3rd Term SS1 Technical Drawing Notes
Week One Topic: Special Curves
Sub-Topic: Construction of Involute and Archimedean Spiral

Definition of the Locus of a Point: The locus of a point is the pattern or line produced, when the different locations of a moving point are joined together from its starting location to the last location. Locus of a point is used in different fields such as in mathematics, physics and chemistry to plot graphs; or, in engineering such as in fluid mechanics, thermodynamics, and machine design to analyze a selected system meant to be studied.

In Technical drawing, we will use it develop certain models or tools or the things that engineers use to produce machine parts or to analyze the machine part. Examples of some of the things we would be developing are involute, Archimedean spiral, parabola, hyperbola, ellipse, etc; and we shall state the uses of each of these things we will construct.

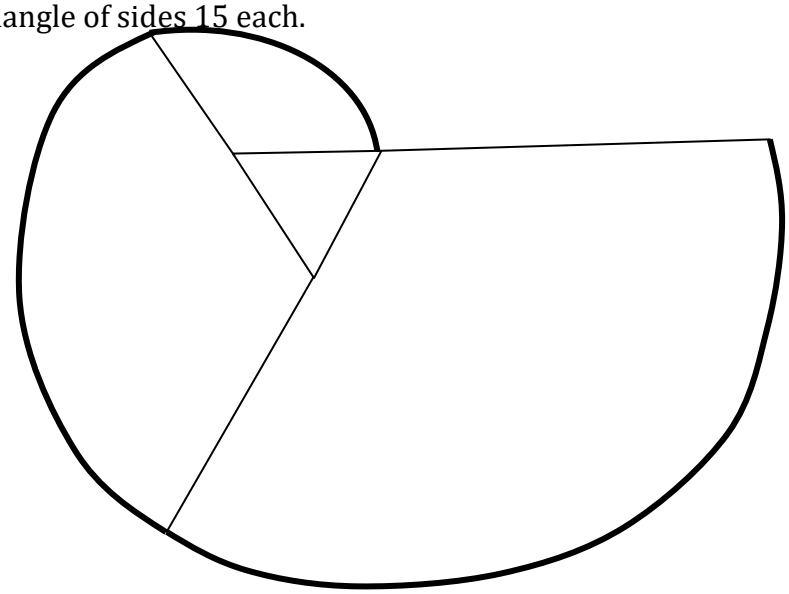
The Involute: An involute is the line that is produced, when points, traced round a polygon are joined so that the resulting line is assumed not to slip along the polygon. Rather using than polygons, circles, triangles and squares are used to achieve that. The teacher will guide the student to master how to construct an involute by using the sample methods given below.

1. An Involute by Triangle method: An equilateral triangle is the only recommended one to be used. A sample is shown below.

Sample Problem

Construct an involute by using a triangle of sides 15 each.

Solution

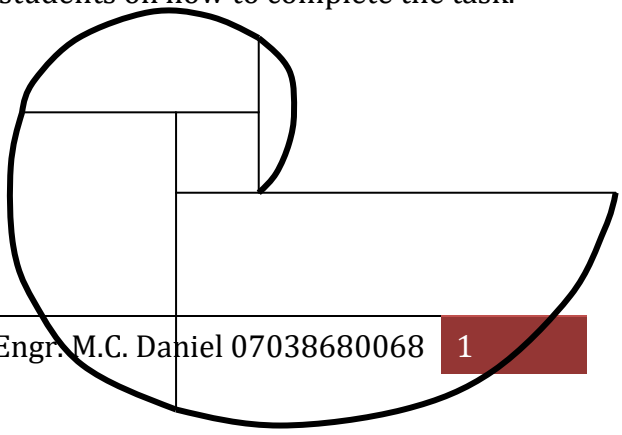


2. Involute by Square method: The teacher will guide the students on how to complete the task.

Sample problem

Construct an involute by using a square of sides 20 each.

Solution

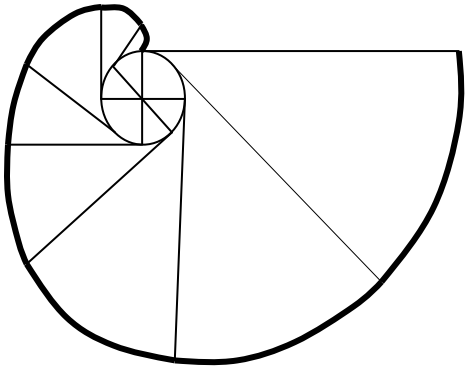


3. Involute by circle method: The teacher will guide the students on how to complete the task.

Sample problem

Construct an involute by using a circle of radius 15.

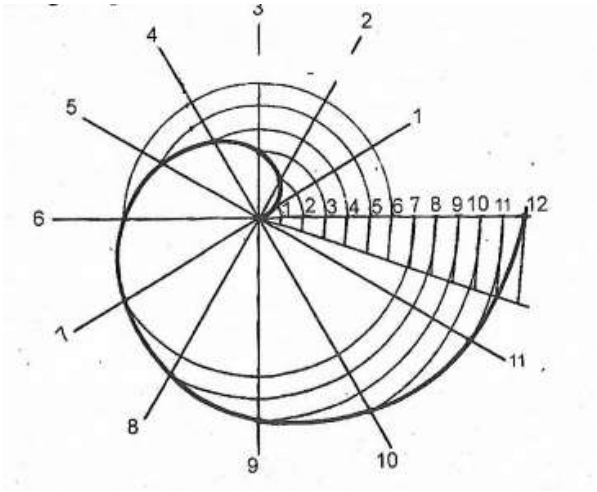
olution



4. Construction of an Archimedean Spiral: The teacher will guide the students on how to complete the task.

Sample problem

Construct an involute by using two circles of radii 5 and 30.



Assignment

1. Construct an involute by using
(a) a circle or radius 15,
(b) a square of sides 25 each, and
(c) a triangle of sides 20 each.
2. Construct an Archimedean spiral by using circles of radii 5 and 30.

<u>Week Two Topic: Special Curves</u>
<u>Sub-Topic: Construction of Parabola and Hyperbola</u>

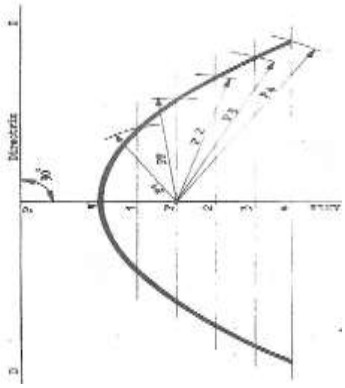
Parabola: This is the locus of a point which moves so that its distance from s fixed point, the **focus**, and a fixed straight line, the **directrix**, are equal. Parabola plays a better role in the design of car headlamps. The distance between one ends of the open mouth of the parabola through its center to the other end of the mouth is called **wide or span.** While the distance from the wide mouth to the deep, curved **vertex** is called the **rise or height**. The **eccentricity** of a parabola is always 1, because it is found by dividing the distance from the fixed straight line at the back of the parabola called directrix to the moving point; with the distance from the moving point to the focus, located just in front of the vertex.

A. In this section, the teacher will guide the students on how to construct a parabola by using two methods only, namely, the **locus method** and the **circumscribing rectangular method.**

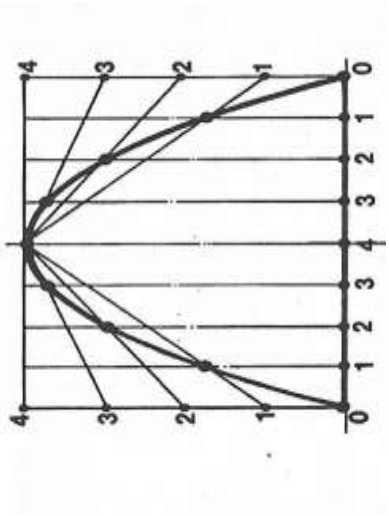
1. The Locus Method:

Sample Problem.
Construct a parabola, whose directrix is 20 from the vertex.

2. The Circumscribing Rectangular method:
Sample problem
Construct a parabola whose rise is 60 and its span or wide is 100.



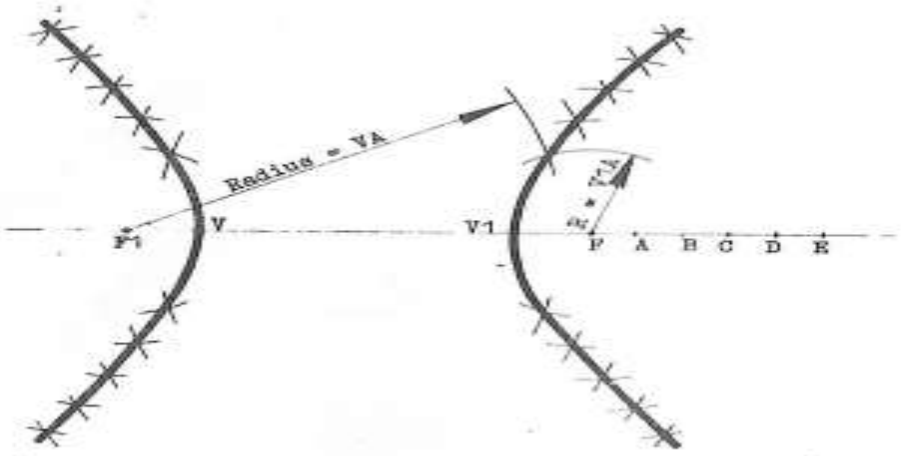
Locus method



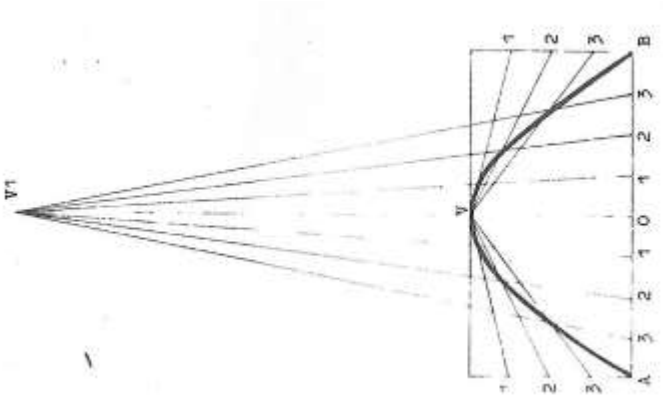
Rectangular method

B. In this section, the teacher will guide the students on how to construct a hyperbola by using two methods only, namely, the **locus method** and by **rectangular method**

1. **Locus method:** The teacher will guide the student on how to construct the hyperbola shown below by using the locus point method.



2. **Rectangular method:** The teacher will guide the student on how to construct the hyperbola shown below by using the rectangular method.



Week Three Topic: Development
Sub-Topic: Meaning. Applications of development. Methods of development.

Meaning/Definition: Development is the use of construction to draw on a plain sheet or a flat surface, the pattern of an object that is to be produced, so that, when the sheet is folded along some of the lines drawn, the object results.

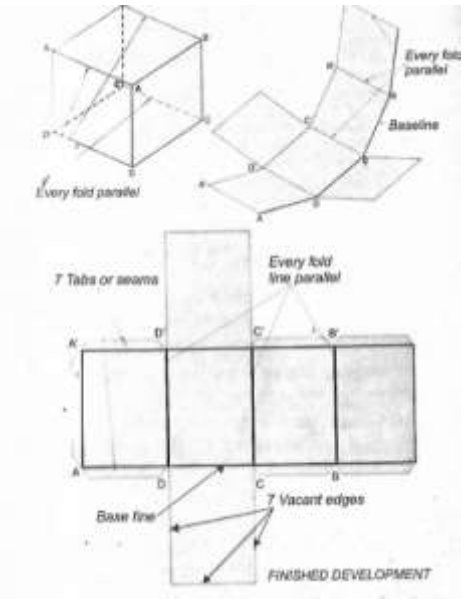
Applications of Development

Many things we use today in our homes, offices and in the industry are made from the principles of development; hence, the name, development; because it is used to develop many items. Some examples of items that are produced through development are bucket, tray, cup, carton, football, cone, cylinders, prisms, pyramids, etc.

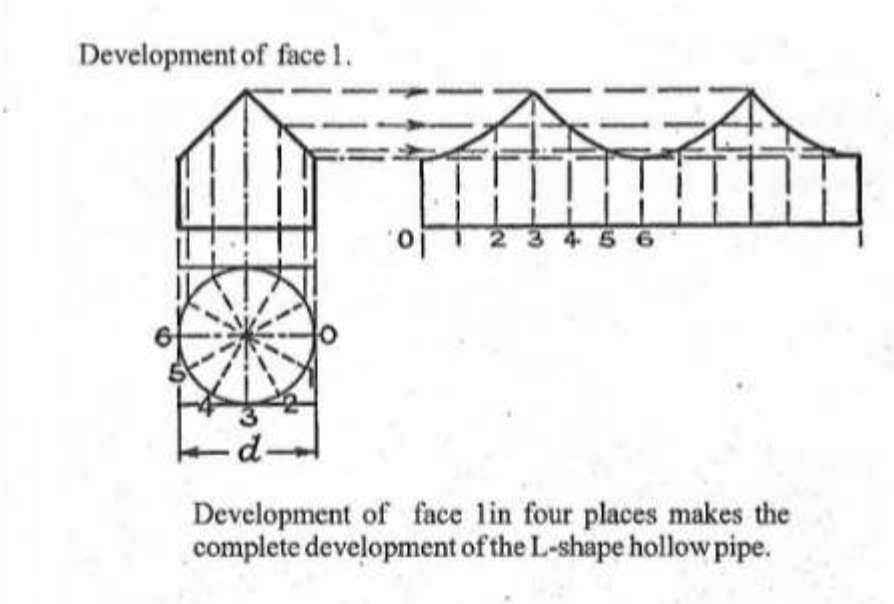
Methods of Development

There are three main methods that are used to develop objects. These are **triangulation methods, parallel lines method,** and **radial lines method.** Because of the complexity that goes with the triangulation method, we are therefore constrained to learn only two methods namely, parallel lines and radial lines methods.

Week Four Topic: Development
Sub-Topic: Development of prisms and cylinders.



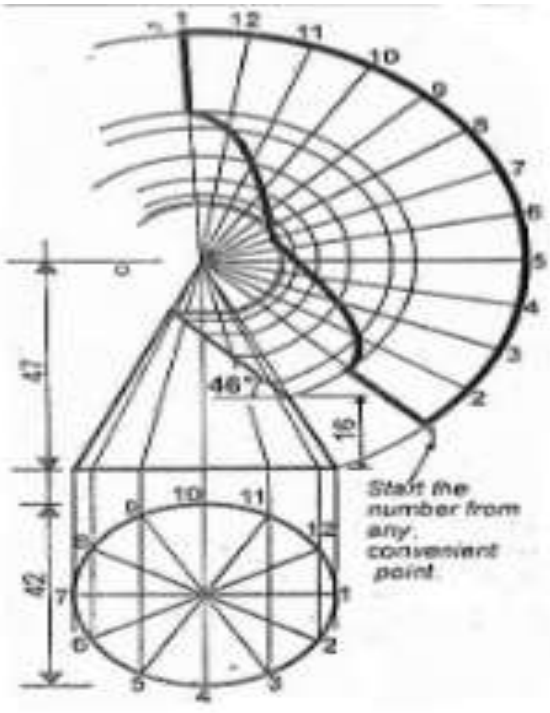
Parallel Lines Method: In this method, that is used to develop all kinds of objects that have vertical sides such as prisms, cylinders and things like that. The lines that are used to develop these kinds of objects are projected at 90^0 to the surface of the object to be developed. The following examples illustrate the use of parallel line method to develop objects.

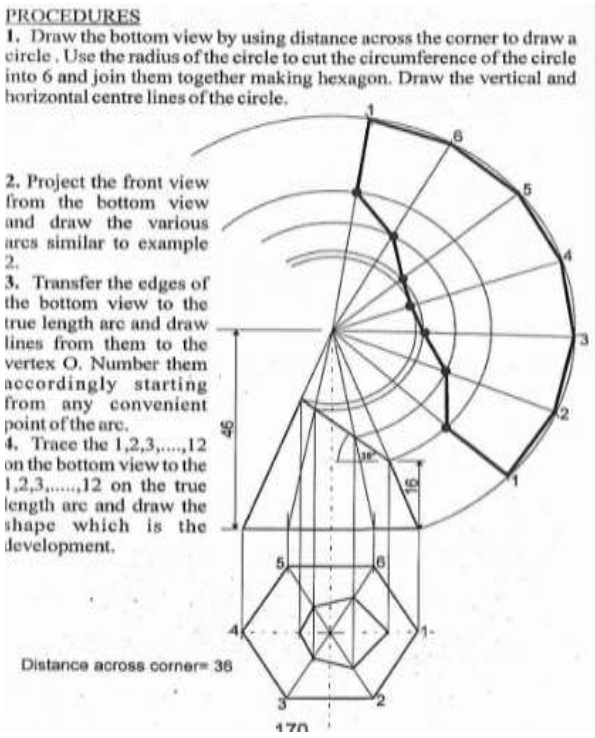


Development of face 1in four places makes the complete development of the L-shape hollow pipe.

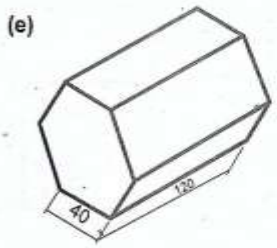
Week Five Topic: Development
Sub-Topic: Development of cone and pyramids.

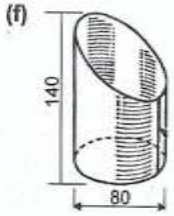
Radial lines method: In this method, the lines are spread away from a fixed point. The objects that are developed by this method include such things as cone, pyramids and others that resemble them. The diagram below gives an example of radial lines method of developing solid objects.

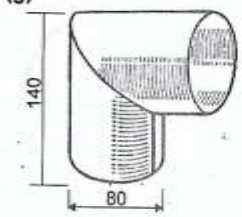


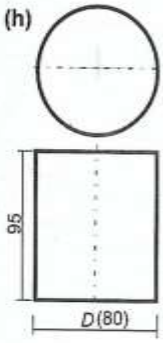


Week Six Topic: Dimensioning
Sub-Topic: Dimensioning.









UNIT 16
DIMENSIONING TECHNIQUES

16.1 Introduction

Dimensioning is very important when a technical drawing is made. Technical drawing is defined as a language and as such, it must be presented with dimension so that it can be easily read and found, and to avoid misunderstanding. Dimension provides information such as sizes and locations of features, material's type, number required, kind of surface finish, manufacturing process, size and geometric tolerances Dimensioning should be very *neat*, *accurate* and not subject to *misinterpretation*. Technical drawings are usually dimensioned in ***millimeters*** unless otherwise stated.

16.2 Practical objectives

At the end of this unit, the students should be able to:

1. define dimensioning.
2. list two types of dimensioning and three systems of dimensioning.
3. dimension ISO screw thread.
4. distinguish between aligned and unidirectional method of dimensioning.
5. dimension figures correctly.

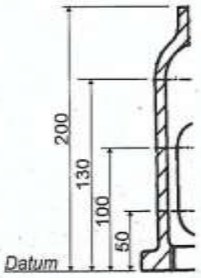
16.3 Definition of dimensioning

Dimensioning is the means of specifying part's information with the use of figures, notes and symbols.

Types of Dimensioning

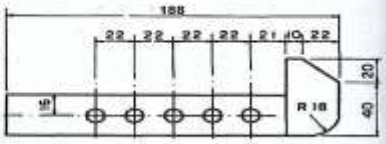
i. Datum dimensioning.

This is the method of dimensioning in which each size is measured separately from one edge. This method has **advantage** of overcoming errors due to addition of two or more small sizes when trying to get the overall dimension since each is measured or dimensioned separately from a particular edge.



ii. Chain dimensioning

This is the method of dimensioning in which each size is measured or dimensioned from one another in the form of chain. This method has **advantage** of easy to read and it does not consume or waste much space unlike the **datum dimensioning**.



16-4 Dimensioning ISO screw threads

Both internal and external threads are shown conventionally on engineering drawing, they must be designated completely by dimensions or a note. The most commonly used thread is the ISO metric thread designated as in the following example;

M16 X 1.5 – 6H *internal thread*
M6 X 0.75 – 6g *external thread*
M – *Thread system symbol for ISO metric*

ISO standing for International Organization for Standardization.

16 and 6 – *Nominal diameter in millimeters*
1.5 and 7.5 – *Pitch in millimeters*
6H and 6g – *Thread tolerance class symbol*

Dimensioning system

1. **Metric system :** ISO and JIS standards
Examples are : 24, 24.5, 24.55, 0.5 (.5 is not accepted).
2. **Fractional-inch system**

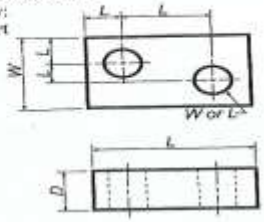
Examples are : $\frac{1}{4}$, $5\frac{3}{8}$, etc.

3. **Decimal-inch system**
Examples are : 0.15 (.15 is not accepted), 7.285, etc.

JIS standing for Japanese Industrial Standards

Designed part for manufacture

Manufacturing this part, we need to know:
1. Width, thickness and depth of the part
2. Diameter and depth of the hole
3. Location of the holes

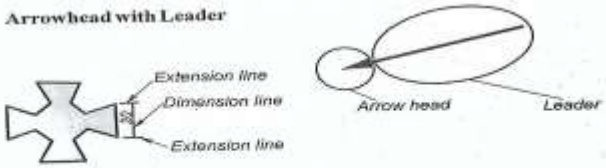


Examination question often asked for only five or six "important" dimensions to be inserted on the finished drawing.
The overall dimensions- length, depth and width – are obviously important but the function of the object dictates for the remaining two or three. Example, if the drawing is of a machine vice the size of the vice jaws should be dimensioned.

Arrowheads: Arrowheads are used to terminate dimension lines. The length of the arrowhead is about three times it width.

Leaders: leaders which touch lines should not normally do so at angle of less than 30°. In the British standard it is recommended that they should be nearly normal to the surface. They should not be parallel to adjacent dimension lines as confusion might arise.

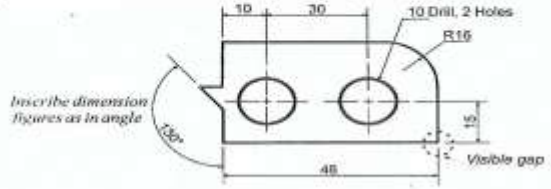
Arrowhead with Leader

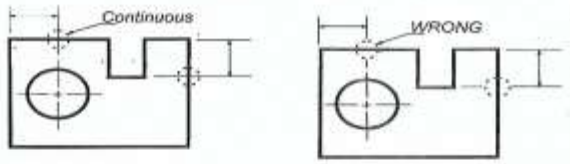


Dimensioning rules

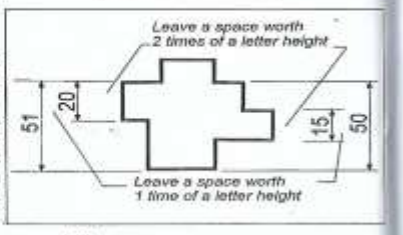
1. Lines

(a) Extension lines: Leave a visible gap of about1 mm from a view and start drawing an extension line. Extend the lines beyond the (last) dimension line 1-2 mm. Extension line should indicate the location on the object's features that are to be dimensioned.
Do not break the lines should they cross object lines.

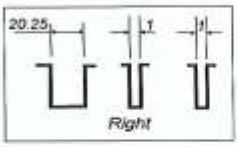


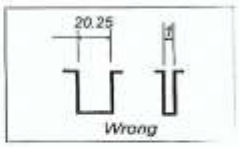


(b) Dimension lines and figures:
Dimension lines should show the direction and extent of a dimension. The height of figures is suggested to be about 3 mm. Place the numbers at about1 mm above dimension line and between extension lines.



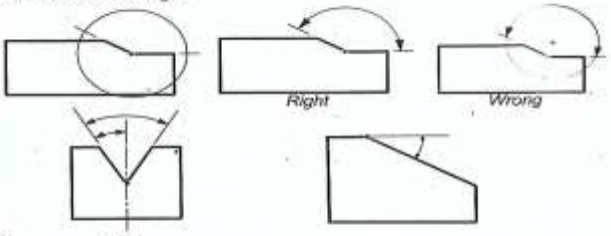
Dimension: Where there is no enough space for figures or arrows, such should be put outside either of the extension lines.





2. Angle

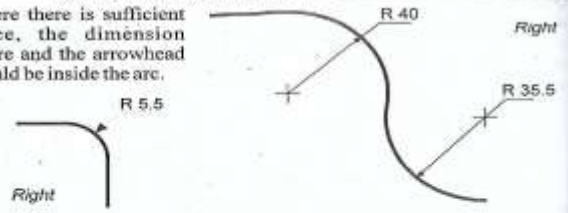
Dimensioning an angle, circular dimension line having the center at the vertex of the angle.



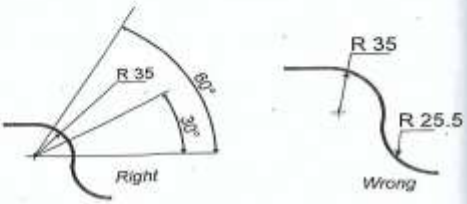
3. Arc

Arcs are dimensioned in the views in which their true shapes appear by giving the radius. The letter "R" is always written before the figures to show that the dimension is radius of an arc.

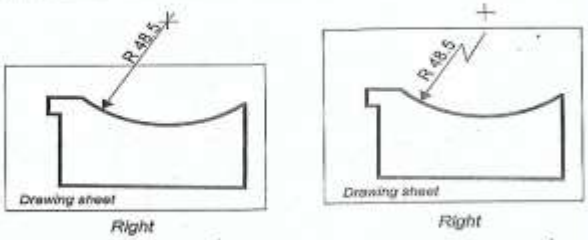
Where there is sufficient space, the dimension figure and the arrowhead should be inside the arc.



Leader line must be inclined with an angle between 30° and 60° to the horizontal.



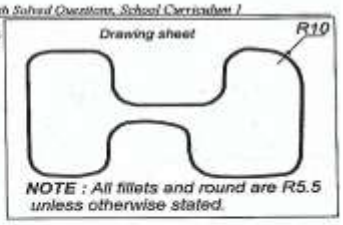
Foreshortened radial dimension line is used when arc's center locates outside the sheet or meet with other views.



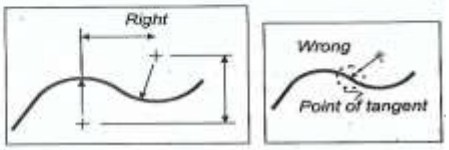
4. Fillets and rounds

The radius of a particular fillet given only by using a local note.

Example: Should all fillets and rounds are uniform in size, dimension may be omitted, but it is important to add the note " All fillets and rounds are Ryy."



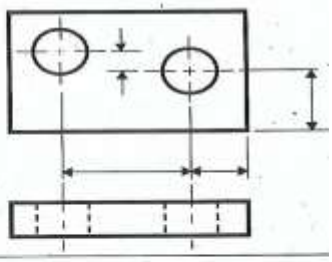
A curve constructed from two or more arcs, radii and center's location must be dimension.



5. Holes

The location dimension for a particular hole must be placed from its center lines and should be given in circular view.

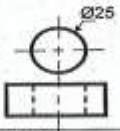
NOTE: Size dimensions of a hole are *diameter* and *depth*.



Through thickness hole

(a) Small size Hole

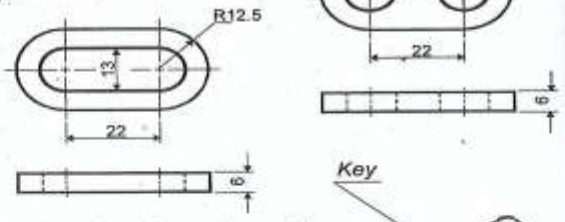
Use leader line and local note to specify diameter and hole's depth in the circular view.



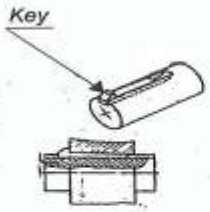
Also acceptable:
Ø25 Drill, Thru.
Ø25 Thru.
Ø25 Drill.

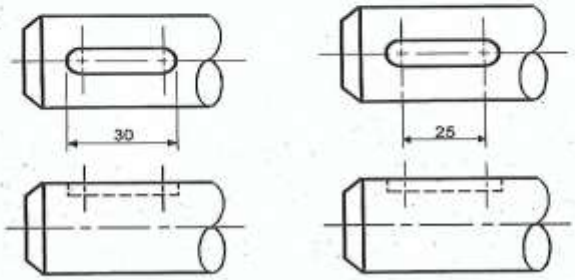
8. Rounded-end shapes

Rounded-end dimension is based on the manufacturing method used.

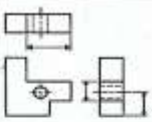
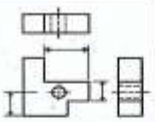
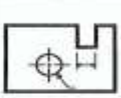
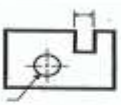
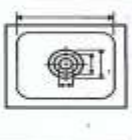
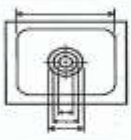
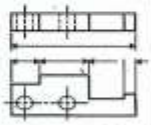
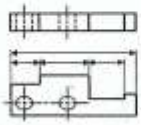
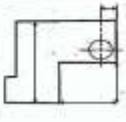
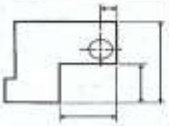


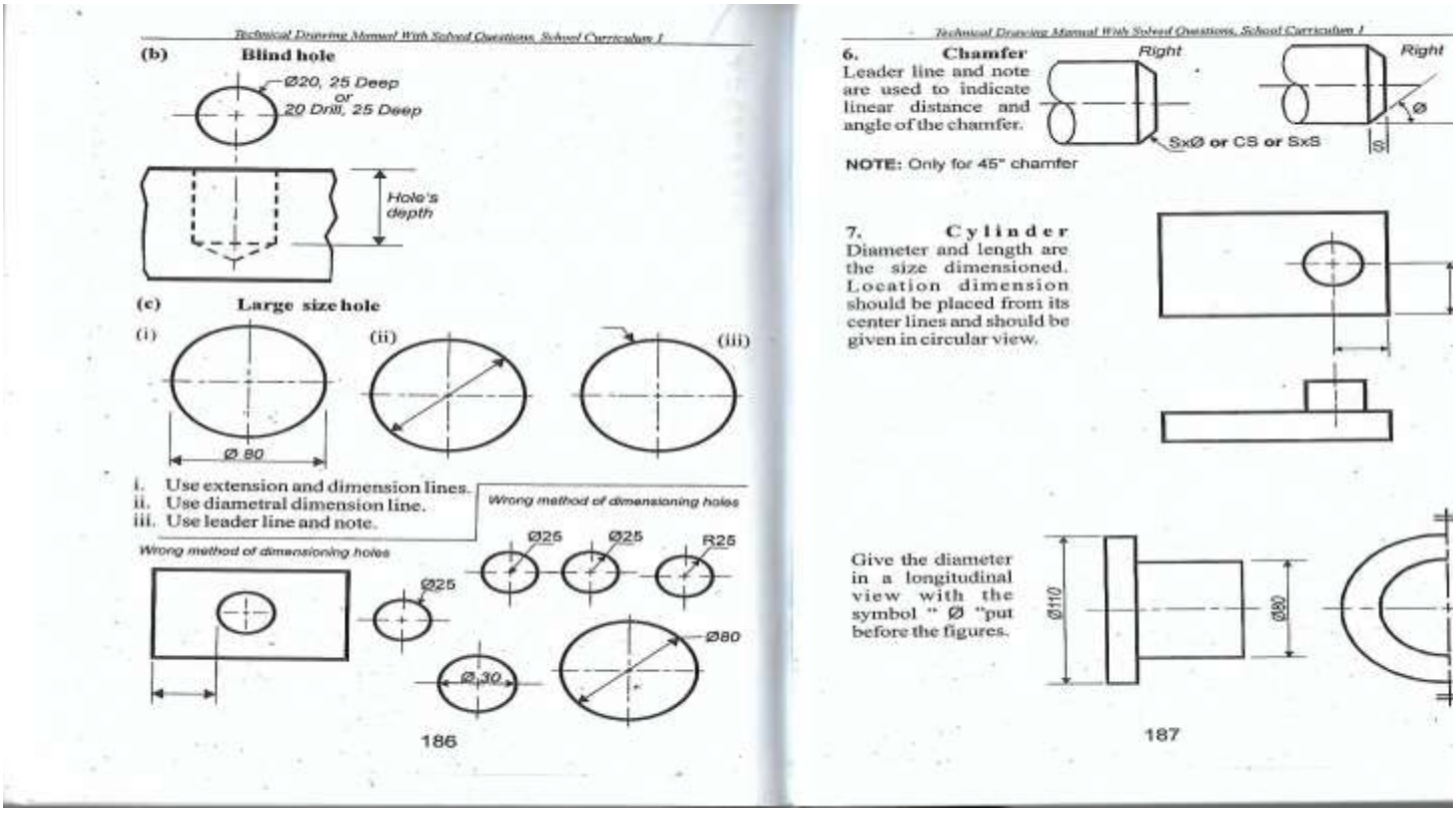
Keys are dimensioned in accordance with the standard sizes of another part to be assembled. It is also dimensioned based on the manufacturing method used.





Further good and poor practices

	Poor	Good	Comment
1			Dimension should be applied to the view that openly show the shape or features of the figure
2			Dimension should be placed outside the view, unless putting them inside brings more understanding.
3			Dimension should be placed outside the view, unless putting them inside brings more understanding.
4			Avoid repeating dimension.
5			Avoid using centre line, object line and dimension line as an extension lines.



Note: In addition to the rules stated above,

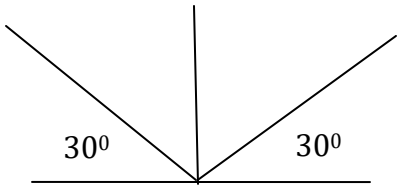
- Extension lines place at the ends of a dimension lines do not touch the body of the object it is dimensioning.
- Extension lines do not also cross each other where dimensioning requires that the cross one another. Hence, one of the extension lines has to be broken to allow the other to pass.
- When dimensioning a slant or inclined side or line on an object, the back of the arrow head is slightly adjusted to be parallel with the extension lines placed at the ends of the dimension line.
- When dimensioning a circle, the tip of the arrow head is made to point to the center of the circle and not any other direction. Or, the dimension line used must through the center of the circle.
- All measurements in technical drawing are in millimeters unless otherwise stated.
- The symbol Ø and **M** when placed behind a number represent the same thing – diameter of a hole or a thread. Ø24 means common or ordinary hole of diameter 24mm. But **M**24 represents the **Metric** diameter of a screw thread of value 24mm.

Week Seven Topic: Isometric Drawing
Sub-Topic: Definition. Introduction. Isometric axis and angle. Principles of parallel lines.

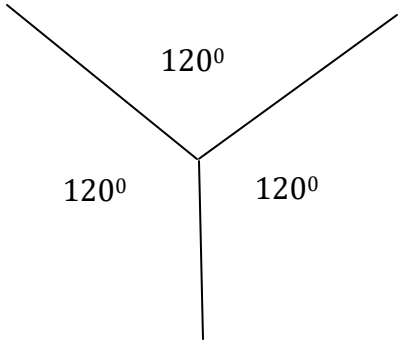
Definition: Isometric drawing is the presentation of an object in 3-dimentisonal form so that three of its faces, facing different directions, can be seen at the same time.

Introduction: Isometric drawing is the type of drawing that present an object when it has been assembled as one whole unit. It is one of the three known pictorial drawings that are used in engineering projects. The other two are **oblique** and **perspective** drawings. We shall look at oblique drawing soon after we are done with isometric drawing. The truth is that no one will understand and appreciate a drawing done in orthographic form if it is not converted to isometric view. And so, in this topic, we would learn how to draw any object in isometric form.

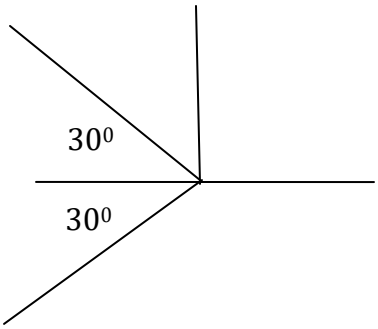
Isometric axis and angle: The angle that is use to present any object in isometric form is 30^0. But this angle is placed within some lines called isometric axis. The 30^0 is placed between two slant lines and a horizontal line. The diagrams below show how isometric axis looks like; and how it can be modified to suit the desires of a technician or a draughtsman.



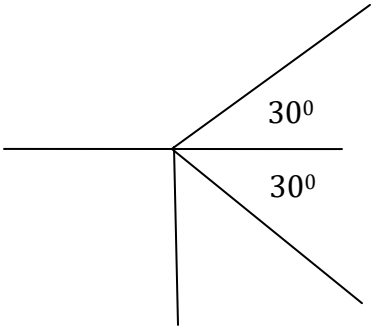
a.



b.



c.



d.

Of all the isometric axis types shown above, type (a) is the most widely used to start an isometric drawing.

Note: If the angle used in the axis is 45^0 instead of 30^0, the drawing that results is called axonometric. The drawing normally does not look tidy and interesting to the eye. It is distorted the more than we see with isometric. But the two drawing types are called dimetric.

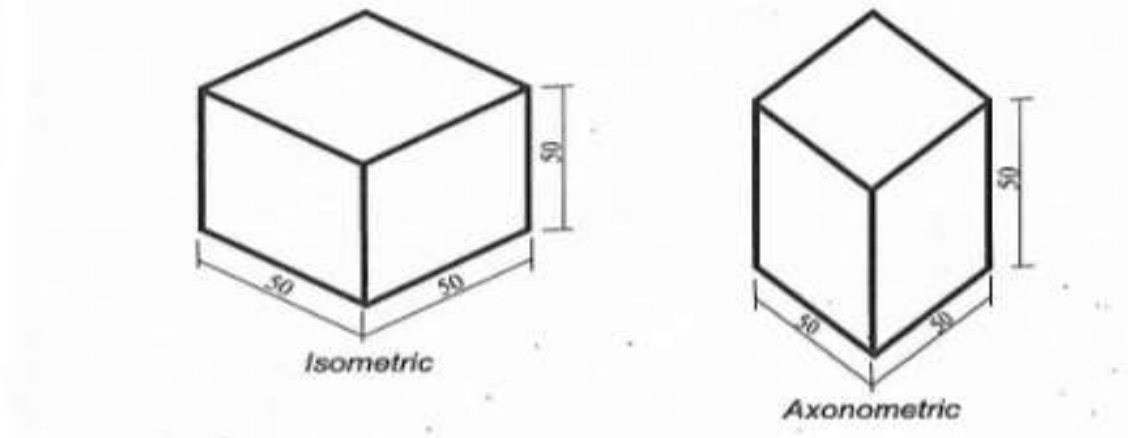
Principle of parallel lines: This is the principle that actually does the drawing. The technician simply follows the stated rule in this principle. Whether the person knows how to draw anything or not, by carefully following the rule, he or she will be able to draw any shape in isometric forms.

This principle is state as follows: ***All vertical, horizontal, slant (inclined) and curved lines must remain parallel unless the shape of the object suggests otherwise.***

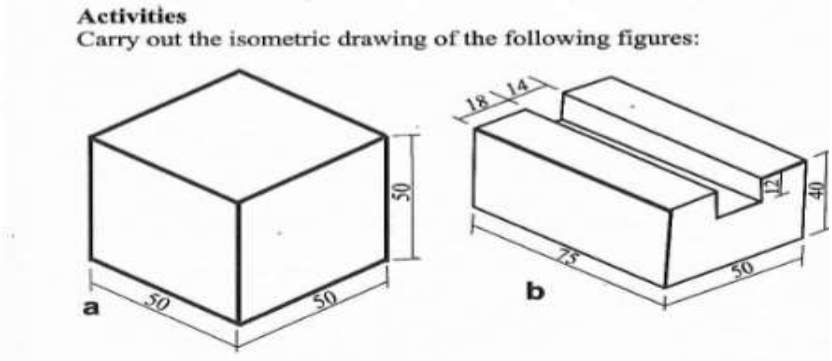
All through the rest of our drawing practices in isometric and oblique drawings, this simple rule will be our guide. Once you choose the axis to work with, then by looking at the object and carefully applying what this rule stated, you will reproduce the object before you know it.

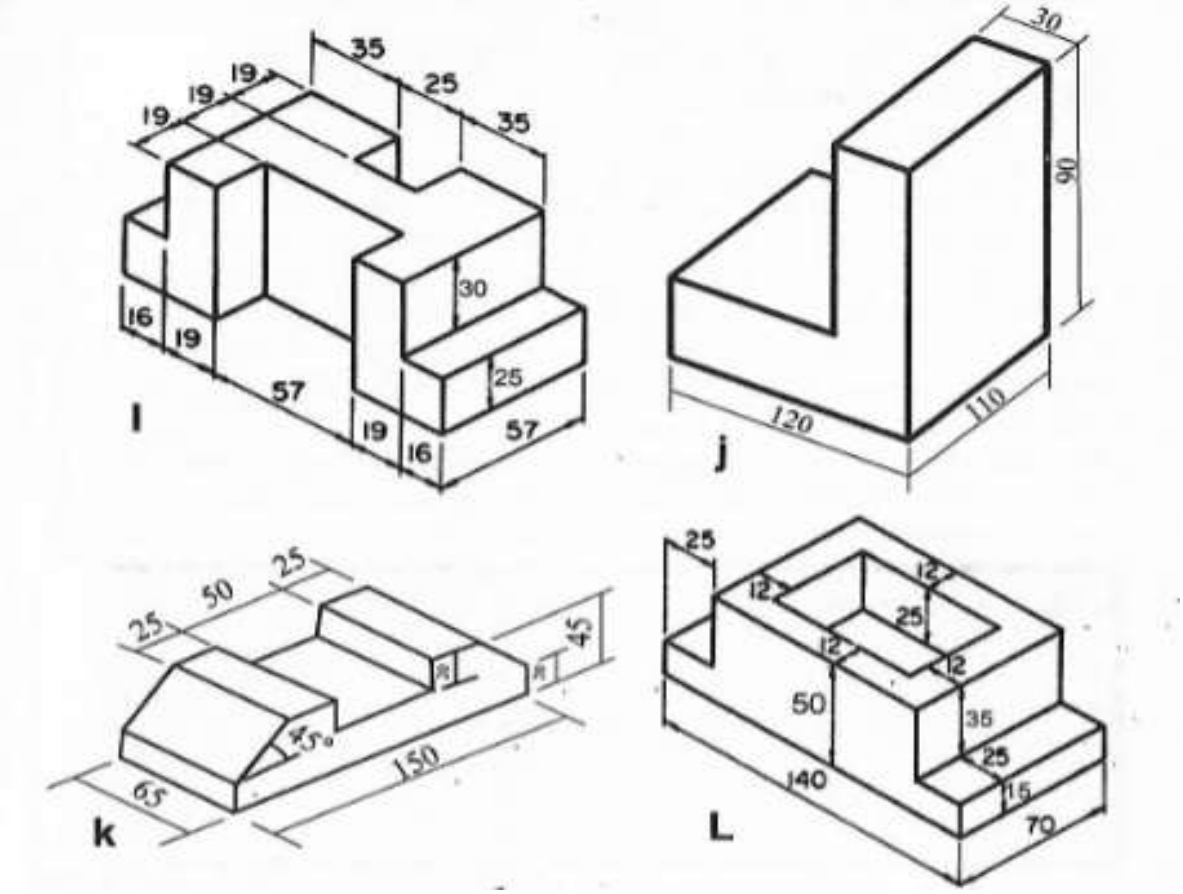
Week Eight Topic: Isometric Drawing
Sub-Topic: Construction of simple objects in isometric.

To construct any object in isometric form requires first, the construction of the isometric axis. Secondly, the application of the principles of parallel lines to insert the various lines and parts that form the object. The axis serves as the reference lines from where others are copied. And with the use of drawing tools and material, an object of desirable quality will result. The will guide you on how to do this by using the following sample problems.



The following examples will help you learn, at the introductory level, how to construct simple shapes in isometric forms. But at a more advanced stage, you will learn how to construct curves and circles in isometric views.

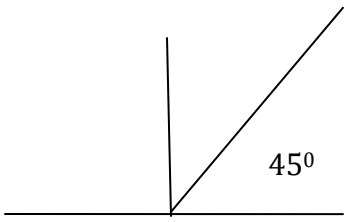




Week Nine Topic: Oblique Drawing
Sub-Topic: Definition. Oblique axis and angle.

Definition: Isometric drawing is the presentation of an object in 3-dimentisonal form so that three of its faces, facing different directions, can be seen at the same time.

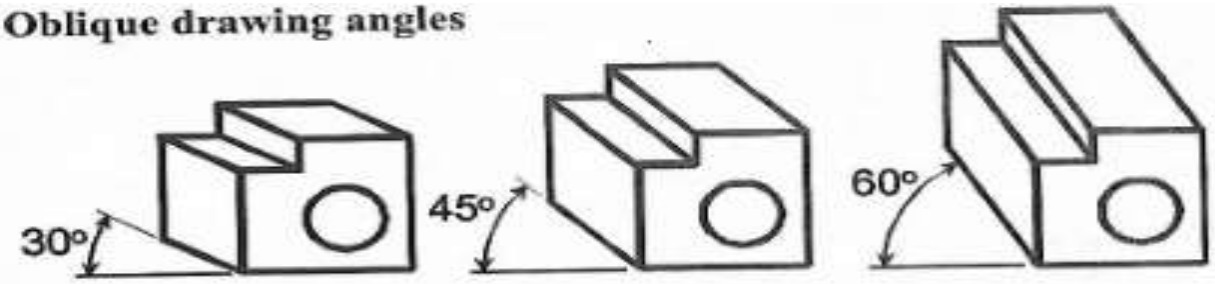
Oblique axis and angle: The angle that is use to present any object in oblique form at this secondary school level is 45^0. The 45^0 is placed between a slant line and a horizontal line, **not** two slant lines and a horizontal line. Other angles such as 30^0 and 60^0 can be used also in advanced cases. The diagrams below show how isometric axis looks like; and how it can be modified to suit the desires of a technician or a draughtsman.



The oblique axis can be varied into different forms to suit what the technician wants before he or she begins to draw. And take note that all the rules applicable to isometric drawing that involves the use of

the principles of parallel lines apply in oblique drawing. But most importantly, take careful note of the following things about oblique drawing:

Oblique drawing angles

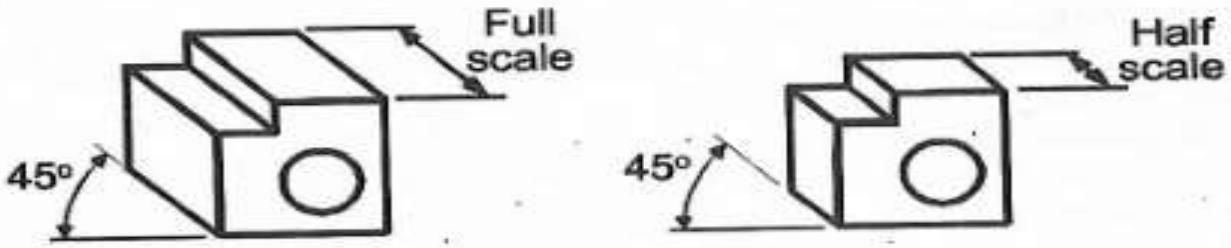


Types of oblique drawing

Oblique drawings can mainly be classified into two types as follows:

(a) **Cavalier projection:** This is when the oblique drawing is made without any reduction in oblique length i.e. full measurement.

(b) **Cabinet projection:** This is when there is a reduction in oblique length by half due to the distortion.



Variation or Alteration in the oblique lengths

When an oblique drawing is made with the front face upright on the plane of the paper, this makes the remaining two faces to appear longer than their true shapes particularly if the real or original object is quite long. This effect or phenomenon is referred to as **distortion in oblique length**.

Rules in alteration of the oblique length:

(a) For oblique angle of 45°, the true length is reduced by half (i.e. True length is multiplied by ½).

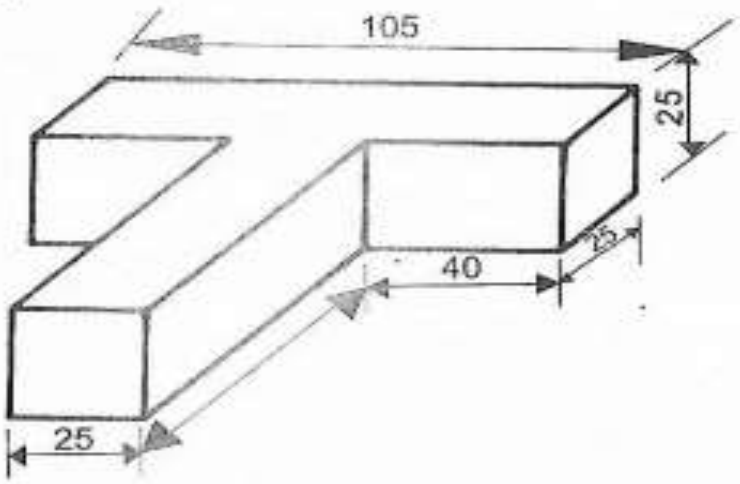
(b) For oblique angle of 30°, the true length is reduced by 2/3 (i.e. true length is multiplied by 2/3).

(c) For oblique angle of 60°, the true length is reduced by 1/3 (i.e. true length is multiplied by 1/3).

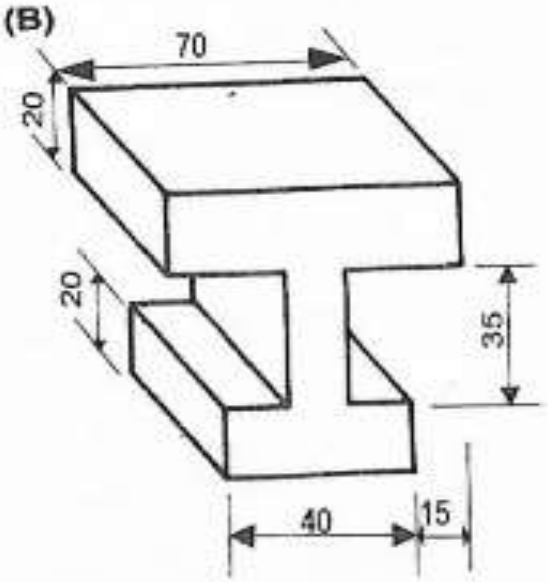
ACTIVITIES

With the aid of drawing materials and instruments, draw the blocks below in oblique form.

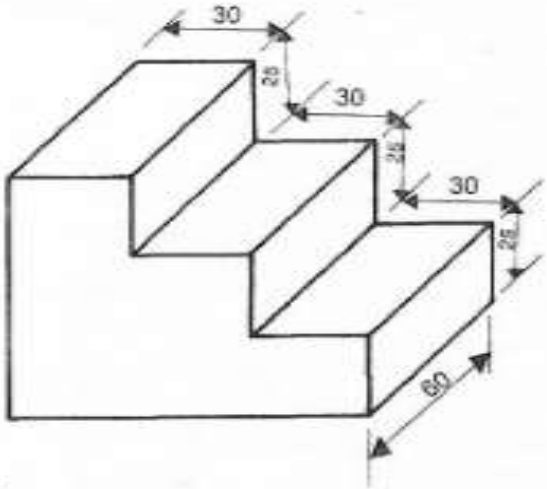
(A)



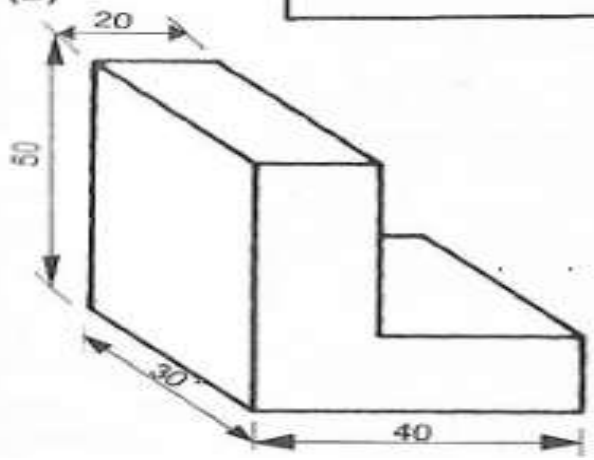
(B)



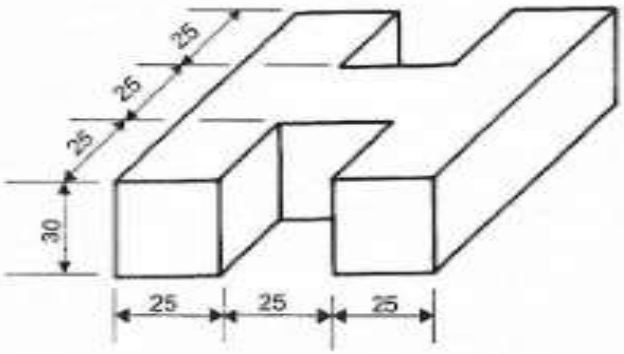
(C)



(D)



(E)



Week Ten Topic: Oblique Drawing
Sub-Topic: Using CorelDraw to draw drawing elements

Introduction: CorelDraw is one of the graphic design applications that are used in the computer to design whatever we want – posters, wedding cards, engineering projects etc.

Activity: The teacher will guide the students to use CorelDraw to letter drawings, draw circles, quadrilaterals, polygons and some simple shapes. This will be a practical-intensive class.