Unit-1 Scale

Measurement units

10 mm = 1 cm
10 cm = 1 decimeter
10 dm = 1 m
10 m = 1 Decameter
10 Dm = 1 Hectometer
10 Hm = 1 km

Types of Scale

1> Engg Scale (graphs)
2> Graphical Scale (maps)

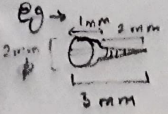
5 types of graphical scale

1> Plain (measure upto 2 units)
2> Diagonal (3 units)
3> Vernier (vernier divisions) (3 units)
4> Comparative
5> Scale of chords

Representative Fraction (R.F.)

$RF = \frac{\text{Drawing length}}{\text{Actual length}}$ (no units)

If R.F. < 1 → Reducing Scale
R.F. = 1 → Full size
R.F. > 1 → Enlarging scale

eg → 

$R.F. = \frac{DL}{AL} = \frac{15\text{cm}}{3\text{mm}} = \frac{150\text{ mm}}{3\text{ mm}}$

RF = 50 Enlarging Scale

Length of Scale (LOS)

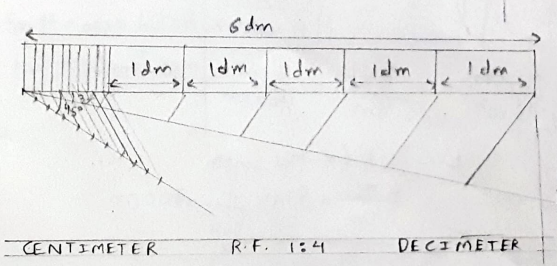
LOS = RF × max length (cm)

Q1> Construct a plain scale, given the R.F. 1:4 to show centimetres and long enough to measure upto 6 decimeter

Ans LOS = RF × max length

$= \frac{1}{4} \times 6\text{ dm} = \frac{60\text{cm}}{4} = 15\text{ cm}$

6dm = 6 parts × 1dm
1dm = 10cm
= 10 parts × 1cm



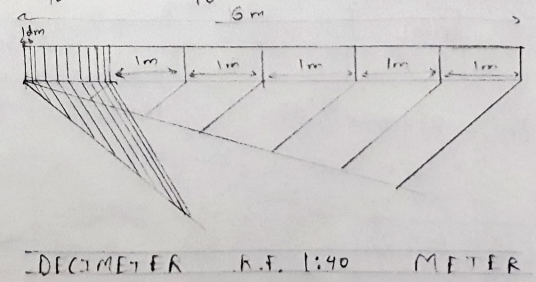
LOS = 8-12 → 3mm
LOS = 12-18 → 4mm
LOS > 18 → 5mm

Q2> - - - R.F. 1:40 - - - 6m.

Ans RF = $\frac{1}{40}$, max length = 6m

LOS = $\frac{1}{40} \times 6\text{m} = \frac{1}{40} \times 600\text{cm} = 15\text{cm}$

6m = 6 × 1m
1m = 10 dm
= 10 × 1dm



Q) RF 1:400 — 6 Decameter

Ans RF = $\frac{1}{400}$, max length = 6 Dm

LOS = $\frac{1}{400}$ × 6 Dm = $\frac{1}{400}$ × 6000 cm = 15 cm

31/3/22

(Scales 4.7)

Q 4.12> An area of 49 square centimetres on a map represents an area of 16 sq. m on a field. Draw a scale long enough to measure 8 m. Mark a distance of 6m 9dm on the scale

Ans R.F. = $\frac{DL}{AL} = \sqrt{\frac{D\ area}{A\ area}} = \sqrt[3]{\frac{D\ volume}{A\ volume}}$

$= \sqrt{\frac{49\ cm^2}{16\ m^2}} = \frac{7\ cm}{4m} = \frac{7\ cm}{400\ cm}$

Drawing area = 49 cm²
Actual area = 4 m²
max length = 8m

RF = $\frac{7}{400}$

LOS = R.F × max length

= $\frac{7}{400}$ × 8m = $\frac{7}{400}$ × 800 cm

LOS = 14 cm

Q 4.15> A cube of 5 cm side represents a tank of 1000 cubic metres volume. Find the R.F. and construct a scale to measure up to 35m. Mark a distance of 27m on it.

Ans RF = $\sqrt[3]{\frac{DV}{AV}} = \sqrt[3]{\frac{125\ cm^3}{1000\ m^3}} = \frac{5\ cm}{1m} = \frac{5\ cm}{1000\ cm}$

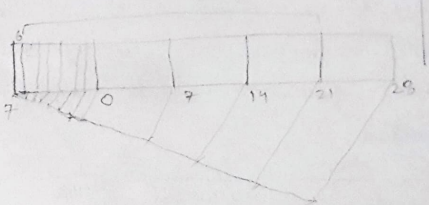
Drawing Volume = 5×5×5 cm³ = 125 cm³
Actual volume = 1000 m³
Max length = 35 m

RF = $\frac{1}{200}$

LOS = RF × max length

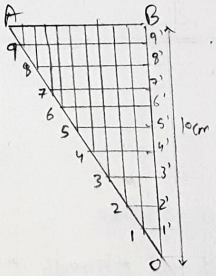
= $\frac{1}{200}$ × 35m = $\frac{1}{200}$ = 3500 cm

LOS = 17.5 cm



35m = 5 × 7m
7m = 7 × 1m

DIAGONAL SCALE



$\triangle ABC \approx \triangle 11'C \approx 22'C \approx \cdots \approx 99'C$

$\therefore \frac{AB}{BC} = \frac{11'}{1'C} = \frac{22'}{2'C}$

$1'C = \frac{1}{10} BC$

$2'C = \frac{2}{10} BC$

$\frac{AB}{BC} = \frac{11'}{\frac{1}{10}BC} \Rightarrow 11' = \frac{1}{10} AB$

Q 4.16) > Construct a diagonal scale of 1:40 to show metre, decimetre & centimetre and long enough to measure upto 6 metre and represent a distance 4.67 metre on it.

Sol Given, RF = 1:40

max length = 6m

LOS = RF × max length

= $\frac{1}{40}$ × 600 cm

LOS = 15 cm

Q> If 1cm long line on a map represents a real length of 4 m. Calculate R.F. and draw a diagonal scale, long enough to measure upto 50m and show a distance of 44.5 m on it

So RF = $\frac{DL}{AL} = \frac{1cm}{4m} = \frac{1cm}{4 \times 100cm} = \frac{1}{400}$

max length = 50 m

LOS = RF × max length

$= \frac{1}{400} \times 5000cm = 12.5cm$

50m = 5p × 10m
10m = 10p × 1m
1m = 10dm = 10p × 1dm

Vernier Scale → 3 units

→ Forward
→ Backward

Q> 4.34
Pg 4.25
Pdf 128

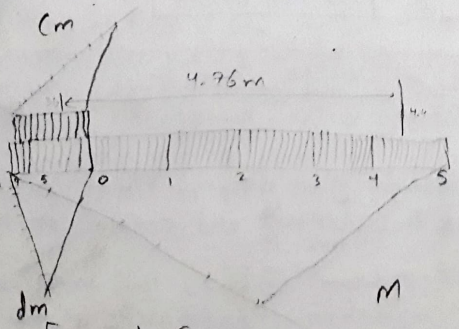
RF = $\frac{1}{40}$, m, dm, cm

max len = 6m

Mark 4.76m = 4.4 m + 0.36 m

LOS = $\frac{1}{40} \times 600cm = 15cm$

6m = 6p × 1m
1m = 10dm
= 10p × 1dm
9dm = 10p × 0.9cm
9cm = 10p × 9cm



Forward (1 per wala scale 1dm kam)

Pdf 113
Q> 4.16
Diagonal scale

Construct a scale of RF 1/10 to read a meter, 1/10 and 1/100 of a meter

1/10 → 1 cm is 1/10 parts of 1 dm
1/100 → 1 cm is 1/100 parts of 1 m

AE → 1/8, 1/32 → 8 parts × 4 parts (dm, cm) ; 1/5 × 1/20 → 5 parts × 4 parts (dm, cm)

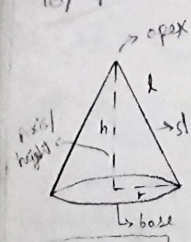
* Agar Mark karne ke liye point diya ho par max len nahi di ho toh max len ke mark wale point ke nearest higher no. assume karke lo

eg → Mark 4.76m → max len = 5m

16/4/22

CONIC SECTIONS

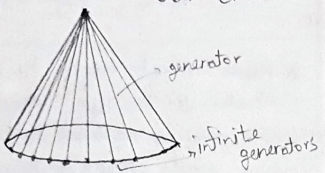
→ to cut

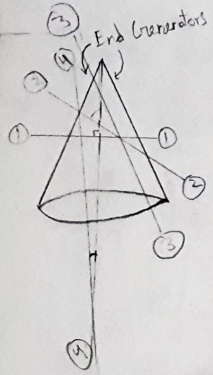


Right Circular Cone

$l^2 = h^2 + r^2$

Generator is a straight line which joins apex and any point taken over circumference





Section plane	Section
① – ① when plane is perpendicular to axis & cuts all generators the curve obtained is a circle	Circle
② – ② inclined at an angle with axis	Ellipse
③ – ③ parallel to a generator, cuts the base, doesn't cut all the generators	Parabola
④ – ④ inclined at a very small angle with the axis, cuts the base, doesn't cut all the generators.	Hyperbola

[both cut all the generators]

"Curves obtained by cutting right circular cone with help of any plane different positions relative to its axis are known as Conic Sections"

Locus = path made by a moving point according to a condition.

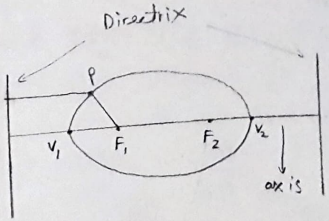
e = eccentricity = Ratio of dist of a point P on the curve from the focus to the distance of the point from the directrix

Ellipse, parabola, hyperbola are locus made by a point whose condition is given in terms of e.

① Ellipse

eccentricity i.e $e < 1$

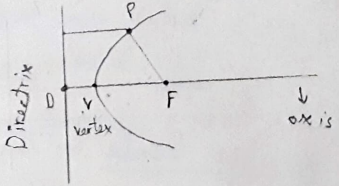
DPF < DPD



② Parabola

$e = 1$

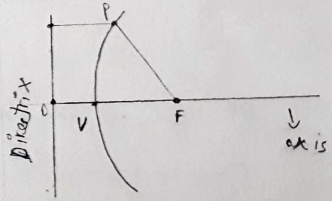
DPF = DPD



③ Hyperbola

$e > 1$

DPF > DPD



$$e = \frac{DPF}{DPD} = \frac{\text{Dist of point from focus}}{\text{Dist of point from directrix}}$$

OR

$$e = \frac{VF}{VD} = \frac{\text{Dist of Vertex from focus}}{\text{Dist of vertex from directrix}}$$

Q) Construct parabola given distance b/w directrix & focus is 5cm. Also draw tangent and normal on the curve.

$e = \frac{VF}{VD} = 1$

$VF = VD$

FD = 5cm

VF + VD = 5cm

2VF = 5cm

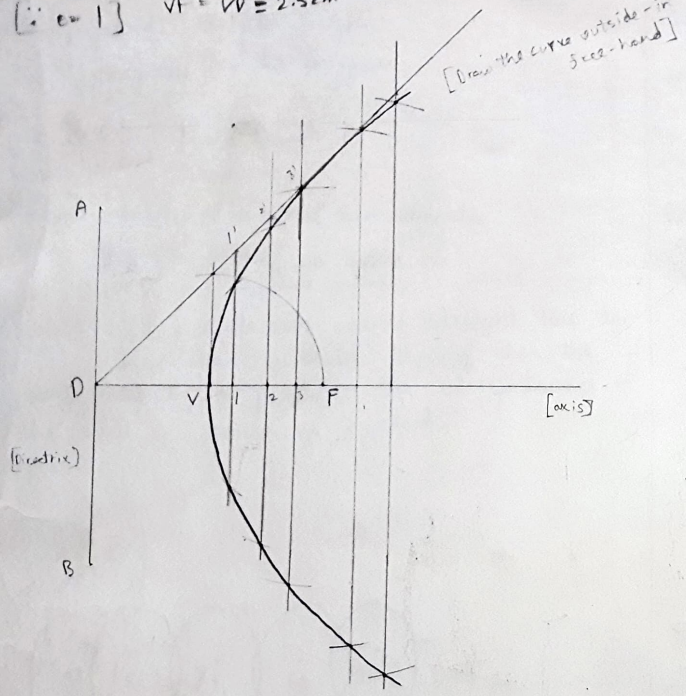
VF = 2.5cm

VD = 2.5cm

Parabola

FD = 5 cm

[∴ e = 1] VF = VD = 2.5 cm



→ Draw directrix, draw ax is in middle of directrix

→ ∴ dist of directrix & focus is 5cm mark F at 5cm from (D)

→ ∵ VF = VD = 2.5cm mark V at 2.5 cm from (D)

→ Take VF radius and draws an arc from (V), draw a line ⊥ar from (V) joining the arc, join the pt on arc & (D) and extend that line.

→ Draw 3 lines at any dist in b/w (V) & (F).

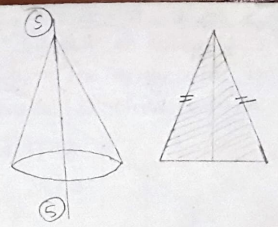
→ Take radius 11' and draw arc on 11' from (F) upwards & downwards

→ " " 22' " " " " 22' from (F) " "

→ " " 33' " " " " 33' from (F) " "

→ Draw 2-3 more lines beyond (F) & repeat the process [Don't draw a line thru 3.(.5)]

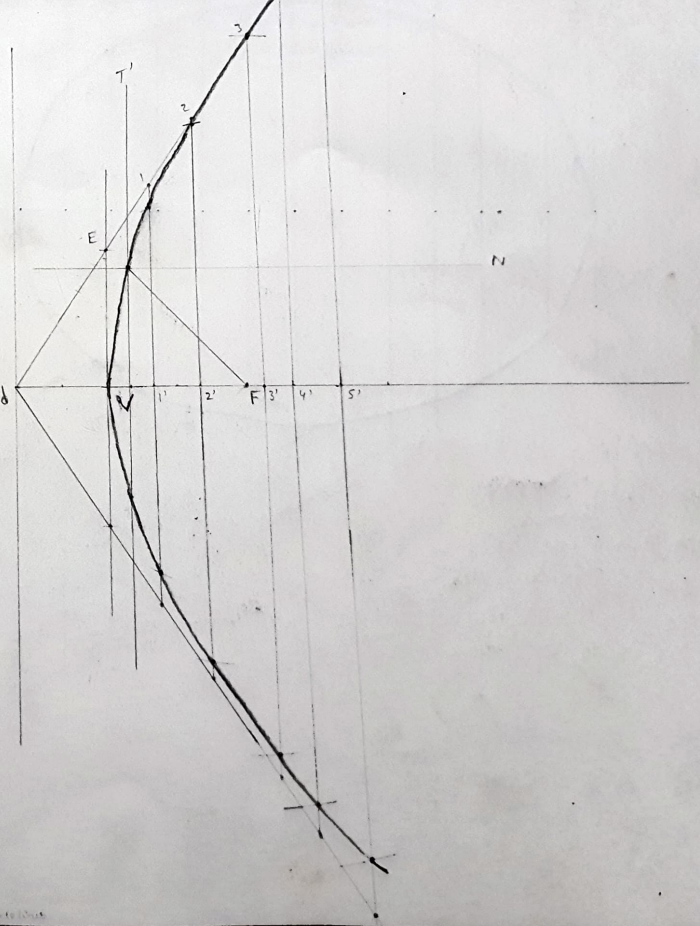
→ Join the points on the lines to make the parabolic curve



Section plane (S) - (S) when cutting plane passes through apex

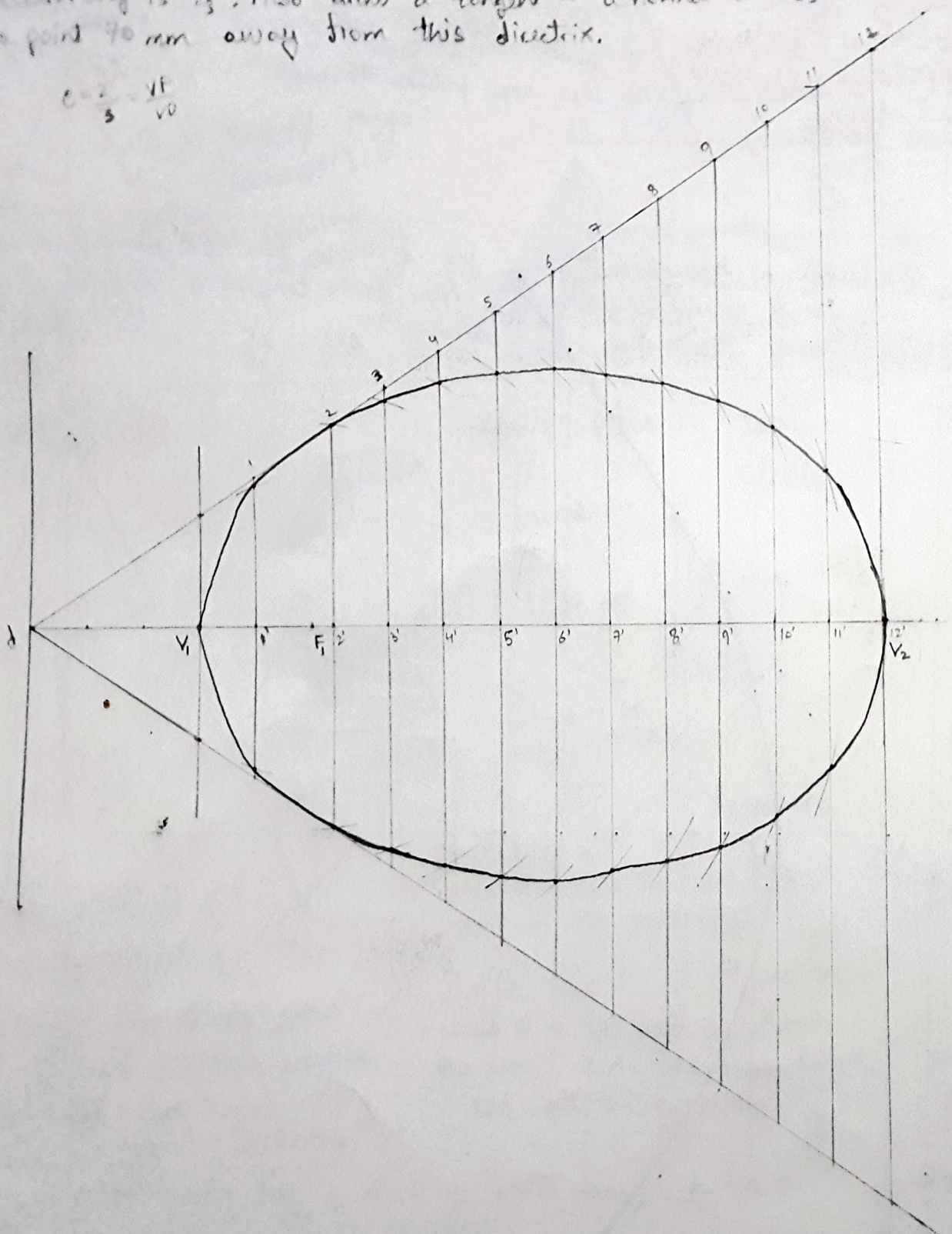
Section (Curve obtained) isosceles triangle

Q) Draw a hyperbola when the distance b/w its focus & directrix is 50 mm & eccentricity is $\frac{3}{2}$. Also draw tangent & normal at a point distance 25 mm from directrix. $e = \frac{3}{2} = \frac{VF}{VD}$



6) Draw an ellipse when distance of its focus from its directrix is 50 mm and eccentricity is 2/3. Also draw a tangent & a normal to this at a point 70 mm away from this directrix.

$e = \frac{2}{3} = \frac{VF}{VD}$



21/9/22

Special Curves (6.2)

1) Cycloid
2) Epicycloid
3) Hypocycloid
4) Involute
   a) Circle
   b) Polygon

Locus traced by the unwound end of the thread

Q) Draw involute of a circle 5cm diameter. Draw tangent & normal on the curve

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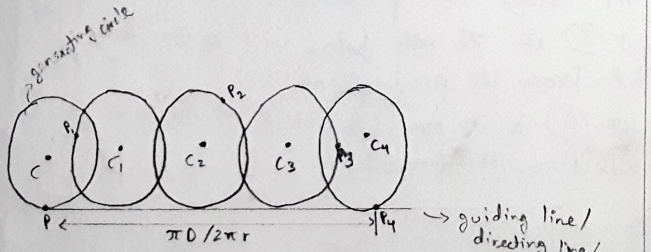
(6.1) Cycloid - If a circle rolls over a straight line for 1 revolution without slipping then the path traced by a point on the circumference of the circle is known as cycloid.



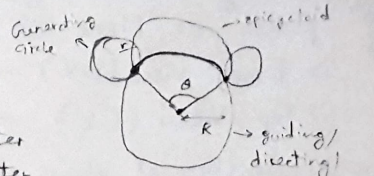
Q) Draw a cycloid for one complete revolution of a circle having a 50 mm diameter. Draw tangent and normal to the curve of a pt. at distance 35mm above base line.

5cm = 12 parts of circle
1 part = 5 parts of circle

PP = πD = 3.14(5) = 15.7 cm

Epicycloid - An epicycloid is a curve traced by a point on the circumference of circle which rolls along another circle outside it, without slipping.

$$\theta = \left(\frac{r}{R}\right) \times 360$$



Q) Draw an epicycloid of circle of diameter 50mm, which rolls outside circle of diameter 180mm for one revolution. Also draw tangent & normal.

$\theta = \frac{25}{90} \times \frac{360}{1} = 100°$

R = OP = 9 cm
r = PC = 2.5 cm

PROJECTION OF POINT

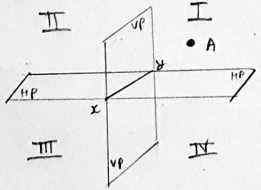
* Projection is also called Image / Views.
* Following views are obtained on following principle planes or Plane of projection :-
  i) Front View (F.V.) → Vertical Plane (V.P.)
  ii) Top View (T.V.) → Horizontal Plane (H.P.)
* Characteristics of planes of projection :-
  i) Purely Imaginary (ii) No fixed size (iii) perpendicular to each other

Quadrant System

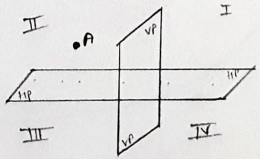
anticlockwise

Statements :-

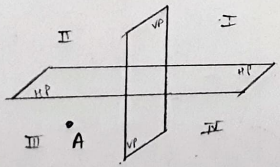
I st A point is in front of V.P and above H.P.



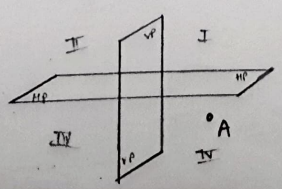
II nd A point is behind V.P and above H.P



III rd A point is behind V.P and below H.P.

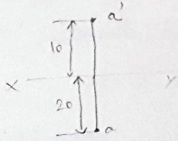


IV th A point is in front of V.P and below H.P.



x-y line = line obtained by intersection of HP & VP
It is also called reference line

Q> A point (A) is 10 mm above the H.P. and 20 mm in front of VP. Draw its projection



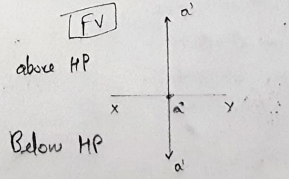
Q1> A point (A) is 70 mm above H.P. & 50 mm in front of V.P. Draw its projection.

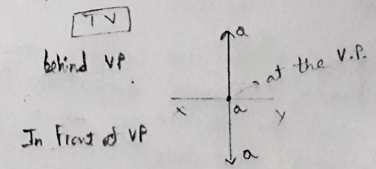
Q2> A point (B) is 70 mm above H.P. 450 mm behind V.P. Draw its projections.

Q3> A point (C) is 70 mm below H.P & 50 mm behind V.P. Draw its projections.

Q4> A point (D) is 70 mm below H.P. & 50 mm in Front of V.P. Draw its projection.

Conclusion





Q5> Point (A) is 20 mm below H.P. & 50 mm in front of V.P. Draw its projection

Q6> Point (B) is in H.P & 40 mm behind V.P. Draw its projection

Q 8.10 Draw the projections of following points on a common reference line keeping distance between their projectors 30 mm apart.

a) Point A is 20 mm below HP. & 50 mm in front of VP

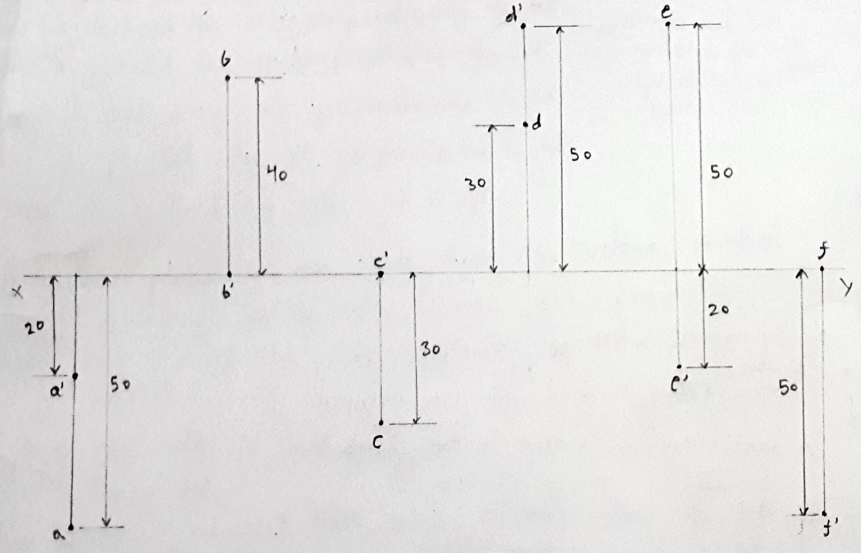
b) Point B is in the HP and 40 mm behind V.P

c) Point C is 30 mm in front of VP and in the H.P

d) Point D is 50 mm above the H.P. & 30 mm behind V.P.

e) Point E is 20 mm below H.P & 50 mm behind V.P.

f) Point F is in V.P. & 50 mm below H.P.



Q 8.11 Pg 8.9 Pdf 275 Projection of various points is given in fig. State position of each point with respect to the planes of project.

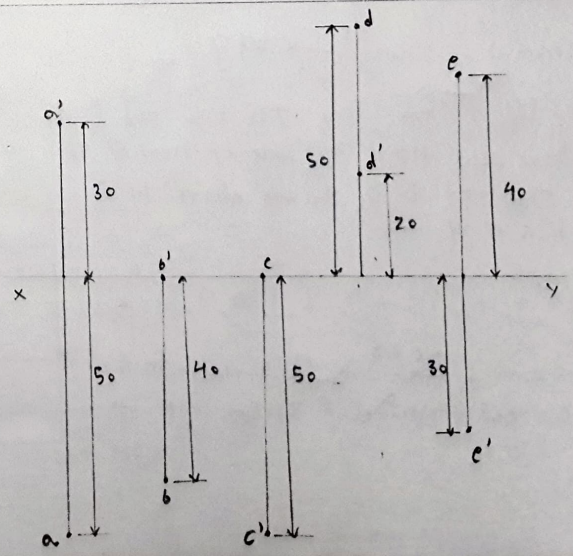
Ans a) Point A is 30 mm above HP & 50 mm in front of VP.

b) Point B is in HP & 40 mm in front of V.P.

c) Point C is 50 mm below HP & in V.P.

d) Point D is 20 mm above HP & 50 mm behind V.P.

e) Point E is 30 mm below HP & 40 mm behind V.P.



10/5/22 || = parallel, ∠ = inclined, ⊥ = perpendicular

PROJECTION OF LINES

There are 6 cases :-

1) Line is || to both H.P & V.P
2) Line is ∠ to H.P but || to V.P.
3) Line is ⊥ to H.P. but || to V.P
4) Line is ∠ to V.P but || to H.P.
5) Line is ⊥ to V.P but || to H.P
6) Line is ∠ to both H.P & V.P.

3 info ingredients → Fundamental Values → θ, φ, TL

Any 4 Parameters :

i) TL
ii) θ
iii) φ
iv) Dist of one end from HP & VP
v) α
vi) β
vii) FV
viii) TV
ix) Dist of other end from HP
x) " " " " " VP
xi) Dist b/w end projectors

other end ki jagah ⊙ locus

Q1) A line CD 70 mm long is || to H.P. as well as || to V.P. The line is 10 mm above H.P. & 20 mm in front of V.P. Draw its projections.

Q2) A line AB 60 mm long is inclined at 40° to H.P. & || to V.P. Its one end is 10 mm above the H.P. & 20 mm in front of V.P. Draw its projection.

[Pdf 279, Fig 9.2, Q 9.1, Pdf 282, Fig 9.5, Q 9.4, Pdf 280, Fig 9.3, Q 9.2, 9.3]

Q3) A line PQ 70 mm long has its end P 20mm above the HP & 30mm in front of the V.P. Length of FV is 60mm & TV is 50 mm. Draw its projections & find the true inclinations.

L> θ, φ

[apparent inclination → α, β]

Q4) A line PQ 70 mm long. Its one end P is 20 mm above the HP & 30 mm in front of VP while the other end Q is 70 mm above HP & 66 mm in front of VP

Q> 9.16, 9.21, 9.25, 9.26, 9.27, 9.28, 9.29, 9.30, 9.31, 9.32

Q5) TL = 70 mm, one end 20mm from HP & 30 mm in front of VP
Dist b/w end projectors = 3.4 cm, θ = 45°

17/5/22

Projection of Planes → Surface (shape)

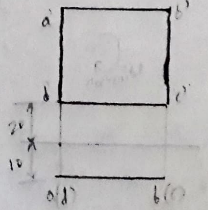
2D figures
a) Square
b) Rectangle
c) Triangle
d) Pentagon
e) Hexagon
f) Circle

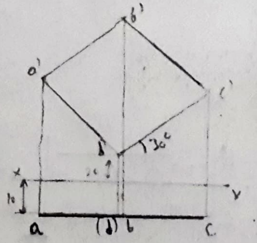
TS - True shape water dikhai dega jis plane ke plane parallel hoga
ie TS in FV if Plane ∥ VP
& TS in TV if Plane ∥ HP
→ Pehale wo view banao jahan par TS mil raha hoga
→ centroid of sq = jahan diagonals meet
→ triangle mei kuch nahi diya ho toh equilateral Δ assume karte hain

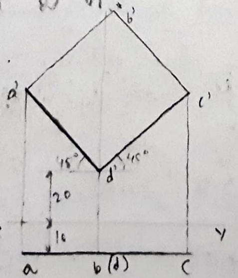
6 Cases.
1) Plane is perpendicular to both HP & VP.
2) Plane is inclined to HP perpendicular to VP
3) Plane is parallel to HP perpendicular to VP.
4) Plane is inclined to VP perpendicular to HP
5) Plane is parallel to VP perpendicular to HP
6) Plane is inclined to both HP & VP.

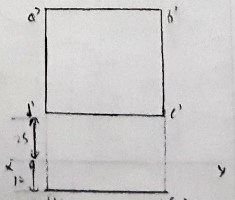
Q1) A square plane 30 mm side has its surface parallel to VP, perpendicular to HP. Draw its projections when i) one of the side is parallel to HP & 20 mm above it. [will apply to side closest to HP]
ii) One of the side is inclined at 30° to HP & nearest corner is 10 mm above HP
iii) Two of its adjacent sides are equally inclined to HP.
iv) One of the side is ⊥ar to HP & its midpoint is 40 mm above HP
- The given surface is 10 mm in front of VP.

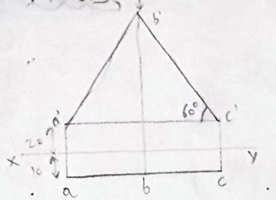
Ans

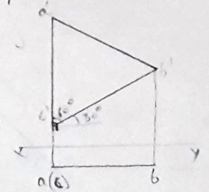

(i)
len of TV is least

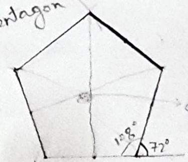

(ii)
len of top view is greater than (i)


(iii)
len of TV is greatest & equal to diagonal


(iv)





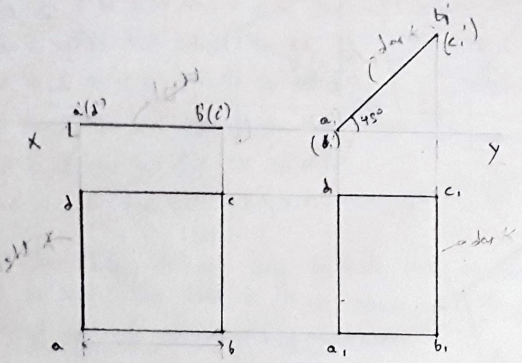
Pentagon

→ Centroid → kisi bhi teen side ke midpoint ko ⊥ se join karna

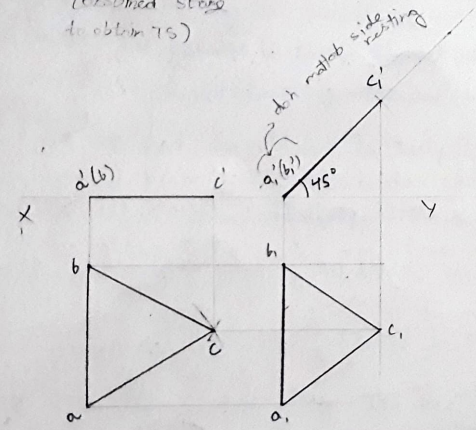
Q2) [Same as ques 1, triangle instead of square]
∵ It isn't specified, we assume equilateral triangle

Q10.4) A square plane of side 30 mm has an side on the H.P. The surface is inclined at 45° to the H.P. & perpendicular to the V.P. Draw its projections.

* TS mei resting side should be on left & ⊥ar to XY line

[P.T.O]

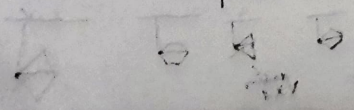




31/5/22

Q) A sq plane of 30mm side has a corner on the H.P with its surface inclined at 30° to HP. Draw its projection

* Corner Resting ⇒ Jis corner ko last side mai chahote hai usse gujarne wala diagonal xy is parallel krna chahiye.



21/6/22
Q 10.22) A Hexagonal plane of side 30 mm has an edge (side) on the H.P. Its surface is inclined at 45° to the H.P. and the edge on which the plane rests is inclined at 30° to V.P. Draw its projections.

Surface ka angle ⇒ 2nd stage

surface jisse inclined hai usshe plane se parallel karke

hai sabse pehele

Section of Solids

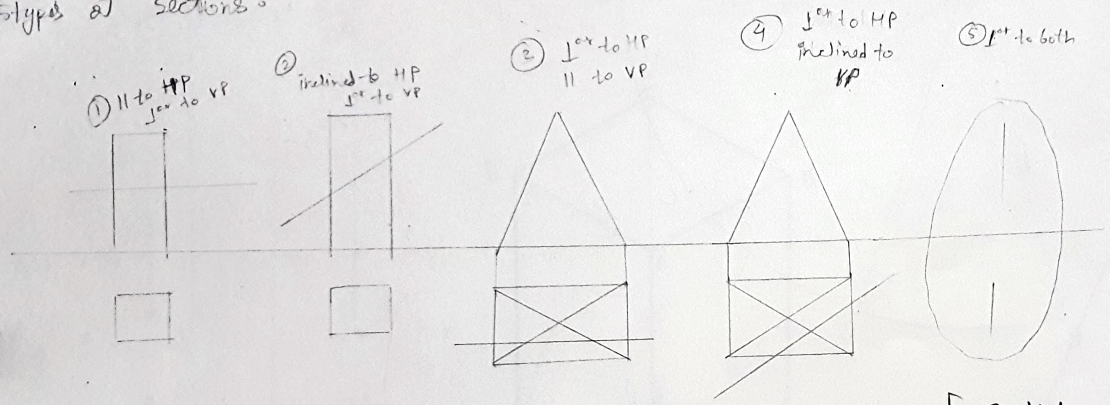
to cut

① → cutting plane or section plane has no shape

② → cutting plane to uss view mein dikhate hai jisme wo line dikhega

③ → wo line cutting plane ka trace hogi

Types of Sections :-



Development of Solids

Products made of sheet (paper / metal)

Prism → cylinder

Pyramid → Cone

① Frustum - Pyramid, cone → when cut parallel to base → remaining part

② Truncated → all solids → cutting plane inclined

H.W. → 13.1, 13.2, 13.19, 13.7

Q> 13.1> ... it is cut by a section plane bisecting the axis inclined at 45° to HP draw development of lateral surface of prism

Pg 13.2
Pdf 523

Q 13.2> (HW)

Pg 13.3
Pdf 524

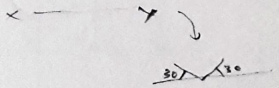
⇒ Agar ek line ka T.V. XY ko ∥ hai toh uska F.V. uss line ko
True length degaa. [Short edge ko TL nikalne ke liye]

Q> A square prism/pyramid base 30 mm axis 60mm is resting on HP on its base with base side parallel to VP. Draw its isometric view

ISOMETRIC VIEW / PROJECTION

[3-D]

Step ① (All questions)

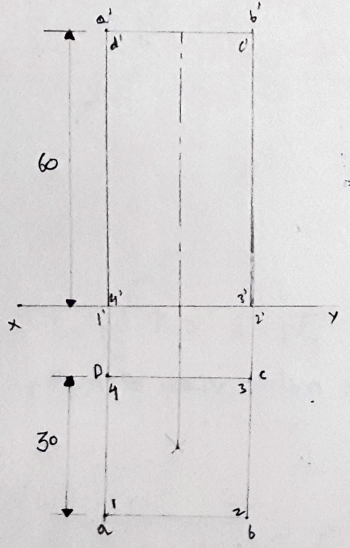


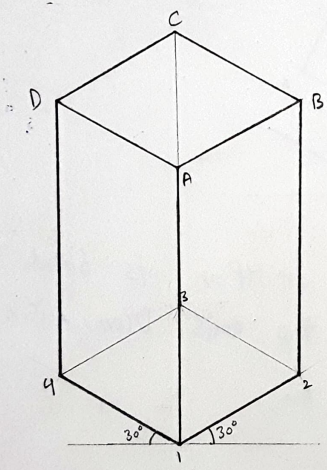
* Body rotates anti-clockwise

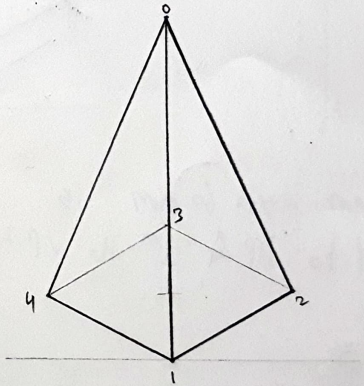
Q1) 15.10 (prism)

Q2) 15.10 (pyramid)

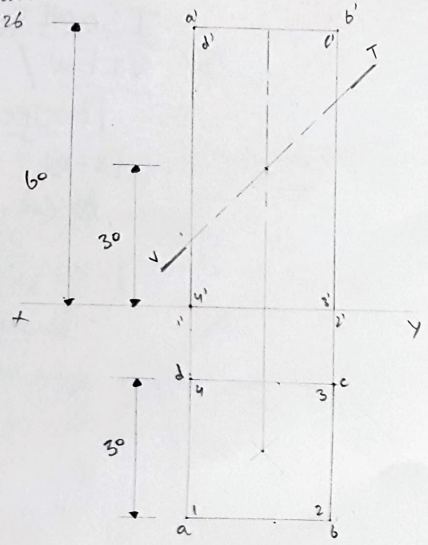
Q3) 15.7



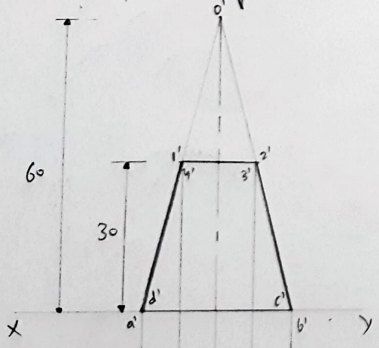


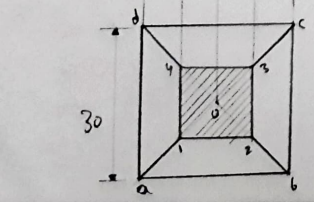


Q 15.20>
Pg 15.19
ABS 626

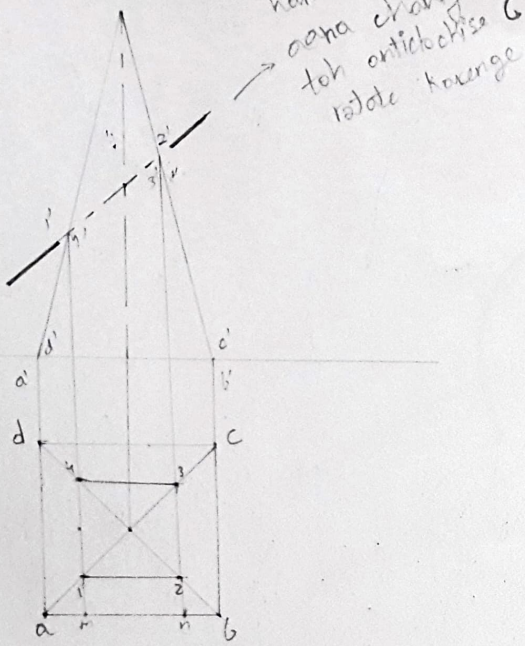


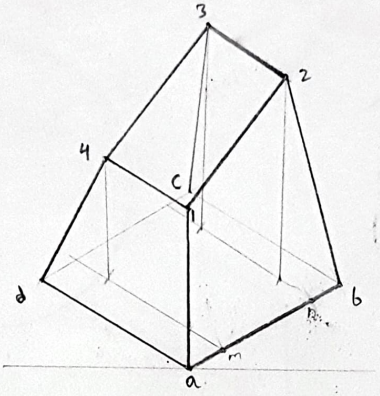
Q7> A sq. pyramid base 30 mm axis 60 mm is resting on HP on its base. It is cut by a section plane parallel to HP & 1/2 to VP & bisecting the axis. Draw isometric views of frustum.





Sloping plane
kenari tarik
cara drawing
toh anticlockwise 6
rotate towards





Using true len = Isometric View

Using Iso len = Isometric Projection

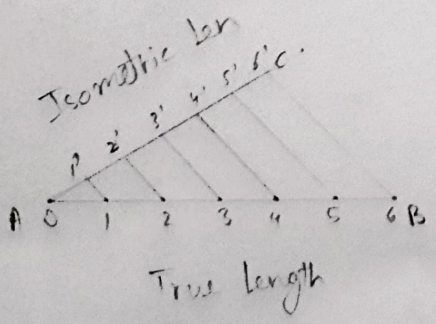
$$\frac{\text{Iso len}}{\text{Tru len}} = 0.8$$

$$\text{Iso} = 0.8 \times \text{Tru}$$

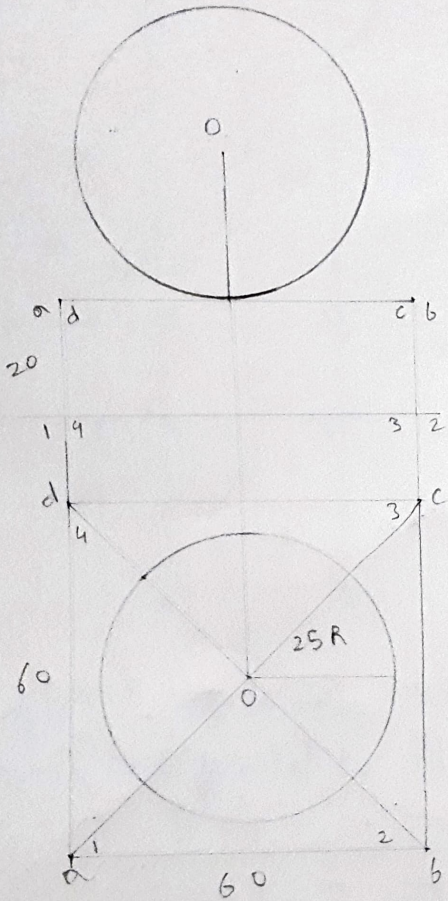
$$\text{Iso} = 0.8 \times 6\text{ cm}$$

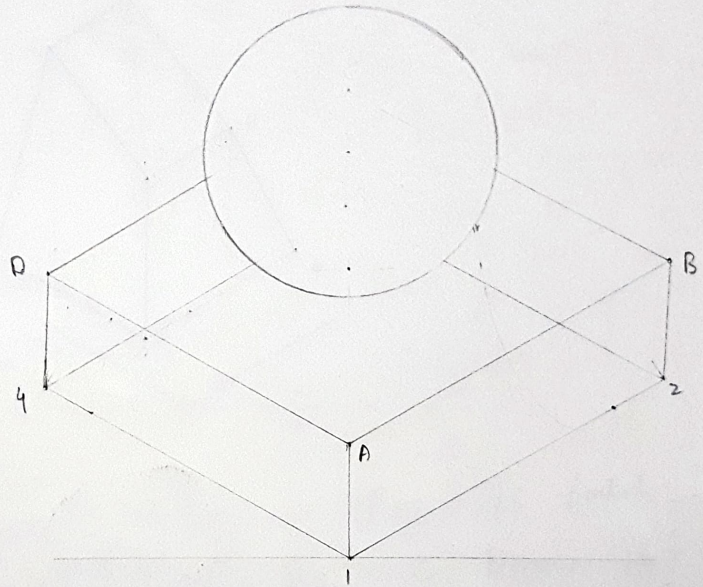
$$= 4.8\text{ cm}$$

$$= 48\text{ mm}$$



Q.1
15.21





→ ED ek language hai → alag alag pencil use karte hai → alag alag lines use karte hai
engineer ki
'language of engineers'

→ graphical scale → plain, diagonal, vernier, comparative, scale of chords
measuring scale → plastic wala → comparative scale

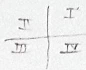
→ ... use hota hai force ka analysis karne ke liye normal, tangent ka use karke

→ projection = Solid obj ke parchai / shadow

Horizontal plain = top view , vertical plain = front view

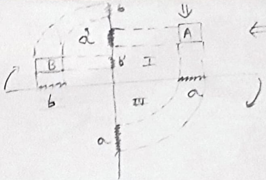
(i) A Capital letter = object
(iii) a small letter = top view
(vi) a' single dash = front view
a" double dash = side view

Poore universe ko agar doh axes se intersect kiya hai toh woh 4 quadrants mae break hote hai



Reference line = Jahan horizontal aur vertical plane milte hai (Ideal)
OR Jahan pe doh plane meet kare

... mae banane ke liye Horizontal plane ko 90° rotate karte hai



Jab obj I^st quad mae ho
toh top view → ref line ke niche
& front view → ref line ke upar

Summary

	TV	FV
1	↓	↑
2	↑	↑
3	↑	↓
4	↓	↓

★ [III^rd aur IV^th quad mae drawing nahi karte kyunki top view aur front view overlap kar jate hai]