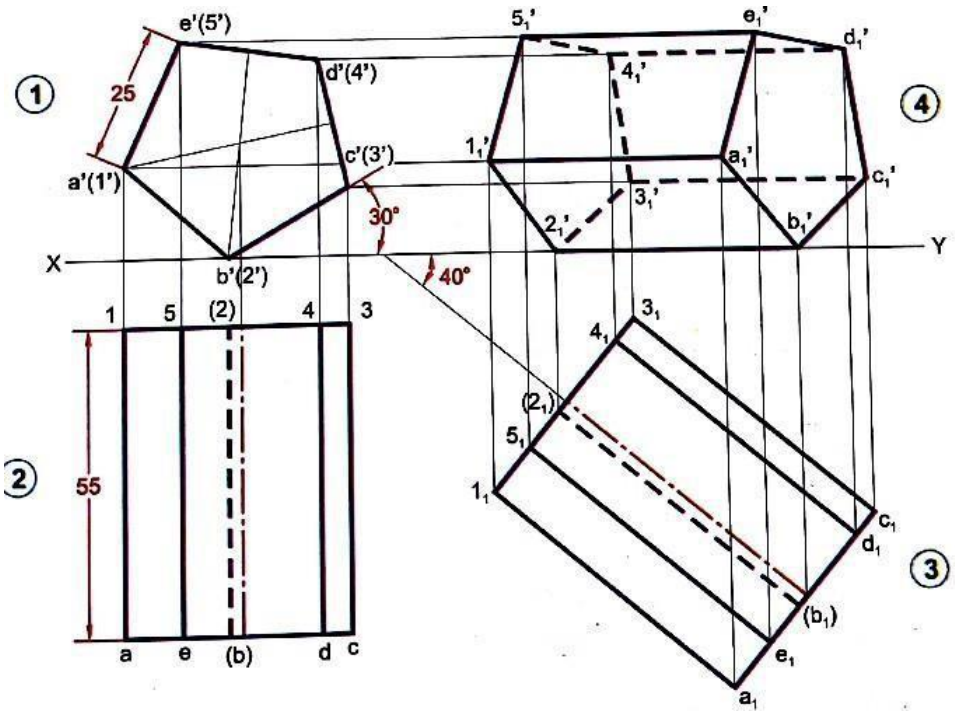
20(a) A pentagonal pyramid of base side 25 mm and axis length 55 mm resting on VP on one of its rectangular faces with its axis inclined to 45^0 to HP. Draw its projections.



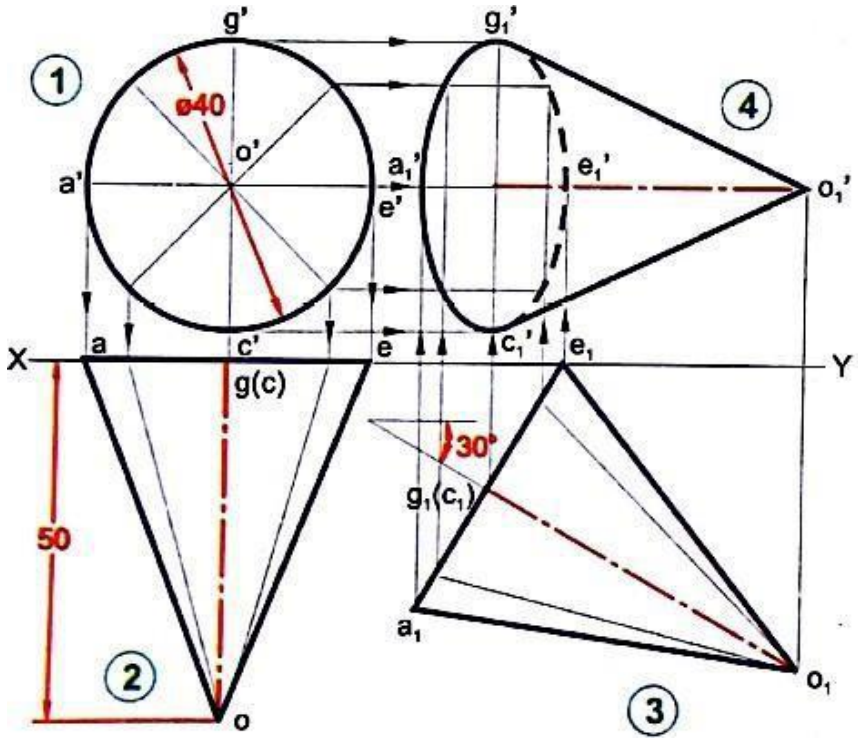
(b) **A square pyramid of base side 40 mm and axis length 60 mm resting on VP on one of its triangular faces with its plane containing axis parallel to HP and 30 mm above it. Draw its projections.**



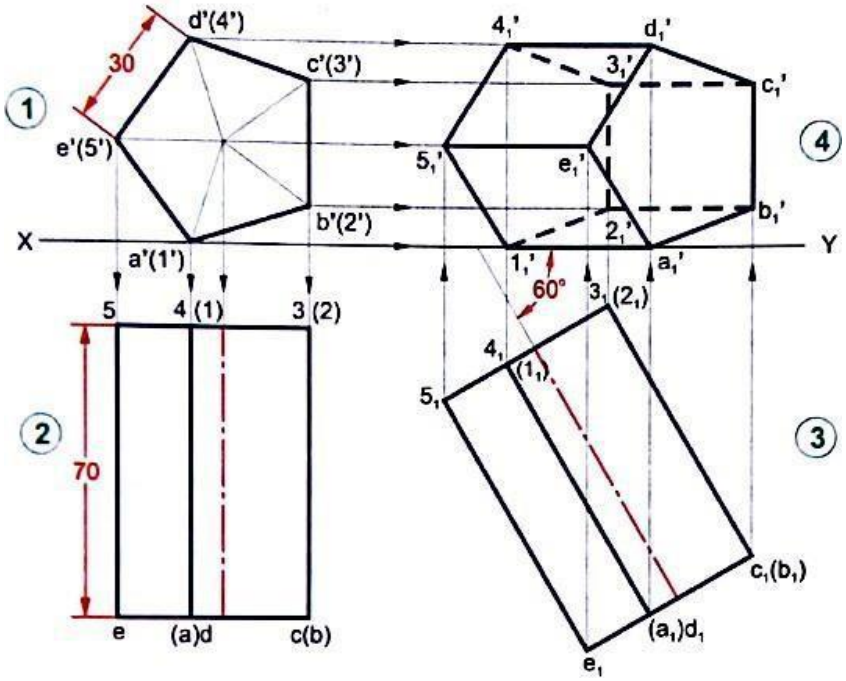
21(a) A pentagonal prism of base side 25 mm and axis length 55 mm resting on a lateral edge on HP. The rectangular faces containing that edge is inclined to 30^0 to HP. When the axis inclined 40^0 to the VP. Draw its projections.



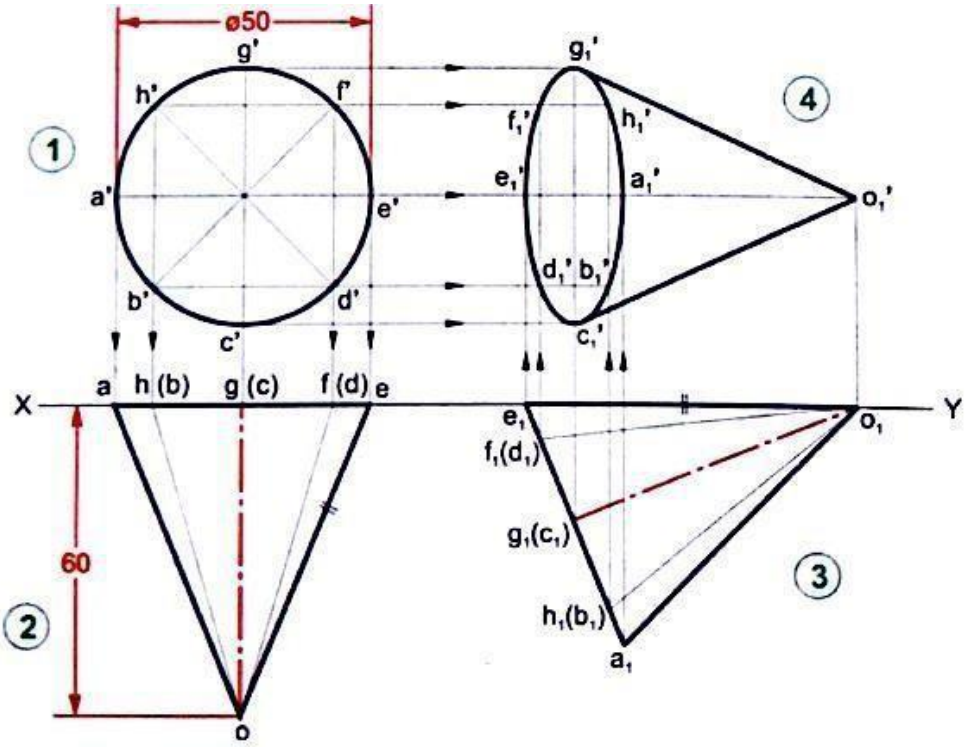
(b) A cone of base 40mm diameter and axis 50 mm long touches the VP on a point of its base circle. Its axis is inclined at 30^0 to the VP and parallel to HP. Draw its projections.



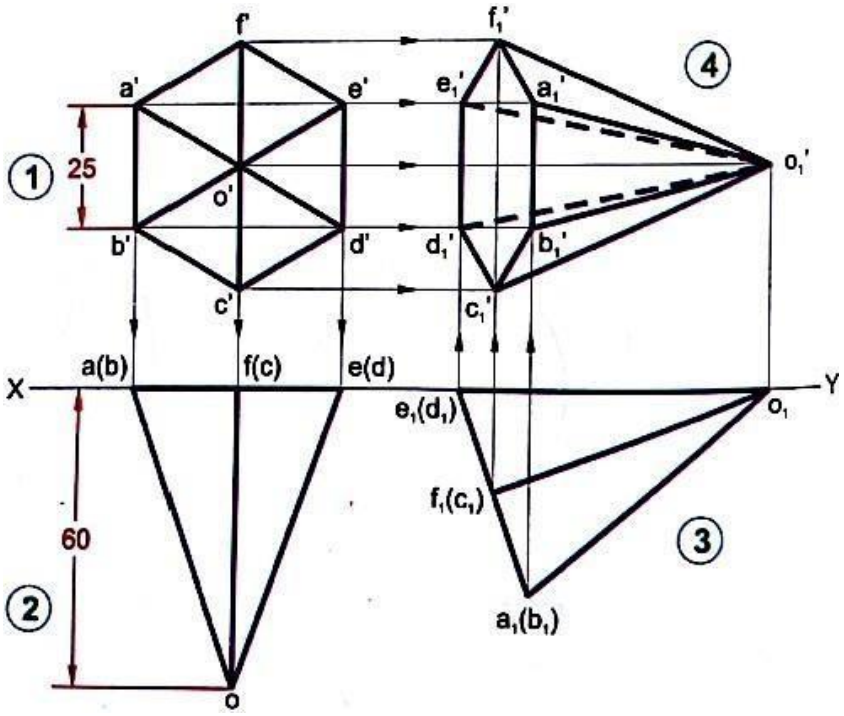
22(a) draw the projection of pentagonal prism 30 mm side of base and 70 mm long lying on one of its longer edges on HP with one of rectangular faces perpendicularto HP such that the axis makes 60^0 with VP.



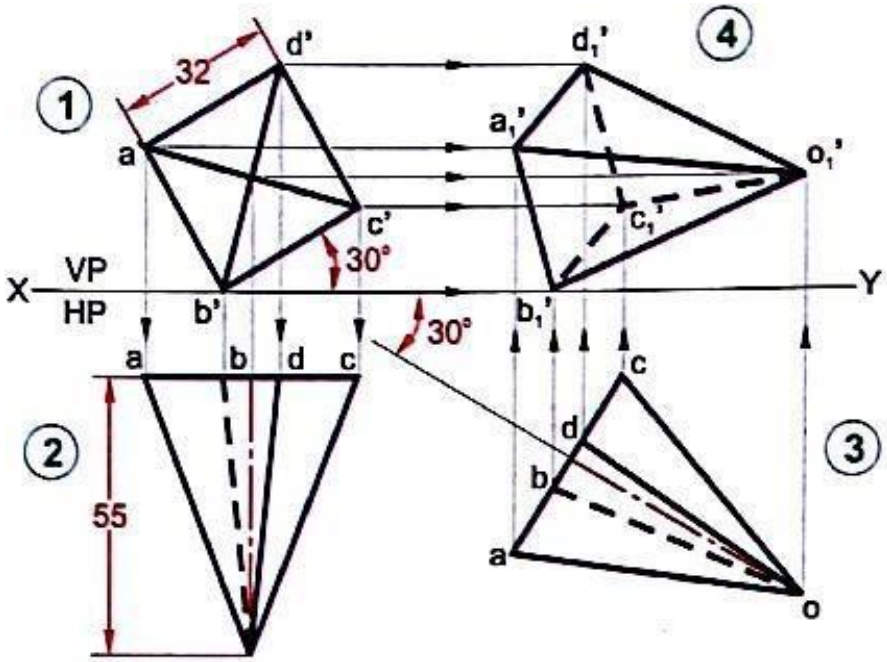
(b) A cone of base diameter 50 mm and axis length 60 mm is resting on VP on one of its generators with its axis parallel to HP. Draw its projections.



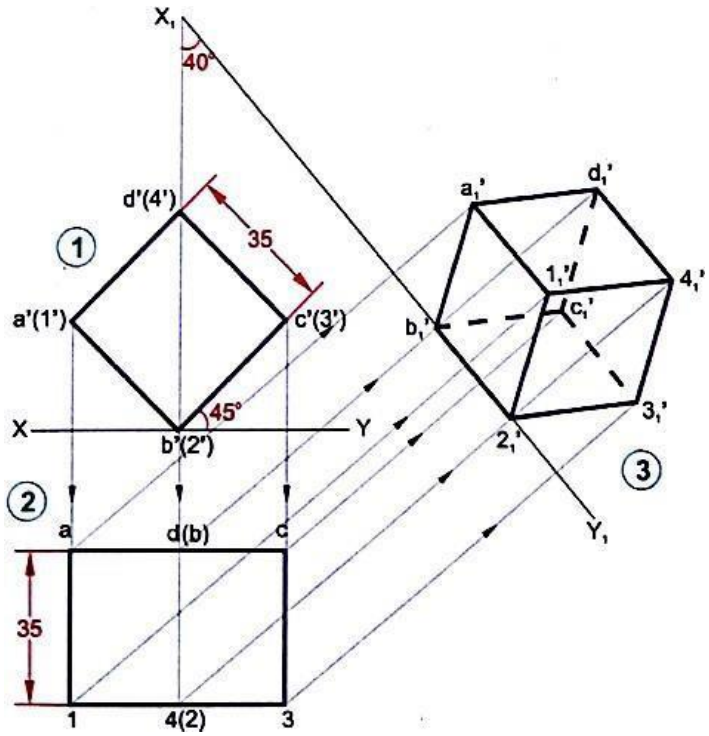
23(a) A hexagonal pyramid of base side 25 mm and axis length 60 mm is resting on VP on one its triangular face with its axis parallel to HP. Draw its projections.



(b) Draw the projections of a square pyramid of 32 mm side of base and axis 55 mm. It is resting on HP on one of its base corners with a base side containing the corners making 30^0 with HP. The axis is inclined at 30^0 to VP and is parallel to HP. The vertex is away from the VP

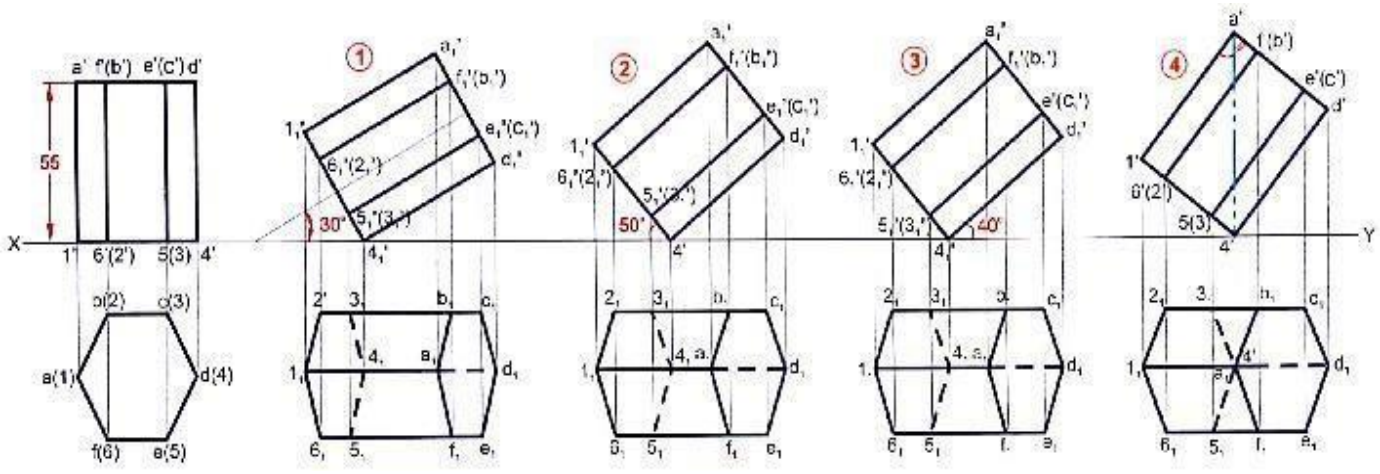


24. Draw the projection of cube of side 35 mm when it is resting on one of itscorners on VP and an edge containing that corner is inclined at 40^0 to VP



SUMMARY

1. Prism -- Axis parallel to VP and perpendicular HP

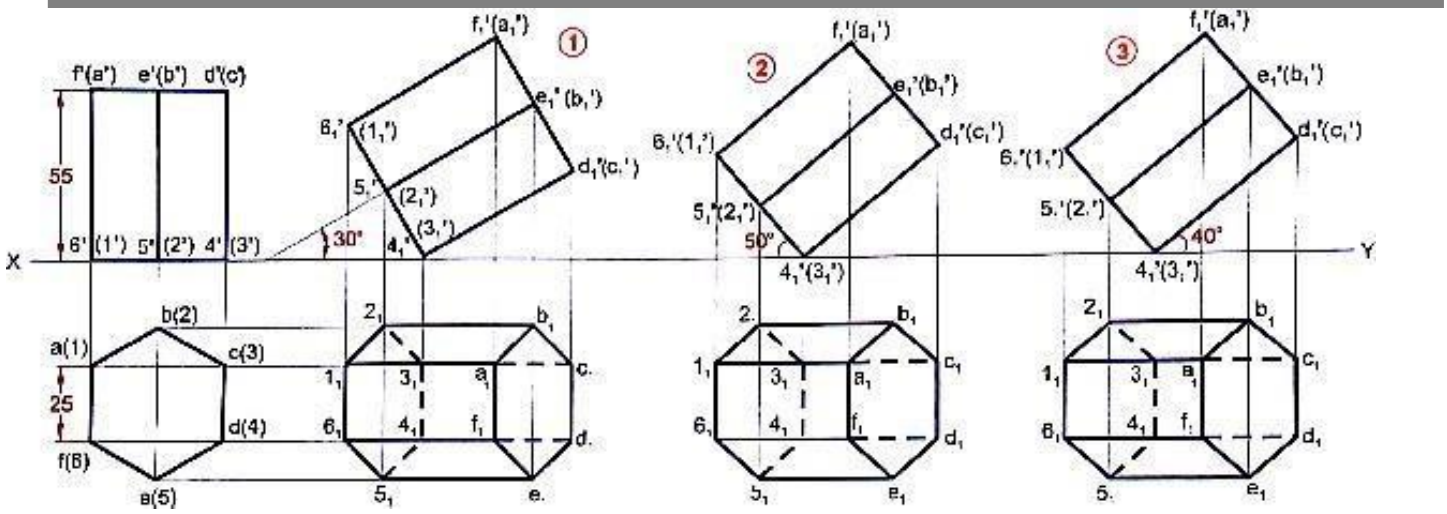


1 - Axis inclined at 30^0 to HP and parallel to VP.

2 - Base inclined at 50^0 to HP.

3 - Longer edge containing the resting corner makes an angle of 40^0 to HP.

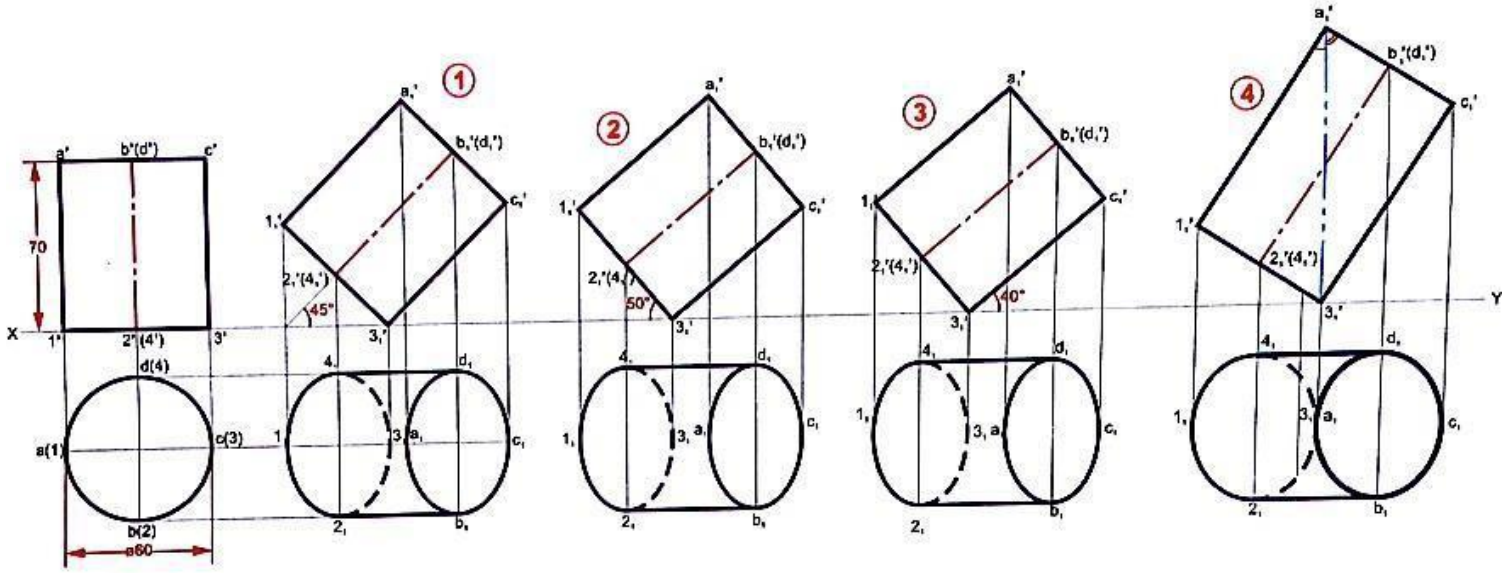
4 – Solid diagonal vertical.



1 - Axis inclined at 30^0 to HP and parallel to VP.

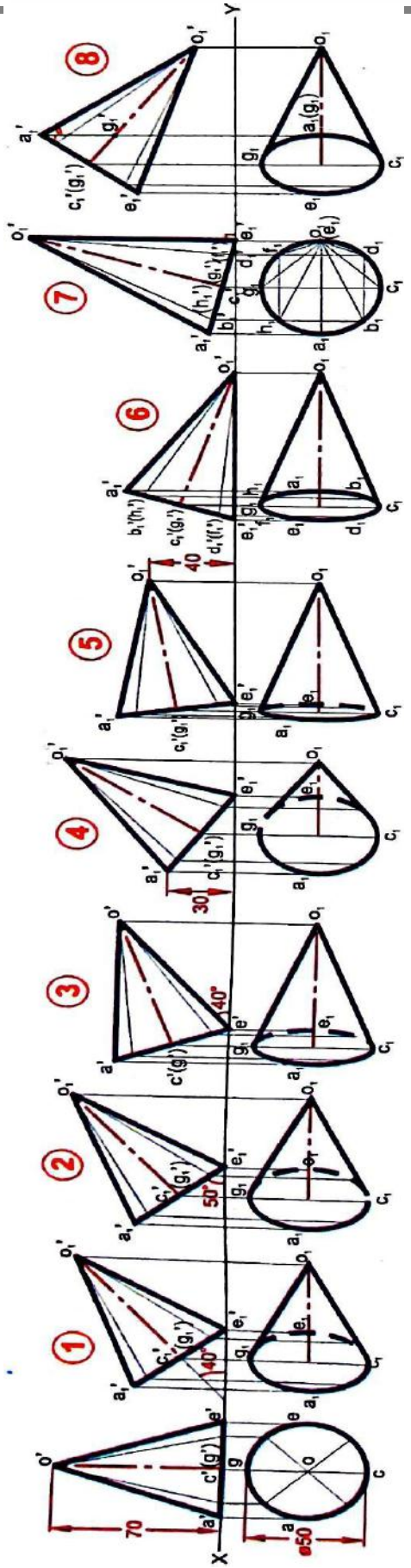
2 - Base inclined at 50^0 to HP.

3 - Rectangular face containing the resting edge makes an angle of 40^0.

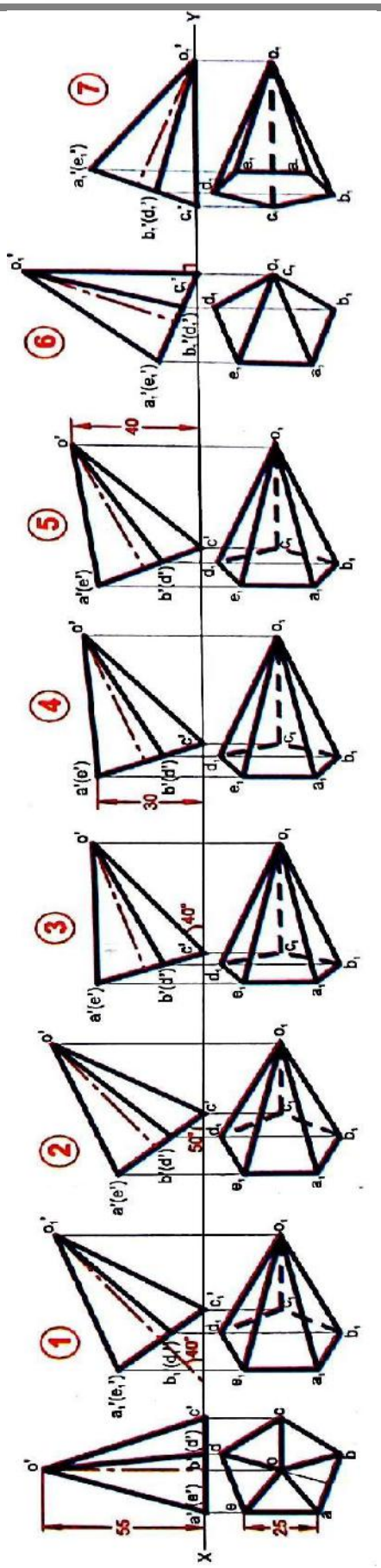


1 - Axis inclined at 45^0 to HP and parallel to VP.2 - Base inclined at 50^0 to HP.

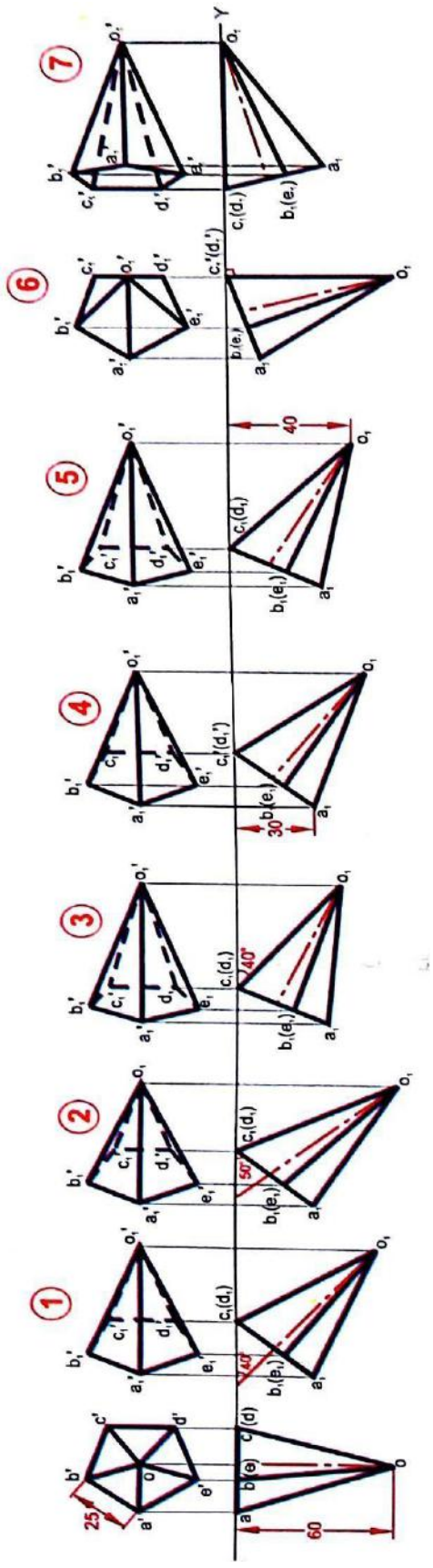
3 – Generator inclined at 40^0 to HP.4 - Solid diagonal vertical.



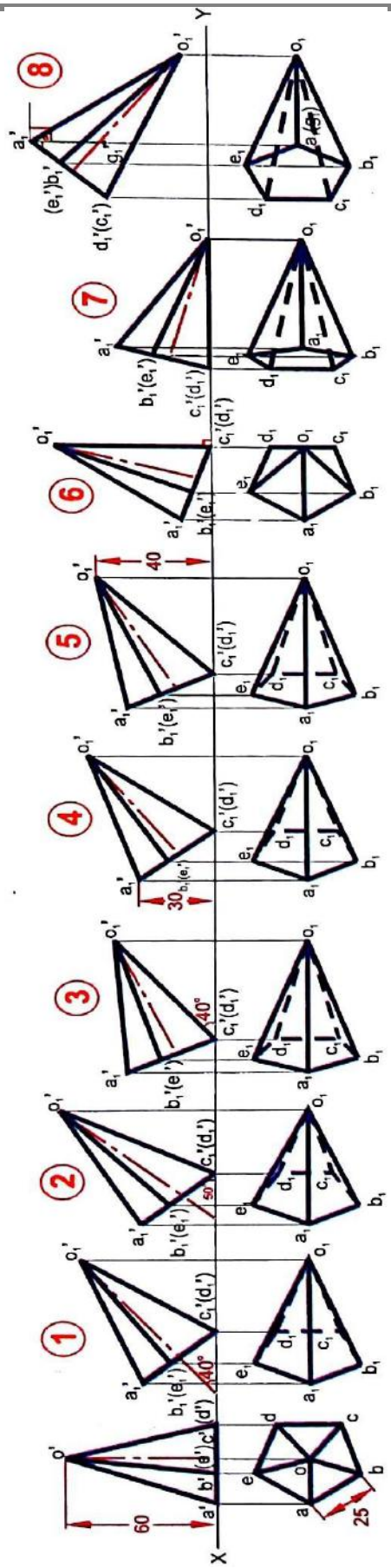
1- Axis inclined at 40^0 to HP and parallel to VP.
2- Base inclined at 50^0 to HP.
3- Generator inclined at 40^0 to HP.
4- Point diametrically opposite to the resting point is being lifted toheight of 30 mm from HP.
5- Apex is being lifted to height of 40 mm from HP.
6- Resting or lying on HP with one of its generators.
7- Generator perpendicular to HP and parallel to VP.
8- Freely suspended from a base point.



1- Axis inclined at 40^0 to HP and parallel to VP.
2- Base inclined at 50^0 to HP.
3- Base corners and the slant edge containing the resting corner makes on angle of 40^0 to the HP.
4- The resting corner is being lifted to height of 30 mm from HP.
5- Apex is being lifted to height of 40 mm from HP.
6- Slant edge perpendicular to HP and parallel to VP.
7- Lying on the ground with one of its slant edge.



1- Axis inclined at 40^0 to HP and parallel to VP.
2- Base inclined at 50^0 to HP.
3- Triangular face containing the resting edge makes an angle at 40^0 to VP.
4- Base edge and the corner opposite to the resting edge is being lifted toa height of 30 mm from VP.
5- Apex is being lifted to height of 40 mm from HP.
6- A triangular face perpendicular to VP and HP.
7- Lying on the wall with one of its triangular face.

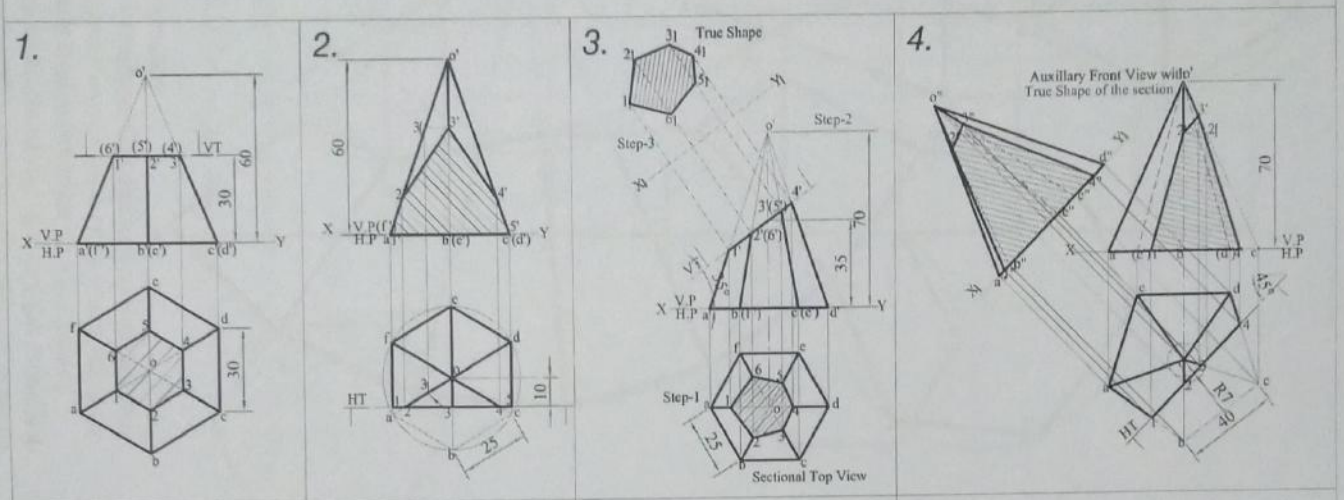


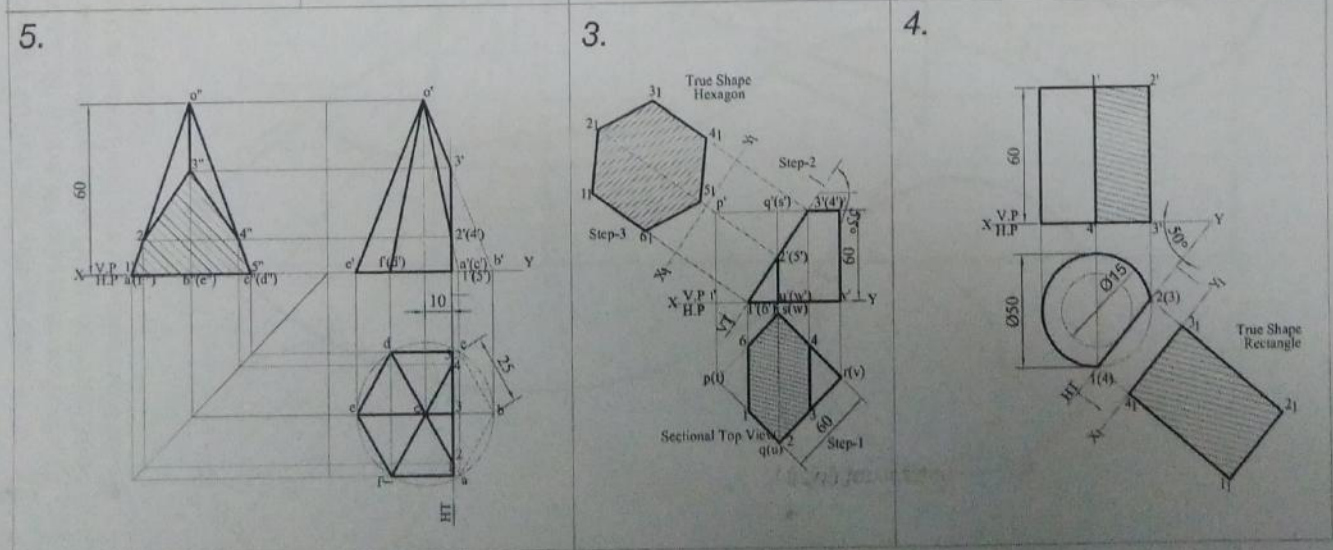
1- Axis inclined at 40^0 to HP and parallel to VP.
2- Base inclined at 50^0 to HP.
3- Triangular face containing the resting edge makes an angle at 40^0 to HP.
4- Base edge and the corner opposite to the resting edge are being lifted to a height of 30 mm from HP.
5- Apex is being lifted to height of 40 mm from HP.
6- A triangular face perpendicular to HP and VP.
7- Lying on the wall with one of its triangular face.
8- Freely suspended from a base point.

Sectioning of above-solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

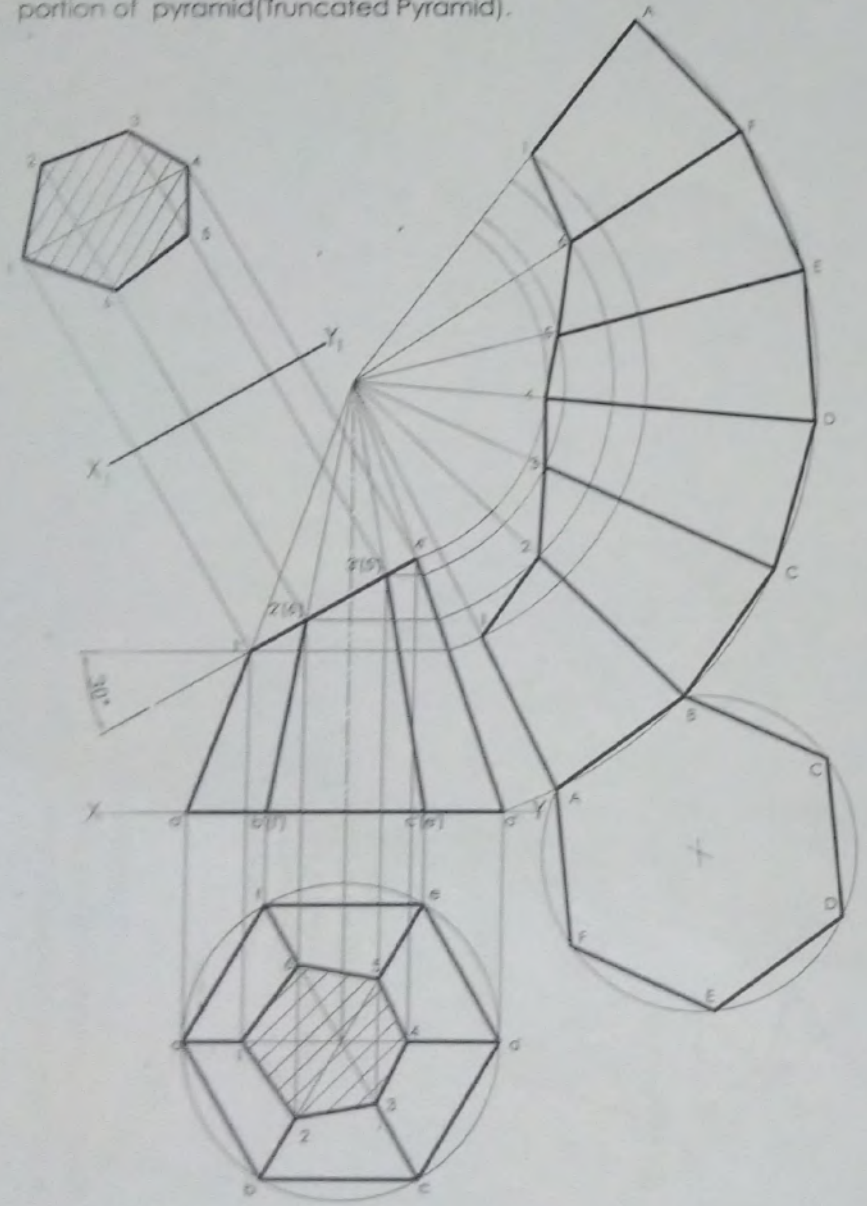
Different Positions of Cutting Plane:

1. Cutting Plane Perpendicular to VP and Parallel to HP.(Top View is True shape of the section)
2. Cutting Plane Perpendicular to HP and Parallel to VP. (Front View is True shape of the Section)
3. Cutting Plane Perpendicular to VP and Inclined to HP. (True shape is perpendicular to the given to θ°)
4. Cutting Plane Perpendicular to HP and Inclined to VP. (True shape is perpendicular to the given to ϕ°)
5. Cutting Plane Perpendicular to both HP and HP. (Side View is True shape of the section)

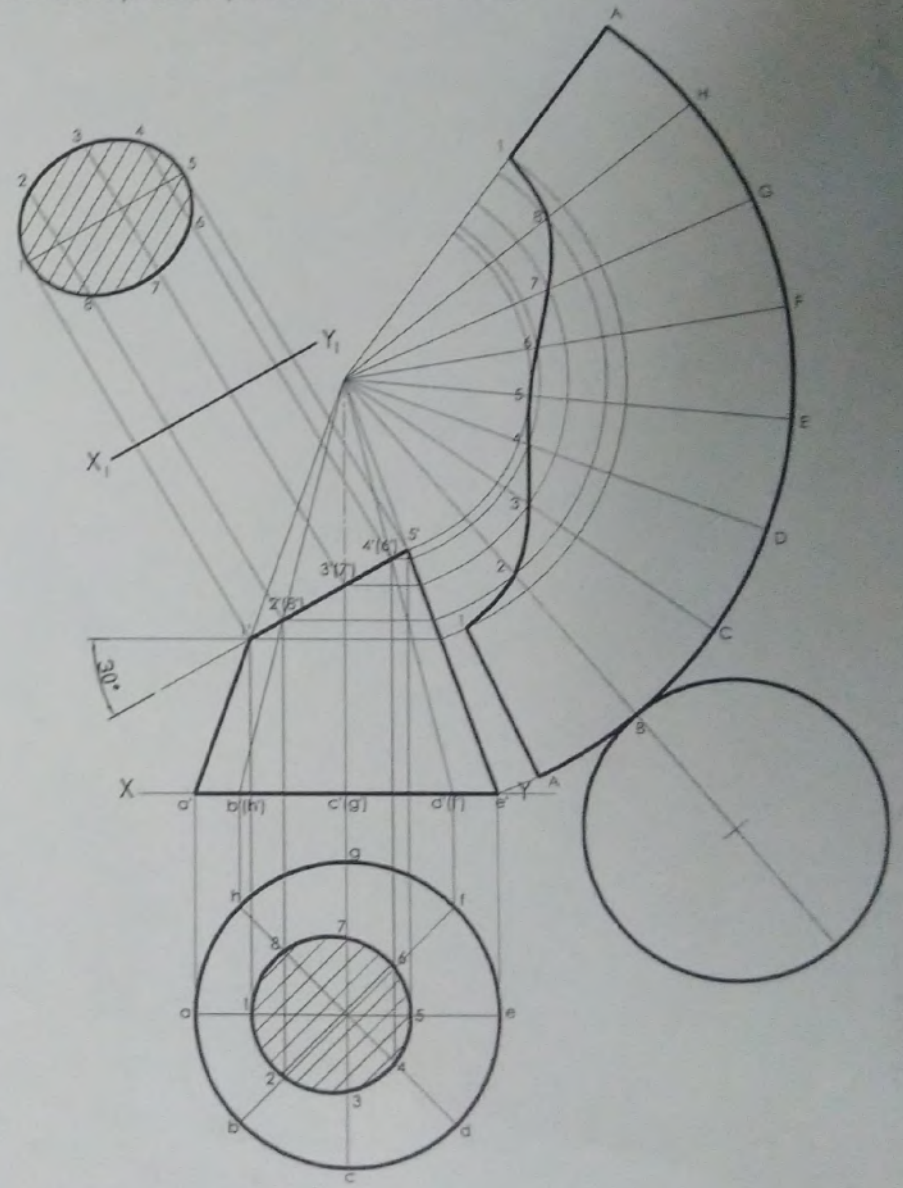




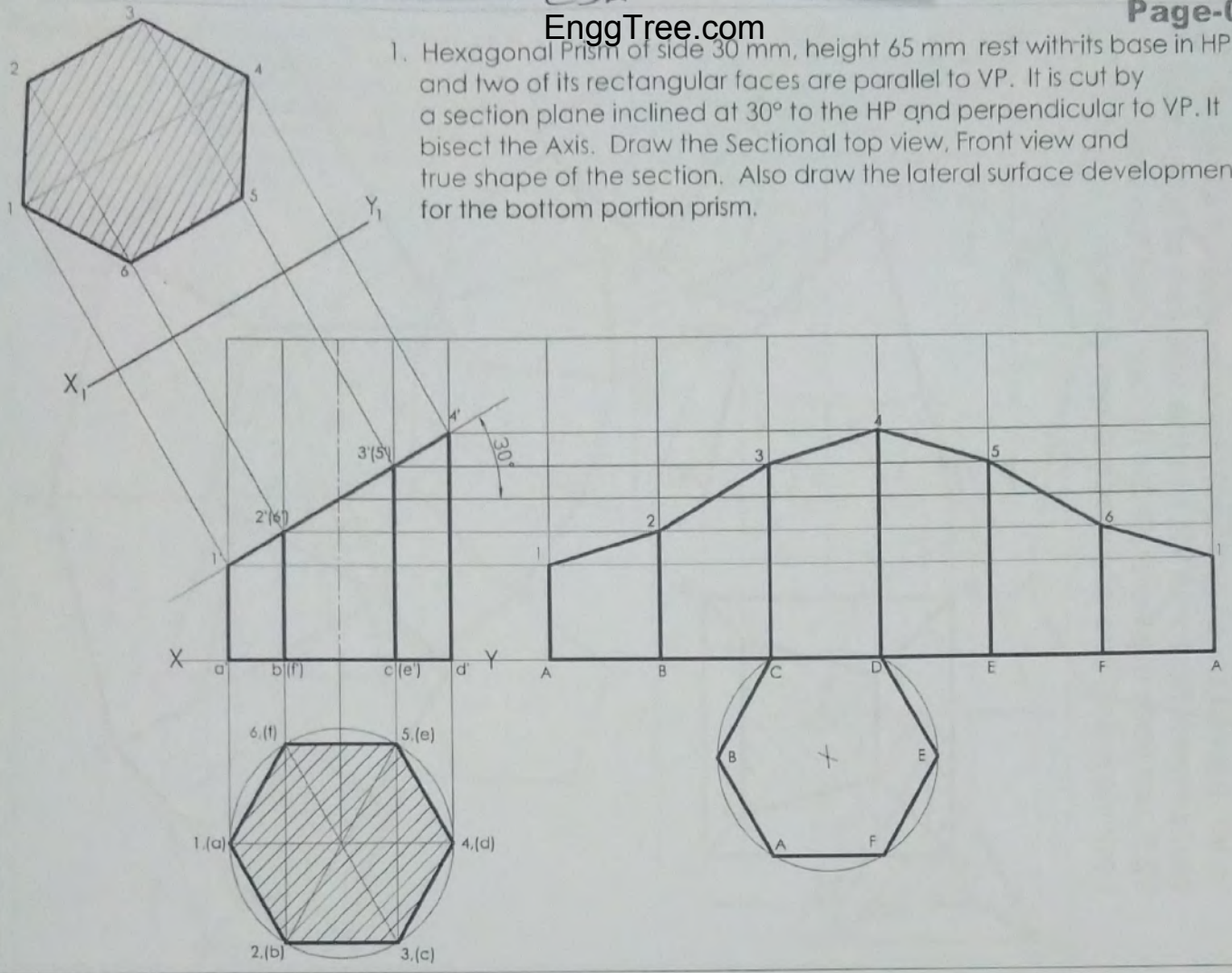
3. Hexagonal Pyramid of side 30 mm, height 65 mm rest with its base in HP and two of its base edges are parallel to VP. It is cut by a section plane inclined at 30° to the HP and perpendicular to VP.It bisect the Axis. Draw the Sectional top view, Front view and true shape of the section. Also draw the lateral surface development the bottom portion of pyramid(Truncated Pyramid).



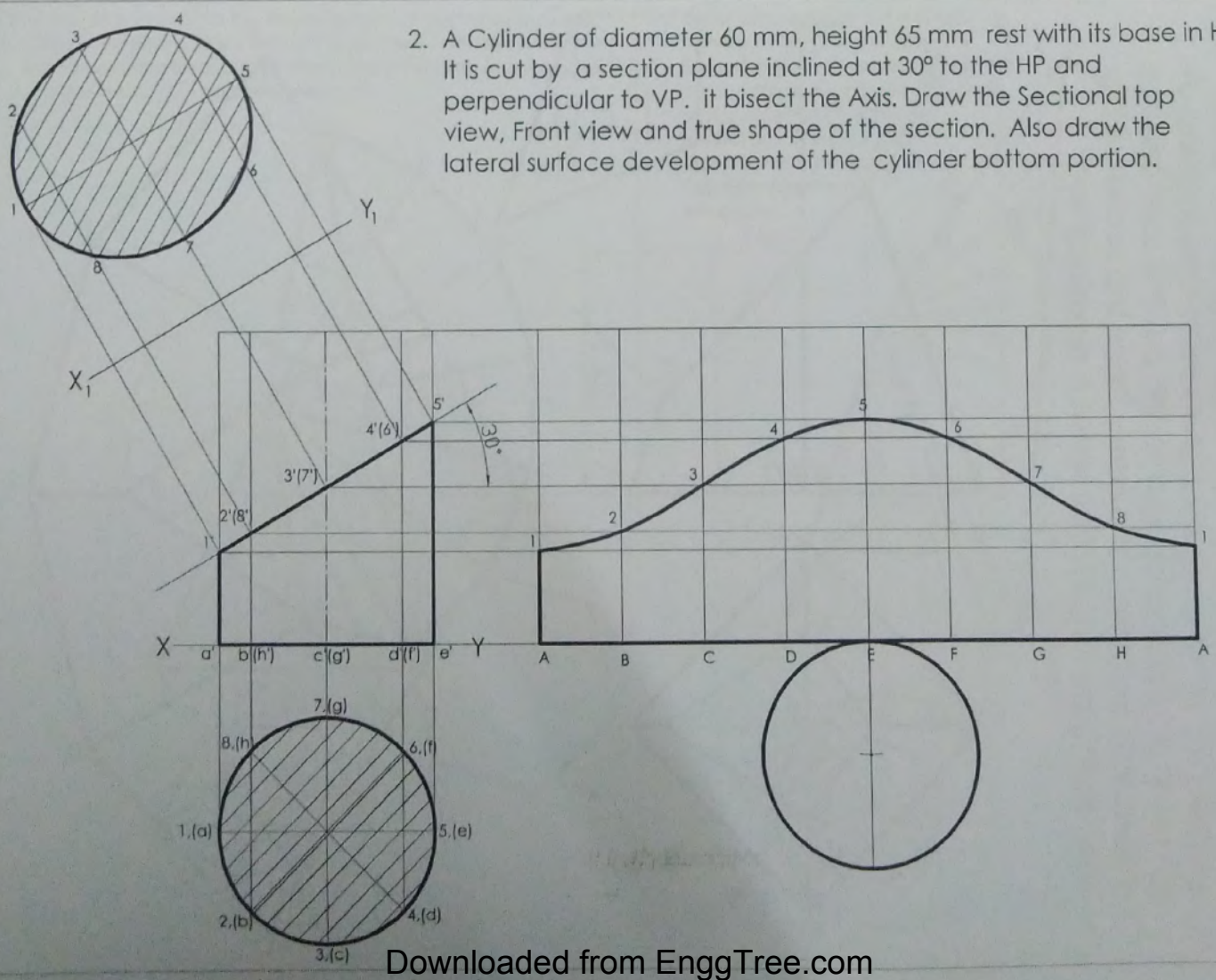
4. A Cone of diameter 60 mm, height 65 mm rest with its base in HP. It is cut by a section plane inclined at 30° to the HP and perpendicular to VP. It bisect the Axis. Draw the sectional top view, Front view and true shape of the section. Also draw the lateral surface development of the cone(bottom portion-Truncated Solid).



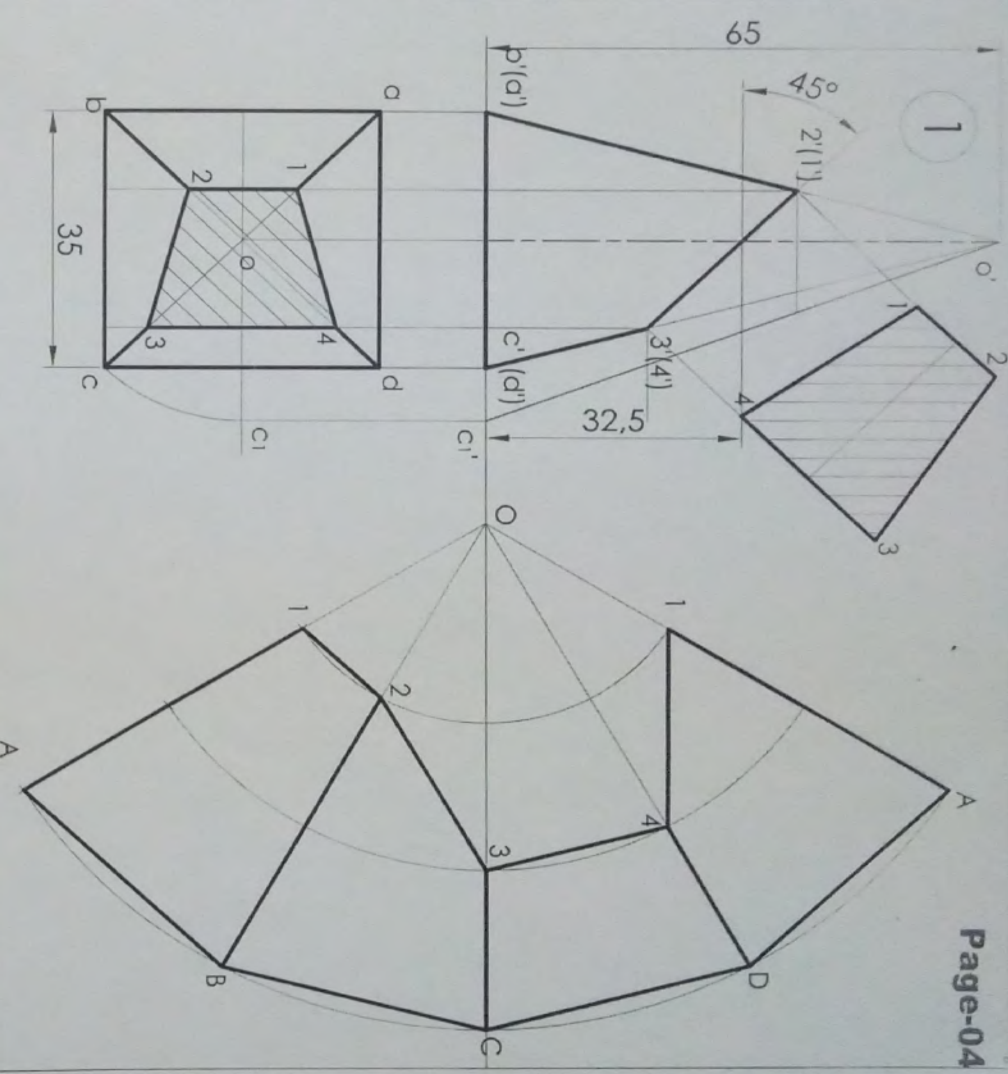
1. Hexagonal Prism of side 30 mm, height 65 mm rest with its base in HP and two of its rectangular faces are parallel to VP. It is cut by a section plane inclined at 30° to the HP and perpendicular to VP. It bisect the Axis. Draw the Sectional top view, Front view and true shape of the section. Also draw the lateral surface development for the bottom portion prism.



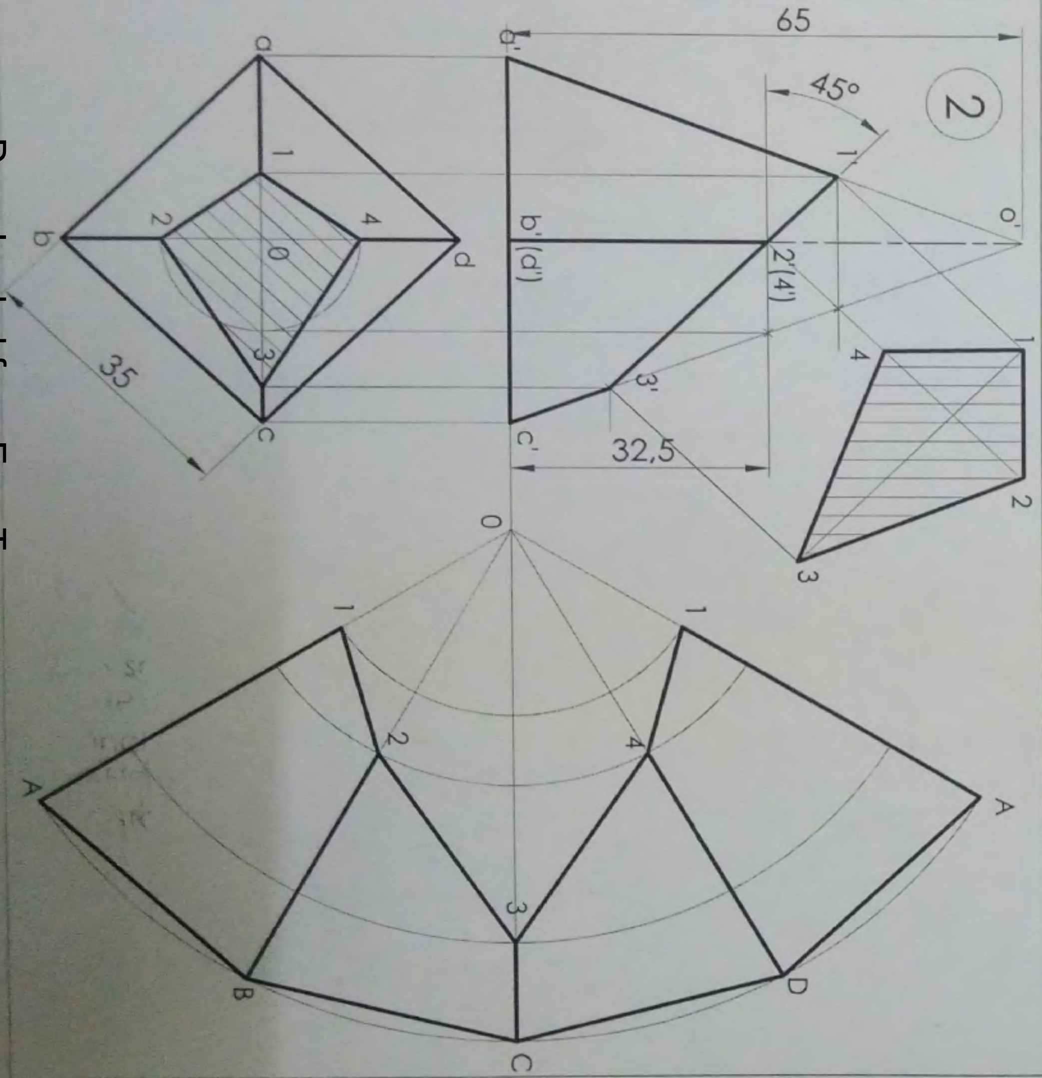
2. A Cylinder of diameter 60 mm, height 65 mm rest with its base in HP. It is cut by a section plane inclined at 30° to the HP and perpendicular to VP. it bisect the Axis. Draw the Sectional top view, Front view and true shape of the section. Also draw the lateral surface development of the cylinder bottom portion.



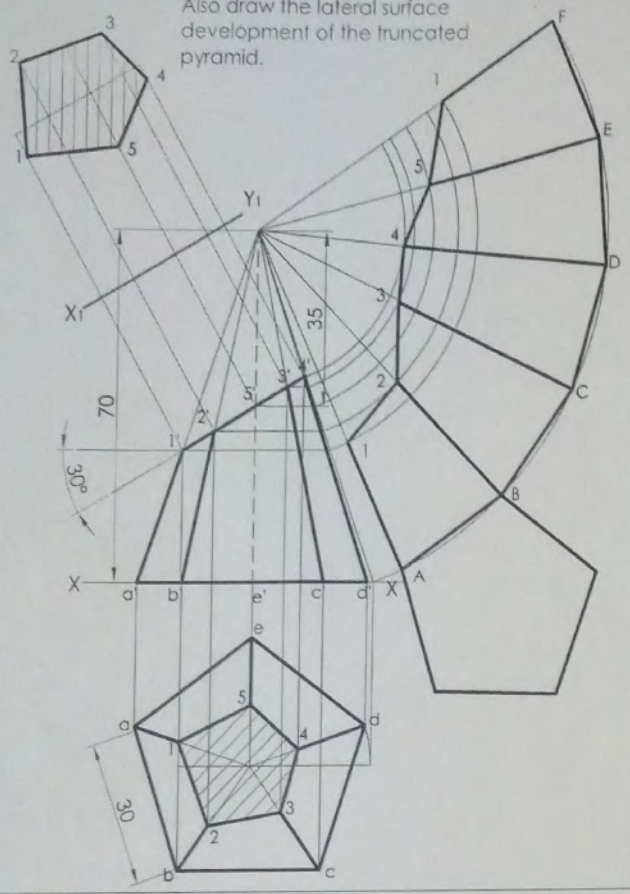
1. A square Pyramid of side 35 mm height 65 mm rests on HP with its base and one of its base edge is parallel to VP. It is cut by a sectional plane inclined at 45° to HP and perpendicular to VP, cut the solid axis at a distance 32.5 mm from the base. Draw the sectional top view, front view and lateral surface development.



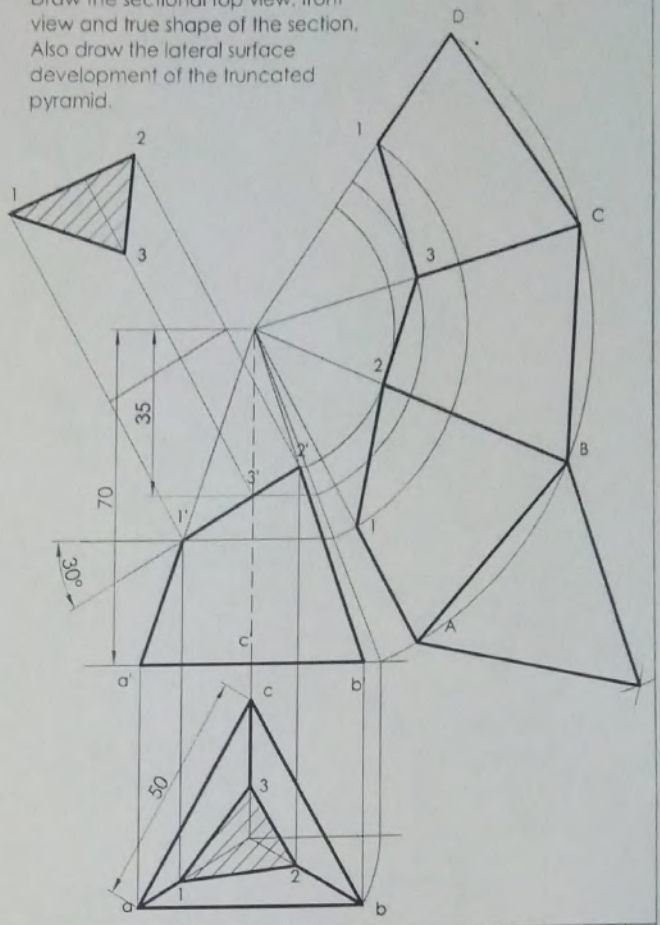
2. A square Pyramid of side 35 mm height 65 mm rests on HP with its base and two of its base edges are equally inclined to VP. It is cut by a sectional plane inclined at 45° to HP and perpendicular to VP, cut the solid axis at a distance 32.5mm from the base. Draw the sectional top view, front view and lateral surface development.



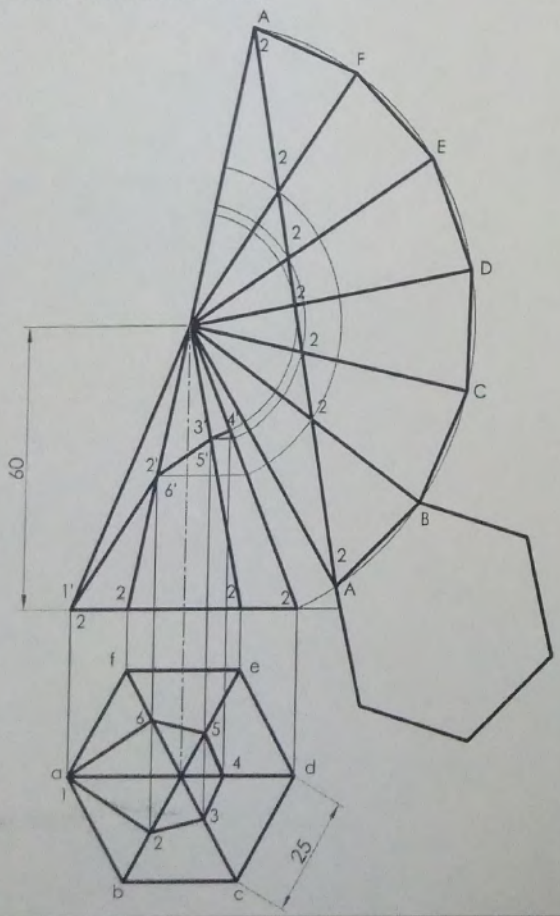
1. A Section plane cuts the solid axis at a distance 35 mm from the vertex. Draw the sectional top view, front view and true shape of the section. Also draw the lateral surface development of the truncated pyramid.



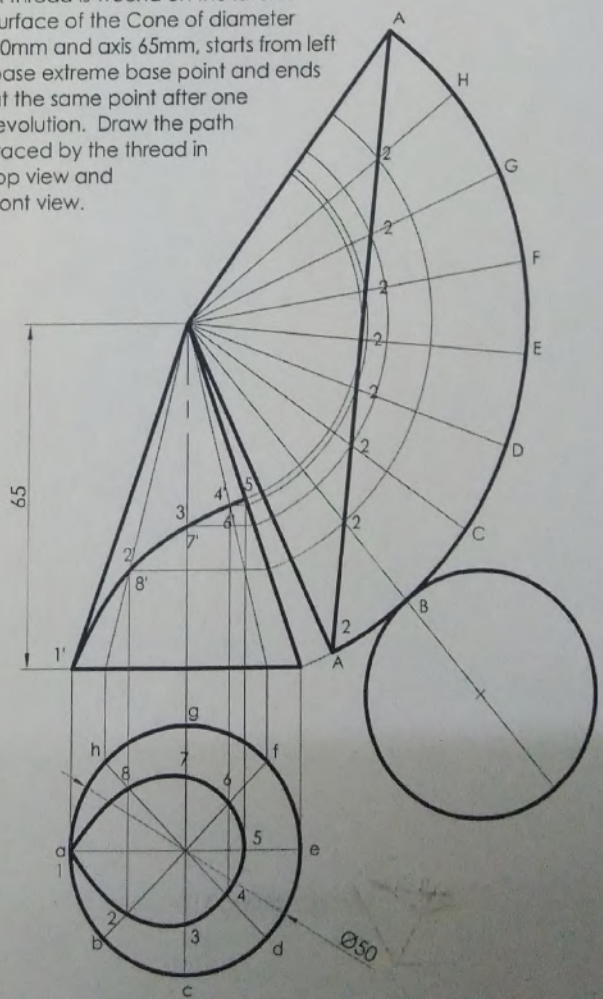
2. A Section plane cuts the solid axis at a distance 35 mm from the vertex. Draw the sectional top view, front view and true shape of the section. Also draw the lateral surface development of the truncated pyramid.



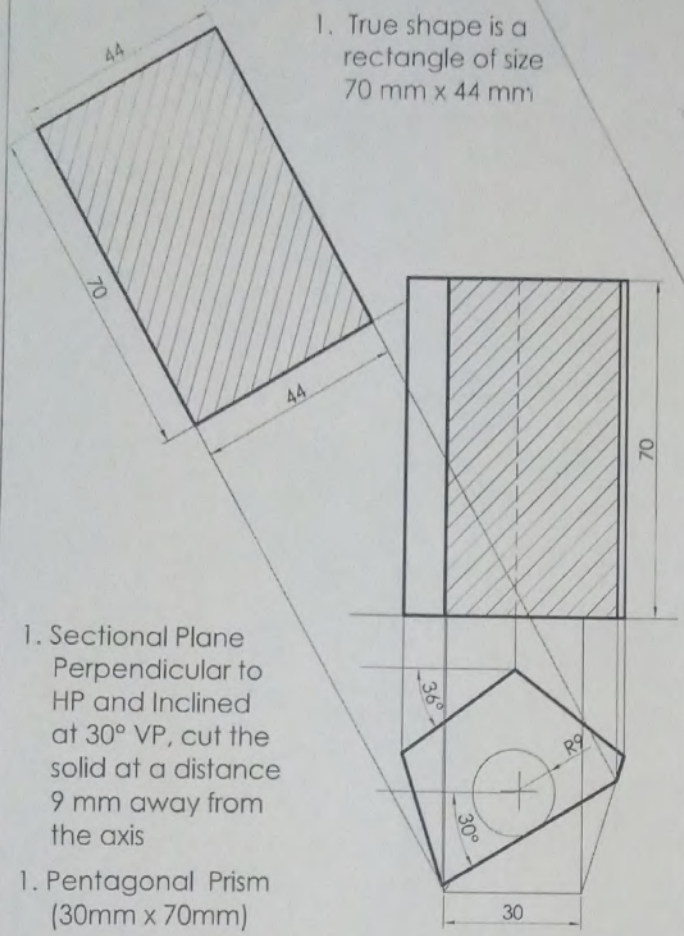
3. A thread is wound on the lateral surface of the Pyramid of side 25mm axis 60mm, starts from left base corner and ends at the same corner after one revolution. Draw the path traced by the thread in top view and front view.



4. A thread is wound on the lateral surface of the Cone of diameter 50mm and axis 65mm, starts from left base extreme base point and ends at the same point after one revolution. Draw the path traced by the thread in top view and front view.



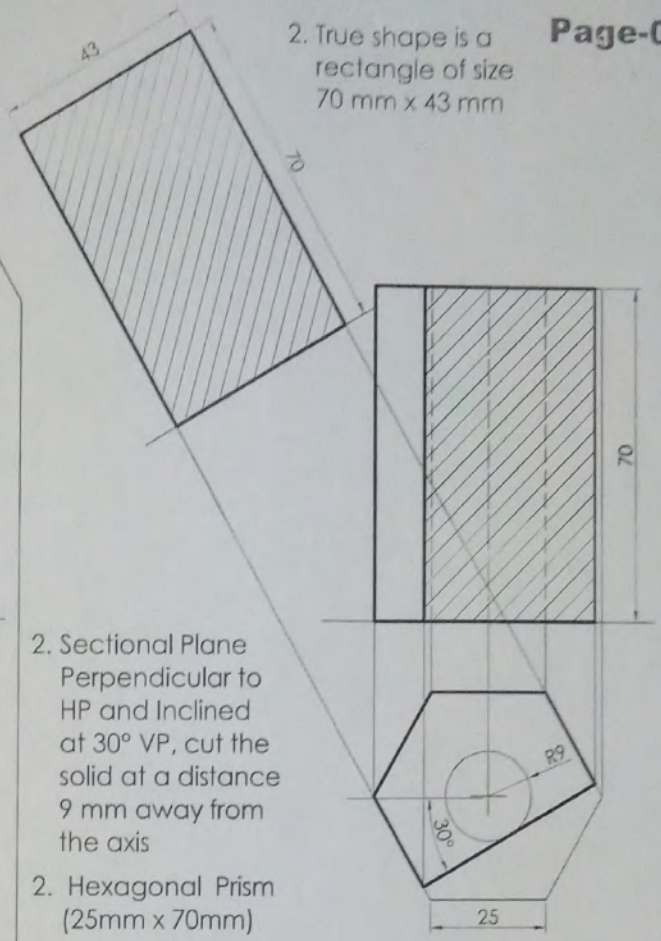
1. True shape is a rectangle of size 70 mm x 44 mm



1. Sectional Plane Perpendicular to HP and Inclined at 30° VP, cut the solid at a distance 9 mm away from the axis

1. Pentagonal Prism (30mm x 70mm)

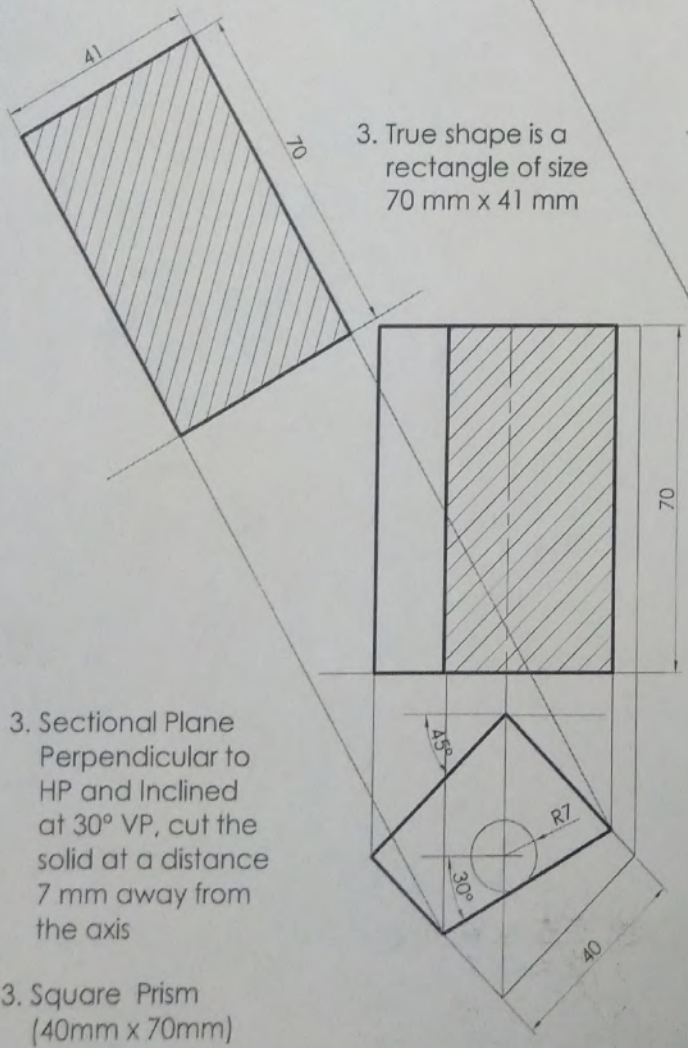
2. True shape is a rectangle of size 70 mm x 43 mm



2. Sectional Plane Perpendicular to HP and Inclined at 30° VP, cut the solid at a distance 9 mm away from the axis

2. Hexagonal Prism (25mm x 70mm)

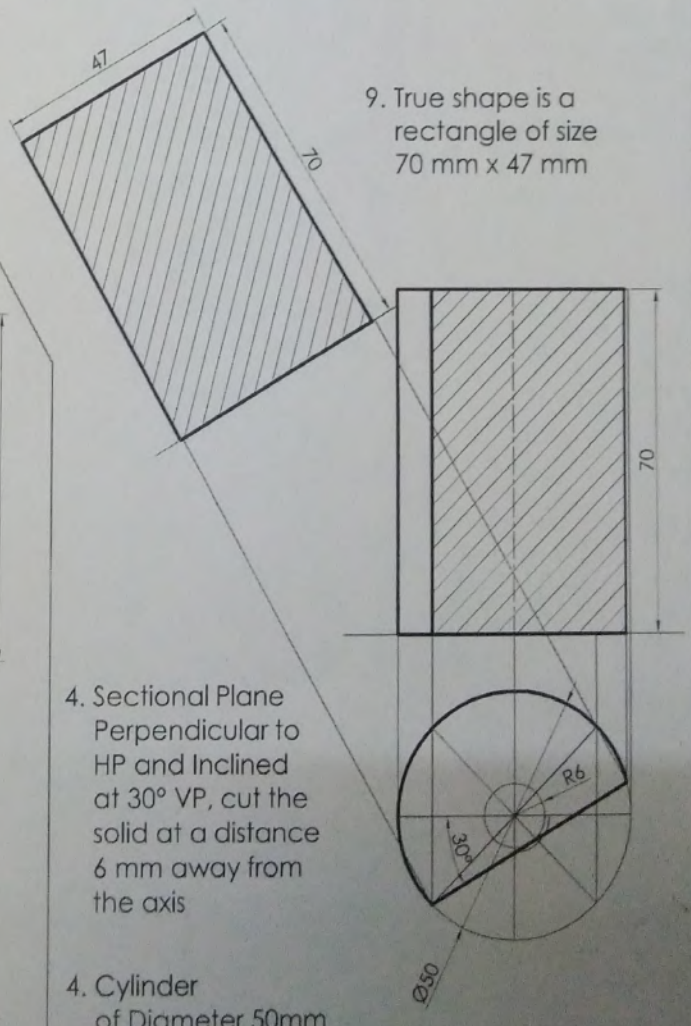
3. True shape is a rectangle of size 70 mm x 41 mm



3. Sectional Plane Perpendicular to HP and Inclined at 30° VP, cut the solid at a distance 7 mm away from the axis

3. Square Prism (40mm x 70mm)

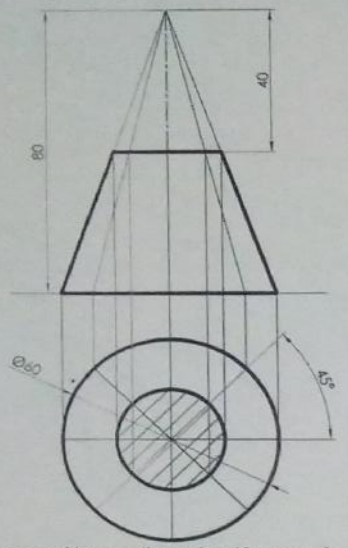
9. True shape is a rectangle of size 70 mm x 47 mm



4. Sectional Plane Perpendicular to HP and Inclined at 30° VP, cut the solid at a distance 6 mm away from the axis

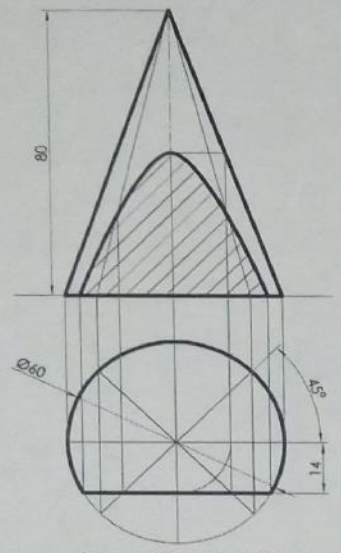
4. Cylinder of Diameter 50mm

1



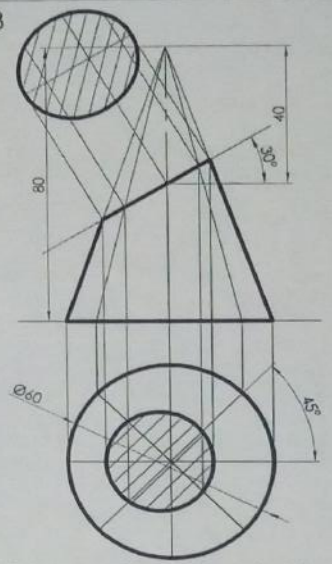
1. A cone of base diameter 60 mm axis 80 mm lies on HP with its base and a Section Plane Parallel to HP and perpendicular to VP, cuts the Axis at a Distance 40 mm from the Vertex / Base.

2



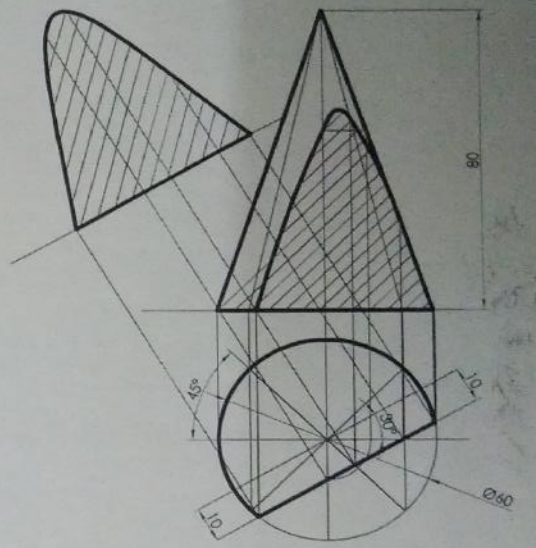
2. A cone of base diameter 60 mm axis 80 mm lies on HP with its base and a Section Plane Parallel to VP and perpendicular to HP, cuts the solid at a Distance 14 mm away from the Axis.

3



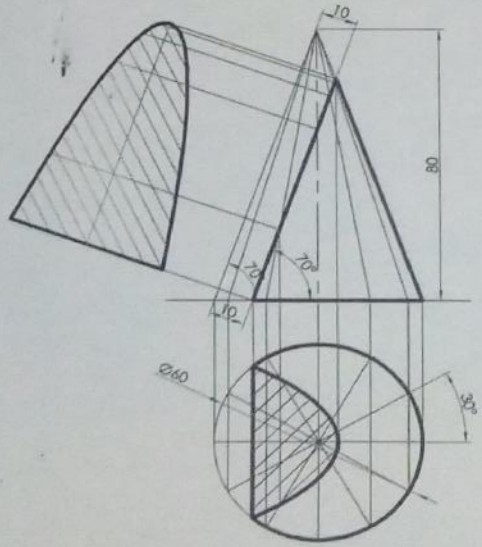
3. A cone of base diameter 60 mm, axis 80 mm lies on HP with its base and a Section Plane inclined at 30° to HP and perpendicular to VP, cuts the axis at a Distance 40 mm from the Vertex.

7



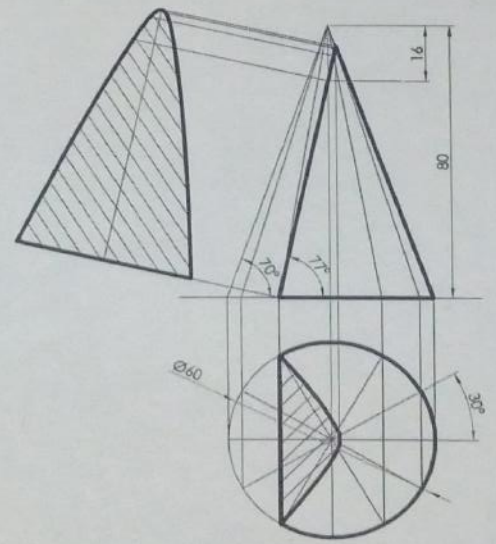
7. A cone of base diameter 60 mm axis 80 mm lies on HP with its base and a Section Plane inclined at 30° to VP and perpendicular to HP, cuts the solid at a Distance 10 mm away from the Axis. Draw the Top View, Sectional Front view and true shape of the section.

4



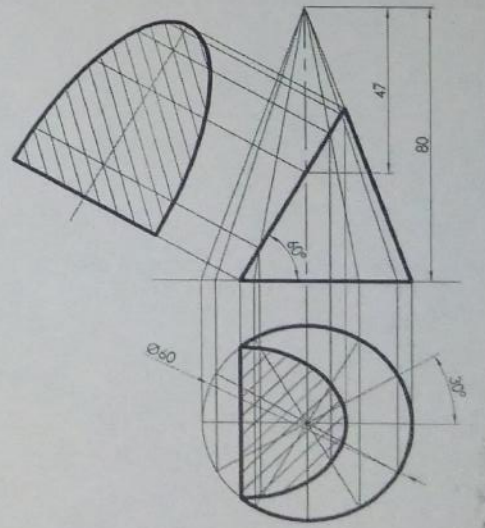
4. A cone of Base diameter 60mm axis 80 mm lies on HP with its base and it is cut by a Section Plane parallel to the extreme generator at a distance 10 mm away from it. Draw the Sectional top view, front view and true shape of the section.

5



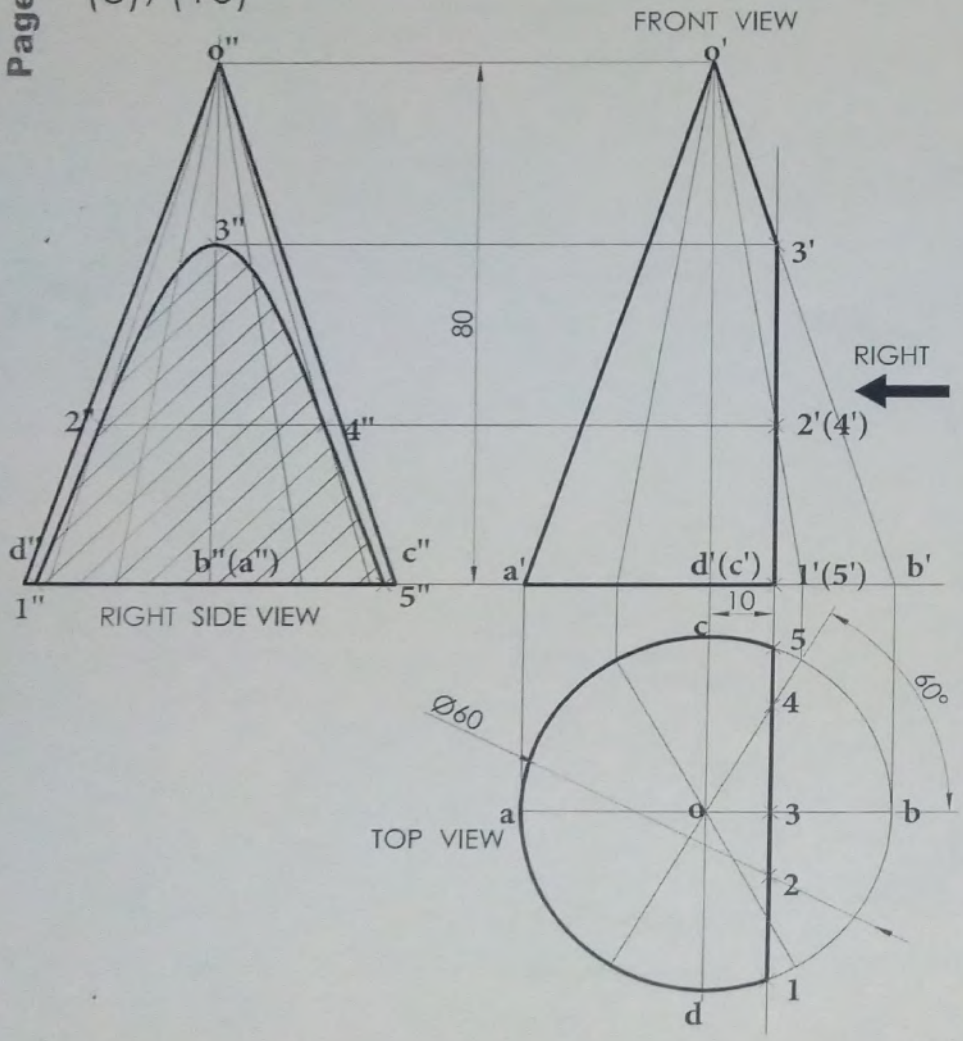
5. A cone of base diameter 60 mm axis 80 mm lies on HP with its base and a section plane inclined at 77° to HP and perpendicular to VP, cuts the axis at a Distance 16 mm from the Vertex. Draw the sectional top view, front view and true shape of the section.

6



6. A cone of base diameter 60 mm axis 80 mm lies on HP with its base and a section plane inclined at 60° to HP and perpendicular to VP, cuts the axis at a Distance 47 mm from the Vertex. Draw the sectional top view, front view and true shape of the section.

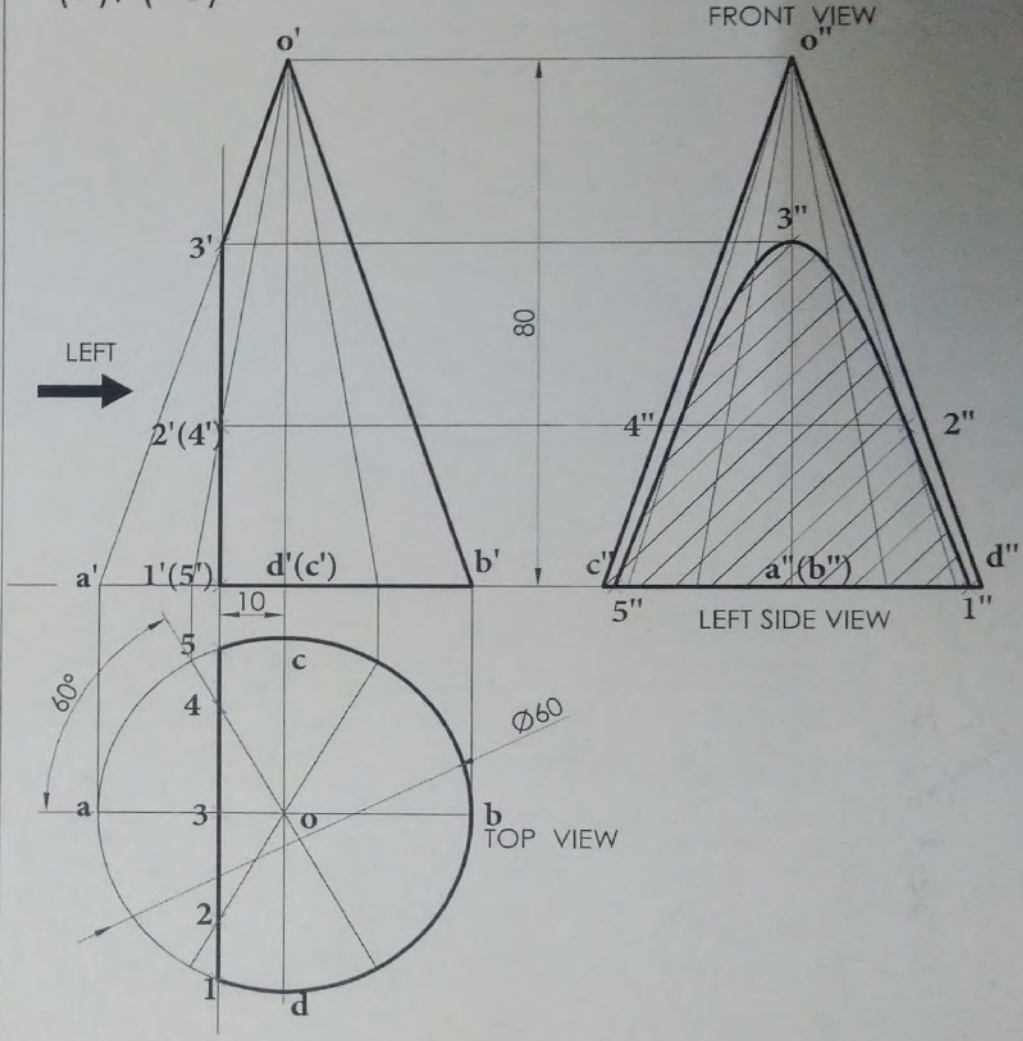
(8), (10)



8. A cone of diameter 60 mm , height 80 mm lies on HP with its base. It is cut by a section plane Perpendicular to both HP and VP. It cuts the solid at a distance 10 mm away from the axis on RIGHT side of the axis. Draw the Top view , Front view of the Truncated cone. Also draw the RIGHT Side view showing the true shape of the Section.

10. A cone of diameter 60 mm , height 80 mm lies on HP with its base. It is cut by a section plane Perpendicular to both HP and VP. It cuts the solid at a distance 10 mm away from the AXIS. Draw the Top view , Front view of the the Truncated cone and side view showing the true shape of the section.

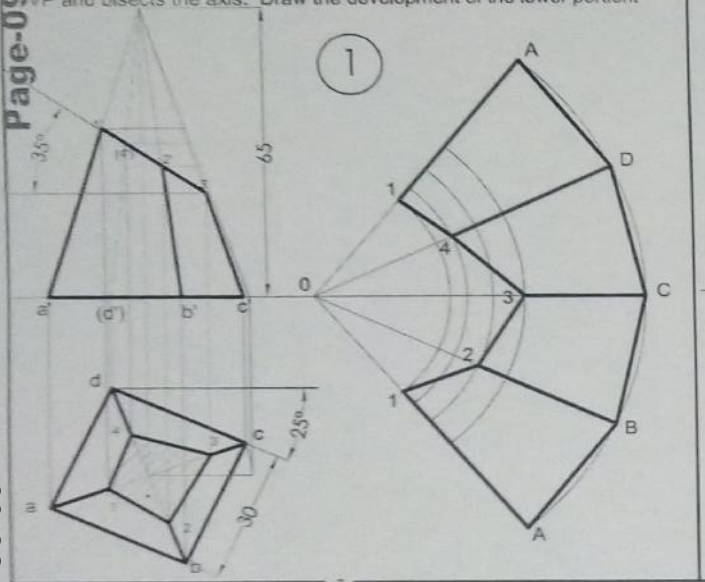
(9), (10)



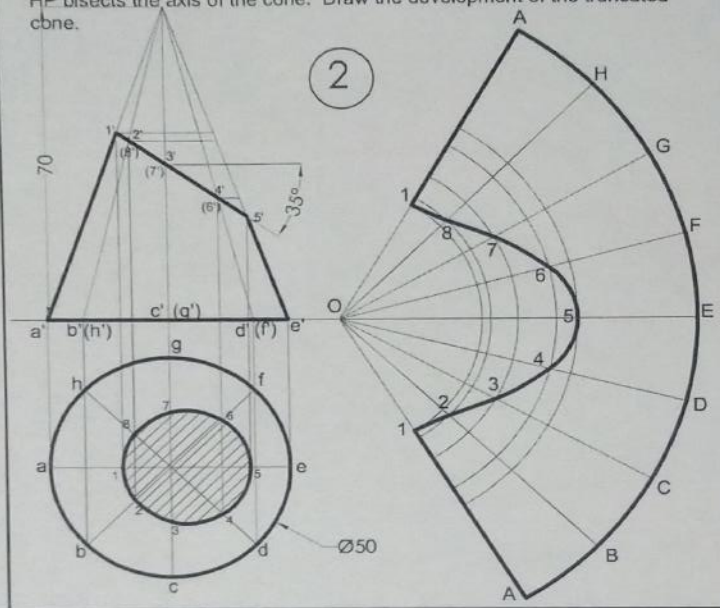
9. A cone of diameter 60 mm , height 80 mm lies on HP with its base. It is cut by a section plane Perpendicular to both HP and VP. It cuts the solid at a distance 10 mm away from the axis on LEFT side of the axis. Draw the Top view , Front view of the Truncated cone. Also draw the LEFT Side view showing the true shape of the Section.

10. A cone of diameter 60 mm , height 80 mm lies on HP with its base. It is cut by a section plane Perpendicular to both HP and VP. It cuts the solid at a distance 10 mm away from the AXIS. Draw the Top view , Front view of the the Truncated cone and side view showing the true shape of the section.

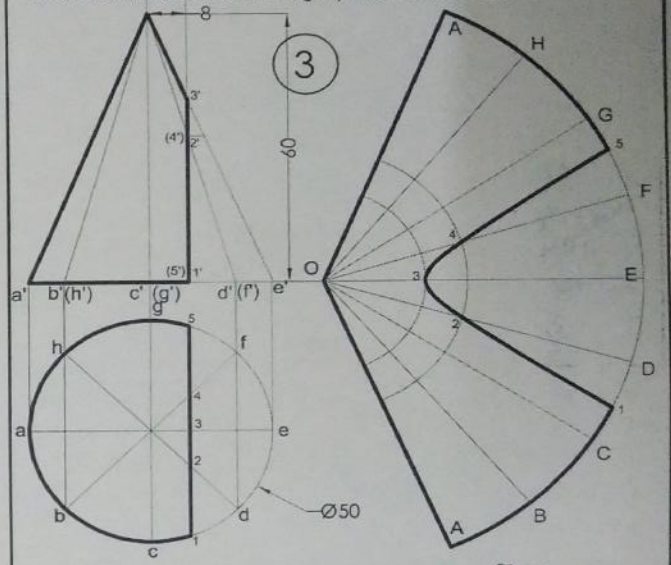
May/June 2007: A square Pyramid of base side 30 mm and altitude 65 mm is resting on HP on its base with a side of base inclined at 25° to VP. It is cut by a plane inclined at 35° to HP and perpendicular to VP and bisects the axis. Draw the development of the lower portion.



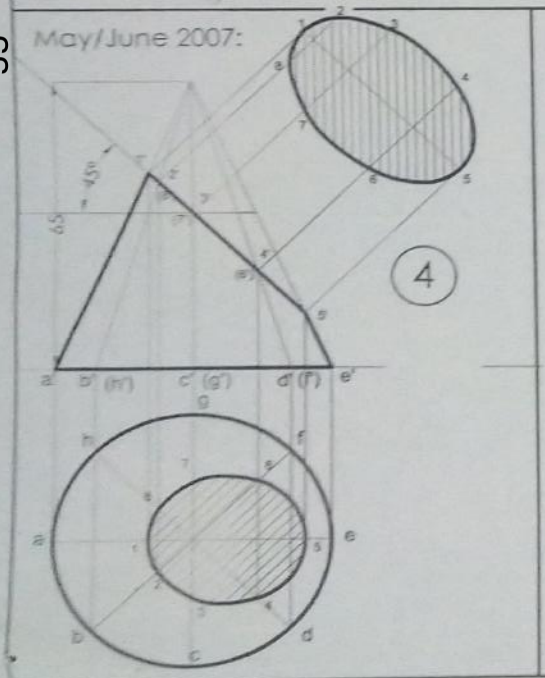
May/June 2007: A cone of base 50 mm and axis length 70 mm rests with its base on HP. A section plane perpendicular to VP and inclined at 35° to HP bisects the axis of the cone. Draw the development of the truncated cone.



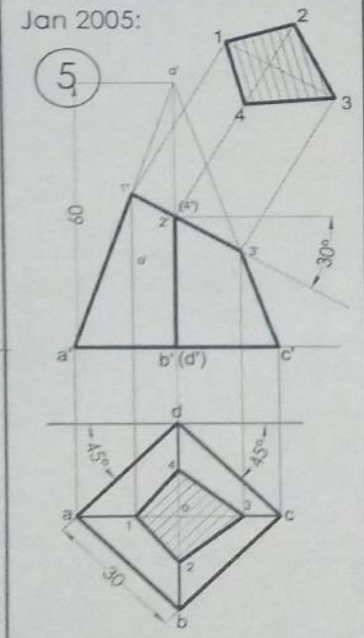
Jan 2005: A cone diameter 50 mm and axis 60 mm is resting on the HP on its base. It is cut by a section plane perpendicular to both HP and VP, 8 mm away from the axis. Draw the development of the lateral surface of the larger portion of the cone.



May/June 2007:



Jan 2005:

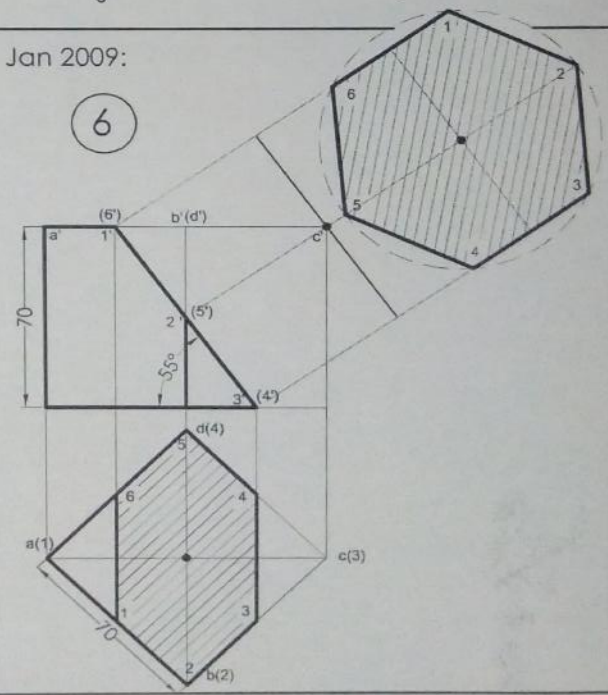


4. May/June 2007: A right circular cone diameter of base 56 mm and height 65 mm, rest on its base on HP. A section plane perpendicular to VP and inclined to HP at 45° cuts the cone meeting its axis at a distance of 36 mm from its base. Draw its front view, sectional top view and true shape of the section.

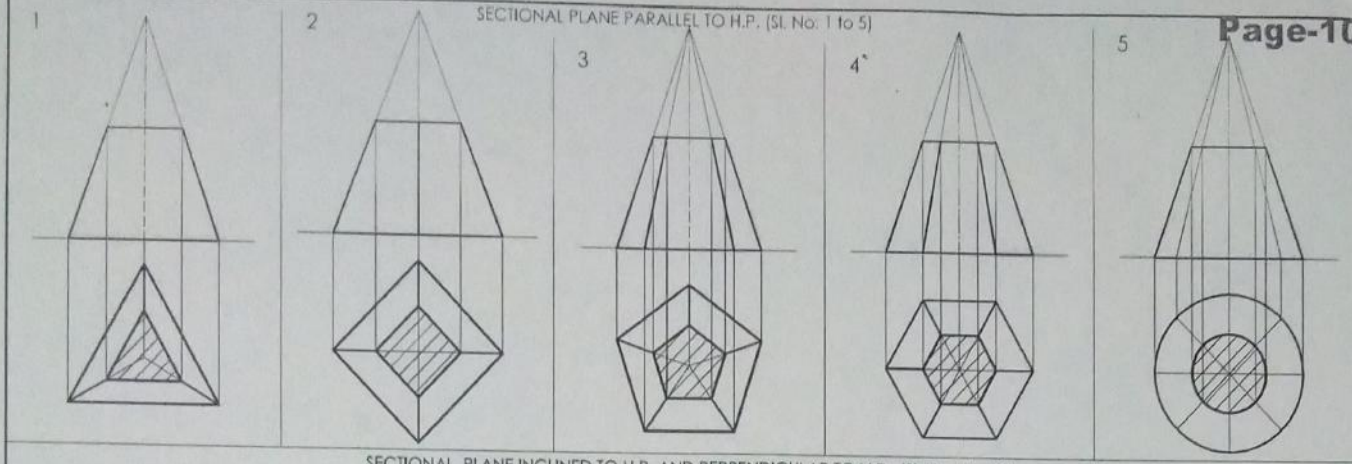
5. Jan 2005: A square Pyramid of base side 30 mm and axis 60 mm long is standing on the HP with its base edges equally inclined to VP. It is cut by a section plane perpendicular to the VP and inclined at 30° to HP, bisects the axis. Draw the sectional top view and true shape of the section, if the upper portion is removed.

6. JAN-2009 : A cube of 70 mm long edges has it's vertical faces equally inclined to VP. It is cut by an auxiliary inclined plane in such a way that the true shape of the cut part is a regular hexagon. Determine the inclination of the cutting plane with the HP. Draw front view, sectional top view and true shape of the section.

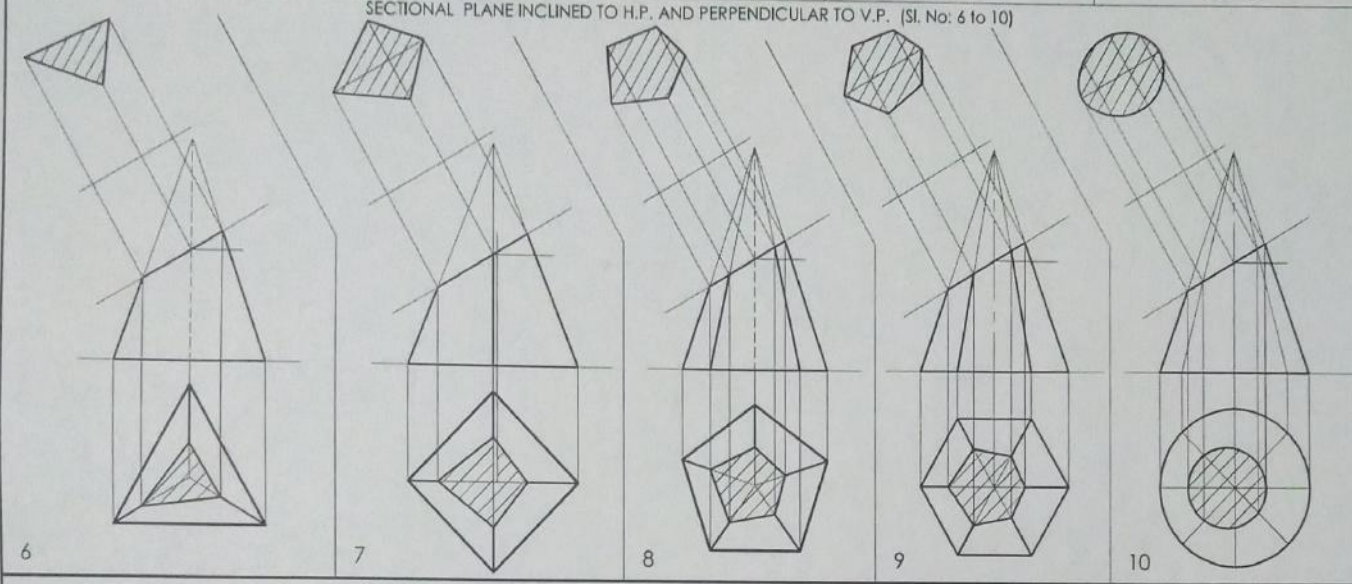
Jan 2009:



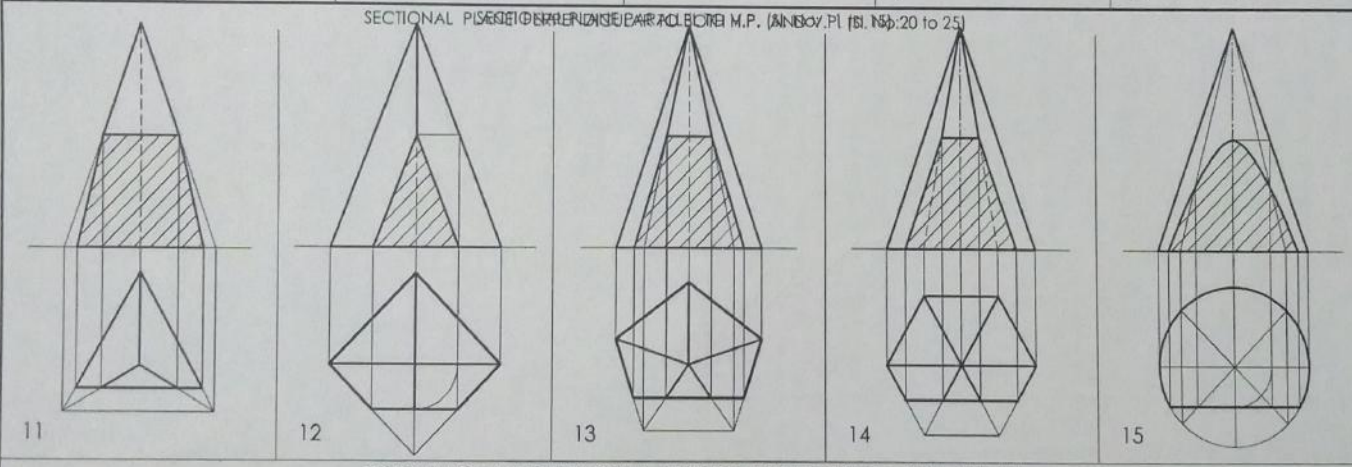
SECTIONAL PLANE PARALLEL TO H.P. (Sl. No: 1 to 5)



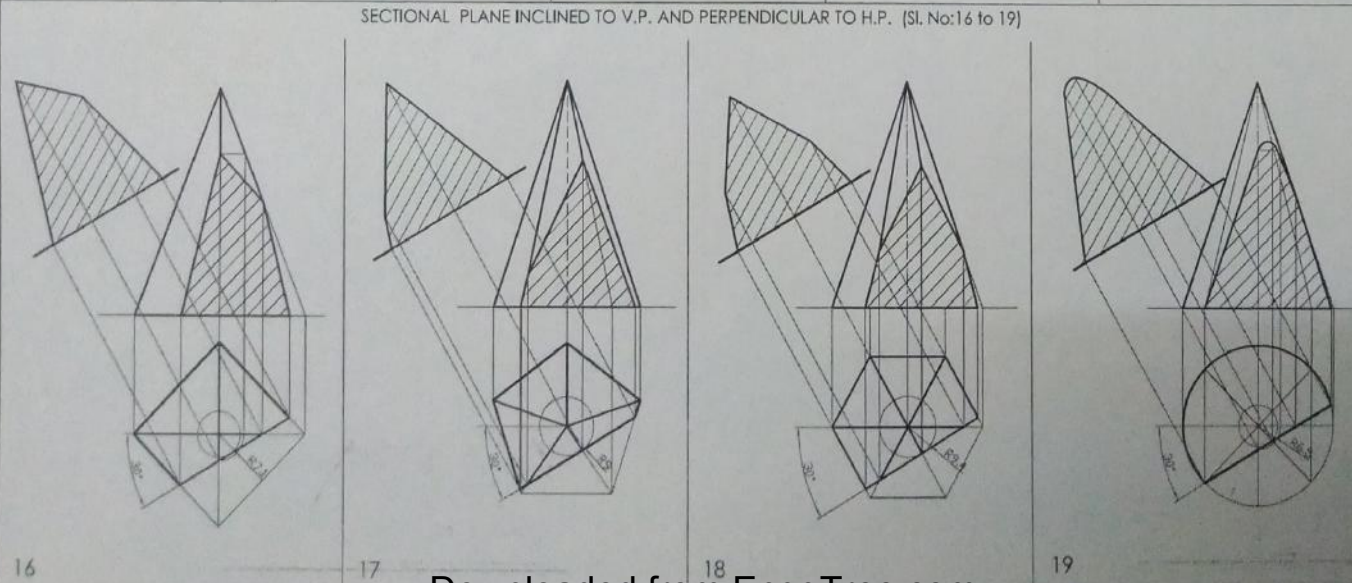
SECTIONAL PLANE INCLINED TO H.P. AND PERPENDICULAR TO V.P. (Sl. No: 6 to 10)



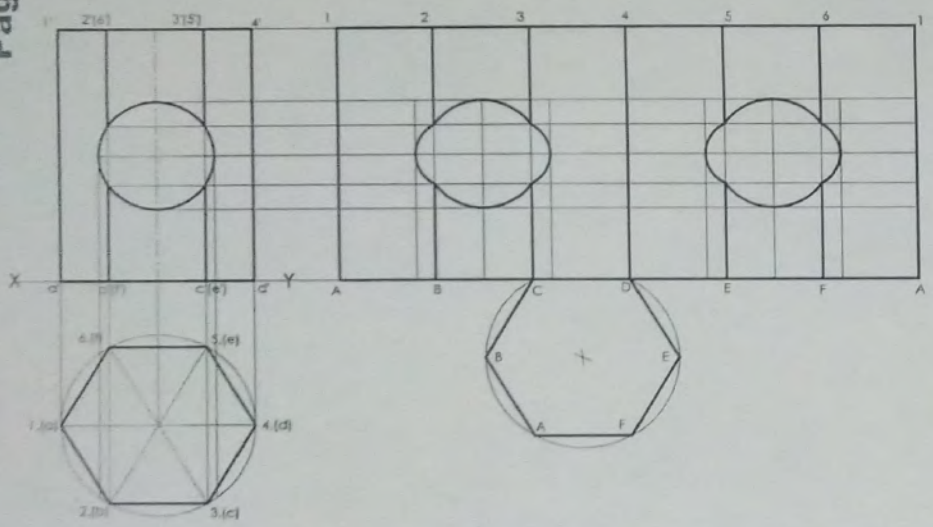
SECTIONAL PLANE PARALLEL TO H.P. AND V.P. (Sl. No: 20 to 25)



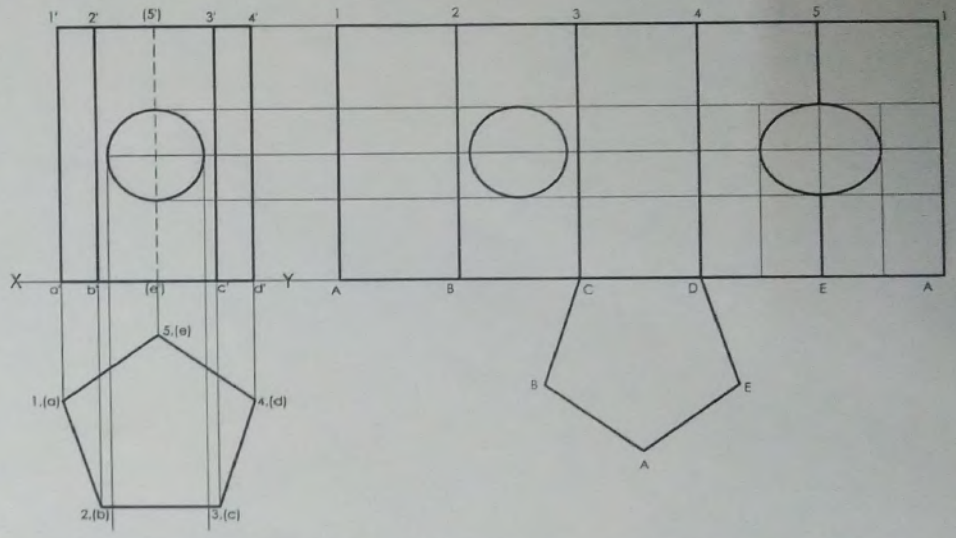
SECTIONAL PLANE INCLINED TO V.P. AND PERPENDICULAR TO H.P. (Sl. No:16 to 19)



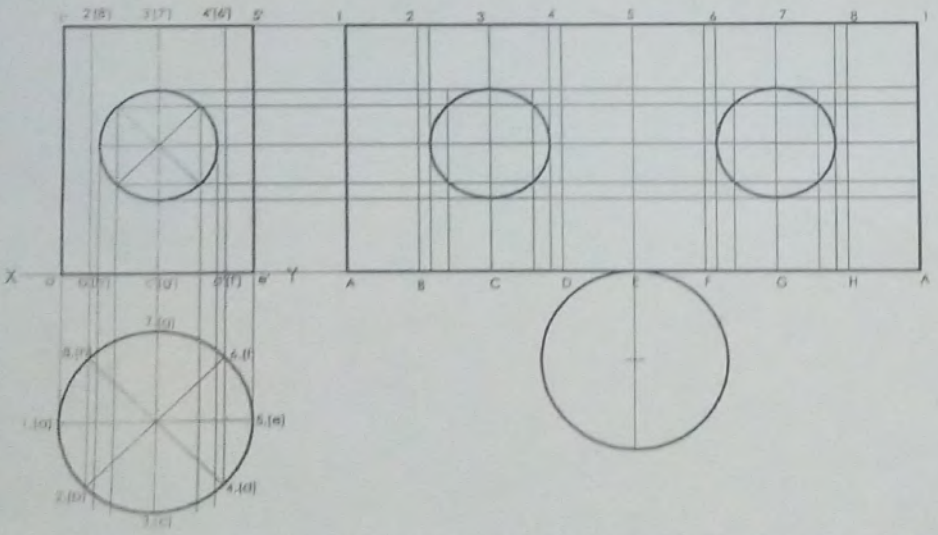
1. Hexagonal Prism of side 30 mm, height 65 mm rest with its base in HP and two of its rectangular faces are parallel to VP. It is drilled to produce a hole of diameter 30 mm such that the axis of the hole is perpendicular to VP and parallel to HP. Draw the lateral surface development of the solid.



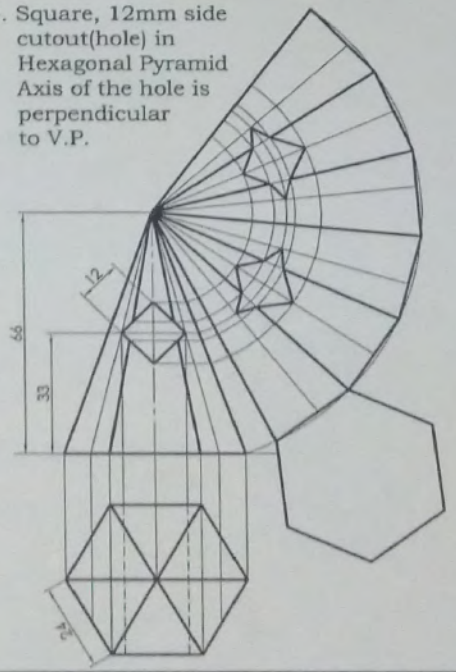
2. Pentagonal Prism of side 30 mm, height 65 mm rest with its base in HP and two of its rectangular faces are equally inclined to VP. It is drilled to produce a hole of diameter 25 mm such that the axis of the hole is perpendicular to VP and parallel to HP. Draw the lateral surface development of the solid.



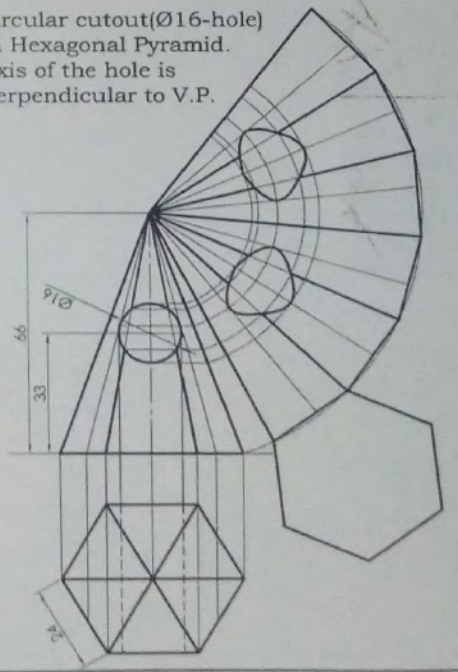
3. A Cylinder of diameter 60 mm, height 65 mm is drilled to produce a hole of diameter 30 mm such that the axis of the hole is perpendicular to VP and parallel to HP. Draw the lateral surface development of the solid.



4. Square, 12mm side cutout(hole) in Hexagonal Pyramid Axis of the hole is perpendicular to V.P.



5. Circular cutout(Ø16-hole) in Hexagonal Pyramid. Axis of the hole is perpendicular to V.P.



UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

Isometric axes : The three lines meeting at the point and making 120∘ angles with each other is called isometric axes.

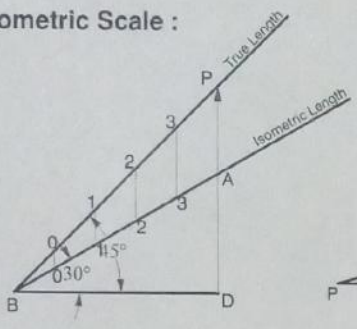
Isometric lines : All lines parallel to these axes are called isometric lines.

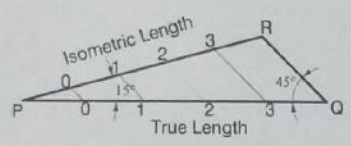
Isometric planes: The planes formed by isometric axes and the parallel planes are called isometric planes.

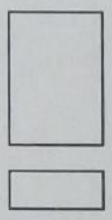
Isometric Scale : A correct isometric projection is drawn with the use of a special isometric scale.The conversion of true length into isometric length is called isometric scale.

Ratio of Isometric length to True length : Isometric length / True length = 0.82

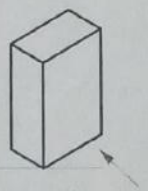
Isometric Scale :



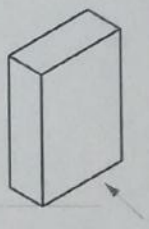




Orthographic Projections (a)

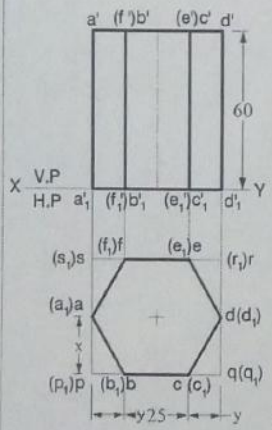


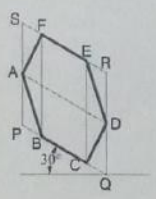
Isometric Projections (b)

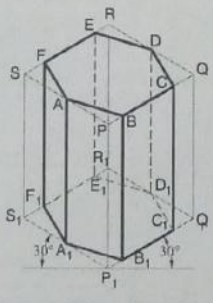


Isometric View (c)

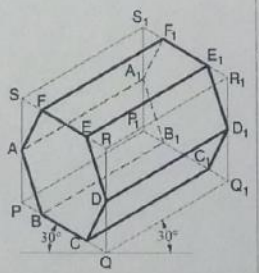
Hexagonal Prism:





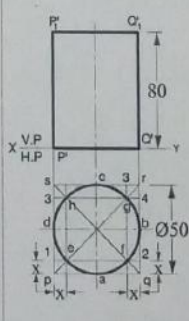


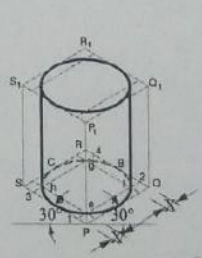
Hexagonal Prism: (Base in HP)



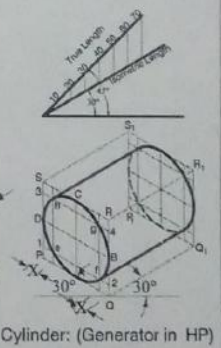
Rectangular face in HP

Cylinder :



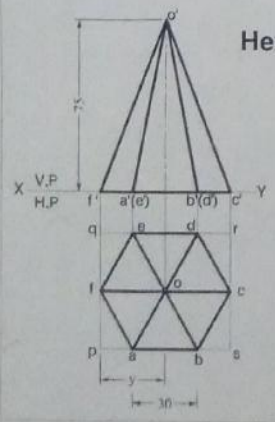


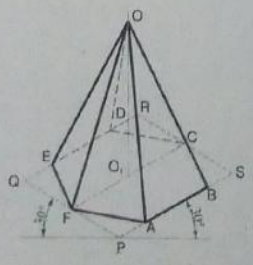
Cylinder: (Base in HP)



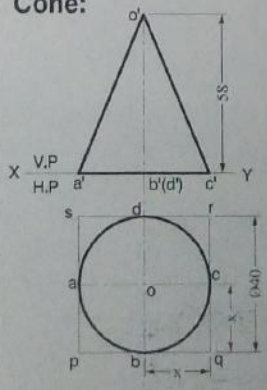
Cylinder: (Generator in HP)

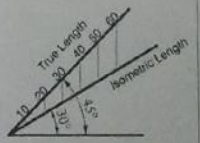
Hexagonal Pyramid:

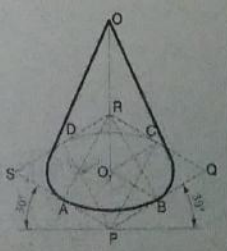




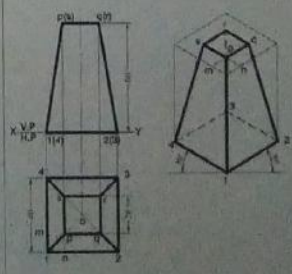
Cone:



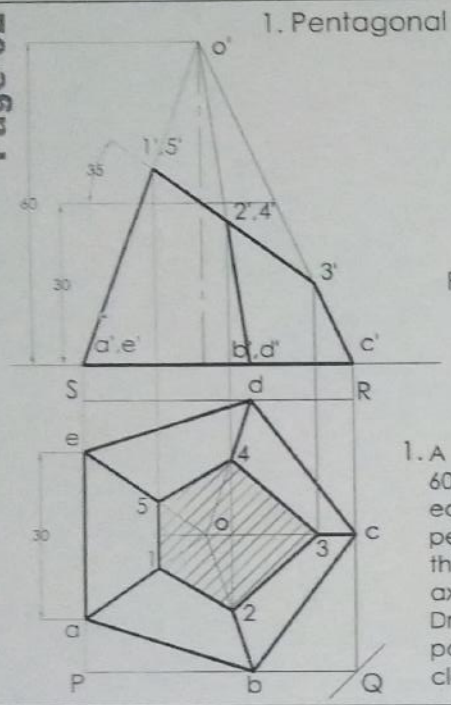


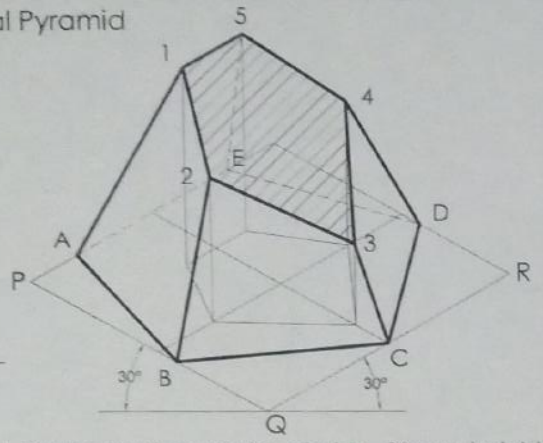


Frustum of a Square Pyramid:



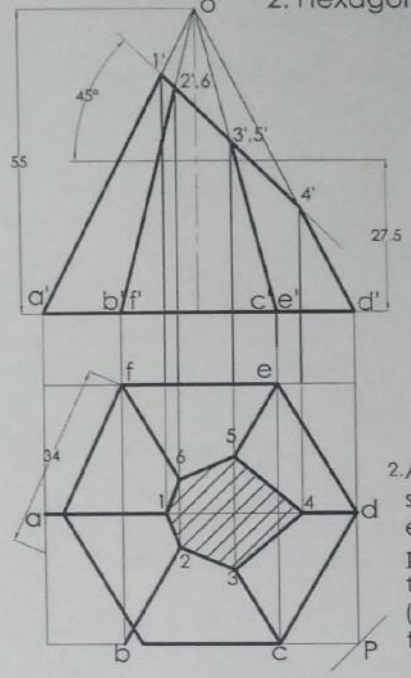
1. Pentagonal Pyramid

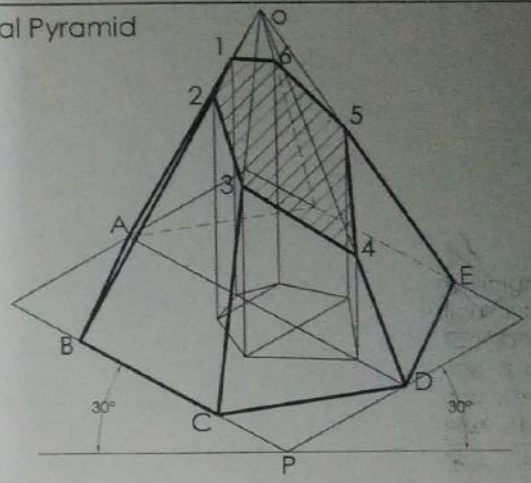




1. A Pentagonal pyramid of side 30mm height 60mm stands on H.P with its base and left base edge is perpendicular to VP. A section plane perpendicular to V.P., inclined at 35° to H.P. cuts the pyramid and passes through a point on the axis at a height of 30 mm above the base. Draw the isometric view of the truncated portion of the pyramid when the cut surface is clearly visible to the observer.

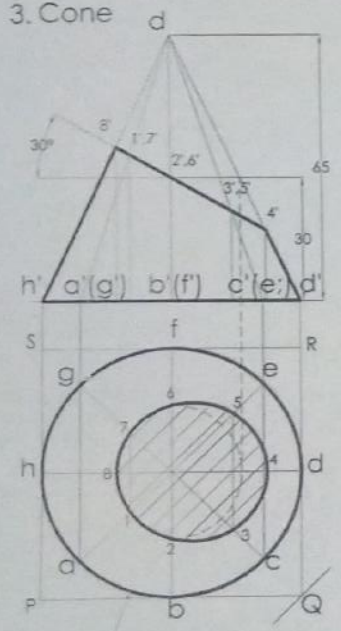
2. Hexagonal Pyramid

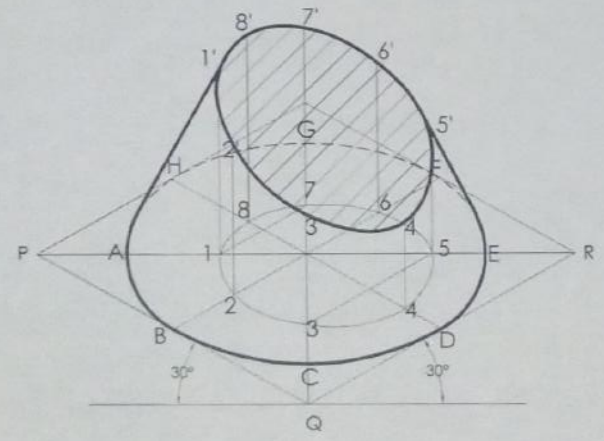




2. A Hexagonal pyramid of side 28mm height 55mm stands on H.P with its base and two of its base edges are parallel to VP. It is cut by a sectional plane inclined at 45° to HP and perpendicular to V.P. and meeting the axis at the midpoint (bisecting the axis). Draw the isometric view of the truncated portion of the pyramid.

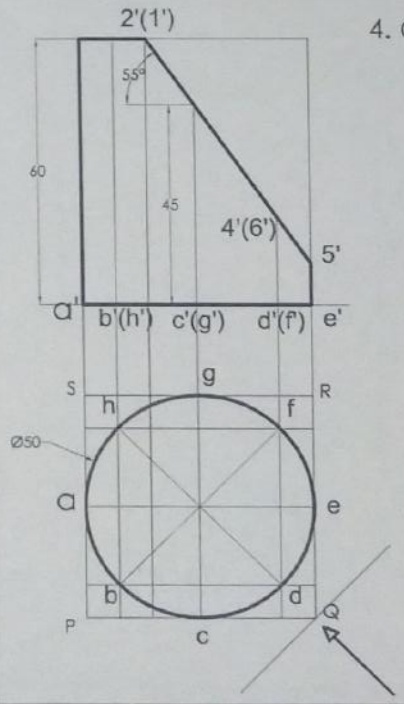
3. Cone

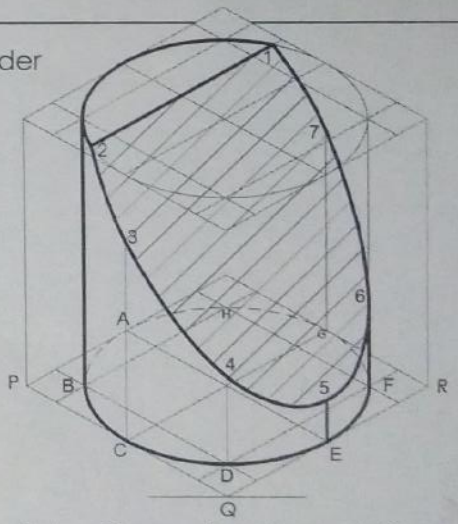




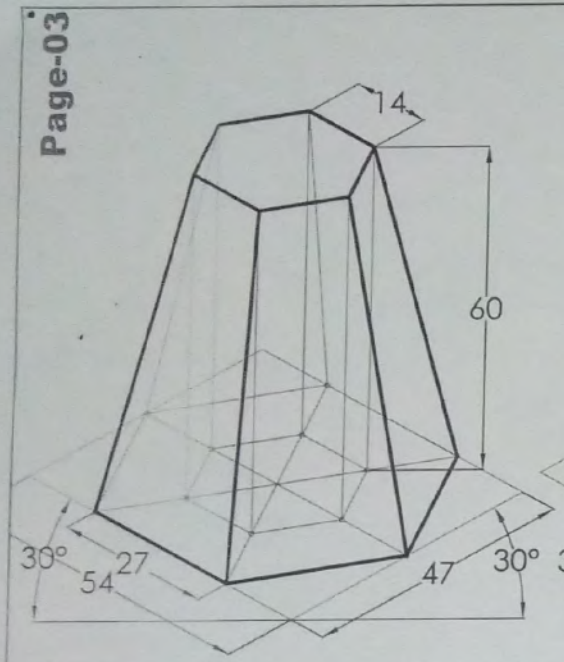
3. A Cone of diameter 60mm height 65mm stands on H.P with its base. A section plane perpendicular to V.P. inclined at 30° to H.P. cuts the pyramid and passes through a point on the axis at a height of 30 mm above the base. Draw the isometric view of the truncated portion of the cone.

4. Cylinder

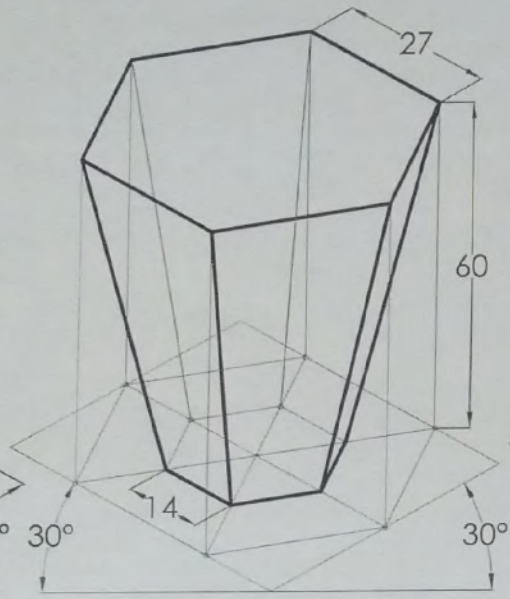




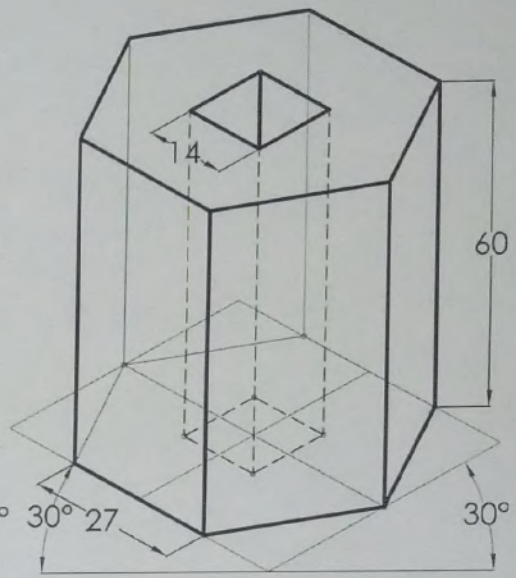
4. A cylinder 50 mm diameter and 60 mm height stands on H.P. A section plane perpendicular to V.P., inclined at 55° to H.P. cuts the cylinder and passes through a point on the axis at a height of 45 mm above the base. Draw the isometric view of the truncated portion of the cylinder when the cut surface is clearly visible to the observer.



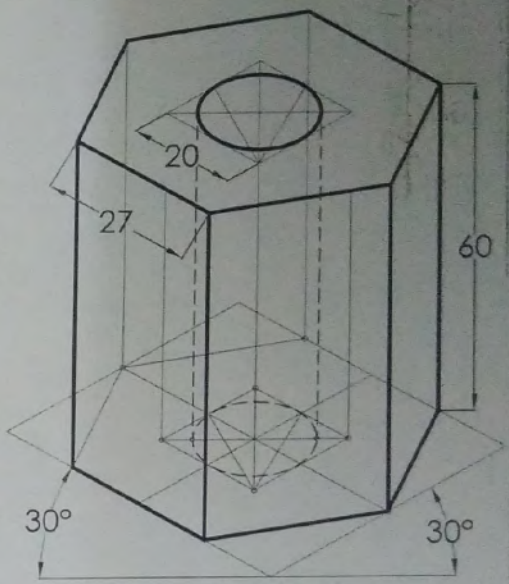
1 FRUSTUM of a hexagonal Pyramid



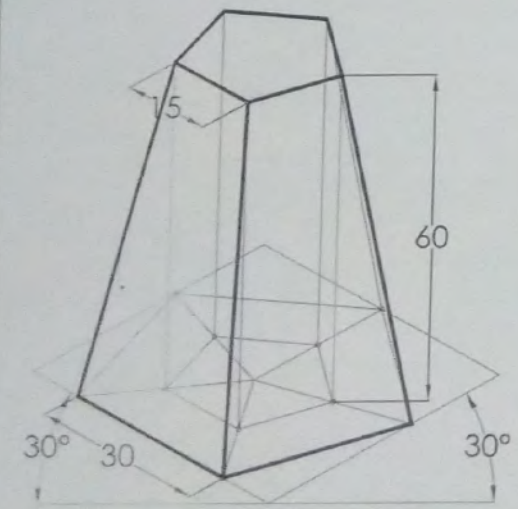
2 INVERTED FRUSTUM



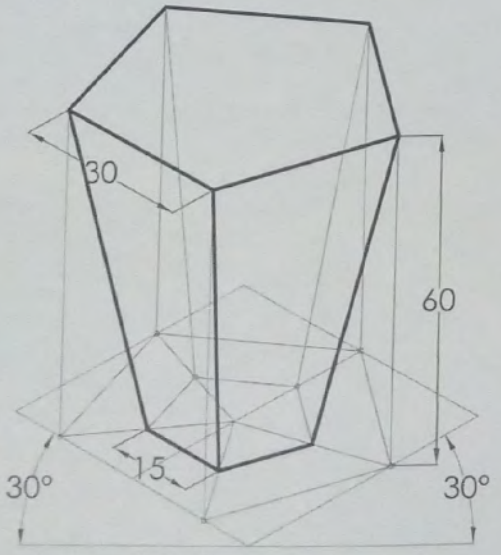
3 PRISM WITH SQURE AXIAL HOLE



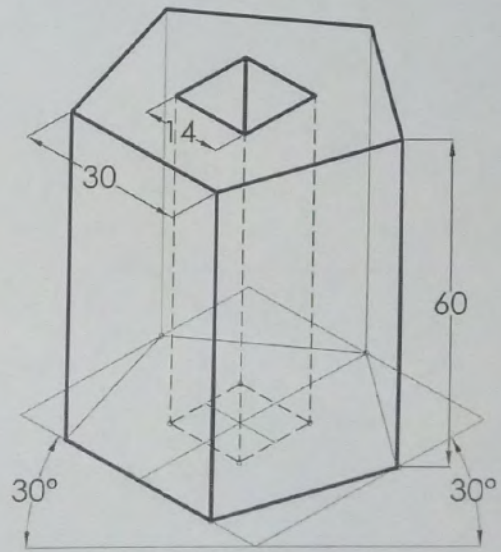
4 PRISM WITH CIRCULAR AXIAL HOLE



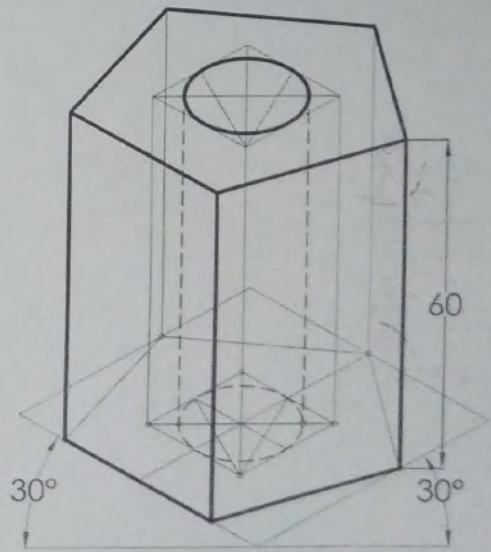
5 FRUSTUM of a pentagonal Pyramid



6 inverted FRUSTUM



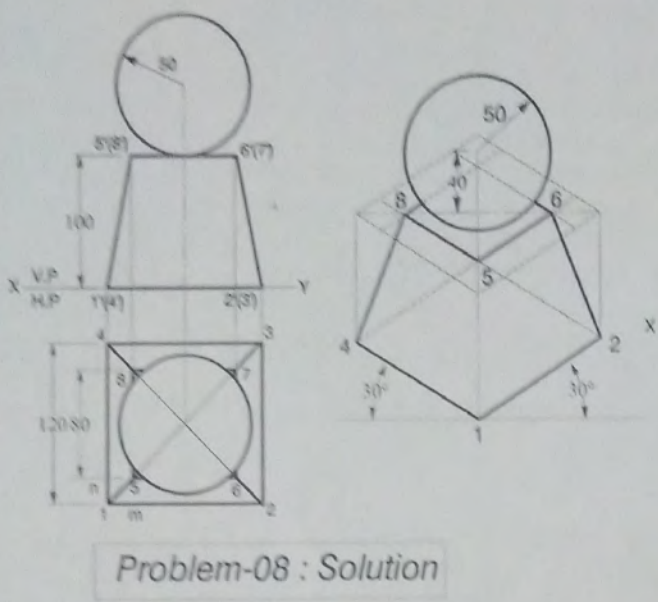
7 Prism with a square axial hole



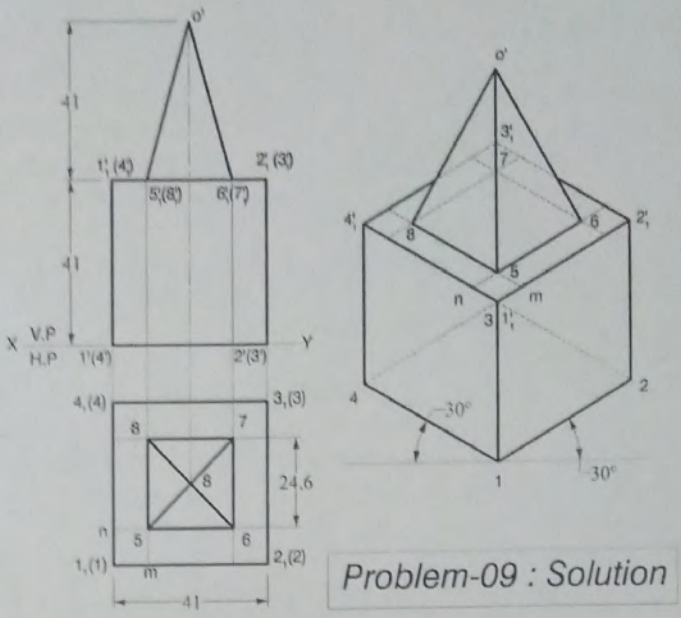
8 with Axial Circular hole

08 - A sphere of radius 50 mm is kept centrally over a frustum of a square pyramid of side 120 mm at the bottom, 80 mm at the top and having a height of 100 mm. Draw the isometric projection of the solid.

09 - A square pyramid of side 30 mm, axis length 50 mm is centrally placed on the top of a cube of side 50 mm. Draw the isometric projection of solids.



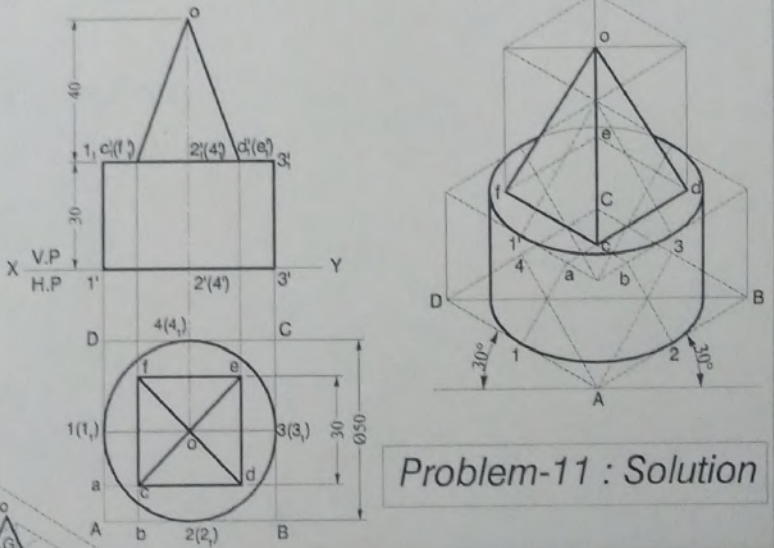
Problem-08 : Solution



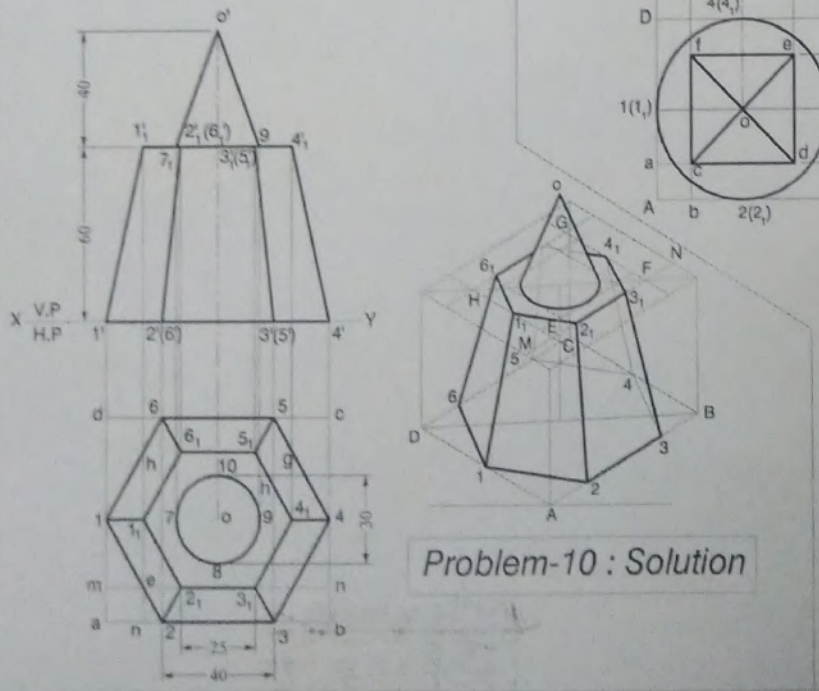
Problem-09 : Solution

10 - A cone of base diameter 30 mm and height 40 mm rests centrally over a frustum of a hexagonal pyramid of base side 40mm, top base 25 mm and 60 mm height. Draw the isometric projection of the solids.

11 - A cylindrical slab of thickness 30 mm and diameter 50 mm is surmounted by a square pyramid of side 30 mm and height 40 mm. Draw the isometric view of the combination if the axis of cylinder and pyramid coincide with each other



Problem-11 : Solution



Problem-10 : Solution

Perspective projection is a method of pictorial projection, where the three dimensional object is drawn more realistically than isometric drawings. The perspective drawings show three – dimensional objects as they appear to the eye or as they are seen in a photograph.

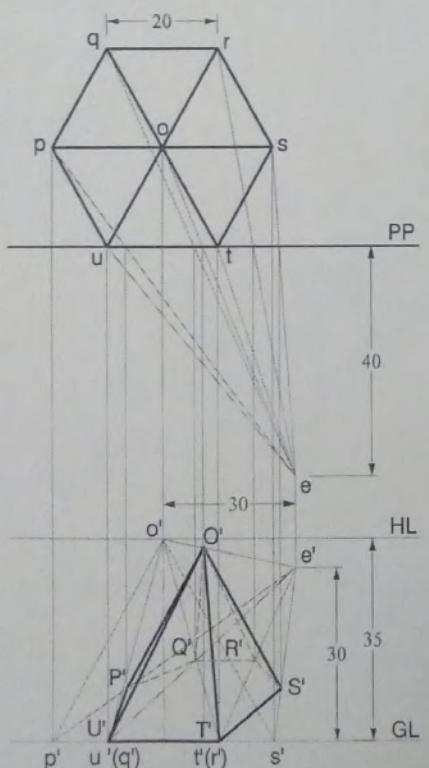
Following are the certain terminologies that are used, while drawing a perspective view:

Ground Plane (GP): It is a horizontal plane on which the object is assumed to be situated.
Picture Plane (PP): It is a transparent plane situated between the observer and the object, through which the object is viewed. The perspective view is formed on this picture plane.
Ground Line (GL): The line of intersection of the picture plane with the ground plane is called the ground line.
Station Point (SP): Location of the eye of the observer while viewing the object, measured from the ground plane and from the picture plane.
Horizon Plane (HP): This imaginary plane is at the level of the eye, i.e. the station point. It is a plane parallel to the ground plane.
Horizon Line (HL): It is a line which the horizon plane intersects the picture plane. It is parallel to the ground line.
Central Plane (CP): It is an imaginary plane passing through the station point (SP) and perpendicular to both the Picture Plane (PP) and Ground Plane (GP).

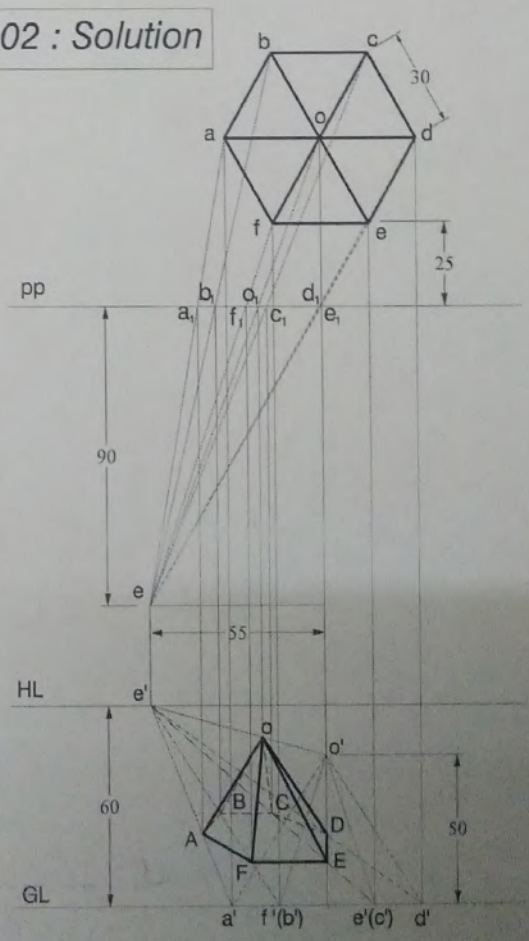
01 -A regular hexagonal pyramid of base edge 20 mm and height 35 mm rests on its base on the ground plane with one of its base edges touching the picture plane. The station point is 30 mm above the ground plane and 40 mm in front of the PP. The central plane is 30 mm to the right of the axis. Draw the perspective projection of the pyramid by visual ray method. Use the top view and the front view.

02 -A hexagonal pyramid of base side 30 mm and axis height 50 mm is resting on GP on its base with a side of base parallel to and 25 mm behind the PP. The station point is 60 mm above GP, 90 mm in front of PP and lies in a central plane which is 55 mm to the left of the axis of the pyramid. Draw the perspective view of the pyramid by visual ray method.

Problem-01 : Solution



Problem-02 : Solution



A square prism of 30 mm side of base and height 40 mm rests with it's base on ground in the following FOUR conditions.

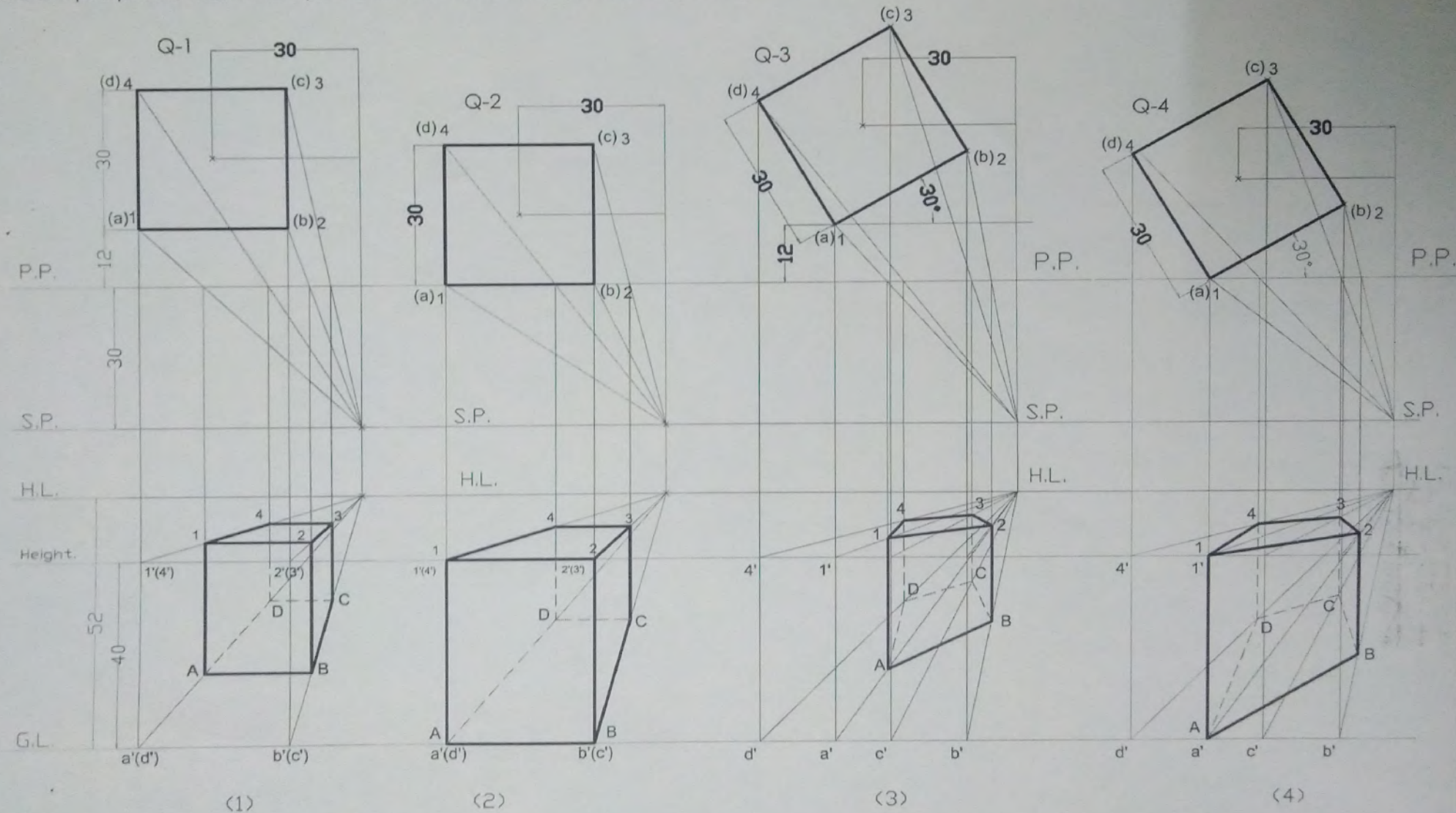
(1) One of the rectangular faces is parallel and 12 mm behind Picture Plane. (2) One of the rectangular faces is touching picture Plane.

(3) One of the rectangular faces is inclined at 30° to the picture plane and nearest vertical edge is 12 mm behind the picture plane.

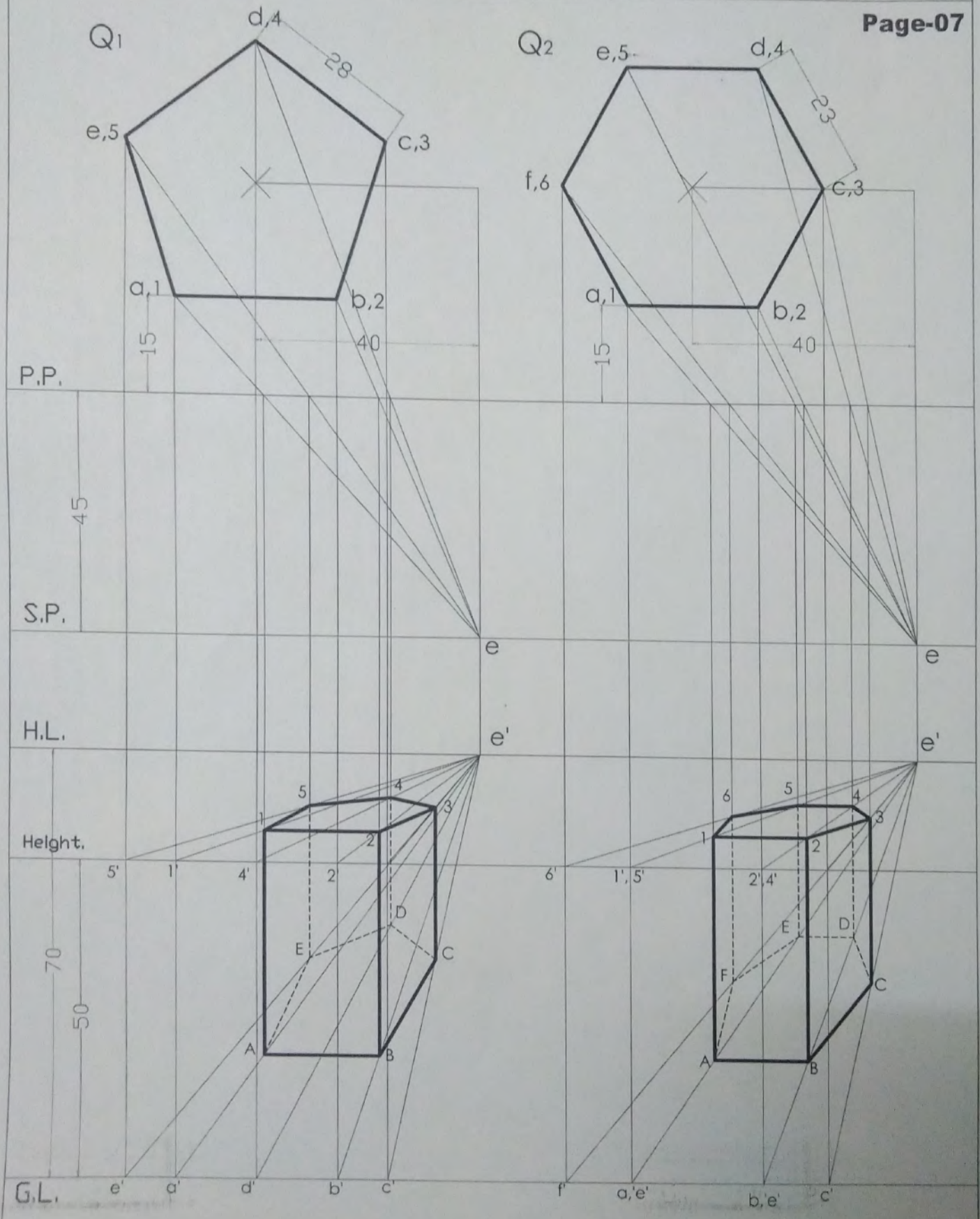
(4) One of the rectangular faces is inclined at 30° to the picture plane and nearest vertical edge touches the picture plane.

The station point is 30 mm infront of the picture plane, 52 mm above the ground and 30 mm right to the axis of the prisim.

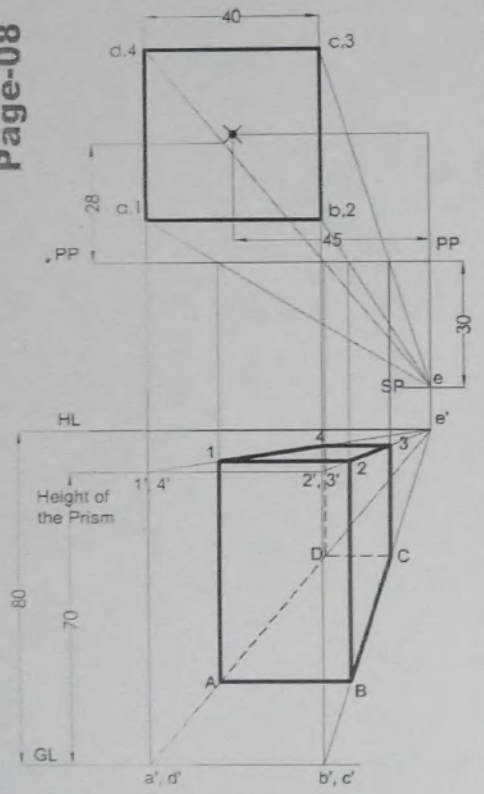
Draw the perspective view of the prisms for the above three conditions separately.



Q1, Q2 : A Pentagonal (or-Hexagonal) Prism of side 28 / 23 mm and Height 70 mm rests with its base in the ground and one of its rectangular faces is Parallel and 15 mm behind the Picture Plane(PP). The station Point is 45 mm in front of PP, 70 mm above the Ground and 40 mm Right to the Axis of the Prism. Draw the Perspective view of the Prism.

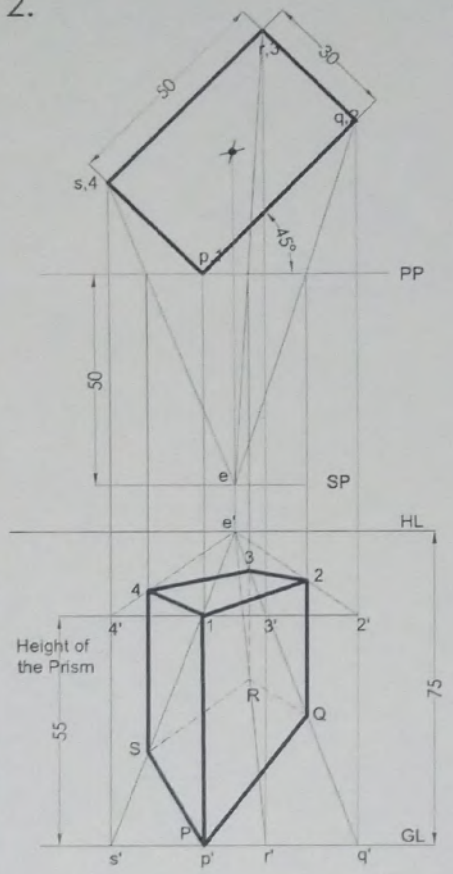


1.



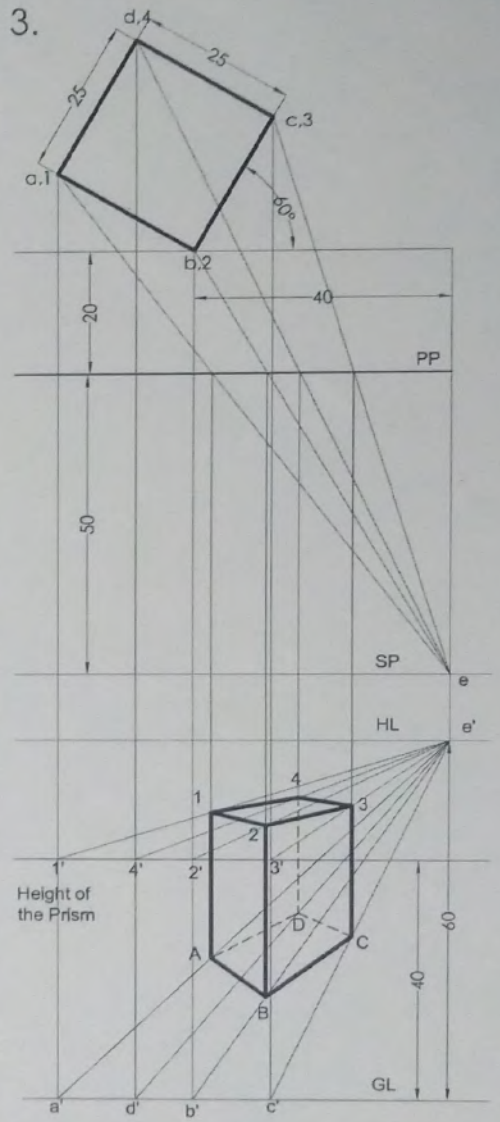
1. Square Prism of side 40mm and height 70mm lies on the ground with its base and one of its rectangular face is parallel and 10 mm ,beight picture plane. The Station Point is 45 mm Right to axis, 30 mm infront of the picture plane and 80 mm above the Ground. Draw the perspective Projection of the solid

2.



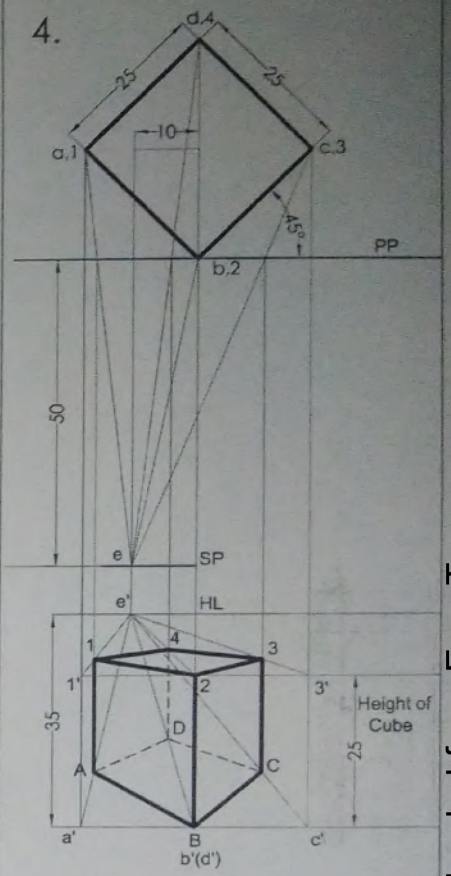
2. A rectangular prism, sides of base 50 mm x 30 mm and height 55 mm rests with its base on the ground plane. A vertical edge is in the picture plane and one of the longer edges of its base is inclined at 45° to PP and behind it. The station point is 50 mm in front of PP, 75 mm above the ground plane and lies in a central plane which passes through the center of the prism. Draw the perspective projection of the rectangular prism.

3.



3. Square Prism of side 25mm and height 40mm lies on the ground with its base and one of its rectangular face is inclined at an angle 60° to PP. The nearest vertical edge is 20 mm behind the picture plane. The Station Point is 40 mm Right to the nearest vertical edge, 50 mm in front of the picture plane and 60 mm above the Ground. Draw the perspective Projection of the solid

4.



4. A cube of side 25 mm lies on the ground with one of its faces and other two faces are equally inclined to PP. The nearest vertical edge is touching the PP. The Station Point is 10 mm left to the nearest vertical edge, 50 mm in front of the picture plane and 35 mm above the Ground. Draw the perspective Projection of the solid