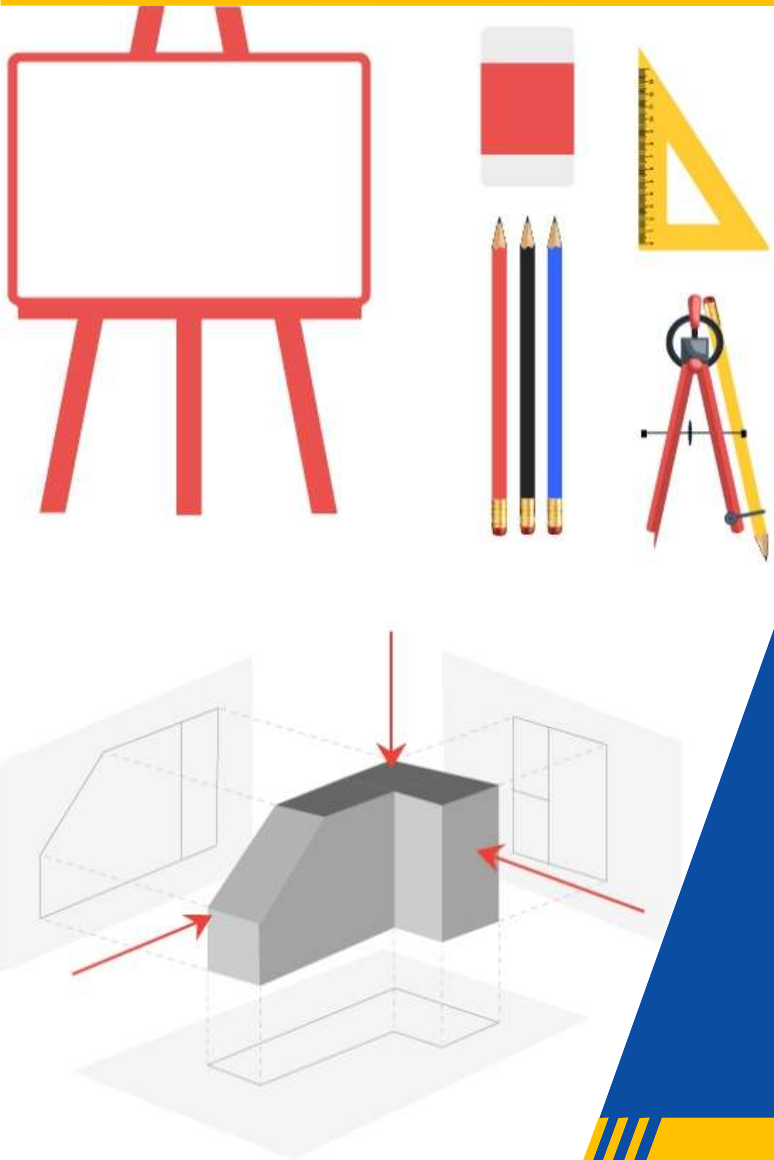
RQF LEVEL 3



GENTD301

MANUFACTURING TECHNOLOGY

Basics of Technical Drawing

TRAINEE'S MANUAL

October, 2024

BASICS OF TECHNICAL DRAWING

RTB | RWANDA TVET BOARD

KOICA Korea International Cooperation Agency

TQUM TVET Quality Management Project

2024

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COORDINATION TEAM

RWAMASIRABO Aimable

MARIA Bernadette M. Ramos

NIKUZE Bernadette

PRODUCTION TEAM

Authoring and Review

NIYONKURU Theophile

HAKIZIMANA Fidele

Validation

NGABONZIZA Jean Felix

GATETE Theophile

Conception, Adaptation and Editorial works

HATEGEKIMANA Olivier

GANZA Jean Francois Regis

HARELIMANA Wilson

NZABIRINDA Aimable

DUKUZIMANA Therese

NIYONKURU Sylvestre

MANIRAKIZA Jean de Dieu

Formatting, Graphics, Illustrations, and infographics

YEONWOO Choe

SUA Lim

SAEM Lee

SOYEON Kim

WONYEONG Jeong

MANIRAKORA Alexis

Financial and Technical support

KOICA Through TQUM Project

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ACRONYMS

2D: Two Dimensional

3D: Three Dimensional

A.P: Auxiliary Plane

A.V.P: Auxiliary Vertical Plane

ANSI: American National Standards Institute

CAM: Computer-Aided Manufacturing

CBT/A: Competency-Based Training and Assessment

CBT: Competency-Based Training**GSM:** Grams Per Square Meter

H.P: Horizontal Plane

ICT: Information and Communication Technology

ISO: International Organization for Standardization

P.P: Profile Plane

PPE: Personal Protective Equipment

RF: Representative Fraction

RQF: Rwanda Qualification Framework

RTB: Rwanda TVET Board

TQUM: TVET Quality Management Project

TVET: Technical and Vocational Education and Training

V.P: Vertical Plane

INTRODUCTION

This trainee's manual includes all the knowledge and skills required in Manufacturing Technology specifically for the module of **"Basics of technical drawing "** Trainees enrolled in this module will engage in practical activities designed to develop and enhance their competencies.

The development of this training manual followed the Competency- Based Training and Assessment (CBT/A) approach, offering ample practical opportunities that mirror real-life situations.

The trainee's manual is organized into Learning Outcomes, which is broken down into indicative content that includes both theoretical and practical activities. It provides detailed information on the key competencies required for each learning outcome, along with the objectives to be achieved.

As a trainee, you will start by addressing questions related to the activities, which are designed to foster critical thinking and guide you towards practical applications in the labor market. The manual also provides essential information, including learning hours, required materials, and key tasks to complete throughout the learning process.

All activities included in this training manual are designed to facilitate both individual and group work. After completing the activities, you will conduct a formative assessment, referred to as the end learning outcome assessment. Ensure that you thoroughly review the key readings and the 'Points to Remember' section.

MODULE CODE AND TITLE: GENTD301 BASICS OF TECHNICAL DRAWING

Learning Outcome 1: Identify drawing materials, instruments and equipment
Learning Outcome 2: Draw symbols, geometric figures and solids used in technical drawing
Learning Outcome 3: Apply 2 and 3 dimensional

Learning Outcome 1: Identify Drawing Materials, Instruments and Equipment

Indicative contents
1.1 Identification of drawing materials **1.2 Identification of drawing instruments** **1.3 Identification of drawing equipment**

Key Competencies for Learning Outcome 1: Identify Drawing Materials, Instruments and Equipment

Knowledge	Skills	Attitudes
• Description of drawing materials used in basicsof technical drawing • Description of drawing instrument used inbasics of technical drawing • Description of drawing and equipment used in basics of technical drawing	• Selecting drawing materials, instrument, andequipment	• Having a critical thinking settingdrawing instrumentand tools • Having team worksplit while selecting material, instrument and equipment to be used in drawing • Having time management while identifying drawing materials, instrument and equipment

Duration: 5 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly the term drawing materials used in basic technical drawing.
2. Describe properly the term drawing instrument used in basic technical drawing.
3. Describe properly the term drawing equipment used in basic technical drawing.
4. Select correctly drawing materials, instrument and equipment used in basic technical drawing according to their uses.

Resources

Equipment	**Tools**	**Materials**
• PPE (Safety shoes, helmets, gl ove, overall, mask, safetyglasses) • Drawing board • Drawing table • Cutting board • A drawing easel	• Ink-pen • Paper cuter • One-meter straight drawing ruler with handle • Right angle ruler • Protractor • Drawing Compass • Engineering Pencils • Drawing Template • French curves • Set squares • T square • Paper holder • Mathematical setInstruments • Razor blade • Scissor	• Paper • Rubber • Pen ink • Drawing pencil • Engineering pencil lead • Dusting brush

Indicative content 1.1: Identification of Drawing Materials

Duration : 1 hrs

Theoretical Activity 1.1.1: Description of drawing materials

Tasks:

1: You are requested to answer the following questions where by drawing materials will be understood:

i. What do you understand by the term drawing materials?

ii. List out the drawing materials used in technical drawing.

iii. Based on the list given on question 2, describe each drawing materials focusing on definition, uses and importance of each in drawing.

2: Provide the answer for the asked questions and write them on papers.

3: Present the findings/answers to the whole class

4: For more clarification, read the key readings 1.1.1. and ask questions where necessary

Key readings 1.1.1.: Description of drawing materials

- Definition of drawing materials
  - ✓ Drawing: Is the act of creating visual representations or images on a surface, typically using various tools such as pencils, paper, rubber, masking tape, pens, pastels. It is a form of artistic expression and communication, where lines, shapes, forms, and textures are used to depict objects, scenes, or ideas.
  - ✓ Drawing materials: Is the materials used to create drawings. These materials can vary depending on the desired style, technique, and purpose of the drawing. Somedrawing materials are Paper, Rubber, Pen ink, propelling pencil, Drawing pencil.
- Common drawing materials and their uses
  - ✓ **Paper**

Drawing paper is a type of paper specifically designed for drawing or sketching purposes. Itis usually heavier and thicker than regular paper, which allows for better support and durability while working with various drawing media, such as pencils, charcoal, pastels, ink,or markers.

Figure 1: Drawing papers

Drawing paper comes in a variety of sizes, weights, and textures to suit different artistic styles and preferences. The most common sizes include standard sizes like 9x12 inches, 11x14 inches, or 18x24 inches, but larger or smaller sizes can also be found.

The weight of drawing paper refers to its thickness and is measured in pounds or grams persquare meter (GSM). A higher weight indicates a thicker and sturdier paper, which can withstand heavier applications of ink or other wet media without warping or tearing.

Texture is another important characteristic of drawing paper. It refers to the surface qualityof the paper, ranging from smooth to rough. Smooth papers are suitable for detailed and precise drawings, while rough-textured papers create a more textured and expressive appearance.

Common types of drawing paper and their use:

- Sketching Paper: Lightweight and versatile, used for quick sketches and preliminarydrawings.
- Bristol Paper: A heavyweight, smooth-surfaced paper often used for detailedillustrations, ink drawings, or markers.
- Charcoal Paper: Specifically designed for charcoal and pastel drawings, with arougher texture to hold the medium effectively.
- Watercolor Paper: Textured paper that can handle water-based media likewatercolors, gouache, and ink washes.

Desirable properties a good drawing paper:

- It should be smooth and uniform in thickness.
- It should be thick, strong and tough.
- Fibers of drawing paper should not be disintegrated when a good eraser isused on it.

✓ **Rubber**

A drawing eraser is an essential tool for artists, designers, and anyone who works with pencil or charcoal. It is used to remove or correct mistakes, smudges, and unwanted marks on a drawing or sketch.

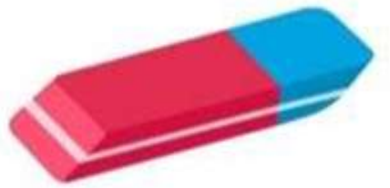

Figure 2: Rubber

Types of drawing rubber/eraser

- **Gum eraser**

Also referred to as "art gum" erasers, a gum eraser has a soft, somewhat gummy texture and can have a slightly translucent-looking appearance. gum erasers are best for erasing graphite on paper. These erasers are usually brown in color. One negative aspect of gum erasers is that they don't last very long. Because they crumble so easily, the life of the gumeraser is a short one.

- **Kneaded eraser**

These erasers are made of a pliable, putty-like material that can be shaped and molded to fit into tight spaces or erase fine details. They are particularly useful for charcoal or pastel drawings.

- **Electric erasers**

These erasers are battery-powered and use a spinning head to quickly and efficiently remove pencil marks. They are useful for large areas or for correcting mistakes in a tight space.

- **Vinyl eraser**

Also referred to as "plastic erasers" or "drafting erasers", these erasers are hard — literally.They have a rigid texture and are capable of doing some heavy-duty erasing, with the abilityto lift even ink from a page. Their clean and complete erasing capabilities make them the favored type for drafters. Because of the very rigid texture of a vinyl eraser, there is a possibility of damaging the paper, so work gently when erasing, and don't use on delicate types of paper.

- **Masking Tape**

This tape sticks the drawing paper on the drawing board. This tape is soft and does not harmthe drawing paper and table if appropriately handled. Is a low tack, lightly adhesive paper tape that is designed to be easily removed without leaving any marks or residue

- **Pen ink**

An ink pen, also known as a ballpoint pen, is a popular writing instrument that uses a smallball made of brass, steel, or tungsten carbide to dispense ink onto paper or other surfaces.The ball, usually housed in a metal or plastic tip, rotates as the pen moves, picking up ink from a reservoir and transferring it onto the surface.

Figure 4: pen ink

Drawing ink

Drawing ink: Is a liquid medium used for creating various forms of artwork, particularly drawings and illustrations. Its composition varies by use, with writing inks typically containing water-soluble dyes and flow-enhancing additives, while printing inks vary basedon the printing method and surface.

Figure 5: drawing ink

- **Propelling pencil**

A propelling pencil, also known as a mechanical pencil or lead pencil, is a writing instrumentthat uses a mechanism to advance a thin lead rod for writing or drawing purposes. Unlike traditional wooden pencils that require sharpening, propelling pencils have a refillable leadreservoir, eliminating the need for frequent sharpening.

Figure 6: Propelling pencil

- **Drawing pencil.**

A drawing pencil is a type of pencil specifically designed for drawing, sketching, and creatingartwork. Unlike regular writing or propelling pencils, drawing pencils have different types of graphite leads that vary in hardness or softness to provide artists with a range of tones and effects.

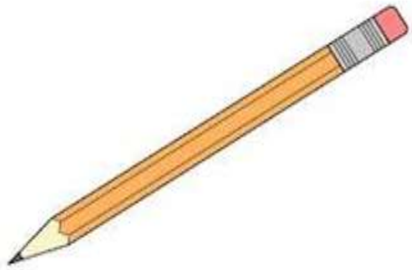

Figure 7: drawing pencil

Here are the main features

Pencil leads: Are the graphite or carbon-based cores that are used in pencils to create marks on paper. Pencil leads come in a range of hardness levels, from soft and smudgy to hard and crisp. The hardness of the lead is determined by the amount of clay mixed with the graphite or carbon.

Based on the hardness of lead pencils are classified in three major grades as hard, mediumand soft.

Figure 8: pencil lead

They are further subdivided and numbered as mentioned in table below: Pencils ofDifferent Grades

Grades	Items arranged ordering harder to softer
Hard	9H> 8H> 7H>6H>5H>4H
Medium	3H>2H>H>F>HB>B
Soft	2B>3B>4B>5B>6B>7B

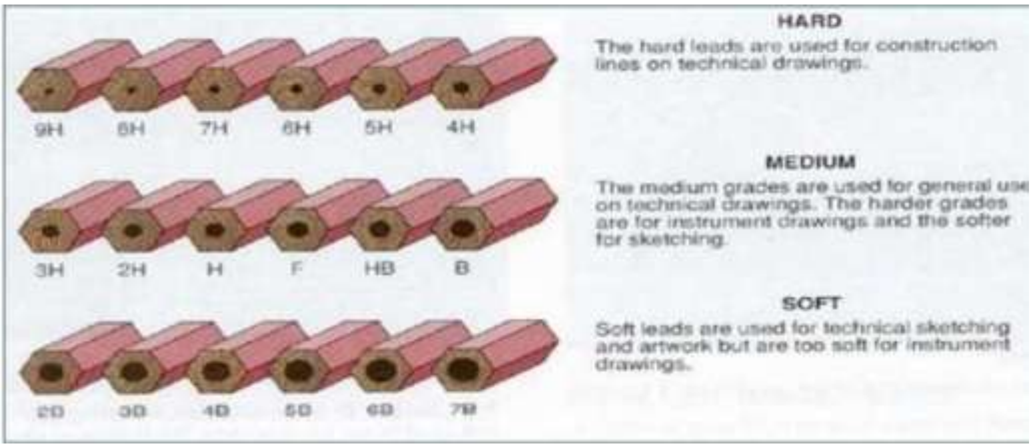

Figure 9: pencil grade

Grade of drawing pencil

The following grades are used in engineering drawing:

HB - (Soft grade) …Used for drawing border lines, lettering and freehand sketching

H - (Medium grade) …Used for visible outline, visible edges and boundary lines

2H – (Hard grade) …Used for construction lines, dimension lines, leader lines, extension

lines, centre line, hatching line and hidden lines.

Remember that:

- ✓ ***B*** stands for Black,and it shows softness.
- ✓ **H** stands for Hard, and it shows hardness.
- ✓ **HB** stands for Hard Black, and it shows *medium-hard*.
- ✓ ***F*** stands for Firm

Wooden Barrel: Drawing pencils typically have a wooden barrel that holds the graphite lead. The barrel may be round or hexagonal in shape, providing a comfortable grip for the artist's hand.

Eraser: Some drawing pencils come with an eraser attached to the end of the pencil. This built-in eraser allows artists to make corrections or remove unwanted marks while drawing.However, keep in mind that erasers on drawing pencils are often small and may not be as effective as separate erasers for larger areas of erasure.

- **Paper towel**

Paper towel is a disposable absorbent material used primarily for cleaning and drying surfaces. It is typically made from wood pulp and is designed to be absorbent and disposable. Paper towels come in various sizes, thicknesses, and textures, and are widely used in homes, offices, and public places

Figure 10: Paper towel

Points to Remember

- Before drawing any object, you must know all drawing materials used basics technical drawing

Application of learning 1.1.

Attend the study trip Organized by your trainer to a local drawing workplace then identify the drawing materials found in the place as well as make the report of the trip.

Indicative content 1.2: Identification of Drawing Instruments

Duration: 2 hrs

Theoretical Activity 1.2.1: Explanation of drawing instruments

Tasks:

1: As open discussion or individually, you are requested to answer the following questions:

i. List out the drawing tools/instrument you know?

ii. Based on the list given on question 1, describe each instrument bydefinition and their uses.

2: Provide the answer of asked questions and write them on papers

3: Present the findings/answers in whole class

4: Pay attention to the trainer's clarification and ask questions where necessary

5: Read the key readings 1.2.1.

Key readings 1.2.1.: Explanation of drawing instruments

- **Definition of drawing instruments**

  Drawing instruments: are non-consumable items used during technical drawing. If well taken care of, they can last for a long time. They include, protractors, compass, set squares,French curves, circles templates, etc.

- **Common drawing instruments and their uses**
  - **Right angle ruler:** is a device consisting of two straight edges set at right angles toeach used in measurement. It is specified to measure right angles.

Figure 11: right angle ruler

  - **Protractor:** A **protractor** is a tool that is used **to measure the size of angles**. They can tell us how many **degrees** the angle is. This helps us to know what type of angleit is and work out missing angles. They can also be used **to draw angles**. Usually made of transparent plastic, glass, steel, or wood materials**.**

There are two types of protractors:

  - **Semi-circular protractor** which can measure angles from 0 to 180 degrees.

- o **Circular protractor** which can be used to measure angles from 0 to 360 degrees (a full turn).

Figure 13: Circular protractor

- ➤ **Drawing Compass:** is a technical drawing instrument that can be used for inscribingcircles or arcs. As dividers, it can also be used as a tool to step out distances, in particular, on maps. Compasses can be used for mathematics, drafting, navigation and other purposes

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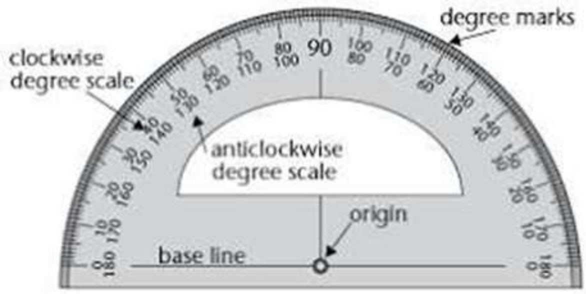


Figure 12: Semi-circular protractor

- o **Circular protractor** which can be used to measure angles from 0 to 360 degrees (a full turn).

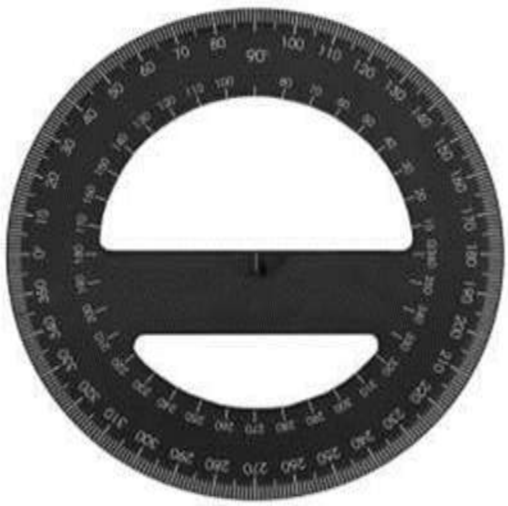


Figure 13: Circular protractor

Drawing Compass: is a technical drawing instrument that can be used for inscribingcircles or arcs. As dividers, it can also be used as a tool to step out distances, in particular, on maps.

Compasses can be used for mathematics, drafting, navigation

Figure 14: drawing compass

- **Dividers:** Used chiefly for transferring distances and occasionally for dividing spaces into equal parts. i.e., for dividing curved and straight lines into any number of equal parts, and for transferring measurements.

- **Pencil Sharpener (Topper):** Pencil Sharpener is used to sharpen the point of your pencil before use and during use if you notice the point getting blunt. A good steel pencil sharpener would achieve a good point**.**

- **French curve:** It is used to draw irregular curves that are not circle arcs. The shape varies according to the shape of irregular curve

- **T-square**

T-square is a tool used in technical drawing, primarily as a guide for drawing straight horizontal lines on a drafting table. It can also be used in conjunction with a set square to draw vertical and angled lines. Its name is derived from its

resemblance to the letter 'T'

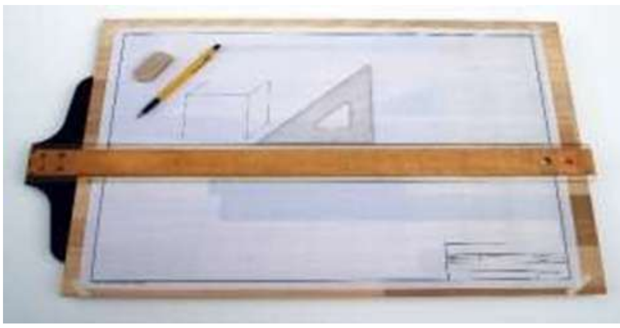
The following are the uses of T-squares:

- T-square is mainly for drawing horizontal lines
- T-square is used as a base to draw various angles with the help of setsquares

- **Setsquare**

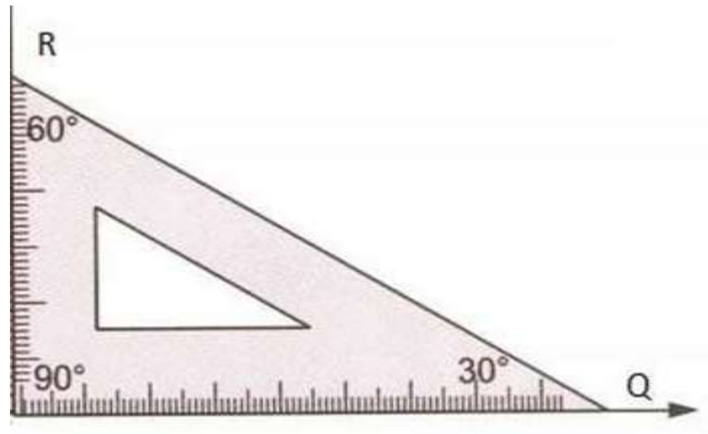
A set square is a triangular-shaped measuring tool used in geometry, drafting, and other technical drawing fields. It typically has two arms, or legs, with one edge that is straight andthe other that is angled.

Set squares come in different sizes and angles, and are typically made of transparent plastic,metal, or wood. They are used to draw straight lines, angles, and perpendicular lines, and are essential tools for technical drawing, architecture, engineering, and design.

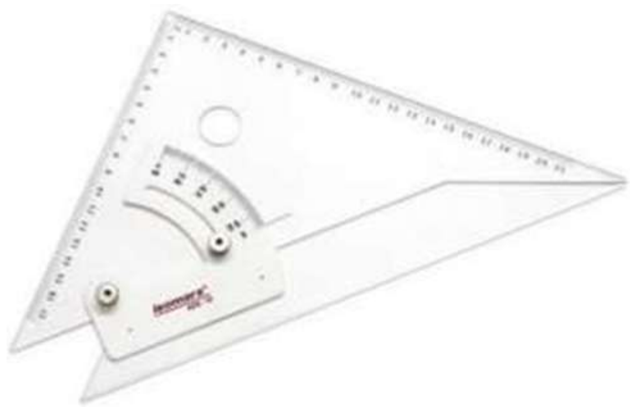


The most common types of set squares are:

- **30-60-90 degree set square:** This set square has one angle of 90 degrees and two angles of 30 and 60 degrees. It is typically used for drawing equilateral triangles, hexagons, and other shapes with 60-degree angles.



- **45-45-90 degree set square:** This set square has two angles of 45 degrees and one angle of 90 degrees. It is typically used for drawing isosceles triangles, squares, and rectangles.
- **Adjustable set square:** This set square has an adjustable angle, which can be set to any angle between 0 and 180 degrees. It is particularly useful for drawing angles thatare not standard, or for drawing curves and arcs.



Set squares are often used in conjunction with a straight edge or ruler, to ensure accuracy and precision when drawing lines and angles. They are also commonly used in combinationwith a compass or protractor, to draw circles and arcs of different sizes.

Uses of set squares

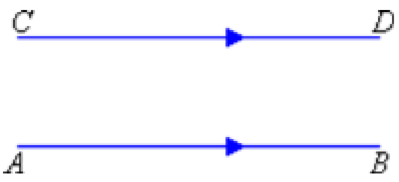
- The set-squares are used for drawing straight line except the horizontal lines whichare usually drawn with T-square.
- The perpendicular lines or the lines at30^0, 60^0 and 90^0 to the horizontal can be drawnby using the set squares.
- The perpendicular lines or the lines inclined at 45^0 and 90^0 to the horizontal can bedrawn by using the set- squares.
- By using two set-squares, angle of 150^0, 750^0 and 105^0 can be drawn. Set

squares areuseful for drawing parallel lines and perpendicular lines

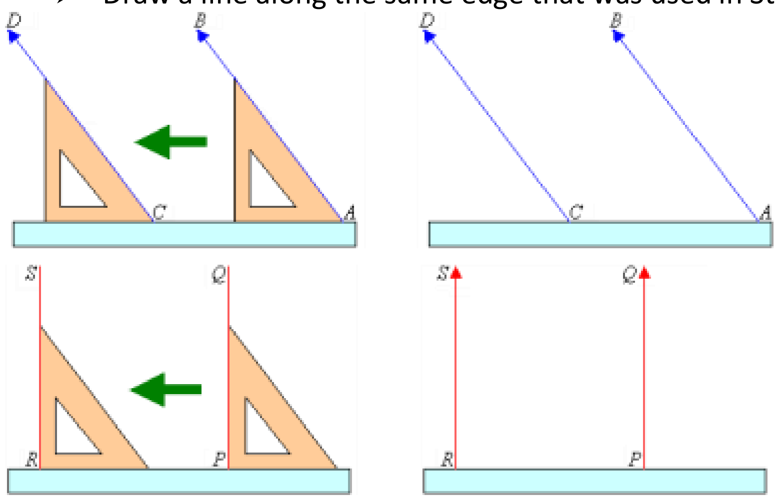
Drawing Parallel Lines: Lines that lie in the same plane and do not meet one another are said to be **parallel lines**. In the accompanying diagram, the line AB is parallel to theline CD. This is indicated by the similar arrows

AB is parallel to the line CD as AB//CD, the symbol // means parallel to. A ruler and set square can be used to draw parallel lines as described below.

Position an edge of the set square against a ruler and draw a line along oneof the other edges.



- Slide the set square into a new position while keeping the ruler fixed exactlyat the same position
- Draw a line along the same edge that was used in Step 1.



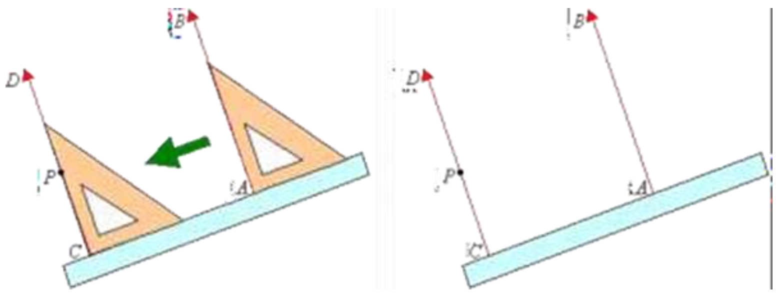
Example of uses of set square

- Use a ruler and set square to draw a line that is parallel to a given line,AB, and passes through a given point, P.

Solution:

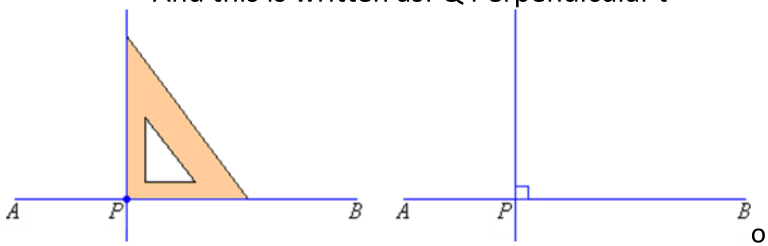
- Position an edge of the set square along the given line, AB.
- Place a ruler against one of the other edges.
- Slide the set square along the ruler until the edge used in Step1 passes through the given point P.
- Draw the line CD through P.

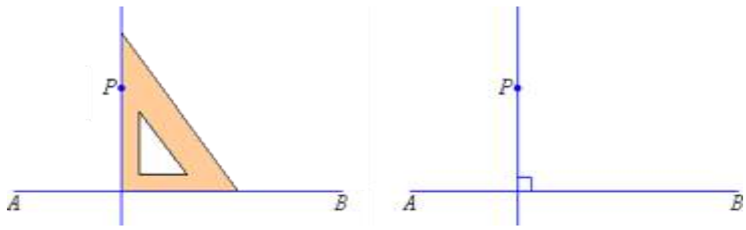
The line CD passes through the given point, P, and is parallel to the given lineAB.



- **Drawing Perpendicular Lines**: Lines that are at right angles to each other are said to be perpendicular lines. Note that a vertical line is perpendicular to the horizontal, whereas perpendicular lines can be drawn in any position. Bricklayers use a plumbedto set out vertical lines and a spirit level to set out horizontal lines.

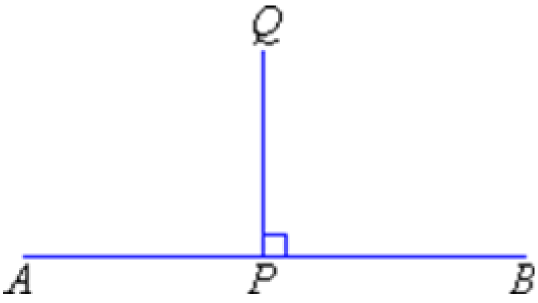
- In the accompanying diagram, line PQ is at right angles to line AB. The right angle is indicated by a small square. We say that PQ is perpendicular to AB. And this is written asPQ Perpendicular to AB.





- A set square can be used to draw a perpendicular at a point on a given line asdescribed below.
- Set an edge of the set square on the given line so that the other edge is just in contactwith the point.
- Draw a line that passes through the given point with the help of the set square.

Example: Use a set square to draw a perpendicular to a given line, AB, througha point, P, not on the line.

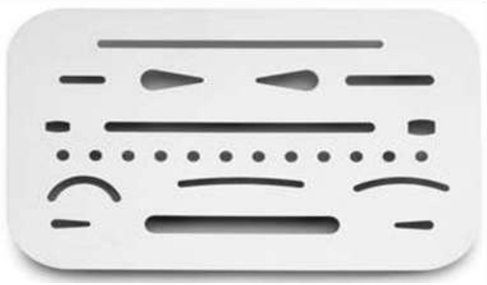


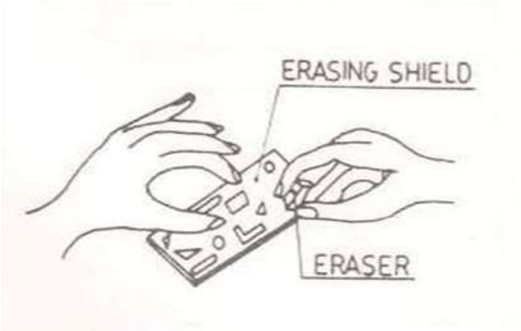
Set an edge of the set square on the given line so that the other edge is just in contactwith the point.

Draw a line that passes through the given point with the help of the set square.

D. **Instrument Box**: Are useful in geometry and other allied subjects' projects. These boxes contain protractor, divider, compass, 2 set angles, sharpener, eraser, pencil and a 15 cm ruler. The **box** is designed specifically to fit in all these products easily

Erasing Shield: Erasing shield is used to protect the adjacent lines on the drawing when some part of a line is being erased. It is usually made of thin metal in whichgaps of different widths, curves, small circles, arcs, etc. are cut according to the lines to be eraser.





b. **Drawing board clamp:** Are tools used to secure sheets of paper or other materials onto a drawing board, drafting table, or similar working surface. These clamps help keep the paper in place, preventing it from shifting, curling, or moving during the drawing or drafting process.

c. **Triangular scales**

A generally used when reproducing a drawing in an enlarged or reduced form to some regular proportion. tool Its primary function is to reproduce the measurements of an objectin full size, reduced size, and enlarged size.

. **Stapler**

It is a common office tool used for fastening or binding together sheets of paper by drivinga metal clasp (staple) through the sheets and folding the ends of the staple over the paperto hold them together. It is used also in an art or design studio for various administrative tasks, such as binding reference materials, organizing sketches, or securing project documentation.

Points to Remember

Application of learning 1.4.

It is necessary to know all drawing instrument used in basics technical drawing andtheir uses.

Attend the study trip organized by your trainer to a local drawing workplace and identify thedrawing instruments found in the place as well as make the report of the trip.

Indicative content 1.3: Identification of Drawing Equipment

Duration: 2 hrs

Theoretical Activity 1.4.1: Identification of drawing equipment

Tasks:

1: You are requested to answer the following questions reflect on drawing equipment.

i. What do you understand by the term drawing equipment?
ii. List out the drawing equipment used in technical drawing.
iii. Based on the list given on question 2, describe each drawing equipment focusing ondefinition, uses and importance of each equipment in drawing.

2: Provide the answer of asked questions and write them on papers.3: Present the findings/answers in whole class

4: Pay attention to the trainer's clarification and ask questions where necessary.

5: Read the key readings 1.3.1

Key readings 1.3.1.: Description of drawing equipment

Definition of drawing equipment

Drawing equipment: Refers to a set of tools or other objects commonly used to achieve a particular objective in drawing.

Common drawing equipment and their uses

a. **The drawing board** (also drawing table, drafting table or architect's table) is made up of wood, plastic, or glass.

Has smooth surfaces where drawing paper is placed and fixed with the help of tape. It is multipurpose desk which can be used for any kind of drawing, writing or impromptu sketching on a large sheet of paper or for reading a large format book or other oversized document or for drafting precise. Paper will be attached to the drawing board with the aid of T-square so that it is kept straight and still, so that the drawing can be completed with accuracy.

− It is a board or platform rectangular in shape.

− Top surface should be smooth.

− Drawing board is made from strips of well-seasoned soft woodgenerally 25 mm thick.

− It is made of wood.

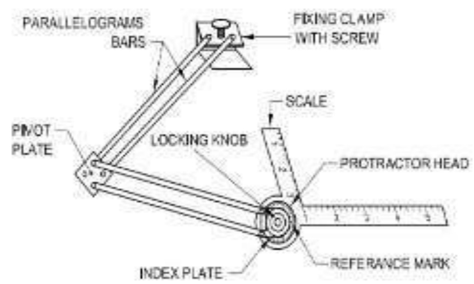
Standard dimension of Engineering ‘drawing board

Designation	Length *Width(mm)	Recommended for use withsheet size

D0	1500*1000	A0
D1	1000*700	A1
D2	700*500	A2
D3	500*500	A3

b. Mini-Drafter

Mini drafter is an instrument, which can be used for multiple functions in drawing like drawing horizontal lines, vertical lines, inclined lines, angles, parallel lines, perpendicular lines etc. It is very useful to draw engineering drawings very accurately. It contains two armsthat is adjustable to required angle and at the end of the lower arm, a scale set is attached.



C. Drafting machine: A drafting machine is a tool used in technical drawing, consisting of a pair of scales mounted to form a right angle on an articulated protractor head that allows an angular rotation

D. A drawing easel

A drawing easel, often simply referred to as an "easel," is a stand or frame designed to holdan artist's drawing or painting surface, such as a canvas, paper, or board, at an appropriateand comfortable angle for the artist to work on.

E. **Paper cutter:** A paper cutter, also known as a paper guillotine or simply a guillotine, is a tool often found in offices and classrooms, designed to administer straight cutsto single sheets or large stacks of paper at once.

Practical Activity 1.3.2: Selection of drawing material, instrument and equipment

Task:

1: Referring to three (3) previous theoretical activity (1.1.1, 1.2.1. and 1.3.1) you are requested to go in store/workshop and select drawing materials, drawing instrument and drawing equipment. This task should be done individually.

2: Apply safety precautions (Wear the PPE)

3: Present out the selection criteria and the procedure of selecting drawing, materials instruments and equipment.

4: Referring to the selection criteria and procedure provided on step 2, select drawing materials instruments and equipment.

5: Present your work to the trainer

6: Read key reading 1.3.2 and ask clarification where necessary 7: Perform the task provided in application of learning 1.3.2.

Key readings 1.3.2.: Selection of drawing material, instrument and equipment

Selection criteria

- **Selection process of drawing materials, instrument and equipment**

By considering these criteria, you can make informed choices when selecting drawing materials, instruments, and equipment that best suit your needs and artistic goals.

- ✓ **Purpose:** Determine the purpose of your drawings. Are you sketching, doing technical drawings, or creating detailed illustrations? Different materials and tools are better suited for different purposes.
- ✓ **Medium:** Decide on the medium you want to work with, such as graphite pencils, color pencils, charcoal, pastels, ink, or markers. Each medium has its unique characteristics and effects.
- ✓ **Quality:** Consider the quality of the materials. Higher-quality supplies often produce b etter results and are more durable. However, they might be more expensive. It's

important to strike a balance between quality and your budget.

- ✓ **Skill level:** Consider your skill level as an artist. Beginners mayfind it easier to work with certain materials, while more experienced artists might prefer more advanced tools.

Surface: Think about the surface you'll be drawing on. Different materials work better on certain surfaces. For example, graphite pencils work well on paper, while markers **are better** suited for smooth surfaces like illustration boards.

- ✓ **Personal preference:** Ultimately, your personal preference matters. Experiment with different materials and tools to find what works best for you and suits your artistic style.
- ✓ **Availability:** Consider the availability of the materials and tools in your area. Some sup plies may be more accessible than others, depending on your location.
- ✓ **Define Your Purpose:** Clarify the purpose of your drawing. Are you working on fineart, technical drawings, architectural sketches, or other types of illustrations? The type of drawing will guide your equipment selection.
- ✓ **Medium and Techniques:** Determine the drawing medium you intend to use, such as pencils, pens, markers, ink, or charcoal. Different equipment is suited for different mediums and techniques.
- ✓ **Surface and Support:** Evaluate the type of surface or support you'll be drawing on, such as paper, canvas, vellum, or digital devices. Consider factors like texture, weight, and compatibility with your chosen equipment.
- ✓ **Precision and Control**: Consider the level of precision and control required for yourdrawing. Some equipment offers fine, precise lines, while others allow for broader expressive strokes.
- ✓ **Technical Features:** If you're using digital equipment, explore technical features such as pressure sensitivity, stylus types, and compatibility with drawing software.
- ✓ **Ease of Use:** Assess the ease of use, comfort, and ergonomics of the equipment. Comfortable and user-friendly tools can enhance your drawing experience.
- ✓ **Shading and Blending:** If your drawing involves shading and blending, select equipment that allows for smooth shading and blending of tones or colors.
- ✓ **Budget:** Take your budget into account. Different drawing equipment varies in

price.

Choose tools that align with your financial constraints.

- ✓ **Experience and Skill Level:** Your experience and skill level as an artist play a role. Beginners might find certain equipment more

accessible and forgiving than others.

- ✓ **Personal Preference:** Your personal artistic style and preference are essential. Experiment with different equipment to find tools that resonate with your style.
- ✓ **Consult Experts:** Seek advice from art supply store experts or experienced artists if you're uncertain about your choices. They can provide insights and recommendationns based on your specific needs.

- Before drawing it is necessary to know all common drawing equipment and their usesas well as found in basics of technical drawing

Application of learning 1.3.

Attend the study trip organized by your trainer to a local drawing workplace and identify thedrawing instruments found in the place as well as make the report of the trip.

Learning outcome 1 end assessment

Theoretical assessment

1. Among the following definitions select the letter corresponding to the real definition ofdrawing?

   I. The act of writing words or sentences

   II. Is the act of creating visual representations or images on a surface, typically usingvarious tools.

   III. The art of singing and performing music

   IV. The practice of designing and constructing buildings

2. Answer by T if the statement is correct otherwise F

   I. Rubber and T-square are drawing materials

   II. T-square is designed for drawing vertical line

   III. The perpendicular lines or the lines at 300, 600 and 900 to the horizontal can be drawnby using the set squares.

3. Choose the correct answer writing the letter which is corresponding to the real answer.

   a. One of the following is drawing equipment

   I. Drawing board

   II. French curves

   III. Pencil

   IV. I and II

   V. All are correct answer

b. Divider is used for

   I. For dividing curved line and straight lines into any number of equal parts and fortransferring measurement.

   II. Used for inscribing circles or arcs.Is mainly for drawing horizontal

   III. Both I and ii are correct

c. One of the following is a type of set squareI. 450-900

II. 300-600

III. 450-900

IV. I and III are correct

d. Which of the following tools is used to draw horizontal lines?

I. Mini – drafter

II. Protractor

III. T – square

IV. French curve

e. Which is the most common tool used for drawing circles?

I. French curve

II. Mini – drafter

III. Compass

4. Match the following drawing tools, materials and equipment from column A withcorresponding to their function from column B

Column A	**Column B**
1. Easel	A. Tool used in technical drawing, geometry, and mathematics to measure and draw angles.
2. Board Clamps	B. b. Used in technical drawing to create smooth, flowing lines and shapes that cannot be easily drawn freehand.
3. Protractor	C. Is a stand or frame designed to hold an artist's drawing or painting surface, such as a canvas, paper, or board, at an appropriate and comfortable angle for the artist to work on.
4. French Curve	D. Is a tool often found in offices and classrooms, designed to administer straight cuts to single sheets or large stacks of paper at once?
5. Guillotine	E. Are tools used to secure sheets of paper or other materials onto a drawing board, drafting table, or similar working surface.

Practical assessment

After covering learning outcome 1 you are requested to facilitate individual trainee to separate drawing materials, instruments and equipment, you are also recommended to Availall drawing materials, instruments and equipment which are unseparated.

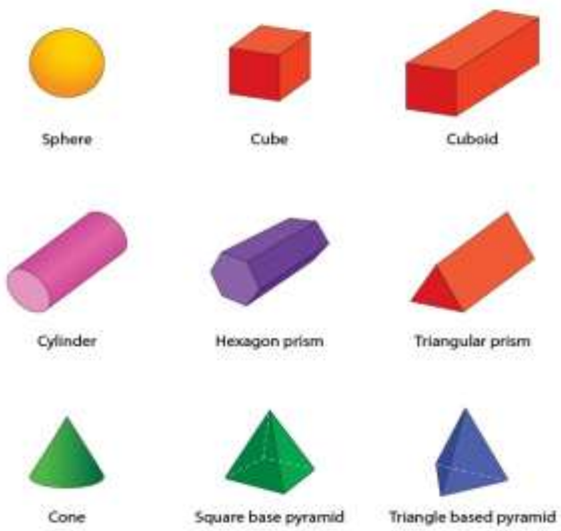
END

Reference

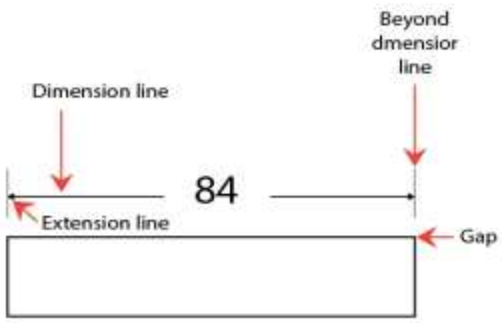
https://www.ducksters.com/kidsmath/finding_the_volume_surface_area_of_a_cone.php
https://edengdrawing.blogspot.com/2013/02/technical-lettering.html
http://engineeringessentials.com/ege5/files/ege/dim/dim_page3_ex1.htm
https://ng.siyavula.com/read/maths/jss1/two-dimensional-shapes/12-two-dimensional-shapes?id=124-practical-applications

Typo

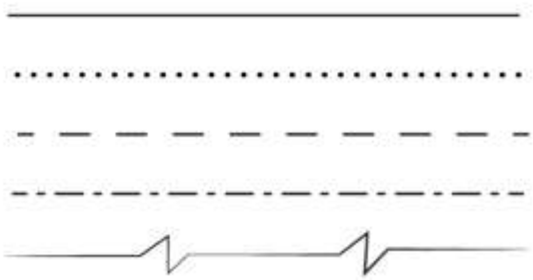
3D Shapes



Dimension elements



Types of Line



Indicative contents

2.1 Description of drawing sheet

2.2 Description of geometric figures in engineering drawing

2.3 Drawing geometric figures

2.4. Description of Engineering Drawing Symbols

2.5. Drawing engineering drawing symbols

2.6. Description of solid object

2.7. Drawing solid objects

2.8. Drawing Lettering

2.9. Application of drawing dimensions

2.10. Application of drawing scale

Key Competencies for Learning Outcome 2: Draw Symbols, Geometric Figures and Solids Used in Technical Drawing

Knowledge	Skills	Attitudes
• Description of Drawing sheet. • Description geometric figures used in engineering drawing. • Description Engineering Drawing Symbols. • Description Solid object. • Description drawing dimensions • Description of drawing scale	• Drawing geometric figures • Drawing engineering drawing symbols • Drawing Lettering • Drawing solid objects • Applying drawing dimensions • Applying drawing scale	• Being consistence while drawing symbols, geometric figures and solids • Having team work while drawing symbols, geometric figures and solids • Being flexible while drawing symbols • , geometric figures and solids • Having time management while drawing symbols • , geometric figures and solids

		• Working as team while drawing symbols ,geometric figures and solids

Duration:25 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly drawing sheet and geometric figures used in basic technical drawing
2. Draw correctly geometric figures used in engineering drawing
3. Describe properly the common types of engineering drawing Symbols used in technicaldrawing
4. Draw correctly the common types of engineering drawing symbols used in basic technicaldrawing
5. Describe properly the types of solid object used in technical drawing
6. Draw clearly the types of solid object used in technical drawing
7. Apply effectively lettering on drawing of an object
8. Apply correctly dimensions on drawing of an object
9. Apply correctly drawing scale on drawing of an object

Resources

Equipment	Tools	Material

• PPE (Safety shoes, helmets, glove, overall, mask, safety glasses) • Drawing board • Drawing table • Cutting board • A drawing easel	• Template • Ink-pen • One-meter straight drawing ruler with handle • Right angle ruler • Protractor • Drawing Compass • Drafting Pencil • Drawing template • French curves • Letter tracing • Set squares • Calculator • T square • Paper holder mathematical set	• Paper, • Rubber, • Pen ink, • Propelling pencil • Drawing pencil • Pencil lead • Drawing pencil

Indicative content 2.1: Description of Drawing Sheet

Duration: 2 hrs

1: You are requested to provide answers of the following questions:

Theoretical Activity 2.1.1: Description of drawing sheet

Tasks:

I. Define the term drawing sheet

II. Differentiate the types of drawing sheet used in technical drawing

III. Explain the parts of drawing sheet layout such as margin, title block, bordersand frames.

Provide the answer of asked questions and write them on flipchart/papers.

3: Present the findings/answers to the whole class

4: Read the key readings 2.1.1, and ask clarification where necessary

Key readings 2.1.1.: Description of drawing sheet

Definition of drawing sheet: Drawing sheet: Refers to a standardized sheet of paper or other material used for creatingprecise and detailed engineering or architectural drawings. These sheets are an essential part of technical documentation and are typically designed to adhere to specific standardsand formats to ensure consistency and clarity in the presentation of technical information.

Characteristics of good drawing sheet

✓ white and light colours are the standard choices for technical drawing sheets.

✓ With uniform thickness

✓ With must resist the easy torn of paper

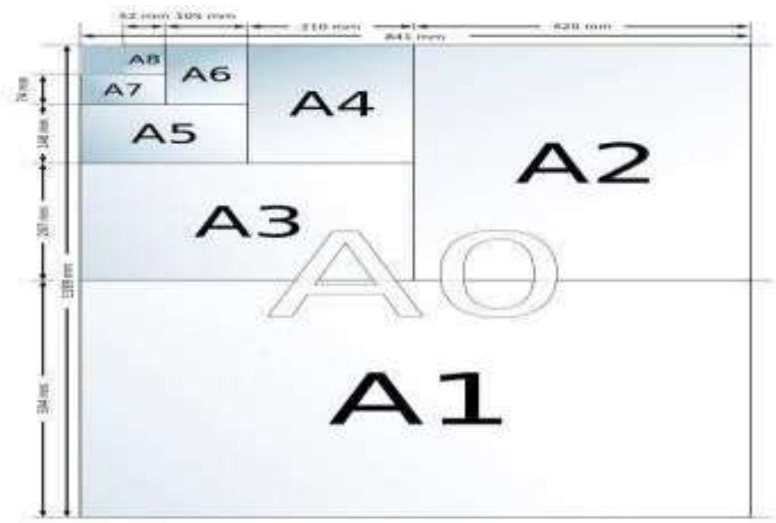
✓ The surface of sheet must be smooth.

Types and their dimensions:

a. ISO A Series: These sheets are based on the ISO 216 standard and include popularsizes.

Popular paper sizes and printing formats are A0, A1, A2, A3, A4, A5, A6, A7, and A8

Paper/sheet types	Size for Width x Height(mm)
A0	841mm X 1189mm
A1	594mm X 841mm
A2	420mm X 594mm
A3	297mm X 420mm
A4	210mm X 297mm
A5	148mm X 210mm
A6	105mm X 148mm
A7	74mm X 105mm
A8	52mm X 74mm



Architectural Sizes: Architectural drawing sheets often use sizes like 24 x 36 inchesand 30 x 42 inches.

b. **Plotter Rolls:** These are continuous rolls of paper used in large-format plotters andcome in various widths, such as 24 inches, 36 inches, and 42 inches.

c. **Square Sheets:** Some drawing sheets are square, with dimensions like 12 x 12 inchesor 18 x 18 inches, which are often used for various artistic and technical applications.

d. **Metric Sizes:** In addition to ISO A series, metric-sized drawing sheets can include Bseries (B0, B1, B2, etc.) and other custom sizes.

- **Parts of drawing sheet layout**

  i. **Margin**

Margin refers to the blank space or area that surrounds the drawing area itself. It is a designated space left empty on all sides of the drawing sheet and is an important aspect ofthe drawing's layout.

  ii. **Borders and frames**

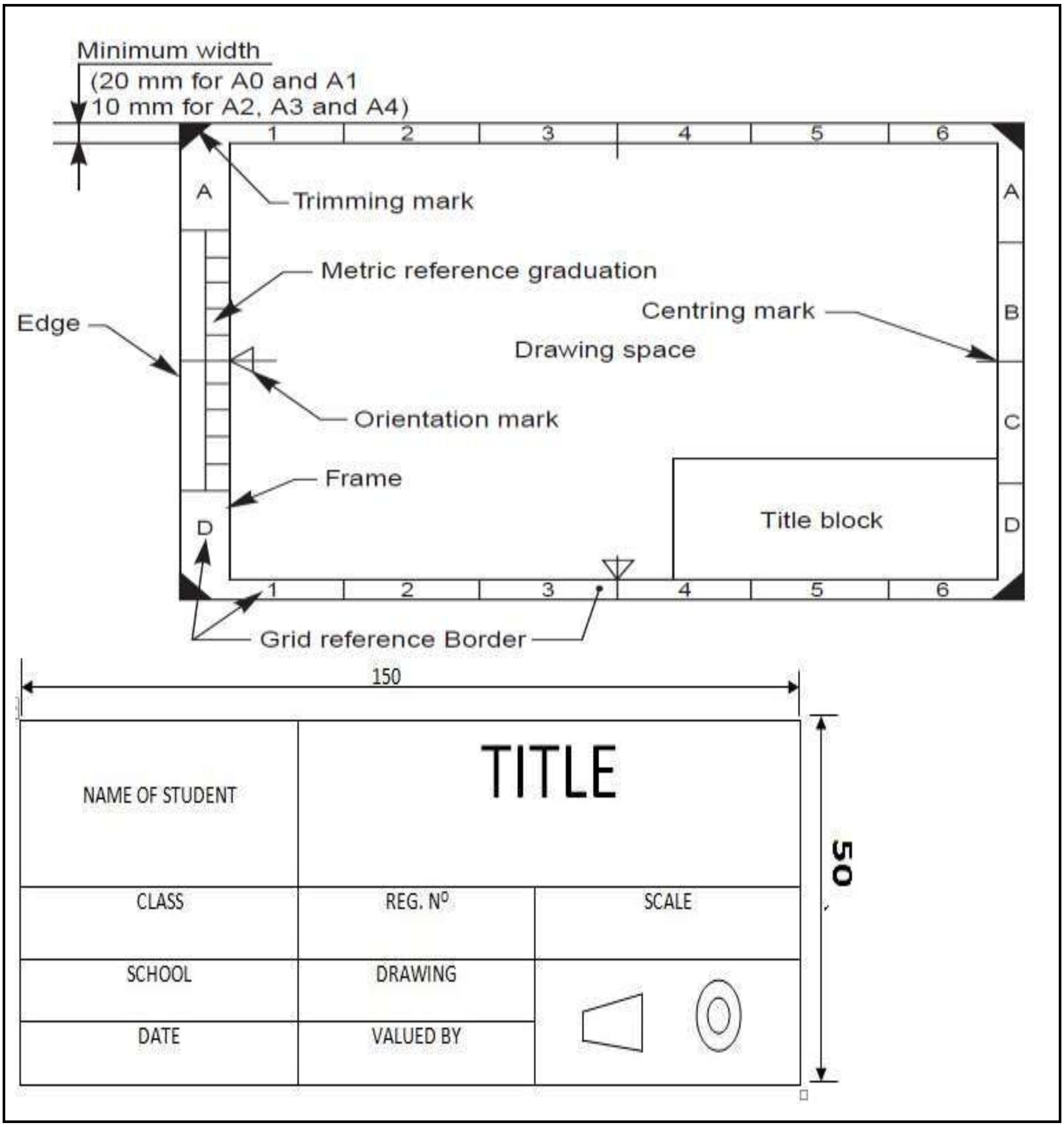
Borders enclosed by the edges of the trimmed sheet and the frame limiting the drawing space should be provided with all sizes. It is recommended that these borders have the minimum width of 20 mm for A0 and A1 and a minimum width of 10 mm for size A2, A3 and A4.

  iii. **Title block**

The title block should lie within the drawing space such that, the location of it, containing the identification of the drawing" is normally placed at the bottom right-hand corner". This must be followed, both for sheets positioned horizontally or vertically.

➢ **Title block should contain the following information:**

- The name of the company or organization
- The title of the drawing
- The drawing number, which is generally a unique filing identifier
- The scale
- The drawing sizes
- The angle of projection used, either first or third, generally shown symbolically
- The signature or initials of the draftsman, checker, approving officer, and issuing officer, with the respective dates.



Points to Remember

- Better to known types of drawing sheet and parts of drawing sheet layout to be used inbasics technical drawing

Application of learning 2.1.

Attend the study trip to a local drawing workplace and describe the drawing sheet found inplace as well as make report of the trip.

Indicative content 2.2: Description of Geometric Figures in Engineering Drawing

Duration: 2 hrs

Theoretical Activity 2.2.1 Description of geometric figures in engineering

Tasks:

1: As open discussion in whole class, you are requested to respond to the following questions:

- **I.** Give fundamental characteristics of point in drawing?
- **II.** What are different types of lines used in engineering drawing and theirapplications?
- **III.** Define the term angles and differentiate their types
- **IV.** Explain the quadrilaterals and their properties.

3.Provide the answers of asked questions and write them on papers.

4: Present the findings/answers to the whole class

5: Read the key readings 2.2.1, and ask questions where necessary

Key readings 2.2.1.: Description of geometric figures in engineering

- **Description of geometric figures**

It is a fundamental concept and does not have any size, shape, or dimension. Instead, a point is considered to be a precise location or position in space, often represented as a dot.Points are used to define and describe other geometric objects like lines, line segments, rays, and shapes.

✓ **Types of lines and their uses**

A line is an identifiable path created by a point moving in space. It is one-dimensional and can vary in width, direction, and length. Lines often define the edges of a form. Lines can be horizontal, vertical, or diagonal, straight or curved, thick or thin.

Types of lines used in engineering drawing:

1. A type –Continuous thick
2. B type – Continuous thin
3. type – Continuous thin Freehand
4. D type – Continuous thin Zig-Zag
5. E type – Dashes thick
6. F type – Dashes thin
7. G type – Chain thin
8. H type – Chain thin and thick
9. J type – Chain thick
10. K type – Chain thin double dash

Drawing lines may be categorized into three groups based on their weights or thickness:

a. **Thick line:**

Example: object line, cutting plane line and the short break lines

b. **Thin line:**

Example: The centerlines, dimension lines, extension lines, long-break lines, and phantom lines

c. **Medium line:**

Visible Outlines, Visible Edges: (Continuous wide lines) The lines drawn to represent the visible outlines/ visible edges / surface boundary lines of objects should be outstanding in appearance.

For general engineering drawings, the types of lines recommended by the Bureau of IndianStandards (BIS) must be used.

Meaning of Lines

Visible lines/outline: Represent features that can be seen in the current view (drawn dark andcontinuous)

Hidden lines: Represent features that cannot be seen in the current view.

Centre line: Represents symmetry, path of motion, centres of circles, axis of ax symmetrical

Dimension line: Thin continuous line terminated by arrowheads touching the outlines,extension lines or centre lines (used to specify end points of a dimension)

Extension lines: An extension of an outline (drawn light and continuous, used to indicatethe entity being dimensioned)

Uses of lines

Dimension Lines (Continuous narrow Lines): Dimension Lines are drawn to Mark dimension.

Extension Lines (Continuous narrow Lines): There are extended slightly beyond the respective dimension lines.

Construction Lines (Continuous narrow Lines): These are drawn for constructing drawings and should not be erased after completion of the drawing.

Hatching / Section Lines (Continuous Narrow Lines): These are drawn for the sectioned portion of an object. These are drawn inclined at an angle of 45° to the axis or to the main outline of the section.

Guide Lines (Continuous Narrow Lines): These are drawn for lettering and should not be erased after lettering.

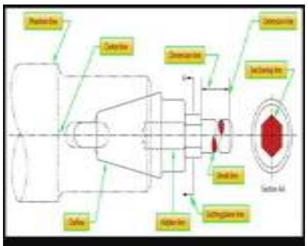
Break Lines (Continuous Narrow Freehand Lines): Wavy continuous narrow line drawn freehand is used to represent break of an object.

Dashed Narrow Lines (Dashed Narrow Lines): Hidden edges / Hidden outlines of objects areshown by dashed lines of short dashes of equal lengths of about 3 mm, spaced at equal distances of about 1 mm. the points of intersection of these lines with the outlines / anotherhidden line should be clearly shown.

Centre Lines (Long-Dashed Dotted Narrow Lines): These are drawn at the centre of the drawings symmetrical about an axis or both the axes. These are extended by a short distance beyond the outline of the drawing.

Cutting Plane Lines: Cutting Plane Line is drawn to show the location of a cutting plane. It is long-dashed dotted narrow line, made wide at the ends, bends and change of direction. The direction of viewing is shown by means of arrows resting on the cutting plane line.

Border Lines: Border Lines are continuous wide lines of minimum thickness 0.7 mm.



A type	Continuous thick	Represents object outline and visible edges.
B type	Continuous thin	Represents object outline especially for fine details.
C type	Continuous thin Freehand	Freehand sketching, artistic representation, or informal annotation
D type	Continuous thin Zig-Zag	Used for irregular, nonspecific outlines.
E type	Dashes thick	Represents hidden feature or sections.
F type	Dashes thin	Used for hidden feature with finer details.

G type	Chain thin	Indicates centre lines o symmetry in an object.
H type	Chain thin and thick	Used for centre lines with additional emphasis.
J type	Chain thick	Indicates dimension line boundary lines, and object outlines.
K type	Chain thin double dash	Represents alternate or phantom features.

Precedence of Lines

1. When a Visible Line coincides with a Hidden Line or Centre Line, draw the VisibleLine. Also, extend the Centre Line beyond the outlines of the view.

2. When a Hidden Line coincides with a Centre Line, draw the Hidden Line.

3. When a Visible Line coincides with a Cutting Plane, draw the Visible Line.

When a Center line coincides with a Cutting Plane, draw the Center Line and show the Cutting Plane line outside the outlines of the view at the ends of the Centre Line by thick dashes

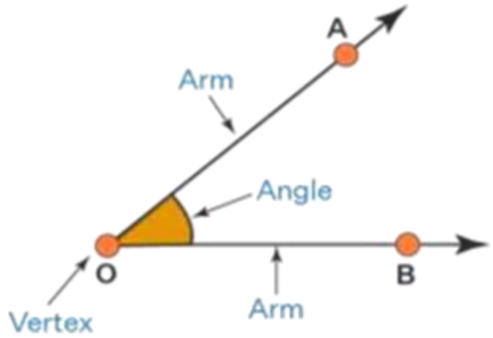
Thickness of lines

Two thicknesses of lines are used in draughting practice. The ratio of the thick to thin line should not be less than 2:1. The thickness of lines should be chosen according to the size and type of the drawing from the following range: 0.18, 0.25, 0.35, 0.5, 0.7, 1, 1.4 and 2

It is recommended that the space between two parallel lines, including hatching, should never be less than 0.7 mm.

- ✓ **Angle and their types**

Angle: The space (usually measured in degrees) between two intersecting lines or surfacesat or close to the point where they meet. There are two main parts related to an angle - the**arms and the vertex.**



Arms of the Angle: The two rays that join at a common point to form the angle are called the arms of the angle

Vertex: The corner points of an angle is known as Vertex. It is the point where two raysmeet.

Types of angles

i. . Zero Angle (0° in Measure)

ii. Acute Angle (0 to 90° in Measure)

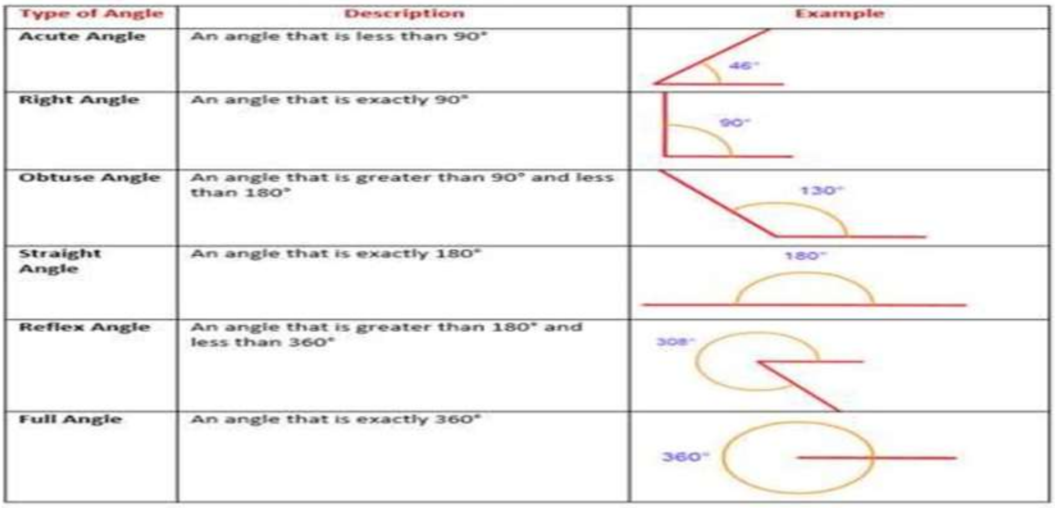
iii. Right Angle (90° in Measure)

iv. Obtuse Angle (90 to 180° in Measure)

v. Straight Angle (180° in Measure)

vi. Reflex Angle (180 to 360° in Measure)

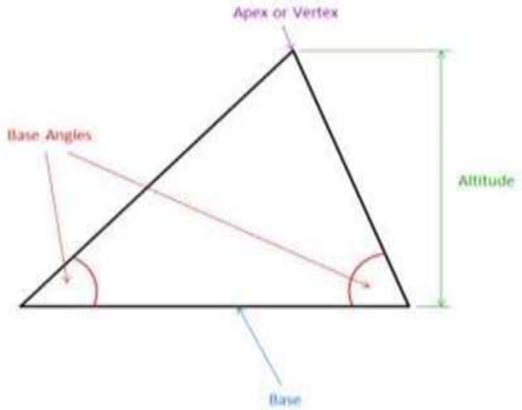
vii. Full or Complete Angle (360° in Measure)



Type of Angle	Description	Example
Acute Angle	An angle that is less than 90°	46°
Right Angle	An angle that is exactly 90°	90°
Obtuse Angle	An angle that is greater than 90° and less than 180°	130°
Straight Angle	An angle that is exactly 180°	180°
Reflex Angle	An angle that is greater than 180° and less than 360°	308°
Full Angle	An angle that is exactly 360°	360°

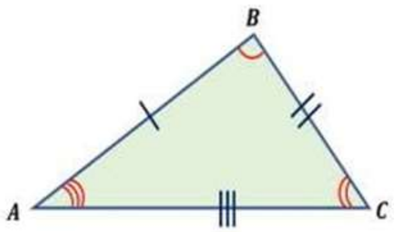
✓ **Triangle and their types**

Triangle: Is a plane figure with three straight sides and three angles



Isosceles triangle: Is a triangle that has any two sides equal in length and anglesopposite to equal sides are equal in measure.

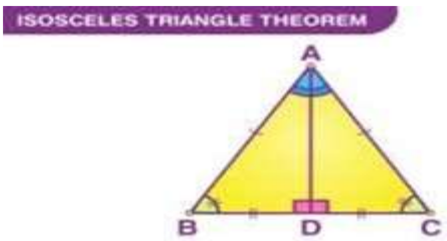
Scalene triangle: Is a triangle in which all three sides are in different lengths, and all three angles are of different measures.

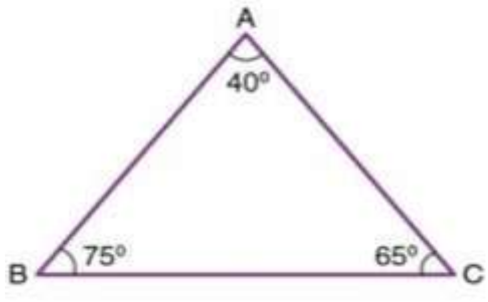


Types of Triangles Based on Angles

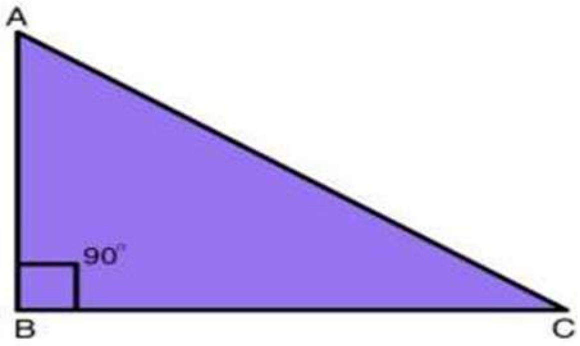
On the basis of angles, triangles are classified into the following types:

- **Acute Triangle:** When all the angles of a triangle are acute, that is, they measure lessthan 90°, it is called an acute-angled triangle or acute triangle.





Right Triangle: When one of the angles of a triangle is 90° measured, it is called a right-angled triangle or right triangle

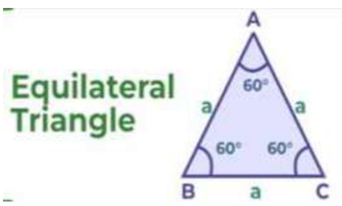


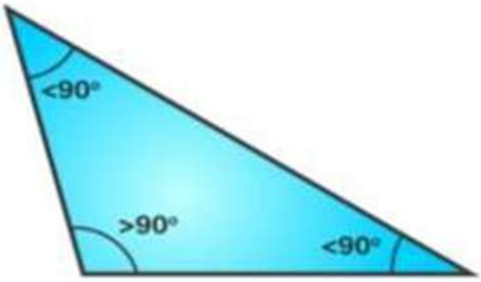
Obtuse Triangle: When one of the angles of a triangle is an obtuse angle, that is, itmeasures greater than 90°, it is called an obtuse-angled triangle or obtuse triangle.

Types of Triangles Based on Sides and Angles

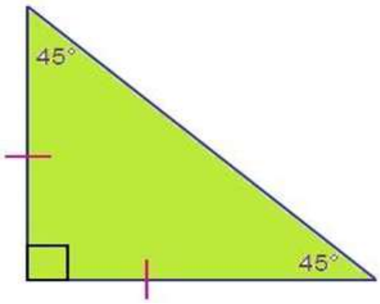
The different types of triangles are also classified according to their sides and angles asfollows:

Equilateral or Equiangular Triangle: When all sides and angles of a triangle are equal, itis called an equilateral or equiangular triangle

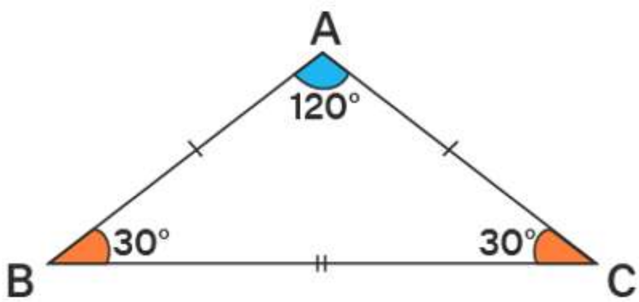




Isosceles Right Triangle: A triangle in which 2 sides are equal and one angle is 90° is called an isosceles right triangle. So, in an isosceles right triangle, two sides and two acute angles are congruent.



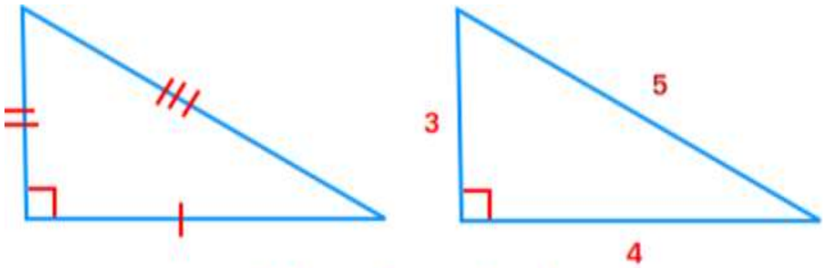
Obtuse Isosceles Triangle: A triangle in which 2 sides are equal and one angle is an obtuse angle is called an obtuse isosceles triangle of triangle



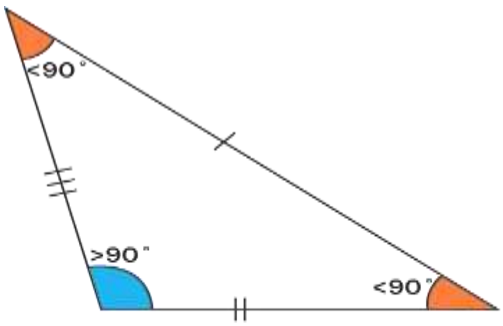
Acute Isosceles Triangle: A triangle in which all 3 angles are acute angles and 2 sides measure the same is called an acute isosceles triangle.

Right Scalene Triangle: A triangle in which any one of the angles is a right angle and allthe 3 sides are unequal, is called a right scalene triangle.

Obtuse Scalene Triangle: A triangle with an obtuse angle with sides of different measures is called an obtuse scalene triangle.



Right scalene triangles



Acute Scalene Triangle: A triangle that has 3 unequal sides and 3 acute angles is calledan acute scalene triangle

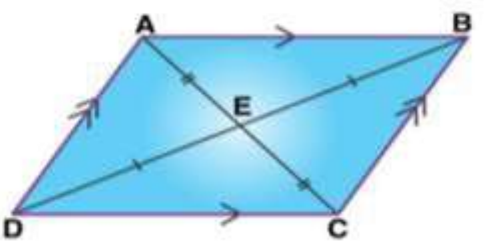
- ✓ **Quadrilaterals and their properties**

A quadrilateral: Is a closed shape and a type of polygon that has four sides, four vertices and four angles. It is formed by joining four non-collinear points. The sum of interior anglesof quadrilaterals is always equal to 360 degrees.

Properties of quadrilaterals

✓ **Properties of Parallelograms**

1. The parallel sides are parallel by definition.
2. The opposite sides are congruent.
3. The opposite angles are congruent.
4. The diagonals bisect each other.

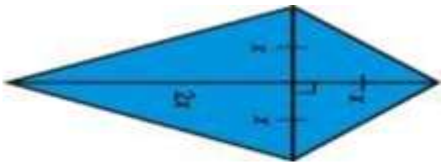


✓ **Properties of Rectangles** In a rectangle

1. All the properties of a parallelogram apply by definition
2. All angles are right angles.
3. The diagonals are congruent

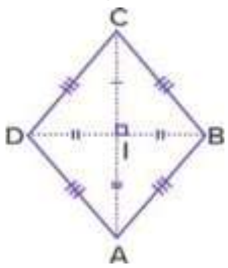
✓ **Properties of Kites In a kite,**

1. Two disjoint pairs of consecutive sides are congruent by definition.
2. The diagonals are perpendicular.
3. One diagonal is the perpendicular bisector of the other.
4. One of the diagonals bisects a pair of opposite angles
5. One pair of opposite angles are congruent

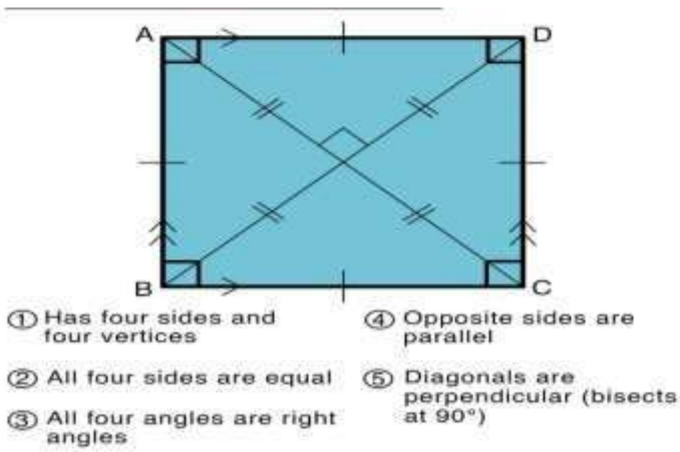


✓ **Properties of rhombuses**

1. In a rhombus,
2. All the properties of a parallelogram apply by definition
3. Two consecutive sides are congruent by definition
4. All sides are congruent by definition
5. The diagonals bisect the angles
6. The diagonals are perpendicular bisectors of each other
7. The diagonals divide the rhombus into four congruent right angles



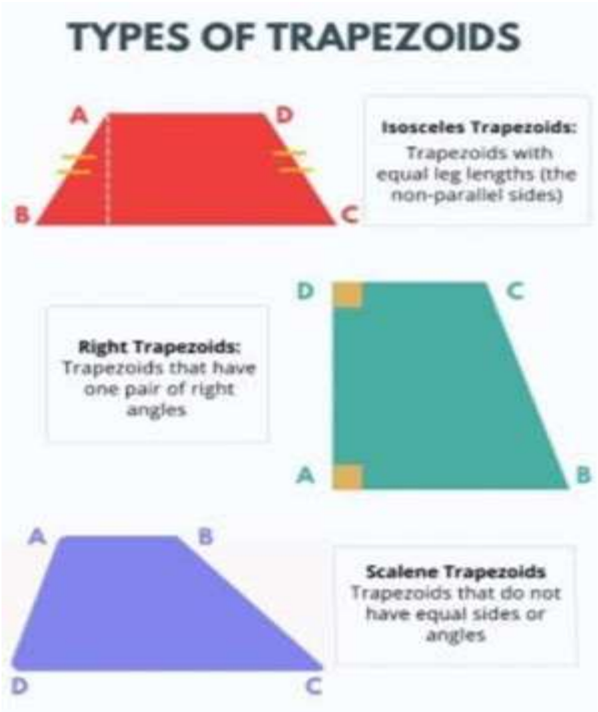
Properties of a square



✓ **Properties of Isosceles Trapezoids**

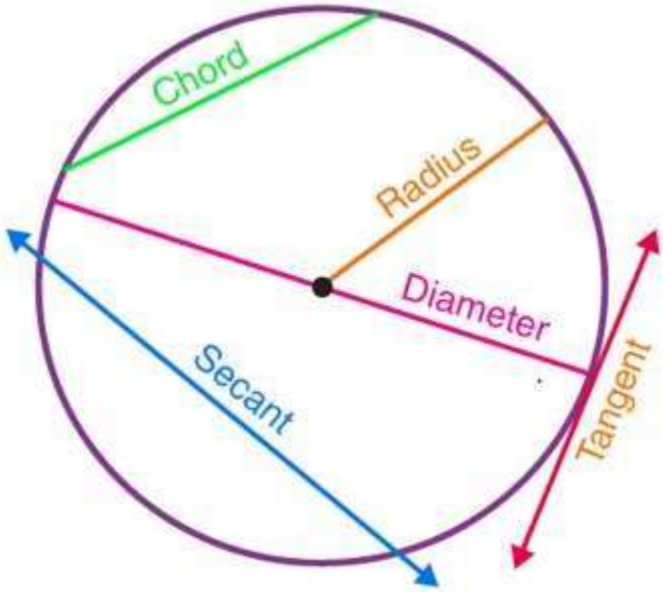
In an isosceles trapezoid, Trapezoids

1. The legs are congruent by definition.
2. The bases are parallel by definition.
3. The lower base angles are congruent.
4. The upper base angles are congruent.
5. The diagonals are congruent.
6. Any lower base angle is supplementary to any upper base angle.



✓ **Circle**

Circle: The collection of all the points in a plane, which are at a fixed distance from a fixed point in the plane, is called a circle. Here, the fixed point is called the center "O". Some of the important terminologies used in the circle are as follows



Terms	Description
Circumference	The boundary of the circle is known as the circumference
Radius	The line from the centre “O” of the circle to the circumference of the circle is called the radius and it is denoted by “R” or “r”
Diameter	The line that passes through the centre of the circle and touches the two points on the circumference is called the diameter and it is denoted by the symbol “D” or “d”
Arc	Arc is the part of the circumference where the largest arc is called the major arc and the smaller one is called the minor arc
Sector	Sector is slice of a circle bounded by two radii and the included arc of a circle
Chord	The straight line that joins any two points on the circumference of a circle is called the chord

Tangent	A line that touches the circumference of a circle at a point is called the tangent
Secant	A line that cuts the circle at the two distinct points is known as the secant

Points to Remember

- While drawing it is necessary to know all types of point and their uses

Application of learning 1.3.

Attend the study trip organized by your trainer to a local drawing workplace and describegeometric figures include point, lines and angles, triangles and quadrilaterals found in place

Indicative content 2.3: Drawing Geometric Figures

Duration: 2 hrs

Theoretical Activity 2.3.1 Drawing geometric figures (point, lines and angles)

Tasks:

1. Referring to the previous activity 2.2.1 As metal fabricator who use drawing in presenting an object, you are asked to draw geometric figures such as point, lines and angles

2: Select drawing tools, materials, and equipment.

3: Present out the procedures of drawing geometric figures.

4: Referring to the procedure provided on step 2, draw geometric figures with respect thetime given.

5: Present your work to the trainer.

6: Read key reading 2.3.1, and ask for clarification where necessary.6: Perform the

task provided in application of learning 2.3.1.

Key readings 2.3.1.: Drawing geometric figures

- **Drawing geometric figures**

Procedure of drawing a geometric figure is the process of drawing a geometrical figure usingtwo geometrical instruments, a compass, and a ruler. We use a compass to draw arcs and circles and mark off equal lengths. We use a ruler to draw line segments and measure theirlengths.

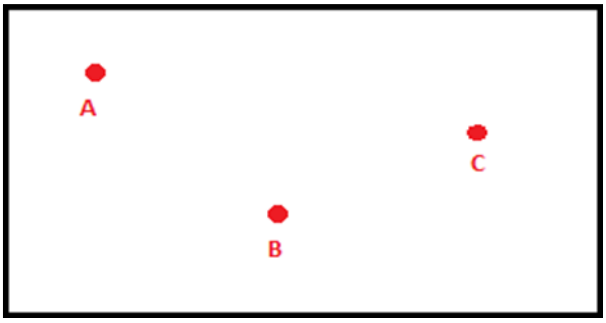
The common procedures for drawing geometric figures

- **Gather the necessary tools:** You will typically need a ruler, compass, protractor, and pencil for drawing geometric figures accurately.
- **Identify the figure:** Determine which geometric figure you want to draw, such as asquare, triangle, or circle.
- **Plan the dimensions:** Decide on the size and proportions of the figure you want todraw. This may involve measuring and marking specific lengths or angles.
- **Start with a base:** For many geometric figures, it helps to start with a base line or shape

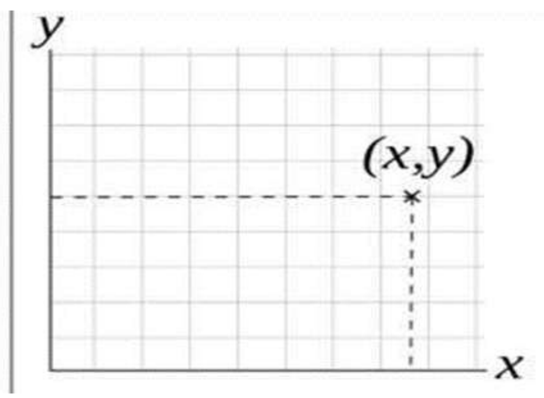
- For example, drawing a square might involve drawing four equal-length lines that form a closed shape.
- **Use construction techniques:** Depending on the figure, you may need to use
- construction techniques. These techniques involve using tools like a compass or protractor to create precise angles, circles, or other shapes.
- **Connect the points:** Once you have established the base or initial shape, connect the necessary points with straight lines or curves to complete the figure.
- **Erase unnecessary lines:** After completing the figure, erase any construction lines or guidelines that are no longer needed.

✓ **Point**

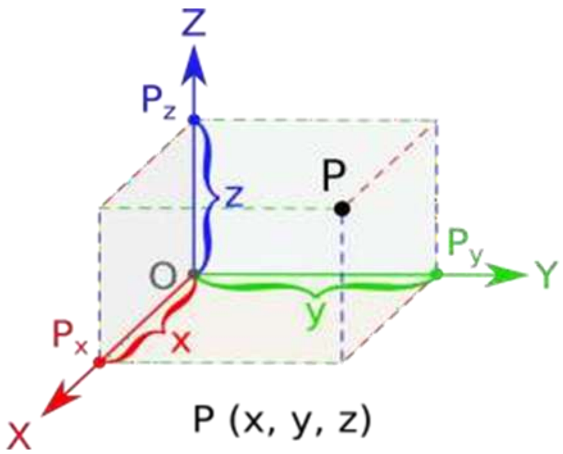
A location somewhere in a space. It has no size, meaning: no width, no length and no depth.A point is shown by a dot. If the point has specific coordinates relevant to your drawing, consider labelling them nearby for reference.



Points in 2D Cartesian space



Points in 3D space



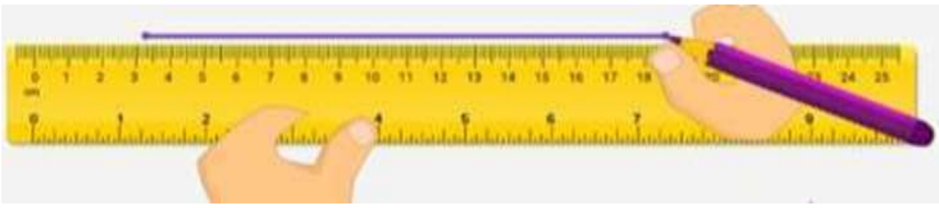
✓ Lines (Horizontal, Vertical, Oblique, curved, parallel, perpendicular)

geometry a line: Is straight (no bends), has no thickness, and extends in both directions without end (infinitely).

a. **Horizontal line**

A horizontal line is a sleeping line. It is a straight line that goes from left to right or right to left. Or you could think of a car or something lying down and sketch your line from **left to right**; called a **horizontal line**.

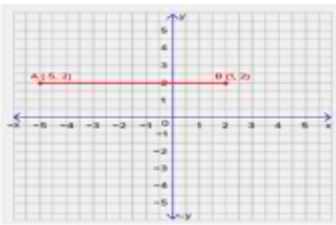
Using a Ruler: To draw a horizontal line using a ruler, keep the ruler in sleeping position, parallel to the edge of the page and draw the line from left to right or right to left.



To draw a horizontal line on a coordinate plane, follow these steps:

- Plot any point on the coordinate plane, for example, (1, 2).
- Identify the y-coordinate of the point marked. Here, it is 2.
- Plot another point on the coordinate plane such that its y-coordinate is the same asthe previous point plotted. For example, (–5, 2).

Join the two points plotted using a ruler to get a horizontal line

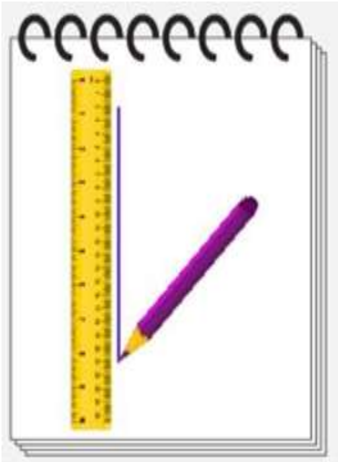


a. **Vertical**

Vertical alignment is when we view things from top to bottom. It is referred to as the alignment when things are standing. if you wanted to think like a mathematician or an artist;you would imagine a tree or something standing and draw a line **top to bottom**; calleda **vertical line**.

Using a Ruler:

To draw a vertical line using a ruler, keep the ruler in a standing position, perpendicular to the edge of the page and draw the line from bottom to top or top to bottom.



To draw a vertical line on a coordinate plane

Follow these steps:

Step 1: Plot any point on the coordinate plane, for example (4,3)
Step 2: Identify the x-coordinate of the point marked. Here, it is 4.
Step 3: Plot another point on the coordinate plane with the same x -**coordinate. Forexample, (4, -2).**
Step 4: Join the two points plotted using a ruler to get a vertical line.

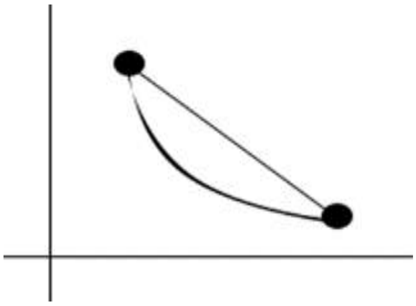
a. **Oblique line**

An oblique line is a type of straight line that is neither horizontal nor vertical. Instead, it fallsat an angle between these two directions. Oblique lines can have various angles, dependingon how they deviate from the horizontal and vertical orientations**.**

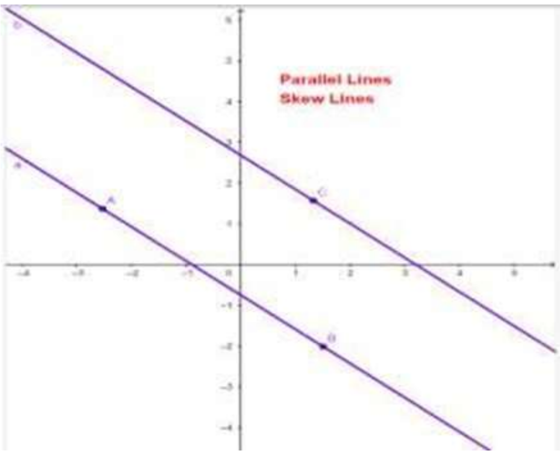
Slanting. Not up-down or left-right. Angles that are not 0°, 90°, 180° or 270°.

b. **Curved line**

A curved line, also known as a curve, is a type of line that does not follow a straight path but instead bends or arcs smoothly. Curved lines are essential in art, design, mathematics,and various fields for creating shapes, contours, and patterns that are not composed of straight segments.



c. **Parallel lines**



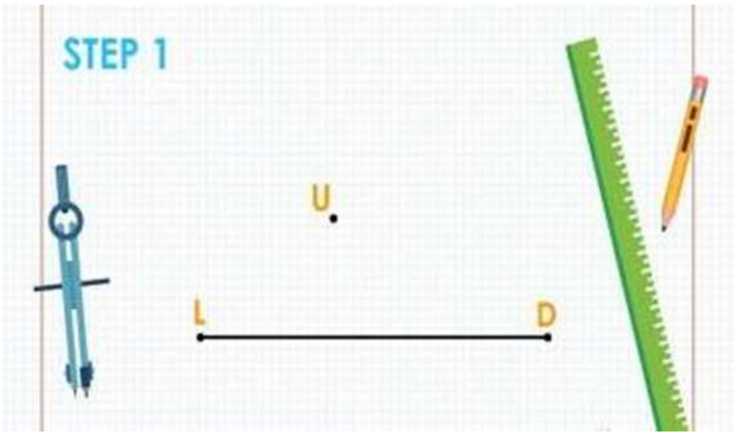
Parallel lines are defined as those lines that lie on the same plane and are always equidistant from each other and hence, never intersect each other

Step to follow for drawing parallel lineStep 1

Begin by drawing a line (or ray or line segment) horizontally on your paper, relative to you.Draw points at each end of your line. Label the points of your line anything you like; the letters are unimportant except to identify your line.

For our example, we will construct line **LD.**

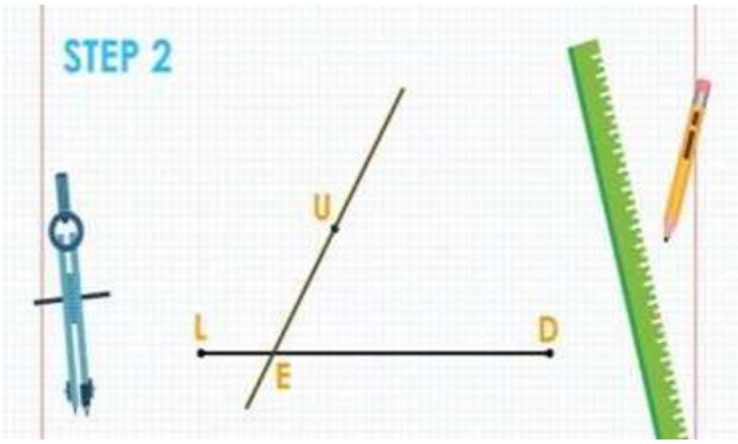
Draw a single point above your line, some distance away (like 3 inches) and give it a label. We will call ours **Point U**



Step 2

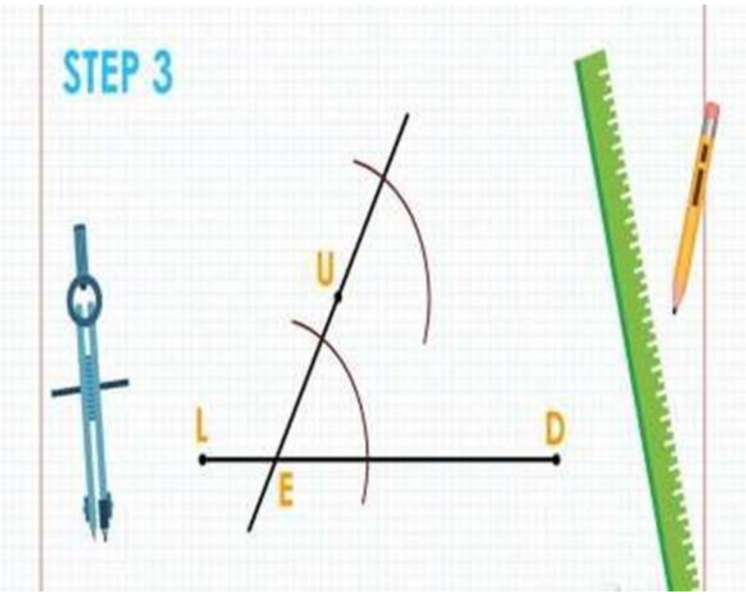
Next, we will use our straightedge to construct a transverse, a line intersecting your originalline and going through your point above the line. Try to make it at an angle not 90°. This will make your work clearer to you.

Label the intersection of your transverse and your original line with another letter not already used. We will call ours Point E.



So far, we have line LD intersected by transverse UE.

Step 3



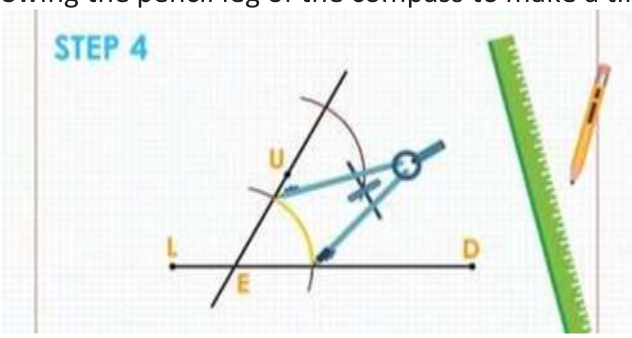
Use your compass to scribe an arc. An arc is a section of a circle. Open the compass legs sothat they are more than half the distance from the two points on your transverse. In our example, the compass is spread slightly more than halfway between Point U and Point E

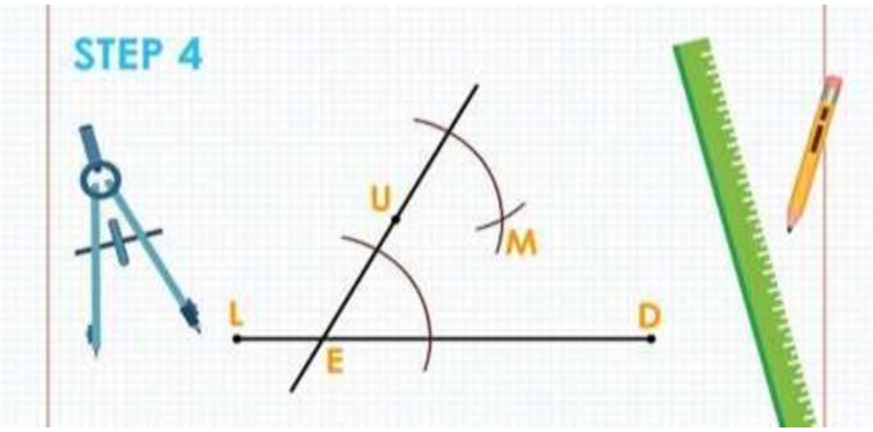
Put the point of the compass on Point E and scribe an arc that goes through the transverseline and the horizontal line (in our example, lines UE and LD). Keep the compass legsthe same distance apart and repeat the arc with the compass's sharp point on Point U. Scribe another arc to look similar to the one you just drew.

Step 4

Lift the compass and do not worry about the distance between the legs. You will put the compass's sharp point on the intersection of the first arc you drew and the transverse. Open or close the compass leg to match the distance from that intersection to the arc's other intersection, where it crosses the horizontal line (LD in our example).

Lift the compass, being careful to keep the legs the same distance apart. Put the point downon the intersection of the second arc and the transverse (Point U in our example). Swing the pencil leg of the compass to make a tiny mark through that second arc

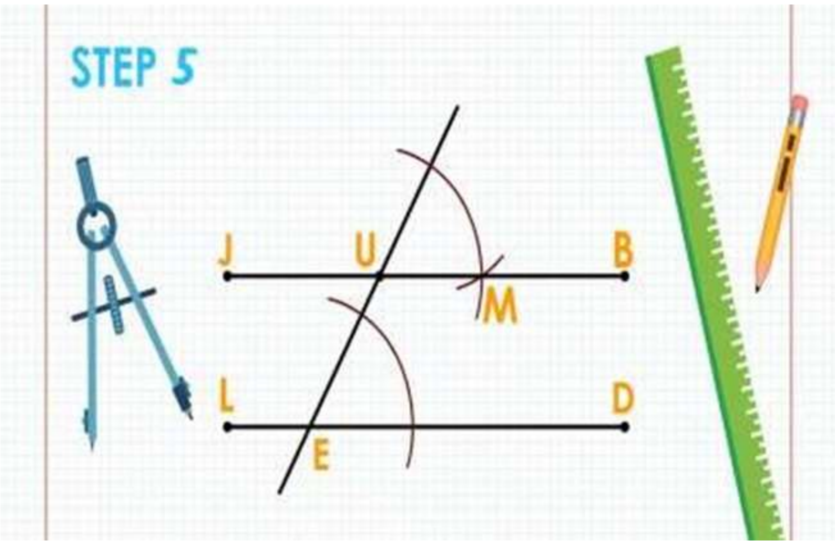




Where you swung the compass and passed through the second drawn arc, you have a newpoint of intersection. Label that point. In our example, we call it Point M

Step 5

Use your straightedge to construct a line that passes through the original point above yourfirst line and through the newly labeled point. In our example, that means a line through Point U and Point M. Put endpoints on that line. Label the endpoints. In our example, we used Point J on the left and Point B on the right.



We have now constructed line JB passing through Points U and M and parallel to line LD (which passes through Point E). Put it all together, and it may feel JUMBLED but it really is not!

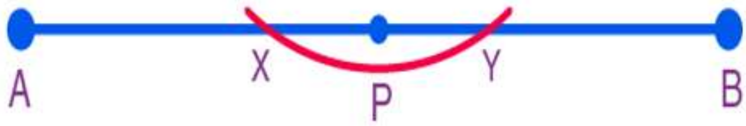
d. Perpendicular

When two lines intersect to form right angles then such lines are known as **perpendicular** to each other. Perpendicular lines lie in the same plane i.e. they are co-planar and intersect at right angles.

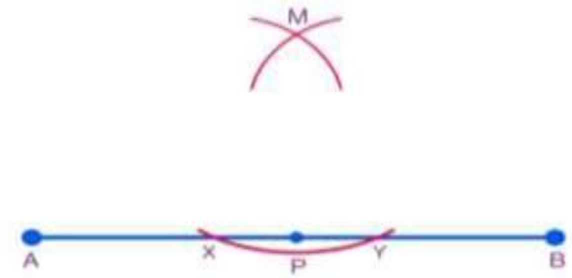
Steps to Construct Perpendicular lines

Constructing a perpendicular to a line through a point on it Given: A line segment AB with a point P on it. To construct A line perpendicular to line AB passing through point P.

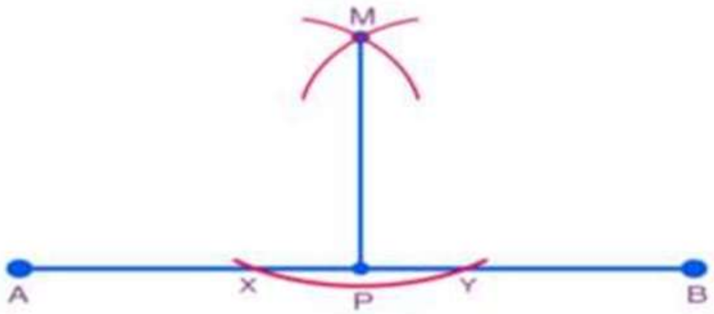
Step 1: With P as a centre and any suitable radius, draw an arc cutting line segment AB at two distinct points as shown in the given figure.



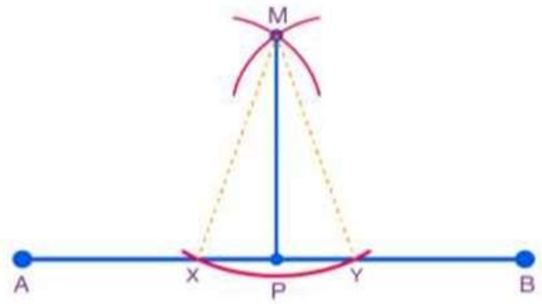
Step 2: Now with X as centre and a suitable radius draw an arc on either side of the given line segment AB. Also, with Y as centre and the same radius as the previous, draw an arc on either side of the given line segment cutting the arc drawn through point X at M as shownin the given figure.



Step 3: Join the points M and P as shown, and the line segment MP is the required perpendicular to AB through point P



Let us see if the line segment MP constructed is actually perpendicular to AB or not. Join Mto the points X and Y as shown:



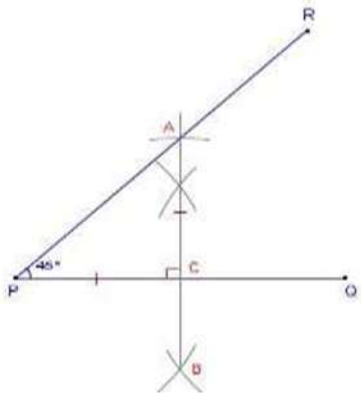
Angles

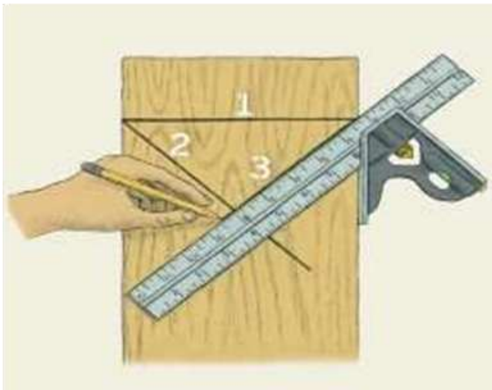
Draw Angles (Acute, Right, Obtuse, Straight, Reflex, Adjacent, complementary and supplementary)

Steps of creating difference angles

. **Right Angle (90 Degrees):**

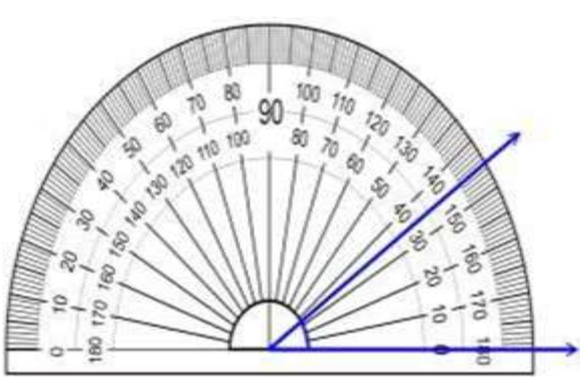
with a horizontal or vertical line. Using a T-square or triangle, draw another line that intersects the first line at a 90-degree angle

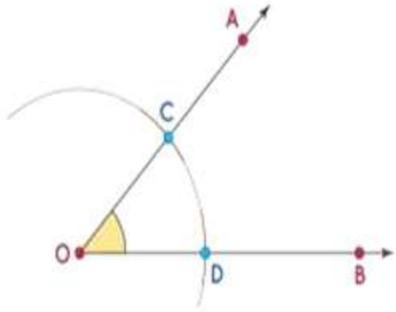




2. **Acute Angle (Less than 90 Degrees):**

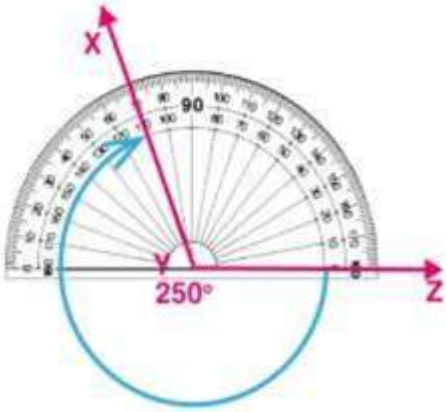
Begin with a horizontal or vertical line. Use a protractor or a set square to measure thedesired acute angle from the starting line and draw the second line accordingly.

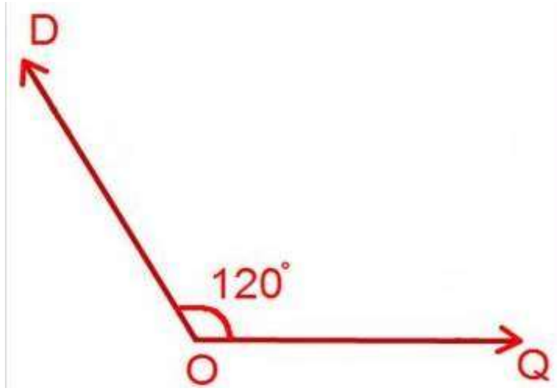




3. **Obtuse Angle (Greater than 90 Degrees):**

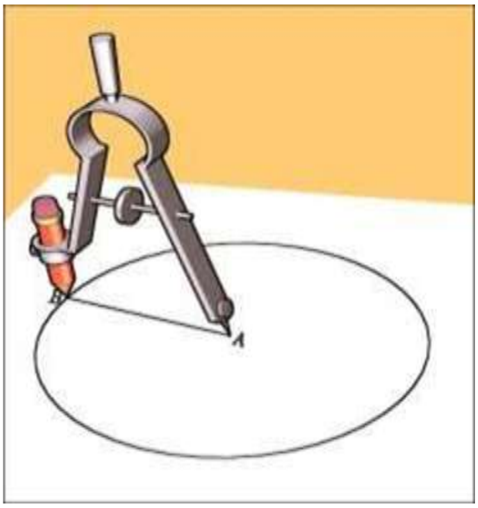
Start with a horizontal or vertical line. Measure the desired obtuse angle using a protractoror set square and draw the second line in the opposite direction.





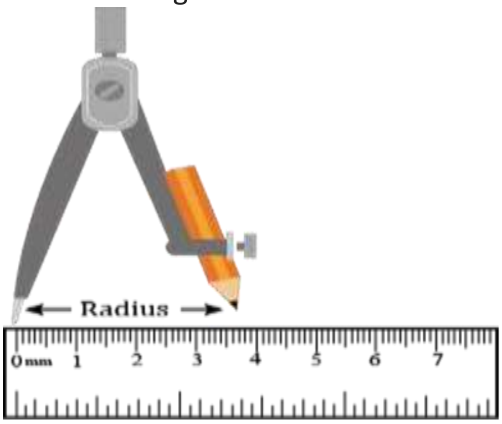
4. **Full Circle (360 Degrees):**

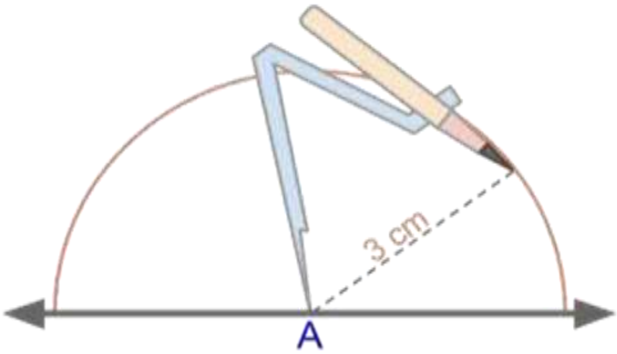
Use a compass to create a circle with the desired radius, and it will represent a full circle,which is 360 degrees.

5. Half Circle (180 Degrees):

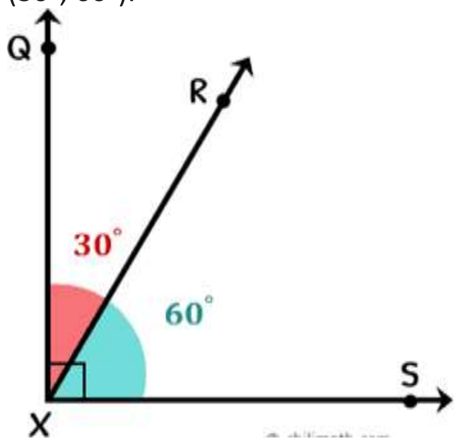
Using a compass, draw a semicircle with the desired radius, and it will represent a half circle, which is 180 degrees.





Complementary angles

Two angles are said to be complementary if the sum of their measures is 90°, and each angle is said to be complement of each other. For example, (45°, 45°), (10°, 80°), (20°, 70°), (30°, 60°).



Note:

(a) If two angles are complementing of each other than each angle is an acute angle, but any two acute angles need not be complementary, for example, 20° and 60° are acute angles but are not complement of each other.

(b) Two obtuse angles and two right angles cannot be complementing of each other.

Supplementary Angles:

Two angles are said to be supplementary, if the sum of their measures is 180°.Two supplementary angles are called the supplement of each other. For example, (10°, 170°), (20°, 160°), (30°, 150°), (40°, 140°), (50°, 130°) etc. are all pairs of supplementary angles.

Application of learning 2.3

In study visit planned by your trainer you are tasked make study visit to a local road found nearthe school and draw point, line and angles signs found in place as well make a report of study.

Practical Activity 2.3.2: Drawing geometric figures (triangles, and

Notes to the trainer

Referring to the previous activity 2.2.1 As metal fabricator who use drawing in presenting
object, you are asked to draw geometric figures such as triangles and quadrilaterals

as trainerdemonstrated.

1: Select drawing tools, materials, and equipment.
2: Present out the procedures of drawing geometric figures.

3: Referring to the procedure provided on step 2, draw geometric figures with respect thetime given.

4: Present your work to the trainer.

5: Read key reading 2.3.2, and ask for clarification where necessary.6: Perform the

task provided in application of learning 2.3.2.

Key readings 2.3.2.: Drawing steps of triangles (Equilateral, Isosceles, scalene, acute-angled, obtuse-angled, right-angled)

Start by drawing a horizontal line segment as the base of the triangle.

From the midpoint of the base, use a protractor to measure and mark a 60-degree angle(since equilateral triangles have all angles of 60 degrees).

Draw two lines from the endpoints of the base to the 60-degree mark, forming the equilateral triangle.

- **Isosceles Triangle (Two Sides and Two Angles are Equal):**

Begin by drawing the base of the isosceles triangle, which is typically a horizontal line.

From one of the endpoints of the base, measure and mark the length of one of the equalsides.

Use a protractor to measure and mark the angle between the base and one of the equalsides.

Draw a line from the other endpoint of the base to the angle mark, creating the isoscelestriangle.

- **Scalene Triangle (No Sides or Angles are Equal):**

Start by drawing the base of the scalene triangle, which can be of any length.

Measure and mark the lengths of the other two sides. These sides can be different lengthsand angles can be different measures.
Use a protractor to measure and mark the angles between the base and the two other sides.Connect the marks to form the scalene triangle

➢ **Acute-Angled Triangle (All Angles are Less than 90 Degrees):**

Draw any base for the triangle.

Use a protractor to measure and mark three acute angles (each less than 90 degrees) onthe base.

Connect the marks to form the acute-angled triangle.

- **Obtuse-Angled Triangle (One Angle is Greater than 90 Degrees):**

Draw any base for the triangle.

Use a protractor to measure and mark one angle that is greater than 90 degrees.

Draw two lines from the end points of the base to the obtuse angle mark, forming the obtuse-angled triangle.

- **Right-Angled Triangle (One Angle is 90 Degrees):**

Start by drawing a horizontal line segment as the base.

Use a protractor to measure and mark a 90-degree angle at one of the endpoints of thebase.

Draw lines connecting the other endpoint of the base to the 90-degree mark, forming theright-angled triangle.

✓ **Draw quadrilaterals (Square, Rectangle, Rhombus/ parallelogram, Tra pezoid, Trapezium/Kite, circles and arcs)**

Drawing steps of quadrilateral

1. **Square**

➢ Start by drawing a straight horizontal line segment. From one endpoint, use a protractor to measure and mark a 90-degree angle.
➢ Draw another line segment connected to the endpoint at the 90-degree mark. Ensure it is of the same length as the first segment.
➢ Continue to draw the remaining two sides, connecting the endpoints and maintaining 90-degree angles between them.

2. **Rectangle**

➢ Begin with a horizontal line segment as the base.
➢ Use a protractor to measure and mark two 90-degree angles at the endpoints of th e base.
➢ Draw two vertical lines connecting the endpoints to complete the rectangle.

3. **Rhombus/Parallelogram**

➢ Start with a horizontal line segment as the base.
➢ Measure and mark the length of one side.
➢ From one endpoint of the base, draw a line at the marked length and at any angle. This creates the first side of the rhombus/parallelogram.
➢ Repeat the process to draw the remaining sides, ensuring they are parallel to the fi rst side.

4. **Trapezoid**

➢ Draw a horizontal line segment as the longer base of the trapezoid.
➢ Draw another line segment at an angle from one endpoint of the longer base. This will be one of the shorter sides of the trapezoid.

- Draw a parallel line from the other endpoint of the longer base, creating the other shorter side.
- Connect the endpoints of the shorter sides to complete the trapezoid.

5. Trapezium/Kite

- Start by drawing a horizontal line segment as the longer base of the trapezium.
- Draw a line segment from one endpoint of the longer base at an angle. This will be one of the shorter sides.
- Draw another line segment from the other endpoint of the longer base, but at a dif ferent angle. This creates the other shorter side.
- Connect the endpoints of the shorter sides to complete the trapezium/kite.

6. Circles and Arcs:

- To draw a circle, use a compass. Place the compass point where the centre of the c ircle should be and adjust the width to the desired radius. Then, draw the circle aro und the centre point.
- To draw an arc, use a compass or a protractor. For a compass, adjust the width to the desired radius and draw the arc. For a protractor, measure the angle of the arc and mark the endpoints, then connect them with the arc.

Points to Remember

Better to know all geometric figures found in drawing include point, lines and angles, triangles and quadrilaterals it's better to know while drawing not only that but also procedure of drawing a geometric figure.

Application of learning 2.3.2

In study visit planned by your trainer you are requested visit a local road found near the school and draw triangle and quadrilaterals signs found in place as well make a report of study.

Indicative content 2.4: Description of Engineering Drawing Symbols

Duration: 1 hr

Theoretical Activity 2.4.1 Description of Engineering Drawing Symbols

Tasks:

1: As open discussion in whole class, you are requested to answer the following questions asked by your trainer that concerns on engineering drawing symbols

I. What do you understand the term engineering drawing symbols?

II. Enumerate the common engineering symbols and their application?

2: Provide the answer of asked questions and write them on papers/flip charts or black board.3: Present the findings/answers in whole class.

4: Pay attention to the trainer's clarification and ask questions where necessary.

5: Read the key readings 2.4.1.

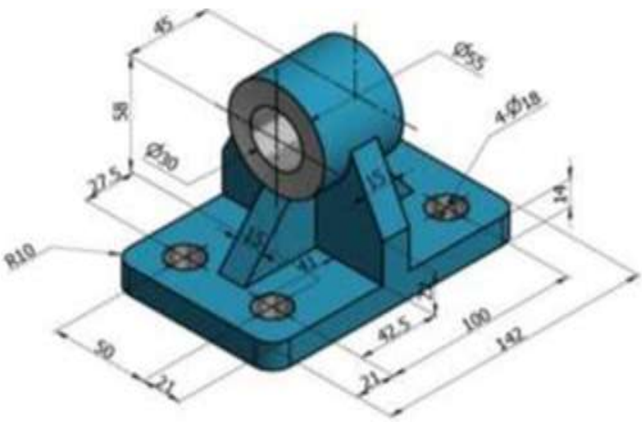
Key readings 2.4.1.: Description of Engineering Drawing Symbols

- **Common types of engineering drawing symbols**

Engineering drawing symbols are used to communicate technical information and specifications in a standardized way. These symbols help engineers, designers, and manufacturers understand and interpret the details of a design or a component.

Engineering drawing symbols encompass a wide range of categories, including:

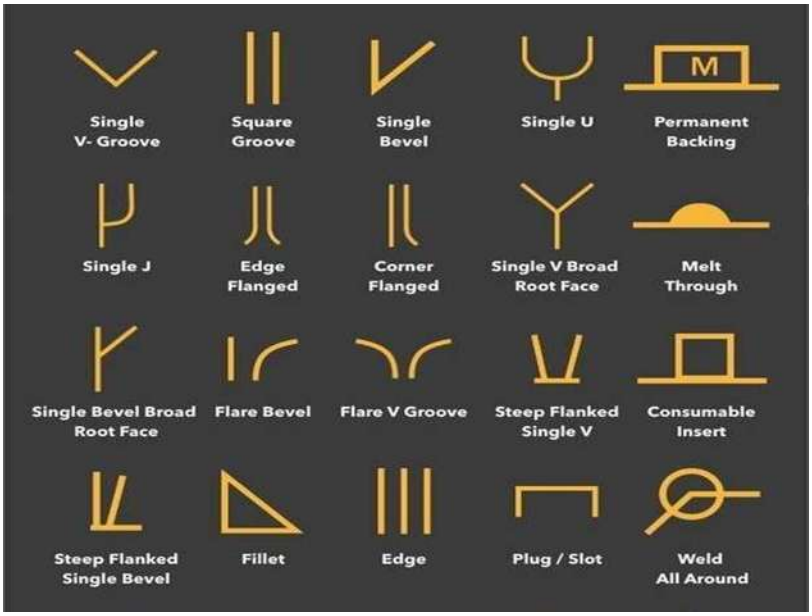
- **Dimensioning symbols:** These symbols are used in technical drawings to indicate the size, measurements, and tolerance of objects, providing essential information for manufacturing and construction.



Geometric tolerance symbols: These symbols specify the allowable variations in the shape, size, and orientation of features in engineering and manufacturing, ensuring that parts fit together correctly

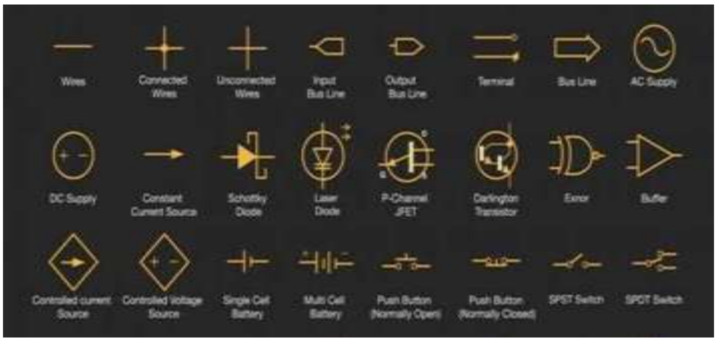
Type of Tolerance	Geometric Characteristics	Symbol
Form	STRAIGHTNESS	⏤
	FLATNESS	⏥
	CIRCULARITY	○
	CYLINDRICITY	⌭
Profile	PROFILE OF A LINE	⌒
	PROFILE OF A SURFACE	⌓
Orientation	ANGULARITY	∠
	PERPENDICULARITY	⊥
	PARALLELISM	//
Location	POSITION	⌖
	CONCENTRICITY	◎
	SYMMETRY	⌯

Welding symbols: They are used in welding blueprints to represent the type of weld jo int, its dimensions, and other welding-related information to guide welders and inspector



- **Material and finish symbols**: These symbols in manufacturing and design indicate the type of material, surface finish, or treatment required for a particular part or component.

- **Electrical and electronic symbols:** These symbols are used in electrical and electronic schematics to represent components, connections, and devices, helping engineers and electricians understand and design circuits.



- **Piping and instrumentation diagram (P&ID) symbols:**

These symbols are used in In the process industry to represent piping, instruments, and control systems, facilitating the design and operation of industrial processes

Mechanical symbols: These symbols are used in mechanical engineering and design to represent components, fasteners, and mechanisms, aiding in the creation of technical drawings and designs.

Points to Remember

- While drawing it very important to know common types of engineering drawing symbols include dimensioning symbols, geometric tolerance symbols, welding symbols, material and finish symbols, electrical and electronic symbols, piping and instrumentation diagram (P&ID) symbols and Mechanical symbols

Application of learning 1.3.

Attend the trip organized by your trainer to local industries and take schematic of any desiredmanufacturing machine then show him common types of engineering drawing symbols (Dimensioning symbols, Geometric tolerance symbols, Material and finish symbols, Welding symbols, Electrical and electronic symbols) found in schematic.

Indicative content 2.5: Drawing Engineering Drawing Symbols

Duration: 1 hr

Practical Activity 2.5.1: Draw engineering drawing symbols

Task:

Referring to the previous activity 2.4.1. you are requested to draw engineering drawingsymbols individually.

1: Select drawing tools, instrument and equipment

2: Present out the procedures of drawing the symbols.

3: Referring to the procedure provided on step 2, draw engineering drawing symbols.

4: Present your work to the trainer

5: Read key reading 2.5.1.

6: Perform the task provided in application of learning 25.1.

Key readings 2.5.1: Draw engineering drawing symbols

- **Procedures of drawing engineering drawing symbols**

Understand Dimensioning Standards: Before creating dimensioning symbols, familiarize yourself with the specific dimensioning standards and conventions used in your field. Standards like ASME Y14.5 or ISO 1101 provide guidelines for dimensioning.

Select the Correct Dimensioning Tool: In traditional hand-drawn technical drawings, use apencil or fine-tipped pen for clarity. For digital drawings, use drafting software or CAD tools,which often have dimensioning functions.

Choose the Type of Dimension Line: Dimension lines are used to indicate the extent of a dimension. Decide whether you need a horizontal, vertical, or aligned dimension line basedon the feature you are dimensioning.

Start with a Baseline: Draw the dimension line as a horizontal or vertical line, depending on the orientation of the feature being dimensioned.

Add Dimension Numerals: Place the dimension number (the numerical value) on or abovethe dimension line, and ensure it is aligned with the dimension line. Use clear and legible numerals.

Specify Tolerances: If tolerances are required, include them as necessary. Typically, tolerances are indicated as "+/-" followed by the tolerance value (e.g., +/- 0.01).
Include Extension Lines: Extension lines are used to indicate the specific points or features being dimensioned. Draw extension lines from the feature to the dimension line, ensuring they do not touch the object.

Place Arrowheads: Place arrowheads at the ends of the dimension line, pointing to the feature being dimensioned. The arrowheads indicate the limits of the dimension.
Label the Dimension: Label the dimension with the appropriate abbreviation or unit (e.g., mm for millimetres or in for inches). Ensure the unit is clearly identified.

Points to Remember

Better to know all common types engineering drawing symbols include: material symbols, fastener symbols, electrical symbols, welding symbols, geometric dimensioning, tolerancing symbols, section lines and centerline

Application of learning2.5.

In trip planned by your trainer to local industries you are requested to draw one machine withrespect to its engineering drawing symbols (Dimensioning symbols, Geometric tolerance symbols, Material and finish symbols, Welding symbols, Electrical and electronic symbols etc….) found in place.

Indicative content 2.6: Description of Solid Object

Duration: 2.5 hrs

Theoretical Activity 2.61: Description of solid object

Tasks:

1. You are requested to answer the following questions asked by your trainer that concernson solid object used in technical drawing.

I. Define the term "solid object" as used in technical drawing?
II. Describe the types of solid object used in technical?

2: Provide the answer of asked questions and write them on papers/flip charts or

black board.3: Present the findings/answers in whole class.

4: Pay attention to the trainer's clarification and ask questions where necessary.

5: Read the key readings 2.6.1.

Key readings 1.1.1.: Description of

- **Definition of Solid**

A solid is an object having three dimensions, which are the length, breadth and height or thickness. It is bounded by planes faces or curved surfaces or a combination of both.

- **Types of solid**

Solids are classified vastly but the two most prominent among them are mentioned below:

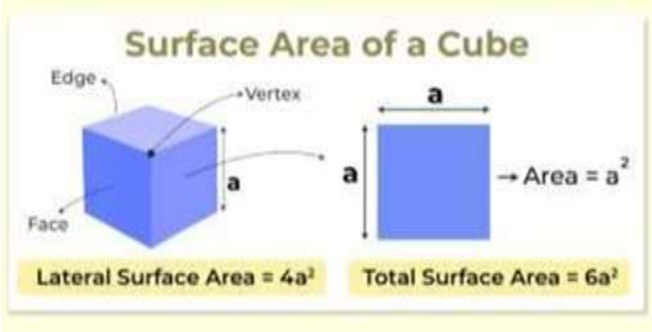
- Polyhedron
- Solids of revolution
- Polyhedron

A three-dimensional shape with flat polygonal faces, straight edges, and sharp corners or vertices is called a polyhedron.
Common examples are: cubes, prisms, pyramids. However, cones, and spheres are not polyhedrons don't have polygonal faces. The plural of a polyhedron is called polyhedron orpolyhedrons. In a regular polyhedron all, the faces are of the same shape and size

The common type of regular polyhedron

- **Cube or Hexahedron**

A cube or hexahedron is surrounded by six equal square faces. it has six faces, twelve edgesand eight vertices.



- **Prism**

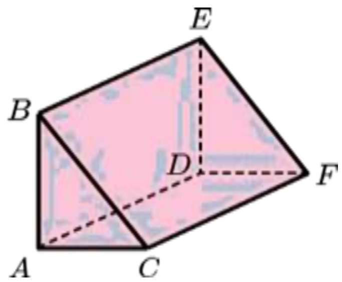
A prism is a solid contained by plain surfaces, having two equal and similar faces parallel to each other which are called the ends and the other faces of a parallelograms. The lowerend of a prism is called the bottom face or base and the upper one is defined as the topface.

The axis of the prism is the imaginary straight line joining the centroids of its ends.

Elements of a Prism

A prism can be labeled with its features, which helps characterize them.

- **Edge**: A straight line that connects any two adjacent vertices of a prism is called itsedge.
- **Vertex**: The corners of a prism where any two edges meet are called vertices.
- **Face**: It is a closed, flat surface surrounded by vertices and edges.



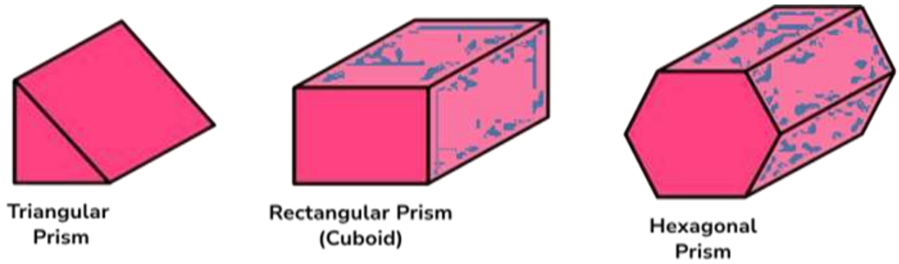
Cross Sections of a Prism

The cross section of a prism is the shape obtained when a plane intersects a prism along itsaxis. Based on the shape of the base, prisms can be categorized into the following:

- Triangular prism: The base of the prism is triangular in shape.
- Hexagonal prism: It is a prism with a base in the shape of a hexagon.

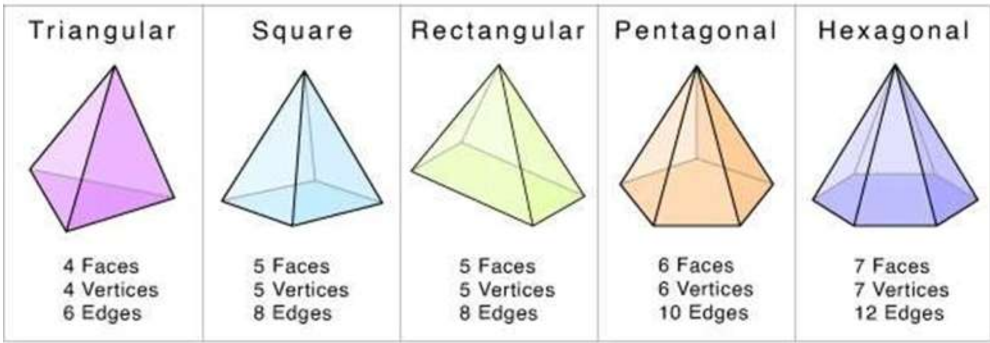
Square prism: A prism that has a base in the shape of a square. You may have seena square prism with a different name, it is also called a cube

- Pentagonal prism: The base of the prism is shaped like a pentagon
- Rectangular prism: A prism that has bases in the shape of a rectangle. A rectangularr prism is also known as a cuboid



i. Pyramids

A pyramid is defined as a three-dimensional structure encompassing a polygon as its base.A pyramid is formed by connecting the bases to an apex. A pyramid is named after the shapeof its base, such as square pyramid, triangular pyramid, pentagonal pyramid, hexagonal pyramid etc.



Properties of Triangular Pyramid

- The triangular pyramid has 4 faces.
- The 3 side faces of the triangular pyramid are triangles.
- The base is also triangular in shape.
- It has 4 vertices (corner points)
- It has 6 edges

The properties of a square pyramid are:

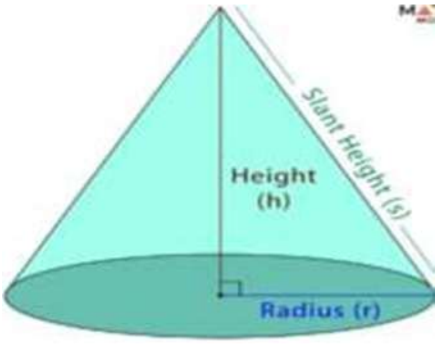
- It has 5 Faces.
- The 4 Side Faces are Triangles.
- The Base is a Square.
- It has 5 Vertices (corner points)
- It has 8 Edges

Solids of revolution

If a plane is rotated about one of its edges, which is kept fixed, a solid is obtained. Such a solid will be symmetrical about its axis (the edge of plane which was rotated) and is called solid of revolution.

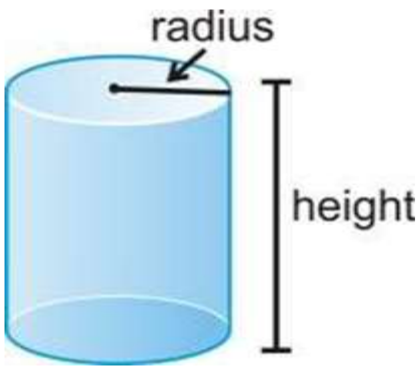
i. Cone

A cone is a solid formed by the revolution of a right-angle triangle about one of its sides which remains fixed. It has a circular base and a vertex. The line joining the centre of the base with the vertex is called axis. The line or hypotenuse of the right-angle triangle whichis rotated around the axis is called the generator of the solid.



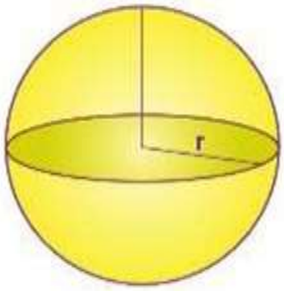
i. Cylinder

A cylinder is a solid formed by the revolution of a rectangle about one of its side which remains fixed. It has two circular faces. The lower end of a cylinder is called the bottomface and upper one is called the top face the edge which has rotated about the axis is called the generator.



ii. Sphere

A sphere is a solid formed by the revolution of a semi-circular about its diameter whichremains fixed. The midpoint of the diameter is also the center of sphere.



Points to Remember

- Better to know that a solid is an object having three dimensions, which are the length,width and height or thickness. It is bounded by planes faces or curved surfaces or a combination of both. Polyhedron and Solids of revolution are types of solid

Application of learning 2.6.

You are requested to attend study visit to the market which is around your school andpurchase solid object to be used in school as didactic materials.

Indicative content 2.7: Drawing Solid Objects used in Technical Drawing

Duration: 2 hrs

Theoretical Activity 2.7.1: Description of solid object

Tasks:

Referring to the previous activity 2.6.1. you are asked to draw solid object Individually. Thistask should be done individually.

1: Select drawing tools, instrument and equipment related with the task 2: Present out the procedure of drawing solid object.

3: Referring to the procedure provided on step 2, draw solid object.

4: Present your work to the trainer

5: Read key reading 2.7.1.

6: Perform the task provided in application of learning 2.7.1.

Key readings 2.7.1.: Draw solid object used in technical drawing

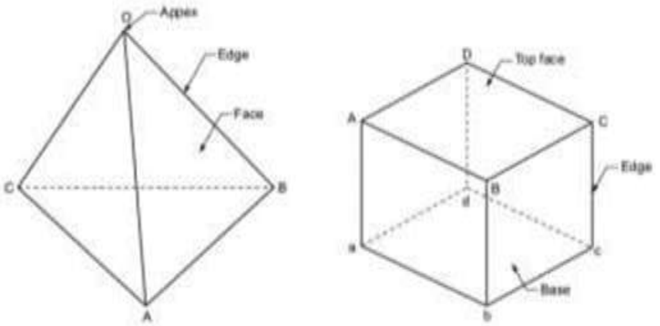
- **Regular Polyhedrons**

i. Cube or Hexahedron

A cube or hexahedron is surrounded by six equal square faces. It has six faces, twelve edges and eight vertices.

Steps of drawing a cube

- Begin by drawing a square. This square represents the base of the cube.
- Draw lines extending from each corner of the square vertically and meeting at a sin gle point above the square to create the illusion of depth. This is a simplified persp ective representation.
- Connect the corresponding corners of the square with straight lines, forming the si des of the cube.
- To emphasize the three-dimensionality, you can shade the sides or label the vertice s (A, B, C, D, E, F, G, H) to differentiate them.



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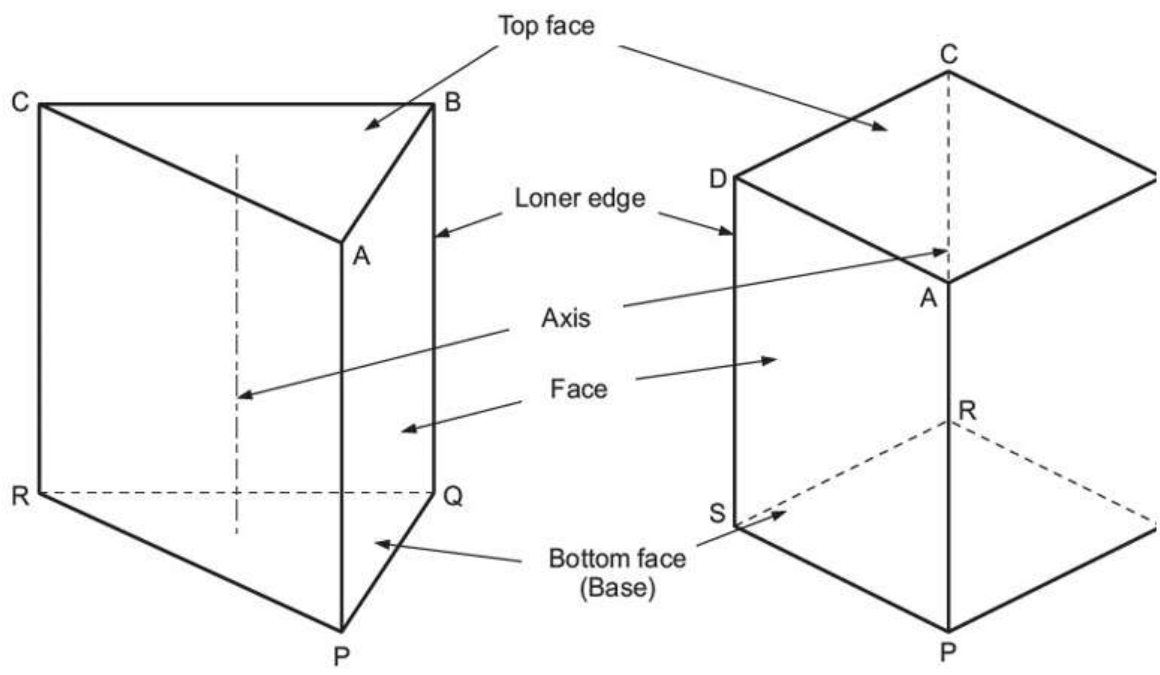
ii. Prism

A prism is a solid shape that is bound on all its sides by plane faces.

Steps of drawing a prism

- Begin by drawing a rectangle, which represents the base of the prism.
- Similar to the cube, draw lines extending from each corner of the rectangle to a sin gle point above it, creating the impression of depth.
- Connect the corresponding corners of the rectangle to create the sides of the prism .
- Draw horizontal lines to connect the top and bottom of the sides, completing the p rism.

As with the cube, you can shade the sides or label the vertices to make the drawing more informative

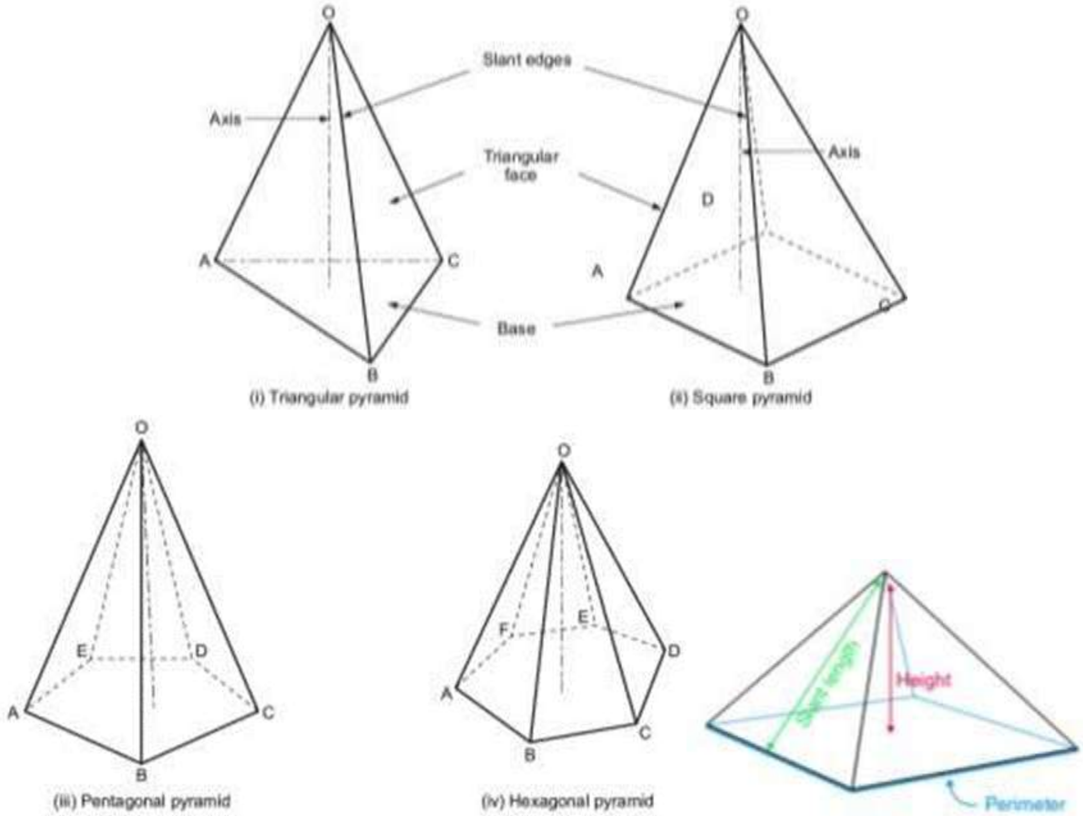


(i) Triangular prism (ii) Square prism

1. **Pyramids**

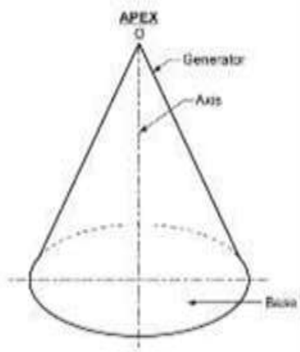
A pyramid is a solid, contained by plane figures having a base and a number of triangular faces meeting at a point, called vertex.

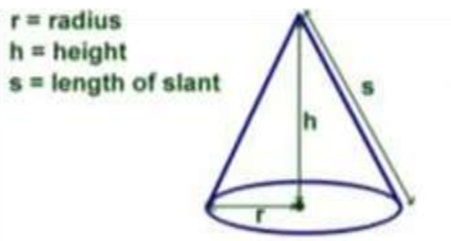
Steps of drawing pyramid



- **Solids of revolution**

  i. **Cone**





Terms of a Cone

In order to calculate the surface area and volume of a cone we first need to understand a few terms:

Radius: The radius is the distance from the centre to the edge of the circle at the end.

Height: The height is the distance from the centre of the circle to the tip of the cone.

Slant: The slant is the length from the edge of the circle to the tip of the cone.

Pi: Pi is a special number used with circles. We will use an abbreviated version where Pi =

3.14. We also use the symbol π to refer to the number pi in formulas.

Steps of drawing cone

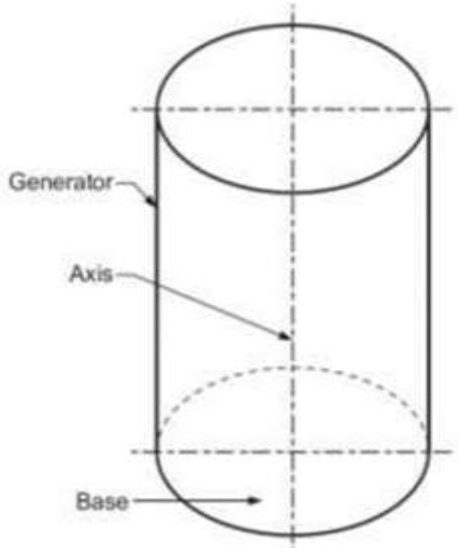
- Draw a circle to represent the base of the cone.
- Draw curved lines extending from the edge of the circle and converging at a single point above the centre of the circle. This point is the apex of the cone.
- Connect the apex with the edge of the circle using straight lines to form the slant h eight of the cone.
- Close the sides of the cone by connecting the apex with the circle, creating a three- dimensional cone.
- To enhance the conical shape, you can add shading or label the apex and the base.

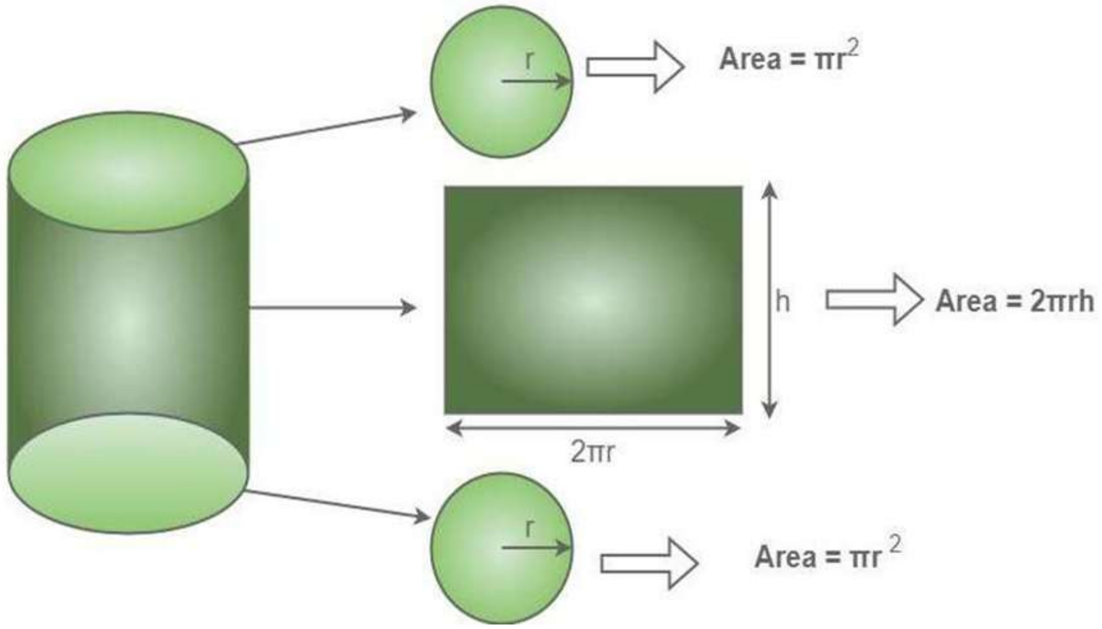
ii. Cylinder

A cylinder has two (2) flat surfaces which are circles and a curved surface that opens up as a rectangle.

Steps of drawing of cylinder

- Draw two circles, one above the other. These circles represent the top and bottom faces of the cylinder.
- Draw straight vertical lines connecting the corresponding points on the top and bot tom circles. These lines represent the sides of the cylinder.
- To give depth to the cylinder, you can add shading or label the top and bottom faces.

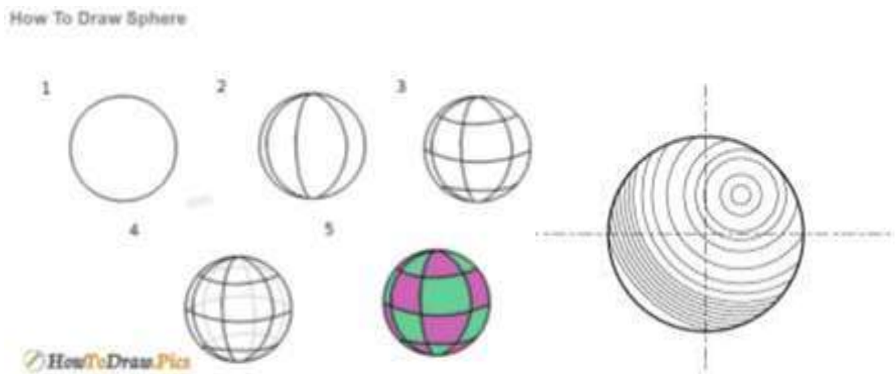




iii. **Sphere Steps of drawing sphere**

- Begin by drawing a circle. This circle represents the base of the sphere.
- Draw curved lines extending from the edge of the circle, converging at a point above the center of the circle. This point represents the top of the sphere.
- Connect the top point with the circle, creating a three-dimensional sphere. Ensure the curves are smooth and symmetrical.

To emphasize the spherical shape, you can add shading or label the central point



Points to Remember

- You have to know all types of solid object used in technical drawing
- Regular Polyhedron (cube, Prism, pyramid)
- Solids of revolution (sphere, cylinder, cone)

Application of learning 2.6.

Attend the trip planned by your trainer to a local drawing workplace around your school anddraw solid object which are then submit the works.

Indicative content 2.8: Drawing Lettering used in Technical Drawing

Duration: 2.5 hrs

Theoretical Activity 2.8.1: Description of solid object

Tasks:

1: In groups, you are requested to answer the following questions:

I. What do you understand the term "lettering" used in technical drawing?

I. What are the features of lettering in drawing?

II. Enumerate the classifications of lettering in technical?

III. List out and explain the Style of freehand lettering in technical drawing2: Participate in grouping

3: Provide the answer of asked questions and write them on papers.

4: Present the findings/answers in whole class

5: Pay attention to the trainer's clarification and ask questions where necessary.

6: Read the key readings 2.8.1.

Key readings 2.8.1.: Description of drawing Lettering used in technical drawing.

Description of drawing Lettering What is lettering?

Lettering: Refers to the process of adding text, labels, and annotations to the drawing to provide information, clarify details, and make the drawing more understandable.

The writing of alphabets and numerals such as A, B, C, D…………………… Z and 1, 2, 3……………9, 0 respectively is called Lettering. The main requirement of lettering on engineering drawing are legibility, uniformity, ease and rapidity in execution.

Characteristics of good lettering

- ✓ **Legibility:** Good lettering is clear and easy to read
- ✓ **Consistency:** Consistency in letter size, style, and spacing is essential.
- ✓ **Alignment:** Proper alignment is crucial. Letters should be aligned horizontally and vertically, and they should follow a clear baseline.
- ✓ **Balance:** Good lettering exhibits a sense of balance.
- ✓ **Creativity:** While consistency is vital, good lettering also allows for creative

expression. Depending on the context, lettering can be decorative.

- ✓ **Attention to Detail:** The smallest details matter. Good lettering pays attention to th e subtleties of letterforms, such as the shape of serifs, terminals, and the overall aesthetics of each letter
- ✓ **Spacing**: Proper spacing between letters (kerning) and words (tracking) is essential. Avoid letters being too cramped together or too far apart, which can affect legibilityand aesthetics.
- ✓ **Purposeful:** Good lettering serves a purpose and contributes to the overall design ormessage. It should enhance and complement the content rather than detract from it.
- ✓ **Suitability**: The choice of lettering style should be suitable for the content or message

e. For example, a technical drawing might use a clean and simple sans-serif font for l abels, while a restaurant menu might opt for a decorative script for a more inviting f eel.

Classification of lettering

The lettering, in general, is classified in two categories: -

i. **Gothic Lettering.**

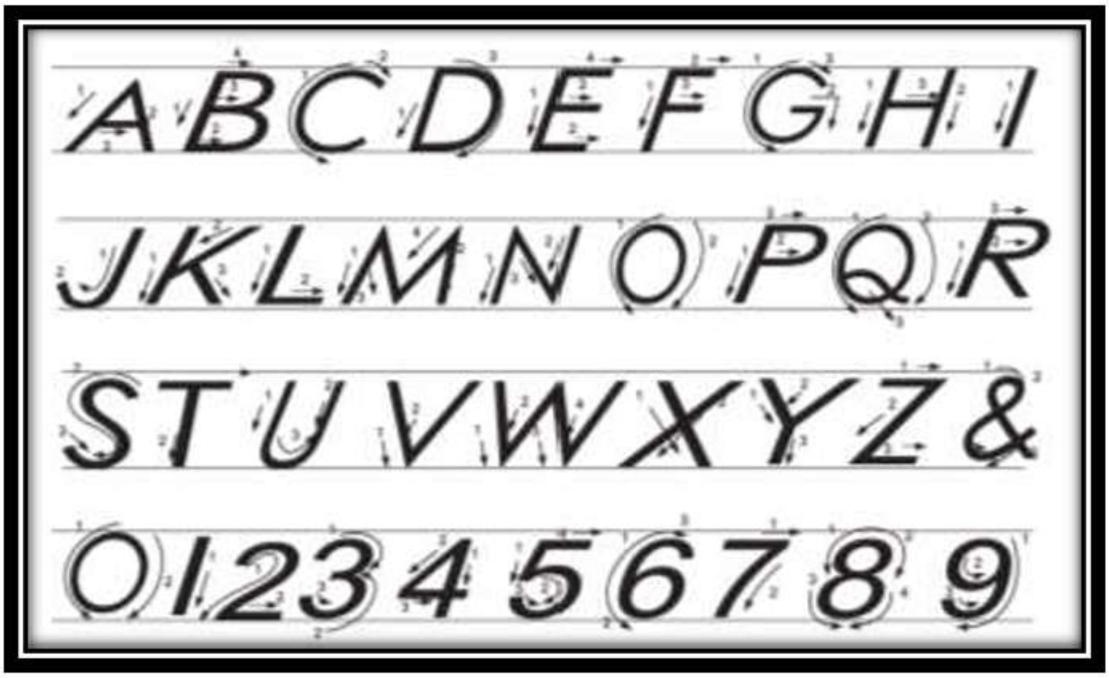
- ✓ Lettering having all the alphabets or numerals of uniform thickness is called Gothic Lettering.
- ✓ Vertical Gothic Lettering
- ✓ Italic or Inclined Gothic Lettering.
- ✓ Single Stroke Vertical Gothic Lettering

These are vertical letter having thickness of each line of alphabet or numerals etc. Same as the single stroke of a pencil.

Since Stroke means that the letter is written with one or more stems or curves and each made with single stroke. ABCDEFGHIJKLMNOPQRSTUVWXYZ and 0123456789.

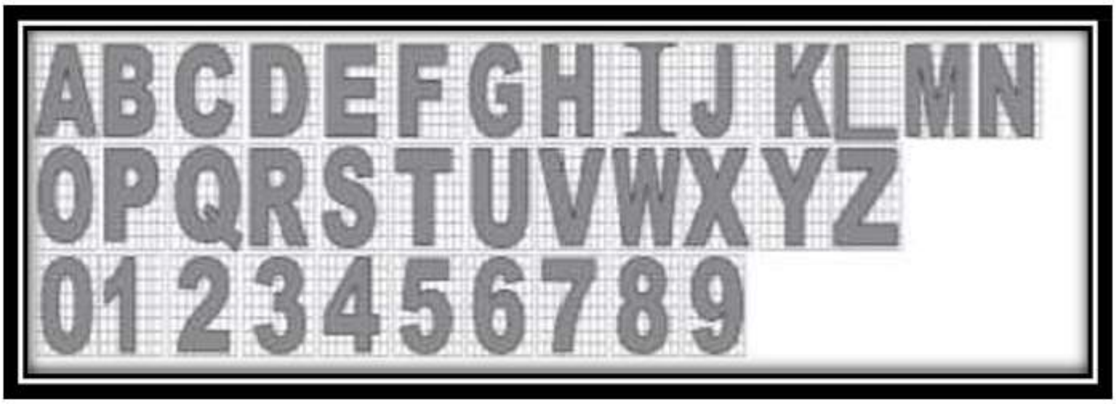
Single Stroke Inclined Gothic Lettering

These are single stroke letter inclined at 75' to the Horizontal. The inclined letters and numerals are written in an inclination of 75° from right towards left. H grade pencil is preferred for free hand inclined lettering and numerals. The height of letters and numerals are same as we described in single stroke vertical letters. The same ratio of height to width and spacing are used in single stroke vertical letters



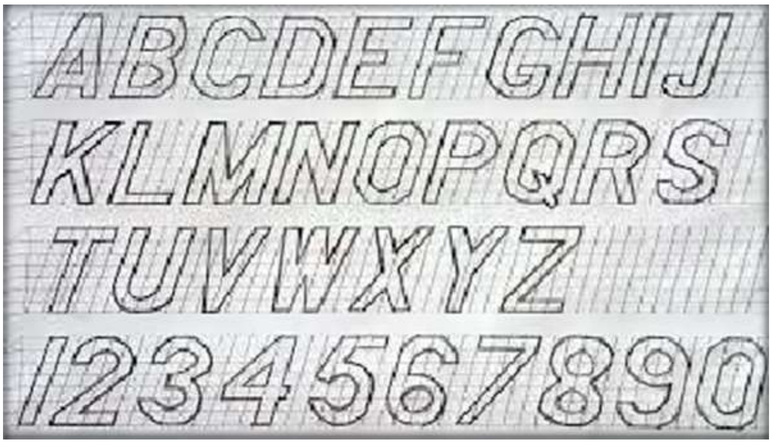
Double Stroke Lettering

Double stroke: The lettering in which the alphabets are written by double stroke of the pencil or pen with uniform spacing in between strokes is called double – stroke. In Double Stroke Lettering the line width is greater than that of Single Stroke Lettering



Double Stroke Inclined Gothic Lettering

Double stroke gothic when inclined at an angle of 75' is called Double Stroke



The lettering in which all the letters are formed by thick and thin elements is called Roman Lettering. It may be vertical or inclined or inclined. It can be written with a chisel pointed Pencil or D-3 type Speed Ball Pen.

The following are the rule, which is to be maintained while lettering –

- The line thickness of the letter should appear in such a way, as it is obtained in one stroke of the pencil with uniform pressure, but not so much that it cut grooves in the drawing sheet.
- Words should be placed one letter apart.
- The letters should be spaced in such a way that the area between letters is almost equal.
- Letters and numerals should not touch each other and should not touch the lines.
- In lettering, the horizontal lines should be drawn from left to right and inclined or v ertical lines are drawn from top to bottom.
- After a few words are made, the pencil point will become dull. To maintain the uniform lettering the pencil point should be maintained well sharpened.
- While lettering, the pencil should be continuously rotated in the finger.
- Lettering in drawing must be of standard height. The standard heights o f letters used are 3.5mm, 5mm, 7mm and 10mm.
- Generally, the height to width ratio of letters and numerals are approxi mately 5:3.
- Different sizes of letters are used for different purposes: Main Title - 7 or 10mm
- Sub-title - 5 or 7mm
- Others - 3.5 or 5mm.

Spacing of letters:

- The spacing means the distance, which is to be left between the two adjacent letters in all types of lettering.

Note:

- The space between each word should be kept equal to height of letter
- The space between the two lines should be left equal to twice the height of letter.
- The space between the two lines should be kept not less than half or more than on e and a half times the height of letter

Freehand lettering

- Freehand lettering is done without the assistance of tools, most freehand lettering is done in a "gothic" style, i.e., with a constant line thickness; either "straight gothic", with vertical strokes perpendicular to the baseline, or "inclined gothic", with vertical strokes at about 75°.

Practical Activity2.8.2: Create drawing lettering

Task:

1.Referring to the previous activity 2.8.1. you are requested to create the drawing lettering.

2: Select drawing tools, instrument and equipment related with the task
3: Present out the procedure of creating drawing lettering.
4: Referring to the procedure provided on step 2, creating drawing lettering
.5: Present your work to the trainer
6: Read key reading 2.8.2.
7: Perform the task provided in application of learning 2.8.2.

Points to Remember

Better to know all process of creating drawing lettering include.

Application of learning 1.2.

Make a trip organized by your trainer to a local building village around your school and type

" **WELCOME IN OUR VILLAGE** " to the post sign

which are there.

Indicative content 2.9: Application of Drawing Dimensions

Duration: 2.5 hrs

Theoretical Activity 2.9.1: Description of drawing dimensions

Tasks:

1: You are requested to answer the following questions reflecting on dimensioning.

I. Differentiate the types of dimensions used in technical drawing?
II. Explain the methods of dimensioning in technical drawing?
III. Give out the elements of dimensioning in technical drawing?
IV. What are the rules and functions of dimensioning in technical drawing?2: Participate in grouping

3: Provide the answer of asked questions and write them on papers

.4: Present the findings/answers in whole class

5: Pay attention to the trainer's clarification and ask questions where necessary.

6: Read the key readings 2.9.1.

Key readings 2.9.1.1.: Description of drawing dimensions

- **Definition of Dimensions**

Dimensions: Is a numerical value expressed in appropriate units of measurement and used to define the size, location, orientation, form or other geometric characteristics of a part. In other words, indicating on a drawing, the sizes of the object and the other details essential for its construction and function using lines, numerals, symbols, notes, etc., is called dimensioning, Therefore, an engineering drawing, illustrating the shape, size and relevant details most essential for the construction of the object.

The purpose of dimensioning is to provide a clear and complete description of an object.

A complete set of dimensions will permit only one interpretation needed to construct the part.

Dimensioning should follow these guidelines.

- **Accuracy:** correct values must be given.

- **Clearness:** dimensions must be placed in appropriate positions.
- **Completeness:** nothing must be left out, and nothing duplicated
- **Readability:** the appropriate line quality must be used for legibility.

- **Types of dimensions**

Dimensions are classified into the following types:

i. Functional dimensions.
ii. Non-functional dimensions.
iii. Auxiliary dimensions.

i. Functional dimensions (F)

provide specific measurements and information about a product, component, or system to ensure that it functions correctly and meets its intended purpose. Functional dimensions are used for production and inspection purposes. They should always be tolerance.

ii. Non-functional dimensions (NF)

Are those dimensions which are used for production purposes but which do not directly affect the function or working of a product.

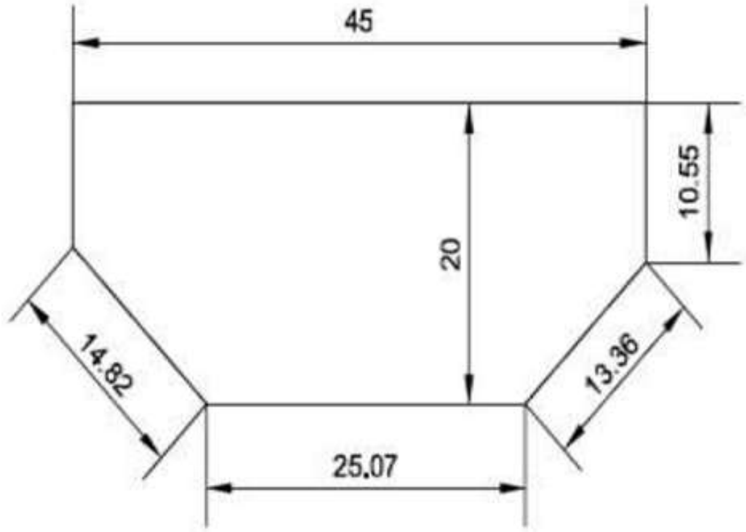
iii. Auxiliary dimensions or reference dimension (AUX or REF)

Auxiliary dimensions, also known as reference dimensions, are a category of dimensions used in engineering and technical drawings to provide additional information, aid in the understanding of the design, and facilitate the inspection and assembly of a product.

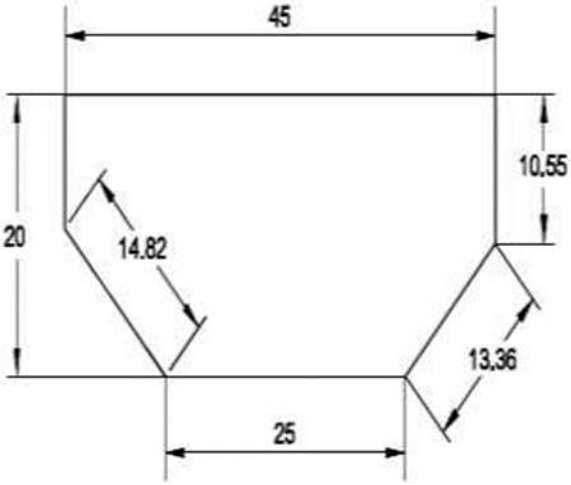
- **Method of dimensioning**

The dimensions should be placed in such a manner that relevant features of the object Should be visible more clearly. There are two recommended methods of placing dimensions:

i. **ALIGNED METHOD:** Place the numerals for the dimension values so that they are readable from the bottom and right sides of the drawing. An aligned expression is placed along and in the direction of the dimension line.



UNIDIRECTIONAL METHOD: The system in which the dimensions are read always from bottom to the top irrespective of direction of dimension line.

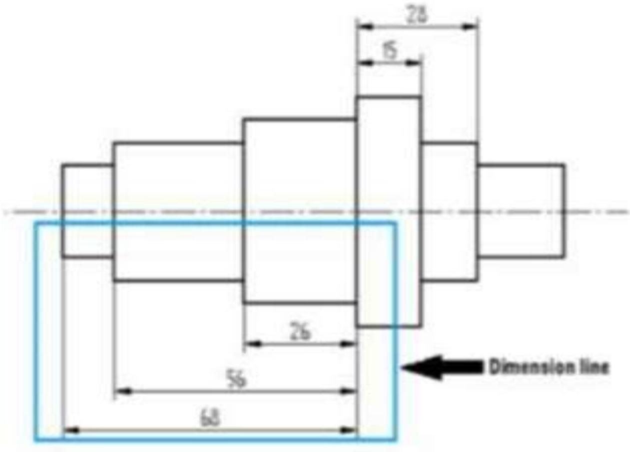


Unidirectional method dimensioning

- **Elements of Dimensioning**

i. **Dimension Line:**

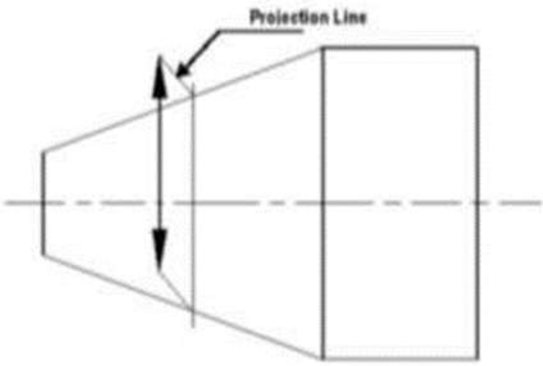
Dimension line is a continuous thin line. It is indicated by arrowheads; it is drawn parallel tothe surface whose length must be indicated. This line should be at a distance from 10 mm to 15 mm from the object line.



Dimension line

i. A projection line or extension line

It is a thin line. It is drawn perpendicular to the surface which is to be dimensioned. The projection line slightly extends than the dimension line. There should be a distance of 1 mm between them and the object line.



Projection line

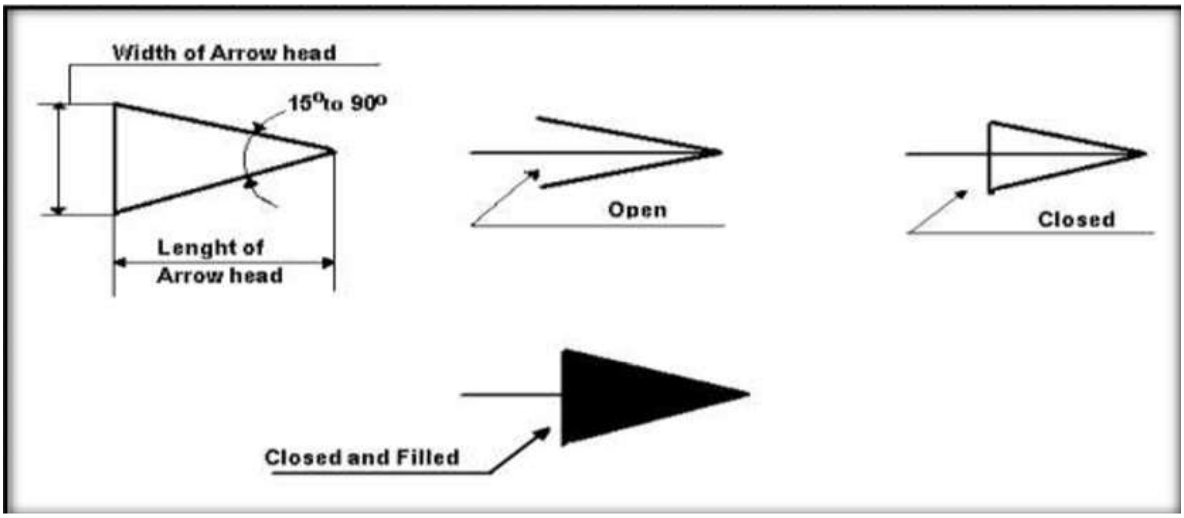
i. A construction lines

It is a thin line drawn to indicate the dimension line. The construction line is extended slightly beyond the point intersection.

Centre Line: Such a line is used to represent the centre of a cylindrical part of a drawing. For example, a hole shaft, etc.

ii. Arrowheads

Are used to indicate the dimension line. Usually, the arrowhead must include angles of a minimum of 15°. The Arrowhead may be open or close or closed and filled.



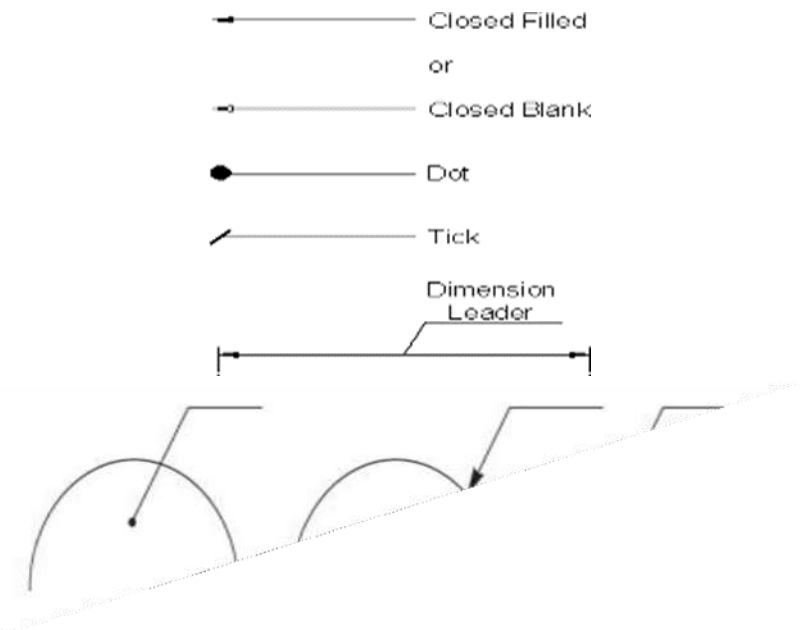
Leader or Pointer Lines:

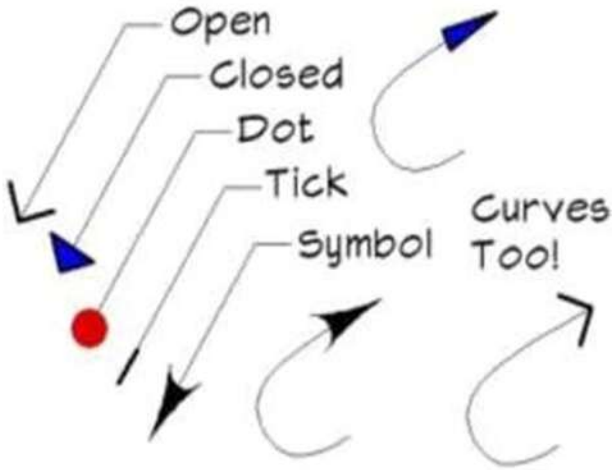
These are thin continuous lines drawn from a dimension figure to the feature to which it refers. Leader line is drawn may be 30° or 60° to the bottom of dimensions.

Termination of Leader Lines.

A leader is a line referring to a feature (dimension, object, outline, etc.). Leader lines should terminate:

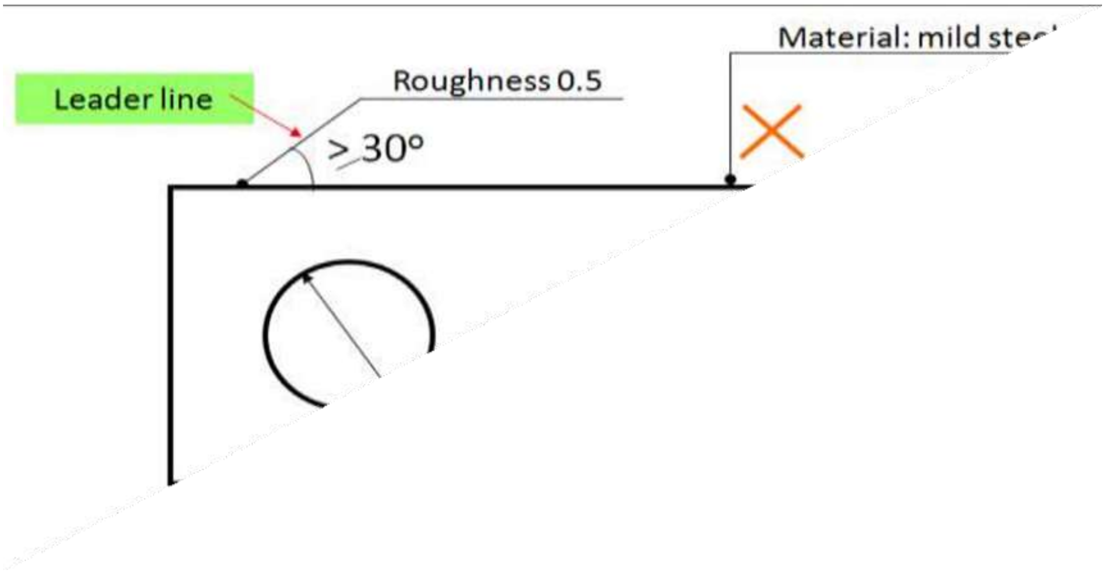
- With a dot, if they end within the outlines of an object,
- With an arrow head, if they end on the outline of an object,
- Without dot or arrow head, if they end on a dimension line





vi. Leader lines and notes

Leader (or pointer) line – Thin continuous line connecting a note or dimension figure with the feature to which it applies. One end of the leader terminates in an arrowhead or dot. The arrowhead touches the outline while the dot is placed within the object or on the outline. The other end of a leader is terminated in a horizontal line underlining the note.



Leader line

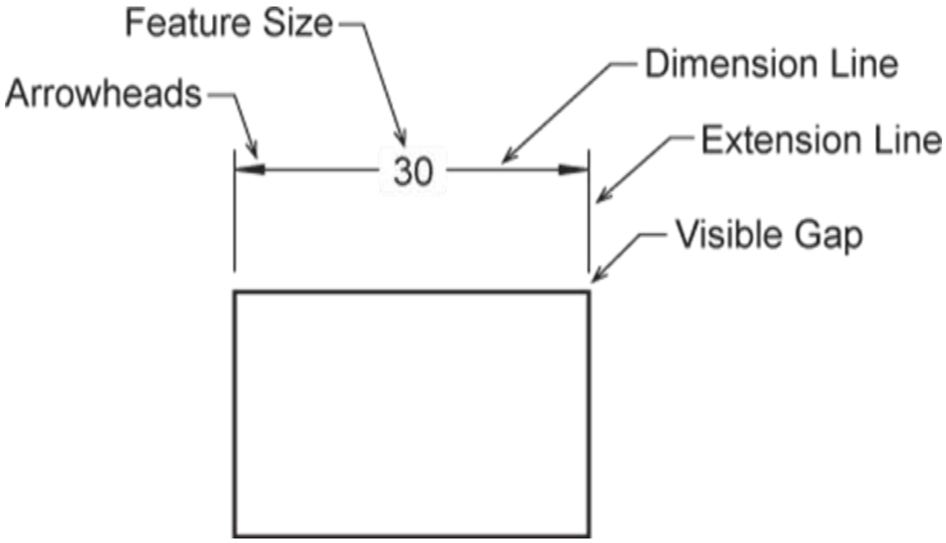
Rules for leader lines

- A leader line is never drawn horizontal, vertical or curved
- It is drawn at an angle not less than 30o to the line that it touches
- When pointing to a circle or arc, it is drawn radially

vi. **Dimension Figure/ Numbers**

After the completion of any geometric shape of an object, the writing of its size is desired. Numbers are used for this purpose. The height of the number is kept 3 mm. These are drawnmay be vertical or inclined to indicate the height of the dimension figure.

The dimension unit is millimetre. The unit of the dimension is omitted while writing the dimension fig. and a footnote stating "ALL DIMENSIONS ARE IN MM" is written at the prominent place on the drawing sheet. This is drawn with 2H or 4H Pencil



Dimension Figure/ Numbers

vii. Methods (ways) of arranging dimensions

The arrangement of dimensions **(**Dimensioning techniques**)** on a drawing must indicateclearly the design purpose.

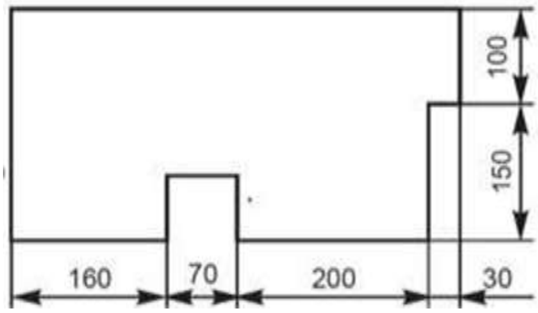
Keep dimensions off the part to be dimensioned where possible.

Arrange extension lines so the larger dimensions are outside of the smallerdimensions.

Stagger the dimension value labels to ensure they are clearlydefined.

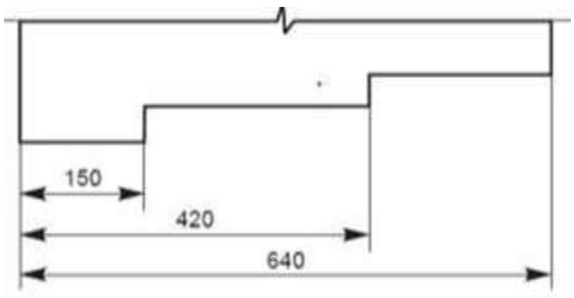
The following are the ways of arranging the dimensions.

. **Chain dimensions:** Chains of single dimensions should be used only where the possible accumulation of tolerances does not endanger the functional requirement of the part.



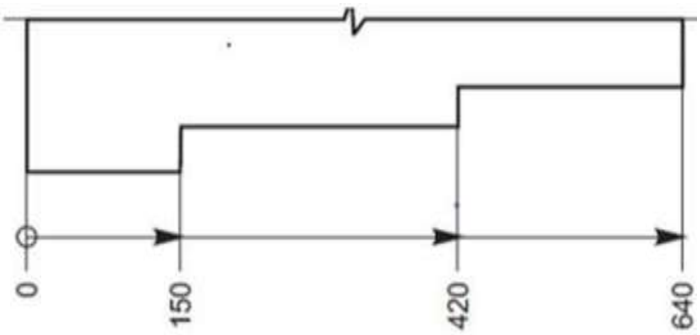
Chain dimensions

a. **Parallel dimensions:** In parallel dimensioning, a number of dimension lines, parallel to one another and spaced-out are used. This method is used where a number of dimensions have a common datum feature (Fig. a). (Parallel dimensioning consists of several dimensions originating from one projection line.)

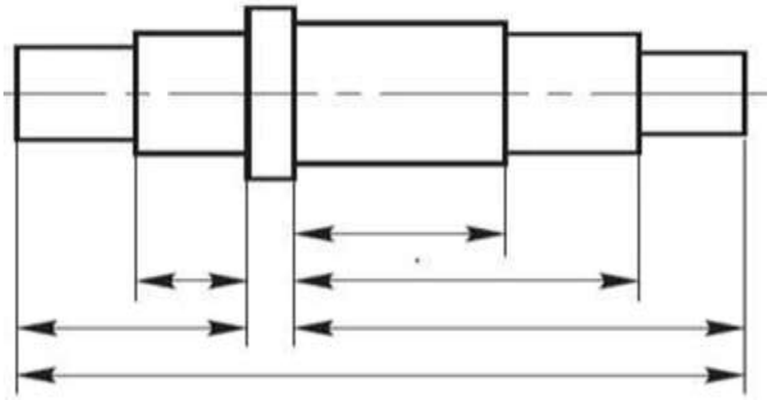


Parallel dimensions

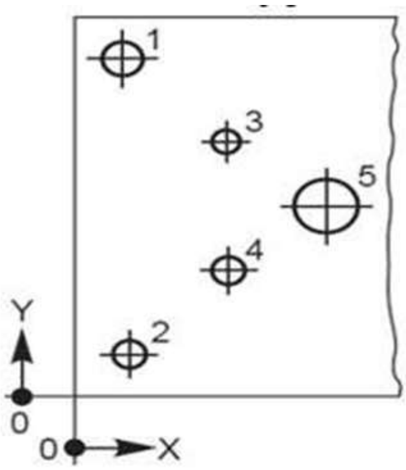
a. **Super –imposed running dimensions:** These are simplified parallel dimensions and may be used where there are space limitations.



a. **Combined dimensions:** These are the result of simultaneous use of chain and parallel dimensions



b. **Co-ordinate dimensions:** The sizes of the holes and their co-ordinates may be indicated directly on the drawing; or they may be conveniently presented in a tabular form,as shown below



	X	Y	ϕ
1	20	160	15.5
2	20	20	13.5
3	60	120	11
4	60	60	13.5
5	100	90	26
6			
7			
8			
9			
10			

c. **Dimensioning Small Features**: When dimensioning small features, placing the dimen sion arrow between projection lines may create a drawing which is difficult to read. In order to clarify dimensions on small features any of the above methods can be use d.

vii. Special indications

Diameters: Diameters should be dimensioned on the most appropriate view to ensure clarity. All dimensions of circles are preceded by the symbol.

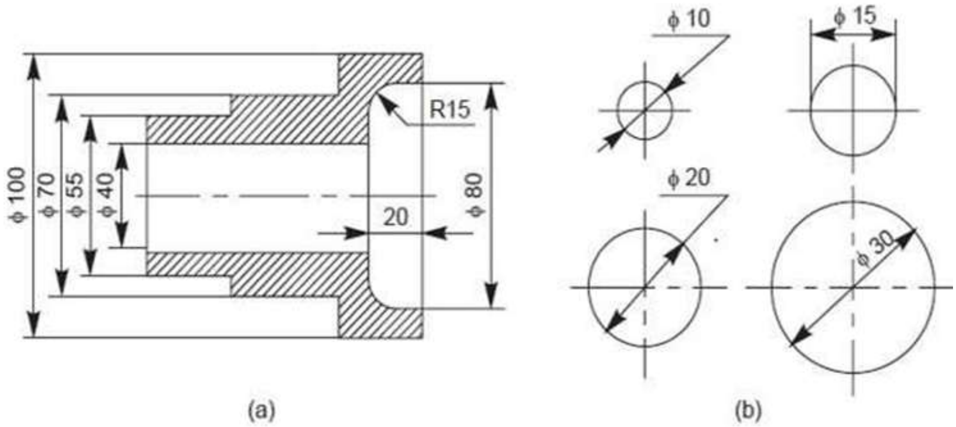
There are several conventions used for dimensioning circles:

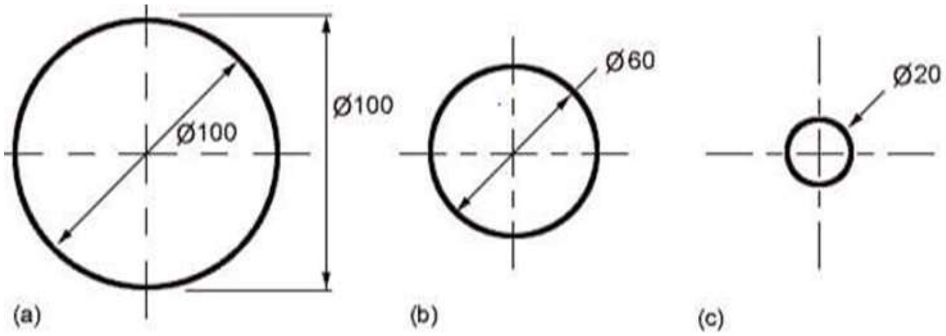
- Shows two common methods of dimensioning a circle. One method dimensions th e circle between two lines projected from two diametrically opposite points. The second method dimensions the circle internally.
- Is used when the circle is too small for the dimension to be easily read if it

was placed inside the circle. A leader line is used to display the dimension.

- The final method is to dimension the circle from outside the circle using an arrow which points directly towards the centre of the circle. The dimension value should be the next figure shows the method of dimensioning diameters.

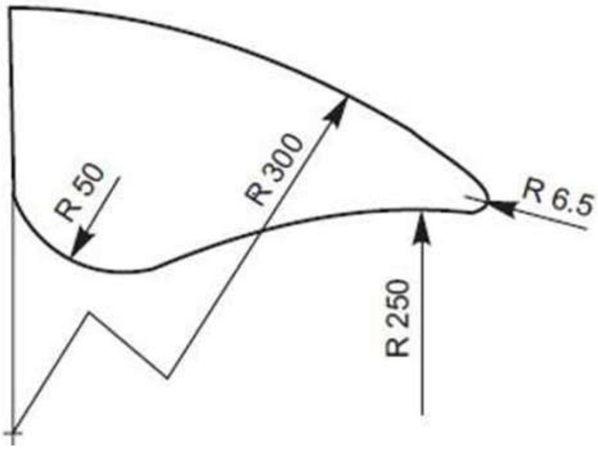
Dimensioning of diameter





ix. Chords, Arcs, Angles and Radius

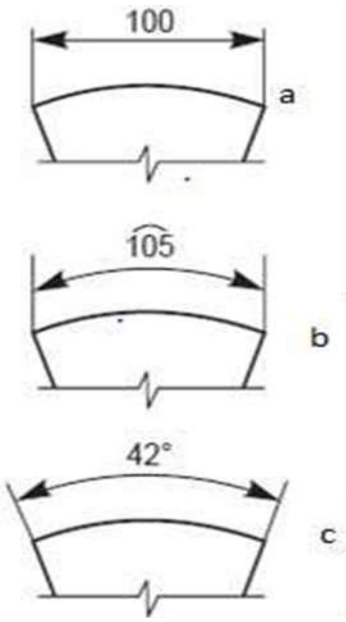
The dimensioning of chords, arcs and angles should be as shown in FIG2.9.13. Where the centre of an arc falls outside the limits of the space available, the dimension line of the radius should be broken or interrupted according to whether or not it is necessary to locatethe centre

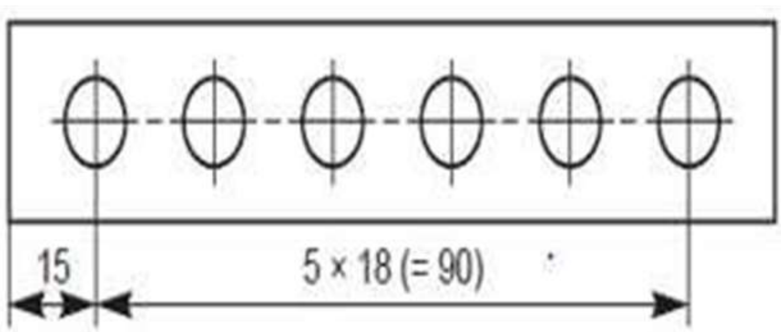


Dimension of radius

Where the size of the radius can be derived from other dimensions, it may be indicated by a radius arrow and the symbol R, without an indication of the value

Equidistant features: Linear spacings with equi-distant features may be dimensioned as shown in figures bellow:

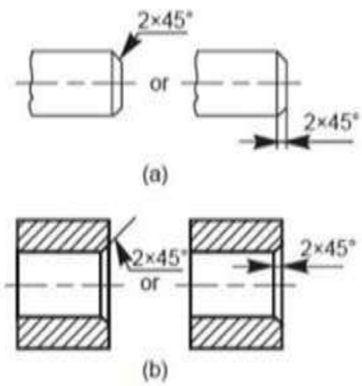


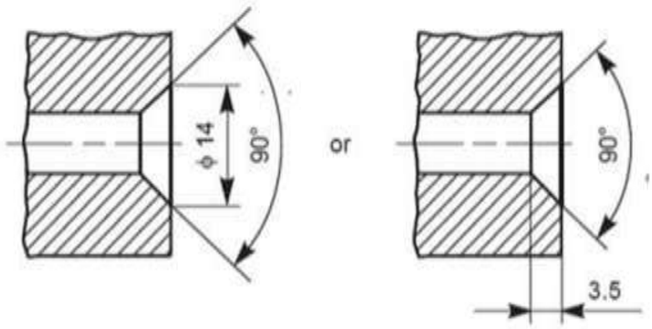


Dimensioning (a)chord, (b)arcs,

Dimensioning of equi-distant

xi. **Chamfers and countersunk:** Chamfers may be dimensioned as





- **Rules for dimensioning**
  1. Dimension should be given on the view which shows the relevant features most clearly
  2. Dimension marked in one view need not be repeated in another view
  3. Dimensions should be placed outside the view
  4. Dimensions should be taken from visible outline rather than from hidden lines
  5. Dimensions should be given from a base line or centre line of a hole or important hole or a finished surface. Dimensioning to a centre line should be avoided, except when the centre line passes through the centre of a hole

Practical Activity 2.9.2: Apply drawing dimension

Task:

1: Referring to the previous activity 2.9.1. you are requested to apply the dimensioning intechnical drawing.
2: Select drawing tools, instrument and equipment related with the task3: Present out the procedure of applying dimensions.

4: Referring to the procedure provided on step 2, apply the dimensions.5: Present your work to the trainer

6: Read key reading 2.9.2.
7: Perform the task provided in application of learning 2.9.2.

Points to Remember

- While drawing you must know all types of dimensions used in technical drawing not onlythat but also methods of dimensioning
- Better to know all elements of dimensioning in technical drawing as well as know rulesand functions of dimensioning.

Application of learning 1.3.

After studying the application of drawing dimension attend the study visit organized by yourtrainer to AGAKIRIRO which located near your school and take dimension of window width and length found in place as well as take short notes on its.

Indicative content 2.10: Application of drawing scale

Duration: 2.5 hrs

Theoretical Activity 2.10.1: Description of drawing scales

Tasks:

1: In groups, you are requested to discuss on the following point about Description of drawingscales by:

I. Explaining the description of drawing Scales.

II. Describing the Sizes of Scales used in technical drawing?

III. Writing and explaining a Scale Representation?2: Engage in the process of group formation.

3: Provide the answer of asked questions by writing them on paper

4: Present your findings to your trainer or classmate

5: Listen to trainer's clarification and ask questions if possible

6: Read the key reading 2.10.1

Key readings 2.10.1.: Description of drawing scales

- **Drawing scales**

The proportion by which we either reduce or increase the actual size of the object on a drawing is known as drawing to scale or simple scale. Scale is the ratio of the linear dimension of an element of an object as represented in the drawing, to the real linear dimension of the same element of the object itself.

Wherever possible, it is desirable to make full size drawings, so as to represent true shapes and sizes. If this is not practicable, the largest possible scale should be used. While drawing very small objects, such as watch components and other similar objects, it is advisable to use enlarging scales.

The scales are either flat or triangular and the material used in their construction may be wood, celluloid, metal, etc.

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

- The scales are used to prepare reduced or enlarged(increase) size drawings

The scales are used to set off dimensions

- The scales are used to measure distances directly

1. **Sizes of scale**

A. Full size scale

The scale in which the actually measurements of the object are drawn to the same sizes on the drawing is known as full size scale. It is written on the stick as under 1:1 – drawing made to actual size

B. Reducing scale

The scale in which the actual measurements of the object are reduced to some proportion is known as reducing scale.

(e.g. vehicles, machines, plants, bridges) The standard reducing proportions are:

1:2 – Drawing made to one half of the actual size 1:5 – drawing made to one fifth of the actual size 1:10 – drawing made to one tenth of the actual size

1:20 – drawing made to one twentieth of the actual size 1:50 – drawing made to one-fiftieth of the actual size 1:100 – drawing made to one-hundredth of the actual size

C. Enlarging scale

The scale in which the actual measurements of the object are increased in some proportion is known enlarging scale (e.g. elements of optical industry). The standard proportions are:

- 2:1 – drawing made to twice the actual size
- 5:1 – drawing made to five times the actual size

Recommended scales

The recommended scales for use on technical drawings are given in Table below. The scale and the size of the object in turn, will decide the size of the drawing.

10:1 – drawing made to ten times the actual size.

Table Recommended scales

Category	*Recommended Scales*		
Enlarged scales	50:1	20:1	10:1
	5:1	2:1	
Full size			1:1
Reduced scales	1:2	1:5	1:10
	1:20	1:50	1:100
	1:200	1:500	1:1000
	1:2000	1:5000	1:10000

2. **Scale Representation**

   a. **Representative Fraction (RF)**

The representative fraction is defined as the ratio of the dimension of an element of an object in the drawing to its actual linear dimension of the same element of the object itself

$$R.F. = \frac{\text{Length of an element in the drawing}}{\text{Actual length of the same element}} \quad \text{(in same unit)}$$

Practical Activity 2.10.2: Apply drawing scale used in technical drawing

Task:

Task:

1: Individually, you are requested to apply drawing scale on the object

2: Prepare the appropriate drawing instrument, equipment, and materials

3: Create drawing of an object and apply drawing scale on that drawing4: Present

your work to the trainer.

5: Read the key reading 2.10.2

6: Perform the task provided in application of learning 2.10.2

Key readings 2.10.2.: Scaling process

The scaling process involves changing the size of an object or drawing while maintaining its proportions.

Scaling is commonly used in various fields, including engineering, architecture, graphic design, and mapmaking. It allows you to resize an object or drawing while preserving its relative dimensions.

Procedures of applying scale

a. **Select a Reference Point**
Choose a point on the object or drawing that serves as the reference point for scaling. This point is often referred to as the "fixed point." The location of this reference point is critical in determining how the scaling operation will affect the object.

b. **Determine the Scale Factor**
The scale factor is a ratio that defines the relationship between the original size and the new size. It specifies how much larger or smaller the object will become. The scale factor can be expressed as a fraction, decimal, or percentage. For example, if the scale factor is 1/2, the object will be scaled down to half its original size.

c. **Calculate New Dimensions**
Determine the new dimensions of the object or drawing by multiplying each dimension (length, width, height) by the scale factor. For example, if you're scaling a rectangular shape with a length of 8 inches and a width of 4 inches by a scale factor of 0.5 (1/2), the new dimensions will be 4 inches in length and 2 inches in width.

d. **Apply the Scale Factor**
Use the scale factor to modify the object or drawing. This can be done manually, using a ruler or other measuring tools for small-scale changes, or digitally, using software for precise and consistent scaling. Ensure that the reference point remains fixed during this process.

e. **Maintain Proportions**

One of the key principles of scaling is to maintain proportions. This means that all dimensions change by the same factor. For example, if the original shape had a length-to- width ratio of 2:1, the scaled shape should have the same ratio after scaling.

f. **Check for Accuracy**

After scaling, check the accuracy of the scaled object or drawing. This can be done by measuring key dimensions and ensuring they match the calculated new dimensions. Software tools often provide scaling functions that automatically calculate the new dimensions for you.

g. **Verify the Result**

If you are working with a drawing or image, visually verify that the scaled version maintainsits original appearance, including shapes, angles, and relative positions of objects. Inaccurate scaling can distort the object.

Points to Remember

- While drawing it is necessary to know all scaling process used in basics technical drawing.

Application of learning 2.10.

In study trip organized by your trainer you are requested to take drawing of any desired manufacturing machine found in local industry then describe the scales of that machine.

Learning outcome 2 end assessment

Theoretical assessment

1. Answer T if the statement is true otherwise F

a) Construction lines are continuous thick lines

b) The line that is drawn under the two extension lines, ending with an arrow is called dimension lines

c) The scaling process involves changing the size of an object or drawing while maintaining its proportions

2. Choose the correct answer among the following questions and their answers bywriting letter which is corresponding to the real answer.

a) Centre lines, section lines are drawn using___pencil.

i. H

ii. 2H

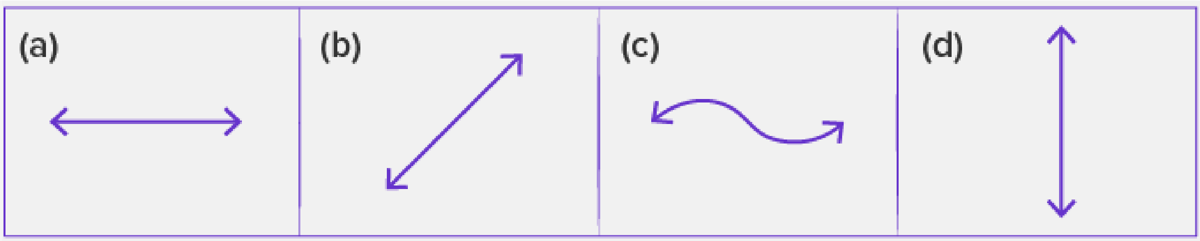
iii. 3H or 4H

iv. HB

b. The line given below is used for___________________

a) Long-break line
b) Cutting planes
c) Centroidal lines
d) Outline of adjacent parts

4. The mentioned lines in letter (a), (b),(c) and (d) are used in technical drawing, Whichletter corresponding to the horizontal line?

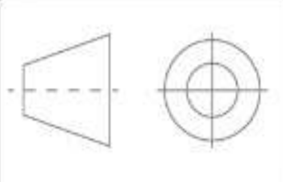
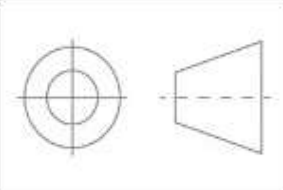


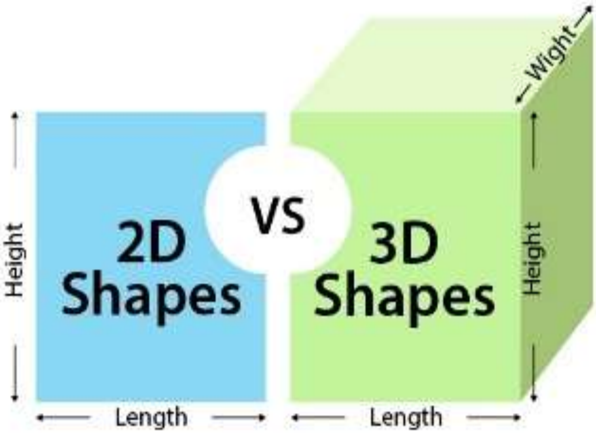
Practical assessment

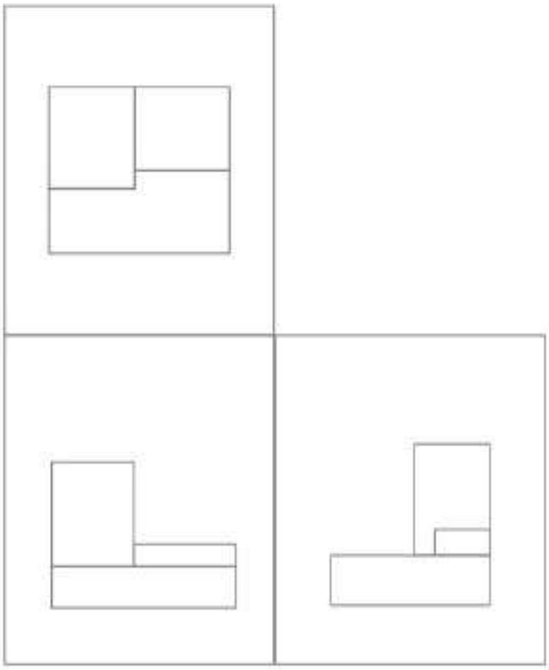
After covering learning outcome 2, Provide all needed materials, instruments and equipmentin drawing work place and ask trainee individually to create Double Stroke Lettering of the school's name.

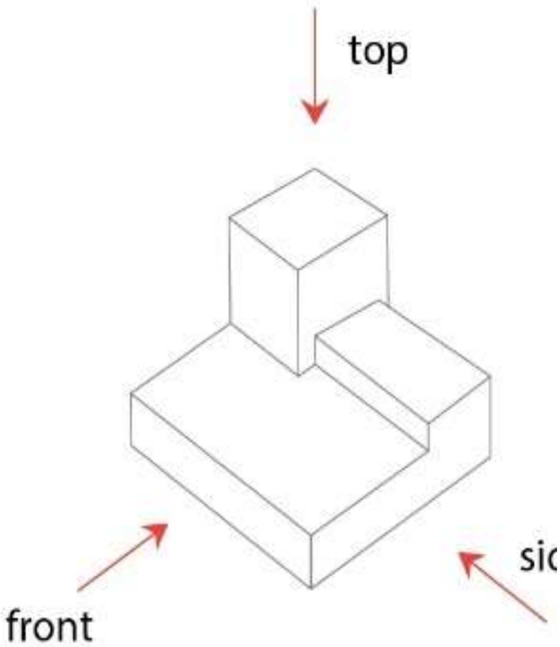
Reference

https://www.ducksters.com/kidsmath/finding_the_volume_surface_area_of_a_cone.php
https://edengdrawing.blogspot.com/2013/02/technical-lettering.html
http://engineeringessentials.com/ege5/files/ege/dim/dim_page3_ex1.htm
https://ng.siyavula.com/read/maths/jss1/two-dimensional-shapes/12-two-dimensional-shapes?id=124-practical-applications

Proiection	Symbol
First angle	
Third angle	







Indicative contents
1.1 Description of 2D and 3D **1.2 Types of projections** **1.3 Views and Sections of objects**

Key Competencies for Learning Outcome 3: : Apply 2 and 3 Dimensional

Knowledge	Skills	Attitudes
• Definition of 2D and 3D • Difference between 2D and 3D Shapes • Applications of 2D and 3D shapes • Formulas of 2D and 3D shapes • Types of projection • Types drawing views of objects • Types drawing Sections of an object	• Creating object drawing views • Projecting an object drawing • Dimensioning Object Views • Creating object Sections	• Having task oriented while applying 2 and 3 dimension • Having team work while applying 2 and 3 dimension • Being commitment while applying 2 and 3 dimension • Having creativity while applying 2 and 3 dimension • Having hard worker while applying 2 and 3 dimension • Having critical • thinking while drawing

Duration: 30 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. Describe properly 2D and 3D used in basic technical drawing
2. Differentiate clearly the two types of projections used in basic technical drawing
3. Describe properly Views and Sections of an objects in technical drawing
4. Apply correctly views and sections of an object in technical drawing

Resources

Equipment	**Tools**	**Materials**
PPE (Safety shoes, helmets, glove, overall, mask, safety glasses) Drawing board Drawing table Cutting board A drawing easel	Paper Rubber Pencil	White boards Marker pens Calculator Scale rulers Pencils Rubber Drawing Compass T square Protractor Pencil sharpener Mathematical se tinstruments

Indicative content 3.1: Description of 2D and 3D

Duration: 10 hrs

Theoretical Activity 3.1.1: Description of 2D and 3D

Tasks:

1: You are requested to describe 2D and 3D shapes by answering the following questions.

I. Define these terms 2D and 3D shapes used in technical drawing

II. Differentiate 2D shapes from 3D shapes based on properties and geometric formula.

III. Give out the applications of 2D shapes and 3D shapes?2: Participate in group forming

3: Provide the answer of asked questions by writing them on paper4: Present your

findings to your trainer or classmate

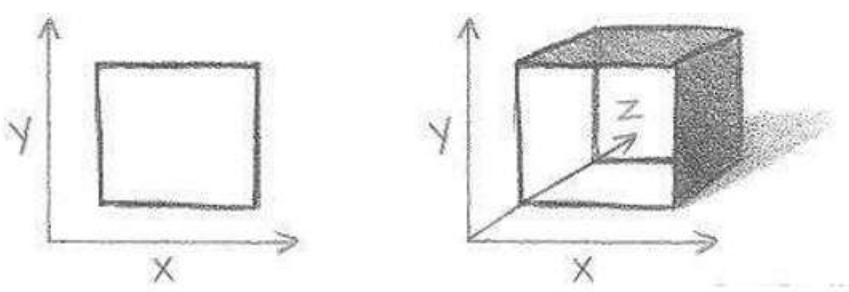
5: Listen to trainer's clarification and ask questions if possible

6: Read the key reading 3.1.1

Key readings 3.1.1.: Description of 2D and 3D

- **Definition 2D and 3D**

2D is to display length and height information on a flat surface without depth. Although 3Dis defined as 3D drawings or models, they describe objects in terms of height, width, anddepth.

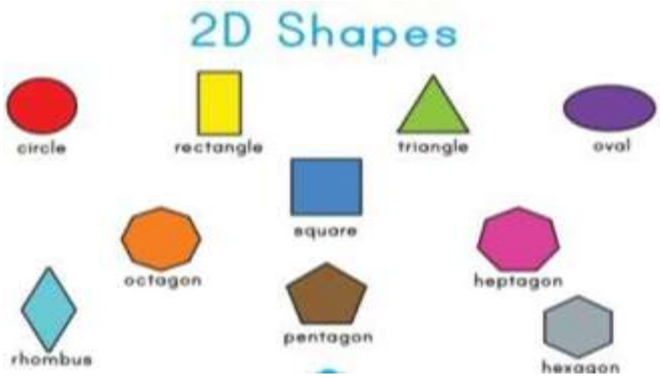


2D 3D

- Difference between 2D and 3D Shapes

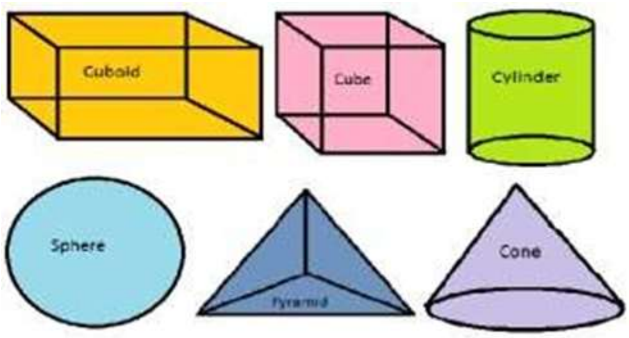
In drawing, 2D refers to two-dimensional representation such as length and width dimensions but they lack depth, which is the third dimension. It is a flat representation of objects on a surface, typically a piece of paper or a computer screen.

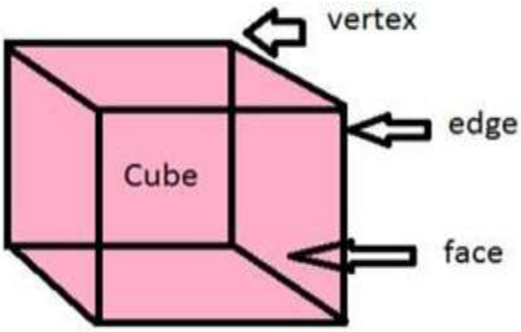
2D shape: A shape or a figure that has a length and a breadth is a 2D shape. In other words, a plane object that has only length and breadth is 2 dimensional. These shapes are composed of points, lines, and curves that lie within the plane. They do not have thickness or depth and are typically represented as flat, outlined figures.



3D shapes: 3D shapes, also known as three-dimensional shapes or solids, are objects that have three dimensions: length, width, and depth. Unlike 2D shapes that exist on a flat plane, 3D shapes occupy physical space and have volume.

The corners of the cube are its **vertices**. The 12-line segments that form the skeleton of thecube are its **edges.** The 6 flat square surfaces that are the skin of the cube are its **faces**. Observe that the two-dimensional figures can be identified as the faces of the three-dimensional shapes.





3D Shapes	Faces	Vertices	Edges
Sphere	1	0	0
Cylinder	3	0	2
Cone	2	1	1
Cube/Cuboid	6	8	12
Rectangular Prism	6	8	12
Triangular Prism	5	6	9
Pentagonal Prism	7	10	15
Hexagonal Prism	8	12	18

- Comparison table between 2D and 3D shapes
  Below is the top most comparison between 2D vs 3D Shapes:

	2D Shape	**3D Shape**
	It has 2 Dimensions, namely X and Y.	It has 3 Dimensions, namely X, Y, and Z.
	Square, circle, and triangle are drawn using 2D shapes.	Cube, sphere, and prism are drawn using 3D shapes.

		2D shapes are used to show a top view, side view, bottom view, front view in engineering drawings	3D shapes are used to draw isometric and orthogonal shapes.
		When we measure than 2 D shapes have length and breadth.	In 3 D shapes, it has length, breadth, and height as well.
		When we draw any plan of a structure in 2D shape, then it gives the overview and explains all details.	While drawing the isometric view (3D), it gives the actual view of the structure.
		Extensively these 2D shapes are used to draw simple images or sketches of	The 3D shape is used to define the architectural view of an object.
		a simple object.	
		Dimensions can be easily explained.	Only outer explained.
		In 2D shapes, all edges used are clearly visible.	In 3D shapes, some edges are hidden, and sometimes we have to hide some edges to get a 3D shape.

- **Applications of 2D and 3D shapes**

a. Application of 2D

1. Graphic Design

2D graphics are used extensively in graphic design for creating logos, illustrations, typography, posters, and digital artwork.

2. Architectural Drawings

Architects use 2D drawings, such as floor plans and elevations, to visualize and communicate their designs. These drawings provide a flat representation of the building'slayout and dimensions.

3. Engineering

2D engineering drawings, such as blueprints, technical diagrams, and schematics, are used to communicate design specifications and instructions for the construction or manufacturing of components.

b. Applications of 3D

1. Architecture and Interior Design

3D models and visualizations are widely used in architecture and interior design to create realistic representations of buildings, spaces, and environments. It helps in understanding spatial relationships, lighting, and materials before construction or modelling.

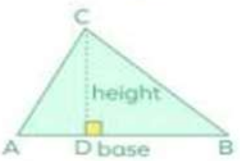
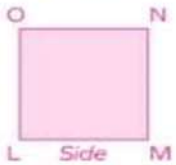
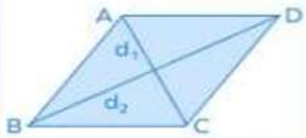
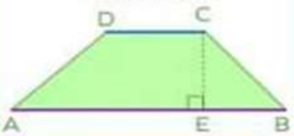
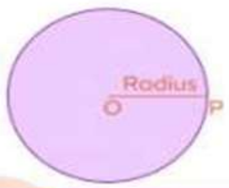
2. Product Design and Manufacturing

3D modeling is employed to create virtual prototypes of products, allowing designers to refine and visualize their designs before production. It also aids in computer-aided manufacturing (CAM) processes.

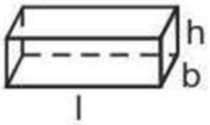
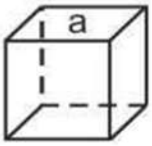
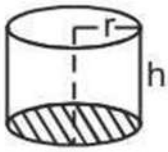
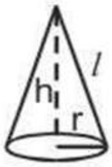
3. Application in Medicine

Three-dimensional geometry is used in figuring out various decisions taken by doctors regarding body surgeries, treatments and manufacture of implants and prosthetics. Considerations of volumes, areas and lengths in prosthetics as per the requirement of human body are done by using three-dimensional geometry.

- **Formulas of 2D and 3D shapes2D Shape formulas**

Shape	Perimeter	Area
Triangle: 	Perimeter is the sum of all sides. Perimeter = AB + BC + CA	Area = $\frac{1}{2}$ × *base* × *height* Area = $\frac{1}{2}$ ×*AB* ×*CD*
Rectangle: 	Perimeter = 2 × (length + breadth) Perimeter = 2 × (PQ + QR)	Area = Length × Breadth Area = PQ × QR
Square: 	Perimeter = 4 × side Perimeter = 4 × LM	Area = $(\text{side})^2$ Area = LM^2
Rhombus: 	Perimeter = 4 × Side Perimeter = 4 × BC	Area = $\frac{1}{2} \times d_1 \times d_2$ Area = $\frac{1}{2}$ ×*AC* ×*BD*
Parallelogram: 	Perimeter = 2 × (length + breadth) Perimeter = 2 × (LM + MN)	Area = Length × Height Area = LM × OP
Trapezoid: 	Perimeter is sum of all sides. Perimeter = AB + BC + CD + DA	Area = $\frac{1}{2}$ × (*sum of parallel sides*) × height Area = $\frac{1}{2}$ × (AB + CD) × CE
Circle: 	Circumference = 2 × π × radius Circumference = 2 × π × OP	Area = π × $(\text{Radius})^2$ Area = π × $(OP)^2$

D Shape formulas

Name	Figure	Curved Surface area	Total surface area	Volume
Cuboid		$2h(l+b)$	$2(lb+bh+lh)$	lbh
Cube		$4a^2$	$6a^2$	a^3
Right circular cylinder		$2\pi rh$	$2\pi r(r+h)$	πr^2h
Right circular cone		πrl	$\pi r(l+r)$	$\frac{1}{3}\pi r^2h$
Sphere		–	$4\pi r^2$	$\left(\frac{4}{3}\right)\pi r^3$
Hemi-sphere		$2\pi r^2$	$3\pi r^2$	$\left(\frac{2}{3}\right)\pi r^3$

Points to Remember

- Better to know the meaning of 2D and 3D shapes found in technical drawing not onlythat but also their applications

Application of learning 3.1.

In the trip which is organized by your trainer you are requested to go to a local market aroundthe school and purchase 2D and 3D shapes to be used in school as didactic materials.

Indicative content 3.2: Types of Projections

Duration: 10 hrs

Theoretical Activity 3.2.1: Description of types of Projection

Tasks:

1: You are requested to answer the following questions related to Pictorial Projection and Orthographic Projection types.

I. How would you define the concept of projection types?

II. Differentiate Pictorial Projection from Orthographic projection techniques?

2: Engage in an open dialogue.

3: Provide the answer of asked questions by writing them 4: Present your findings to your classmates and trainer

5: listen carefully trainer's clarification and ask questions where necessary.

6: Read the key readings 3.2.1.

Key readings 3.2.1.: Description of types of Projection

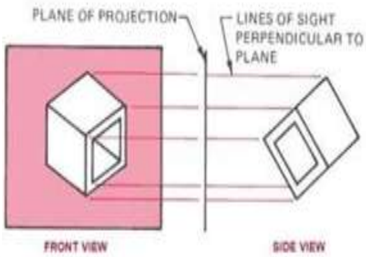
- **Definition of projection**

In technical drawing, a projection refers to the process of representing a three-dimensional object or scene on a two-dimensional surface, such as a sheet of paper or a computer screen. This is necessary because most technical drawings, like blueprints, plans, and schematics, are created in two dimensions, but they need to convey the information of three-dimensional objects accurately. In engineering practice, the followings are the common types of projections.

- **Pictorial projection**

Pictorial projection is a technique used in technical drawing and engineering to represent three-dimensional objects on a two-dimensional surface, such as paper but does not necessarily show the exact dimensions

PICTORIAL DRAWINGS



.

The pictorial projection is: **axonometric, oblique projection and perspective projections.**

- **Axonometric projection**

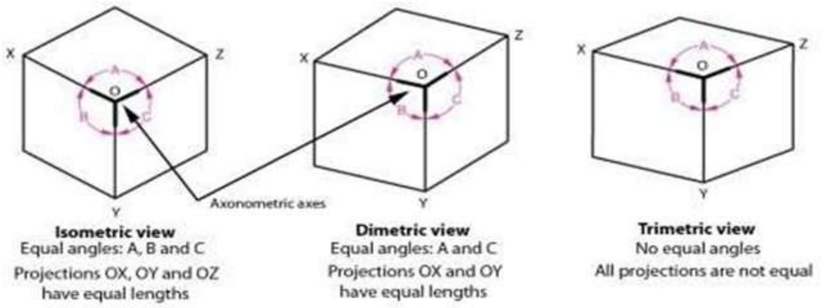
If the object is turned and then tilted so as those three faces are inclined to the plane of ''projection, the resulting projection is a special type of orthographic projection known as axonometric projection. Note that the projectors from the plane to the object are perpendicular to the plane. This axonometric or pictorial view shows three of the object's sides in one projection and therefore is called a one plane projection.

There are three subdivisions of axonometric projection:

Isometric: Three sides of the object are shown on one projection plane and are equally inclined.

Dimetric: Three sides of the object are shown on one projection plane and two of th e three sides are equally inclined

Trimetric: Three sides of the object are shown on one projection plane and are inclined differently



- **Oblique projection**

Another form of one plane projection is the oblique projection. This is not an orthographicprojection because, although one face is imagined to be parallel to the plane of projection, the projectors are not perpendicular to it. Oblique projection provides an easy way of turning an existing orthographic view into a pictorial view.

The oblique projection is further discussed as under:

Cavalier projection: when the projection lines make angle of 45^0 with the plane of projection, the projection is called a cavalier projection**.**

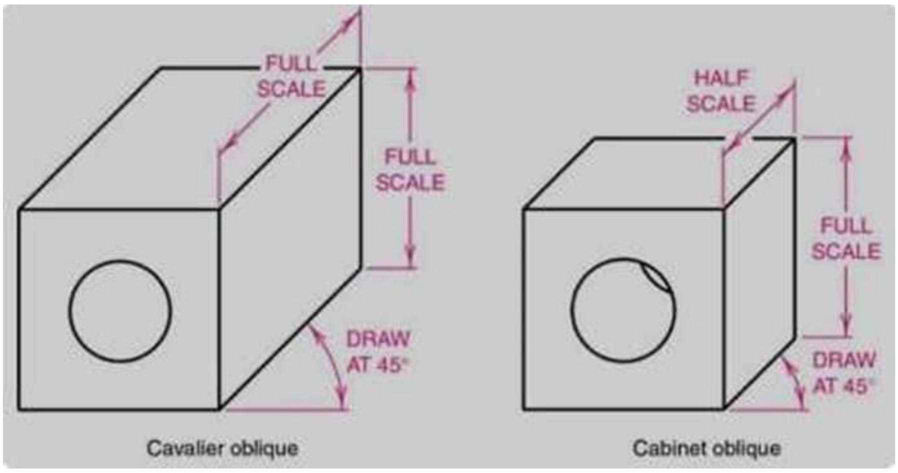
projection: When the angle that the projecting lines make with the plane of projection is the scale on the reading axis in the drawing is about one half as long as the two axes, the alled a cabinet projection.

Clinographic projection: In cavalier and cabinet projections the principal face of the objectis made parallel to the plane of projection. For some cases it may be desirable to turn the object at an angle with respect to the plane of projection and is known as clinographic projection.

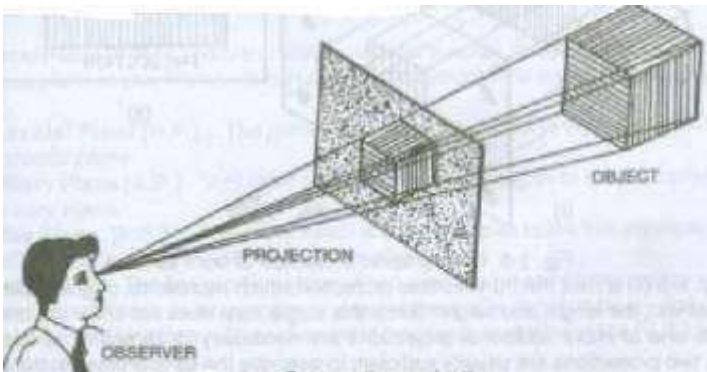
- **Perspective**

The projection obtained on a plane when the projectors converge to a point is known as perspective projection. There are three kinds of perspective projections.

- **Parallel or one-point perspective**: If the principal face of the object is parallel to the plane of projection and there is only one vanish point; the projection is known asparallel or one-point perspective.



- **Angular or two points perspective:** When the two faces of the object are at an angle with plane of projection
- **Three-point perspective:** If the three principal faces of the object are inclined to the plane of projection, the projection obtained is known as an oblique or three points perspective



Perspective projection

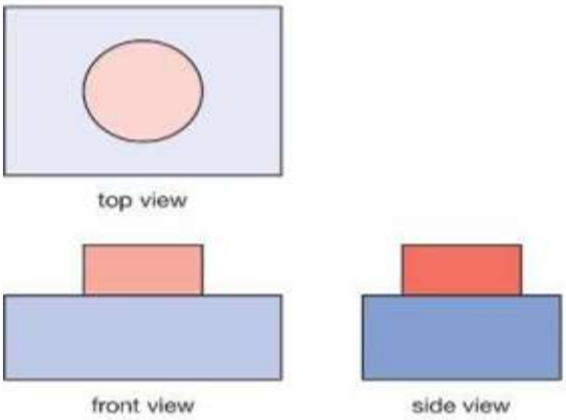
- **Orthographic projection**

The projection or view obtained on a plane of projection when the projectors are parallel to each other, but perpendicular to the plane of projection, is known as orthographic projection.

While drawing the orthographic projections, the following items should invariably exist:

- The plane of projections
- The object to be projected
- The projector

The observer's eye or station point



2-dimensional orthographic projection

- **Plane of projection**

The plane which is used for the purpose of projection is called plane of projection

Type of projection plane

- **Reference plane:** In general, two planes are employed for projection and are known as reference planes or principal planes of projection. These planes intersect at right an gle to each other.

- **Vertical plane (V.P):** The plane which is vertical is called vertical plane and is denoted by V.P. Vertical plane is also known as frontal plane since front view is projected onthis plane
- **Horizontal plane (H.P):** The plane which is horizontal but at right angle to the V.P
- **Auxiliary plane (A.P):** Any other plane, placed at any angles to the principal planes

Profile plane (P.P): The plane which is at right angles to the two-principal plane is called auxiliary vertical plane (A.V.P) PP

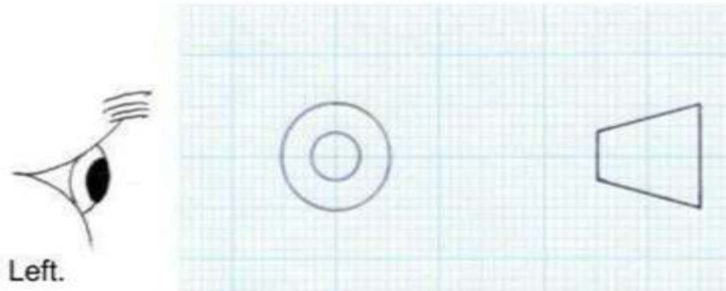
Types of angle projection

- First angle projection
- Third angle projection

On each orthographic drawing produced the symbol the method used has to be indicated on the drawing sheet. This is conventionally done by means of symbols. Consider yourself looking at the following cone

If you draw its front and left view and present it as in the figure below then yourmethod of drawing will be **First Angle Projection**.

Once again if you draw its front and left view and present it as in the figure below then your method of drawing will be **Third Angle Projection**.

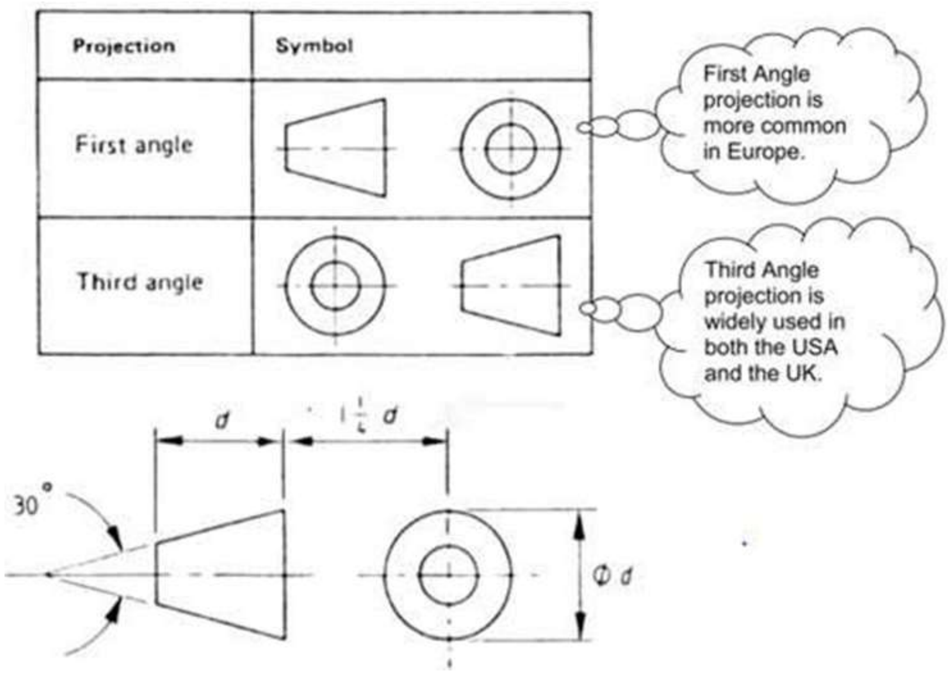


Third Angle.

There you are! You have got the international representation of objects in First and Third Angle Projection.

Difference between First angle projection and third projection.

Both system of projection, first and third angle, are approved internationally and haveequal status. The system used must be clearly indicated on every drawing, using the appropriate symbol shown in figure below.



Projection system symbols and recommended proportions

Difference between First Angle Projection and Third Angle Projection

Characteristics of First Angle Projection:

D	First Angle Projection	Third Angle Projection
	The object is placed in the firstquadrant.	The object is placed in the third quadrant
	The object is placed between theplane of projection and observer.	The plane of projection is placed bet the object and observer.
	The plane of projection is opaque.	The plane of projection is transparent.
	Front view is at the top of thehorizontal axis.	Front view at the bottom of the horiz ontal axis.
	Top view athorizontal axis. botto m of the	Top view at the top of horizontal axis.
6	Right view is at the left side of verticalaxis.	Right view is at the right side of vertical axis
	Left view is at the right side of verticalaxis.	Left view is at the left side of vertical axis
8	It is widely used in Europe, India, and Canada.	It is widely used in United State and Australia.

- Front view always comes over the top view.
- Top view always comes under the front view.
- Right side view always comes to the left at the front view.

- Left side view always comes to the right of the front view.
- The view is always in opposite direction to the observer.
- The object is always in the middle of the view and the observer.

Characteristics of Third Angle Projection:

- Top view always comes over the Front view.
- Front view always comes under the top view.
- Right side view always comes to the right of the front view.
- Left side view always comes to the left of the front view
- The view is always formed to the side of the observer.
- The view is always in the middle of the object and the observer

c) Dimensions of Object Views

All three-dimensional objects have width, height, and depth. Width is associated with an object's side to-side dimension.

Height is the measure of an object from top-to-bottom. Depth is associated with front-to-back distance.

Practical Activity 3.2.1: Presentation of object in pictorial projection and orthographic projection.

Task:

1: With reference to the theoretical activity 3.2.1. and trainer's demonstration, you are askedto go in drawing workplace and present a drawing of mild steel product in pictorial projection and orthographic projection Individually.

2: Select the appropriate drawing instrument, equipment, and materials

3: Outline the process for presenting a drawing of a mild steel product in pictorial projectionand orthographic projection

4: Referring to the procedure provided on step 2, proceed to present a drawing of a mild steelproduct in pictorial projection and orthographic projection.

5: Present your work to the trainer for review and feedback.6: Read key reading

3.2.2.

7: Perform the task provided in application of learning 3.2.2.

Key readings 3.2.2

Presentation of object in pictorial projection and orthographic projection.

- **Process of creating pictorial and orthographic projection**

Creating both pictorial and orthographic projections involve a structured process to accurately represent three-dimensional objects in two dimensions. Here are the steps for creating these types of technical drawings:

Creating Pictorial Projections:

- Choose the Object: Select the three-dimensional object you want to show in pictorialprojection.
- Determine the Projection Type: Decide whether you will create an Isometric, Dimetric, or Trimetric projection. Each type has a different angle and perspective, so choose the one that best suits your purpose.
- Establish the Principal Planes: Set up the principal planes (front, top, and side) that correspond to your chosen projection type. These planes represent how the object will be viewed in 2D.
- Draw the Object: Start by drawing the object on each of the principal planes according to the projection type's guidelines. Maintain accurate proportions and dimensions.
- Add Depth and Shading: Use shading, hatching, or other techniques to give depth an d volume to the object, making it appear three-dimensional.
- Combine the Views: Combine the drawings from the principal planes to create the fin al pictorial projection, representing the object from your chosen perspective.

Creating Orthographic Projections:

- Select the Object: Choose the object that you want to represent in orthographic projection.
- Establish the Principal Planes: Define the principal planes (front, top, and side views) from which you will project the object. These views should be orthogonal to each other.

- Draw the Object Views: Create separate 2D views of the object from each principal plane, ensuring that all lines are perpendicular and dimensions are accurately represented.
- Align the Views: Align the views properly, with the corresponding edges and features matching up across the different views.
- Label and Dimension: Add labels to identify different parts and dimensions to specify the object's size and features.
- Combine Views on a Sheet: Arrange the different views on a single sheet of paper or i n a digital format, making it easy to reference and understand the object in 2D.

Add Auxiliary Views (if needed): Include auxiliary views to represent features that are not easily visible in the standard orthogonal views.

Both pictorial and orthographic projections serve different purposes and are used in various fields like engineering, architecture, and design to convey the details and dimensions of three-dimensional objects accurately in two dimensions. The specific steps may vary basedon the chosen projection type and the complexity of the object being represented.

Points to Remember

- Better to know the meaning of projection found in basics technical drawing as well asknow their types
- Process of creating Pictorial and orthographic projection are not similar better to knoweach.

Application of learning 1.2.

Attend the study visit planned by your trainer to agakiriro located near your school and draw a door in orthographic and pictorial projection found in place as well as apply dimensionand scales on it.

Indicative content 3.3: Views and Sections of objects

Duration: 10 hrs

Theoretical Activity 3.3.1: Description of views and sections of objects

Tasks:

1: In groups you are requested to answer the following questions asked by trainer describe views and sections of objects by:

I. What do you understand by the terms “views and sections” of object in technical?

drawing.

II. Give out the drawing views of object in technical drawing?

III. Differentiate the longitudinal section and transversal section?2: Participate in group forming

3: Provide the answer of asked questions by writing them on papers.4: Present your findings to your classmates and trainer

5: listen carefully trainer’s clarification and ask questions where necessary.

6: Read the key readings 3.3.1

Key readings 1.1.1.: Description of views and sections of objects

Views and Sections of objects

In technical drawing and engineering, "views and sections of objects" refer to the various representations and ways in which three-dimensional objects or components are depicted in two-dimensional drawings or diagrams. These views and sections are essential for communicating the shape, dimensions, and details of objects for manufacturing, construction, or analysis.

1. **Views of object**

Views are two-dimensional representations of an object as seen from a specific direction or viewpoint. In technical drawings, objects are typically represented from multiple views to provide a complete understanding.

1. **Front View:**

This view is prepared by placing the object in front. The length and height of an object are shown in this view.

2. **Top View:**

This view is prepared by looking to the object from the upper side. The length and breadth of the object are shown in it.

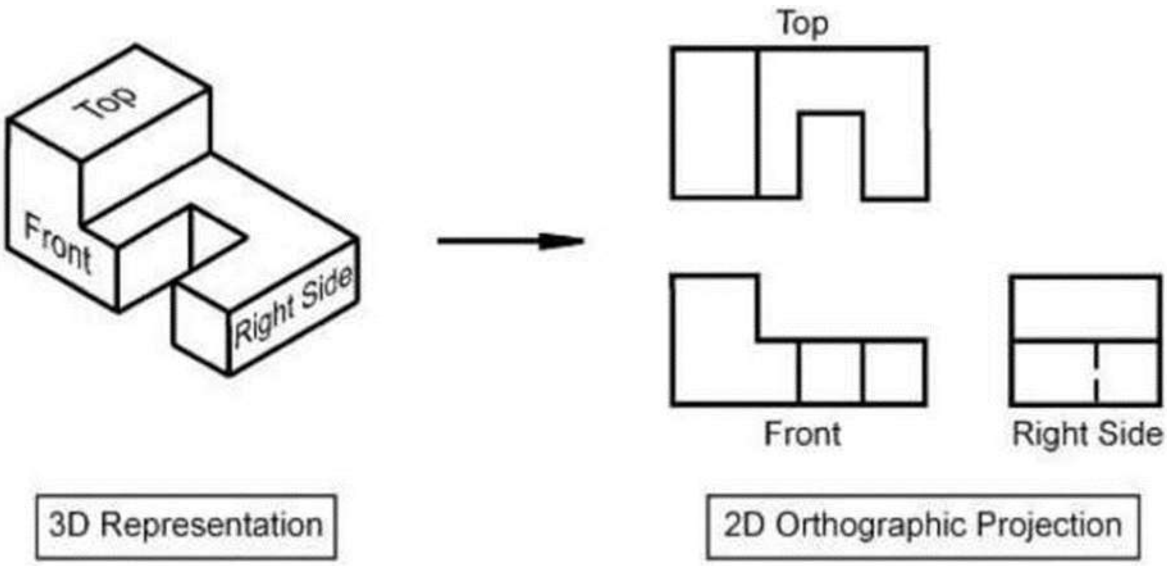
3. **Side View:**

This view is prepared by looking to the object from the right side or left side. The breadth and height of the object are shown in it.

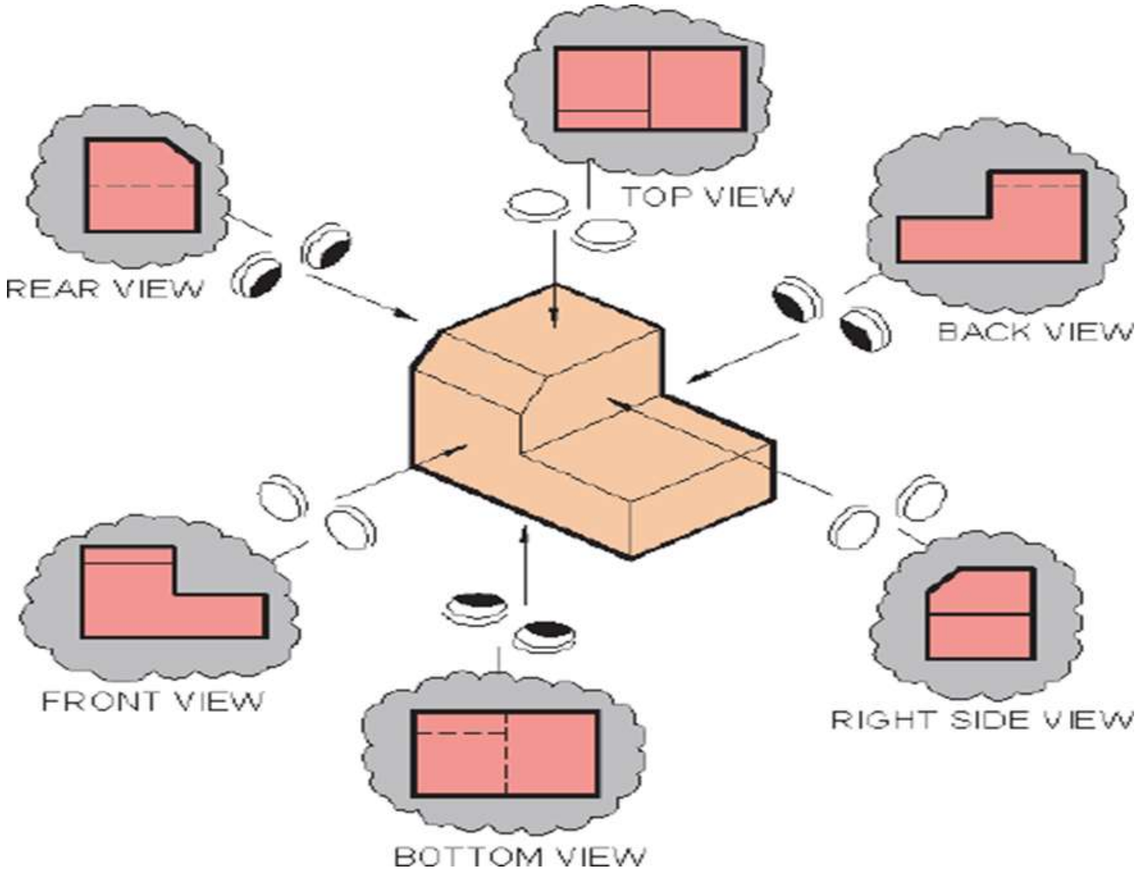
4. **Bottom view**

The view to the left of the front view is the left side view.

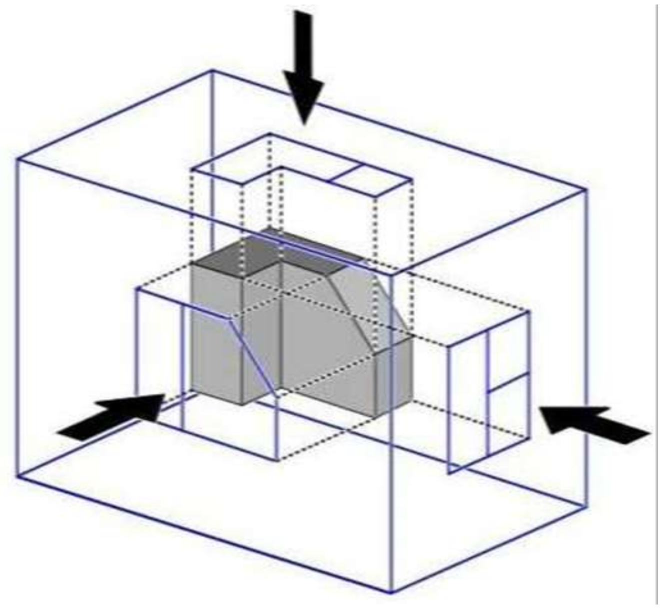
The view above the front view is called the top view and the view below the front view is the bottom view.



3D Representation VS 2D Orthographic projection



Types of views



The views are named as follows:

a. Front view or main view/elevation
b. Side view from the left or left side view
c. Top view
d. Rear view

e. Side view from the right- or right-side view

f. Bottom view

I. Methods of Obtained Orthographic Views

a. **View from the front:** The view from the front of an object is defined as the view that is obtained as projection on the vertical plane by looking at the object normal to its front surface

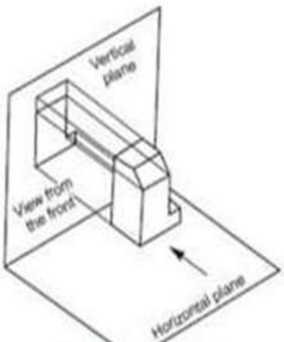
b. **View from Above:** The view from above of an object is defined as the view that is obtained as projection on the horizontal plane, by looking the object normal to its top surface.

c. **View from the side:** The view from the side of an object is defined as the view that is obtained as projection on the profile plane by looking the object, normal to its side surface. As there are two sides for an object, viz., left side and right side, two possible views from the side, viz., view from the left and view from the right may be obtained for any object.

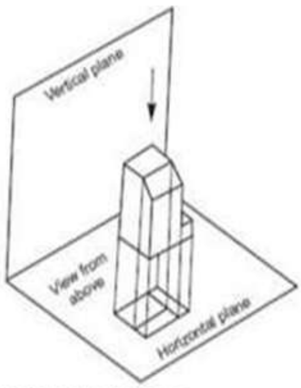
Principle of obtaining views

View from the front

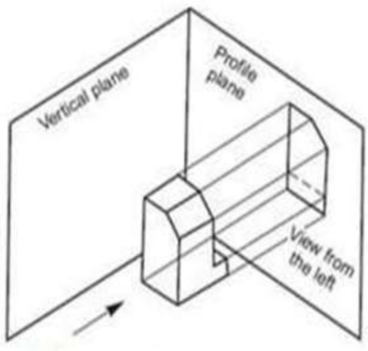
Presentation of view: The different views of an object are placed on a drawing sheet which is a two dimensional one, to reveal all the three dimensions of the object.For this, the horizontal and profile planes are rotated till they coincide with the vertical plane. Figure below shows the relative positions of the views, viz., the view from the front, above and the left of an object



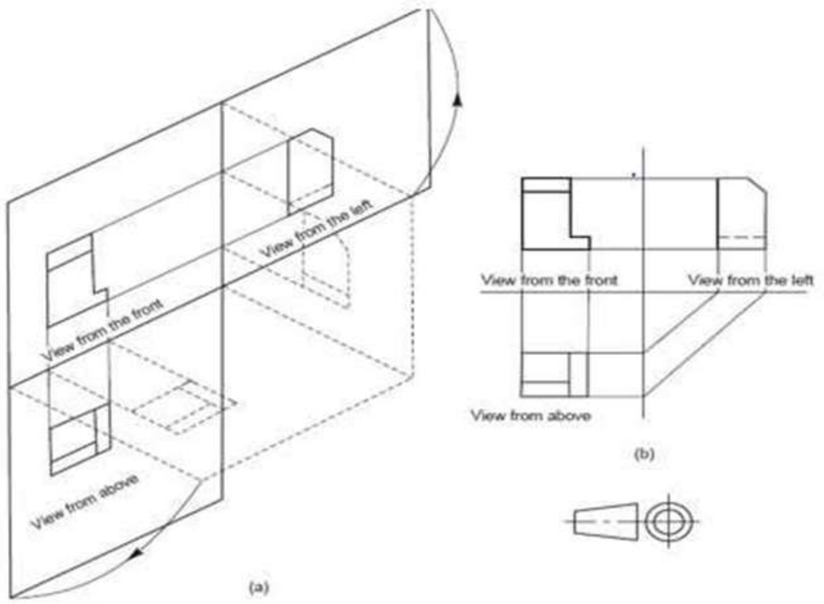
Principle of obtaing view from front



Principle of obtaining view from the above



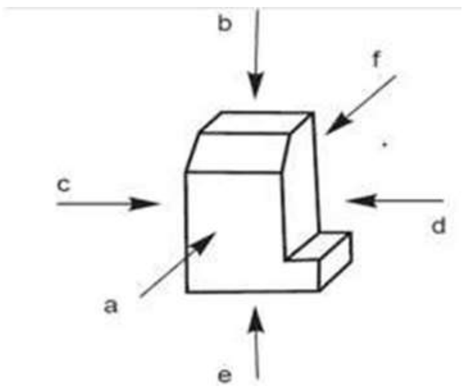
Principle of obtaing view from the left

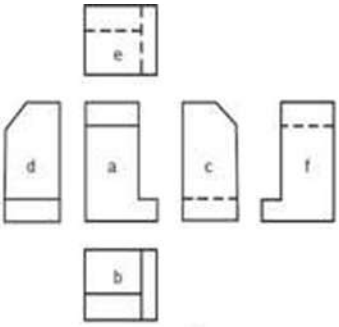


Relative position of the three views and the symbol

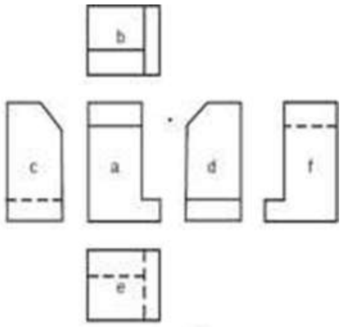
A. **Designation and relative position of view:** An object positioned in space may be i magined as surrounded by six mutually perpendicular planes. So, for any object, si x different views may be obtained by viewing at it along the six directions, normal to these planes. Figure 3.5 shows an object with six possible directions to obtain the different views which are designated as follows:

1) View in the direction **a** = view from the front
2) View in the direction **b** = view from above
3) View in the direction **c** = view from the left
4) View in the direction **d** = view from the right
5) View in the direction **e** = view from below
6) View in the direction **f** = view from the rear





(a)



(a)

FIG3.3.7

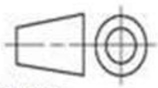
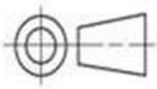


FIG3.3.6

(b)



(b)

Figure 3.6a shows the relative positions of the above six views in the first angle projection and Fig.3.6b, the distinguishing symbol of this method of projection. Figure 3.7 a show the relative position of the views in the third angle projection and Fig. 3.7b, the distinguishing symbol of this method of projection

NOTE A comparison of Figs. 3.6 and 3.7 reveals that in both the methods of projection, theviews are identical in shape and detail. Only their location with respect to the view from the front is different.

It is important to understand the significance of the position of the object relative to the planes of projection. To get useful information about the object in the orthographic projections, the object may be imagined to be positioned properly because of the followingfacts:

1. Any line on an object will show its true length, only when it is parallel to the planeof projection.
2. Any surface of an object will appear in its true shape, only when it is parallel to the plane of projection.

In the light of the above, it is necessary that the object is imagined to be positioned such that its principal surfaces are parallel to the planes of projection.

Isometric View

Isometric projection is a method for visually representing three-dimensional objects in two dimensions in technical and engineering drawings. It is an axonometric projection in which the three coordinate axes appear equally foreshortened and the angle between any two ofthem is 120 degrees.

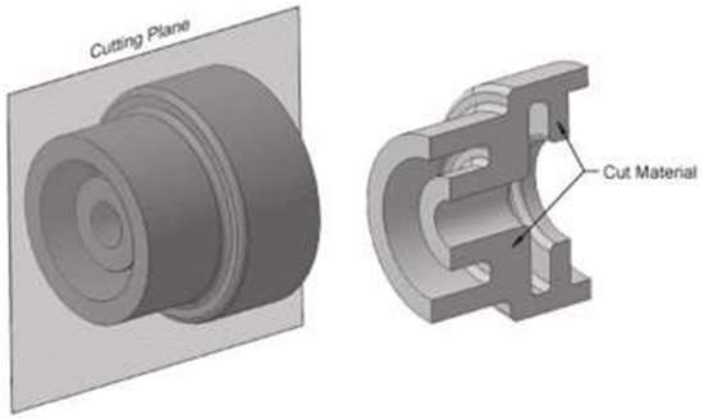
2. **What is a section view?**

A section view is a view used on a drawing to show an area or hidden part of an object by cutting away or removing some of that object. The cut line is called a "cutting plane", and can be done in several ways. A sectional view or a section looks inside an object.

Sections are used to clarify the interior construction of a part that cannot be clearly described by hidden lines in exterior views

Creating a section view.

1. The part is cut using an imaginary cutting plane.
2. The unwanted portion is mentally discarded exposing the interior construction.



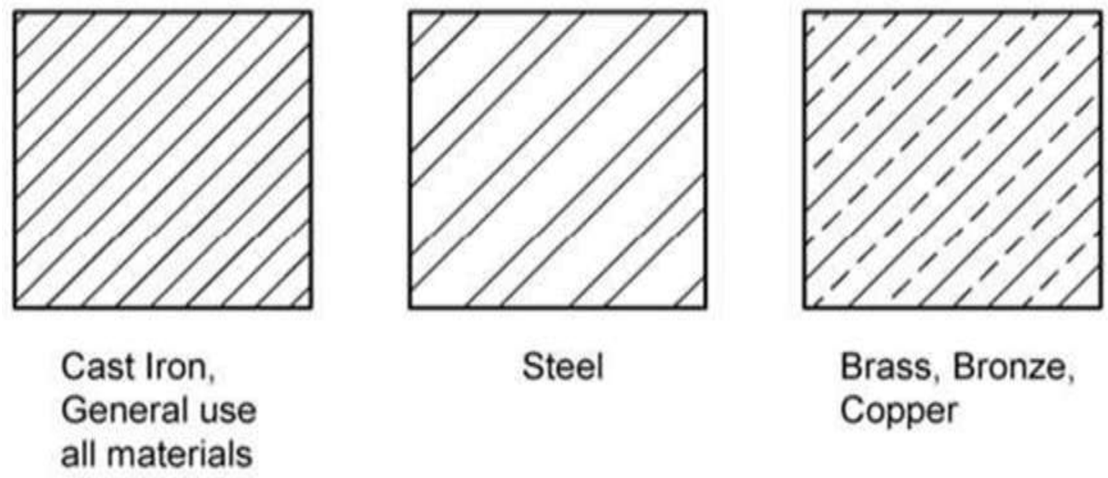
Lines used in section views.

<u>Cutting Plane</u>: An imaginary plane along which a section is taken.

<u>Cutting Plane Line:</u> A line on a normal view that shows where the cutting plane passes through the object. It is used to show where the object is being cut. (Phantom or Hidden linetype)

Used for long distances

Used for short distances



Longitudinal section

Section Lines: Used to indicate where the cutting plane cuts the material. Section lines are thin and symbols (type of lines) are chosen according to the material of the object. Section lines are generally a 45° angle and they are generally drawn 1/8" apart. However, different materials (steel and bronze different patterns that may have a uniquely different spacing.

A full section that runs across the longest dimension of a building is known as a longitudinal

✓ **The difference between longitudinal and transversal section of object**

A longitudinal section and a transversal section of an object differ in the orientation of thecut made through the object and the perspective they provide:

1. **Orientation of the Cut:**

   - **Longitudinal Section**: A longitudinal section is made by cutting an object along itslength, in a direction parallel to its longest axis. It provides an internal view along the length of the object, often revealing the arrangement of components from t he side.
   - **Transversal Section:** A transversal section is created by cutting an object perpendicular to its length, typically along its width or height. This results in a cross-sectional view, exposing the internal details as if the object were sliced horizontally or vertically.

2. **Perspective Offered:**

   - **Longitudinal Section:** A longitudinal section offers a view that extends along the object's length. It is useful for showing how components and features are organize d from the side, providing insights into the object's internal structure in that direction.

- **Transversal Section:** A transversal section provides a view that cuts across the object's width or height, revealing the internal features in a cross-sectional manner. It is helpful for understanding how components are distributed in relation to the object's cross-section.

Practical Activity 3.3.2: Presenting of object views and

Task:

1: With reference to the theoretical activity 3.3.1. and trainer's demonstration, you are askedto go in drawing workplace and present a drawing of mild steel product by difference views and sections Individually.

2: Select the appropriate drawing instrument, equipment, and materials

3: Outline the process for presenting a drawing of a mild steel product by difference viewsand sections.

4: Referring to the procedure provided on step 2, proceed to present a drawing of a mild steelproduct by difference views and sections.

5: Present your work to the trainer for review and feedback.

6: Read key reading 3.3.2.

6: Perform the task provided in application of learning 3.3

Key readings 3.3.2.:

Steps for sectioning in technical drawing:

1. **Select the Cutting Plane:** Determine the location and orientation of the cutting plane. The cutting plane is a theoretical plane that passes through the object, indicating where thesection will be taken.
2. **Indicate the Cutting Plane: Draw** the cutting plane line on the object's primary view (e.g.,front view) to show where the section will be made. Use a thick, continuous line to indicatethe cutting plane.
3. **Create a Section View:** Select a specific section view (e.g., full section, half section, cross- section) based on the object's features and requirements. Draw this section view in the space adjacent to the object's primary view.

4. **Label the Section View:** Provide a title for the section view (e.g., "Section A-A") and place it above or below the view. This title helps identify the section and cross-reference it with the cutting plane line.
5. **Indicate the Direction of View:** Use arrowheads to show the direction from which the section is viewed. The arrowhead should be placed at the end of the cutting plane line.
6. **Draw the Section Lines**: Create section lines within the section view to represent the exposed internal features of the object. These lines should be evenly spaced and typically drawn at a 45-degree angle to the cutting plane
7. **Show Hidden Features:** Display hidden features or components in a section view using hidden lines. These lines are typically drawn as dashed lines to distinguish them from visiblefeatures.
8. **Add Dimensions:** Include dimensions within the section view to indicate the size and positioning of internal components and features.
9. **Include Labels and Notes:** Add labels, notes, and annotations to provide additional information about the sectioned object, materials, or any specific instructions for manufacturing or assembly.
10.

Points to Remember

While describing views and section of an object it is necessary to know all types of views used in basics technical drawing

- While sectioning in technical drawing it very important to know all types of sectioninginclude: select the cutting plane, indicate the cutting plane, create a section view, label the section view, indicate the direction of view, draw the section lines, show hidden features, add dimensions, include labels and notes

Application of learning 3.3

During the trip of study organized by your trainer to a local drawing workplace, you arerequested to draw a detailed table with respect to drawing views and sections.

Learning outcome 3 end assessment

Theoretical assessment

1. Choose the correct answer by writing the letter corresponding to the real answer.

I) View obtained from the top is called

a) Top view

b) Front view

c) Rear view

II) Among the following shapes Which of the following is not 3D shape?

a) Pyramid

b) Sphere

c) cylinder

d) Triangle

III) From the following solid which is solid of revolution

a) Sphere

b) Pyramid

c) Cube

2. Choose the real meaning of a section view among the followings by writing the lettercorresponding to the answer

a) A section view is a view used on a drawing to show dimensions of an object.

b) A section view is a view used on a drawing to show an area or hidden part of an object bycutting away or removing some of that object.

c) Both a) and b) are correct answer

d) Both a) and b) are not correct answer

3. Answer T if the statement is true and F if the statement is false

a) In technical drawing and engineering, "views and sections of objects" refer to the various representations and ways in which three-dimensional objects or components are depicted in two-dimensional drawings or diagrams

b) 2D is to display length and height information on a flat surface without depth. Although 3Dis defined as 3D drawings or models, they describe objects in terms of height, width, and depth.

c) 3D shapes: 3D shapes, also known as ten -dimensional shapes or solids, are objects that have three dimensions: length, width, and depth

4. The following are comparison of 2D and 3D Shapes, use 2D and 3D to complete the gapof the following sentences?

a) has 2 Dimensions, namely X and Y.

b) has 3 Dimensions, namely X, Y, and Z.

c) ………………… are used to show a top view, side view, bottom view, front view inengineering drawings

d) are used to draw isometric and orthogonal shapes

e) are used to draw simple images or sketches of a simple object.

f) is used to define the architectural view of an object.

Practical assessment

Ask trainees to do the following task:

MUGISHA designing company receive tender from metal furniture company ltd of making home table drawing, as qualified trainee in technical drawing, request trainees to draw homemild steel table by referring to the following specification within 3 hours.

Home table specificationMaterials: mild steel Dimension:

Table top:(1200*1000*50) mm length*width*thickness respectivelyHeight: 1100 mm

Reference

https://www.ducksters.com/kidsmath/finding_the_volume_surface_area_of_a_cone.php
https://edengdrawing.blogspot.com/2013/02/technical-lettering.html
http://engineeringessentials.com/ege5/files/ege/dim/dim_page3_ex1.htm
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END

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