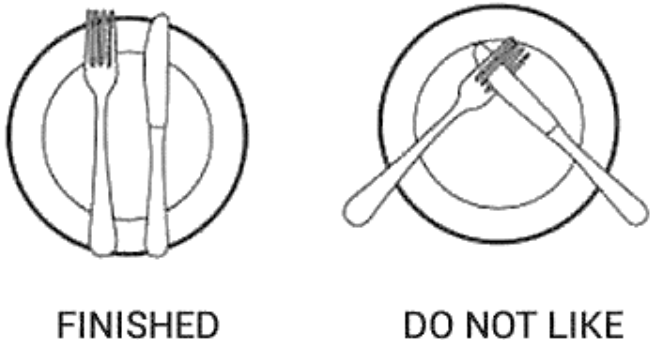
GAYATRI VIDYA PARISHAD COLLEGE FOR DEGREE AND PG COURSES (A)

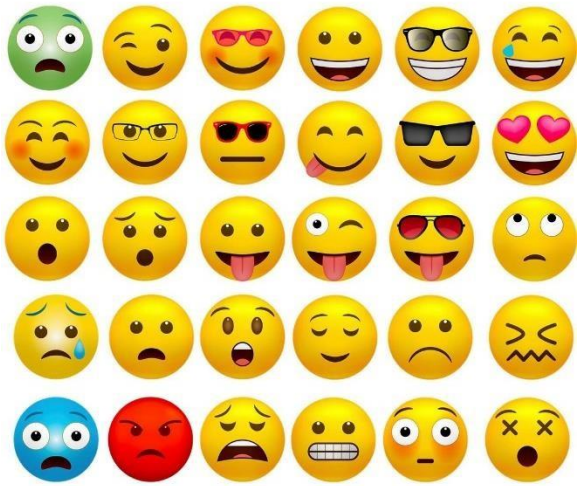
ENGINEERING AND TECHNOLOGY PROGRAM

I/IV B.Tech. I Semester

ENGINEERING GRAPHICS

Communication





ENGINEERING GRAPHICS

Engineers use graphics to communicate technical information without ambiguity to executives, fabricators, customers, and each other

Elements of Engineering Drawing

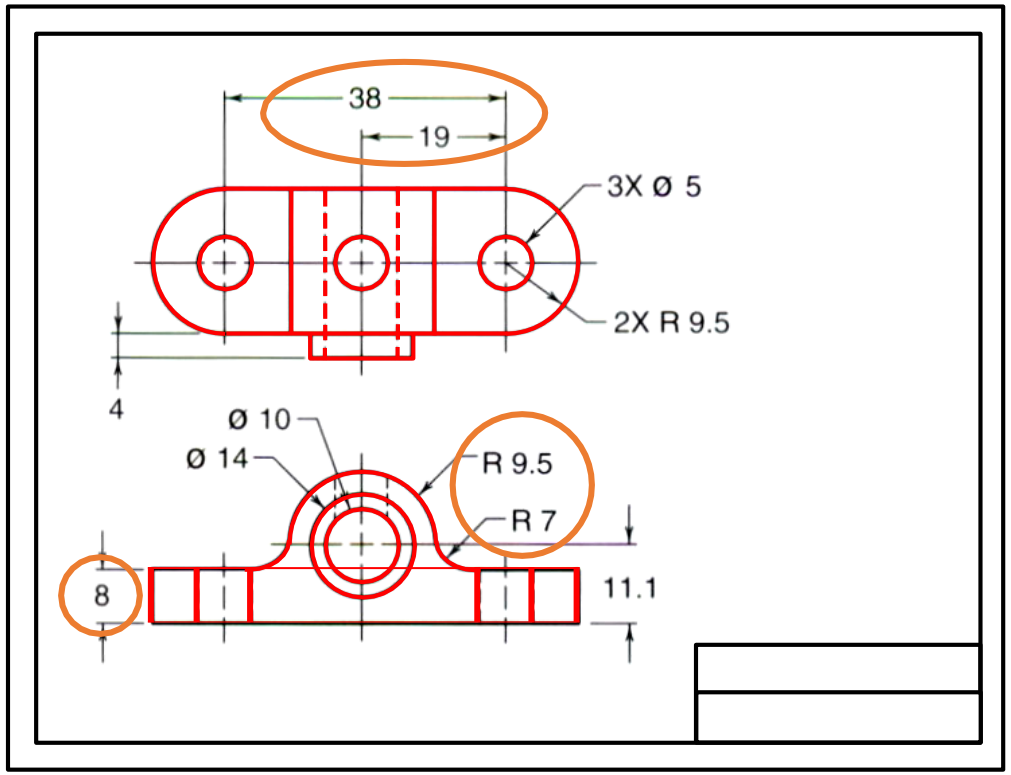
Engineering drawing are made up of ***graphics language*** and ***word language***.

Graphics language

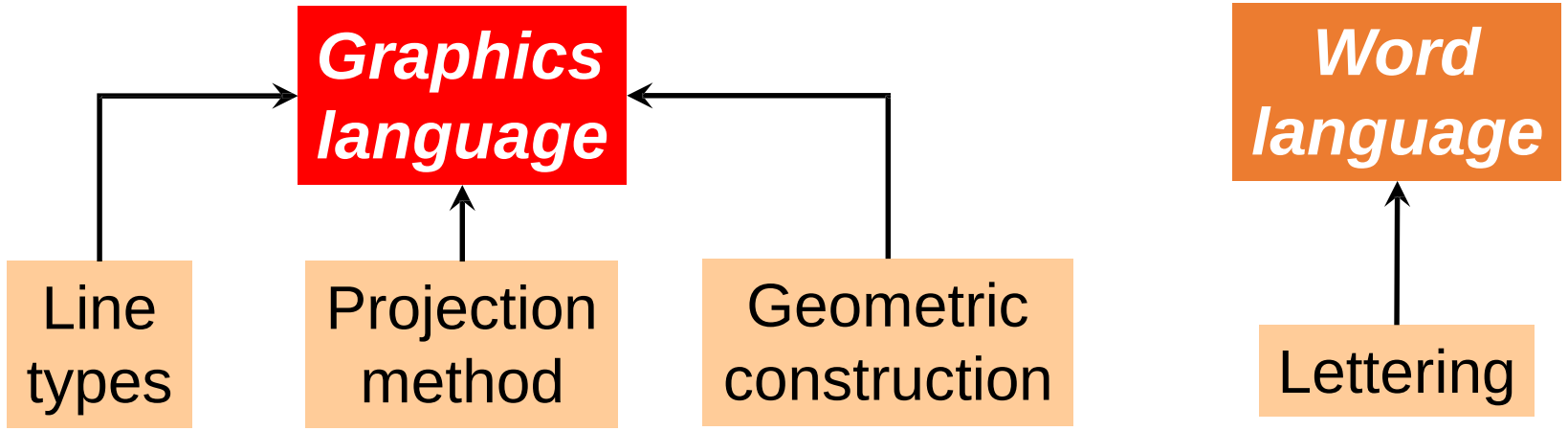
Describe a shape (mainly).

Word language

Describe size, location and specification of the object.



Basic Knowledge for Drafting



Composition of Graphic Language

Graphic language in **“engineering application”** use ***lines*** to represent the ***surfaces***, ***edges*** and ***contours*** of objects.

- The language is known as “***drawing***” or “***drafting***” .
- A drawing can be done using ***freehand***, ***instruments*** or ***computer*** methods.

Course Objectives

1. The course is aimed at developing Basic Graphic skills
2. Develop skills in preparation of basic drawings
3. Skills in reading and interpretation of engineering drawings

Syllabus

Unit 1: Introduction to geometrical construction and Curves

Unit 2: Projection of points and straight lines

Unit 3: Projection of planes

Unit 4: Projection of solids

Unit 5: Isometric Views

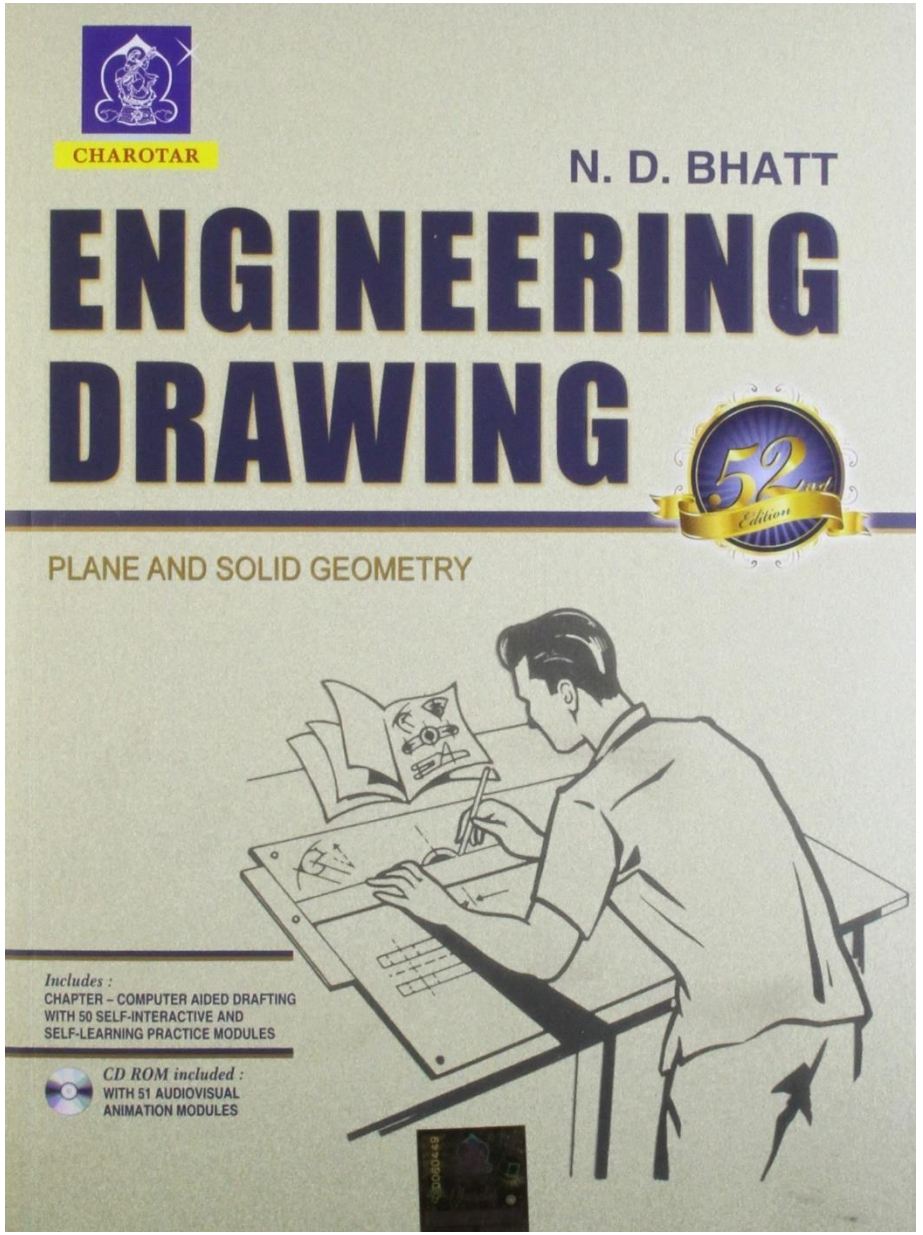
Course Outcomes

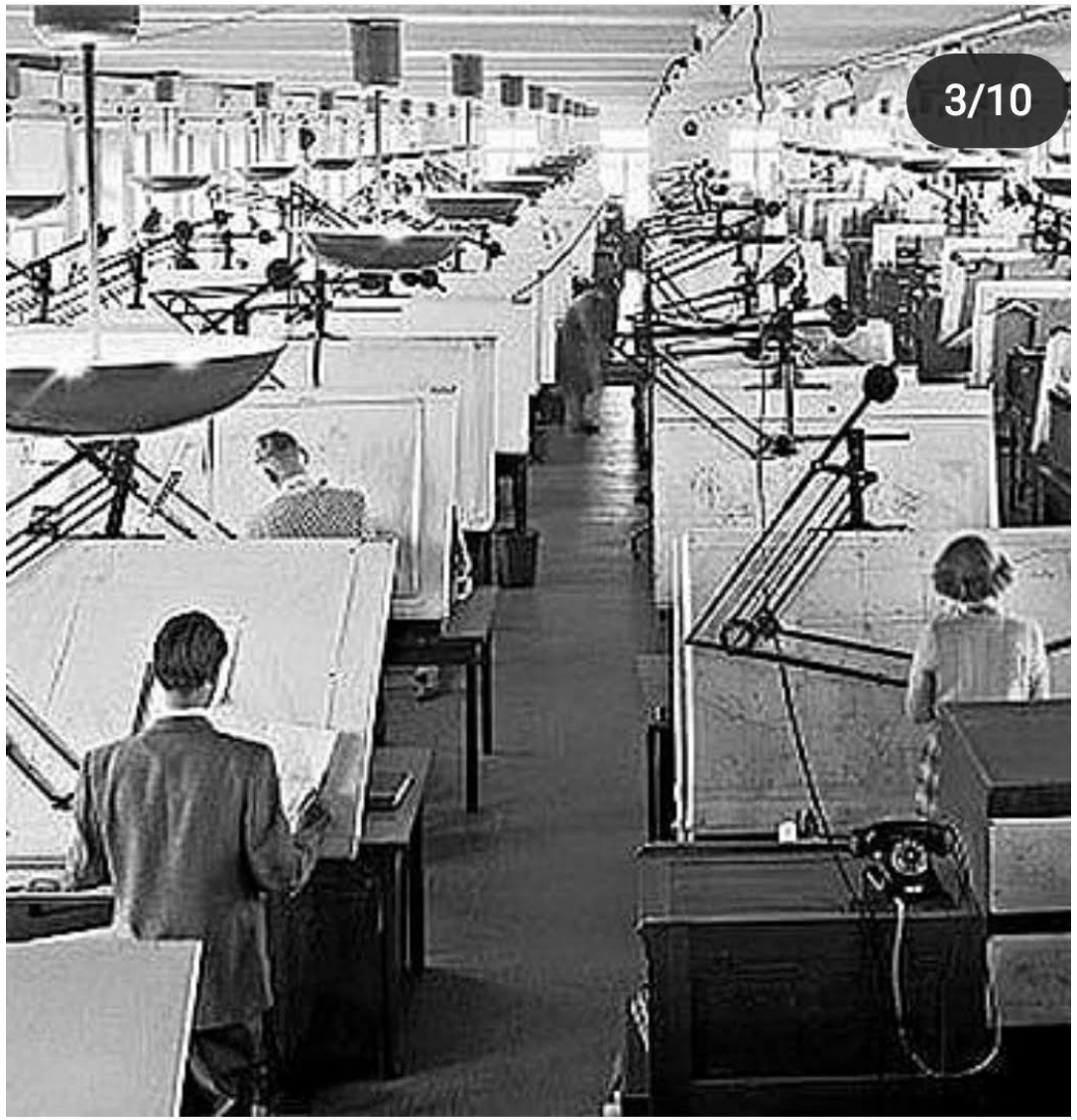
At the end of this course, the student will be able to:

CO	Outcome
CO 1	Graphically construct and understand, the importance of mathematical curves in Engineering applications.
CO 2	Graphically Visualize and construct orthographic projection of points and lines.
CO 3	Visualize and construct different views of planes in different orientations.
CO 4	Visualize and construct different views of solids in different orientations.
CO 5	Interpret and draw the orthographic and isometric views of different solids.

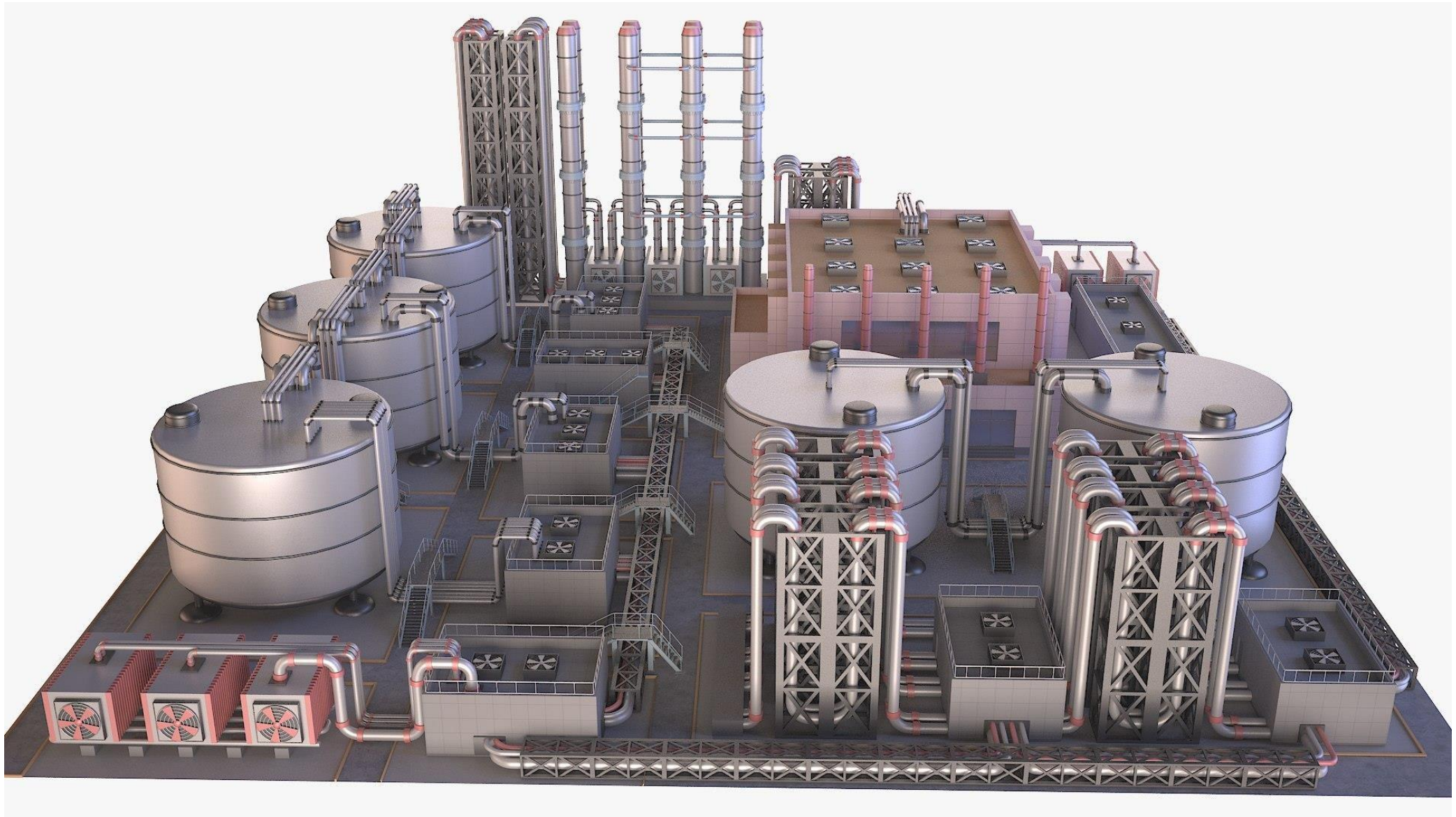
TEXT BOOK

Elementary Engineering Drawing by N.D. Bhatt, Charotar Publishing House.





Computer Aided Design (CAD)

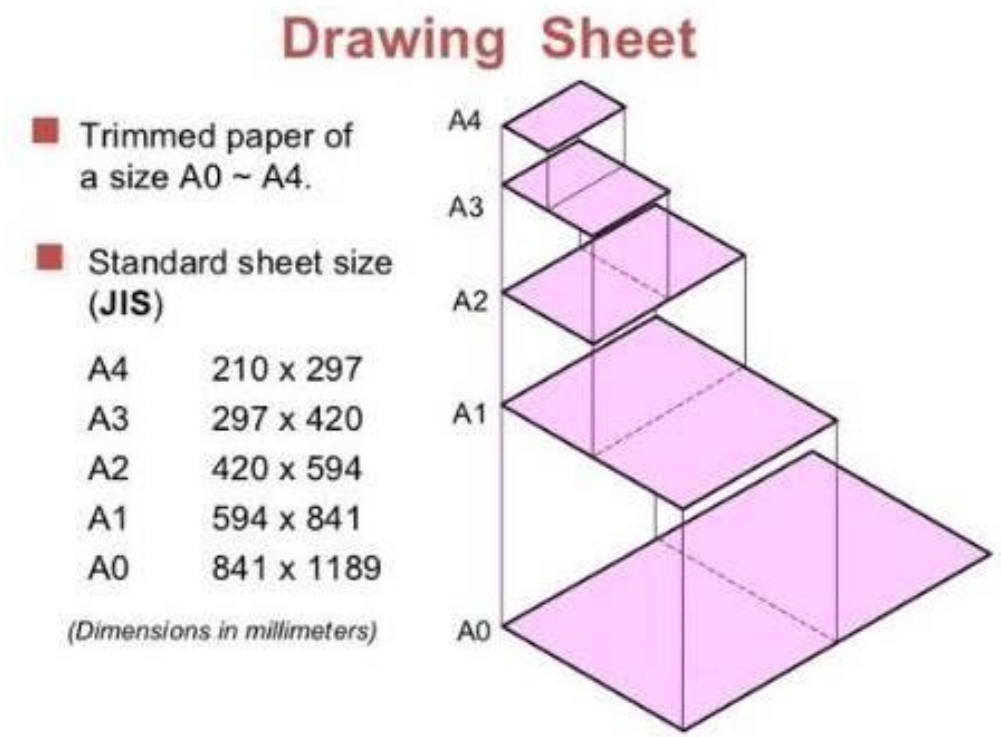


Introduction – Tools Required

- So what things are generally required to draw any diagram:
  - Paper
  - Pencil
  - Scale
  - Eraser
  - Curving and angular tools.
  - Drawing board & Clips
- So let us discuss about each of these individually

1. Paper

- How many sizes of white papers are there actually..?
  - As per the BIS, there are 6 paper sizes available.
- So what are they..?
  - A0 - 841 mm × 1189 mm
  - A1 - 594 mm × 841 mm
  - A2 - 420 mm × 594 mm
  - A3 - 297 mm × 420 mm
  - A4 - 210 mm × 297 mm
  - A5 - 148 mm × 210 mm



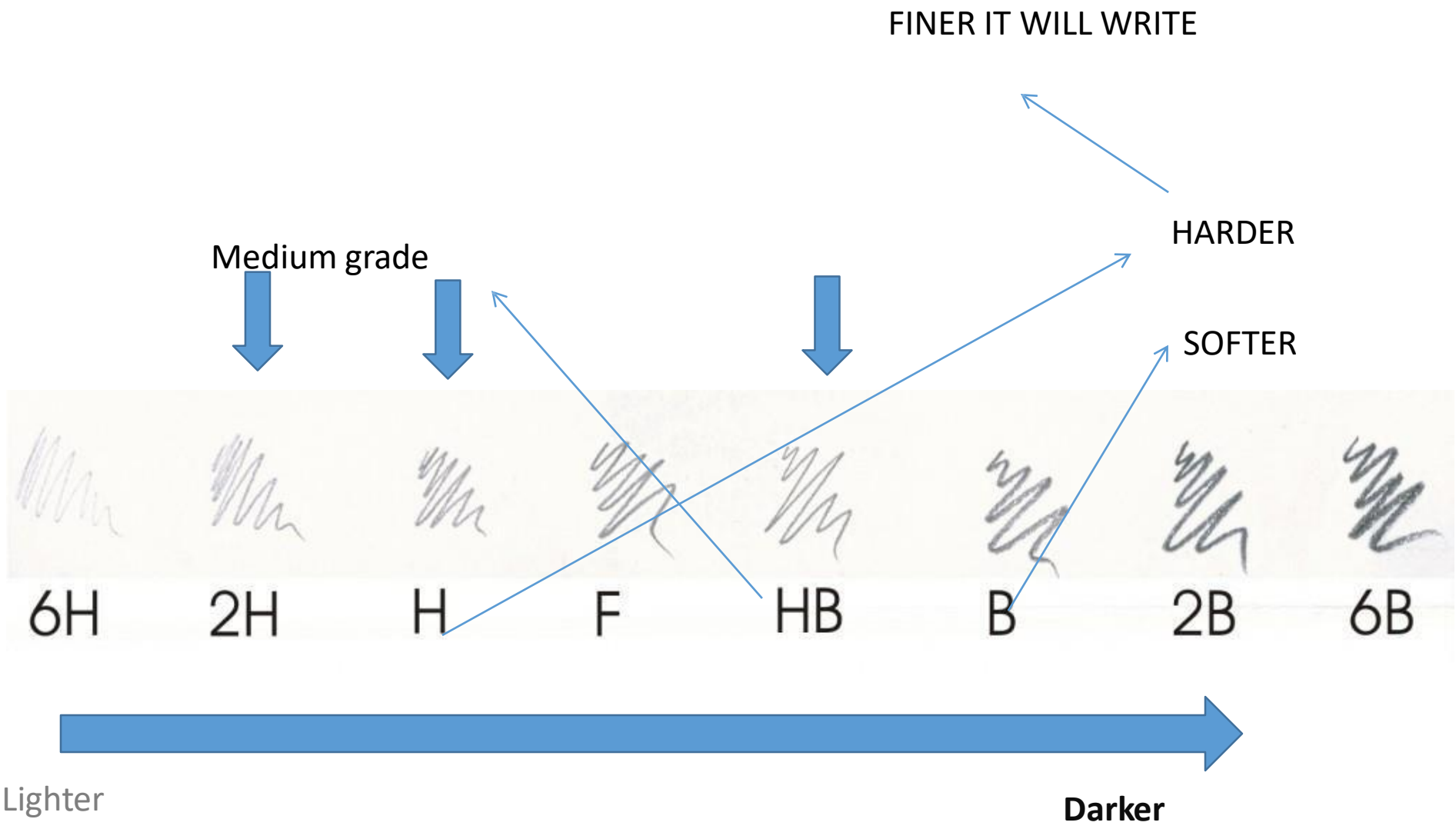
2. Pencil

- How many pencils do you know…?
  - Lead pencil
  - Color pencils
  - Crayons etc…
- What do we actually use…?
  - Generally we use black color lead pencil.
- So can we use any black lead pencil for EG..?
  - No
- So how to differentiate between the available black pencils in market..?
  - By the grade of the pencil, which is usually shown by fig. and letters marked at its end.
- As per BIS, the pencil grades are denoted by letters H and B

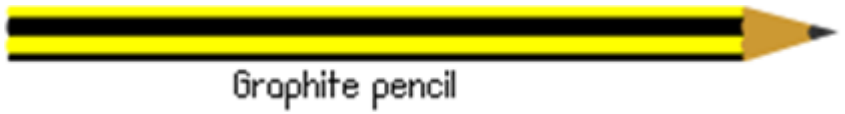
2. Pencil

- **H**
  - H indicates the hardness/thickness of the pencil
  - The increase in hardness/thickness is shown by the values put in front of the letter.
  - The available pencils in the market are : H, 2H, 3H and so on.
- **B**
  - B indicates the softness of the pencil
  - Increase in number before B says that the pencil writes most softly/lightly.
  - Available pencils are: B, 2B, 3B and so on.
- H, B and HB pencils are more suitable for beginners.

What kind of pencils you need for drawing?



Different types of pencils



Graphite pencil

Mechanical pencil

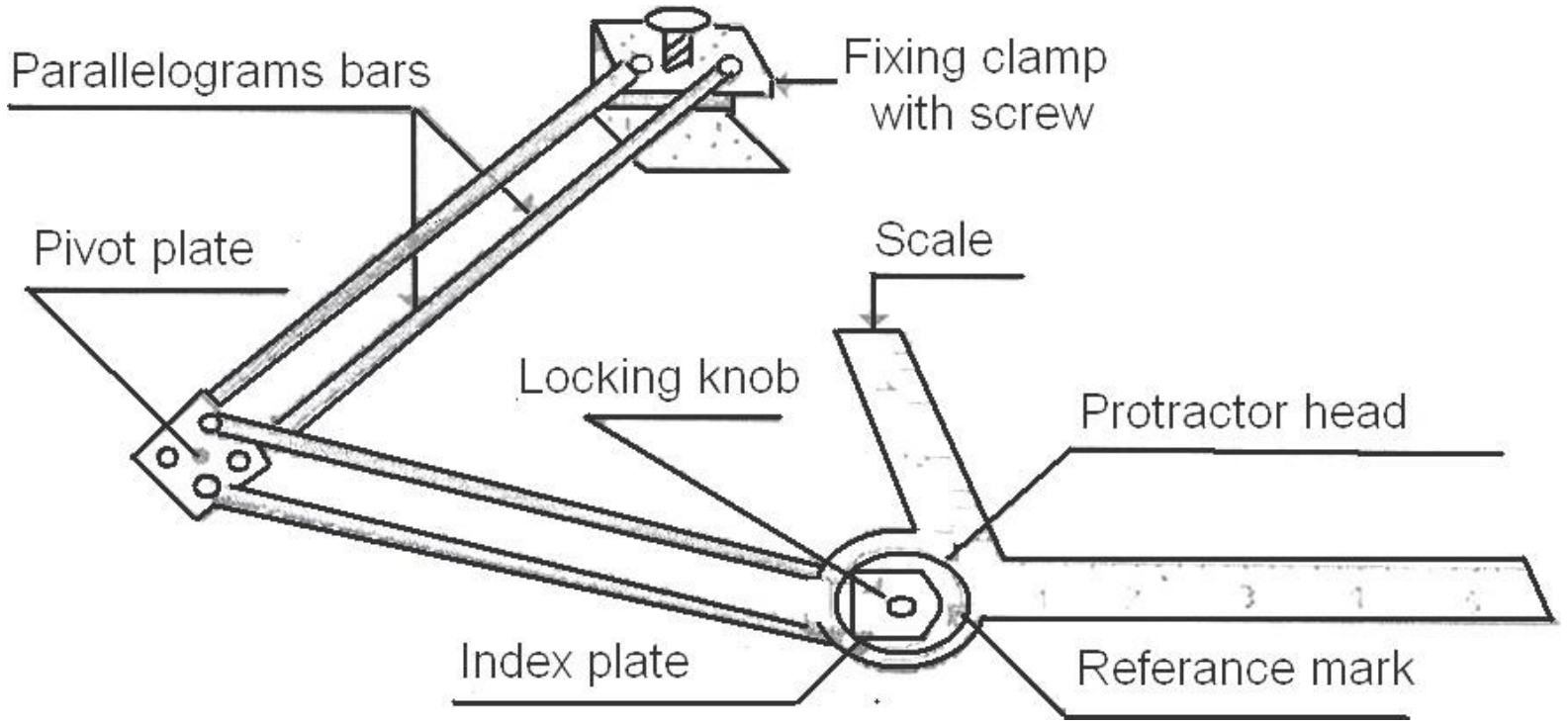
Propelling pencil

3. Scale

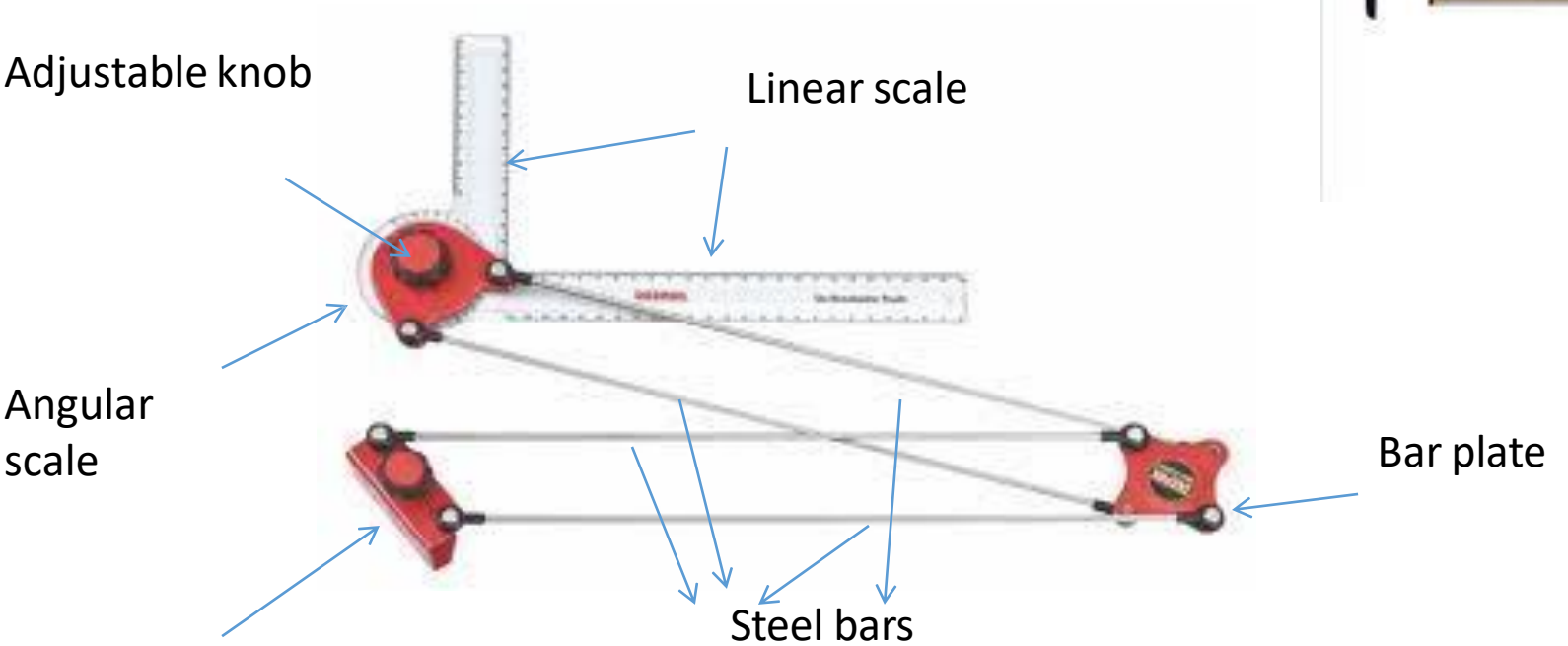
- What is the size of our A1 Paper ..?
  - 594 mm × 841 mm
- So can we use any scale and reach the end from the beginning ..?
- What is the alternative then..?
  - Drafter.

Drafter:

- What is the advantage of a drafter..?
  - It can able to reach any point in the A1 paper.
  - It has two scales which can be used to draw perpendicular lines.
  - The perpendicular scales can rotate to any specific angles also.



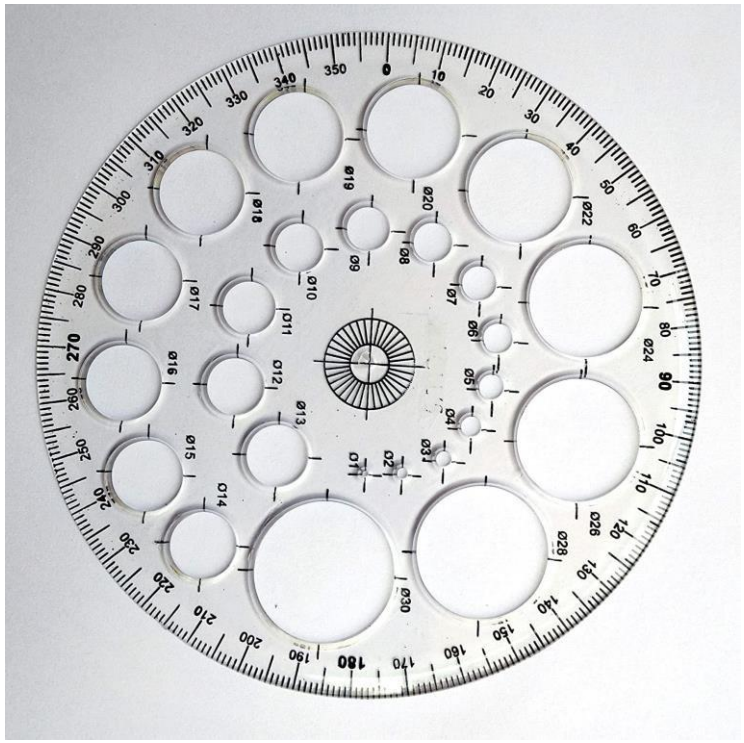
T -Squares



Mini drafter

5. Curving and angular tools

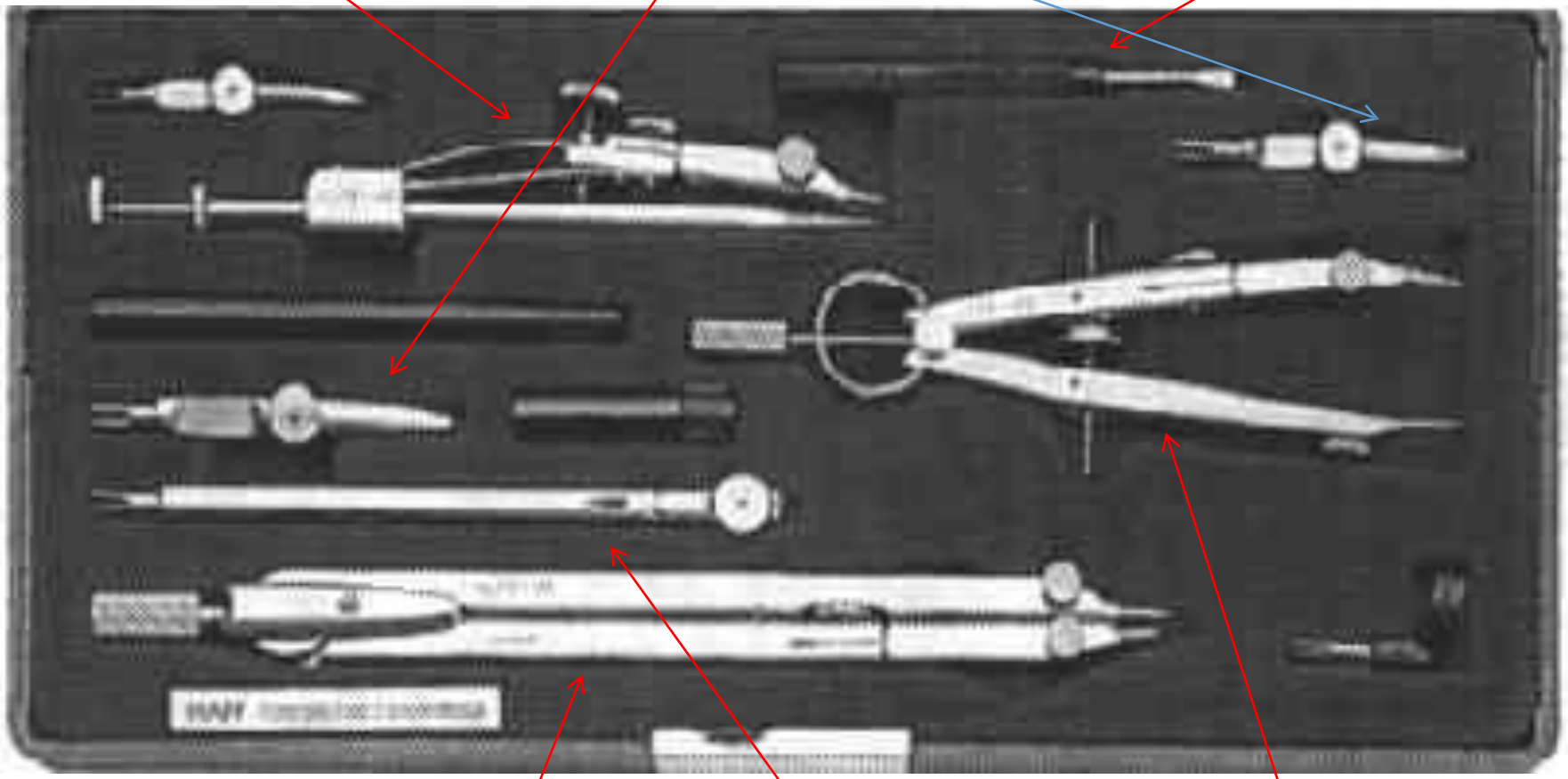
- There are certain tools which are used to draw smooth curves, we call them as French curves.
- And for angular tools we can use protractor and compass.



spring Bow compass

Ink attachments

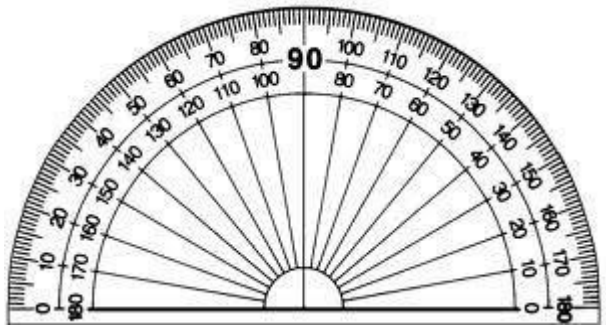
Screw driver



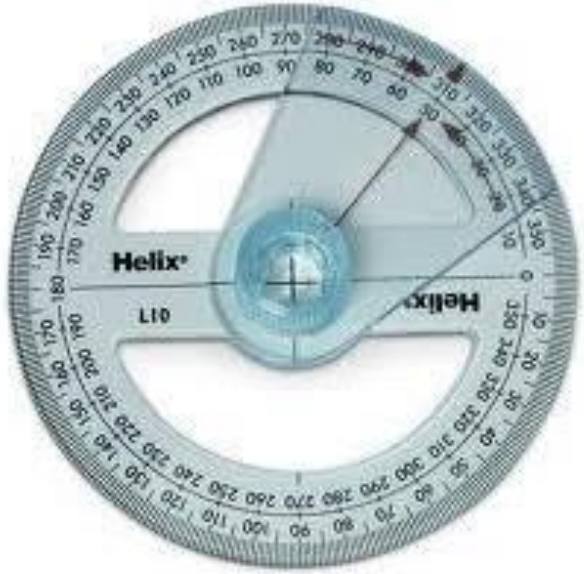
Large size divider
Cum compass

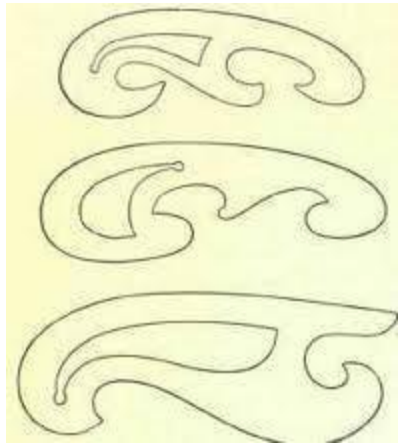
Extension arm

Small spring Bow divider

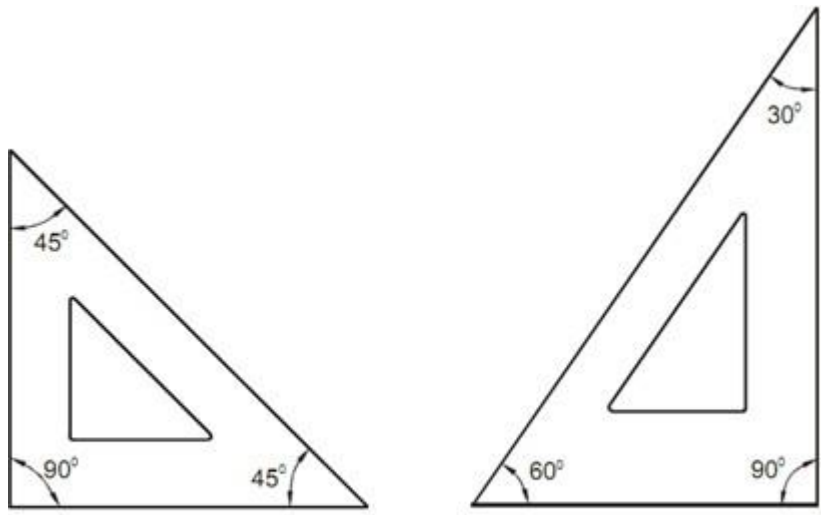


protractor





French curves



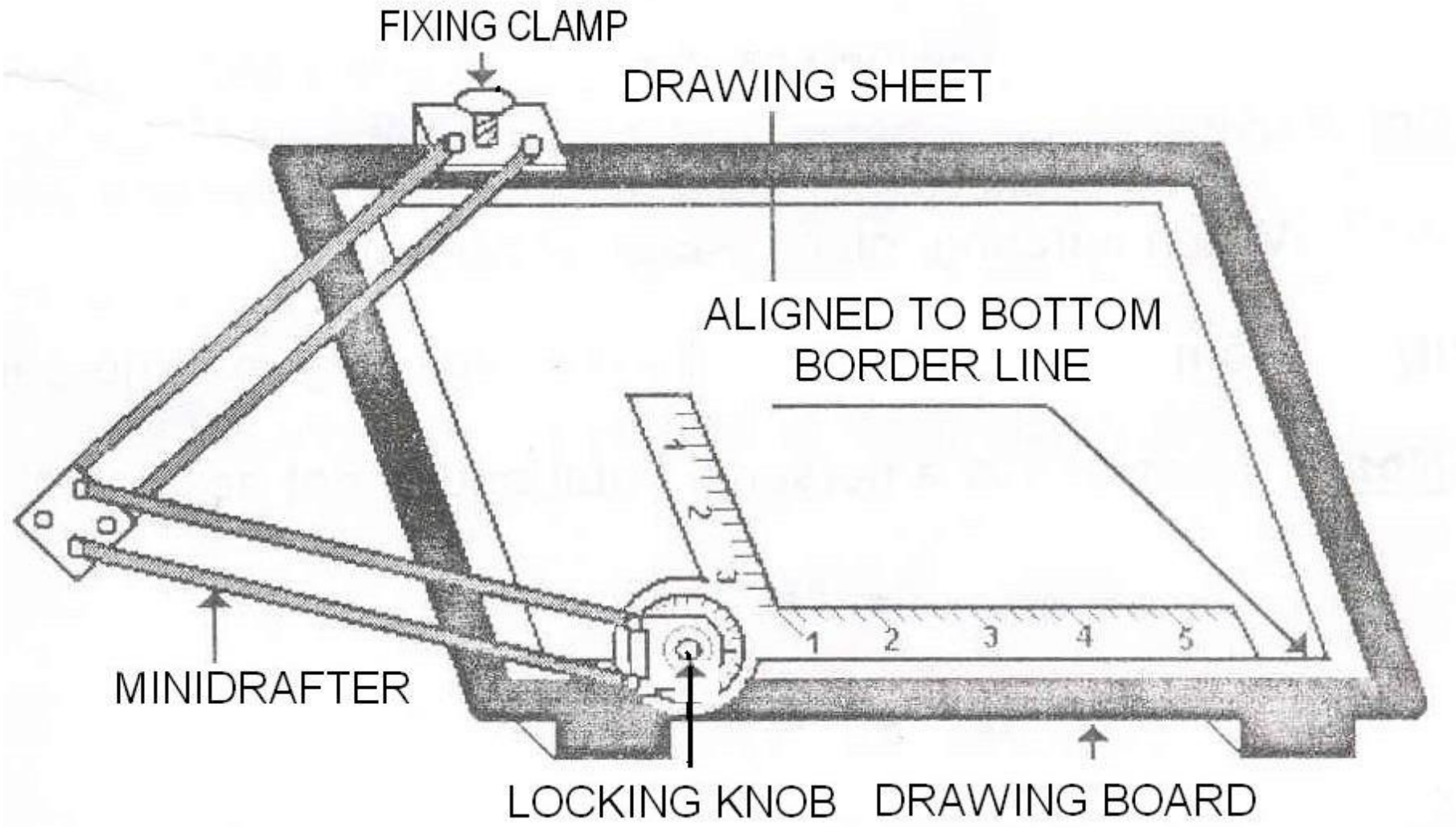
(a) 45° Square

(b) 30°-60° Set-square

Set squares

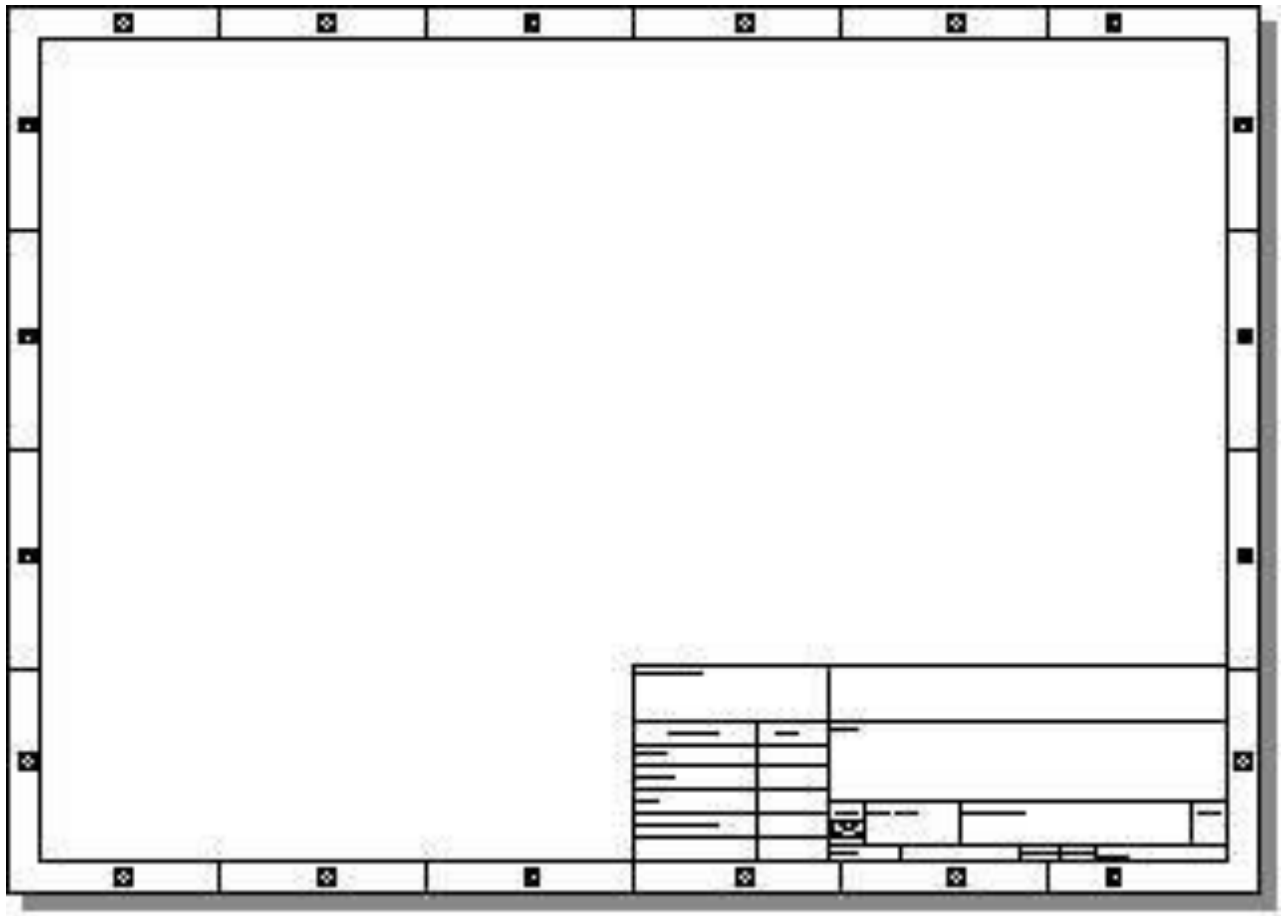
6. Drawing Board & Clips

Drawing sheet arrangement



Drawing sheet border lines

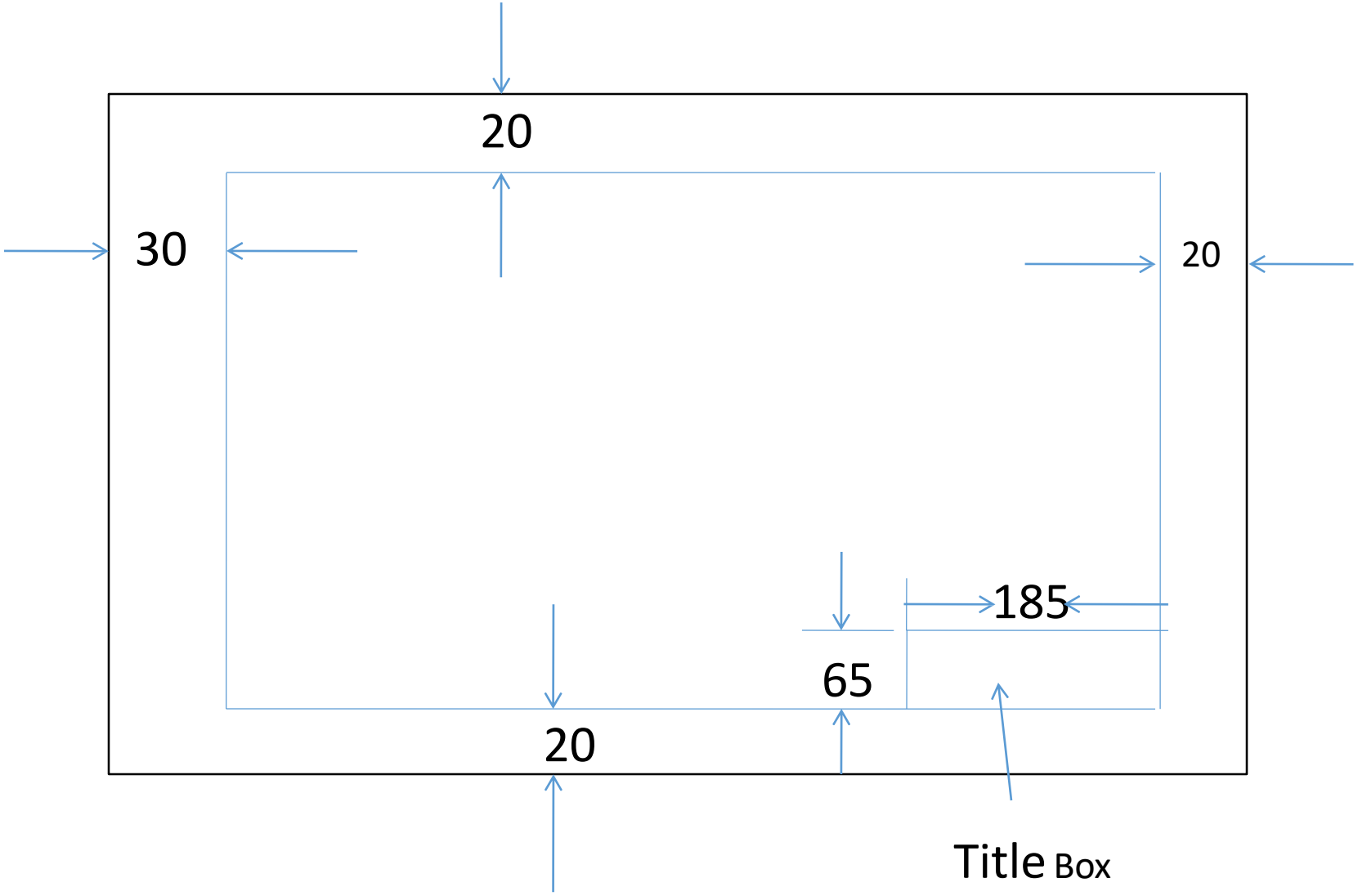
- Why do we need to draw border lines for a drawing sheet..?
    - Working area.
- How do we need to draw the border lines..?

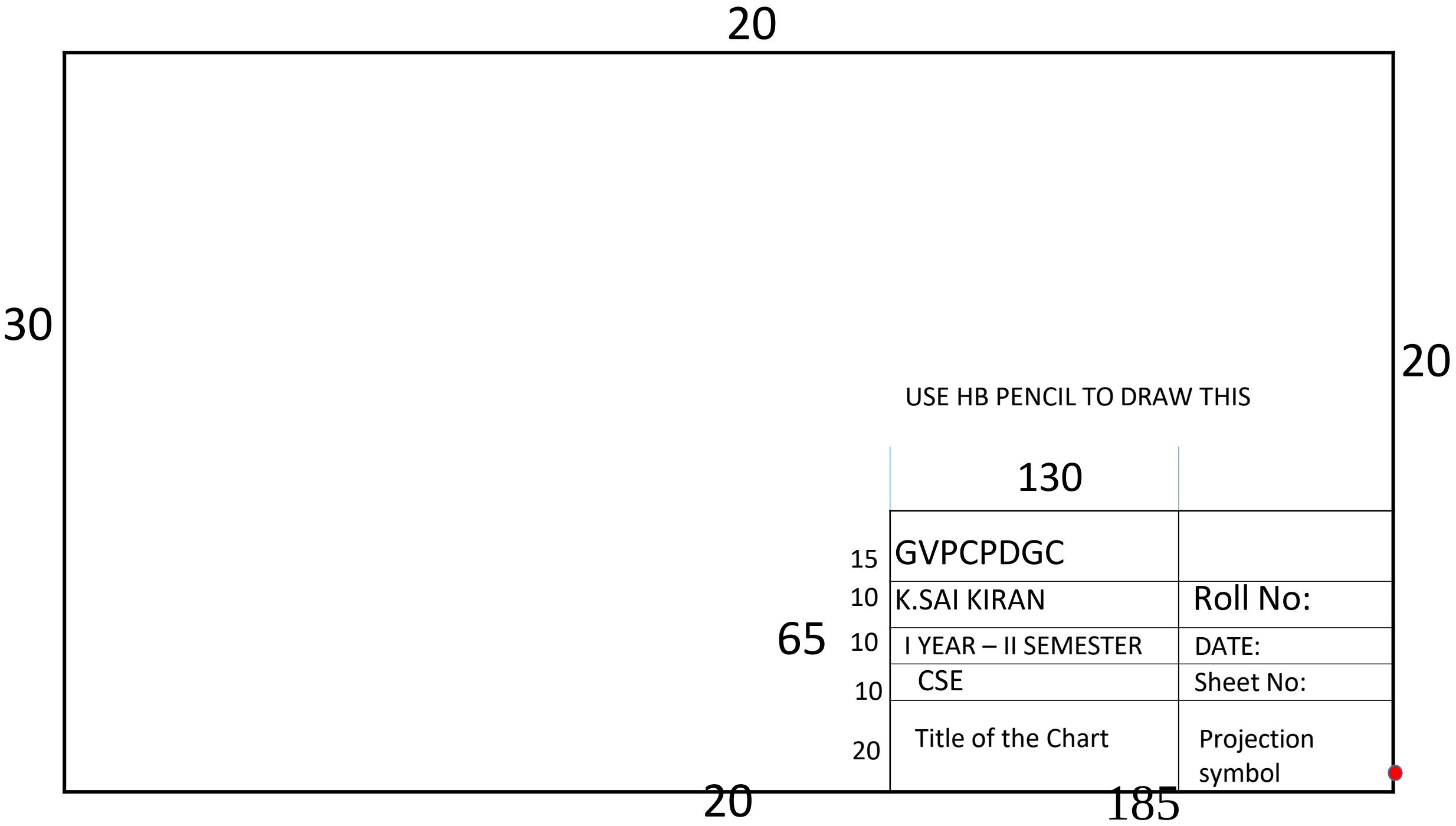


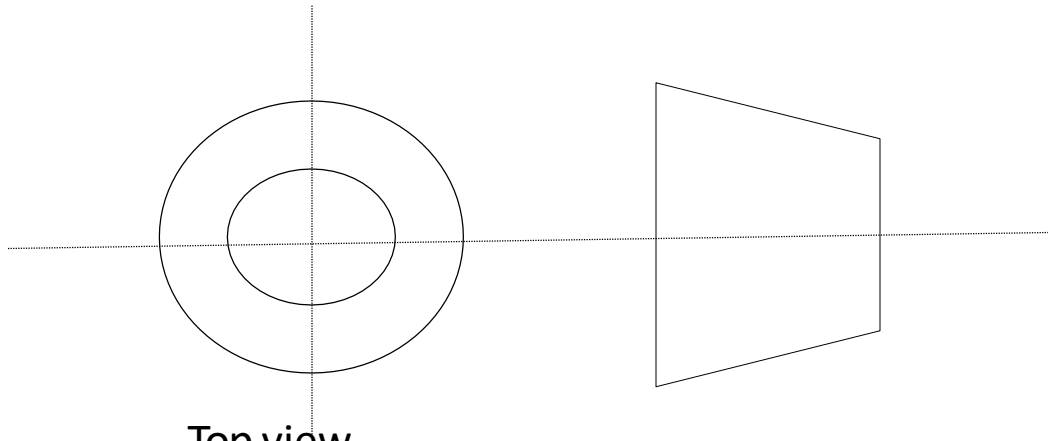
Traditional Drawing Sheet

Title Block

- Why title block is needed..?
  - It indicates the particulars of the drawing sheet
- What are the particulars indicated by the title block..?
  - Name
  - Roll number
  - Class
  - College
  - Sheet number
  - Date
  - Title of the sheet
  - Scale
  - All dimensions are in mm
  - View of the sheet.


20
30
20
185
65
20
Title Box

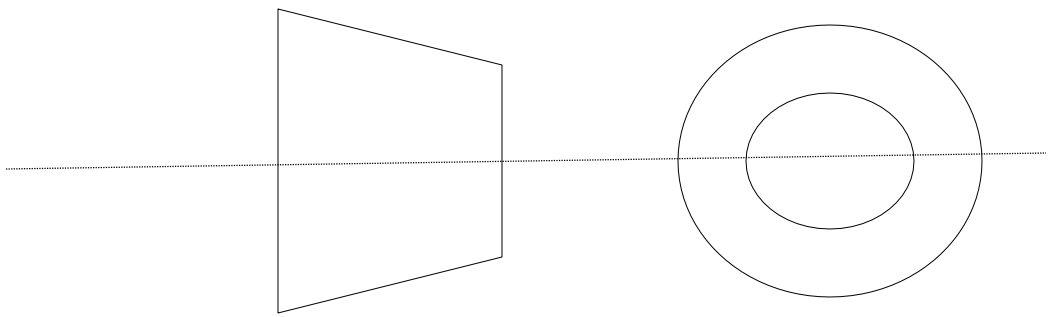

20
30
20
USE HB PENCIL TO DRAW THIS
130
65
15
10
10
10
20
GVPCPDGC
K.SAI KIRAN
I YEAR – II SEMESTER
CSE
Title of the Chart
Roll No:
DATE:
Sheet No:
Projection symbol
20
185



Top view

Top view

First Angle projection



Third angle projection

Different types of lines

Part Outlines

Heavy

Section Lines

Light

Hidden Lines

Medium

Center Lines

Light

Dimension and Extension Lines

3.000

Light

Heavy

Cutting Plane

Heavy

Breaking lines

Light

Lettering

- The BIS had divided lettering styles in to two types:
  - Lettering Style A
  - Lettering Style B

Characteristic		Ratio	Dimensions (mm)						
Lettering height Height of capitals	h	$\left(\frac{10}{10}\right)$ h	2.5	3.5	5	7	10	14	20
Height of lower-case letters	c	$\left(\frac{7}{10}\right)$ h	–	2.5	3.5	5	7	10	14
Spacing between characters	a	$\left(\frac{2}{10}\right)$ h	0.5	0.7	1	1.4	2	2.8	4
Minimum spacing of base lines	b	$\left(\frac{14}{10}\right)$ h	3.5	5	7	10	14	20	28
Minimum spacing between words	e	$\left(\frac{6}{10}\right)$ h	1.5	2.1	3	4.2	6	8.4	12
Thickness of lines	d	$\left(\frac{1}{10}\right)$ h	0.25	0.35	0.5	0.7	1	1.4	2

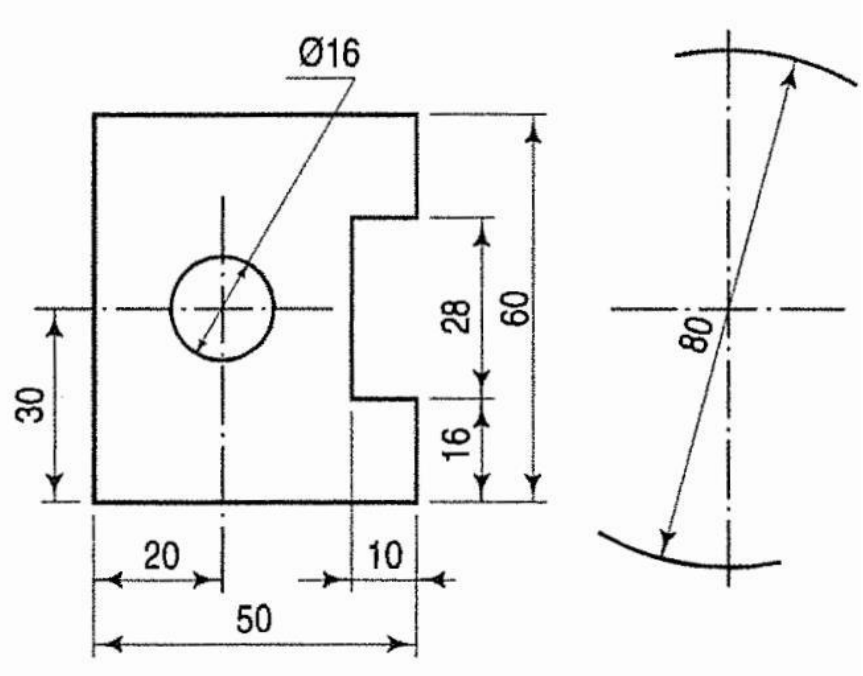
Lettering

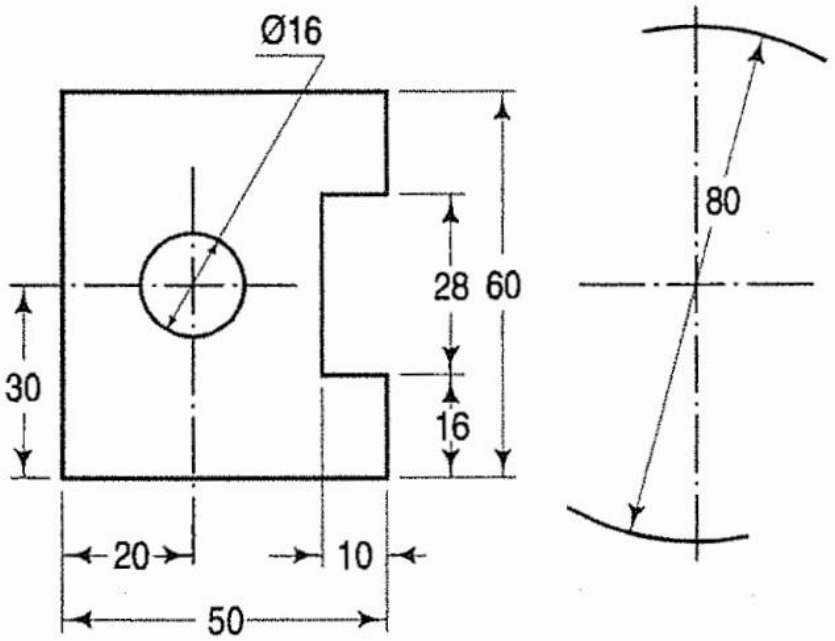
- Rules:
  - Lettering is one in capital letters
  - Main titles are generally written in 6 mm to 8 mm
  - Subtitles are written in 3 mm to 6 mm
  - Dimension fig are written in 3 mm to 5 mm
  - Gap between each letter is maintained as 1 mm
  - Lettering style B with Height 5 mm is usually taken.


ABCDEFGHIJKLMN
OPQRSTUVWXYZ
1234567890
abcdefghijklmnopqrst
uvwxyz

Dimensioning

- Dimensioning is divided in to two types:
  - Aligned system
    - The dimensions should be placed in center of the line
    - Dimension should be mentioned above the line.
  - Unidirectional system
    - The dimensions should be placed in center of the line
    - Dimension is mentioned in the middle f the line by breaking it.





Always ready with your textbook and tools when there is a class

Unit 1 – Introduction to Geometrical Construction and Curves

- **Syllabus**
  - Introduction
    - Lines
    - Lettering and dimensioning
    - Geometrical constructions
  - Curves
    - Construction of conic sections
    - Normal and tangent to curves.

ENGINEERING CURVES

Part- I {Conic Sections}

ELLIPSE

1.Concentric Circle Method

2.Rectangle Method
(OR)
Oblong Method

4.Arcs of Circle Method

5.Rhombus Method

6.Basic Locus Method
(Directrix – focus)

PARABOLA

1.Rectangle Method

2 Method of Tangents
(Triangle Method)

3.Basic Locus Method
(Directrix – focus)

HYPERBOLA

1.Rectangular Hyperbola
(coordinates given)

2 Rectangular Hyperbola
(P-V diagram - Equation given)

3.Basic Locus Method
(Directrix – focus)

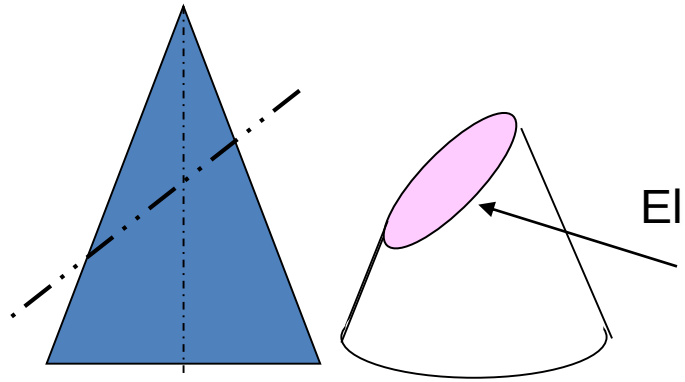
Methods of Drawing Tangents & Normals To These Curves.

CONIC SECTIONS

ELLIPSE, PARABOLA AND HYPERBOLA ARE CALLED CONIC SECTIONS BECAUSE

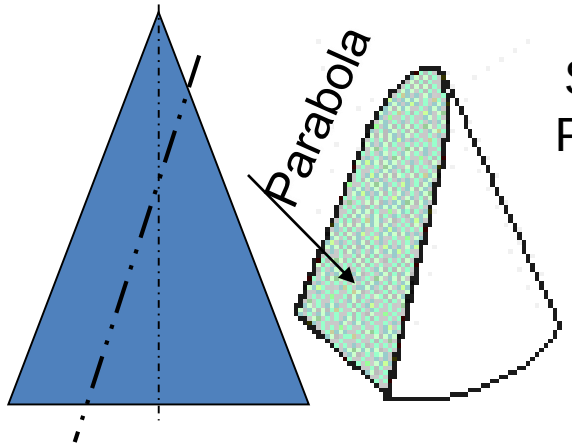
THESE CURVES APPEAR ON THE SURFACE OF A CONE WHEN IT IS CUT BY SOME TYPICAL CUTTING PLANES.

OBSERVE ILLUSTRATIONS GIVEN BELOW..

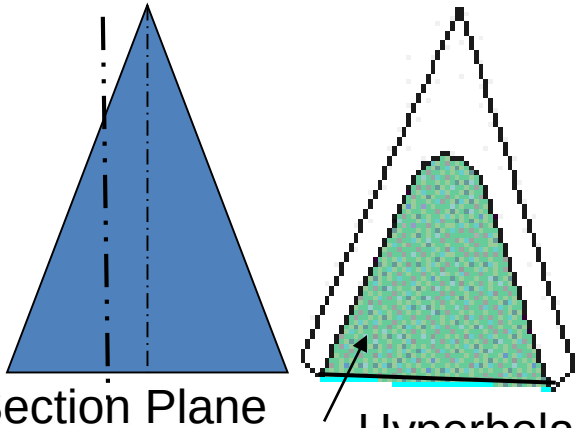


Ellipse

Section Plane Through Generators



Section Plane Parallel to end generator.



Section Plane Parallel to Axis.

Hyperbola

COMMON DEFINATION OF ELLIPSE, PARABOLA & HYPERBOLA:

These are the loci of points moving in a plane such that the ratio of it's distances from a *fixed point* And a *fixed line* always remains constant.
The Ratio is called ECCENTRICITY. (E)

A) For Ellipse E<1
B) For Parabola E=1
C) For Hyperbola E>1

Refer Problem nos. 6. 9 & 12

SECOND DEFINATION OF AN ELLIPSE:-

It is a locus of a point moving in a plane
such that the SUM of it's distances from TWO fixed points
always remains constant.
{And this *sum equals* to the length of *major axis*.}
These TWO fixed points are FOCUS 1 & FOCUS 2

Refer Problem no.4
Ellipse by Arcs of Circles Method.

ELLIPSE

BY CONCENTRIC CIRCLE METHOD

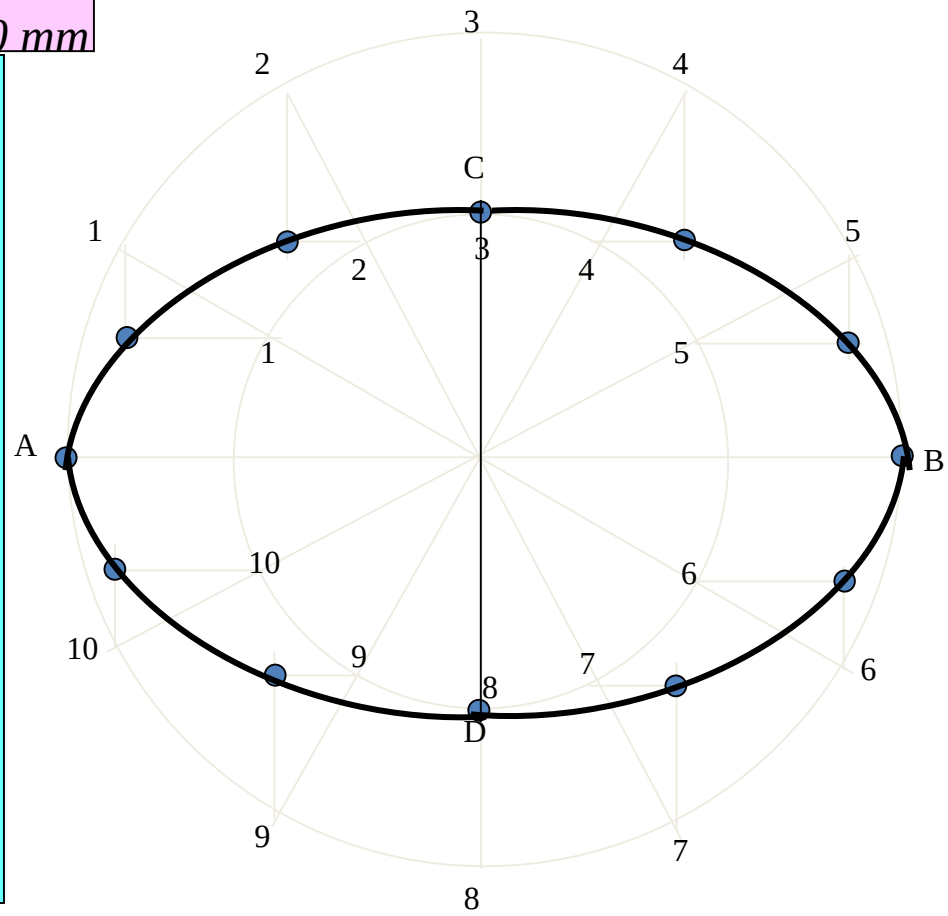
Problem 1 :-

Draw ellipse by concentric circle method.

Take major axis 100 mm and minor axis 80 mm long.

Steps:

1. Draw both axes as perpendicular bisectors of each other & name their ends as shown.
2. Taking their intersecting point as a center, draw two concentric circles considering both as respective diameters.
3. Divide both circles in 12 equal parts & name as shown.
4. From all points of outer circle draw vertical lines downwards and upwards respectively.
5. From all points of inner circle draw horizontal lines to intersect those vertical lines.
6. Mark all intersecting points properly as those are the points on ellipse.
7. Join all these points along with the ends of both axes in smooth possible curve. It is required ellipse.



ELLIPSE

BY RECTANGLE METHOD

Steps:

1 Draw a rectangle taking major and minor axes as sides.

2. In this rectangle draw both axes as perpendicular bisectors of each other..

3. For construction, select upper left part of rectangle. Divide vertical small side and horizontal long side into same number of equal parts.(here divided in four parts)

4. Name those as shown..

5. Now join all vertical points 1,2,3,4, to the upper end of minor axis. And all horizontal points i.e.1,2,3,4 to the lower end of minor axis.

6. Then extend C-1 line upto D-1 and mark that point. Similarly extend C-2, C-3, C-4 lines up to D-2, D-3, & D-4 lines.

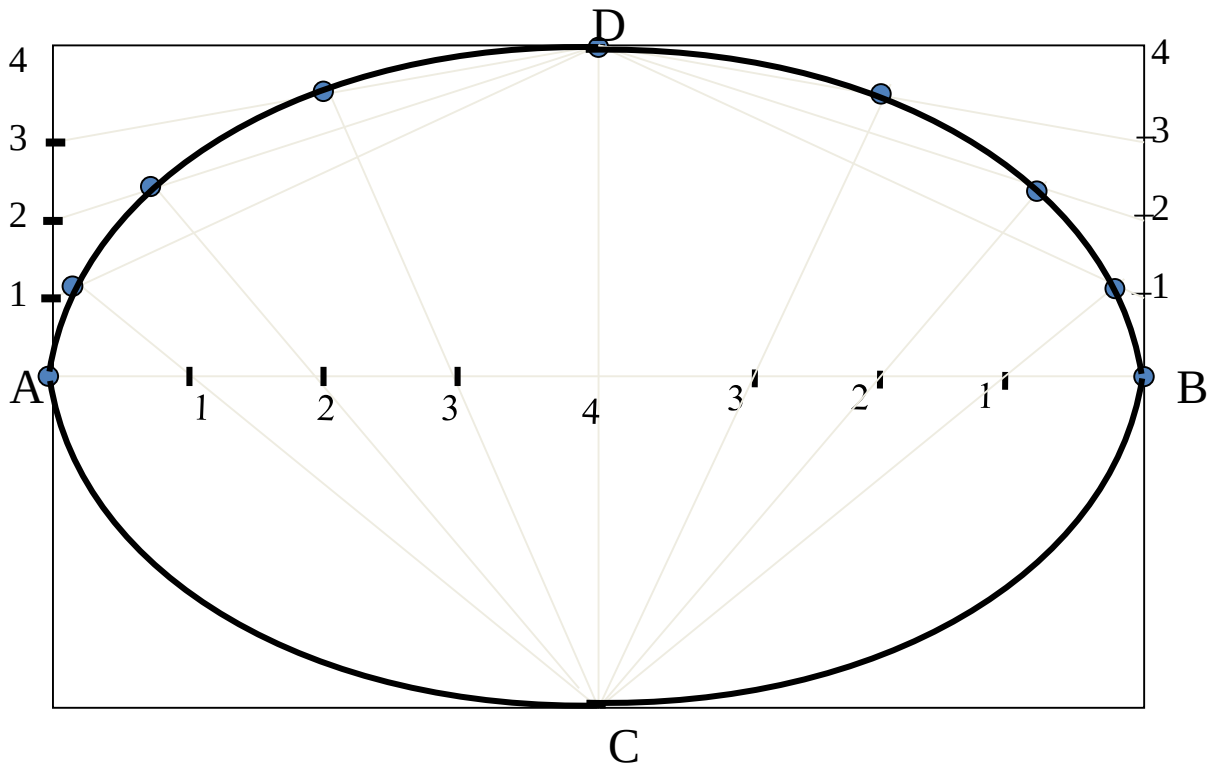
7. Mark all these points properly and join all along with ends A and D in smooth possible curve. Do similar construction in right side part.along with lower half of the rectangle.Join all points in smooth curve.

It is required ellipse.

Problem 2

Draw ellipse by Rectangle *method.*

Take major axis 100 mm and minor axis 70 mm long.

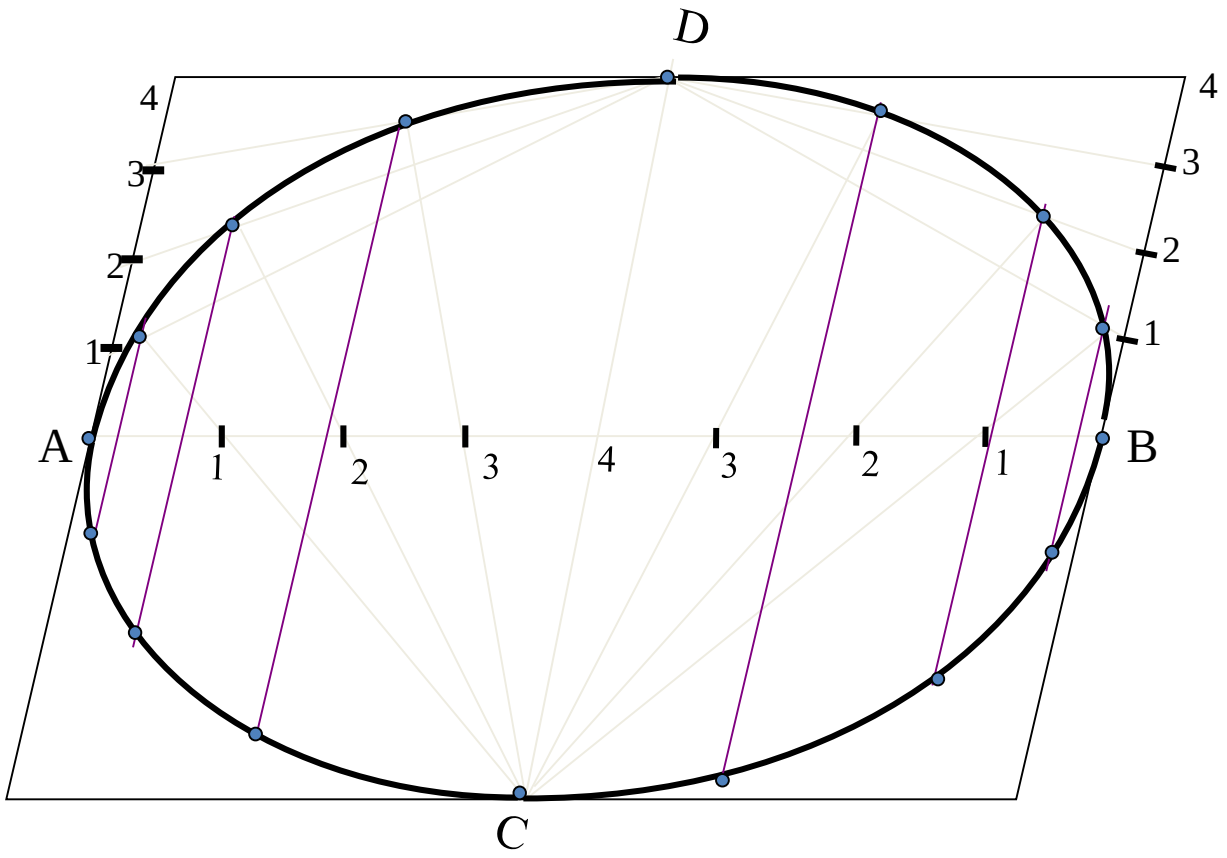


Problem 3:-

Draw ellipse by Oblong method.

Draw a parallelogram of 100 mm and 70 mm long sides with included angle of 75^0. Inscribe

STEPS ARE SIMILAR TO
THE PREVIOUS CASE
(RECTANGLE METHOD)
ONLY IN PLACE OF RECTANGLE,
HERE IS A PARALLELOGRAM.



ELLIPSE

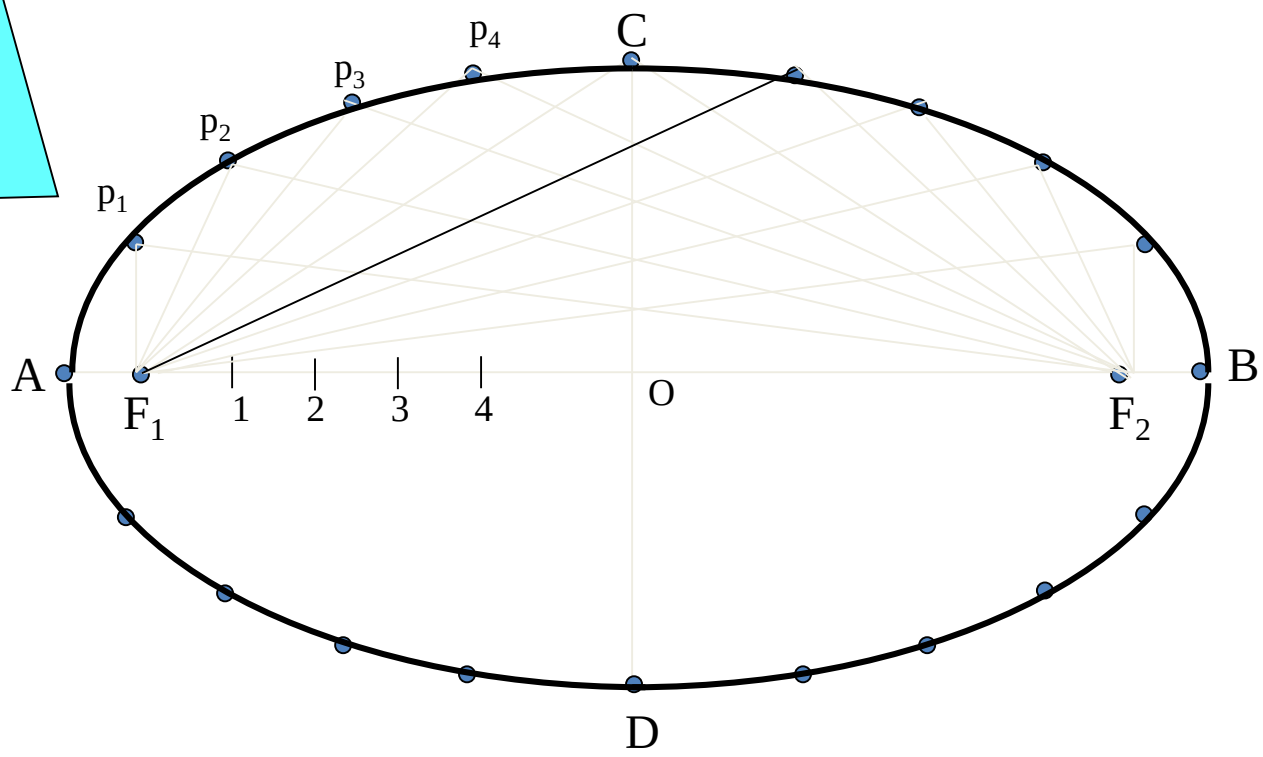
BY ARCS OF CIRCLE METHOD

PROBLEM 4.
MAJOR AXIS AB & MINOR AXIS CD ARE 100 AMD 70MM LONG RESPECTIVELY .DRAW ELLIPSE BY ARCS OF CIRLES METHOD.

As per the definition Ellipse is locus of point P moving in a plane such that the SUM of it's distances from two fixed points (F_1 & F_2) remains constant and equals to the length of major axis AB.(Note A .1+ B .1=A . 2 + B. 2 = AB)

STEPS:

1. Draw both axes as usual.Name the ends & intersecting point
2. Taking AO distance I.e.half major axis, from C, mark F_1 & F_2 On AB . (focus 1 and 2.)
3. On line F_1- O taking any distance, mark points 1,2,3, & 4
4. Taking F_1 center, with distance A-1 draw an arc above AB and taking F_2 center, with B-1 distance cut this arc. Name the point p_1
5. Repeat this step with same centers but taking now A-2 & B-2 distances for drawing arcs. Name the point p_2
6. Similarly get all other P points. With same steps positions of P can be located below AB.
7. Join all points by smooth curve to get an ellipse/



PROBLEM 6:- POINT F IS 50 MM FROM A LINE AB.A POINT P IS MOVING IN A PLANE SUCH THAT THE *RATIO* OF IT'S DISTANCES FROM F AND LINE AB REMAINS CONSTANT AND EQUALS TO 2/3 DRAW LOCUS OF POINT P. { ECCENTRICITY = 2/3 }

ELLIPSE

DIRECTRIX-FOCUS METHOD

STEPS:

1 .Draw a vertical line AB and point F 50 mm from it.

2 .Divide 50 mm distance in 5 parts.

3 .Name 2nd part from F as V. It is 20mm and 30mm from F and AB line resp. It is first point giving ratio of it's distances from F and AB 2/3 i.e 20/30

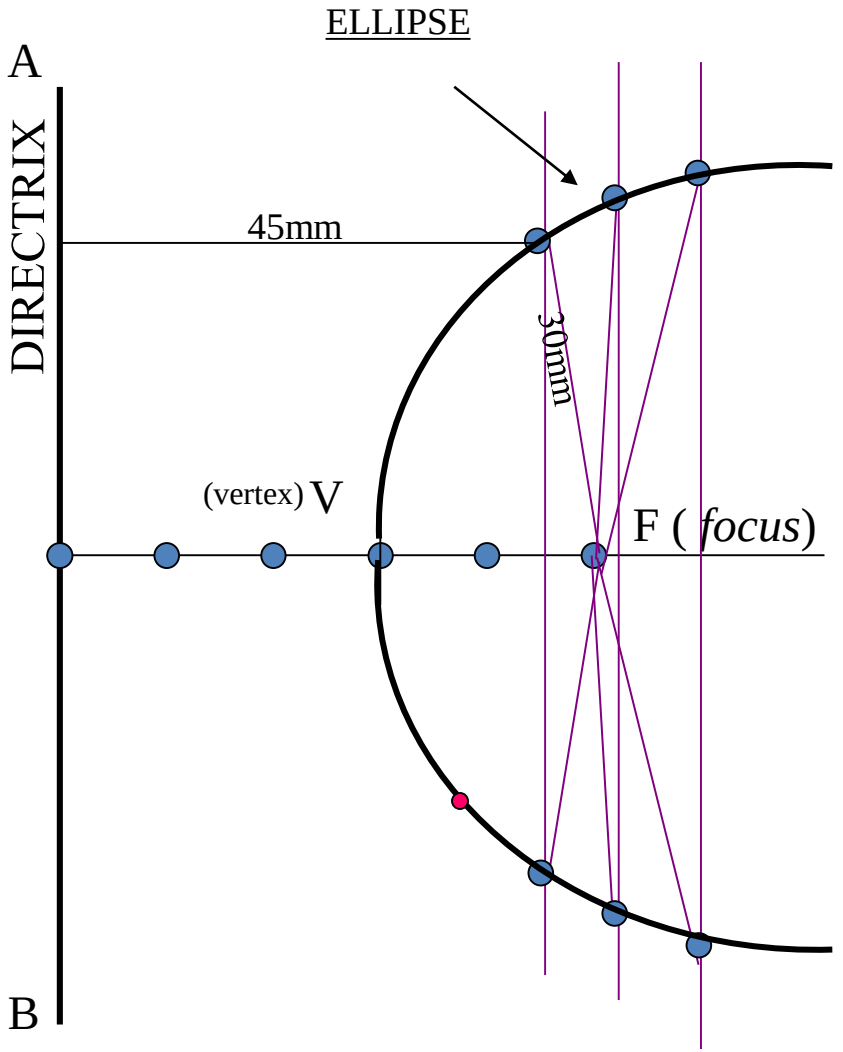
4 Form more points giving same ratio such as 30/45, 40/60, 50/75 etc.

5.Taking 45,60 and 75mm distances from line AB, draw three vertical lines to the right side of it.

6. Now with 30, 40 and 50mm distances in compass cut these lines above and below, with F as center.

7. Join these points through V in smooth curve.

This is required locus of P.It is an ELLIPSE.



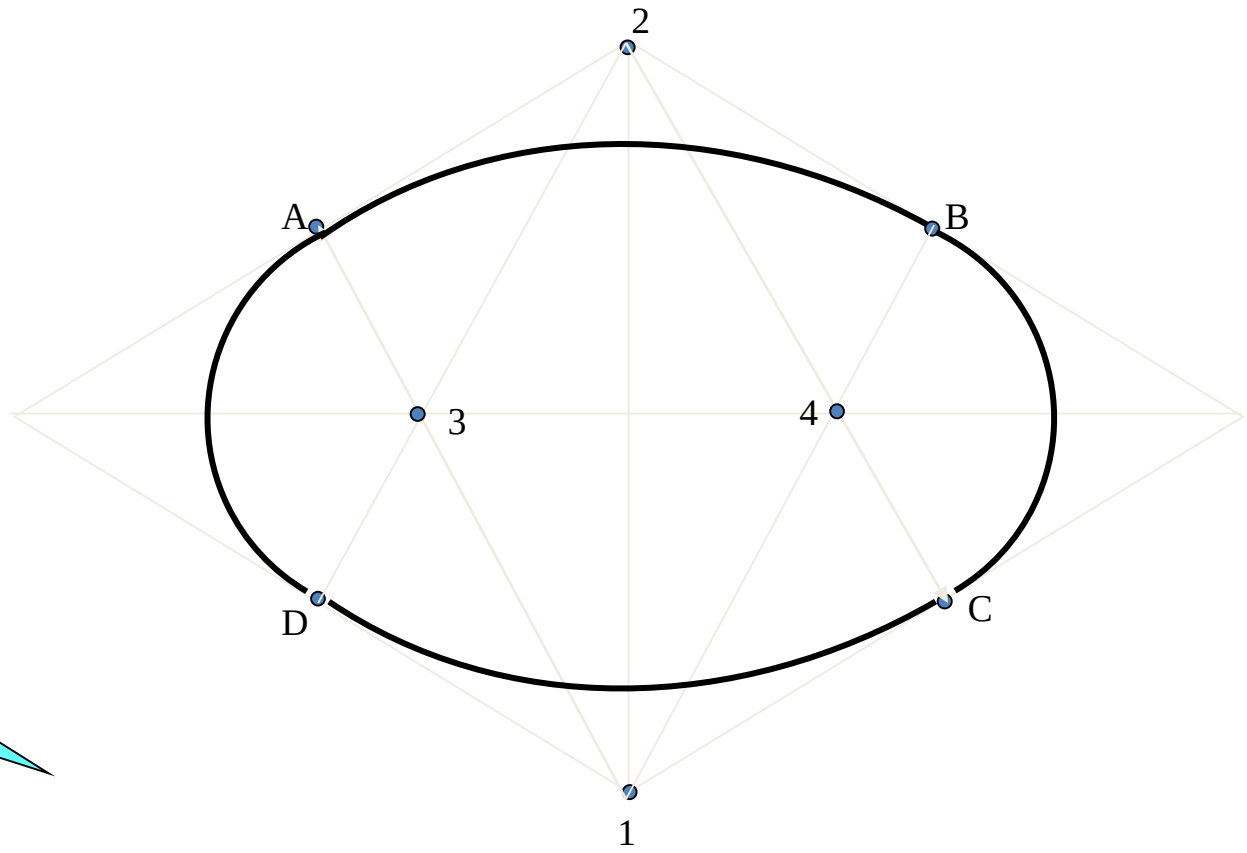
PROBLEM 5.
DRAW RHOMBUS OF 100 MM & 70 MM LONG DIAGONALS AND INSCRIBE AN ELLIPSE IN IT.

ELLIPSE

BY RHOMBUS METHOD

STEPS:

1. Draw rhombus of given dimensions.
2. Mark mid points of all sides & name Those A,B,C,& D
3. Join these points to the ends of smaller diagonals.
4. Mark points 1,2,3,4 as four centers.
5. Taking 1 as center and 1-A radius draw an arc AB.
6. Take 2 as center draw an arc CD.
7. Similarly taking 3 & 4 as centers and 3-D radius draw arcs DA & BC.

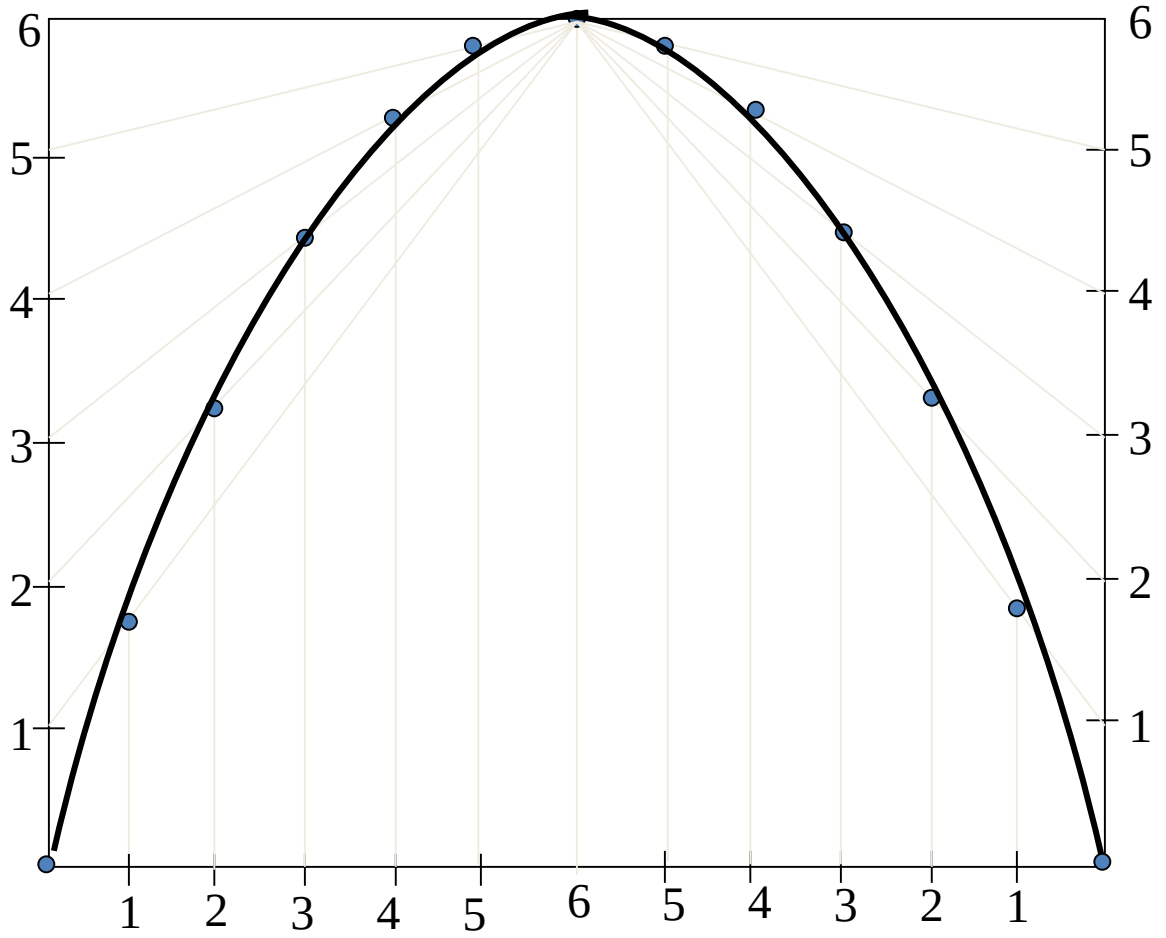


PARABOLA
RECTANGLE METHOD

PROBLEM 7: A BALL THROWN IN AIR ATTAINS 100 M HIEGHT AND COVERS HORIZONTAL DISTANCE 150 M ON GROUND. Draw the path of the ball (projectile)-

STEPS:

1. Draw rectangle of above size and divide it in two equal vertical parts
2. Consider left part for construction. Divide height and length in equal number of parts and name those 1,2,3,4,5& 6
3. Join vertical 1,2,3,4,5 & 6 to the top center of rectangle
4. Similarly draw upward vertical lines from horizontal1,2,3,4,5 And wherever these lines intersect previously drawn inclined lines in sequence Mark those points and further join in smooth possible curve.
5. Repeat the construction on right side rectangle also.Join all in sequence. This locus is Parabola.

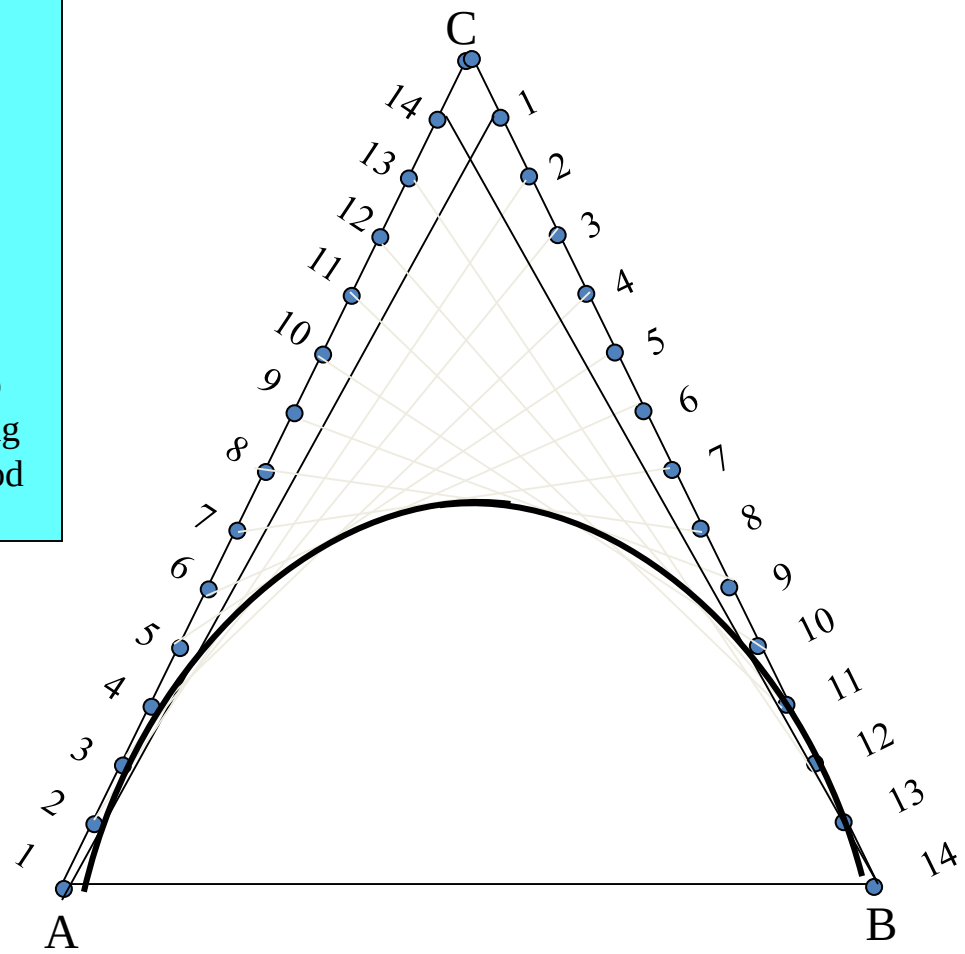


PARABOLA
METHOD OF TANGENTS

Problem no.8: Draw an isosceles triangle of 100 mm long base and 110 mm long altitude.Inscribe a parabola in it by method of tangents.

Solution Steps:

1. Construct triangle as per the given dimensions.
2. Divide it's both sides in to same no.of equal parts.
3. Name the parts in ascending and descending manner, as shown.
4. Join 1-1, 2-2,3-3 and so on.
5. Draw the curve as shown i.e.tangent to all these lines. The above all lines being tangents to the curve, it is called method of tangents.

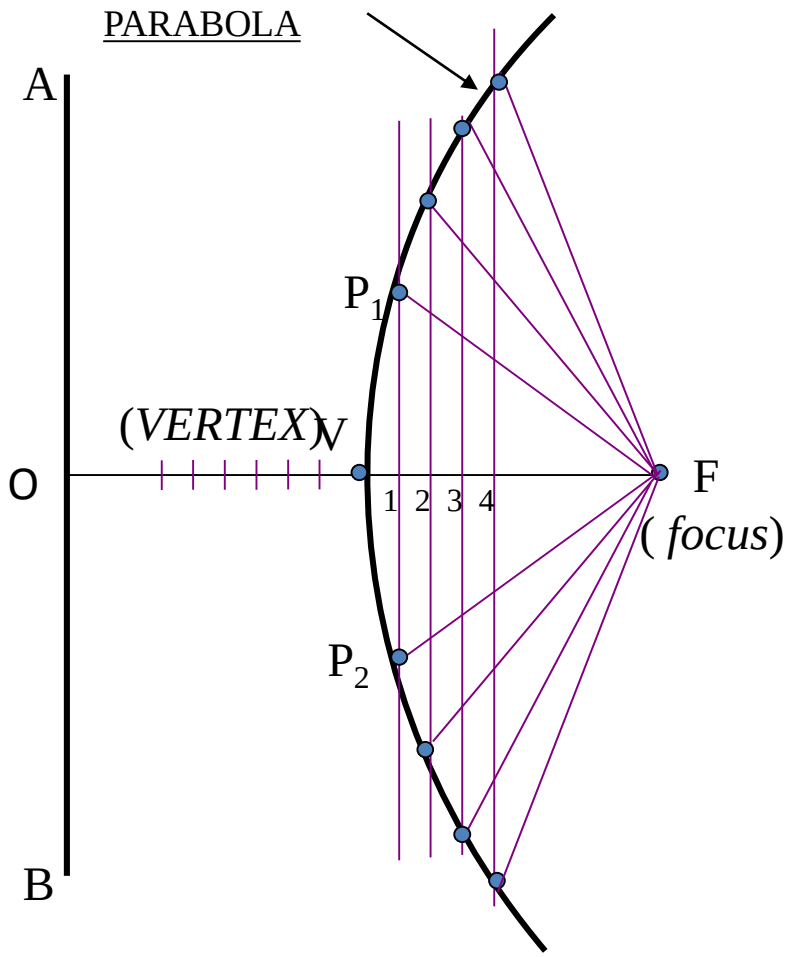


PARABOLA
DIRECTRIX-FOCUS METHOD

PROBLEM 9: Point F is 50 mm from a vertical straight line AB. Draw locus of point P, moving in a plane such that it always remains equidistant from point F and line AB.

SOLUTION STEPS:

1. Locate center of line, perpendicular to AB from point F. This will be initial point P and also the vertex.
2. Mark 5 mm distance to its right side, name those points 1,2,3,4 and from those draw lines parallel to AB.
3. Mark 5 mm distance to its left of P and name it 1.
4. Take O-1 distance as radius and F as center draw an arc cutting first parallel line to AB. Name upper point P_1 and lower point P_2. (FP_1=O1)
5. Similarly repeat this process by taking again 5mm to right and left and locate P_3P_4.
6. Join all these points in smooth curve.



It will be the locus of P equidistance from line AB and fixed point F.

PROBLEM 12:- POINT F IS 50 MM FROM A LINE AB.A POINT P IS MOVING IN A PLANE SUCH THAT THE *RATIO* OF IT'S DISTANCES FROM F AND LINE AB REMAINS CONSTANT AND EQUALS TO 2/3 DRAW LOCUS OF POINT P. { ECCENTRICITY = 2/3 }

HYPERBOLA DIRECTRIX FOCUS METHOD

STEPS:

1 .Draw a vertical line AB and point F 50 mm from it.

2 .Divide 50 mm distance in 5 parts.

3 .Name 2nd part from F as V. It is 20mm and 30mm from F and AB line resp. It is first point giving ratio of it's distances from F and AB 2/3 i.e 20/30

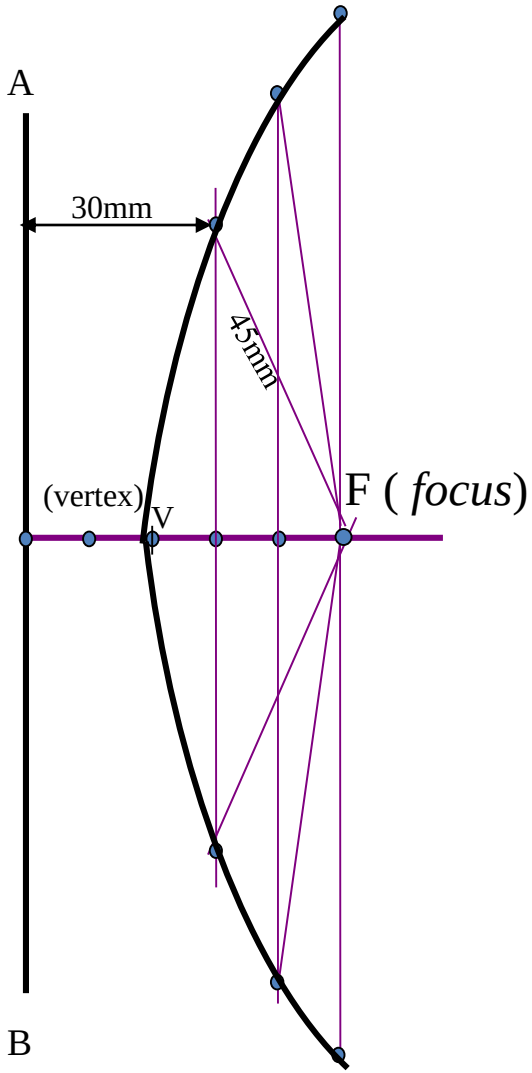
4 Form more points giving same ratio such as 30/45, 40/60, 50/75 etc.

5.Taking 45,60 and 75mm distances from line AB, draw three vertical lines to the right side of it.

6. Now with 30, 40 and 50mm distances in compass cut these lines above and below, with F as center.

7. Join these points through V in smooth curve.

This is required locus of P.It is an ELLIPSE.



ENGINEERING CURVES

Part-II

(Point undergoing two types of displacements)

INVOLUTE	CYCLOID	SPIRAL	HELIX
1. Involute of a circle a)String Length = πD b)String Length > πD c)String Length < πD 2. Pole having Composite shape. 3. Rod Rolling over a Semicircular Pole.	1. General Cycloid 2. Trochoid (superior) 3. Trochoid (Inferior) 4. Epi-Cycloid 5. Hypo-Cycloid	1. Spiral of One Convolution. 2. Spiral of Two Convolutions.	1. On Cylinder 2. On a Cone

AND

Methods of Drawing Tangents & Normals To These Curves.

DEFINITIONS

CYCLOID:

IT IS A LOCUS OF A POINT ON THE PERIPHERY OF A CIRCLE WHICH ROLLS ON A STRAIGHT LINE PATH.

SUPERIORTROCHOID:
IF THE POINT IN THE DEFINATION OF CYCLOID IS OUTSIDE THE CIRCLE

INFERIOR TROCHOID.:
IF IT IS INSIDE THE CIRCLE

EPI-CYCLOID
IF THE CIRCLE IS ROLLING ON ANOTHER CIRCLE FROM OUTSIDE

HYPO-CYCLOID.
IF THE CIRCLE IS ROLLING FROM INSIDE THE OTHER CIRCLE,

INVOLUTE:

IT IS A LOCUS OF A FREE END OF A STRING WHEN IT IS WOUND ROUND A CIRCULAR POLE

SPIRAL:

IT IS A CURVE GENERATED BY A POINT WHICH REVOLVES AROUND A FIXED POINT AND AT THE SAME MOVES TOWARDS IT.

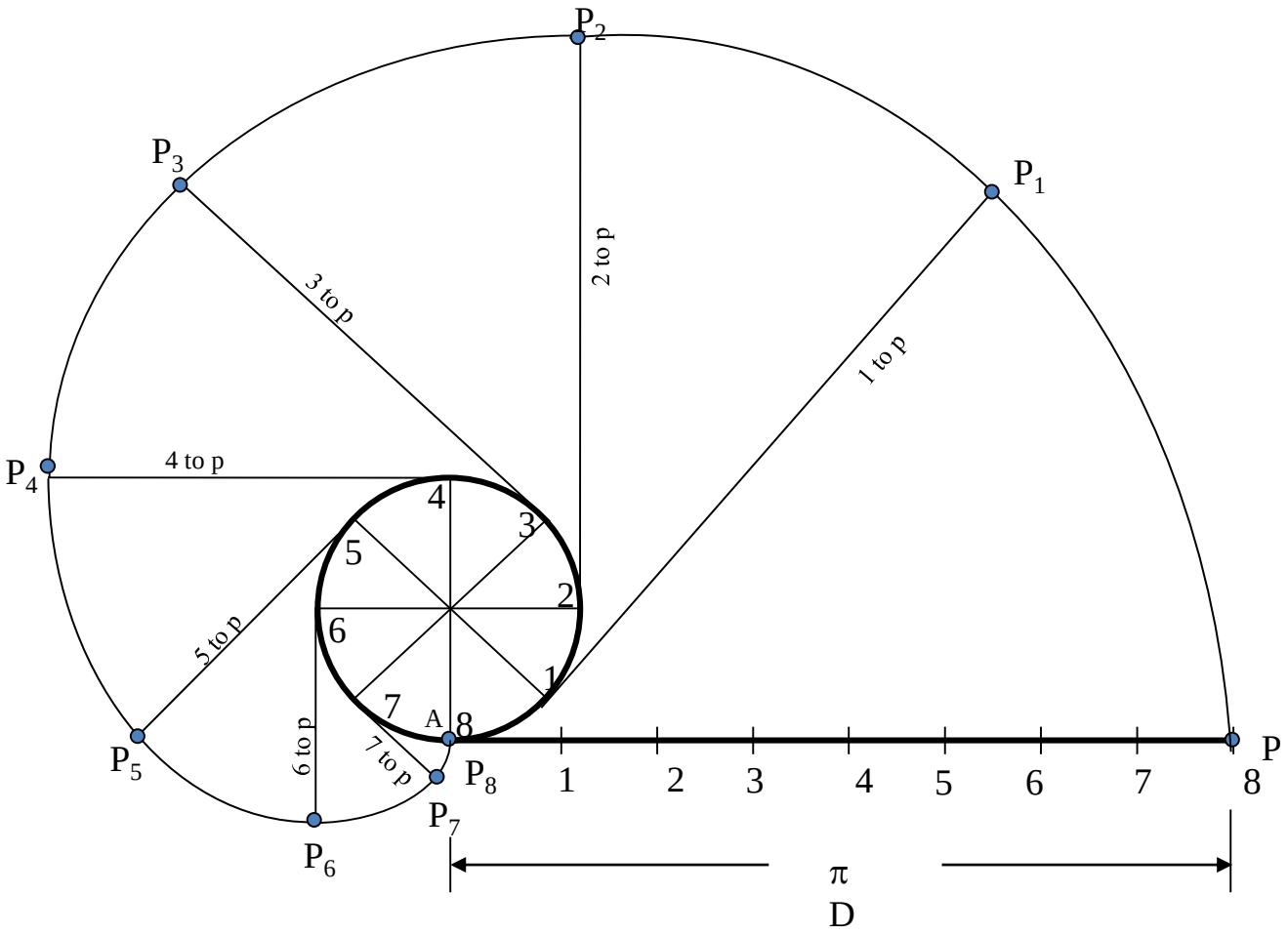
HELIX:

IT IS A CURVE GENERATED BY A POINT WHICH MOVES AROUND THE SURFACE OF A RIGHT CIRCULAR CYLINDER / CONE AND AT THE SAME TIME ADVANCES IN AXIAL DIRECTION AT A SPEED BEARING A CONSTANT RATIO TO THE SPPED OF ROTATION.

Problem no 17: Draw Involute of a circle.
String length is equal to the circumference of circle.

Solution Steps:

1) Point or end P of string AP is exactly πD distance away from A. Means if this string is wound round the circle, it will completely cover given circle. B will meet A after winding.
2) Divide πD (AP) distance into 8 number of equal parts.
3) Divide circle also into 8 number of equal parts.
4) Name after A, 1, 2, 3, 4, etc. up to 8 on πD line AP as well as on circle (in anticlockwise direction).
5) To radius C-1, C-2, C-3 up to C-8 draw tangents (from 1,2,3,4,etc to circle).
6) Take distance 1 to P in compass and mark it on tangent from point 1 on circle (means one division less than distance AP).
7) Name this point P1
8) Take 2-B distance in compass and mark it on the tangent from point 2. Name it point P2.
9) Similarly take 3 to P, 4 to P, 5 to P up to 7 to P distance in compass and mark on respective tangents and locate P3, P4, P5 up to P8 (i.e. A) points and join them in smooth curve it is an INVOLUTE of a given circle.



PROBLEM 20 : A POLE IS OF A SHAPE OF HALF HEXABON AND SEMICIRCLE. ASTRING IS TO BE WOUND HAVING LENGTH EQUAL TO THE POLE PERIMETER DRAW PATH OF FREE END *P* OF STRING WHEN WOUND COMPLETELY.

(Take hex 30 mm sides and semicircle of 60 mm diameter.)

INVOLUTE
OF
COMPOSIT SHAPED POLE

SOLUTION STEPS:

Draw pole shape as per dimensions.
Divide semicircle in 4 parts and name those along with corners of hexagon.
Calculate perimeter length.
Show it as string AP.
On this line mark 30mm from A
Mark and name it 1
Mark πD/2 distance on it from 1
And dividing it in 4 parts name 2,3,4,5.
Mark point 6 on line 30 mm from 5
Now draw tangents from all points of pole
and proper lengths as done in all previous involute's problems and complete the curve.