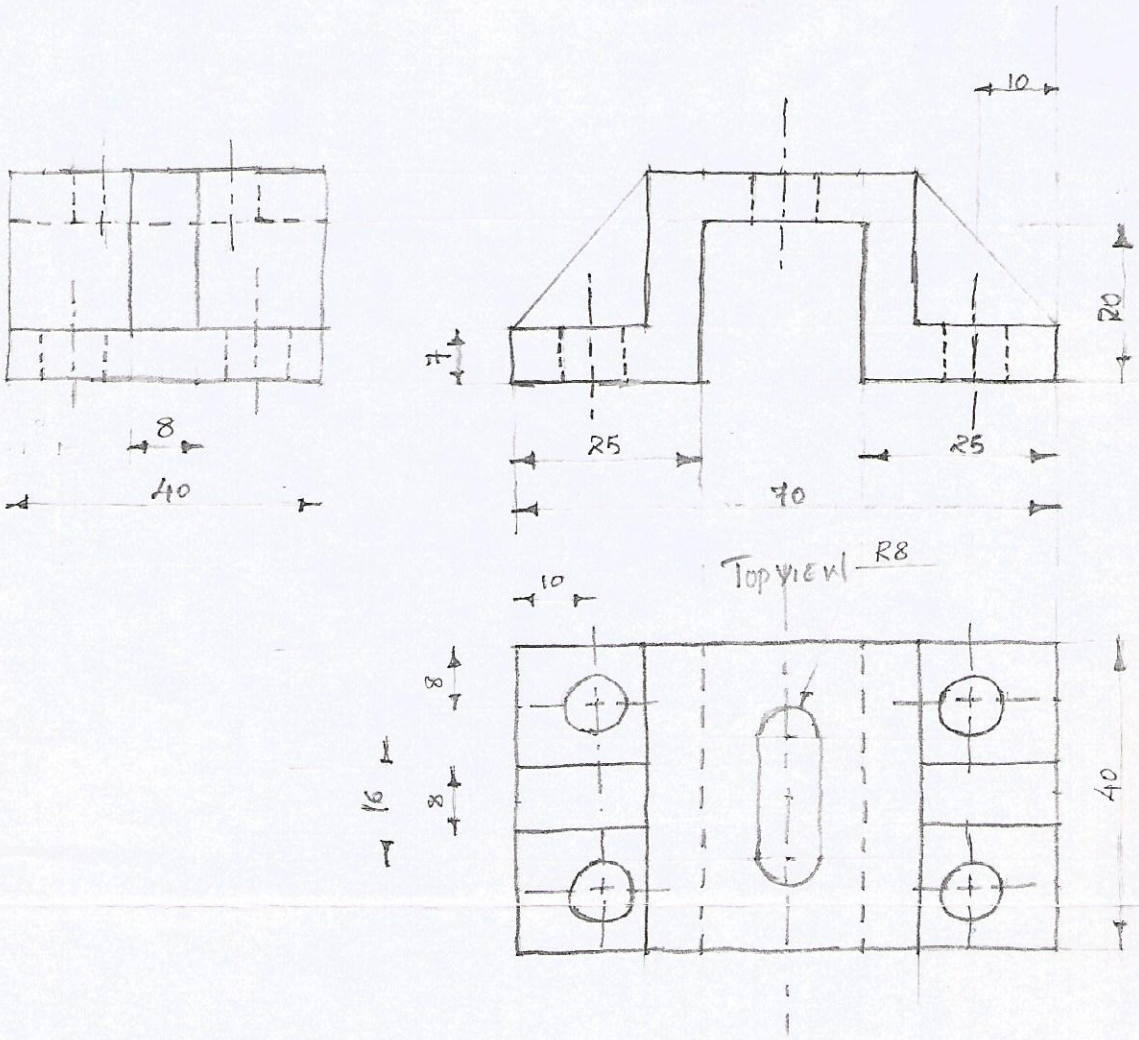
Free Hand sketching

(i).

RIGHT SIDE VIEW

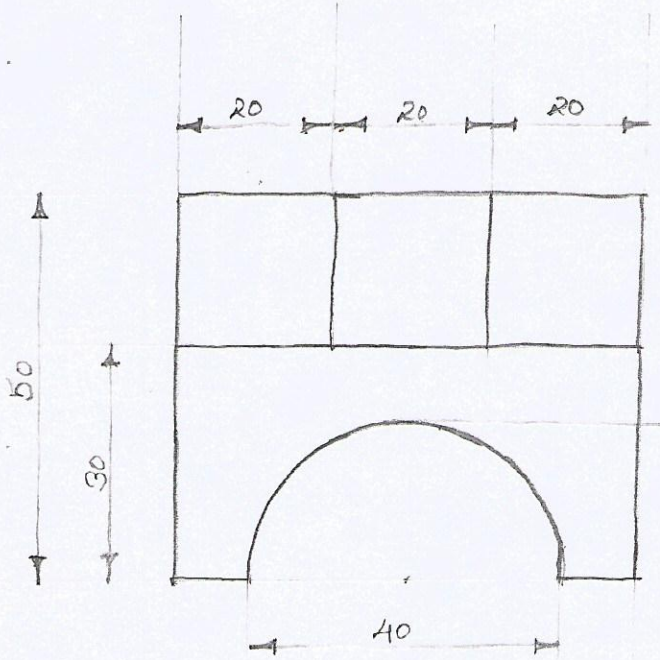
FRONT VIEW



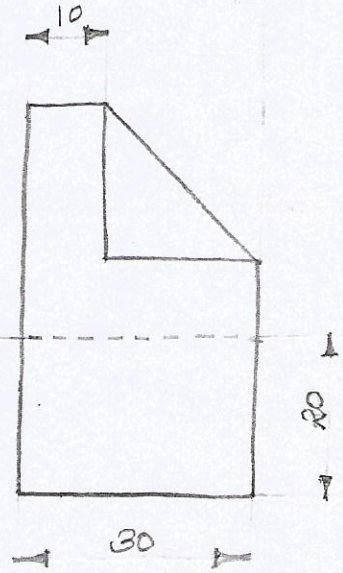
A free hand sketching is a drawing drawn by free hand without using drawing instruments. It is not drawn to scale, but should be in good proportion by eye judgment.

(2)

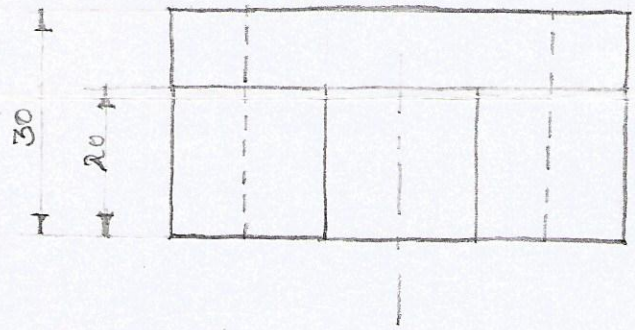
FRONT VIEW



LEFT SIDE VIEW



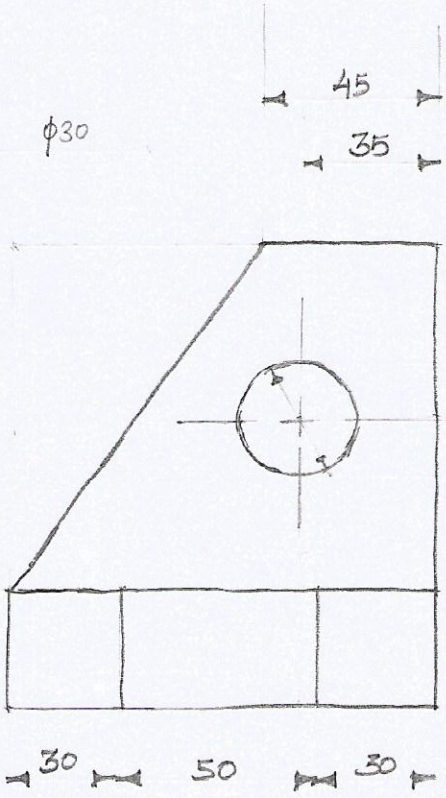
Top VIEW



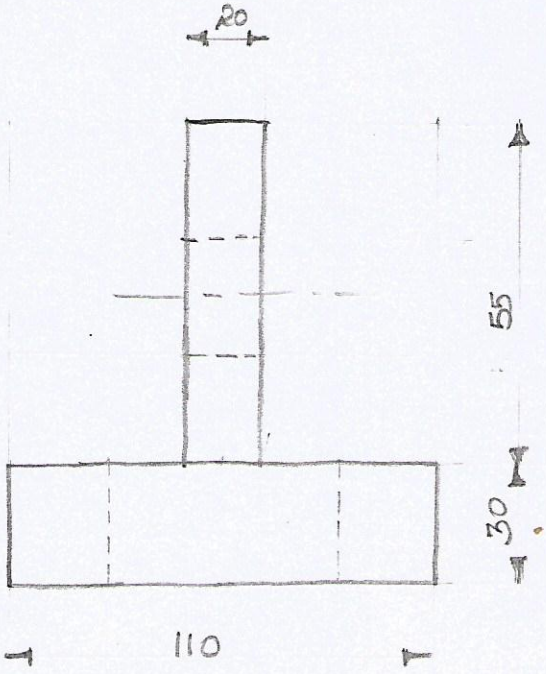
(3)

RD/2

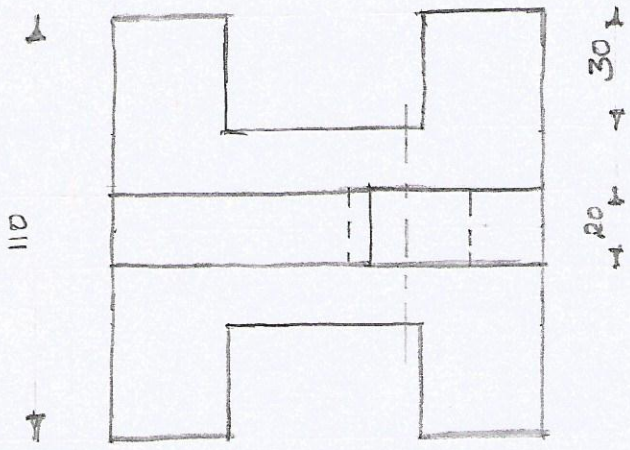
FRONT VIEW



LEFT SIDE VIEW

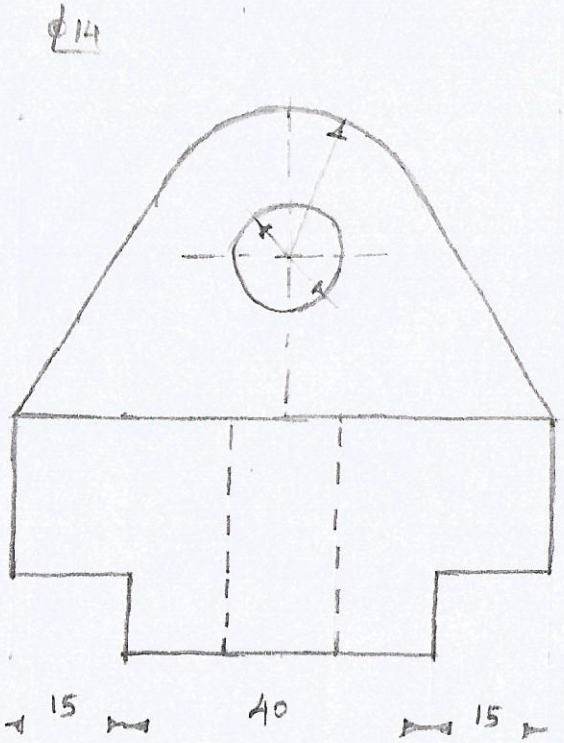


TOP VIEW

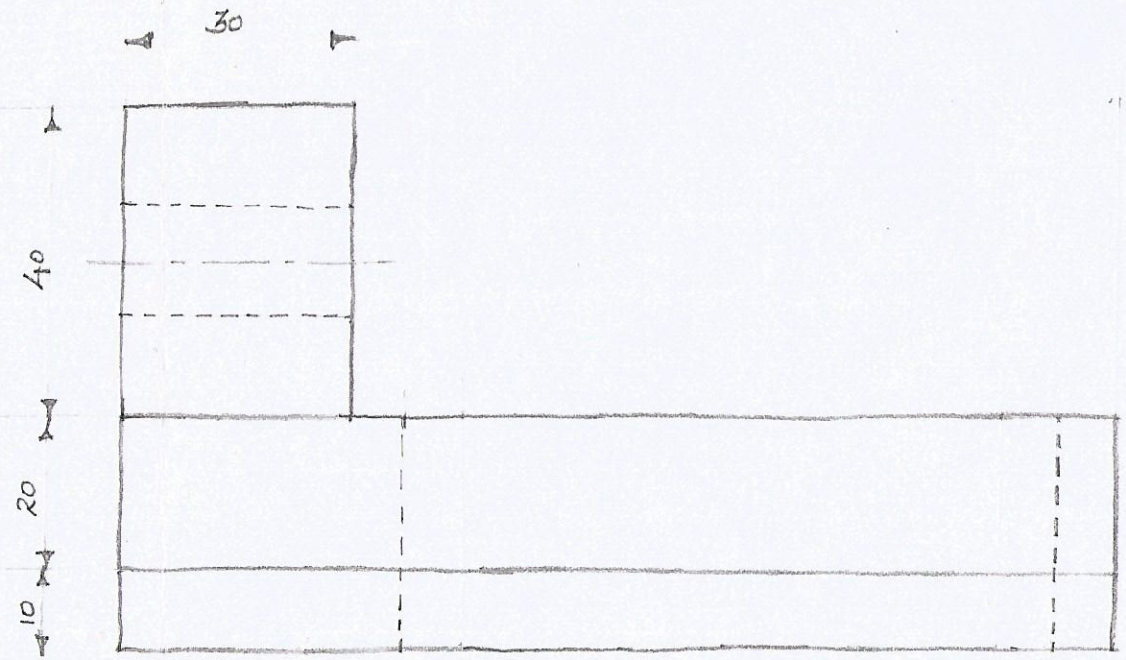


SCALE 1:2

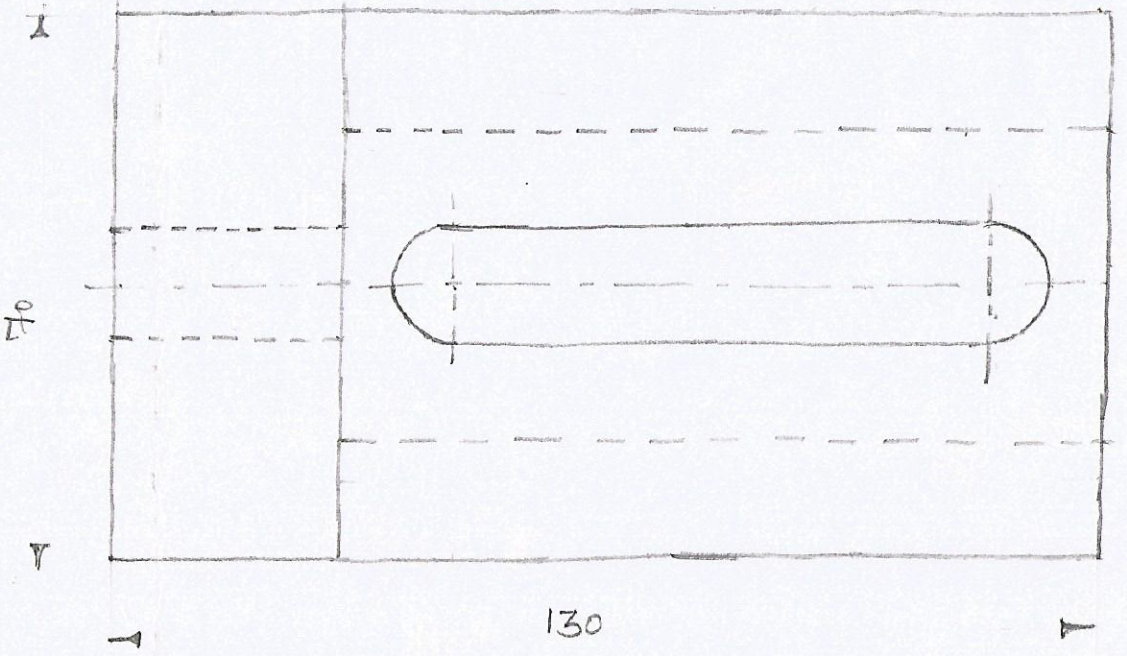
RIGHT SIDE VIEW



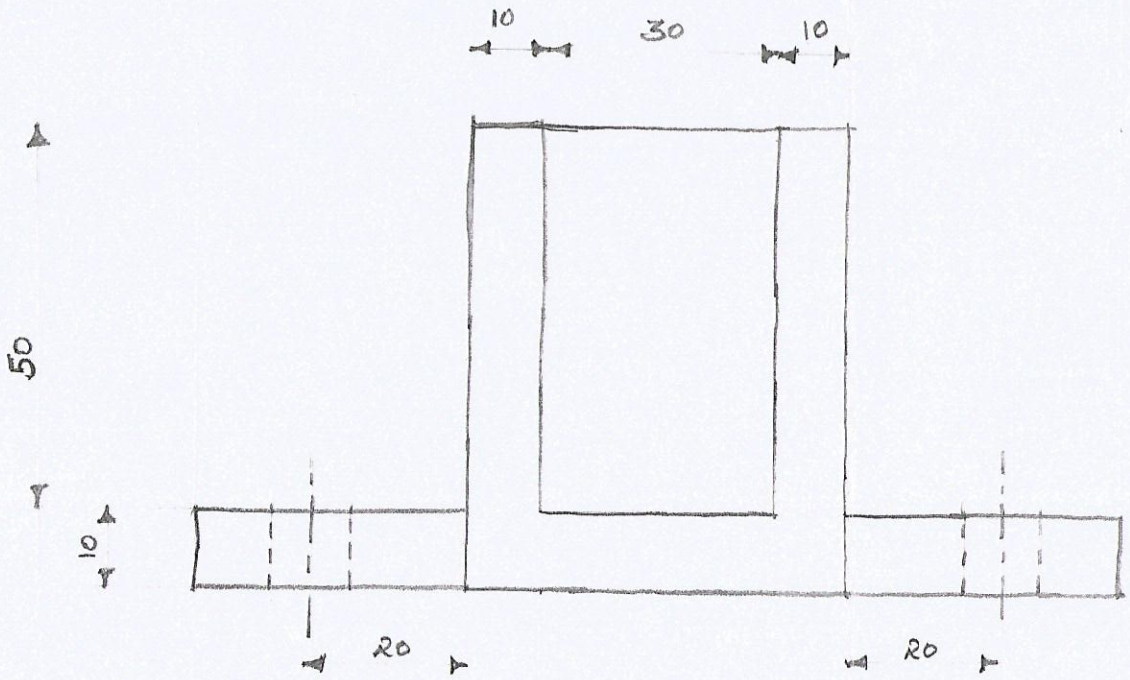
FRONT VIEW



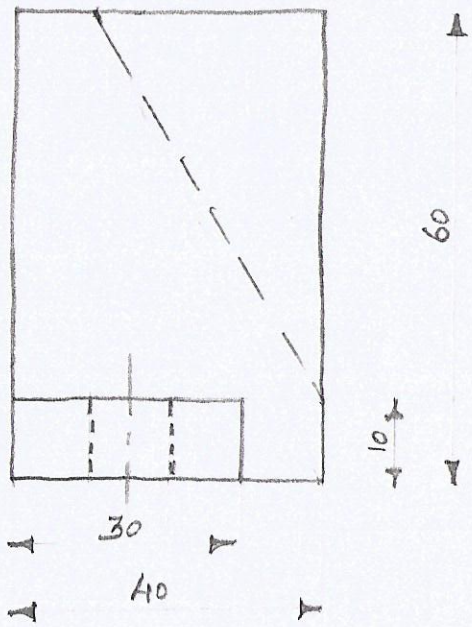
Top



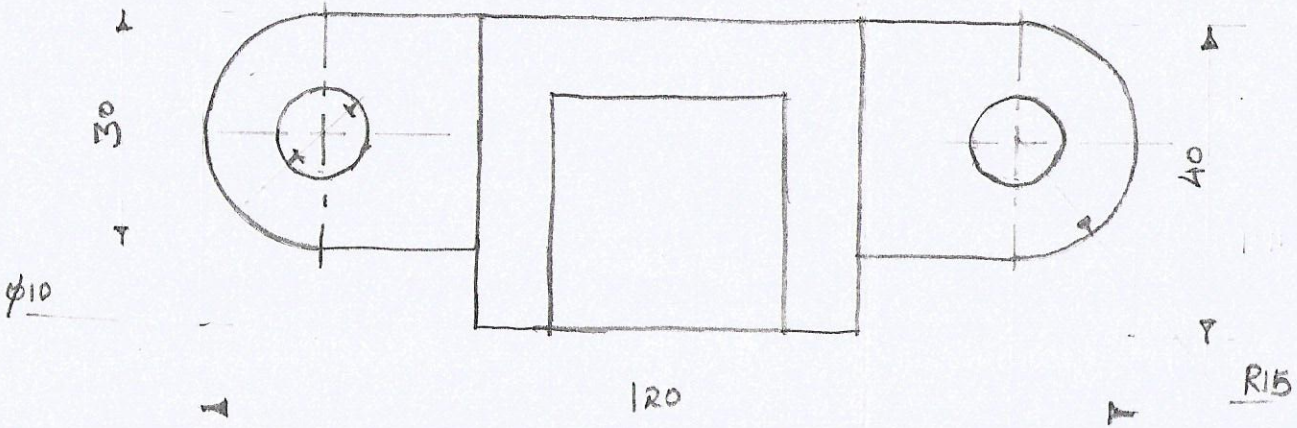
ELEVATION



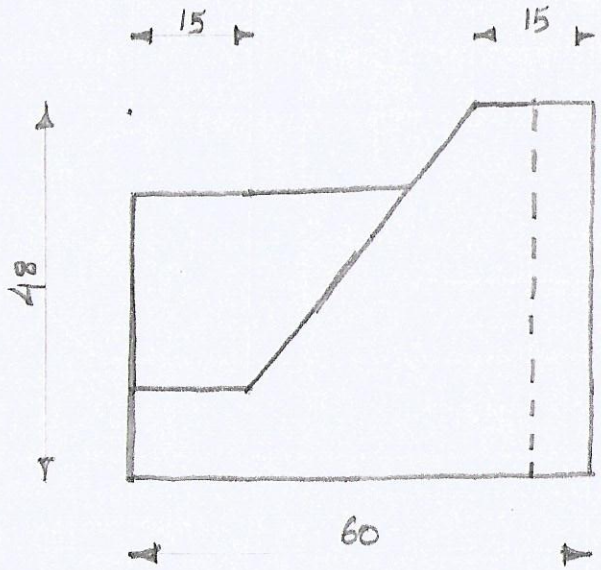
LEFT SIDE VIEW



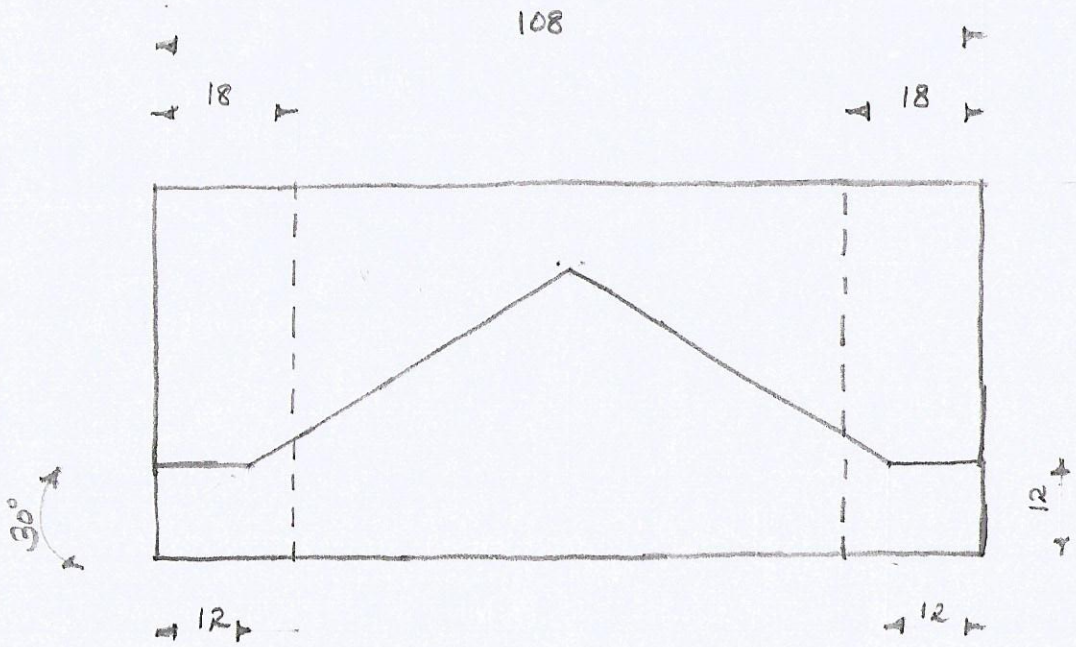
PLAN



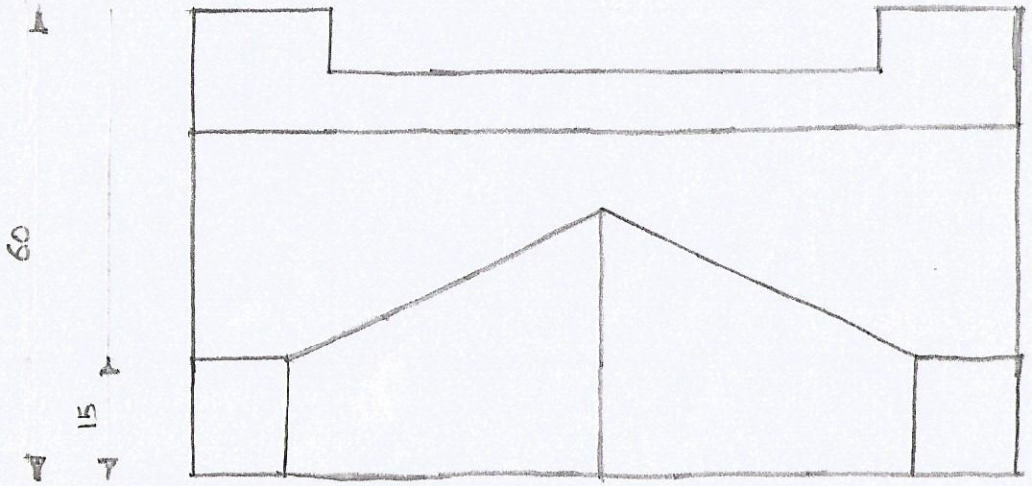
SIDE VIEW



FRONT VIEW

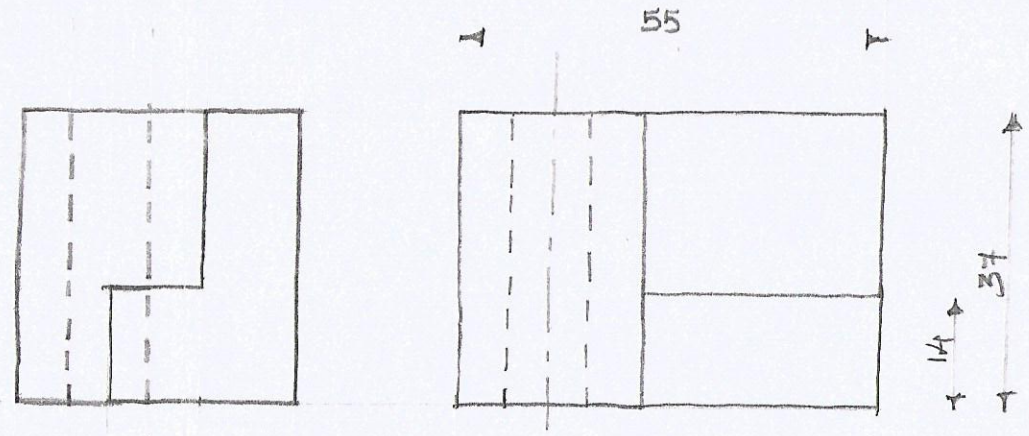


TOP VIEW

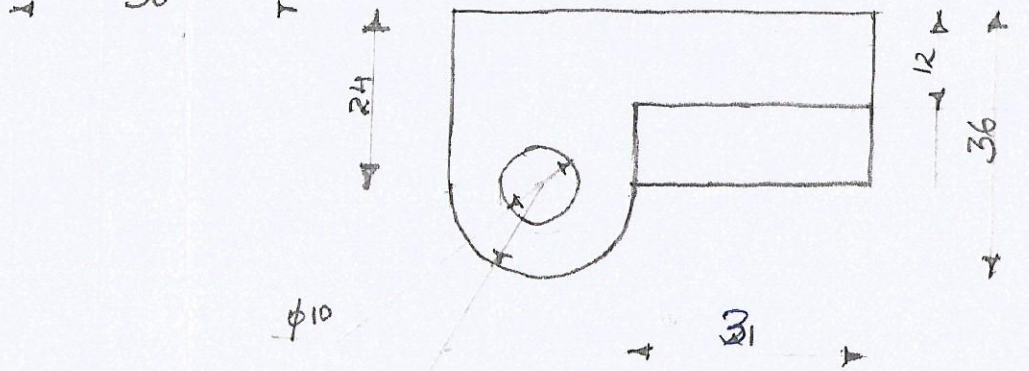


RIGHT SIDE

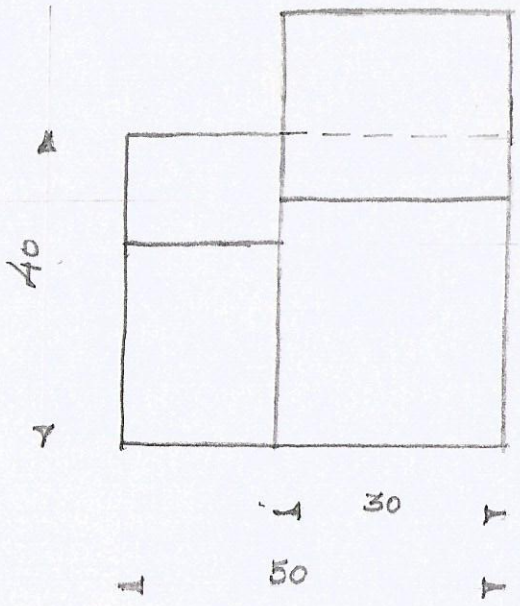
FRONT



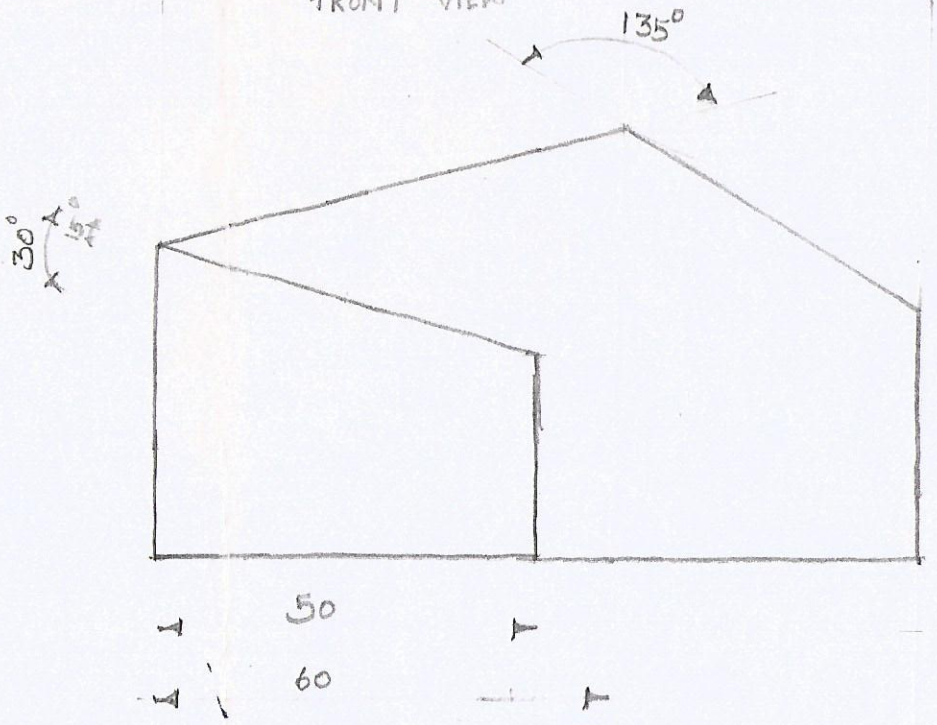
TOP



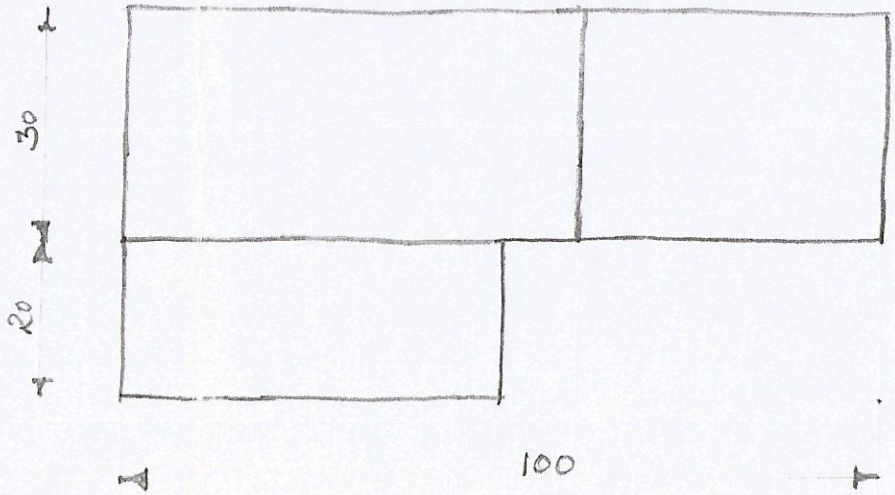
RIGHT SIDE VIEW



FRONT VIEW



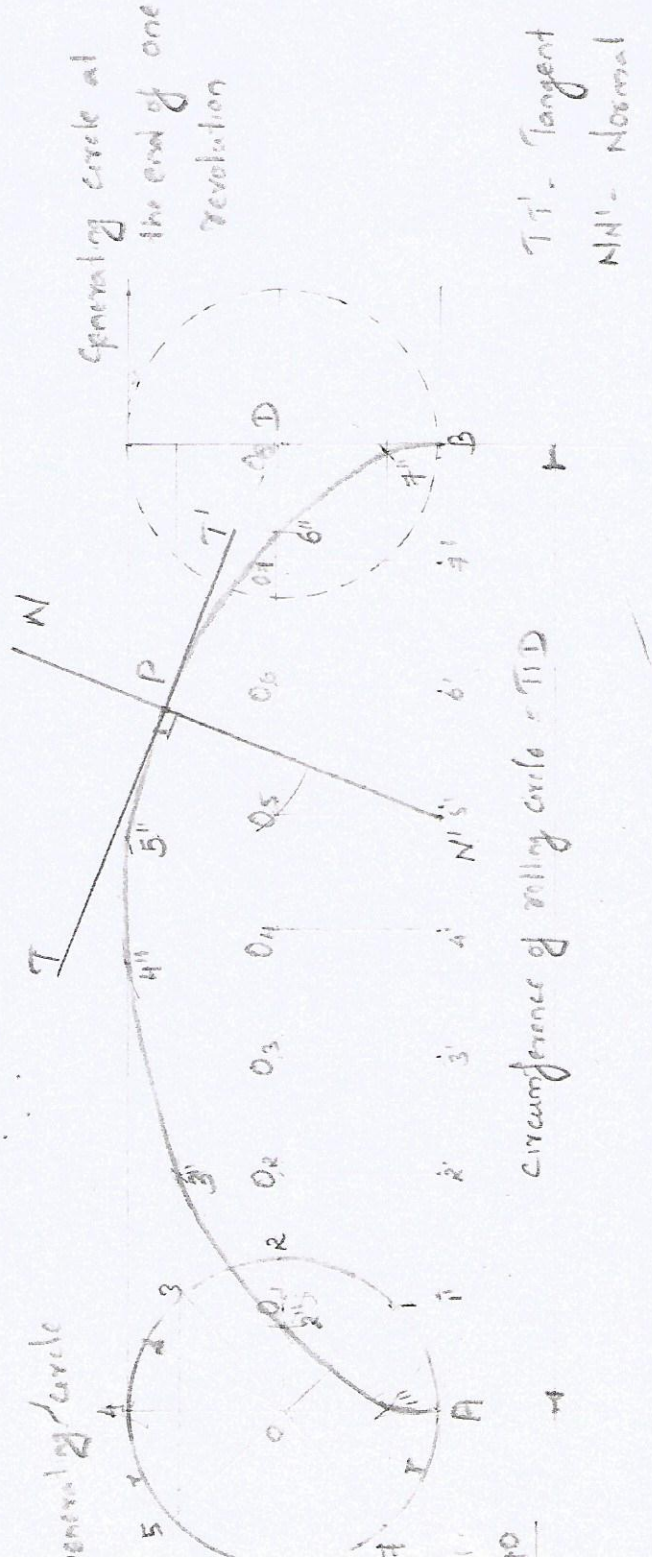
TOP VIEW



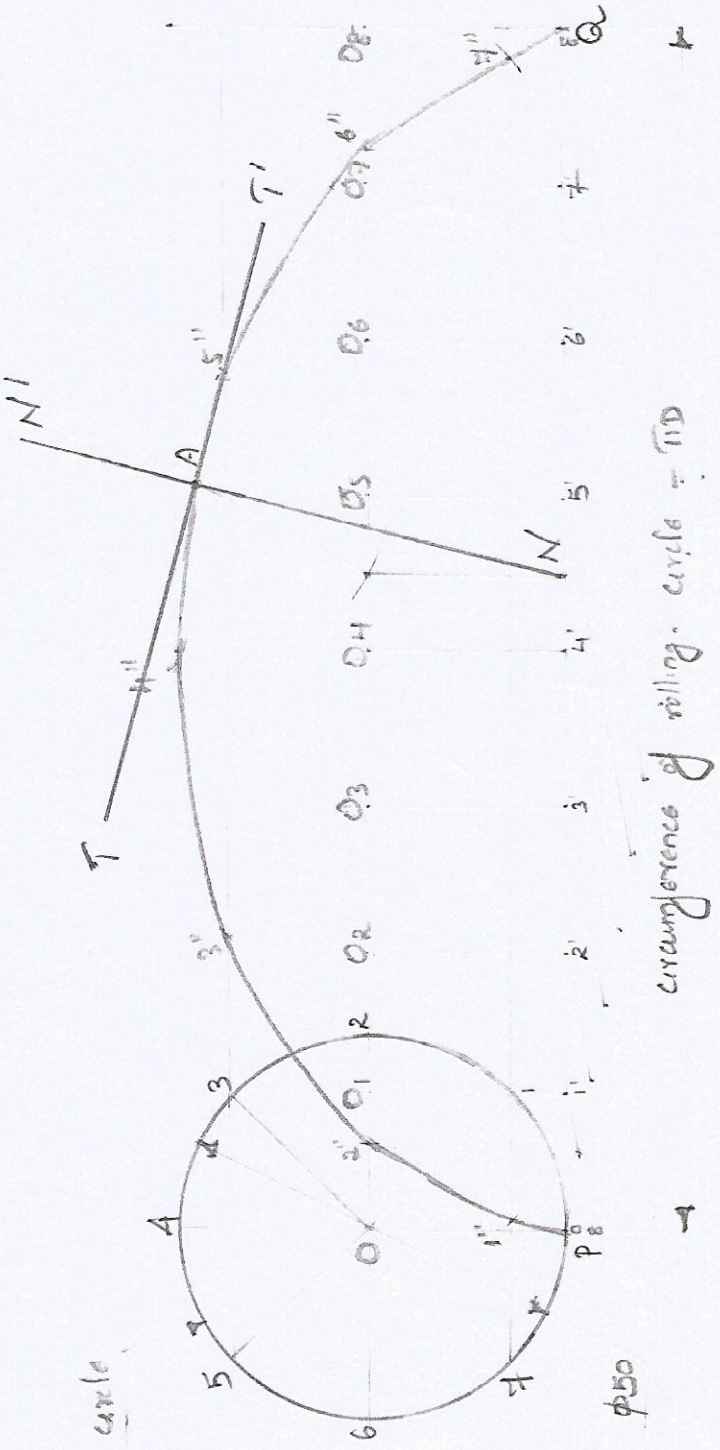
cycloid

A cycloid is a curve generated by a point on the circumference of a circle as the circle rolls along a straight line. The rolling circle is called the generating circle and the line along which it rolls is called the directing line or base line.

Draw a cycloid given the diameter of the generating circle as 40 mm
And also draw the tangent and Normal of the curve at any point on it.



A circle of 50 mm diameter rolls along a straight line. A point P on the circumference of the circle is in contact with the straight line initially and the end of one revolution. Draw the cycloidal curve traced by the point P. Draw tangent & Normal to any point on the curve.



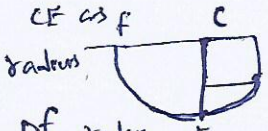
Involute

An involute is a curve traced by a point on a string as it unwinds from around a circle of a polygon

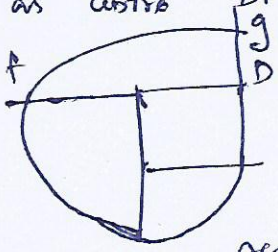
Involute of a Square

- Draw a Square
- AB as radius B as centre draw an arc

- C as centre CE as radius

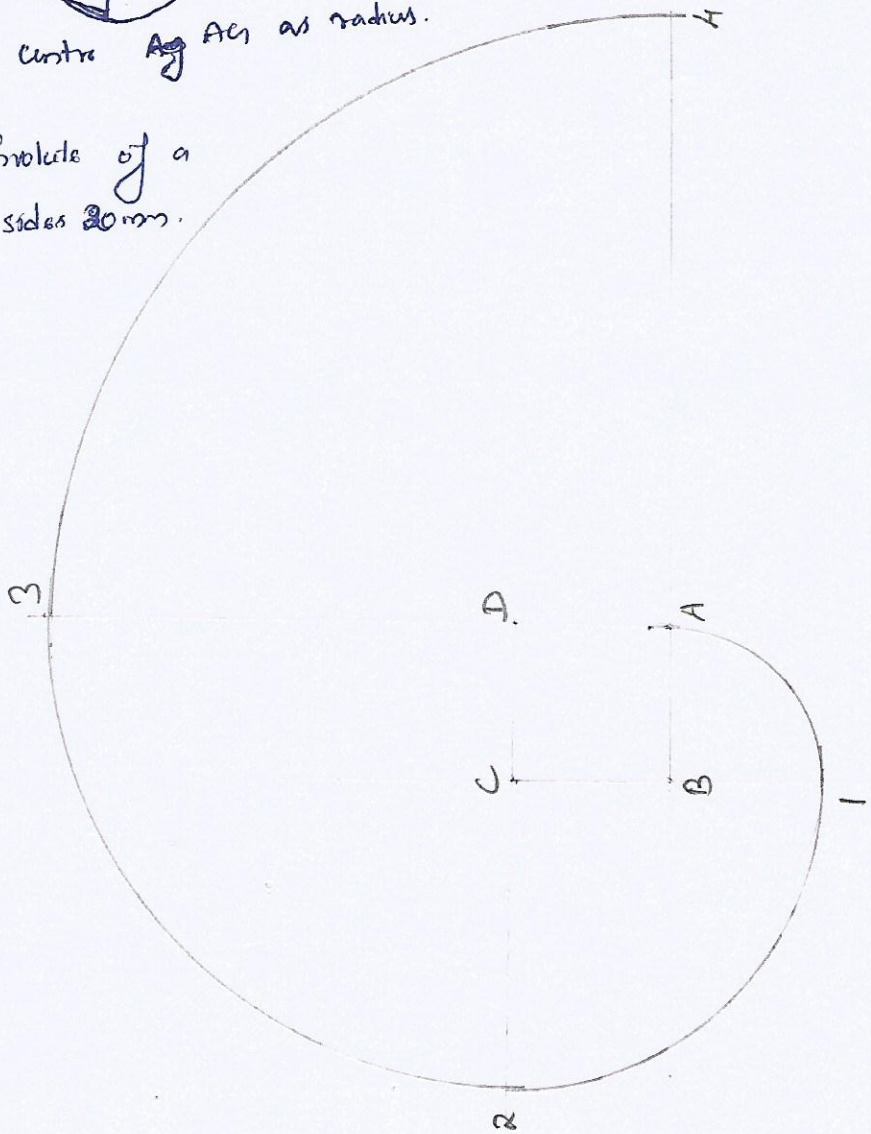


- D as centre Df radius

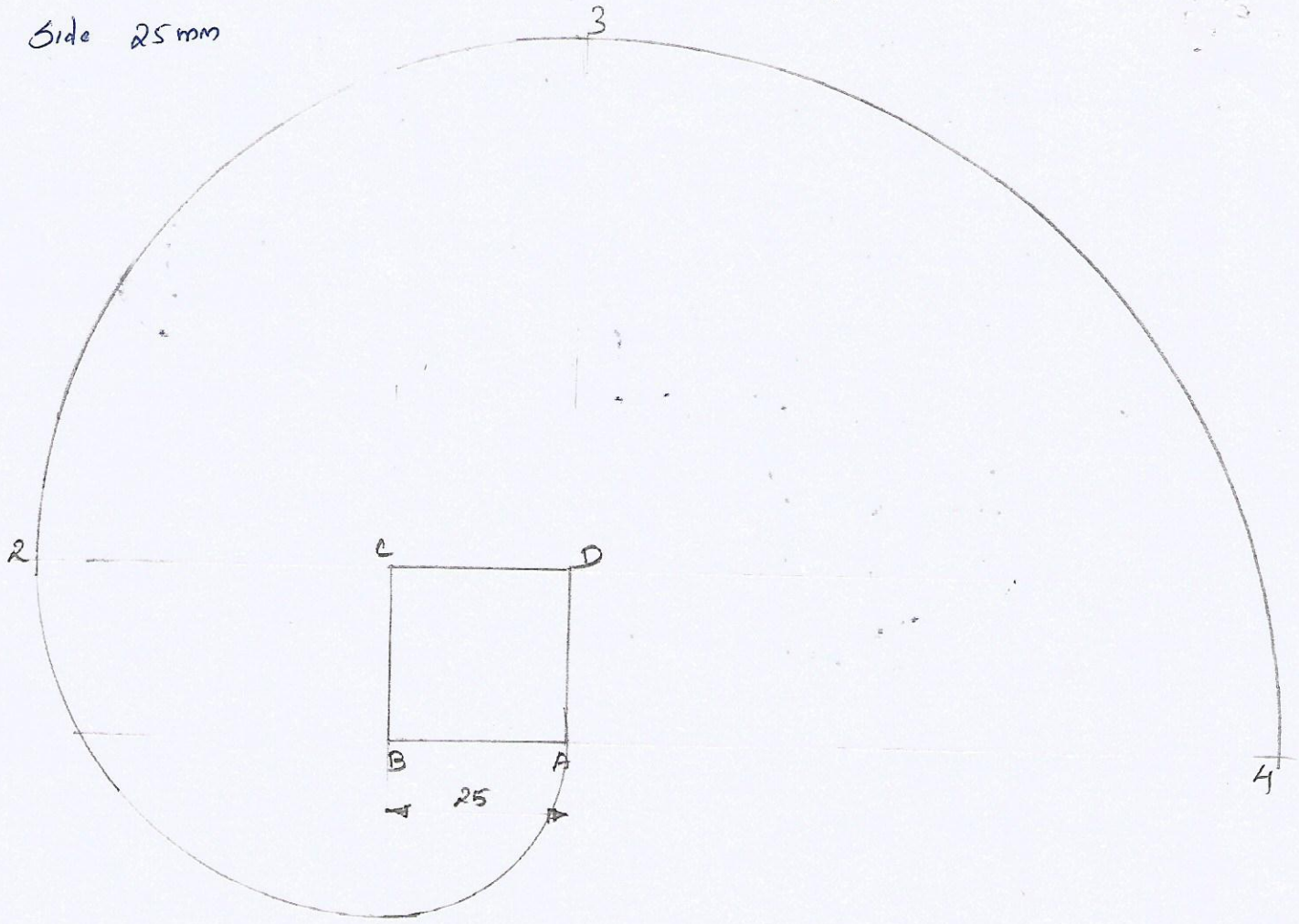


- A as centre Ag as radius.

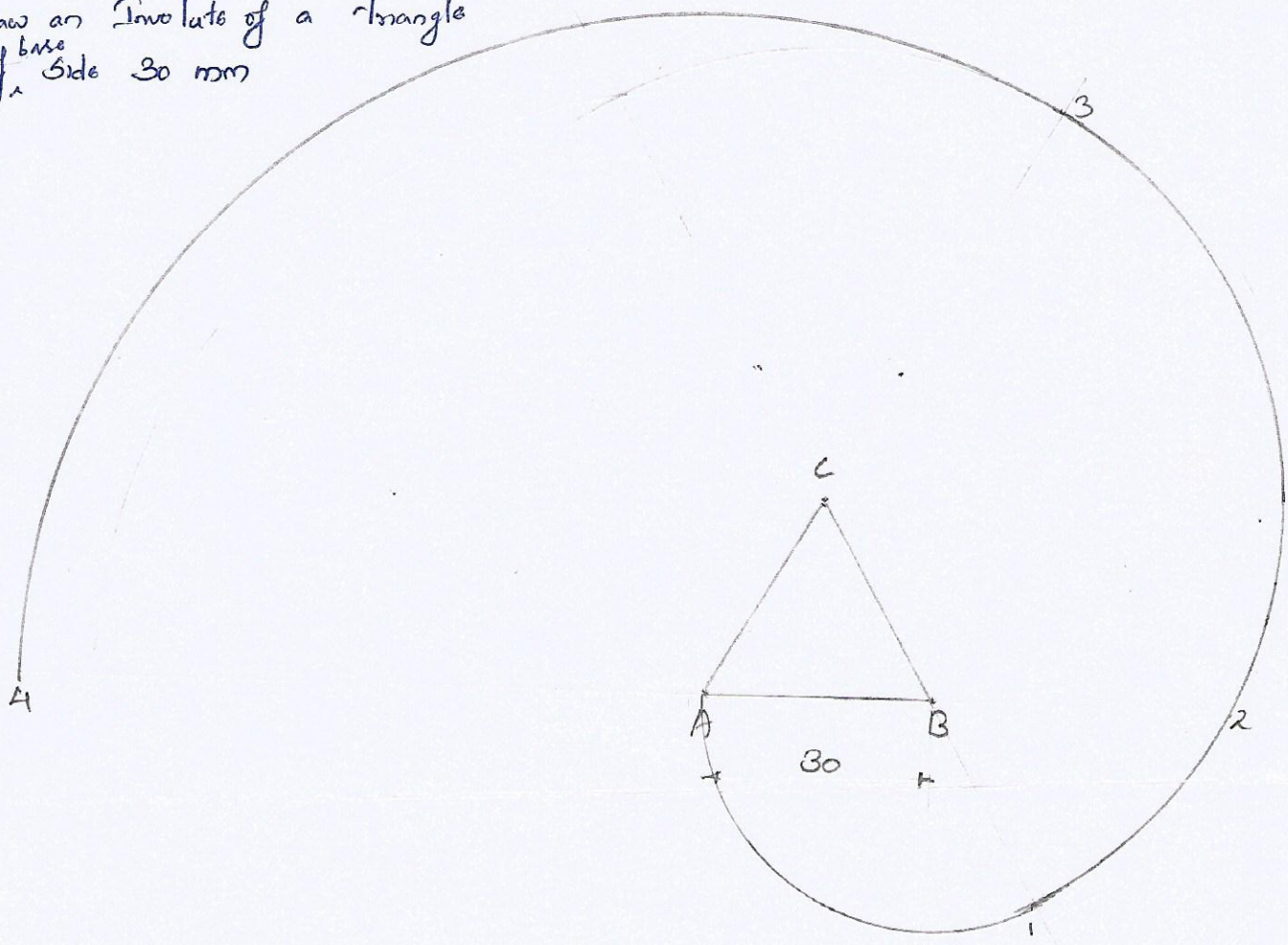
Draw an Involute of a Square of sides 20mm.



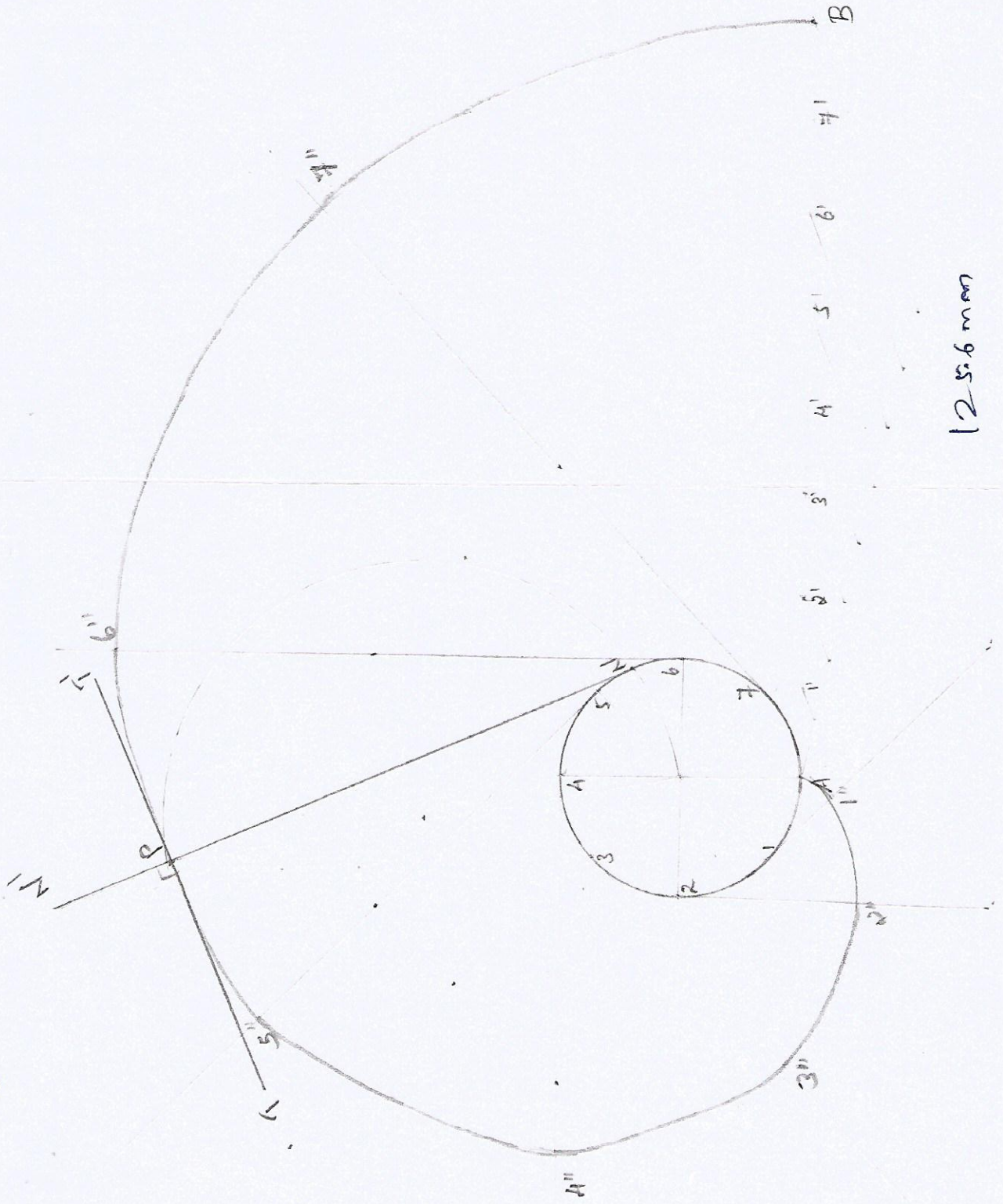
Side 25 mm



Draw an Involute of a triangle of base Side 30 mm

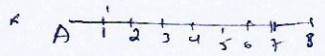


Draw an involute of a circle of diameter 40 mm

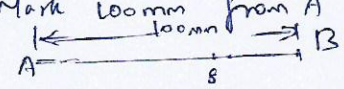


An inelastic string of length 100 mm is wound around a circle of 26 mm diameter. Draw the path traced by the end of the string. Also draw the tangent & Normal to the obtained curve at a point 80 mm away from the centre of the circle.

- First Mark $\pi D = \frac{22}{7} \times 26$
  $= 81.6$ mm
- Divide 81.6 into 8 parts

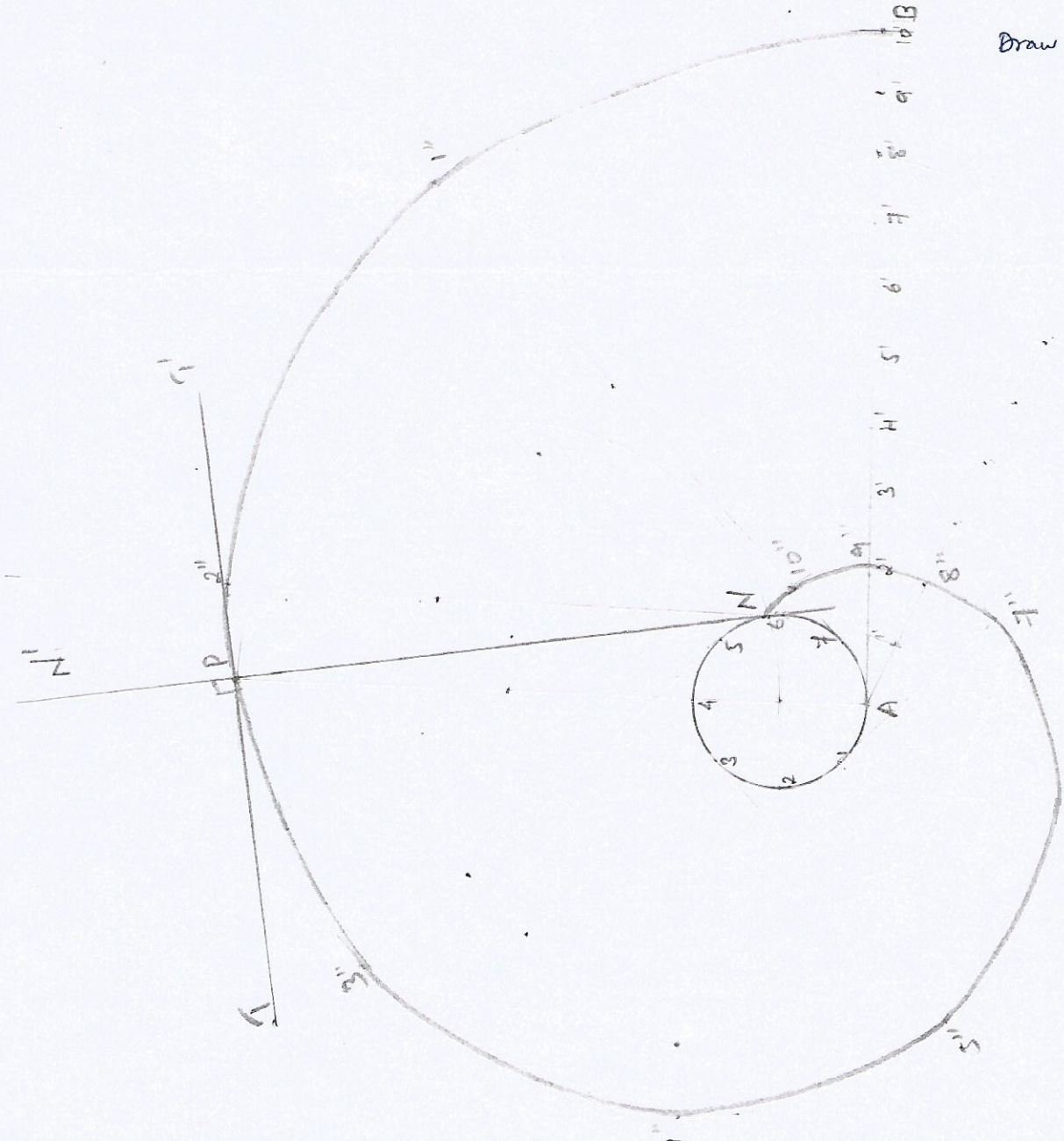


- Mark 100 mm from A



Divide 8 to B into two parts & mark 9 & 10

Draw the curve from Point 'B'



Perimeter = 81.64 mm

Fx 99 MS

99 pm protractor

80°

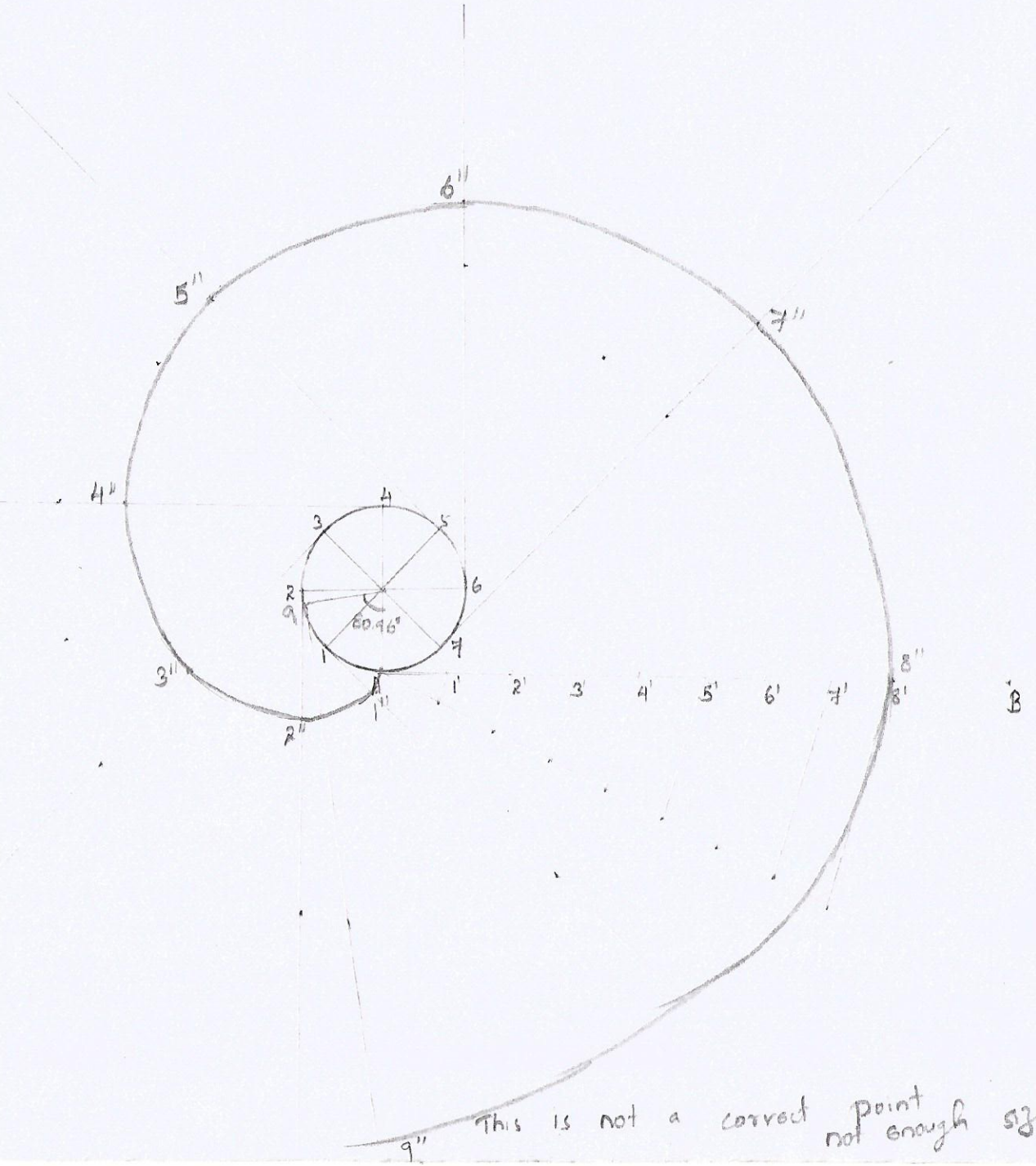
$L = \frac{81.64}{100} = 81.64$

$= 18.36$

$L = r\theta$

$18.36 = 13 \times \theta$

$\theta = 1.412$ rad



This is not a correct point not enough size (Point out of paper)

Circumference = πD

$= \pi \times 26$

$= 81.64\,mm$

$L = r\theta$

$L = 100 - 81.64$

$= 18.36\,mm$

$18.36 = 13 \times \theta$

$\theta = 1.4123\,rad \times \frac{180}{\pi}$

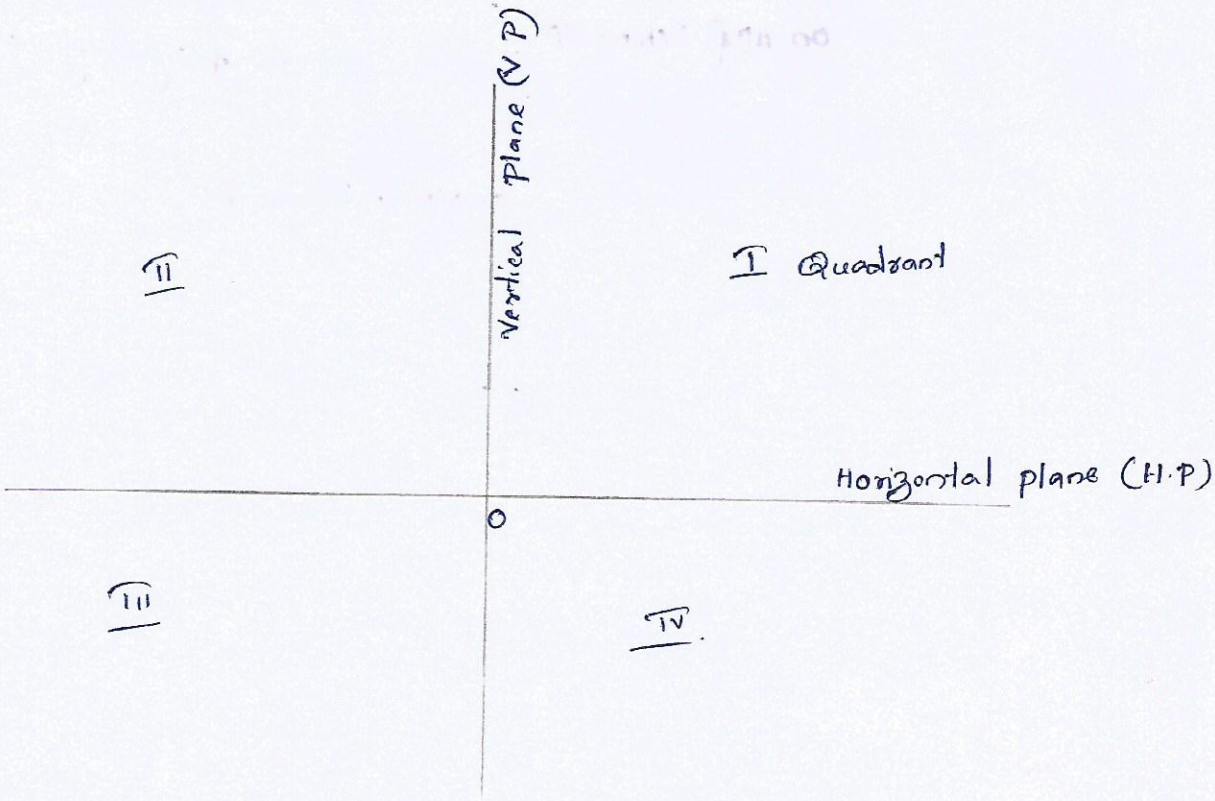
$= 80.96°$

Unit-II

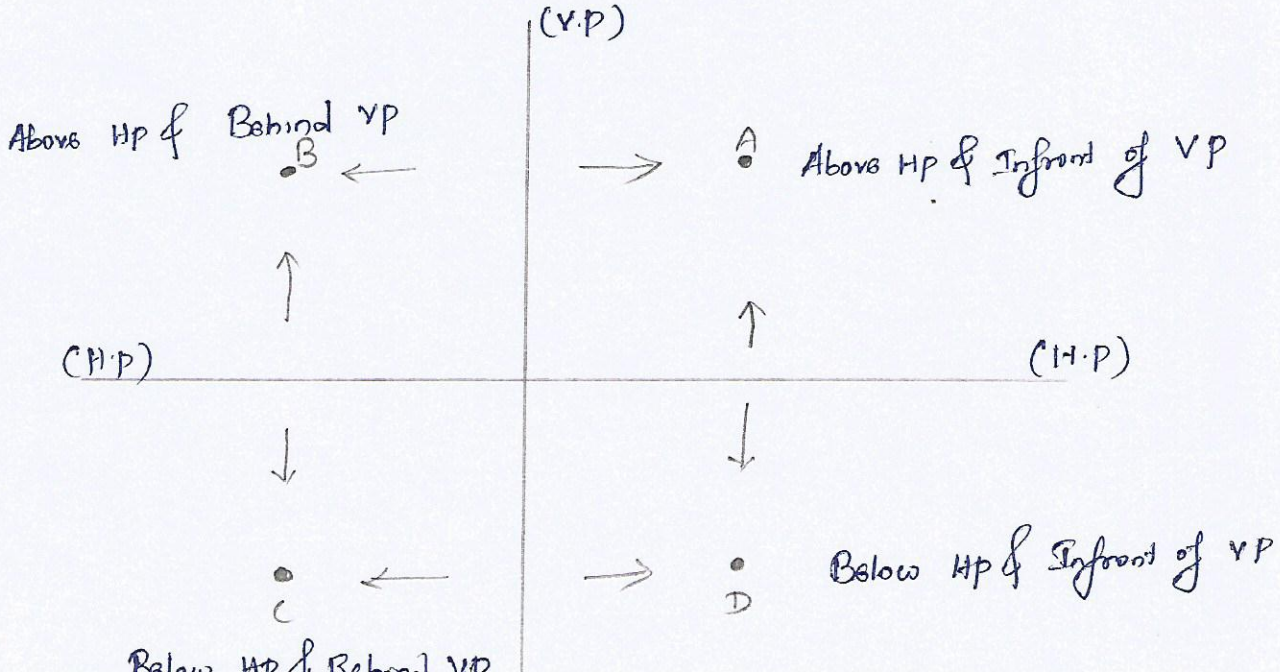
Projection of Points, lines and Plane surfaces

Projection of Points

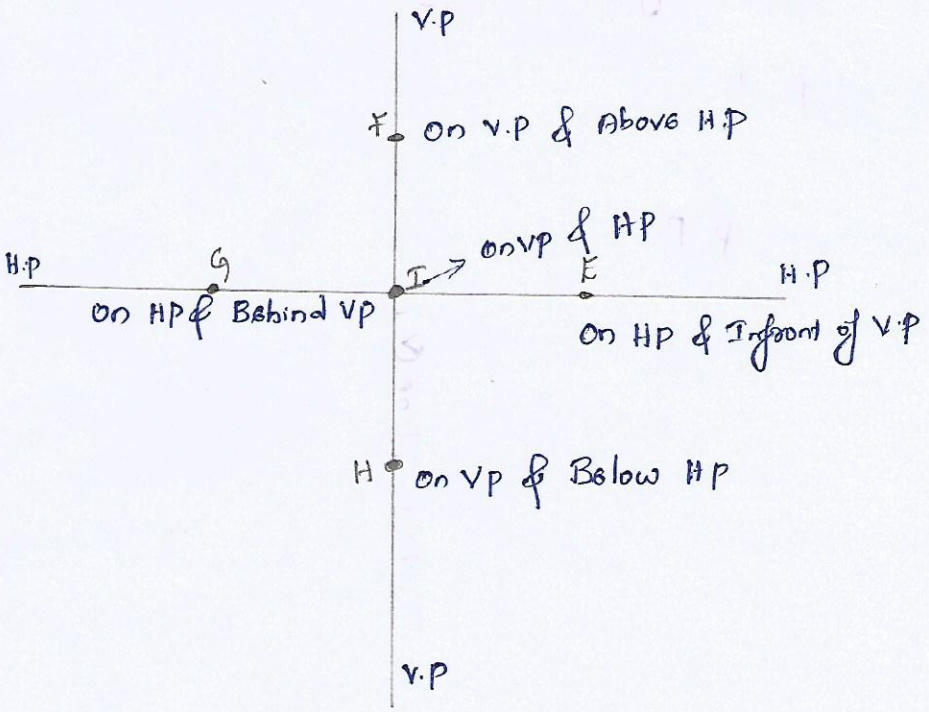
Four Quadrants & Planes:



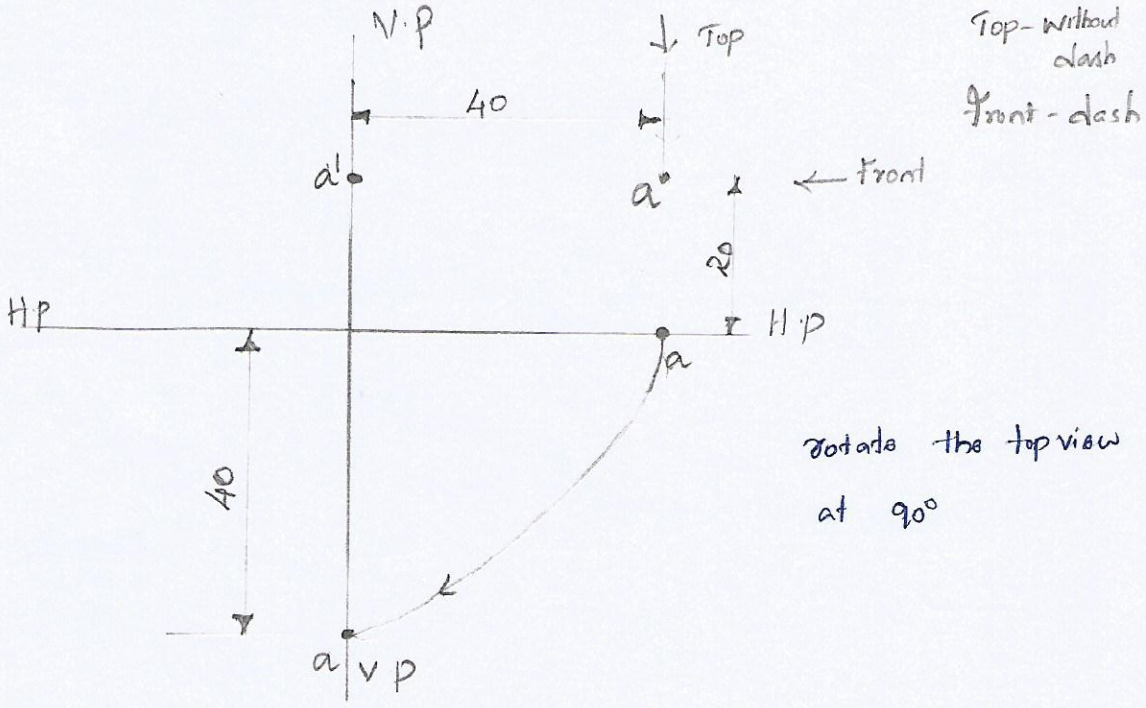
Position of Point in the four Quadrants:



Position of Point on it's Quadrants



A Point A is 20 mm above the HP and 40 mm infront of the V.P. Draw the Projection ~~the point~~.



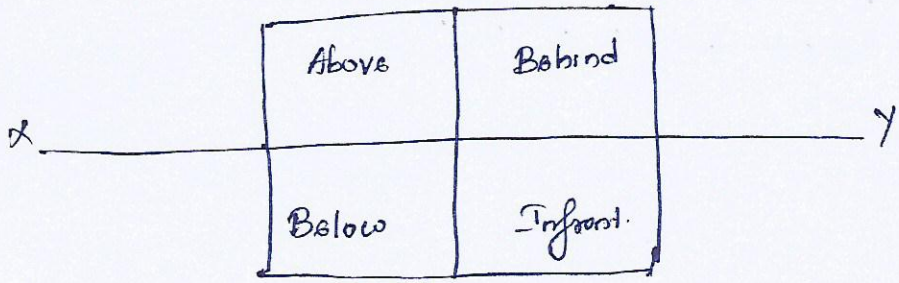
Short cut method:

Hp refers → front view

Vp refers → Top view

front view should be marked with dash (a')

Top view should be marked without dash (a)

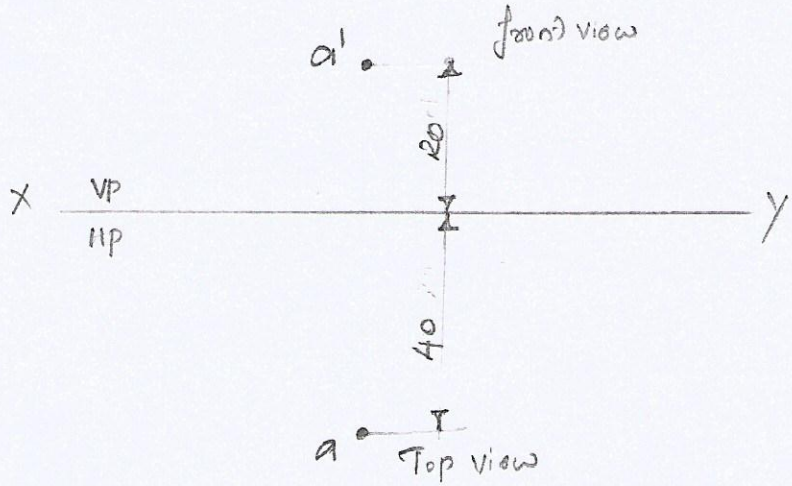


Top front view with dash

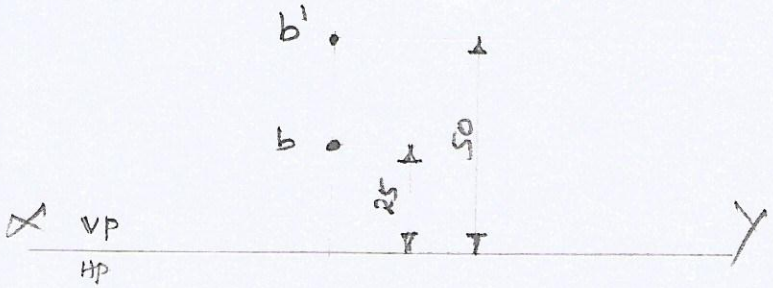
20mm above HP

40mm Infront of VP

below Top view



A point B is 50mm above the Hp & 25mm behind the V.P. Project the Point.



Mark the projection of the following Points on a common reference line.

i. P, 35 mm behind the V.P and 20 mm below H.P

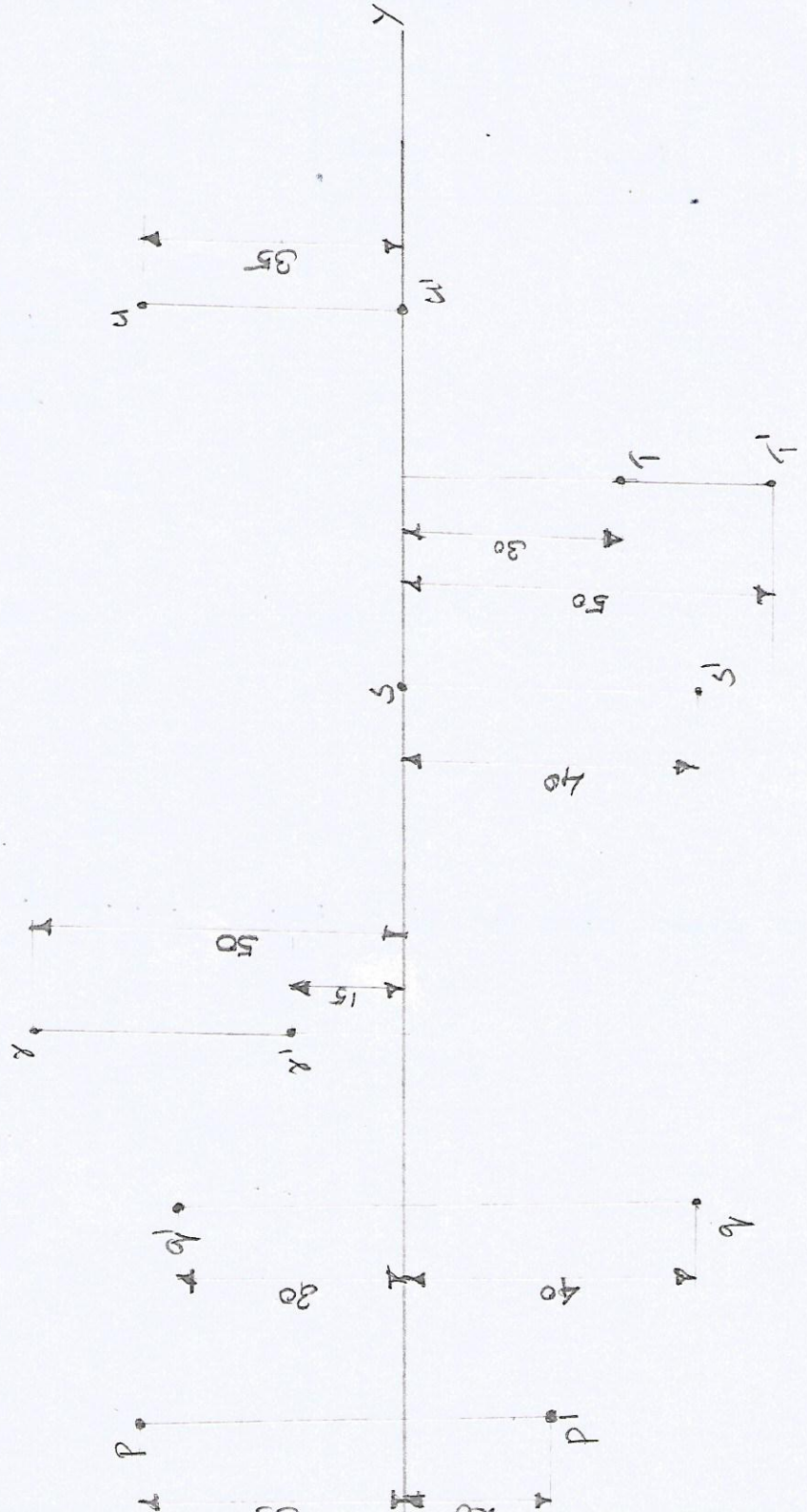
ii. Q, 40 mm infront of the V.P & 30 mm above the H.P

iii. R, 50 mm behind the VP & 15mm above the HP

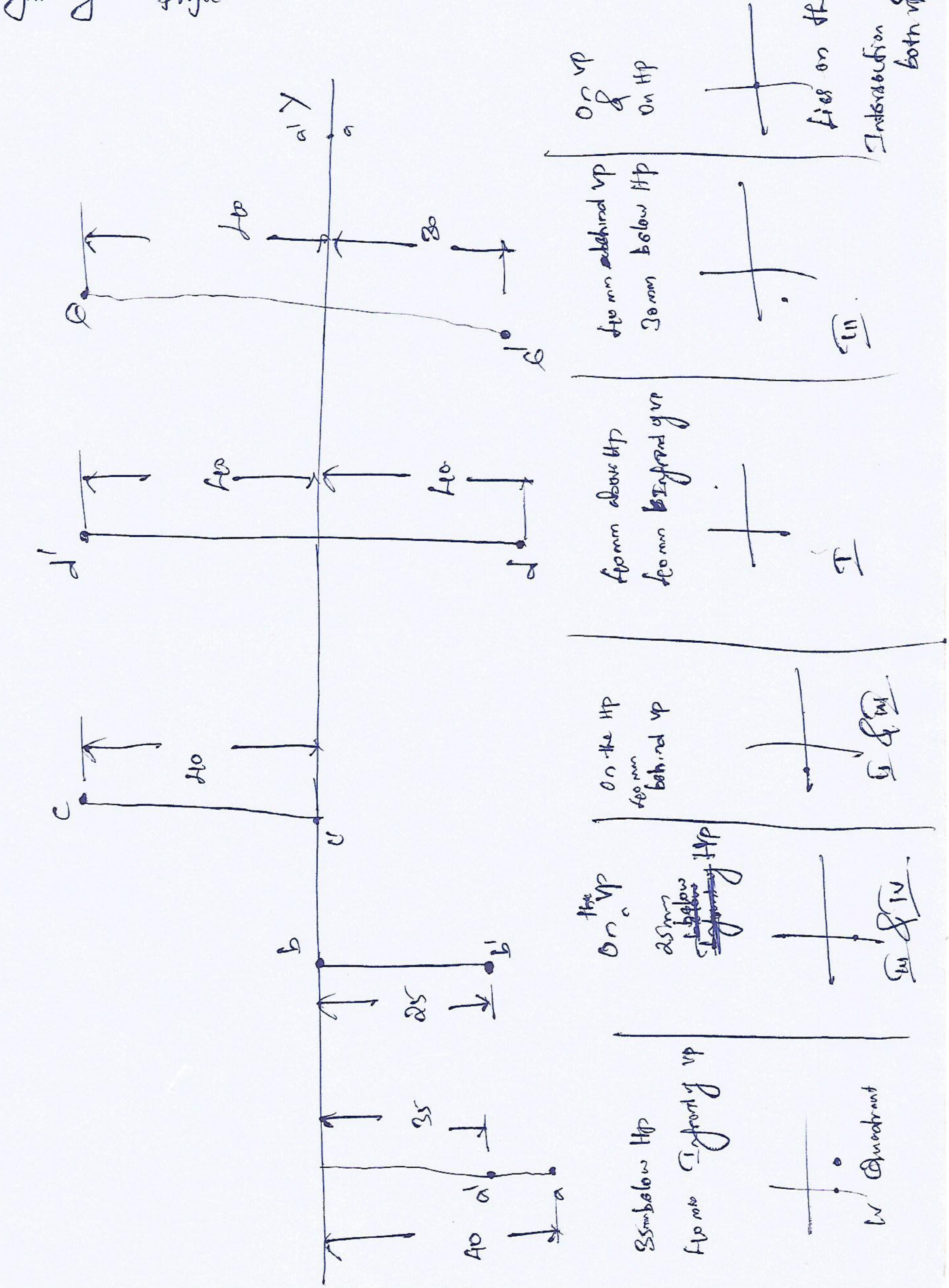
iv. S, 40 mm below the HP & in the V.P.

v. T, 30 mm infront of the V.P & 50 mm below the HP

vi. U, 35mm behind the V.P & in the HP.



State Quadrant & Specify the Position of Point for the following Projections.

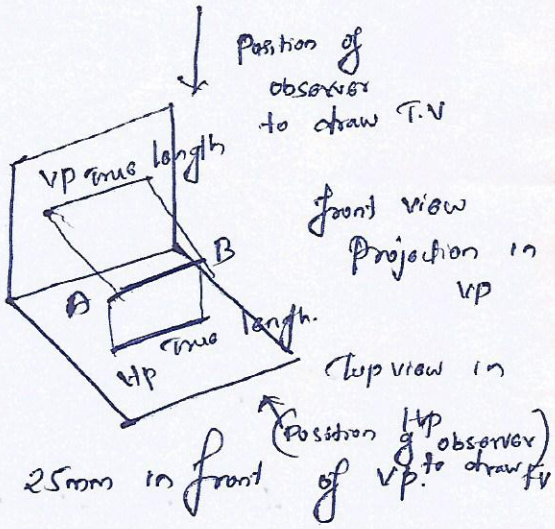


Projection of straight lines

A line joining any two points along the shortest route is called a straight line. Thus, the ends of a straight line are points.

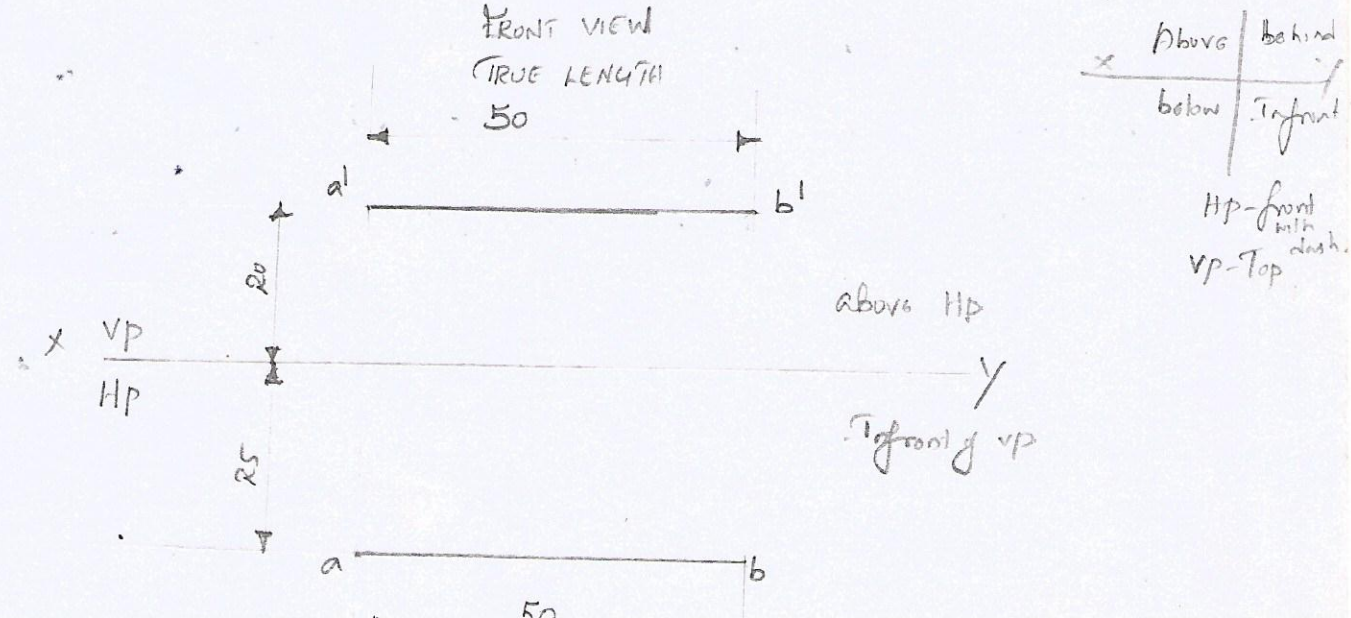
Positions of a straight line:

1. Line Parallel to HP & VP.
2. Line Parallel to Hp & Perpendicular to VP
3. Line Parallel to VP & ⊥ to Hp
4. Line Parallel to Hp & Inclined to VP
5. Line Parallel to VP & Inclined to Hp
6. Line inclined to Hp & lies on VP
7. Line inclined to VP & lies on Hp.
8. Line inclined to both VP & Hp.



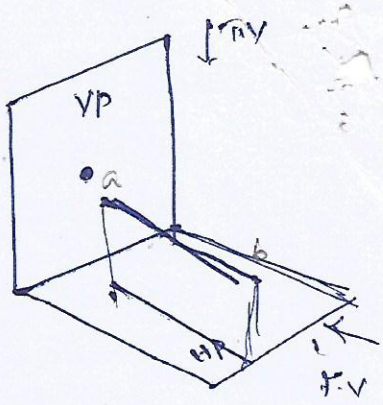
1. Line Parallel to Hp & VP

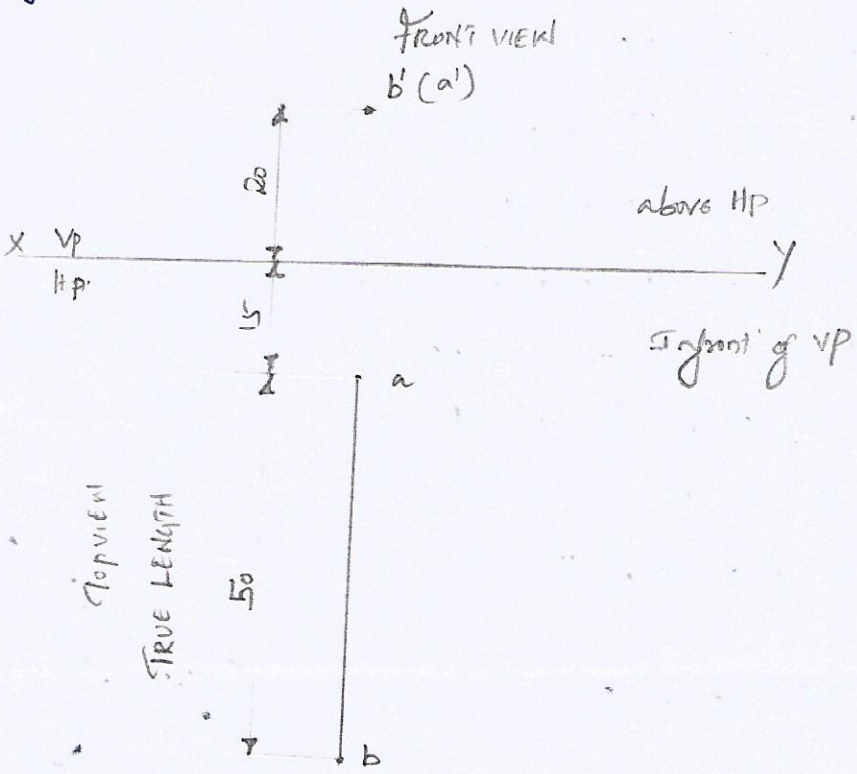
A line AB 50 mm long is placed Parallel to both Hp & VP. One end of the line A is 20 mm above Hp and 25mm in front of VP.



2. Line parallel to Hp & ⊥r to VP:

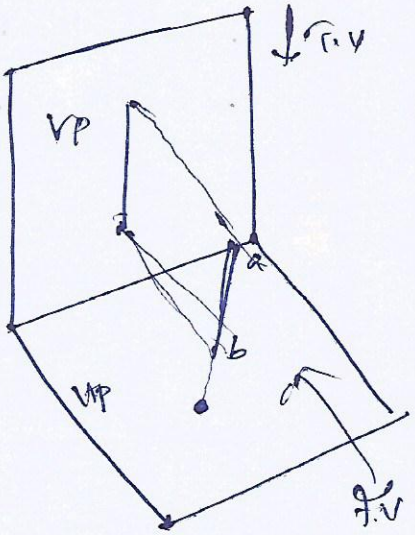
A line AB 50 mm long is parallel to Hp & ⊥r to vp. One end A of the line is 15mm in front of VP & 20 mm above Hp. Draw its Projections.

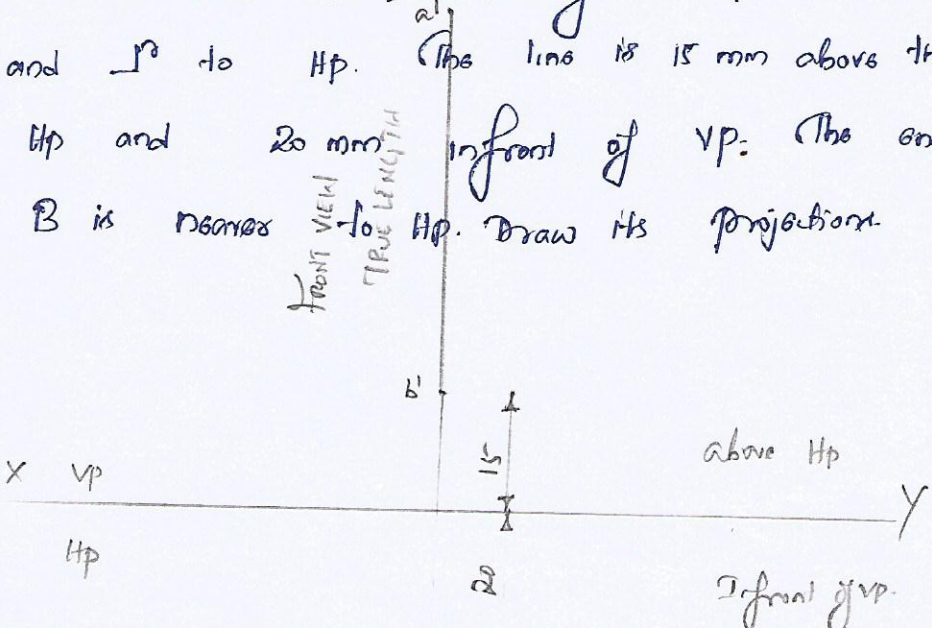




3. Line parallel to vp & ⊥r to Hp:

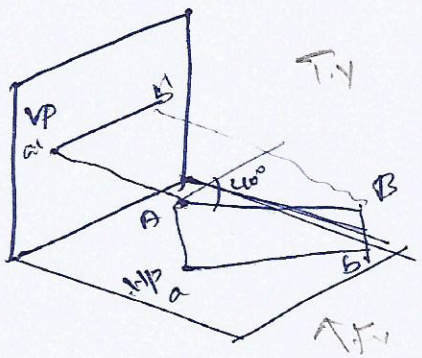
A line AB 50 mm long is parallel to Vp and ⊥r to Hp. The line is 15 mm above the Hp and 20 mm infront of VP. The end B is nearer to Hp. Draw its projections.

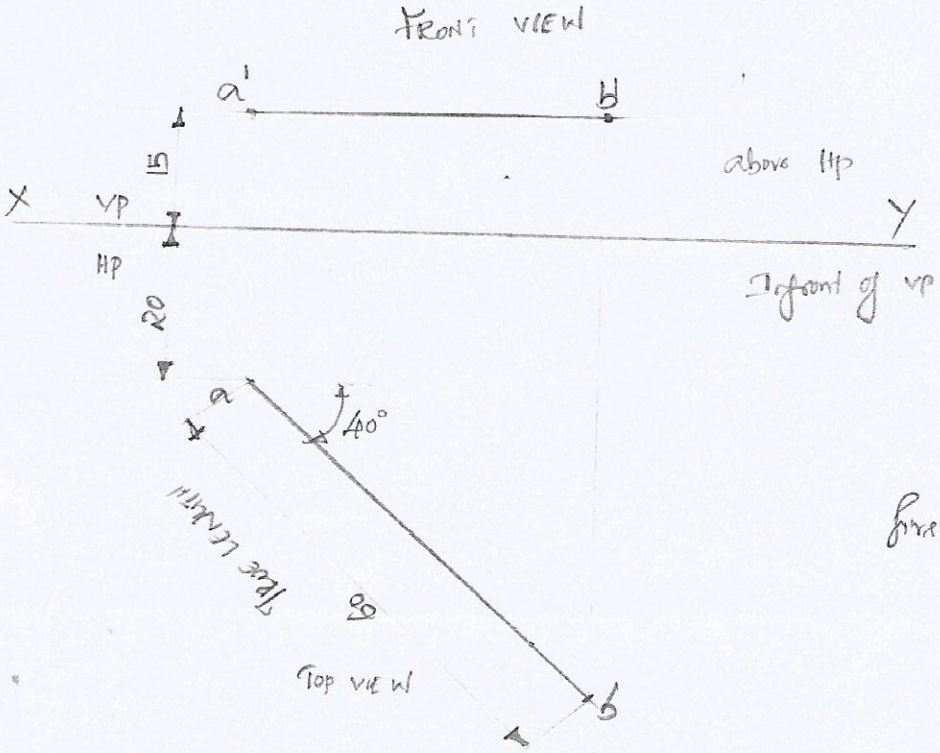




4. Line Parallel to Hp & Inclined to Vp:

A line AB 60 mm long is Parallel to Hp and inclined 40° to Vp. The Point A is 15 mm above Hp & 20 mm infront of Vp.



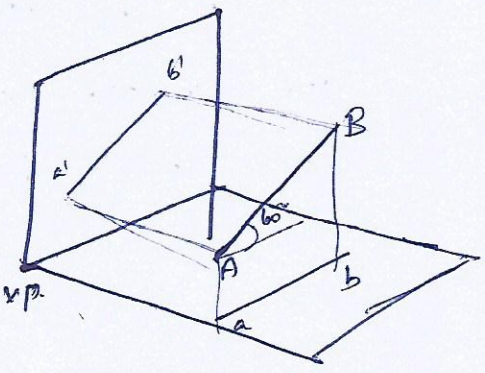


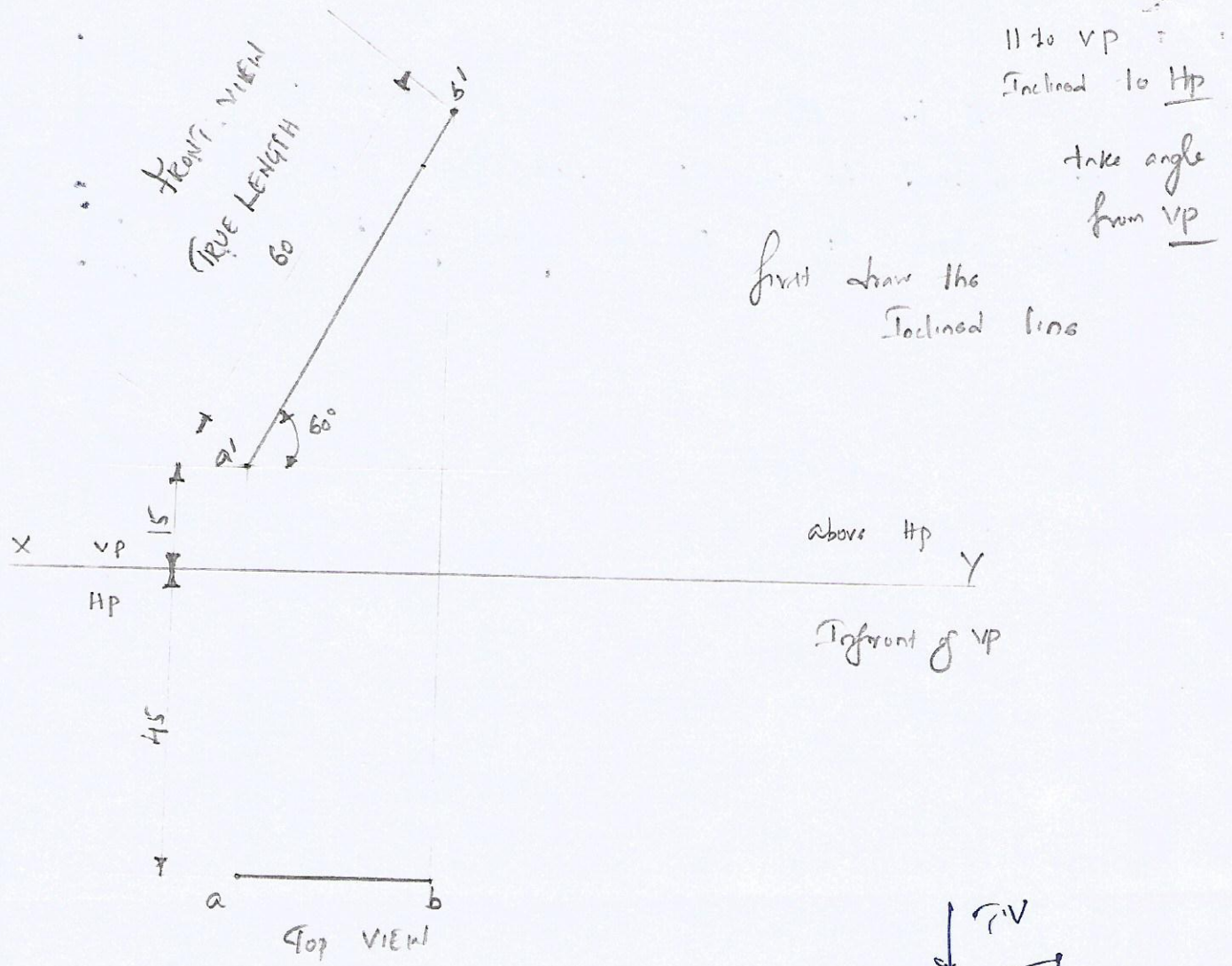
Inclined to vp
take angle
from Hp.

first draw the
Inclined line

5. Line Parallel to vp & Inclined to Hp:

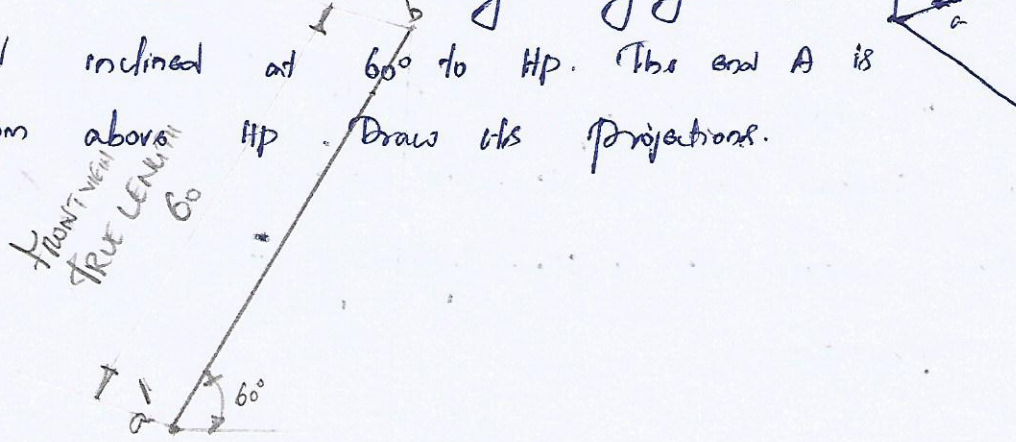
A line AB 60 mm long is Parallel to vp & Inclined 60° to Hp. The end A is 15mm above Hp & 45mm infront of vp. Draw its Projections.

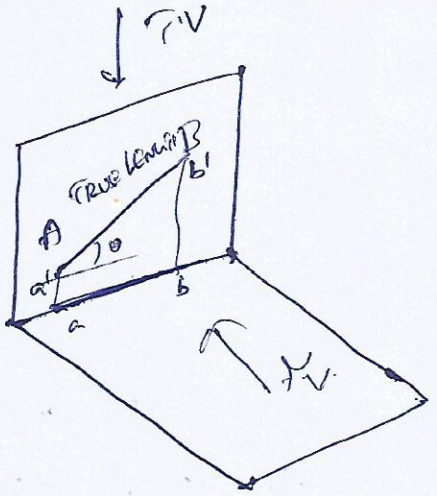




6. Line inclined to Hp and Lies on vp:

A line AB 60mm long is lying on VP and inclined at 60° to Hp. The end A is 15 mm above Hp. Draw its projections.

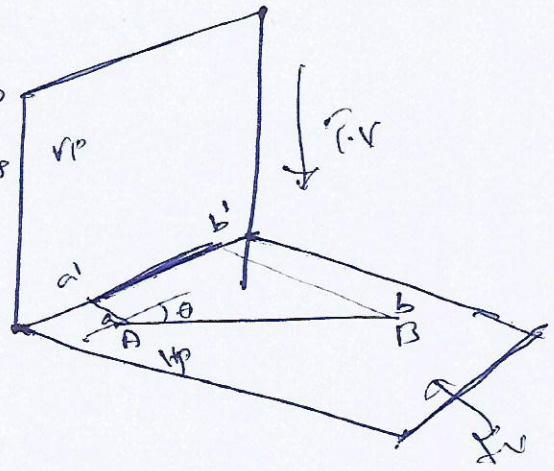


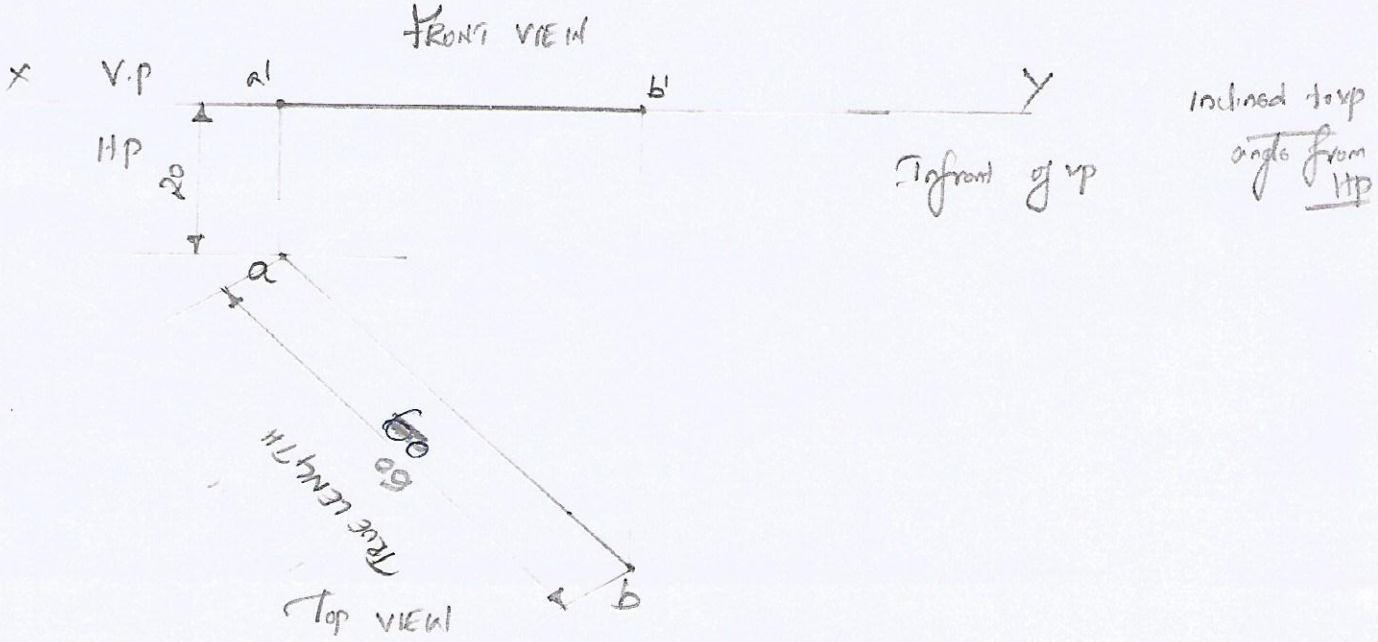


Inclined to Hp
Angle from VP

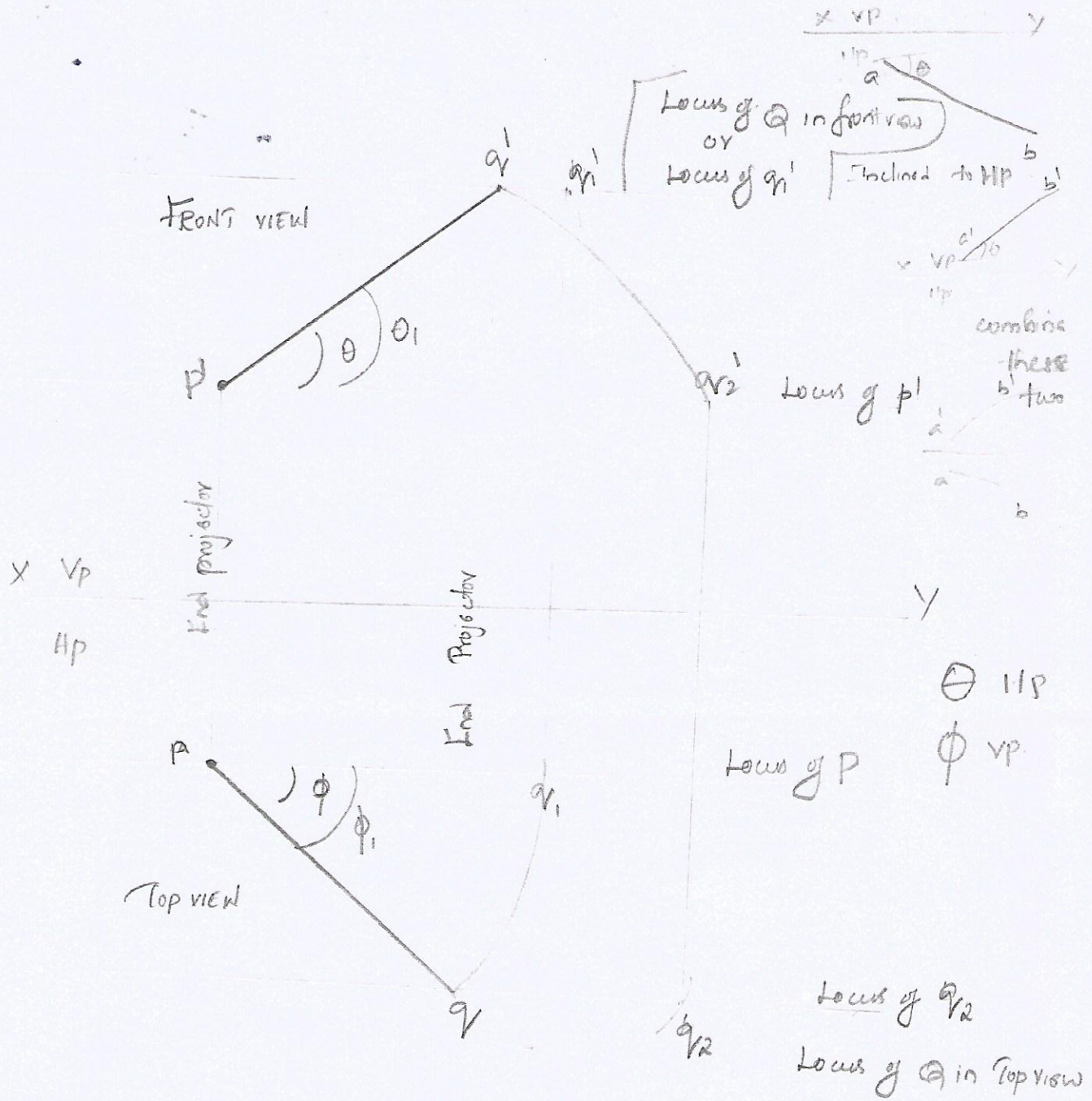
7. Line inclined to Vp & Lies on Hp:

A line AB 60 mm long is lying on Hp and inclined at 40° to Vp. The end A is 20mm infront of Vp. Draw its projections.





8. Line inclined to both VP & HP:



$P'q_1'$, Pq_2 → True length

$p'q'$ → front view

Pq → Top view

θ → Angle of inclination with HP

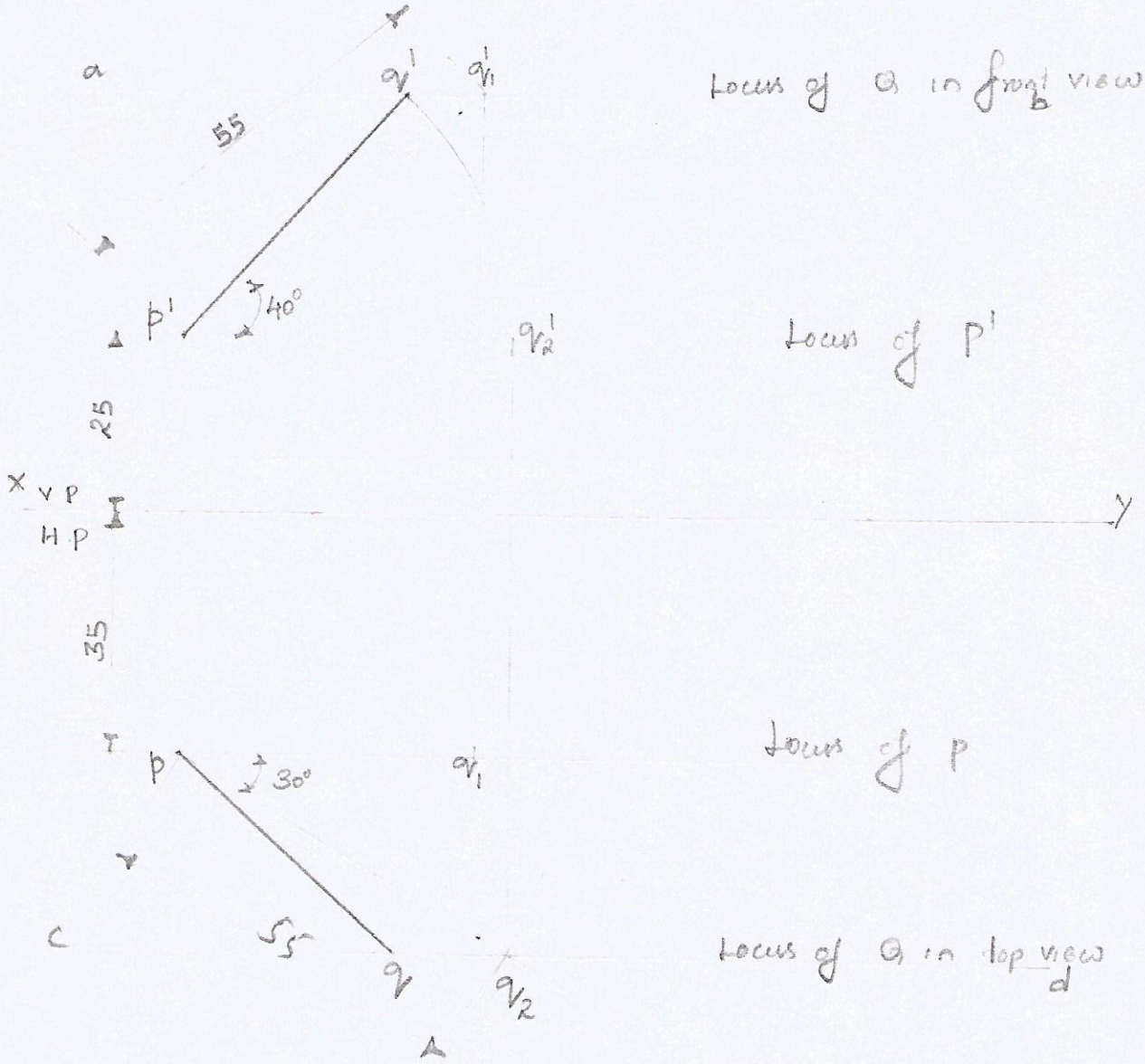
ϕ → " with VP.

1. One end P of a line PQ, 55mm long is 35mm in front of the Vp and 25mm above the HP the line is inclined at 40° to the Hp and 30° to the Vp. Draw the Projections of PQ.

Given: True length PQ = 55 mm

End P 35 mm in front of VP
25 mm above HP

Inclination with Hp = 40°
" with Vp = 30°



2. One end S of a line SR, 70mm long is in both the HP & the VP. The line is inclined at 40° to the HP and at 35° to the VP. Draw its Projections.

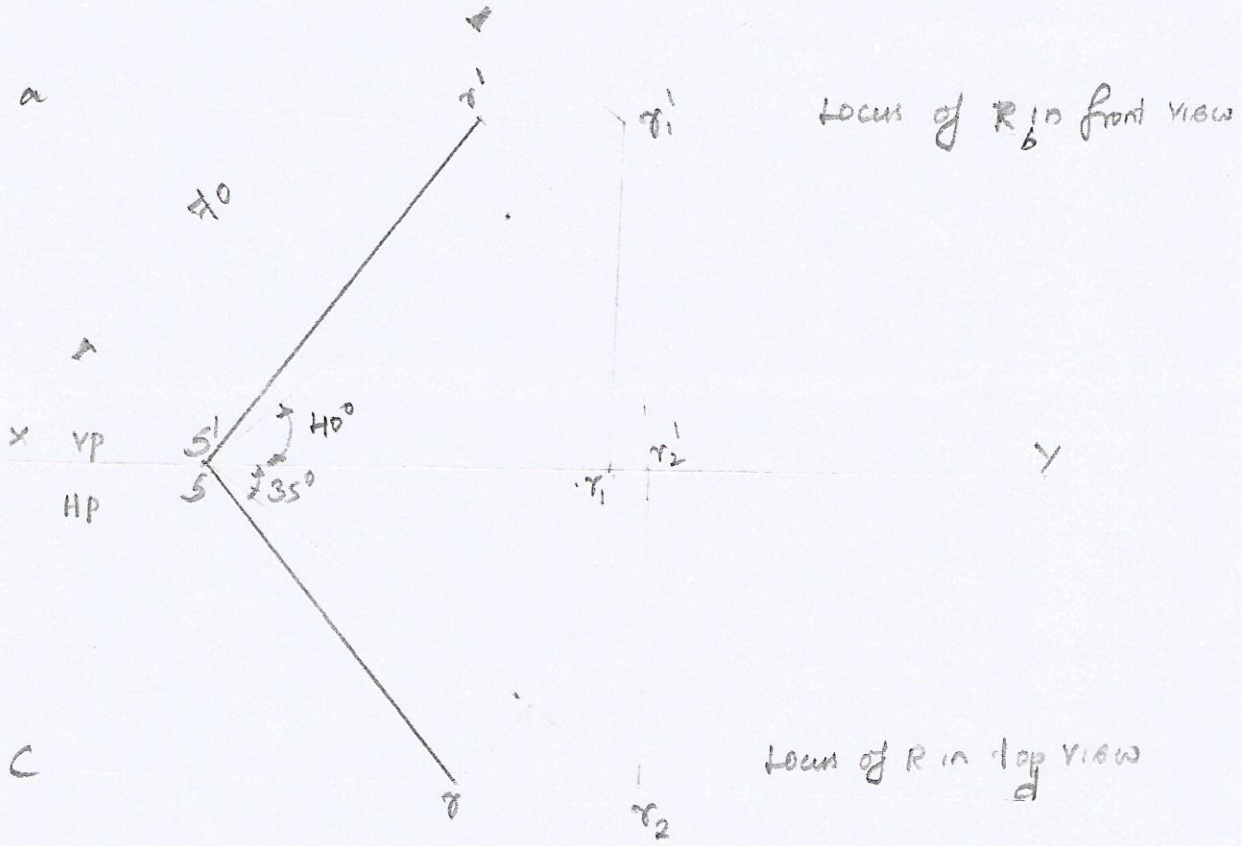
Given:

True length SR = 70mm

End S in HP & VP

Inclination with HP = 40°

" With VP = 35°



s'r' → Top view

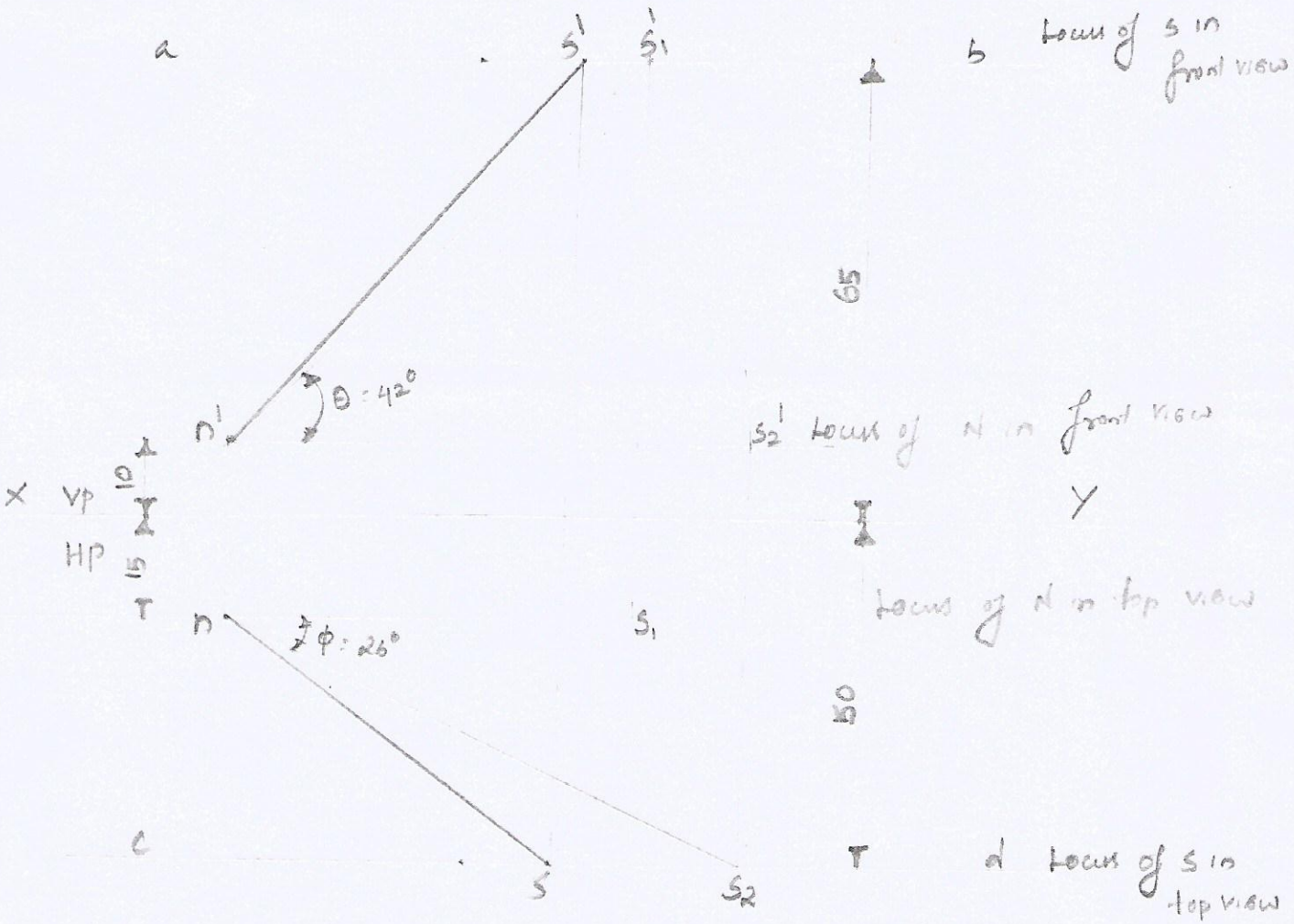
sr → Front view

3. A line NS, 80mm long has its end N, 10mm above the Hp & 15mm infront of the vp. The other end S is 65mm above the Hp and 50mm in front of the Vp. Draw the projections of the line and find its true inclinations with Hp & Vp.

Given: True length NS = 80 mm

End N: 10 mm above Hp
15 mm infront of Vp

End S: 65 mm above Hp
50 mm infront of Vp



n's' → front view

ns → Top view

Inclination with Hp = 42°

" Vp = 26°

4. A line PF, 65mm long has its end P, 15mm above the HP and 15mm in front of the VP. It is inclined at 55° to the HP and 35° to the VP. Draw its Projections.

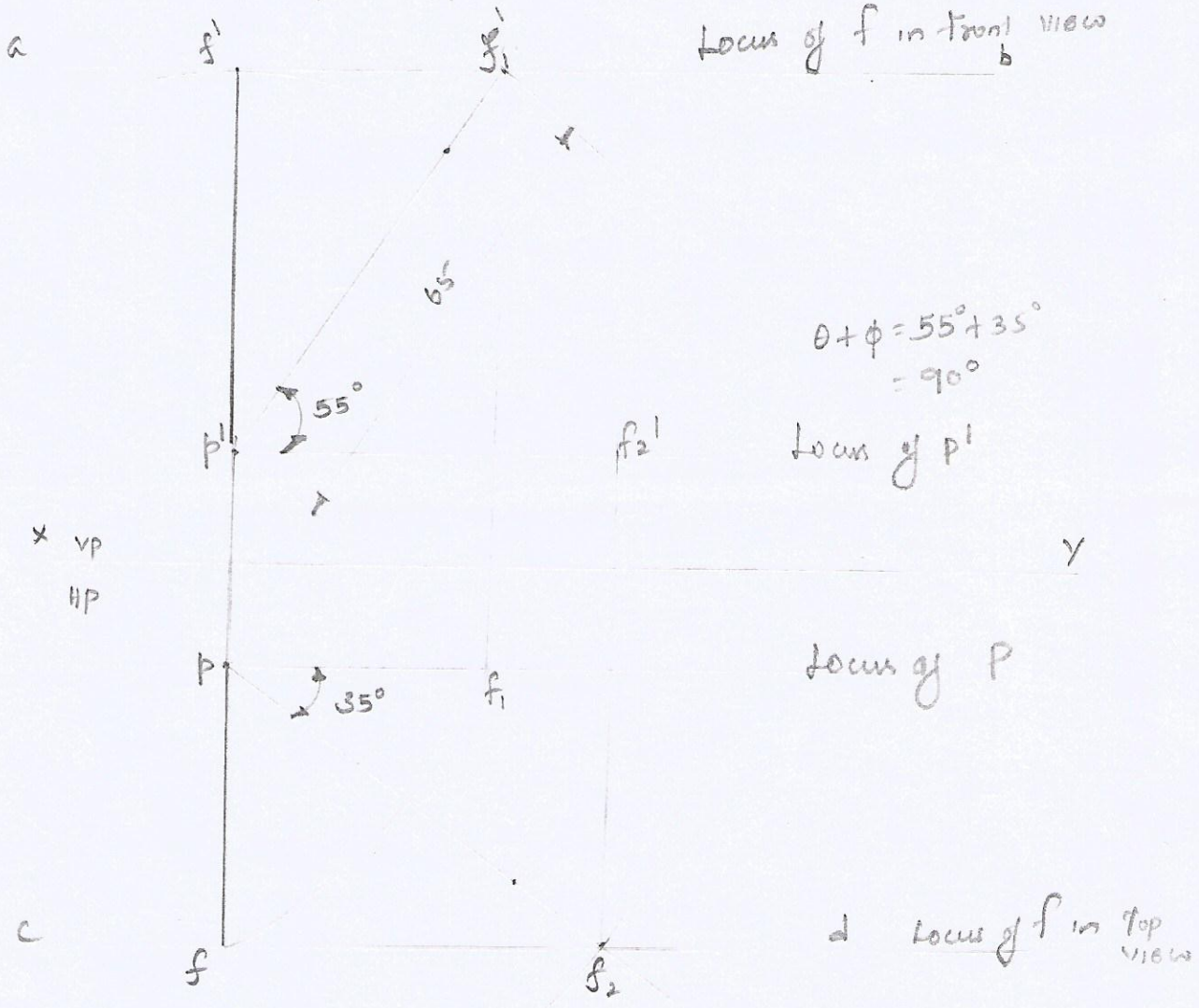
Given: True length PF = 65mm

end P 15 mm above HP

15 mm in front of VP

Inclination with HP = 55°

" with VP = 35°



p'f' — Front view

pf — Top view

5. The end P of a line PQ, 70 mm long is 15 mm above the Hp and 20 mm infront of the VP. Q is 40 mm above the Hp. Its top view is inclined at 45° to the VP. Draw the projections of the line and find its true inclinations with the VP & the Hp.

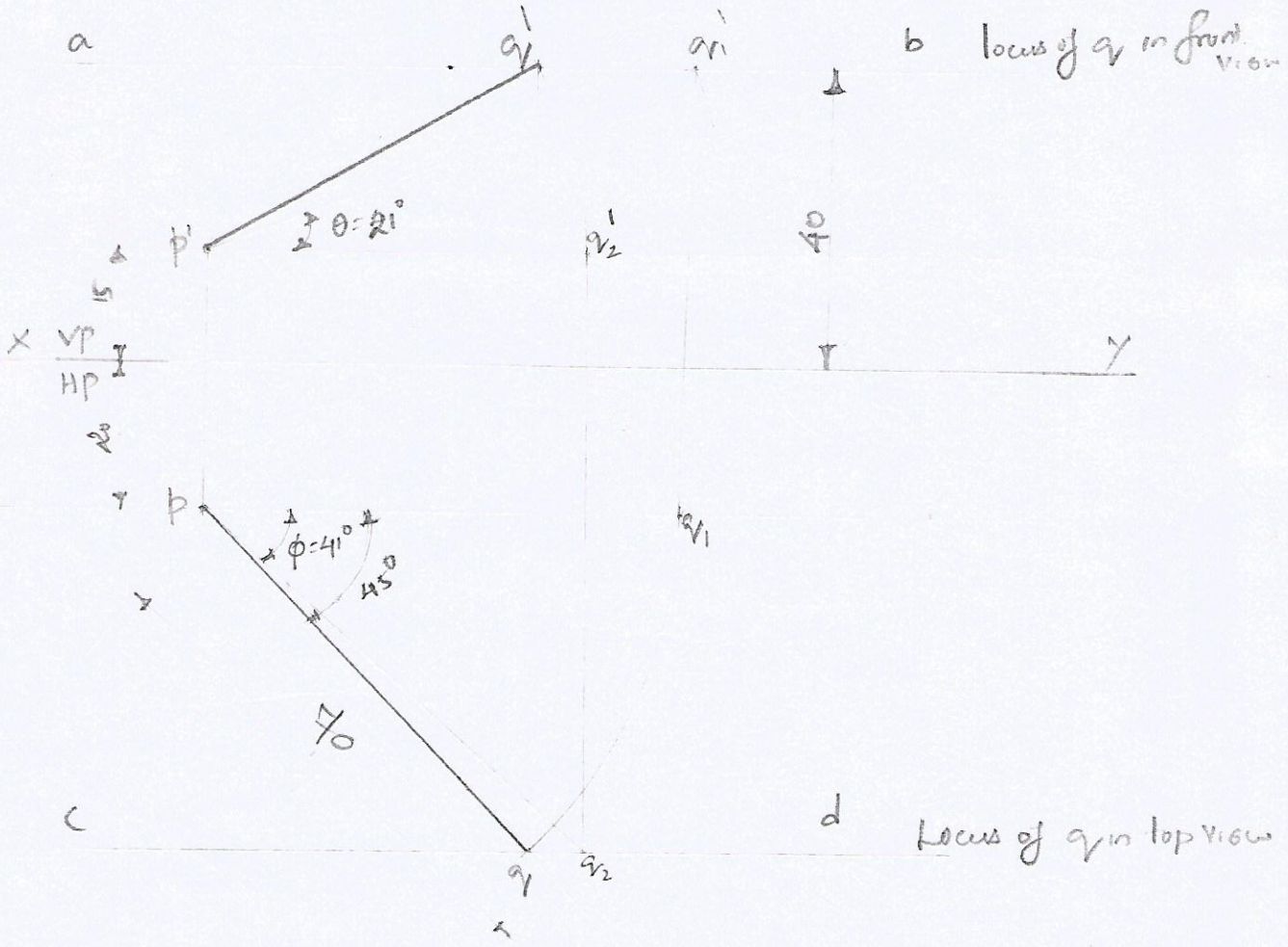
Given: True length = 70mm PQ

End P 15 mm above Hp

20 mm infront of VP

Q 40 mm above Hp

Inclination of top view PQ = 45° with VP



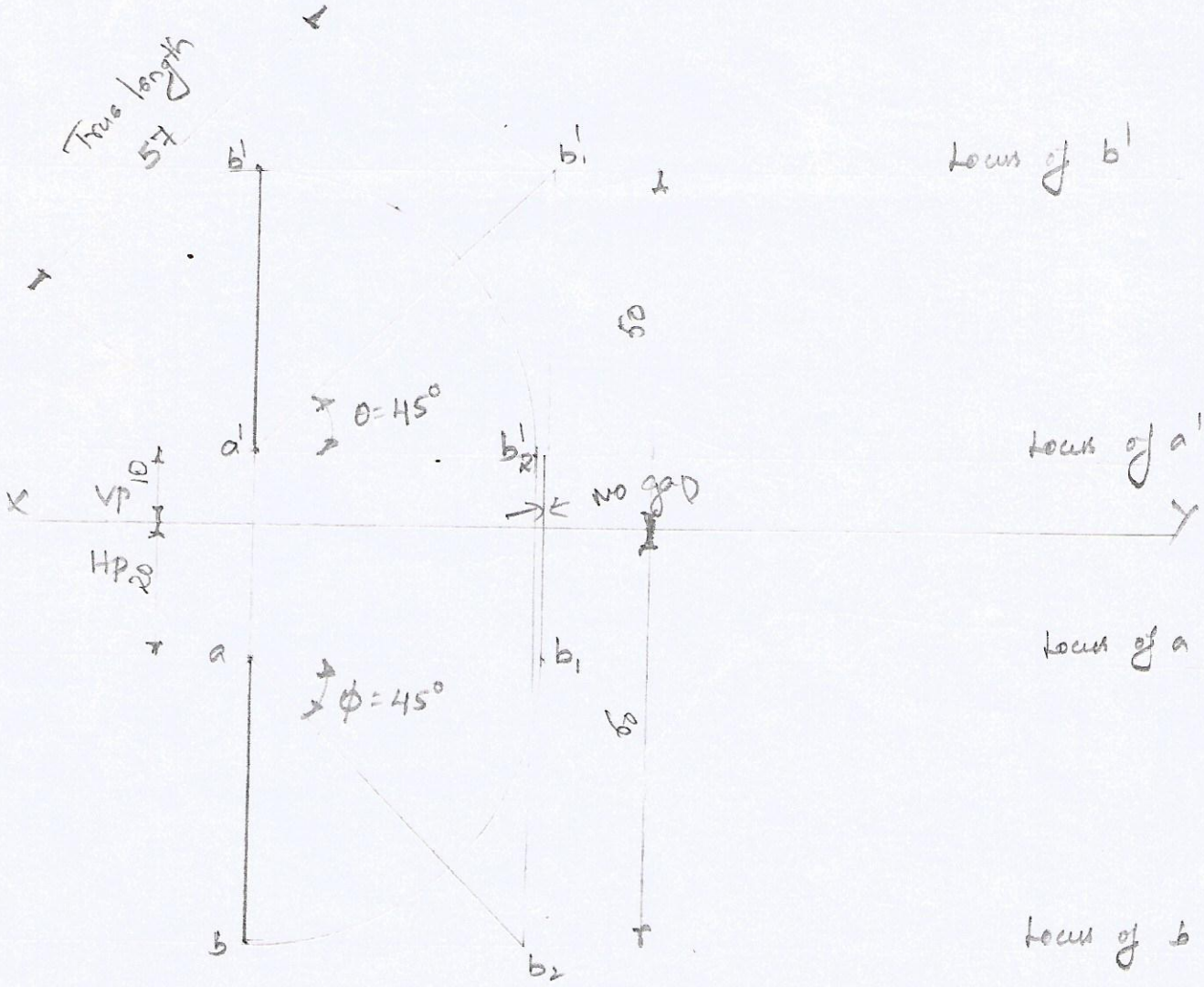
Inclination with Hp $\theta = 21°$

" VP $\phi = 41°$

6. A line AB, one end A is 10 mm above HP and 20 mm infront of VP. The other end B is 50 mm above Hp and 60 mm infront of Vp. The end projectors are the same projector. Draw it's projection. Also find the true lengths and true inclinations with Hp & Vp.

Given:

End A is 10 mm above Hp
" 20 mm infront of Vp
End B is 50 mm above Hp
" 60 mm infront of Vp
End projectors are same. $\Rightarrow \theta + \phi = 90°$



θ = 45°
φ = 45°

7. A line EF, 85 mm long has its end E, 25 mm above the HP and 20 mm infront of the VP. The top and front views of the line have lengths of 55 mm and 70 mm respectively. Draw the Projections of the line and find its true inclinations with the VP and the HP.

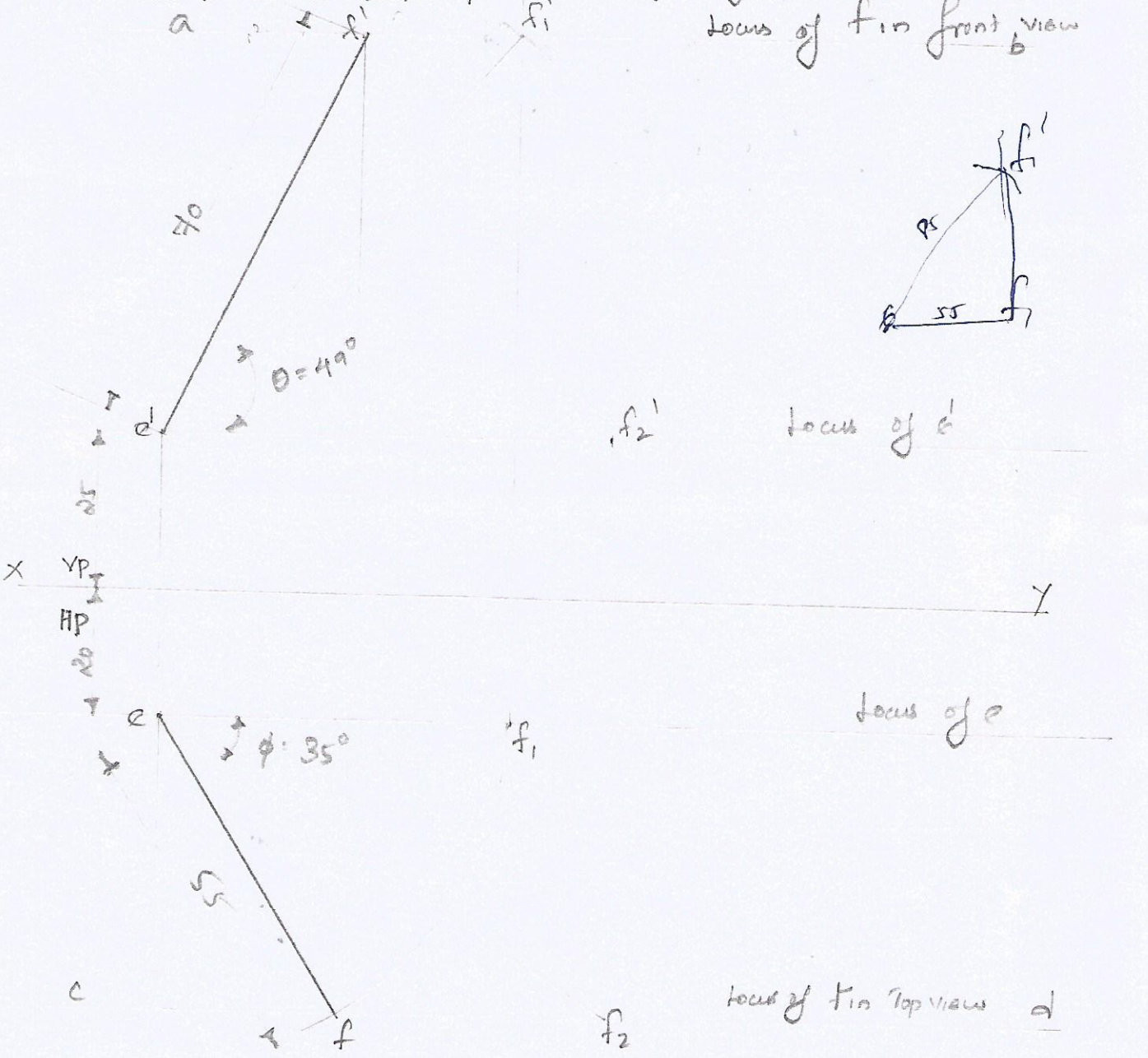
Given

True length EF = 85 mm

End E 25 mm above HP & 20 mm infront of VP

Length of F.V = 55 mm

Length of T.V = 70



8. A line PQ has its end P, 10mm above the Hp and 20 mm infront of the Vp. The end Q is 35mm infront of the Vp. The front view of the line measures 75 mm. The distance b/n the end projectors is 50 mm. Draw the Projections of the line and find its true length and its true inclinations with the Vp and the Hp.

Given:

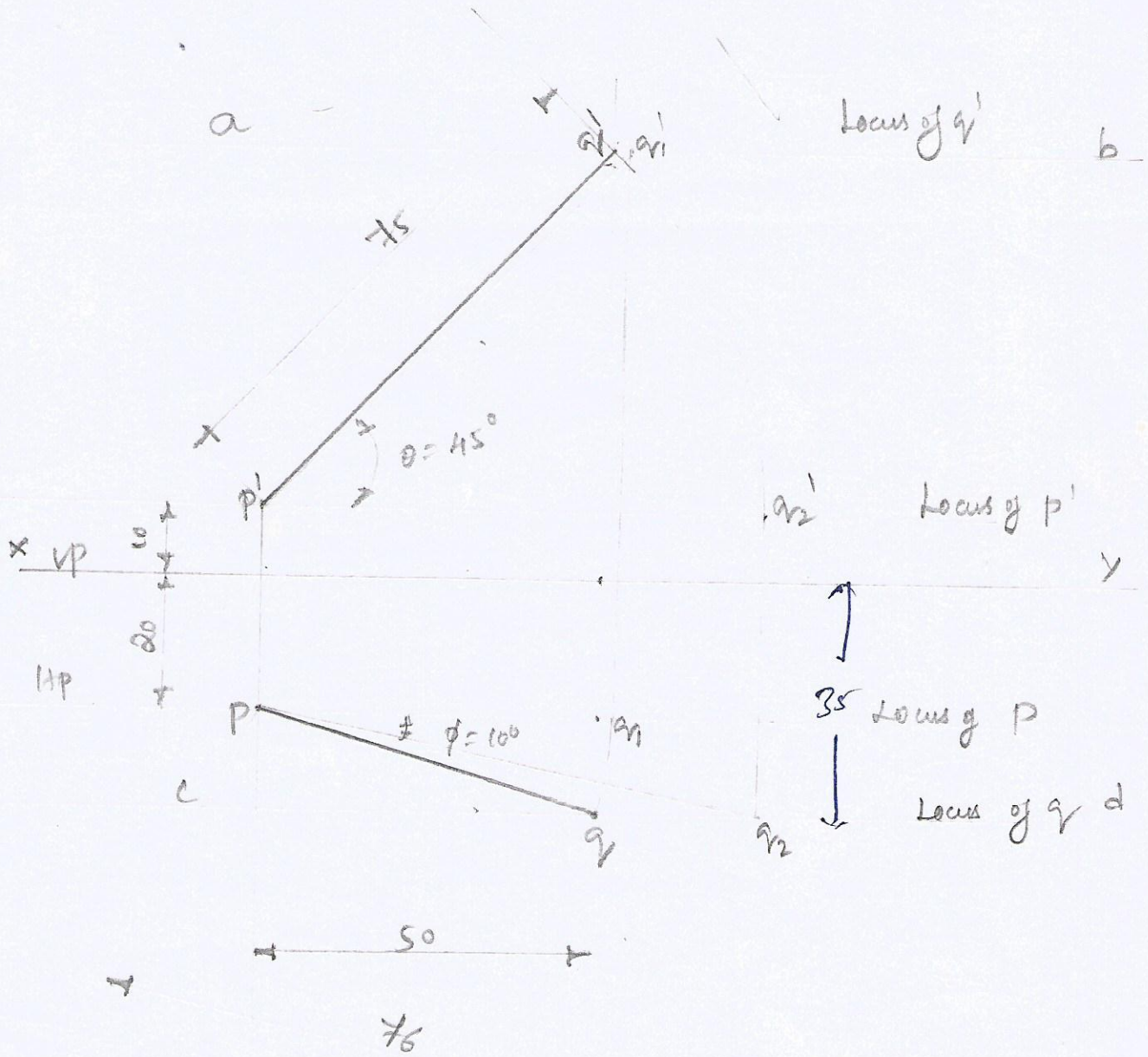
End P 10 mm above Hp

" 20 mm infront of Vp

End Q 35mm infront of Vp

Length of front View 75mm

Distance b/n end projectors = 50mm



9. One end P of a line PQ, 80mm long is 25mm above the Hp and 20mm infront of VP. The line is inclined at 35° to the VP. Its top view has a length of 50mm. Draw the Projection of the line and find its true inclination with the Hp.

Given: True length PQ = 80mm

End P 25mm above Hp

20mm infront of VP

Inclination with VP = $\phi = 35°$

length of Top view = 50 mm

10. A line measuring 65 mm long has one of its ends 45mm infront of vp and 20 mm above Hp. The top view of the line is 45mm long. The other end is 20 mm infront of vp and is above Hp. Draw its projections and find the true inclinations with Hp & vp.

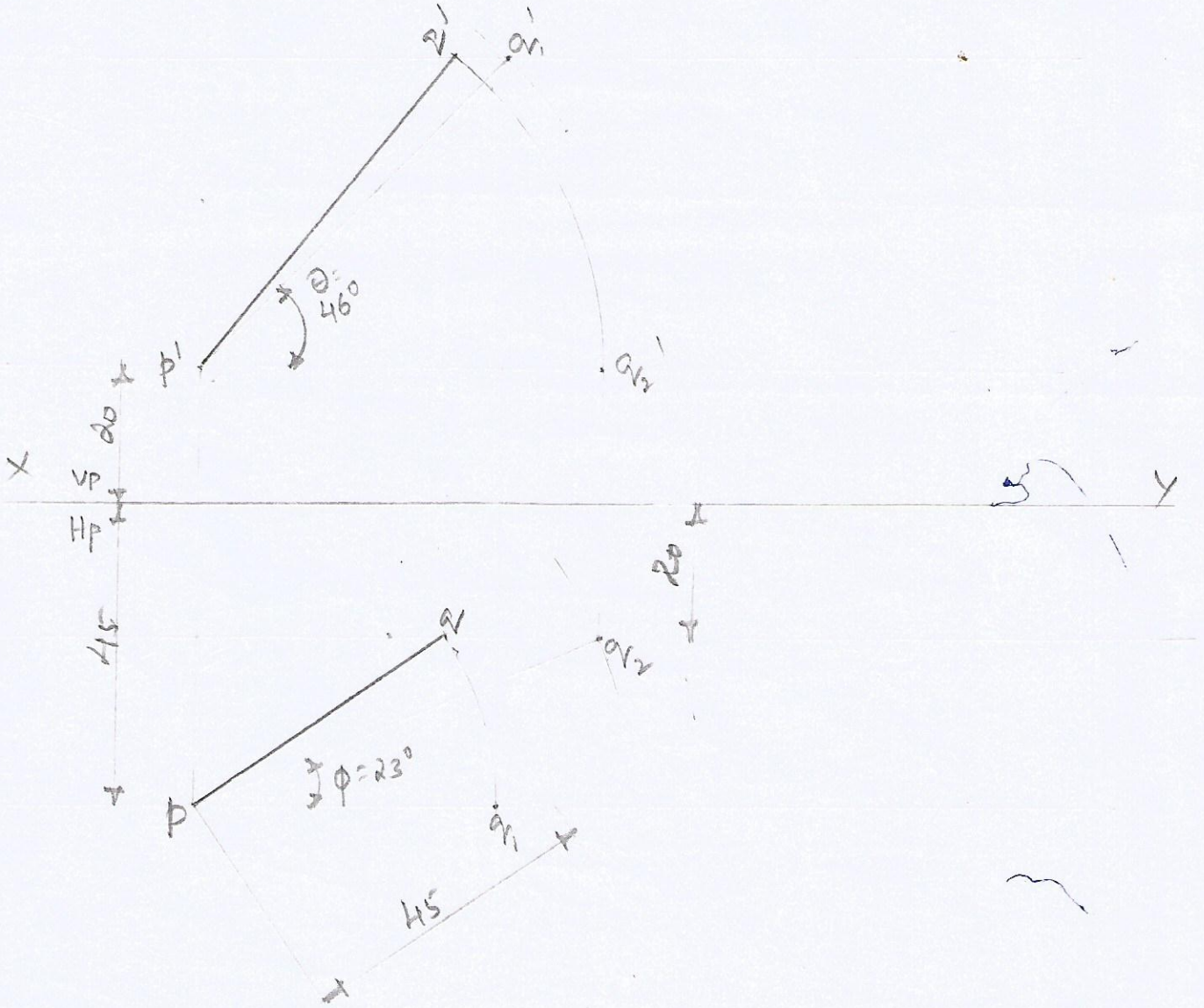
Given:

PQ = 65mm

End P 45mm infront of vp
20 mm above Hp

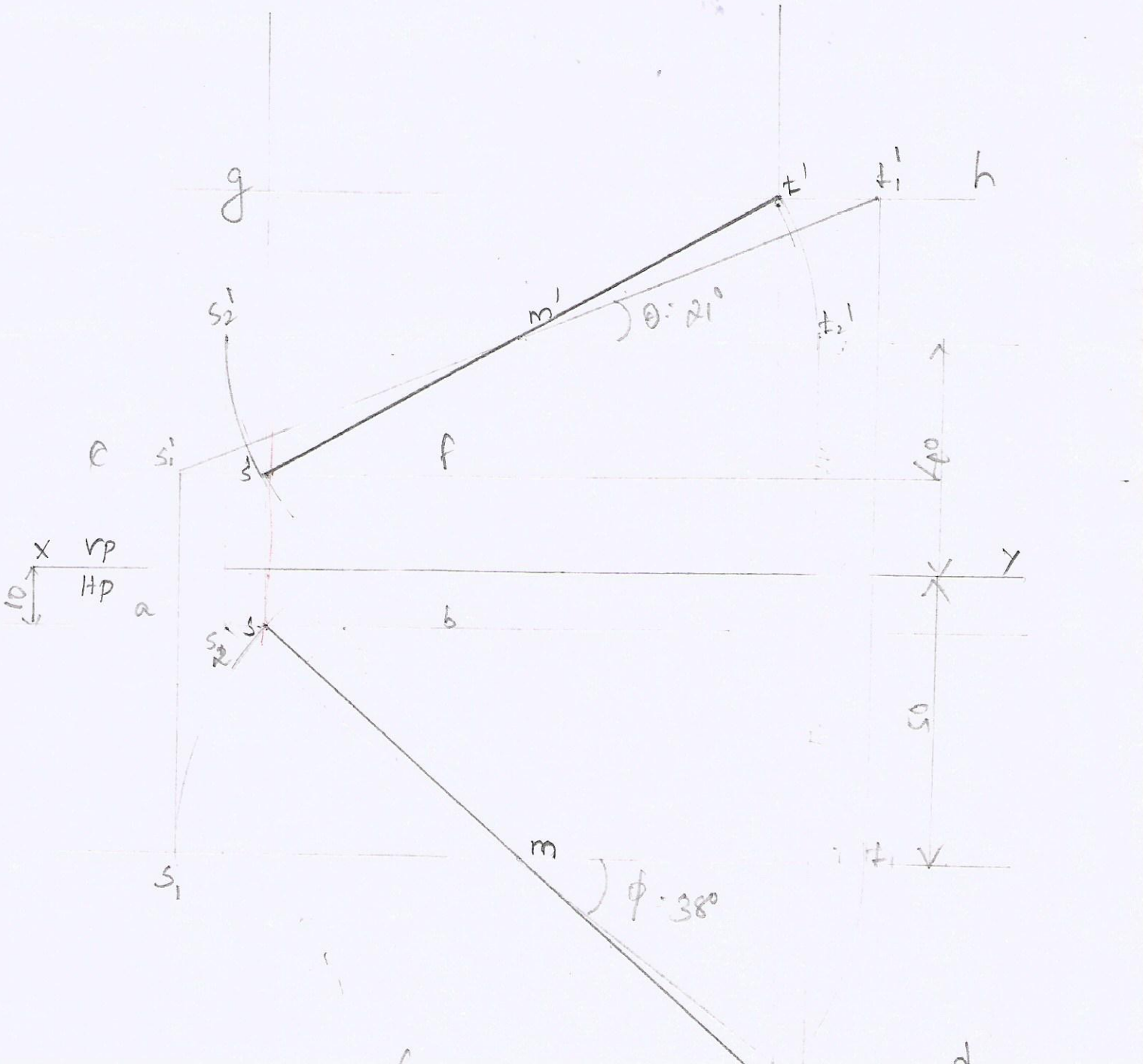
length of top view = 45mm

Q 20 mm infront of vp & above Hp



11. A straight line ST has its end S, 10 mm infront of the VP and nearer to it. The mid-point of the line is 50 mm infront of the VP and 40 mm above the HP. The front and top views measure 100 mm and 120 mm respectively. Draw the projections of the line. Also find its true length and true inclinations with the HP and the VP.

Given: End S 10 mm infront of VP
Mid point 50 mm infront of VP
" 40 mm above HP
length of top view = 100 mm
" front view = 120 mm



A line PQ has its ends 10 mm and 45 mm above the Hp and the length of its front view is 70 mm. The line is inclined at 25° to the Hp. The HT of the line is 15mm in front of the Vp. Draw the projections of the line and find its true length and true inclination with the Vp. Also show its VT.

Given:

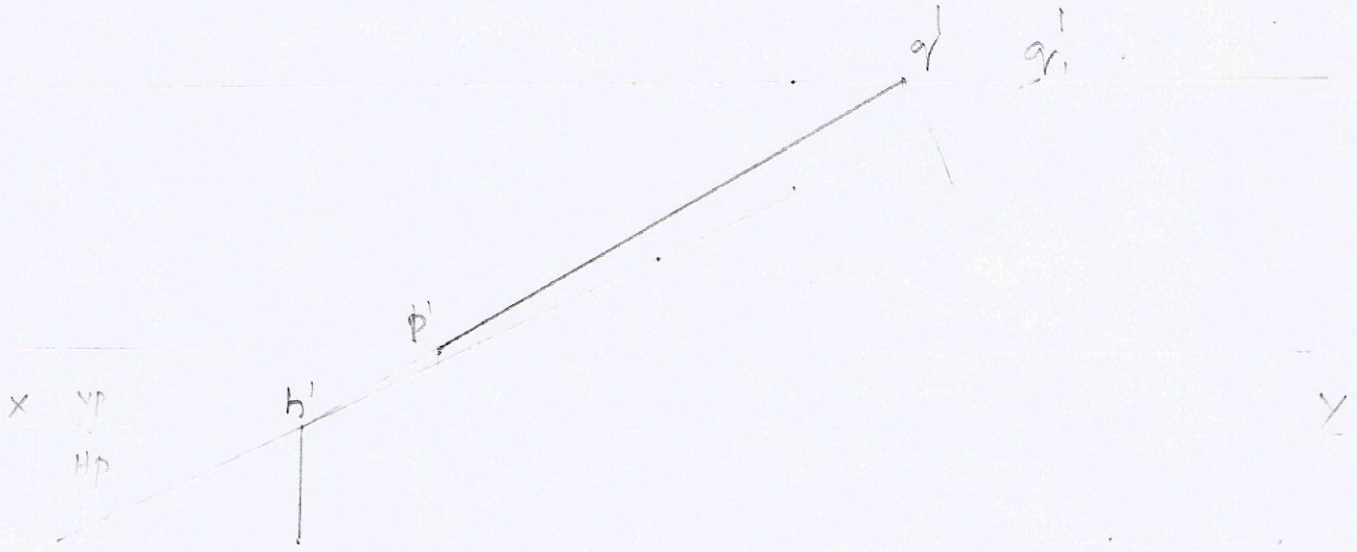
End P 10 mm above Hp

Q 45mm above Hp

Length of front view = 70 mm

$\theta = 25°$

HT 15mm infront of Vp.

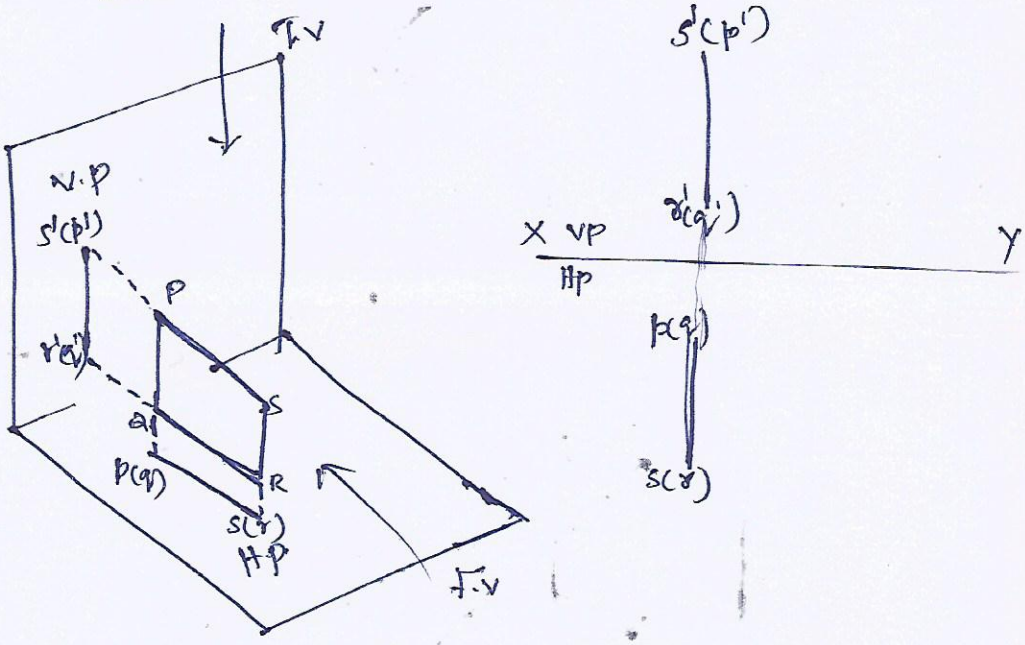


Projections of Planes

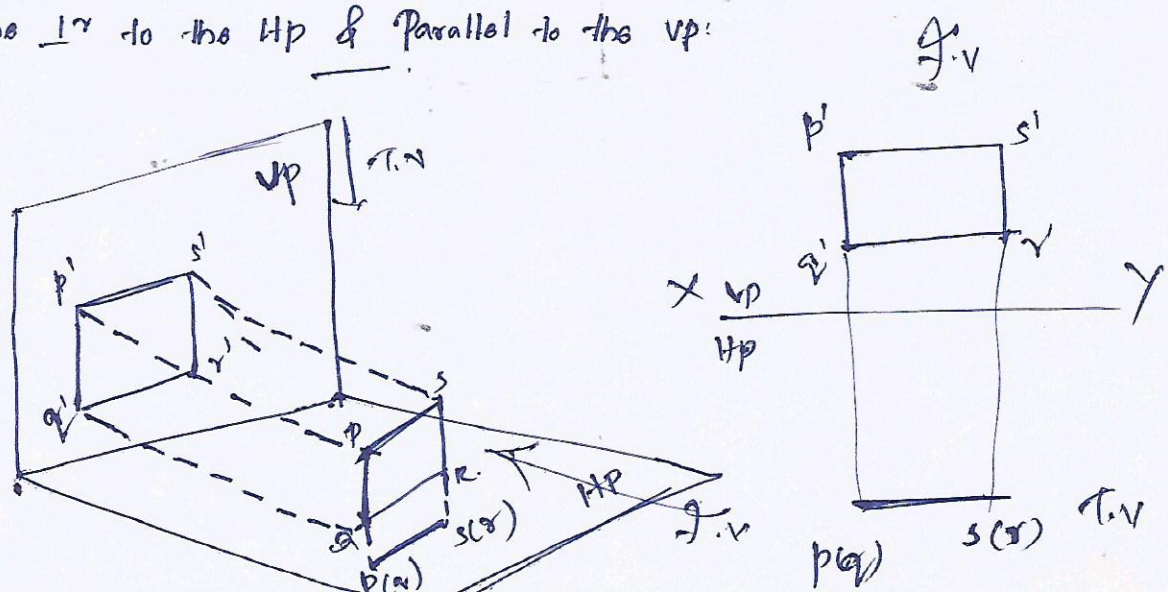
Position of plane:

1. Plane $\perp^r$ to both the reference planes
2. Plane $\perp^r$ to the Hp & Parallel to the Vp.
3. Plane $\perp^r$ to the Vp & Parallel to the Hp.
4. Plane $\perp^r$ to the Hp & inclined to the Vp.
5. Plane $\perp^r$ to the Vp & inclined to the Hp

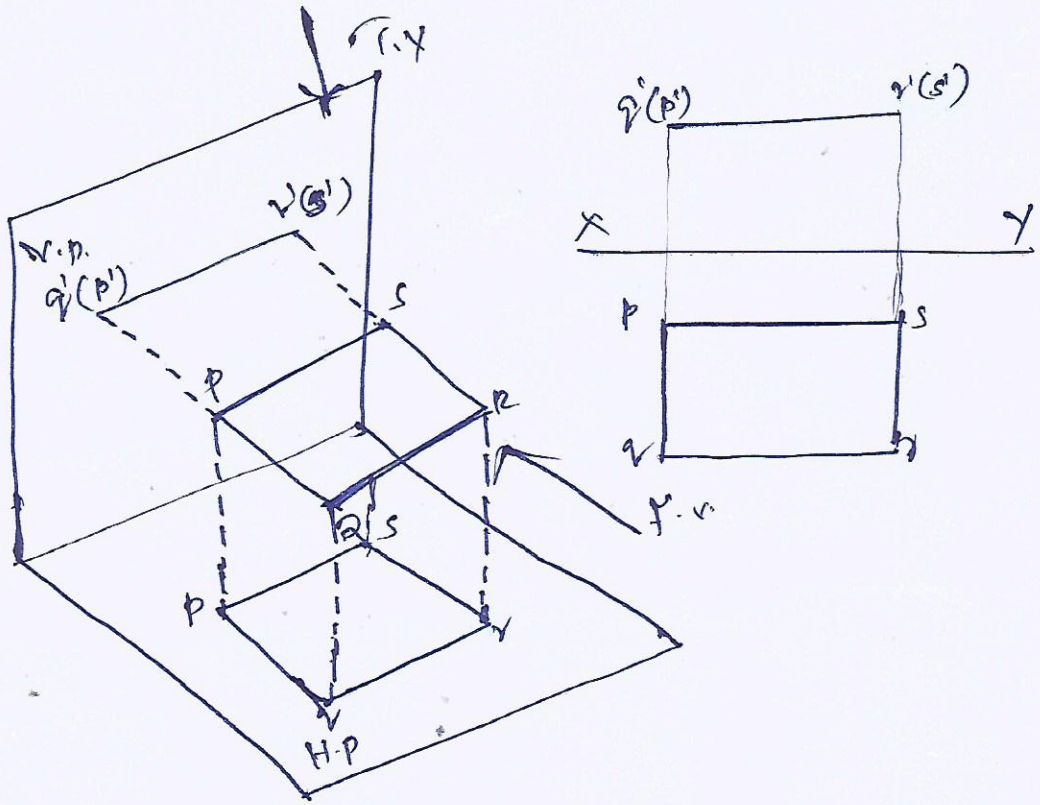
1. Plane $\perp^r$ to both the Hp & the Vp:



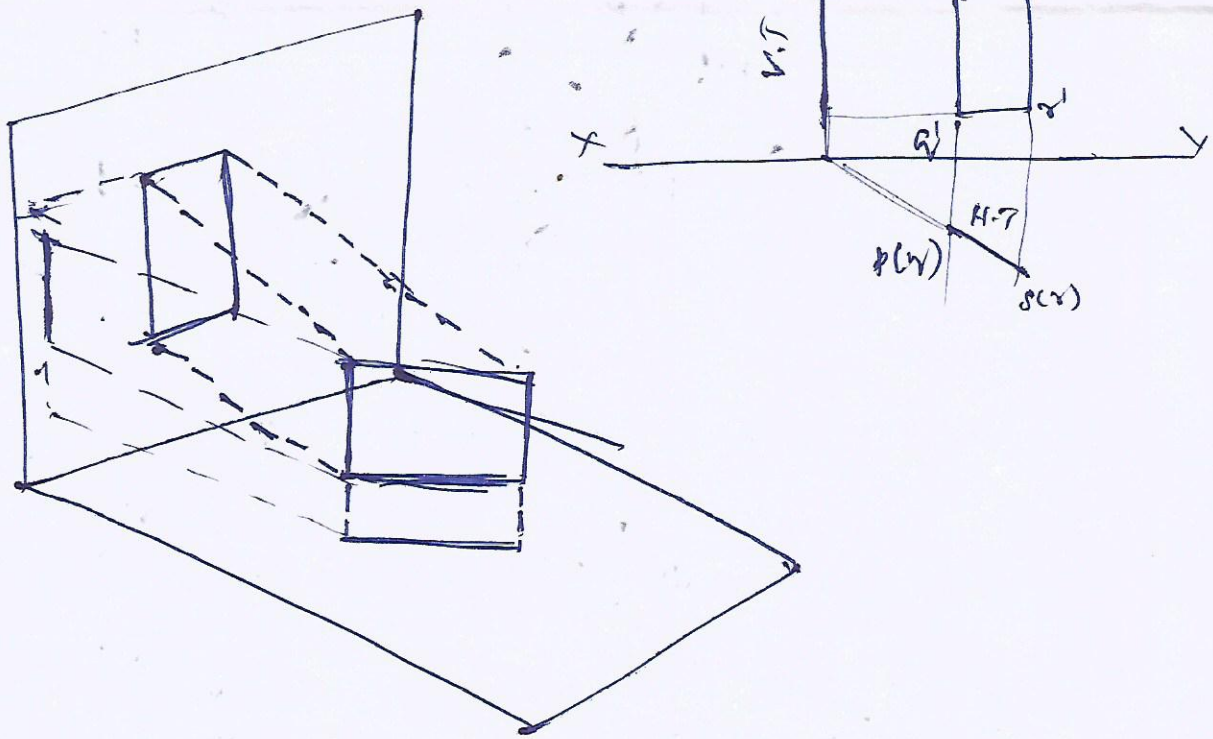
2. Plane $\perp^r$ to the Hp & Parallel to the Vp:



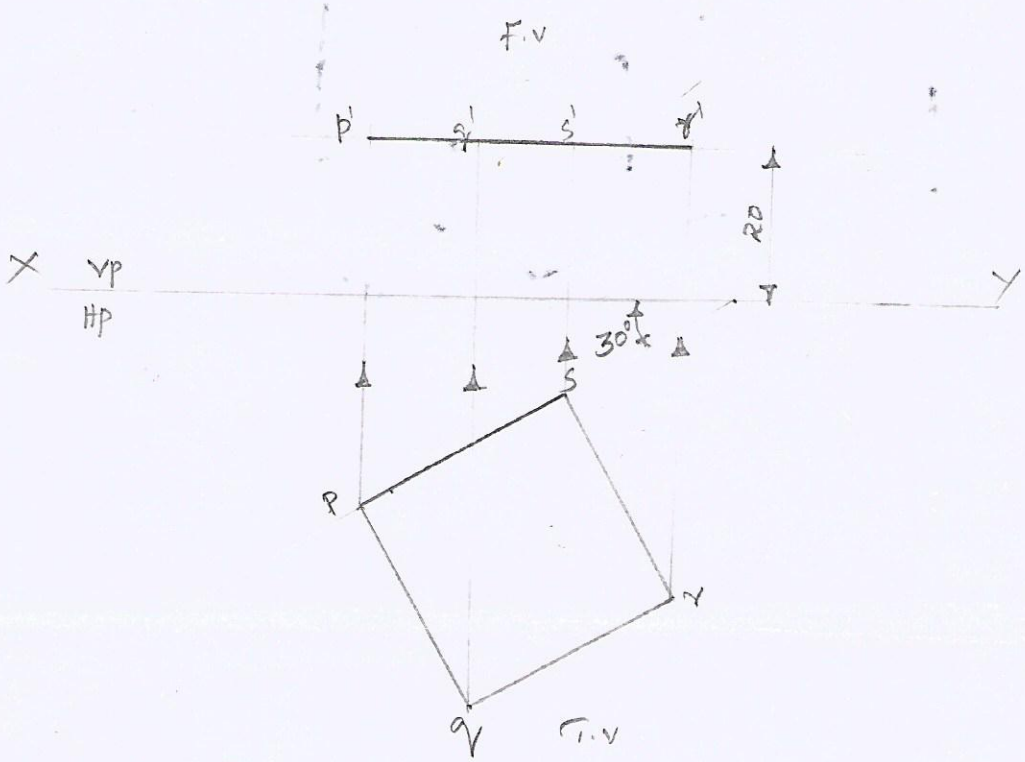
3. Plane ⊥r to the VP & Parallel to the Hp:

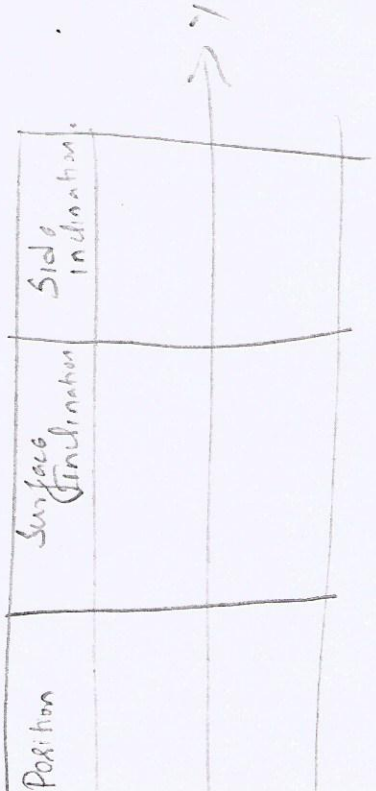


4. Plane ⊥r to the Hp and inclined to the Vp:

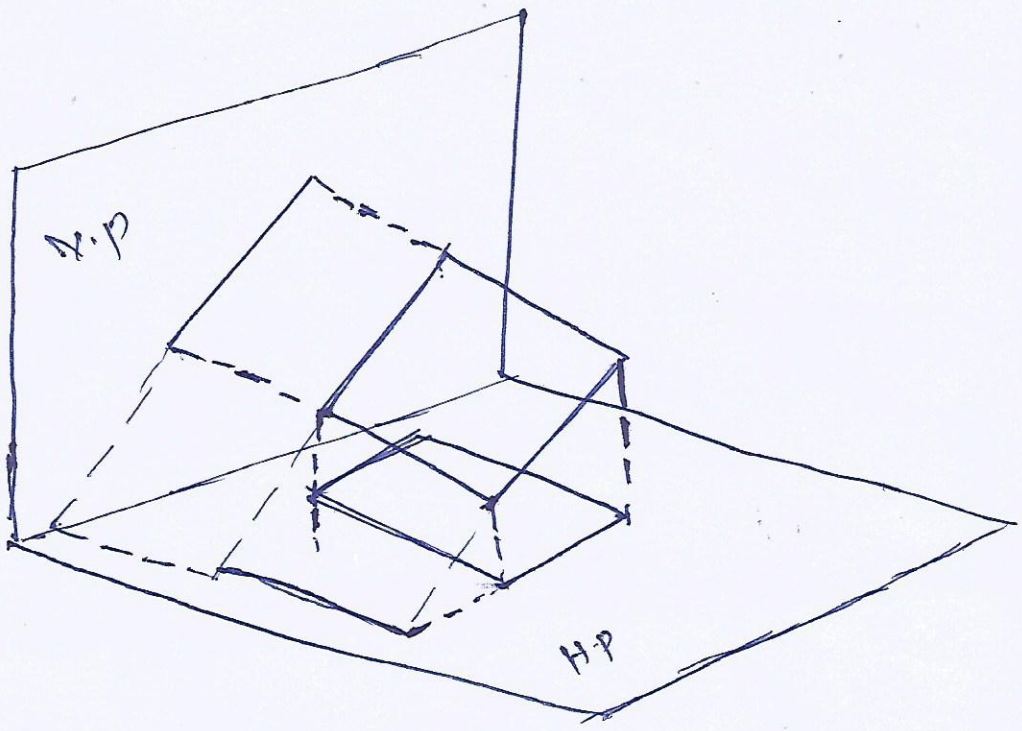


b: A square lamina of side 35mm is parallel to the Hp with one of its sides inclined at 30° to the Vp. The lamina is 20 mm above the Hp. Draw its top and front views and ~~show~~ ~~its traces~~.



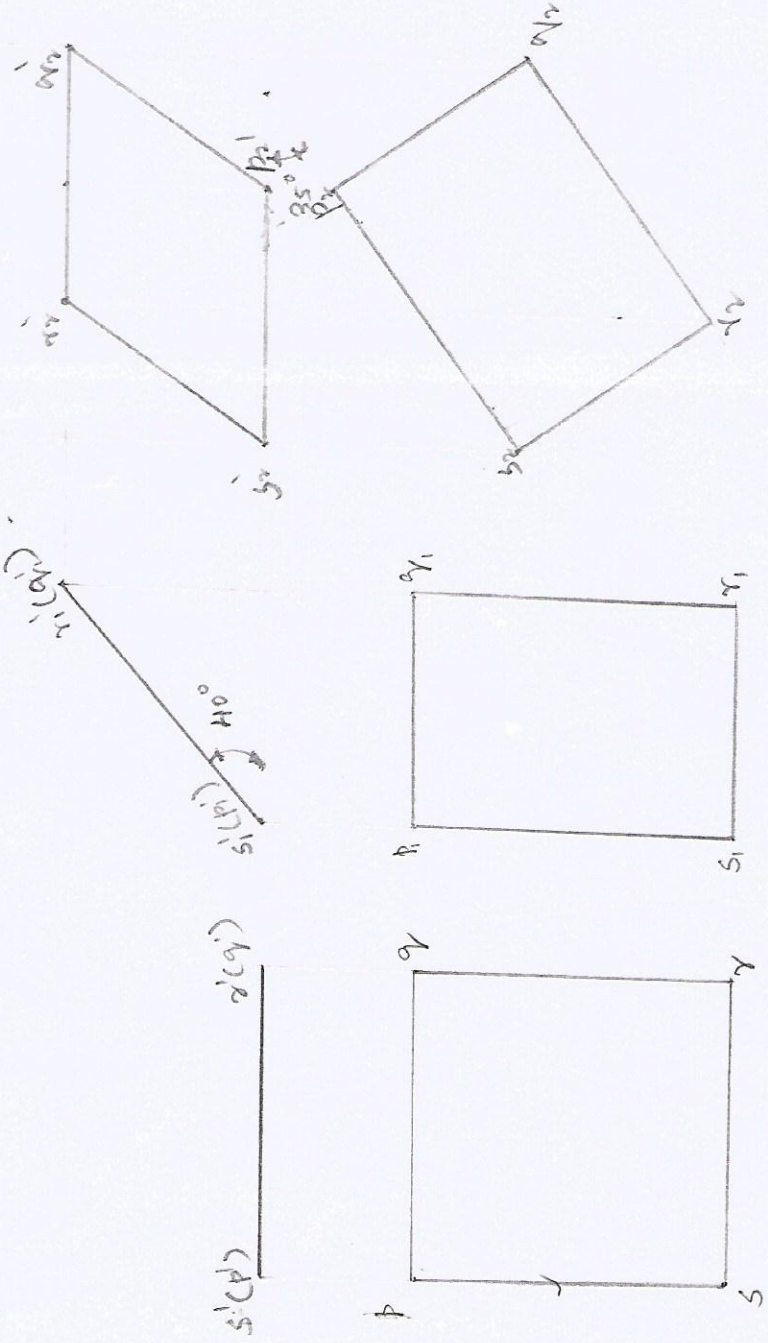


5. Plane ⊥r to the vp & inclined to the Hp:



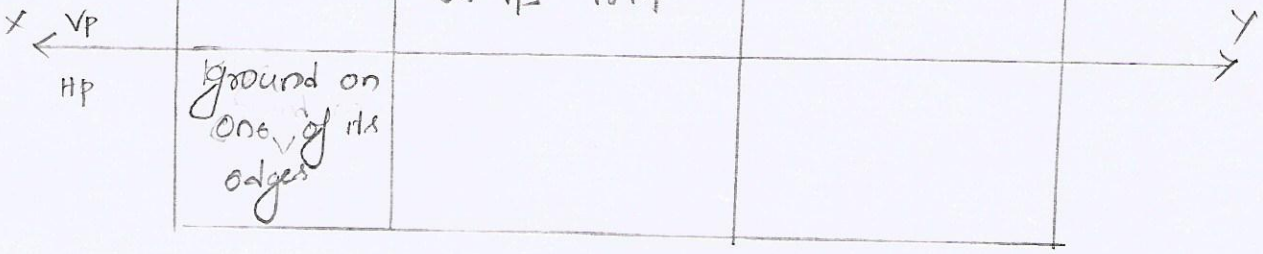
1. A square lamina PQRS of 40 mm side with one of its edges on Hp, and lamina inclined at an angle of 40° to Hp and one of its edges inclined at an angle of 35° to Vp.

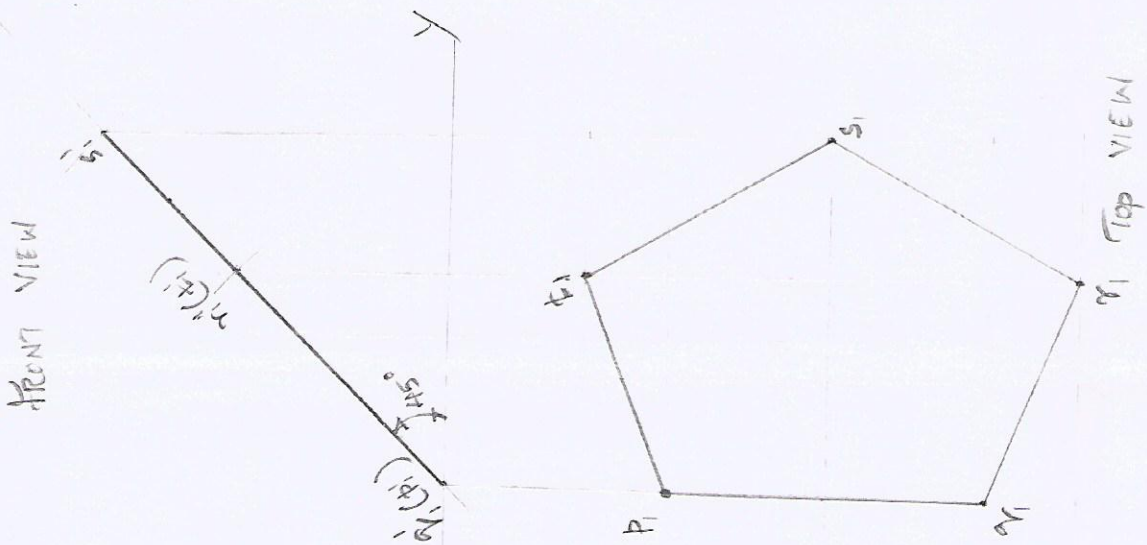
	Position	Surface inclination	Side inclination
Vp		lamina inclined at 40° to Hp	
Hp	Edge on Hp		Edge inclined at 35°

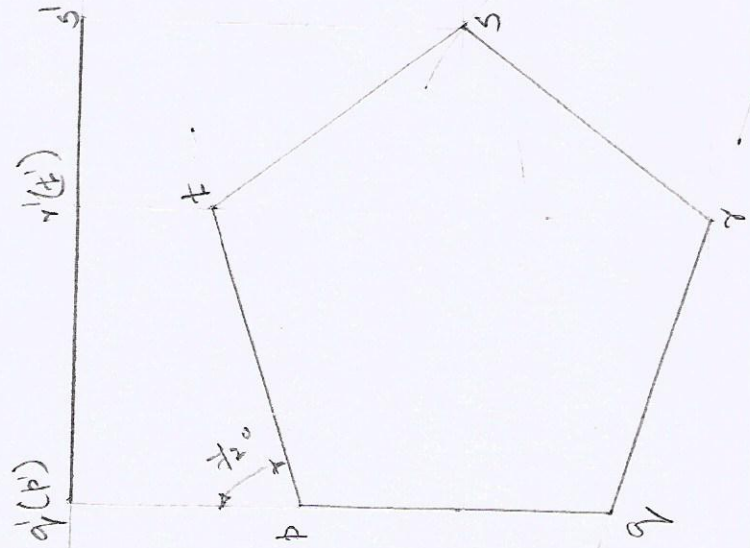


2. A Pentagon of side 40 mm is resting on the ground (HP) on one of its base edges (side), the surface of the Pentagon is inclined at 45° to Hp. Draw the front and top views.

Position	Surface Inclination	Side Inclination
	Surface inclined at 45° to Hp	
ground on one of its edges		

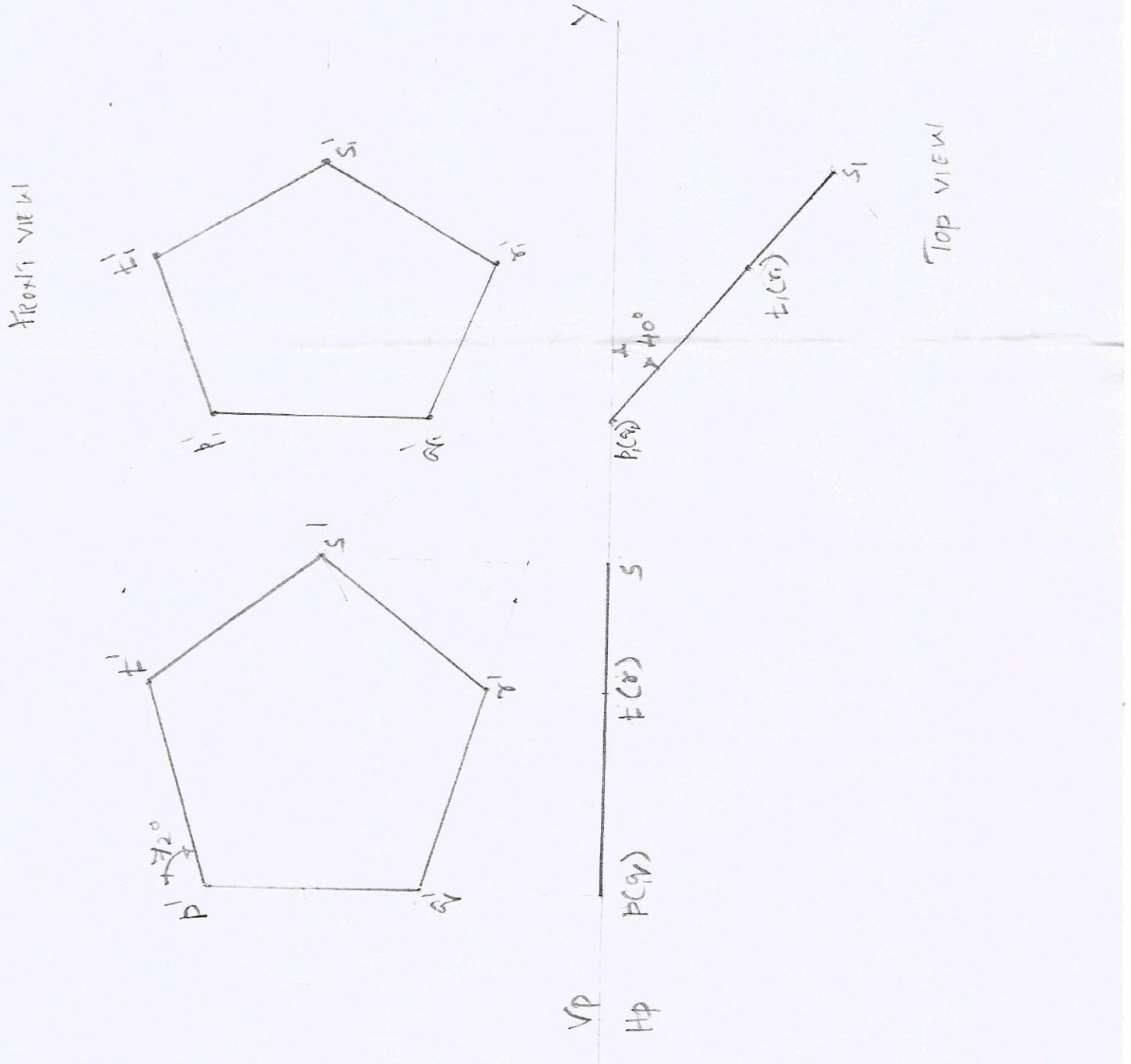






3. A Pentagon of side 35mm is resting on V.P on one of its edges. Side
The surface of the Pentagon is 40° to V.P. Draw its Projection.

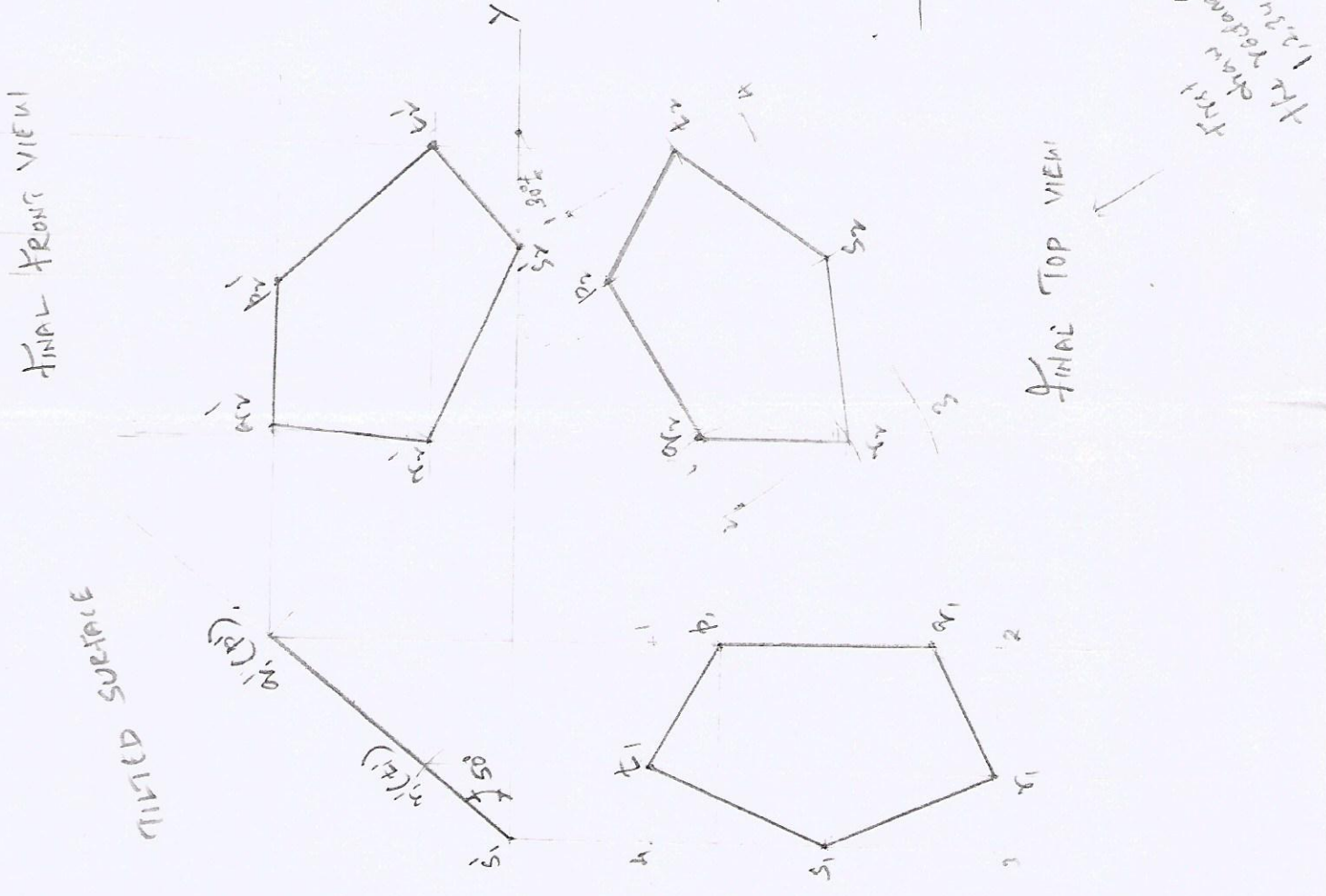
Position	Surface inclination	Side inclination
Edge resting on VP		
	Surface 40° to VP	

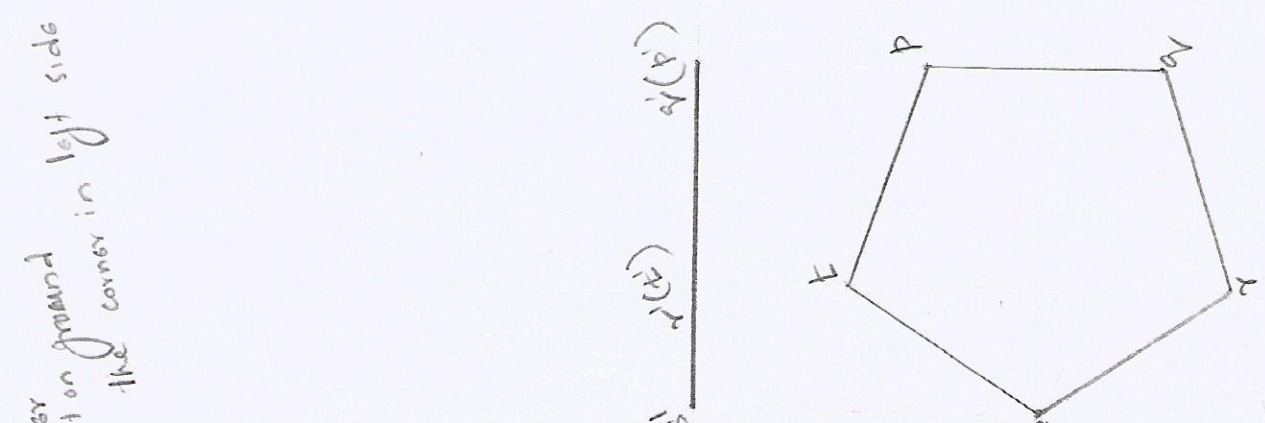


4. A Pentagon of side 30 mm rests on the ground on one of its corners with the sides containing the corner being equally inclined to the ground. The side opposite to the corner on which it rests is inclined at 30° to the VP and is Parallel to the HP. The surface of the Pentagon makes 50° with the ground. Draw the top & front views of the Pentagon.

Position	Surface Inclination	Side Inclination
Hp rest on ground on one of its corner	Surface 50° with ground (Hp)	Side opposite to the corner is 30° to Vp

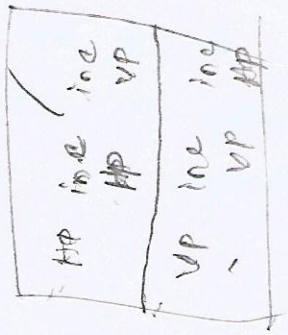
H.W.
rest on Vp. corner resting on HP

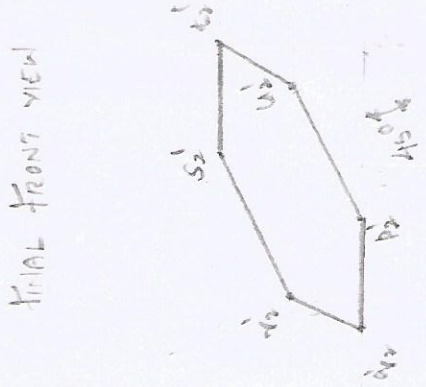


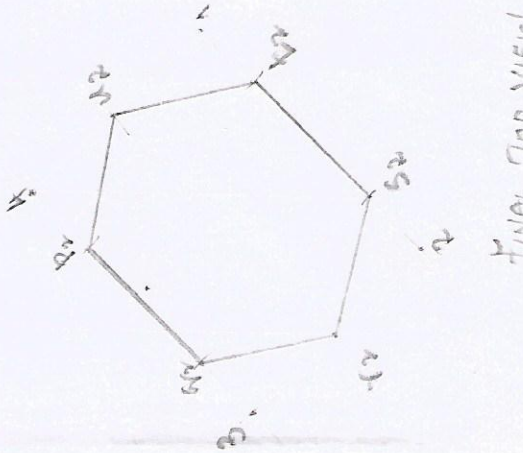


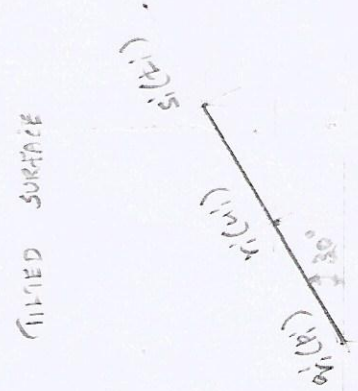
5. A hexagonal plate of side 20mm rests on the Hp on one of its sides inclined at 45° to the VP. The surface of the plate makes an angle of 30° with the Hp. Draw the front & top views of the plate.

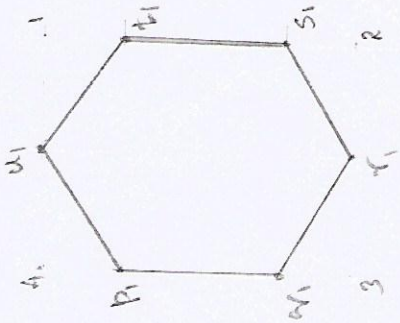
	Position	Surface inclination	Side inclination
		Surface makes an angle of 30° with Hp	
VP	rest on the Hp on one of its sides		side inclined at 45° to VP
Hp			

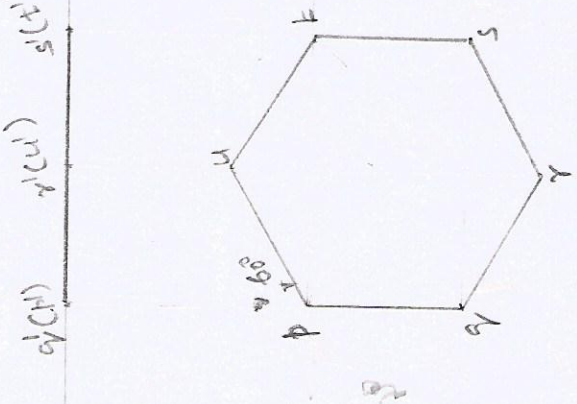






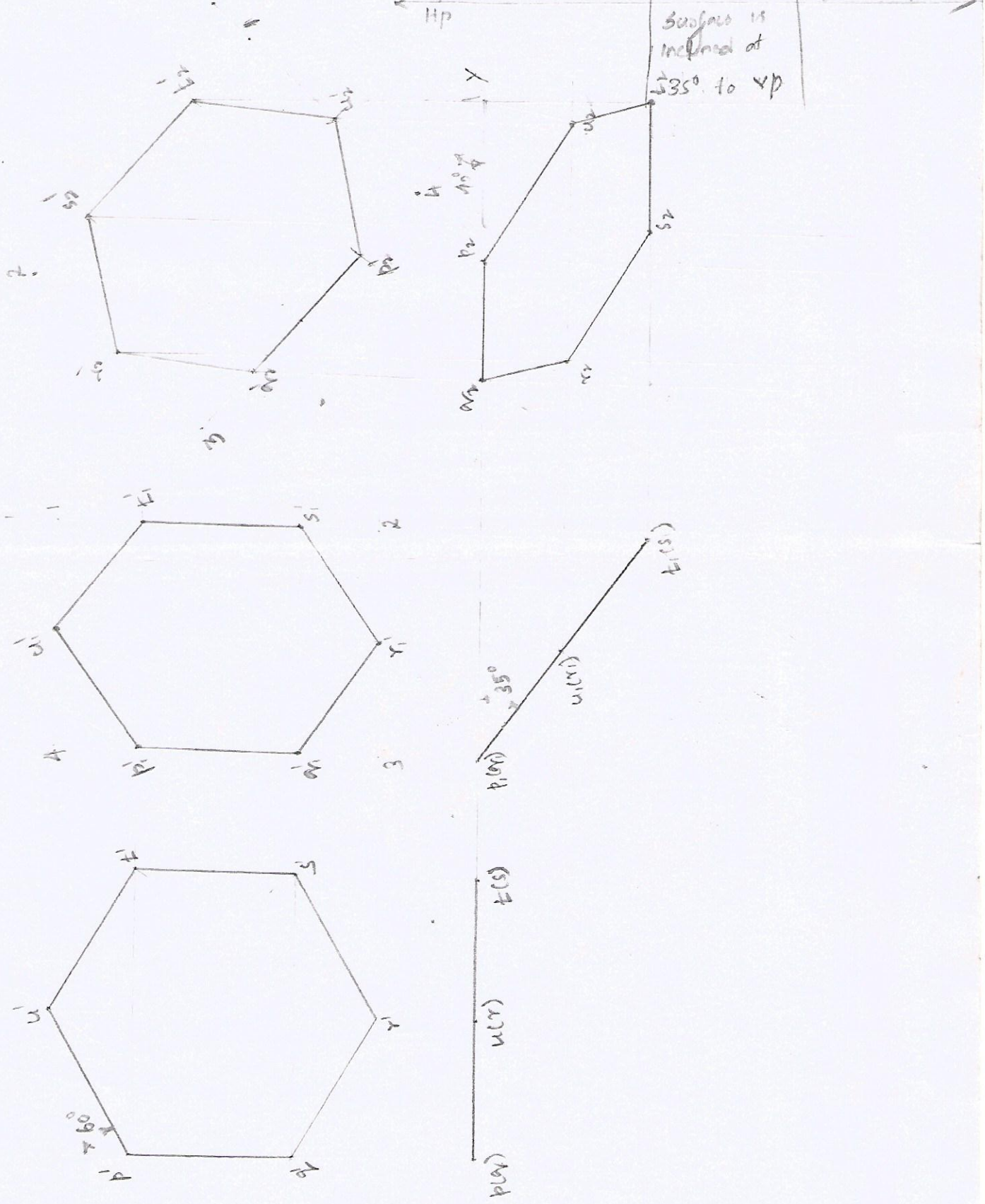






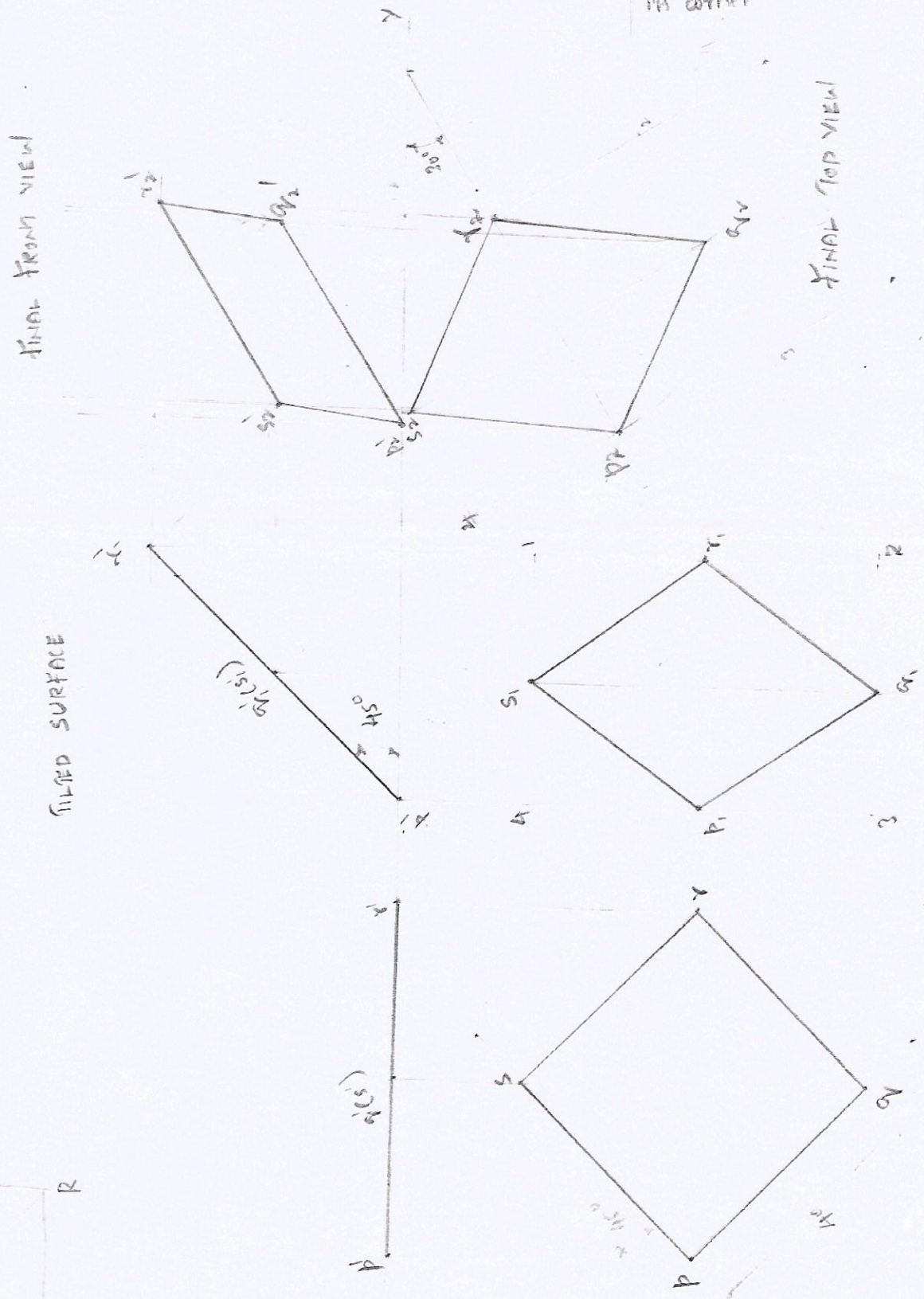
6. A hexagonal lamina of side 30mm is resting on V.P. on one of its side and resting edge is inclined at 40° to H.P. If's surface is inclined at 35° to V.P. Draw its Projection.

Position	Surface Inclination	Side Inclination
Resting on VP on one of its side	Surface is inclined at 35° to VP	resting edge is inclined at 40° to Hp.

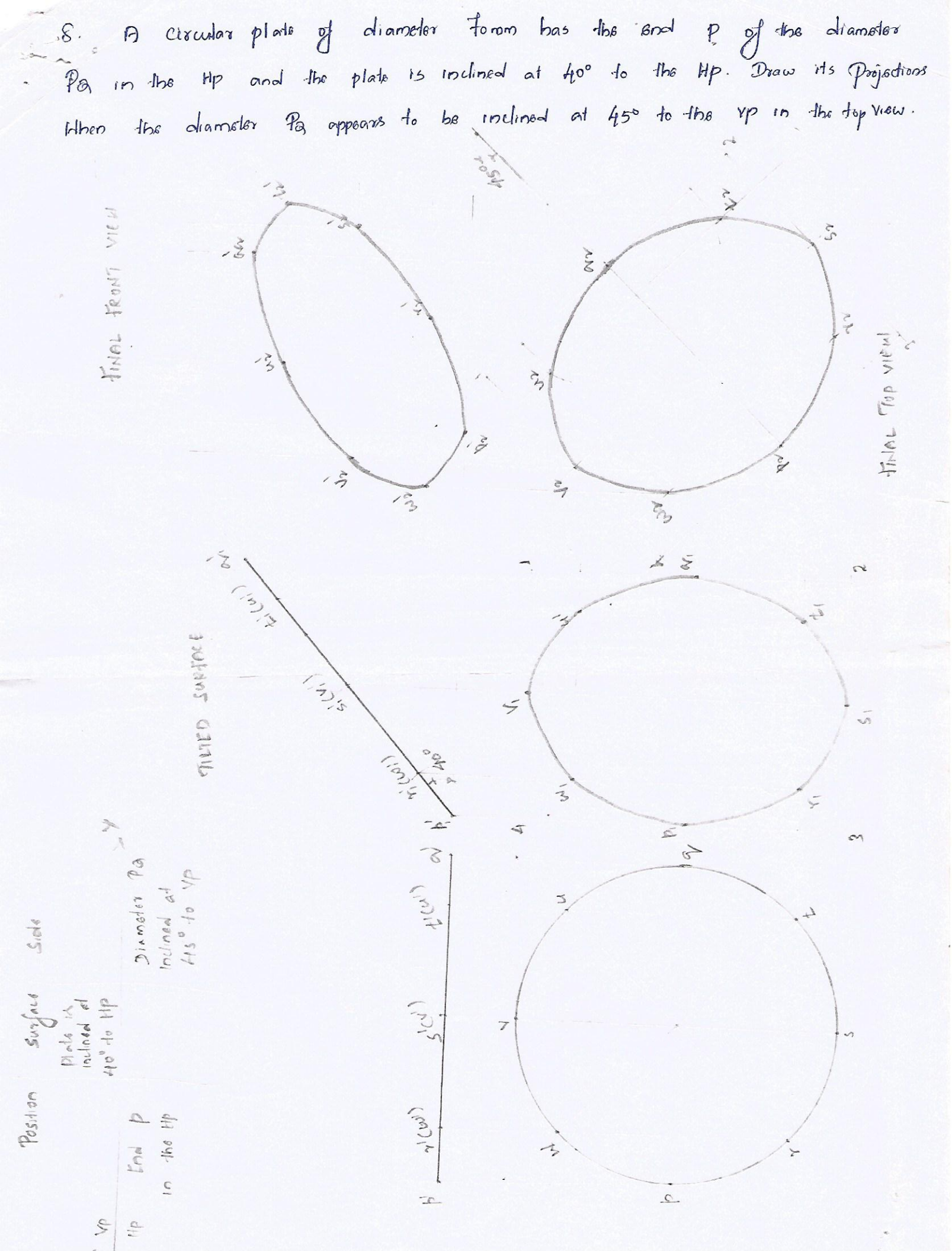


7. A square lamina PQRS of side 40 mm rests on the ground on its corner P in such a way that the diagonal PR is inclined at 45° to the HP and apparently inclined at 30° to the VP. Draw its Projections.

Position	Surface	Side
Rest on the ground on its corner	Diagonal PR is inclined at 45° to HP	Diagonal inclined at 30° to VP



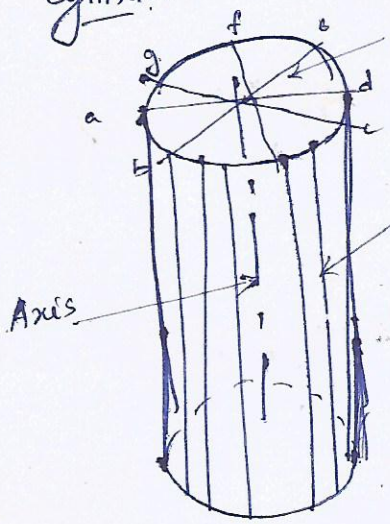
8. A circular plate of diameter 70mm has the end P of the diameter PQ in the HP and the plate is inclined at 40° to the HP. Draw its Projections when the diameter PQ appears to be inclined at 45° to the VP in the top view.



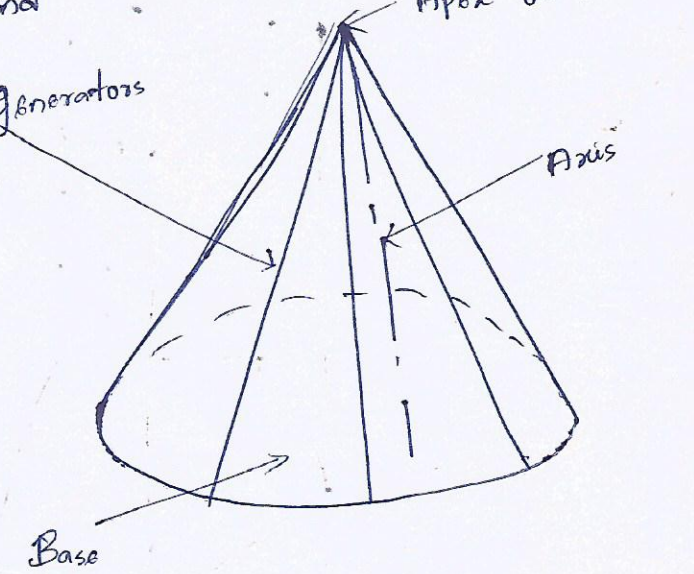
Unit. III

Projections of solids

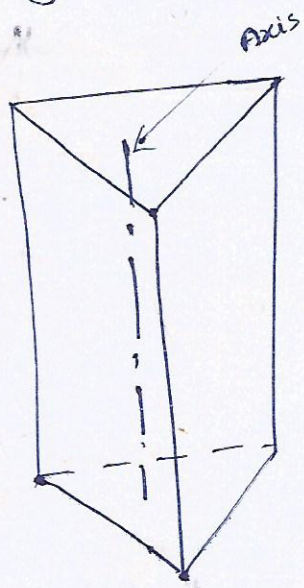
Cylinder



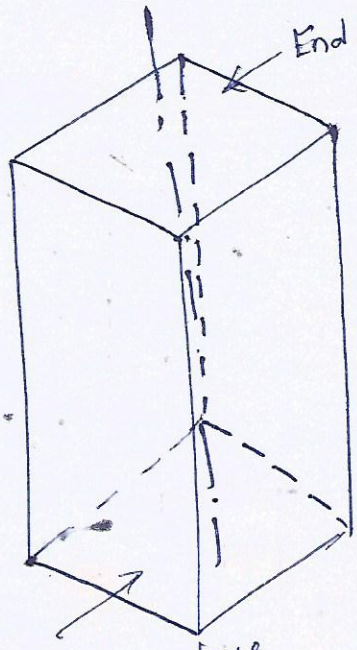
Cone



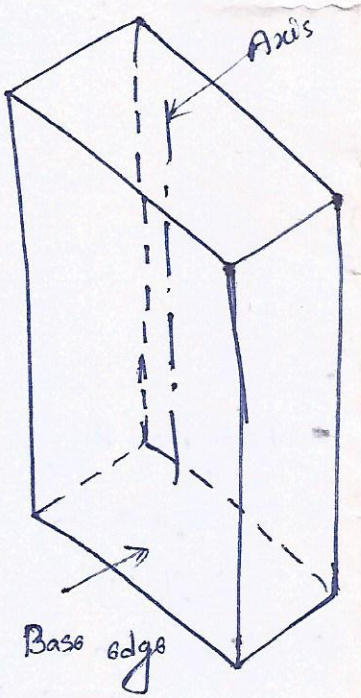
Triangular Prism



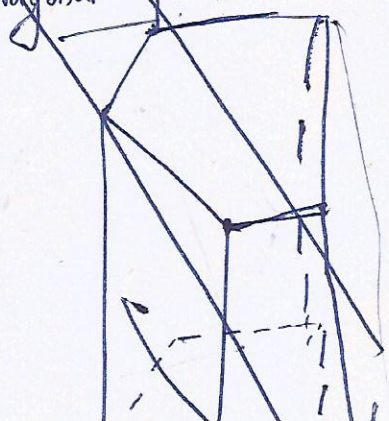
Square Prism



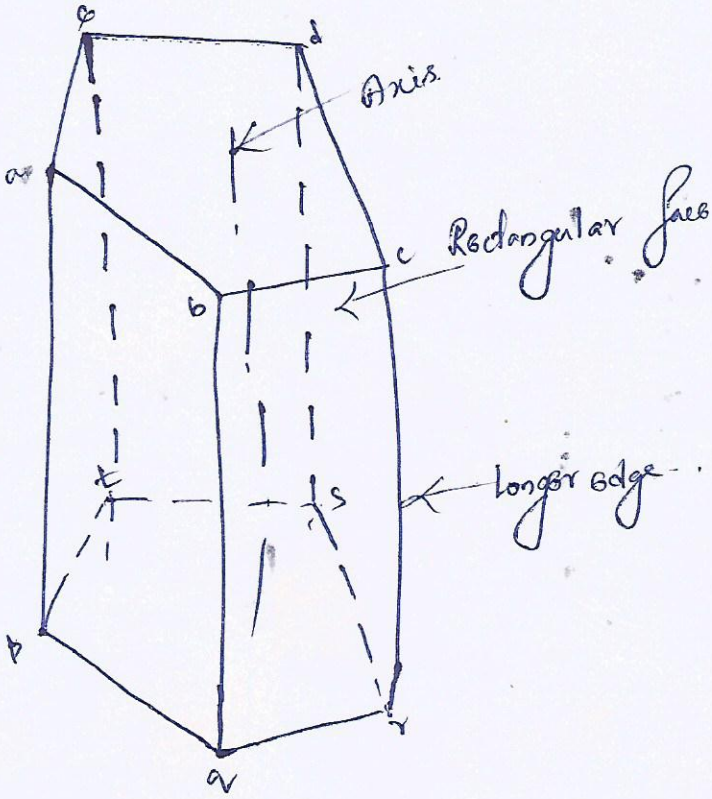
Rectangular Prism



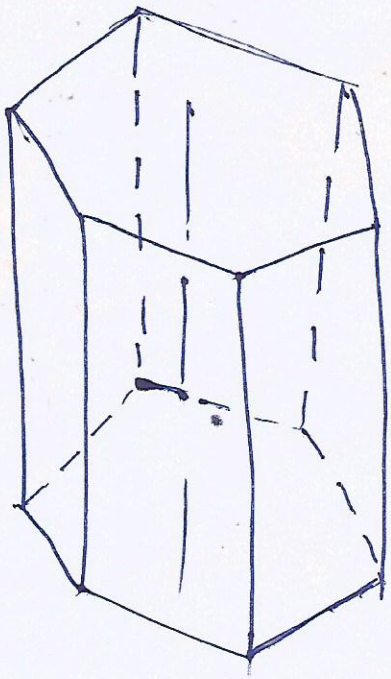
Pentagonal Prism



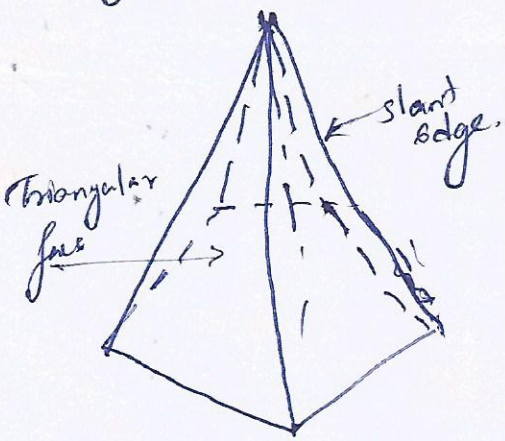
Pentagonal Prism



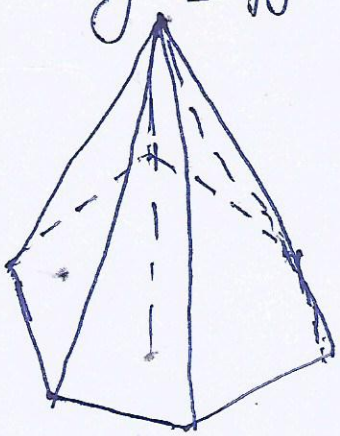
Hexagonal Prism.



Pentagonal Pyramid



Hexagonal pyramid



- Resting on Hp / ground
  front view touches the X-y line
- Inclination with Hp : means draw the circle, Pentagon etc in Hp.
- Lying on Hp means front view touches the X-y line.

Vp - means top view

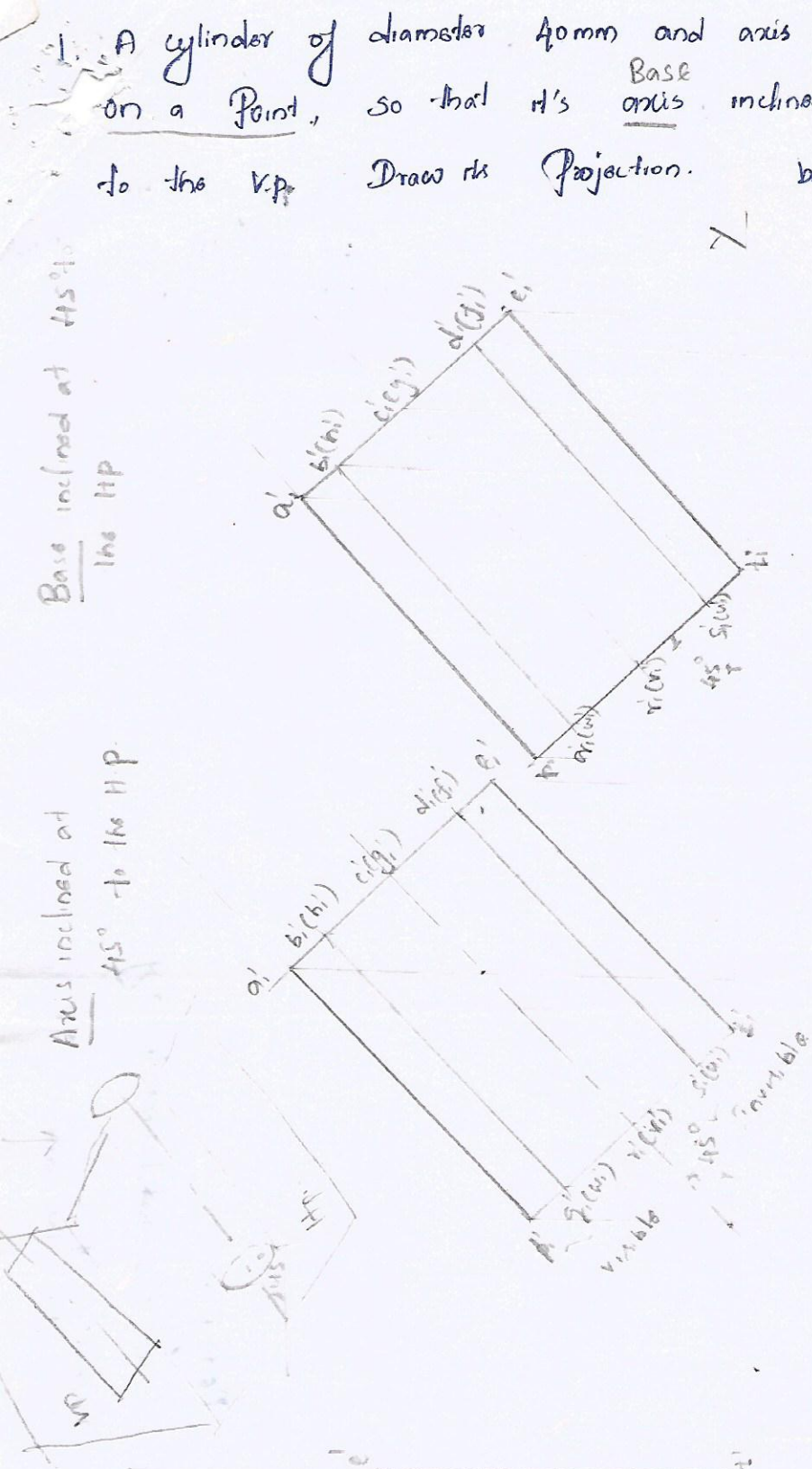
1. A cylinder of diameter 40mm and axis length 50mm is resting on the H.P. on a Point, so that its Base axis inclined at 45° to the H.P. and Parallel to the V.P. Draw its Projection.

Base Angle = 90° - Axis angle

HW resting on the VP
Base & axis inclined at 45° to the H.P

Base inclined at 45° to the HP

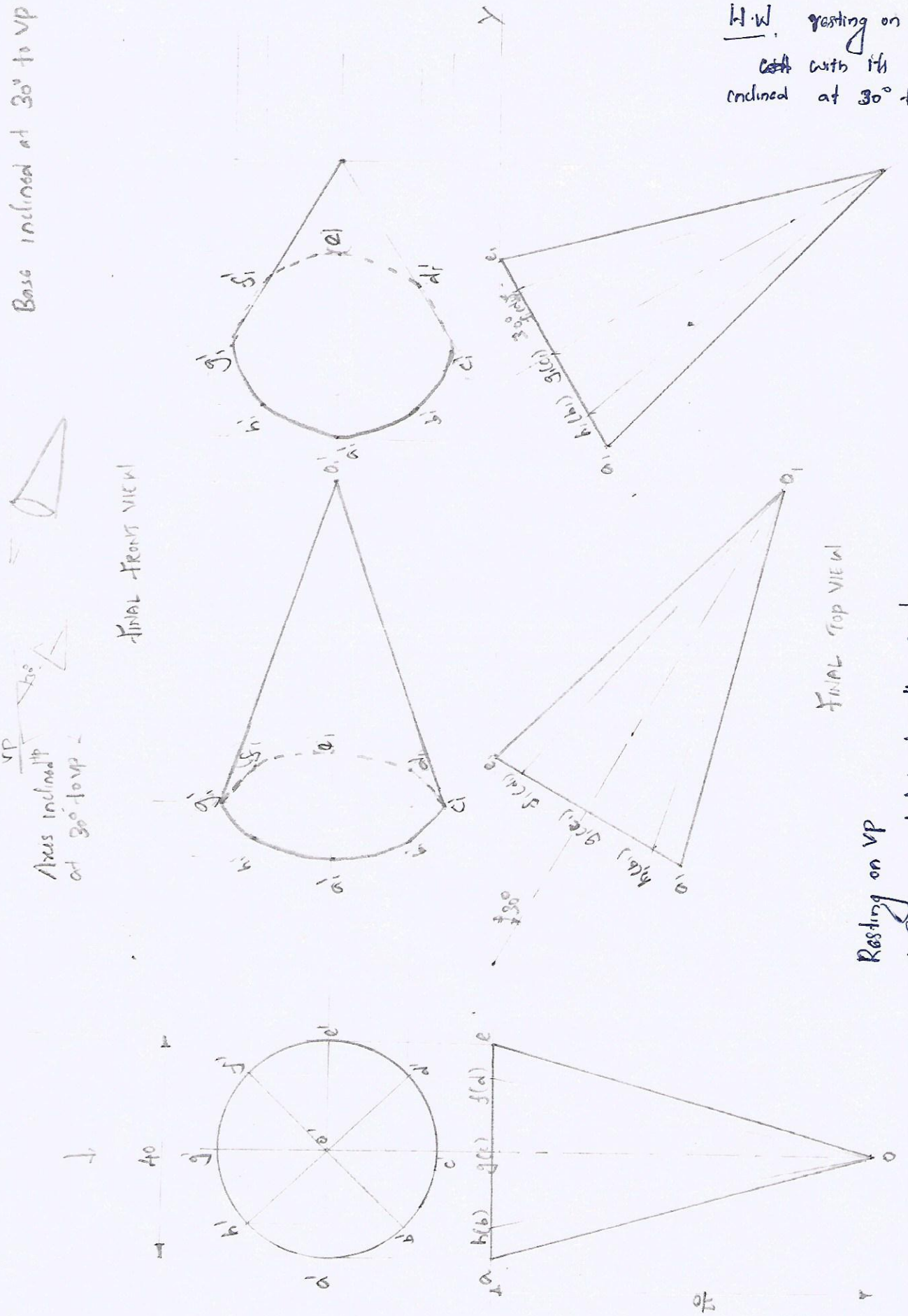
Axis inclined at 45° to the HP



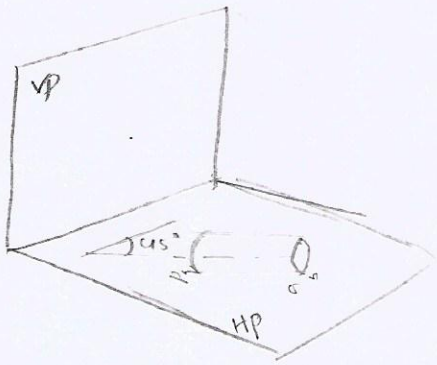
Resting on HP
∴ front view touches the x-y line
∴ draw the circle in HP
inclined to HP

2. A cone of base diameter 40mm and altitude 70mm is resting on V.P. with its Base axis inclined at 30° to V.P. Draw its Projections.

H.W. resting on HP
with its axis (or) Base inclined at 30° to V.P.



2. Draw the Projection of a cylinder of diameter 50 mm and axis length 80 mm when it is lying on the ground on one of its generator. with its axis inclined at 45° to V.P.



Lying on ground : front view touches the xy line
Inclined to VP: Draw the circle in VP

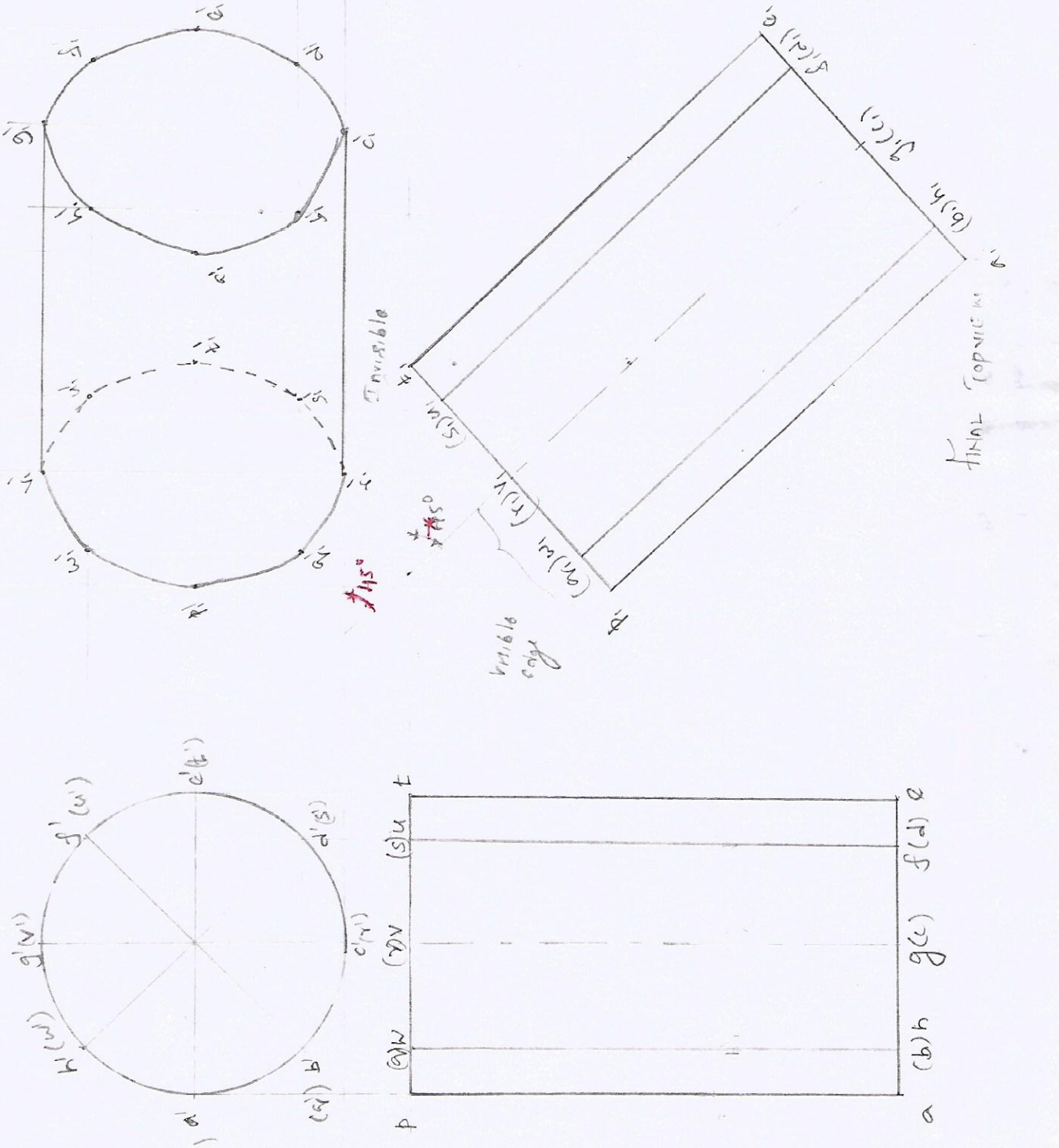
FINAL FRONT VIEW

Invisible

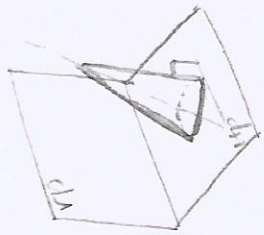
45°

FINAL TOP VIEW

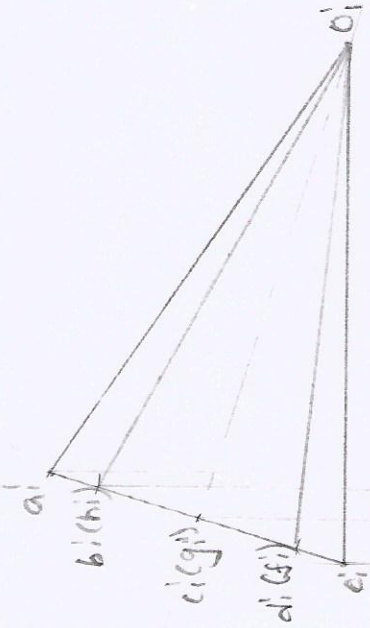
Visible edge

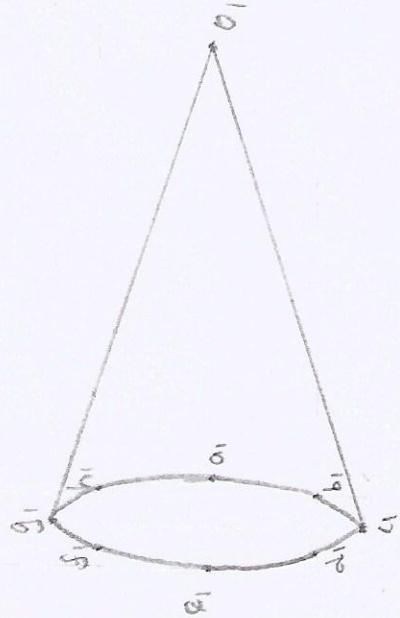


4. A cone of base diameter 40mm and axis length 65mm resting on H.P. on a point in the circumference of the base with one of its slant generators is lying on the ground ⊥r to the H.P. Draw its Projection.



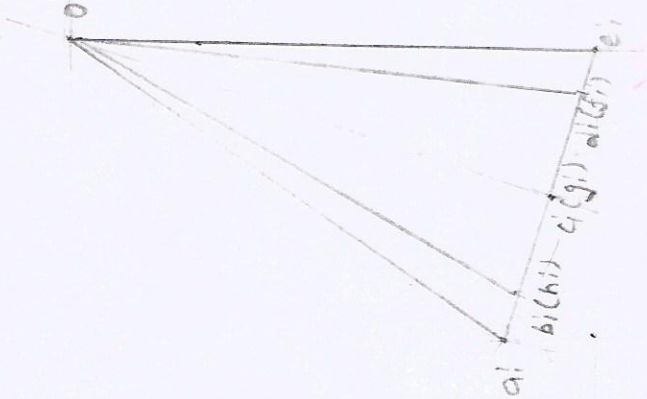
Slant generator is lying on the ground

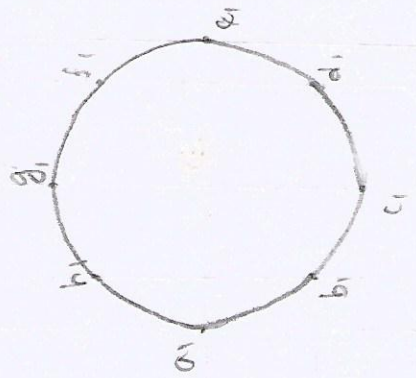


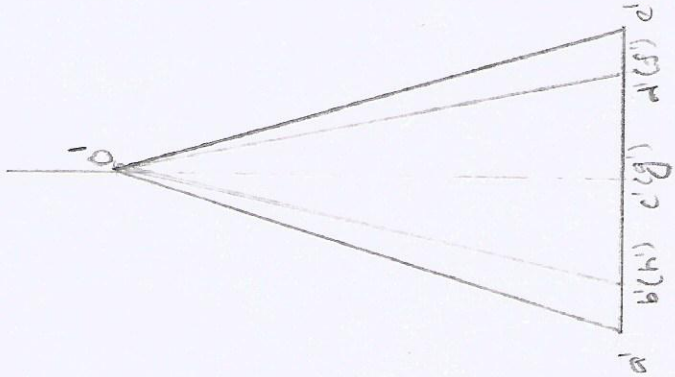


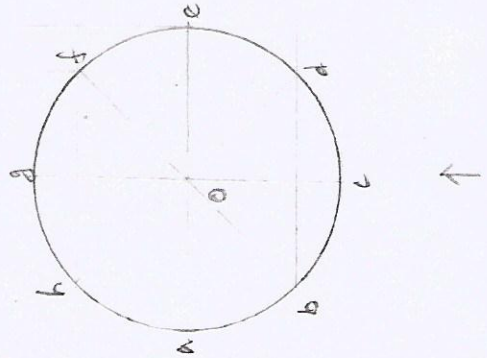
Resting on Hp: Front View touches the x-y line
⊥r to Hp: Draw Circle in Hp

Slant generator is ⊥r to Hp





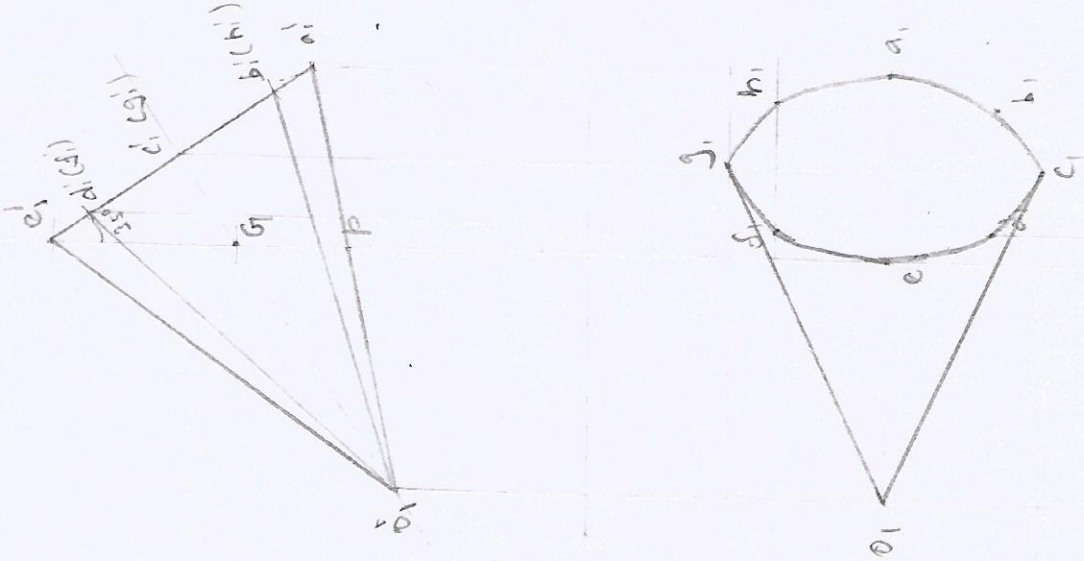




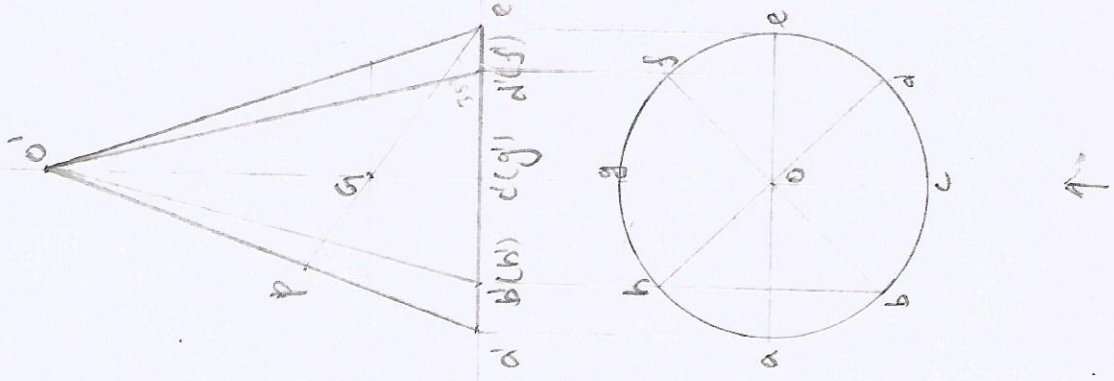
5. A cone of base diameter 40 mm and height 56 mm is freely suspended from one of its base Point such that its axis Parallel to V.P. Draw its Projection.

Centre of gravity of cone $= \frac{h}{4} = \frac{56}{4} = 14$ mm.

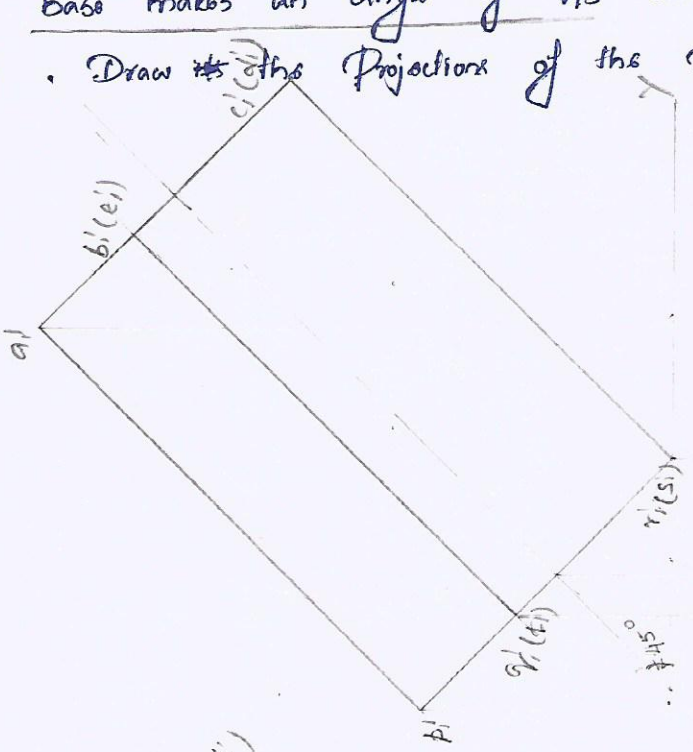
First mark e', c, & P in 1st line



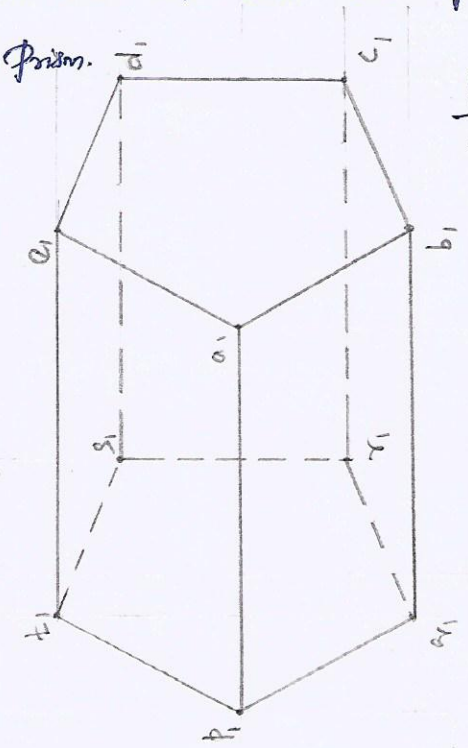
Parallel to VP = Inclined to HP = Draw circle in HP



6. A Pentagonal Prism of 30 mm side of base and height 80 mm is resting on one of its edges of the base in such a way that the base makes an angle of 45° with the H.P. and axis Parallel to V.P. Draw the Projections of the Prism.

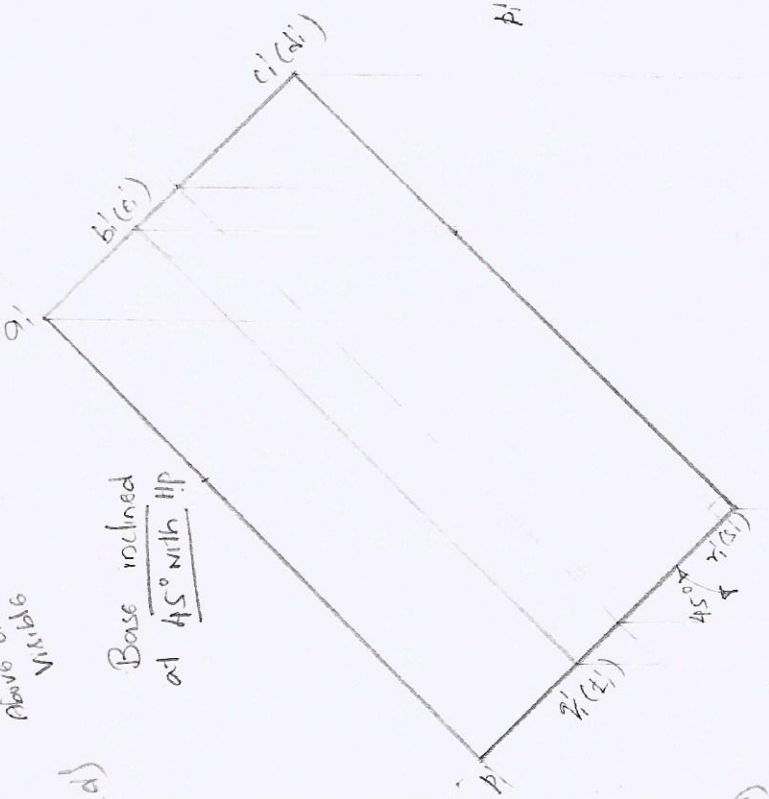


Axis inclined at 45° with HP



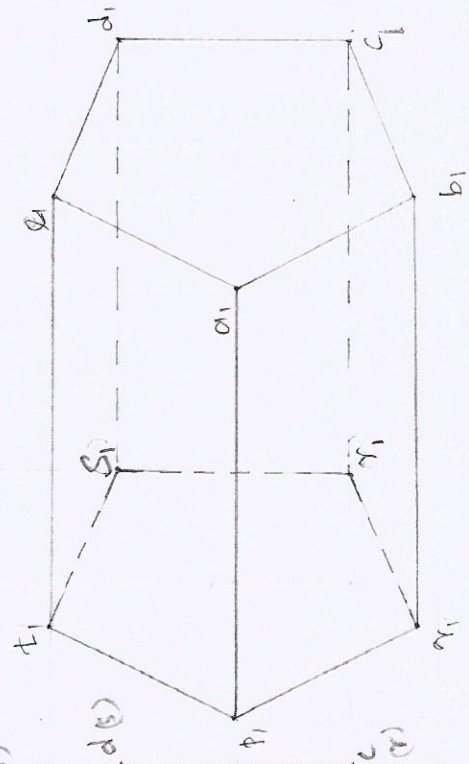
H.W.
resting on one of its corner of the base

resting on HP.



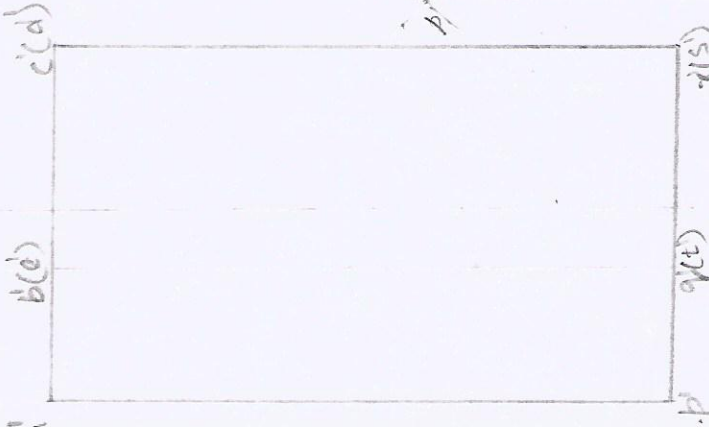
FINAL FRONT VIEW

Base inclined at 45° with HP

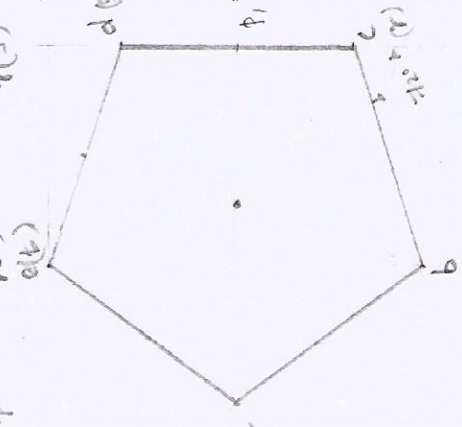


FINAL TOP VIEW

Bottom side above axis Visible



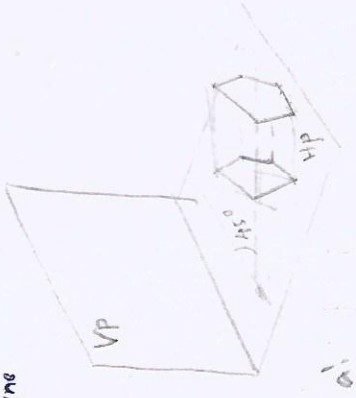
Draw Pentagon in HP

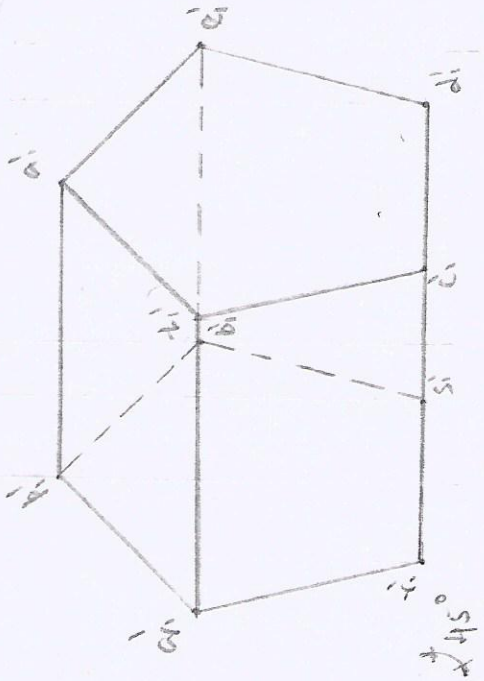


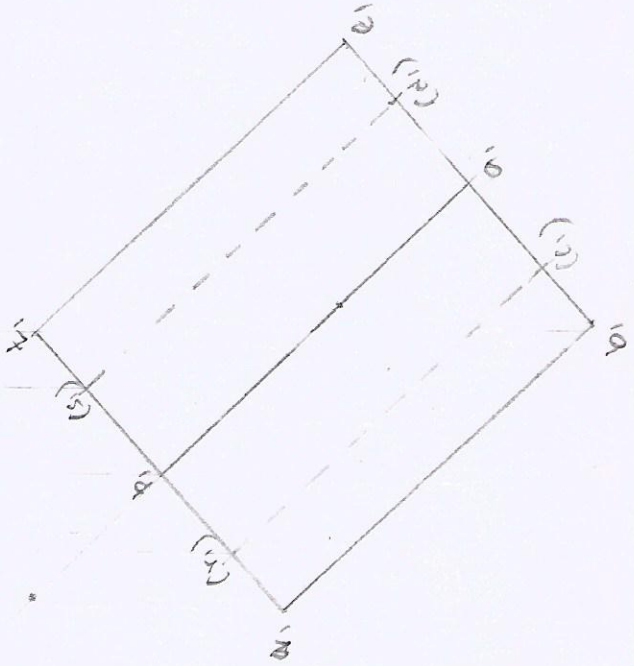
Edge resting on right side

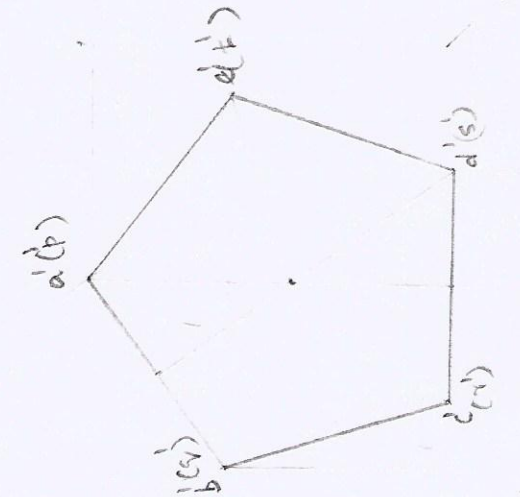
7. A Pentagonal Prism of base side 30 mm and axis length 55 mm is lying on the ground on one of its rectangular faces with its axis inclined at 45° to V.P. Draw its front & top views.

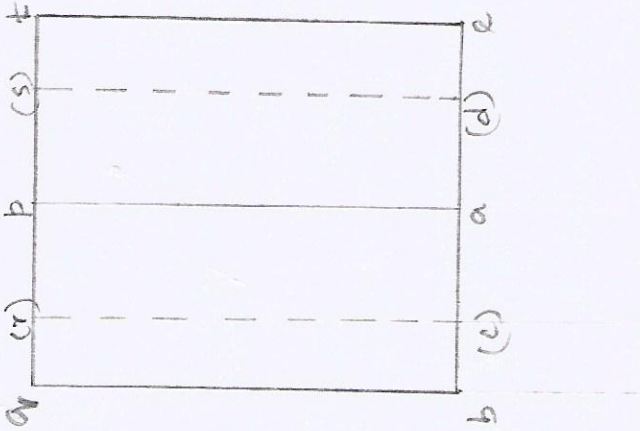
Lying on ground: front view touches the x-y line
Inclined to VP. Draw the Pentagon in VP.



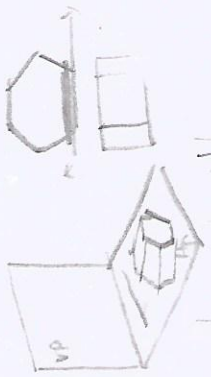




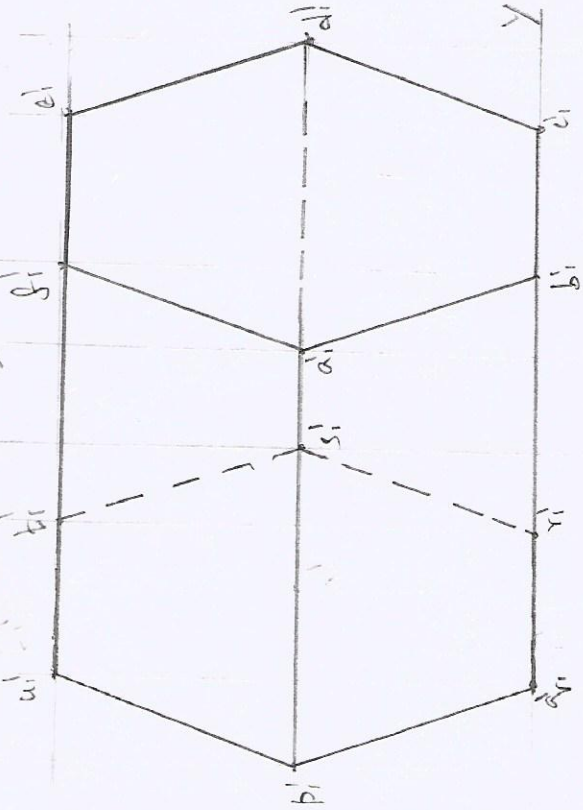


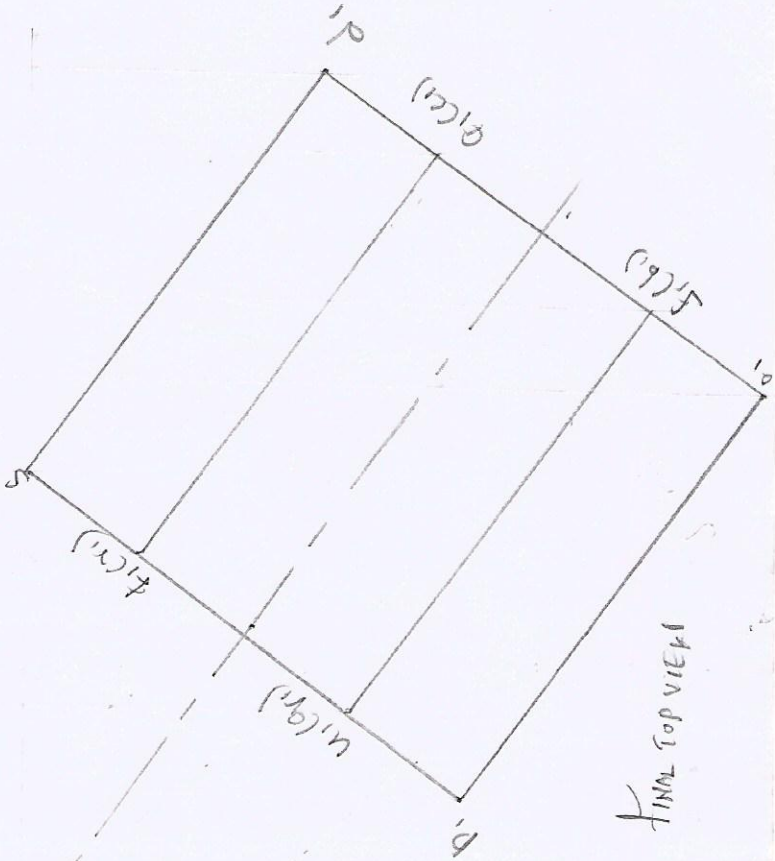


8. A hexagonal Prism of base Side 35mm and axis length 65mm is lying on the ground on one of its rectangular faces with its axis inclined at 35° to V.P. Draw its Projections.



FINAL FRONT VIEW

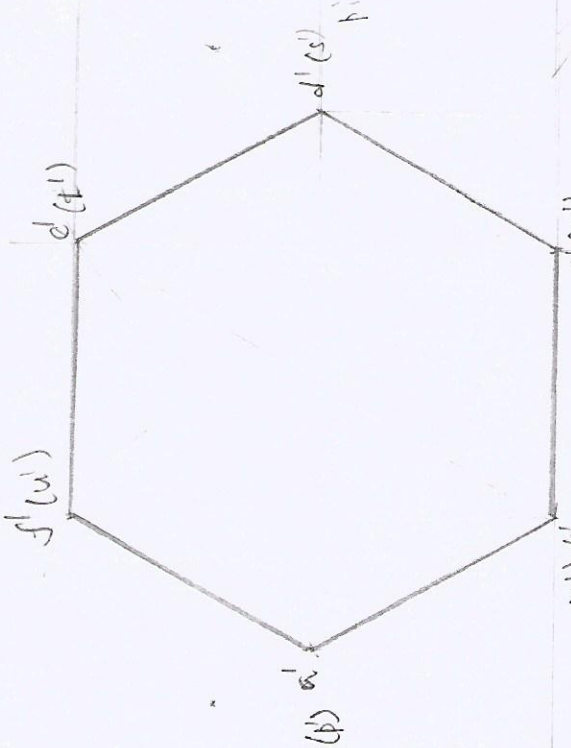




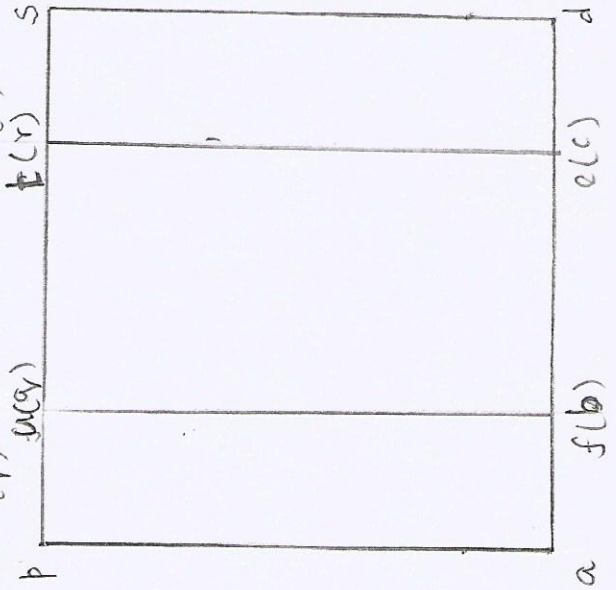
FINAL TOP VIEW

35°

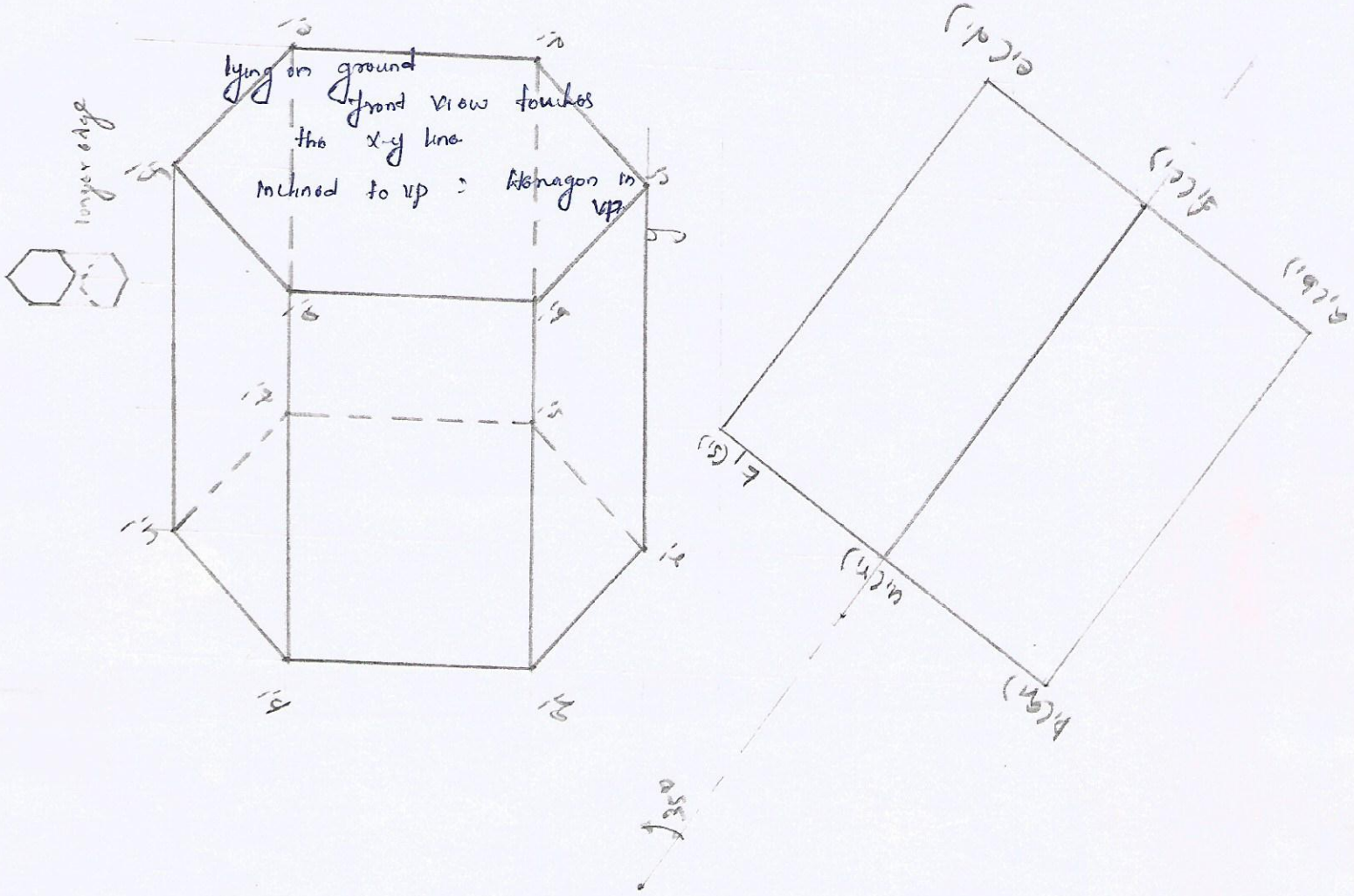
lying on ground : front view touches the x-y line
Inclined to VP: Draw the Hexagon in VP

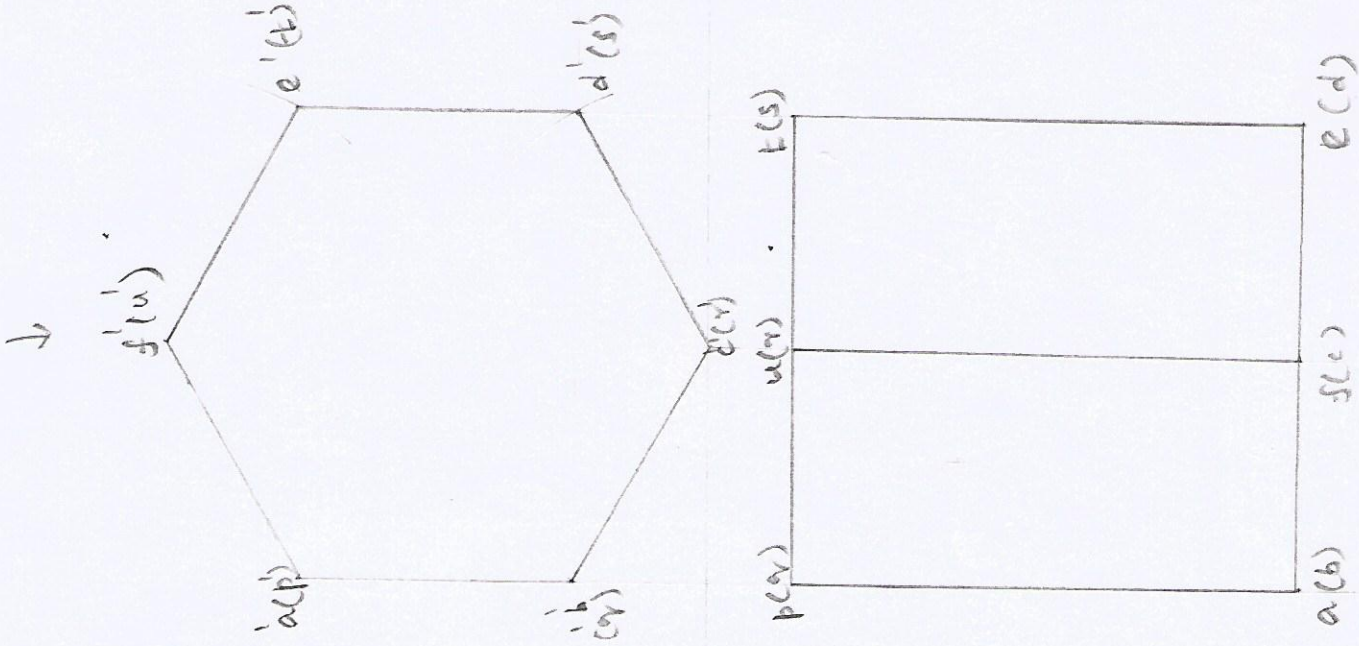


(b)



9. A hexagonal Prism of base side 35mm and axis height 65mm is lying on the ground on one of its longer edges with its axis inclined at 35° to the V.P. Draw its Projection.

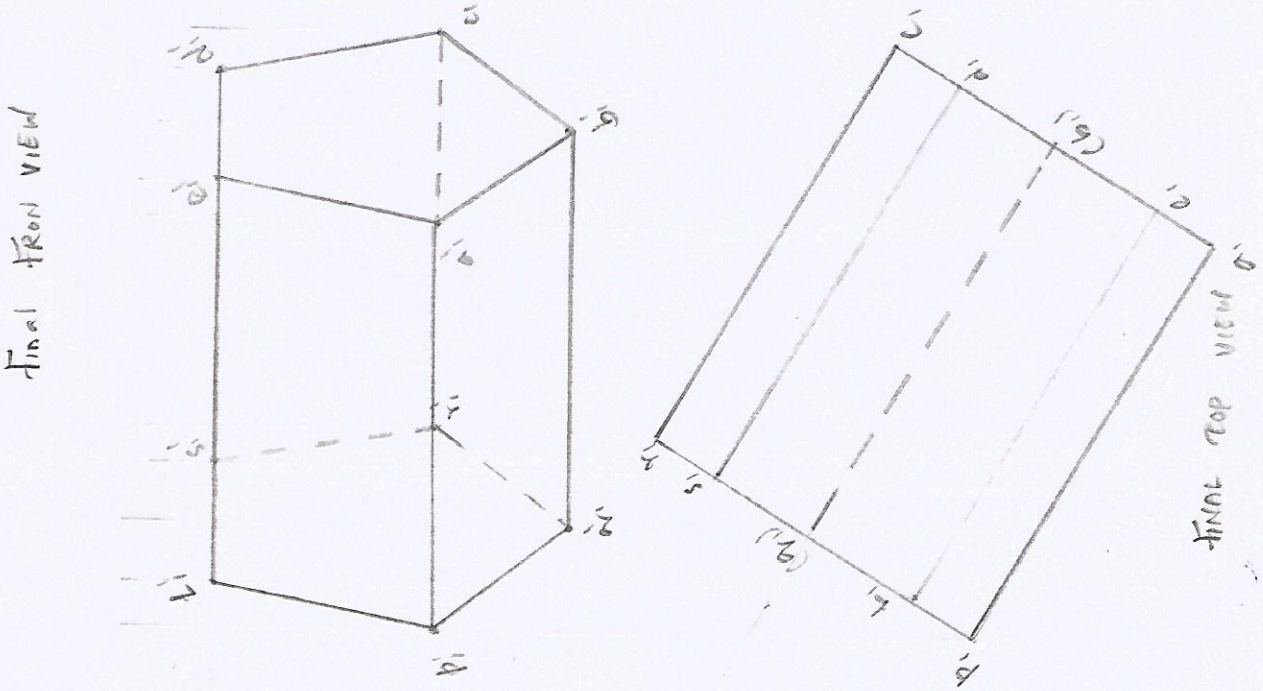


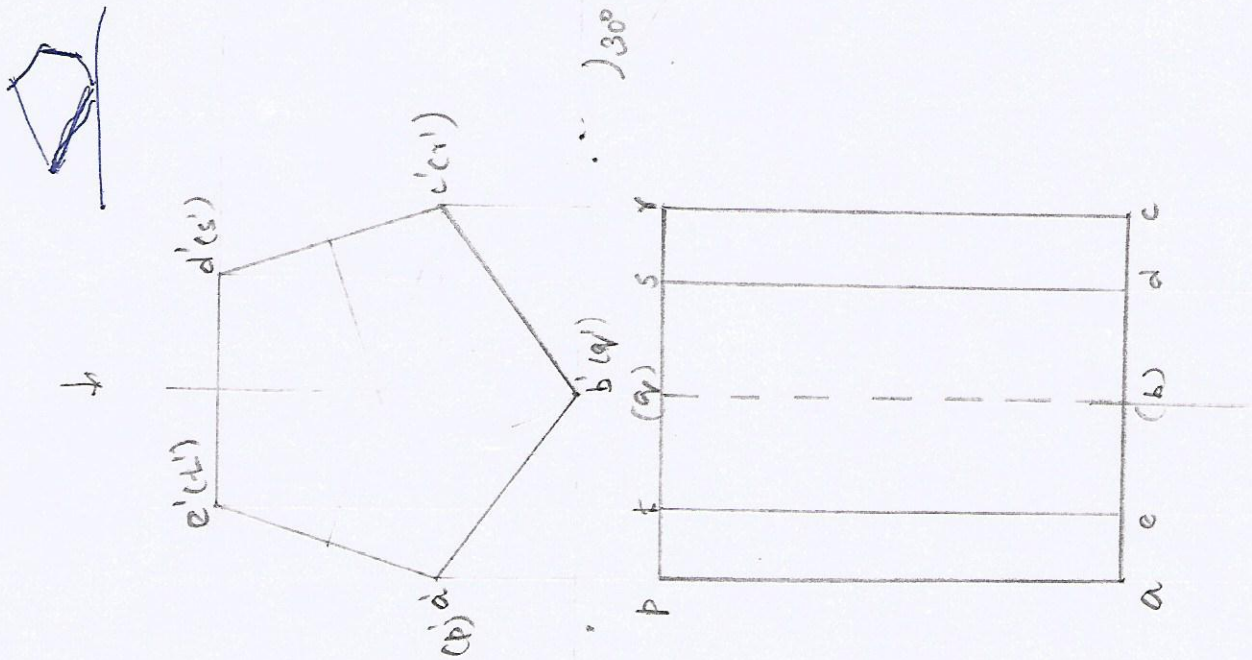


10. A Pentagonal Prism of base side 30 mm and axis height 60 mm is lying on the ground on one of its longer edges with its axis inclined at 30° to V.P. Draw its Projection.

lying on ground
∴ front view touches the x-y line

Inclined at 30° to HP
∴ Pentagon in HP.



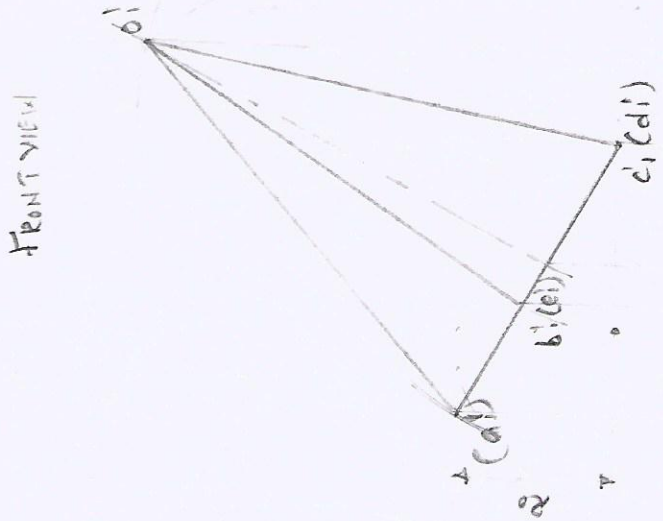


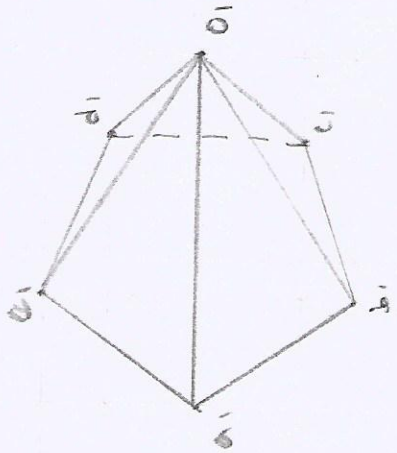
11. A Pentagonal pyramid of base edge 25 mm and axis length 60 mm resting on one of the base edges on H.P, such that the highest base corner is 20 mm above the H.P. Draw its Projection.

resting on H.P
∴ Front view touches the x-y line

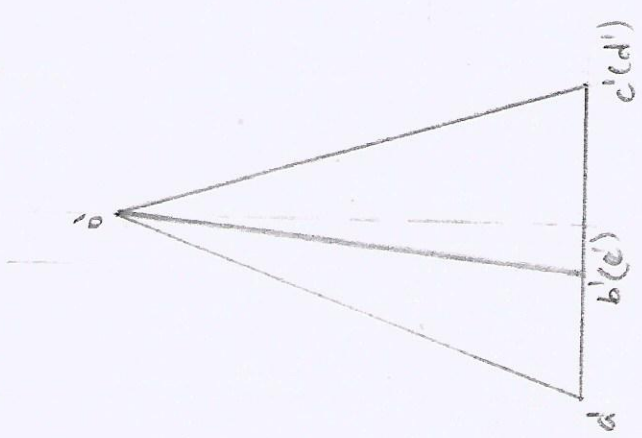
20mm above HP
∴ Draw the pentagon in HP

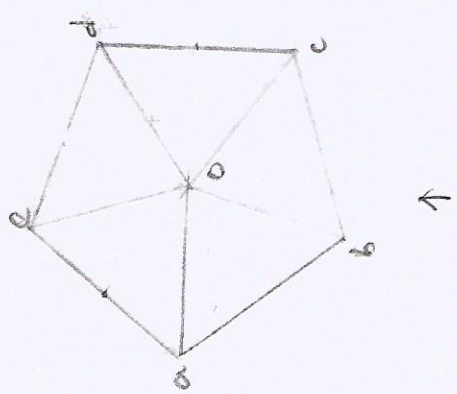
Edge resting ∴ Edge in right side.





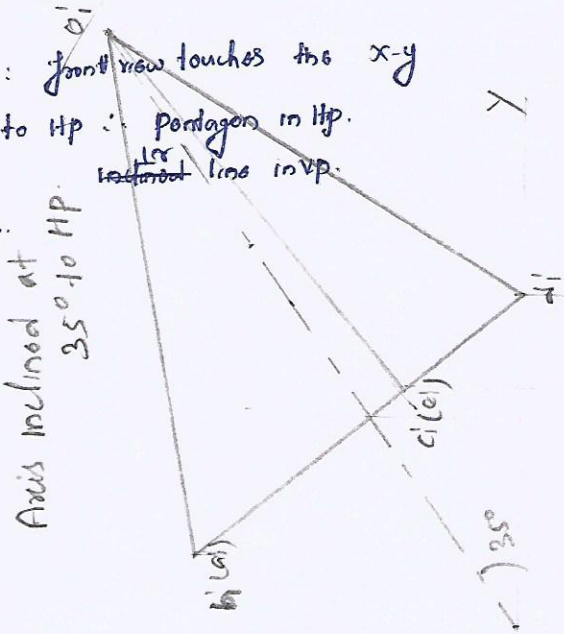
Edge resting ∴ Edge in right side

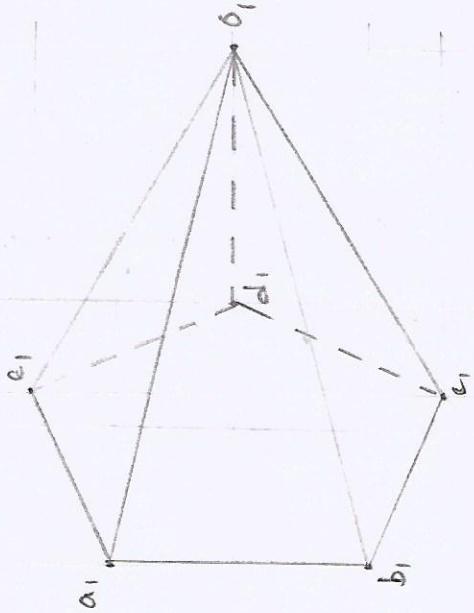


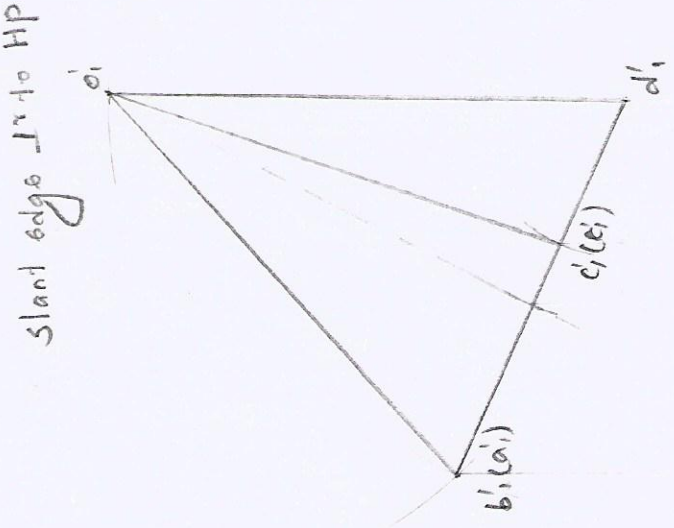


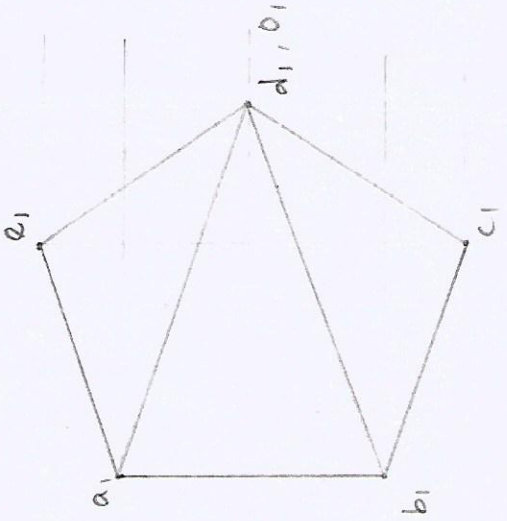
12. A Pentagonal Pyramid of base side 35mm and axis height 60mm is resting on Hp on (a point with its slant edge is ⊥r to Hp)
(one of its base corner with its axis inclined at 35° to Hp)
~~one of its base corner with its axis inclined at 35° to Hp~~. Draw its Projection.

rest on Hp: front view touches the x-y
~~inclined~~ ⊥r to Hp ∴ pentagon in Hp.
~~inclined~~ ⊥r line in vp.

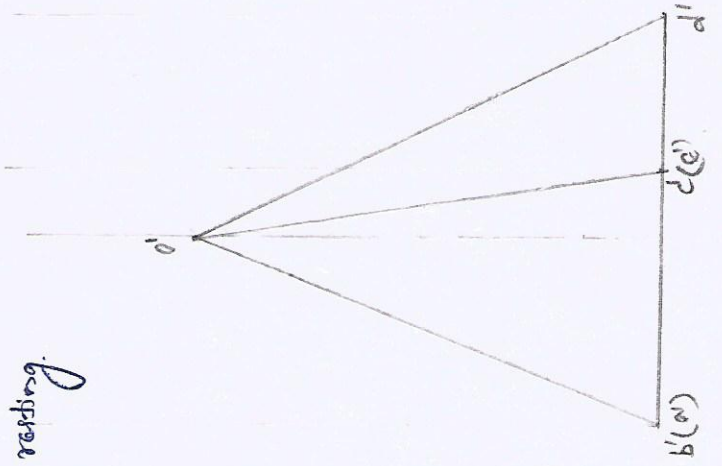


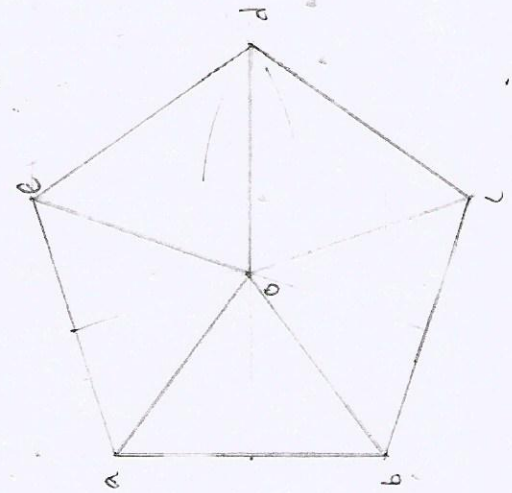






resting on a point in right side corner



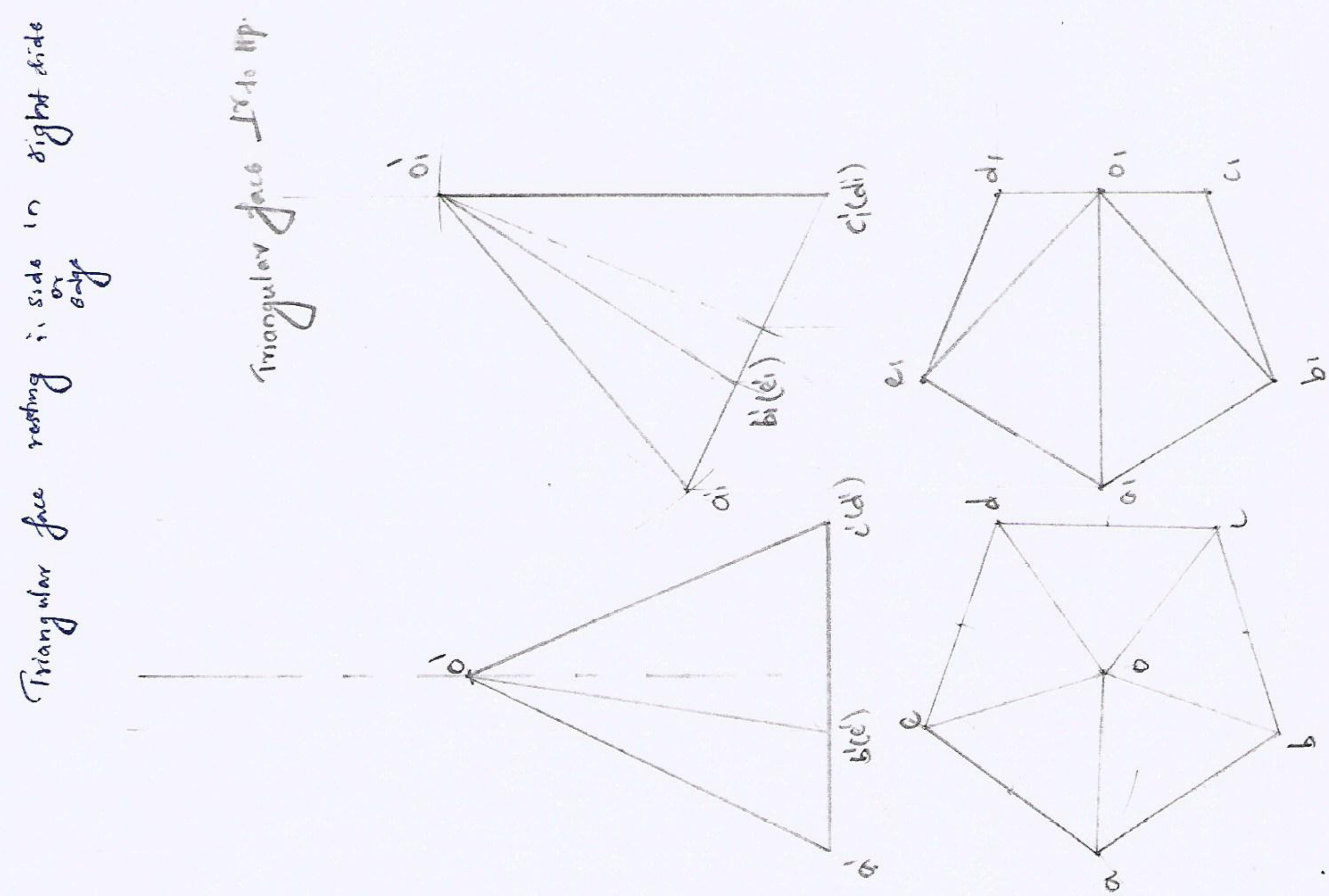


resting.

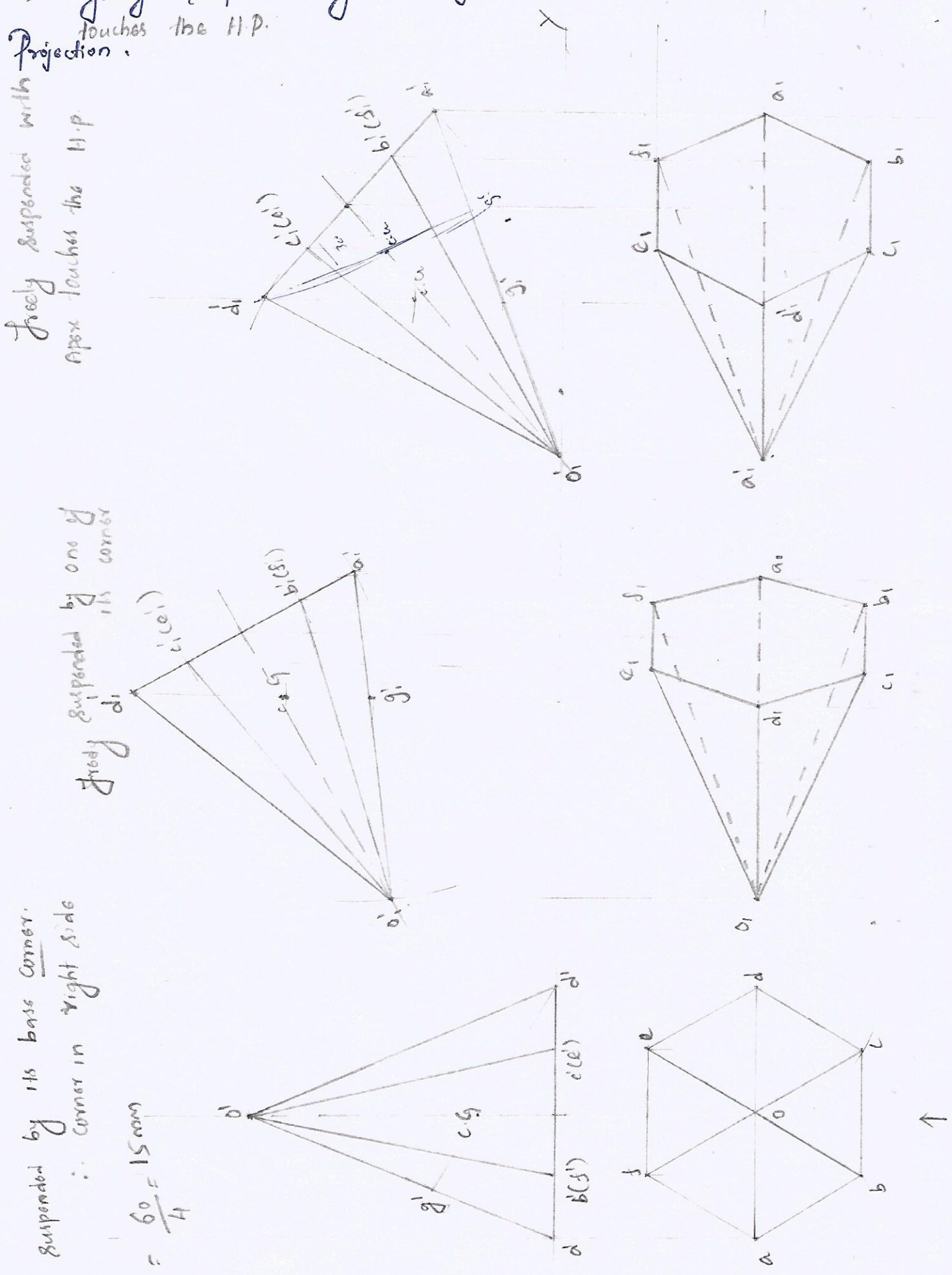
13. A Pentagonal Pyramid, side of base 30mm and axis 50mm long lying with one of its triangular faces on H.p and ⊥r to both V.p & H.p. Draw its Projection.

lying on Hp : front view touches the x-y line

⊥r to Hp : Pentagon in Hp.



14. A hexagonal Pyramid of base edge 25mm and axis height 60mm is freely suspended by one of its base corner, with its apex just touches the H.P. Draw its Projection.



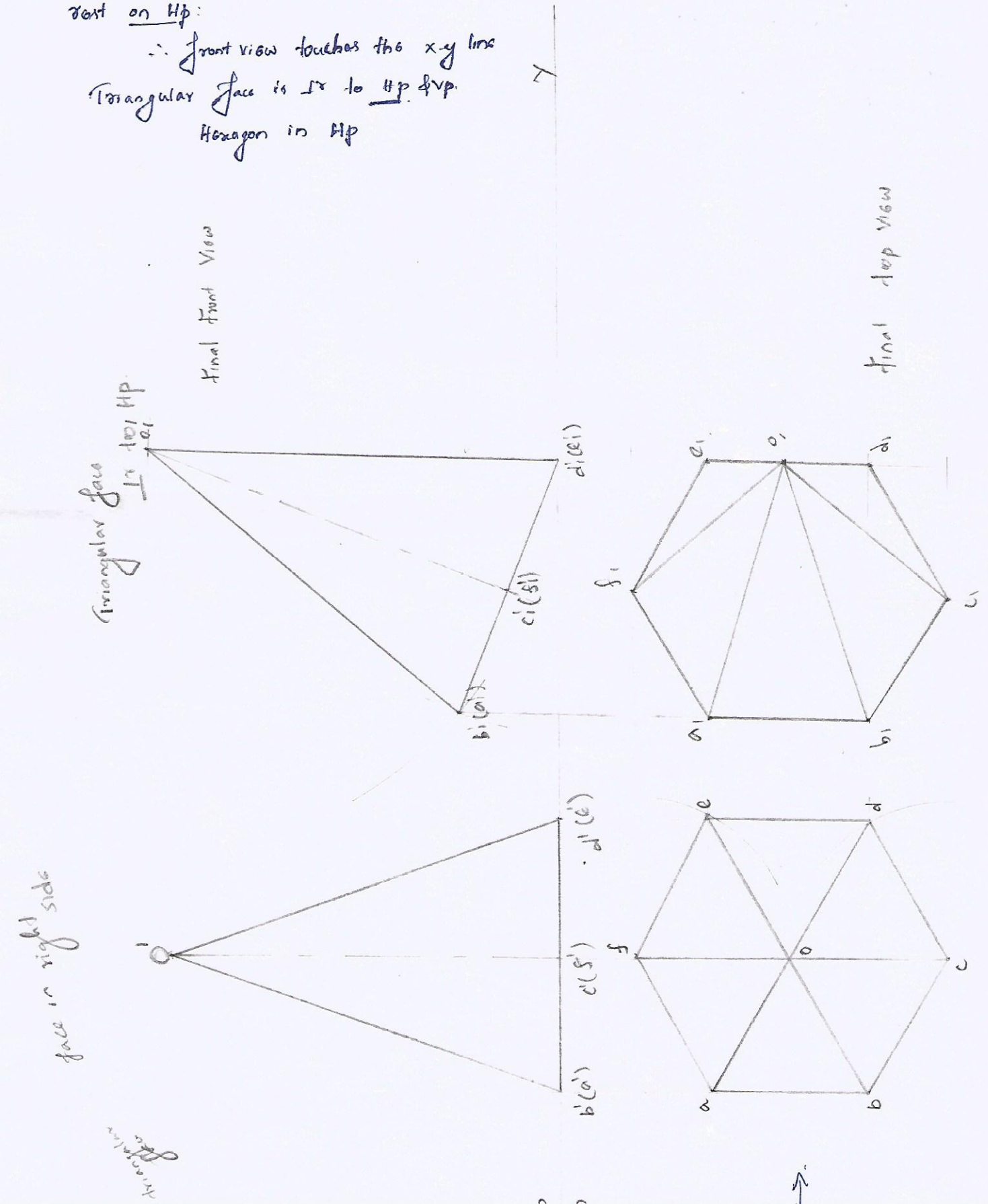
15. A hexagonal Pyramid of base side 30mm and altitude 45mm rests on the HP on one of its base edges such that the triangular face containing the resting edge is ⊥r to both the HP & VP. Considering Draw its Projections.

rest on Hp:

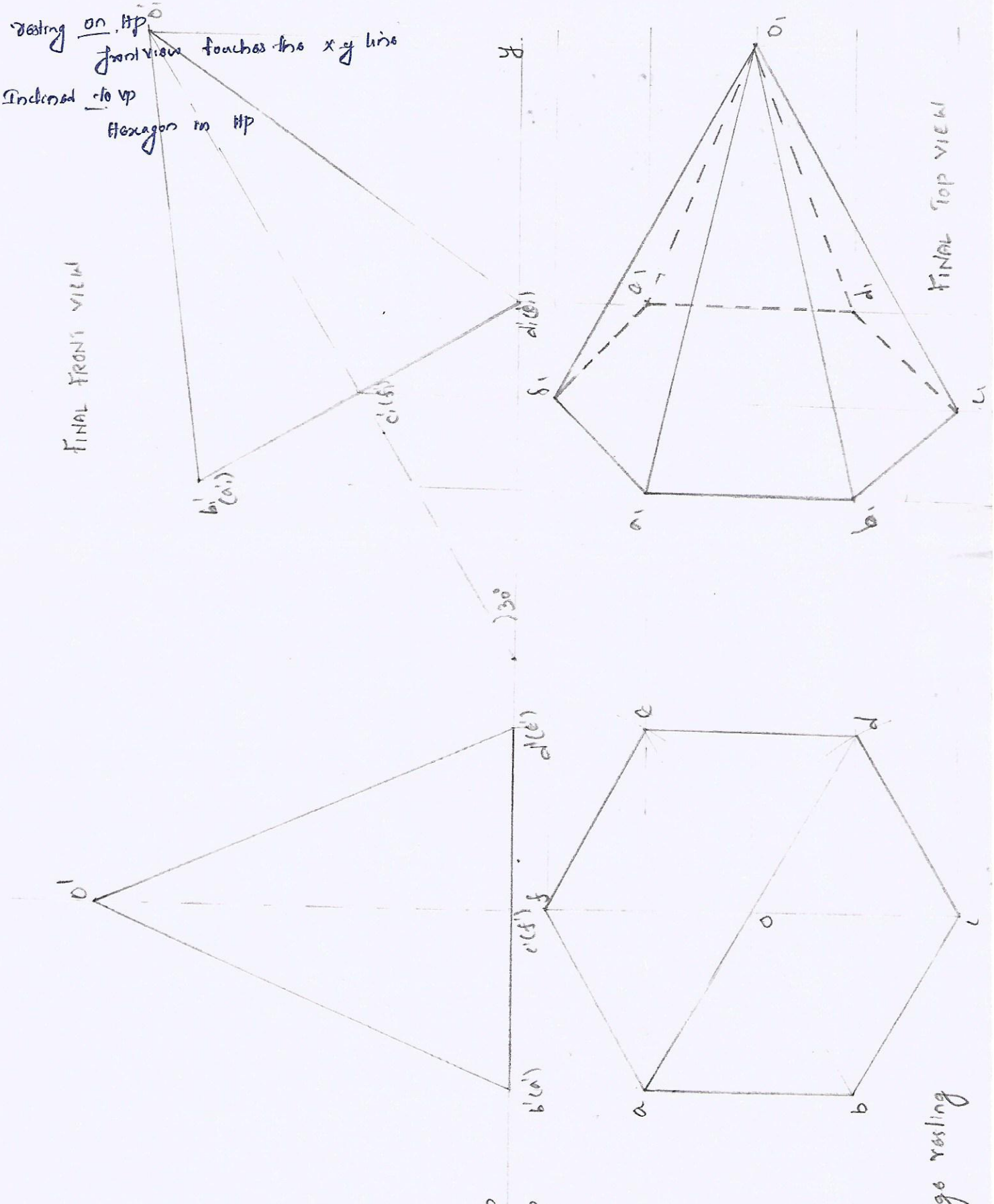
∴ Front view touches the x-y line

Triangular face is ⊥r to Hp & Vp.

Hexagon in Hp



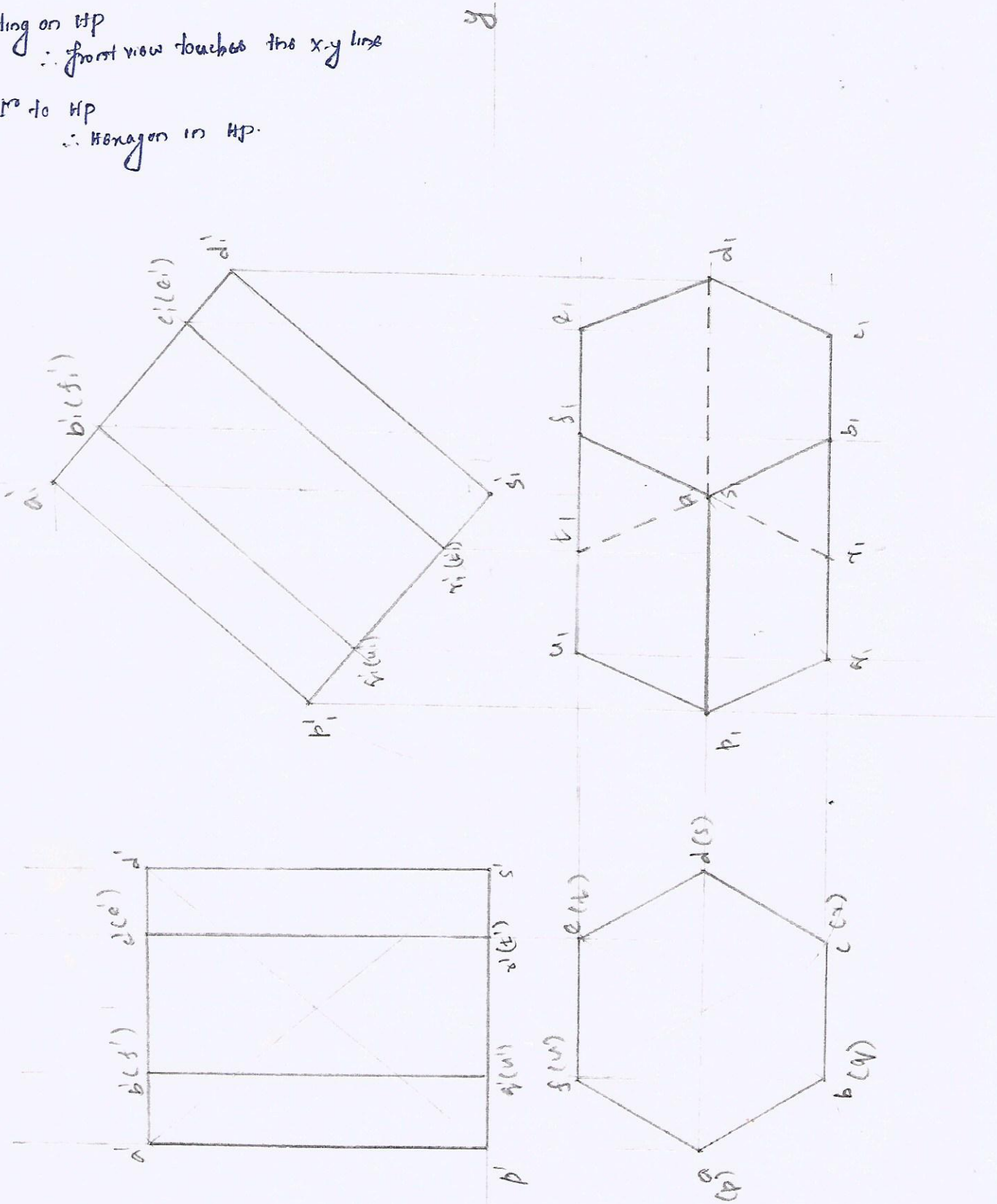
16. A hexagonal pyramid of base edge 40 mm and altitude 60 mm rests on one of its base edges on the HP. With its axis inclined at 30° to the HP and parallel to the VP. Draw its top and front views.



17. A hexagonal Prism of base side 25 mm and axis height 60 mm is resting on one of its base corners on H.P. with its solid diagonal is Vertical (⊥r to HP).

resting on HP
∴ front view touches the x-y line

⊥r to HP
∴ Hexagon in HP.

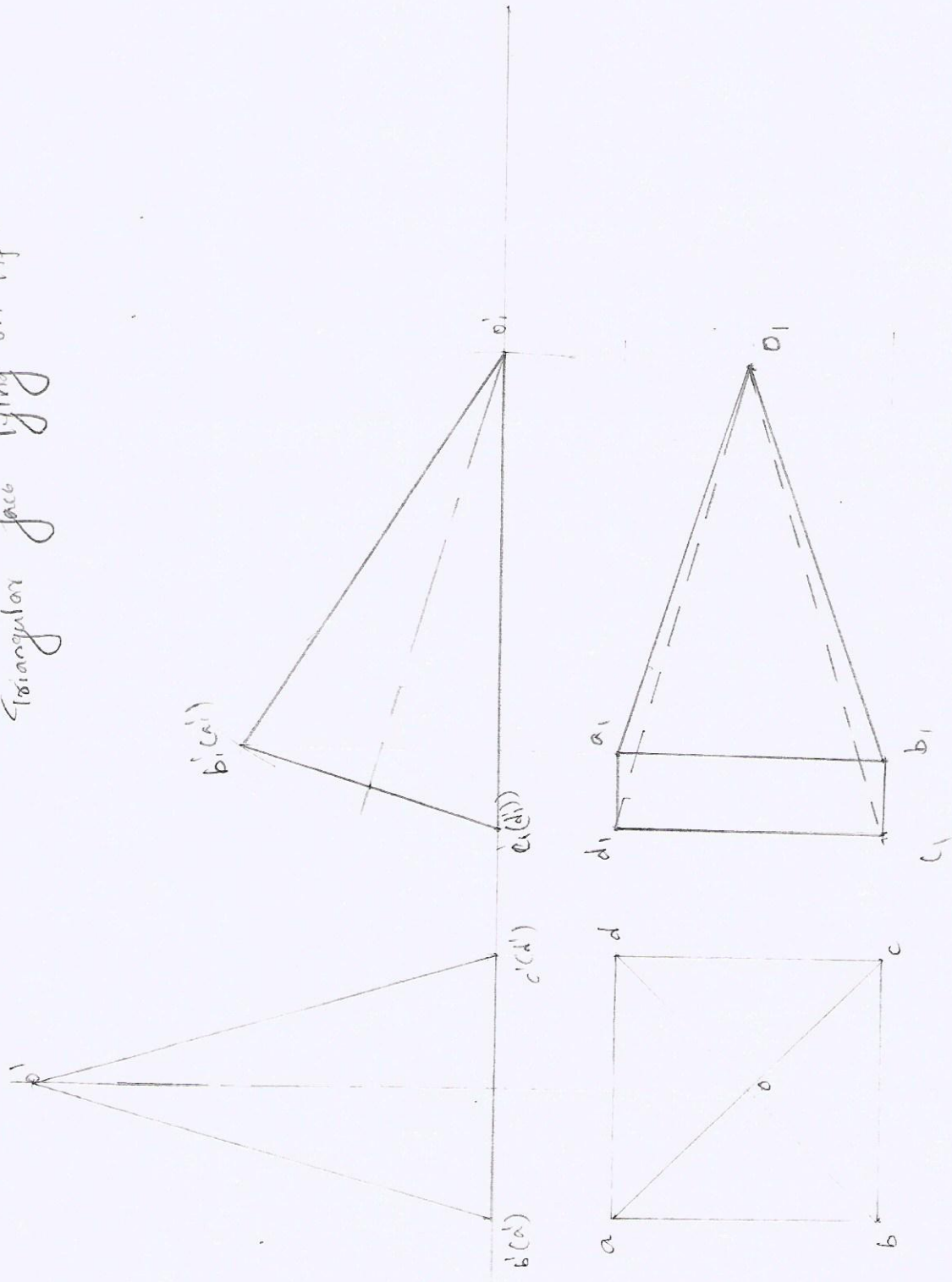


18. A Square Pyramid of base side 40 mm and altitude 70 mm lies on the Hp on one of its triangular faces. Draw the Projections of the Pyramid.

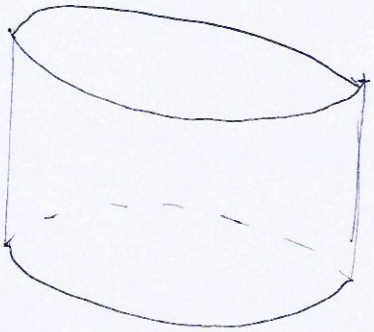
Lying on Hp
∴ Front view touches the x-y line
& Square in Hp

Triangular face lying on Hp

(Triangular face on Hp
∴ Axis is Right Angle

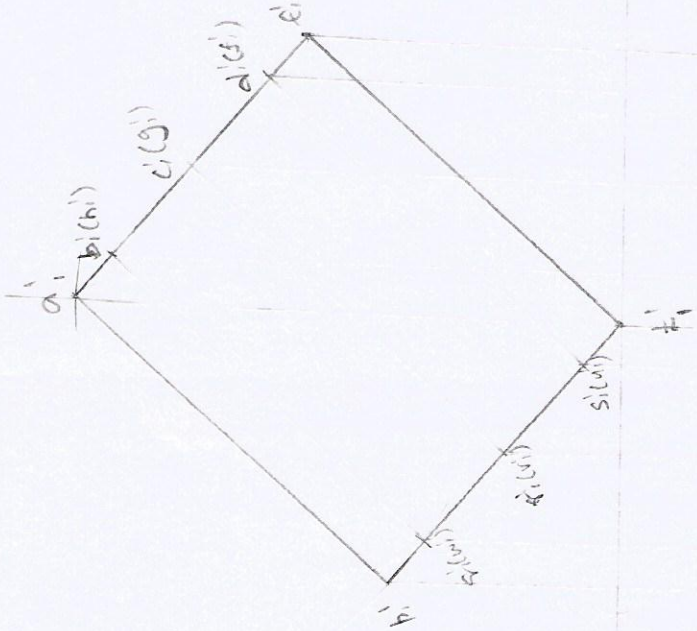


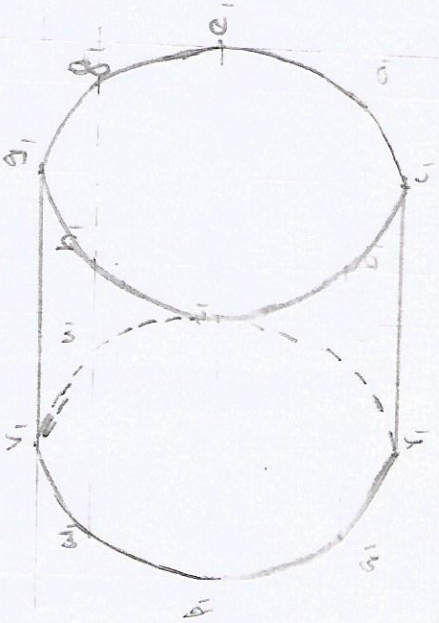
19. A cylinder of base diameter 45mm and axis height 55 mm is resting on one of its point on the circumference of the base on H.P with its solid diagonal is Vertical or ⊥r to H.P.

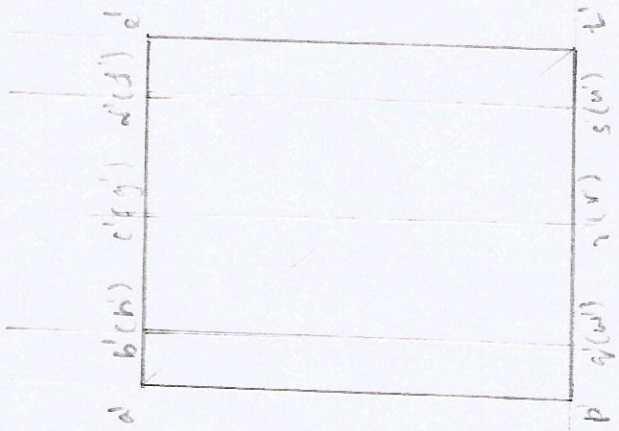


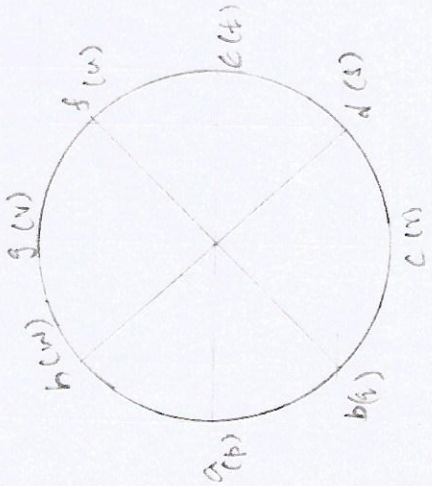
resting on Hp
∴ f.v touch the x-y

⊥r to Hp
∴ Circle on Hp



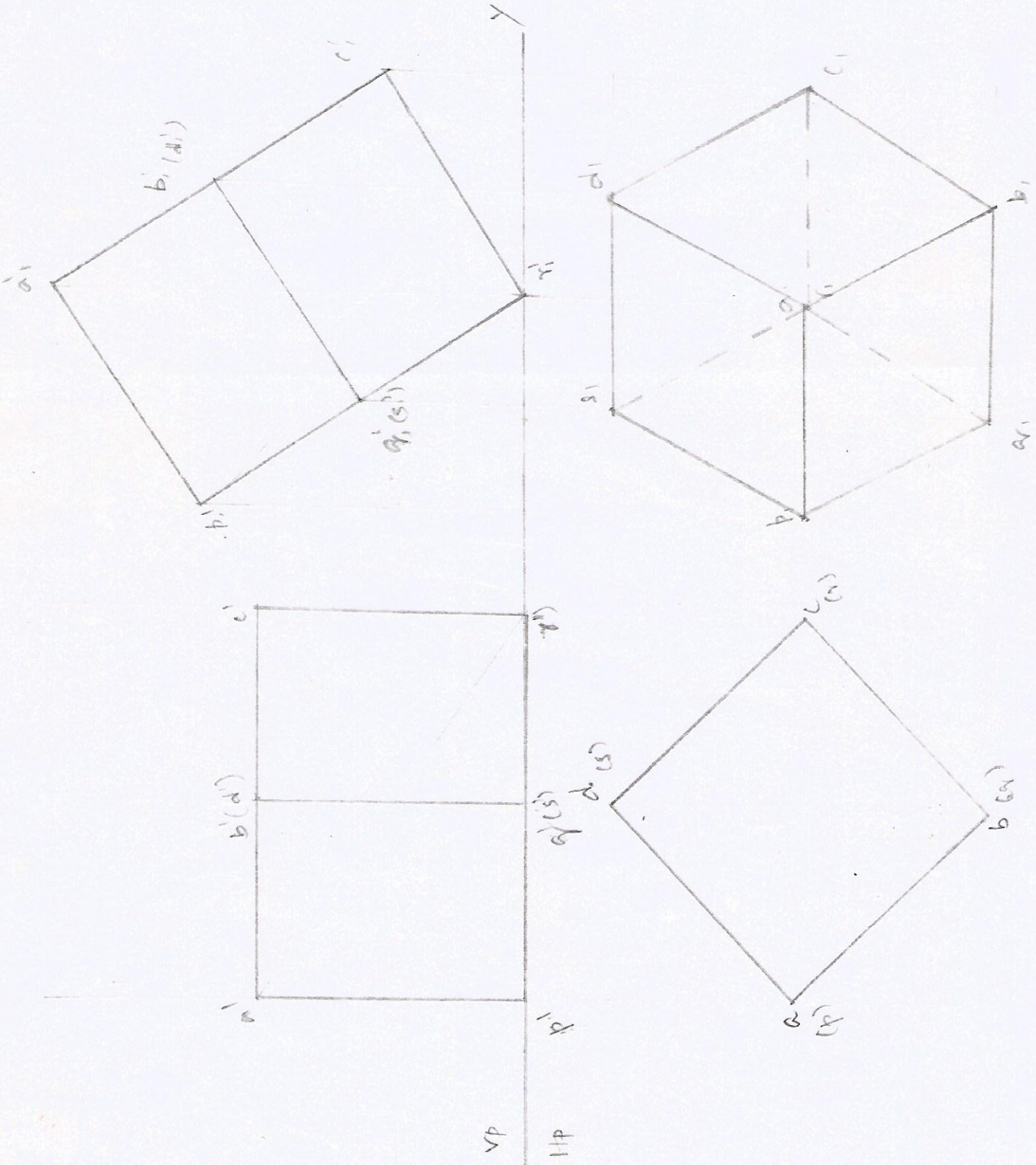






VP HP

20. Draw the Projection of a cube of 45 mm side resting on one of its corners in the H.P. with a solid diagonal ⊥ to H.P



(31)

Unit - IV

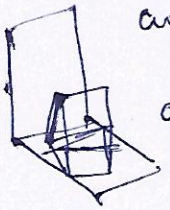
Sections of Solids

1. A cube of side 30mm rests on the Hp on its end with the Vertical faces equally inclined to the VP. It is cut by a plane Perpendicular to the VP and inclined at 30° to the Hp meeting the axis at 25mm above the base. Draw its front view, Sectional top view and the true shape of the section.

rest on Hp : ⊥.r touches the x-y line

@equally inclined to vp.

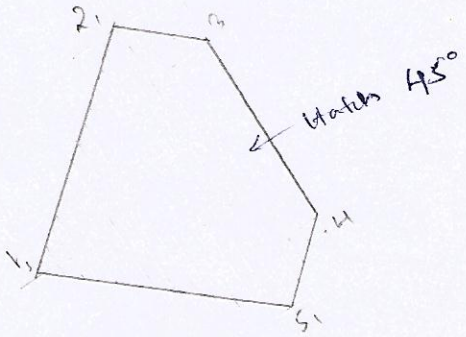
∴ 45° to vp Draw 45° in Hp



cutting plane 30° to Hp.

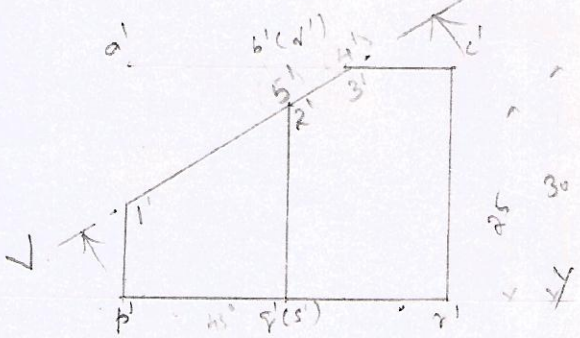
inclination in VP

cutting plane meeting the axis at 25 mm above the base.



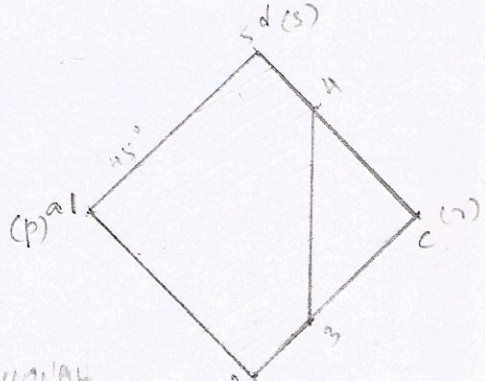
a'-p' - 1
b'-r' - 2
c'-b' - 3
c'-d' - 4
(s')-(d') - 5

Total points - 5



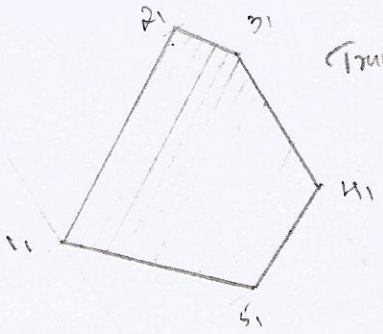
X VP

Hp



Width 45°

2. A cube of side 25 mm rests on the Hp on one of its faces with a vertical face inclined at 35° to the Vp. It is cut by a plane perpendicular to the Vp and inclined at 35° to the Hp and meeting the axis at 20 mm above the Hp. Draw the front view, sectional top view and the true shape of the section.



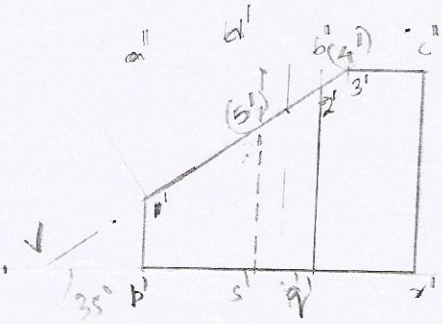
True shape of section

Cutting plane

Vp — inclined to Hp

Hp — ⊥r to Vp

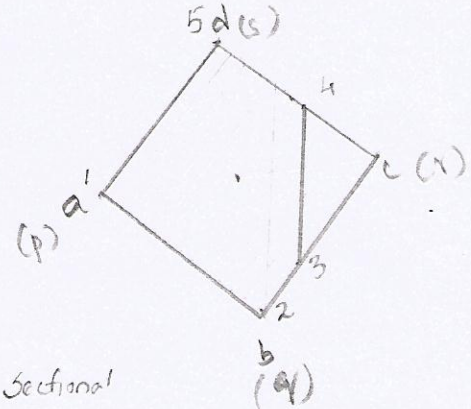
a'-p'-1'
b'-q'-2'
c'-6'-3'
c'-d'-4'
d'-s'-5' (Invisible)



Front view

X Vp

Hp

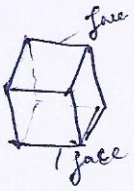


Sectional top view

Unit. IV

Sections of solids

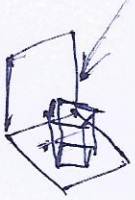
3. A cube of side 25 mm rests on the HP on one of its faces with a Vertical face inclined at 35° to the VP. A plane Perpendicular to the HP and inclined at 50° to the VP cuts the cube, 3mm away from the axis. Draw the top view and the sectional front view. Also draw the true shape of the section.



rest on HP
∴ front view touches x-y line

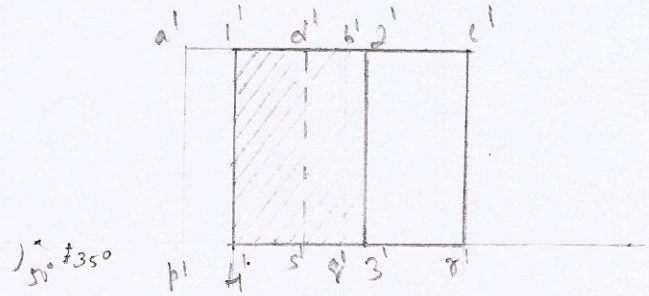
face inclined to VP
Square in HP

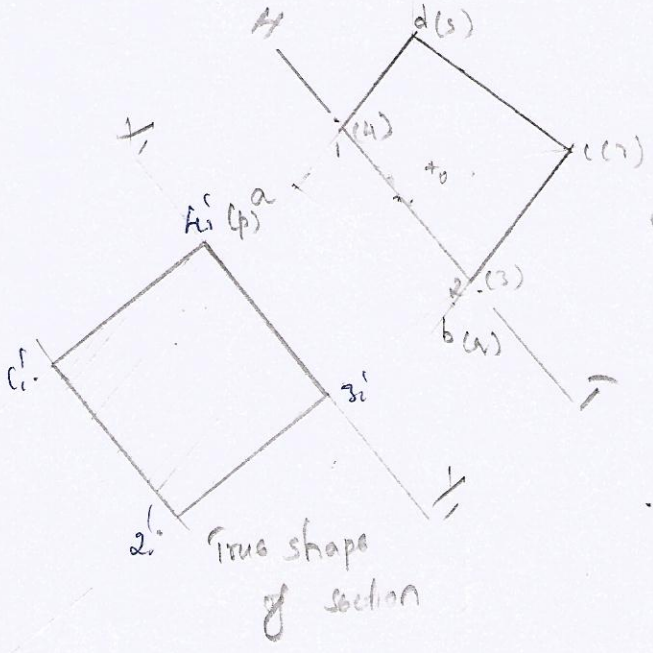
cutting plane inclined at 50° to VP
∴ cutting Plane in HP



Draw an arc of radius 3mm from o
Draw a tangent to the arc at 50°

Sectional front view



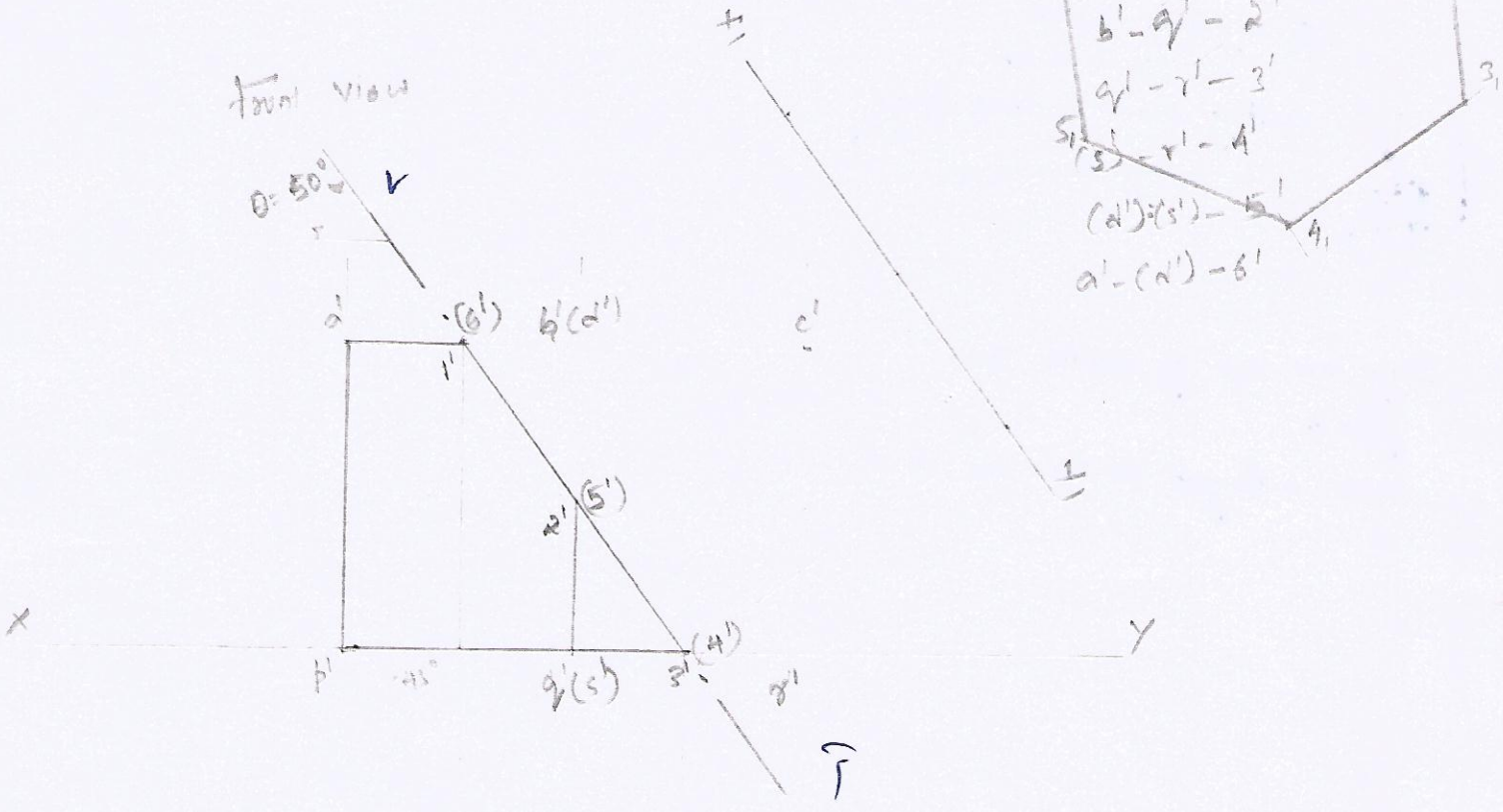


Top view

True shape of section

A. A cube of side 40mm is placed and cut by a plane in such a way that the true shape of the section is a regular hexagon. Draw the front and top views of the cube and determine the inclination of the plane with the Hp.

Draw a face at 45° in Hp



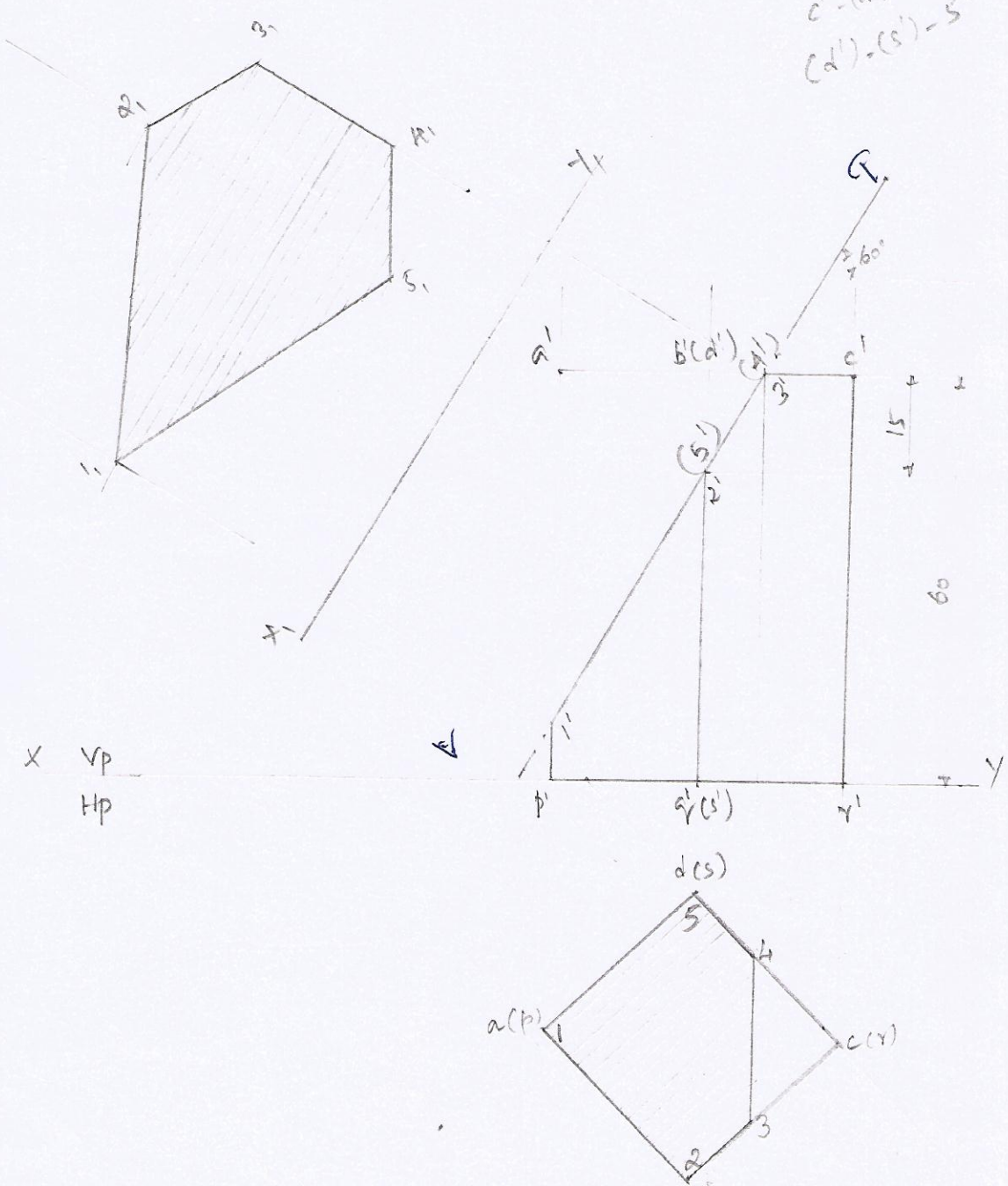
Sections of Prisms

5. A Square Prism of base side 30mm and height 60mm rests on the Hp on one of its ends with two of its rectangular faces equally inclined to the VP. It is cut by a plane perpendicular to the VP and inclined at 60° to the Hp meeting the axis at 15 mm from the top. Draw its front view, sectional top view and the true shape of the section.

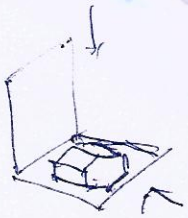
rectangular face
Equally inclined to VP
∴ Draw the face at 45° in Hp

cutting plane inclined at 60° to Hp
∴ cutting plane in VP

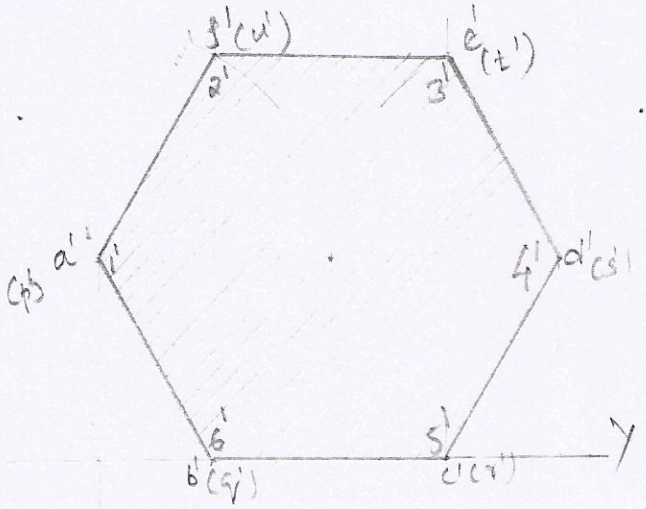
a'-p'-1'
b'-q'-2'
c'-b'-3'
c'-(d')-4'
(a')-(s')-5'

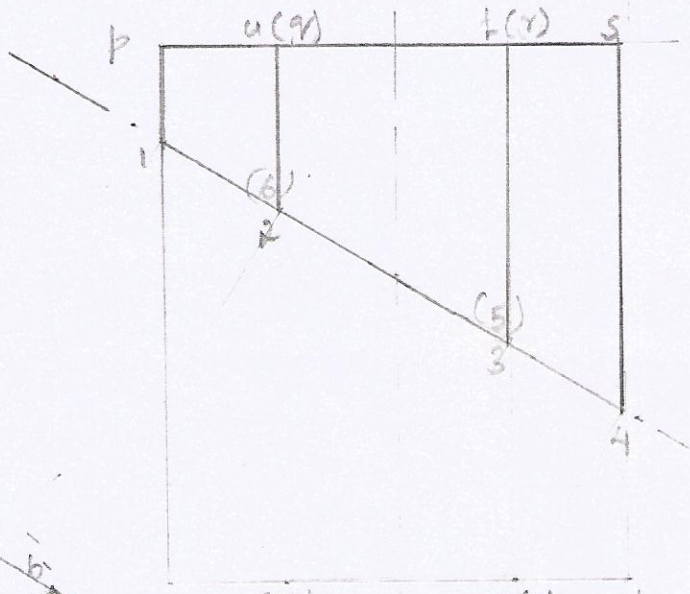


6. A hexagonal Prism of base side 30 mm and axis length 70 mm rests on the HP on one of its rectangular faces with its axis Perpendicular to the VP. It is cut by a Vertical plane inclined at 30° to the VP. The cutting plane meets the axis at a distance of 30 mm from one end. Draw the top view, Sectional front view and the true shape of the section.



Hexagon in VP.
Cutting plane inclined to VP.
∴ Cutting plane in HP





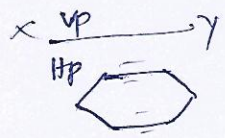
Measured from front view
1', 2'

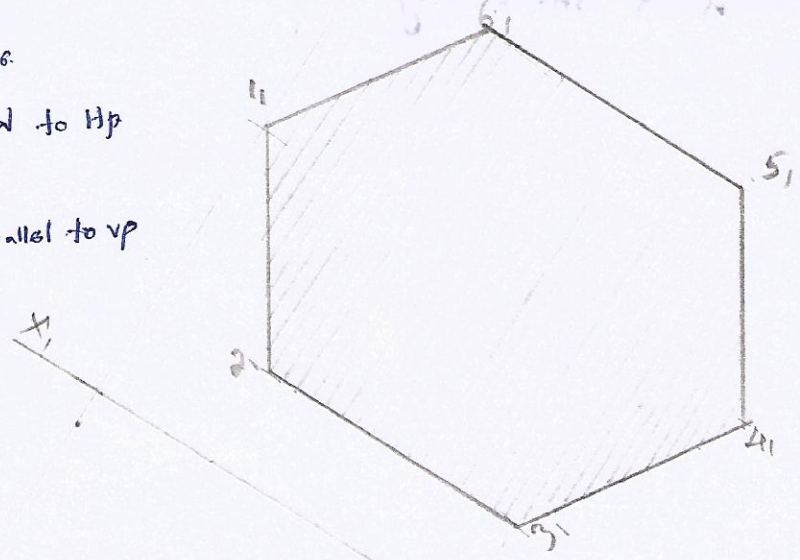
7. A hexagonal Prism of base side 30mm and axis length 70mm rests on one of its ends on the Hp with two base sides parallel to the Vp. It is cut by a plane ⊥r to the Vp and inclined at 30° to the Hp. The cutting plane meets the axis at 30mm from the top. Draw the front view, Sectional top view and the true shape of the section.

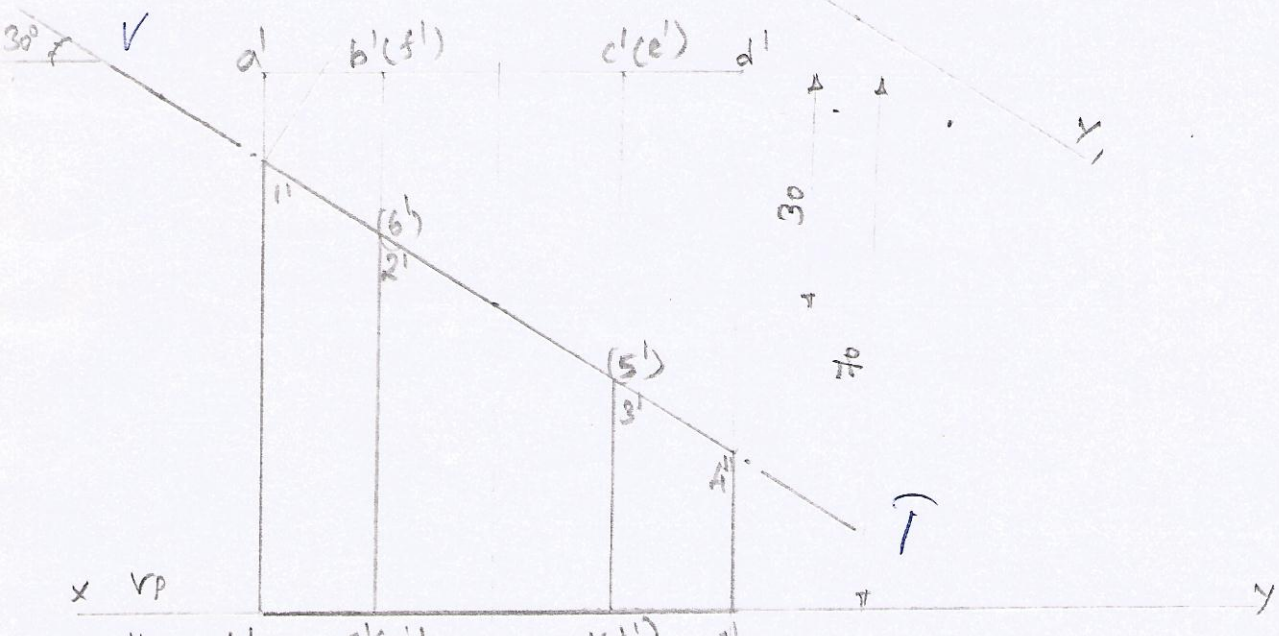
rest on Hp.
∴ ⊥r in x-y line.

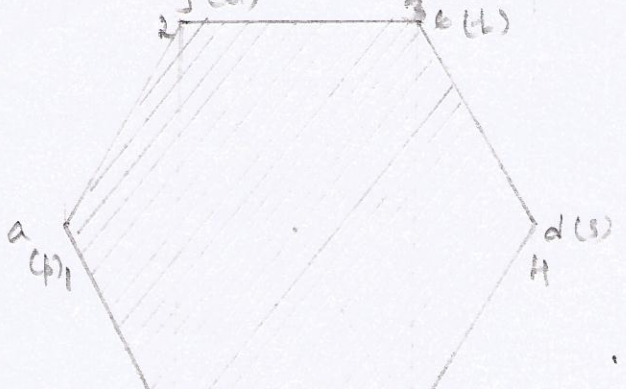
cutting plane inclined to Hp
∴ Plane in Vp

Two base sides parallel to Vp

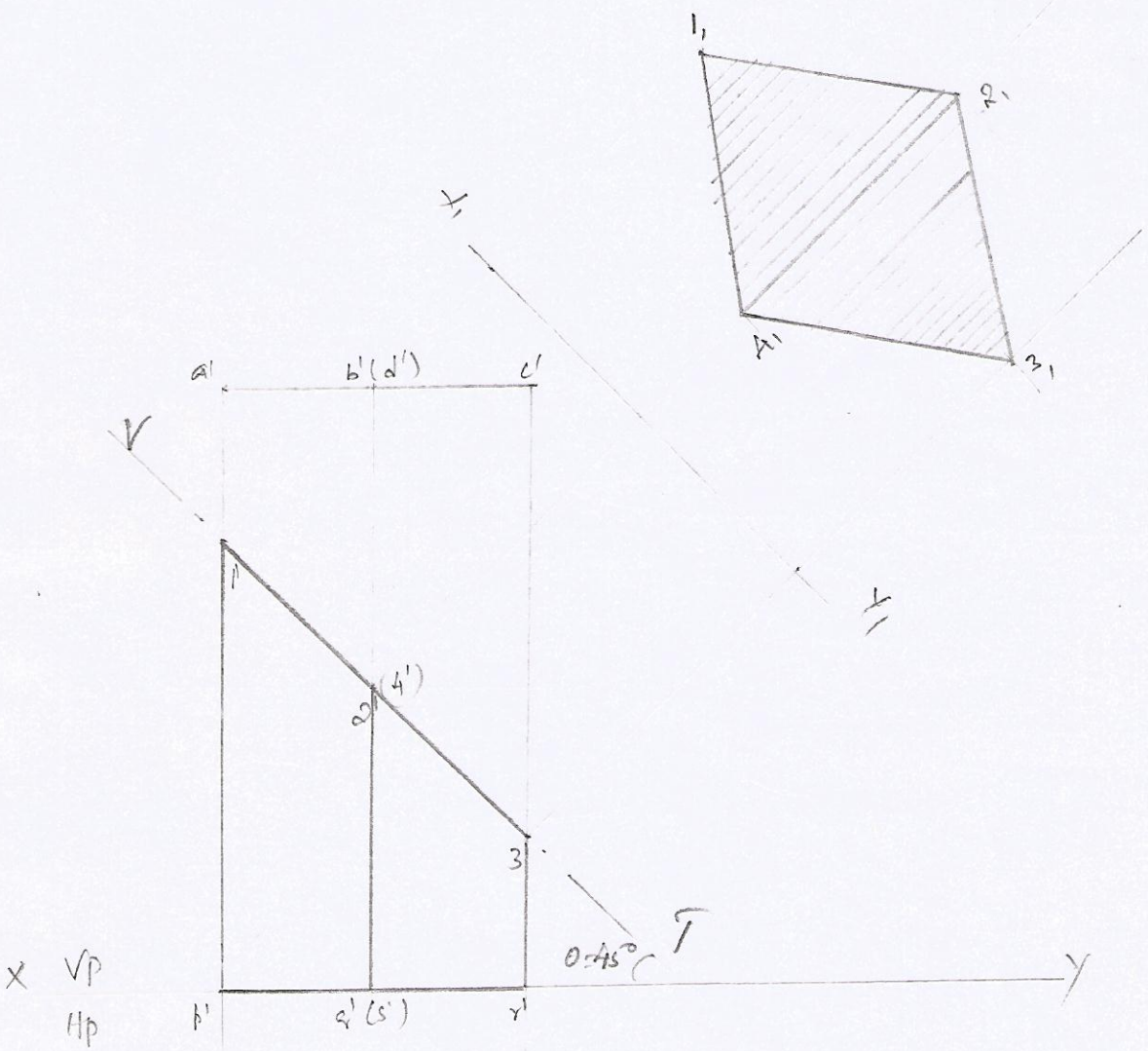


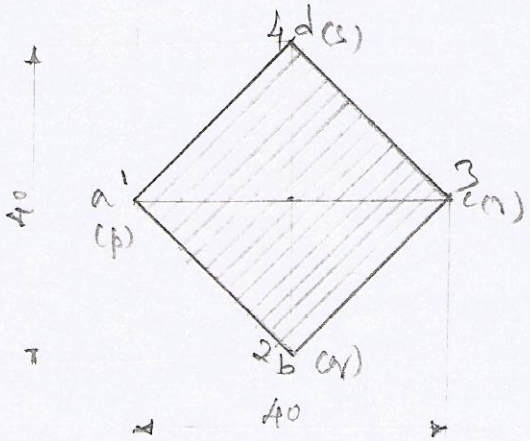






8. A Square Prism of height 80mm and base of diagonal 40mm rests on the Hp on its base with base edges equally inclined to the Vp. It is cut by a section plane passing through the mid-Point of the axis of the Prism Perpendicular to the Vp and inclined to the Hp. Find the inclination of the cutting plane if the true shape of the section is a rhombus of diagonals 60mm and 40mm.

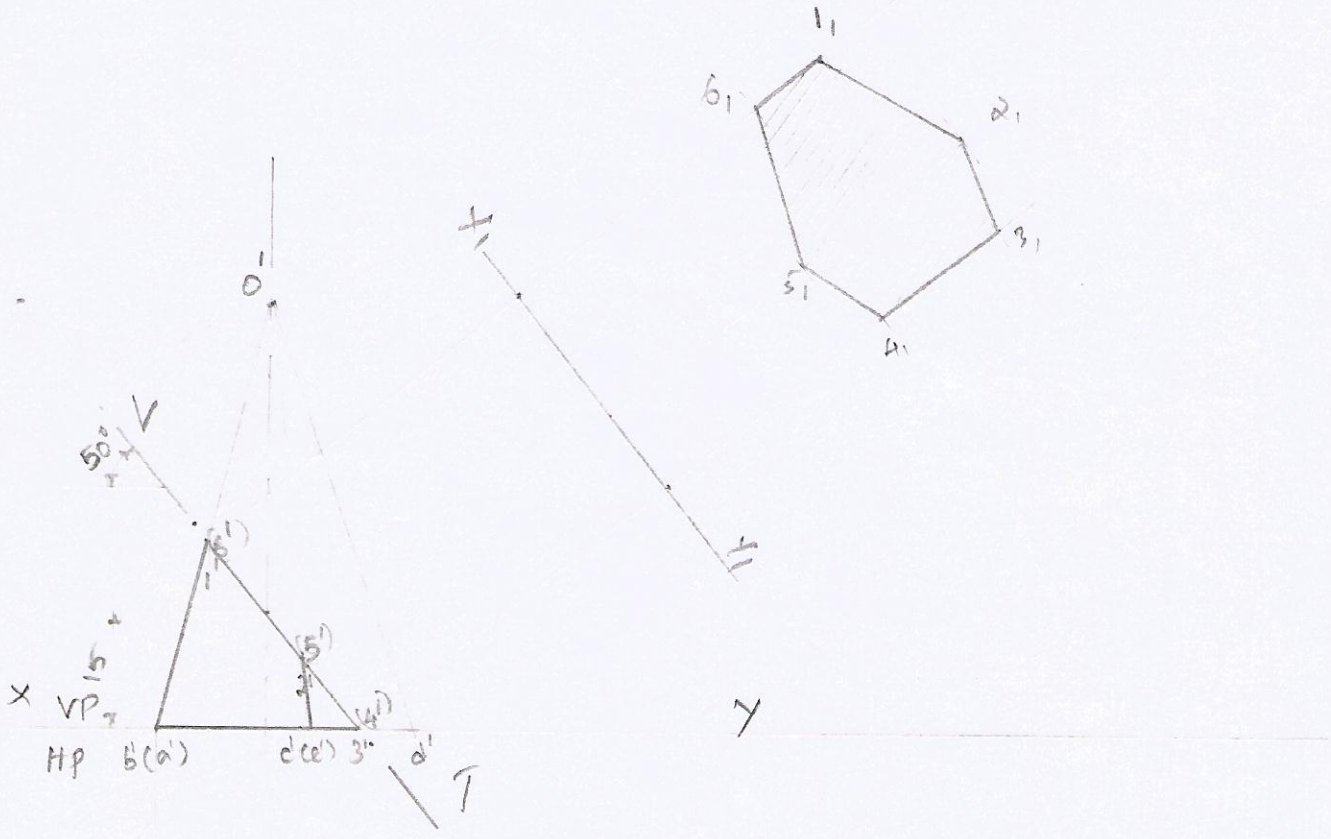


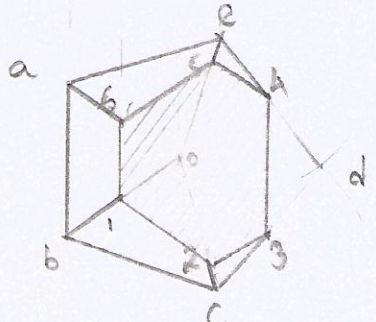


a' - b' - 1'
b' d' - 2'
c' - c' - 3'

Sections of Pyramids

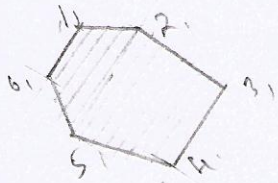
9. A Pentagonal Pyramid of base side 20mm and altitude 55mm rests on its base on the HP with one of the base edges perpendicular to the VP. It is cut by a plane inclined at 50° to the base. The cutting plane meets the axis at 15mm above the base. Draw the front view, sectional top view and the true shape of the section.

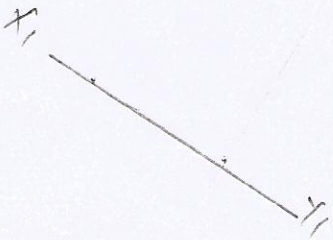


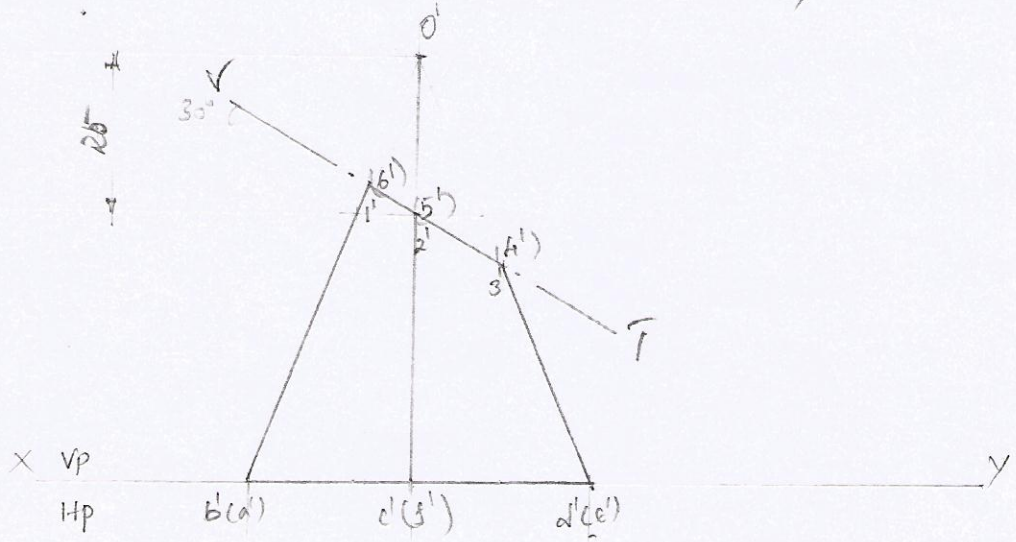


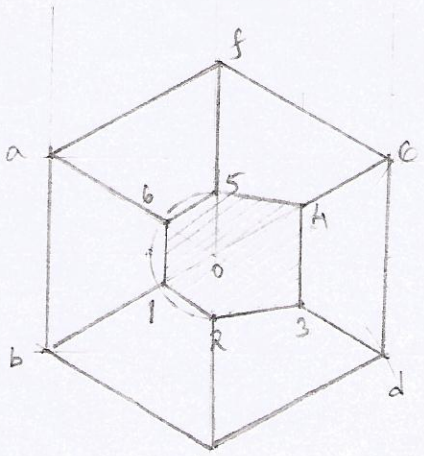
o-b'-1'
o-c'-2'
d'-c'-3'
d'-(e')-4'
o-(e')-5'
o-(a')-6'

10. A hexagonal Pyramid of base side 25mm and axis 65 mm rests on its base on the Hp with two base edges Perpendicular to the Vp. It is cut by a plane ⊥r to the Vp and inclined at 30° to the Hp meeting the axis at 20mm from the Vertex. Draw the front view, Sectional top view & the true shape of the Section.



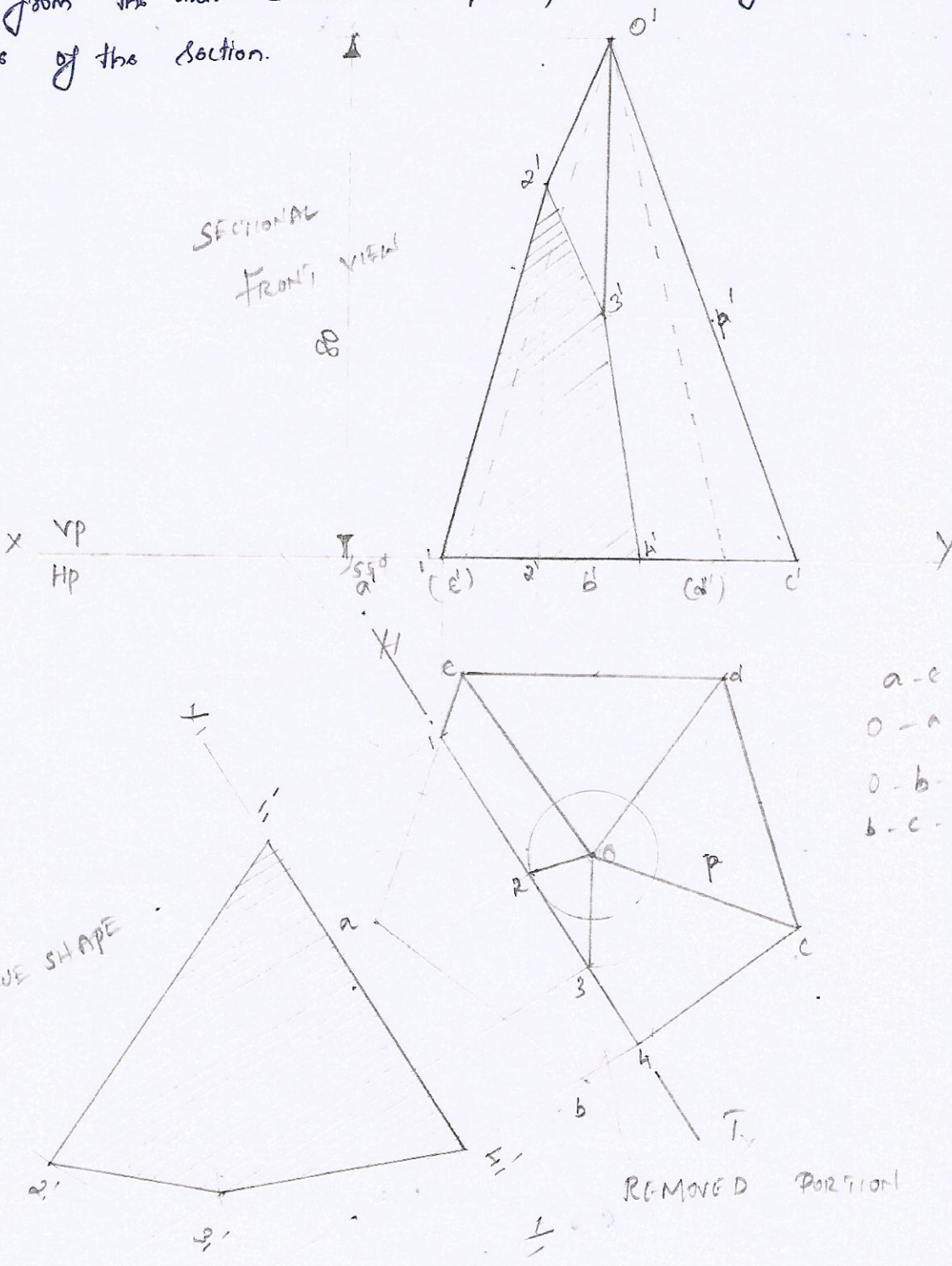




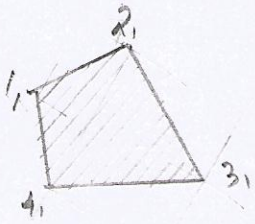


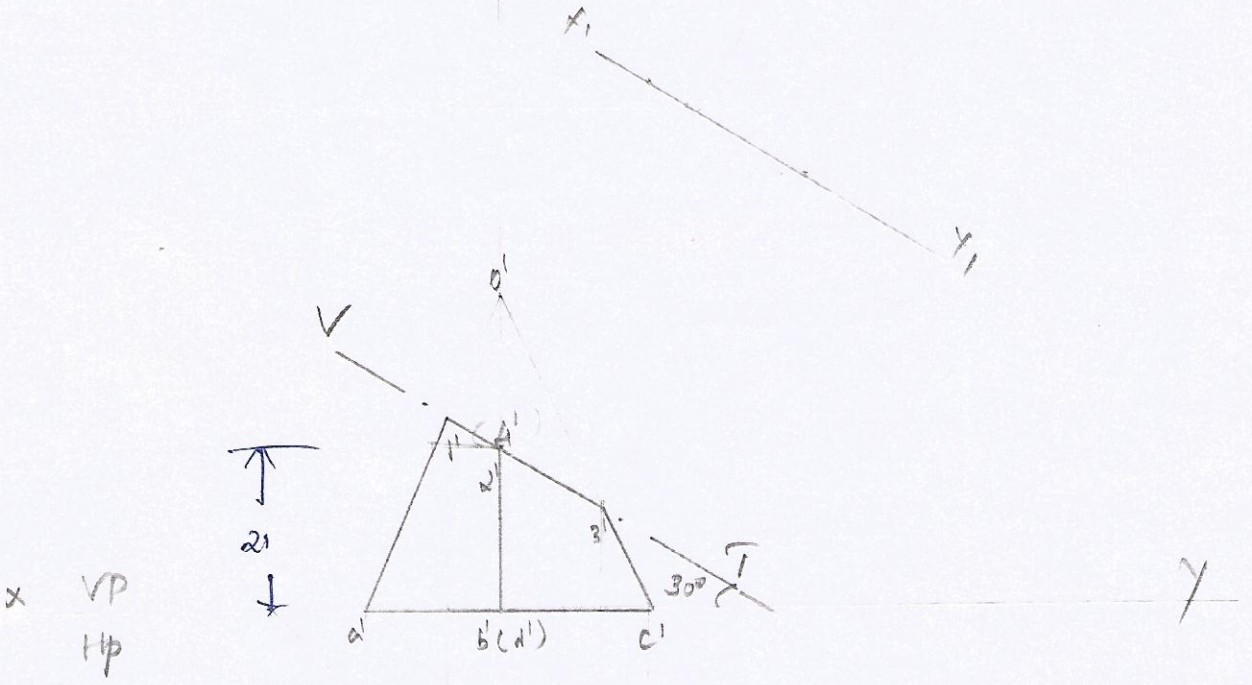
o'-b'-1'
o'-c'-2'
o'-d'-3'
o'-(e')-4'
o'-(f')-5'
o'-(a')-6'

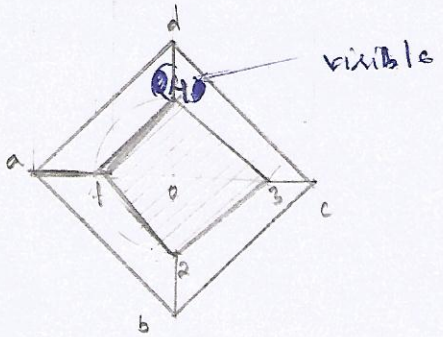
11. A Pentagonal Pyramid of base side 40mm and altitude 80mm rests on the Hp on its base with an edge of the base Parallel to the Vp. It is cut by a Vertical plane inclined at 45° to the Vp at a distance 10mm from the axis. Draw the top view, Sectional front view and the true shape of the section.



12. A Square Pyramid of base side 25mm and altitude 40mm rests on the Hp on its base with the base edges equally inclined to the Vp. It is cut by a plane Perpendicular to the Vp and inclined at 30° to the Hp meeting the axis at 21mm above the Hp. Draw the Sectional top view and the true shape of the Section.

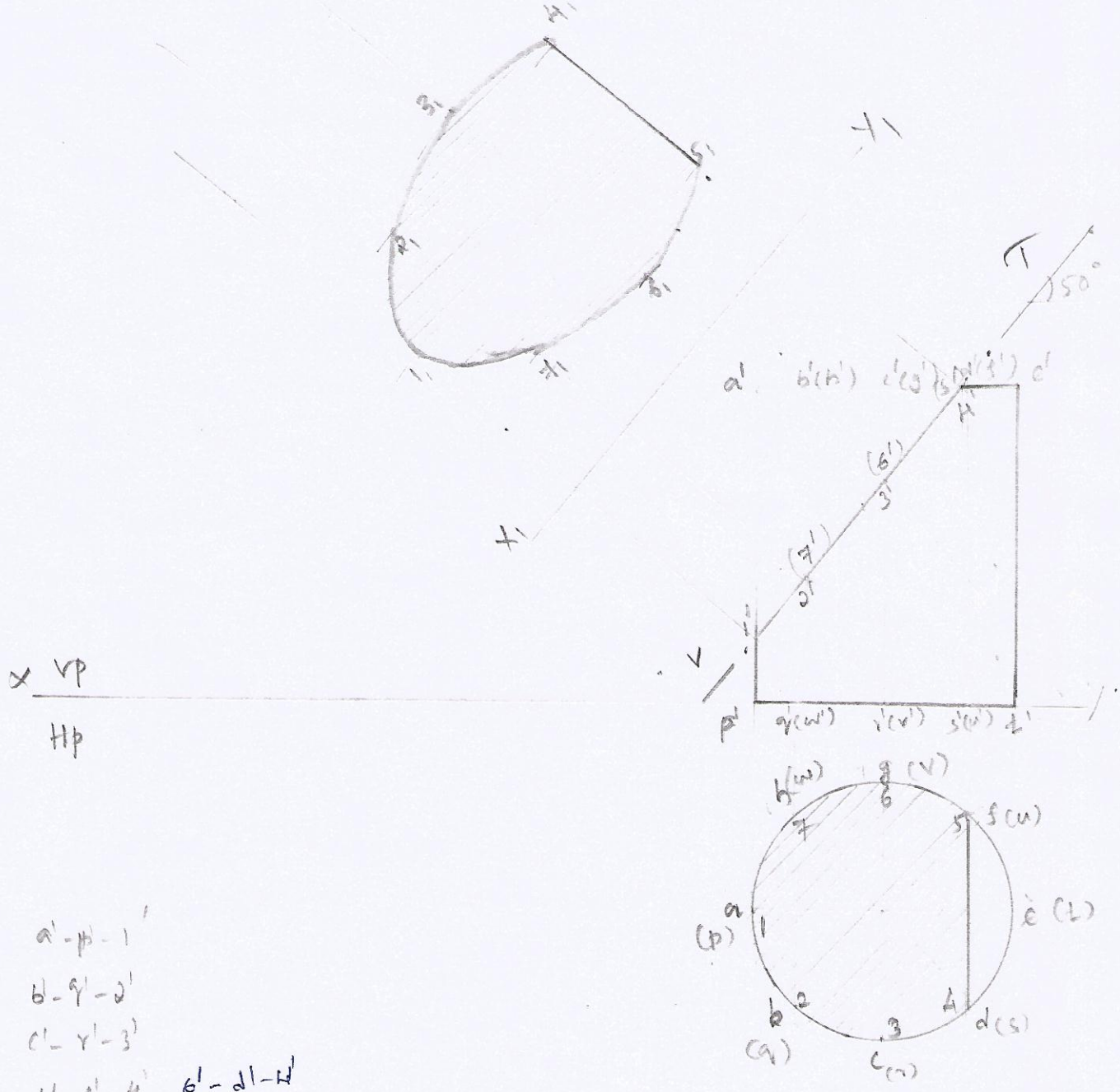






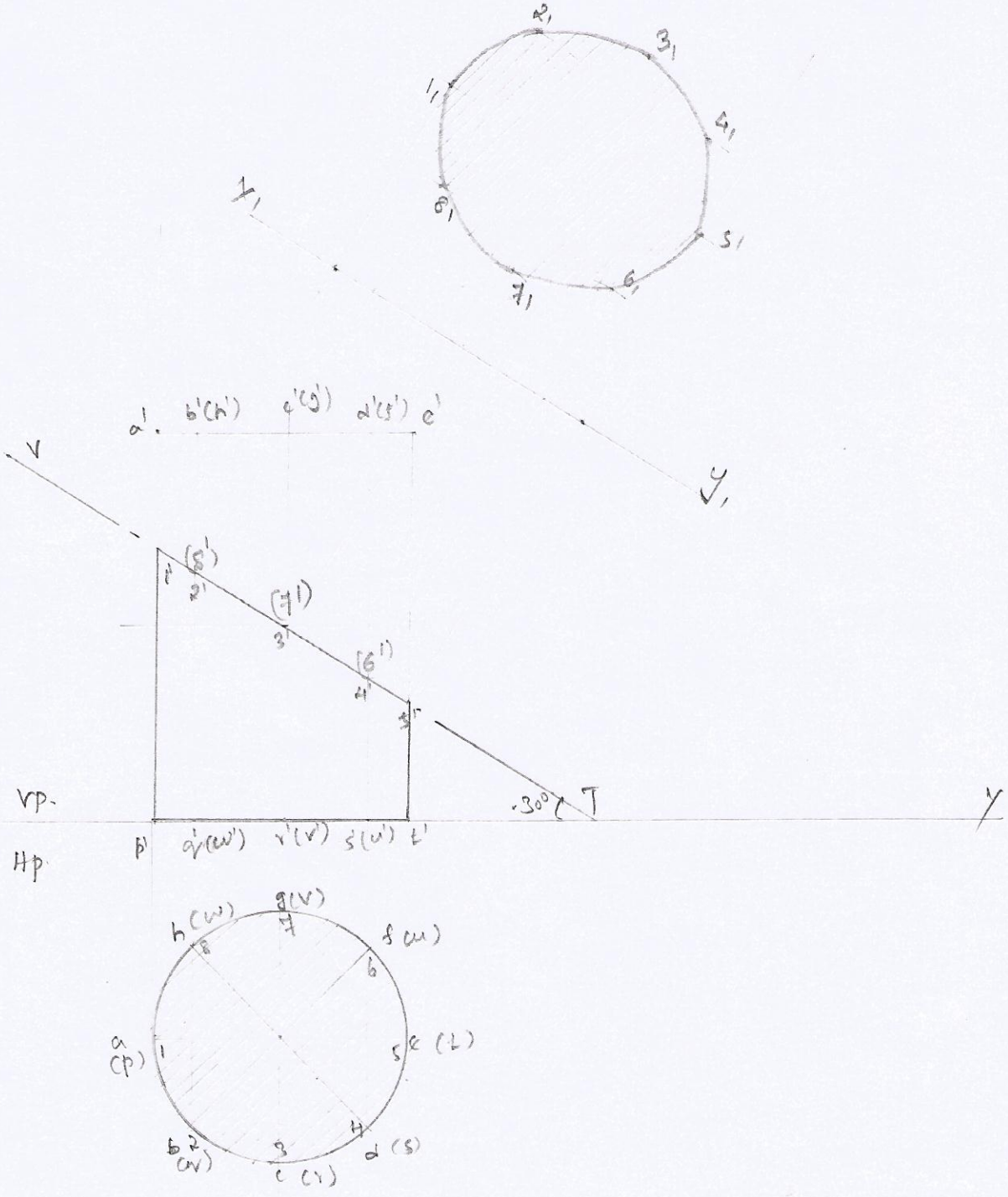
Sections of cylinders

13. A cylinder of diameter 40 mm and height 50 mm rests on its base on the HP. It is cut by a plane ⊥r to the VP and inclined at 50° to the HP. The cutting plane meets the axis at a distance of 15 mm from the top. Draw the front view, sectional top view and the true shape of the section.



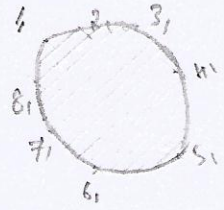
a'-p'-1'
b'-q'-2'
c'-r'-3'
d'-s'-4'
e'-(t')-5'
(f')-(u')-6'
g'-(v')-7'

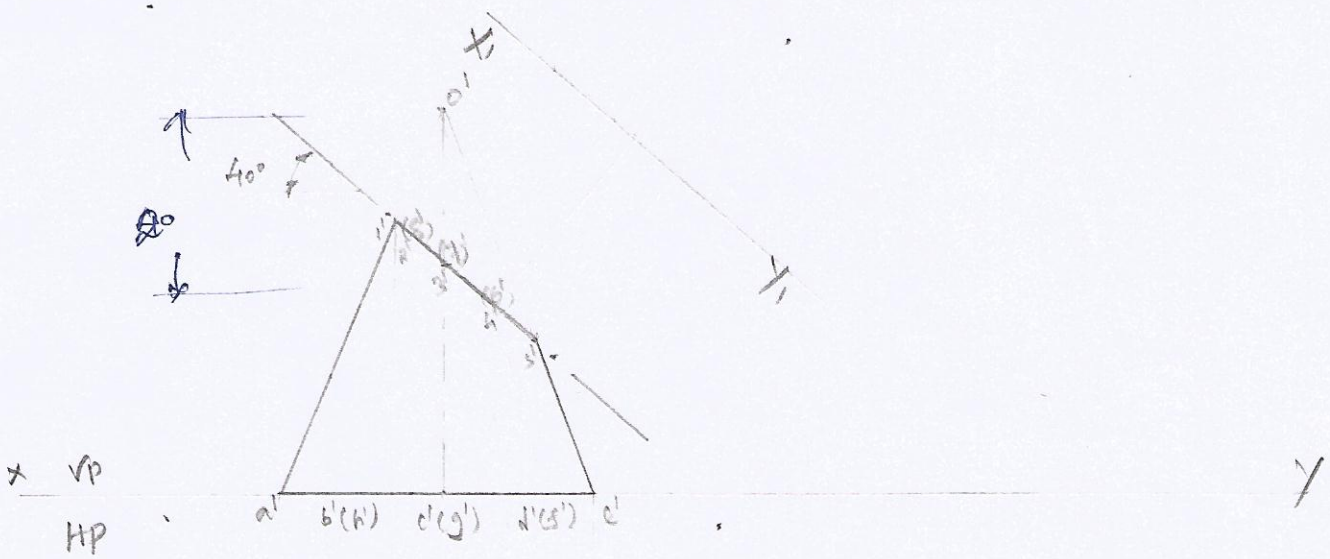
14. A cylinder of diameter 40mm and height 60mm rests on its base on the Hp. It is cut by a plane ⊥r to the Vp and inclined at 30° to the Hp. The plane bisects the axis. Draw the front view, Sectional top view, & the true shape of the section.

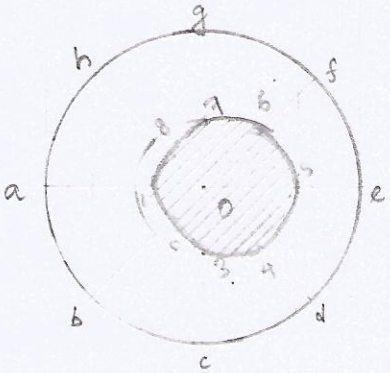


Sections of cones:

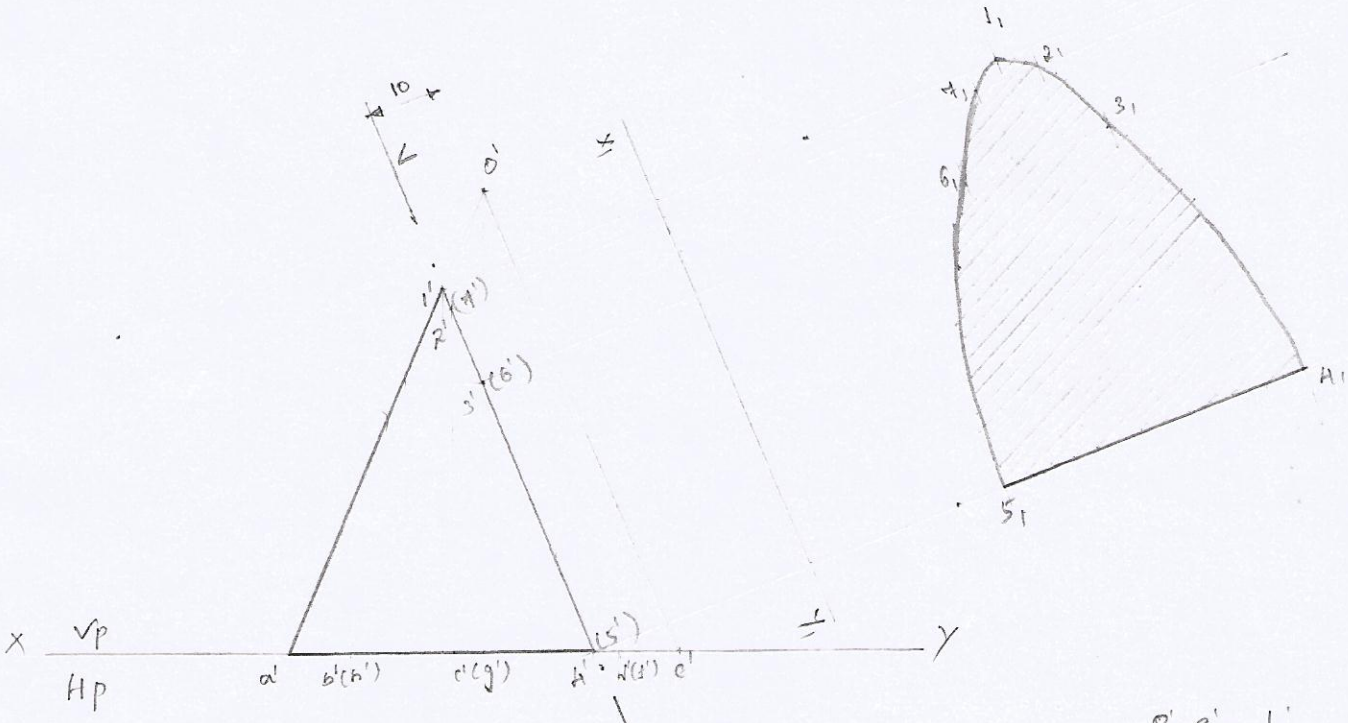
15. A cone of base diameter 40mm and height 50mm rests on its base on HP. It is cut by a Plane ⊥r to the VP. and inclined at 40° to the HP. The cutting plane meets the axis at 20mm from the Vertex. Draw the Sectional top view and the true shape of the section.

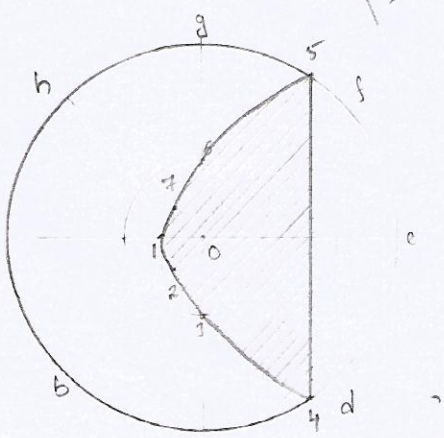






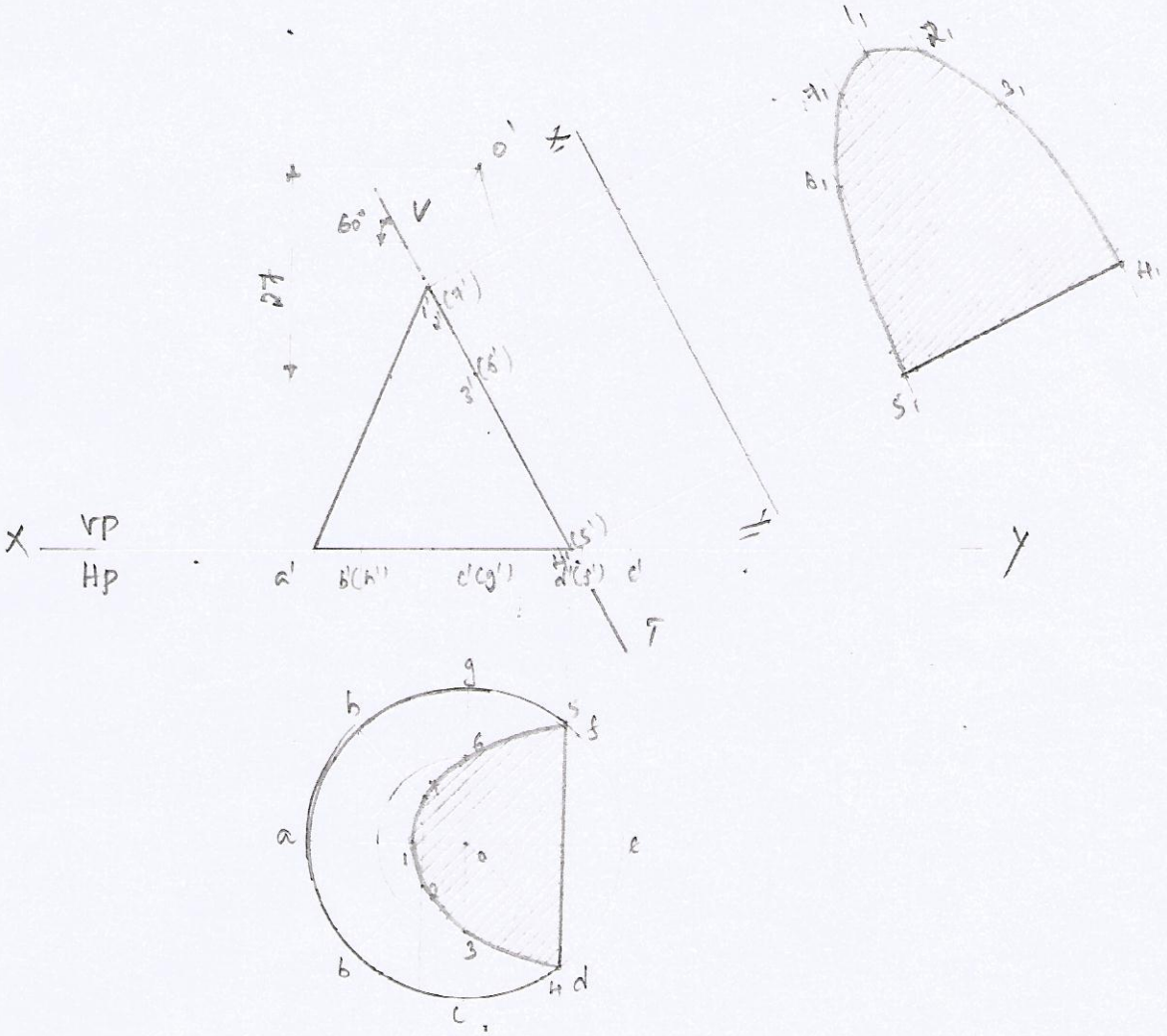
16. A cone of base diameter 50 mm and altitude 60 mm rests on its base on the HP. It is cut by a plane ⊥r to the VP & Parallel to one of the extreme generators, 10 mm away from it. Draw the sectional top view & the true shape of the section.



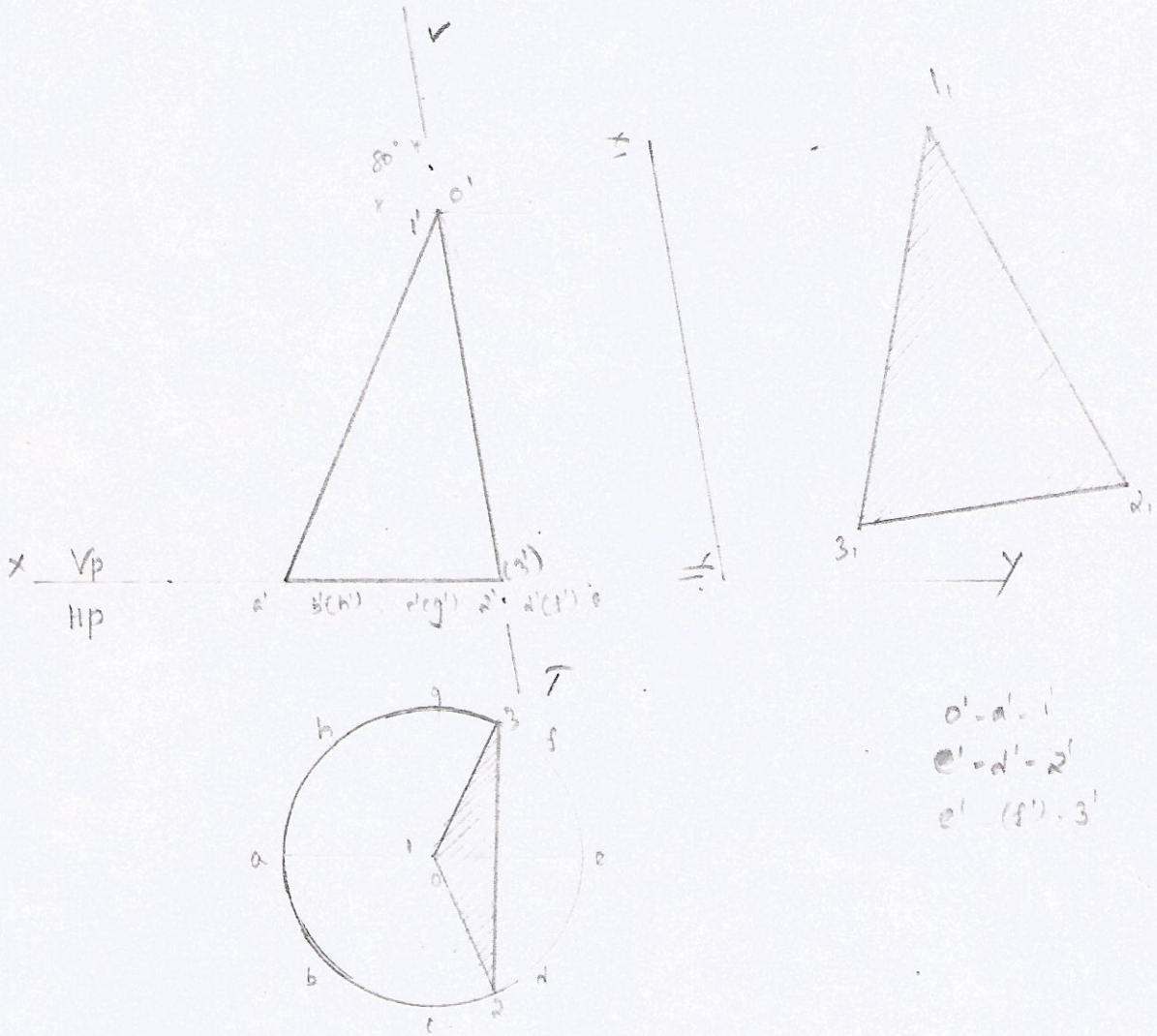


o'-a'-1'
o'-b'-2'
o'-c'-3'
e'-d'-4'
e'-(f')-(5')
o'-(g')-(6')
o'-(h')-(7')

11. A cone of base diameter 40mm and altitude 50mm rests on its base on the HP. It is cut by a plane ⊥r to the VP and inclined at 60° to the HP. The cutting plane meets the axis at 27mm from the vertex. Draw the sectional top view & the true shape of the section.



18. A cone of base diameter 40 mm and altitude 50 mm rests on its base on the Hp. It is cut by a section plane 1° to the Vp & inclined at 80° to the Hp, Passing through the apex. Draw the sectional top view and the true shape of the section.



o'-a'-1'
e'-d'-2'
e'(f')-3'

34 2

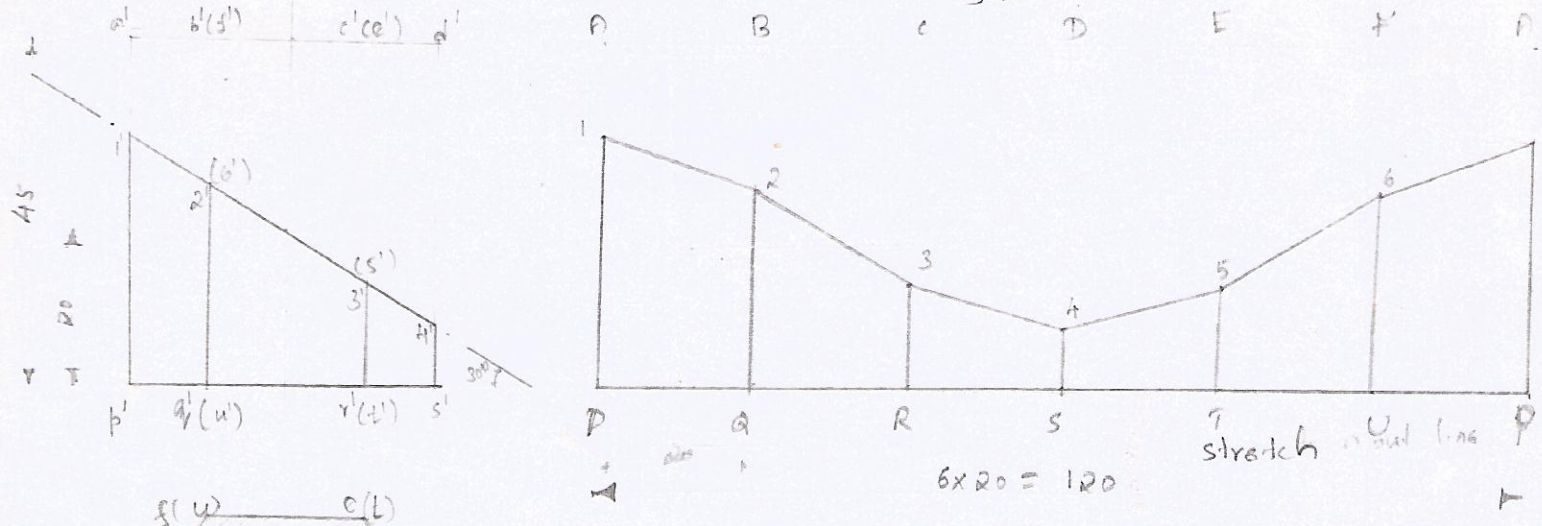
Development of Surfaces

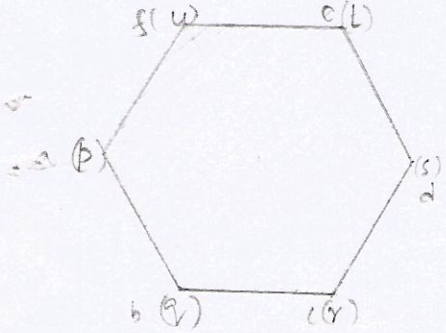
128 16

Development of Prisms:

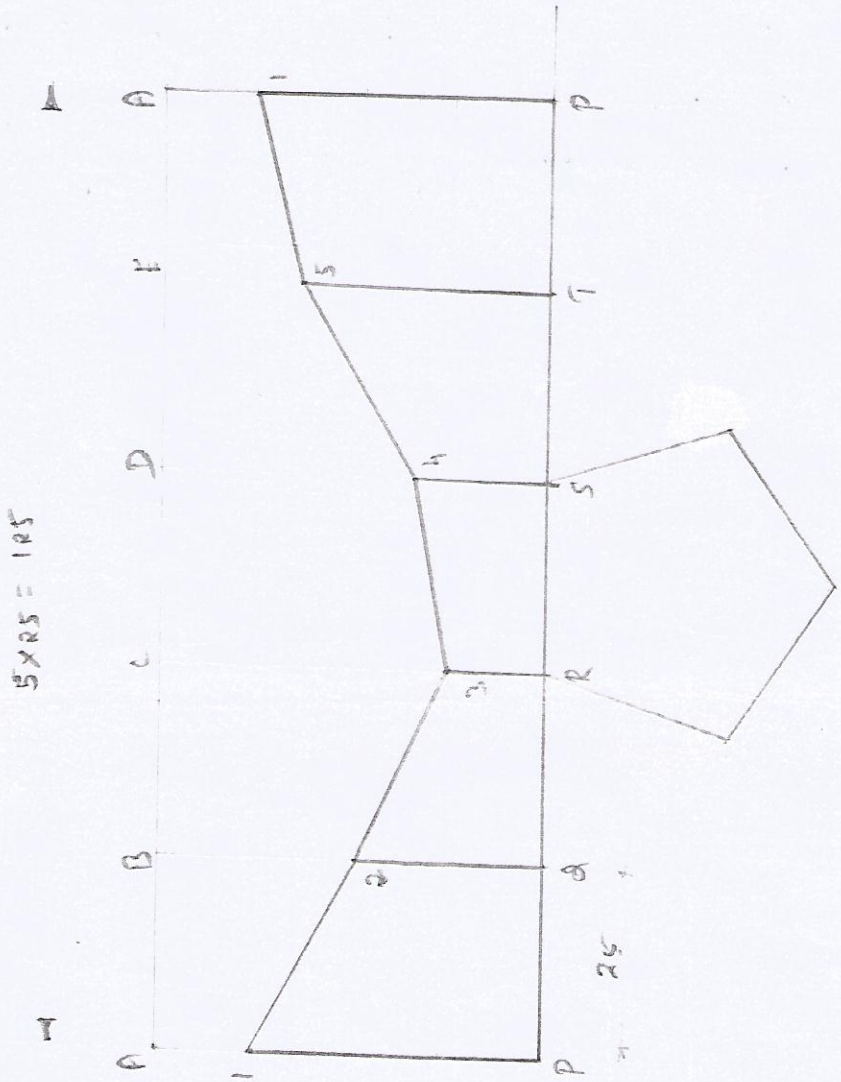
1. A hexagonal Prism of base sides 20mm and height 45mm is resting on one of its ends on the HP with two of its lateral faces Parallel to the VP. It is cut by a plane ⊥r to the VP & inclined at 30° to the HP. The plane meets the axis at a distance of 20mm above the base. Draw the development of the lateral surfaces of the lower portion of the Prism.

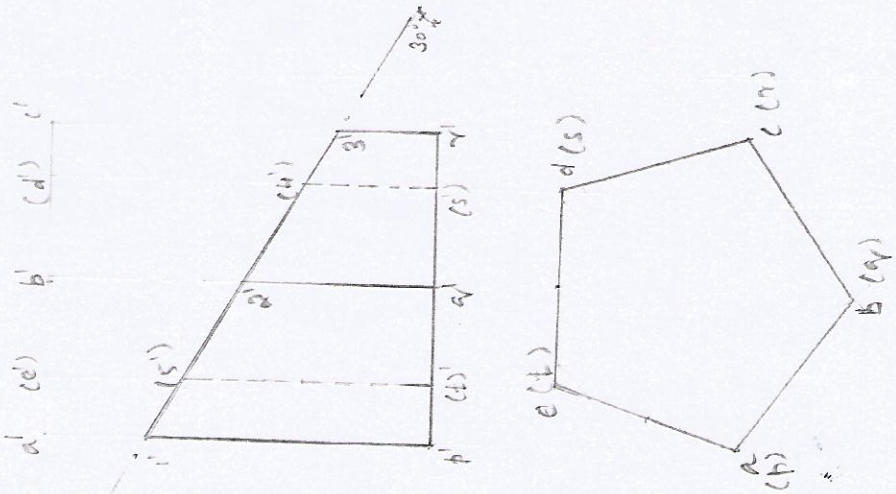
a'-p'-1'
b-q'-2'
c'-r'-3'
d'-s'-4'
(1')-(2')-(5')
(5')-(6')-(6')



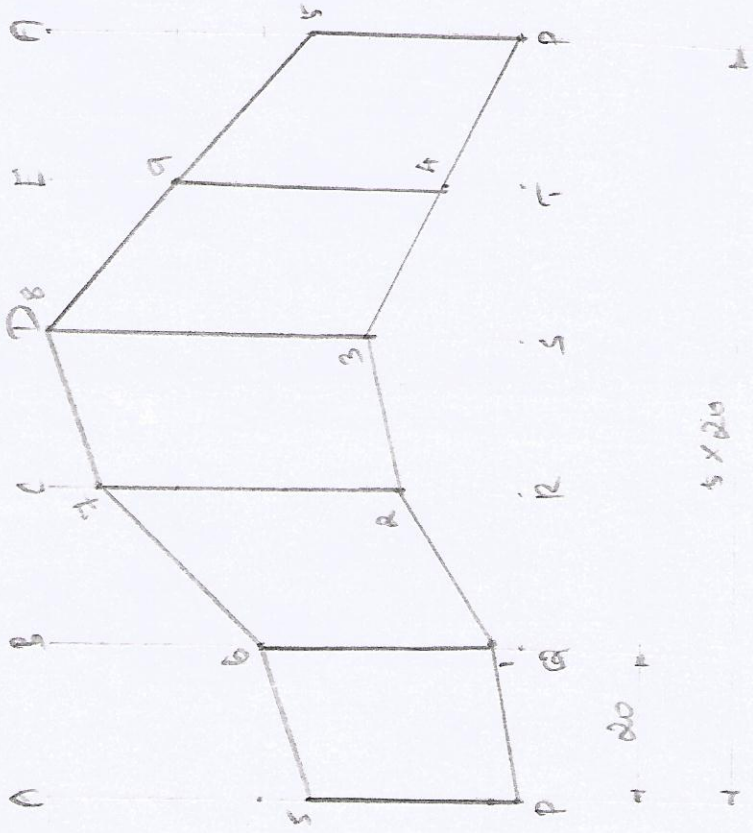


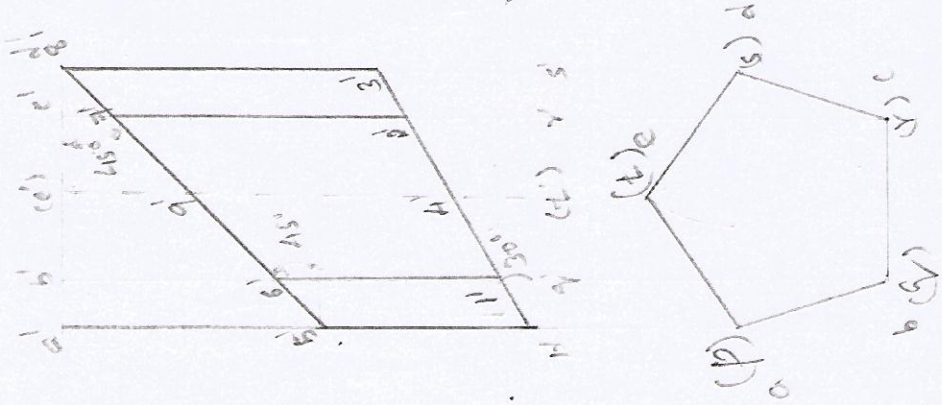
2. A Pentagonal Prism of base side 25mm & height 50mm is resting with one of the rectangular faces Parallel to VP and it is cut by a plane ⊥r to V.P & 30° to H.P, meets the axis at a height of 25mm above the base. Draw the development of lower Portion of the Prism.



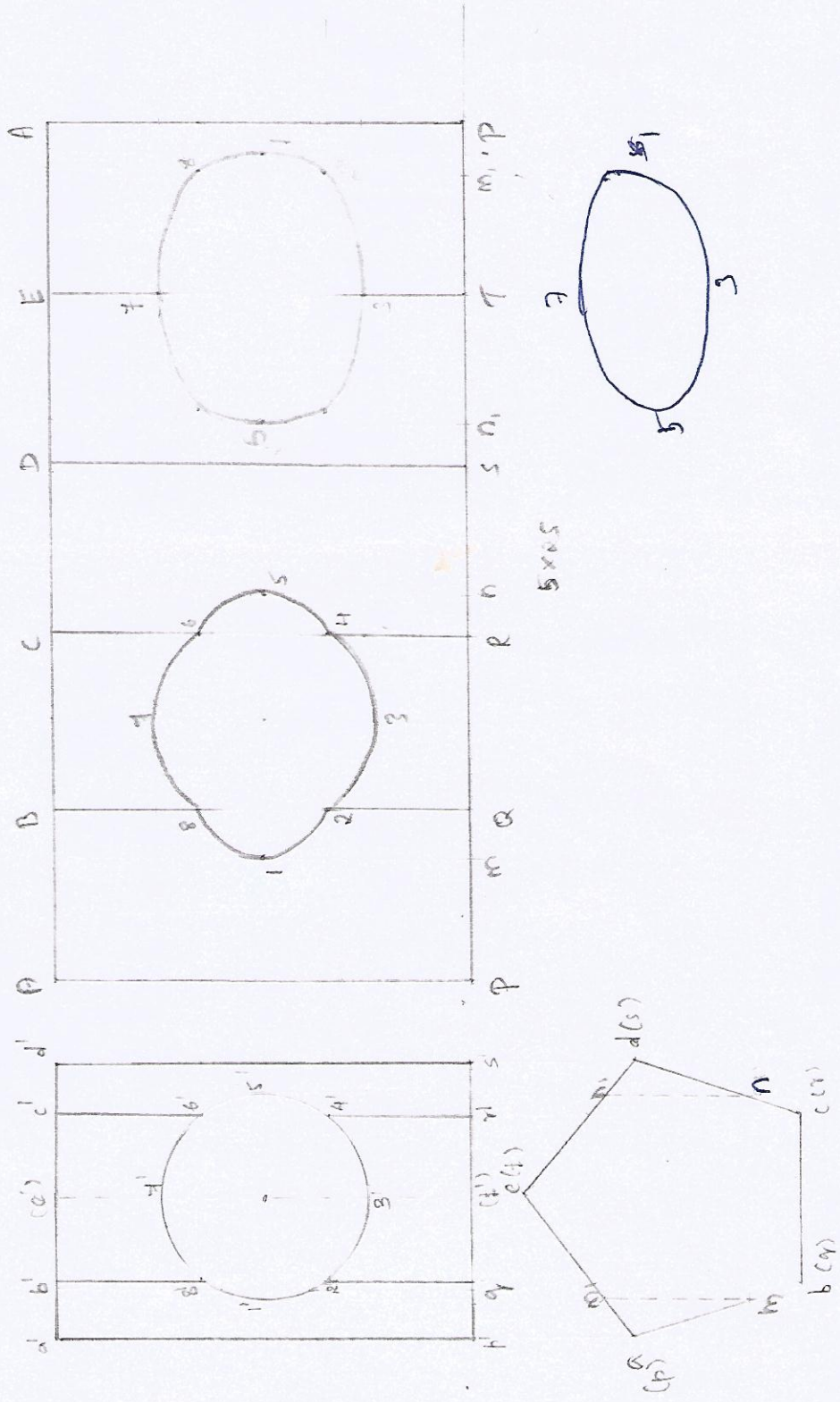


3. A Pentagonal Prism of base side 20mm and height 60 mm is cut by two planes as shown in fig. Draw the development of the lateral surface of the Portion b/n the cutting planes.

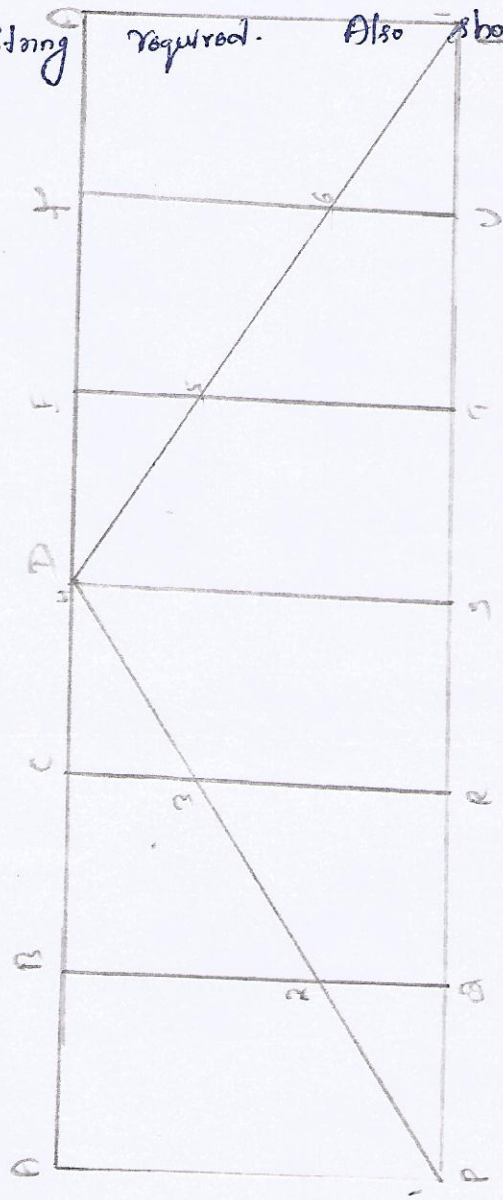




4. A Pentagonal Prism of base side 25mm and height 60mm stands on one of its ends on the Hp with a rectangular face Parallel to the Vp. A hole of diameter 30mm is drilled centrally through the Prism in such a way that the axis of the hole bisects the axis of the Prism at right angles. The axis of the hole is ⊥r to the Vp. Draw the development of the lateral surfaces of the Prism.

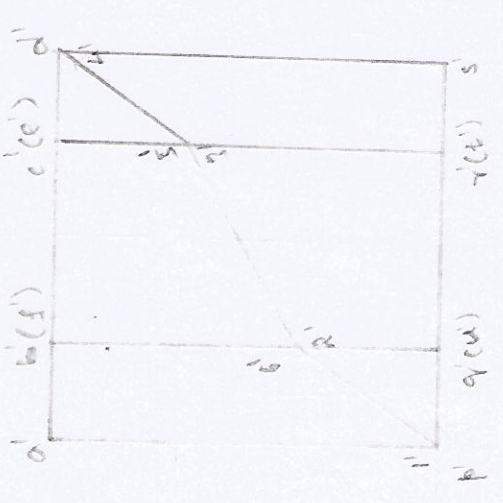


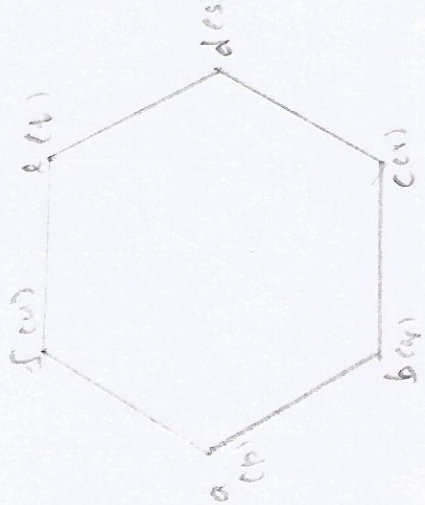
6. A hexagonal prism of base side 25mm and height 50 mm rests Vertically on the HP with a base side Parallel to VP. A string is wound round the surface of the Prism starting from extreme Point on the base, Passing through the diametrically opposite corner on the top end & ending at the starting Point. Find graphically the shortest length of the string required. Also show the path of the string in the front view.



6 × 25 = 150

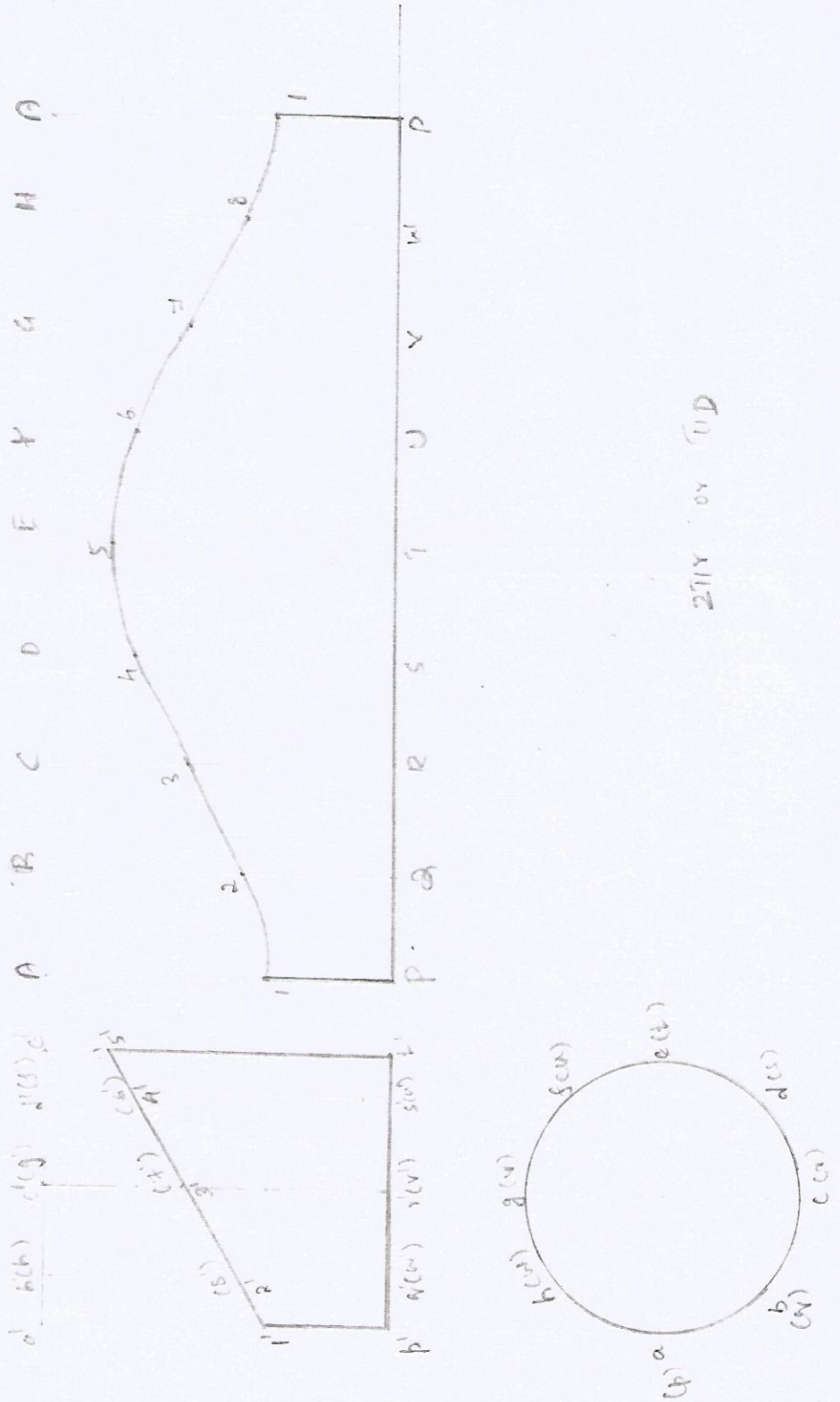
Shortest length of the string = 180 mm



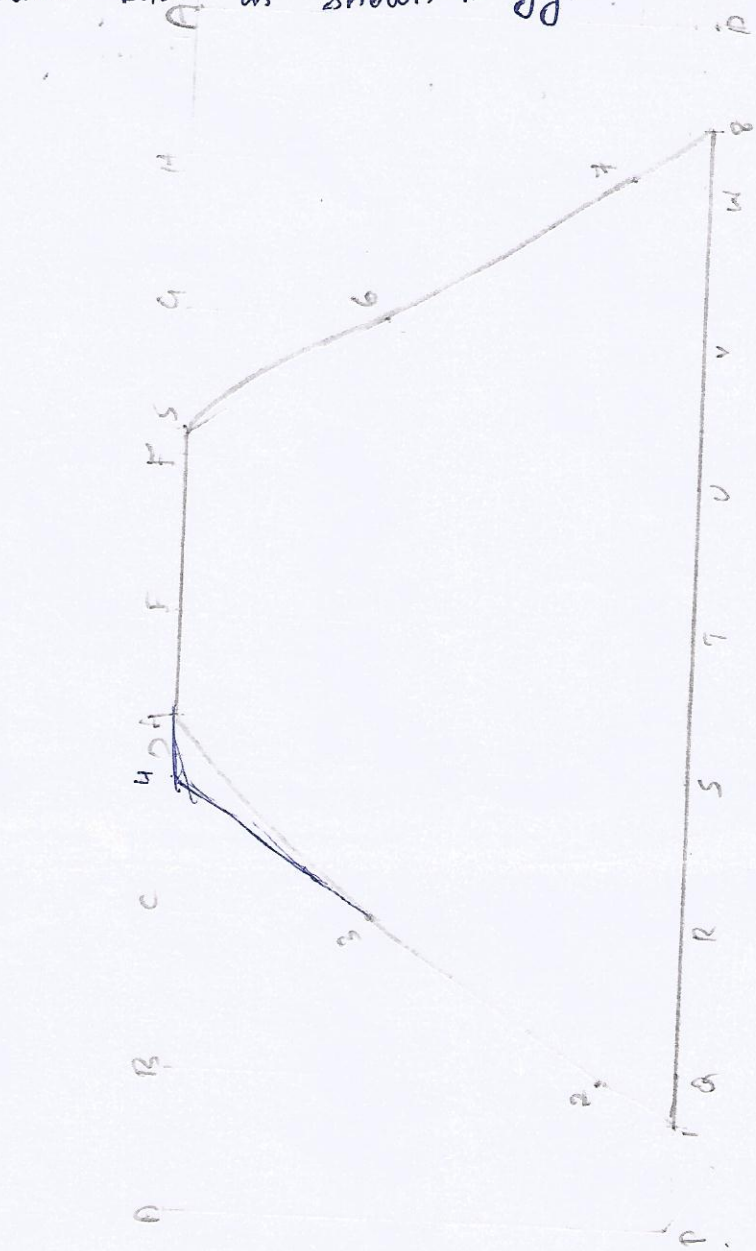


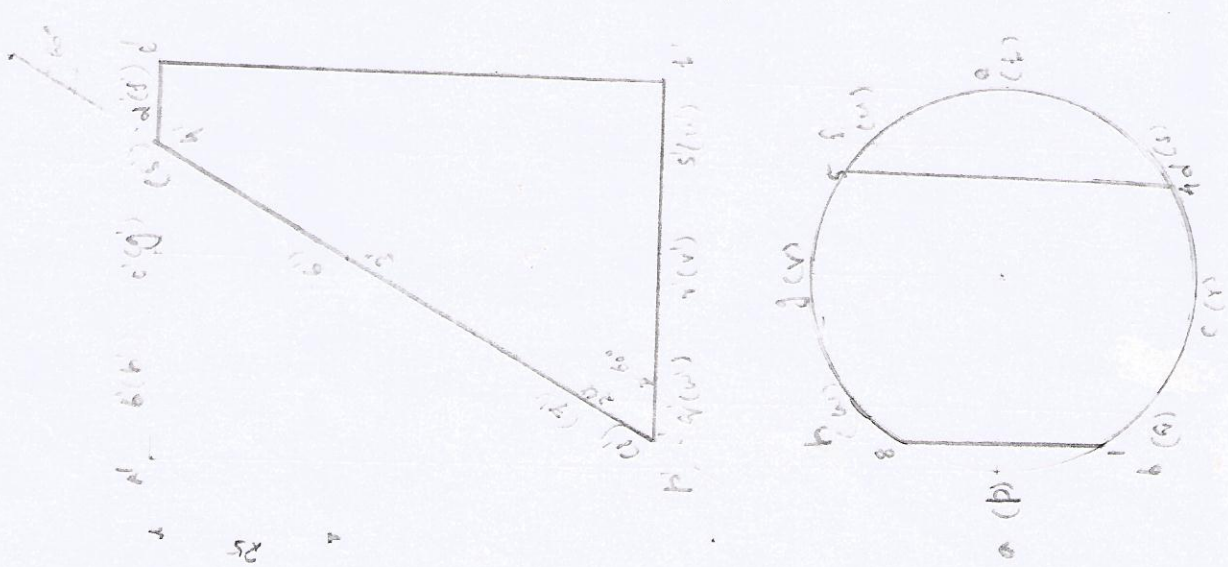
Development of cylinders

6. A cylinder of diameter 40 mm and height 50 mm is resting Vertically on one of its ends on the HP. It is cut by a plane ⊥r to the VP and inclined at 30° to the HP. The plane meets the axis at a point 30 mm from the base. Draw the development of the lateral surface of the lower portion of the ~~truncated~~ truncated cylinder.

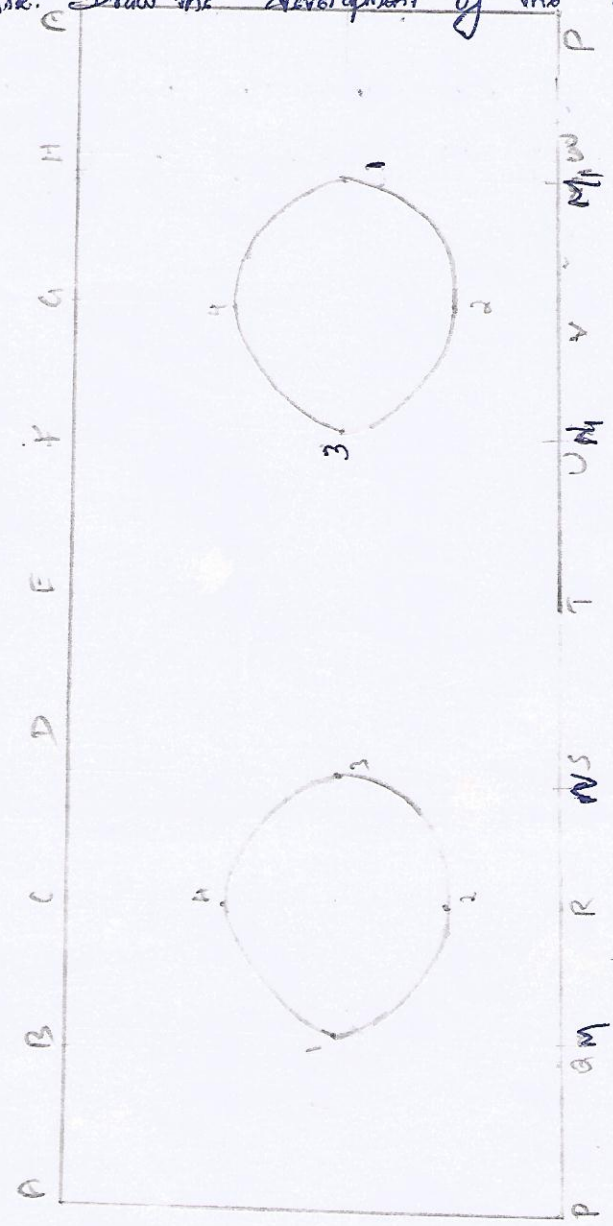


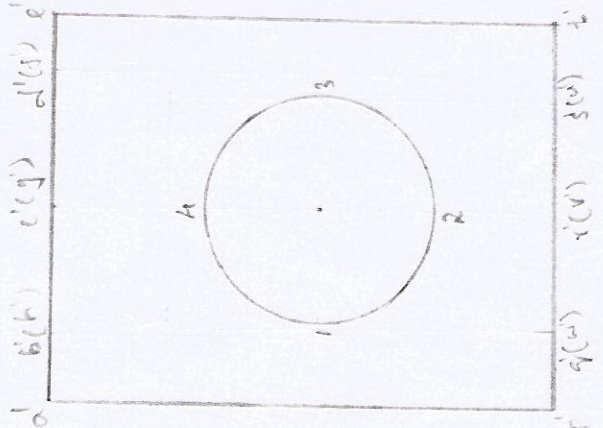
67. Draw the development of the lateral surface of the right portion of the cylinder of diameter 50 mm & height 65mm cut by a plane inclined at 60° to the base and passing through the axis at a height of 40mm above base as shown in fig.

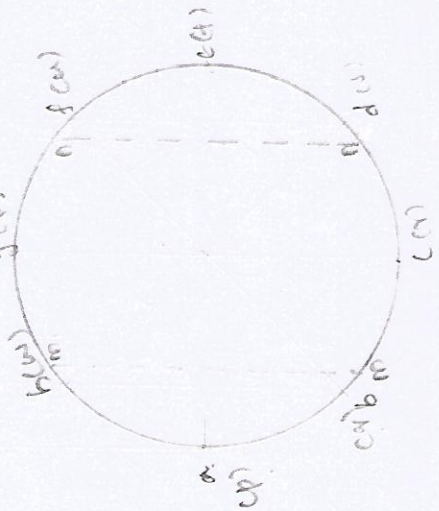




8. A circular hole of diameter 30mm is drilled through a vertical cylinder of diameter 50mm and height 65mm. The axis of the hole is ⊥r to the VP and meets the axis of the cylinder at right angles at a height of 30mm above the base. Draw the development of the lateral surface of the cylinder.

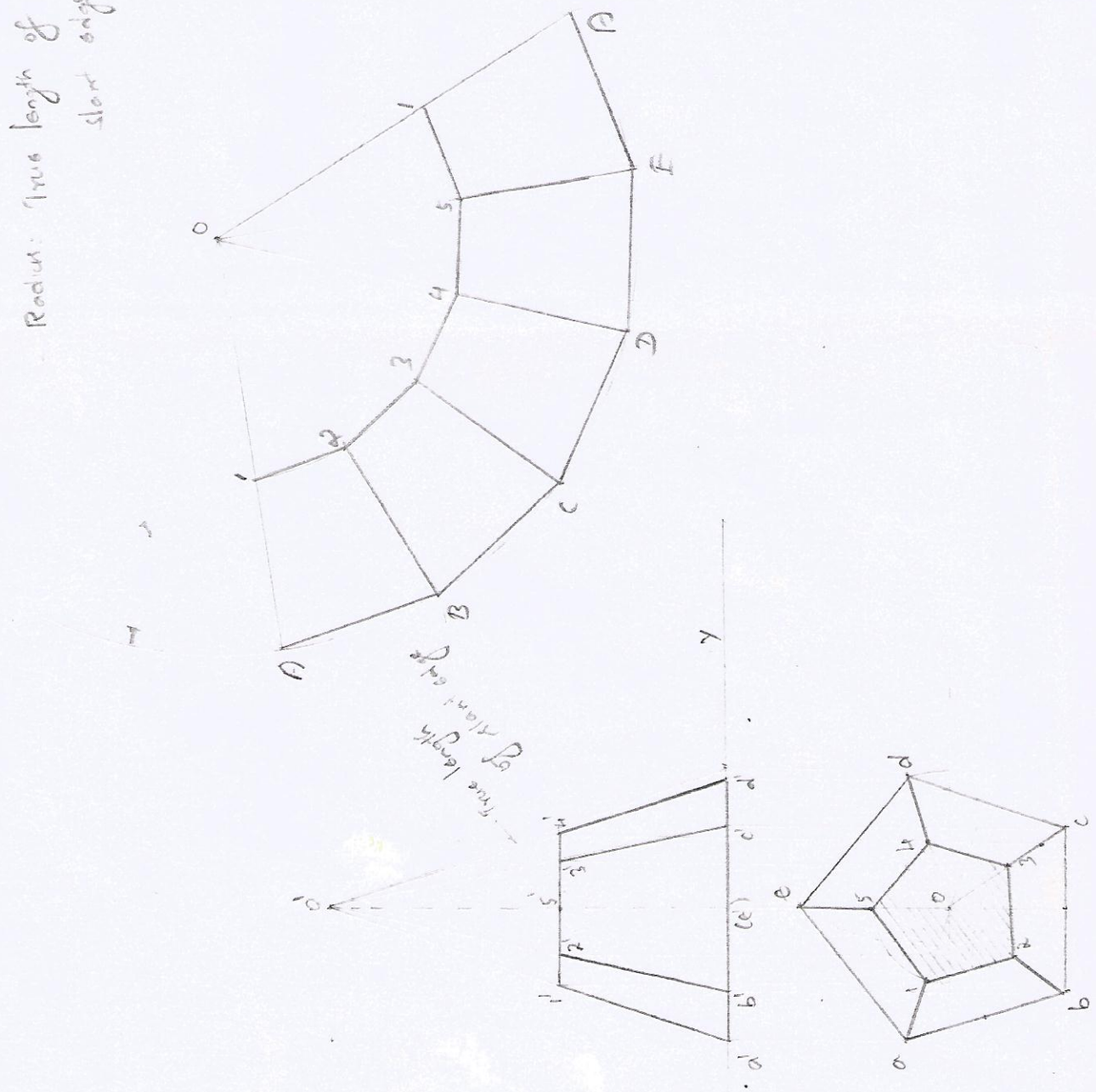




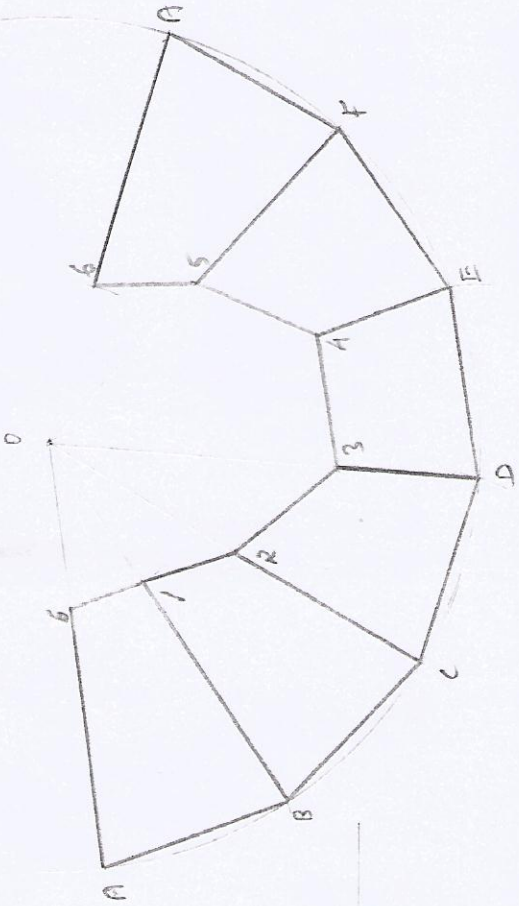


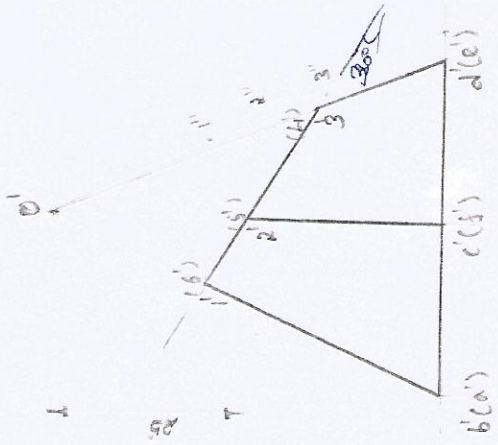
Development of Pyramids

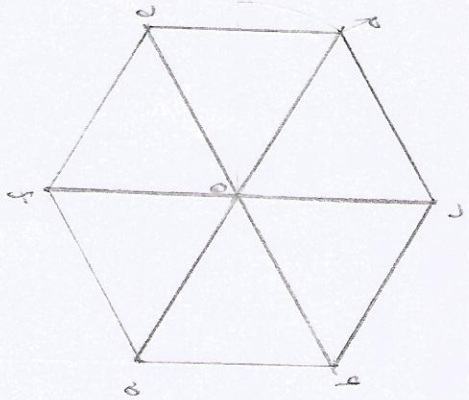
9. A Pentagonal Pyramid of base side 25 mm & height 60mm is resting vertically on its base on the ground with one of the sides of the base Parallel to the vp. It is cut by a plane ⊥r to the vp & Parallel to the hp at a distance of 25mm above the base. Draw the development of the lateral surfaces of the frustum of the Pyramid. Also show the top view of the cut surface.



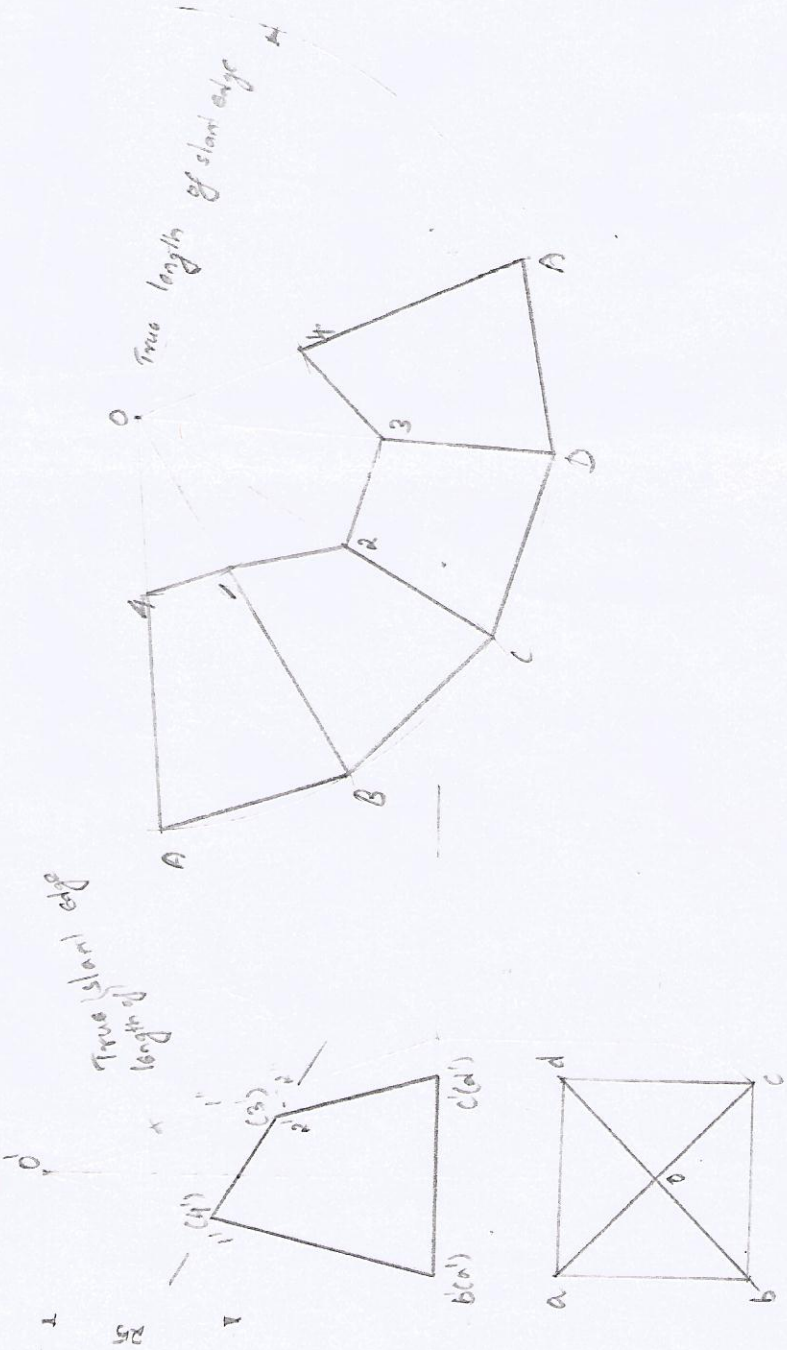
10. A hexagonal Pyramid of base of side 25mm & altitude 50 mm is resting Vertically on its base on the ground with two of the sides of the base ⊥r to the vp. It is cut by a Plane ⊥r to the vp and inclined at 30° to the hp. The Plane bisects the axis of the Pyramid. Draw the development of the lateral surfaces of the Pyramid.



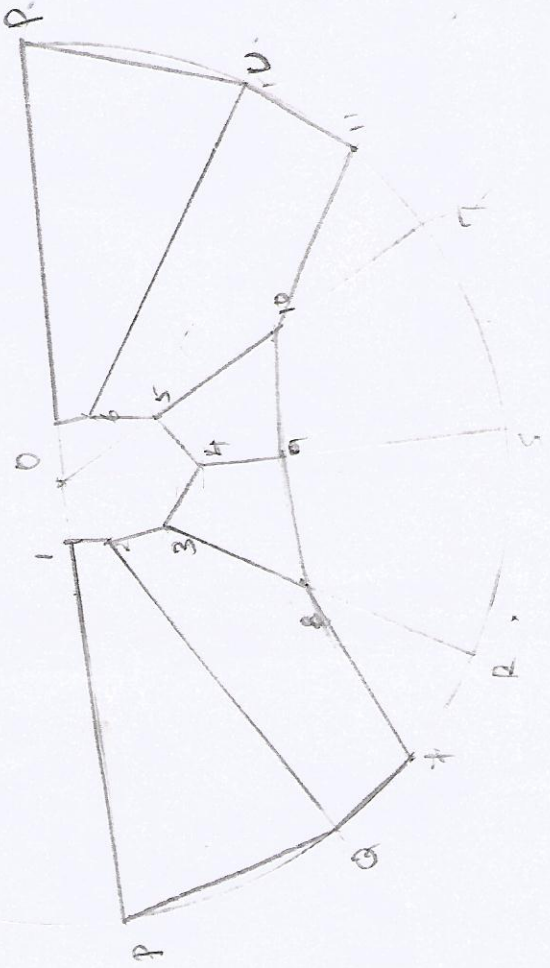


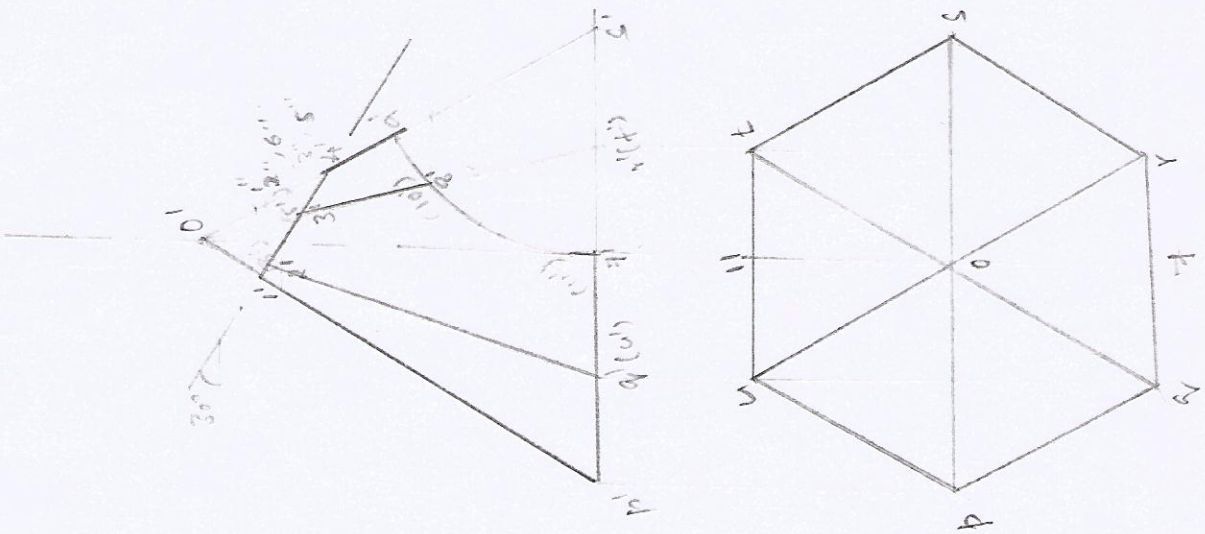


11. A square Pyramid of base side 25mm & altitude 50mm rests on its base on the HP with two sides of the base Parallel to the VP. It is cut by a plane bisecting the axis and inclined at 30° to the base. Draw the development of the lateral surfaces of the lower part of the cut pyramid.

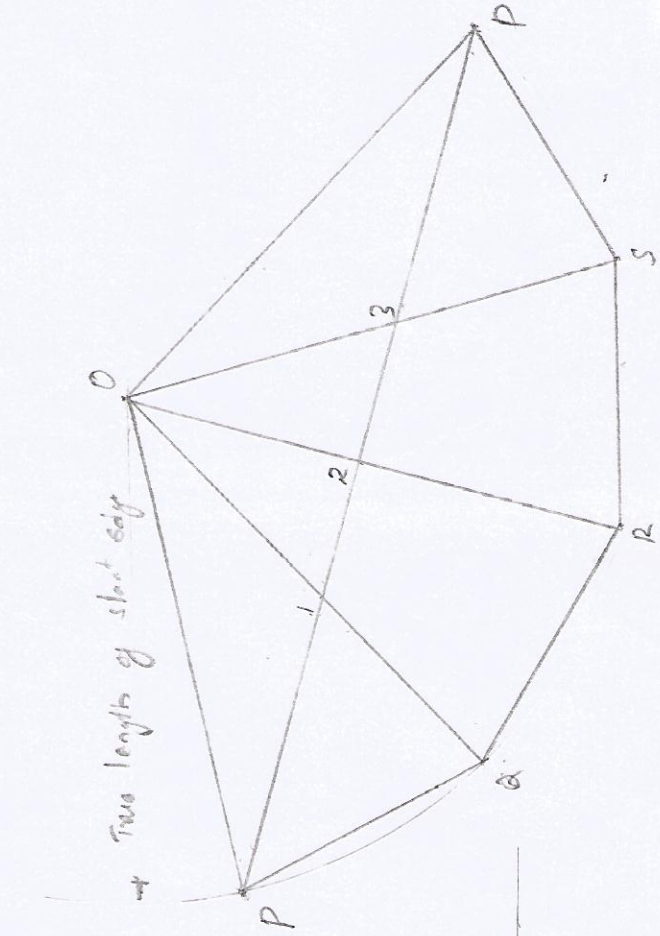


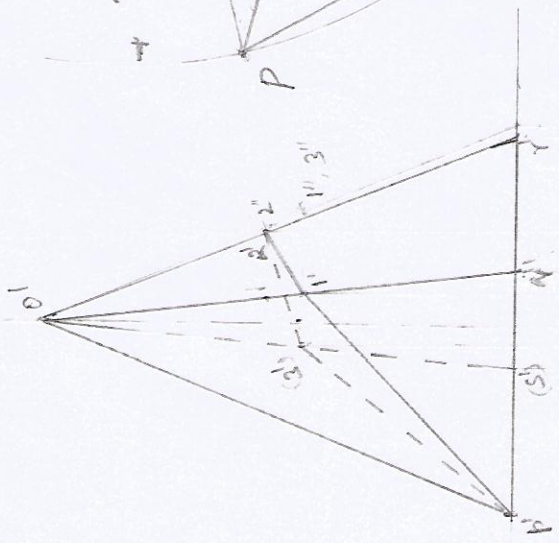
12. A hexagonal Pyramid of base of side 30mm & height 50mm rests Vertically on its base on the ground with two of its base sides Parallel to the vp. It is cut by a plane inclined at 30° to the HP and ⊥r to the vp. & meeting the axis at a point 10mm below the Vertex. There is also a circular slot of radius 20mm from the extreme point on the base, as shown in fig. Draw the Development of the lateral surfaces of the Pyramid.

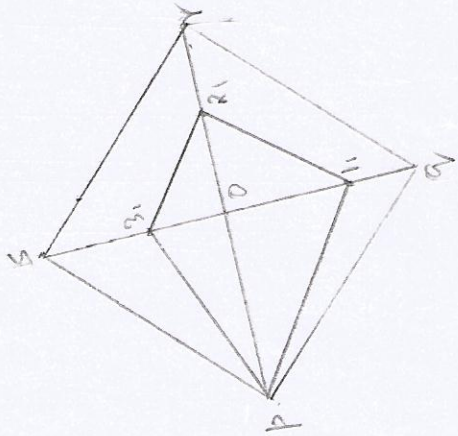




13. A square Pyramid of base side 35mm and axis 60mm rests on its base on the ground with one of the sides of the base inclined at 30° to the vp. A string is wound round the surfaces of the Pyramid starting from left extreme point on the base and ending at the same point. Find the shortest length of the string required. Also trace the path of the string in the front & top views.

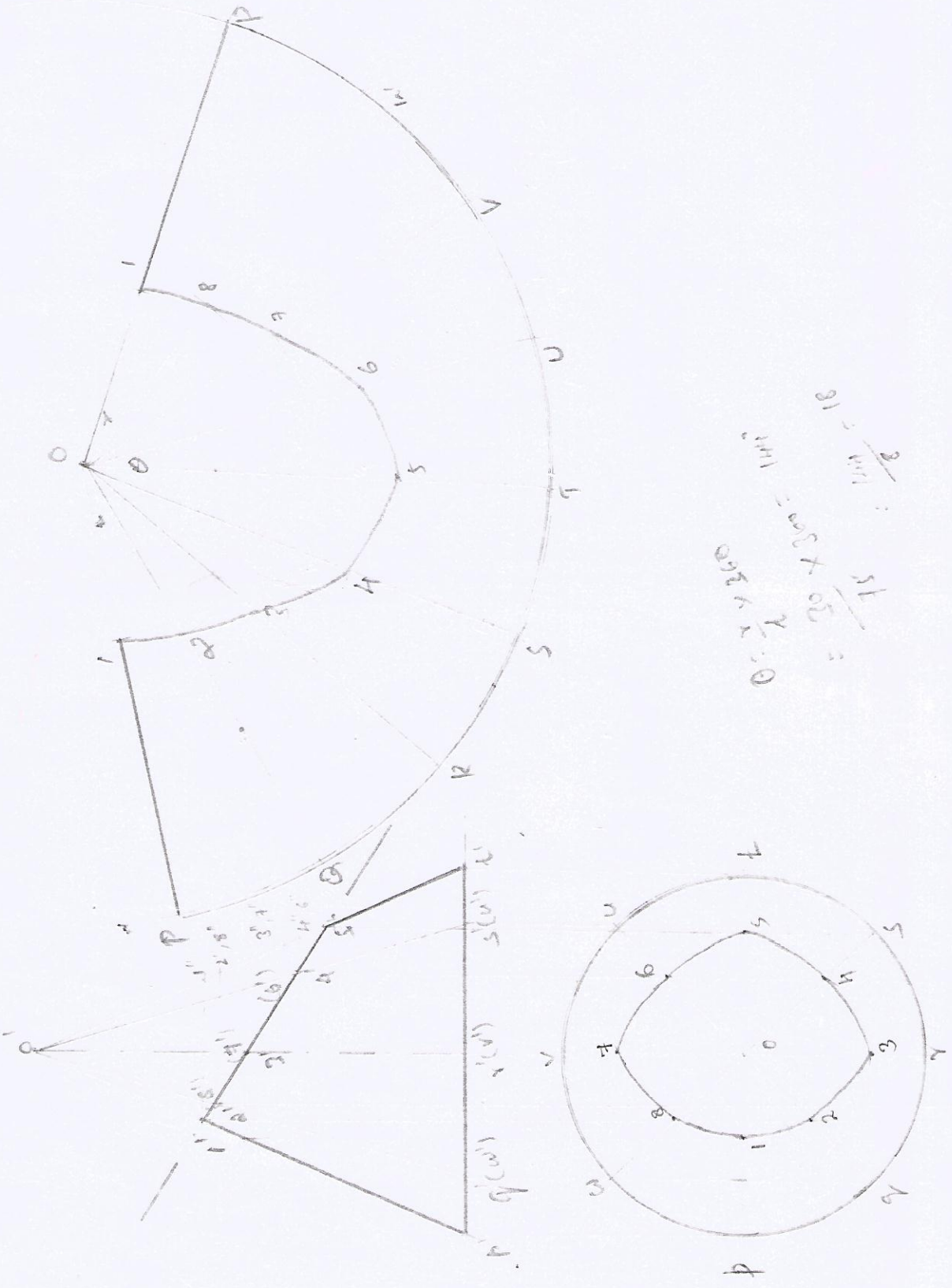




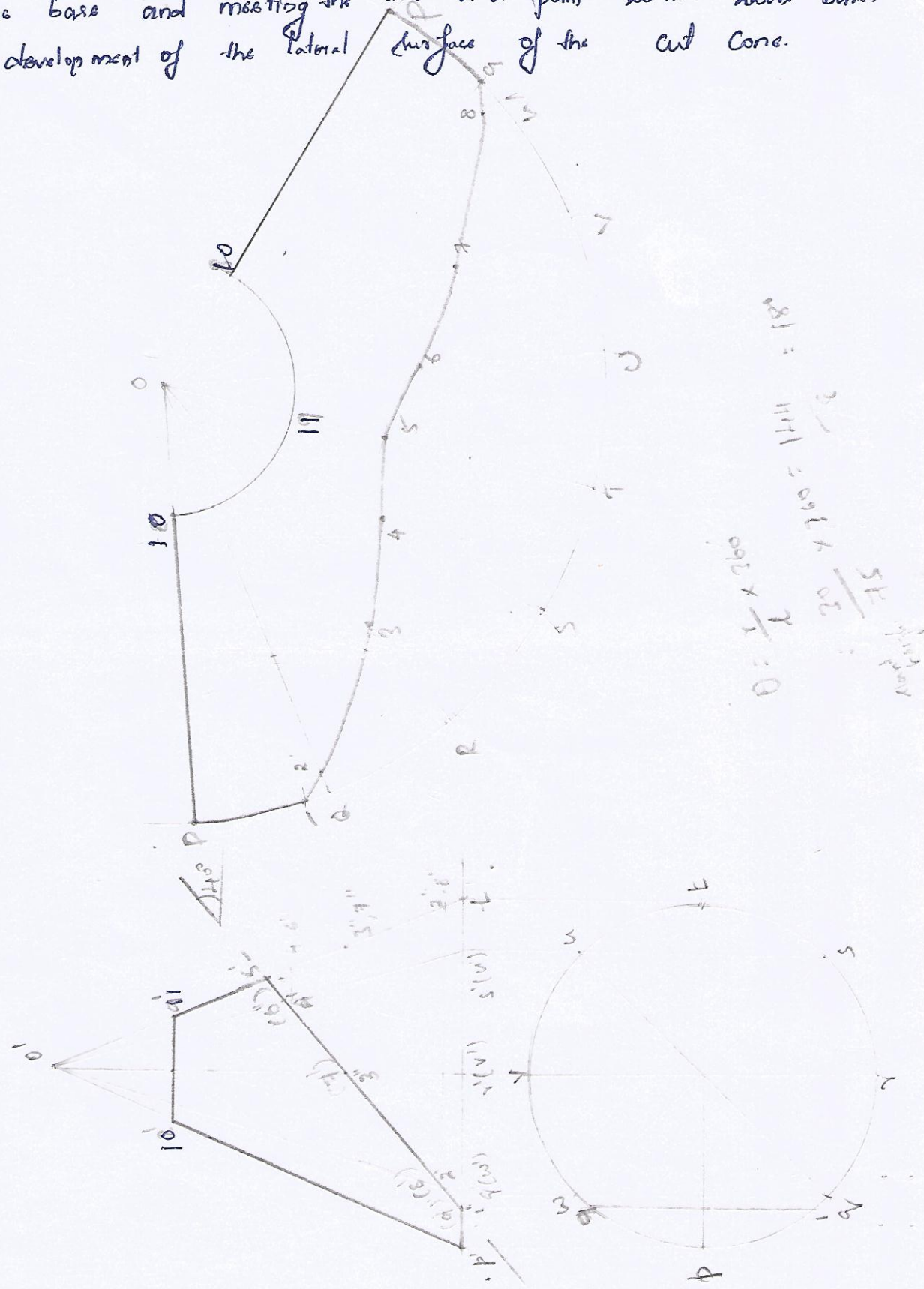


Development of cone:

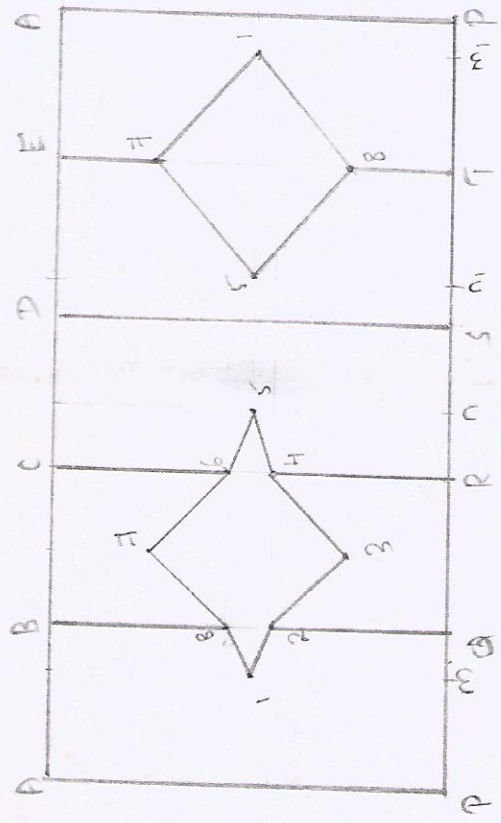
14. A right circular cone of base diameter 60mm & height 70mm is resting on its base on the ground. It is cut by a plane perpendicular to the VP and inclined at 30° to the HP. The cutting plane bisects the axis of the cone. Draw the development of the lateral surface of the truncated cone.

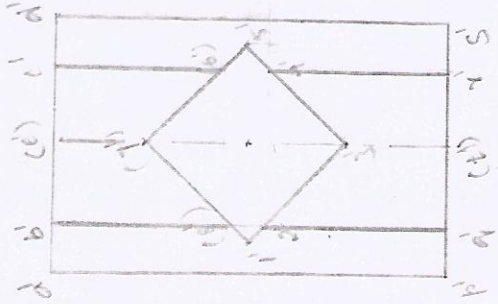


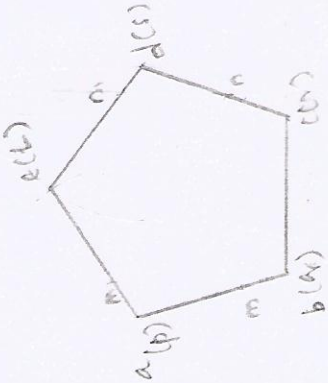
15. A cone of base diameter 60mm & height 70mm is resting on its base on the ground. It is cut by a plane ⊥r to the Vp. and parallel to the Hp at a distance 20mm from the vertex. It is also cut by a plane inclined at 45° to the base and meeting the axis at a point 20 mm above base. Draw the development of the lateral surface of the cut cone.



17. A Pentagonal Prism of base edge 20mm and axis length 50mm stands on one of its ends on the HP with a vertical face parallel to the VP and farther away from it. A square slot of diagonals 25mm is drilled centrally right through the Prism in such a way that one diagonal coincides with the axis of the Prism. The axis of the square slot is ⊥r to the VP. Draw the development of the lateral surfaces of the Prism with the square cut-out.







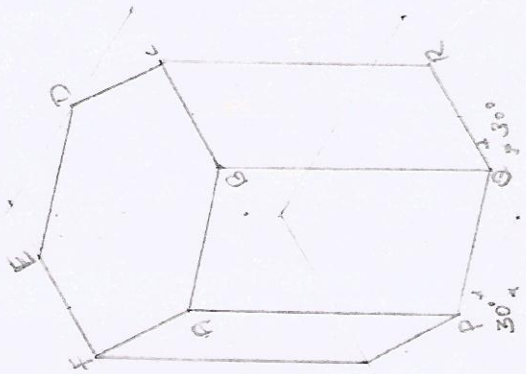
2 set - 18

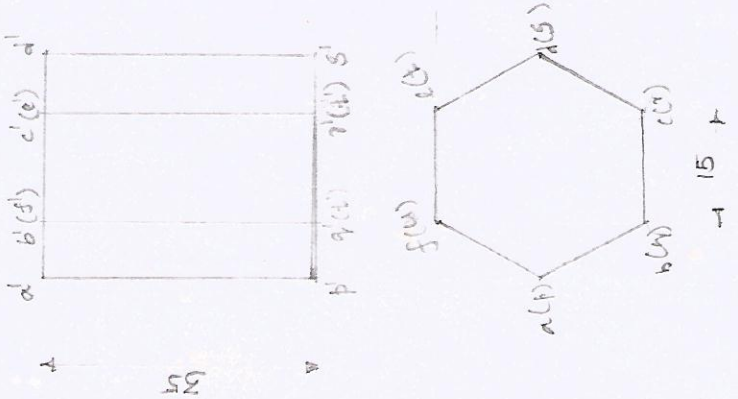
3

Unit. V

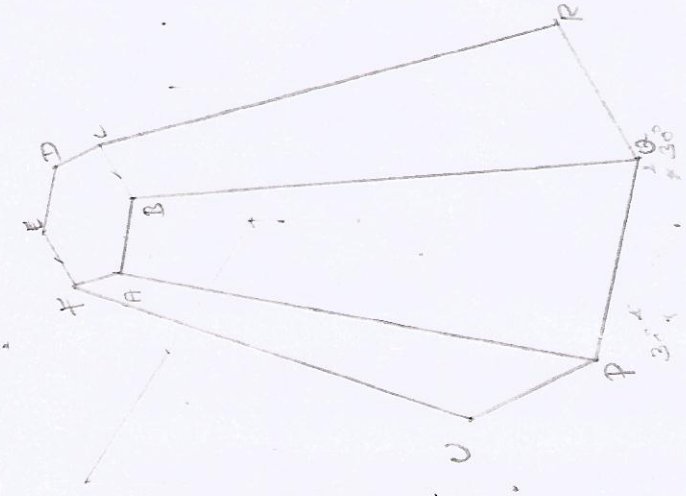
Isometric Projection

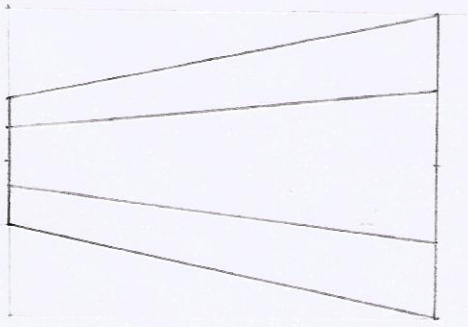
1. Draw the isometric view of a hexagonal Prism of base side 15mm and height 35mm when it rests on one of its ends on the Hp with two of its base sides parallel to the VP.

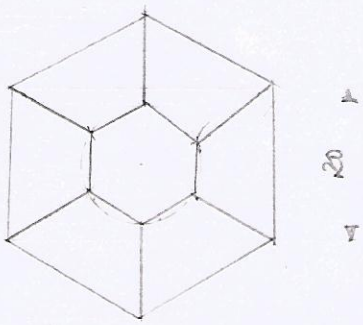




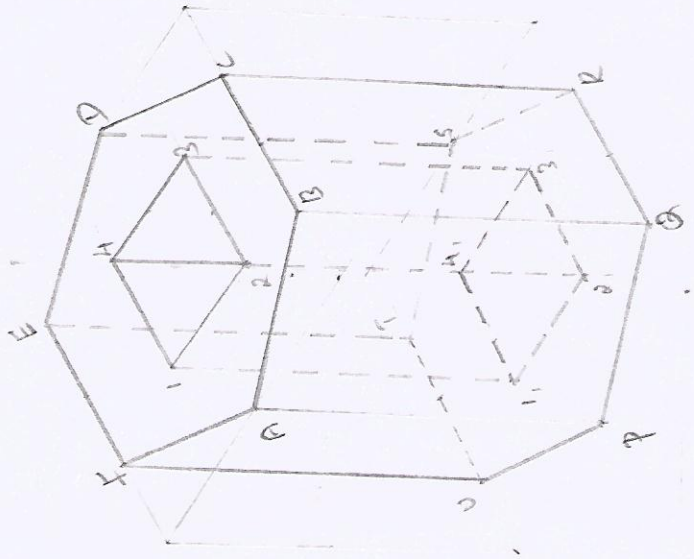
2 Draw the isometric view of a frustum of a hexagonal Pyramid when it is resting on its base on the HP with two sides of the base Parallel to the VP. The side of base is 20mm & top 8mm. The height of the frustum is 55mm.

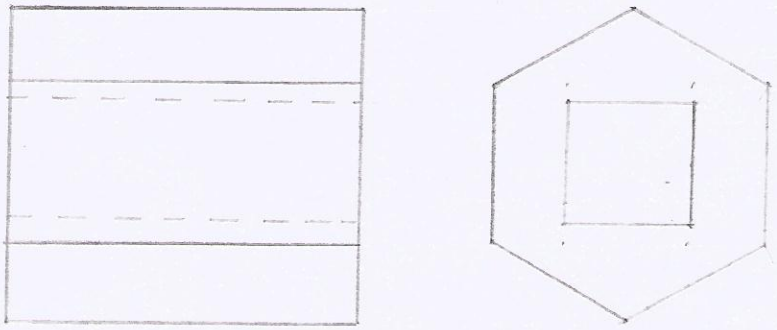




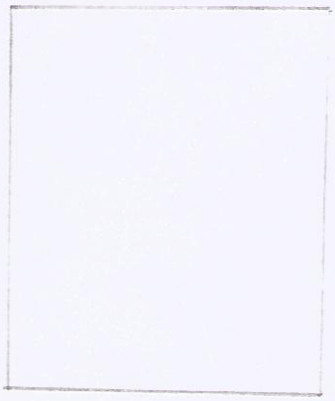


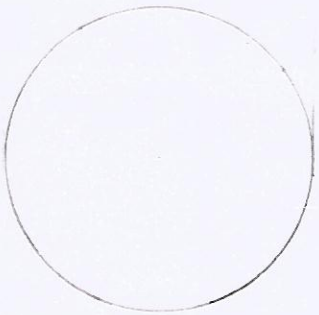
3. A hexagonal Prism of base side 20mm & height 45mm has a square hole of side 16mm at the centre. The axes of the square and hexagon coincide, one of the faces of the square hole is Parallel to a face of the hexagon. Draw the isometric view of the Prism with hole to full scale.

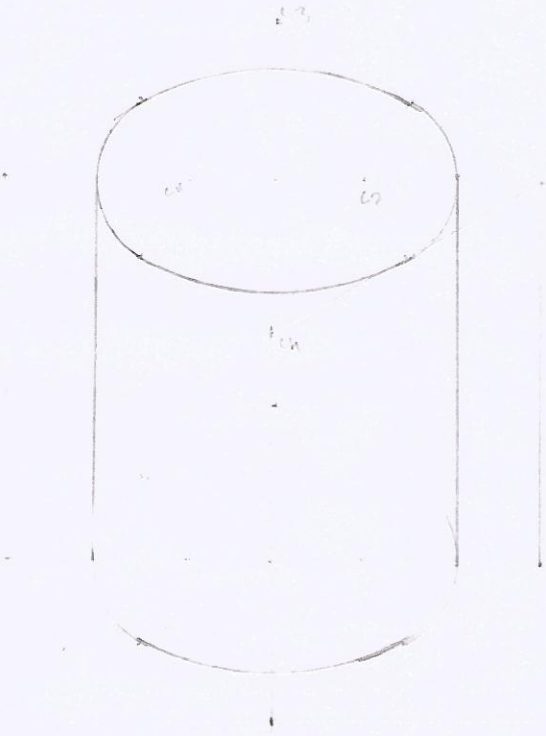




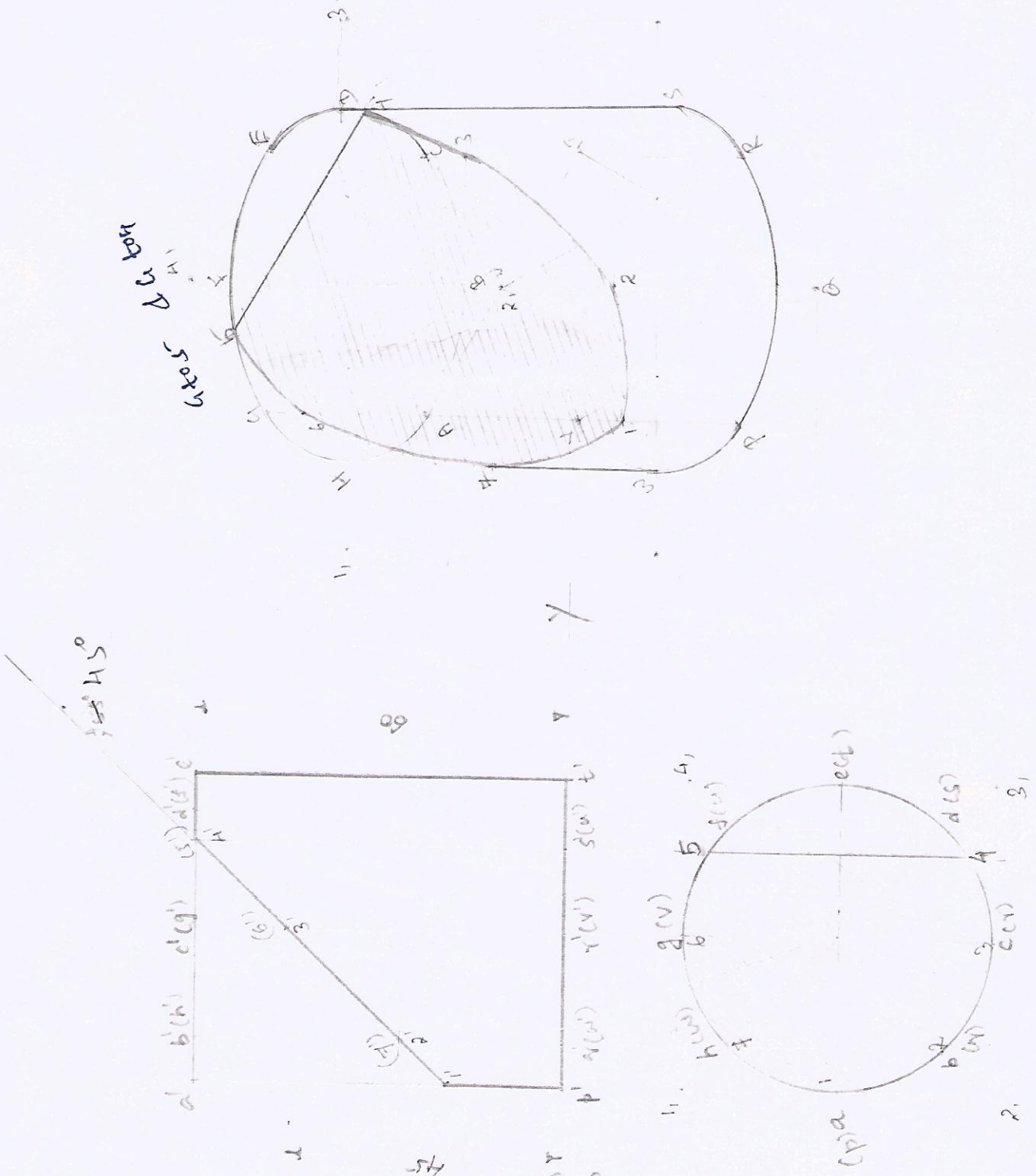
4. Draw the isometric view of a cylinder resting on one of its ends on the HP.



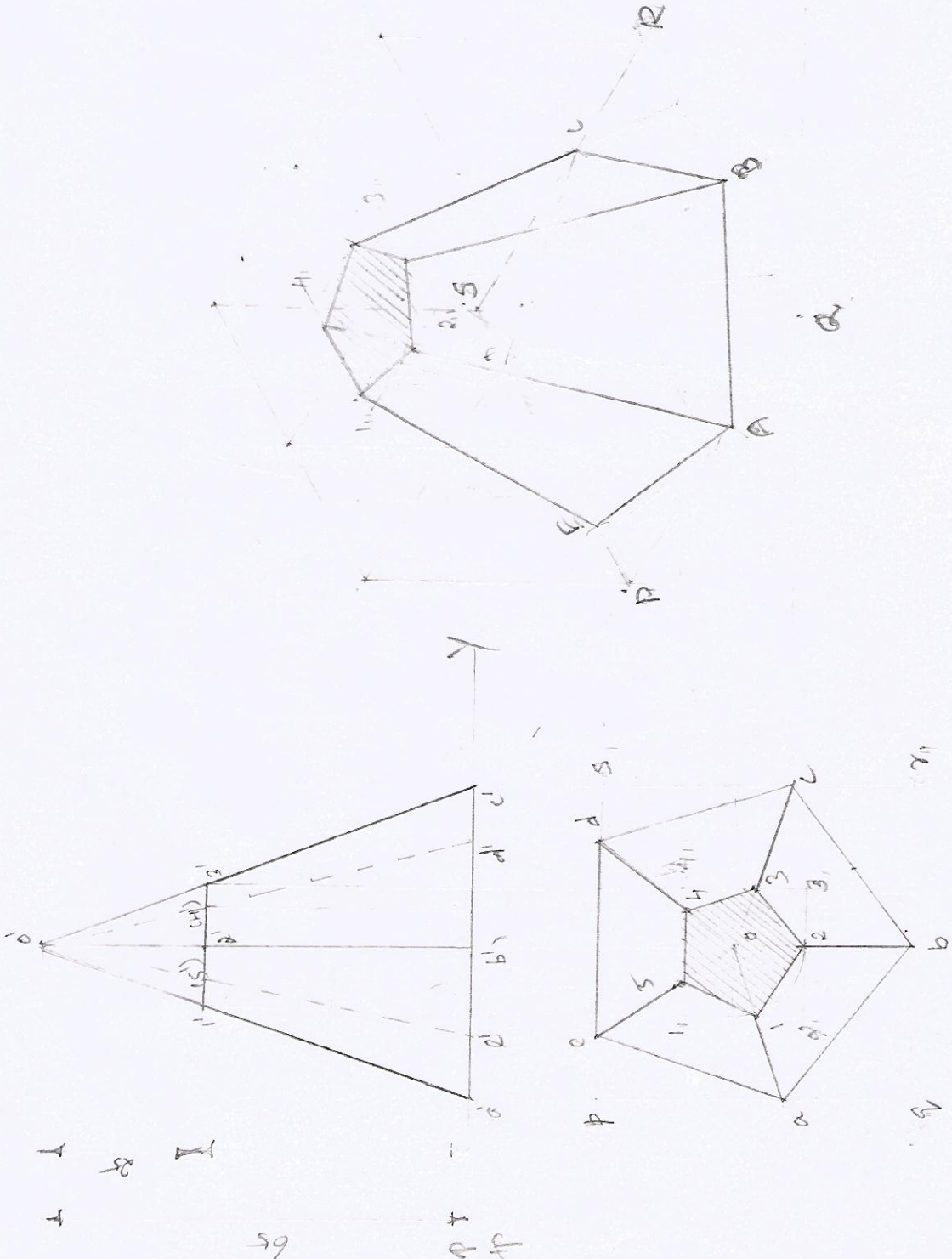




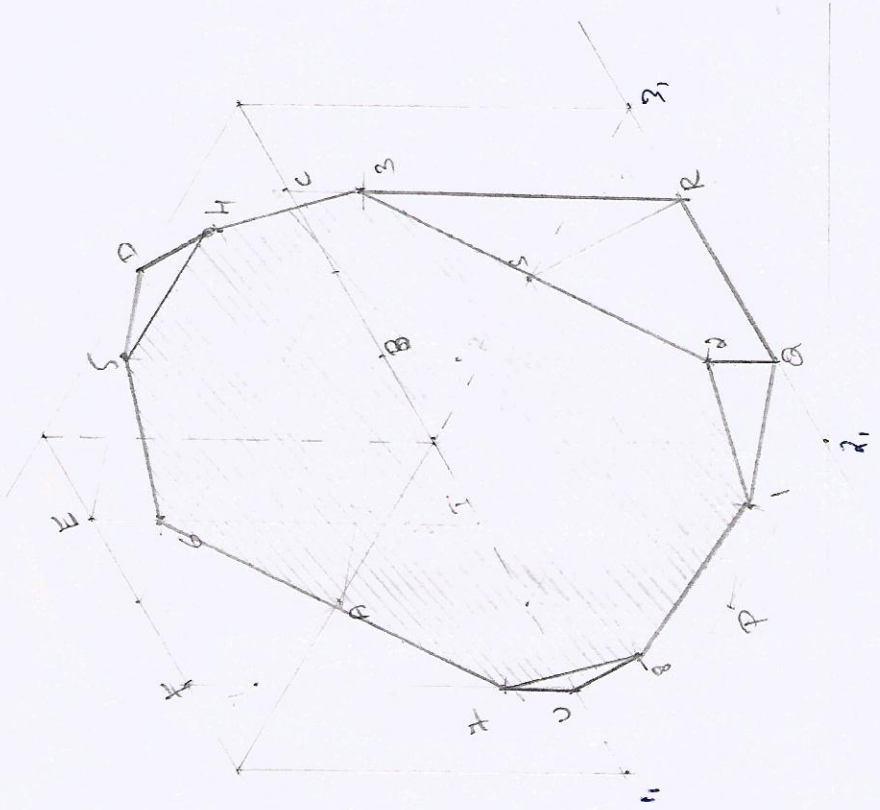
5. A cylinder 50 mm diameter & 60 mm height stands on Hp. A Section Plane $\perp^r$ to Vp, inclined at 45° to Hp cuts the cylinder and Passes through a Point on the axis at a height of 45mm above the base. Draw the isometric ~~Projection~~ view of the truncated Portion of the cylinder, when the cut surface is clearly visible to the observer.

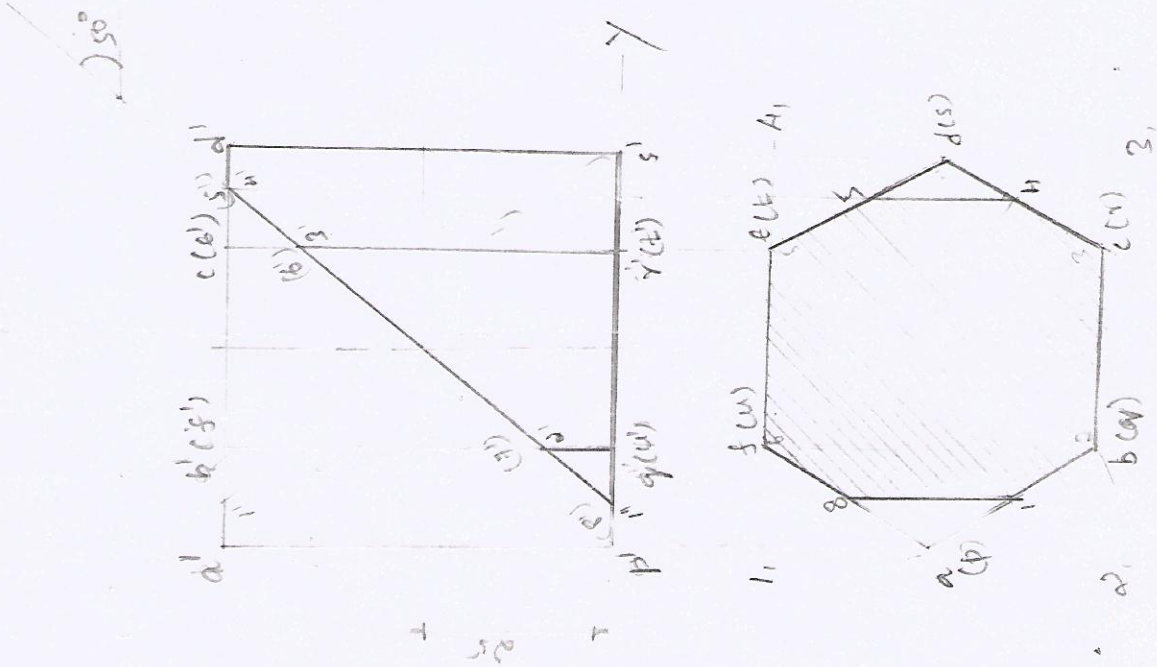


6. A Pentagonal Pyramid, base 30mm & axis 65mm long, rests with its base on Hp. An edge of the base is Parallel to Vp and nearer to it. A horizontal section Plane Cuts the Pyramid and Passes through a Point on the axis at a distance of 25mm from the apex. Draw the isometric Projection of the frustum of the Pyramid.

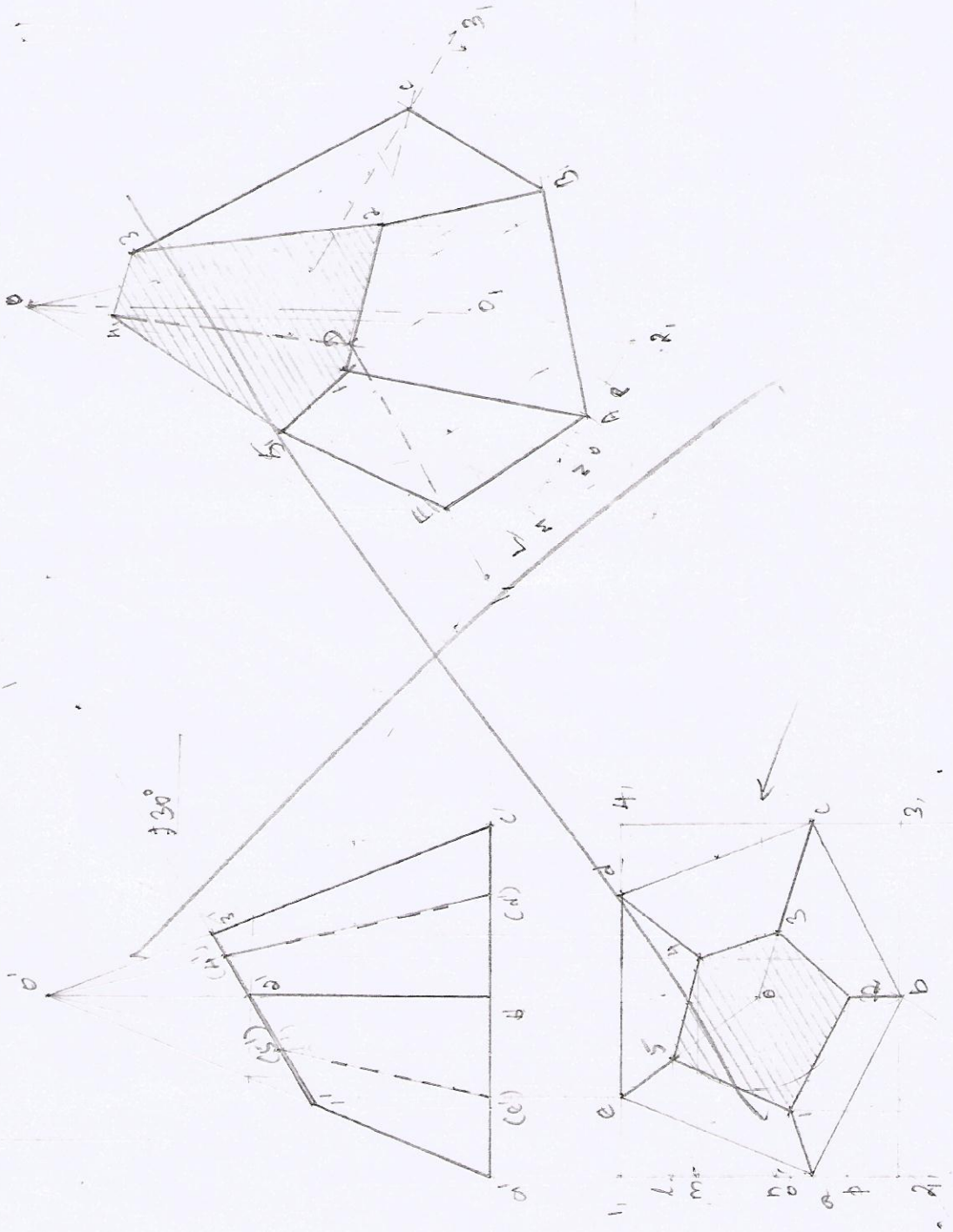


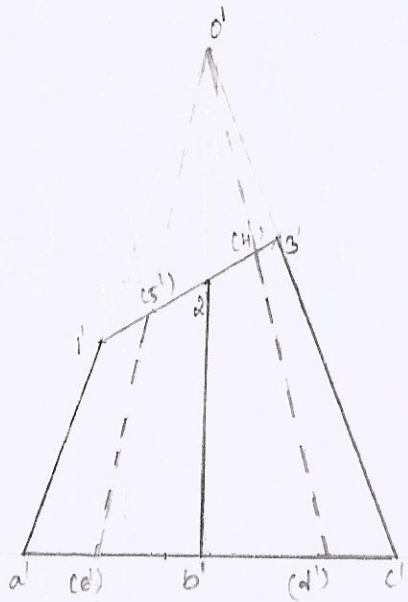
7. A hexagonal Prism, side of base 25mm and height 50mm rests on Hp and one of the edges of its base is Parallel to Vp. A Section Plane ⊥r to vp and inclined at 50° to Hp bisects the axis of the Prism. Draw the isometric ~~Projection~~ View of the truncated Prism, showing the cut surface.

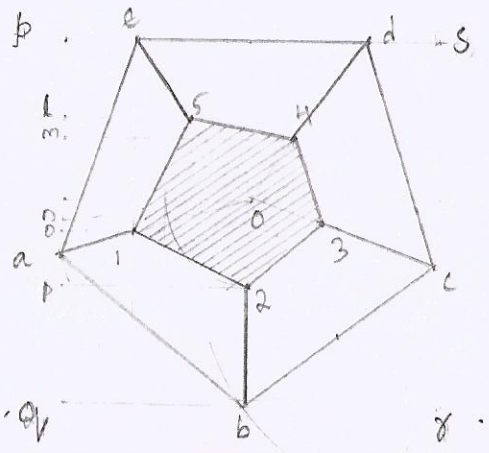




8. A Pentagonal Pyramid, 30mm edge of base and 65mm height, stands on HP such that an edge of the base is Parallel to V.P. and nearer to it. A Section Plane ⊥r to VP & inclined at 30° to HP cuts the Pyramid Passing through a point on the axis at a height of 35mm from the base. Draw the isometric Projection of the Truncated Pyramid. Showing the cut surface.




o'
(4')
3'
(5')
2'
1'
a'
(e')
b'
(d')
c'


e
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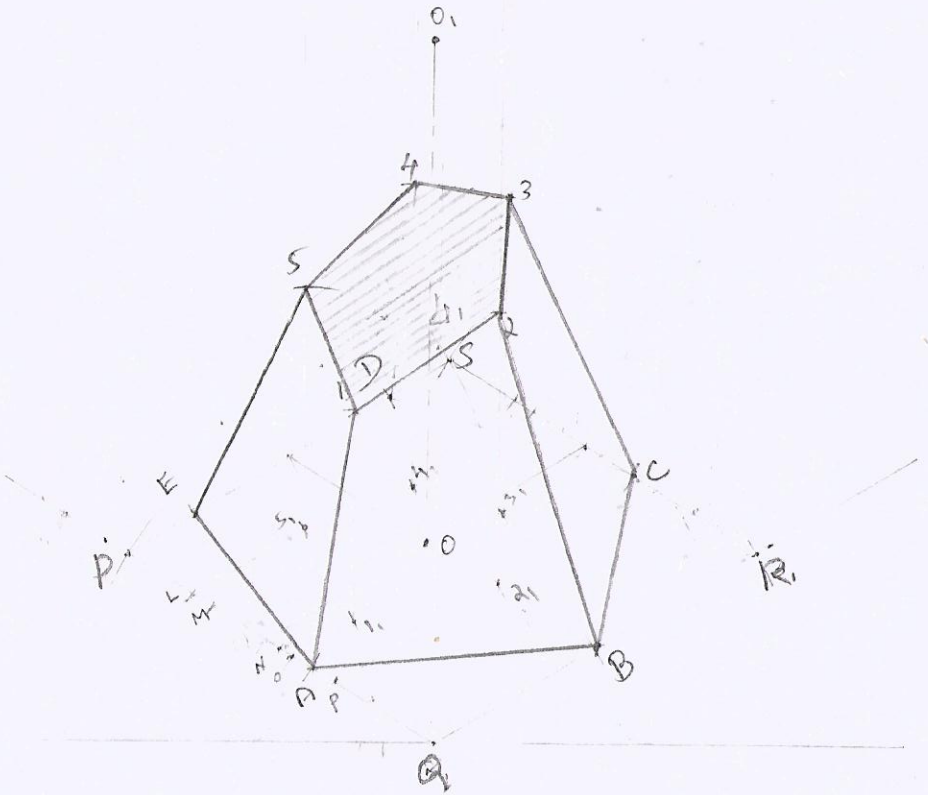
4
3
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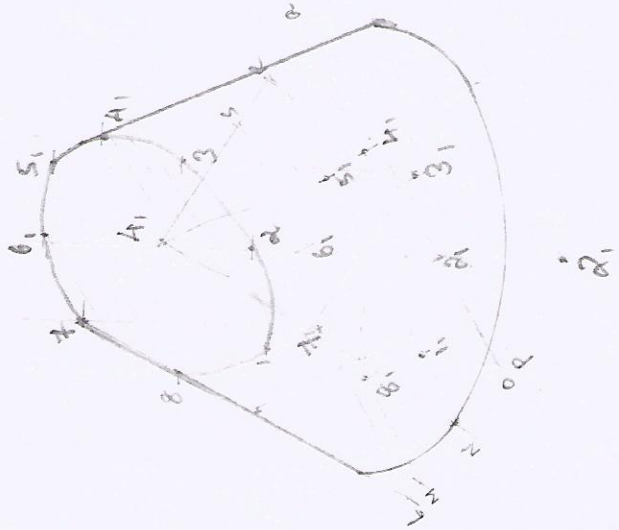
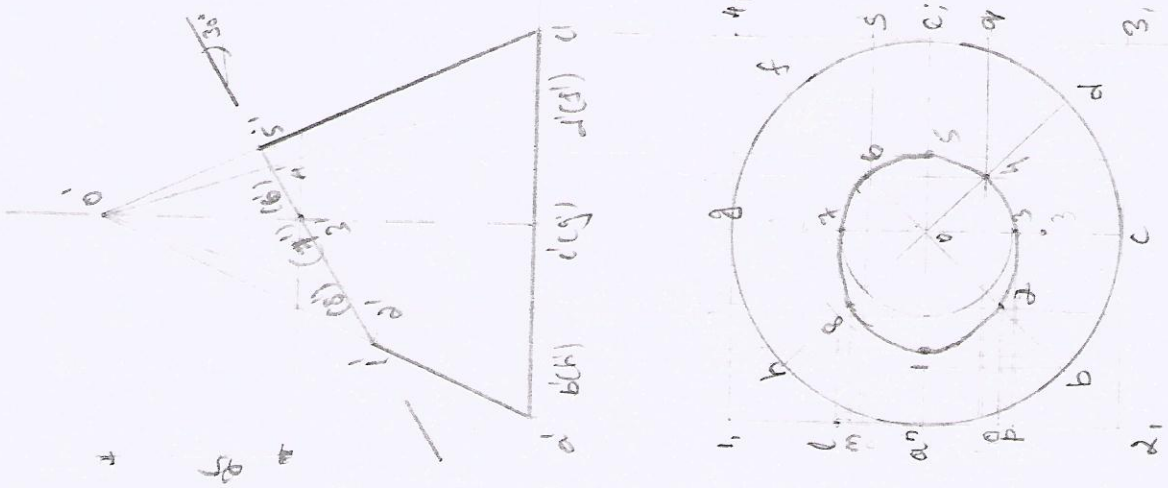
A

9. A cone of base diameter 50mm and height 55 mm is resting on its base on Hp. It is cut by a plane ⊥r to V.p and inclined at 30° to H.p. The plane meets the axis at a distance of 25mm from apex. Draw the isometric view of the truncated cone.





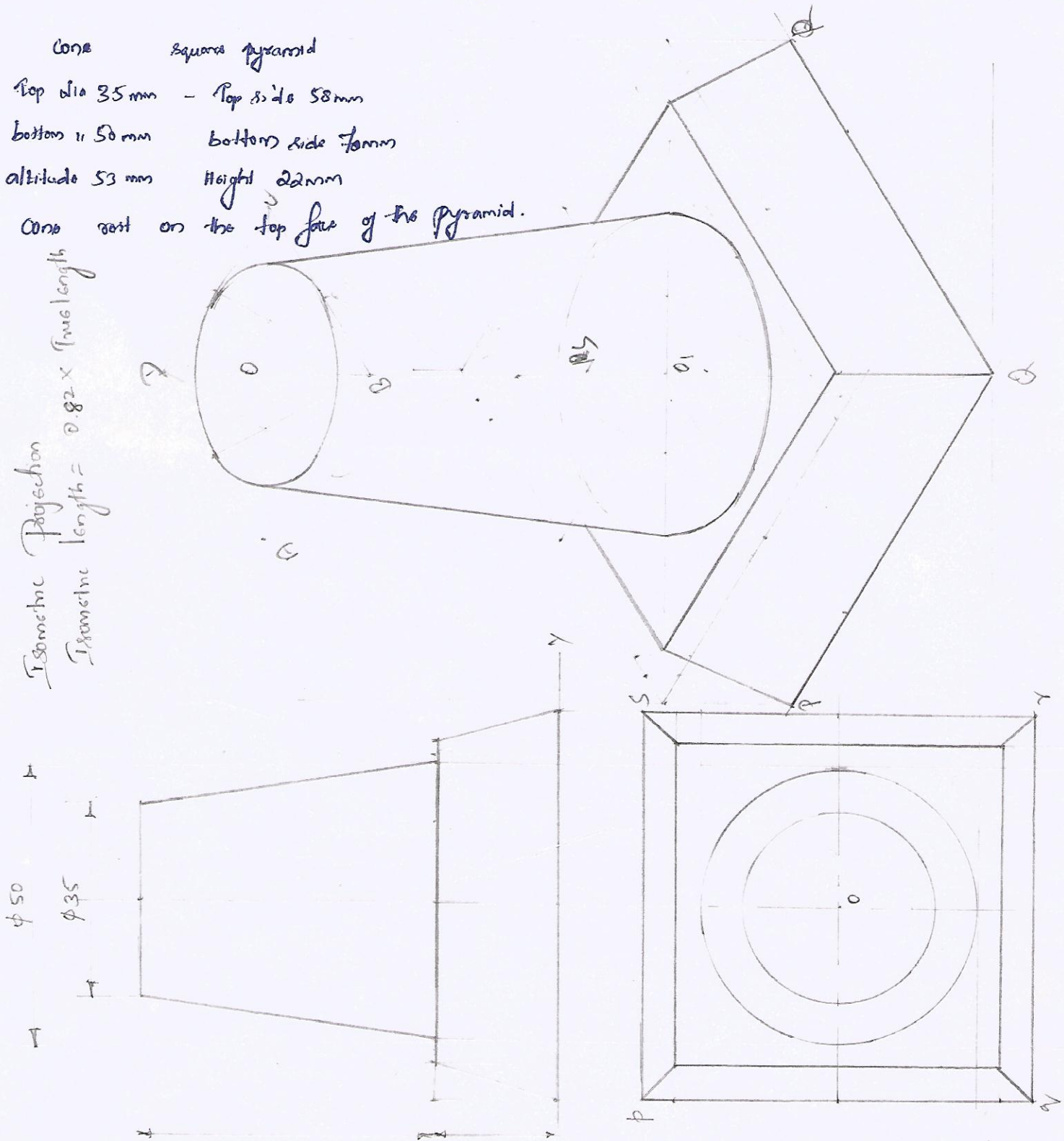
Combination of solids

10. A frustum of a cone has its top & bottom diameters 35mm and 50mm respectively and altitude 53 mm. It rests on the top face of a frustum of a square Pyramid. Sides of the top & bottom faces of the Pyramid are 58 mm and 70mm respectively. Height is 22 mm. Draw the isometric Projection of the combination of solids.

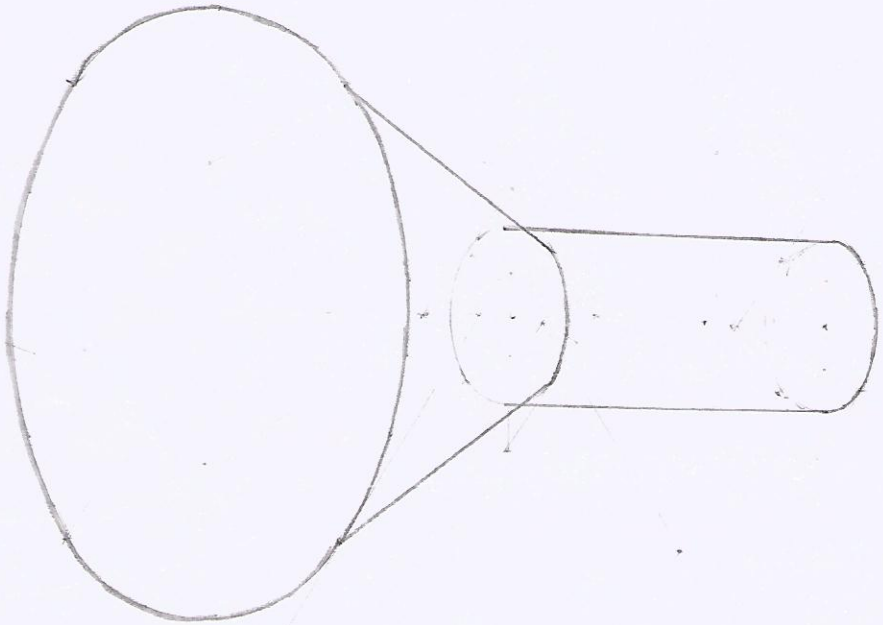
Cone	square pyramid
Top dia 35 mm	Top side 58mm
bottom " 50 mm	bottom side 70mm
altitude 53 mm	Height 22mm

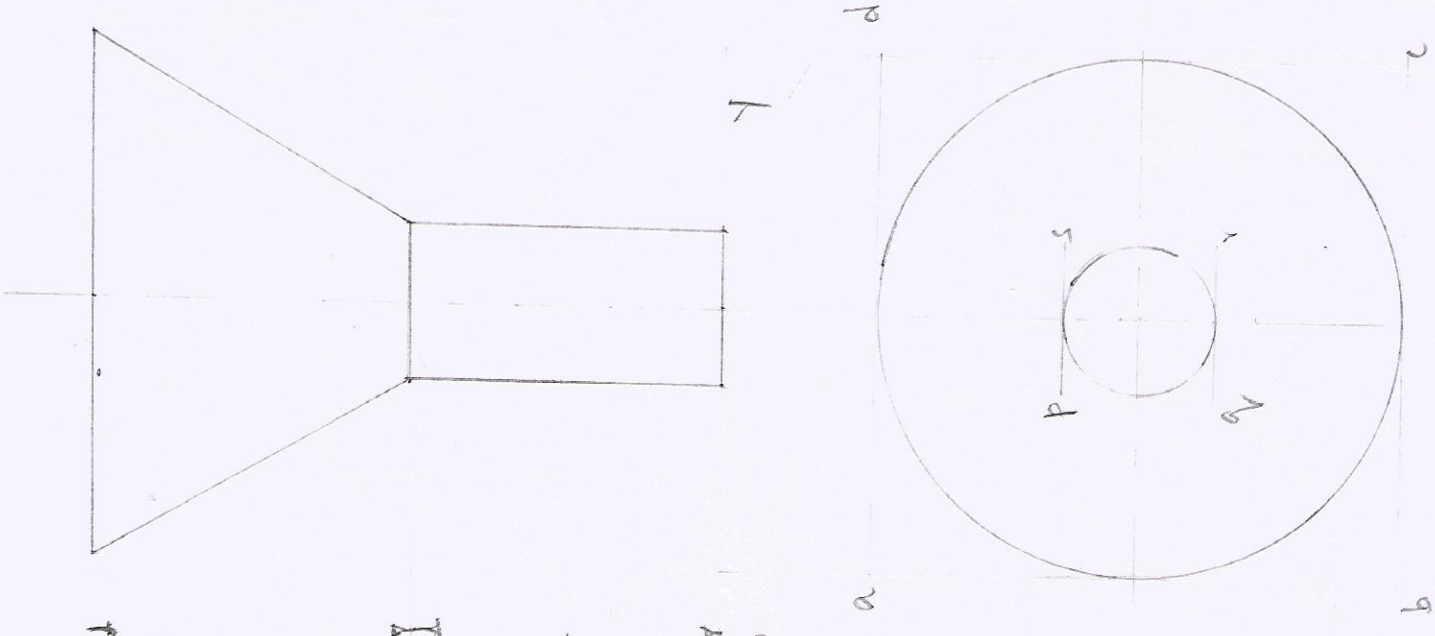
Cone rest on the top face of the Pyramid.

Isometric Projection
Isometric length = 0.82 × True length

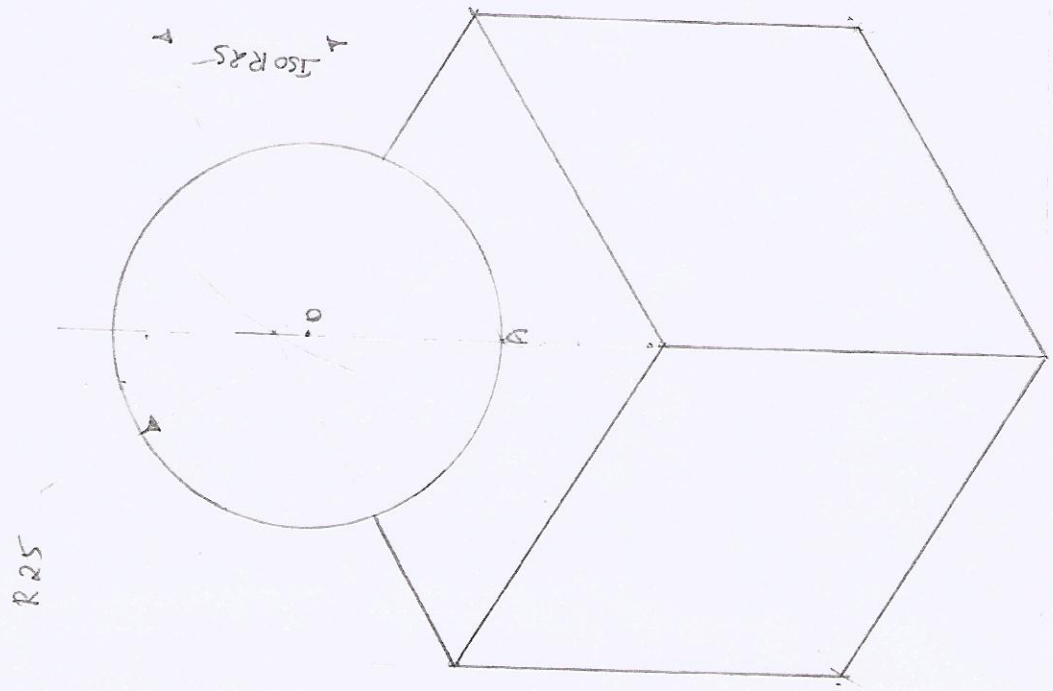


11. Draw the isometric Projection of a funnel consisting of a cylinder and a frustum of a cone. The diameter of the cylinder is 80mm & the top diameter of the funnel is 68mm. The height of the frustum & cylinder are each equal to 40mm.

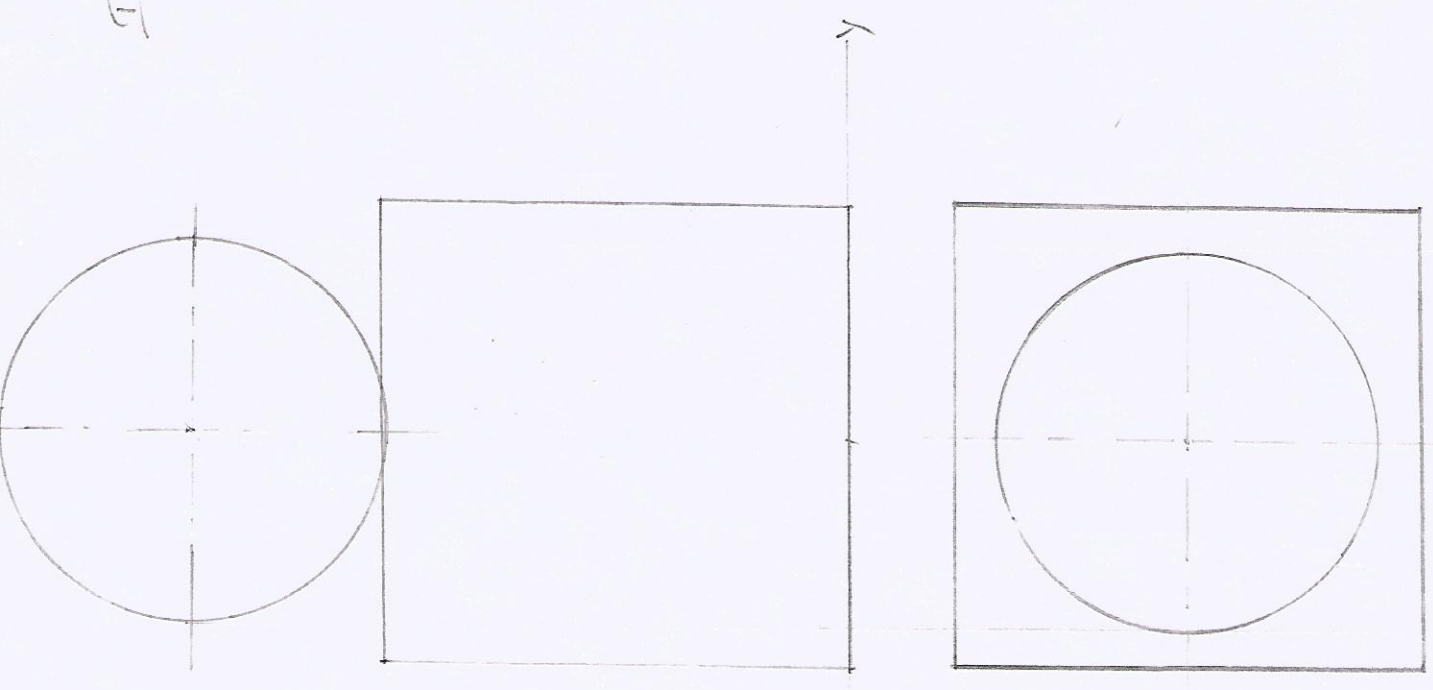




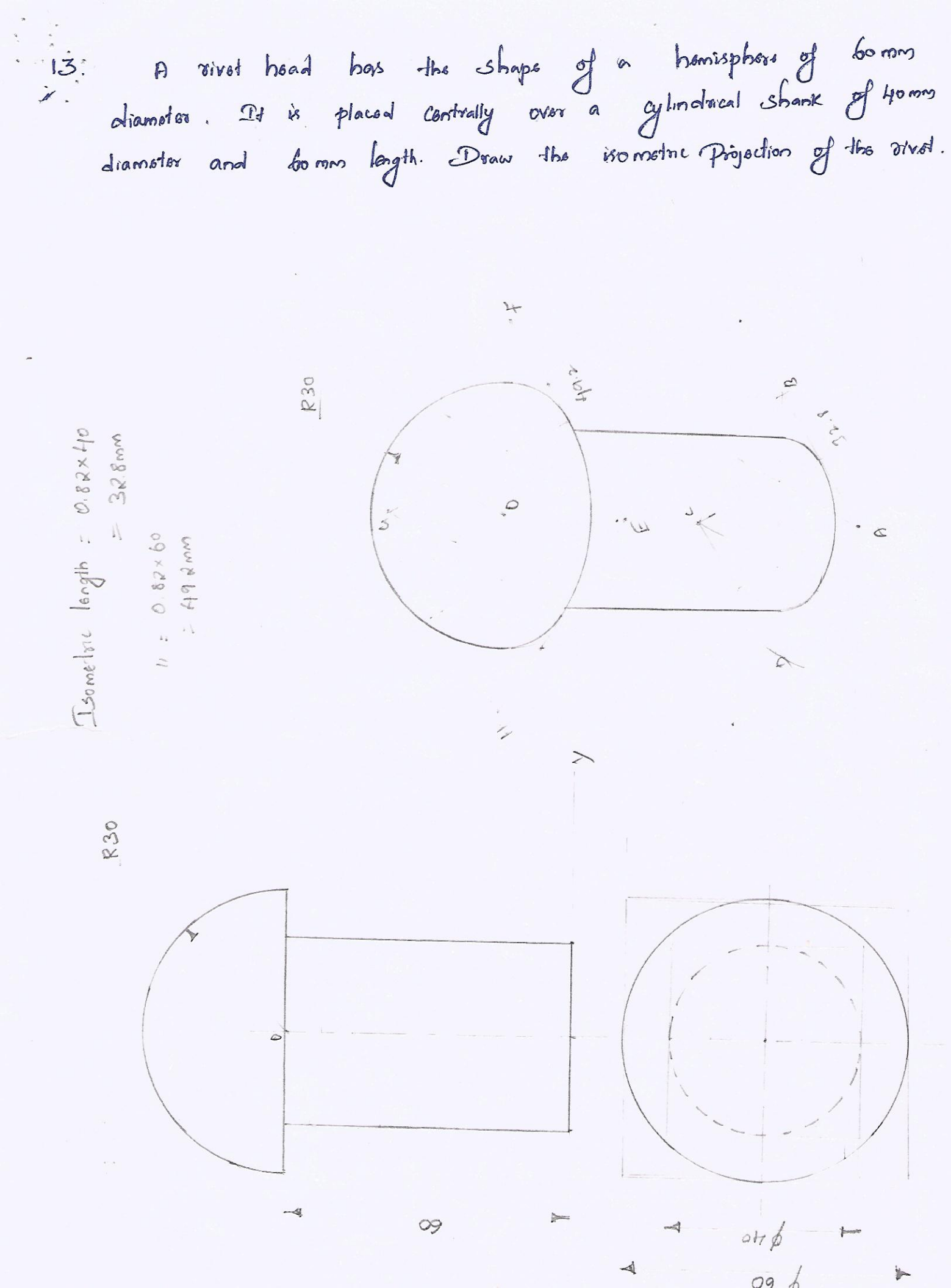
12. Draw the isometric Projection of a sphere of diameter 50mm resting centrally on the top of a cube of side 60mm.



Isometric length $= 0.82 \times 60 = 49.2\text{mm}$



13. A rivet head has the shape of a hemisphere of 60 mm diameter. It is placed centrally over a cylindrical shank of 40 mm diameter and 60 mm length. Draw the isometric Projection of the rivet.



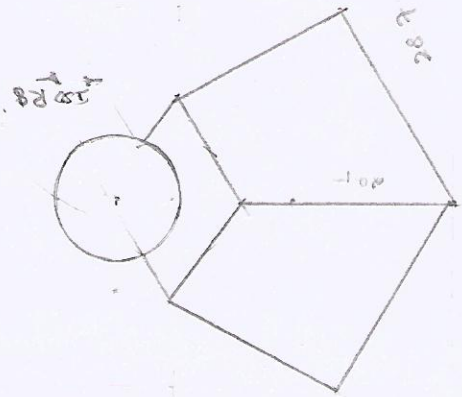
14. Draw the isometric Projection of sphere of diameter 16mm kept centrally over a frustum of a square Pyramid of height 25mm. The frustum has a base of side 35mm and top of side 20mm.

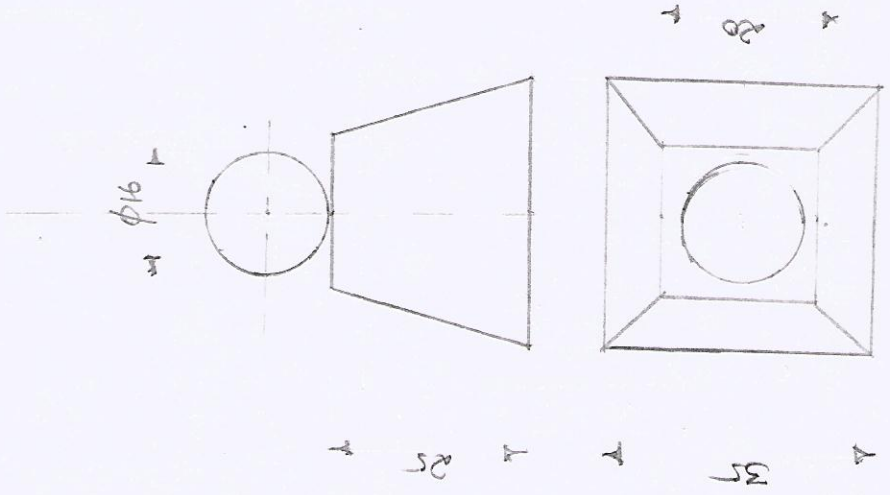
Height = 0.82 × 25
= 20.5mm

R = 0.82 × 8
= 6.56mm

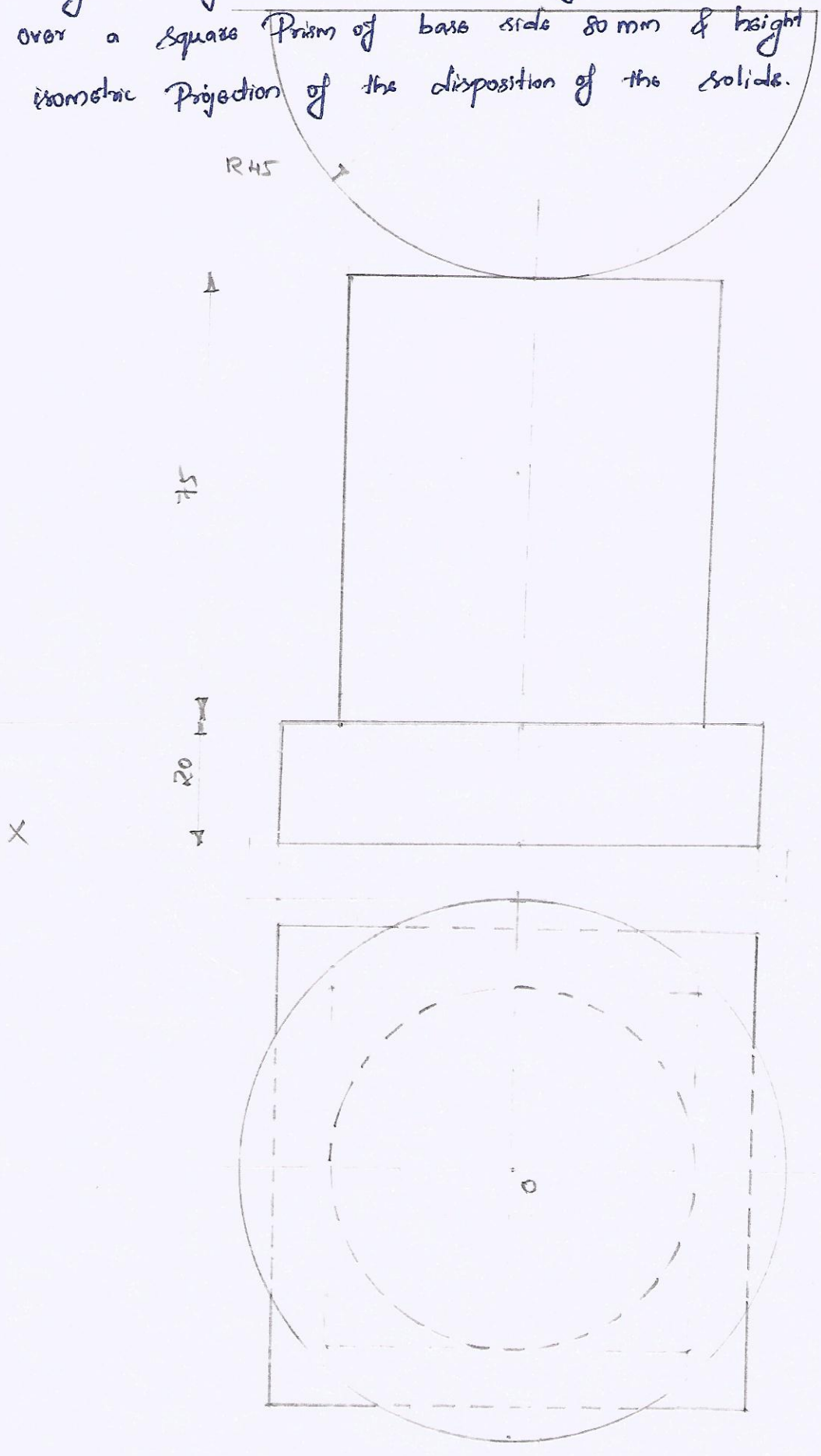
Isometric length = 0.82 × 35
= 28.7 mm

= 0.82 × 20 = 16.4mm



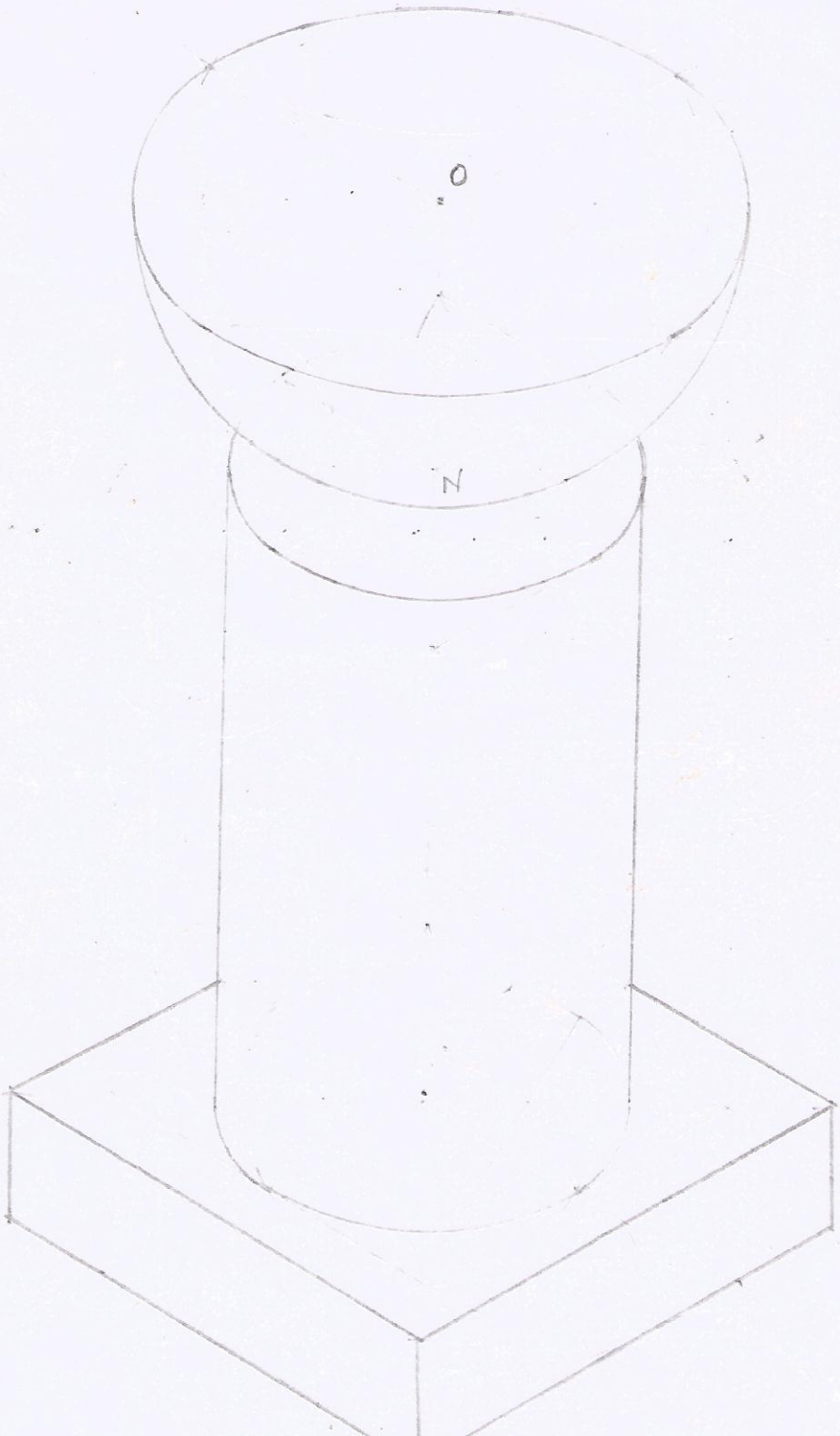


15. A hemispherical vessel of diameter 90mm is placed centrally over a cylinder of diameter 60mm & height 75mm which in turn is kept centrally over a square Prism of base side 80 mm & height 20mm. Draw the isometric Projection of the disposition of the solids.



Prism
80 = 0.82 × 80
= 65.6 mm
20 = 0.82 × 20
= 16.4mm

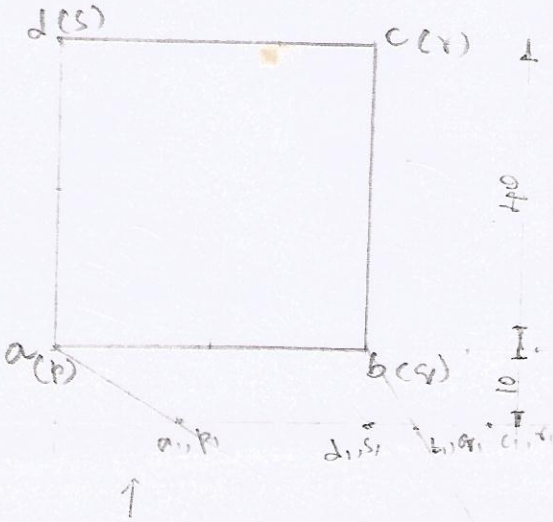
Cylinder
60 = 0.82 × 60
= 49.2mm
=
75 = 0.82 × 75
= 61.5mm


O
N

PERSPECTIVE PROJECTION — Visual Ray method

1. A square Prism, side of base 40mm and height 60mm rests with its base on the ground such that one of its rectangular faces is Parallel to and 10mm behind the picture plane. The station Point is 30mm infront of PP, 80mm above the ground plane and lies in a central plane 45mm to the right of the center of the Prism.

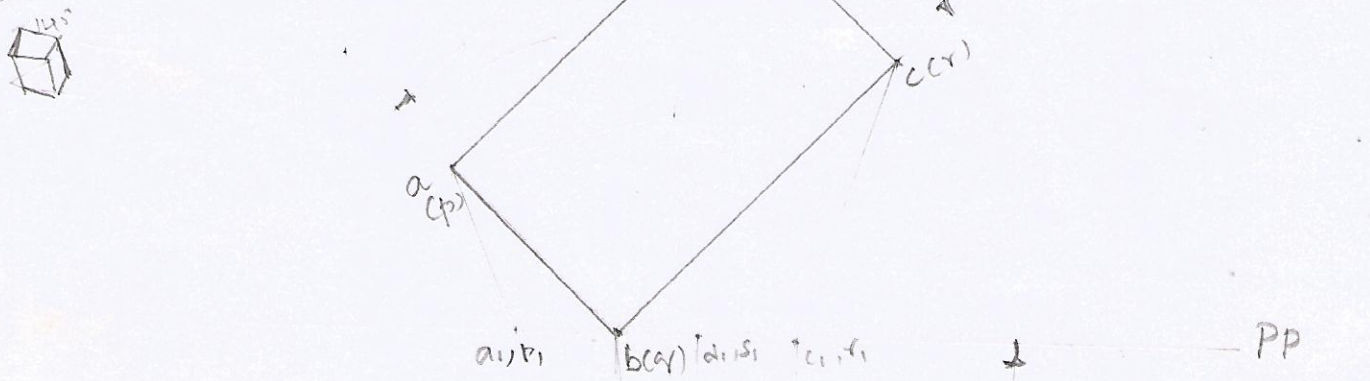
CP → Central plane
PP → Picture plane
HL → Horizon plane
GL → Ground plane

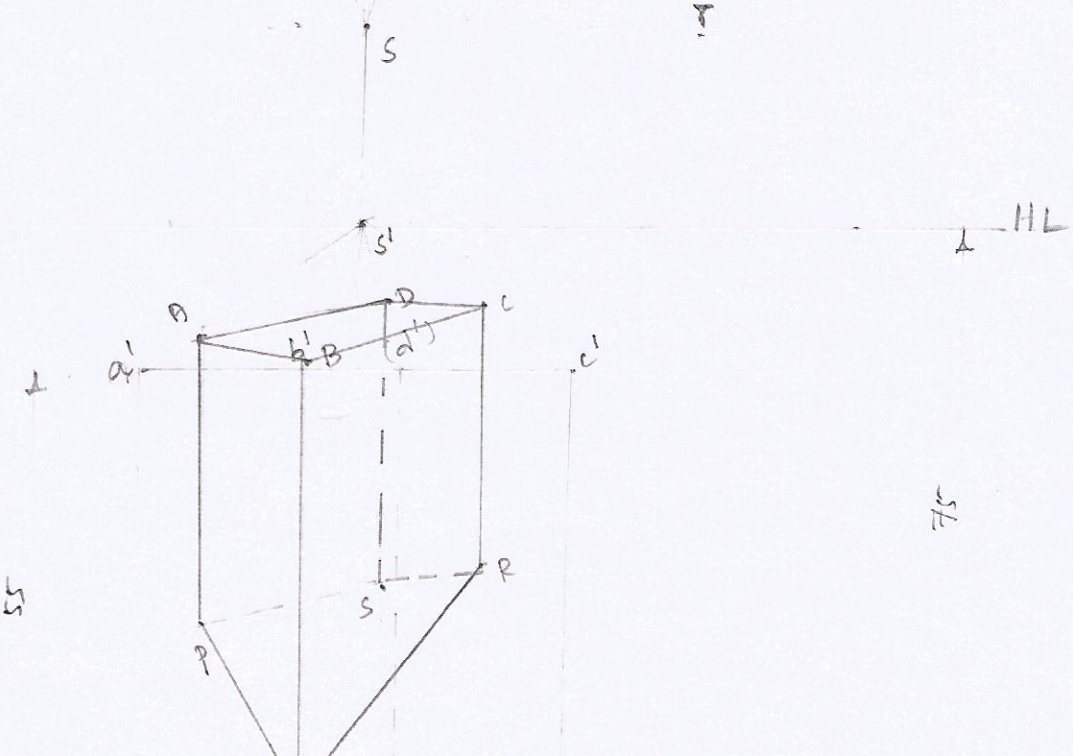


Top view

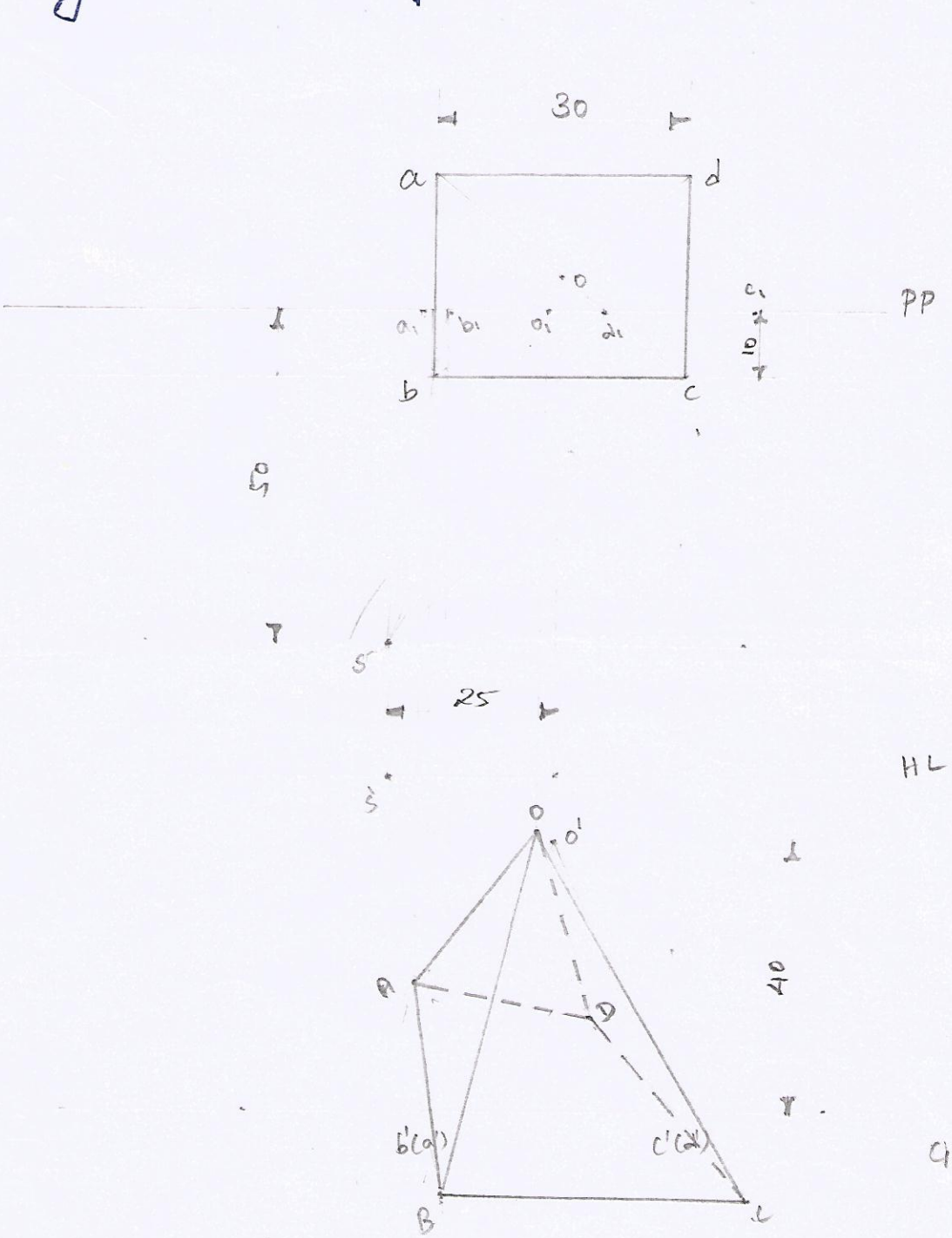
PP to GL
30+80 = 110
more than 110mm

2. A rectangular Prism, sides of base 50mm × 30 mm and height 55mm, 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 infront of PP, 75mm above the ground plane and lies in a central plane which passes through the center of the Prism. Draw the Perspective Projection of the solid.

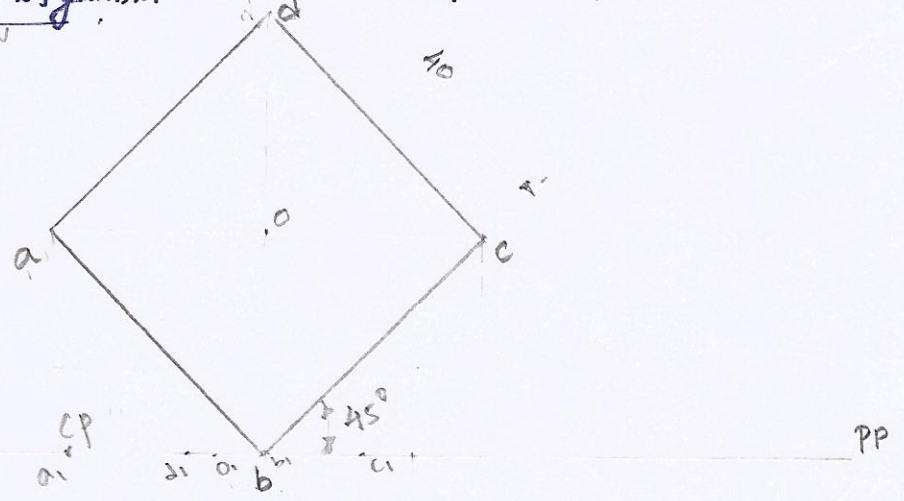


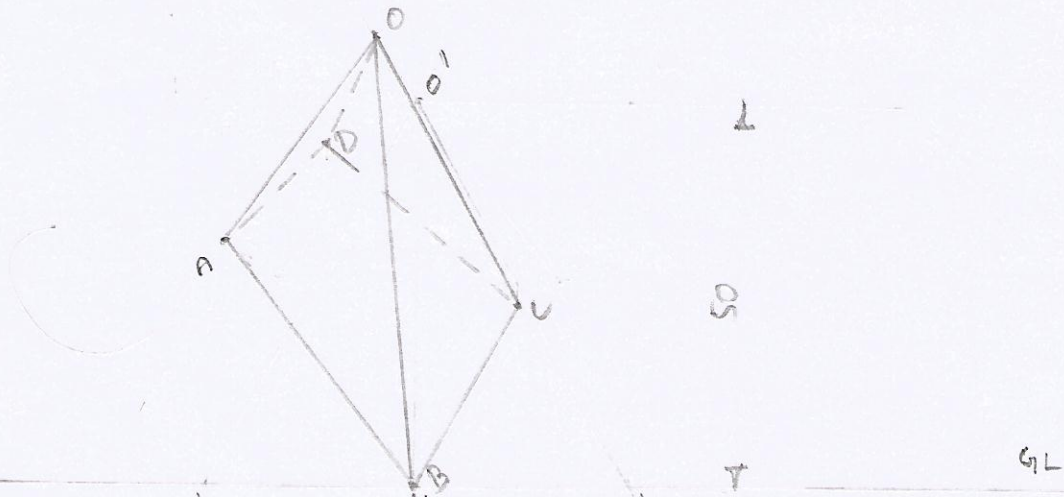


3. A Square Pyramid of base side 30 mm & altitude 40 mm rests on its base on the ground such that one of its base sides is Parallel to the Picture plane and 10 mm in front of it. The station point is 50 mm in front of the Picture plane, 25 mm to the left of the axis of the Pyramid and 55 mm above the ground. Draw the Perspective view of the Pyramid.

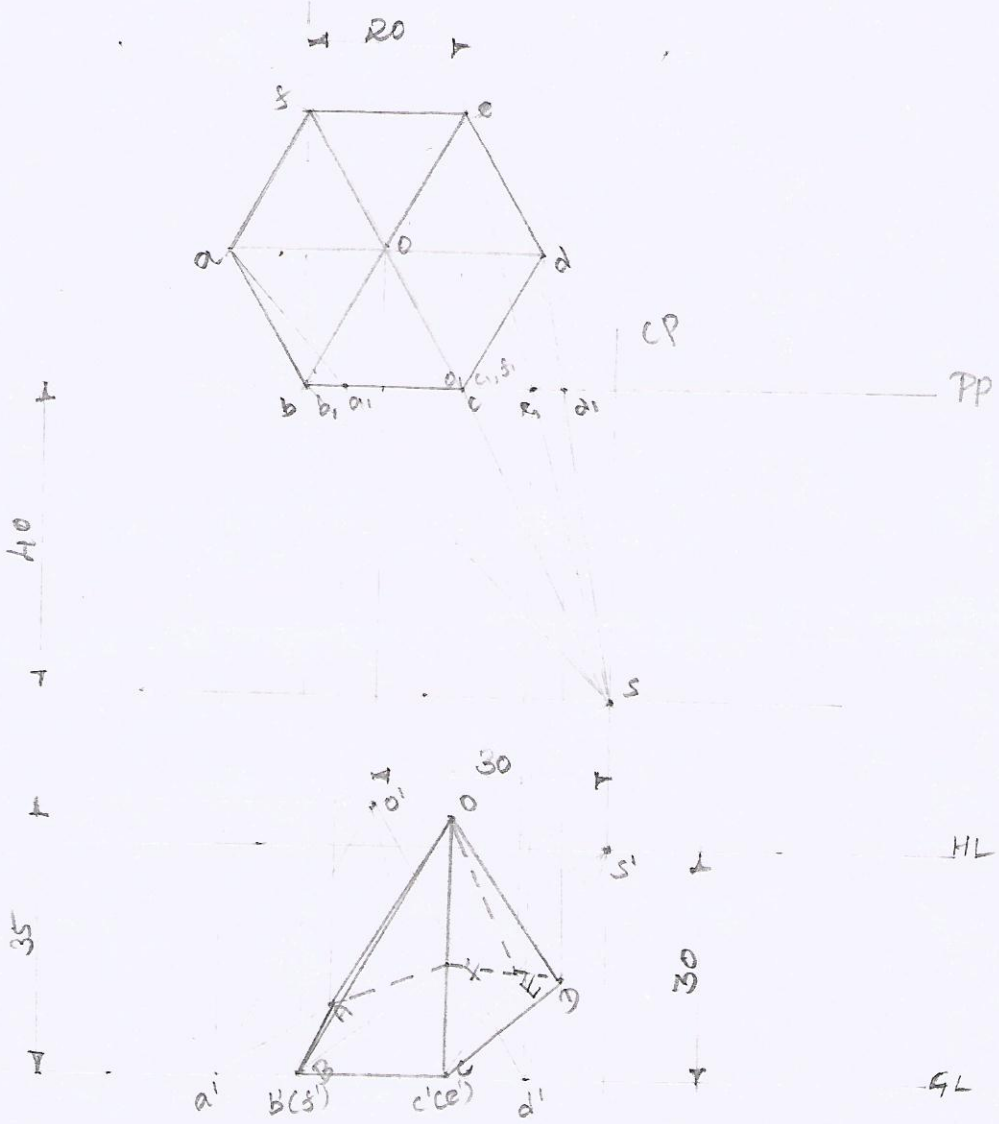


4. A square Pyramid of base edge 40mm & altitude 50mm, rests with its base on the ground plane such that all the edges of the base are equally inclined to the pp. One of the corners of the base is touching the pp. The station point is 60mm infront of the pp, 80mm above the ground plane and lies in a central plane is 20mm to the left of the axis of the pyramid. Draw the Perspective Projection.

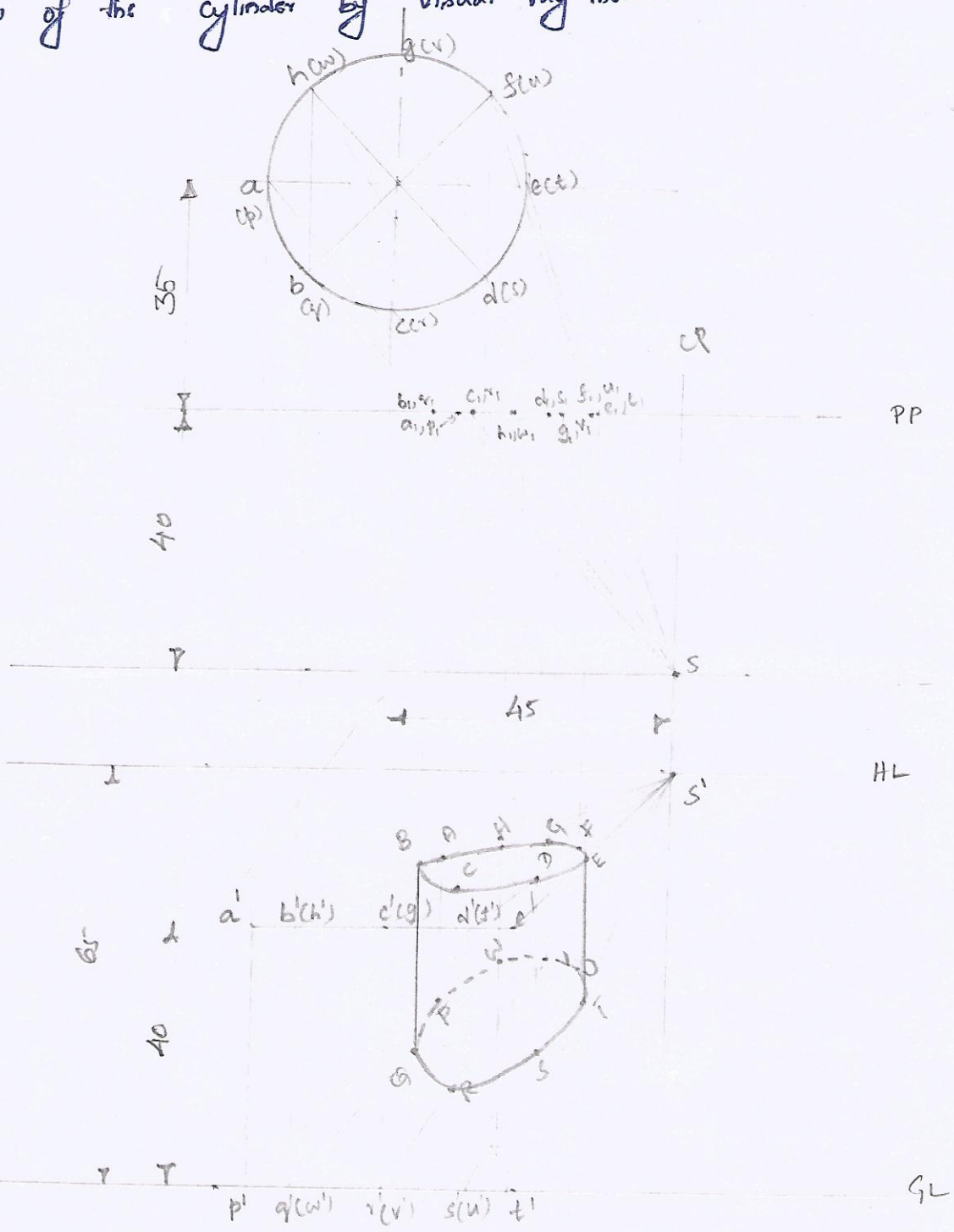




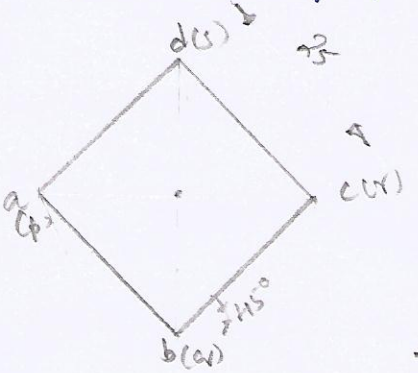
5. A regular hexagonal Pyramid of base edge 20mm and height 35mm rests on its base on the ground plane with one of its base edges touching the Picture plane. The station point is 30 mm above the ground plane and 40 mm in front of the PP. The central plane is 30 mm to the right of the axis. Draw the Perspective Projection of the Pyramid.

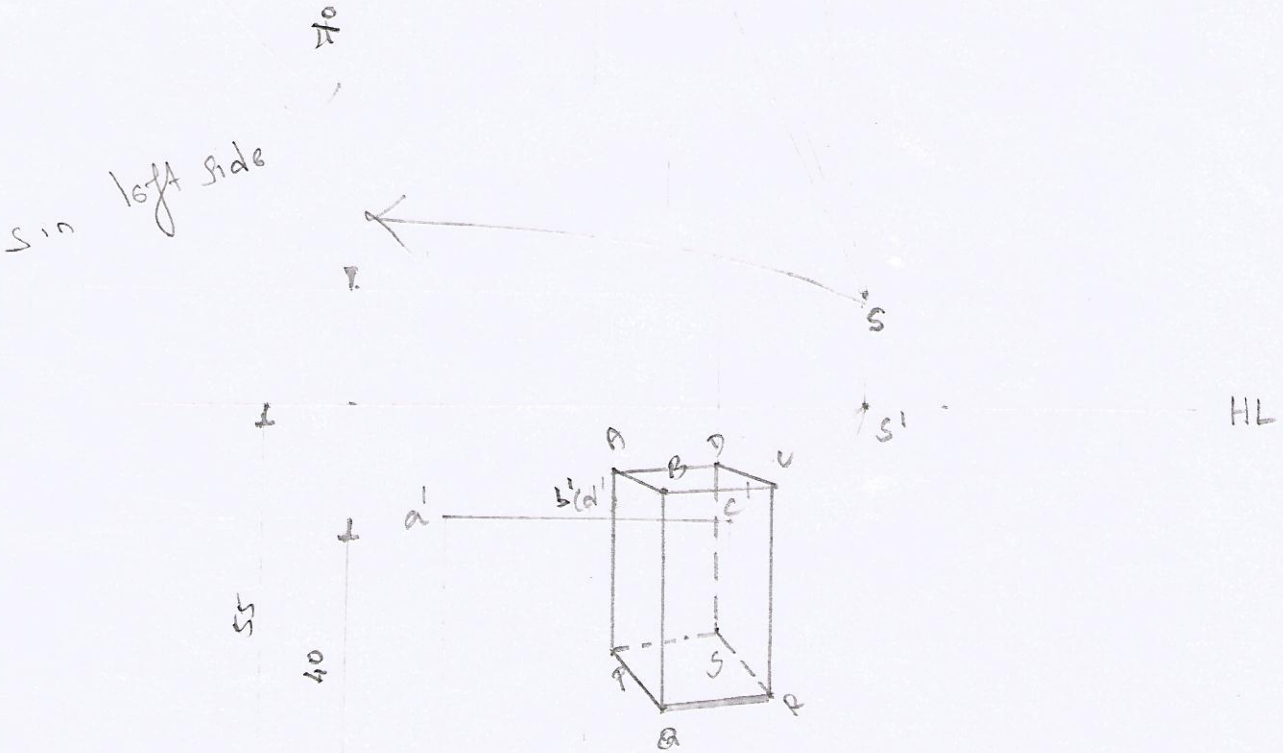


6. A cylinder of diameter 40mm & height 40mm rests on the GP on one of its ends with its axis 35mm behind the Picture plane. The station point is 45mm to the right of the axis. The station point is 65mm above the GP and 40mm infront of the PP. Draw the Perspective view of the cylinder by Visual ray method.

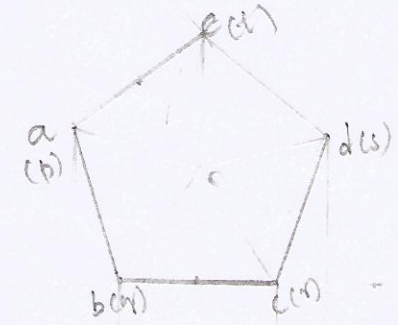


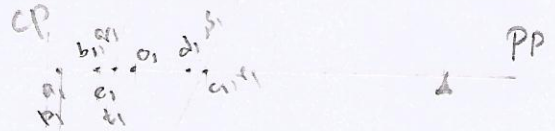
1. A square Prism of base 25 x 25 mm & height 40mm rests on the GP with the edges of the base making 45° with PP. The corner nearest to the PP is 25mm to the right of the station point and 25mm behind the PP. The station point is 55 mm above the GP & 50 mm infront of the PP. Draw the Perspective view of the square Prism.

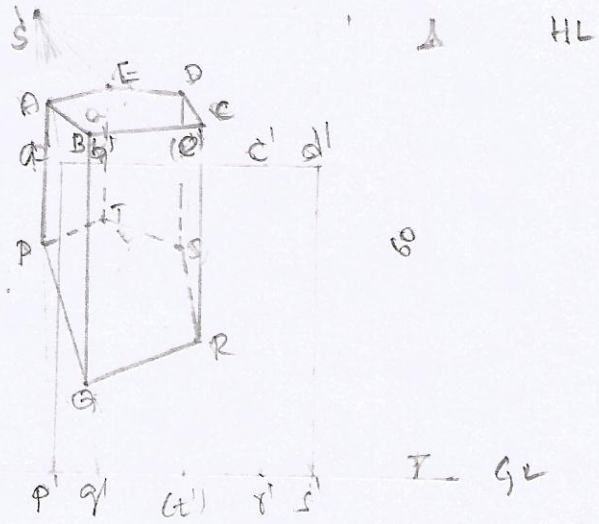




8. Draw the Perspective view of a Pentagonal Prism of base side 30mm and height 40mm when it rests on its base on the ground plane with one of its rectangular faces parallel to and 20mm behind the picture plane. The station point is 45mm in front of the PP and 60mm above the GP. The observer is 20mm to the left of the axis. Also the ~~top view and~~







Top - ABCD

Bottom - PQRS

9. A cone of base diameter 40mm & height 40mm rests on the GP on one of its ends with its axis 35mm behind the picture plane. The station point is 45mm to the right of the axis. The station point is 65mm above the GP and 40mm infront of the PP. Draw the Perspective view of the cone.

28/12/13