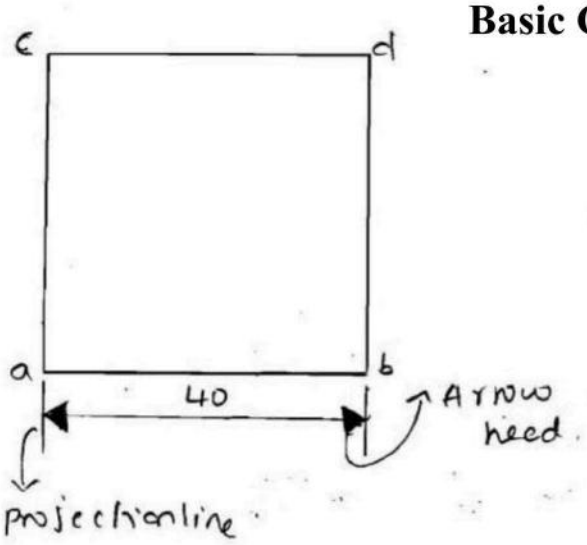
UNIT-I

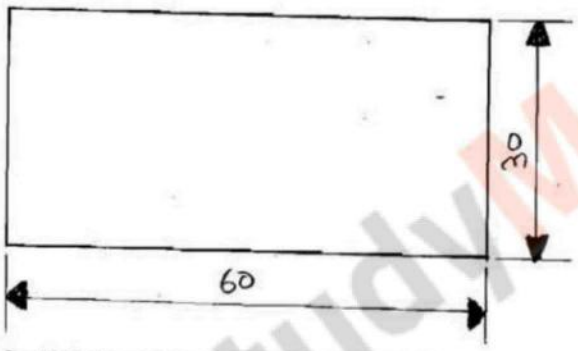
Content

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Scales – Plain & Diagonal.

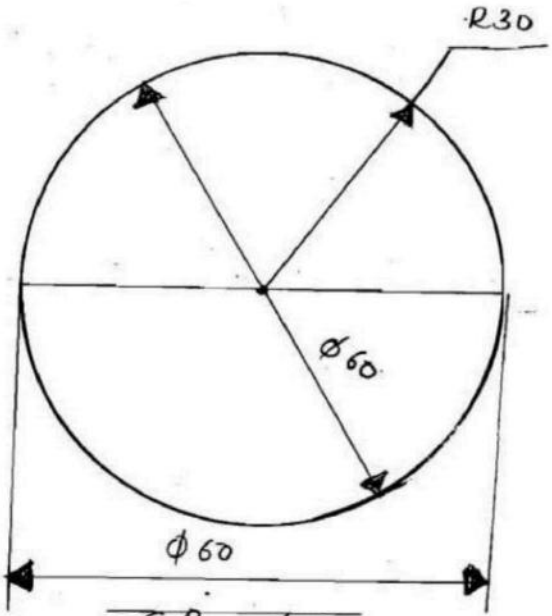
Basic Concepts



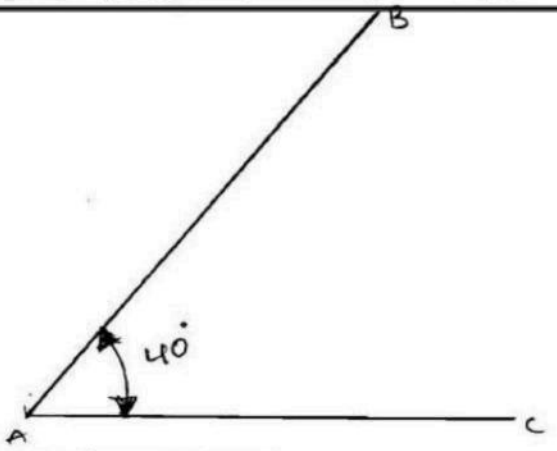
Square.



Rectangle



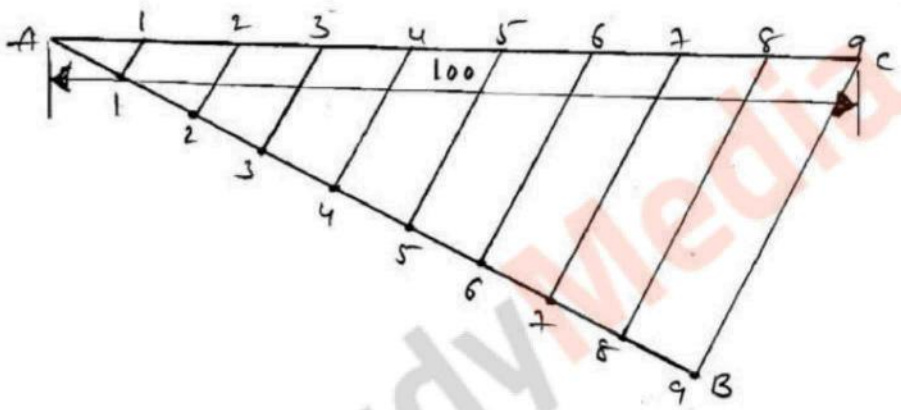
Circle



Angle

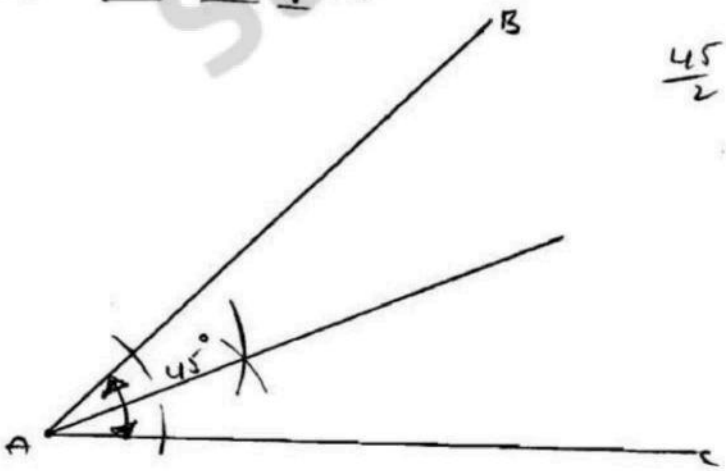
Divide a line into Number of equal Parts

n = 9

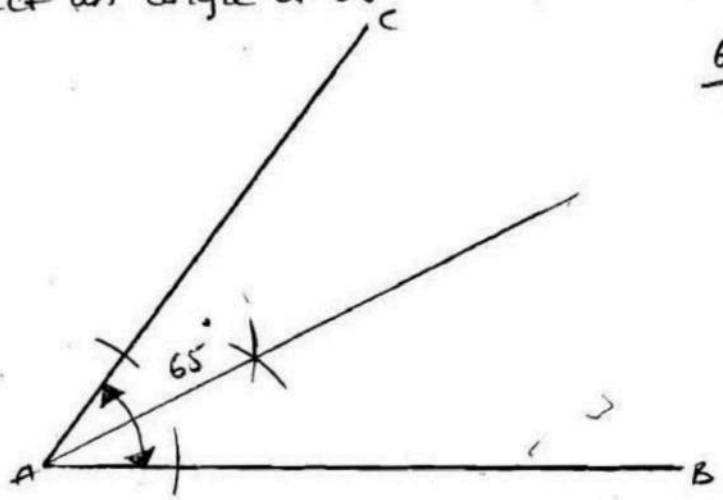


Bisecting an angle :-

$\frac{45}{2} = 22.5$

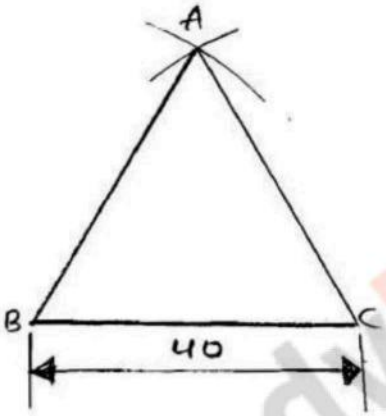


Bisect an angle of 65°



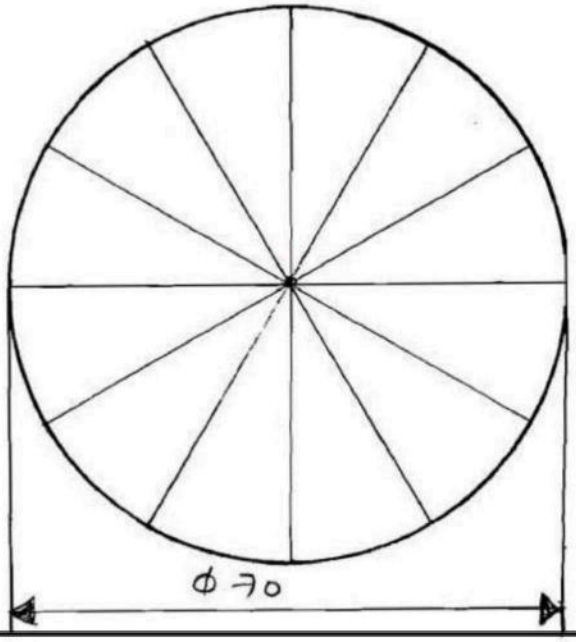
$\frac{65^\circ}{2} = 32.5^\circ$

Construct an equilateral triangle of side 40 mm



Divide a circle of diameter 70mm into 12 equal parts

n = 12 equal parts

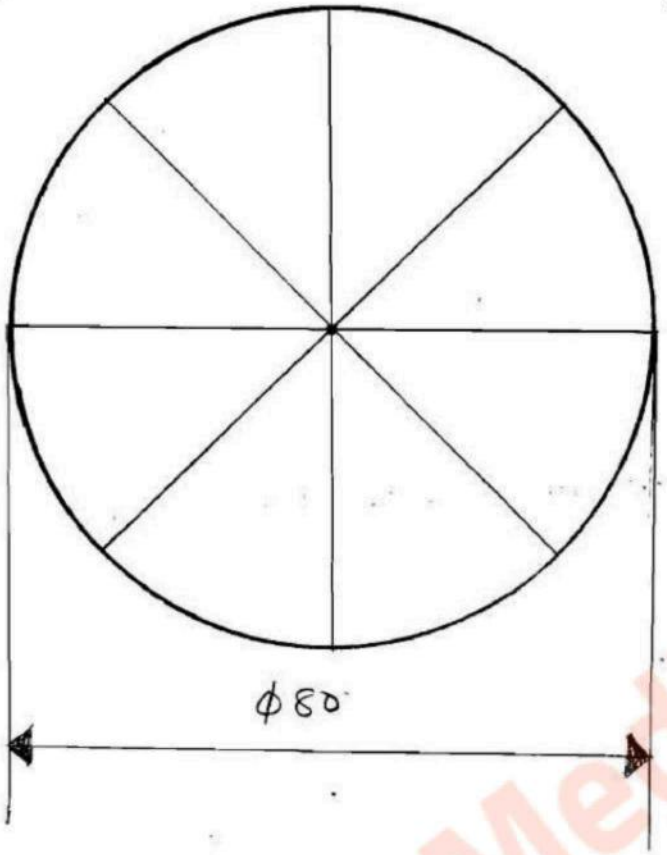


$\frac{360^\circ}{12} = 30^\circ$

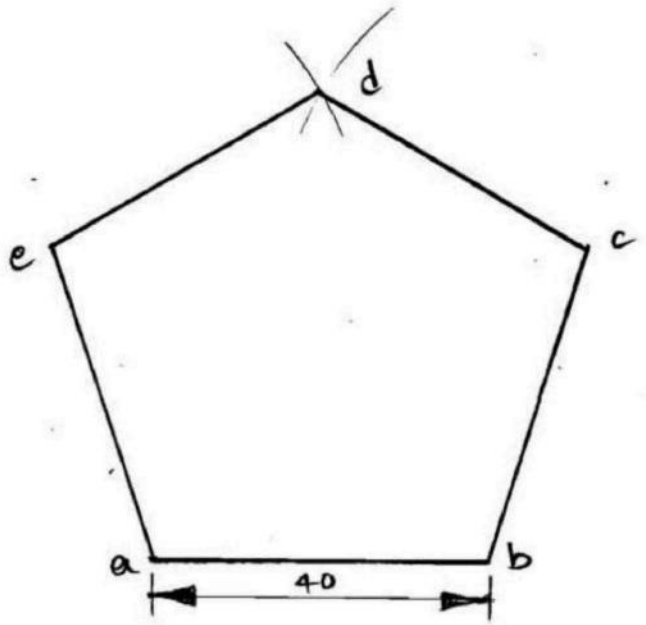
Divide a circle of diameter 80 mm into 8 equal parts.

n = 8 equal parts

$\frac{360^\circ}{8} = 45^\circ$

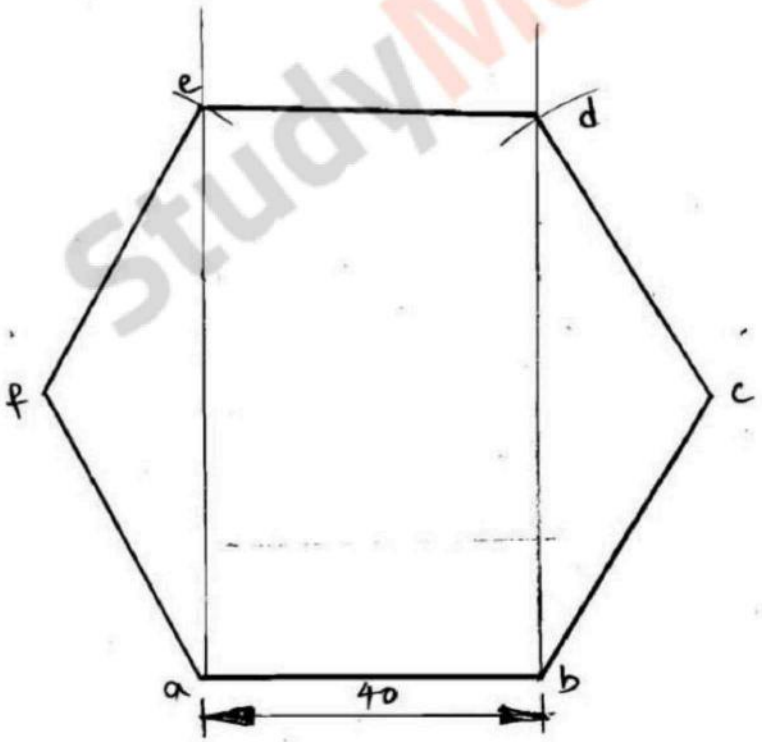


Construct a Pentagon of side 40mm



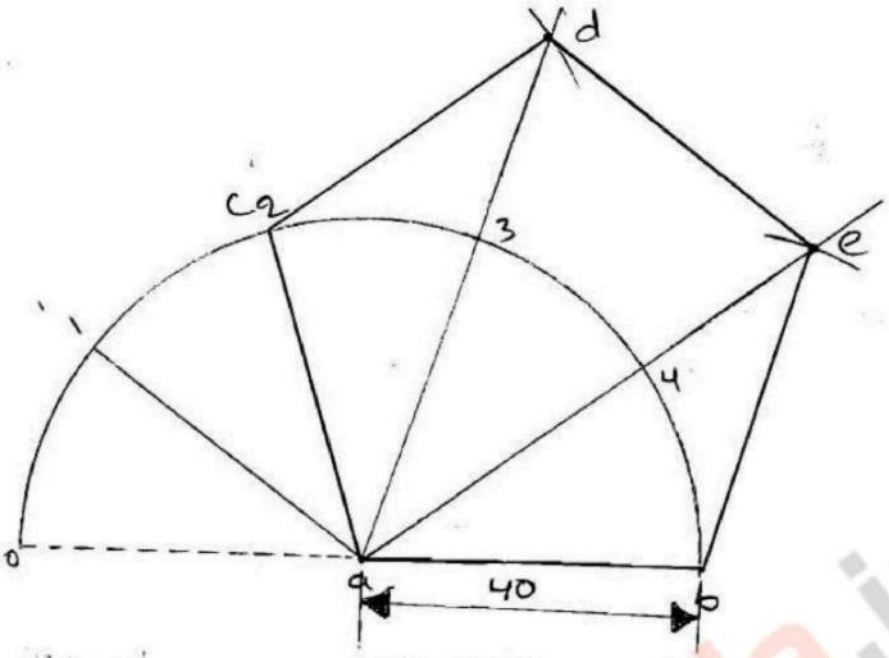
Pentagon

Construct a Hexagon of side 40mm

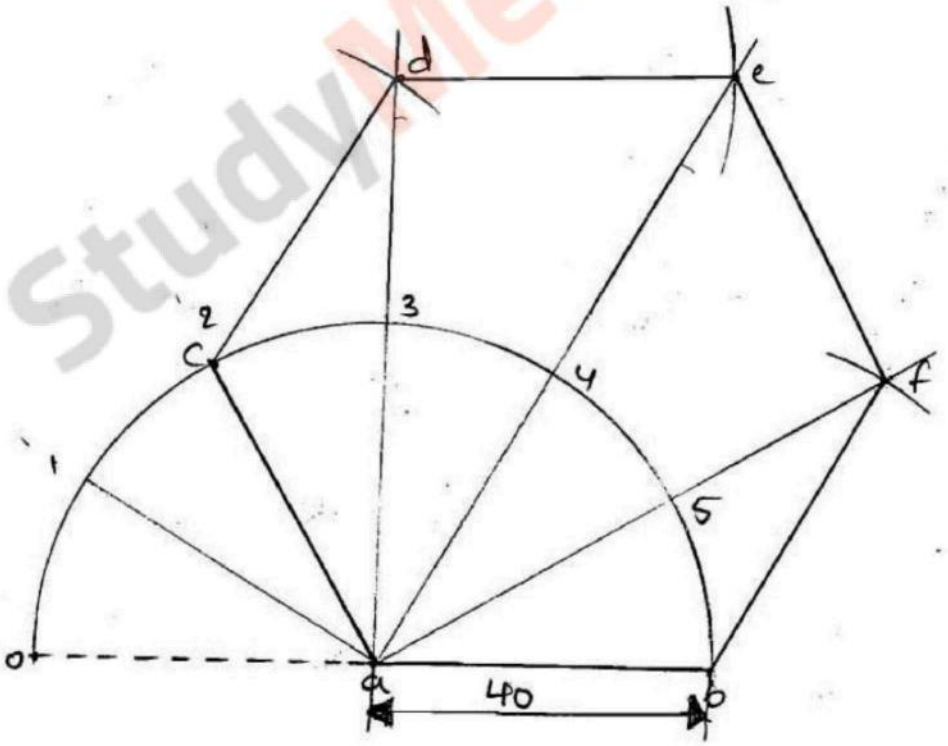


Hexagon

Draw a regular Pentagon and regular Hexagon having 40mm side Length

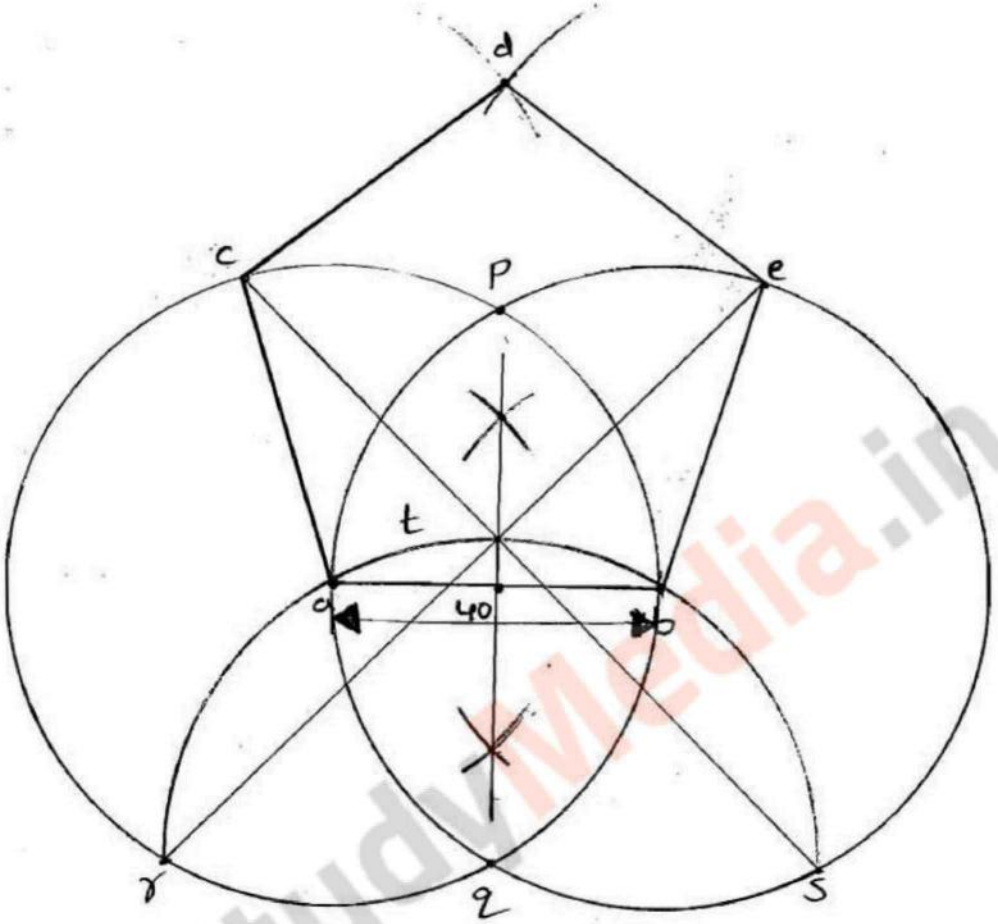


Pentagon

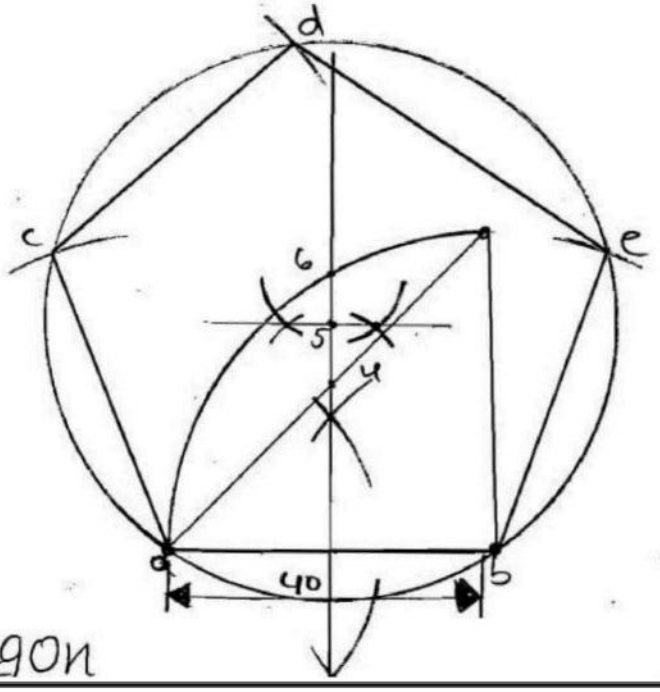


Hexagon.

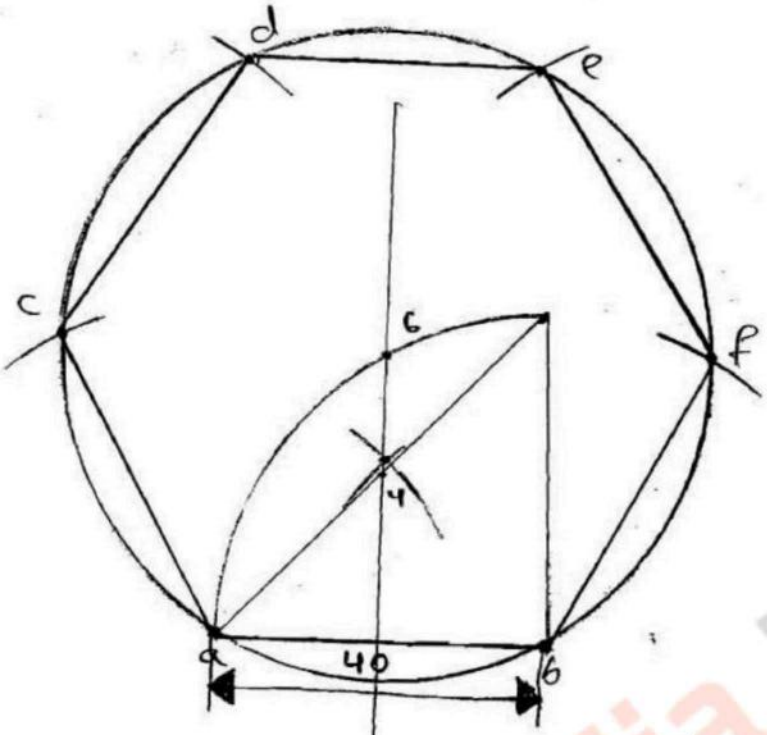
Q:- Draw a regular Pentagon of side 40 mm by using arcs of circle method



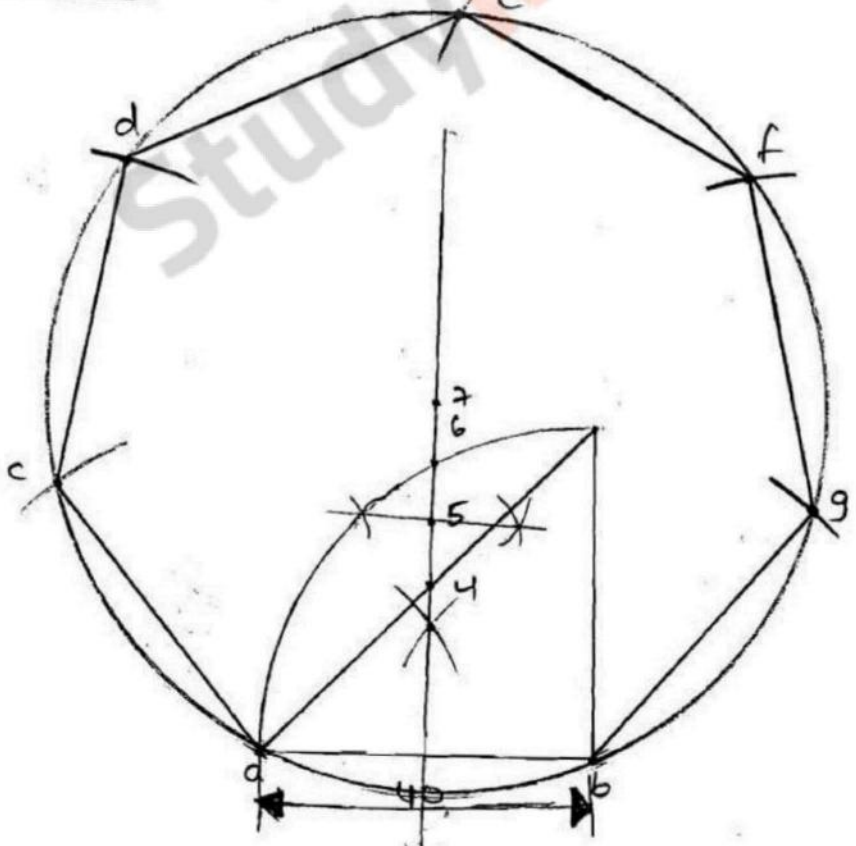
⇒ Special method of construction of any Polygon.



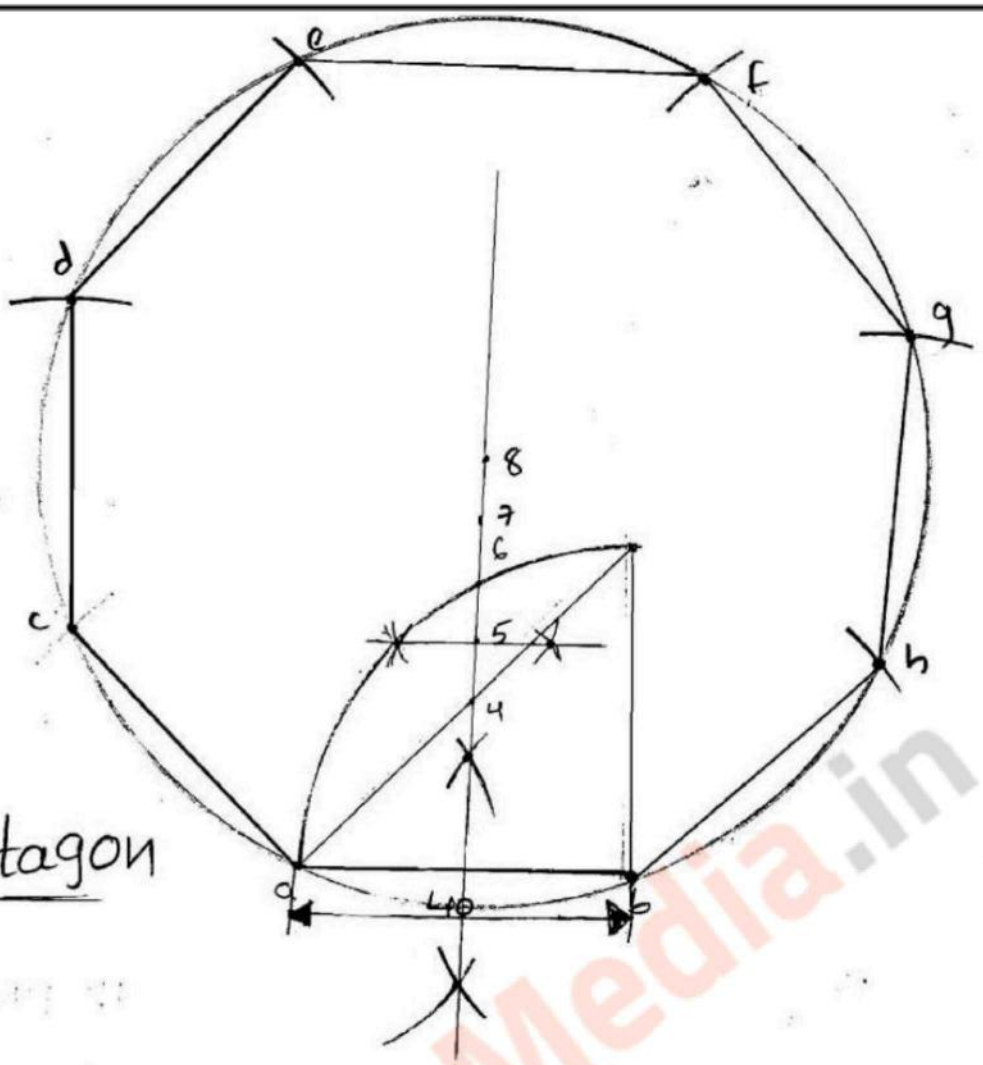
Pentagon



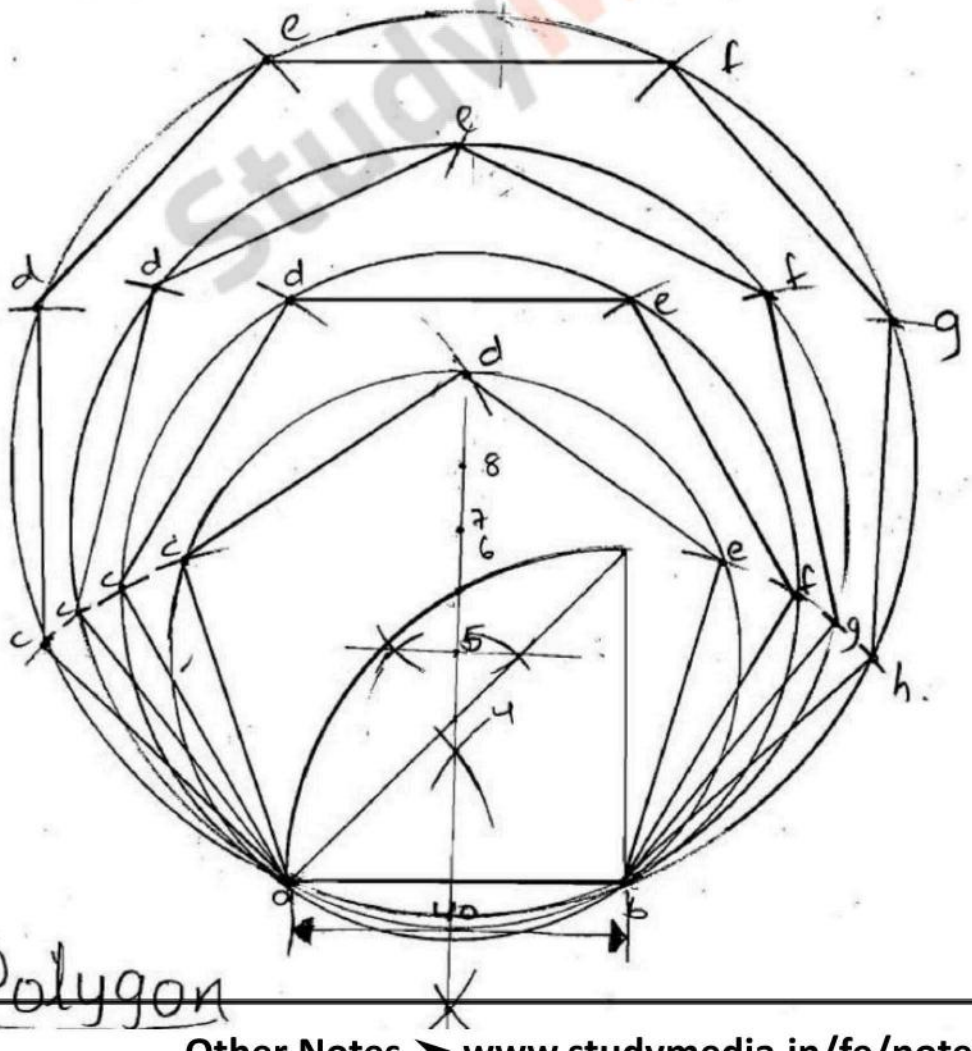
Hexagon



Septagon



Octagon



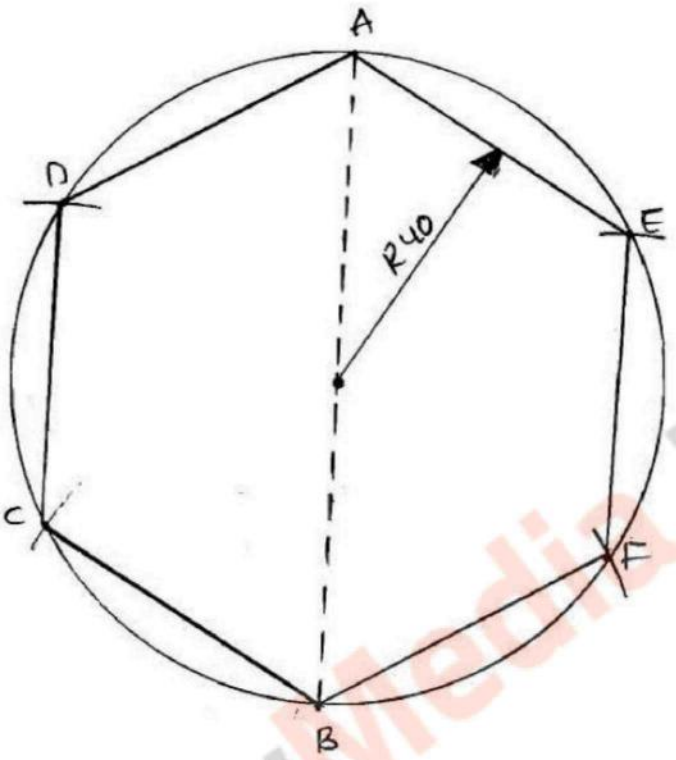
Polygon

Construct a Hexagon of side 40mm

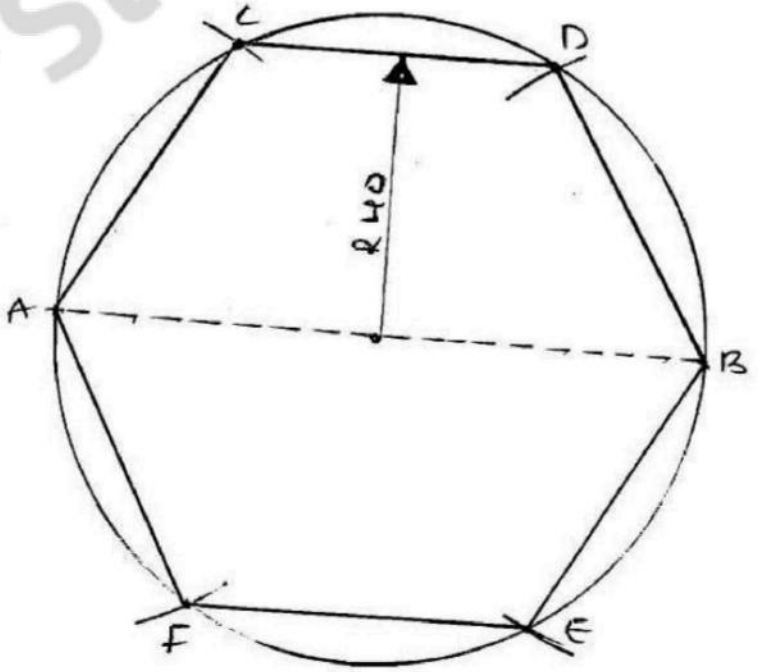
a) Side is vertical.

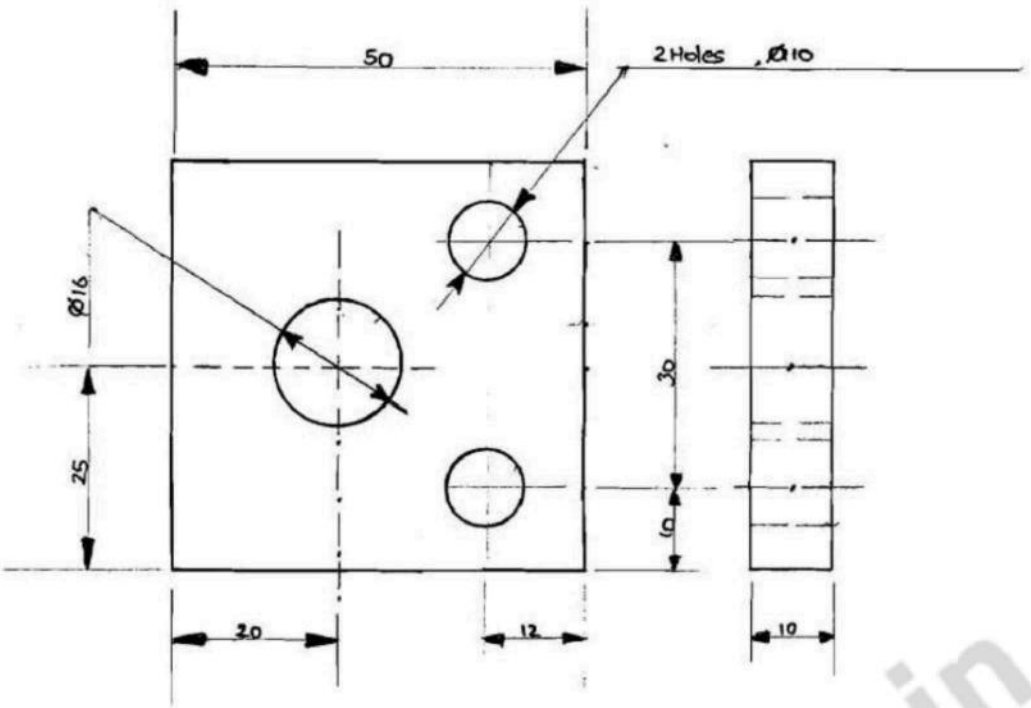
b) side is Horizontal.

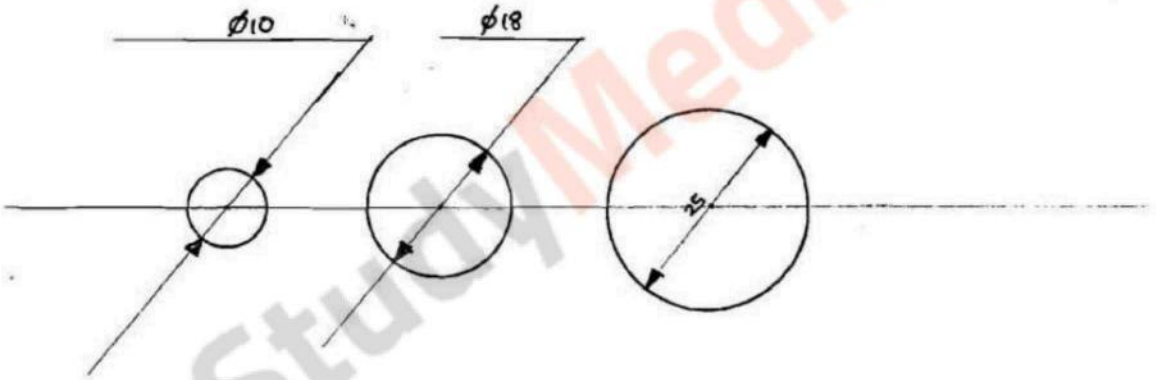
a)

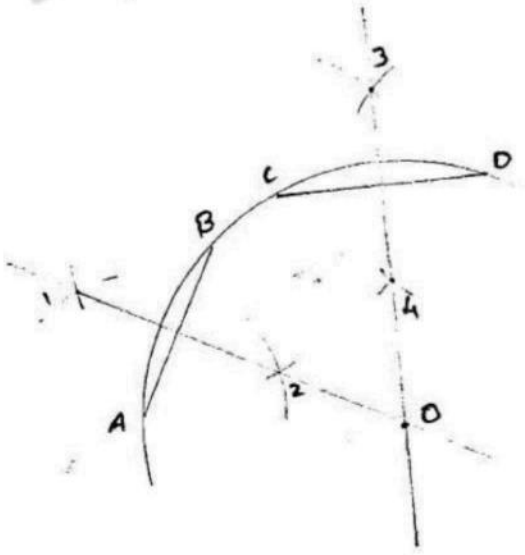


b)





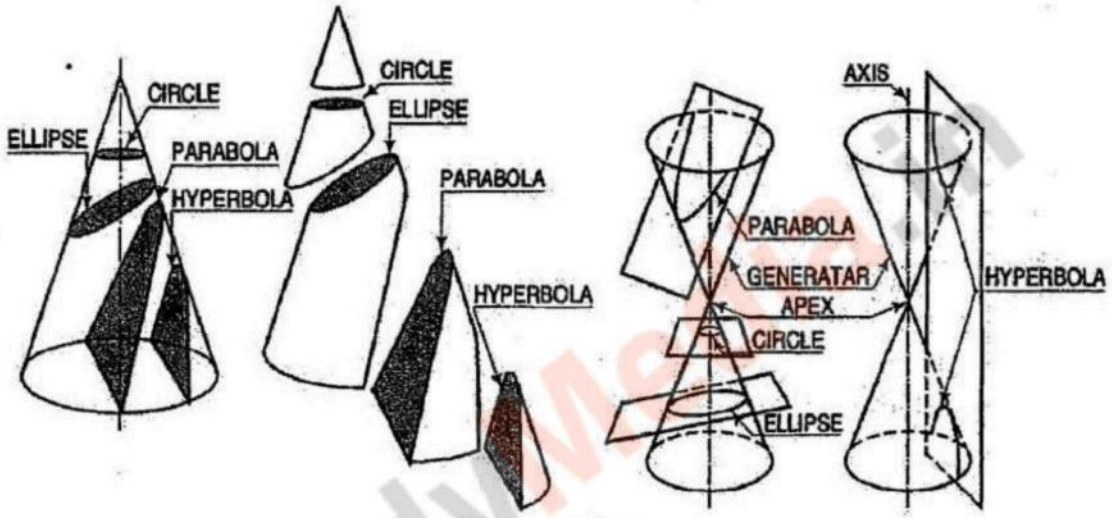




Unit-I

Conic Sections:

The section obtained by the intersection of a right circular cone by a plane in different positions relative to the axis of the cone are called conics.



Conic sections

(i) When the section plane is inclined to the axis and cuts all the generators onone side of the apex, the section is an ellipse

(ii) When the section plane is inclined to the axis and is parallel to one of thegenerators, the section is a parabola

(iii) A hyperbola is a plane curve having two separate parts or branches, formedwhen two cones that point towards one another are intersected by a planethat is parallel to the axes of the cones.

The conic may be defined as the locus of a point moving in a plane in such a waythat the ratio of its distances from a fixed point and a fixed straight line is alwaysconstant. The fixed point is called the focus and the fixed line, the directrix.

The ratio $\frac{\text{distance of the point from the focus}}{\text{distance of the point from the directrix}}$ is called eccentricity and isdenoted by e. It is always less than 1 for ellipse, equal to 1 for parabola and greaterthan 1 for hyperbola i.e.

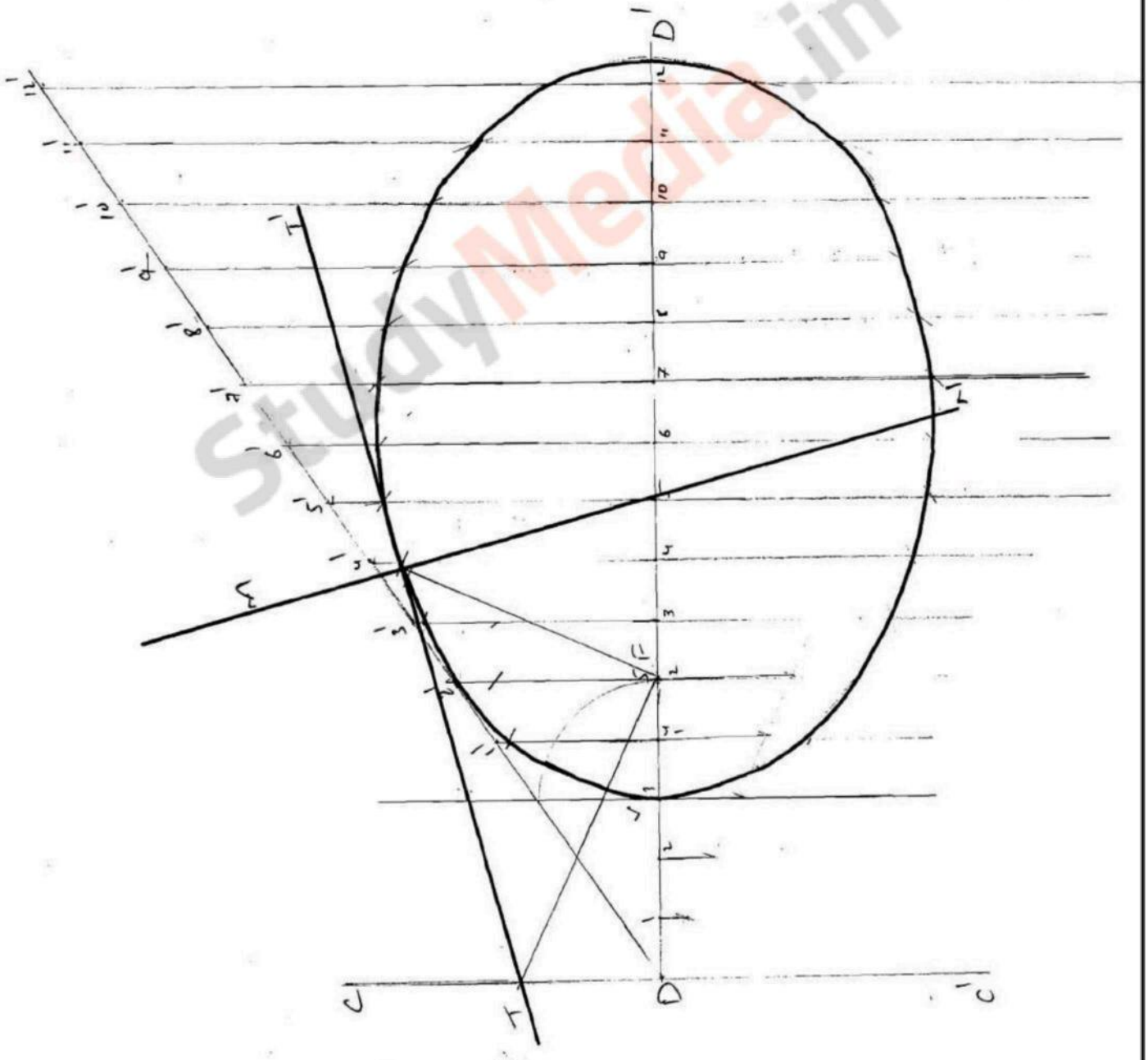
(i) ellipse :$e < 1$

(ii) parabola : $e = 1$

(iii) hyperbola : $e > 1$.

The line passing through the focus and perpendicular to the directrix is calledthe axis. The point at which the conic cuts its axis is called the vertex.

Draw a ellipse when the distance of its focus from its directrix is 50mm and eccentricity is 2/3 also, draw a tangent and a normal to the ellipse at point 70mm away from directrix.

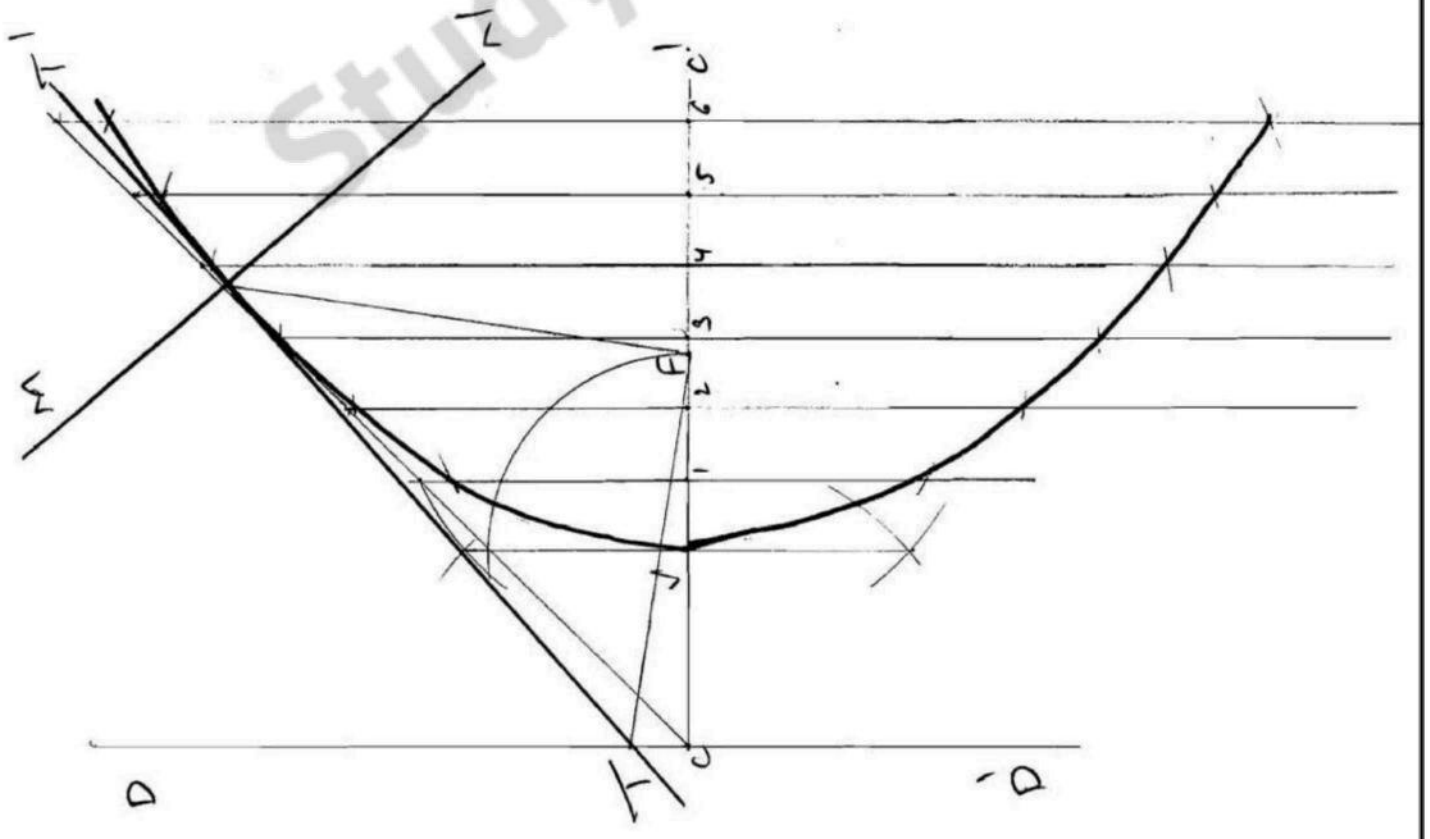


1. Draw focus F on axis AB such that AF = 50mm.
2. Divide AF in 5 equal parts. mark vertex V_1 on 3rd division from A. and Draw vertical line V_1E equal to V_1F. Join A to E and produce it to some distance.
3. Mark a point 1 anywhere on line AB (less than 1cm). Draw a perpendicular line through 1 and meet AE produced at point 1'.
4. with centre F and radius 1-1', draw arcs to intersect the perpendicular line 1-1' at points P_1 and P_1'. These are the loci points of ellipse
5. similarly, mark other point. These gives some more loci points of ellipse like; P_2 and P_2', P_3 and P_3', P_4 and P_4', etc.
6. Join all the loci points of ellipse and obtain the required ellipse. and the required ellipse

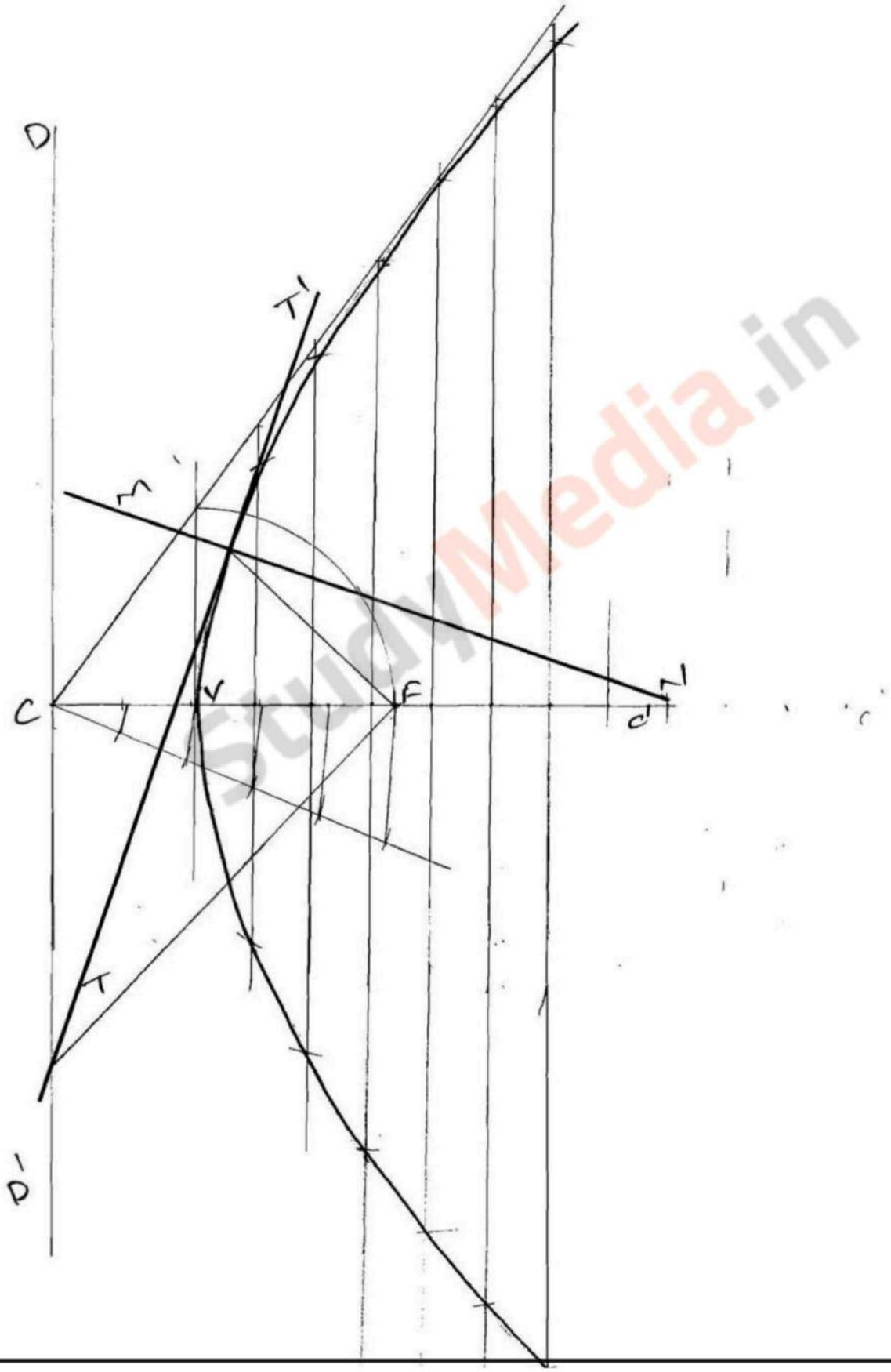
Tangent and normal to an ellipse.

1. Mark a point P on ellipse at 70mm from directrix and join PF.
2. Draw a line FT perpendicular to line PF to meet directrix DD' at point T.
3. Join TP and produce to some point T'. The line TT' is required tangent.
4. Through point P, draw a line NN' perpendicular to TT'. The line NN' is the required normal.

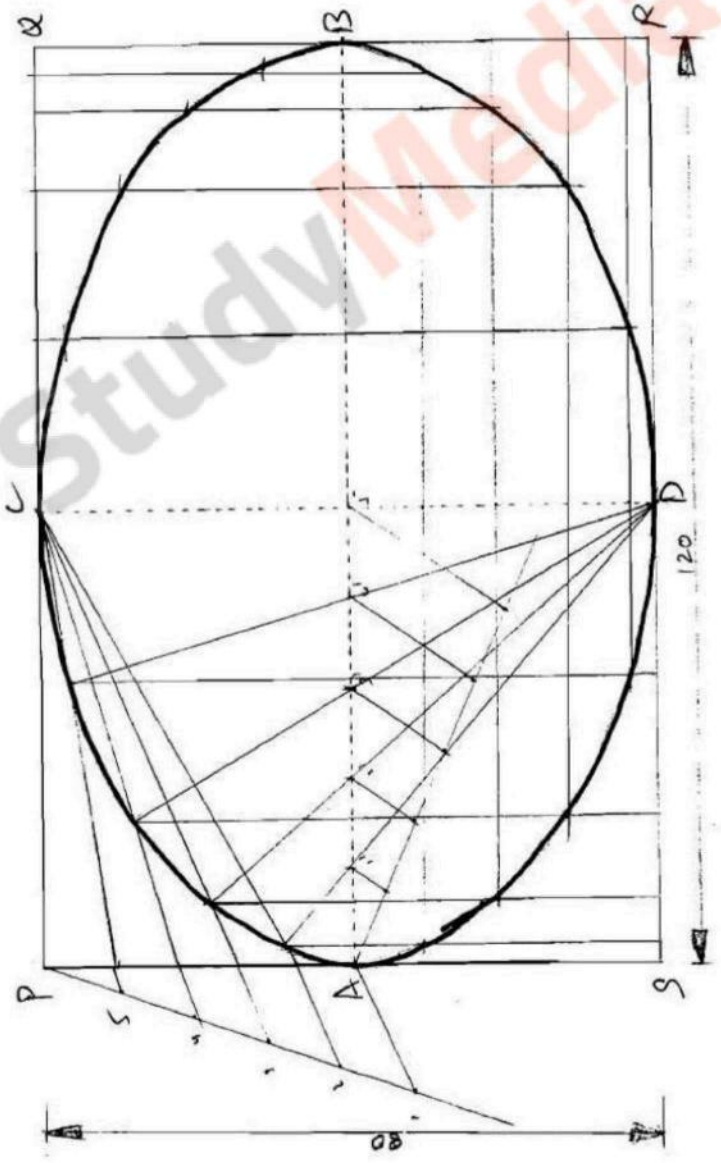
Draw parabola when the distance between its focus and directrix is 55 mm also a tangent and a normal at a point 65mm from directrix.



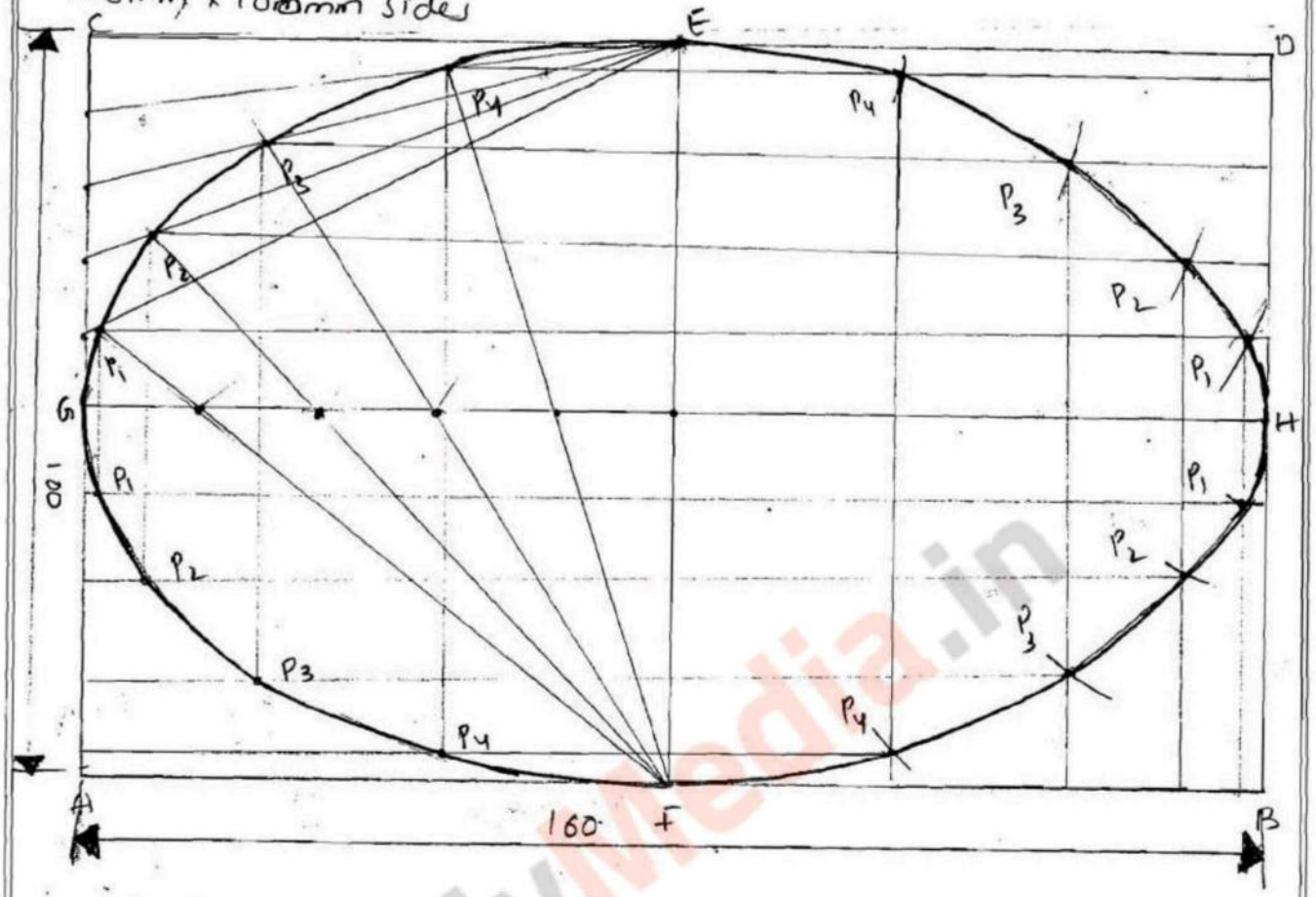
Draw a hyperbola when the distance of its focus from its directrix is 58mm and eccentricity is 3/2 also draw a tangent and a normal to the hyperbola at a point 30mm from the directrix.



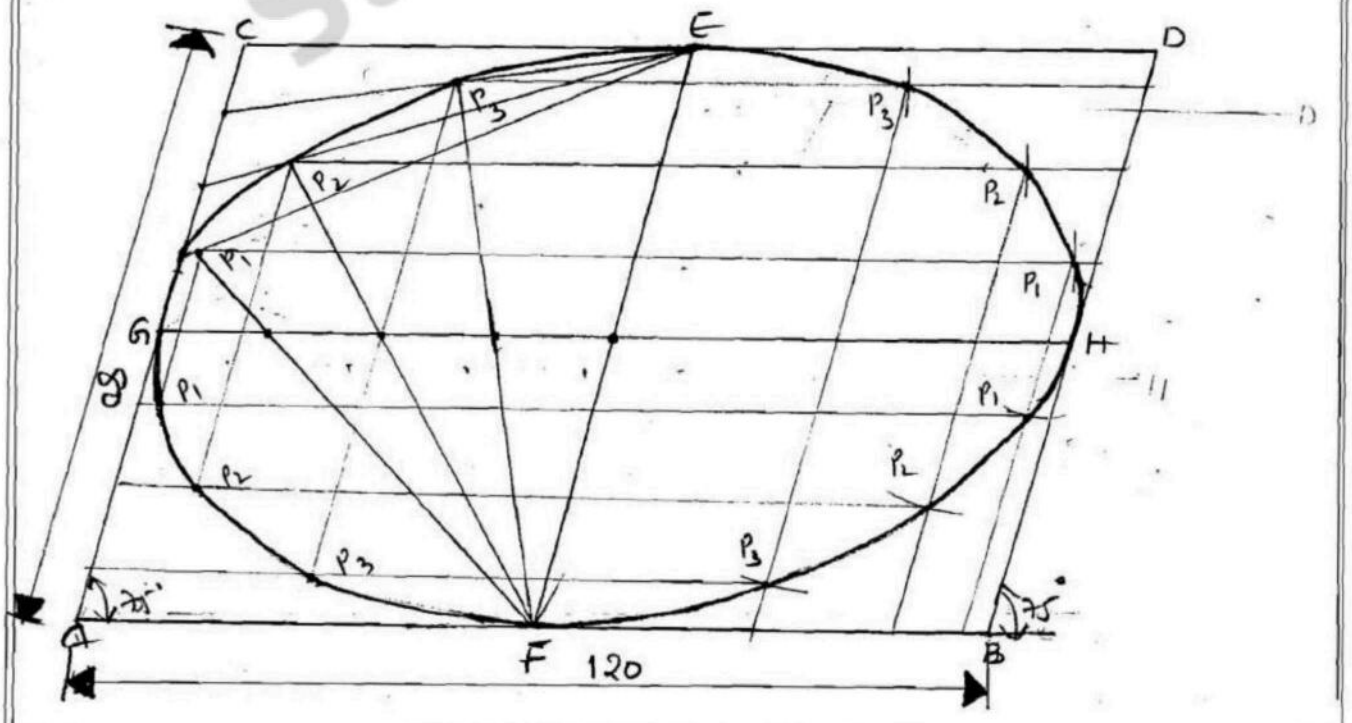
Draw an ellipse having 120mm long major axis and 80mm minor axis.



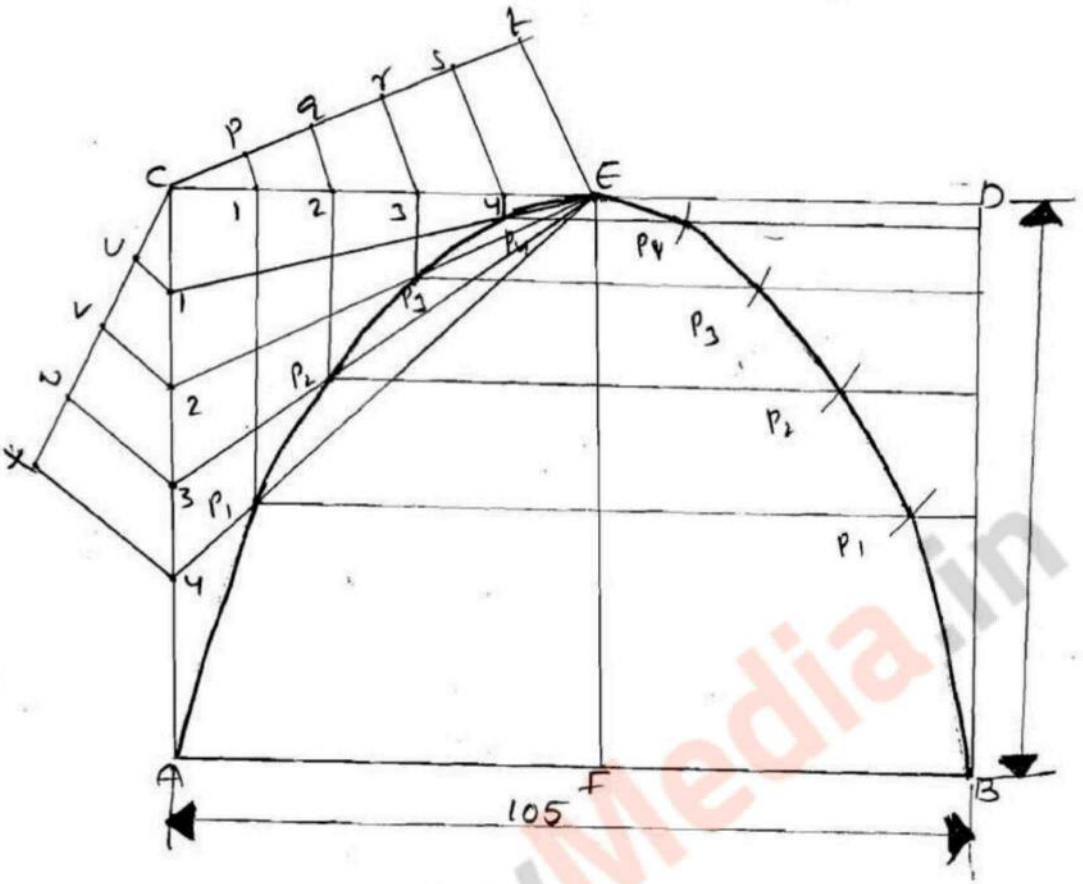
Q:- Inscribe the largest possible ellipse in a rectangle with 160mm x 100mm sides



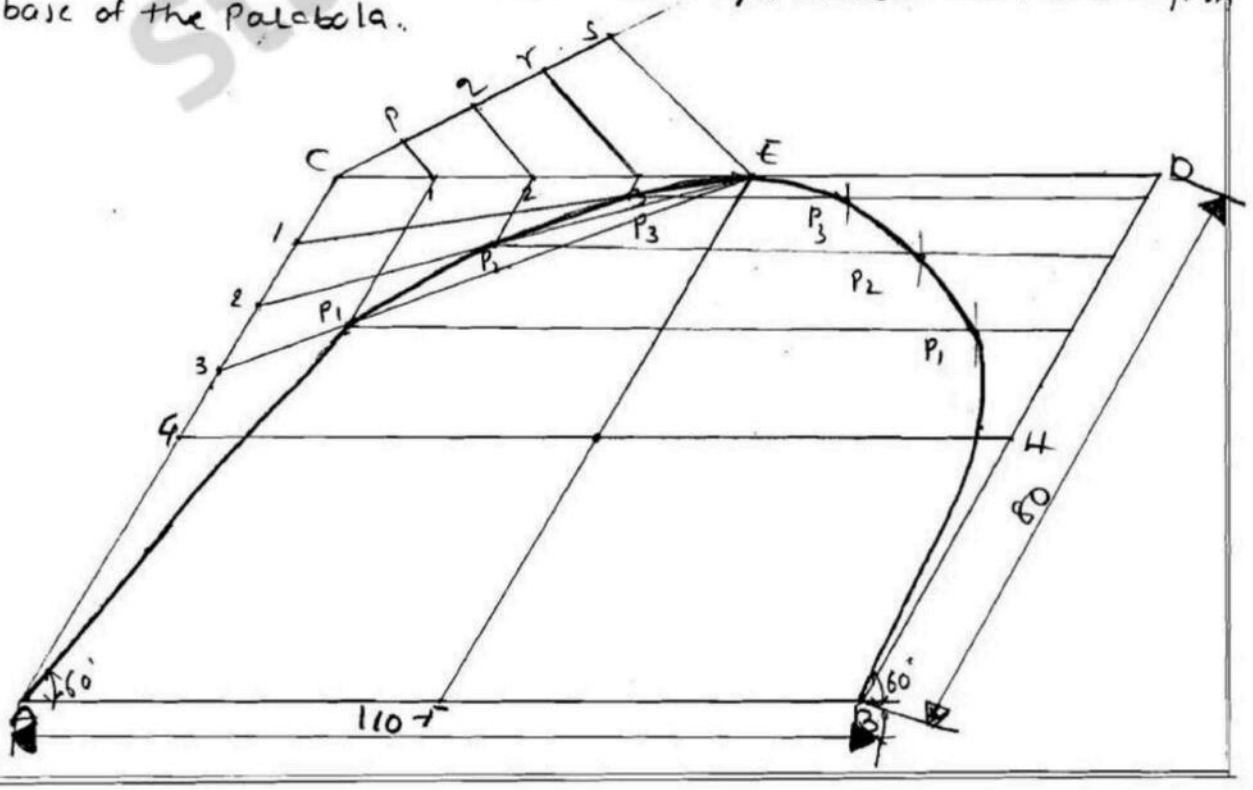
Q: The sides of a Parallelogram are 120mm x 80mm. The included angle between them is 75°. Inscribe an ellipse. In the given llgram



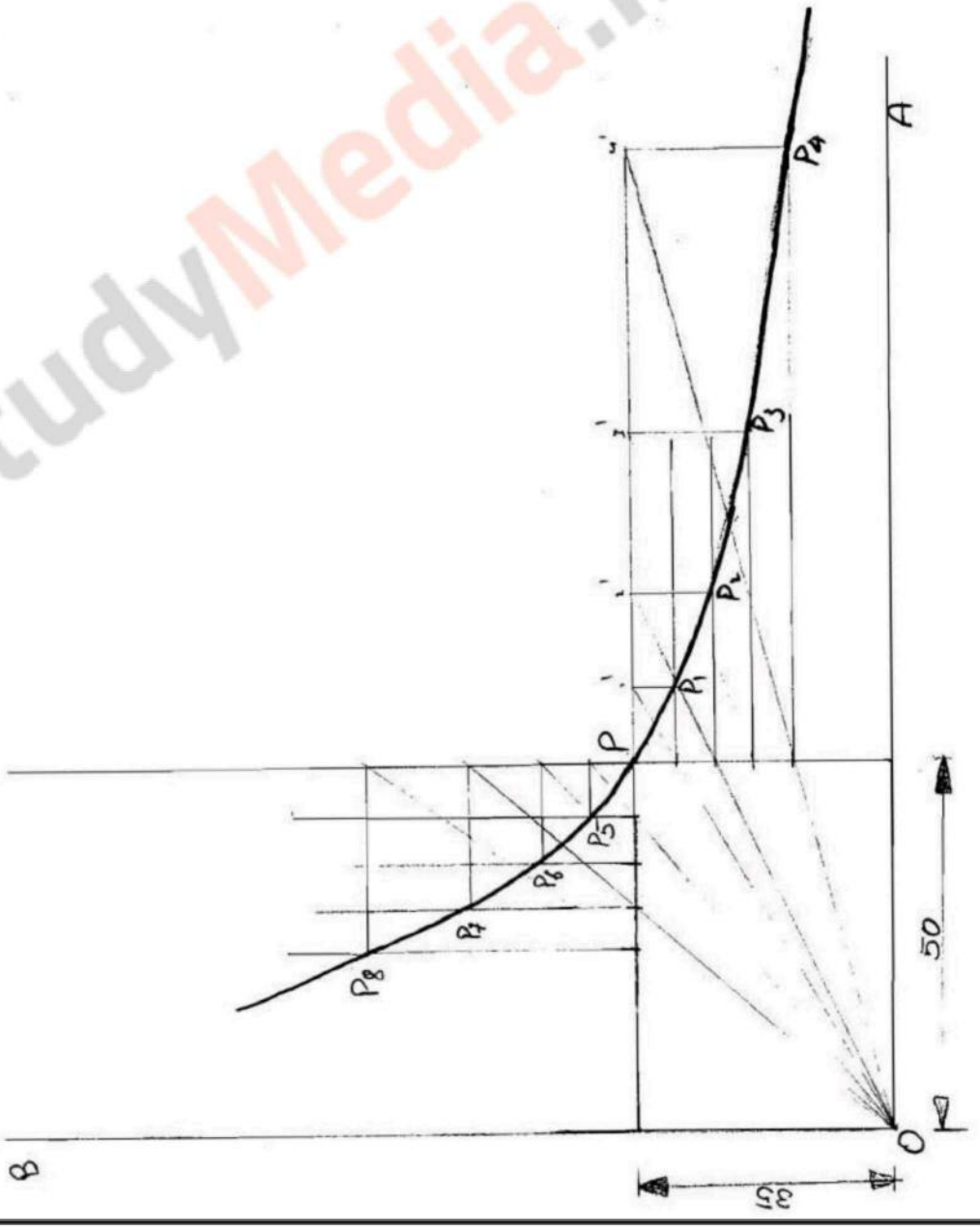
Q: Draw a Parabola given the width and height of its enclosing rectangle as 105mm x 75mm respectively.



Q: Inscribe a Parabola in a Parallelogram of 110 x 80mm sides, The Included angle being 60°. Consider the longer side of the Parallelogram as base of the Palabola.

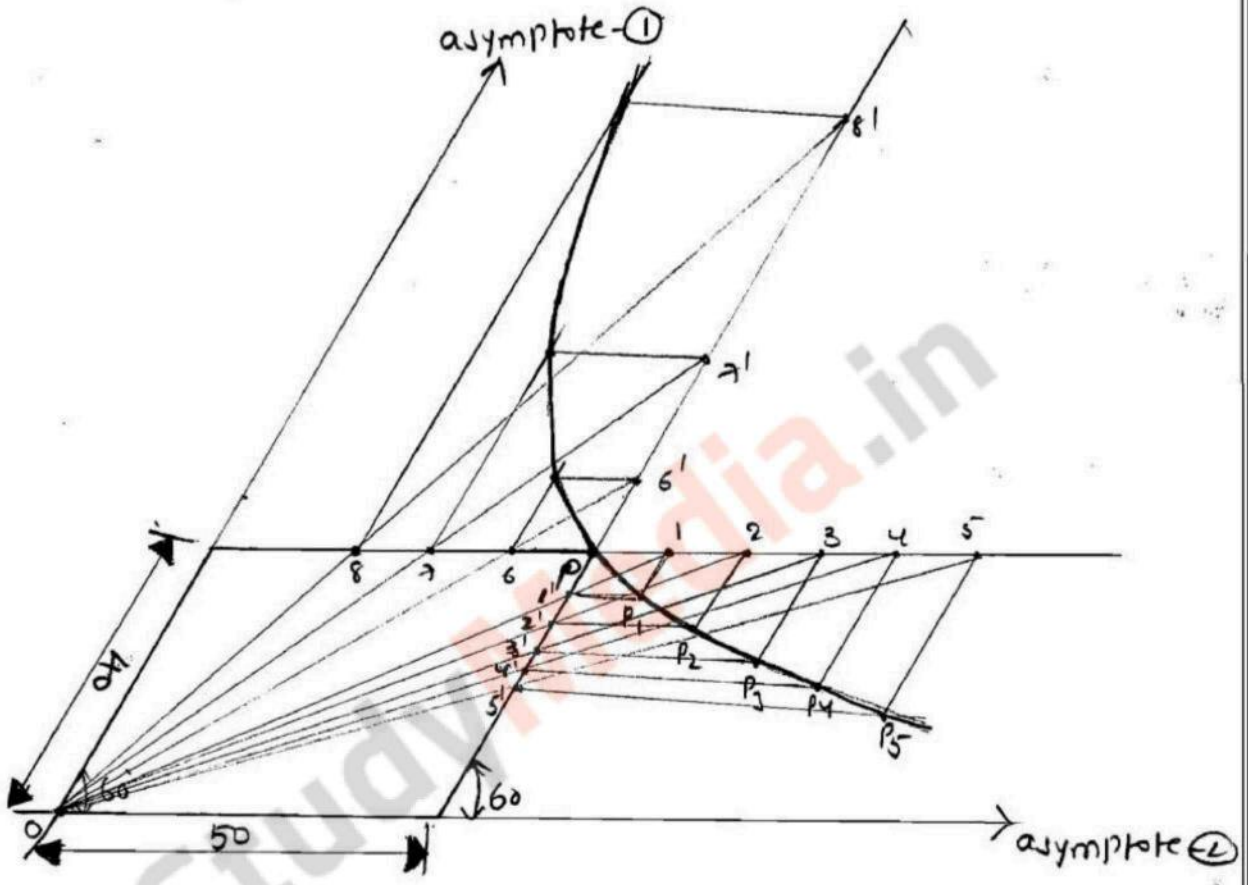


A point P of the hyperbola is situated at a distance of 35mm and 50mm from the pair of asymtodes. The asymtodes are perpendicular to each other. Draw hyperbola using orthogonal asymtodes method.



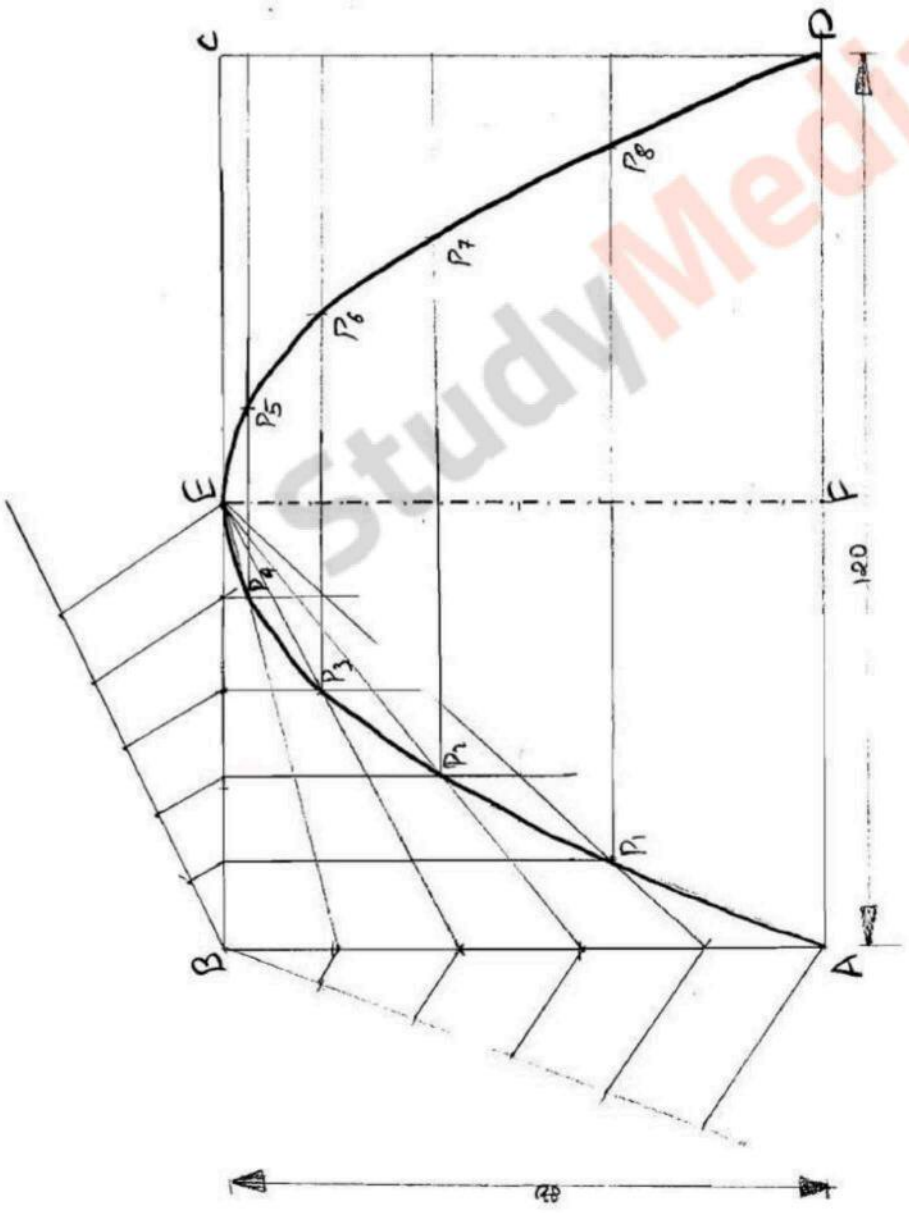
1. Draw asymptotes OA and OB perpendicular to each other.
2. Mark P such that OA = 35 mm and OB = 50 mm.
3. Draw CD, EF parallel to OA, OB respectively · pass through P.
4. Mark points 1, 2, 3, etc..., on PD at equal distance.
5. Join O1, O2, O3 etc.., to intersect the line EP at 1', 2', 3' etc.
6. Draw lines from points 1, 2, 3, etc.., parallel to OB to intersect lines drawn from points 1', 2', 3' parallel to OA at points P_1, P_2, P_3 · etc.
7. Mark point 5, 6, 7 etc.., on CP at equal distance.
8. Repeat step 5, 6 with 5, 6, 7.. etc points. you will get
9. P_5, P_6, P_7.., etc
9. Draw a smooth curve passing through P_1, P_2, P_3, P_5, P_6, P_7... etc., to get required rectangular hyperbola.

Q:- Draw a hyperbola when its asymptotes are Inclined at 60° to each other and it passes through a point 'P'. At a distance of 40mm and 50mm from the Asymptotes.



Hyperbola

Draw a parabola of base 120mm and axis 80mm by rectangular method.

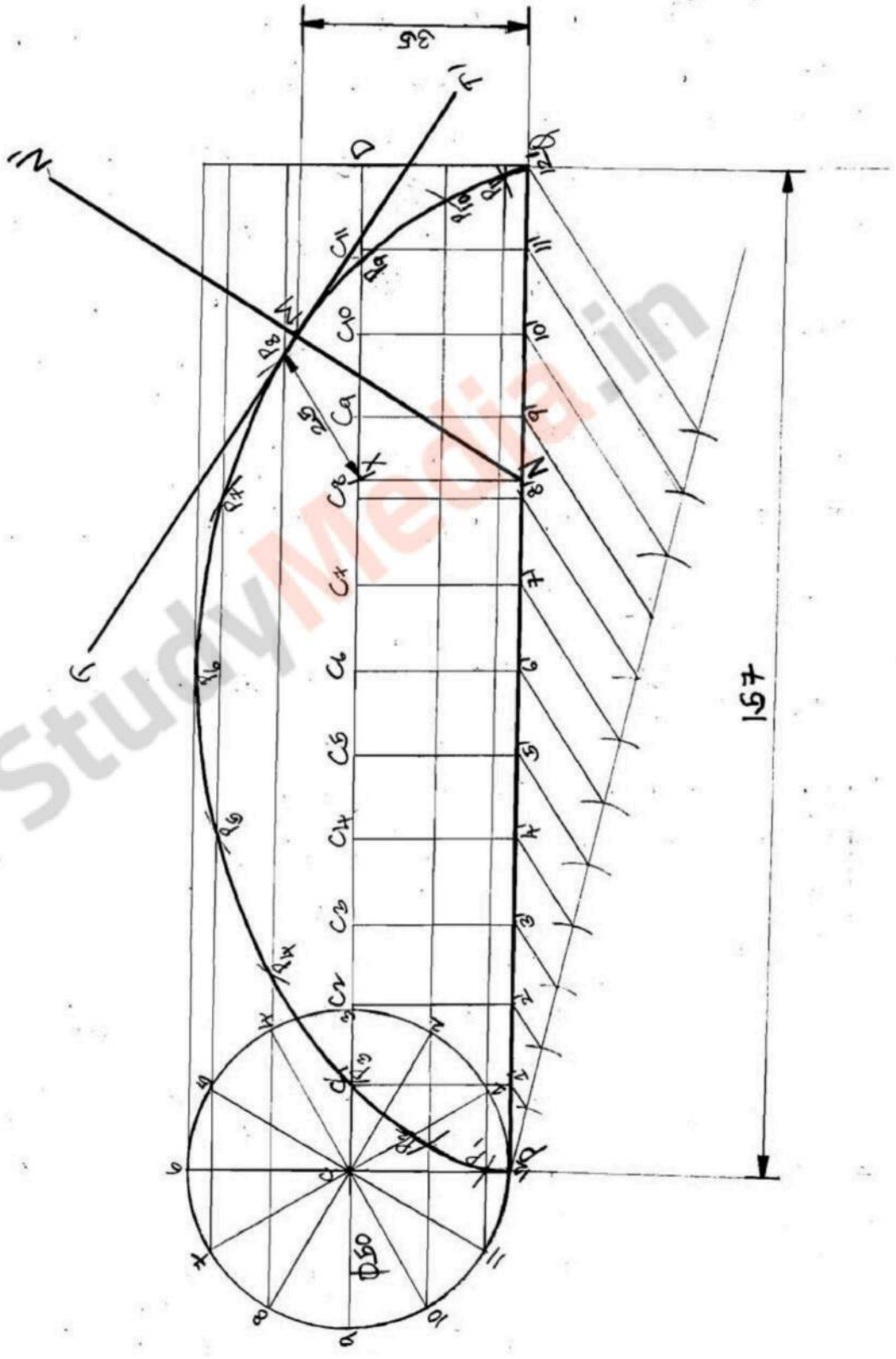


1. Draw a rectangle ABCD taking A = 120 mm and AD = 80 mm
2. Mark E and F as the midpoints of AB and CD respectively. Join EF to represent the axis.
3. Divide FD and DA, into equal number of parts, say 4. mark division of side DA as 1, 2, 3 and divisions of FD as 1', 2', 3'. Now join F with points 1, 2, 3.
4. Through 1', 2', 3' draw lines parallel to axis EF to meet F1, F2, F3 at P_1, P_2, P_3 respectively.
5. As the curve is symmetric about axis, obtain points P_1', P_2', P_3' of the curve by drawing horizontal lines through points P_1, P_2, P_3 and making them equal on both side of axis EF.
6. Draw a smooth curve passing through A, P_3, P_2, P_1, F, P_1', P_2', P_3' and B to get the required parabola.

Cycloids:

These curves are generated by a fixed point on the circumference of a circle, whichrolls without slipping along a fixed straight line or a circle. The rolling circle iscalled generating circle and the fixed straight line or circle is termed directing lineor directing circle. Cycloidal curves are used in tooth profile of gears of a dial gauge.

revolution also draw a tangent and a normal to the curve at a point 35mm above base line.

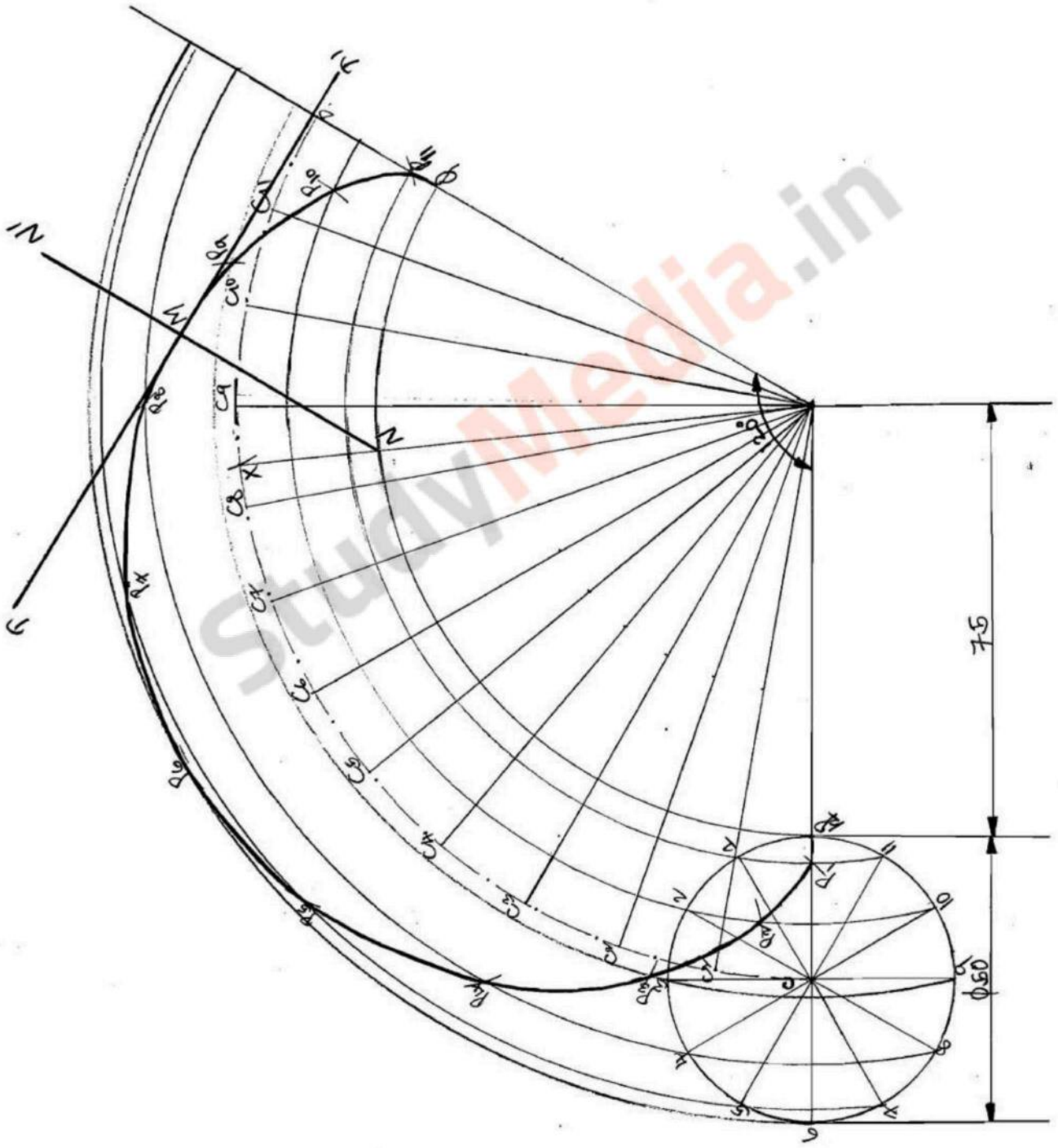


1. Draw a circle of diameter 50mm with centre C.
2. Draw the directing line PQ = πD = 157 mm long, horizontal and tangential to the circle.
3. Divide the circle into 12 equal parts and mark the divisions as 1, 2, 3 etc. Draw lines through points 1, 2, 3, etc., parallel to PQ.
4. Divide PQ into 12 equal parts and mark the divisions as 1', 2', 3', etc.
5. Exact vertical lines from points 1', 2', 3' etc. to meet the centre line CD at C_1, C_2, C_3, etc. When the circle rolls through 1/12th rotation, point 1 of the circle will coincide with 1' centre C will move to C_1. The point P will move to new position P_1 lying on the horizontal line through point 1 at a distance of 25 mm from C_1.
6. Draw an arc with centre C_1 and radius 25mm to intersect the horizontal line through point 1 at point P_1.
7. Similarly, draw arc with centre C_2, C_3, C_4 etc.
8. Draw a smooth curve passing through P_1, P_2, P_3, P_4 etc. to get the required cycloid.

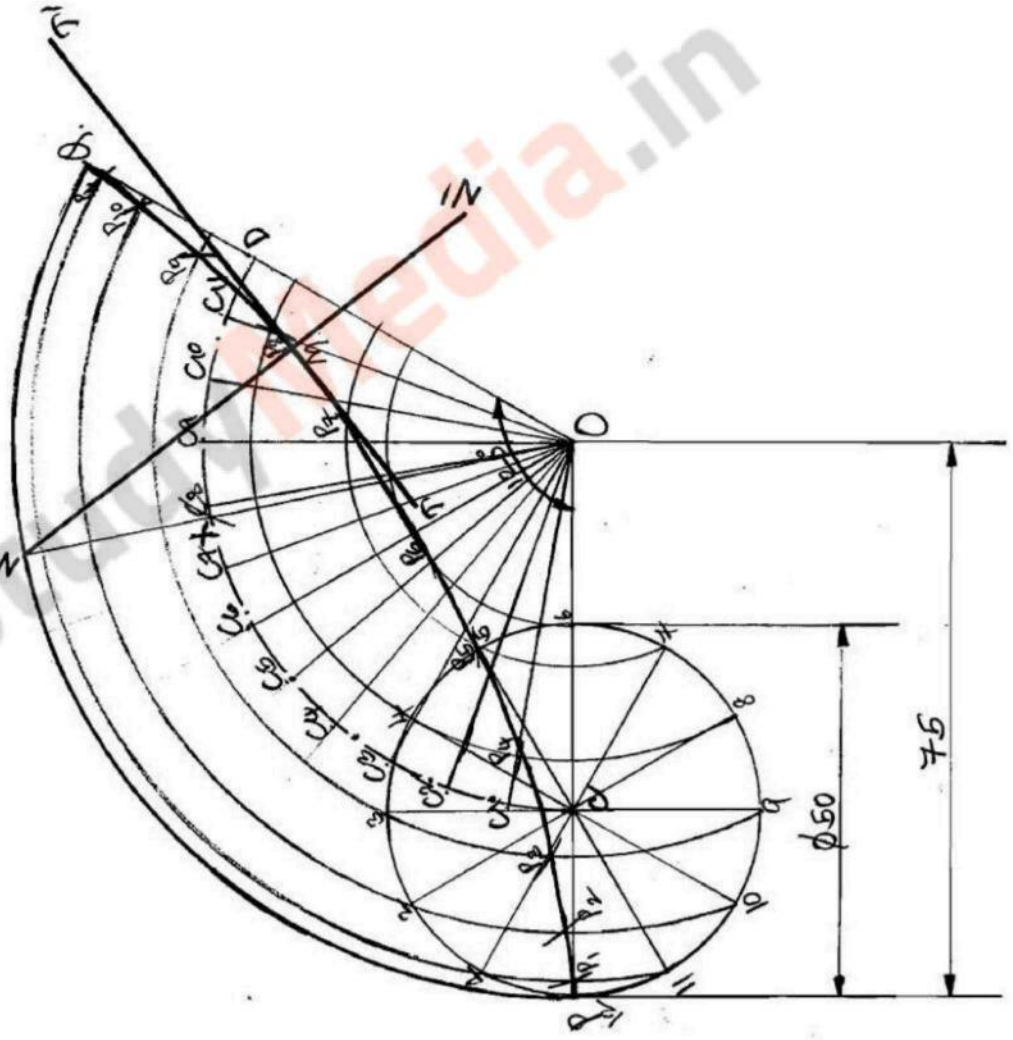
Tangent and normal to the cycloid:

1. Mark a point M on the cycloid 35mm above PQ.
2. Draw an arc with centre M and radius 25mm, to intersect the centre line at X.
3. Draw a vertical line from X to meet PQ at N.
4. Join NM and produce to N'. This line NN' is the required normal.
5. Through point M draw a line TT' perpendicular to NN'. This line TT' is the required tangent

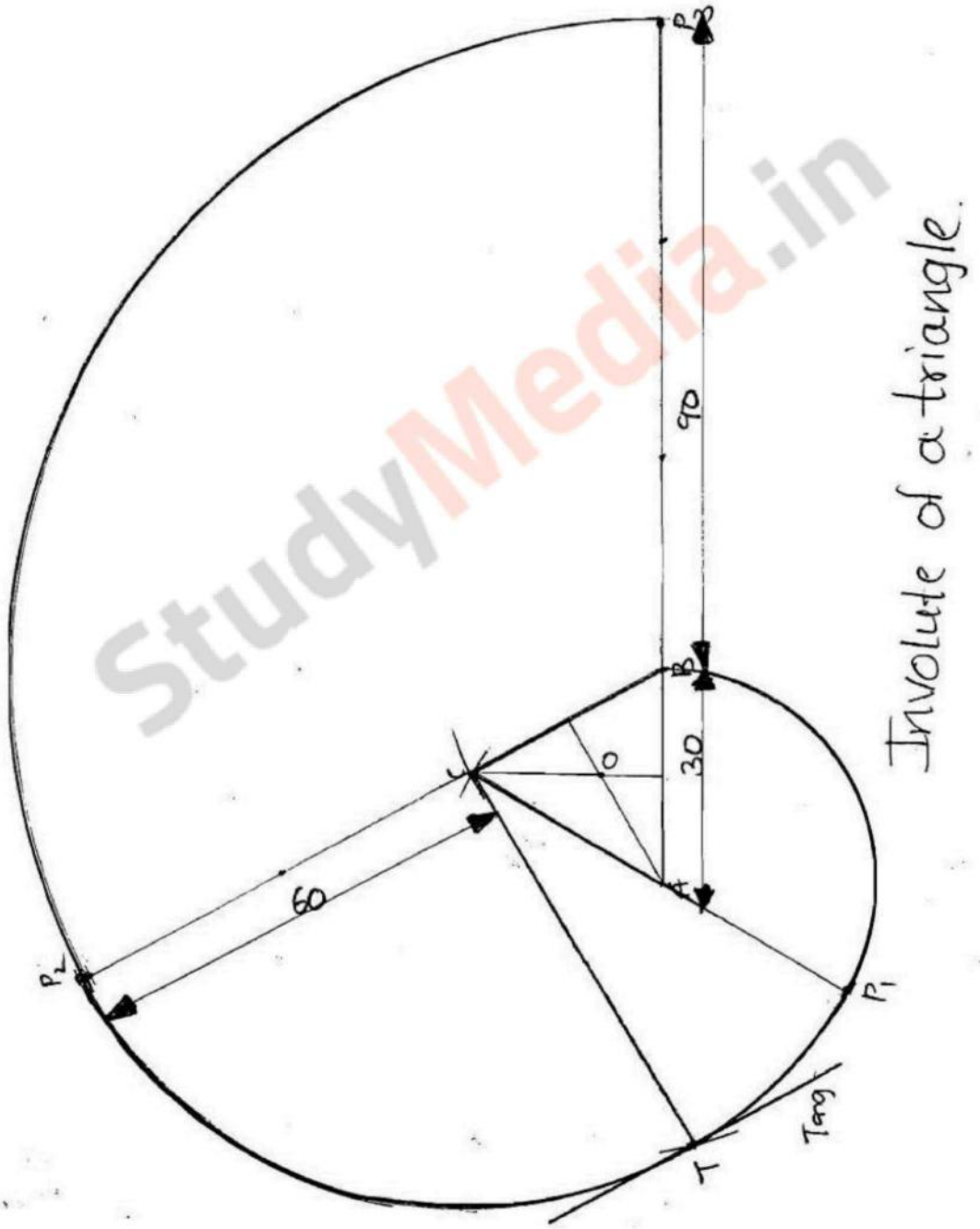
Draw an epicycloid of a circle of diameter 50mm which rolls outside a circle of diameter 150mm for one revolution also draw a tangent and normal to epicycloid at a point 110mm from the centre of directrix circle.



Draw a hypocycloid of a circle of diameter 50mm which rolls inside a circle of diameter on 50mm for one revolution also draw a tangent and normal to hypocycloid of a point 40mm from the centre of the directrix circle.

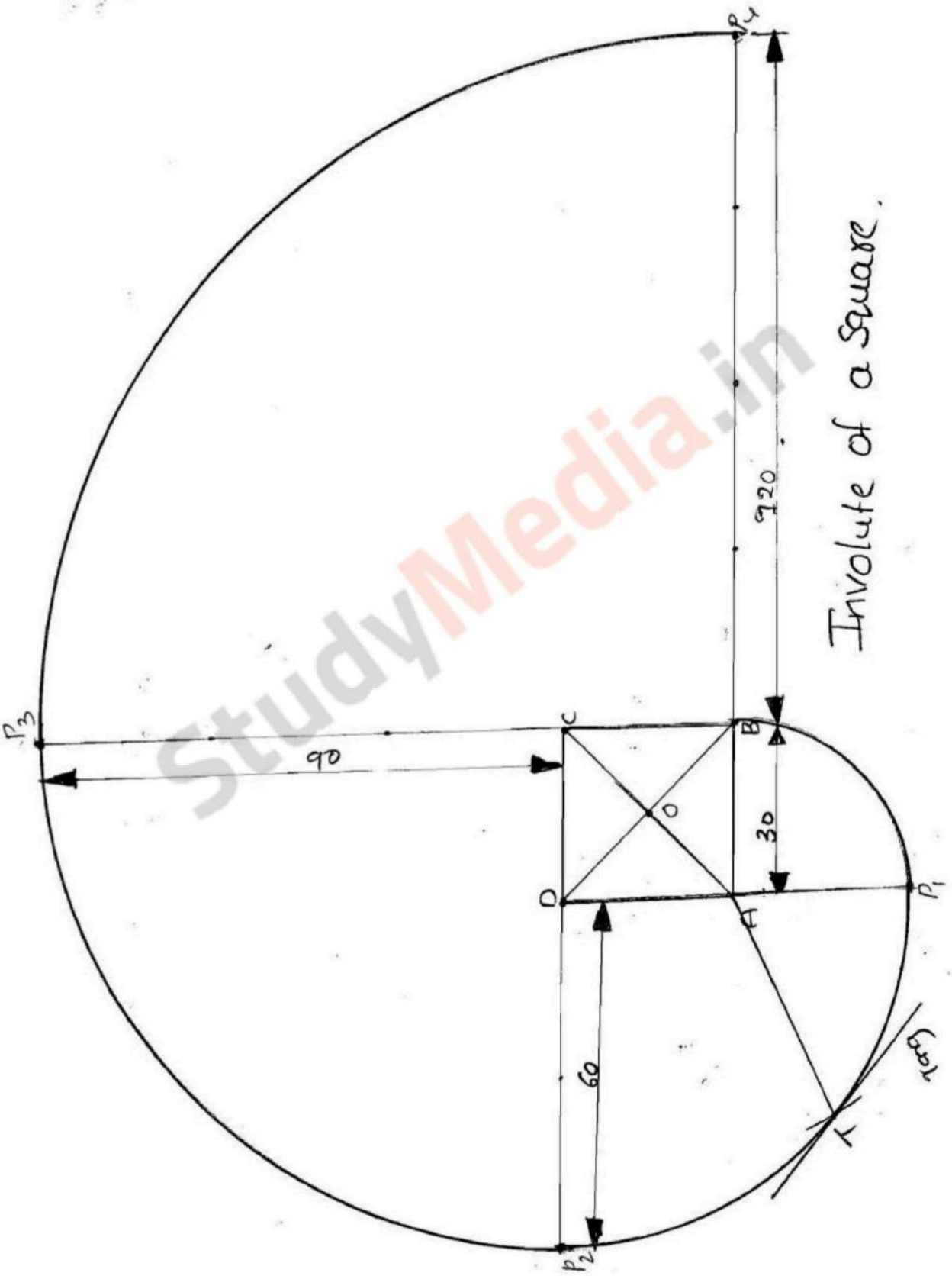


Draw an Involute for a triangular Plane of side Length 30mm and also draw tangent and Normal at a Point 55mm from the center of the triangle.

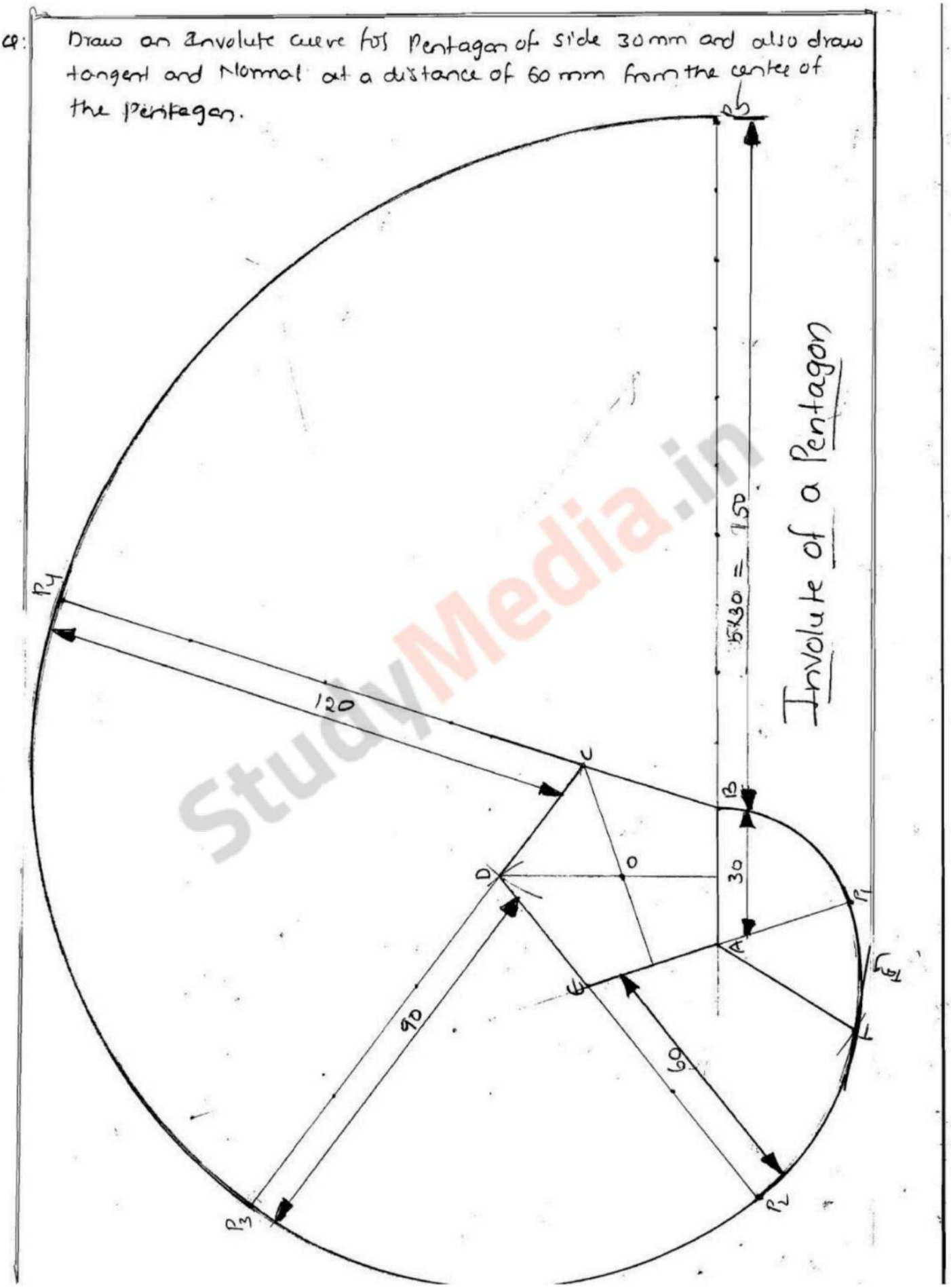


Involute of a triangle.

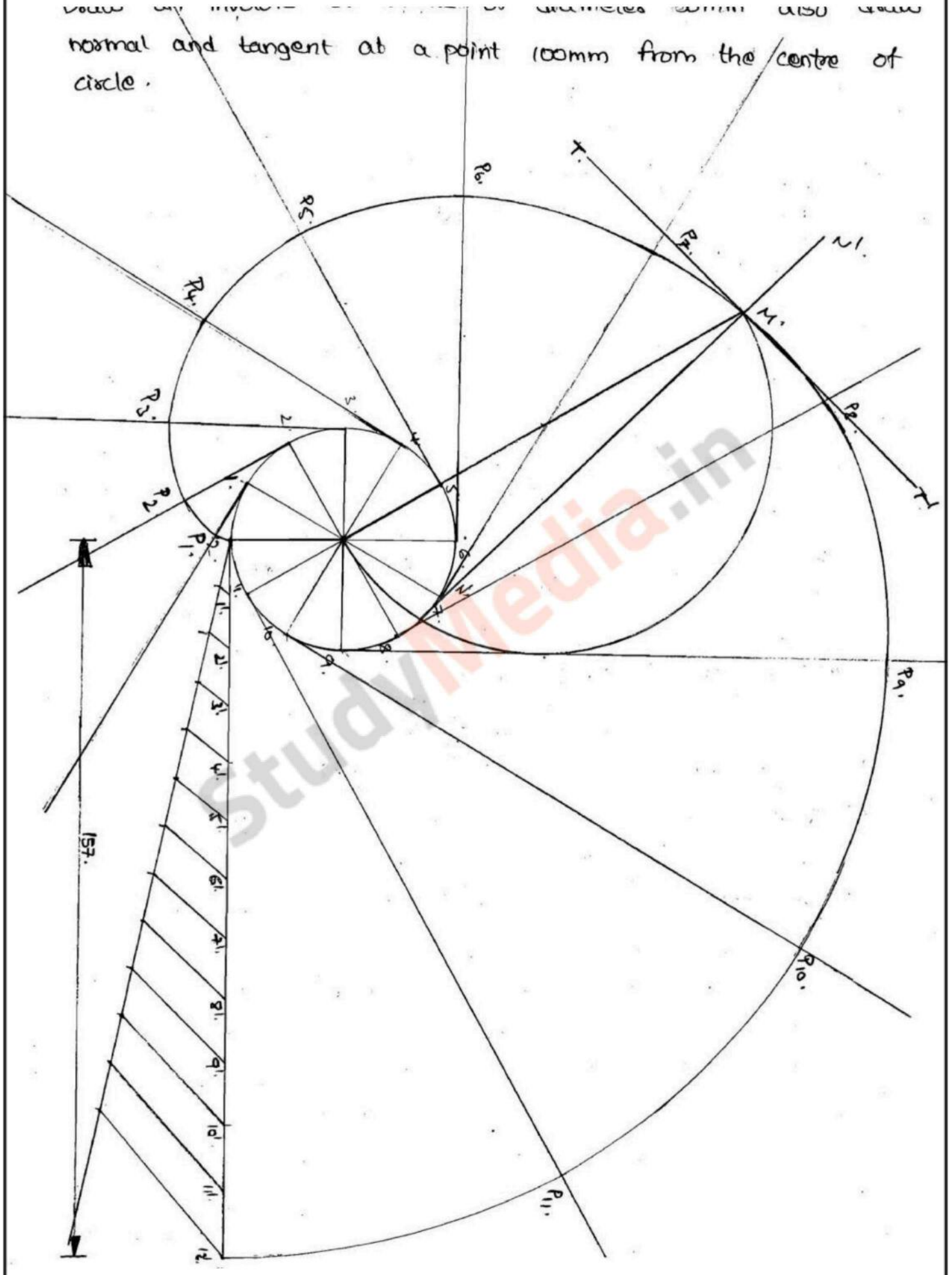
Construct an Involute curve for a square of side 30 mm and also draw tangent and Normal at a distance of 60 mm from the center of the square.



Q: Draw an Involute curve for Pentagon of side 30 mm and also draw tangent and Normal at a distance of 60 mm from the centre of the Pentagon.



normal and tangent at a point 100mm from the centre of circle.



1. Draw a circle of diameter 50mm and divide it into 12 parts and mark them as 1, 2, 3.., etc.
2. Draw line PQ = πD = 157mm. divide it into 12 equal parts. mark them as 1', 2', 3'..., etc.
3. Draw tangents to circle at 1, 2, 3 etc.
4. Draw an arc with centre 1 and radius P1' to intersect the tangent point 1.. at P_1.
5. Draw an arc with centre 2 and radius P2' to intersect the tangent line through point 2 at P_2.
6. Similarly, draw arc with centres 3, 4, 5 etc and radii P3', P4', P5' etc.., respectively to intersect the tangent line through points 3, 4, 5 etc., at points P_3, P_4, P_5 etc., respectively.
7. Draw a smooth curve to pass through P_1, P_2, P_3 ..etc,, and obtain required involute.

Tangent and normal to involute:

1. Mark a point M on involute at radial distance 100m from O.
2. Join OM and mark O_1 as its mid point.
3. Draw a semi-circle in clockwise direction with O_1 as centre and diameter OM to intersect the base circle at N.
4. Join MN and produce it to N'. The line NN' is the required normal.
5. Through point M, draw a line TT' perpendicular to NN' The line TT' is required tangent.

Scales:

Drawings of small objects can be prepared of the same size as theobjects theyrepresent. A 150 mm long pencil may be shown by a drawing of 150 mm length.Drawings drawn of the same size as the objects, are called full-size drawings. Theordinary full-size scales are used for such drawings.

A scale is defined as the ratio of the linear dimensions of element of the objectas represented in a drawing to the actual dimensions of the same element of theobject itself.

Representative fraction: The ratio of the length of the object representedon drawing to the actual length of the object represented is called the RepresentativeFraction (i.e. R.F.).

$$\text{R.F.} = \frac{\text{Length of the drawing}}{\text{Actual length of object}}$$

Types of scales

The scales used in practice are classified as under:

(1) Plain scales
(2) Diagonal scales
(3) Vernier scales

Plain scale

1. A 1cm length of the drawing represents 5m length of the object. Then find R.f value.

Sol: $$R.f = \frac{\text{Length of the object in drawing}}{\text{Actual length of object}}$$

$$R.f = \frac{1\,cm}{5\,m}$$

$$= \frac{1\,cm}{500\,cm}$$

$$\therefore \boxed{R.f = \frac{1}{500} = 1:500}$$

2. A 5cm long line represents 3 km length of a Road find the R.f value.

Sol: $$R.f = \frac{\text{Length of the object in drawing}}{\text{Actual length of object}}$$

$$= \frac{5\,cm}{3\,km}$$

$$R.f = \frac{5\,cm}{3\times105\,cm}$$

$$\therefore \boxed{R.f = \frac{5}{3\times105}}$$

(∵ 1 km = 10hm
= 10×10 dm
= 10×10×10 m
= 10×10×10×10 dm
= 10×10×10×10×10 cm
∴ 1 km = 105 cm).

3. Find the R.f value of a 1cm = 1m

$$R.f = \frac{\text{Length of the object in drawing}}{\text{Actual length of object}}$$

$$= \frac{1\,cm}{1\,m}$$

$$R.f = \frac{1\,cm}{1\times100\,cm}$$

$$\therefore \boxed{R.f = \frac{1}{100} = 1:100}$$

4. In a map of India, a distance of 36 km between two localities is shown by a line of 45 cm long calculate its R.F.

$$R.f = \frac{\text{Length of the object in drawing}}{\text{Actual Length of the object}}$$

$$R.f = \frac{45\text{cm}}{36\text{ km}}$$

$$R.f = \frac{45\text{ cm}}{36 \times 10^5\text{ cm}}$$

$$\therefore \boxed{R.f = \frac{5}{4 \times 10^5}}$$

5. A Rectangular Plot of 100 km^2 is represented by a rectangular area of 4 sq cm. Find the R.f.

Rectangular Plot = $100\ km^2$

Area of Drawing = $4\ cm^2$

$$R.f = \sqrt{\frac{L.O.I.D}{A.L.O}}$$

$$R.F = \sqrt{\frac{\text{Area of } O.I.D}{\text{Actual Area of } O}}$$

$$R.F = \sqrt{\frac{4\text{cm}^2}{100\text{ km}^2}}$$

$$R.f = \frac{2\text{cm}}{10\text{km}} = \frac{2\text{ cm}}{10 \times 10^5\text{ cm}} = \frac{1}{5 \times 10^5}$$

6. A cube of 5cm side represents a tank of 8000 cubic m volume. Find the R.f

Cube side length = 5cm

Tank volume = 8000 m^3

$$R.f = \sqrt[3]{\frac{\text{Volume of } O.I.D}{\text{actual Vol. of } O}}$$

$$= \sqrt[3]{\frac{5^3\ cm^3}{8000\ m^3}} = \frac{5\ cm}{20\ m} = \frac{5\ cm}{\frac{20}{4} \times 100\ cm}$$

$\therefore R.f = \frac{1}{400}$.

7. The area of a field is 50,000 m^2 the length and breadth of the field on the map is 15cm and 8cm respectively. Find the value of R.F.

$$R.f = \sqrt{\frac{15^2 \times 8^2\ cm^2}{50{,}000\ m^2}}$$

$$R.f = \sqrt{\frac{3}{1250}} \times \frac{cm}{m}$$

$$R.F = \frac{1}{5}\sqrt{\frac{3}{50}} \times \frac{cm}{100\ cm} = \frac{1}{500}\sqrt{\frac{3}{50}}$$

$\therefore R.f = \frac{1}{500}\sqrt{\frac{3}{50}}$.

8. A Room of 1728 m^3 volume is shown by a cube of 4cm side. Find the R.f.

A: $$R.f = \sqrt[3]{\frac{4^3\ cm^3}{1728\ m^3}}$$

$$= \sqrt[3]{\frac{4^3\ cm^3}{3^3 \times 4^3\ m^3}}$$

$$= \frac{1\ cm}{3\ m}$$

$$= \frac{1\ cm}{3 \times 100\ cm}$$

$\therefore R.f = \frac{1}{300}$.

$\therefore$ **R.f = 1 : 300**

PLAIN SCALES

Plain scale :

(1) Construct a scale of 1 : 60 to show meters and decimeters and long enough to measure upto 6m. Mark on it a distance of 4.7m, 3.6m.

Ans

R.F = 1/60

Long enough to measure upto 6m

Mark a distance = 4.7m, 3.6m.

$$R.F = \frac{L.O.I.D}{A.L\ o(or)\ Mak\ length\ of\ obicct}$$

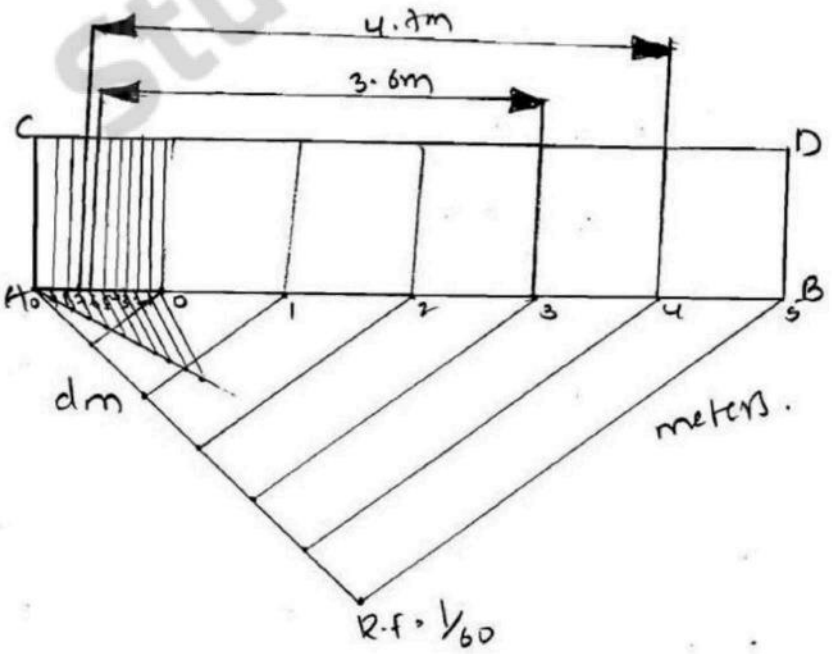
$$\frac{1}{60} = \frac{L.O.I.D}{6m}$$

$$\frac{6m}{60} = L.O.I.D$$

$$\frac{1}{10} = L.O.I.D$$

$$L.O.I.D = \frac{1}{10}m = 10cm$$

$$\boxed{L.O.I.D = 100mm}$$



2. Construct a scale of 1cm = 1m to read meters and decimeters and long enough to measure upto 14m. Show a distance of 12.4m.

A:- 1 cm = 1 meter.

Max Length = 14m

Marking distance = 12.4 m

$$R.F = \frac{\text{Length of the object in drawing}}{\text{Actual length of object}}$$

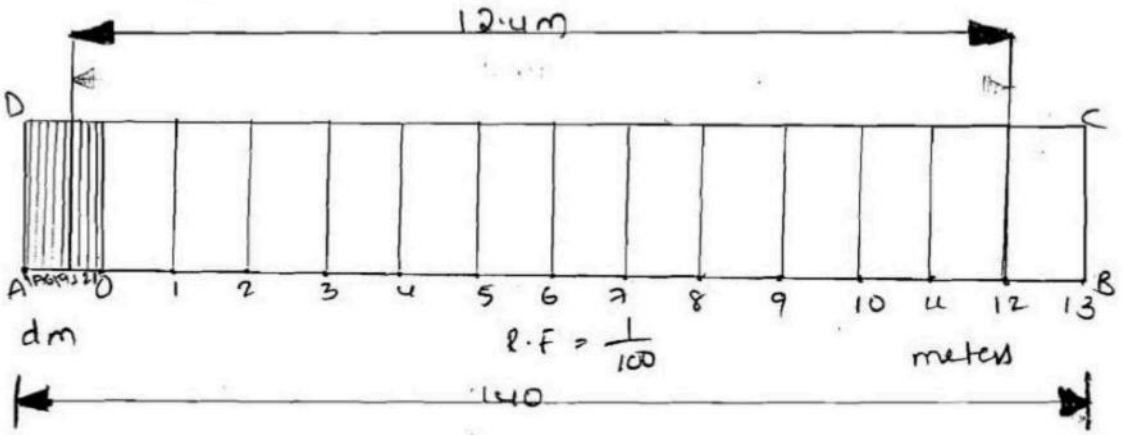
$$R.F = \frac{1cm}{1m} = \frac{1cm}{100cm} = \frac{1}{100}$$

$$\frac{1}{100} = \frac{L.O.I.D}{14m}$$

$$\frac{14m}{100} = L.O.I.D$$

$$L.O.I.D = \frac{14 \times 100cm}{100} = 14cm$$

$$L.O.I.D = 140mm.$$



3. A length of 1 decameter (Dm) is represented by 5cm. Find the R.F and construct a plainscale to measure upto 2.5 Dm and mark a distance of 19m on it.

A: R.f = ?

1 Dm = 5cm

$$R.f = \frac{\text{Length of object in drawing}}{\text{Actual length of object.}}$$

$$R.F = \frac{5cm}{1Dm} = \frac{5}{1000}$$

$$\therefore R.f = \frac{1}{200}$$

$$\frac{1}{200} = \frac{L.O.I.D}{2.5Dm}$$

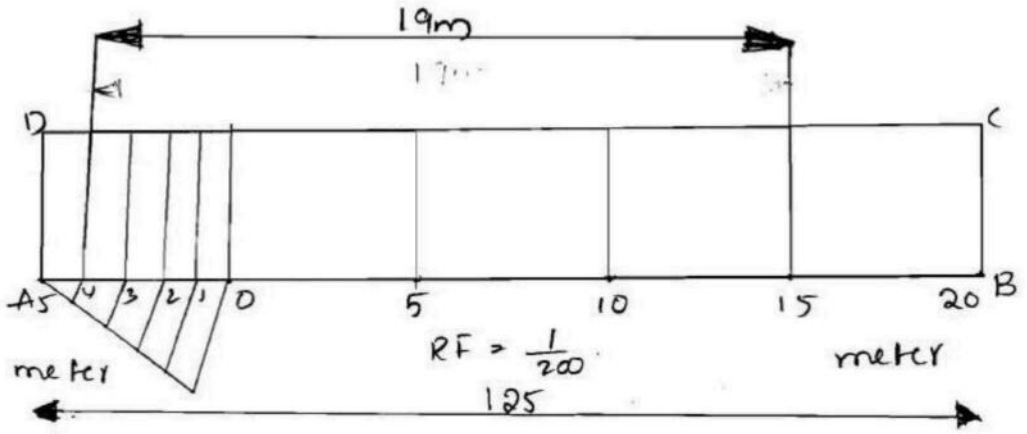
$$L.O.I.D = \frac{2.5Dm}{200}$$

$$= \frac{2.5 \times 1000cm}{200}$$

L.O.I.D = 12.5cm (or) 125mm

max length = 2.5Dm

marking distance = 19m.



4. A rectangular plot of $100\ km^2$ is represented by a rectangular area of $4\ cm^2$. Draw a scale to show 50 km and mark a distance of 41 km on it.

A:

$$R.F = \sqrt{\frac{4\ cm^2}{100\ km^2}}$$

$$R.F = \frac{2\ cm}{10\ km}$$

$$= \frac{2\ cm}{10 \times 10^5\ cm} = \frac{1}{5 \times 10^5}$$

Max length = 50 km

marking distance = 41 km.

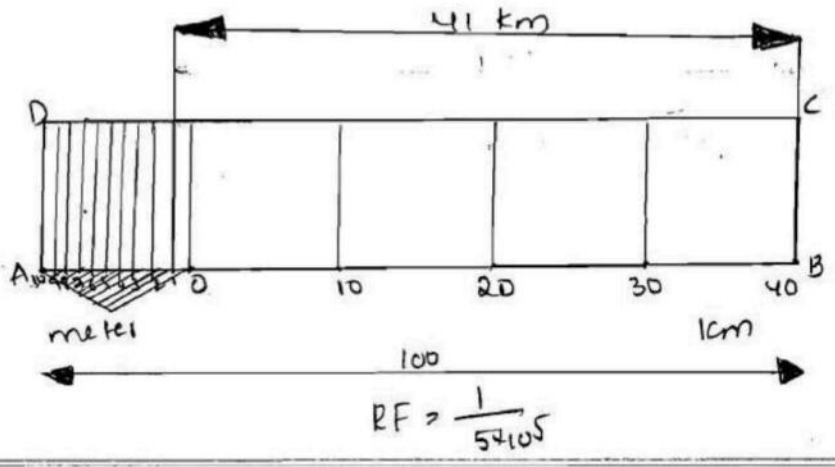
$$R.F = \frac{\text{length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{1}{5 \times 10^5} = \frac{L.O.I.D}{50\ km}$$

$$L.O.I.D = \frac{50 \times 10^5\ cm}{5 \times 10^5}$$

$$= 10\ cm$$

$$\boxed{L.O.I.D = 100\ mm}$$



5- Construct a scale of 1:14. to read feet and inches and long enough to measure 7 feet. show a distance of 5ft and 10 inches on it.

A:

$$R.F = \frac{1}{14}$$

$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{1}{14} = \frac{L.O.I.D}{7 \text{ feet}}$$

$$\frac{7 \times 12 \times 2.54 \text{ cm}}{1 \times 3} = L.O.I.D$$

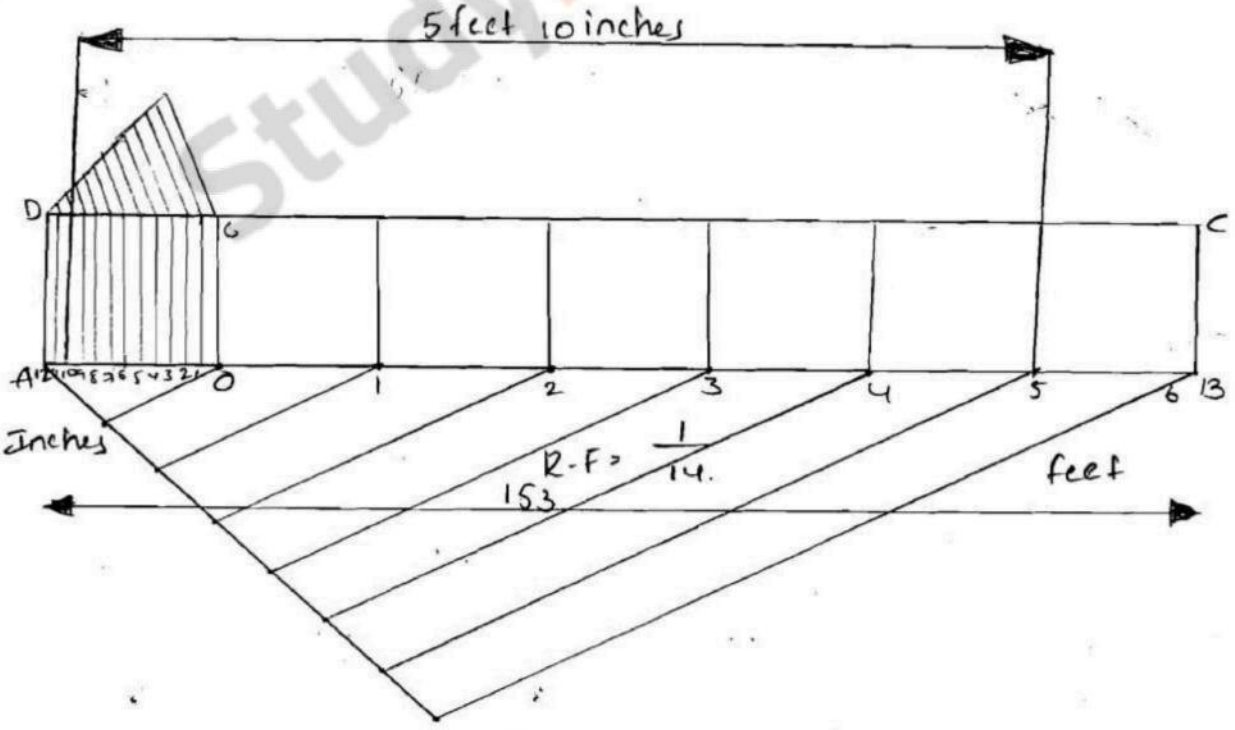
$$L.O.I.D = 15.24 \text{ cm}$$

$$\cong 15.3 \text{ cm}$$

$$L.O.I.D = 153 \text{ mm}.$$

marking distance = 5 feet 10 inches

Max length = 7 feet



6. Construct a scale of 1:54 to show yards and feet and long enough to measure 9 yards. Mark a distance of 6 yard 2 feet.

A:-

$$R.F = \frac{1}{54}$$

$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{1}{54} = \frac{L.O.I.D}{9 \text{ yards}}$$

$$\frac{9 \text{ yards}}{54} = L.O.I.D$$

$$\frac{9 \times 36 \times 2.54 \text{cm}}{54} = L.O.I.D$$

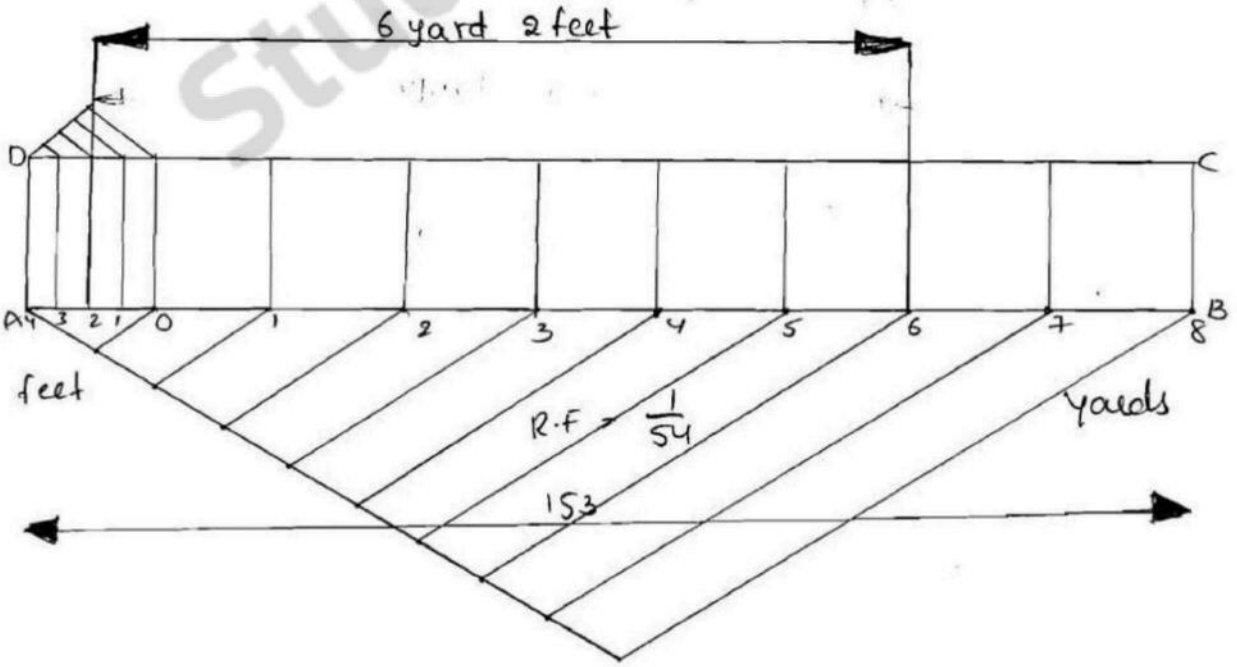
$$L.O.I.D = 15.24 \text{cm}$$

$$\simeq 15.3 \text{cm}$$

$$L.O.I.D = 153 \text{ mm}$$

∴ max length = 9 yards

∴ marking distance = 6 yard and 2 feet.



7. A cube of 5cm side represents a tank of $8000\ m^3$. Find R.f and Construct a scale to measure upto 60 m and mark a distance of 47m

A: $$R.f = \sqrt[3]{\frac{5^3 cm^3}{8000\ m3}}$$

$\therefore$ max length = 60 m

$$R.f = \frac{5\ cm}{20\ m}$$

$$= \frac{1\ cm}{400\ cm}$$

$$R.f = \frac{1}{400}$$

$$R.f = \frac{\text{length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{1}{400} = \frac{L.O.I.D}{60\ m}$$

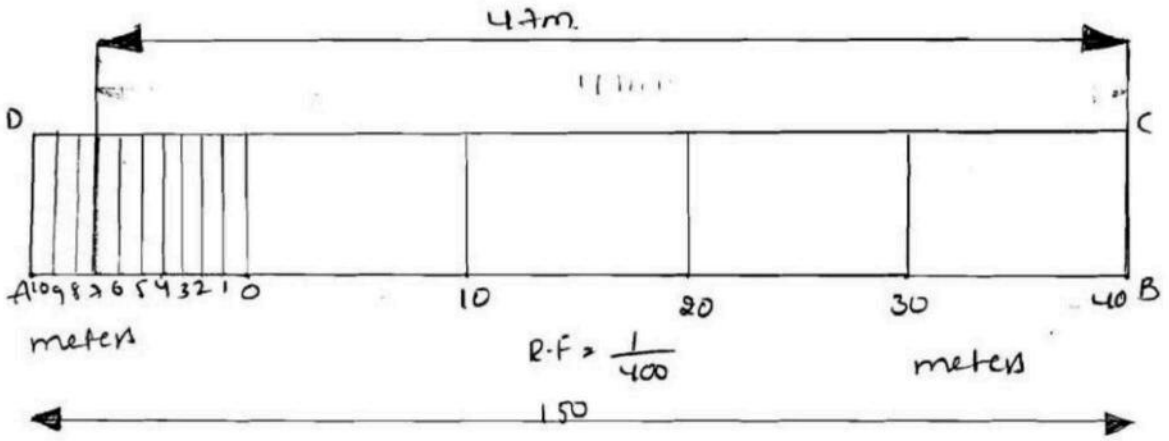
$$\frac{60\ m}{400} = L.O.I.D$$

$$L.O.I.D = \frac{6000\ cm}{400}$$ (15)

$$L.O.I.D = 15\ cm$$

$$= 150\ mm$$

marking distance = 47m



Diagonal scale

1. A map is to be drawn with R.F 1:40 · construct a scale to read in meters, dm and cm and long enough to measure upto 6m. show on it a distance of 3.84cm

A: Scale → m, dm, cm

$R.f = \frac{1}{40}$

max length of object = 6m

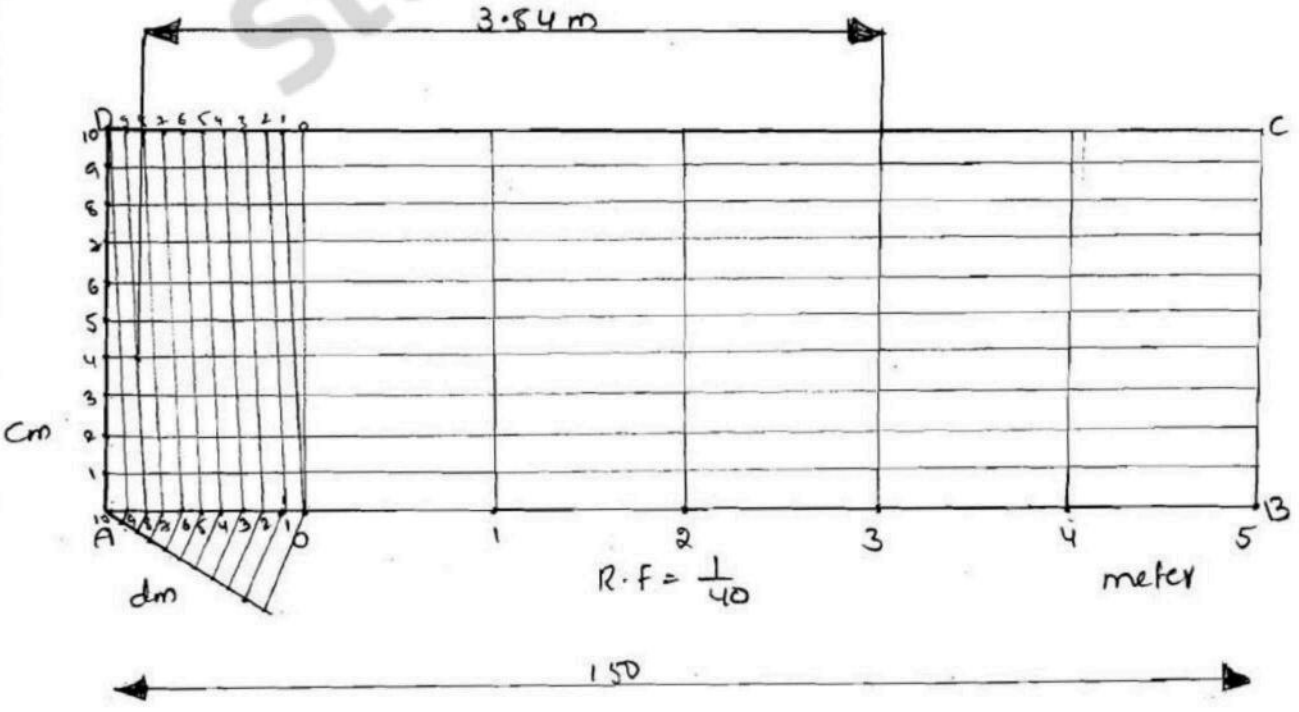
Masking distance = 3.84m

$R.f = \frac{\text{Length of object in drawing}}{\text{Actual Length of object}}$

$\frac{1}{40} = \frac{L.O.I.D}{6m}$

$L.O.I.D = \frac{6m}{40} = \frac{6 \times 100cm}{40} = 15cm$

$L.O.I.D = 150mm$



2. Construct a diagonal scale showing km, hm, Dm in which 2cm long line represents 1 km, and the scale is long enough to measure upto 7 km. Find the R.f and marking distance of 4.53 km on it.

A: Scale → km, hm, dm

$$R.f = \frac{2\,cm}{1\times10^5\,cm}$$

$$R.f = \frac{1}{5\times10^4}$$

$$R.f = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

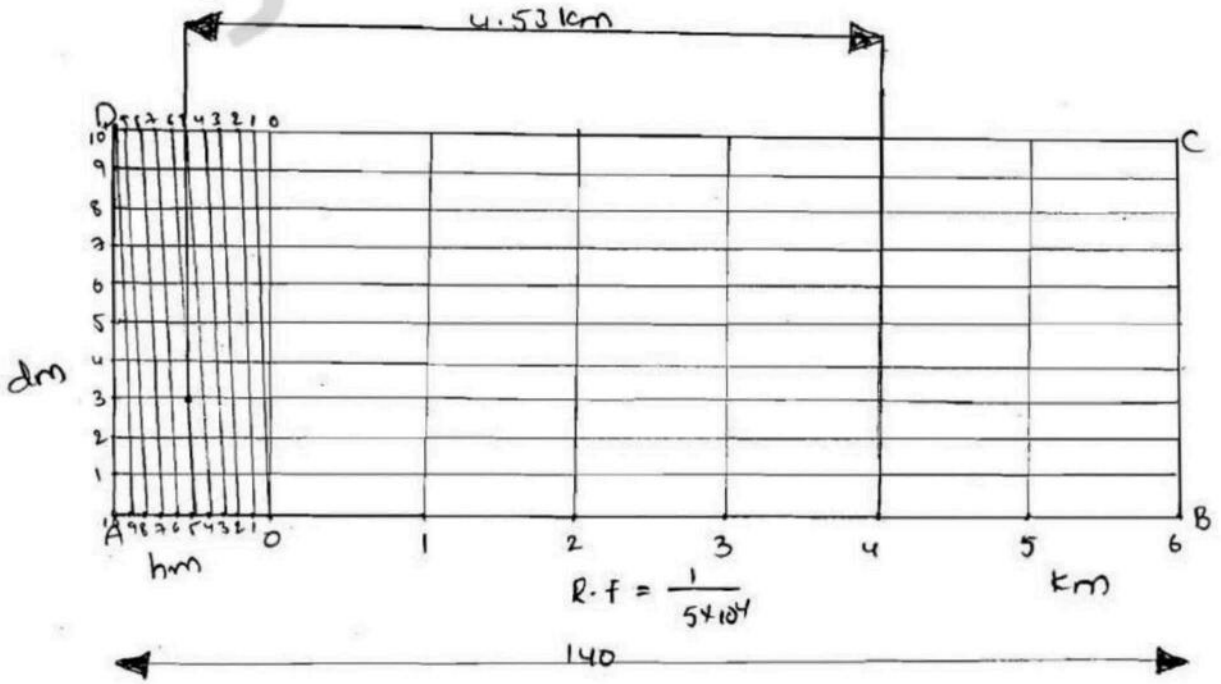
$$\frac{1}{5\times10^4} = \frac{L.O.I.D}{7\,km}$$

$$\frac{7\times10^5\,cm}{5\times10^4} = L.O.I.D$$

$$L.O.I.D = 14\,cm \text{ (or) } 140\,mm$$

max length = 7 km

marking distance = 4.53 km.



3. Draw a diagonal scale of R.f 3:100 showing in meters, dm and cm and measure upto 5m. Mark a length of 3.69 m.

A:- $R.F = \frac{3}{100}$ scale → meters, dm, cm

$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{3}{100} = \frac{L.O.I.D}{5m}$$

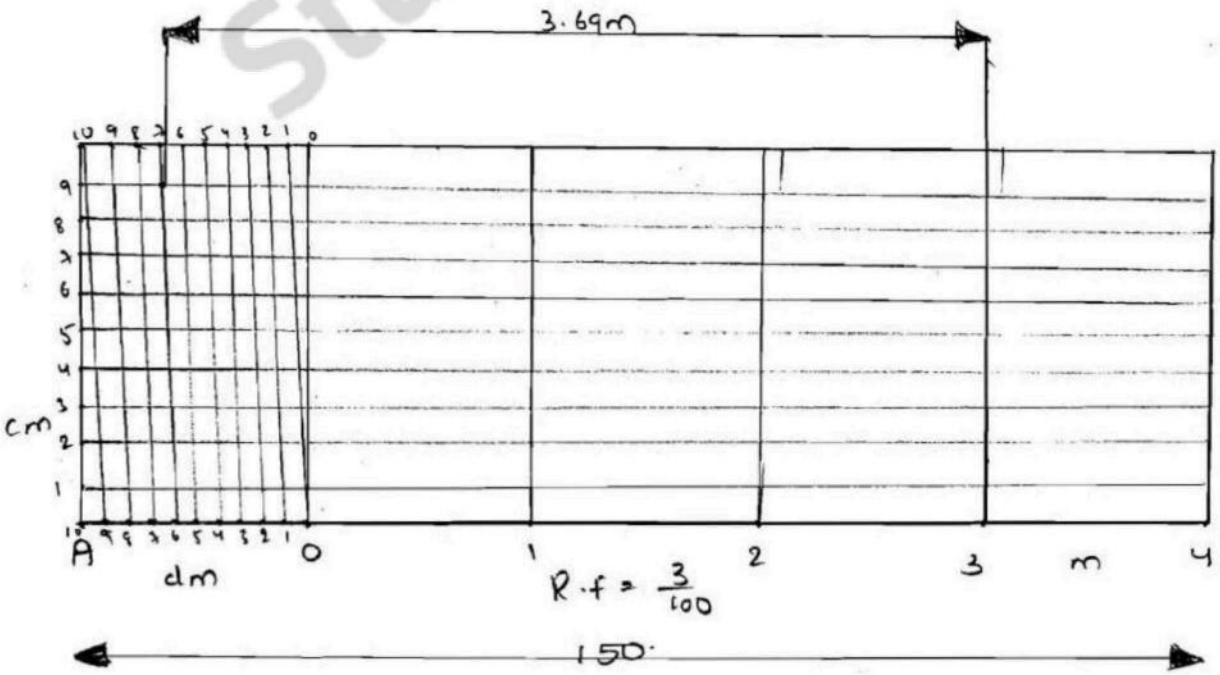
$$\frac{3 \times 5 \times 100\,cm}{100} = L.O.I.D$$

$L.O.I.D = 15\,cm.$

$L.O.I.D = 150\,mm.$

max length = 5m

marking distance = 3m 6dm and 9cm (3.69m).



4. The distance between two cities 'A' and 'B' is 300 km. Its equivalent distance on the map measures only 6cm. what is R.F? Draw a diagonal scale show 100's of km, Ten's km and km indicate on the scale the following distances.

(i) 525 km, (ii) 313 km and 258 km.

A: Distance blw two cities = 300 km (A.L)

distance on the map = 6cm (L.O.I.D).

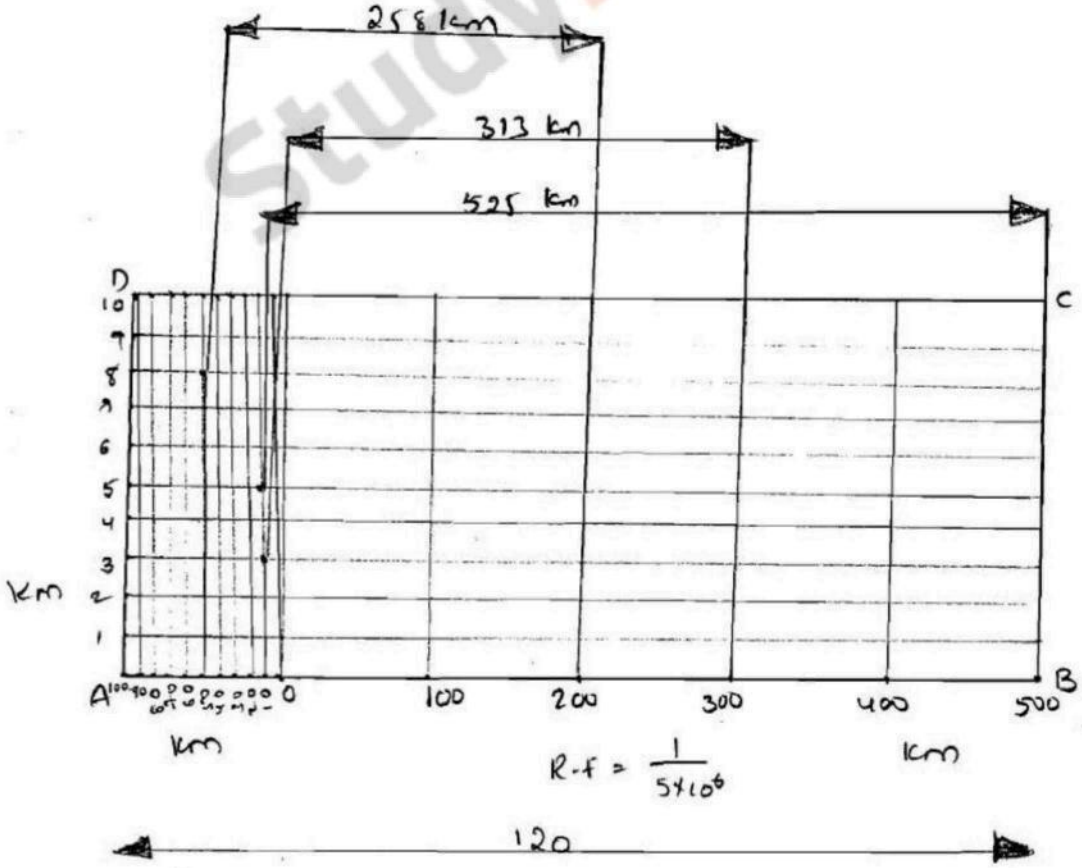
$$R.F = \frac{6cm}{300km} = \frac{6cm}{300\times10^5cm} = \frac{1}{5\times10^6}$$

max length = 600 km (∵ max marking distance is 525 km)

$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}} = \frac{1}{5\times10^6} = \frac{L.O.I.D}{600km}$$

$$L.O.I.D = \frac{600\times10^5cm}{5\times10^6} = 12cm$$

$$L.O.I.D = 120\ mm.$$



5. On a map the actual distance of 5m is represented by a line of 25mm long. Calculate the R.F. Construct a diagonal scale long enough to measure upto 25m and make a distance of 19m and 11m.

A: Max Length = 25m

$$R.F = \frac{\text{Length of object in Drawing}}{\text{Actual Length of object}}$$

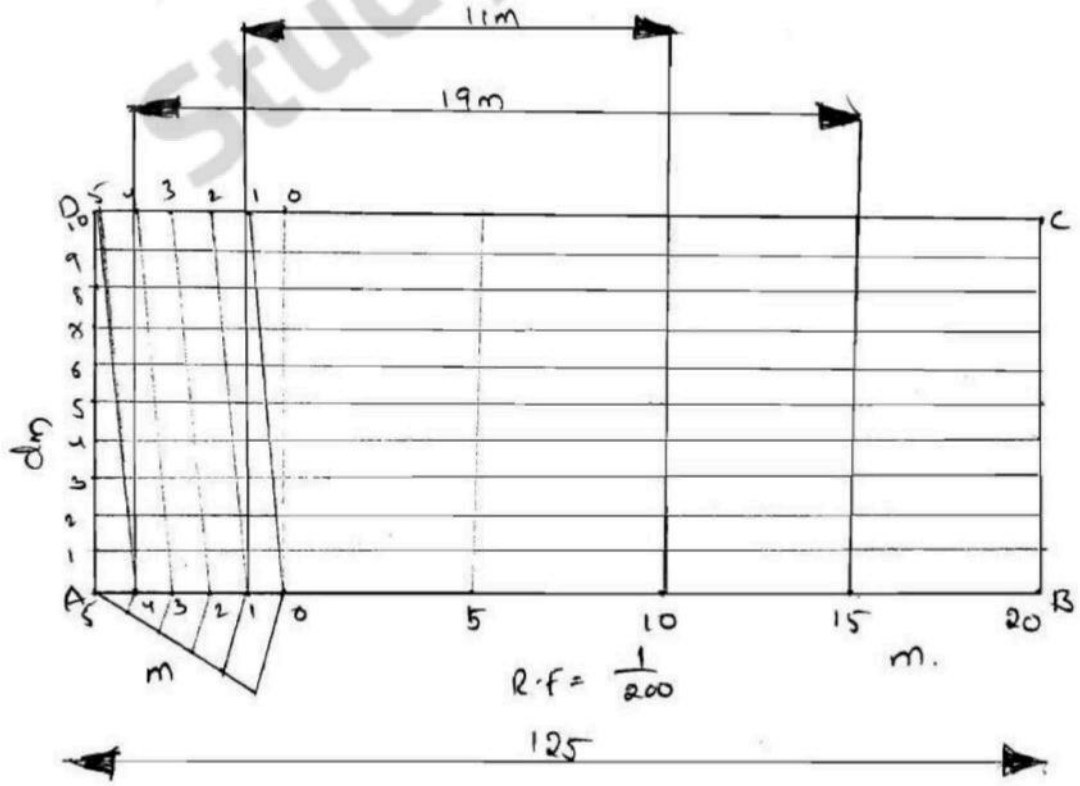
$$= \frac{25mm}{5m} = \frac{25mm}{5\times10^3 mm} = \frac{1}{200}$$

$$R.F = \frac{1}{200}$$

$$\frac{1}{200} = \frac{L.O.I.D}{25m}$$

$$\frac{25\times100cm}{200} = L.O.I.D$$

$$L.O.I.D = 12.5cm \text{ or } 125mm.$$



6. Construct a diagonal scale showing yards, feets and inches. In which 2 inches long line represents 1.25 yards and it is long enough to measure upto 5 yards, marking distance as 3 yards 2 Feets and 10 inches.

Sol:

2 inches = 1.25 yards

$$R.F = \frac{2 \text{ inches}}{1.25 \text{ yards}} = \frac{2 \text{ inches}}{1.25 \times 3 \times 12 \text{ inches}}$$

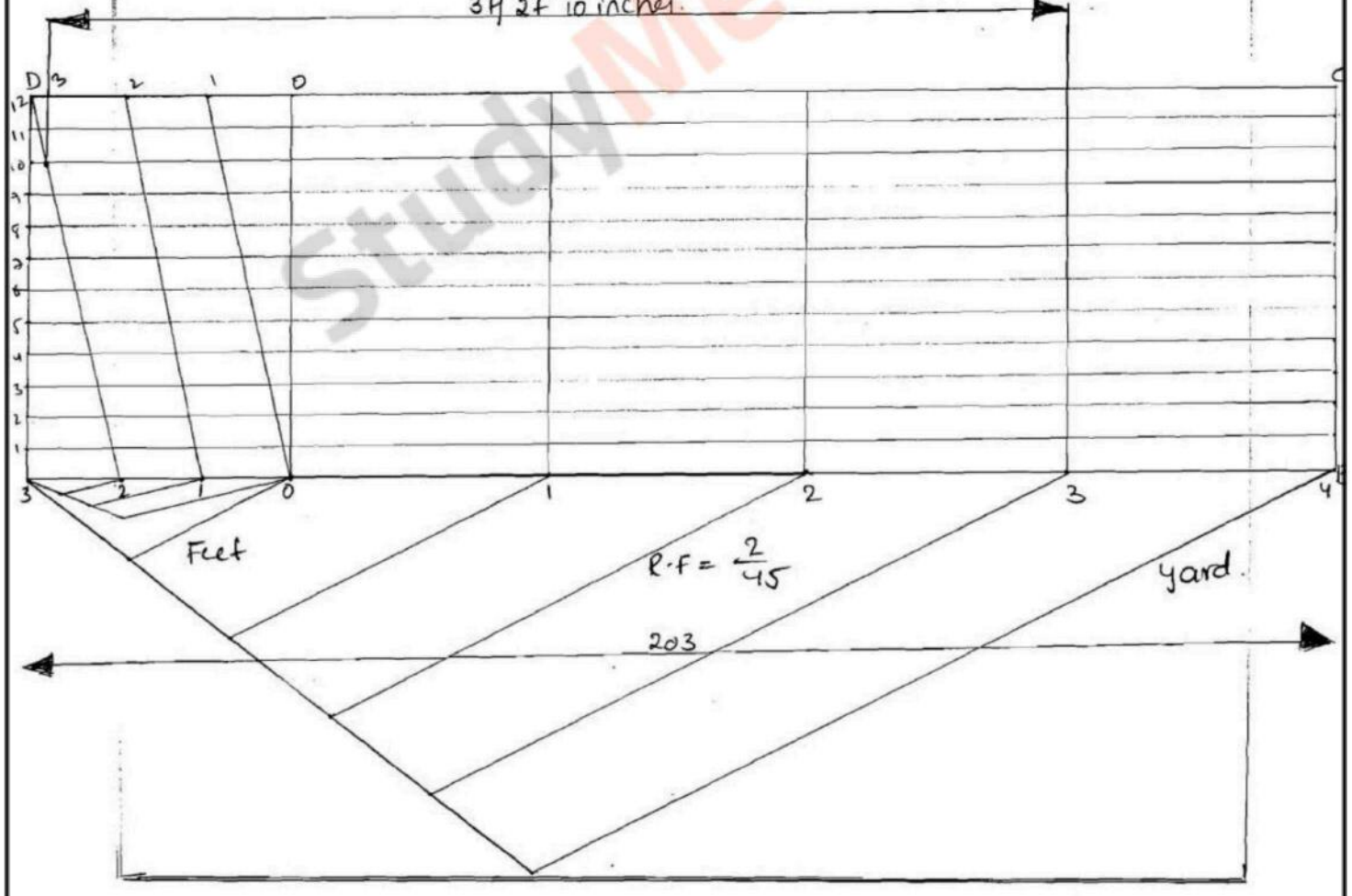
$$R.F = \frac{106\ 2}{\frac{225}{45}} = \frac{2}{45}$$

max length = 5 yards

$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{2}{45} = \frac{L.O.I.D}{5 \text{ yards}} = 5 \times 3 \times 12 \times 2.54 \text{cm} \times \frac{2}{45} = L.O.I.D.$$

$$L.O.I.D = 20.32 \text{cm} \simeq 20.3 \text{cm (or) } 203 \text{m}$$



7. A rectangular plots of land measuring 1.28 hectares is showing on a map by a similar rectangle of $8cm^2$ calculate R.F of the scale. Draw a diagonal scale two read 1m and long enough to measure 600m. show a distance of 438m on it.

Sol:

$$R.F = \frac{8cm^2}{1.28\times10^4 m^2}$$

$$= \sqrt{\frac{8cm^2}{1.28\times10^4 m^2}} = \sqrt{\frac{8}{1.28\times10^2}} \times \frac{cm}{m}$$

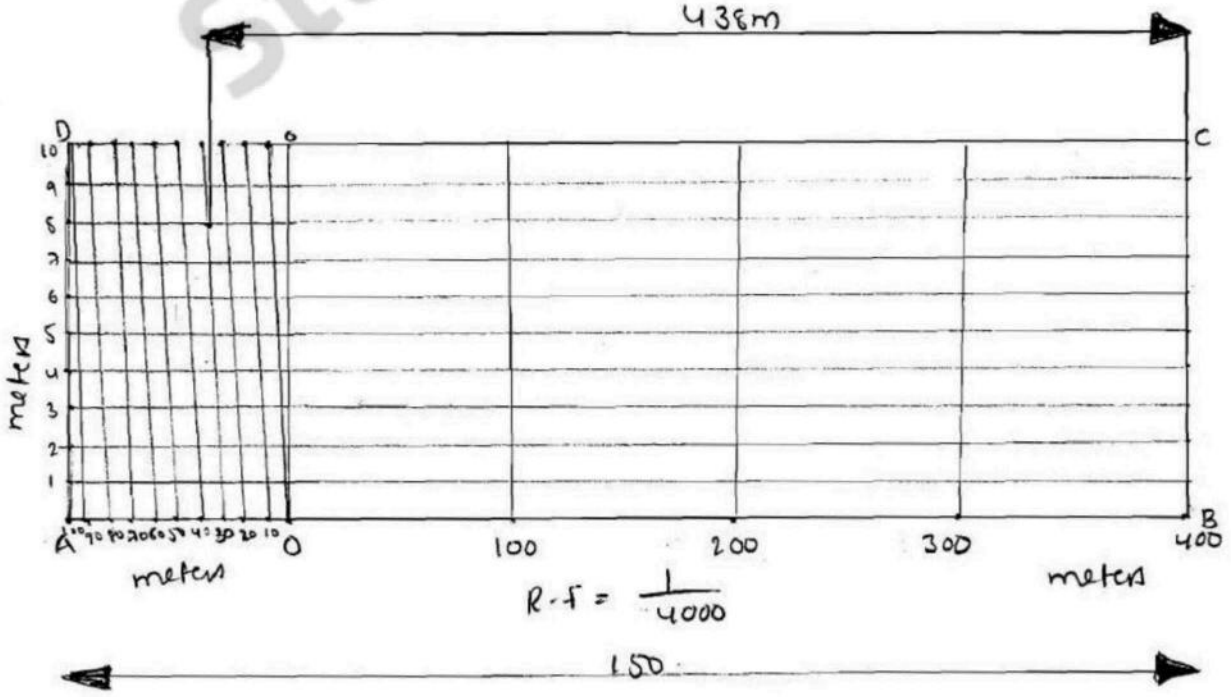
$$\therefore R.F = \frac{1}{4\times10} \times \frac{cm}{100cm} = \frac{1}{4000}$$

$$R.F = \frac{\text{Length of the object in drawing}}{\text{Actual length of object.}}$$

$$\frac{1}{4000} = \frac{L.O.I.D}{600m} = \frac{600\times100}{4000} = 15cm \text{ (or) } 150mm$$

$\therefore$ max length = 600m

marking distance = 438m.



8. The distance between two stations is 100 km and on a map it is shown by 30 cm. Draw a diagonal scale and indicate 46.8 km and 32.4 km.

Sol:

$$R.F = \frac{30\,cm}{100\,km} = \frac{30\,cm}{100 \times 10^5\,cm} = \frac{3}{10^6}$$

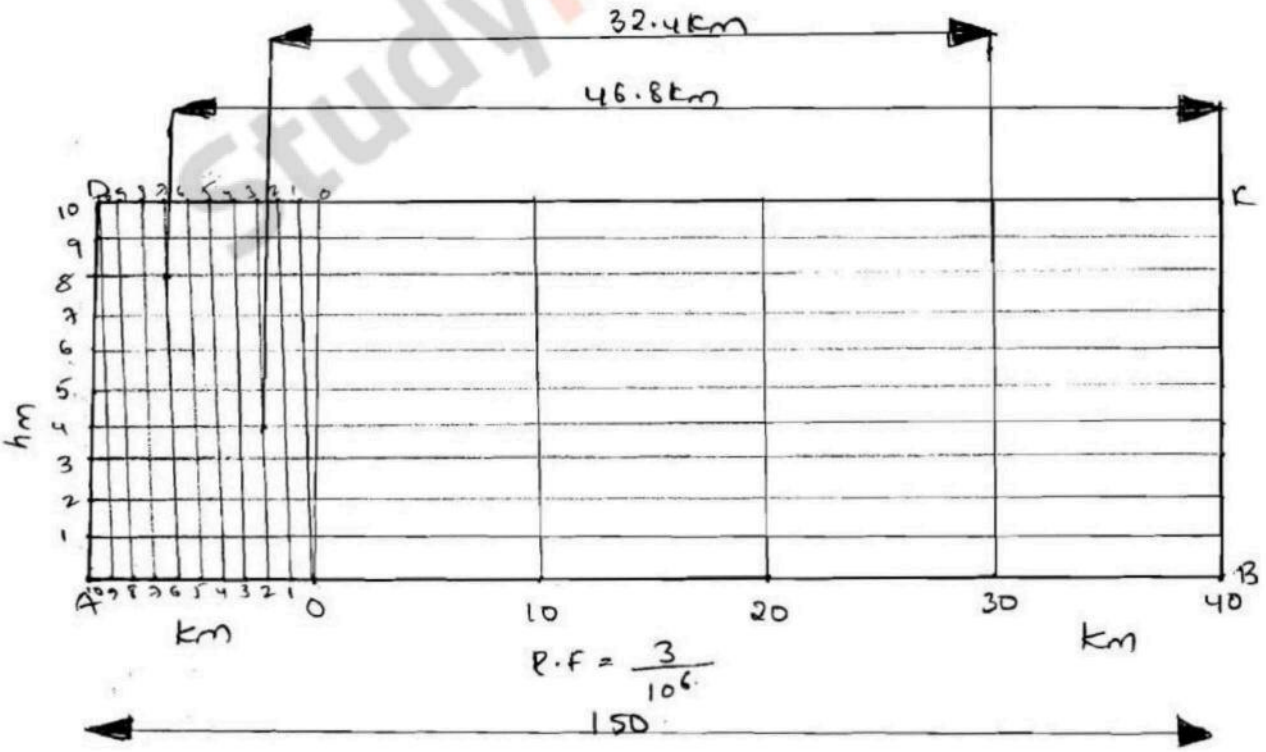
$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual Length of object}}$$

Max Length = 50 km (∵ max marking is 46.8 km).

$$\frac{3}{10^6} = \frac{L.O.I.D}{50\,km}$$

$$L.O.I.D = \frac{50 \times 10^5 \times 3\,cm}{10^6} = 15\,cm \text{ or } 150\,mm$$

marking distance = 46.8 km and 32.4 km



9. Construct a scale to measure km, $\frac{1}{8}$ km and $\frac{1}{40}$ km, in which 1 km is showing by 4cm. Mark on the scale at a distance of 2.775 km.

Sol: $R.f = \frac{4\,cm}{1\,km} = \frac{4\,cm}{1\times10^5\,cm} = \frac{1}{25\times10^3}$

$\therefore R.F = \frac{1}{25\times10^3}$

$R.f = \frac{\text{Length of the object in drawing}}{\text{Actual Length of object}}$

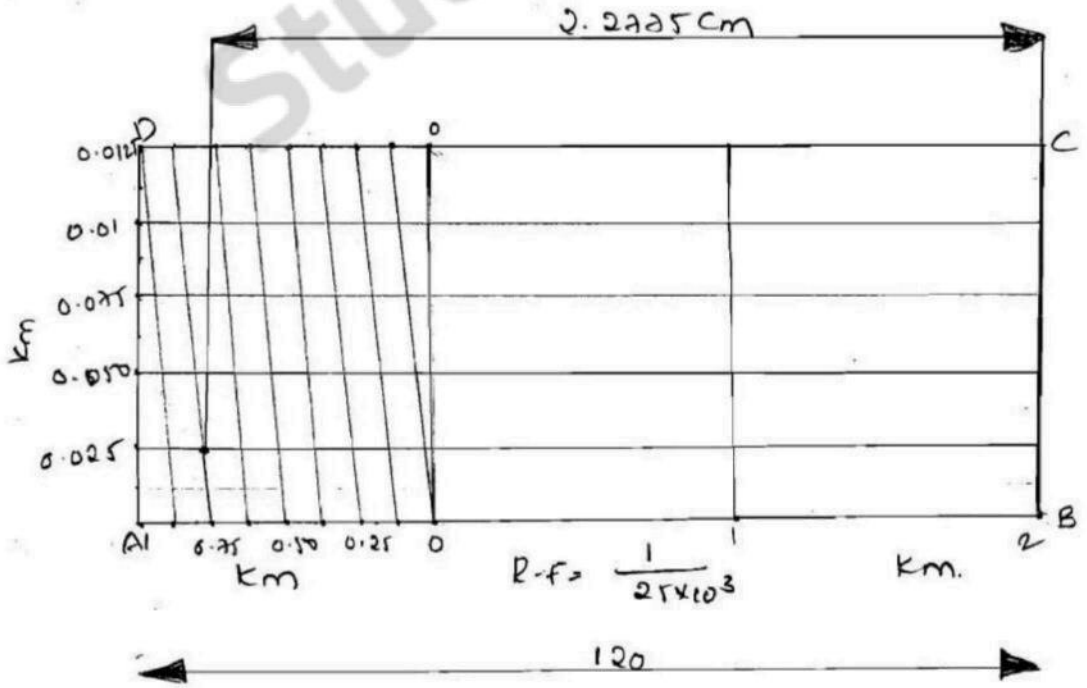
max Length = 3km (∵ max marking is 2.775 km).

$\frac{1}{25\times10^3} = \frac{L.O.I.D}{3\,km}$

$L.O.I.D = \frac{3\times10^5\,cm}{25\times10^3} = 3\times4\,cm = 12\,cm$

$\therefore L.O.I.D = 120\,mm$

Marking distance = 2.775 km.



1-Q:- Construct a scale of R.f = 2.5 to show m, dm, cm and long enough to measure upto 4m.

Sol:

$R.f = 2.5$

$R.f = \frac{25}{10} = \frac{5}{2}$

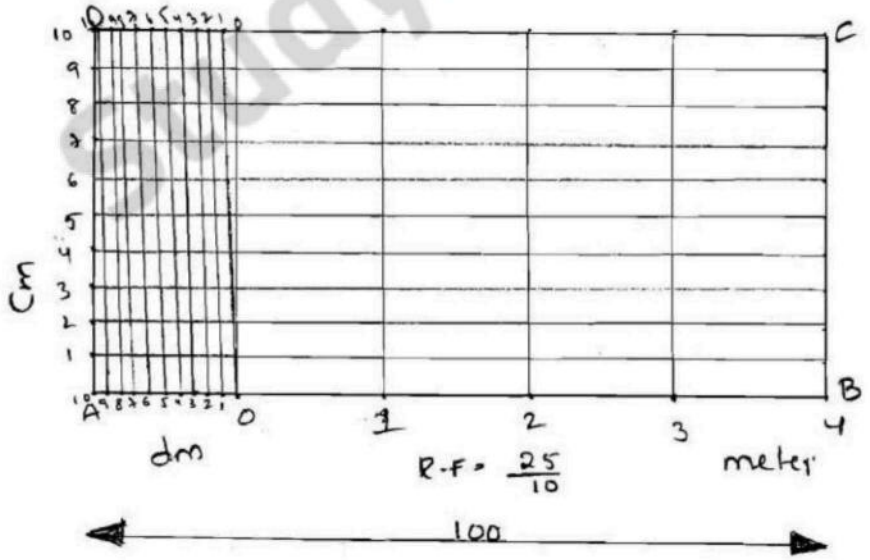
$R.f = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$

$\therefore$ max length = 4m

$\frac{5}{2} = \frac{L.O.I.D}{4m}$

$\frac{5}{2} \times 2 \times 100 = L.O.I.D$

$L.O.I.D = 1000cm\ (or)\ 10{,}000mm.$



Scale = 1:100

2. Q:- Draw a diagonal scale of R.F = 4 to read cm, $\frac{1}{5}$ cm, $\frac{1}{25}$ cm and to measure upto 5cm. Mark on the scale distance of 3.36 cm.

Sol:

R.F = 4

$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

Max Length = 5cm

$$\frac{4}{1} = \frac{L.O.I.D}{5cm}$$

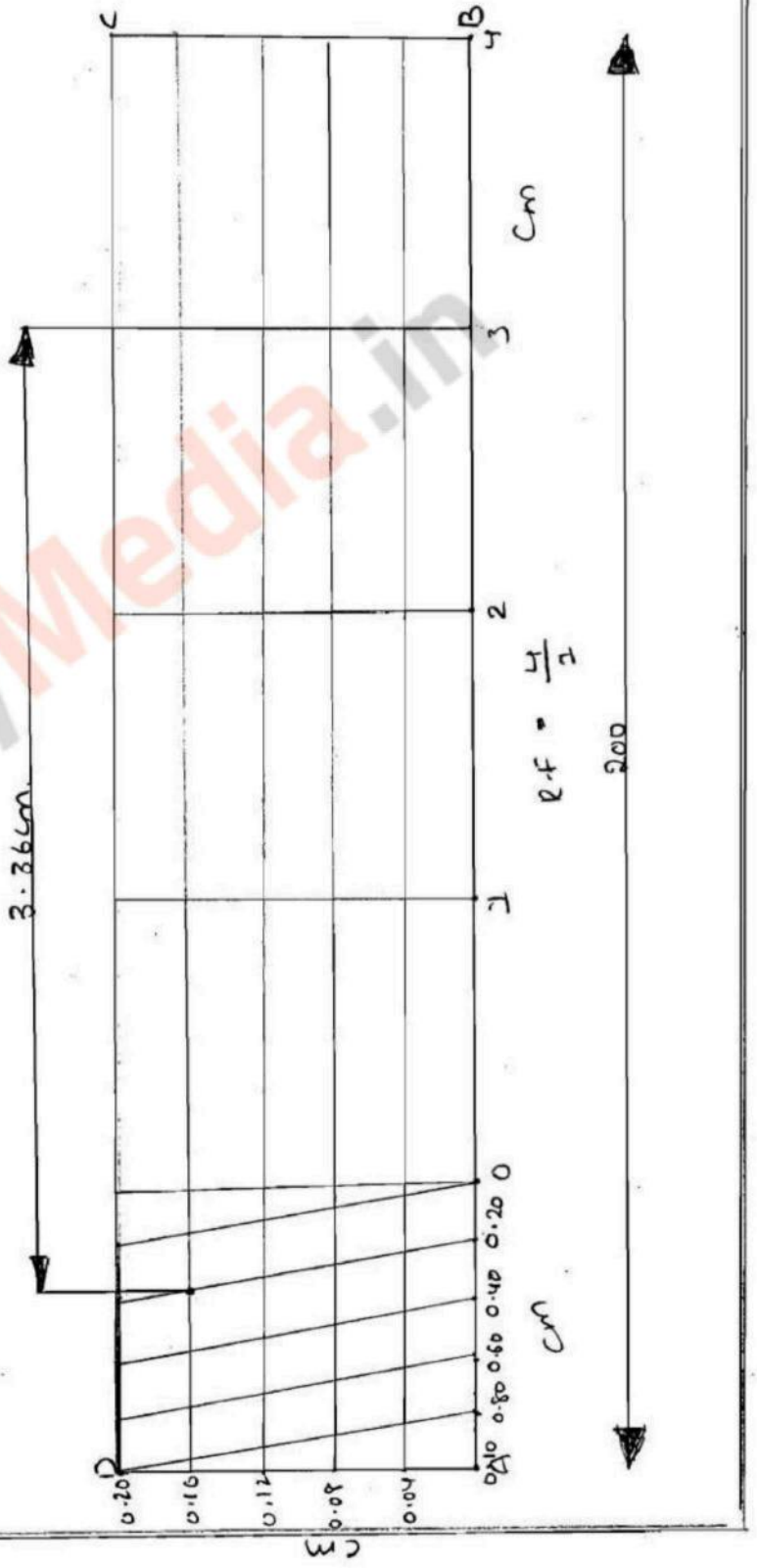
$4 \times 5cm = L.O.I.D$

$L.O.I.D = 20cm$ (or)

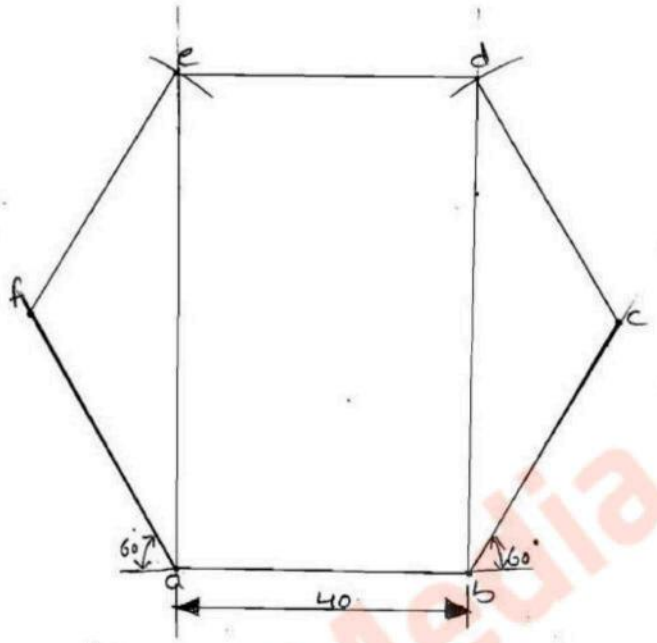
$200mm$

Marking distance.

$= 3.36cm.$



3. Q:- a) Draw a regular hexagon of 40mm side using general method.



Hexagon

b) The distance between two points on a map is 15cm. The real distance blw them is 20 km. Draw a diagonal scale to measure upto 25 km and show a distance of 18.6 km on it.

Sol. $R.f = \frac{15\text{cm}}{20 \times 10^5\text{cm}} = \frac{3}{4 \times 10^5}$

$R.f = \frac{\text{Length of object in drawing}}{\text{Actual Length of object}}$

max length = 25 km

$\frac{3}{4 \times 10^5} = \frac{L.O.I.D}{25\text{ km}}$

$L.O.I.D = \frac{25 \times 10^5 \times 3\text{ cm}}{4 \times 10^5}$

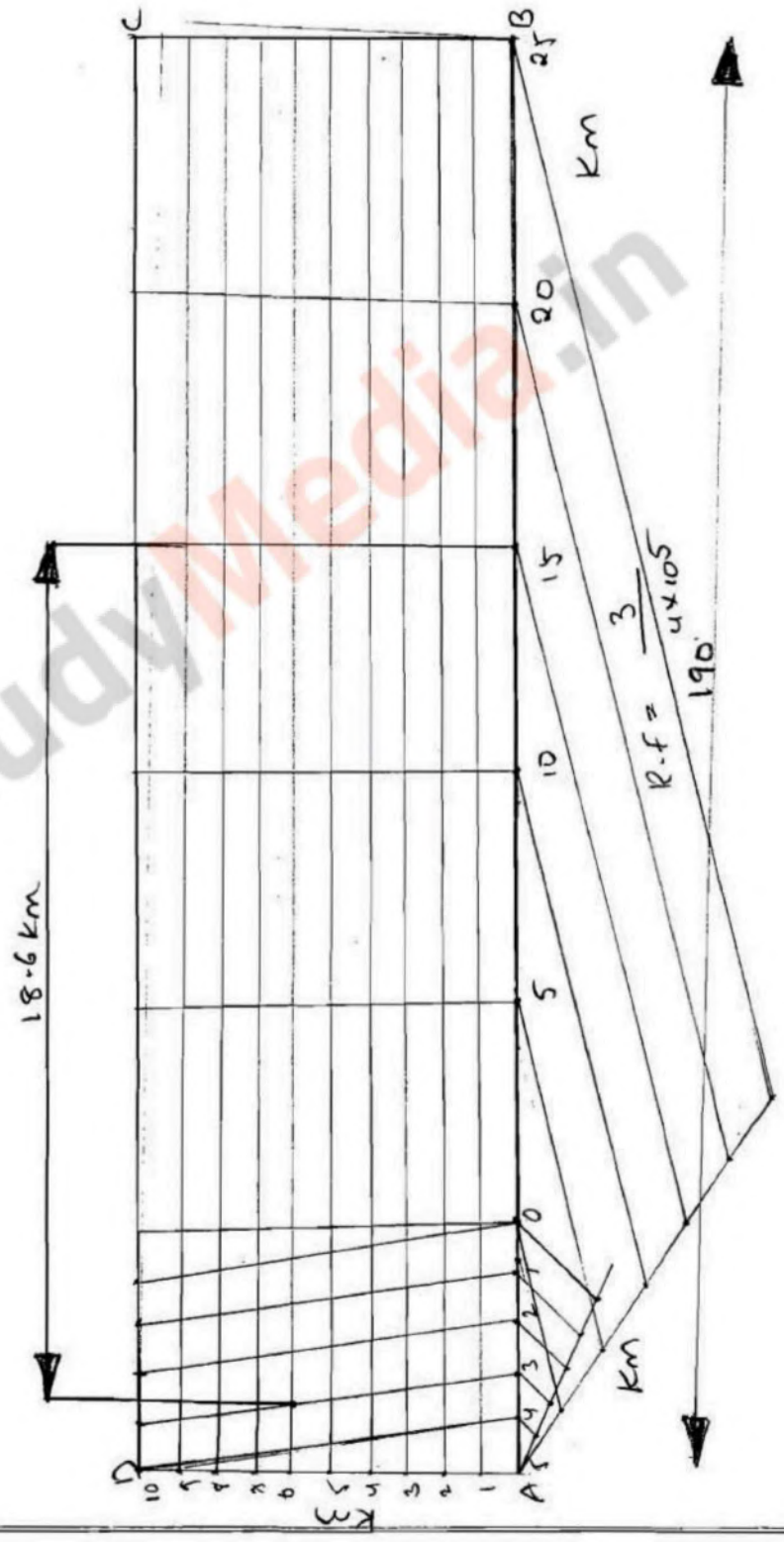
$= \frac{75}{4}$ cm

$= 18.75$ cm

≈ 19 cm

L.O.I.D = 19cm (or) 190mm

Marking distance is 18.6 km.



Vernier scale

1. Construct a vernier scale of 1:40 to read meters, dm and cm and long enough to measure upto 6m and mark distance of 5.76m on it.

Sol:

$$R.F = \frac{1}{40}$$

$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object.}}$$

$\therefore$ max length = 6m

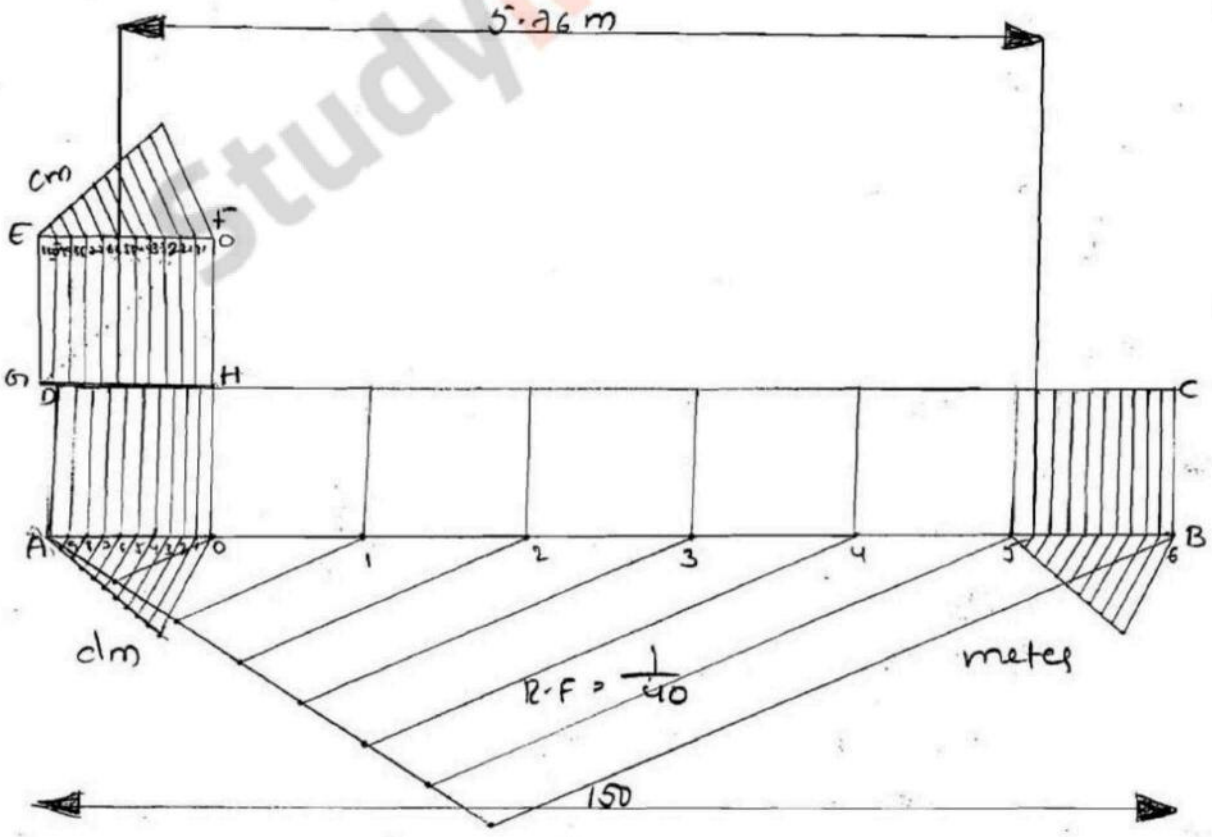
$$\frac{1}{40} = \frac{L.O.I.D}{A.L.O}$$

$$\frac{1}{40} = \frac{L.O.I.D}{6m}$$

$$\frac{6 \times 100cm}{40} = L.O.I.D$$

$\therefore$ L.O.I.D = 15cm (or) 150mm

$\therefore$ Marking distance = 5.76 m



2. If 1cm long line on a map represents a real distance of 4m. calculate the R.F Draw a vernier scale long enough to measure upto 50m show a distance of 44.5m on it

Sol:

$$R.F = \frac{1cm}{4m} = \frac{1cm}{4 \times 100cm}$$

$$R.F = \frac{1}{400}$$

∴ max length = 50 m

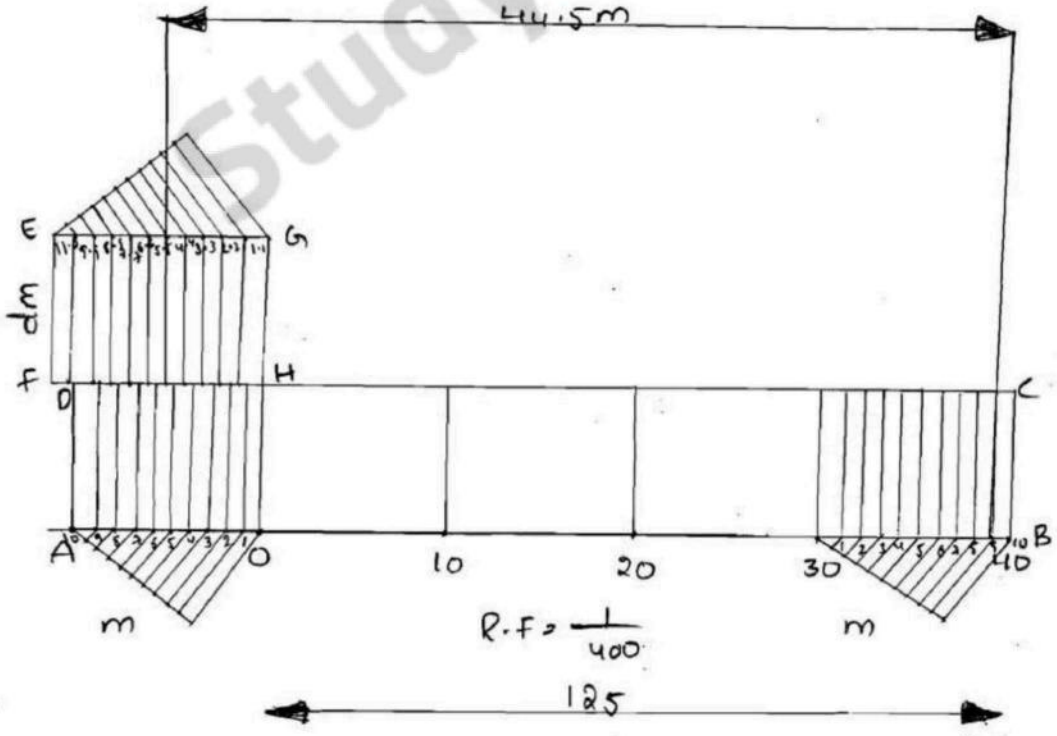
$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{1}{400} = \frac{L.O.I.D}{50m}$$

$$\frac{50 \times 100cm}{400} = L.O.I.D$$

L.O.I.D = 12.5cm or 125mm

making distance = 44.5 m.



Vernier Scale

3. A real length of 10m is represented by a line of 5cm on a drawing. Find the R.F and construct a vernier scale such that least count is 2dm and measure upto 25m mark a distance of 19.4m on it

Sol

$$R.F = \frac{5cm}{10m}$$

$$R.F = \frac{5cm}{10 \times 100cm} = \frac{1}{200}$$

max length = 25m

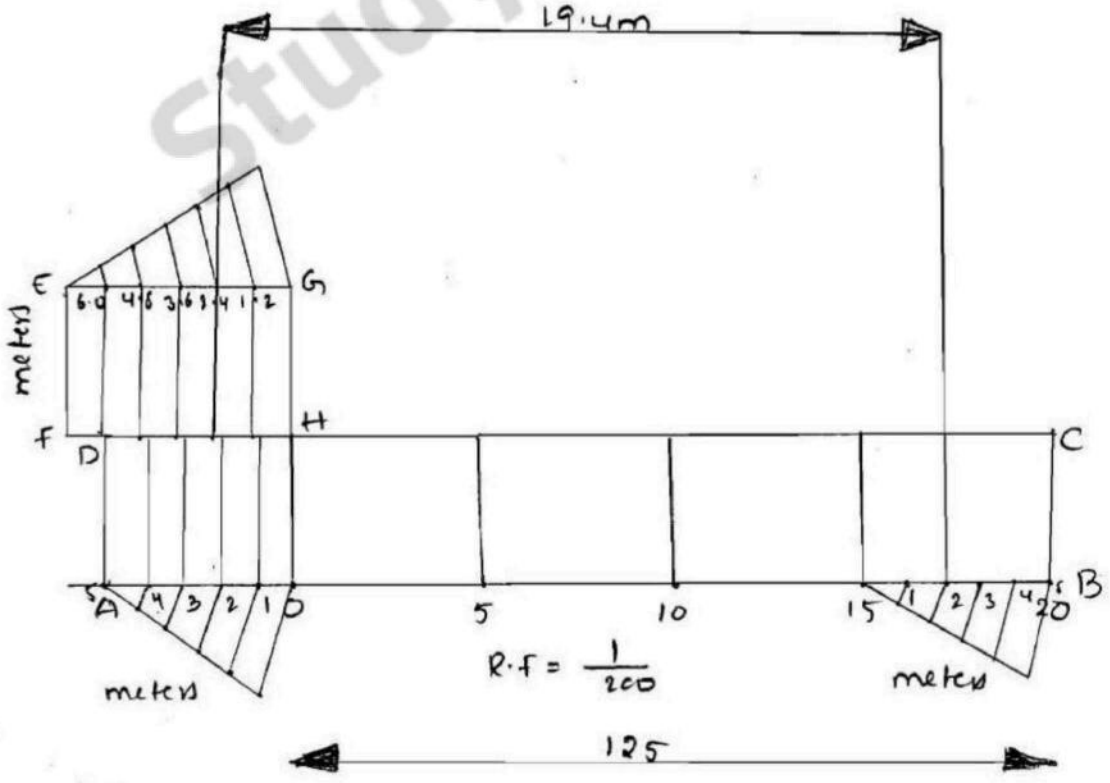
$$R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{1}{200} = \frac{L.O.I.D}{25m}$$

$$\frac{25 \times 100\ cm}{200} = L.O.I.D$$

$$L.O.I.D = 12.5\ cm \text{ or } 125mm$$

$\therefore$ making distance = 19.4m.



Vernier scale

4. On a map rectangle of 125cm x 200cm represents area of 6250 km^2. Draw a vernier scale to show Dm, and long enough to measure upto 7 km. show a distance of 6.43 km on it.

Sol:

$$R.F = \sqrt{\frac{125 \times 200\,cm^2}{6250\,km^2}}$$

$$= \sqrt{\frac{25000}{6250} \times \frac{cm}{km}} = \sqrt{\frac{2500}{625} \times \frac{cm}{10^5\,cm}}$$

$$= \frac{50}{25\times10^5} = \frac{2}{10^5} = \frac{1}{5\times10^4}$$

$$\therefore R.F = \frac{1}{5\times10^4}$$

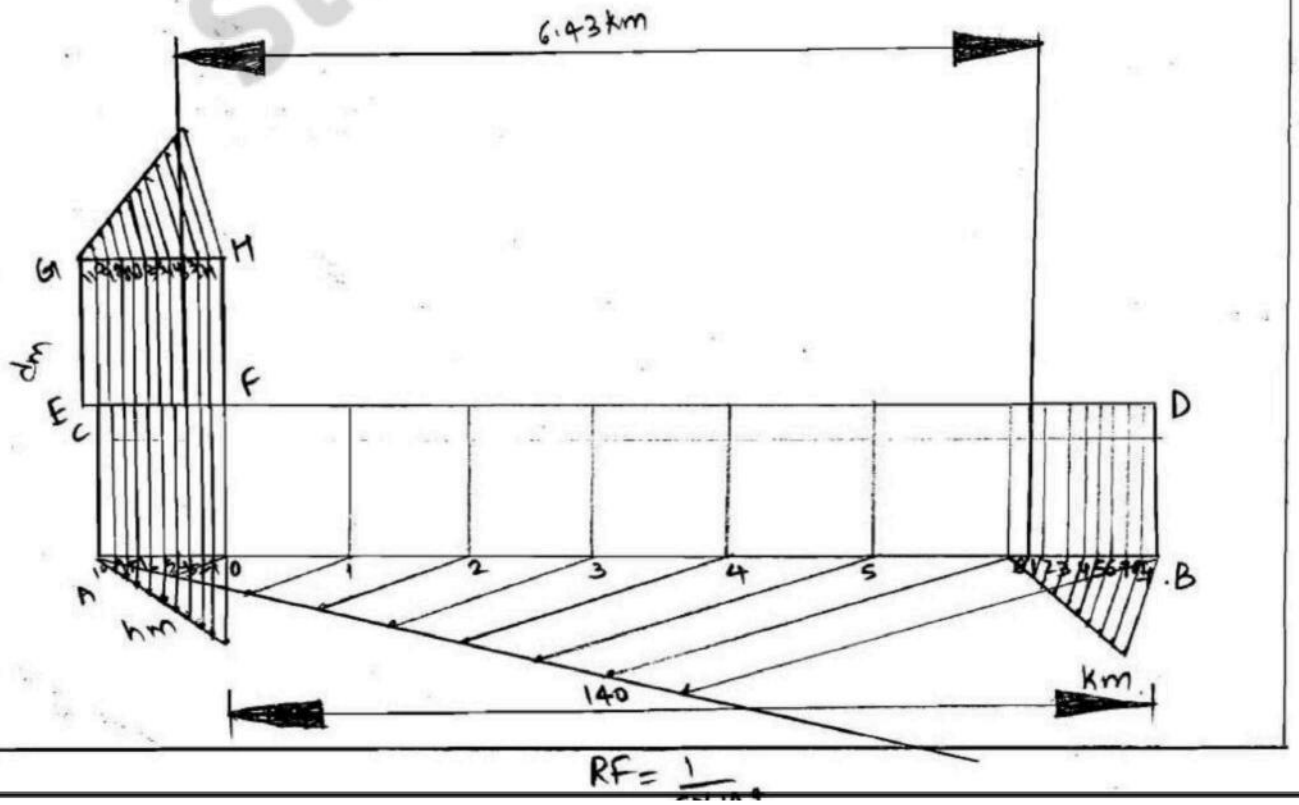
R.F = max length = 7 km

$$\therefore R.F = \frac{\text{Length of object in drawing}}{\text{Actual length of object}}$$

$$\frac{1}{5\times10^4} = \frac{L.O.I.D}{7\,km}$$

$$L.O.I.D = \frac{7\times10^5\,cm}{5\times10^4} = 14cm \text{ or } 140mm$$

marking distance = 6.43 km



RF = 1/

5. Construct a full size vernier scale of inches and show on it length of 4.67 inches.

Sol: Full size scale ratio = 1:1

R.F = $\frac{1}{1}$

max length = 5 inches (max marking is 4.67).

R.F = $\frac{\text{Length of object in drawing}}{\text{Actual length of object}}$

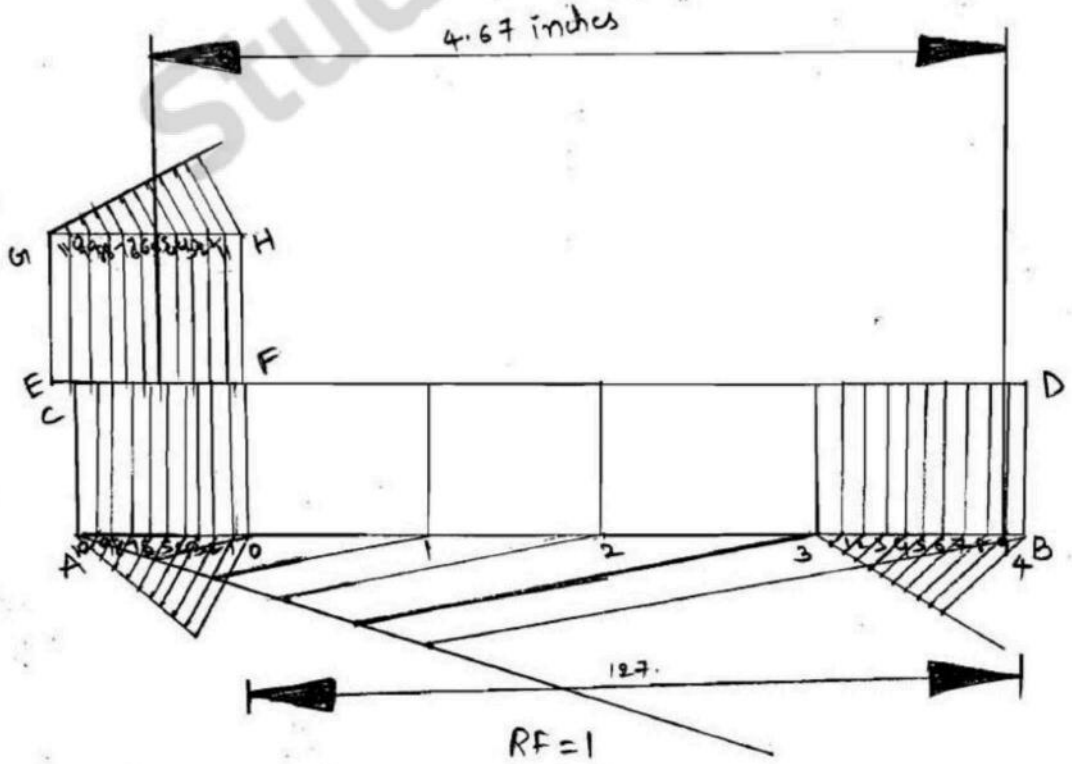
$\frac{1}{1} = \frac{\text{L.O.I.D}}{5 \text{ inches}}$

L.O.I.D = 5 × 2.54 cm

= 12.7 cm

= 127 mm

marking distance = 4.67 inches.



RF = 1