Chapter 1

INTRODUCTION

Introduction to Engineering Drawing

There are many different ways of communicating ideas, information, instruction etc. They can be transmitted by signs or gestures, by words of mouth, in writing or graphically. In an industrial context the graphical method is commonly used and communication being achieved by means of engineering drawings.

Engineering drawing is a graphical language used by those concerned with the constructive arts e.g. in the manufacturing of: Machinery, Structure, Ships, Aircraft and so on. If oral and writing communication only were used when dealing with technical matters, misunderstanding could arise, particularly in relation to shape and size. In other words, it is used when words alone will not convey all the information required.

Engineering drawings convey accurate information about shape in a way which words cannot. This language of lines, signs and symbols has to be learned before it can be expressed on paper. When it is being expressed, it has to be understood by others. But in order for it to work effectively, everyone concerned must interpret the drawings in the same way so that there is uniformity in its interpretation. So the British Standard Institution has prepared a booklet ***BS 308:1972*** having all the standards and conventions to be used. This standard is now adopted for the preparation of drawings used in the engineering industry.

Basically, drawing is a principle means of communication in engineering. It is the method used to impart ideas and convey information and is often said to be the language of the engineer. It is an international language but it has its own rules and conventions.

इंजीनियरिंग ड्राइंग का परिचय

विचारों, सूचनाओं, निर्देश आदि को संप्रेषित करने के कई अलग-अलग तरीके होते हैं। इन्हें संकेत या हावभाव से, मुंह के शब्दों से, लिखित रूप में या रेखांकन द्वारा प्रेषित किया जा सकता है। एक औद्योगिक संदर्भ में ग्राफिकल विधि का आमतौर पर उपयोग किया जाता है और संचार को इंजीनियरिंग ड्राइंग के माध्यम से प्राप्त किया जाता है।

इंजीनियरिंग ड्राइंग एक ग्राफिकल भाषा है, जिसका उपयोग रचनात्मक कलाओं से संबंधित लोगों द्वारा किया जाता है, जैसे: मशीनरी, संरचना, जहाज, विमान और इतने पर। यदि मौखिक और लेखन संचार का उपयोग केवल तकनीकी मामलों से निपटने के दौरान किया गया था, तो गलतफहमी पैदा हो सकती है, खासकर आकार और आकार के संबंध में। दूसरे शब्दों में, इसका उपयोग तब किया जाता है जब अकेले शब्द आवश्यक सभी जानकारी को व्यक्त नहीं करेंगे। इंजीनियरिंग रेखाचित्र आकार के बारे में सटीक जानकारी देते हैं जो शब्दों में नहीं हो सकती। लाइनों, संकेतों और प्रतीकों की इस भाषा को कागज पर व्यक्त किए जाने से पहले सीखना होगा। जब इसे व्यक्त किया जा रहा है, तो इसे दूसरों को समझना होगा। लेकिन इसके लिए प्रभावी ढंग से काम करने के लिए, संबंधित सभी को उसी तरह से ड्राइंग की व्याख्या करनी चाहिए ताकि इसकी व्याख्या में एकरूपता हो। इसलिए ब्रिटिश स्टैंडर्ड इंस्टीट्यूशन ने एक बुकलेट ***बीएस 308: 1972*** तैयार किया है जिसमें सभी मानकों और सम्मेलनों का उपयोग किया जाना है। यह मानक अब इंजीनियरिंग उद्योग में उपयोग किए जाने वाले चित्र की तैयारी के लिए अपनाया जाता है।

मूल रूप से, ड्राइंग इंजीनियरिंग में संचार का एक सिद्धांत है। यह विचारों को व्यक्त करने और जानकारी देने के लिए प्रयोग की जाने वाली विधि है और अक्सर इसे इंजीनियर की भाषा कहा जाता है। यह एक अंतरराष्ट्रीय भाषा है, लेकिन इसके अपने rules और सम्मेलन हैं।

Purpose of studying Engineering Drawing

• To develop the ability to produce simple engineering drawing and sketches based on current practice.]

- To develop the skills to read manufacturing and construction drawings used in industry.
- To develop a working knowledge of the layout of plant and equipment.
- To develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators.

इंजीनियरिंग ड्राइंग का अध्ययन करने का उद्देश्य

- वर्तमान अभ्यास के आधार पर सरल इंजीनियरिंग ड्राइंग और स्केच बनाने की क्षमता विकसित करना।]
- उद्योग में उपयोग किए जाने वाले निर्माण और निर्माण चित्र पढ़ने के लिए कौशल विकसित करना।
- संयंत्र और उपकरण के लेआउट का एक कामकाजी ज्ञान विकसित करने के लिए।
- निर्माता, इंस्टालर और फैब्रिकेटर के लिए काम करने वाले चित्र बनाने के लिए गणना शीट्स और योजनाबद्ध आरेखों से सार जानकारी में कौशल विकसित करना।

The purpose, use and care of drafting equipment
Drawing Instruments and Other Drawing Materials:

1. Drawing Board
2. Drawing Sheet
3. Drawing Sheet Holder
4. Set-squares – 45^o and 30^o – 60^o
5. Large size Compass
6. Small bow Compass
7. Large size Divider
8. Small bow Divider
9. Scales – 6” and 12”
10. Protractor
11. French Curve
12. Drawing Pencils – H, 2H, HB
13. Sand Paper
14. Eraser (Rubber)
15. Drawing Pins and Clips
16. Cello Tape
17. Duster or Handkerchief
18. Drafting Machine / Mini Drafter
19. Sketch Book (Medium size)
20. Roller Scale
21. Pencil Sharpener
22. Sheet Folder

Drafting Equipment

❖ The Drawing Board

It is a flat piece of wood on which all drawings are made. It can be a very complicated instrument as seen in a drawing office or it can simply be a piece of wood cut to a certain size. The size of the board should be big enough to take a piece of paper or size known as A3. This is a metric standard size of A3 paper 420mm x 297mm. See Figure 1 (a) Portable Drawing Board. Figure 1

यह लकड़ी का एक सपाट टुकड़ा होता है जिस पर सभी चित्र बने होते हैं। यह एक बहुत ही जटिल उपकरण हो सकता है जैसा कि एक ड्राइंग कार्यालय में देखा जाता है या यह बस एक निश्चित आकार के लिए लकड़ी का एक टुकड़ा हो सकता है। बोर्ड का आकार कागज़ का एक टुकड़ा लेने के लिए पर्याप्त बड़ा होना चाहिए या ए 3 के रूप में जाना जाता है। यह ए 3 पेपर 420 मिमी x 297 मिमी का एक मीट्रिक मानक आकार है। चित्र 1 (ए) पोर्टेबल ड्राइंग बोर्ड देखें। आकृति 1

Fig.1 (a) Portable Drawing Board

(b) Office Drawing Board.

Fig.1 (b) Office Drawing Board

❖ The Tee-Square

This is an instrument with which you draw all your horizontal lines. It is the instrument on which other instruments are used. It is not possible to make a good technical drawing without a tee-square of reasonable quality and cleanliness. The tee-square only be used on the ***left-hand side*** of the drawing board. This is because your board may not be square which would make some of your constructions inaccurate. (Fig. 2 (a) Tee-square. Fig.2 (b) Drafting Equipment.)

The golden rules, every time you position your paper on the drawing board, make sure the paper you use must be in-line with the tee-square at the top of the board. The reason for this is that if you do not finish a drawing, the next time you position your paper on the board it must line itself up with the previous work, it is not lined up, and your work will be inaccurate.

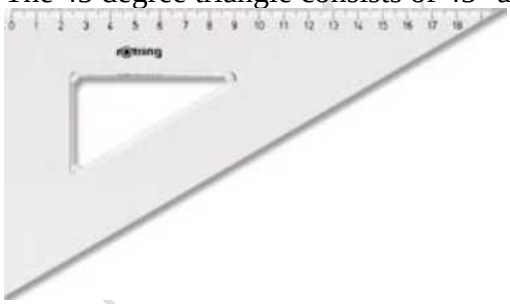
Fig.2 (a) Tee-Square

यह एक ऐसा उपकरण है जिसके साथ आप अपनी सभी क्षैतिज रेखाएँ खींचते हैं। यह वह उपकरण है जिस पर अन्य उपकरणों का उपयोग किया जाता है। उचित गुणवत्ता और स्वच्छता के टी-स्क्वायर के बिना एक अच्छी तकनीकी ड्राइंग बनाना संभव नहीं है । टी-स्क्वायर का उपयोग केवल ड्राइंग बोर्ड के ***बाईं ओर*** किया जाता है । ऐसा इसलिए है क्योंकि आपका बोर्ड वर्गाकार नहीं हो सकता है जो आपके कुछ निर्माणों को गलत बना देगा। (fig 2) (ए) टी-वर्ग। fig 2 (बी) मसौदा उपकरण।)

सुनहरा नियम, हर बार जब आप अपने पेपर को ड्राइंग बोर्ड पर रखते हैं, तो सुनिश्चित करें कि आप जिस पेपर का उपयोग करते हैं, वह बोर्ड के शीर्ष पर टी-स्क्वायर के अनुरूप होना चाहिए। इसका कारण यह है कि यदि आप एक ड्राइंग खत्म नहीं करते हैं, तो अगली बार जब आप बोर्ड पर अपना पेपर डालते हैं तो उसे पिछले काम के साथ ही लाइन अप करना होगा, यह पंक्तिबद्ध नहीं है, और आपका काम गलत होगा।

- The Set-Square

This instrument is normally made of plastic and come in various sizes. The set square is used for constructing angles and drawing vertical lines. One is called the 30°- 60° triangle, see Fig.3a. The 30-60 degree triangle contains a 30°, 60° and 90° angle. The other is a 45° triangle, see Fig.3b. The 45 degree triangle consists of 45° and 90° angle.



g.3 (a) ***30-60 degree Triangle***

Fig.3 (b) ***45 degree Triangle***

When laying out lines, triangles are placed firmly against the upper edge of the Tee-Square. Pencils are placed against the left edge of the triangle and lines drawn upwards, away from the Tee-Square. Parallel angular lines are made by moving the triangle to the right after each line has

been drawn, see Fig. 4 - Construction of Right Angles.

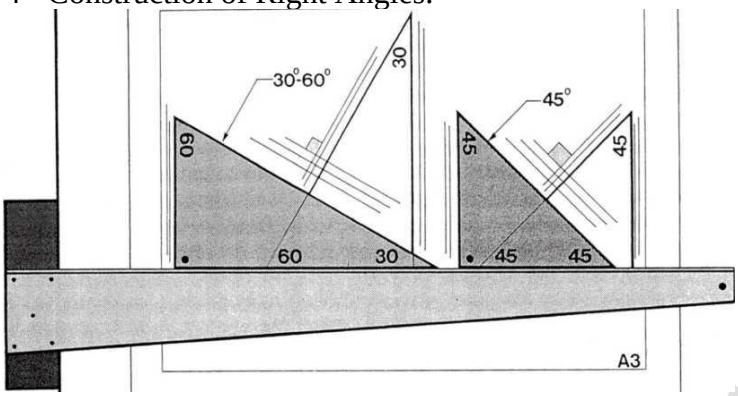


Fig. 4 - Construction of Right Angles

Any angle divisible by 15 can be made by combining the 30-60 degree and 45 degree triangle, See Fig.5 - Angle drawn with the combine's triangles.

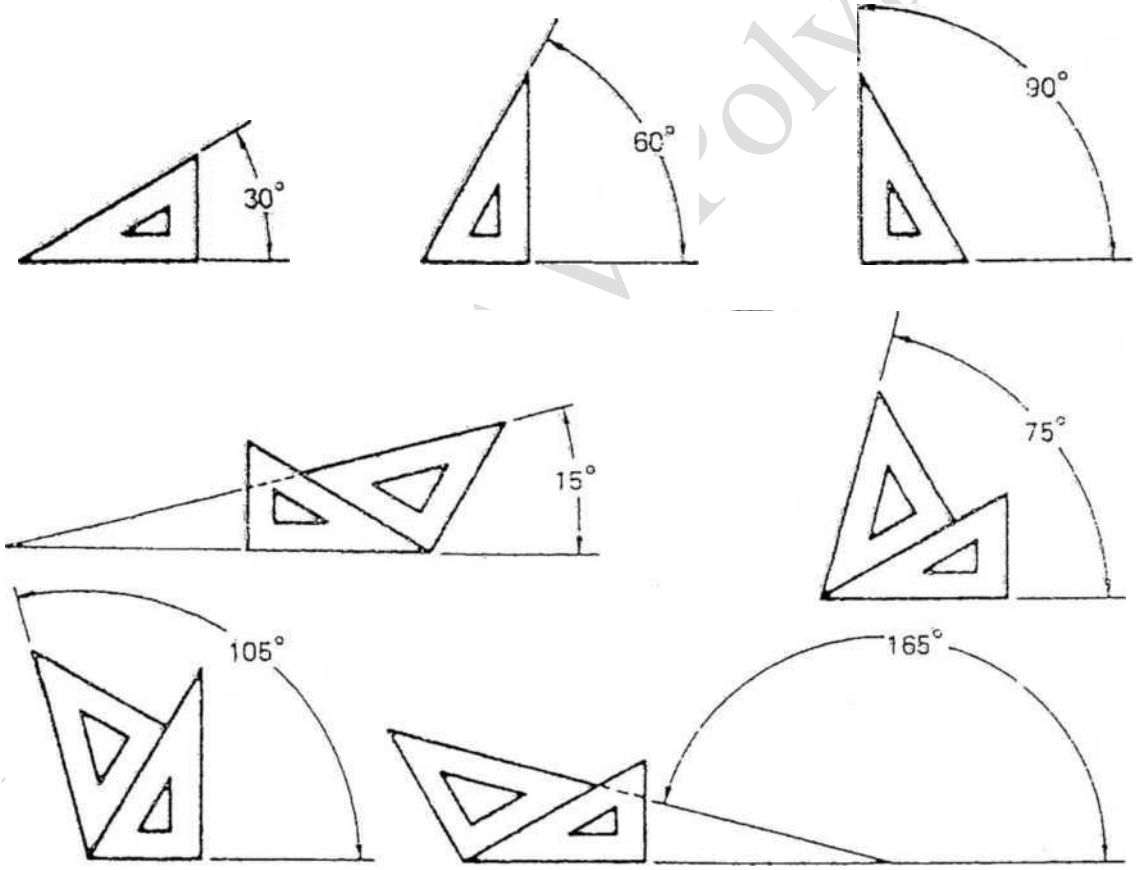


Fig.5 - Angle drawn with the combine's triangles

- Protractor

A protector is a circular or semicircular tool used for measuring an angle or a circle. The units of measurement utilized are usually degrees. Some protectors are simple half-discs, See Fig.6a - Half Discs Protractor and Fig.6b - Circular protractor.

Fig.6a – Half Discs Protractor

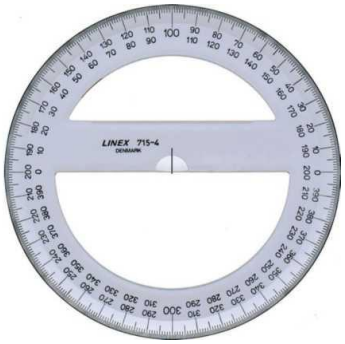


Fig. 6b - ***Circular protractor***

❖ Drawing Instrument Set

Typical drawing sets include compass and dividers. Many sets include a variety of tools not normally used by drafting students. It is recommended that only those tools actually needed be purchased. Divider is like a compass except it has a metal point on each leg. It is used to lay off distance and to transfer measurements', see Fig.7a - Typical Drawing sets & Fig.7b - Compass and Divider.

g. 7a - ***Typical Drawing sets***

Fig. 7b - ***Compass and Divider***

❖ Pencils

Pencils come in 18 degrees of hardness ranging from 9H (which is very hard) to 7B (which is very soft). The scale of hardness divided into 3 groups:

1) ***Hard*** - for accuracy use; 9H, 8H, 7H, 6H, 5H and 4H.
2) ***Medium*** - for general use; 3H, 2H, H, F, HB, B.
3) ***Soft*** - for art work; 2B, 3B, 4B, 5B, 6B and 7B.

Good quality pencils are needed to achieve good quality

drawing. The ***4H*** is recommended for layout work, extension lines, dimension lines, centre lines and section lines. ***2H*** is used for object of visible edge lines and hidden lines. The main advantage is that they are more convenient to use. Thus HB or H grade leads in compasses are preferable when 2H or 3H pencils are used for the other pencil work.

Now a day, ***Mechanical Pencil*** known by names Drafting Pencil or Technical Pencil are design and used to provide lines of consistent thickness without requiring sharpening making them well suited to be used for technical drawing. This pencil only label with lead diameter in millimetre such as ***0.7mm - 2H, 0.5mm - 4H*** and ***0.3mm - 6H.***

Drafting Pencil

- Eraser/Rubber

Eraser or rubber is used for removing pencil and sometimes pen writings. There are various kinds of erasers available to a drafter but use only a good quality eraser. Erasers have a rubbery consistency and most commonly used is a soft white eraser. If good drawing habits are developed, erasing can be kept to a minimum.

- Drafting Tape

Drafting tape also known as the second most useful tape in the world not as strong as other type of tape. This kind of tape will break with minimal effort and not water proof. The good thing about this tape is that it easily removable and does not leave sticky residue when it is removed even from delicate surfaces like paper. This is the main reason engineers and architects use this kind of tape in their blueprints.

Care of drafting equipment

Drafting equipment is very delicate and expensive. Extreme care must be used in adjusting, cleaning, using and storing all instruments. Cleanliness of instruments is very important if clean drawings are to be achieved such as before making a technical drawing, you should always make sure that the Tee-Square and Drawing Board are clean. Sweat from hands used by a student in a previous class will leave dirty marks on your paper which in turn will lose your marks. Use a piece of scrap paper to wipe the tee-square, Set-square and drawing board (if not made of wood) before you start work.

Instruments should be stored flat in clean dry compartments either drawers or boxes or cupboards which are reasonably dustproof. Tee-square can be hung inside the cupboard in which they are kept clean and dry. Steel compass points must be sharpened as necessary. A broken compass point can be sharpened on a small carborundum stone.

Note: Proper care of equipment is the responsibility of each student.

- Things to avoid

The following are considered poor in drafting practice:

- Do not use a scale (ruler) as a straightedge for drawing lines.
- Do not draw horizontal lines with the lower edge of the straightedge.
- Do not work with an unsharpened pencil.
- Do not jab the dividers or compass points into the drawing board.
- Do not sharpen a compass lead over the drawing board.
- Do not draw a circle or radius with a compass unless the point is sharp and extends 9mm from the edge of the compass.

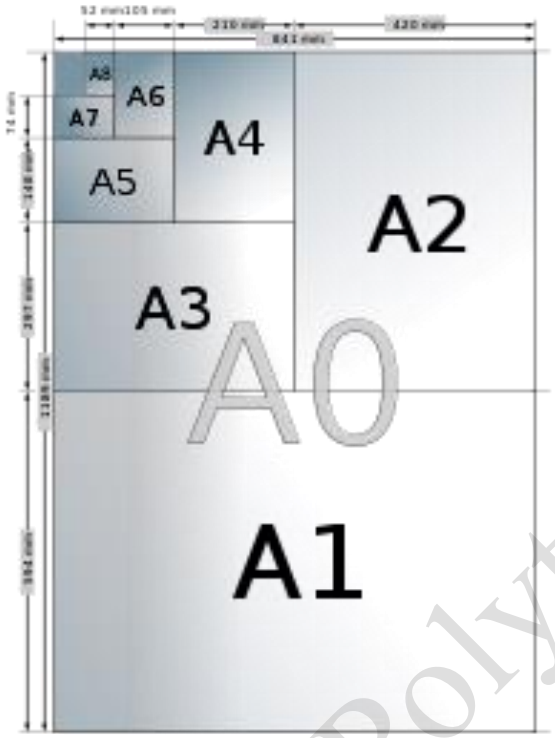
Do not cut paper with a knife using the edge of a straightedge or triangle as a guide

- <u>The different types of paper sizes and scaled used in technical drawing</u>

- Drawing Paper Sizes

There are many sizes of drawing papers used particularly in the engineering dustry. The most commonly used are:

A4	210 X 297
A3	297 X 420
A2	420 X 594
A1	594 X 841
A0	841 X 1189



- Drawing Paper Format

Drawing sheets have two formats:

1) Landscape - with the longer side in horizontal position.
2) Portrait - with the longer side in the vertical position.

- Boarder Line

A drawing must have a frame around it to give it a good appearance. This frame is referred to as a border. Just make it 20mm border line.

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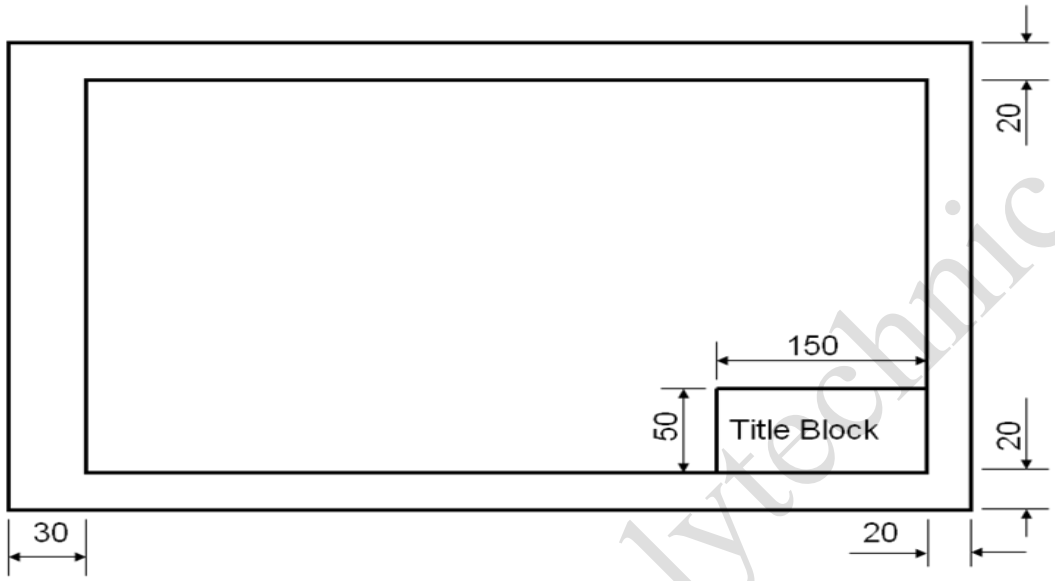
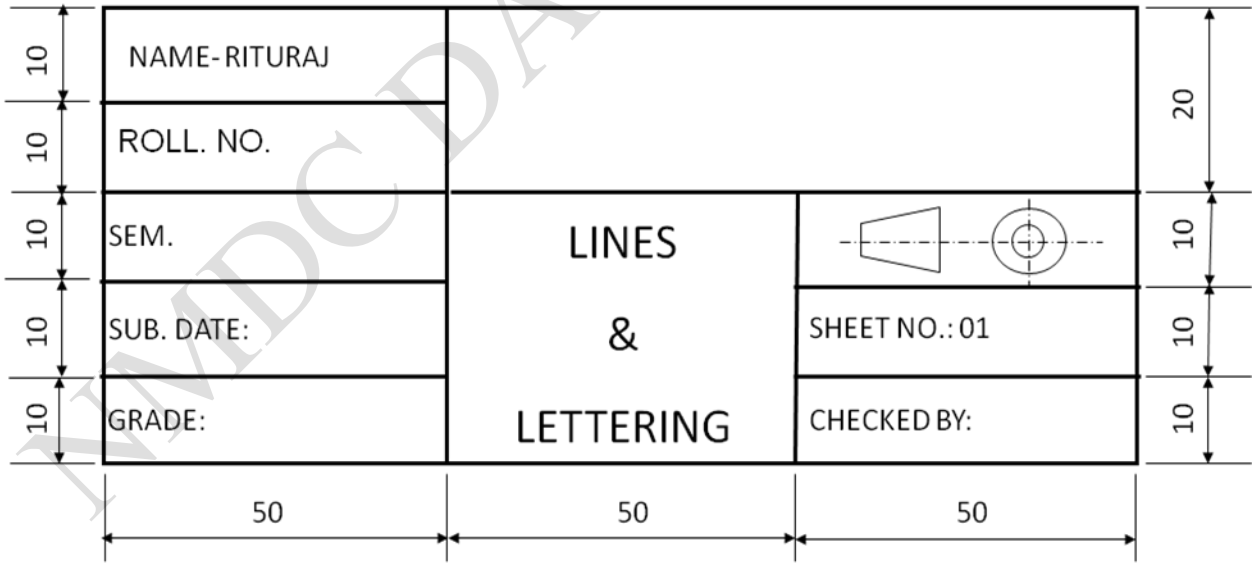
Layout of Drawing Sheet



All the dimensions are in millimeters.

Title Block (Sample)



NOTES:

All the dimensions are in millimeters.

Name and Roll No. should be written by ink-pen.

LETTERING IN ENGINEERING DRAWING

In engineering drawing, the details about the object drawn, title of the drawing, scale, and some other relevant information to supplement the drawing in the form of notes, and annotations are given using free-hand lettering. The size of letters and numerals should be in proportion to the size of the body of drawing; neither too large or nor too small. Generally, the guidelines are drawn to maintain uniformity in height, and spacing of the letters and numerals. The following are some of the guidelines for lettering in technical drawings:

1. Standard height for uppercase or capital letters and numerals according to the Bureau of Indian Standards (BIS) is

1.8, 2.5, 3.5, 5, 6, 10, 14, 20 mm.

The size for a particular drawing is selected according to the size of the drawing.

2. Drawing numbers, title block, and letters denoting the cutting planes and sections are written in 10 mm size.
3. Drawing title is written in 7 mm size.
4. Hatching, subtitles, materials, dimensions, notes, *etc.*, are written in 3.5 mm size.
5. Space between the lines is 3/10 *h* (height of capital letters).
6. Space between the words may be equal to the width of the alphabet M or 3/5 *h* (height of capital letters).
7. The guidelines shown in Fig. 1.1 are drawn to maintain the height of letters, spacing, and uniformity.

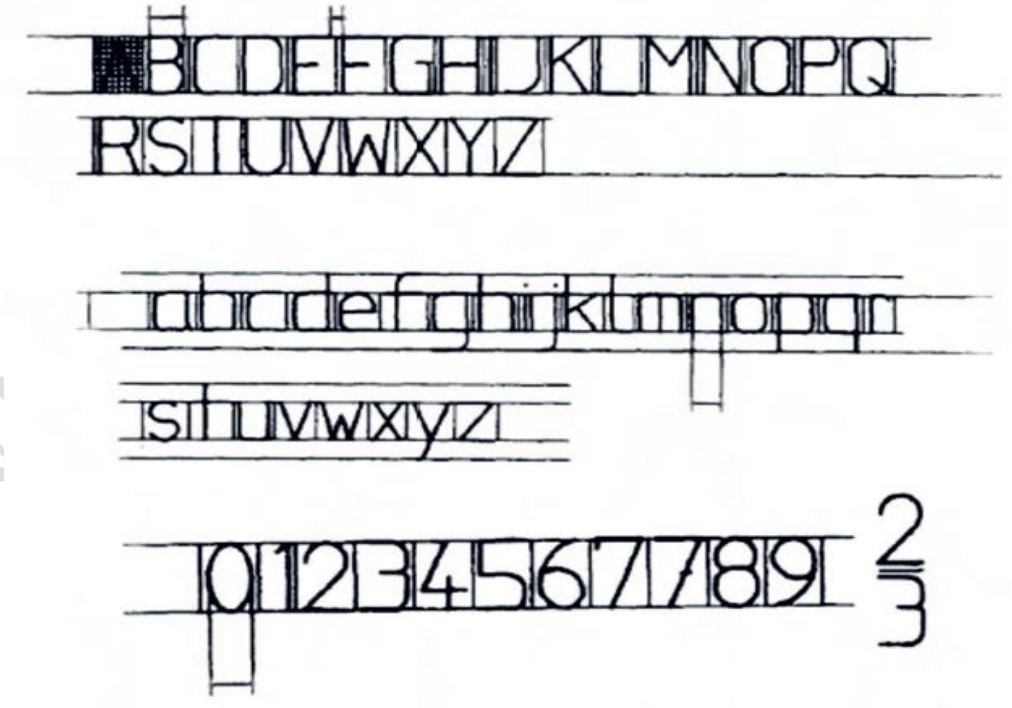
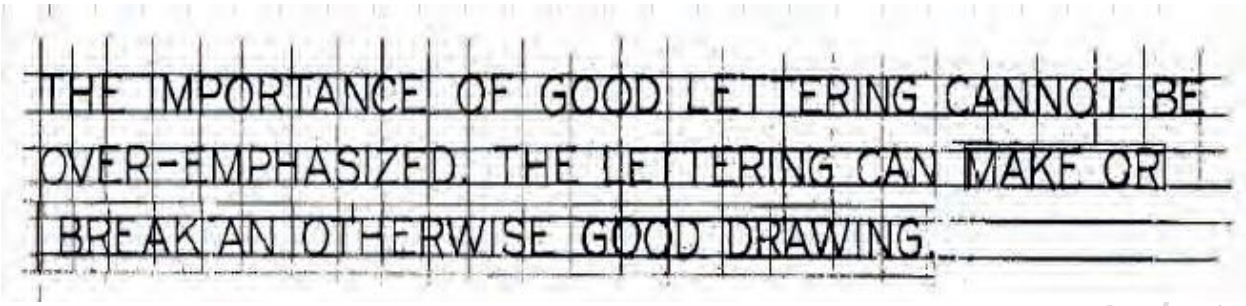


Fig.-Guidelines for lettering



8. Extremely light horizontal lines to regulate the height of the letters are drawn. In addition, light vertical lines are also drawn to keep the letters uniformly vertical (Fig. 1.2). After the lettering has been completed, the guidelines are not erased.
9. For technical drawings, single stroke vertical capital Gothic letters are used.
10. The order of strokes for various letters and numerals is shown in Fig. 1.3.
11. Spacing between the characters is normally 2/10 *h* (height of capital letters), and the spacing between the words is generally 6/10 *h*.
12. Letter uniformity in style, size, weight, and space should be maintained to produce a good drawing.

Writing of titles, dimensions, notes and other important particulars on a drawing

Classification:

1. **Single-stroke Letters:**

   The thickness of the line of the letter is obtained in one stroke of the pencil.

   Recommended by B.I.S.

   It has two types:

   i. Vertical

   ii. Inclined (slope 75º with the horizontal)

- **The ratio of height to width varies but in most of the cases it is 6:5.**
- **Lettering is generally done in capital letters.**
- **The lower-case letters are generally used in architectural drawings.**
- The spacing between two letters should not be necessarily equal.
- The letters should be so placed that they do not appear too close together

  too much apart.

- The distance between the words must be uniform and at least equal to the height of the letters.

- Lettering, except the dimension figures, should be underlined to make them more prominent.

Size of Alphabets for Drawing:

Main titles ----------6-8 mm

Sub titles ----------3-6 mm

Notes, dimension figures, etc. ----------3-5 mm

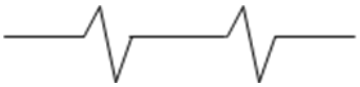
Drawing no. ----------10-12 mm

2. Gothic Letters:

Stems of single-stroke letters are given more thickness (vary from 1/5 to 1/10 of the height of the letters). Mostly used for main titles of ink-drawings.

Different Types of Lines used in Engineering Practice

Lines		Description	General Applications
A	———————	Continuous thick	Visible outlines Visible edges

B		Continuous thin (straight / curve)	Imaginary lines of intersection Dimension lines Projection lines Leader lines Hatching or section lines Outlines of revolved sections in plane Short centre lines
C		Continuous thin (free-hand)	Limits of partial or interrupted views and sections Short-break lines
D		Continuous thin (straight with zigzags)	Long-break lines
E		Dashed thick	Hidden outlines Hidden edges
F		Dashed thin	Hidden outlines Hidden edges
G		Chain thin	Centre lines Lines of symmetry Trajectories
H		Chain thin, thick at ends and changes of direction	Cutting planes
J		Chain thick	Indication of lines or surfaces to which a special treatment applies
K		Chain thin double-dashed	Outlines of adjacent parts Alternative and extreme positions of movable parts Centroidal lines Parts situated in front of the cutting plane

NMDC DAV POLYTECHNIC

Shri Atal Bihari Vajpeyee, Education City, Jawanga, Geedam

Dimensioning techniques and standard conventions

The art of writing the various sizes or measurement on the finished drawing of an object.

Types of Dimensioning:

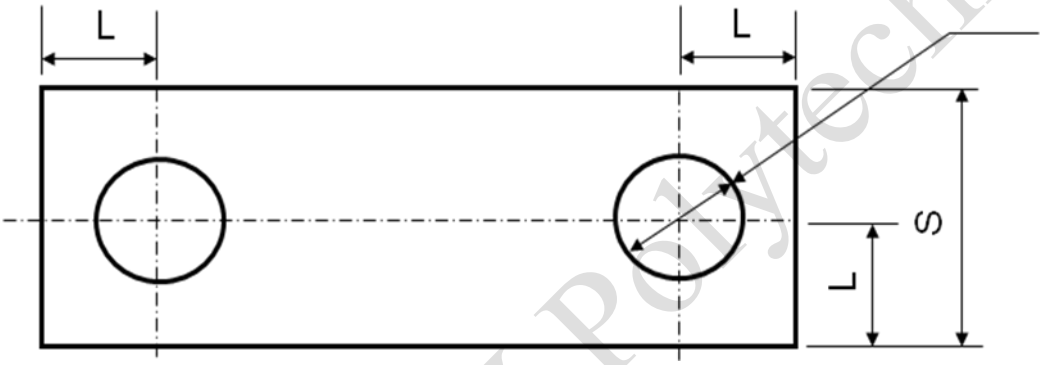
i. **Size or Functional Dimensions (S):**

It indicates sizes.

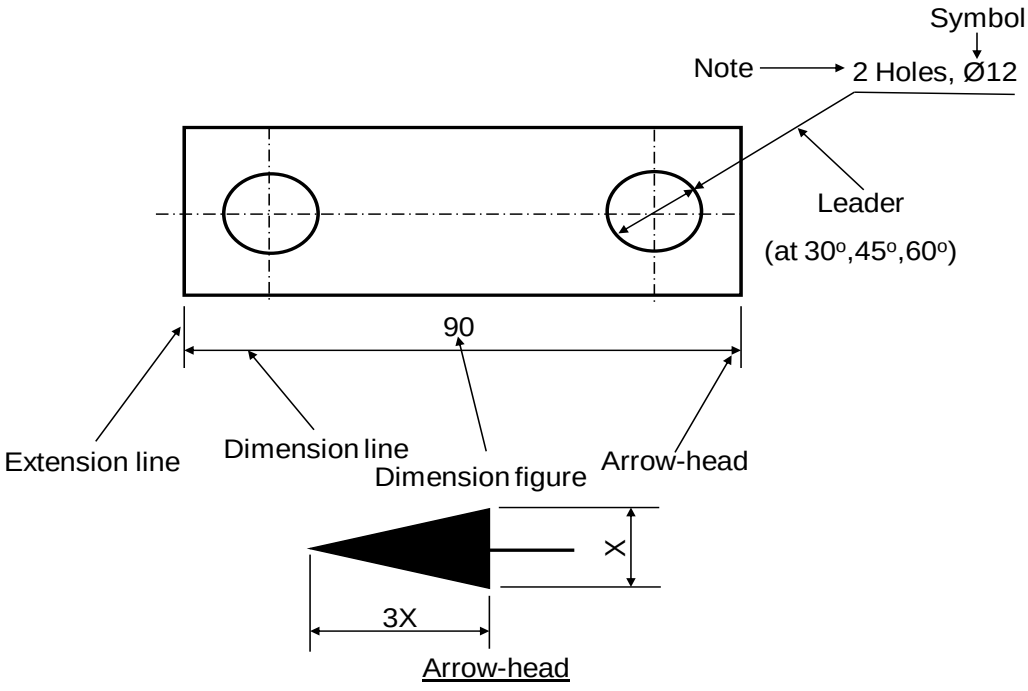
e.g. length, breadth, height, diameter, etc.

ii. Location or Datum Dimensions (L):

It shows location or exact position of various constructional details within the object.



Notations of Dimensioning



1.Dimension line:

Thin continuous line used to indicate the measurement.

2.**Extension line:**

Thin continuous line extending beyond the outline of the object.

3.**Arrow-head:**

Used to terminate the dimension line. Length: width ratio is 3:1. Space filled up.

4.**Note:**

Gives information regarding specific operation relating to a feature.

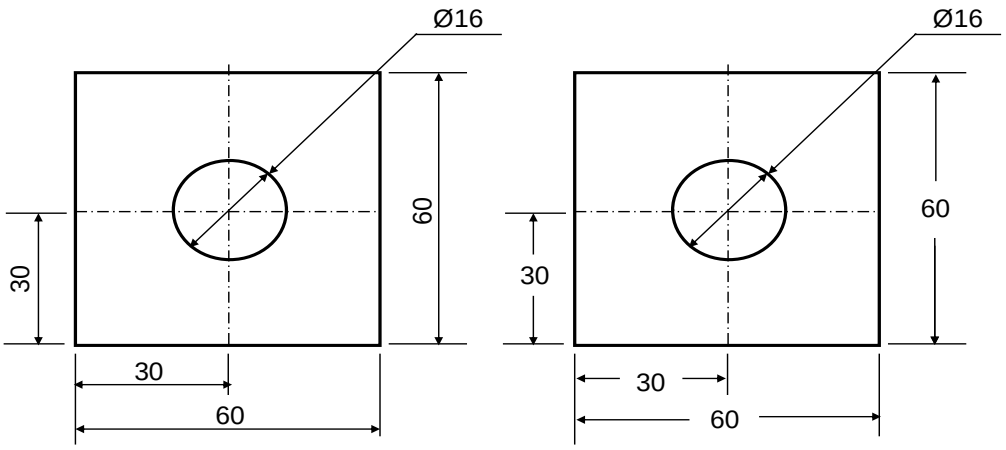
5.**Leader:**

Thin continuous line connecting a note or a dimension figure with the feature to which it is applied. Terminated by arrow-head or dot.

6.**Symbol:**

The representation of any object by some mark on the drawing. It saves time and labour.

System of Placing Dimensions



Aligned System Unidirectional System

System of Placing Dimensions

1. **Aligned System:**

All the dimensions are so placed that they may read from the bottom or the right hand edges of the drawing sheet.

All the dimensions are placed normal and above the dimension line.

Commonly used in Engineering Drawing.

2. **Unidirectional System:**

All the dimensions are so placed that they may read from the bottom edge of the drawing sheet.

Dimension lines are broken near the middle for inserting the dimensions.

Commonly used on large drawing – aircrafts, automobiles.

Units of Dimensioning

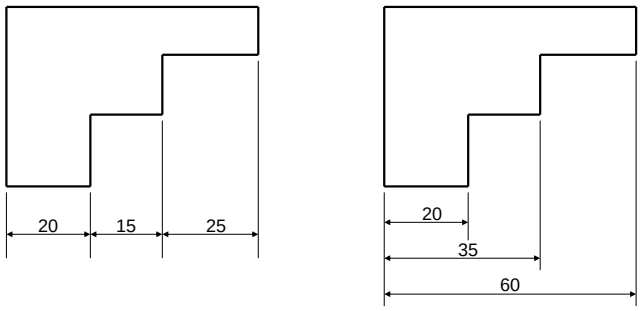
As for as possible all dimensions should be given in millimeters omitting the abbreviation mm.

If another unit is used, only the dimension figures should be written. But a foot note such as 'All the dimensions are in centimeters' is inserted in a prominent place near the title box.

e.g. 15.50

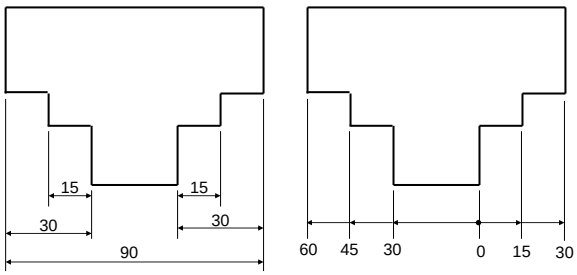
0.75 (Zero must precede the decimal point.)

The ways of Placing the Dimensions in a Series



Chain Parallel

The ways of Placing the Dimensions in a Series



Combined Progressive

The ways of Placing the Dimensions in a Series

1. **Chain Dimensioning:**

   Dimensions are arranged in a straight line.

2. **Parallel Dimensioning:**

   All the dimensions are shown from a common base line.

   The smaller dimension is placed nearer the view.

3. **Combined Dimensioning:**

   Chain and parallel dimensioning used simultaneously.

4. **Progressive Dimensioning:**

   One datum or surface is selected which reads as zero. All the dimensions are referred to that point or surface.

Some Important Rules for Dimensioning

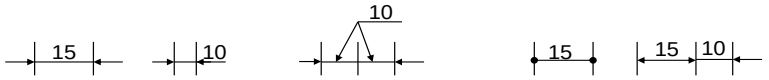
1. All the dimensions necessary for the correct functioning of the part should be expressed directly on the drawing.

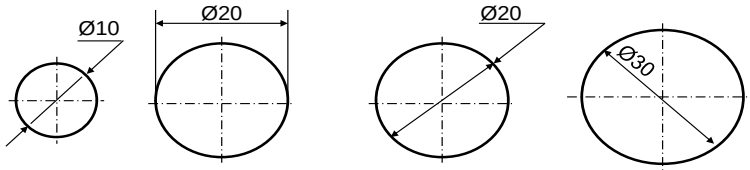
2. Every dimension should be given, but none should be given more than once.

3. A dimension should be placed on the view where its use is shown more clearly.

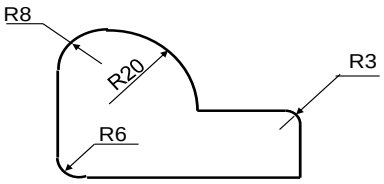
4. Dimensions should be placed outside the view, as for as possible.

5. Mutual crossing of dimension lines and dimensioning between hidden lines should be avoided. Also it should not cross any other line of the drawing.
6. An outline or a centre line should never be used as a dimension line. A centre line may be extended to serve as an extension line.
7. Aligned system of dimensioning is recommended.
8. Dimension lines should be drawn at least 8 mm away from the outlines and from each other.
9. The extension line should be extended by about 3 mm beyond the dimension line.
10. When the space is too narrow, the arrow-head may be placed outside. Also a dot may be used to replace an arrow-head.
11. The various methods of dimensioning different sizes of circles are as follows:

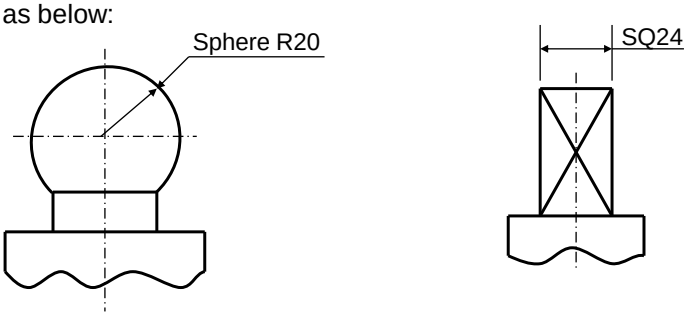




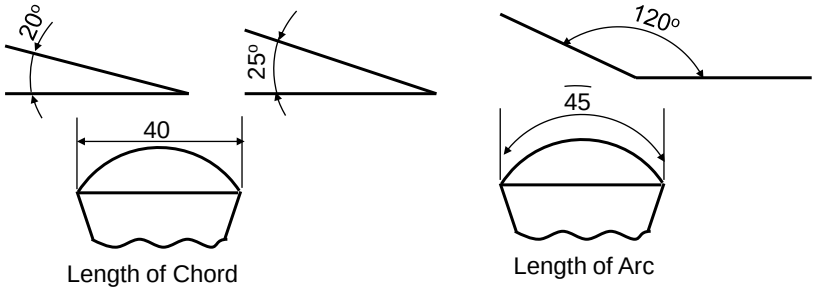
12. Arcs of circles should be dimensioned by their respective radii.



13. Radii of a spherical surface and square cross section of a rod is shown as below:



14. Angular dimension may be given as follows:



Length of Chord

Length of Arc

Scale

Definition

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

Necessity

- Drawings drawn with the same size as the objects are called full sized drawing.

• It is not convenient, always, to draw drawings of the object to its actual size. e.g. Buildings, Heavy machines, Bridges, Watches, Electronic devices etc.

• Hence scales are used to prepare drawing at

- Full size
- Reduced size
- Enlarged size

Dimensions of large objects must be reduced to accommodate on standard size drawing sheet. This reduction creates a scale of that reduction ratio, which is generally a fraction. Such a scale is called reducing scale and that ratio is called representative factor.

For full size scale R.f. =1 or (1:1) Means drawing & object are of same size. Other Rfs are described As

1:10,

1:100,

1:1000,

1:1,00,000

Similarly in case of tiny objects dimensions must be increased for above purpose. Hence this scale is called enlarging scale. Here the ratio called representative factor is more than unity.

Use following formulas for the calculations in this topic.

Representative fraction

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

R.F = Length of the drawing / Actual length of object.

Example: When a 1 cm long line in a drawing represents 1 metre length of the object , the R.F. is equal to [1 cm / 1 metre] = [1cm / 100 cm] = 1/100 And the scale of the drawing of the drawing will be 1:100 or 1/100 full size.

Scales on Drawing

When an unusual scale is used , it is constructed on the drawing sheet . To construct a scale the following information is essential:

- RF of the scale
- The unit which it must represent, for example millimeter, centimeter, feet and inches etc.

The maximum length which it must show. The length of the scale is determined by the formula:

Length of the scale = R.F. × Maximum length It may not be always possible to draw as long a scale as to measure the longest length in the drawing . The scale is there fore drawn 15 cm to 30 cm long, longer length being measured by marking them off in parts.

BE FRIENDLY WITH THESE UNITS.

Metric Unit

1 KILOMETRE = 10 HECTOMETRES

1 HECTOMETRE = 10 DECAMETRES

1 DECAMETRE = 10 METRES

1 METRE = 10 DECIMETRES

1 DECIMETRE = 10 CENTIMETRES

1 CENTIMETRE = 10 MILIMETRES

British Unit

1 FOOT = 12 INCHES

1 YARD = 3 FEET

1 FURLONG = 220 YARD = 10 CHAIN

1 MILES = 8 FURLONG

Types of Scale

- ***Engineers Scale:*** The relation between the dimension on the drawing and the actual dimension of the object is mentioned numerically (like 10 mm = 15 m).
- ***Graphical Scale:*** Scale is drawn on the drawing itself.

Types of Graphical Scale

1. Plain Scale (For Dimension Up To Single Decimals)
2. Diagonal Scales (For Dimension Up To Two Decimals)
3. Vernier Scales (For Dimension Up ToTwo Decimals)
4. Comparative Scales (For Dimension Up To Different Units)
5. Scales Of Chord (For Measuring/Constructing Angles)

SHORT ANSWER QUESTION

1. **What is Representative Fraction and Gives its value of enlarging and reducing Scale?**

   Or

   What is Representative Fraction?

   Ans: The ratio of the distance on the drawing sheet of an object to the corresponding actual distance of the object is known as representative fraction or scale factor.

R.F. = Distance on drawing sheet of the object / actual distance of the object in same units

R.F is greater than one for enlarging scale, i.e. R.F. > 1

R.F is less than one for reducing scale, i.e. R.F. < 1

2. **Write the uses (applications) of the scale?**

Ans: The following are the main uses of scales in engineering practice:-

a) The scales are used to prepare reduced or enlarged size drawings.
b) The scales are used to set off dimensions.
c) The scales are used to measure distances directly.

3. **What is the signification of engineering drawing for engineers?**

Ans:- Engineering drawing is a graphical language used by those concerned with the constructive arts e.g. in the manufacturing of: Machinery, Structure, Ships, Aircraft and so on. If oral and writing communication only were used when dealing with technical matters, misunderstanding could arise, particularly in relation to shape and size. In other words, it is used when words alone will not convey all the information required.

• Help To develop the ability to produce simple engineering drawing and sketches based on current practice.
• To develop the skills to read manufacturing and construction drawings used in industry.
• To develop a working knowledge of the layout of plant and equipment.
• Help to develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators.

4. **Differentiate between plain and diagonal scale?**

   Ans:- **Plain Scale:-** A plane scale is simply a line which is divided into suitable number of equal parts or units, the first part of which is further sub-divided into small parts or sub-units of main unit.

   The plain scales are used to represent either two units or one unit and its fraction such as kilometers, hectometers, meters or decimeters or meters and $1/10^{th}$ of meters, etc.

   Diagonal Scale: - Diagonal scale is that in which small divisions of short lines are obtained by following the principle of diagonal divisions.

Diagonal scales are used to represent either three units of measurements such as meters, decimeters and centimeters or two units and a fraction of its second unit.

5. What are the different types of scales?

Ans: - Types of scales

1. Plain or simple scales.
2. Diagonal scales.
3. Comparative or Corresponding scales.
4. Vernier scales.
5. Chord scales of chords.

6. Fill up the blanks (April - May 2008)

I. The ratio of the length of the drawing to the actual length of the object is called …… …….

Ans:- **Representative Fraction (RF)**

II. For drawing small instruments, watches, etc. ……. Scale is always used.

Ans:- **Enlarging Scale**

7. *What is a scale?*

Ans:-A scale is defined as the proportion by which we either reduce or increases the actual size of the object
on a drawing.

1) Full size scale:-The scale in which the actual measurements of the object are drawn to same size on the drawing is known as full size scale.

2) Reducing scale: - The scale in which the actual measurements of the object are reduced to some proportion
is known as reducing scale.

3) Enlarging scale: - The scale in which the actual measurements of the object are increased to some proportion
is known as enlarging scale.

LONG ANSWER QUESTION

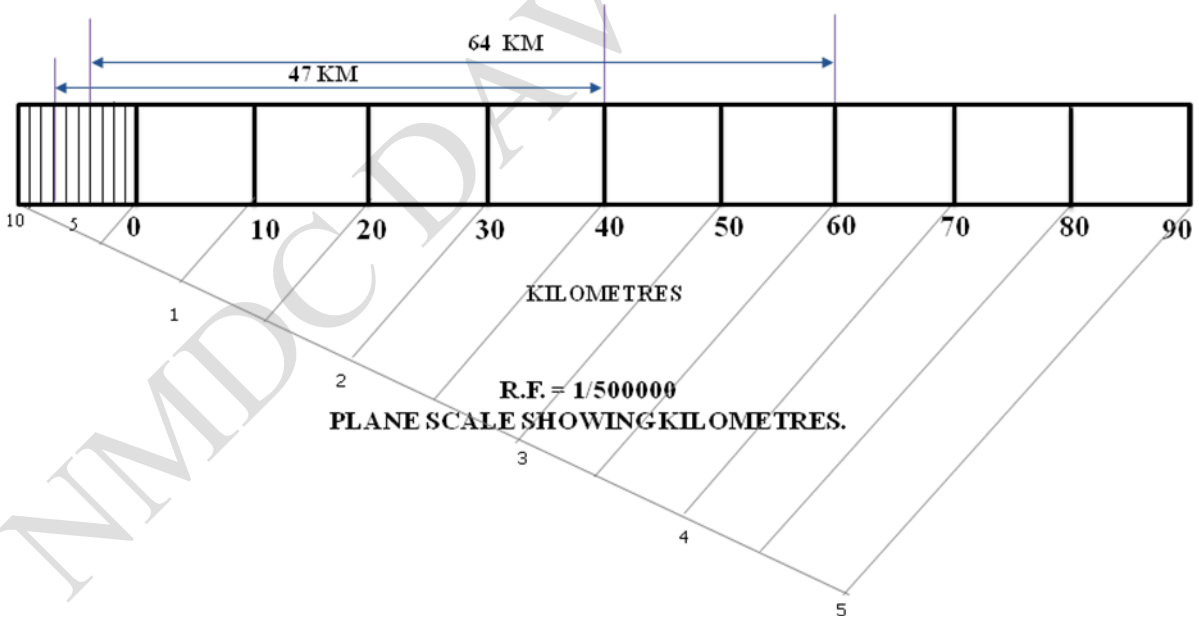
1. **In a map of Chhattisgarh 1 cm represents 5 km. construct a plain scale long enough to measure distance between Raipur and Bilaspur. Assume the distance from Raipur to Bilaspur be 100 km. Indicate on the scale a distance between**

(i) Raipur and Rajnandgaon = 64 km.

(ii) Raipur and Durg = 47 km.

SOLUTION :

- Calculate R.F. (1 cm = 5 km)
- R.F. = 1/500000
- Calculate Length of scale = R.F. X Max. length to be measured
  - = (1/500000) X 100000 X 100 cm
- LOS = 20 cm
- Draw a line 20 cm long. It will represent 100 km. Divide it in 10 equal parts. (Each will represent 10 km.)
- Divide first division in ten equal parts. Each will represent 1 kilometer.
- Name those parts 0 to 10 as shown.
- Then draw parallel lines to this line from remaining complete plne scale.
- Mark a distance of 64 km and 47 km.



R.F. = 1/500000

PLANE SCALE SHOWING KILOMETRES.

2. On a building plan, a line 20 cm long represents a distance of 10 m. calculate R.F., device a diagonal scale for the plan to read up to 10 m, showing meters, decimeters and centimeters. Show on your scale, the lengths 6.48 m and 9.14 m.

SOLUTION :

1. Calculate R.F.

R.F. = 1/50

2. Calculate Length of scale = R.F. X Max. length to be measured

= (1/50) X 10 X 100 cm

LOS = 20 cm

3. Draw a line 20 cm long. It will represent 10 m. Divide it in 10 equal parts. (Each will represent 1 m.)

4. Divide first division in ten equal parts. Each will represent 1 decimeter.

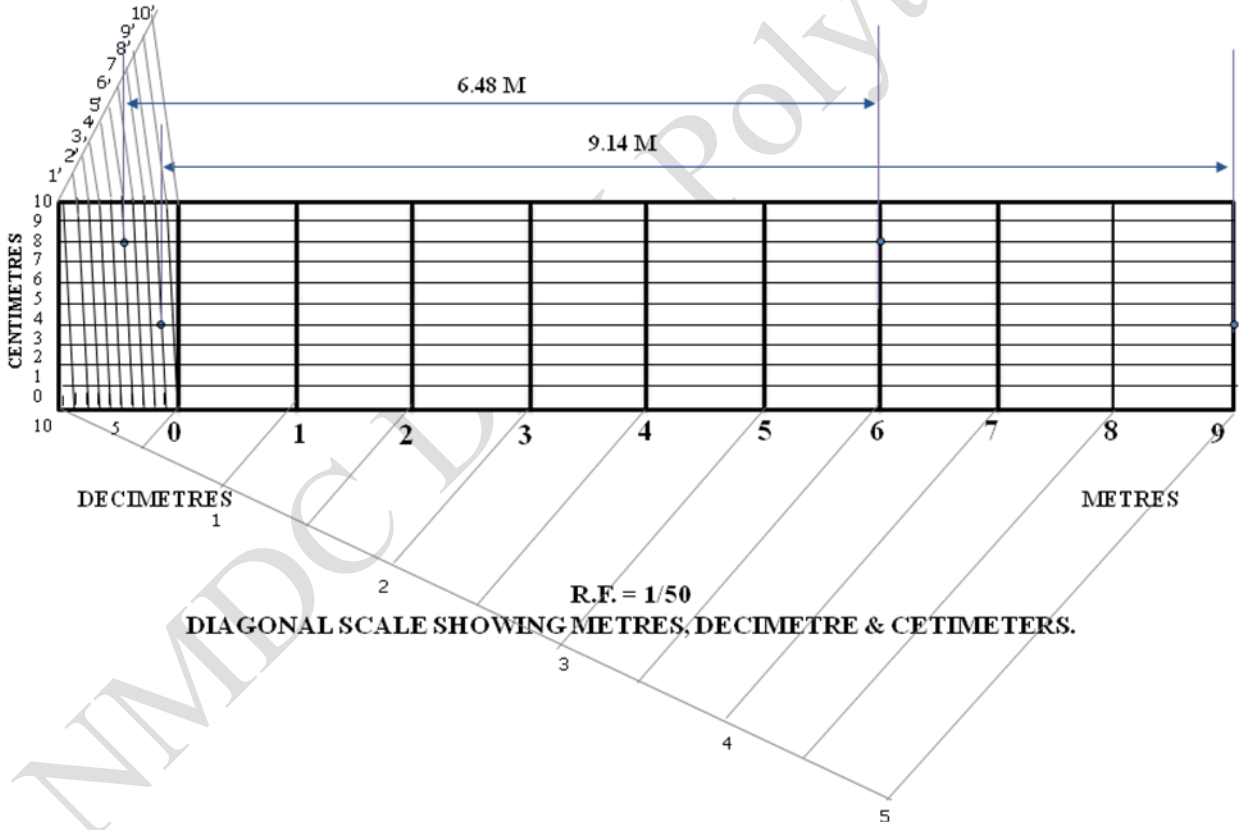
5. Draw a line upward from left end and mark 10 parts on it. Each will represent 1 centimeter

6. Name those parts 0 to 10 as shown.

7. Join 9th sub-division of horizontal scale with 10th division of the vertical divisions.

8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.

9. Mark a distance of 9.14 and 6.48 m.



R.F. = 1/50

DIAGONAL SCALE SHOWING METRES, DECIMETRE & CETIMETERS.

3. **On a map the distance between two points is 14 cm. the real distance between them is 20 Km. draw a diagonal scale of this map to read kilometers and hectometers and to measure up to 25 Km. show a distance of 17.6 Km on this scale.**

SOLUTION :

1. Calculate R.F.

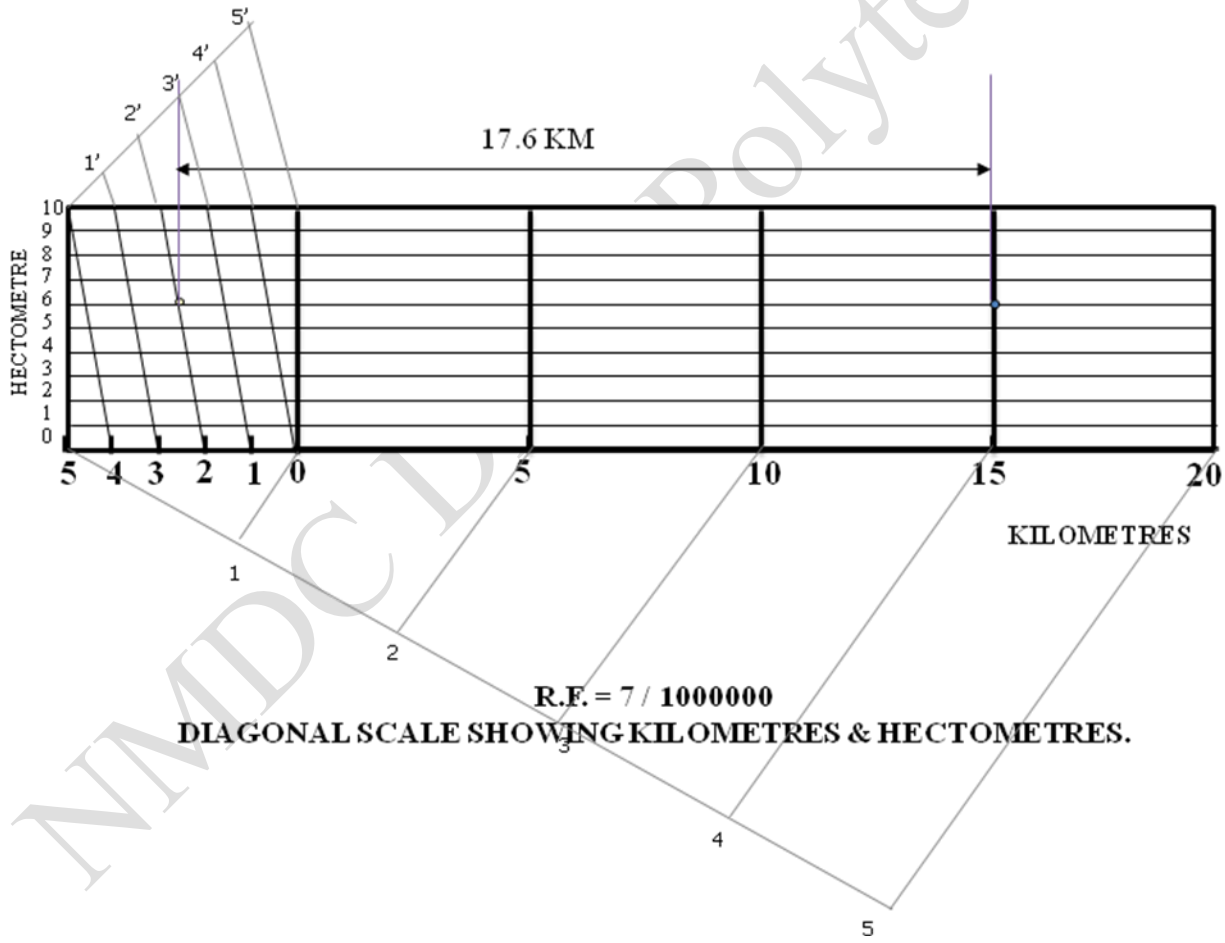
   R.F. = (14 cm)/(25 km) = 7 / 1000000

2. Calculate Length of scale = R.F. X Max. length to be measured

   = (7 / 1000000) X 25 X 1000 X 100 cm

   LOS = 17.5 cm

3. Draw a line 17.5 cm long. It will represent 25 km. Divide it in 5 equal parts. (Each will represent 5 km.)
4. Divide first division in 5 equal parts. Each will represent 1 km.
5. Draw a line upward from left end and mark 10 parts on it. Each will represent 1 hm.
6. Name those parts 0 to 10 as shown.
7. Join 4th sub-division of horizontal scale with 10th division of the vertical divisions.
8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.
9. Mark a distance of 17.6 km.



R.F. = 7 / 1000000

DIAGONAL SCALE SHOWING KILOMETRES & HECTOMETRES.

4. **On a map the distance between two points is 14 cm. the real distance between them is 20 Km. draw a diagonal scale of this map to read Kilometers and hectometers and to measure up to 30 Km. Show a distance of 18.9 Km on this scale.**

SOLUTION :

1. Calculate R.F.

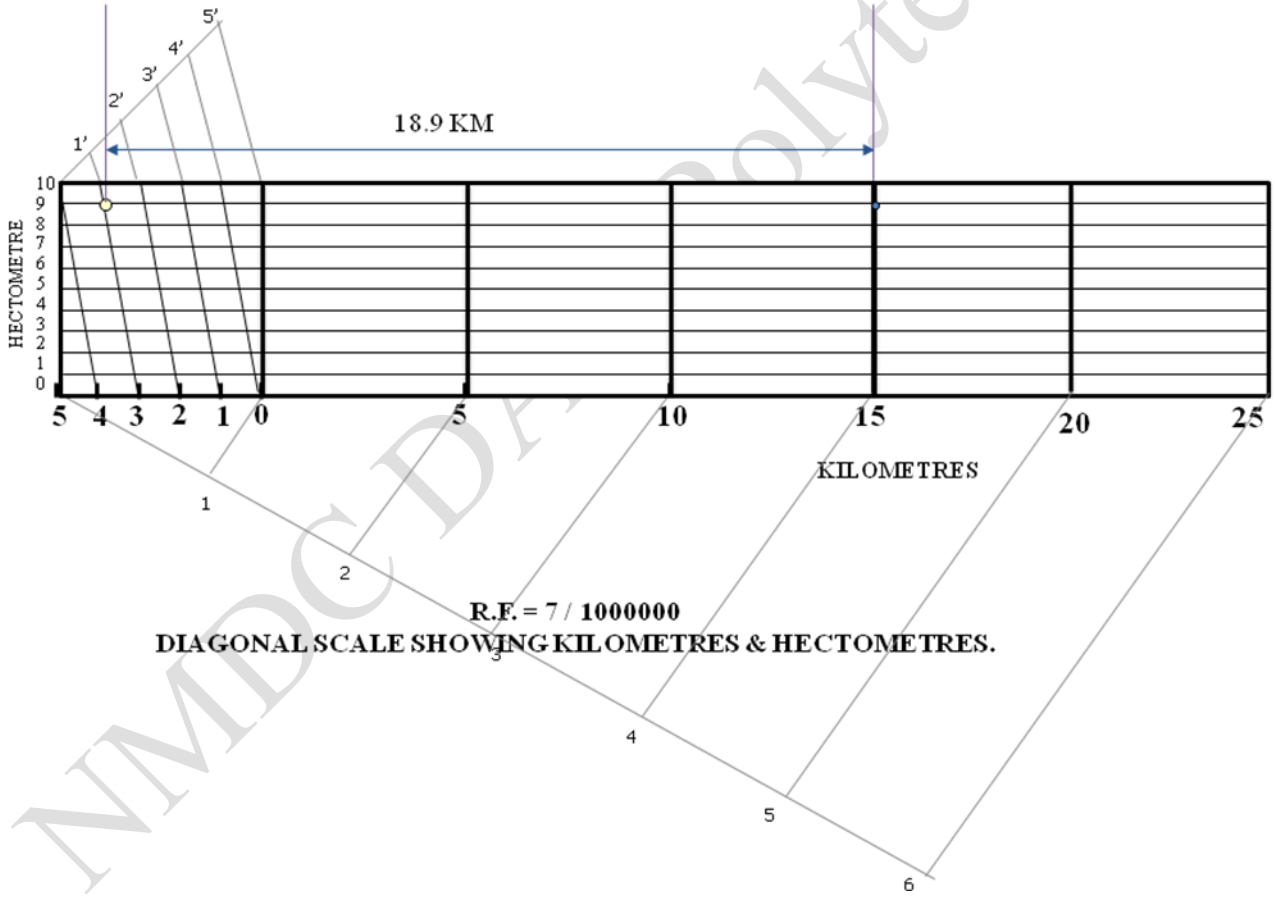
   R.F. = (14 cm)/(20 km) = 7 / 1000000

2. Calculate Length of scale = R.F. X Max. length to be measured

   = (7 / 1000000) X 30 X 1000 X 100 cm

   LOS = 21 cm

3. Draw a line 21 cm long. It will represent 30 km. Divide it in 6 equal parts. (Each will represent 5 km.)
4. Divide first division in 5 equal parts. Each will represent 1 km.
5. Draw a line upward from left end and mark 10 parts on it. Each will represent 1 hm.
6. Name those parts 0 to 10 as shown.
7. Join 4th sub-division of horizontal scale with 10th division of the vertical divisions.
8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.
9. Mark a distance of 18.9 km.

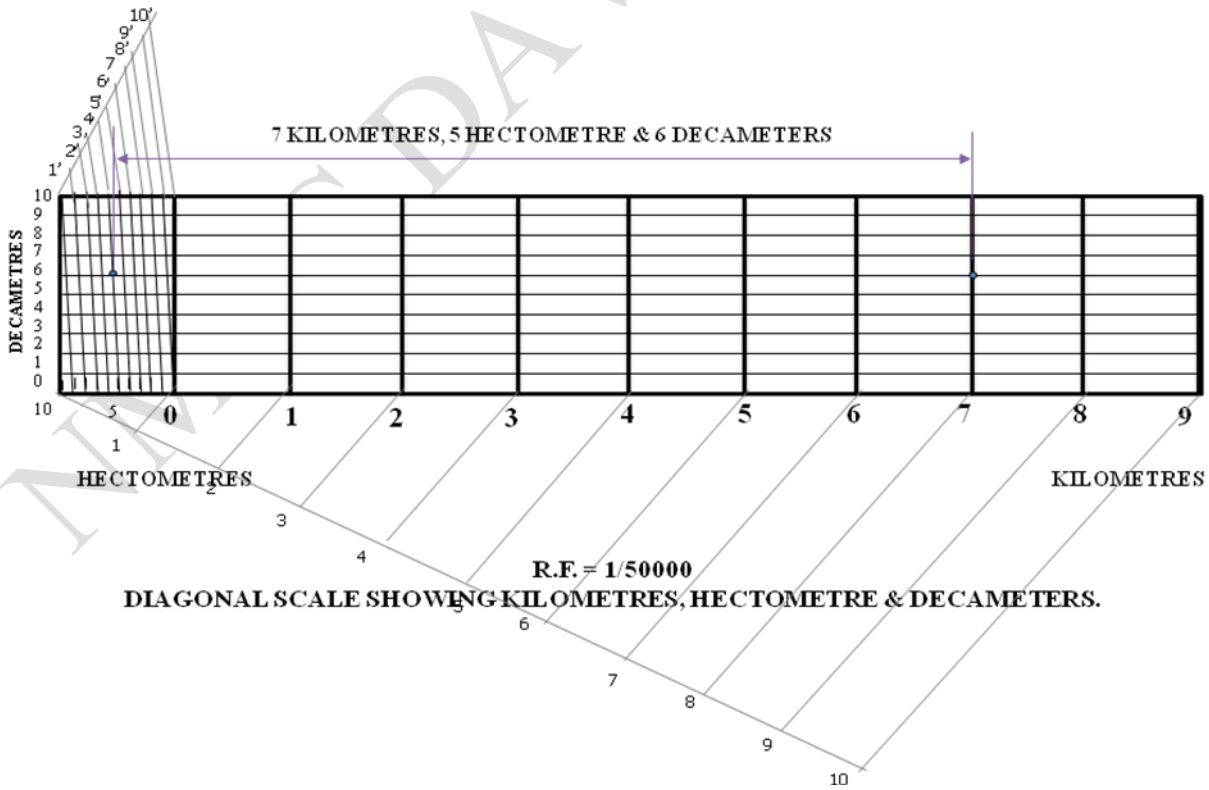


5. **An area of 144 square centimeters on a map represents an area of 36 square kilometer on the field. Find the representative fraction of the scale of this map to measure up to 10 kilometers indicate on this scale a distance of 7 Kilometers, 5 hectometers and 6 decameters.**

. **SOLUTION :**

144 cm sq. on map represents
= 36 sq km on land
4 cm sq. on map represents
= 1 sq km on land
So, 2 cm on map represents
= 1 km on land

1. Calculate R.F.
R.F. = 2 cm / 1 km = 1/50000
2. Calculate Length of scale = R.F. X Max. length to be measured
= 1/50000 X 1000 X 100 cm
LOS = 20 cm
3. Draw a line 20 cm long. It will represent 10 km. Divide it in 10 equal parts. (Each will represent 1 km.)
4. Divide first division in 10 equal parts. Each will represent 1 hm.
5. Draw a line upward from left end and mark 10 parts on it. Each will represent 1 Decameter
6. Name those parts 0 to 10 as shown.
7. Join 9th sub-division of horizontal scale with 10th division of the vertical divisions.
8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.
9. Mark a distance of 7 KM 5 HM and 6 Decameter.



6. **The area of a field 50,000 sq. m. the length and breadth of the field on the map is 10 cm and 8 cm respectively. Construct a diagonal scale which can read up to one meter. Mark the length of 235 m on the scale. What is the R.F. of the scale ?**

Solution:-

$$50000\ m^2 = (10 \times 8)\ cm^2$$

$$625\ m^2 = 1\ cm^2$$

$$\sqrt{625\ m^2} = \sqrt{1\ cm^2}$$

1. Calculate R.F.

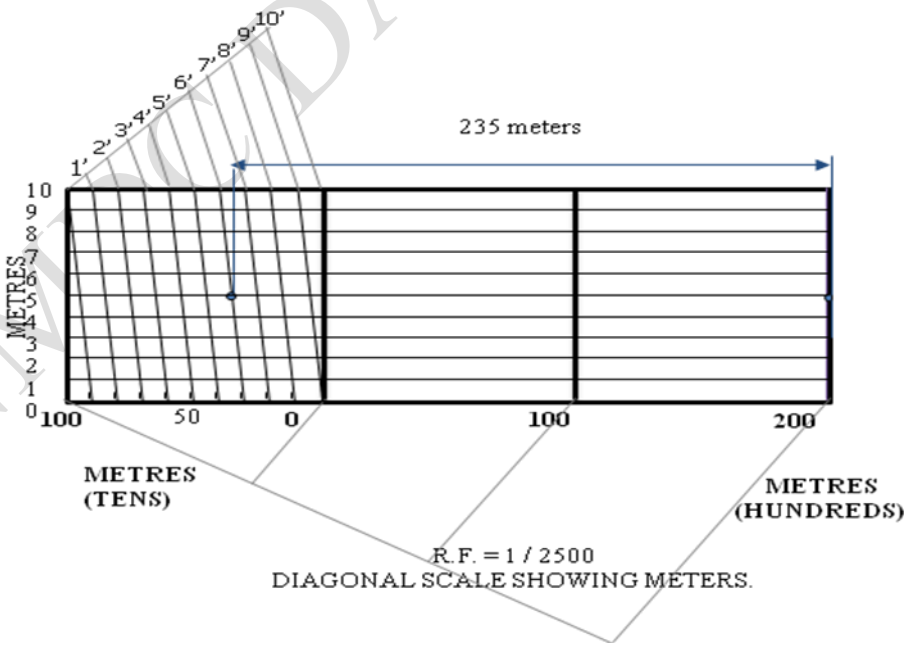
   R.F. = 1/2500

2. Calculate Length of scale = R.F. X Max. length to be measured

   = (1/2500) X 300 X 100 cm (Assume Max. length to be measured = 300 M)

   LOS = 12 cm

3. Draw a line 12 cm long. It will represent 300 m. Divide it in 3 equal parts. (Each will represent 100 m.)
4. Divide first division in ten equal parts. Each will represent 10 m.
5. Draw a line upward from left end and mark 10 parts on it.
6. Name those parts 0 to 10 as shown.
7. Join 9th sub-division of horizontal scale with 10th division of the vertical divisions.
8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.
9. Mark a distance of 235 m.



7. **A rectangular plot of land, of area 0.45 hectare is represented on a map by a similar rectangle of 5 Sq cm. calculate the R.F. also construct a scale to read up to a single**

metre and long enough to measure 400 meters. Mark a distance of 257 meters on this scale.

SOLUTION :

1 hector = 10, 000 sq. meters

0.45 hectors = 0.45 X 10, 000 sq. meters

= 4500 X 10^4 sq. cm

5 sq. cm area on map represents = 4500 X 10^4 sq. cm on land

1 cm sq. on map represents

= (4500 X 10^4)/ 5 sq cm on land

1 cm on map represents

= $\sqrt{900 \text{ X } 10^4}$

1 cm on map represents = 3000 cm on land

1. Calculate R.F.

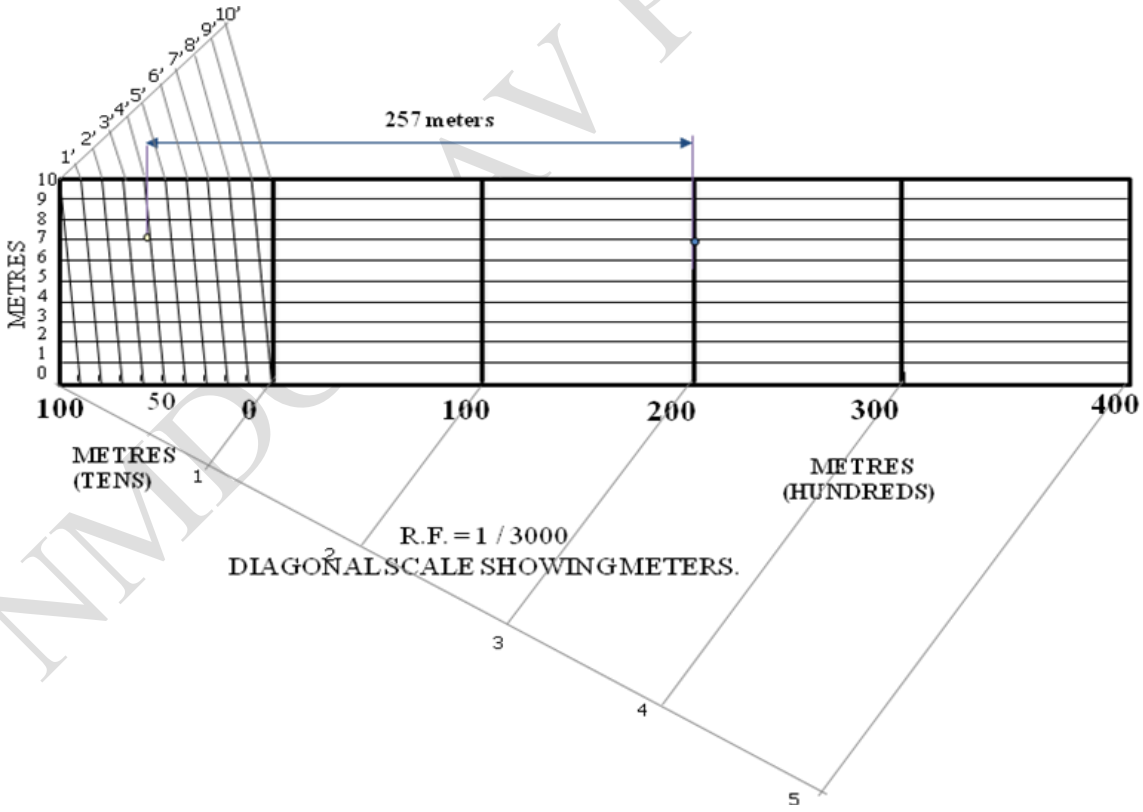
R.F. = 1/3000

2. Calculate Length of scale = R.F. X Max. length to be measured

= (1/3000) X 500 X 100 cm

LOS = 16.67 cm

3. Draw a line 16.67 cm long. It will represent 500 m. Divide it in 5 equal parts. (Each will represent 100 m.)



4. Divide first division in ten equal parts. Each will represent 10 m.
5. Draw a line upward from left end and mark 10 parts on it.
6. Name those parts 0 to 10 as shown.

7. Join 9th sub-division of horizontal scale with 10th division of the vertical divisions.
8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.
9. Mark a distance of 257 m.

8. **A block of ice of 1000 m3 volume is represented by a block of 27 cm3 volume. Find the R.F. and construct a scale to measure up to 60 m. mark a distance of 42.5 m on the scale.**

SOLUTION : $27\ cm^3 = 1000\ m^3$

$$\sqrt[3]{27\ cm^3} = \sqrt[3]{1000\ m^3}$$

$$3\ cm = 10\ m$$

1. Calculate R.F.

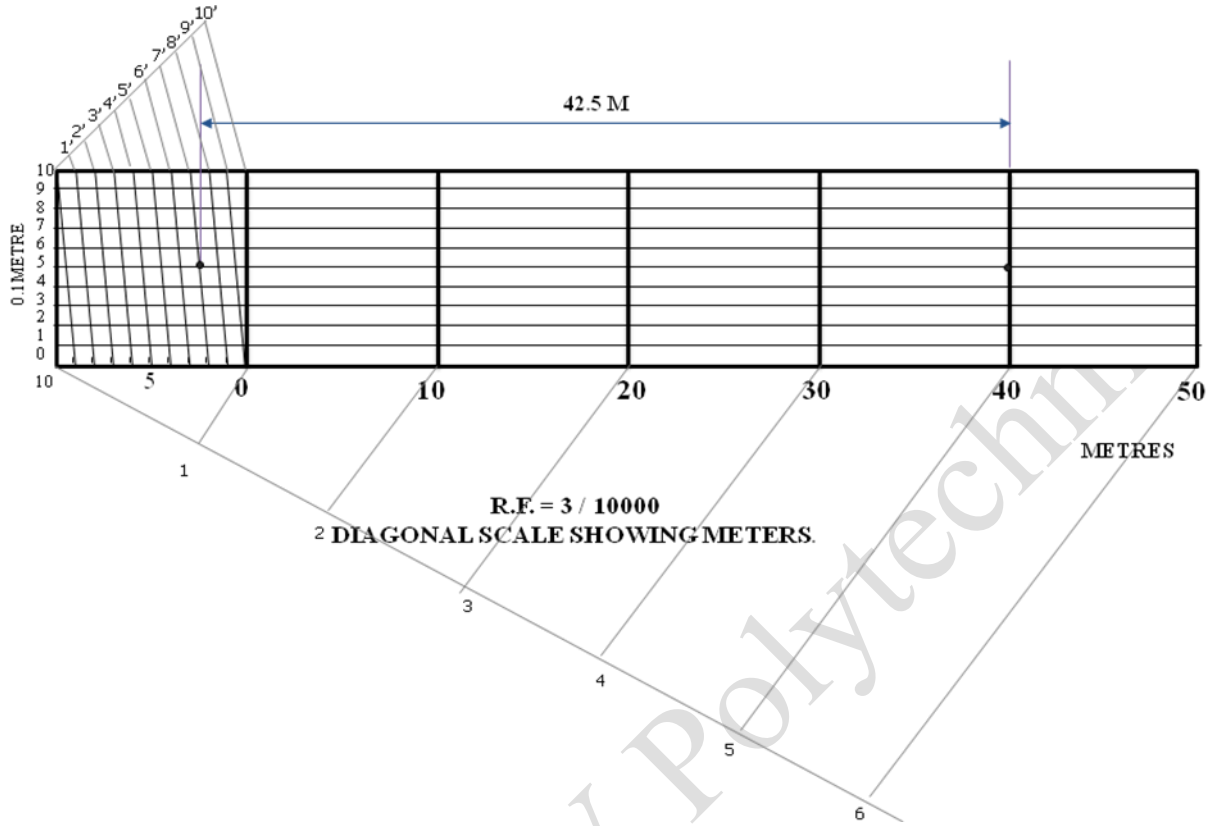
R.F. = (3 cm)/(10 m) = 3 / 1000

2. Calculate Length of scale = R.F. X Max. length to be measured

= (3 / 1000) X 60 X 100 cm

LOS = 18 cm

3. Draw a line 18 cm long. It will represent 60 m. Divide it in 6 equal parts. (Each will represent 10 m.)
4. Divide first division in 10 equal parts. Each will represent 1 m.
5. Draw a line upward from left end and mark 10 parts on it. Each will represent 0.1 m.
6. Name those parts 0 to 10 as shown.
7. Join 9th sub-division of horizontal scale with 10th division of the vertical divisions.
8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.
9. Mark a distance of 42.5 m.



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9. The representative fraction of a scale showing miles, furlongs and chains is 1/50688. Draw a scale to read up to 5 miles and show on it the length representing 3 miles 5 furlongs 3 chains.

SOLUTION :

1. Calculate R.F.

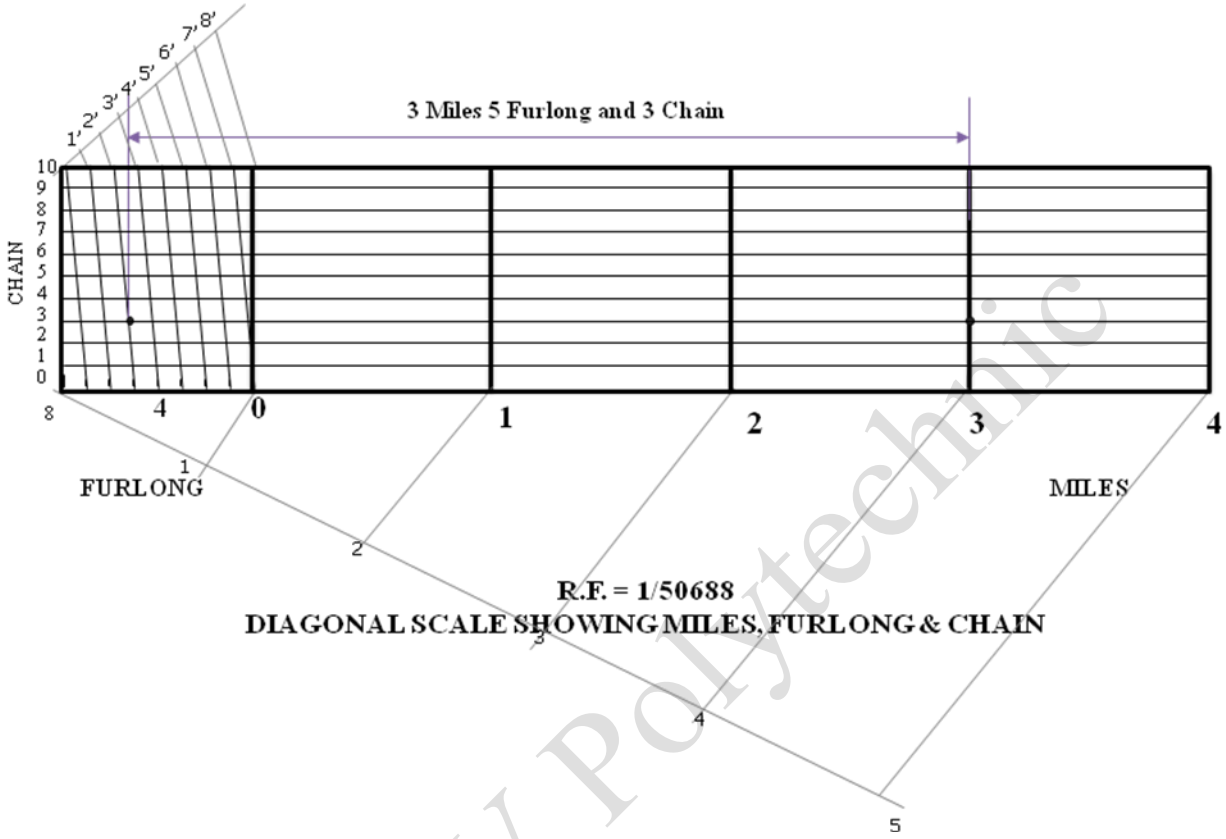
   Given: - R.F. = 1 / 50688

2. Calculate Length of scale = R.F. X Max. length to be measured

   = 1 / 50688 X 5 miles X 8 furlongs X 220 yards X 3 feet X 12 inches

   LOS = 6.25 inches

3. Draw a line 6.25 inches long. It will represent 5 miles. Divide it in 5 equal parts. (Each will represent 1 mile.)
4. Divide first division in 8 equal parts. Each will represent 1 furlong.
5. Draw a line upward from left end and mark 10 parts on it. Each will represent 1 chain (220 yards)
6. Name those parts 0 to 10 as shown.
7. Join 9^{th} sub-division of horizontal scale with 10^{th} division of the vertical divisions.
8. Then draw parallel lines to this line from remaining sub divisions and complete diagonal scale.
9. Mark a distance of 3 Miles 5 Furlong and 3 Chain.



R.F. = 1/50688

DIAGONAL SCALE SHOWING MILES, FURLONG & CHAIN

Engineering Curves

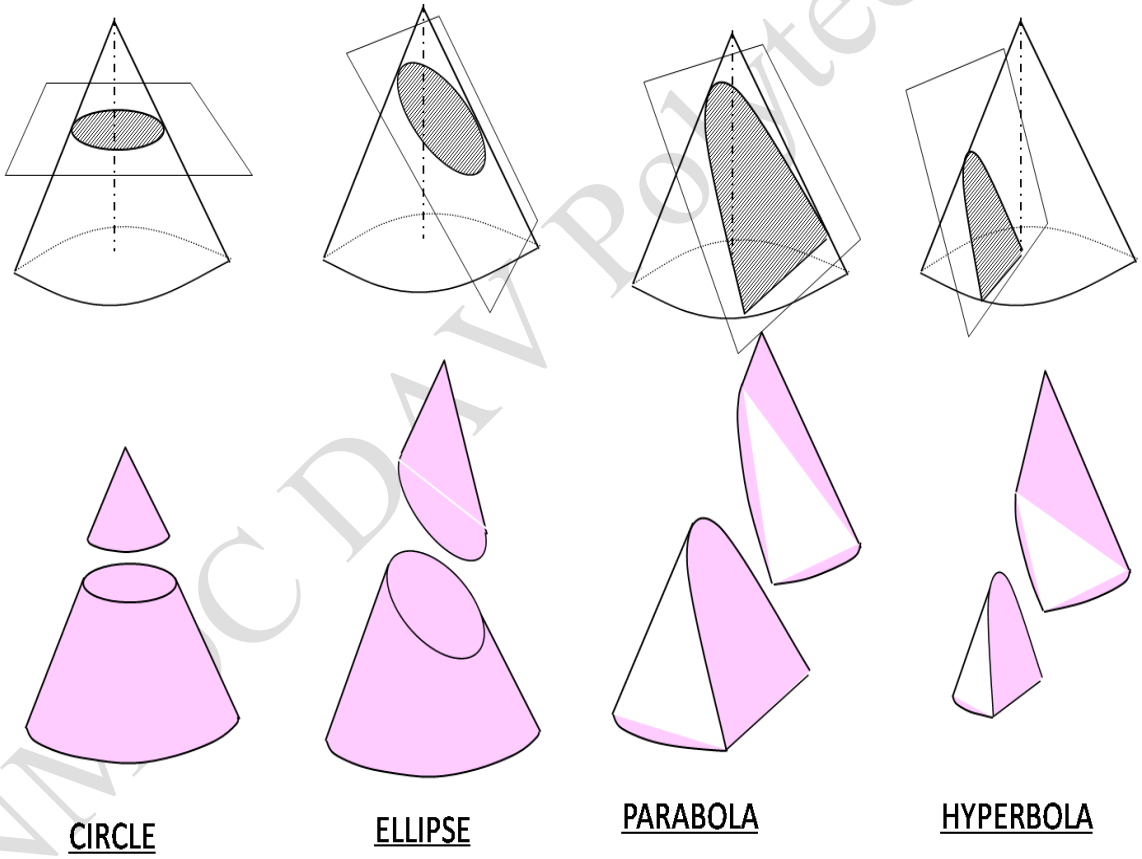
CURVES

Curves used in Engineering Practice:

1. Conic sections:-Ellipse, Parabola, Hyperbola,
2. Cycloidal curves
3. Involute
4. Evolutes
5. Spirals
6. Helix

CONICS

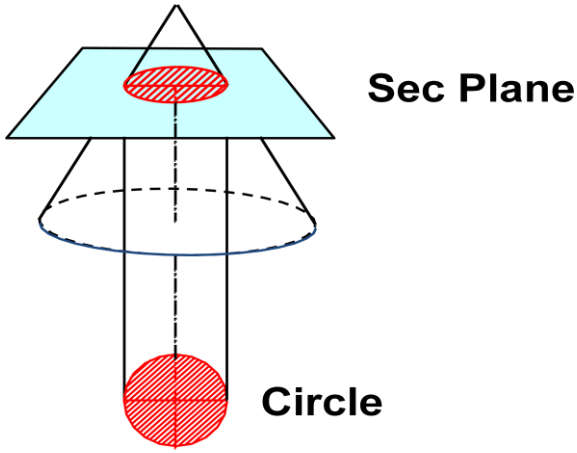
- ***Definition :-*** **The section obtained by the intersection of a right circular cone by a cutting plane in different position relative to the axis of the cone are called CONICS.**



1

CIRCLE

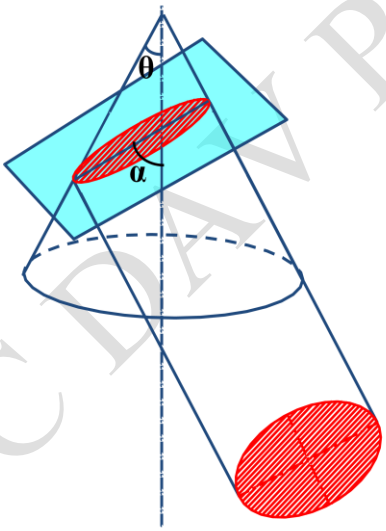
- **When the cutting plane is perpendicular to the axis or parallel to the base in a right cone we get circle the section.**



ELLIPSE

Definition :-

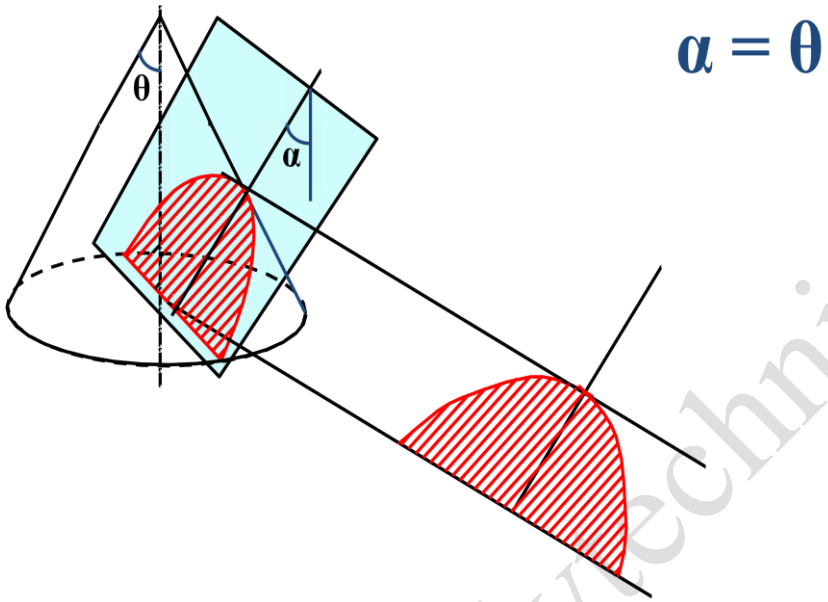
- **When the cutting plane is inclined to the axis but not parallel to generator or the inclination of the cutting plane(α) is greater than the semi cone angle(θ), we get an ellipse as the section.**



$\alpha > \theta$

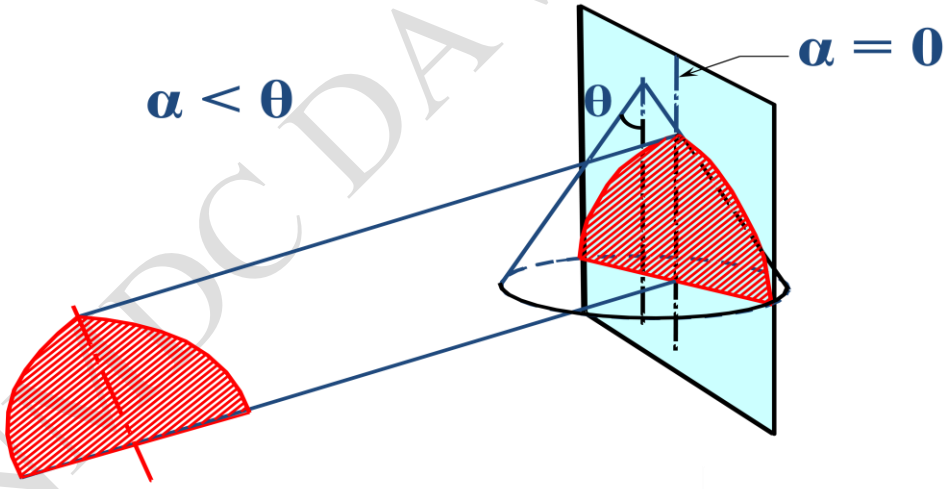
PARABOLA

- **When the cutting plane is inclined to the axis and parallel to one of the generators of the cone or the inclination of the plane(α) is equal to semi cone angle(θ), we get a parabola as the section.**



HYPERBOLA

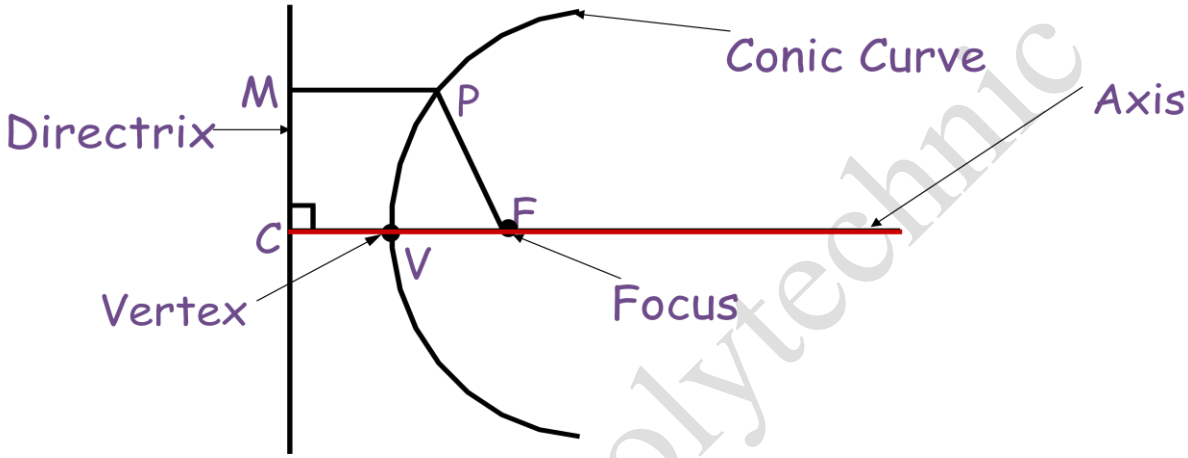
When the cutting plane is parallel to the axis or the inclination of the plane with cone axis(α) is less than semi cone angle(θ), we get a hyperbola as the section.



CONICS

- Definition :- The locus of point moves in a plane such a way that the ratio of its distance from fixed point (focus) to a fixed Straight line (Directrix) is always constant.

- Fixed straight line is called as directrix.
- Fixed point is called as focus.
- **The line passing through focus & perpendicular to directrix is called as axis.**
- **The intersection of conic curve with axis is called as vertex.**



$$\text{Ratio} = \frac{\text{Distance of a point from focus}}{\text{Distance of a point from directrix}}$$

e = **PF/PM**

COMMON DEFINATION OF ELLIPSE, PARABOLA & HYPERBOLA:

The Ratio is called **ECCENTRICITY. (E)**

A) **For Ellipse E<1**

B) **For Parabola E=1**

C) **For Hyperbola E>1**

Short Type Answer Question

1. **Explain "Hypocycloid" curve. (April - May 2009)**

Ans: curve traced by a point on the circumference of a circle, which rolls without slipping along circle inside it.

2. **Define conic section. What is eccentricity? (Nov- Dec. 2008)**

Ans:- **Conic Section**:- The section obtained by the intersection of a right circular cone and a plane in different positions relative to the axis of the cone are called conic sections.

Eccentricity: - The ratio of distance of the point from the focus to the distance of the point from the directrix is called eccentricity. Therefore,

$$\text{Eccentricity} = \frac{\text{Distance of the point from the focus}}{\text{Distance of the point from the directrix}}$$

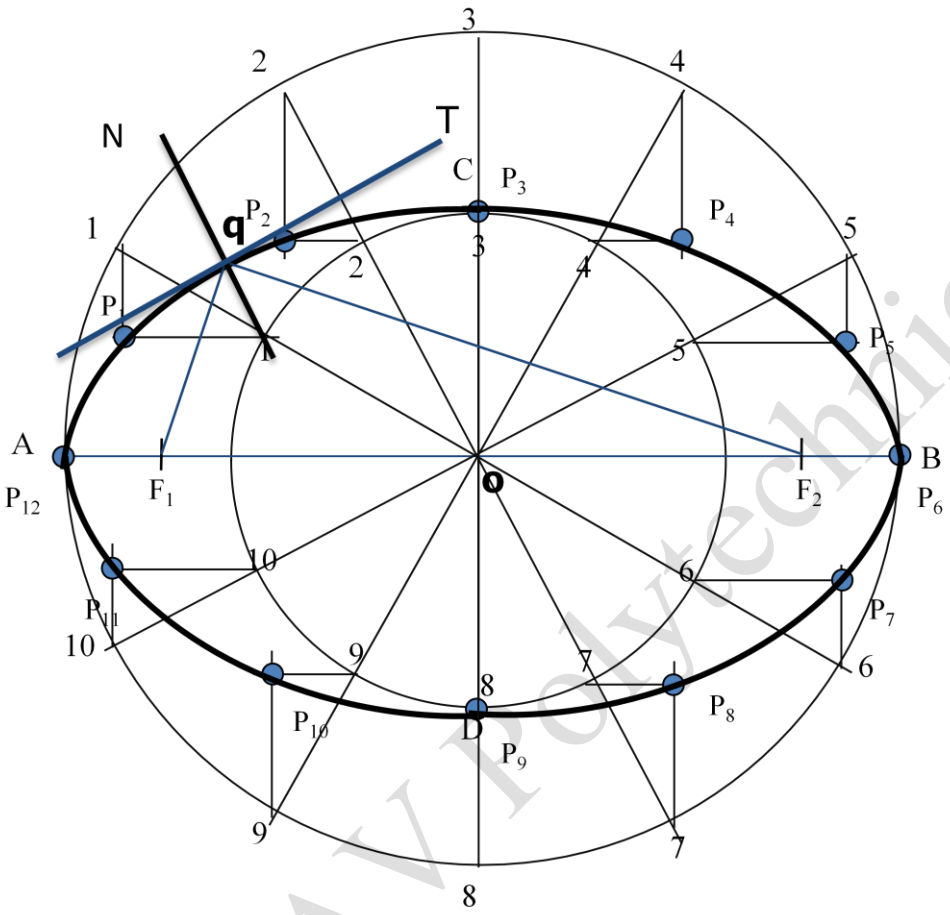
It is always less then 1 for ellipse, equal to 1 for parabola and greater than 1 for hyperbola

Long Type answer question

1. The foci of an ellipse are 90 mm apart and the minor axis is 65 mm long. Determine the length of major axis and draw ellipse by concentric circle method. Draw a tangent and a normal to the ellipse at a point 25 mm above the major axis. (**Nov- Dec. 2012, 2008)**

Solution Steps-

- Draw both axes as perpendicular bisectors of each other & name their ends as shown. Mark foci F_1, F_2 = 90 mm, take arc of F_1, to C and centre O mark A & B (Major axis).
- Taking their intersecting point as a center, draw two concentric circles considering both as respective diameters.
- Divide both circles in 12 equal parts & name as shown.
- From all points of outer circle draw vertical lines downwards and upwards respectively.
- From all points of inner circle draw horizontal lines to intersect those vertical lines.
- Mark all intersecting points properly as those are the points on ellipse.
- Join all these points along with the ends of both axis in smooth possible curve. It is required ellipse.
- Mark Point q 40 mm above major axis on curve.
- Join point q to f_1 & f_2
- Bisect angle $f_1 q f_2$ the angle bisector is normal
- A perpendicular line drawn to it is tangent to the curve.

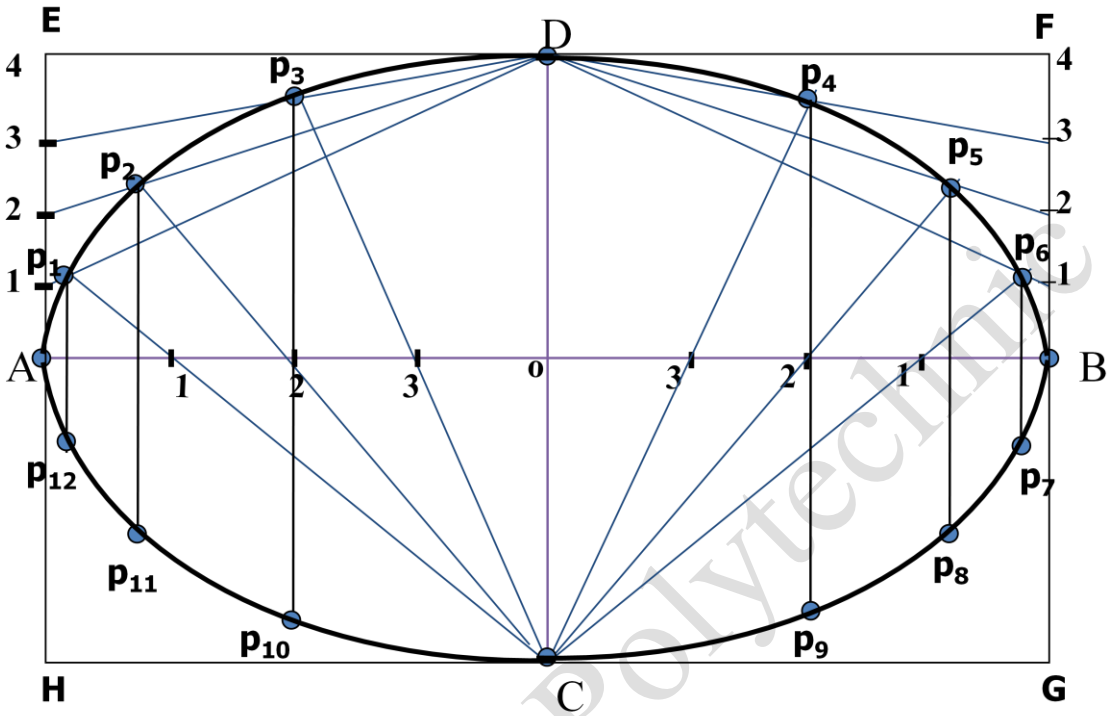


Length of major axis is 100mm

2. A Plot of ground is in the shape of rectangle 110 m X 50 m. inscribe an elliptical lawn in it. Take a scale of 1: 1000. (April- May, 2007)

Solution steps:-

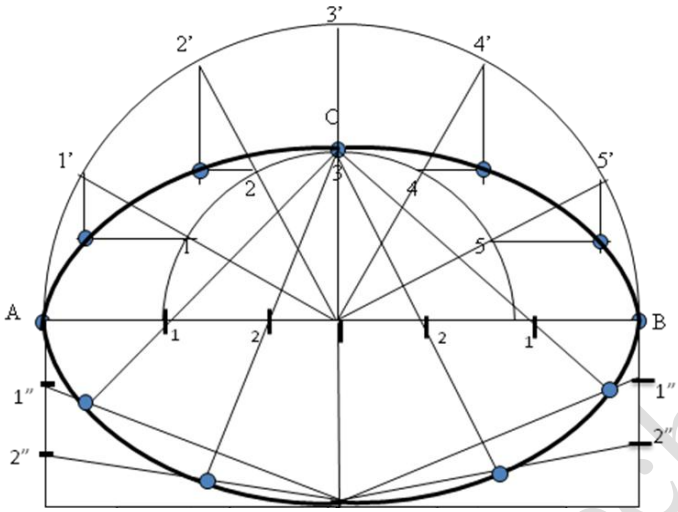
- Take Scale 10m = 1cm, RF = 1/1000
- Draw the two axis AB and CD intersecting at O (110X50mm).
- Construct oblong having its side equal to the two axis
- Divide semi major axis AO in equal no of parts say 4 and AE into same no of equal parts, numbering them from A toward O as 1, 2 and 3. and toward E as 1', 2' and 3'
- Draw lines joining 1', 2', 3' with C.
- From D, draw lines through 1, 2 and 3 intersecting C1', C2', C3' at points P1, P2, P3 respectively.
- Draw the curve through A, P1, P2…. C. It will be one quarter of the ellipse.
- As the curve is symmetrical about two axis, remaining points of ellipse may be located by drawing parallel lines from P1, P2, P3 with axes and taking equidistance from the axes.



3. The foci of an ellipse are 80 mm apart and the minor axis is 60 mm long. Determine the lengths of major axis and draw half the ellipse by concentric circle method and the other half by oblong method. (Nov- Dec 2010)

Solution steps:-

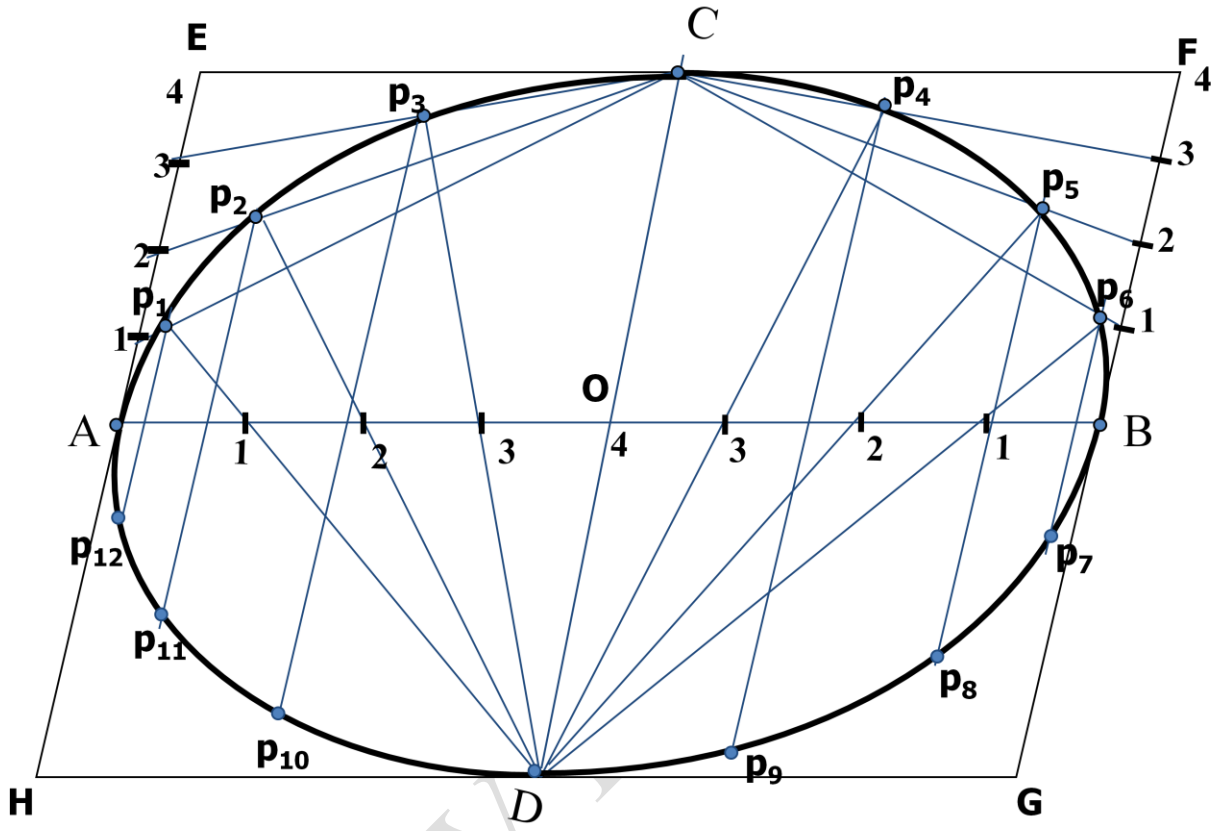
1. Draw both axes as perpendicular bisectors of each other & name their ends as shown. Mark foci F_1, F_2 = 90 mm, take arc of F_1, to C and centre O mark A & B (Major axis).
2. Taking their intersecting point as a center, draw two concentric circles considering both as respective diameters (only Half part) and Same steps should be taken as in case of Concentric circle method.
3. Similarly for half part use oblong method, same steps should be taken as in case of oblong method.



Length of major axis is 100mm

4. Inscribe an ellipse in a parallelogram having sides 150 mm and 100 mm long, and an included angle of 120 degree. (Nov- Dec, 2007)
   Solution Steps:-

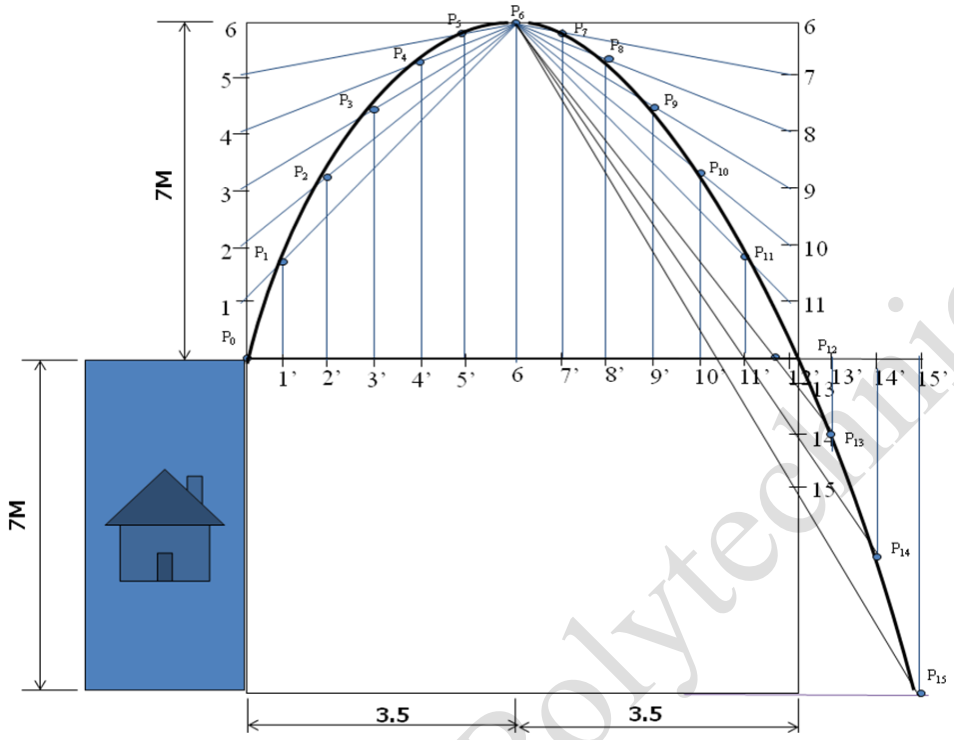
- Draw the two axes AB and CD intersecting at O angle with 120^0.
- Construct oblong having its side equal to the two axes
- Divide axis AO in equal no of parts say 4 and AE into same no of equal parts, numbering them from A toward O as 1, 2,3 and 4. and toward E as 1', 2' ,3'and 4'
- Draw lines joining 1', 2'.. 4' with C.
- From D, draw lines through 1, 2 and 3,4 intersecting C1', C2', C3',C4' at points P1, P2, P3,P4 respectively.
- Draw the curve through A, P1, P2…. C. It will be one quarter of the ellipse.
- As the curve is symmetrical about two axis, remaining points of ellipse may be located by drawing parallel lines from P1, P2, P3 with axes and taking equidistance from the axes.



5. A stone is thrown from a building of 7 m height and at its highest flight the stone just crosses a palm tree of 14 m height. Trace the path of the stone, if the distance between the building and the tree is 3.5 m. (Nov- Dec, 2010)

Solution Step:

1. Take Scale 1 cm = 10 m, RF = 1/1000
2. Draw rectangle and divide it in two equal vertical parts. And same steps should be taken as in case of rectangle method.



Unit -3
Projection of Points, Lines and Planes

Projection

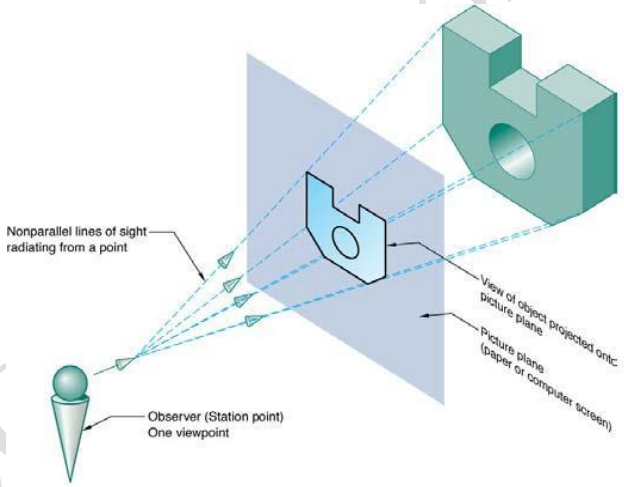
Introduction

The projection is achieved by the use of imaginary "projectors". The projected, mental image becomes the technician's vision of the desired, finished picture. By following the protocol the technician may produce the envisioned picture on a planar surface such as drawing paper. The protocols provide a uniform imaging procedure among people trained in technical graphics (mechanical drawing, computer aided design, etc.).

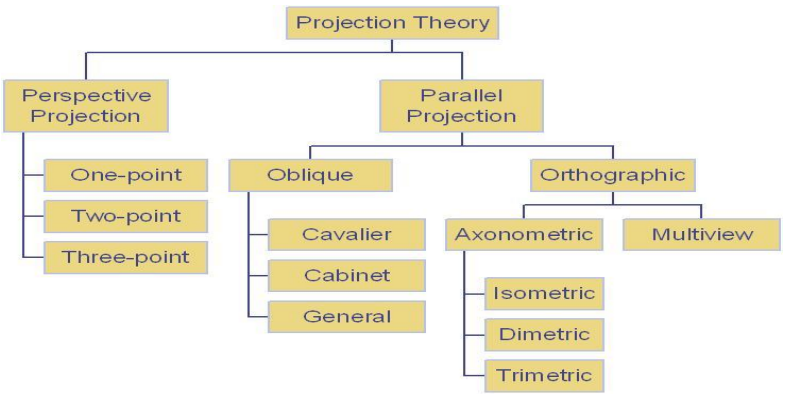
A projection is a mapping of a 3D space onto a 2D subspace

- 2D space is called the projection plane
- Projection also refers to image resulting from such a mapping

If straight lines are drawn from various points on the contour of an object to meet a plane, the object is said to be projected on that plane. The figure formed by joining, in correct sequence, the points at which these lines meet the plane, is called the projection of the object. The lines from the object to the plane are called projectors.



Classification of Projections



Method Of Projection

1. Orthographic Projection
2. Isometric Projection
3. Oblique Projection
4. Perspective Projection

Parallel projection

In parallel projection, the lines of sight from the object to the projection plane are parallel to each other. Within parallel projection there is an ancillary category known as "pictorials". Pictorials show an image of an object as viewed from a skew direction in order to reveal all three directions (axes) of space in one picture. Because pictorial projections innately contain this distortion, in the rote, drawing instrument for pictorials, some liberties may be taken for economy of effort and best effect.

Orthographic projection

The Orthographic projection is derived from the principles of descriptive geometry and is a two-dimensional representation of a three-dimensional object. It is a parallel projection (the lines of projection are parallel both in reality and in the projection plane). It is the projection type of choice for working drawing.

Axonometric projection

A characteristic of axonometric projections/drawing is, one axis of space usually displays as vertical

Isometric projection

In **isometric pictorials** the direction of viewing is such that the three axes of space appear equally foreshortened, of which the displayed angles among them and also the scale of foreshortening are universally known. However in creating a final, isometric instrument *drawing*, in most cases a full-size scale, i.e., without using a foreshortening factor, is employed to good effect because the resultant distortion is difficult to perceive.

Oblique projection

In oblique projections the parallel projection rays are not perpendicular to the viewing plane as with orthographic projection, but strike the projection plane at an angle other than ninety degrees. In both orthographic and oblique projection, parallel lines in space appear parallel on the projected image. Because of its simplicity, **oblique projection** is used exclusively for pictorial purposes rather than for formal, working drawings. In an oblique pictorial *drawing*, the displayed angles among the axes as well as the foreshortening factors (scale) are arbitrary. The distortion created thereby is usually attenuated by aligning one plane of the imaged object to be parallel with the plane of projection thereby creating a true shape, full-size image of the chosen plane. Special types of oblique projections are cavalier projection and cabinet projection.

Perspective projection

Perspective projection is a type of projection where three dimensional objects are not projected along parallel lines, but along lines emerging from a single point. This has the effect that distant objects appear smaller than nearer objects. It also means that lines which are parallel in nature appear to intersect in the projected image, for example if railways are pictured with perspective projection, they appear to converge towards a single point, called vanishing point. Photographic lenses and the human eye work in the same way, therefore perspective projection looks most realistic

Perspective projection is usually categorized into one-point, two-point and three-point perspective, depending on the orientation of the projection plane towards the axes of the depicted object

Projection of Points

Notation

Following notation should be followed while naming different views in orthographic projection.

OBJECT	POINT A	LINE AB
IT'S TOP VIEW	a	a b
IT'S FRONT VIEW	a'	a' b'
IT'S SIDE VIEW	a"	a" b"

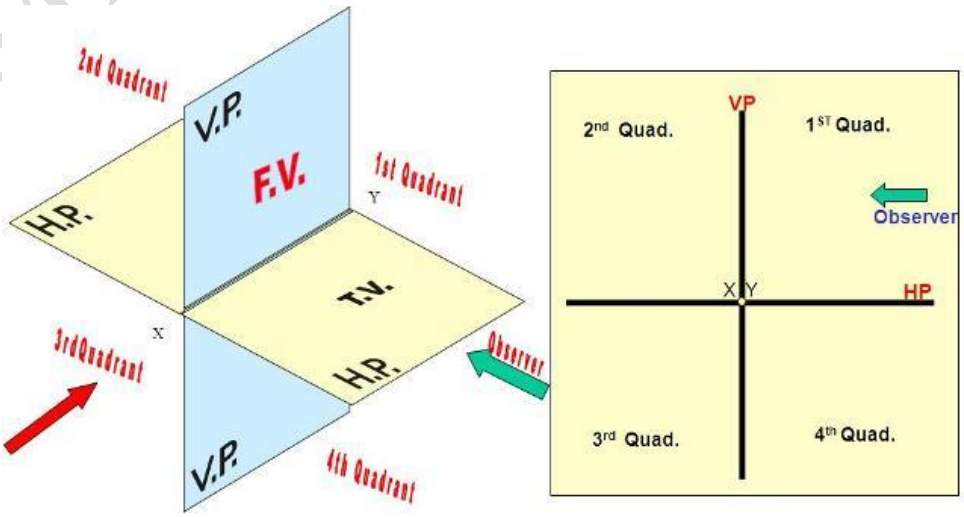
Same system of notation should be followed incase numbers like 1,2,3 - are used.

Introduction

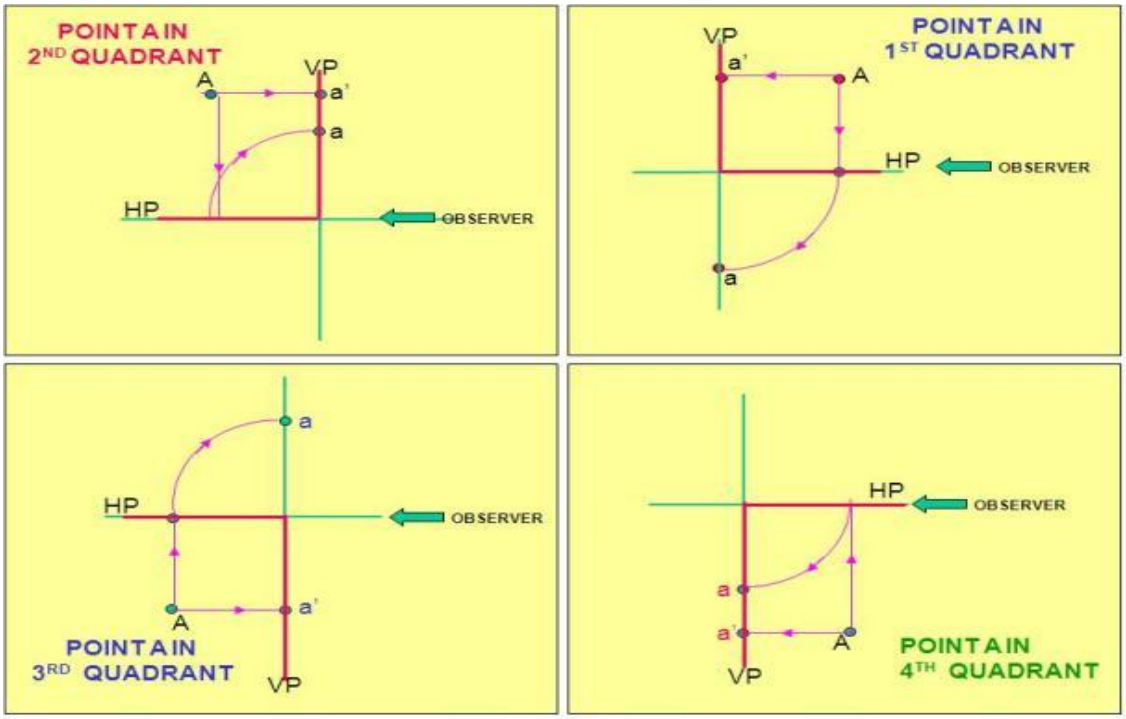
A point may be situated, in space, in any one of the four quadrants formed by the two principal planes of projection or may lie in any one or both of them.Its projections are obtained by extending projectors perpendicular to the planes.One of the planes is then rotated so that the first and third quadrants are opened out. The projections are shown on a flat surface in their respective positions either above or below or in xy.

Four Cases:

1. The point is situated in the first quadrant.
2. The point is situated in the second quadrant.
3. The point is situated in the third quadrant.
4. The point is situated in the fourth quadrant.



Point A is Placed In different quadrants and it's Fv & Tv are brought in same plane for Observer to see clearly. Fv is visible asit is a view on VP. But as Tv is is a view on Hp, it is rotated downward 90^0, In clockwise direction. The In front part of Hp comes below xy line and the part behind Vp comes above. Observe and note the process.



ANSWER QUESTIONS

1. Explain clearly the difference between first angle projection and third angle projection.

Ans: Comparison of first & third angle projection:

S.N.	First angle projection	Third angle projection
1.	The object is assumed to be situated in the first quadrant.	The object is assumed to be situated in the third quadrant.
2.	**The object lies in between the observer and the plane of projection.**	**The plane of projection lies in between the observer and the object.**
3.	View from above (top view) is drawn below of front view.	View from above (top view) is drawn above of front view.
4.	View from below (bottom view) is drawn above front view.	View from below (bottom view) is drawn below front view.
5.	View from left (left side view) is drawn on the right of front view.	View from left (left side view) is drawn on the left of front view.
6.	View from right (right side view) is drawn on the left of front view.	View from right (right side view) is drawn on the right of front view.
7.	View from the rear (rear view) is drawn on left or right of front view.	View from the rear (rear view) is drawn on right or left of front view.

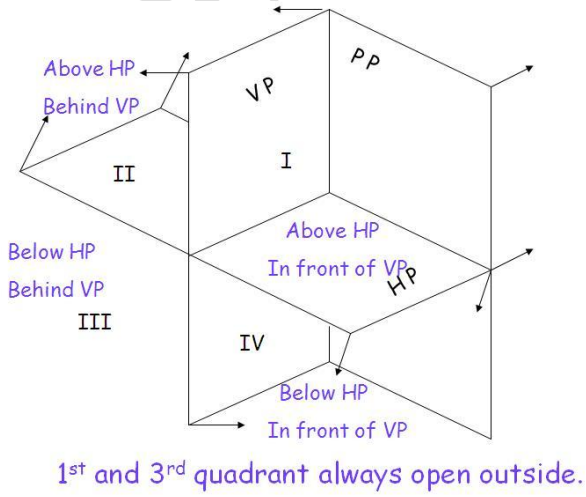
2. List the four method of projection.

   Ans: Method of projection are;

   - Orthographic Projection
   - Isometric Projection
   - Oblique projection
   - Perspective projection

3. What do you mean by four quadrants?

   Ans:



1st and 3rd quadrant always open outside.

4. Draw the symbols of first and third angle projection.

Ans: According to Indian Standard fig.(a) shows conventional representation or symbol of first angle projection.

According to I.S.I. fig.(b) shows the conventional representation symbol of third angle projection.

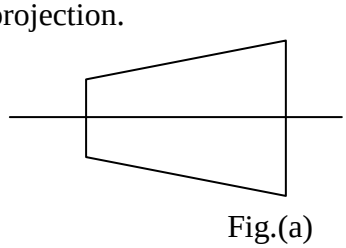


Fig.(a)

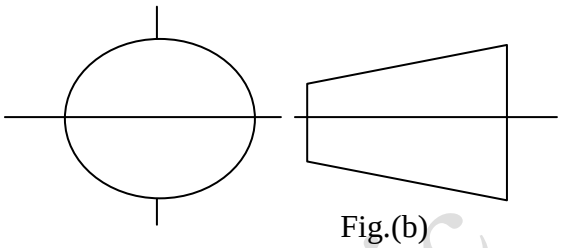


Fig.(b)

5. **What is orthographic projection?**

   Ans: When the projectors are parallel to each other and also perpendicular to the plane, the projection is called orthographic projection.

   Orthographic projection is a means of representing a three-dimensional object in two dimensions. It is a form of parallel projection, where the view direction is orthogonal to the projection plane, resulting in every plane of the scene appearing in affine transformation on the viewing surface. It is further divided into *multi view orthographic projections* and *axonometric projections*.

   In the orthographic projection an object is represented by two or three views on the mutual perpendicular projection planes .Each projection view represents two dimensions of an object. For the complete description of the three dimensional object at least two or three views are required.

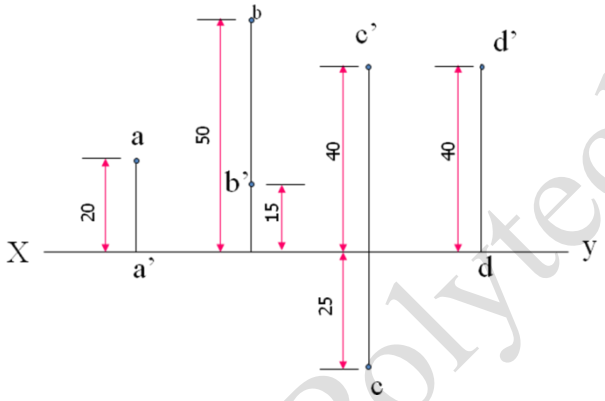
6. **Why the projections of an object are not drawn in second and fourth quadrants?**

   Ans; Second and fourth quadrants are closing quadrants, front view and Top view overlap each other, Hence they are generally not used for practical purpose.

LONG ANSWER QUESTION

1. Draw the projections of following points on the same bar line, keeping the projections 25 mm apart.
   - I. Point A, in the HP and 20 mm behind the VP.
   - II. Point B, 15 mm above HP and 50 behind VP.
   - III. Point C, 40 mm above the HP and 25 mm in front of VP.
   - IV. Point D, in the VP and 40 mm above the HP

Solution:



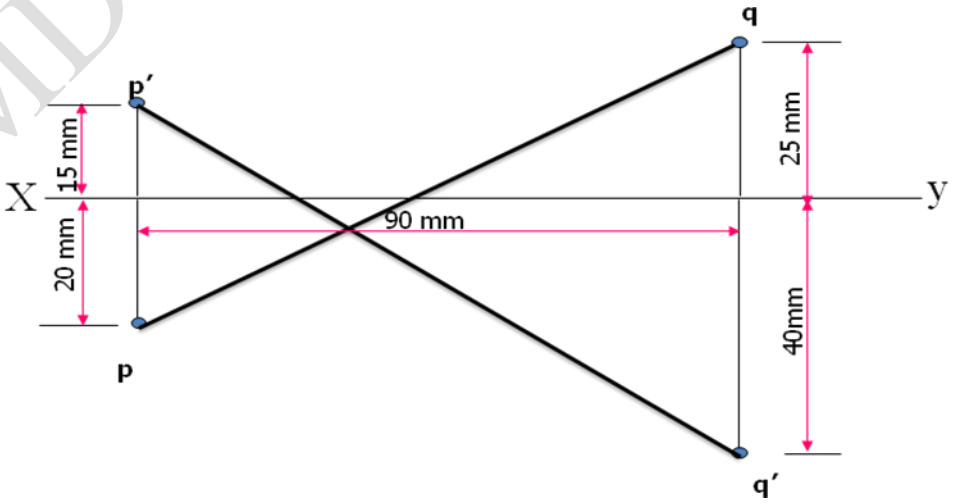
2. A point P is 15 mm, above the HP and 20 mm in front of the VP. Another point Q is 25 mm behind the VP and 40 mm below the HP. Draw projections of P and Q keeping the distance between their projectors equal to 90 mm. draw straight lines joining (i) their top views and (ii) their front views.

   Solution: 1. Draw XY line.

   2. Point P is in first quadrant, its front view p' therefore is 15 mm above XY line and its top view p is 20mm below XY.

   3. Point Q is in third quadrant, its front view q' therefore is 40mm below XY and its corresponding top view q will be 25mm above XY line.

   4. The distance between the projectors is 90mm. Draw the projection as shown in figure.



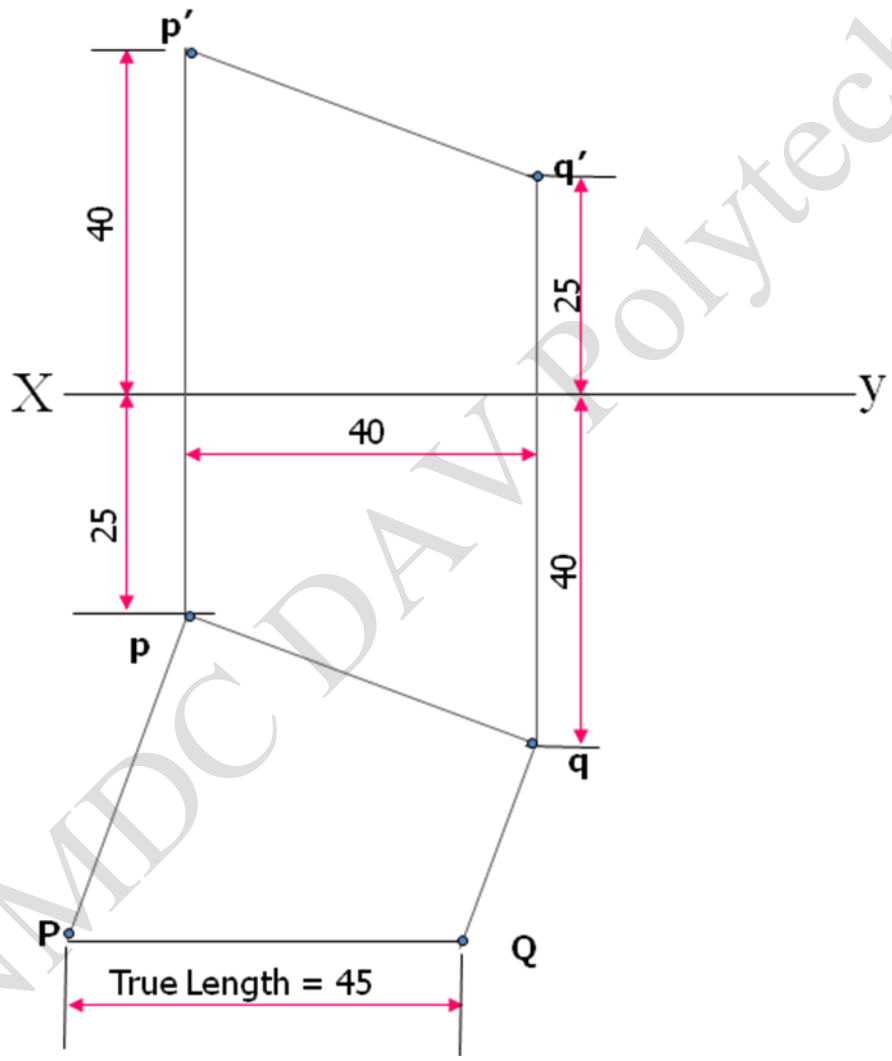
3. A point P is 25 mm in front of the V.P. and 40 mm above the H.P. Another point Q is 40 mm in front of the V.P. and 25 mm above H.P. the distance measured between the projectors is 40 mm. Draw the projections and the distance P and Q.

Solution: 1. Draw XY line.

2. Point P is in first quadrant, its front view p' therefore is 40 mm above XY line and its top view p is 25mm below XY.

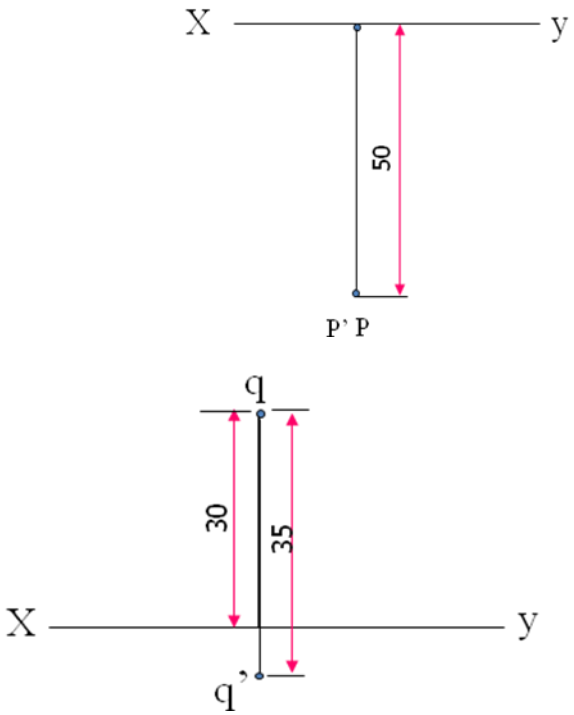
3. Point Q is in first quadrant, its front view q' therefore is 40mm below XY and its corresponding top view q will be 25mm above XY line.

4. The distance between the projectors is 40mm. Draw the projection as shown in figure.



4.(i) State the quadrant in which following points are situated (1) points Q its top view is 30 mm above xy & front view is 35 below the top view.(2) Point P its projection coincide with each other 50 mm below xy.

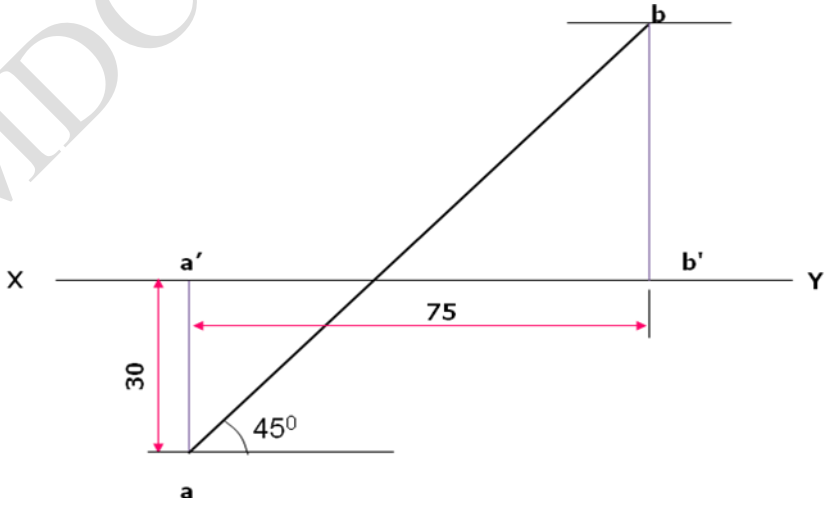
(ii) Two points A & B are in the H.P. The point A is 30 mm in front of the V.P. while B is behind VP. The distance between their projectors is 75 mm & line joining their top views makes an angle of 45^0 with xy. Find the distance of point B from the VP.



From the figure we can conclude that point P is in second quadrant and Q is in third quadrant.

(i)

Solution: 1. Draw XY line.
2. Point A is in first quadrant, its front view a' therefore is in XY line and its top view a is 30mm below XY.
3. Point b is in VP and, draw 45^0 from point a up to extension line of b' and mark point b.
4. The distance between the projectors is 75mm. Draw the projection as shown in figure.



The distance of point B from the VP is 45 mm

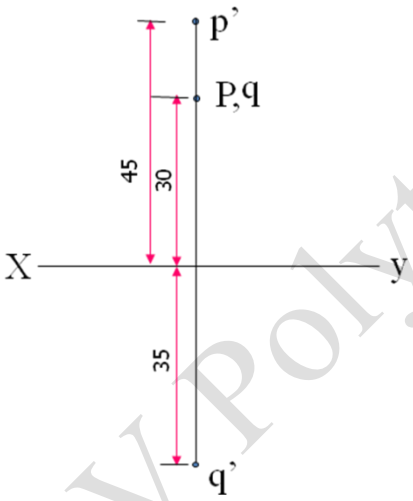
(ii)

5. A point 30 mm above xy line is the plan view of two points P and Q. the elevation of P is 45 mm above the HP, while that of Q is 35 mm below HP. Draw the projections of the points and state their position with reference to the principal plane and the quadrant in which they lie.

   Solution –

   1. First mark plan view of points P and Q 30mm above XY line.
   2. As point P is above HP, mark p' 45mm above XY.
   3. Mark q' 35mm below XY line.

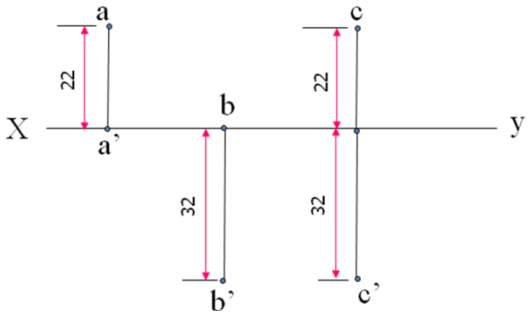
   From the figure we can conclude that point P is in second quadrant and Q is in first quadrant.



1. Draw the projections of the following points in third quadrant, when the point A lies in the HP and 22 mm away from the VP point B lies in the VP and 32 mm away from the HP point C lies 32 mm from the HP and 22 mm from the VP.

Solution –

1. Draw a reference line XY.
2. Through any point in it, draw a perpendicular, as point A lies in the HP and 22mm away from VP, its FV will be in the XY line and TV will be above XY line.
3. On the perpendicular mark a' in XY line and point a such that its distance from XY line will be 22mm.
4. Similarly draw projections for point B and C.



NMDC DAV POLYTECHNIC

Shri Atal Bihari Vajpeyee, Education City, Jawanga, Geedam

Projection of Lines

Introduction

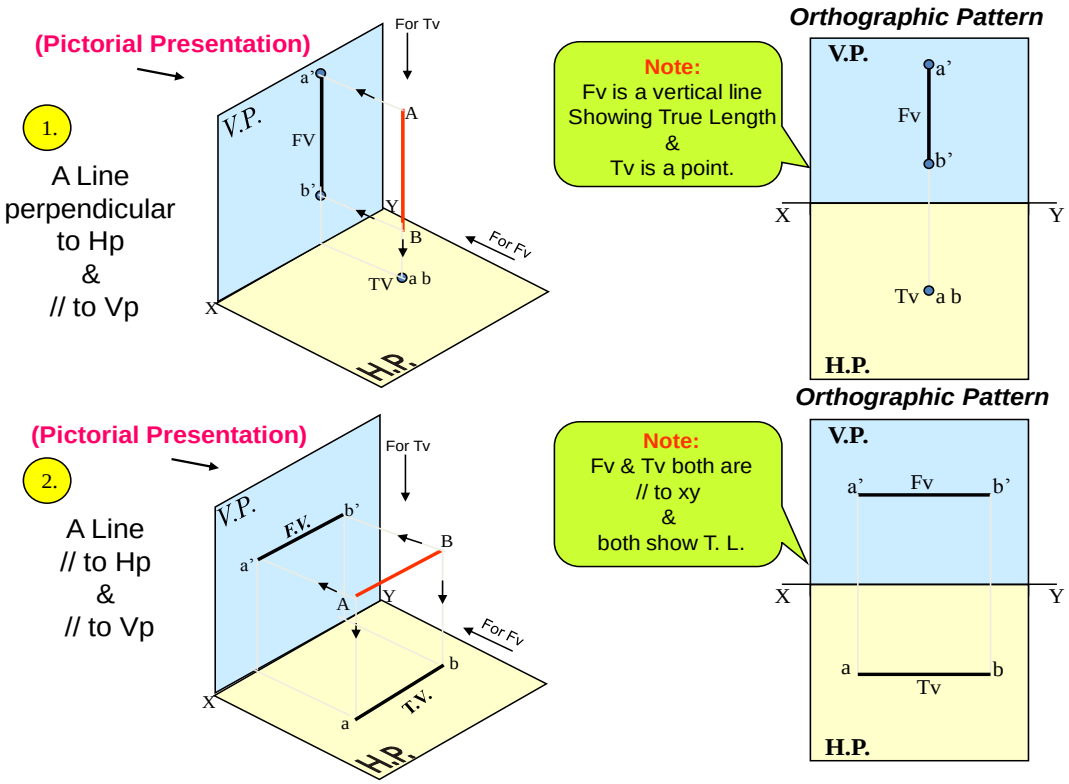
A straight line is the shortest distance between the two points. Hence, the projections of a straight line may be drawn by joining the respective projections of its ends which are points.

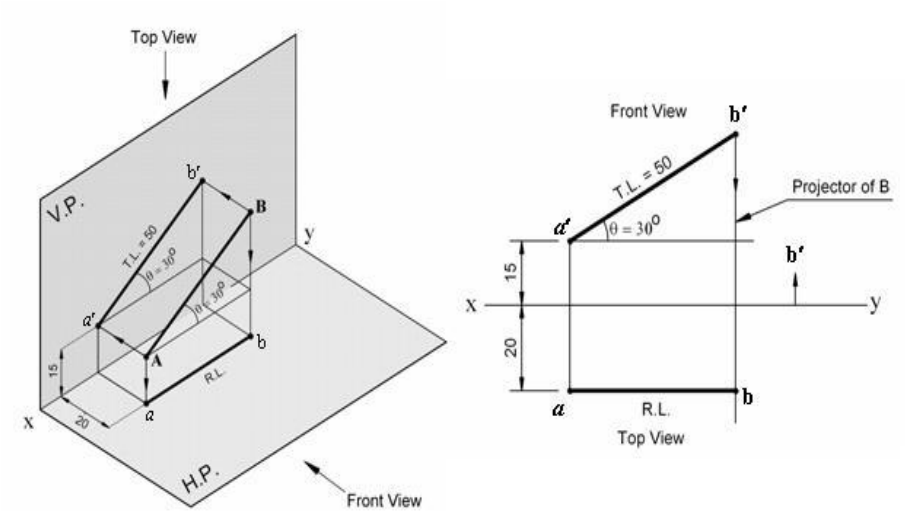
The position of a straight line may also be described with respect to the two reference planes.

It may be :-

1. Parallel to one or both the planes.
2. Contained by one or both the planes.
3. Perpendicular to one of the planes.
4. Inclined to one plane and parallel to the other.
5. Inclined to both the planes.
6. Projections of lines inclined to both the planes.
7. Line contained by a plane perpendicular to both the reference planes.
8. True length of a straight line and its inclinations with the reference planes.
9. Traces of a straight line.
10. Methods of determining traces of a line.
11. Traces of a line, the projection of which are perpendicular to xy.
12. Positions of traces of a line.

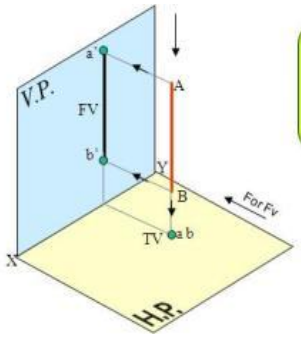
Line Parallel to One or Both the Planes



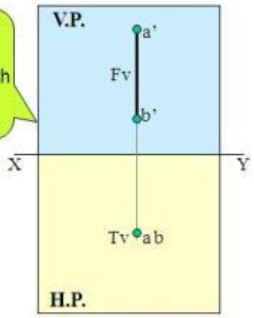


Line perpendicular to one of the planes

A Line perpendicular to Hp & // to Vp

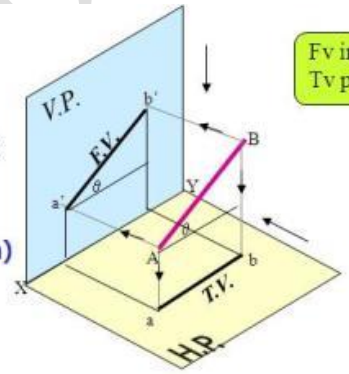


Note:
Fv is a vertical line Showing True Length
&
Tv is a point.

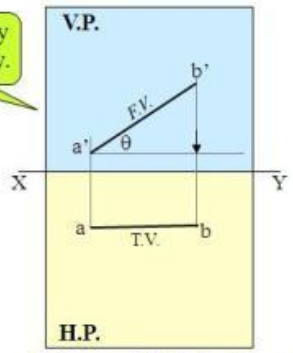


Line Inclined To One Plane and Parallel to Other

A Line inclined to Hp and parallel to Vp
(Pictorial presentation)

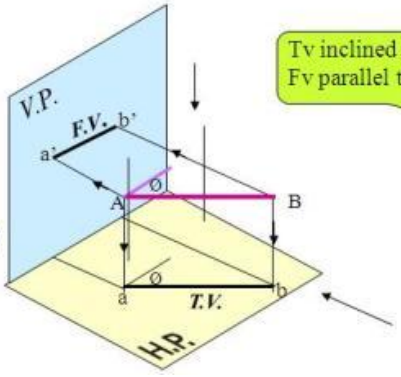


Fv inclined to xy
Tv parallel to xy.

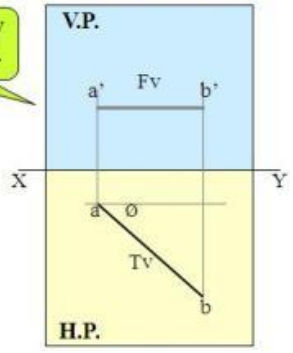


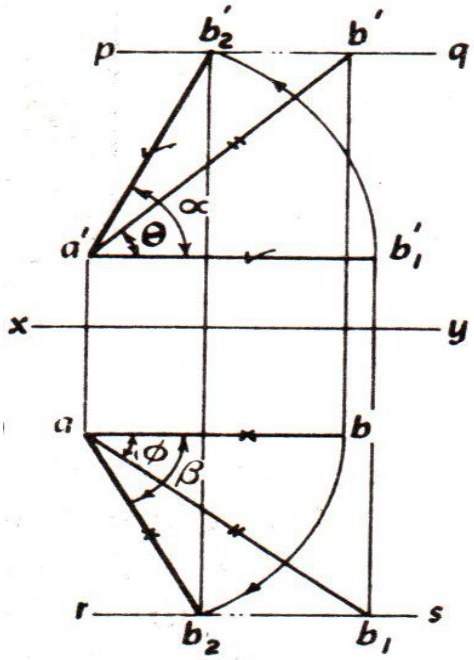
Orthographic Projections

A Line inclined to Vp and parallel to Hp
(Pictorial presentation)



Tv inclined to xy
Fv parallel to xy.



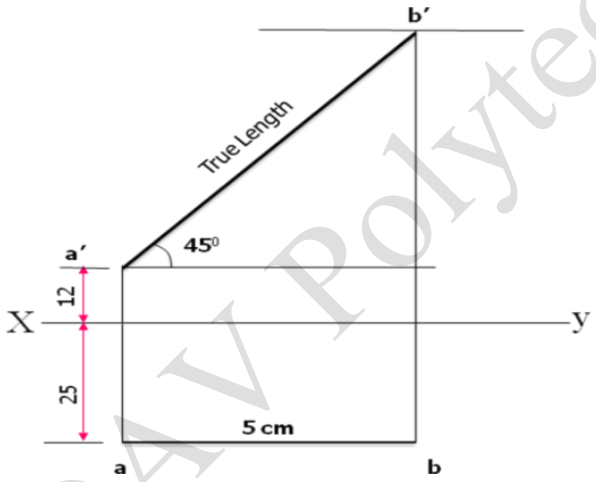


1. The length of the top view of a line parallel to the VP and inclined to 45 degree to the HP is 5 cm one end of the line is 1.2 cm above the HP and 2.5 cm in front of the VP. Draw the projections of the line and determine its true length.

Sol. : Given data - θ = 45˚(inclination with the HP)

Length of TV = 5cm

1. Draw reference line XY.
2. Draw top view of point A 2.5cm below and front view 1.2cm above XY line as given.
3. From point a draw a 5cm line parallel to XY i.e. the top view of the line.
4. Project point a and b to the upper side of XY line.
5. From point a', draw a line inclined at 45˚with the locus of a'.
6. The intersection point of inclined line and projector of point b will give point b'.
7. Measure the length of a'b', which is the TL of AB.



TL = 7.5 cm

2. A verticals line AB, 75 mm long, has its end A in the H.P. and 25 mm in front of the V.P. A line AC, 100 mm long, it in the H.P. and parallel to the V.P. Draw the projection of the line joining B and C, and determine its inclination with the H.P.

Solution:- 1. Draw xy line.

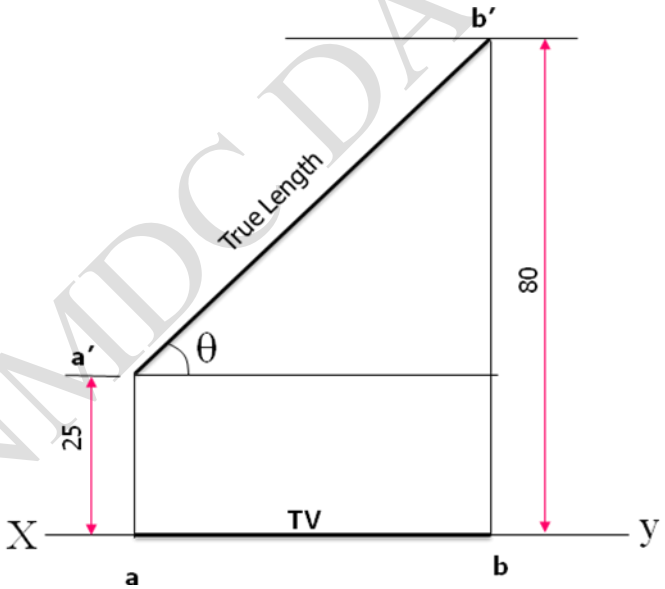
1. Mark a' on xy.
2. Draw a'b' = 75mm long.
3. Mark c' on xy such that a'c' = 100 mm.
4. mark a, b, c, 25 mm below xy, as shown.
5. Join b'c' and measure θ.

Inclination with H.P is 37^0

3.The top view of a 75 mm long line measures 55 mm. the line is in the V.P., its one end being 25 mm above the H.P. Draw its projections. (Nov- Dec. 2012)

Solution:-

1. Draw xy line.
2. Draw ab = 55mm long on xy.
3. locate a', 25mm above xy.
4. Draw projector for b'.
5. Locate b' such that a'b' = 75mm.



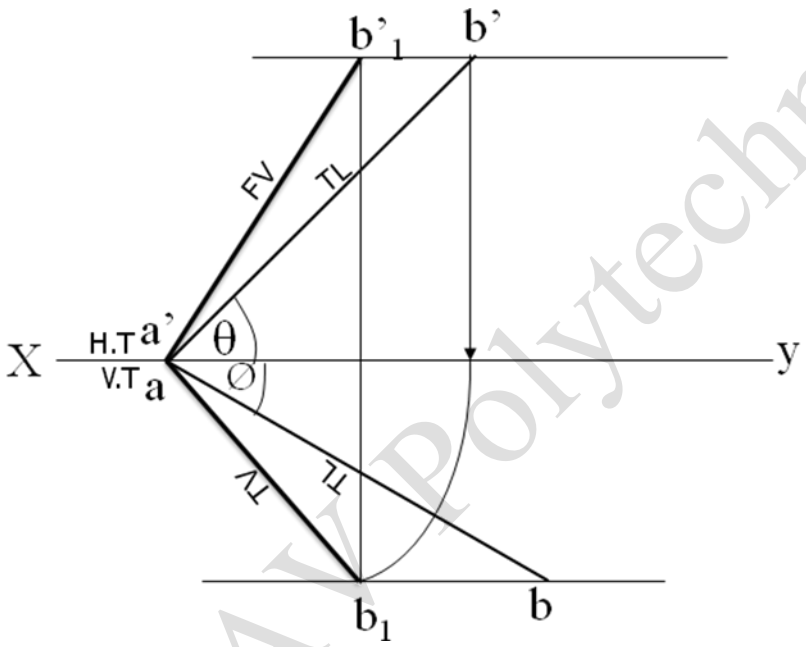
4. A line AB 60 mm long has its end A in both HP and VP. It is inclined at 45 degree to HP and 30 degree to VP. Draw the projections of the line AB and determine its traces.

Solution –

Procedure:- 1. Draw reference line XY.

2. Mark point a' and a in XY line as point A is in HP and VP both.

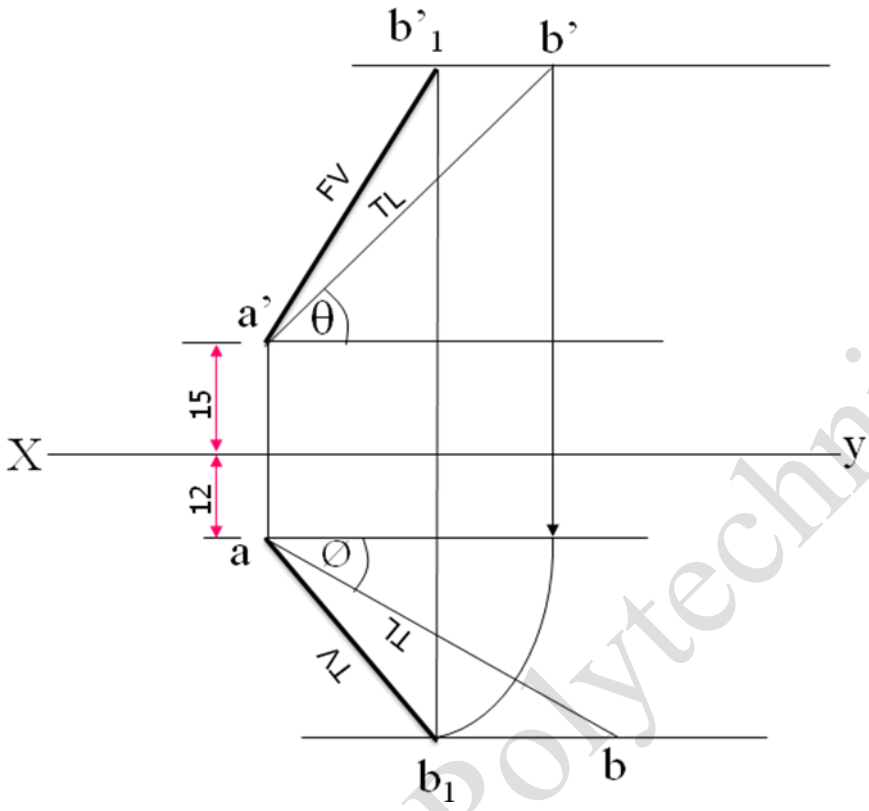
3. From point a' draw 60mm long line at an inclination of 45˚with XY line i.e. a'b'. draw locus of point b' .
4. Similarly draw 60mm long line from point a at an inclination of 30˚with XY line. Draw locus of point b .
5. Now from point b' draw projector to the locus of point a, rotate it to the locus of point b. Join point a with b_1 . ab_1 is the TV of the line AB.
6. Draw projector from point b_1 to the locus of b'. Join a' with b_1'. ab_1' is the FV.
7. It has no traces, as its both FV and TV intersect each other in XY line.



True length of AB = 55 mm
$\theta = 45^0$ (True inclination of line with H.P.)
$\phi = 30^0$ (True inclination of line with V.P.)

5. A straight line AB 55 mm long makes an angle of 30 degree to the HP and 45 degree to the VP. The end is 12 mm in front of VP and 15 mm above HP. Draw the projections of line AB.

Procedure:- 1. Draw reference line XY.
2. through any point in XY line draw a perpendicular and mark point a' 15mm above and point a 12mm below XY line.
3. From point a' draw 55mm long line at an inclination of 30˚with XY line i.e. a'b'. draw locus of point b' .
4. Similarly draw 55mm long line from point a at an inclination of 45˚with XY line. Draw locus of point b .
5. Now from point b' draw projector to the locus of point a, rotate it to the locus of point b. Join point a with b_1 . ab_1 is the TV of the line AB.
6. Draw projector from point b_1 to the locus of b'. Join a' with b_1'. ab_1' is the FV.

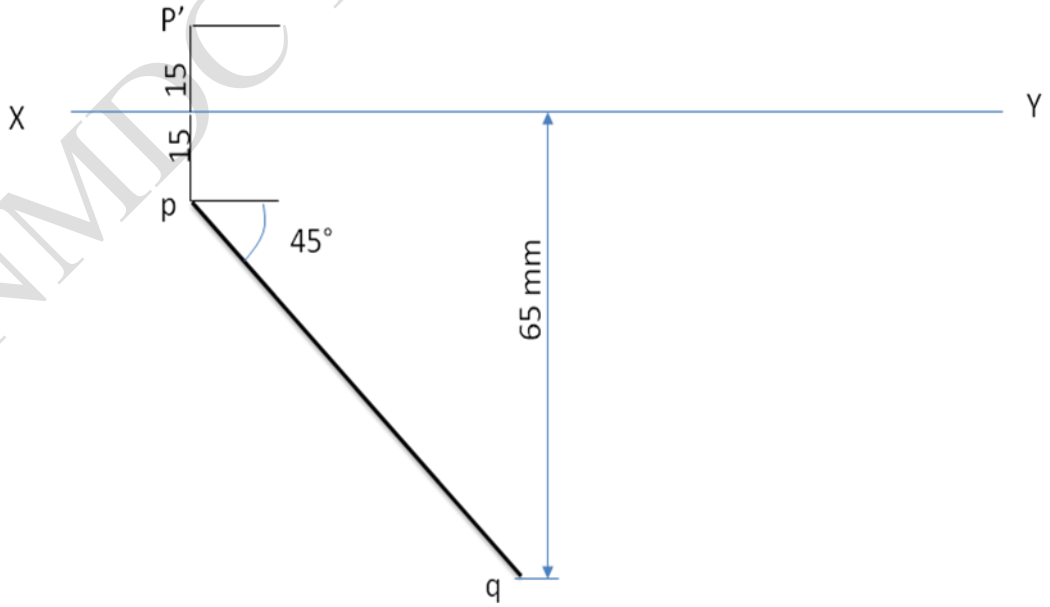


True length of AB = 55 mm

$\theta = 30^0$ (True inclination of line with H.P.)

$\phi = 45^0$ (True inclination of line with V.P.)

6. Incomplete projections of a line PQ, inclined at 30 degree to the HP are given in the figure. Complete the projections and determine its true length and inclination with the VP.



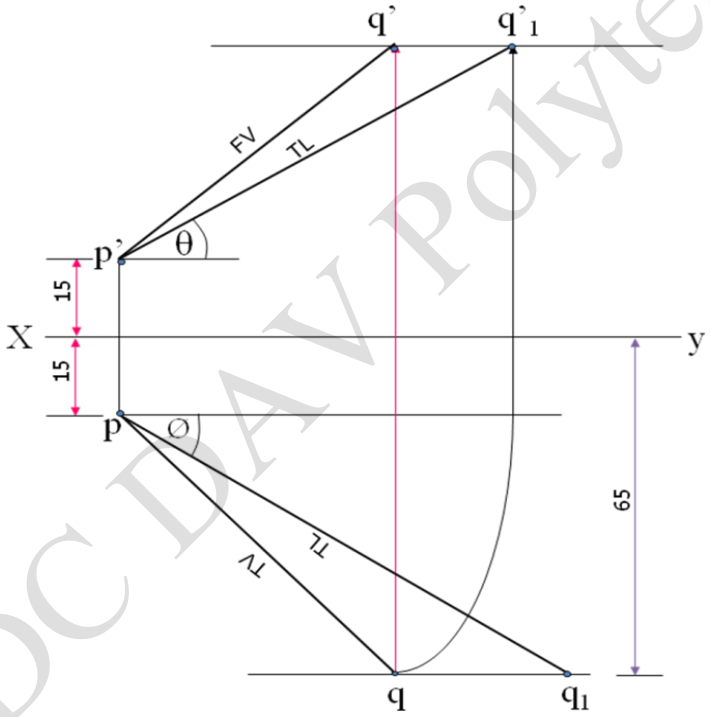
Solution:

True length of AB = 82 mm

$\theta = 30^0$ (True inclination of line with H.P.)
$\phi = 37^0$ (True inclination of line with V.P.)
$\beta = 45^0$(Final (TV) inclination of line with V.P.)

1. Rotate the top views pq to locus of point p, so that it is parallel to xy and then draw projector from this point above xy line
2. Through p' draw a line making an angle 30° with xy and cutting the projector through q_1. $p'q_1'$ is true length of the front view of PQ.
3. Through q_1' , draw a line parallel to xy and cutting the projector through q and q'. p'q' is the front view of PQ.
4. With p as centre and radius equal to $p'q_1'$, draw an arc cutting the locus of q at q_2.

Join q with q_2. ϕ is the inclination of PQ with the VP.

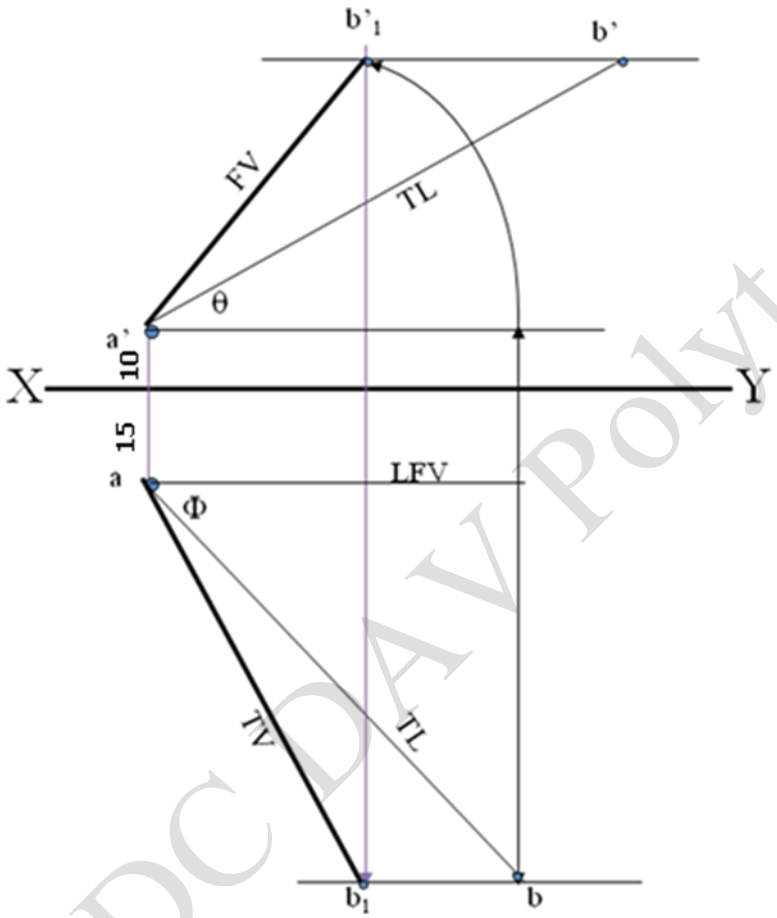


7. A line AB 70 mm long, has its end A at 10 mm above HP and 15 mm in front of VP. Its front view and the top view measure 50 mm and 60 mm respectively. Draw the projections of the line and determine its inclinations with HP and VP.

Solution :- True length of AB = 70mm
F.V = 50mm
T.V = 60
$\theta = 30^0$ (True inclination of line with H.P.)
$\phi = 43^0$ (True inclination of line with V.P.)

1. Mark a' 10mm above and a 15mm below XY line.
2. In the locus of point a, at a distance of 60mm i.e. equals to FV ,draw a projector above XY line.

3. From a' length equal to 70mm, draw a line intersecting the projector drawn. Mark intersection point as b'. join a' and b'.
4. From a' draw a line of length 50mm to meet the locus of b'. it is the TV of the line.
5. Draw a projector from b1' below XY line. From point a draw 60mm long line to meet this projector at b1.
6. Draw line ab of length 70 mm as shown.
7. Measure θ and ϕ.



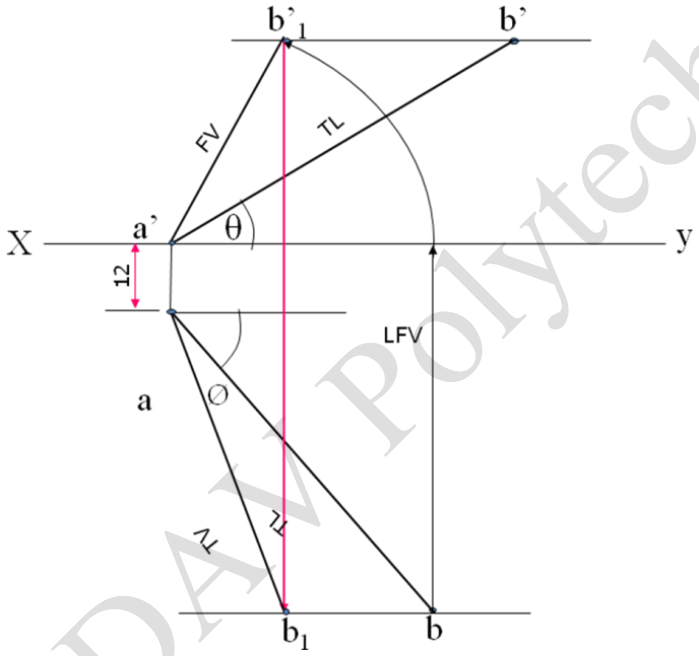
8. The top view of a 75 mm long line AB measures 65 mm while the length of its front view is 50 mm its one end A is in the HP and 12 mm in front of the VP. Draw projection of AB and determine its inclination with HP and the VP.

Sol. Given data – True length of AB = 75mm
Length of TV = 50mm
Length of FV = 65mm
θ = 30^0 (True inclination of line with H.P.)
ϕ = 47^0 (True inclination of line with V.P.)

Procedure:-

1. As point A is in the HP mark point a' in XY line and its front view is 12mm in front of VP, mark point a 12mm below XY line.

2. Mark point on XY line distance equal to 50mm i.e. TV and project it below reference line.
3. From point a draw a line of 75mm length, i.e. TL, intersecting the projector as shown. Name that point as b. draw its locus.
4. From point a draw 65mm line i.e. the TV to the locus of point b. Join a and b1.
5. Project b1 above XY line.
6. Draw an arc of 50mm from point a' such as to cut the projector of point b1.
7. Join a' with b1' which is FV of the line.
8. Measure θ and ϕ.



9. A line AB 50 mm long has its end A in both HP and VP it is inclined at 30 degree to the HP and at 45 degree to the VP. Draw its projections.

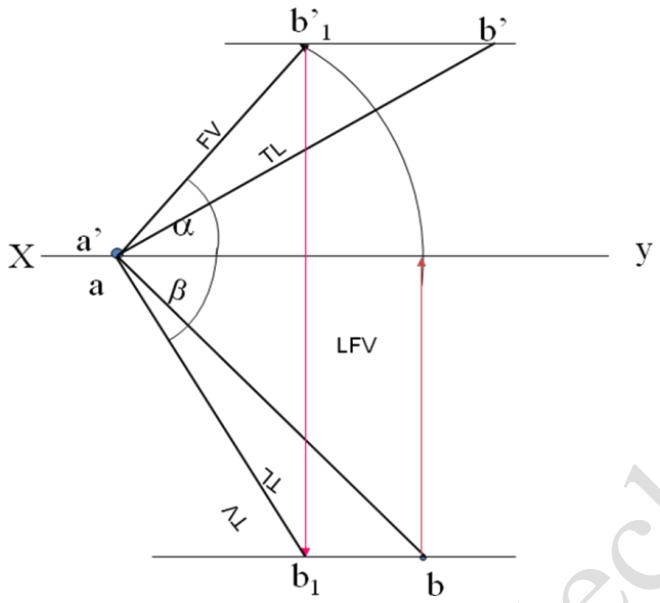
Sol. : Given data - True length = 50mm

θ = 30˚(inclination with HP)

ϕ = 45˚(inclination with VP)

Procedure:-

1. As point A is in both HP and VP, point a and a' will be in XY line.
2. At an angle 30˚draw 50mm long line above XY line.
3. Similarly at an angle of 45˚draw 50mm long line below XY line.
4. Draw the locus of point b and b' as shown in fig.
5. Project point b to the XY line and then rotate it till the locus of point b'.
6. Join a' and b1', which will give the true length of front view .
7. Project point b1' to the locus line of point b as shown.
8. Join a and b1 , which will be the top view of line Ab.



10. A line AB, 75 mm long is inclined at 45 degree to the HP and 30 degree to the VP. Its end A is in the HP and 10 mm in front of the VP. Draw its projections.

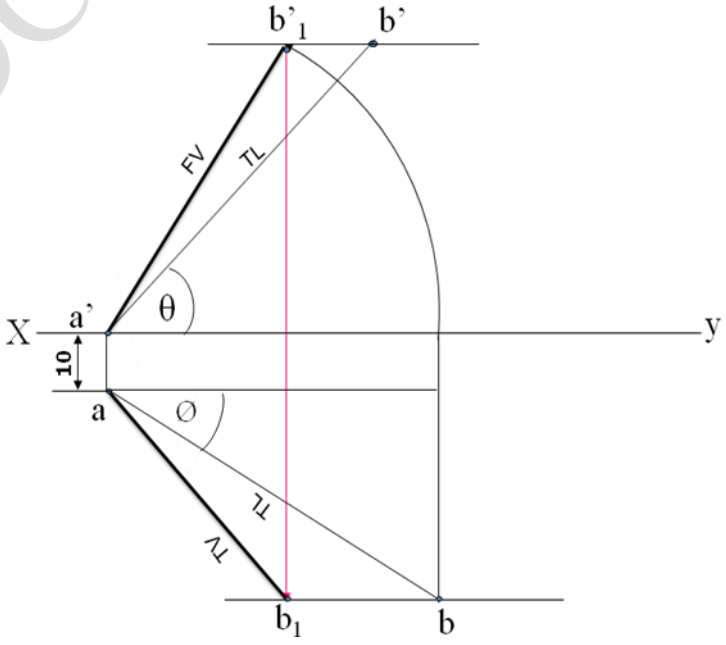
Sol. Given data : TL = 75mm

θ = 45° (inclination with H.P.)

ϕ = 30° (inclination with V.P.)

Point B is in H.P. and 10mm in front of VP , therefore front view and top view of point B i.e. b' and b is in XY and 10mm below XY line respectively.

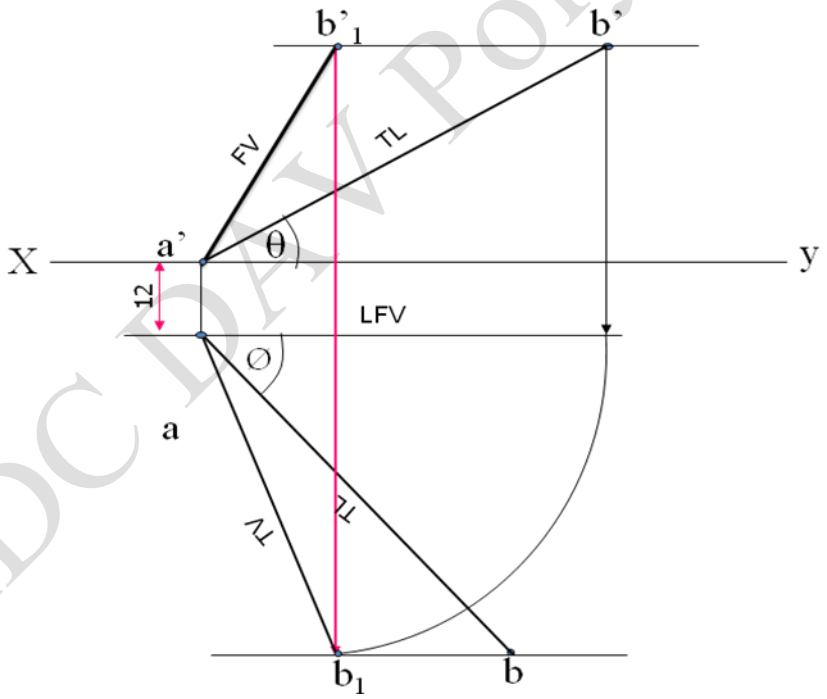
1. After plotting front and top view of point B, draw b'a' and b a = 75mm with angle θ and ϕ respectively.
2. Draw locus of a' and a. From a' and a draw projectors upto point a and a'.
3. With b' and b as centre and radius equal to b'a' and ba respectively draw arcs which cuts the locus at a' and a. Join b'a' and b a, these are front and top views of line AB.



11. A line AB, 90 mm long is inclined at 45 degree to the HP and its top view makes an angle of 60 degree with the VP. The end A is in the H.P. and 12 mm in front of the V.P. Draw its front view and find its true inclination with the VP.

    Solution :

    - Draw x-y line.
    - Draw a line 45^0 inclined to XY from point a' and cut TL 90 mm on it and name that point *b'* and Draw locus from point *b'*.
    - Take 60^0 angle from a, for TV below XY line.
    - Draw a vertical line from b'_1 up to locus of a. It is horizontal component of TL & is LTV, so rotate downward up to the line of TV and name it b_1. This Line a *b* is TV of line AB.
    - Drop a projector from b_1 on locus from point *b'* and name intersecting point b'_1. Line $a_1\ b_1$ is FV of line AB.
    - Draw locus from b_1 and from *a* with TL distance cut point *b*.
    - Join $a\ b_1$ as TL and measure its angle at *a*. It will be true angle of line with VP.



TL = 90mm

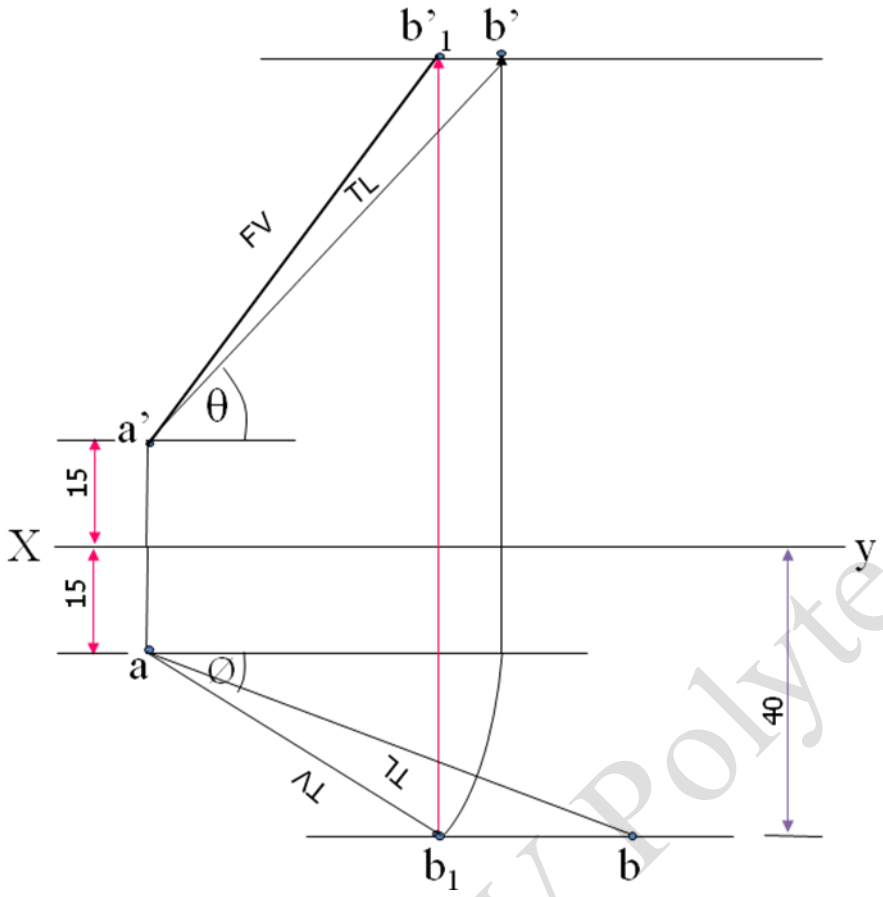
$\theta = 45^0$ (True inclination of line with H.P.)

$\alpha = 60^0$ (Final (FV) inclination of line with H.P.)

$\beta = 60^0$(Final (TV) inclination of line with V.P.)

12. A line measuring 75 mm has one of its ends 40 mm in front of VP & 15 mm above HP other end is 15 mm in front of VP and above HP. The top view of line is 50 mm long. Draw front view of the line & inclination of the line with the HP & VP.

    Solution:

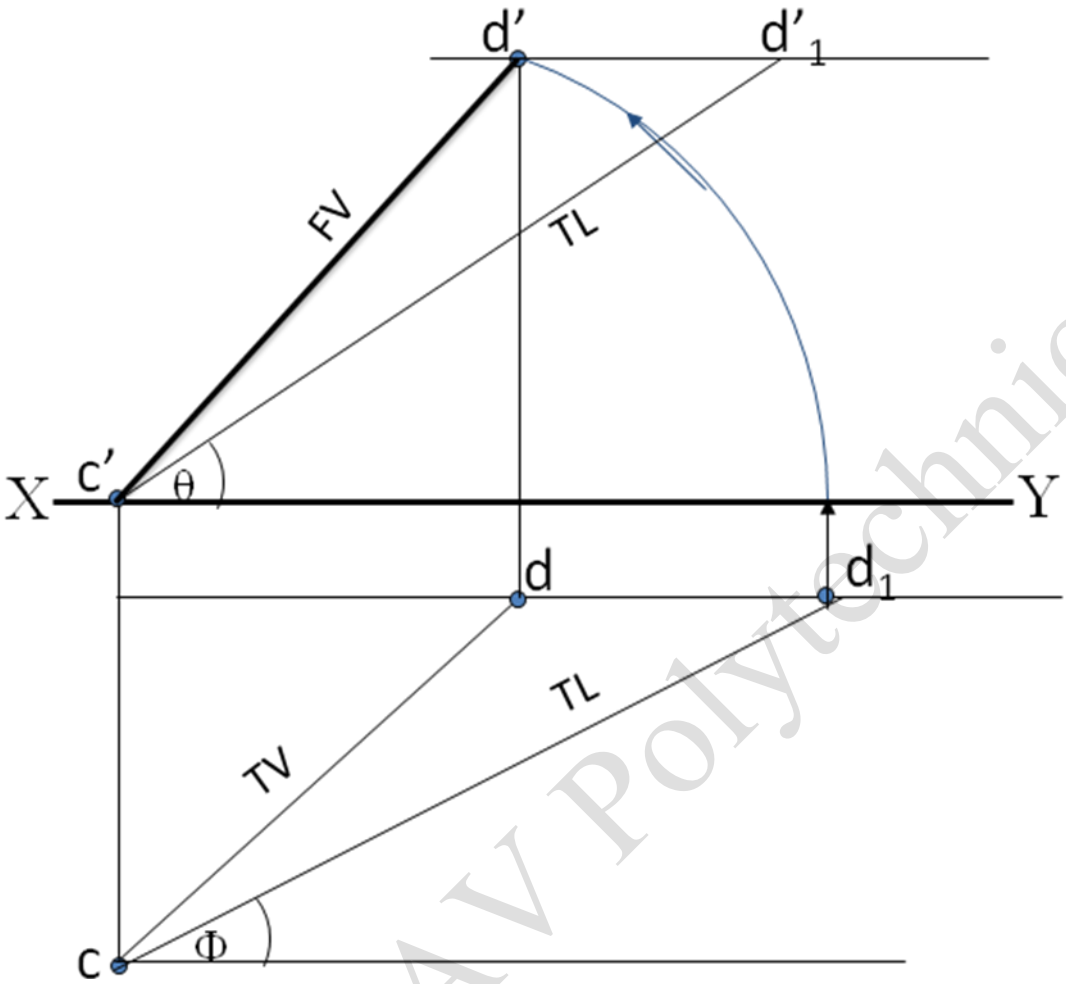


TL = 90mm
TV = 50 mm
θ = 46^0 (True inclination of line with H.P.)
ϕ = 20^0 (True inclination of line with V.P.)

13. Top View of a 75 mm long Line CD, measures 50 mm. End C is in Hp and 50 mm in front of VP. End D is 15 mm in front of VP and it is above Hp. Draw projections of CD and finds angles with Hp and VP. (Nov.- Dec. 2013)

SOLUTION:

1. Draw xy line and one projector.
2. Locate c' on xy and c 50mm below xy line, Draw locus from these points.
3. Draw locus of d 15 mm below xy
5. Cut 50mm & 75 mm distances on locus of d from c and mark points d & d_1 as these are Tv and line CD lengths respectively & join both with c.
6. From d_1 draw a vertical line upward up to xy I.e. up to locus of c' and draw an arc as shown.
7. Draw one projector from d to meet this arc in d' point & join c' d'
8. Draw locus of d' and cut 75 mm on it from c' as TL

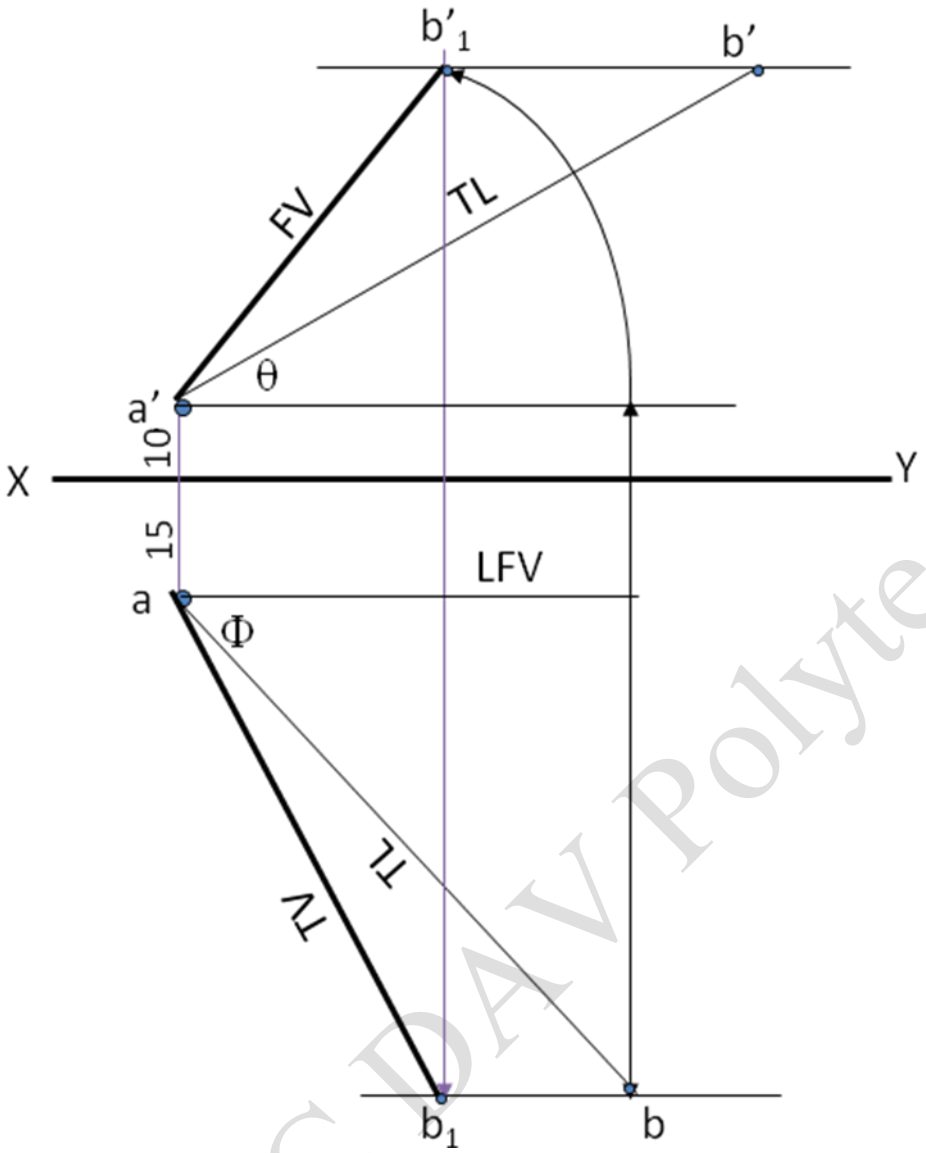


TL = 75mm
TV = 65mm
$\theta = 33^0$ (True inclination of line with H.P.)
$\phi = 26^0$ (True inclination of line with V.P.)

14. FV of line AB is 50^0 inclined to xy and measures 55 mm long while it's TV is 60^0 inclined to XY line. If end A is 10 mm above Hp and 15 mm in front of VP, draw it's projections, find TL, inclinations of line with HP & VP.

SOLUTION STEPS:

1. Draw xy line and one projector.
2. Locate a' 10 mm above xy and a 15 mm below xy line, Draw locus from these points.
4. Draw FV 50^0 to xy from a' and mark b_1' Cutting 55mm on it.
5. Similarly draw Tv 60^0 to xy from a & drawing projector from b_1' Locate point b_1 and join a b_1.
6. Locate True Lengths ab & a'b' and their angles with Hp and Vp.



TL = 70mm
TV = 55mm
$\theta = 30^0$ (True inclination of line with H.P.)
$\phi = 47^0$ (True inclination of line with V.P.)
$\alpha = 50^0$ (Final (FV) inclination of line with H.P.)
$\beta = 60^0$(Final (TV) inclination of line with V.P.)

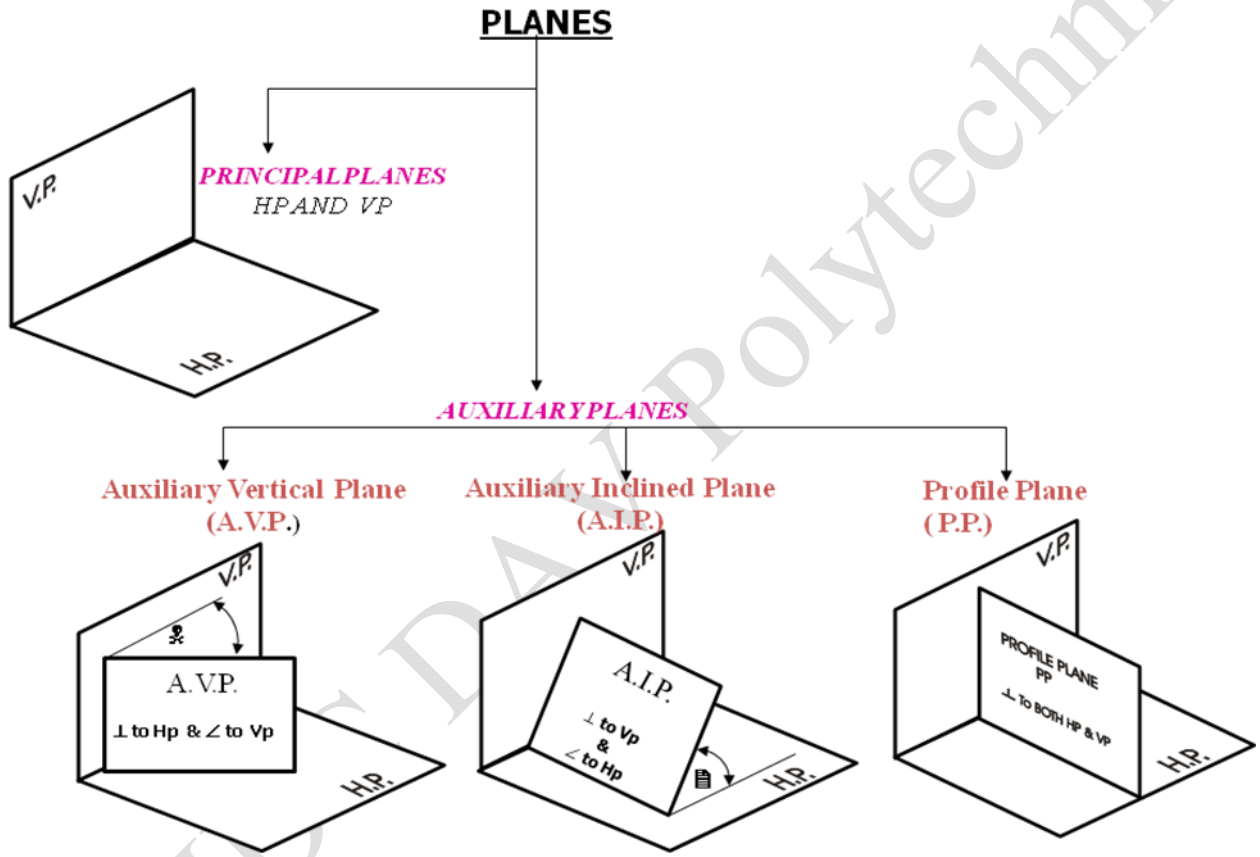
PLANES

Plane figures or surfaces have only two dimensions, viz. length and breadth. They do not have thickness. A plane figure may be assumed to be contained by a plane, and its projection can be drawn, if the position of that plane with respect to the principal planes of projection is known.

TYPES OF PLANES:- Planes may be divided into following two types:-

- PERPENDICULAR PLANES.
- OBLIQUE PLANES.

.



What is usually asked in the problem?

To draw their projections means F.V, T.V. & S.V.

What will be given in the problem?

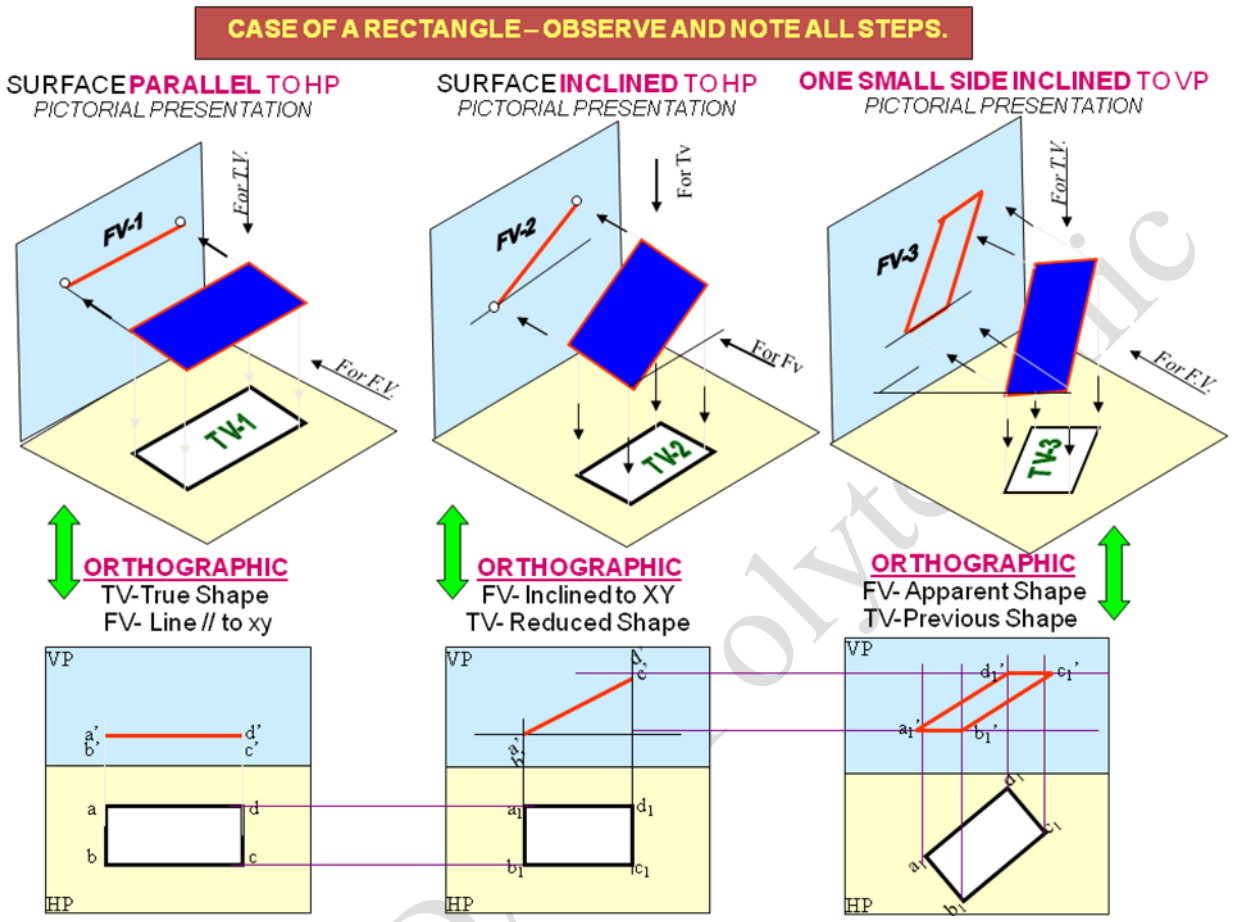
1. Description of the plane figure.
2. It's position with HP and VP.

In which manner it's position with HP & VP will be described?

1.Inclination of it's SURFACE with one of the reference planes will be given.

2. Inclination of one of it's EDGES with other reference plane will be given

(Hence this will be a case of an object inclined to both reference Planes.)



PROCEDURE OF SOLVING THE PROBLEM:

IN THREE STEPS EACH PROBLEM CAN BE SOLVED

STEP 1. Assume suitable conditions & draw Fv & Tv of initial position.

STEP 2. Now consider surface inclination & draw 2nd Fv & Tv.

STEP 3. After this,consider side/edge inclination and draw 3rd (final) Fv & Tv.

ASSUMPTIONS FOR INITIAL POSITION:

STEP 1 (Initial Position means assuming surface // to HP or VP)

1.If in problem surface is inclined to HP – assume it // HP Or If surface is inclined to VP – assume it // to VP

2. Now if surface is assumed // to HP- It's TV will show True Shape. And If surface is assumed // to VP – It's FV will show True Shape.

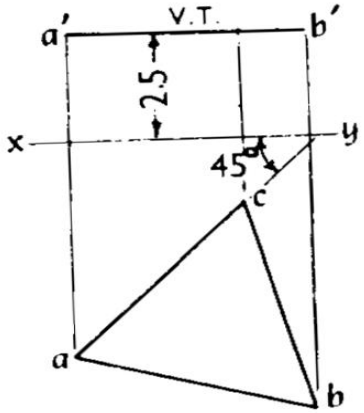
3. Hence begin with drawing TV or FV as True Shape.

4. While drawing this True Shape – keep one side/edge (which is making inclination) perpendicular to xy line

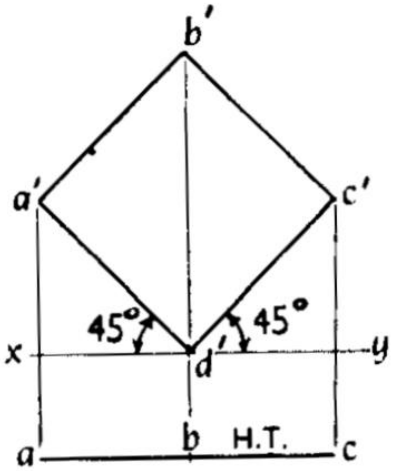
Now Complete STEP 2. By making surface inclined to the plane & project it's other view.

Now Complete STEP 3. By making side inclined to the plane & project it's other view.

1. An equilateral triangle of 5 cm side has its V.T. parallel to and 2.5 cm above xy. It has no H.T. Draw its projections when one of its sides is inclined at 45o to the V.P.

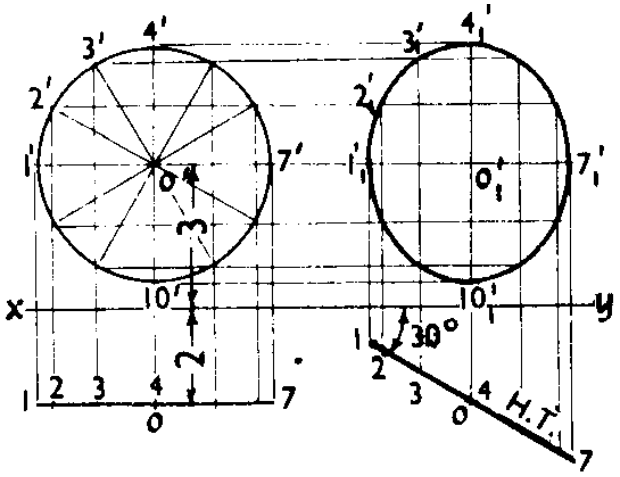


2. A square ABCD of 40 mm side has a corner on the H.P. and 20 mm in front of the V.P. All the sides of the square are equally inclined to the H.P. and parallel to the V.P.



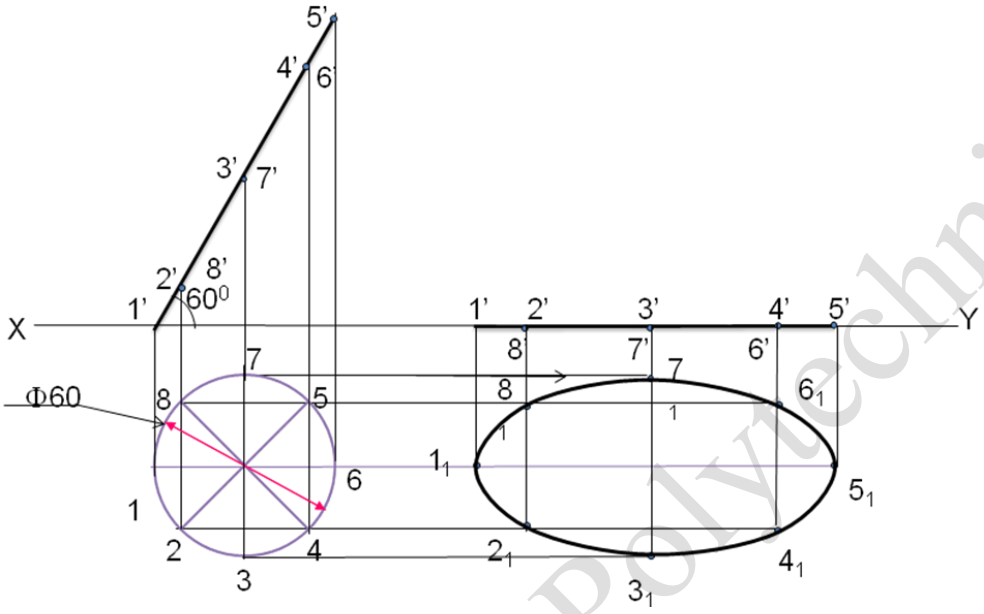
3.

3. Draw the projections of a circle of 5 cm diameter, having its plane vertical and inclined at 30o to the V.P. Its centre is 3 cm above the H.P. and 2 cm in front of the V.P.



4. The top view of a plate, the surface of which is perpendicular to the VP and inclined at 60^0 to the H.P. is a circle of 60 mm diameter. Find the true shape of the plate.

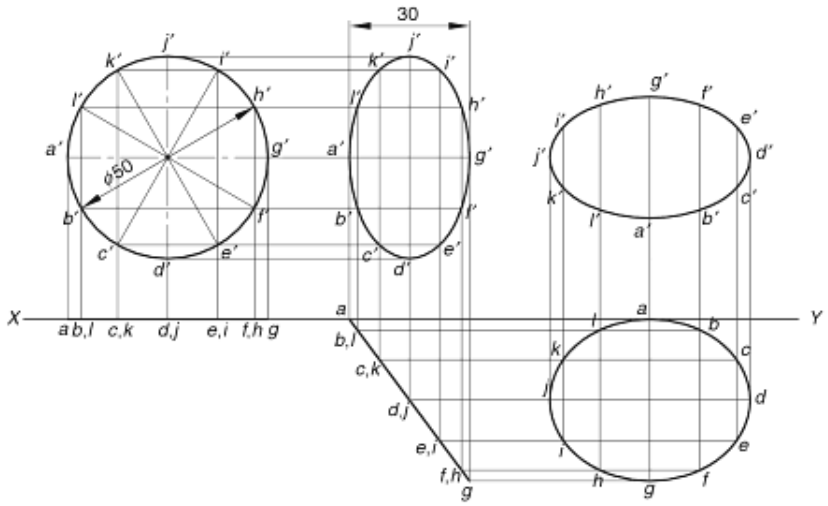
Solution:- 1. Draw a circle in top view. Draw the end projectors and mark 1'5' at 60^0 to xy.
2. Rotate 1'5' and make it parallel to xy. Project the true shape of ellipse.
3. Draw projections. Mark 1'5' at 60^0 to xy.
4. Mark the top view as shown.



5. A Circular plate of negligible thickness and 50 mm diameter appears as an ellipse in the front view, having its major axis 50 mm long and minor axis 30 mm long. Draw its top view when the major axis of the ellipse is horizontal.

Solution :

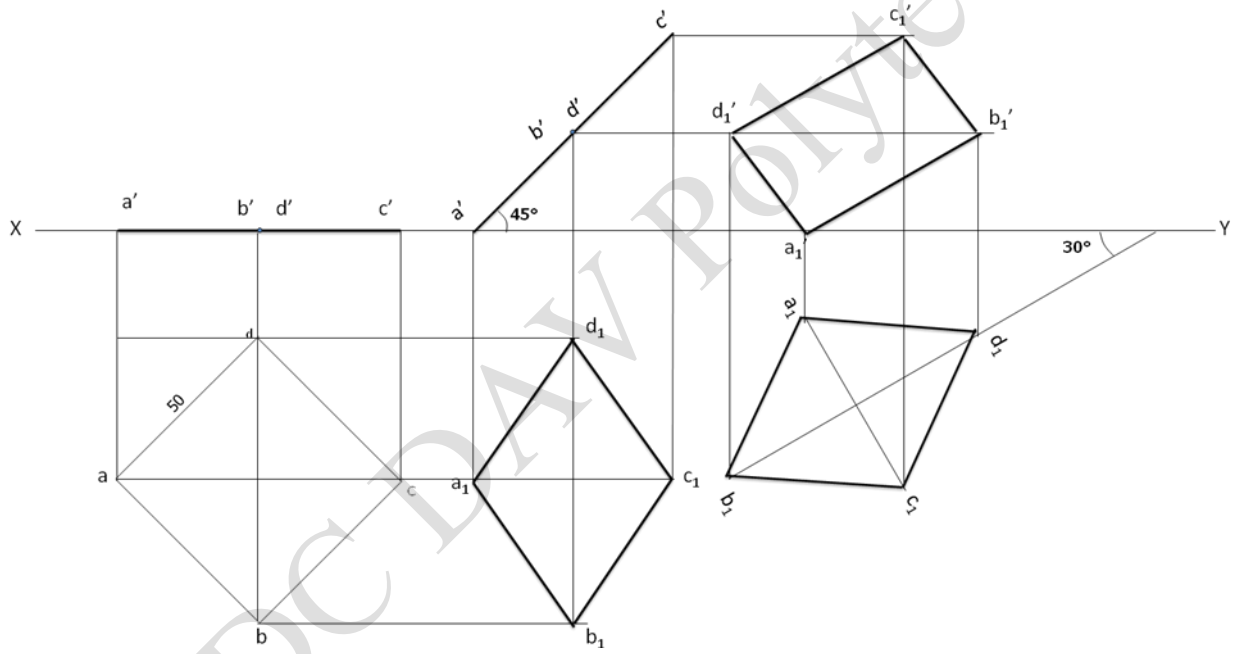
a. Assume plate is in first angle.
b. So assume it to be parallel to the H.P and draw its top view and F.V.
c. Trun the line ab so that its length in the top view becomes 30mm, and project the T.V. It will be an ellipse whose major axis is vertical.
d. Reproduce this view so that the major axis c_1' d_1' is horizontal, and project required front view.



6. A square lamina ABCD of side 50 mm has the diagonal AC inclined 45^0 to the HP & diagonal BD inclined 30^0 to VP. Draw its projections.

Solution Steps:-

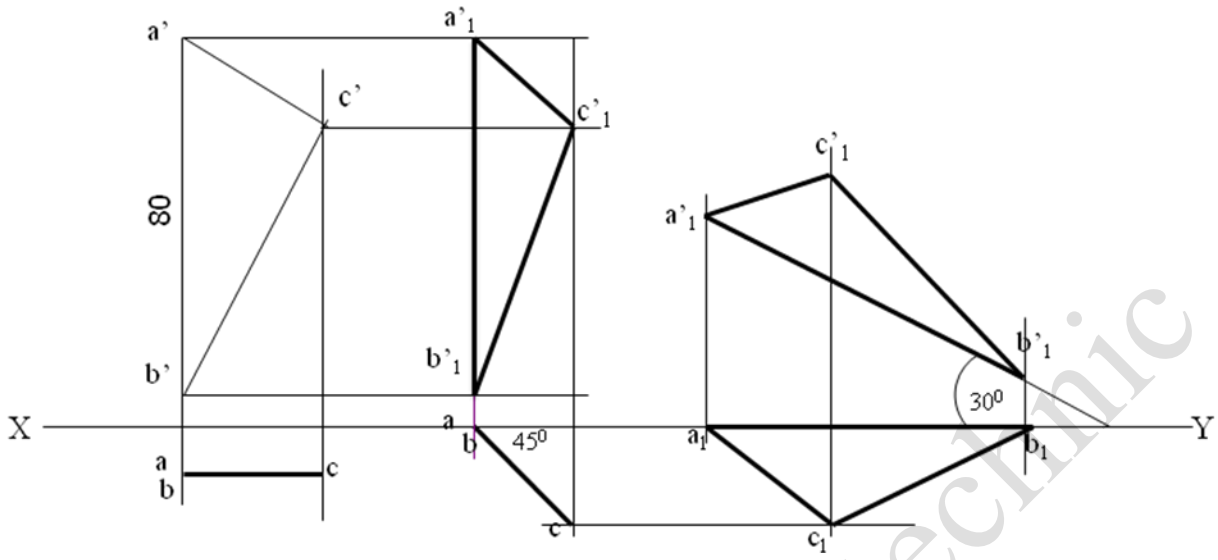
a. Surface inclined to which plane ------- HP
b. Assumption for initial position ------// to HP
c. So which view will show True shape --- TV
d. Which diagonal will be parallel --- Diagonal AC.
e. **Hence begin with TV, draw** square **below X-Y drawing** diagonal AC **parallel.**
f. As Plane of square (a'c') is inclined to the HP by 45^0. Draw projections and Join points and get top view.
g. As the TV of the diagonal BD of square is inclined to the VP by 30^0. Again Draw projections and Join points and get FV view.



7. A thin $30^0 - 60^0$ set square has its longest edge 80 mm long, in the VP and 30^0 inclined to HP. while it surface makes an angle of 45^0 with the VP. Draw its projections.

Solution Steps:-

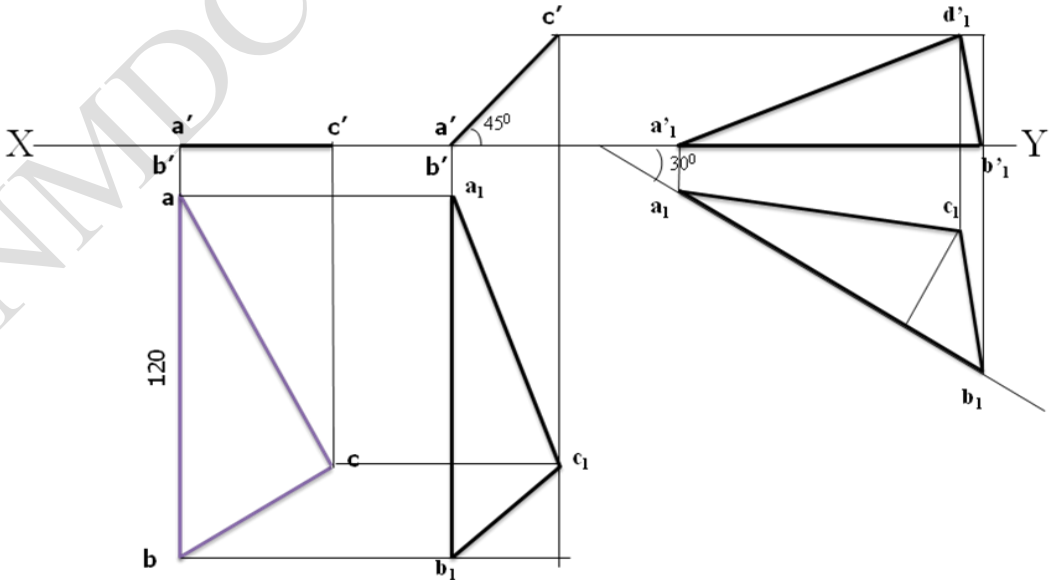
a. Surface inclined to which plane ------- VP
b. Assumption for initial position ------// to VP
c. So which view will show True shape --- FV
d. Which side will be vertical --- Longest edge
e. Hence begin with FV, draw Set Square above X-Y drawing one side vertical.
f. As Plane of Set Square is inclined to the VP by 45^0. Draw projections and Join points and get front view.
g. As the FV of the longest edge of set square is inclined to the HP by 30^0. Again Draw projections and Join points and get top view.



8. A 60^0 set square of 120 mm longest side is so kept that the longest side is in the H.P. making an angle of 30^0 with the V.P. and the set square itself inclined at 45^0 to H.P. Draw the projections of the set square.

Solution Steps:-

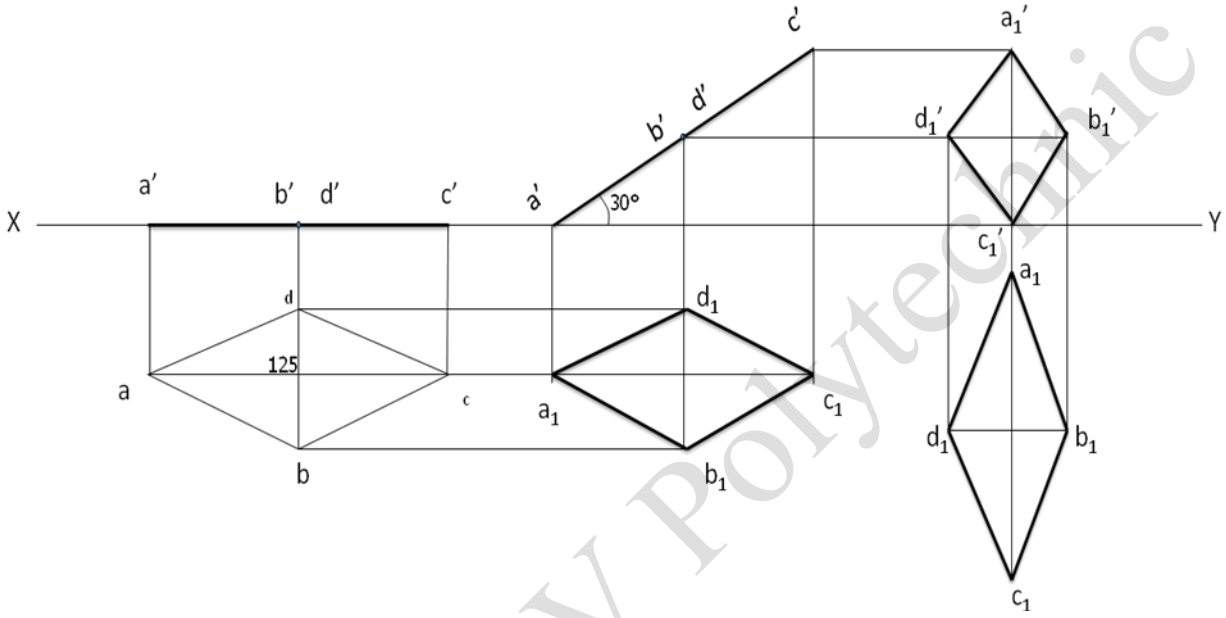
a. Surface inclined to which plane ------- HP
b. Assumption for initial position ------// to HP
c. So which view will show True shape --- TV
d. Which side will be vertical --- Longest edge
e. Hence begin with TV, draw Set Square below X-Y drawing one side vertical.
f. As Plane of Set Square is inclined to the HP by 45^0. Draw projections and Join points and get front view.
g. As the TV of the longest edge of set square is inclined to the VP by 30^0. Again Draw projections and Join points and get FV.



9. Draw the projections of a rhombus having diagonals 125 mm and 50 mm long the smaller diagonal of which is parallel to both the principal planes, while the other is inclined at 30^0 to the HP.

Solution:-

a. Draw xy line.
b. Draw the true shape in top view with ac parallel to xy. Mark a'b'd'c'.
c. a_1 b_1 c_1 d_1 so that b_2d_2 parallel to xy. Project a'_2 b'_2 c'_2 d'_2.

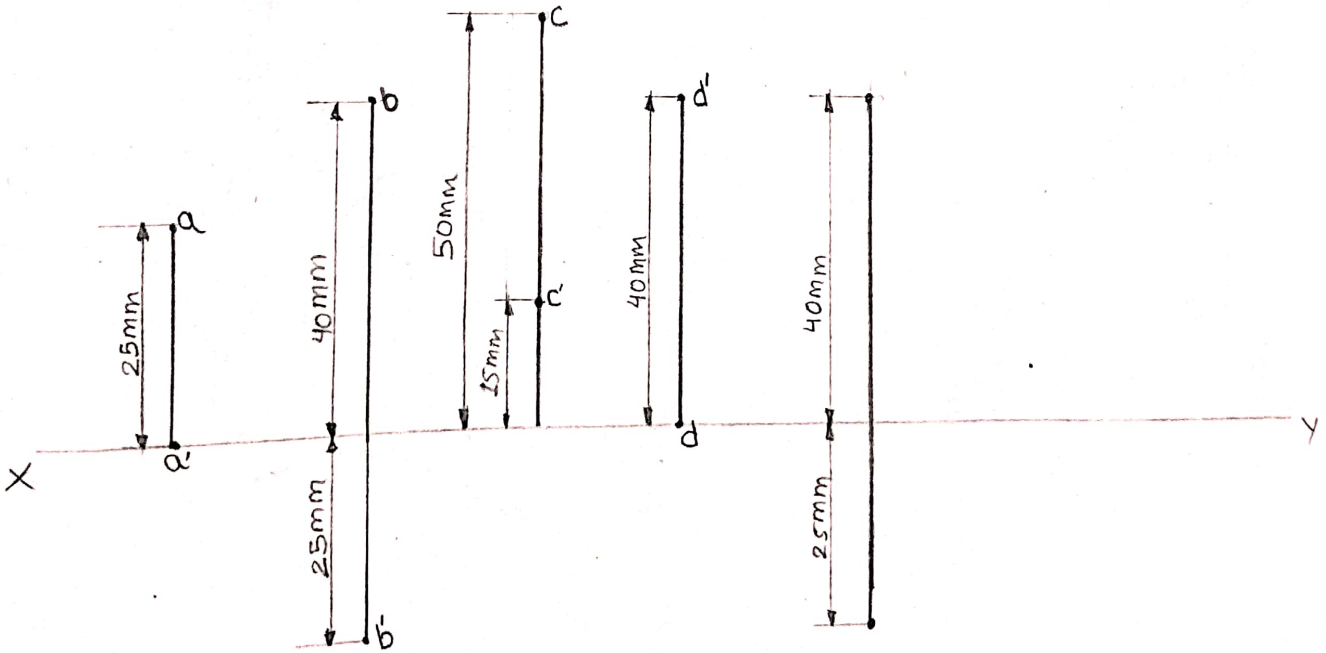


Assingment Unit - 03.

Projection of Point

1. Draw the projection of the following points.

(i) A, in the HP and 25 mm behind the VP.
(ii) B, 25mm below the HP and 40mm behind the VP.
(iii) C, 15 mm above the HP and 50mm behind the VP.
(iv) D, in the VP and 40mm above the HP.
(v) E, 40mm above the HP and 25mm in front of the VP.



Keeping the proj

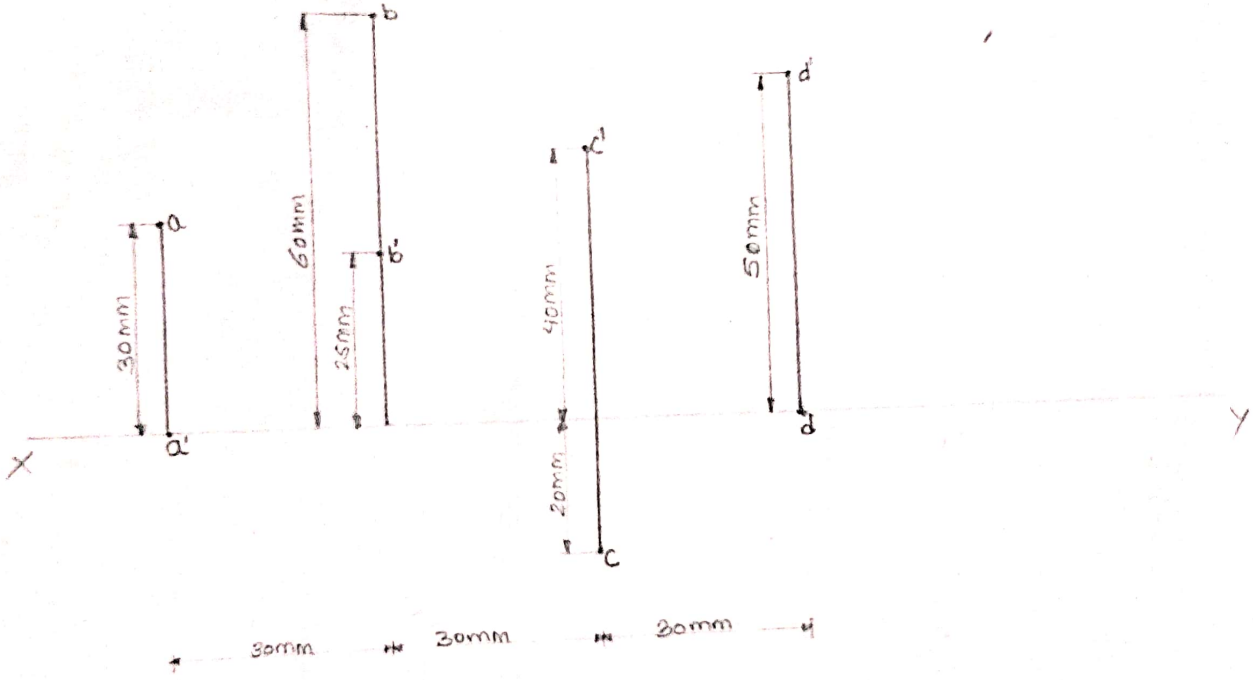
Q2. Draw the projections of the following points keeping the projections 30 mm apar

(i) Point A, in the HP and 30 mm behind the V.P.

(ii) Point B, 25 mm above HP and 60 mm behind VP.

(iii) Point C, 40mm above the H.P and 20 mm in front of the V.P.

(iv) Point D, in the VP. and 50mm above the HP.

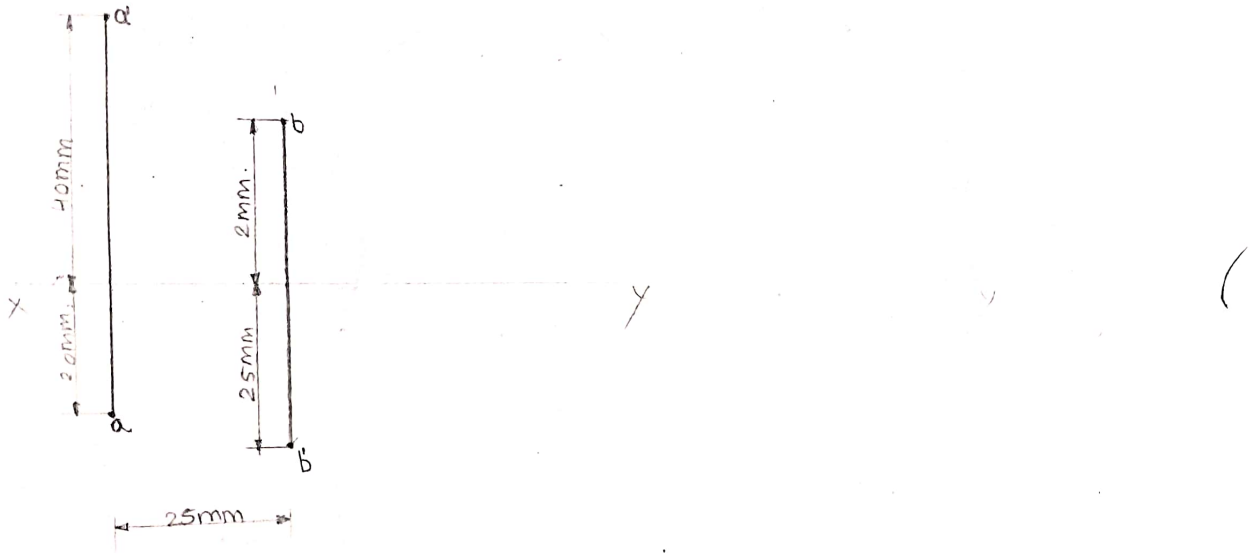


keeping projectors 25

Q3. Draw the projection of the following points on same reference line keeping projectors 25mm apart.

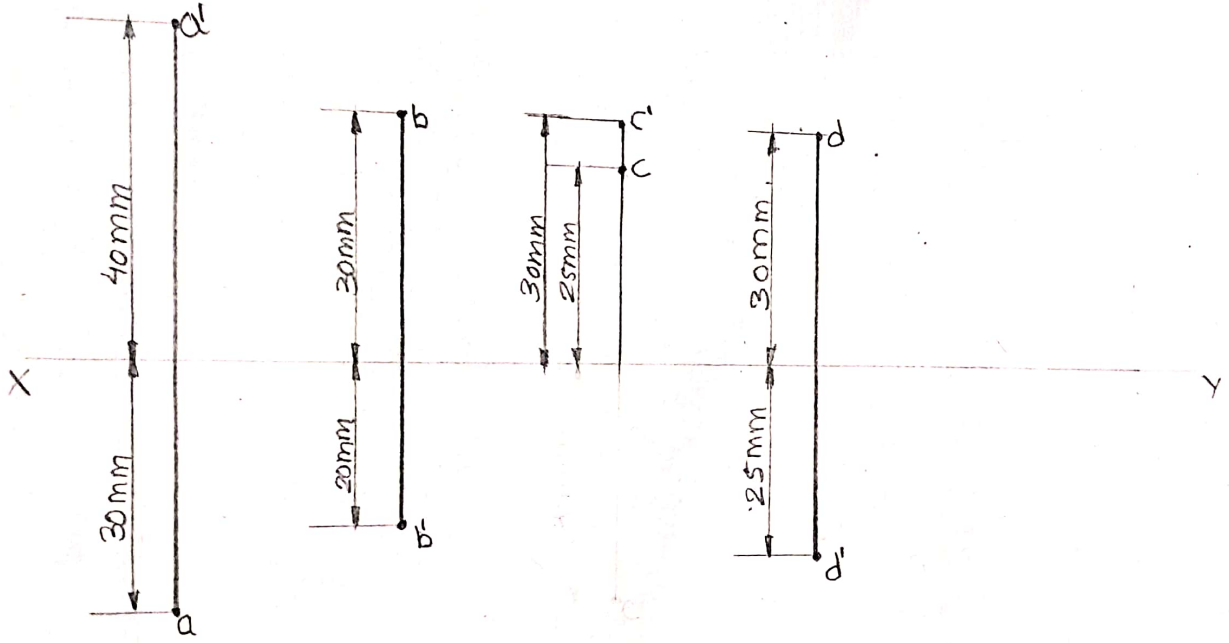
(i) Point A, 40 mm above HP, and 20mm in front of V.P.

(ii) Point B, 25 mm below HP, and 25mm behind V.P.



Q.4 Draw the projection of the following points!

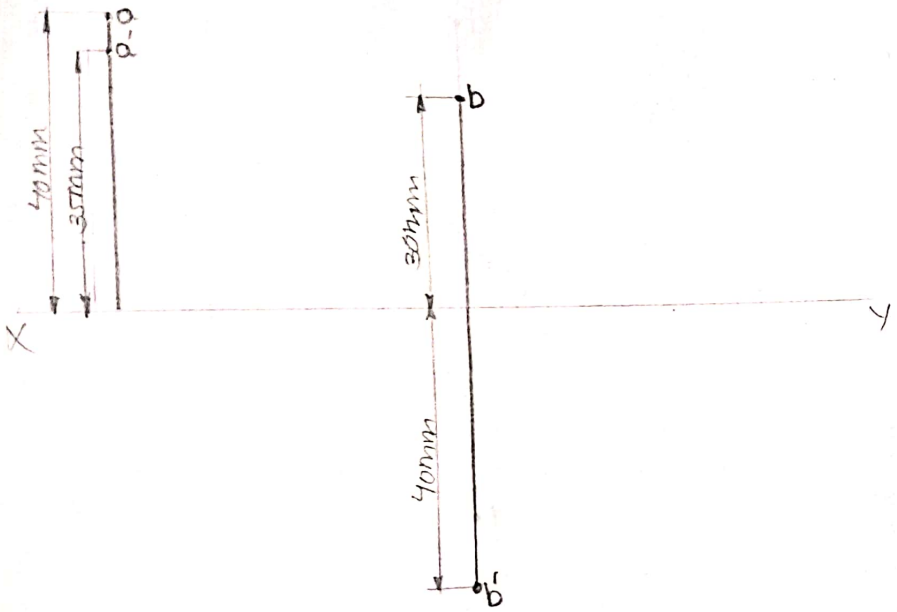
(a) 30 mm in front of VP and 40mm above the HP.
(b) 20mm below HP. And 30mm infront of the VP.
(c) 25mm behind the VP and 30mm above the HP.
(d) 30mm behind the VP and 25mm below the HP.



Q.5. Draw the projection of given point, if:

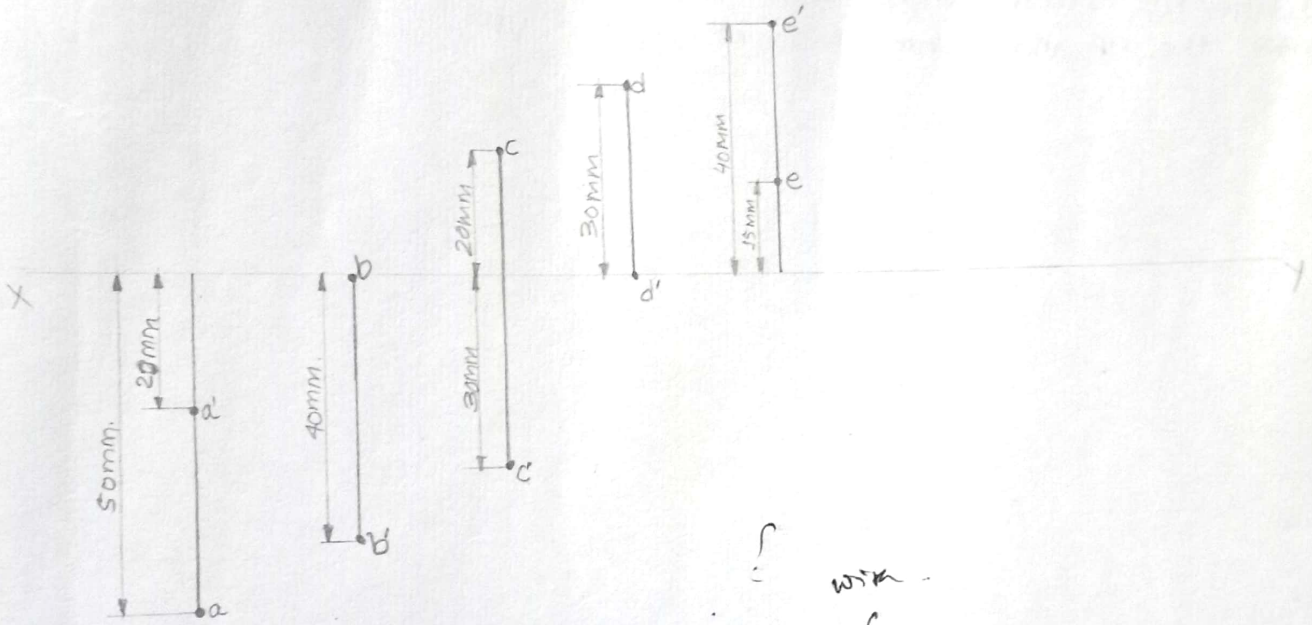
(i) Point 'A' is situated at 35 mm above the H.P. and 40mm behind the V.P.

(ii) Point B' is situated at 40 mm below the H.P. and 30mm behind the V.P.



point with

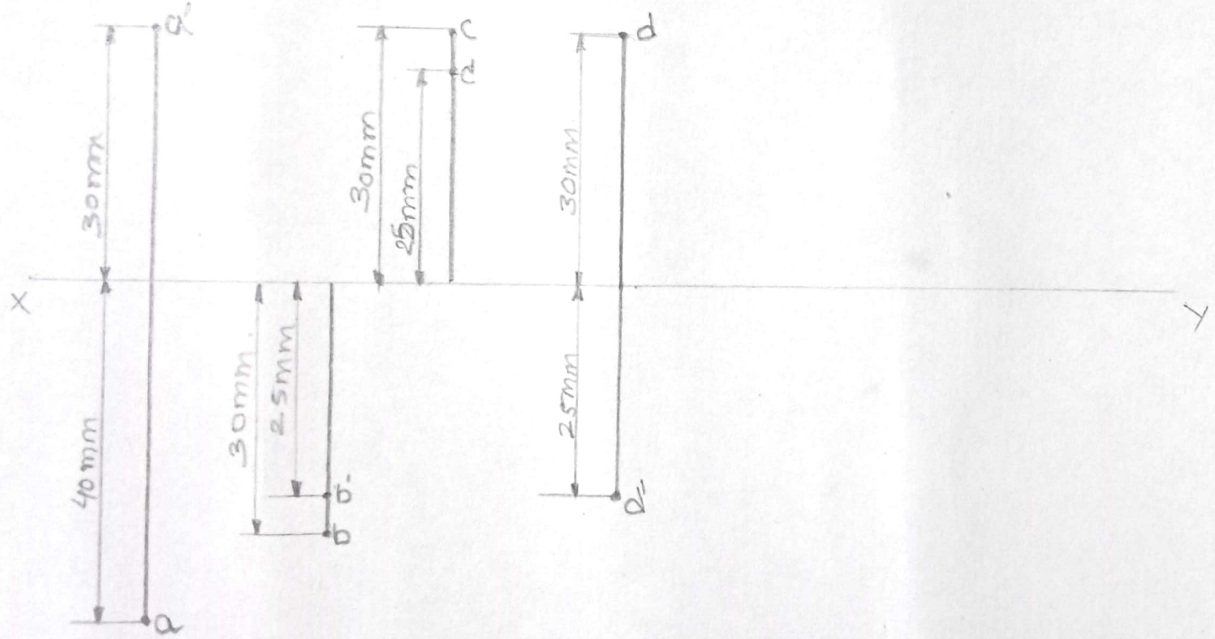
6 Projections of various points are given in figure state the position of each point with respect the planes of projections.



Ans i) A, 20 mm below HP and in front of 50mm VP.
ii) B, in the VP and 40 mm below the HP.
iii) C, 30mm below HP and 20mm behind VP.
iv) D, in the HP and 30 mm behind VP
v) E, 40 mm above HP and 15 mm behind VP.

Q.7. Draw the projection of the following

(a) 40mm in front of VP and 30 mm above the HP.
(b) 25mm below the HP and 30 mm in front of the VP.
(c) 30 mm behind the VP and 25 mm above the HP.
(d) 30mm behind the VP and 25 mm below the HP.



Q. Draw the projections of the following points.

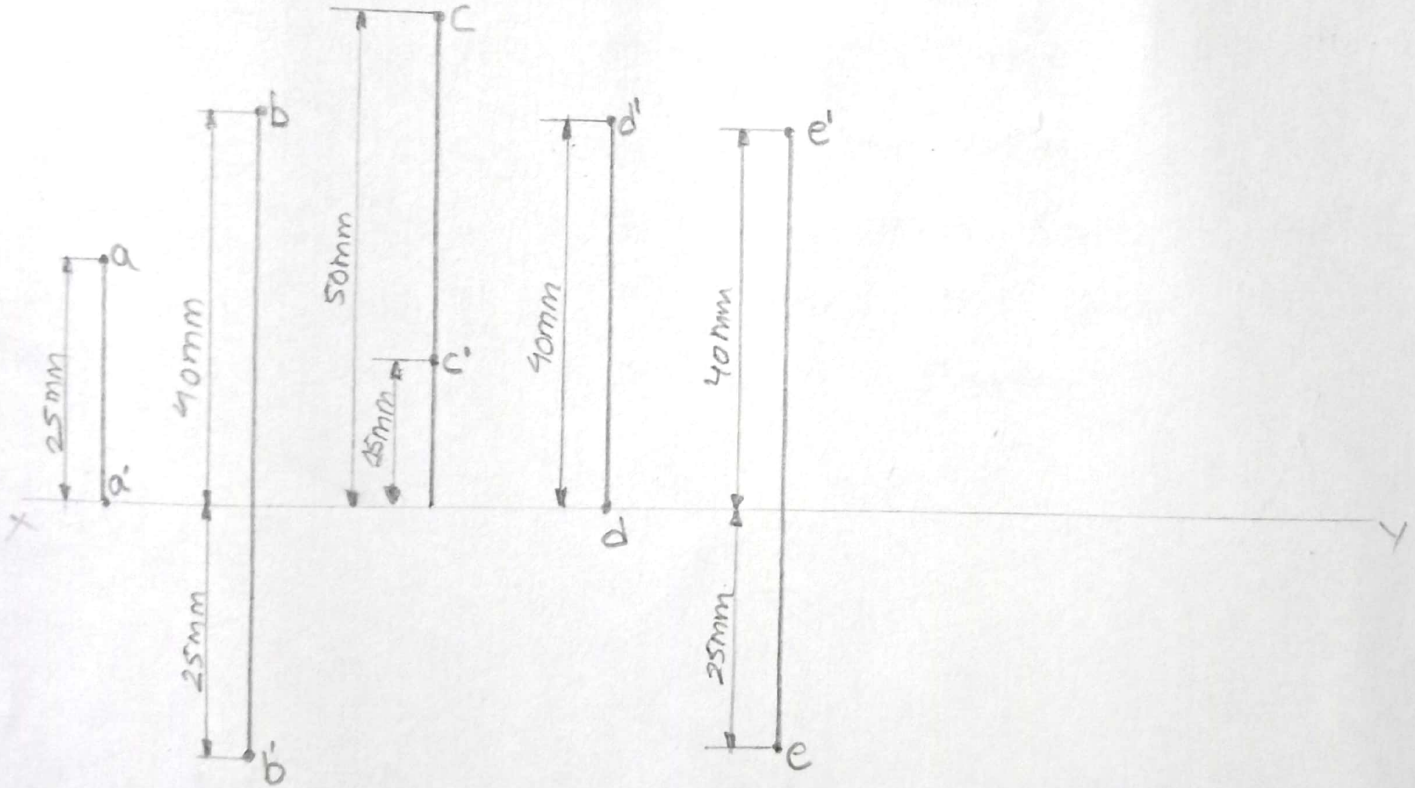
i) A, in the HP and 25 mm behind the VP

ii) B, 25mm below the HP and 40mm behind the VP.

iii) C, 15mm above the HP and 50mm behind the VP.

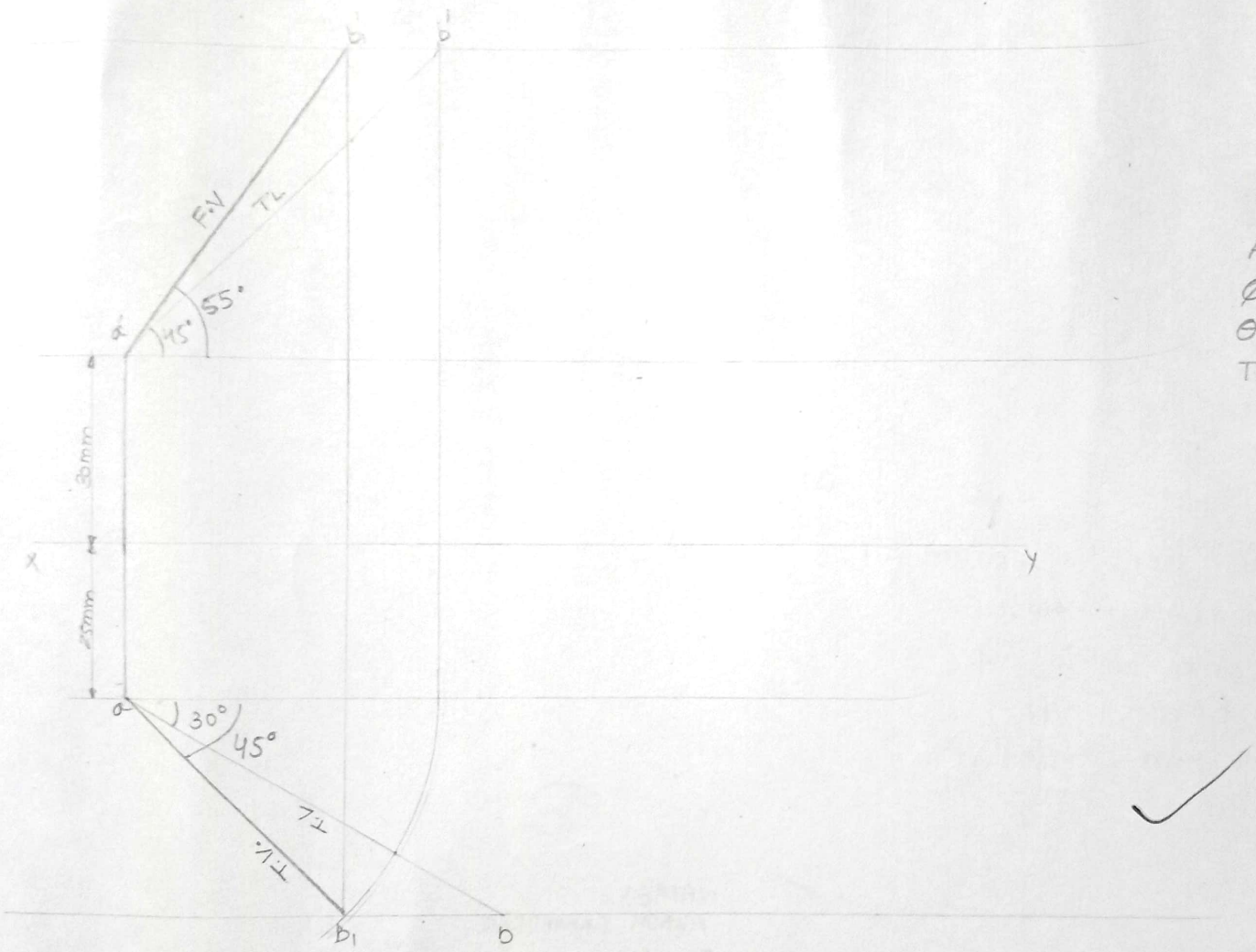
iv) D, in the VP and 40mm above the HP.

v) E, 40mm above the HP and 25mm in front of the VP.



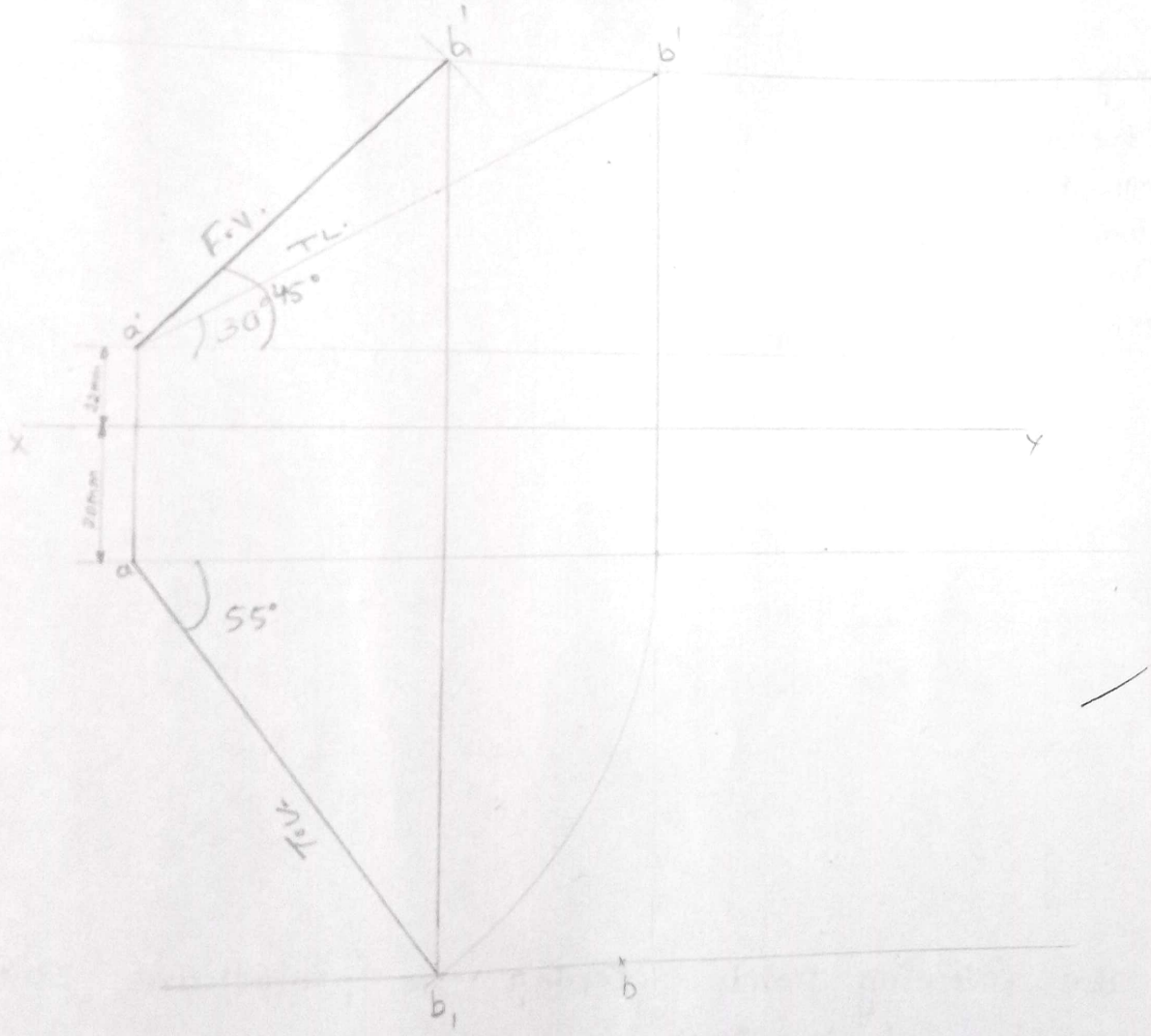
Projection of Line

1. Draw the projection of a line AB 70mm long, which is inclined at 45° to HP and 30° to VP. Its one end A is 30mm above the HP and 25mm in front of the VP.



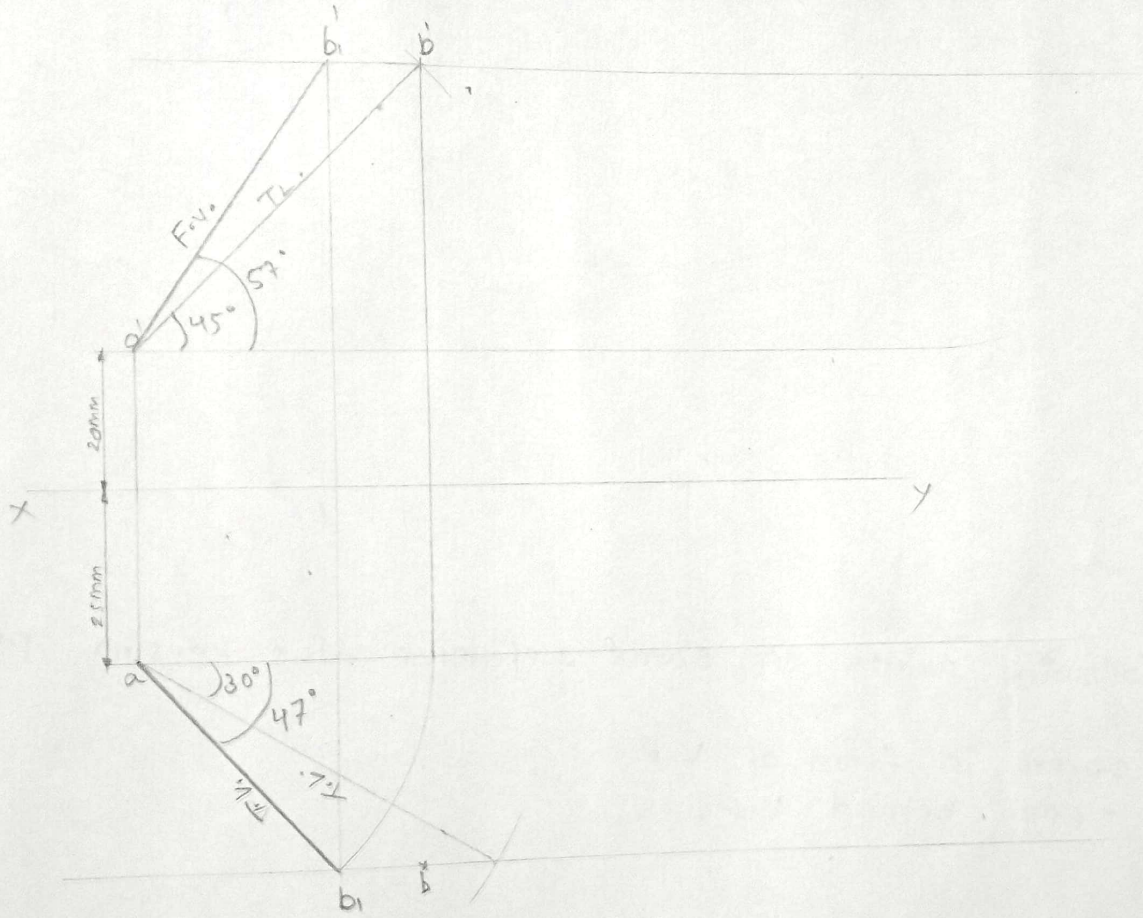
$\alpha = 55°$
$\beta = 45°$
$\phi = 30°$
$\theta = 45°$
T.L. = 70mm.

Q.2 - A line AB, 90 mm long, is inclined at 30° to the H.P. its end A is 12 mm above the H.P. and 20mm in front of the V.P. Its front view measures 65 mm. Draw its projection.



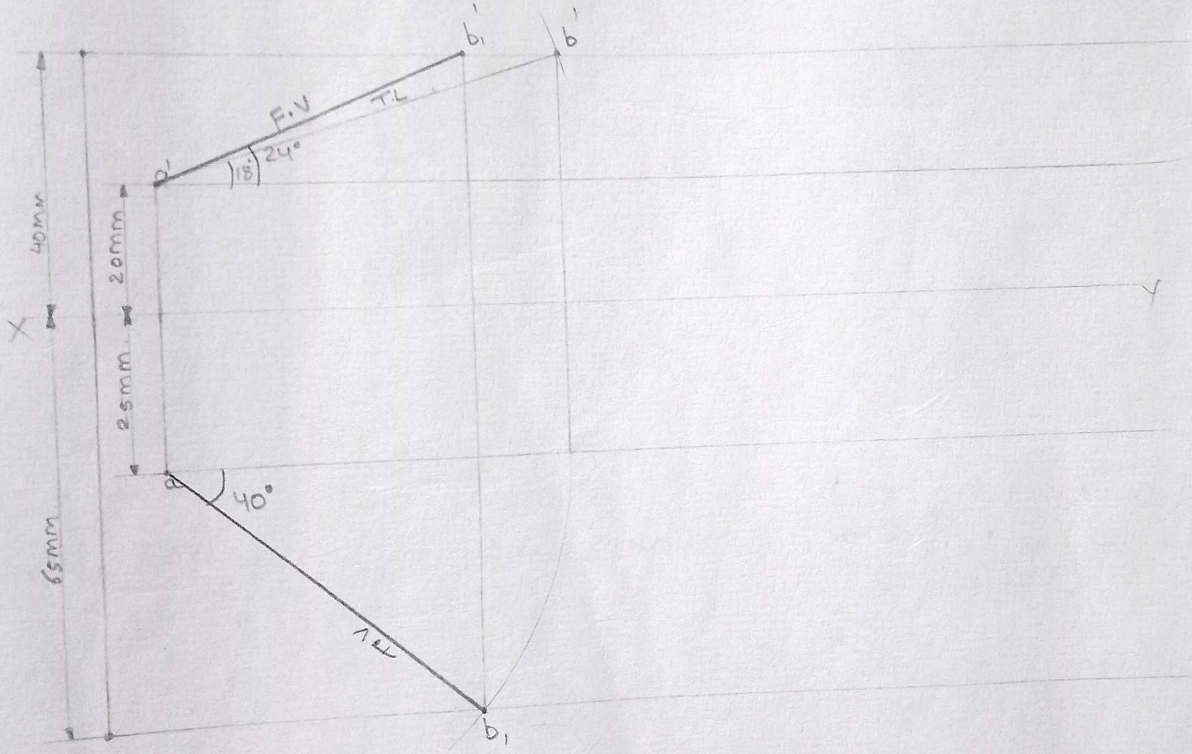
θ = 30
α = 45°
β = 55°
TL = 90°
FV = 65 mm
TV = 79 mm

Q.3. Draw the projection of a line AB 60 mm long, which is inclined at 45° ~~on~~ to HP and 30° to VP. Its one end A is 20mm above the HP and 25 mm in front of the VP.



$\theta = 45°$
$\phi = 30°$
$\alpha = 57°$
$\beta = 47°$
T.L = 60mm
F.V. = 50mm
T.V. = 42mm

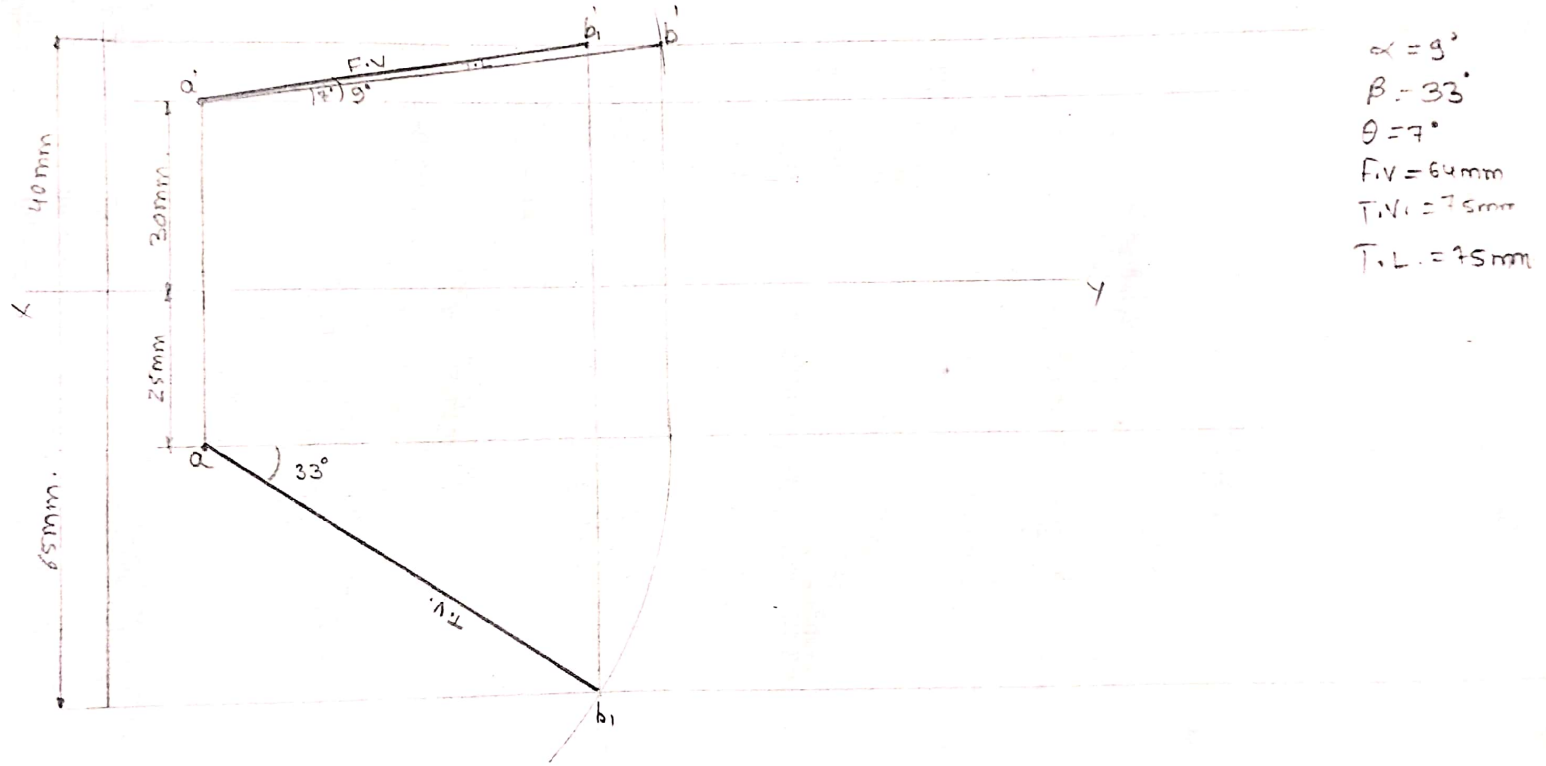
Q.4. A line AB 65 mm long, has its end A 20 mm above the H.P. and 25mm in front of V.P. The end B is 40 mm above H.P, and 65mm in front of V.P. Draw the projections of AB and show its inclinations with H.P and V.P.



T.L. = 65mm
F.V = 51mm
T.V = 63mm.
$\theta = 18°$
$\alpha = 24°$
$\beta = 40°$

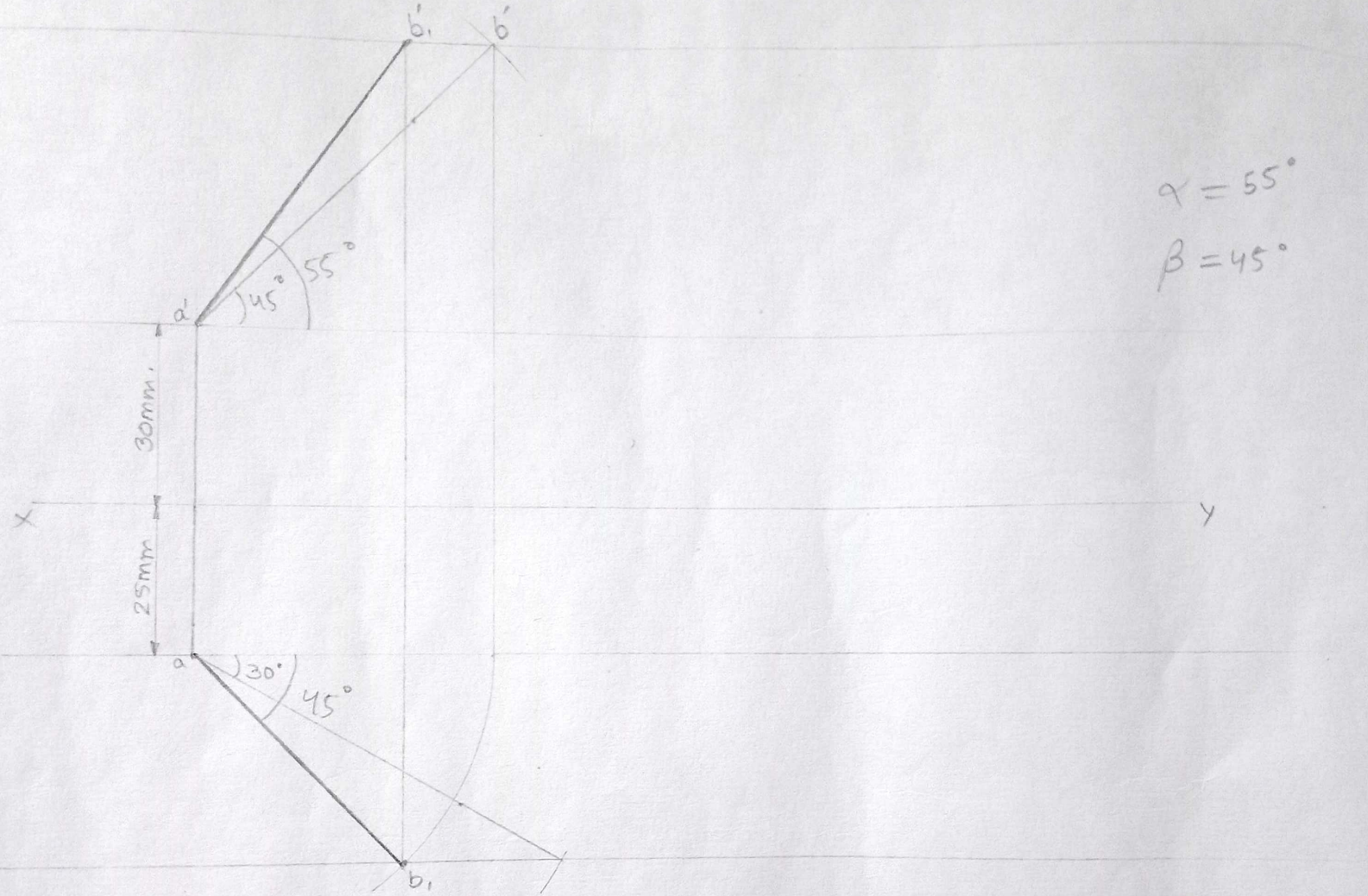
Q.5. A line AB, 75mm long, has its end A 30mm above the H.P and 25mm in front of the V.P. The end B is 40mm above H.P., and 65 mm in front of V.P. Draw the projections of AB and show its inclinations with H.P and V.P.

Q.5. A line AB, 75mm long, has its end A 30mm above the H.P and 25mm in front of the V.P. The end B is 40mm above H.P., and 65 mm in front of V.P. Draw the projections of AB and show its inclinations with H.P and V.P.



$\alpha = 9°$
$\beta = 33°$
$\theta = 7°$
F.V = 64mm
T.V. = 75mm
T.L. = 75mm

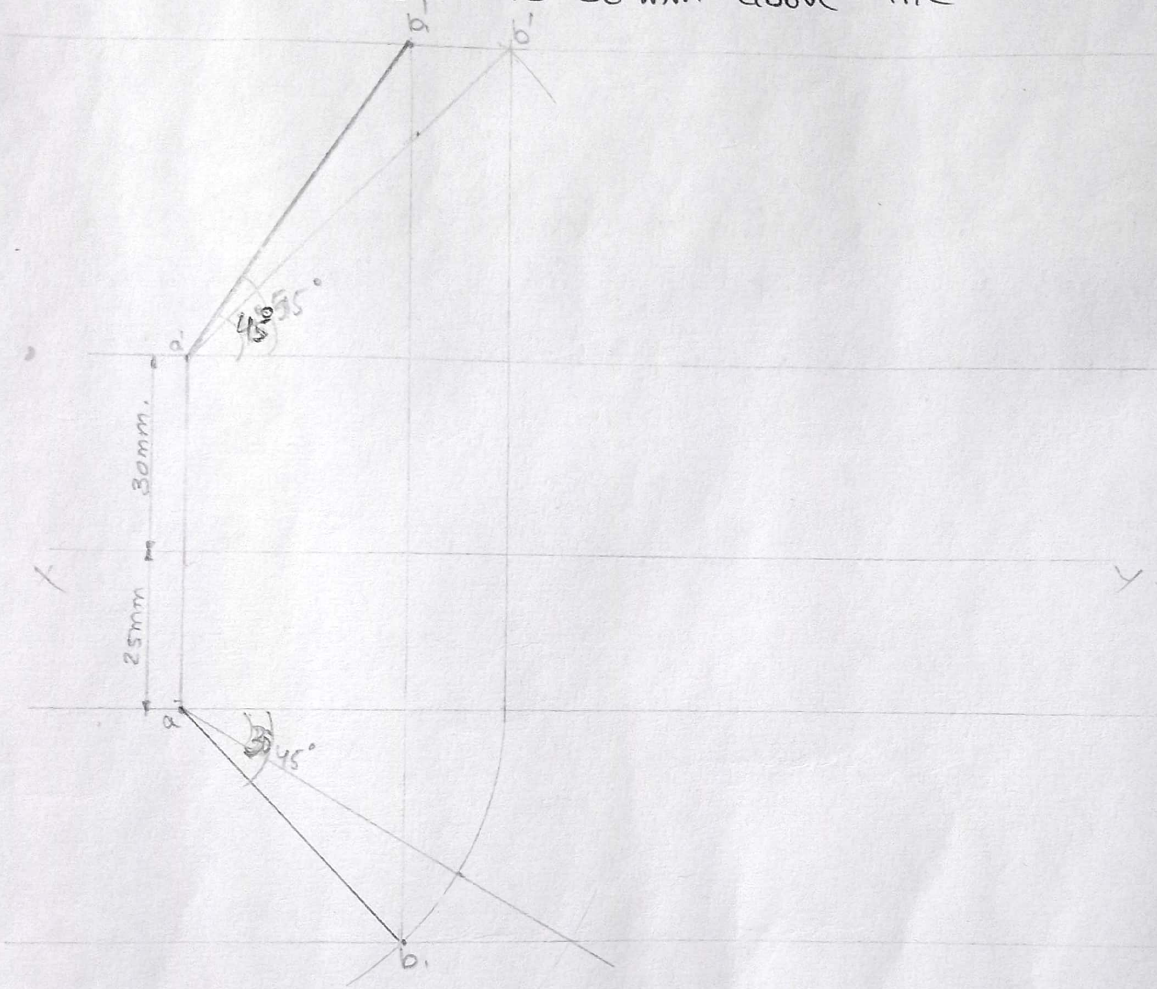
Q.6. Draw the projection of a line AB 70mm long, which is inclined at 45° to HP and 30° to V.P. Its one end A is 30mm Above the HP. and 25mm in front of the VP. &



Q.8 Draw the projection of line AB 70 mm long, which is inclined at 45° to HP ar
30° to VP. Its one end A is 30 mm above the HP and 25mm in front of the

b1 b'

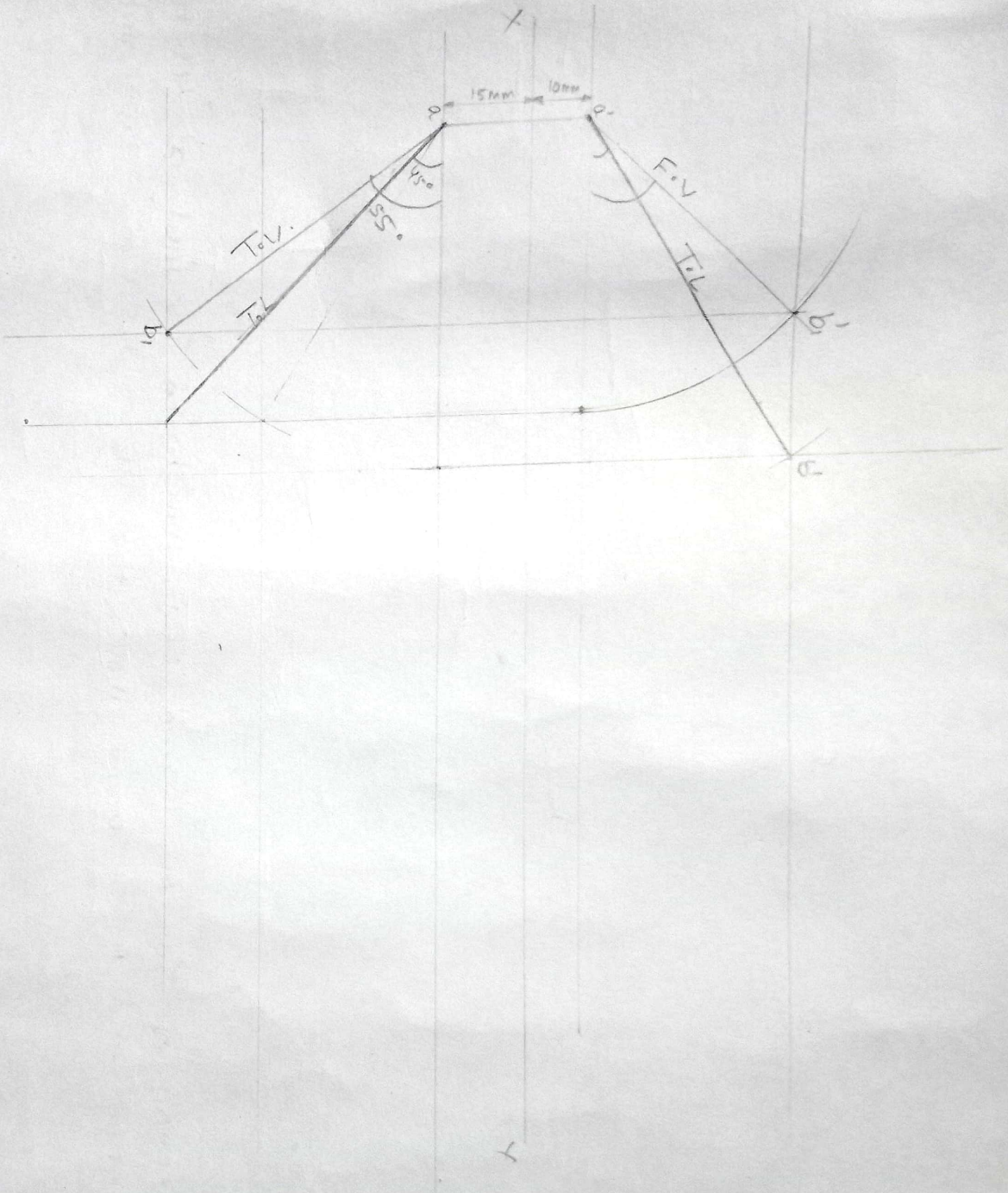
Q.7 Draw the projection of line AB 70 mm long, which is inclined at 45° to HP and 30° to VP. Its one end A is 30 mm above the HP and 25 mm in front of the VP



$\alpha = 55°$

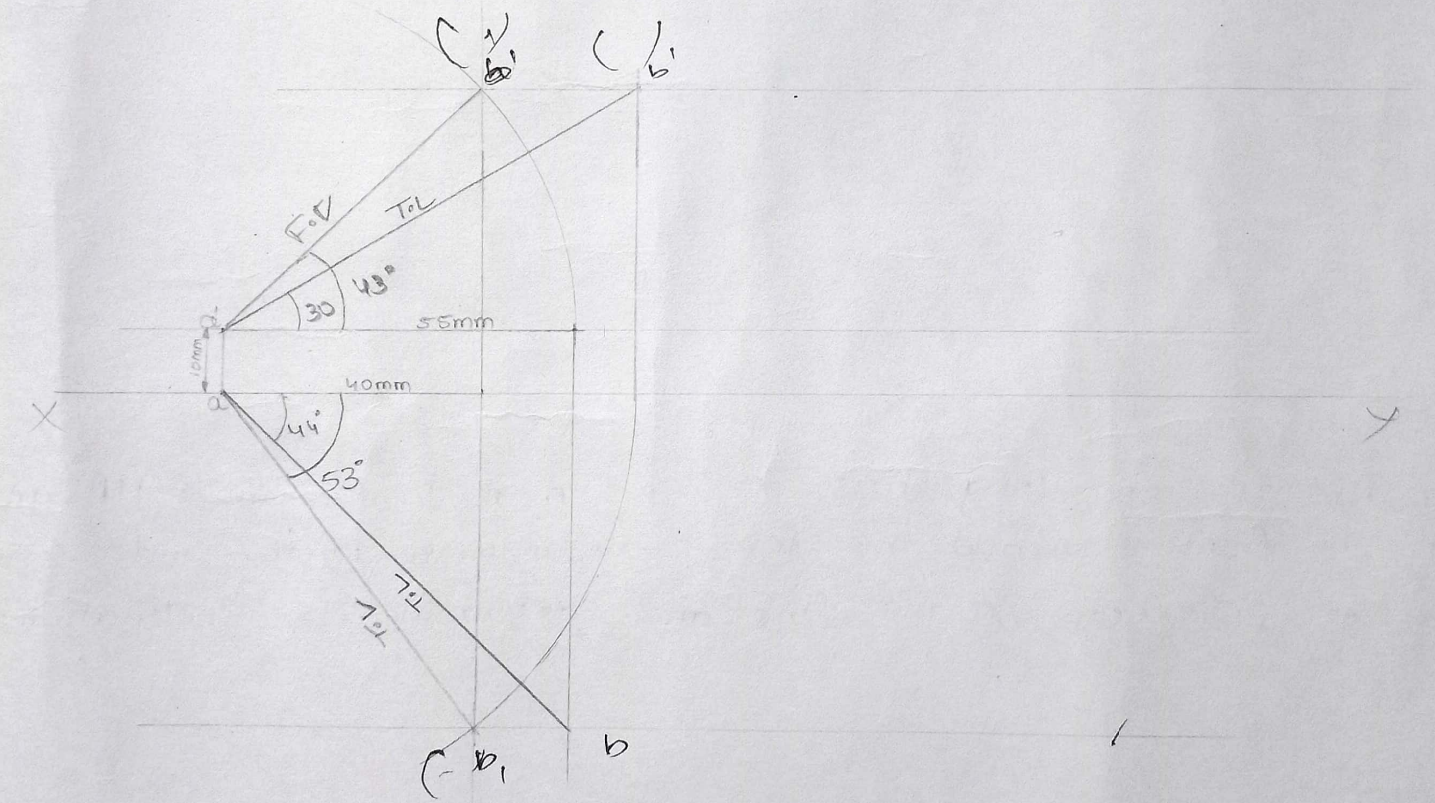
$\beta = 45°$

Q.8. A line AB 70 mm long, has its end A at 10 mm above HP and 15mm in front of VP. Its front view and the top view measure 50mm and 60mm respectively. Draw the projections of the line and determine its inclinations with HP and VP.



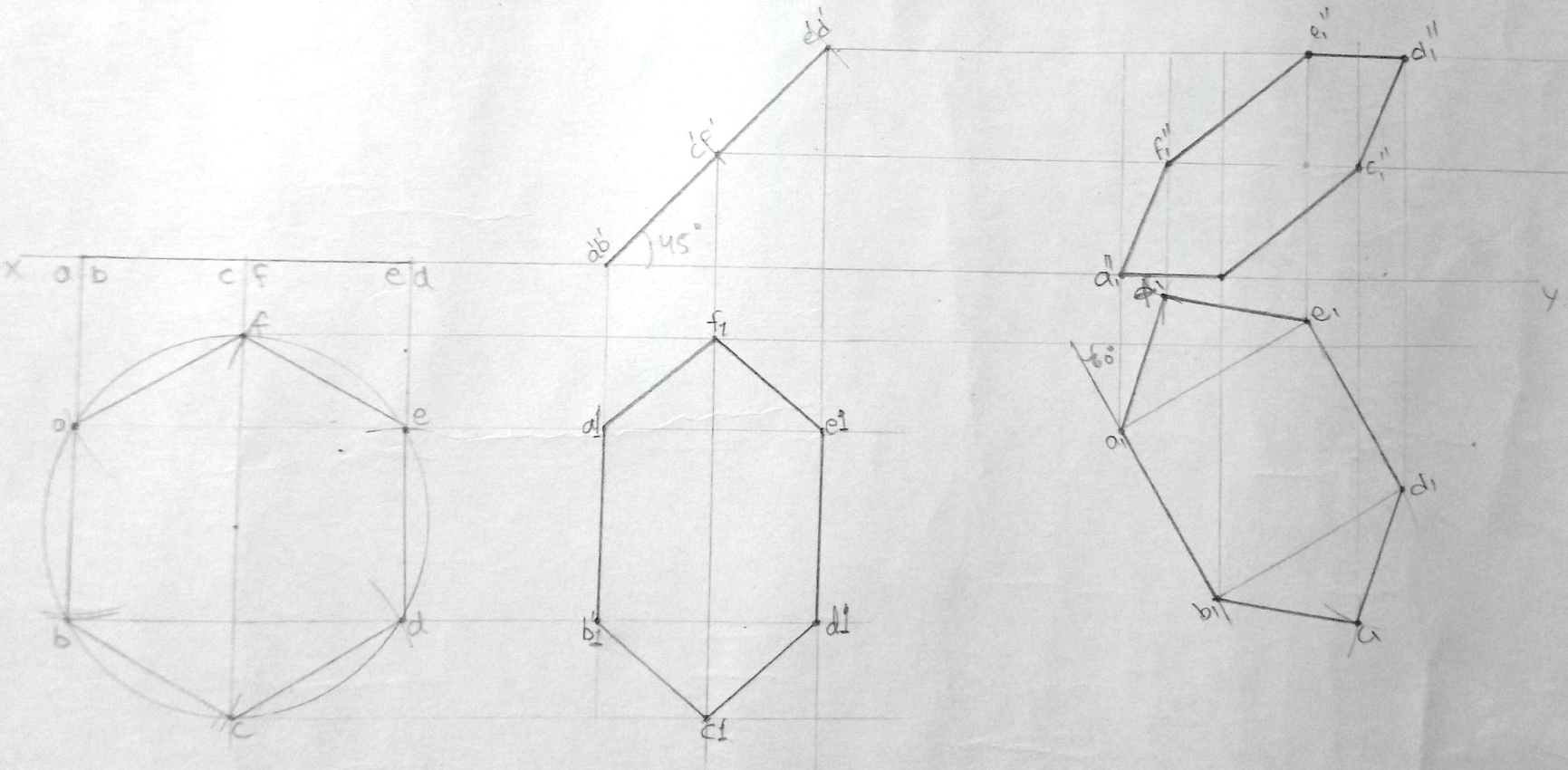
T.V = 50mm
F.V = 60mm
α = 45°
β = 55°
θ = 30°
ϕ = 45°

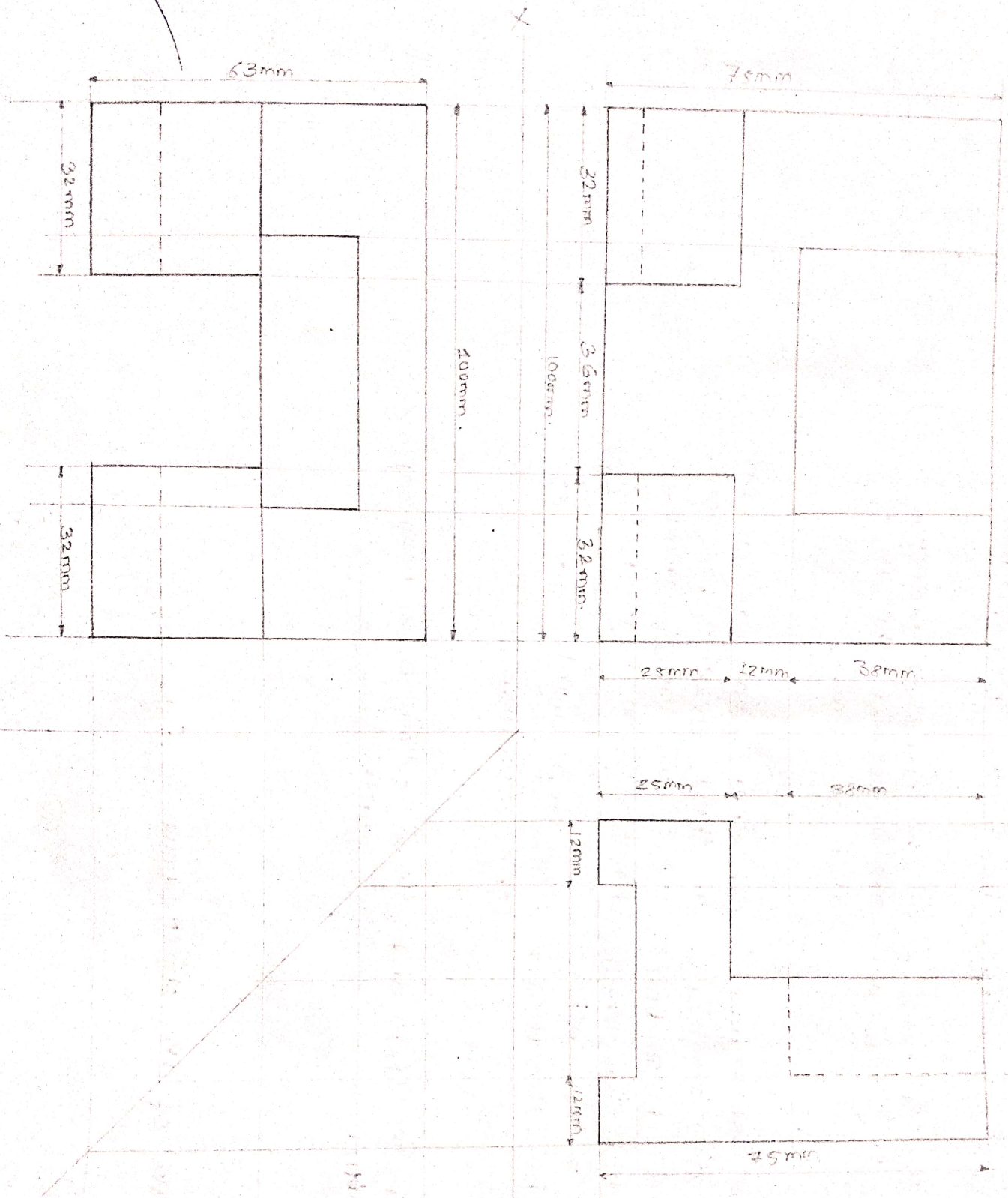
2.9. The front view and top view of a line measures 55mm and 65mm respectively. The end Projectors are 40mm Apart and one end of line is 10mm above the HP and in the VP. Draw the projections and find the true length and true inclination of line.

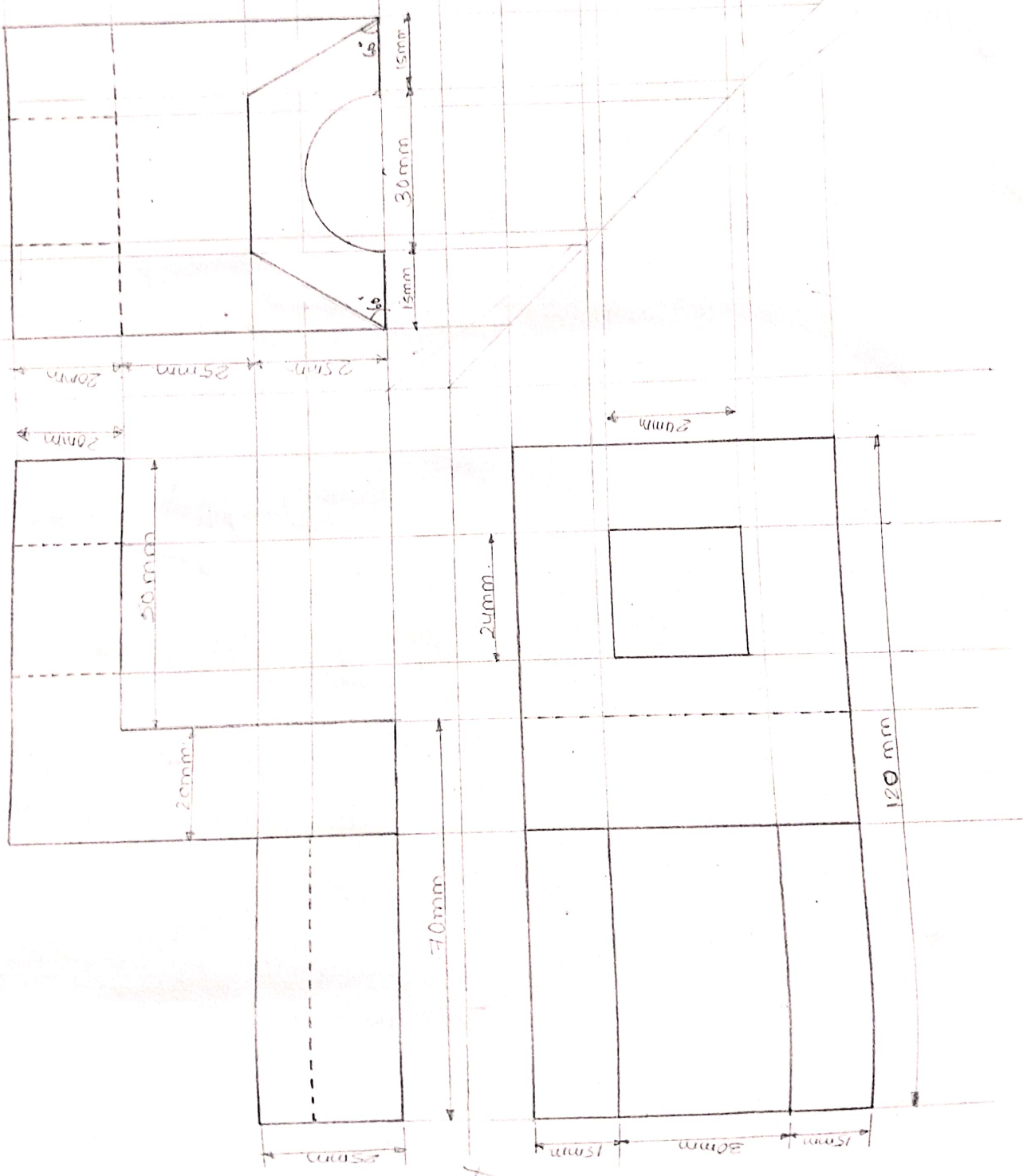


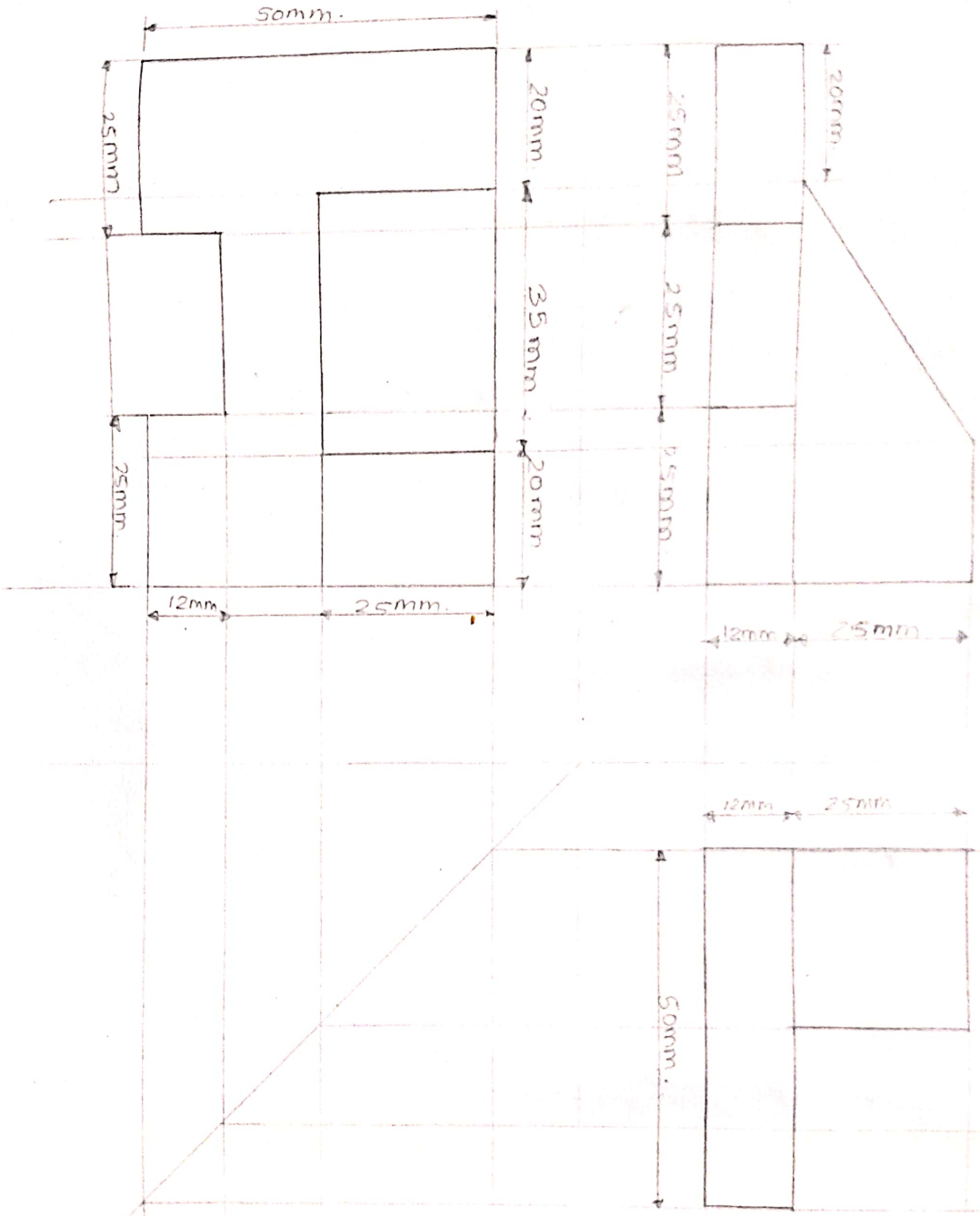
F.V = 55 mm
T.V = 65 mm
θ = 30°
ϕ = 44°
α = 43°
β = 53°
T.L = 75 mm.

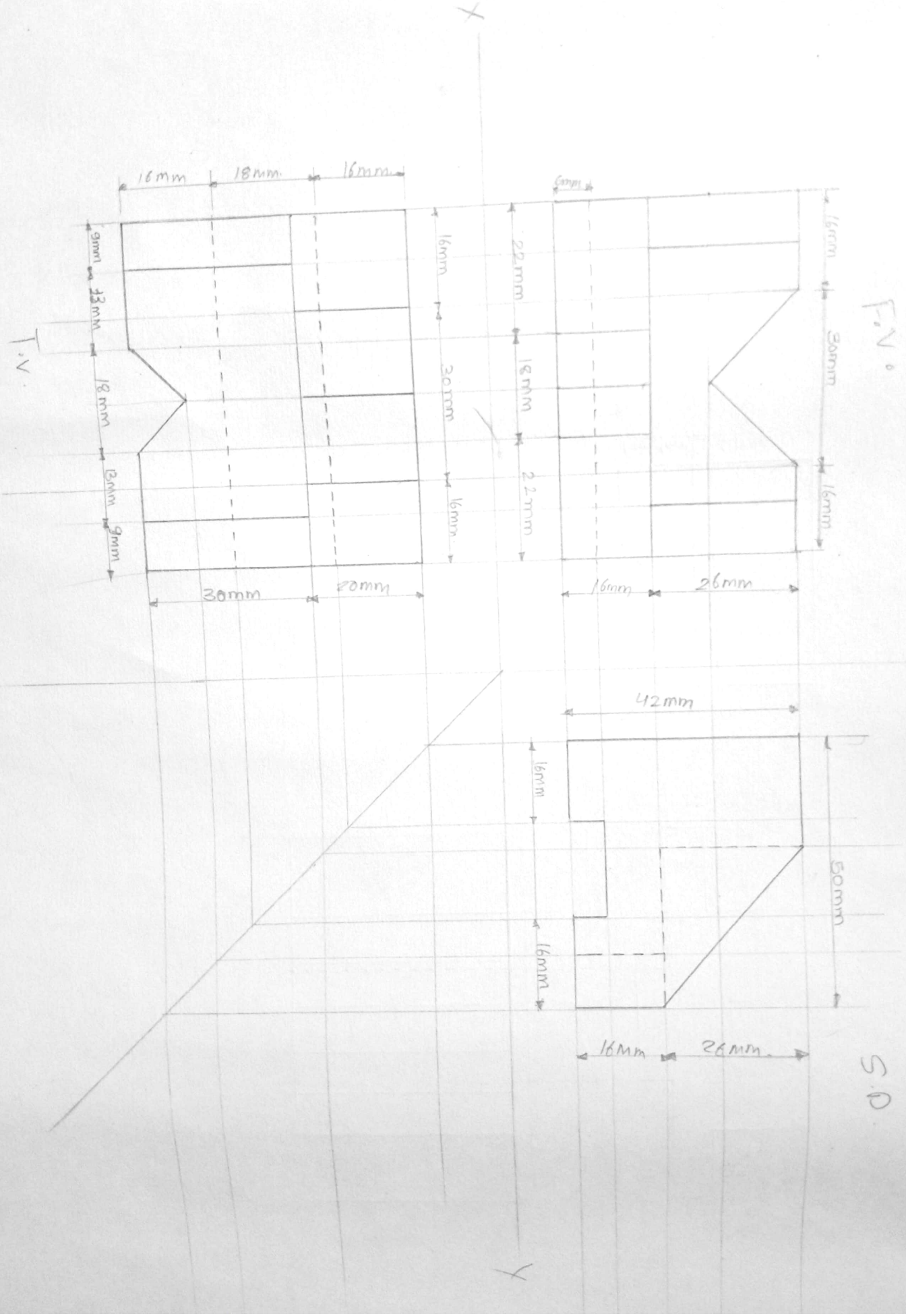
Q.11. A regular hexagonal ABCDEF of 30 mm side, having one of its sides in the the HP and inclined 60° to the VP. And its surface makes and angle of 45° with HP. Draw its projection.

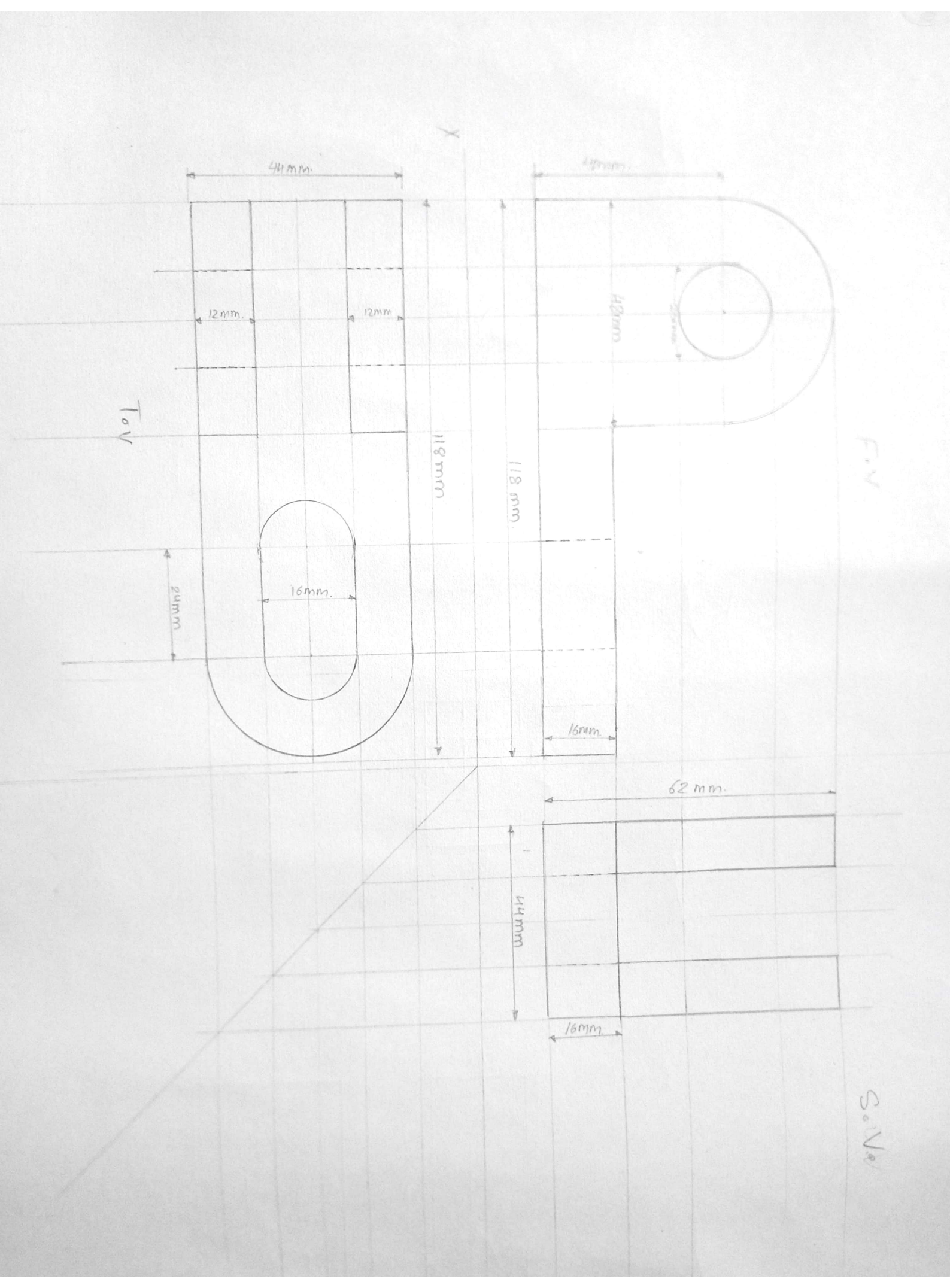


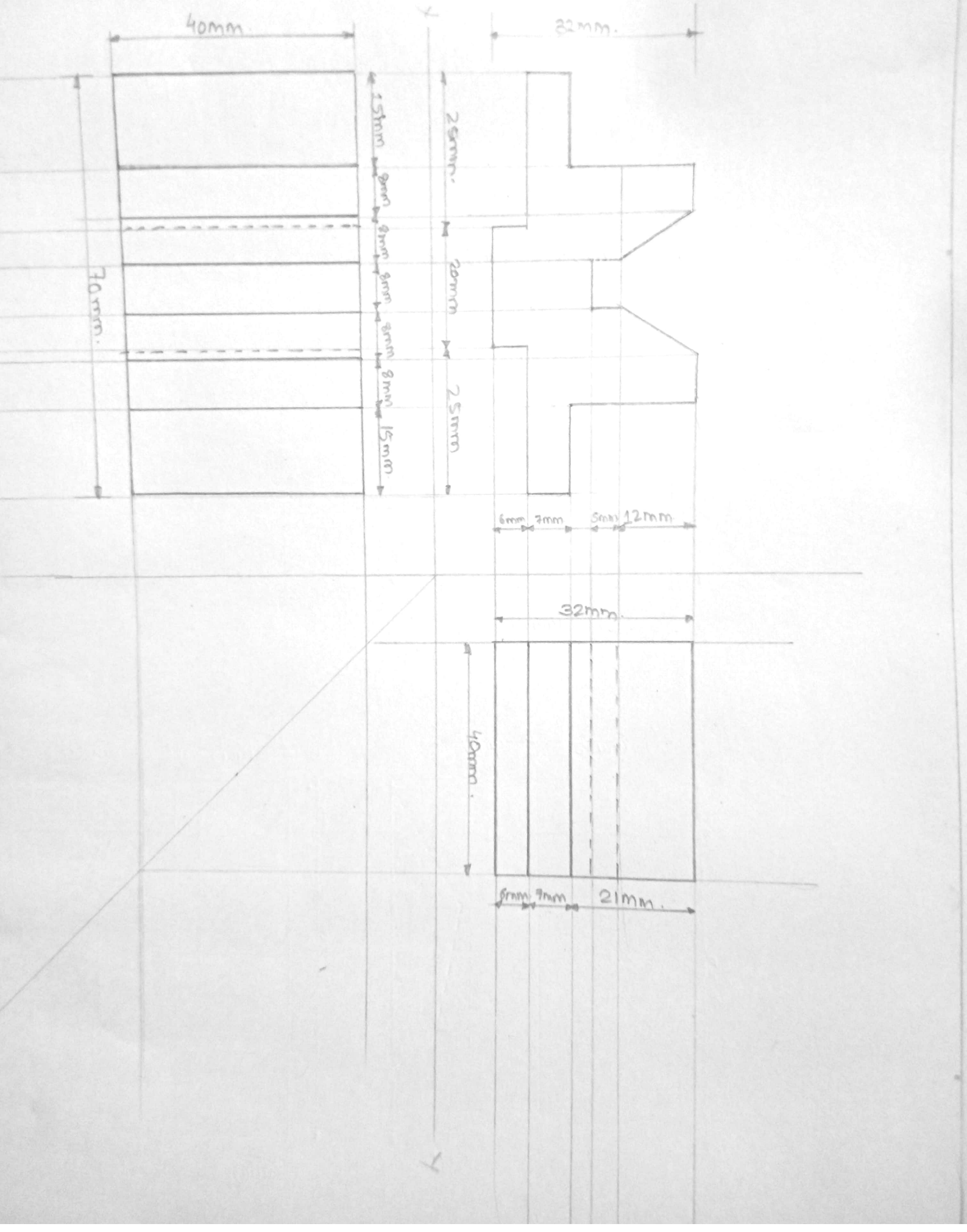

63mm
32mm
32mm
100mm
75mm
32mm
36mm
32mm
100mm
28mm
12mm
38mm
25mm
38mm
12mm
12mm
25mm



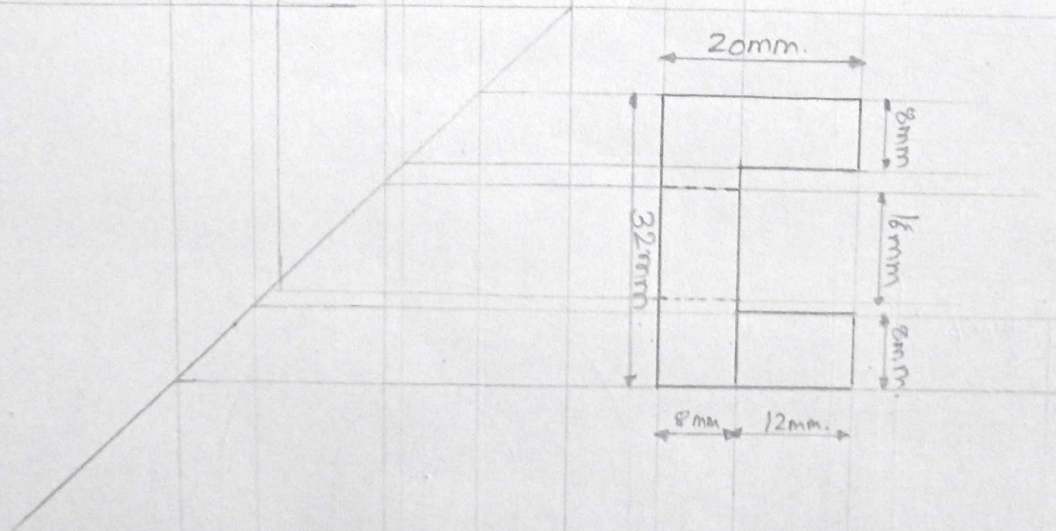

50mm.
25mm
20mm
35mm
20mm
25mm
12mm
25mm.
25mm
20mm
25mm
45mm
12mm
25mm
12mm
25mm
50mm.

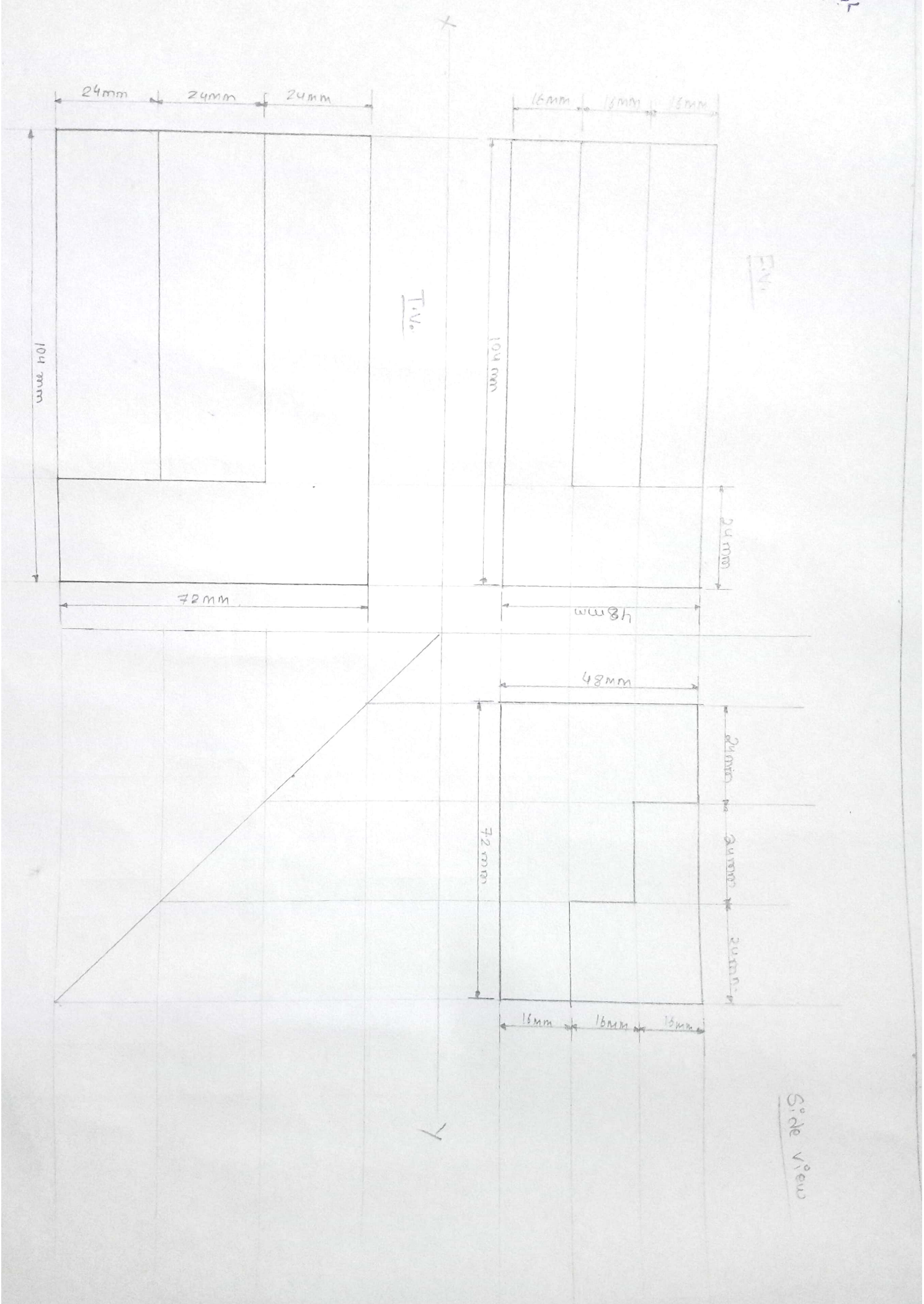

X
Y
16mm
18mm
16mm
6mm
9mm
13mm
18mm
13mm
9mm
16mm
30mm
16mm
22mm
18mm
22mm
16mm
30mm
16mm
T.V.
F.V.
30mm
20mm
16mm
26mm
42mm
16mm
16mm
50mm
16mm
26mm
S.D.


41 mm.
12mm.
12mm
118 mm
118 mm
16mm.
24mm
16mm.
62 mm.
44mm
16mm

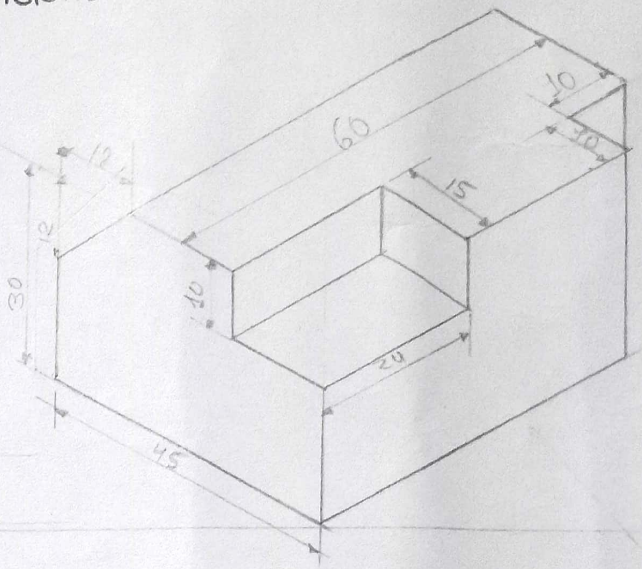


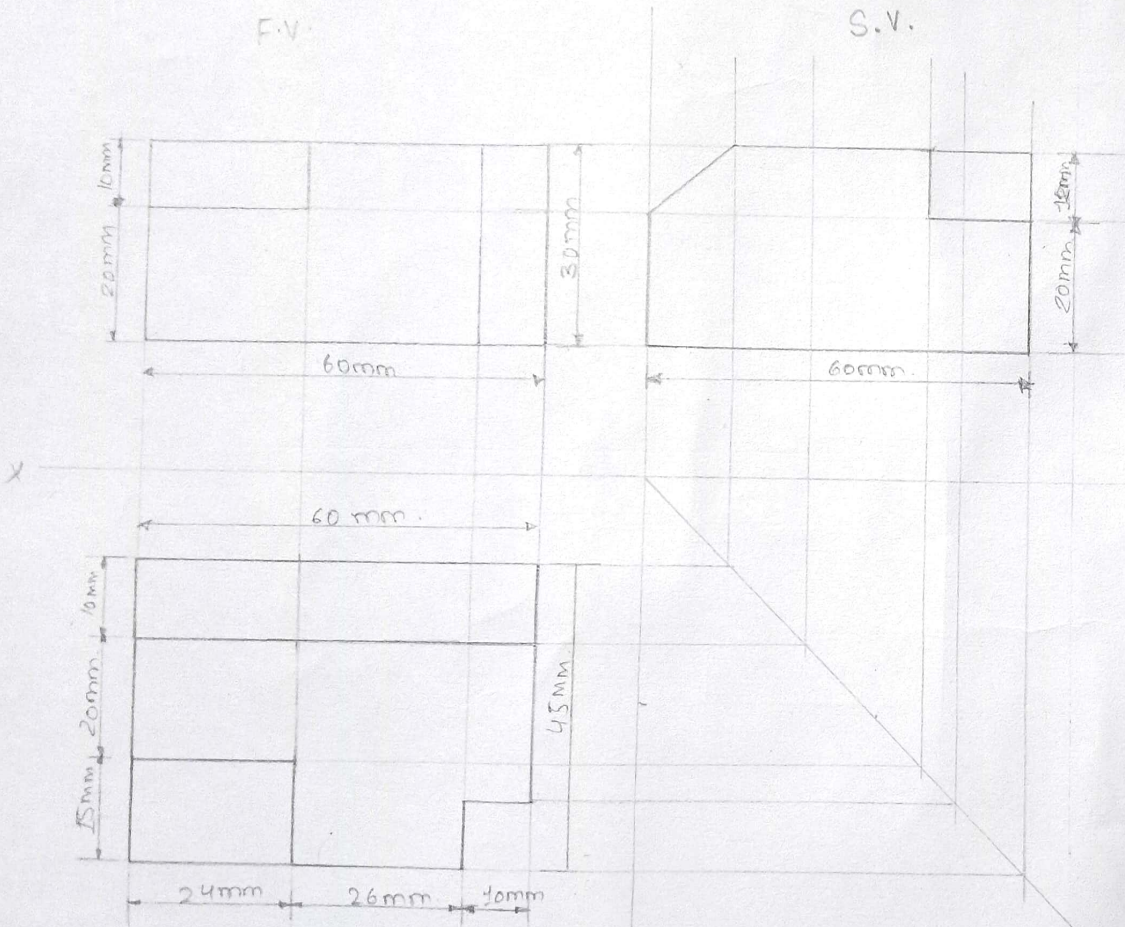

32 mm.
8mm
12mm
16mm
16mm
16mm
56mm
56mm
16mm
16mm
16mm.
8mm.
12 MM
8mm
20mm.

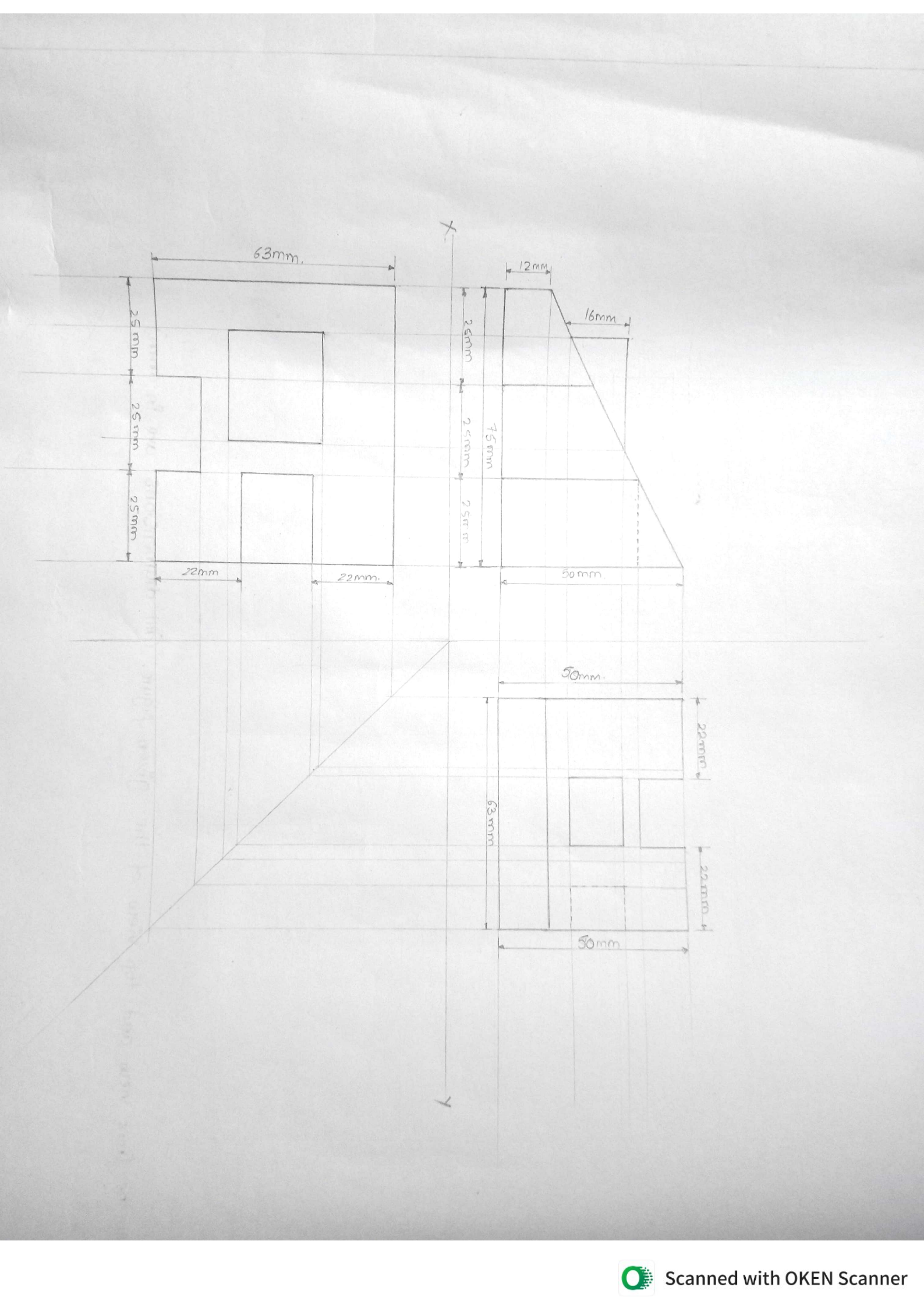

20mm.
8mm
16mm
32mm
8mm
8mm
12mm.

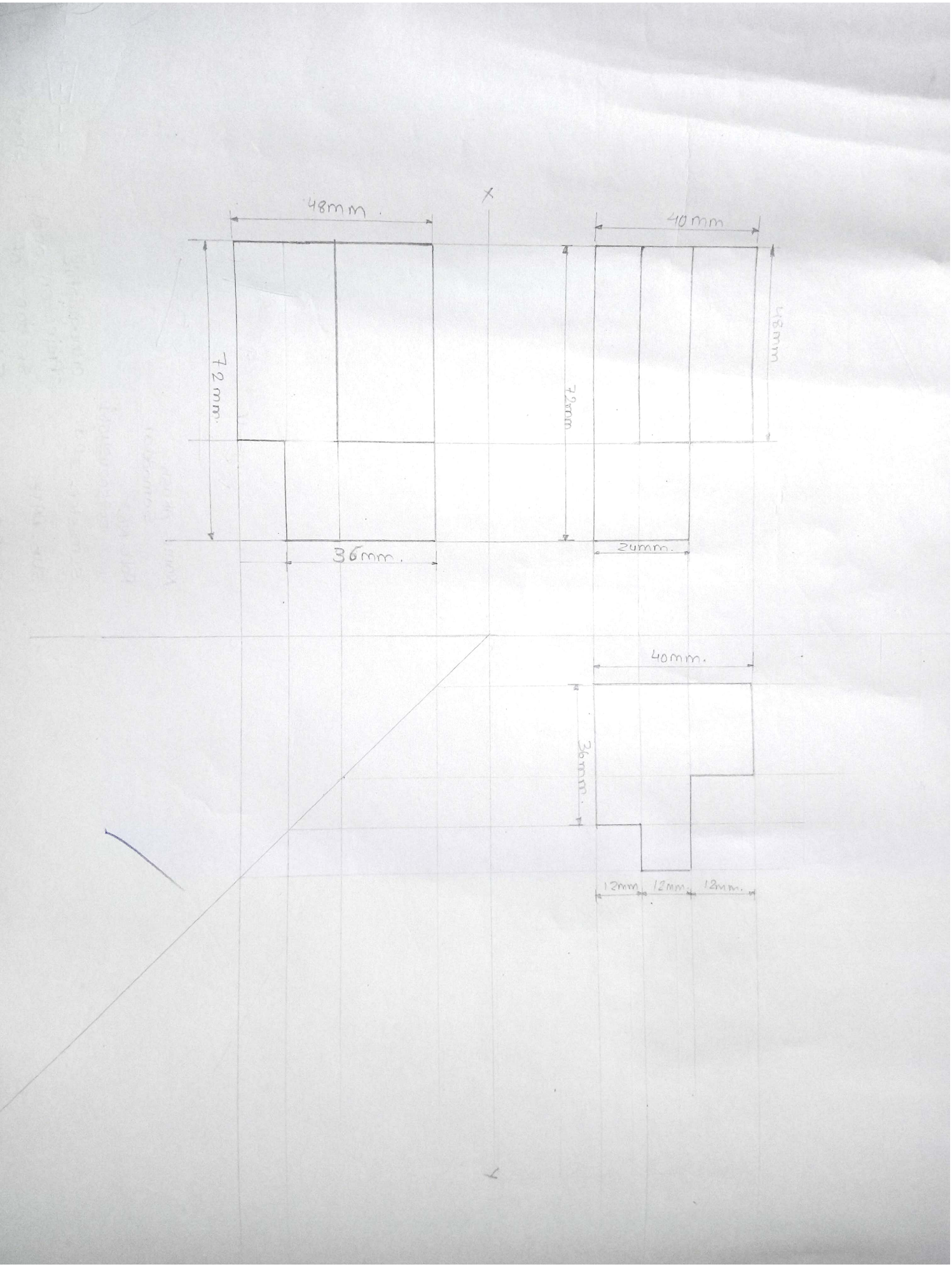

24mm
24mm
24mm
16mm
16mm
16mm
10cm
10cm
24mm
72mm
48mm
48mm
24mm
24mm
24mm
72mm
16mm
16mm
16mm
T.V.
F.V.
Side View

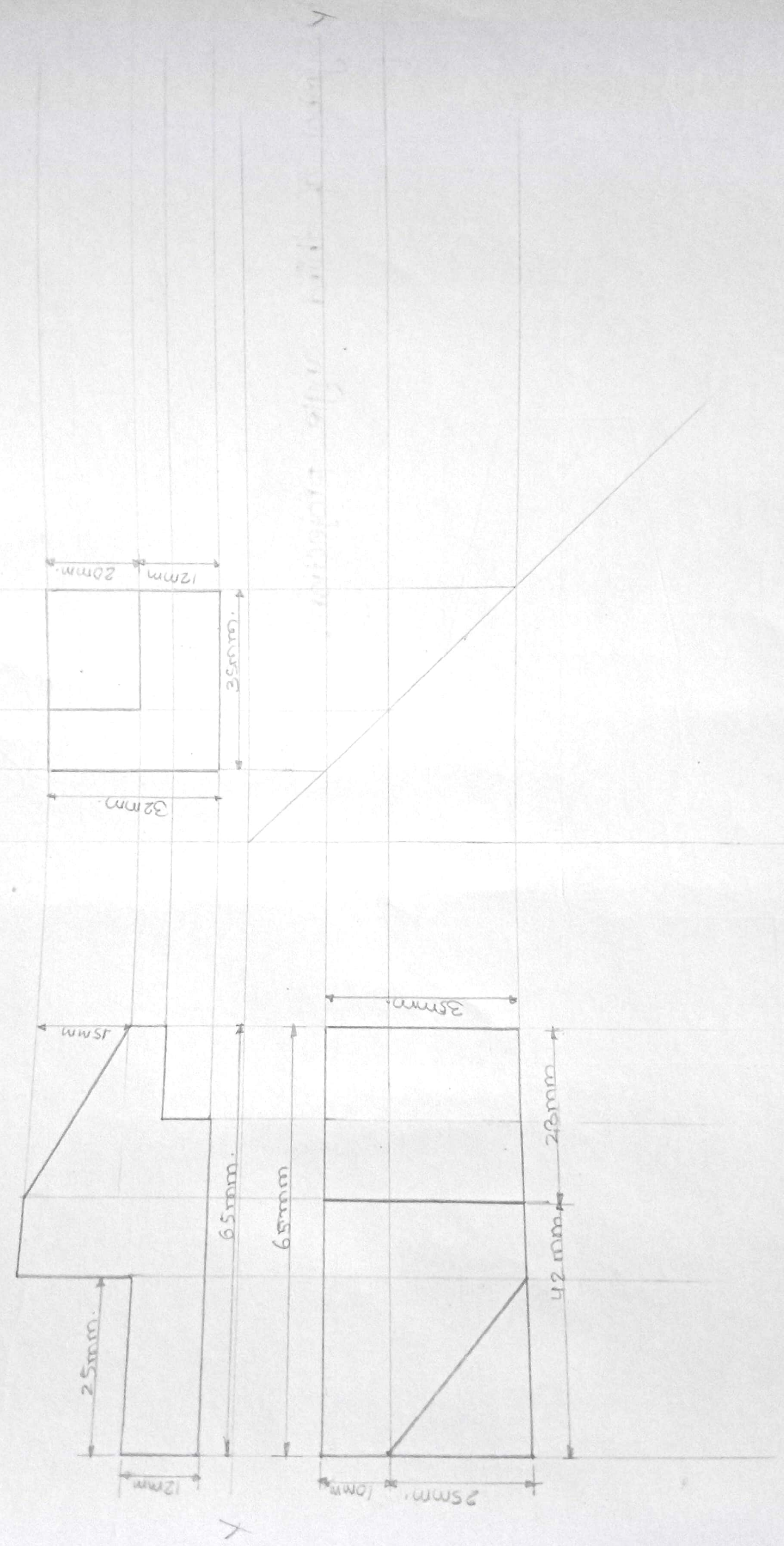
Q. Draw the front view and top view of the given figure. (All diamensions are in mm)





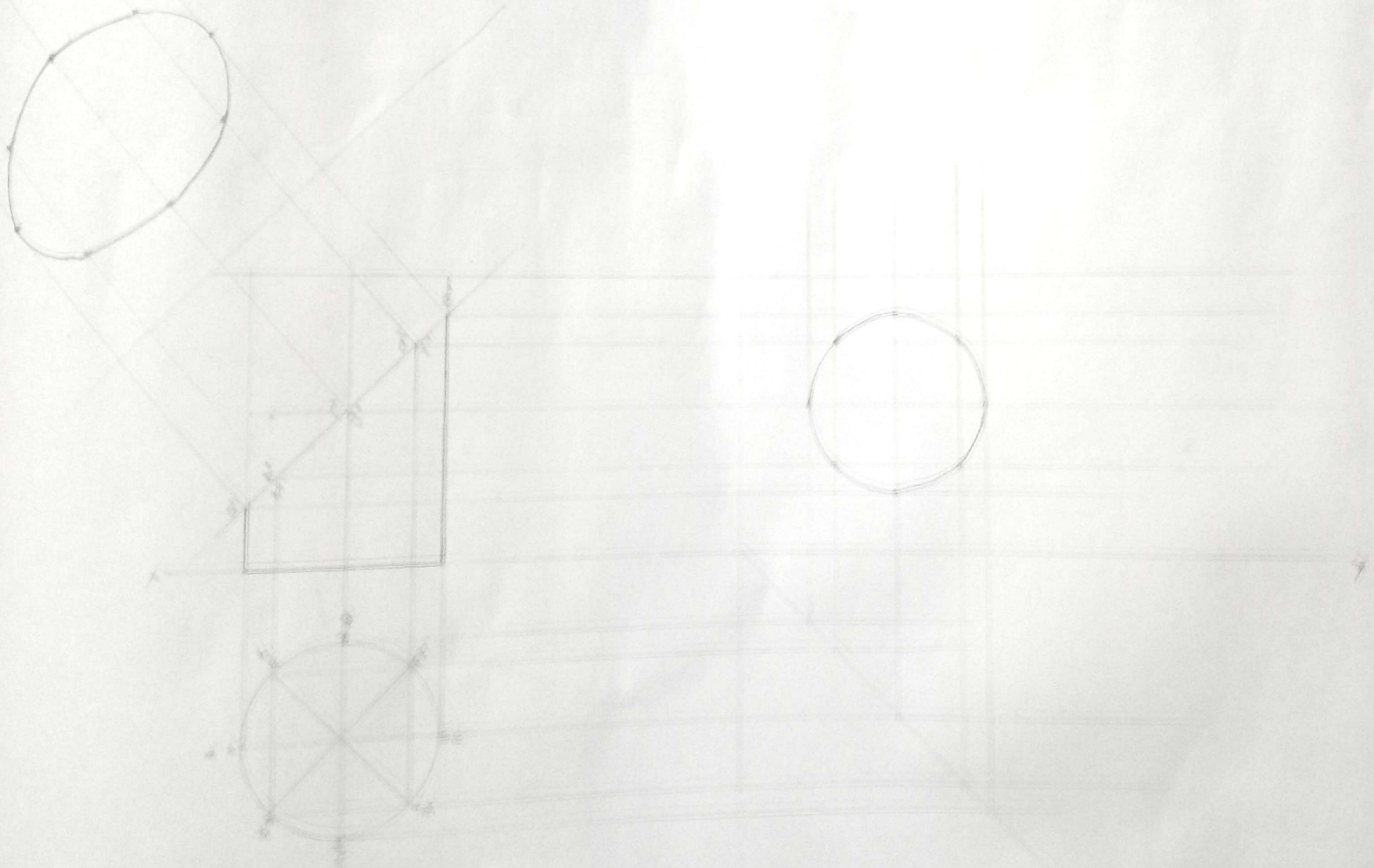

63mm.
25mm
25mm
25mm
22mm
22mm.
12mm
16mm
25mm
25mm
25mm
75mm
50mm.
50mm.
22mm
63mm
22mm
50mm

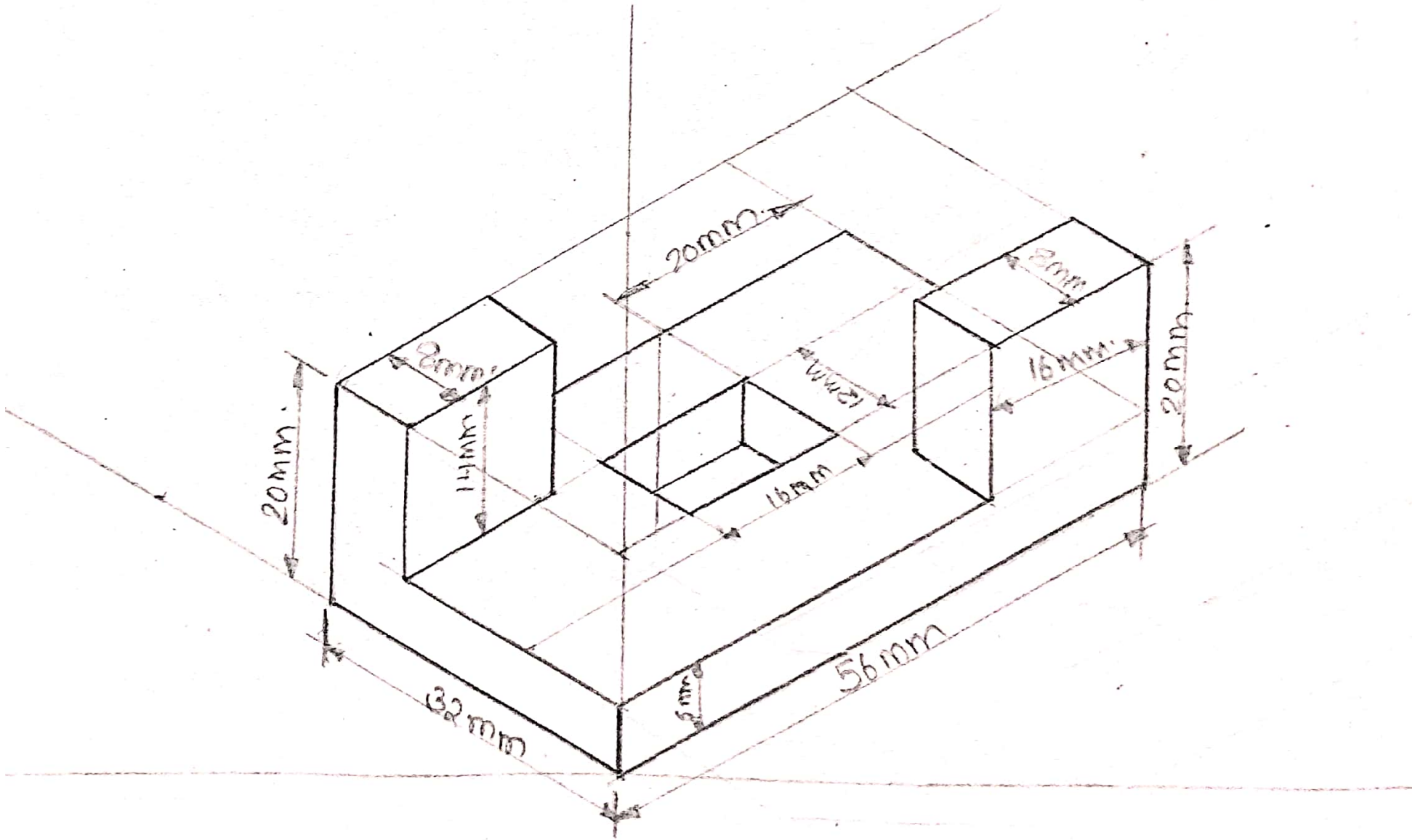


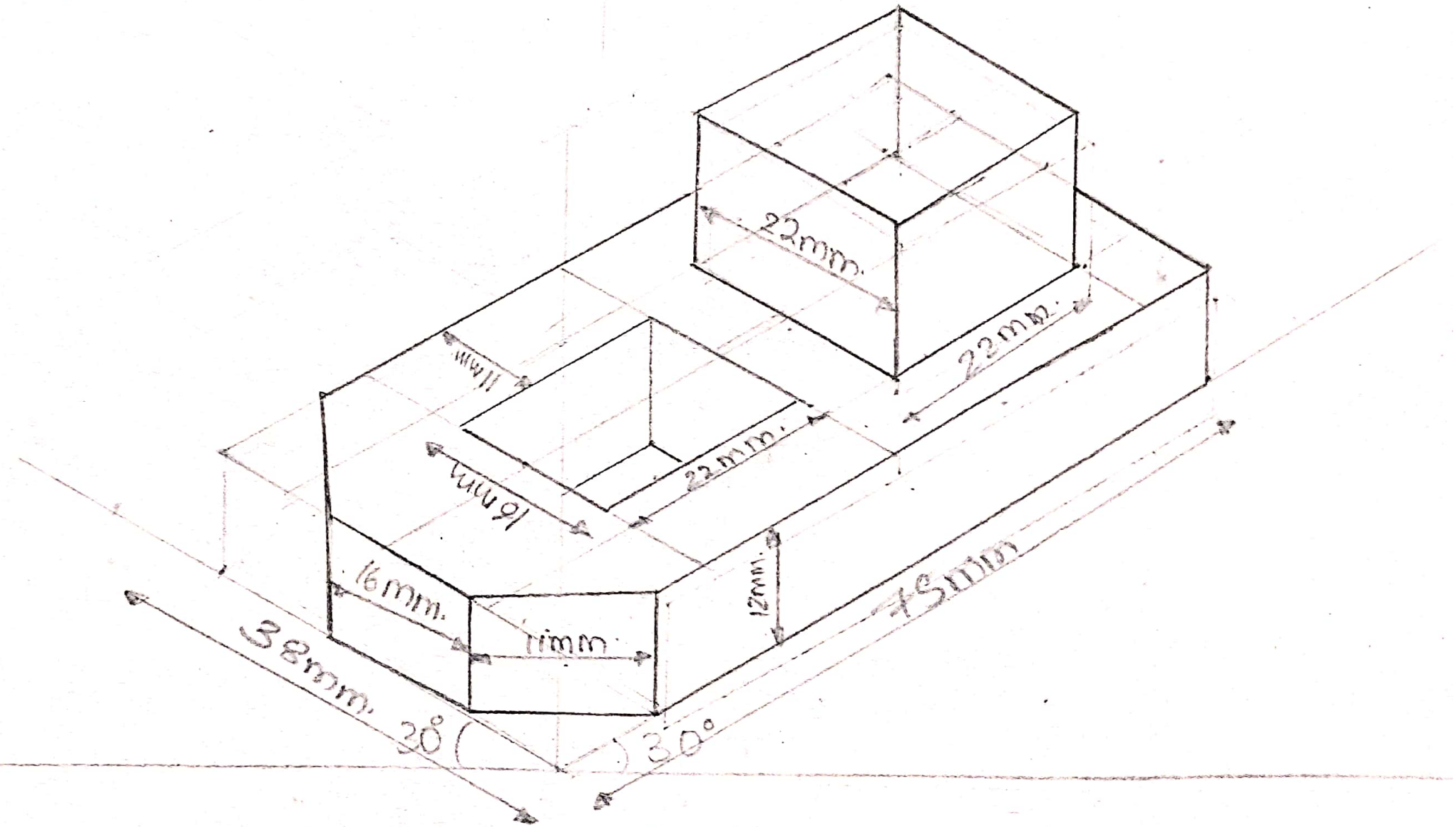


Assignment no. 5

1. A cylinder of 40 mm diameter, 60mm height and having its axis vertical, it is cut by a section perpendicular to the VP and inclined at 45° to the HP, it is intersecting the axis 32 mm above the base. draw its front view sectional top view and true shape of section.







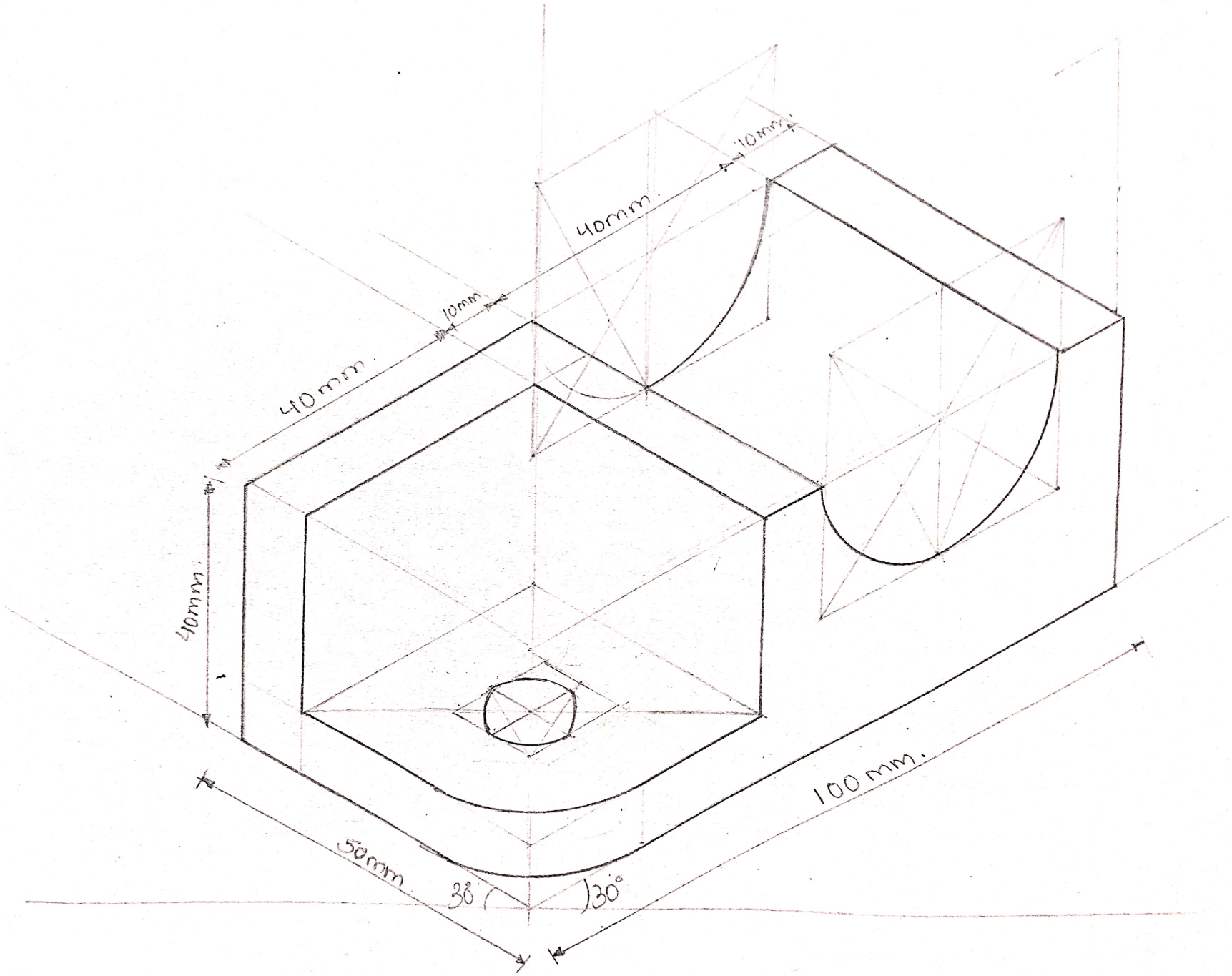
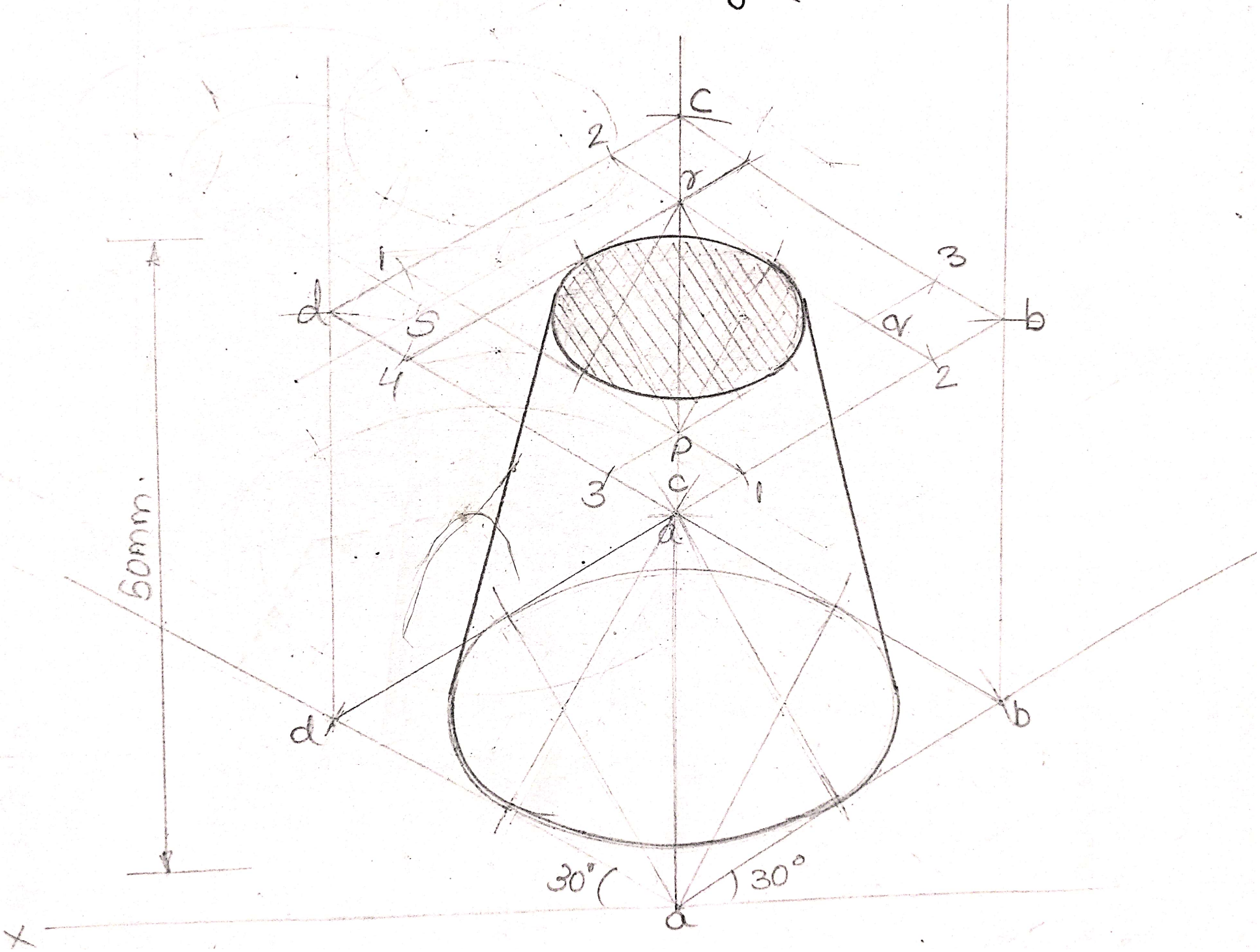
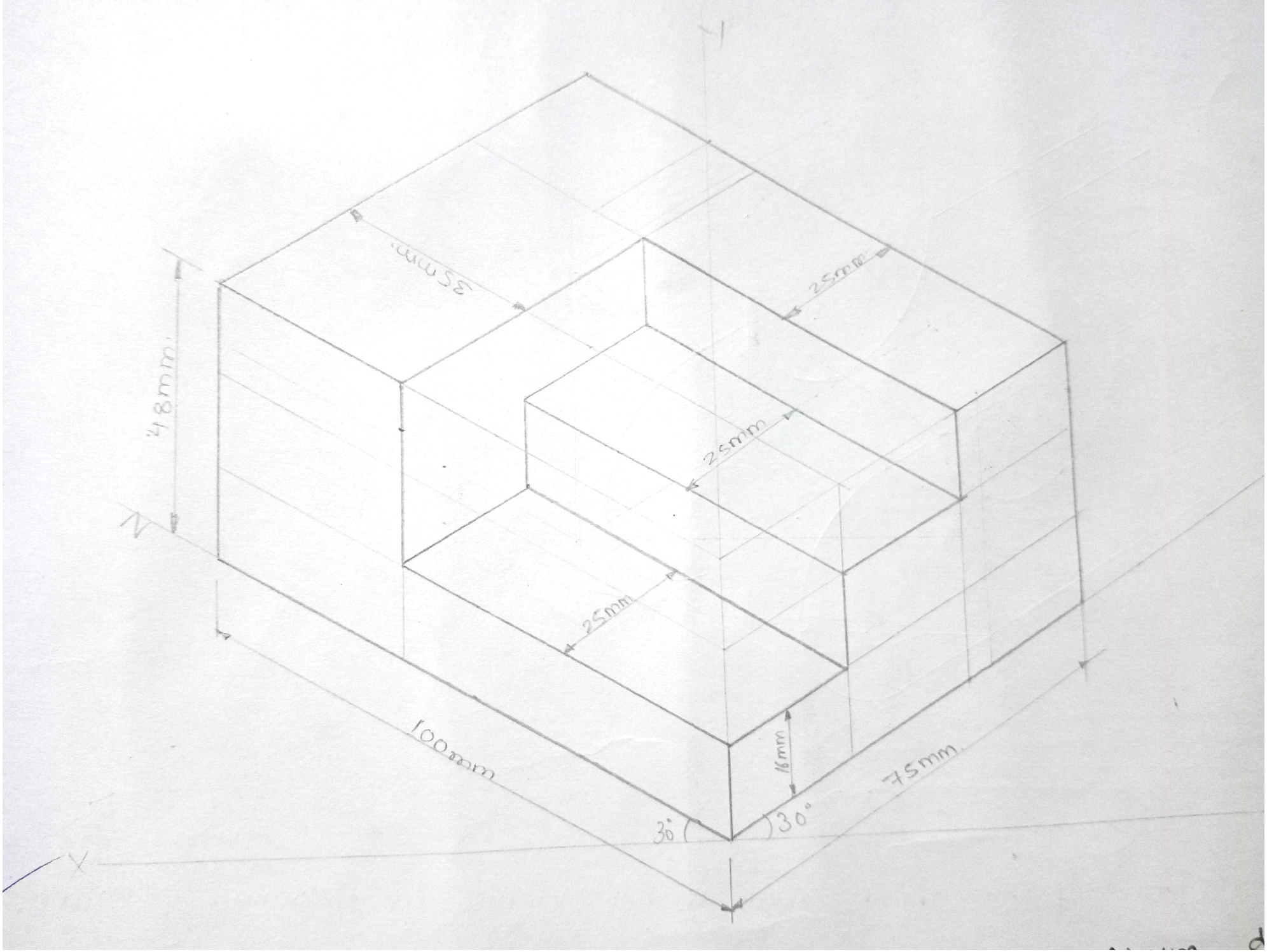
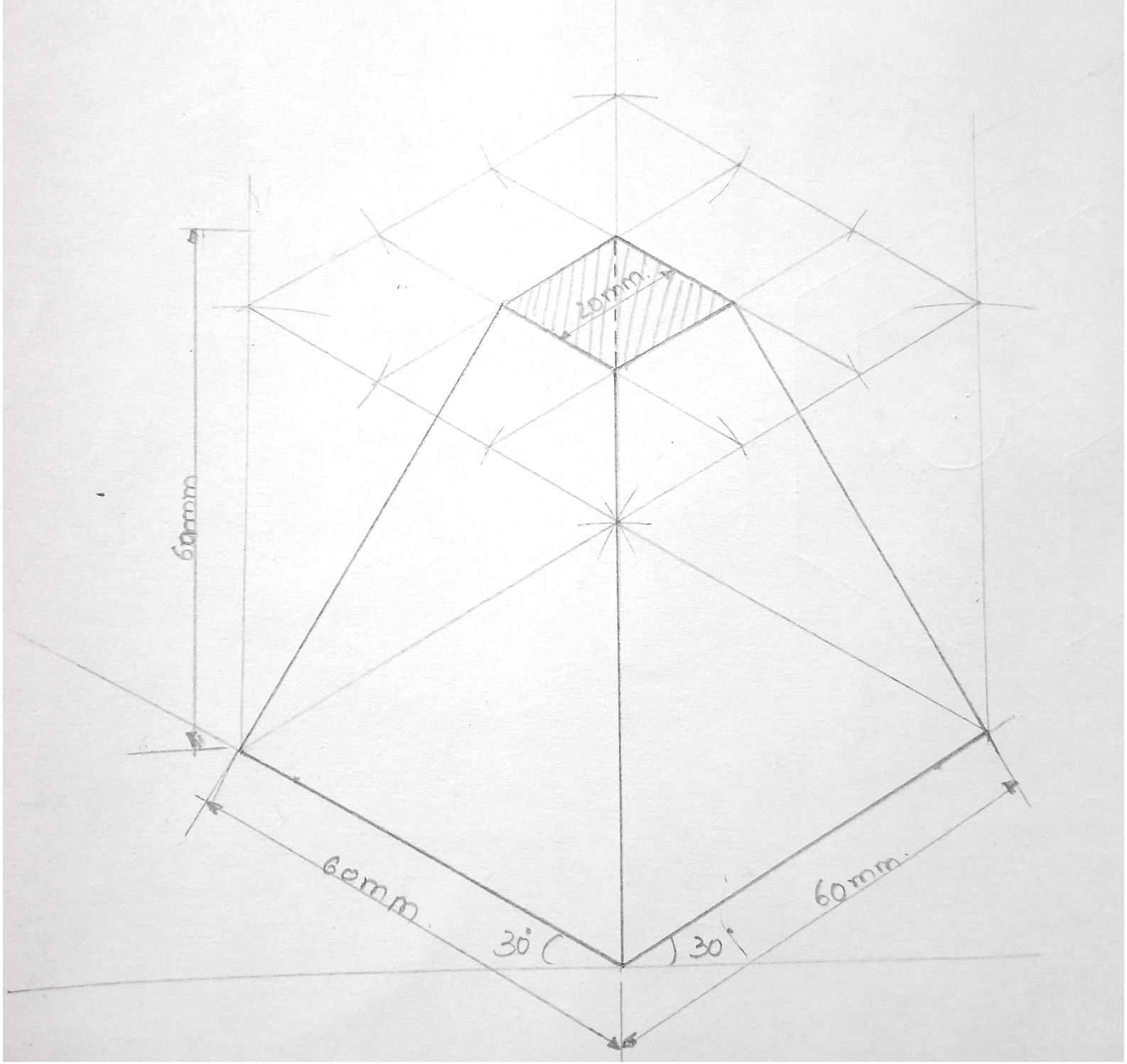


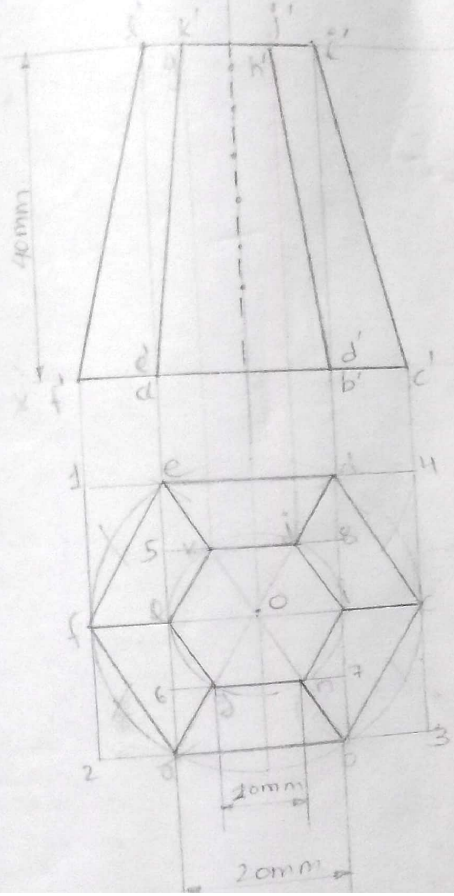
Figure.

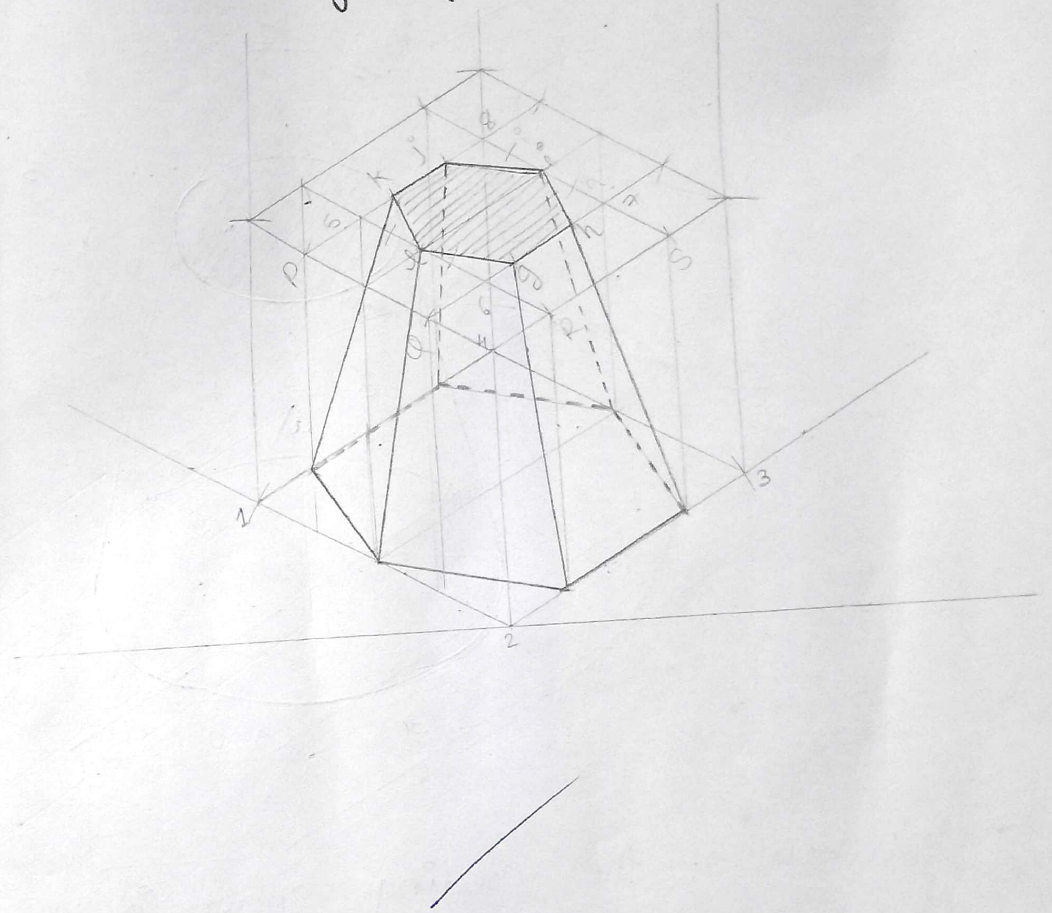




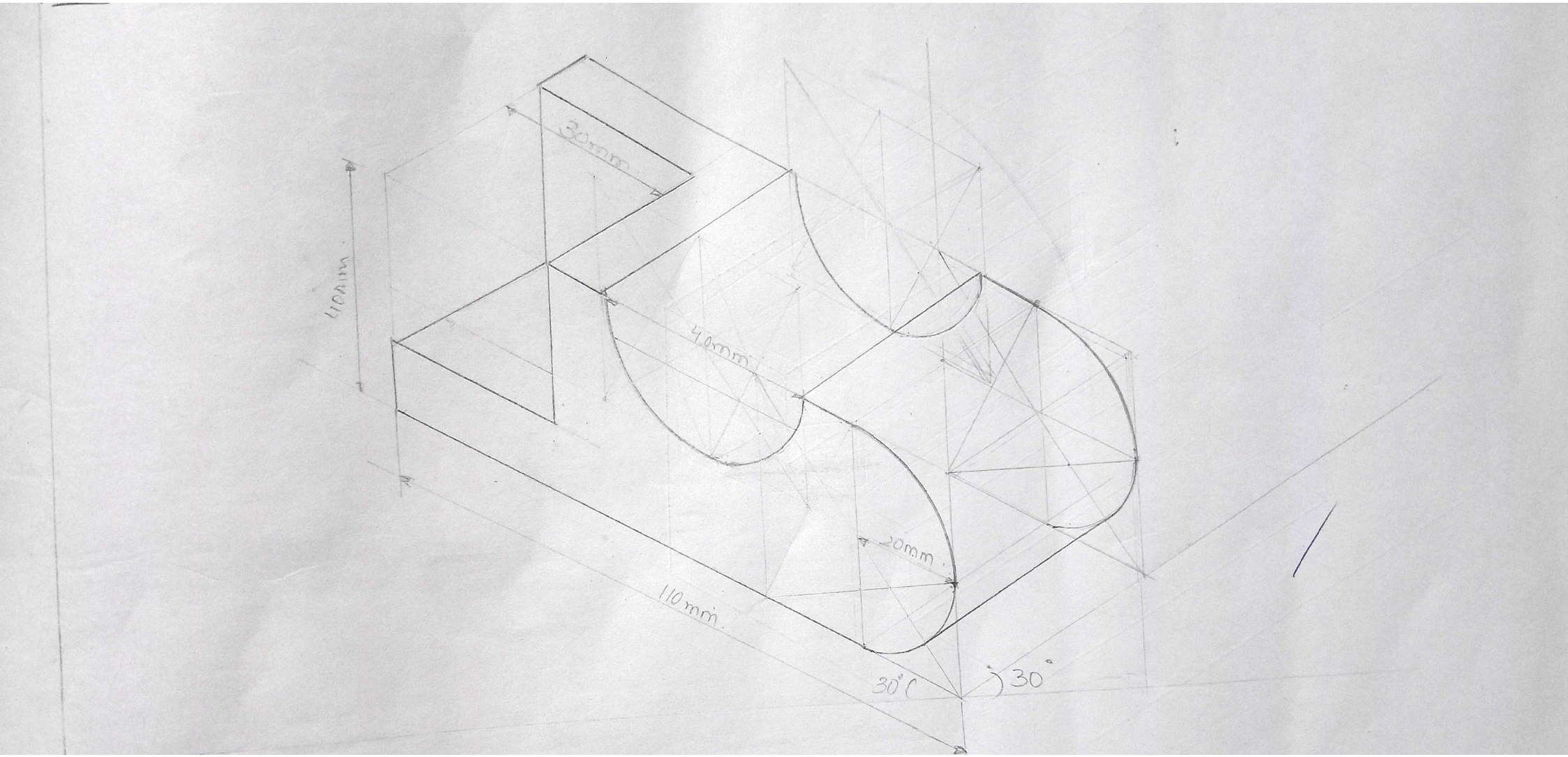


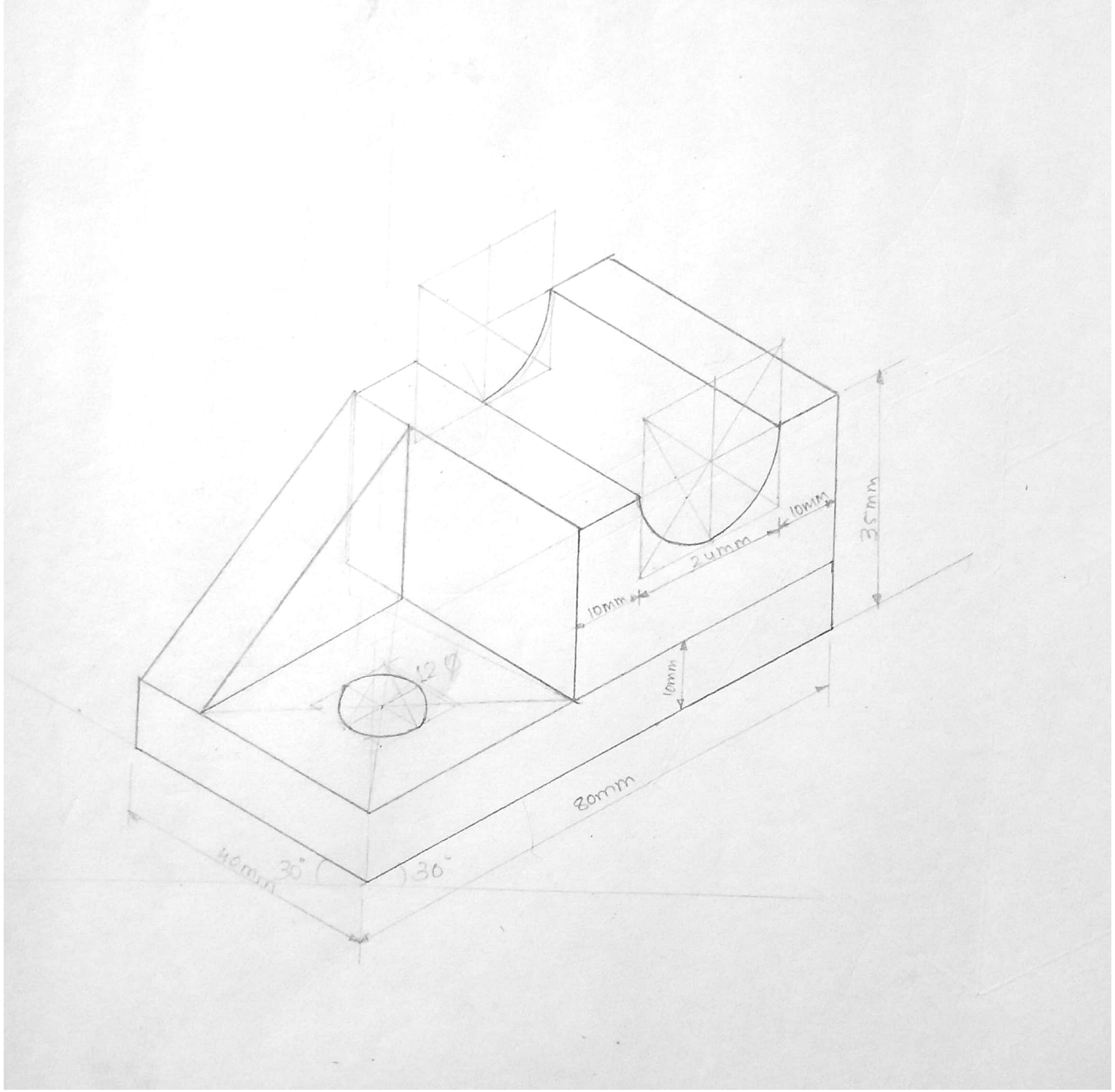
Q.7. Draw the isometric drawing of the frustum of ~~the~~ a regular pyramid, side of base hexag is 20 mm and of the top hexagon is 10mm and height of the frustum is 40 mm.

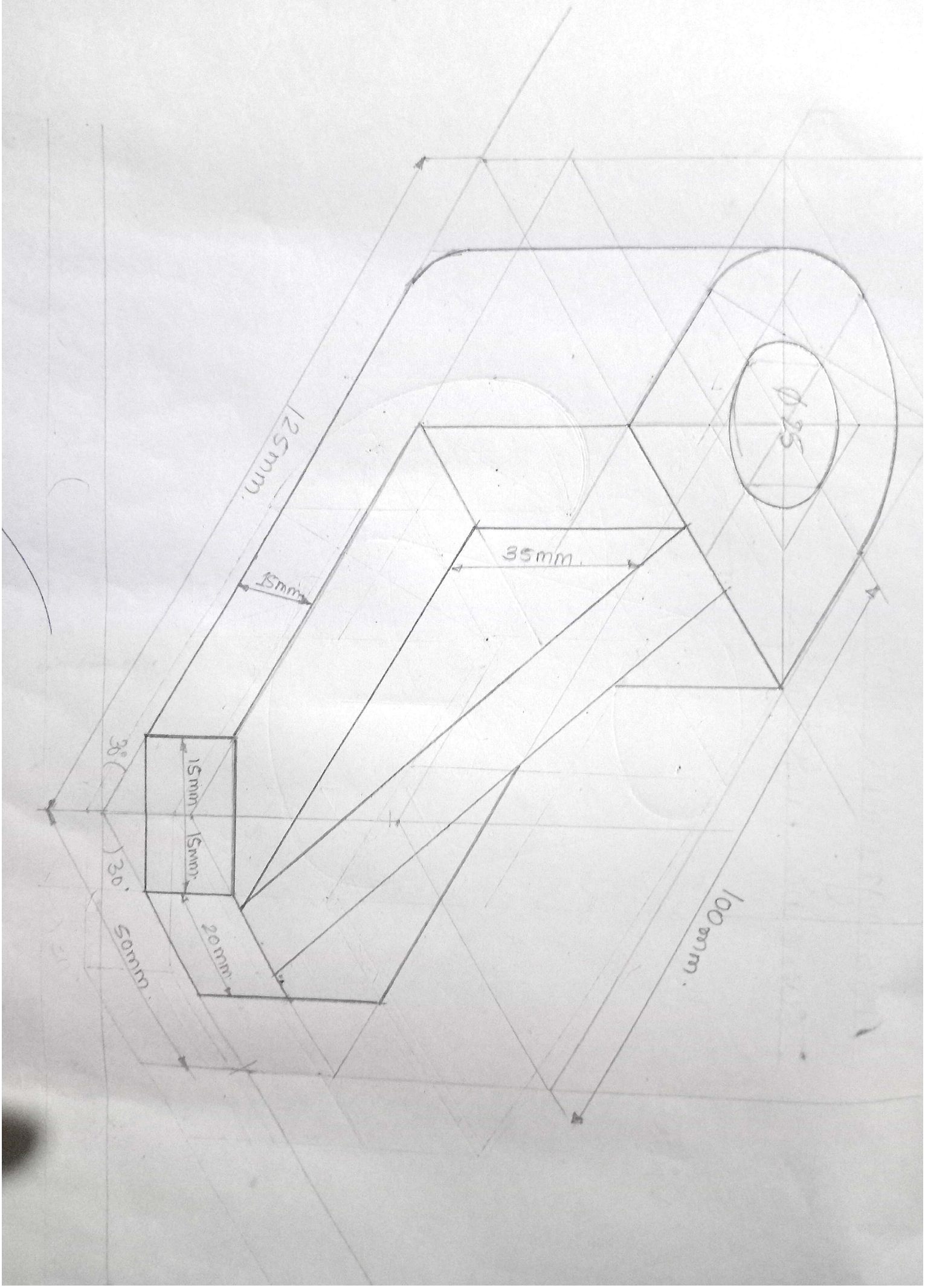




orthographic projection.







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Ed.,-(Part -01)

Definition of CAD (CAD की परिभाषा):-

Computer Aided Drafting (CAD) एक ऐसा Process है. जिसके द्वारा किसी Object का drawing बनाया जाता है और drawing बनाने के लिए Computer की सहायता ली जाती है। उँड Software एक आसान तथा उपयुक्त विधि है, जिसके द्वारा सामान्य या विशेष डिजाइन, मैकेनिकल तथा विद्युत इंजीनियरिंग में करते हैं।

Advantages of computer Aided Desing and Drafing (CAD):-

(i) CAD में उपलब्ध सुविधा से किसी Job का माडल develop करना तथा drafting करना बहुत ही सरल होता है।

(ii) CAD traditional विधि से fast तथा ज्यादा यथार्थ होता है।

(iii) CAD द्वारा विभिन्न diamention की गणना उसके मॉडल बनाये बिना ही Accuracy से की जा सकती है।

(iv) CAD में एक बार बनी Drawing को पुनः नहीं बनाया जाता है। इसे अल्प समय (Short time) में copy करके आगे का कार्य किया जाता है।

(v) माडल में संशोधन बहुत सरल होता है और भविष्य को देखते हुए Designer द्वारा दिये गये उत्पाद में आवश्यक परिवर्तन किया जा सकता है।

(vi) Traditional drawing विधि की तुलना में कैड द्वारा ड्रॉइंग की dimentions विशेषताओं तथा दूरी को संशोधित किया जा सकता है।

(vii) 3D देखने की Avalable सुविधा को व सभी direction (दिशा) में देखा जा सकता है।

(viii) Desing में Productivity (उत्पादकता) सुधार तथा Shoart lead time. लगता है।

(ix) किसी जटिल भाग का निरीक्षण, डॉक्यूमेंट बनाने में सहायता करता है,

(xi) यह निर्माण, योजना तथा निरी. में उपयोगी है।

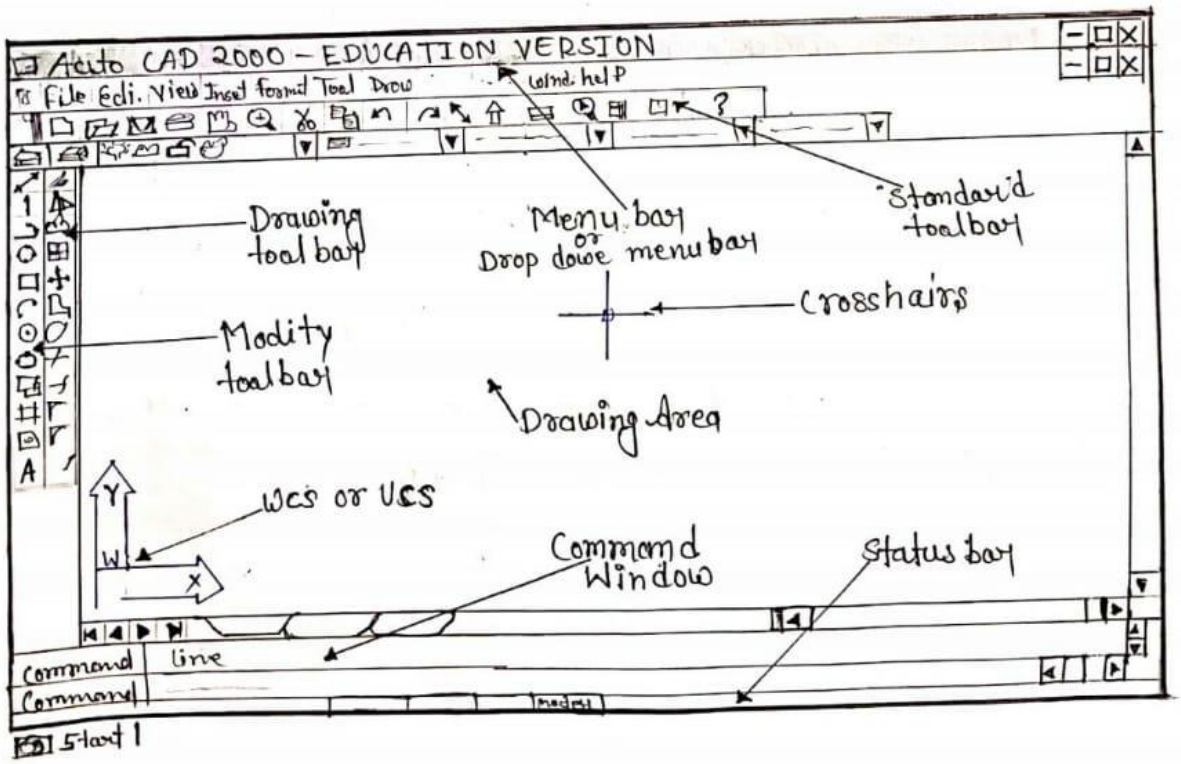
(xi) Colwies भी use कर सकते Product को बेहतर ढंग से देखने के लिए।

List of various CAD softwares :-

1. Corel draw.
2. Microsoft office
3. Photo finish,
4. Point
5. Page makes,
6. Auto - CAD
7. Micro- station
8. Corel - CAD
9. Pro - E
10. Solidworks

Components of Auto CAD 2000 (Auto CAD 2000 के अवयव):

Auto CAD को Auto desk compney ने सन् 1982 में कैलिफोर्निया में विकसित किया। भारत में इसकी Branch Banglore. में है। इसका प्रथम संस्करण R, विकसीत किया गया उसके बाद R_1 से R_{13} तक के संस्करण DOS आधारित बनाये गये। सन् 1999 में R_{14} Windos आधारित संस्करण बनाया गया। इसके 2000, 2001, 2003, 2004 इंटरनेट आधारित है। इसके बाद और बहुत सारे संस्करण विकसीत किये गये।



Auto CAD के मुख्य रूप से 9 अवयव (Element) हैं :—

(1) Title Bar :- Auto CAD एवं Graphic window के सबसे ऊपरी भाग में टाइटल (Title) बार होता है।

(2) Drop Down menu bar :- Title bar के ठीक नीचे Drop Down menu bar होता है, Menu bar कहते हैं। इसमें File, Edit, view, Insert, format, Tools, Draw, Diamention, modify, exports, window, Help.

(3) Standard toal bar :- Standard toal bar menu bar के ठीक नीचे होता है। इसमें निम्नलिखित विकल्प (Option) होते हैं।
Menu ; Open, Save, plot, print privew, publish, Cut, copy, paste, match properties, Block editor, Undo, Rdo, panel. Reat time., Zoom Real time, Zoom, Zoom. privious. properties, Design centre, window help.

(4) Drawing tool bar :- यह window screen के गई (left) side vertical bar होता है। इसमें निम्नलिखित (following) options होता है। लाइन, पॉलीलाइन, बहुभुज, आयत, वृत, ऐव, क्लाउड, स्प्लाइन, दीर्घवृत, इनसर्ट, ब्लाक, बिन्दु ड्रैच, रीजन, m text.

(5) Drawing Area :- यह Graphic window के मध्य भाग का Area होता है, जिसमें Drawing बनायी जाती है।

(6) VSC or WCS Icon :- यह Drawing Area के निचले left कोने में होता है, जिसमें दो तीर x व y दिशा में होते हैं।

(7) Cross Hair :- जब माउस को पैड पर चलाया जाता है तब Cross Hair screen पर दिखाई देता है।

(8) Command window :- यह Graphic window के निचले हिस्से में मॉडल के ठीक नीचे होता है। इसमें Command लिखा होता है।

(9) Status bar :- Graphic window के सबसे निचले हिस्से में क्रमांक (1) window के ठीक नीचे status bar होता है। यह एक Horizontal bar होता है।

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Q.3 Functions of utility commands (setting Drawing Units, Limits, grid, and snap)

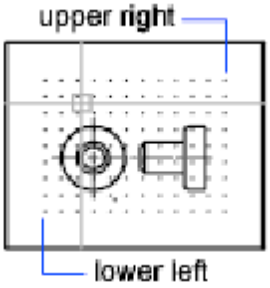
1. LIMITS: Allows changing the upper and lower limits of the drawing area while working on a drawing.

For example to set the screen for A3 size (420x297), following steps are to be carried out:

Command: limits ↵
ON/OFF/⟨lower left corner⟩ ⟨0.000, 0.000 or current⟩ : ↵
Upper right corner ⟨12.000, 9.000⟩ : 420,297 ↵
This will set the drawing screen of A3 size.

Sets and controls the limits of the grid display in the current Model or named layout.

Command entry: 'limits for transparent use



On Turns on limits checking. When limits checking are on, you cannot enter points outside the grid limits. Because limits checking tests only points that you enter, portions of objects such as circles can extend outside the grid limits.

Off Turns off limits checking but maintains the current values for the next time you turn on limits checking.

2. **GRIDS:** It displays a dot grid in the current view port.

Command: grid ↵
Grid spacing (x) or ON/OFF/Snap/Aspect/<current>: specify a value or enter an option.
Displays a grid pattern in the current viewport.

Toolbar: Status bar ➢ Grid

Grid Spacing (X) Sets the grid to the specified value. Entering **x** after the value sets the grid spacing to the specified value multiplied by the snap interval.

On Turns on the grid using the current spacing.

Off Turns off the grid.

Snap Sets the grid spacing to the snap interval specified by the SNAP command.

Major Specifies the frequency of major grid lines compared to minor grid lines. Grid lines rather than grid dots are displayed when SHADEMODE is set to Hidden.

3. SNAP- Sets the grid spacing to the current snap interval as set by the snap command.

Aspect- Sets the grid to a different spacing in x & y. It restricts cursor movement to specified intervals.

Command: snap ↵

Snap spacing or ON/OFF/Aspect/Rotate/Style/<current>: specify a distance, enter an option or press enter.

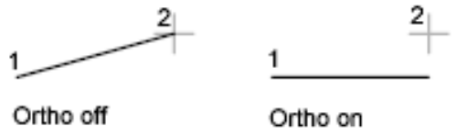
Spacing- Activates snap mode with the value you specify.

Rotate- Sets the rotation of the snap grid.

Style- format of the snap grid, standard or isometric.

4. ORTHO: Constrains cursor movement to the horizontal or vertical.

In the fig, a line is drawn using Ortho mode. Point 1 is the first point specified, and point 2 is the position of the cursor when the second point is specified.



Ortho mode is used when you specify an angle or distance by means of two points using a pointing device. In Ortho mode, cursor movement is constrained to the horizontal or vertical direction relative to the UCS.

5. Osnap

Sets running object snap modes. **Allows to select specify points on an object. e.g. endpoints, midpoints, intersection etc.**

Menu: Tools ➢ Drafting Settings

Toolbar: Status bar ➢ Osnap

Shortcut menu: Press Shift while right-clicking in the drawing area and choose Osnap Settings.

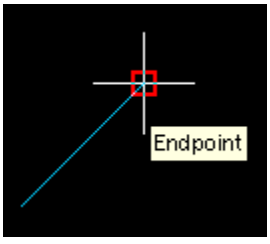
Command entry: F3

Command entry: 'osnap for transparent use

Function

The Object Snap tab of the Drafting Settings dialog box is displayed. If you enter -**osnap** at the Command prompt, the following prompts are displayed.

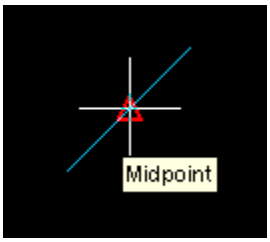
Endpoint



Toolbar	Object Snap 
Pull-down	Shift + Right Click Endpoint
Keyboard	END (when picking)

The Endpoint Osnap snaps to the end points of lines and arcs and to polyline vertices. This is one of the most useful and commonly used Osnaps.

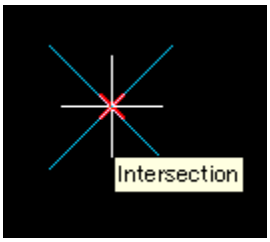
Midpoint



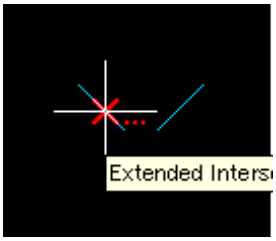
Toolbar	Object Snap 
Pull-down	Shift + Right Click Midpoint
Keyboard	MID (when picking)

The Midpoint Osnap snaps to the mid points of lines and arcs and to the mid point of polyline segments.

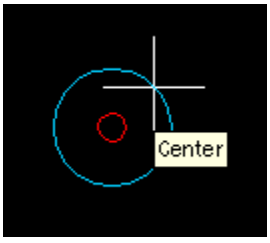
Intersection



Toolbar	Object Snap 
Pull-down	Shift + Right Click Intersection
Keyboard	INT (when picking)



Center



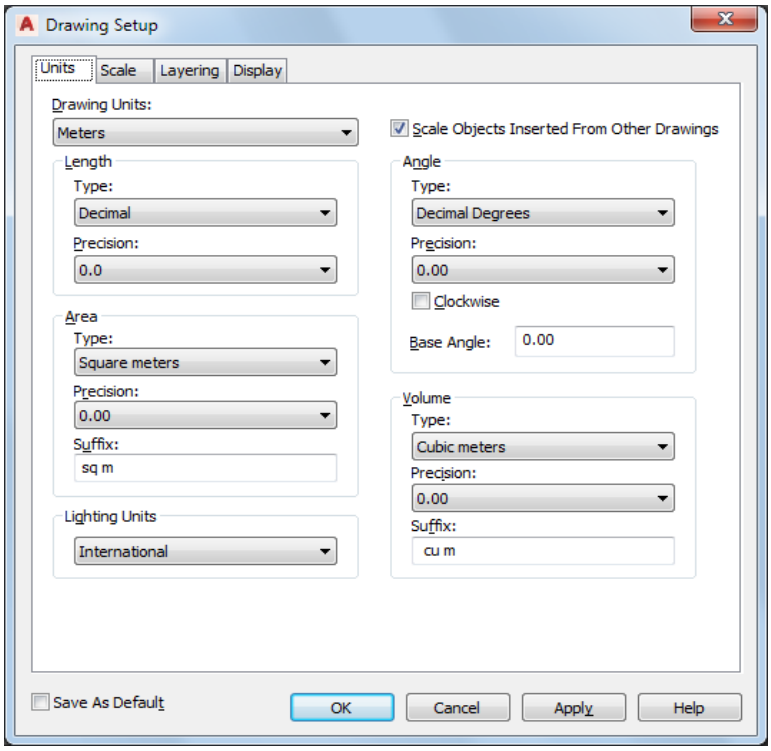
Toolbar	Object Snap 
Pull-down	Shift + Right Click Center
Keyboard	CEN (when picking)

The Center Osnap snaps to the centre of a circle, arc or polyline

arc segment. The cursor must pass over the circumference of the circle or the arc so that the centre can be found. This often causes some confusion for new users.

6. DRAWING UNITS

1. Click ➤ Utilities ➤ Drawing Setup.
2. Click the Units tab.



Specifying default units options for the current drawing

3. Under Drawing Units, select the desired units.
   Various imperial and metric units are available. The units that you select determine the unit of measurement that each unit in your drawing represents. For example, if you select Inches, each drawing unit equals one inch.
4. To scale objects that you insert into the current drawing from drawings with different drawing units, select Scale Objects Inserted from Other Drawings.
5. Under Length, select a unit type and desired precision.
6. Under Angle, select an angle type and desired precision.
   If you want to measure angles clockwise instead of counterclockwise, select Clockwise.
7. Under Area, select an area type and precision.
8. Under Lighting Units, select a lighting unit type.
9. Save the units settings:

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Q.4 Basic Draw Commands used in Autocad

1. LINE

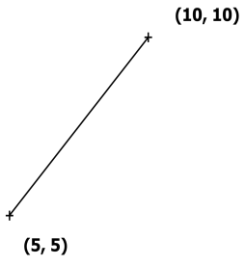
Lines can be drawn by any one of the following three methods using LINE command.

(i) Using absolute co–ordinates (ii) Using relative co–ordinates
(iii) Using polar co–ordinates

a) Using Absolute Co-ordinates:

Ex. Drawing a line from point (5, 5) to point (10, 10).

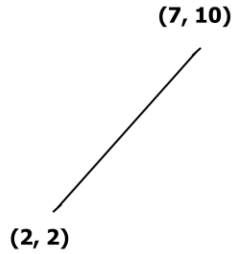
Command: Line ↵
From point: 5, 5(select the point by mouse or Enter the Co-ordinates by keyboard) ↵
To Point: 10, 10 ↵
To Point: ↵



(b) Using Relative Co-ordinates

Ex. Draw a line from point (2, 2) to point 7 units in X-axis and 10 units in Y-axis relative to first co-ordinate.

Command: Line↵
From point: 2, 2↵
To point: @ 7, 10↵
To point: ↵



(c) Using Polar Co-ordinates

Example:- Draw a line from point (1, 2) to a length of 6 units at 90 degree.

Command: Line↵

From point: 1, 2↵

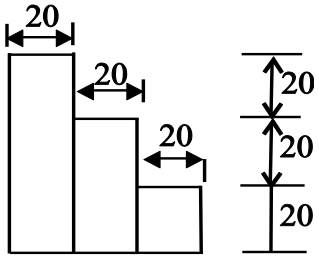
To point:@6<90↵

To point: ↵

Ex1.. Write the method by AutoCAD to draw the following sketch using:

(i) Absolute coordinate and

(ii) Polar coordinate system.



Solution: Absolute coordinate

Let point A is 0,0. And we start with point A

Command: LINE↵

Specify start point: 0, 0 ↵

Specify next point: 60,0↵

Specify next point: 60,20↵
Specify next point: 40,20↵
Specify next point: 40,40↵
Specify next point: 20,40↵
Specify next point: 20,60↵
Specify next point: 0,60↵
Specify next point: 0,0↵
Specify next point: ↵

(ii) Polar coordinate system.
Command: LINE↵
Specify start point: 0, 0 ↵
Specify next point or [undo]: @ 60<0↵
Specify next point or [undo]: @ 20<90↵
Specify next point or [close/undo]: @ 20<180↵
Specify next point or [close/undo]: @20<90↵
Specify next point or [close/undo]: @ 20<180↵
Specify next point or [close/undo]: @20<90↵
Specify next point or [close/undo]: @20<180↵
Specify next point or [close/undo]: @ 60<270↵
Specify next point or [close/undo]: ↵

2. CIRCLE :-

Different Methods Used For Drawing A Circle in Auto CAD- Circle can be drawn by any one of following five methods using circle command.

a. Center, Radius Option
Draw a circle with centre (7, 7) and radius 6 units.

Command: circle↵
3P/2P/TTR/<centre point> : 7, 7↵
Diameter/<radius> : 6 ↵

b. Center, Diameter Option
Draw a circle with centre (5, 16) and diameter 9 units.

Command: circle↵
3p/2p/TTR/<centre point> : 5, 16 ↵
Diameter/<radius> : D ↵
Diameter: 9 ↵

C. 2P Option

Draw a circle with using given two points (7, 47) & (7, 35).

Command: circle↵

3P/2P/TTR/<centre point> : 2 P ↵

First point on diameter: (7, 47) ↵

Second point on diameter: (7, 35) ↵

d. 3P Option

Draw a circle with using given three points (10, 60), (14, 52), (20, 50).

Command: circle↵

3P/2P/TTR/<centre point> : 3 P ↵

First point: (10, 60) ↵

Second point: (14, 52) ↵

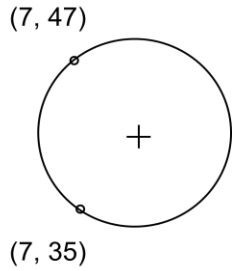
Third point: (20, 50) ↵

e. TTR Option

Draw a circle with radius 2 units and two existing line as tangents.

Take: For line 1: (15, 3) to point (18, 8)

For line 2: (19, 1) to point (20, 8)



Command: circle↵

3P/2P/TTR/<centre point> : TTR ↵

Enter Tangent spec: line 1 (pick up using mouse)

Enter Tangent spec: line 2 (pick up using mouse)

Radius: 2↵

3. ARC :-

Arcs are partial circles and can be drawn in eight different methods using ARC command. Some of them are follows:

(a) Three points and the arc

(b)Start point, centre, end point

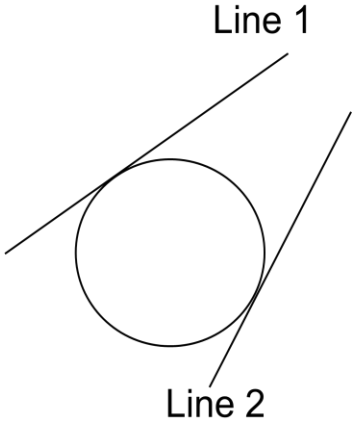
(c)Start point, centre , included angle

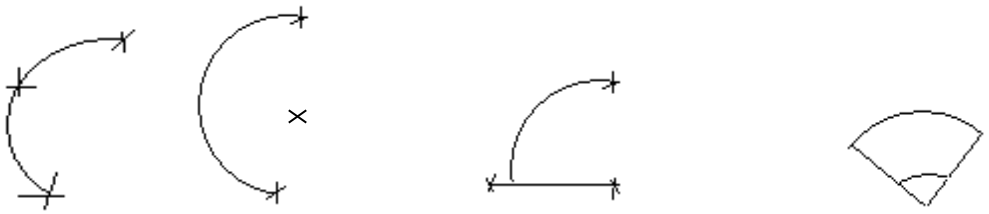
(d)Start point, centre, length of chord

(e)Start point, end point, angle

(f)Start point, end point, radius

(g)Start point, end point, starting direction





3 points start, centre, end point start, centre, angle start, end, angle

(a) **Using three given points**

Draw an arc using the given three points: (75, 50), (55, 90), (105,110).

Command: arc ↵

Centre/<Start point>: 75, 50 ↵

Centre/end/<Second point>: 55, 90 ↵

End point: 105,110 ↵

(b) **Using Start points, centre and end point (SCE)**

Draw an arc using start point (240, 20), centre point (250, 60) and end point (250,100).

Command: arc ↵

Centre/<Start point>: 240, 20 ↵

Centre/end/<Second point>: C ↵

Centre point: 250, 60 ↵

Angle/length of chord/<end point>: 250,100↵

(c) Using Start points, centre and length of chord (SCL)

Draw an arc using start point (140, 10), centre point (100, 10) and chord length 45 units.

Command: arc ↵

Centre/<Start point>: 140, 10 ↵

Centre/end/<Second point>: C ↵

Centre point: 100, 10 ↵

Angle/length of chord/<end point>: L↵

Length of chord: 45↵

(d) Using Start points, end point and Radius (SER)

Draw an arc using Start points (230, 80), end point (190, 80) and radius 22 units.

Command: arc ↵

Centre/<Start point>: 230, 80 ↵

Centre/end/<end point>: E ↵

End point: 190, 80 ↵

Angle/Direction/Radius/<centre point>: R↵

Radius: 22↵

4. Polygon

(a) Using radius of given circle in which polygon is inscribed:

Draw a polygon of eight sides with centre (50, 50) inscribed in a circle of radius 40 units.

Command: polygon ↵

Number of sides: 8 ↵

Edge/<centre of polygon>: 50, 50 ↵

Inscribed in circle/circum-scribed about circle (I/C): I ↵

Radius of circle: 40↵

(b) Using radius of given circle in which polygon is circumscribed:

Draw a polygon of eight sides with centre (140, 50) circumscribed in a circle of radius 40 units.

Command: polygon ↵

Number of sides: 8 ↵

Edge/<centre of polygon>: 50, 50 ↵

Inscribed in circle/circle-scribed about circle (I/C): C ↵

Radius of circle: 40↵

(C) Using Edge method

Draw a polygon of ten sides using "Edge method". The first end point of the edge is (90,100) and Second end of the edge is (120,100).

Command: polygon ↵

Number of sides: 10 ↵

Edge/<centre of polygon>: E ↵

First end point of edge: 90,100 ↵

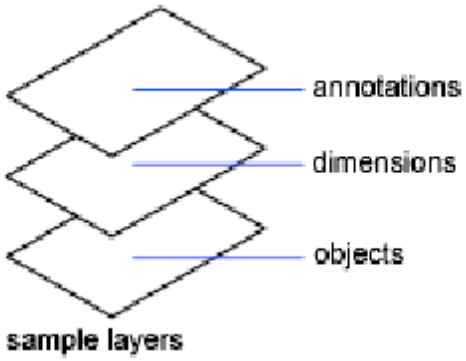
Second end point of edge: 120,100 ↵

5. Concept and utility of layer

A layer is like an overlay that allows us to separate different types of information. AutoCAD allows an unlimited number of layers on new drawings the default layer is 0. This command creates new layer, selects the current layer, sets the color and line type for designated layers, turns layers on and off, locks or unlocks layer, freezes or throws layers and lists defined layers.

Command: layer↵

?/make/set/new/on/off/color/Ltype/Freeze/Thaw/lock/unlock: enter an option.



One of the very important features of AutoCAD is having the facility of using different layers in your drawing. It helps to draw more several complex drawings in a single drawing using layer properties and it highly save the time and also it give proper understanding for users. For example, you can draw your building structure in several layers, electrical wiring in another several layers, A/C system in any other layers etc. when you refer the drawing, you can refer each individually by disabling other relevant layers. There are several properties of layers, those are explained below.

Editing Commands

1. Erase

Get rid of objects you do not want. To use:
1. Type or select the command
2. Select the objects you want to get rid of.
3. Press enter.

Note: A really quick way to erase is to select items and hit the Delete key.

2. COPY

Function: It duplicates objects. To copy objects within a drawing, specify a starting point and an endpoint of displacement.
Command: **COPY**
Select objects: **(pick object to copy)**
Select objects: ↵ **(to end selection)**
Specify base point or displacement, or [Multiple]: **(pick a point or M for multiple copies)**
Specify second point of displacement or <use first point as displacement>: **(pick a point)**

3. ARRAY

Function: It creates a multiple copies of the selected objects in a rectangular matrix (columns and rows) or a circular/polar pattern.

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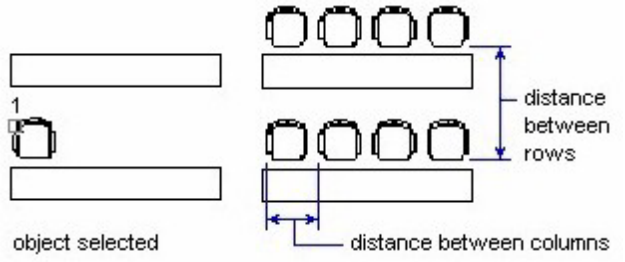
Types of array:

A **rectangular array** is defined by a number of rows and columns of copies of the selected objects and the distance between rows and columns. The copies of the selected objects are arranged vertically upward and horizontally rightward. If opposite direction is required, the distance of rows and columns must be preceded with a –ve sign.



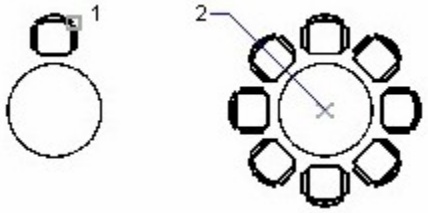
Command: array↵

Rectangular or polar array (R/P) <current>: enter an option or ↵

Option:

RECTANGULAR: – Creates an array defined by a number of rows and columns of copies of selected objects.

A **polar array** is defined by specifying a centre point about which the selected object is replicated, number of items and angle to fill. A positive angle value specifies counter-clockwise rotation and a negative value specifies clockwise rotation.



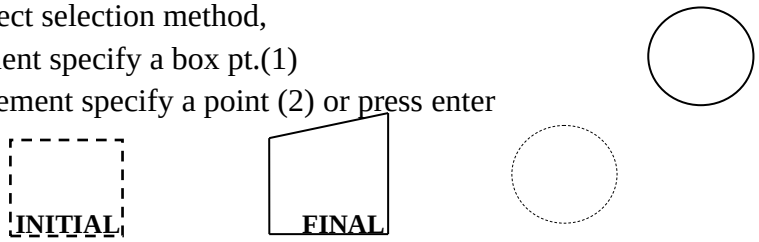
MOVE: This allows to move or displace objects at a specified distance in a specify direction.

At the command prompt, enter MOVE

Select object use an object selection method,

Base point or displacement specify a box pt.(1)

Second point or displacement specify a point (2) or press enter

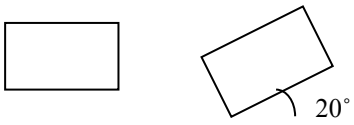


ROTATE: It Rotate an object about a specified base point.

Defines horizontal line right side angle 0˚

At the command prompt, enter rotate

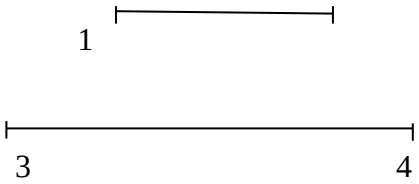
Selection objects: use an object selection method



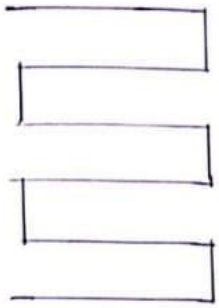
Base point: specify a point (1)
< Rotation angle > / Reference: specify an angle or enter Y

SCALE:-**This enlarges or reduces selected object equally in X & Y directions.**
At command prompt, enter SCALE
Select object: Use an object selection method.
Base point: Specify a point (1)
< Scale factor > / Reference: Specify a scale or enter Y

STRETCH:- This stretches object. It also stretches lines, arcs, elliptical arcs, rays, splines & polylines segments that cross the selection window.
At command prompt, enter STRETCH
Select object: - Use an object selection method (pt. 1 2)
2
Base point or displacement: Specify a point (3) or press Enter
Second point of displacement, specify a point (4) or press Enter



Example → इस diagram की area को adjust करना है तो solid fills के द्वारा Pen width Option में जाकर किया जा सकता है।



Note →

If setting is too low Auto CAD will take long than neccesary to drow and if too tight solid fill will appear as crass hatches instedd of blank area.

Drawing orientation → Drawing orientation को define करने के कुछ Point निम्नलिखित हैं –

(i) Plotter and printer को select करने के लिए dialog box के Plot configration device से तथा default selection button पर Click करते हैं उसके बाद विभिन्न output device के list पर click करते हैं।

(ii) Plot dialog box के list पर Click करने के लिए dialog box में sheet size के list पर Click करते dialog box का use input box के right में होता है।

(iii) Popey Size के image के orientation को control करने के लिए Popey size और orientation group के size पर Click करते हैं जो हमारी इच्छा अनुसार orientation पर depand करती है

Plot Scale:- Plot command के हम Auto CAD के file menubar को open करना पड़ता है इसके लिए हमें mouse के द्वारा filemenubar पर ले जाकर Click करना पड़ता है। Mouse से Click करने पर file menu bar open हो जाता है। इस file menu bar में कुछ कमाण्ड हमें दिखाई देते है। इसमें Plot option उपस्थित रहते है। अब Plot option पर जाकर हम Plot setting में set कर सकते है।

Plot command के द्वारा drawing sclale को कम या ज्यादा कर सकते है।

Example → इस Plot scale के अंदर drawing बना सकते है circul, line, polygen, etc. + 80(plot scale)

Plot Area → Auto CAD की help से area को adjust किया जा सकता है area को adjust Auto CAD में Solid option के द्वारा किया जा सकता है.

(iv) 3D drawing को Plot करने और hiddne line को Plot dialog box से हटाने के लिए addition parameter group में hidden line chek box पर Click करते है।

(v) Plot dialog box से line weight को control करने के लिए PEN assignment पर Click करते है जिससे line के विभिन्न weight और विभिन्न drawing color होते है।

(vi) Plotter setting के easilly Refriable को save करने के लिए Plot dialog box में device और default Section पर Click करते है उसके बाद file में save default पर Click करते है।

Print preview ⇒ Print preview में सोचे गये drawing का सबसे पहले setting में जाकर preview Click करते है। उसके बाद Auto CAD में दिखायेगा कि setting के हिसाब से drawing कैसे दिखायेगा।

Actual ploting process के किसी और drawing और message के बाद preview select करते है। जब हम इन सब चीज को देख लेते है, तब drawing का print out ले सकते है।