



Basic Electrical Electronics Equipment Servicing Level - I Learning guide- 32

Unit of Competence: **Prepare and Interpret
Technical Drawing**

Module Title: **Preparing and Interpreting
Technical Drawing**

LG Code: EEL BEE1 M08 Lo1-LG32

TTLM Code: EEL BEE1 TTLM 0919V1

LO1. Identify different kinds of technical drawings

Page 1 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
---------------	---	---	----------------------------



This learning guide is developed to provide you the necessary information regarding the following learning outcome coverage:–

- selecting Correct technical drawing according to job requirements
- segregating technical drawings in accordance with the types and kinds of drawings

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to –**

- select Correct technical drawing according to job requirements
- segregate technical drawings in accordance with the types and kinds of drawings

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2 , and Sheet 3
4. Accomplish the “Self-check 1, Self-check 2 and, Self-check 3 **in page -6, 9, 12 and 14** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, **in page -15.**
6. Do the “LAP test” **in page – 16** (if you are ready



1.1. Selecting correct technical drawing

Different literatures define drawing in different terms while basically their core message remains the same. For instance, look the following definitions given for drawing on different literatures;

- **Drawing**:-Is graphic representation of a real thing, an idea, or a proposed design for later manufacture or construction.
- **A graphic** that represents an idea, a concept, or an entity which actually or potentially exists in life. A way of communicating all necessary information about an abstraction such as an idea or a concept.

1.2. Types of drawing

There are two basic types of drawings: **Artistic** and **Technical** drawings.

A. Artistic Drawings :

Artistic Drawings range in scope from the simplest line drawing to the most famous paintings. Regardless of their complexity, artistic drawings are used to express the feelings, beliefs, philosophies, and ideas of the artist. In order to understand an artistic drawing, it is sometimes necessary to first understand the artist. Artists often take a subtle or abstract approach in communicating through their drawings, which in turn gives rise to various



interpretations

Fig 1.1 Artistic Drawing



B. Technical Drawings:

The technical drawing, on the other hand, is not subtle, or abstract. It does not require an understanding of its creator, only an understanding of technical drawings. A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept into reality. Therefore, a technical drawing often contains more than just a graphic representation of its subject. It also contains dimensions, notes and specifications.

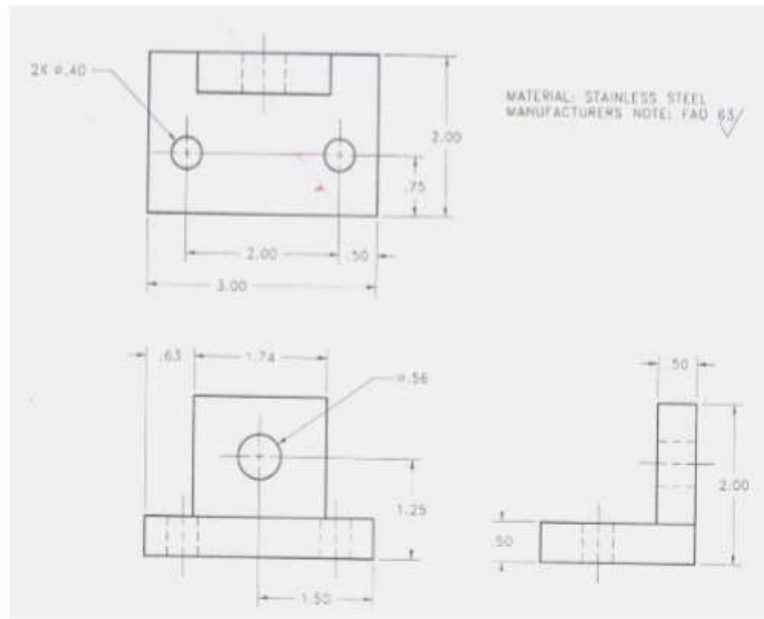


Fig: 1:2 Technical drawing

Page 4 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
---------------	---	---	----------------------------



Self-Check -1	Written Test
----------------------	---------------------

Directions: Answer all the questions listed below.

I. Say True if the statement is correct and Say False if the statement is incorrect

1. Drawing is a graphic representation of a real thing, an idea, or a proposed design for later manufacture.
2. Artists some time take a subtle or abstract approach in communicating through their drawings
- 3 .A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality
- 4.Artistic drawings are used to express the feelings, beliefs, philosophies, and ideas of the artist.

Note: Satisfactory rating - 2 and 4 points

Unsatisfactory - below 2

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Name: _____

Date: _____



2.1 segregate technical drawings with the types and kinds of drawings

The preparation of technical drawing is possible only through knowledge and skill in the use of a variety instruments. With the aid of knowledge and skill practice will bring perfection! The following listed drawing instruments are the basic ones:

2.1.1. Types of drawing tools and equipment

Drafting equipment like T-square, drawing board or binder, ruler, set squares, compasses, protractors, French curves, templates, eraser, dividers, ... etc

- **T-square**

T-square is provides a parallel straight edge for the beginning drawing drafter.

It is composed of two parts:

- The head and
- The blade.

The two parts are fastened together at an exact right angle. The blade must be straight and free of any necks and imperfections. Used to draw horizontal lines on the drawing sheet Used to draw vertical lines and slanted lines with the help of additional equipment basically 45° and 60° set- squares. Draw lines only against the upper edge of the blade. Make sure the head is held against the left edge of the drawing board to guarantee parallel lines. The uses of T-square are to align the drawing paper to the

drawing board, and to draw parallel horizontal lines on the paper.

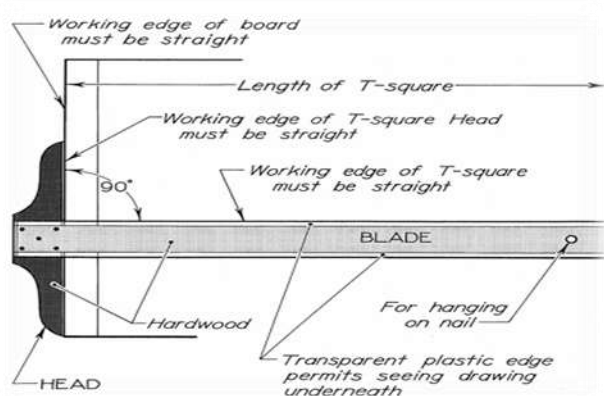


Figure 2.1. T-square



- **Drawing Board**

Drawing Board; is Available in a variety of styles and sizes. Most are adjustable up and down, and can tilt to almost any angle from vertical 90° to horizontal. The drawing surface must be clean, flat, smooth, and large enough to accommodate the drawing and some drafting equipment. If a T-square is to be used, at least one edge on the board must be absolutely true. Most quality boards have a metal edge to ensure against warping and to hold the T-square securely.



Figure 2.2. Drawing Board

- **Tracing paper** is a thin white transparent paper for general use where one drawing is to be made over another. But if ink was applied then you cannot use again. This material is recommended to use in preparation of plans and specifications.



Figure 2.3: Tracing paper

Page 7 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
---------------	---	---	----------------------------



- **Compass**

Drawing Compass History and Types of Compasses

A technical drawing tool named drawing compass is used to draw circles or arcs. This tool is also known as a pair of compasses, or simply as a compass. It can also be used for measuring distances or more precisely distances on the maps. Apart from that, drawing compasses are used in navigation, mathematic, drafting and any many other disciplines. Materials of which compasses are made are usually plastic or metal. Drawing compass has two parts connected by a hinge so the radius of the circle that is drawn can be adjusted and changed. Usually at the end of one part is a needle and at the end of another is a pencil. First drawing compasses were found in the archeological digging of ancient Rome. Every drawing compass before the eighteenth century didn't have a pen but a needle instead so it scratches the surface. By the twentieth century, drawing compasses were spread widely throughout the world.



Figure 2.4: Compass

- **Divider**

Dividers are similar to compasses, except that both legs are provided with needle points. As with compasses, dividers are available in large and small sizes, Dividers are used to transfer measurements. To step off a series of equal distances, and to divide lines into a number of equal parts A divider is similar to a compass, except that it has a metal point on each leg. It is used to lay off distances and to transfer measurements



Figure: 2:5 Divider

Page 8 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
---------------	---	---	----------------------------



- **Triangles (Set- square)**

Triangles (setsquares) They are used to construct the most common angles (i.e. 30° , 45° , 60°) in technical drawings. The $45^{\circ} \times 45^{\circ}$ and $30^{\circ} \times 60^{\circ}$ triangles are the most commonly used for ordinary work.

Triangles are used in combination with the T square or straightedge to draw vertical and inclined lines. They are usually made of transparent plastic, which allows you to see your work underneath the triangles

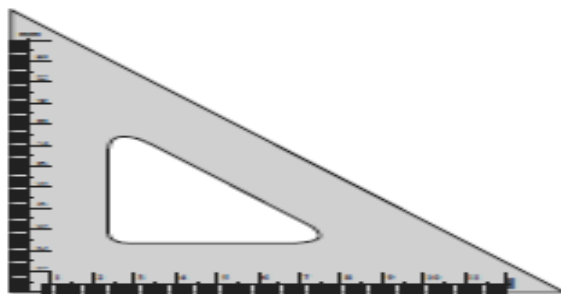


Fig.2;6 45 Set Square

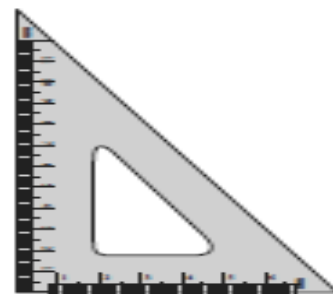


Fig.2.7: 30|60 Set Square

- **Drawing Templates**

A template is a thin, flat piece of plastic containing various cutout shapes. It is designed to increase the speed and accuracy of the Drafter. Templates are available for drawing issee as following circles, ellipses

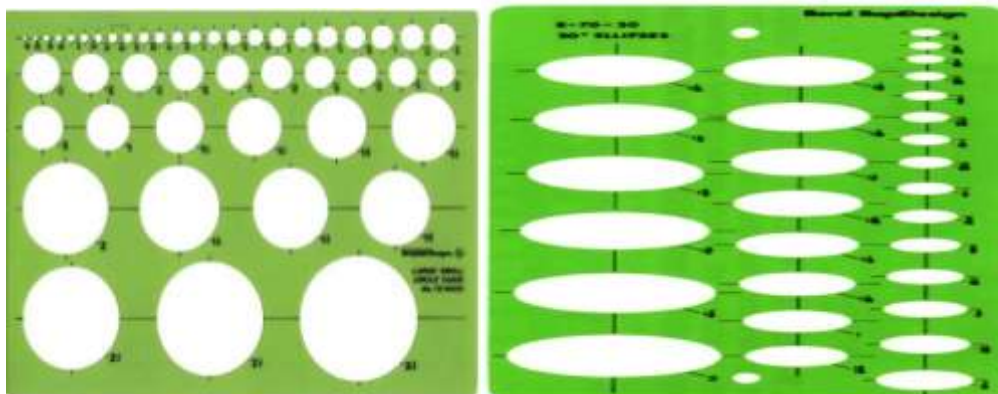


Figure 2:6 Circle Template

Figure2 :7 ellipse template

- **French curves and flex curves**

French curves are thin plastic tools that come in assortment of curved surfaces. They are used to produce curved lines that cannot be made by a compass. Most common French curves are actually segments of ellipses, **parabolas** and **hyperbolas**.



Figure: 2; 8 French curves and flex curve

Protractor

Protractors are used to mark or measure angles between 0 and 180°. They are semicircular in shape (of diameter 100mm) and are made of Plastic or celluloid which has more life. Protractors with circular shape capable of marking and measuring 0 to 360° are also available in the market.



Figure.2; 9 Protractors

- **Drawing Paper**

They are available in many varieties and good quality paper with smooth surface should be selected for Drawings which are to be preserved for longer time. Recommended Standard size of drawing sheet Designation Size (mm) is.

SIZE (MILLIMETERS)		LETTER SIZE
WIDTH	LENGTH	
210	x 297	A4
297	x 420	A3
420	x 594	A2
594	x 841	A1
841	x 1189	A0

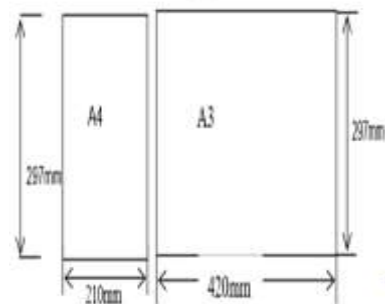


Figure 2.10: Drawing Paper

Drawing Pencils:



The accuracy and appearance of a Drawing depends on the quality of Pencil used to make Drawing. The grade of a Pencil lead is marked on the Pencil. HB denotes medium grade. Increase in hardness is shown by value put in front of H such as 2H, 3H etc., Softer pencils are marked as 2B, 3B, and 4B etc. A Pencil marked 3B is softer than 2B and Pencil marked 4B is softer than 3B and so on. Beginning of a Drawing may be made with H or 2H. For lettering and dimensioning, H and HB Pencils are used.



Figure 2.11: Drawing Pencils

- **Pencil sharpener** is an essential for sharpening pencils. Accurate drawings cannot be produced unless they are sharp. However, when shading a blunt pencil is sometimes useful. This is an electrical pencil sharpener and it is a heavy duty. Very precise and sensitive pencil sharpener. Be very careful with it so that it will not consume your pencil easily.



Figure 2.12: Pencil sharpener

- **Eraser:** Are a soft and a consumable material. There are two kinds of it, an eraser for pencil and an eraser for ink pen.



Figure 2.13: Erase

- **Ruler:** is possibly one of the most important pieces of drawing equipment. Be remembered that the edge of a ruler is not guaranteed to have a perfectly straight edge unlike a good T-Square or set square. The recommended material for a ruler is a plastic but for cutting purpose, it is advisable to

Page 11 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



use a metal ruler. Recommended maximum dimension of a ruler is 12 inches and it is commonly known as one foot ruler.

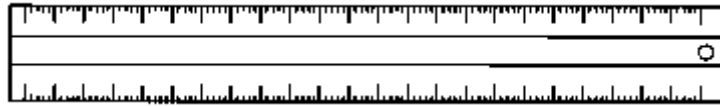


Figure: 2.3. Ruler

- **Scales:** The architectural draftsman's scale is made in various lengths, but 12 -inch triangular scale will be found best for student use. This has in one face the normal full size division of the foot.

The scale at which the drawing is to be made may depend upon three things: first the size of the paper on which the draftsman wishes to work; second the size of the building or detail to be drawn; third, the amount of detail that is desirable to show in the drawing.

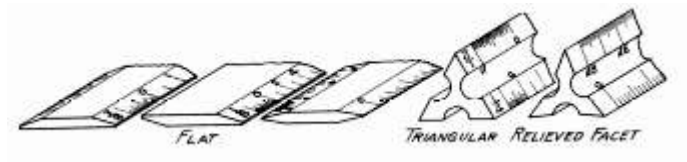


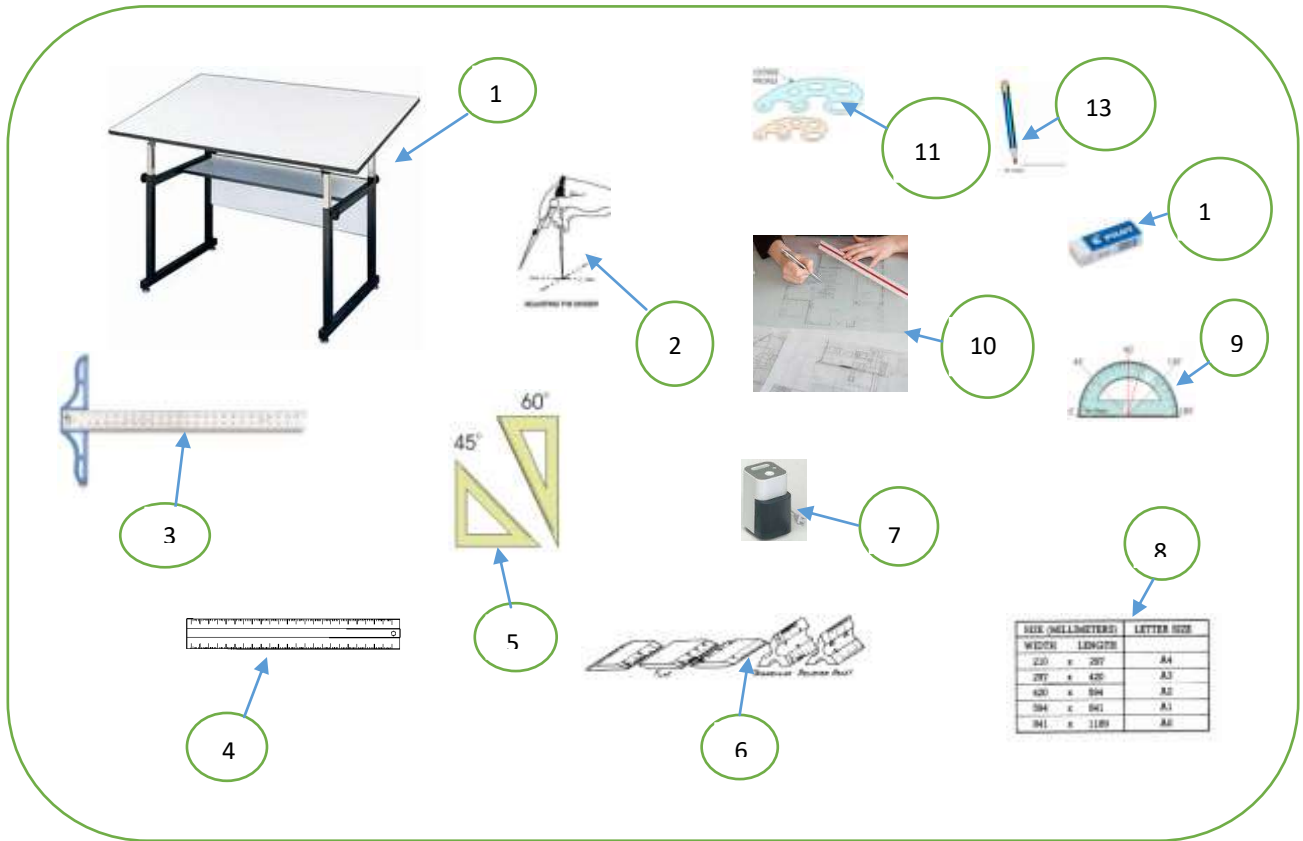
Figure: 2.4. Scales:

Page 12 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Self-Check -2	Written Test
----------------------	---------------------

Directions: Answer all the questions listed below.



Note: Satisfactory rating - 8 and 12 points

Unsatisfactory - below 8

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Name: _____

Date: _____



Basic Electrical Electronics Equipment Servicing Level - I Learning guide- 33

Unit of Competence: **Prepare and Interpret
Technical Drawing**

Module Title: **Preparing and Interpreting
Technical Drawing**

LG Code: EEL BEE1 M08 Lo2-LG33

TTLM Code: EEL BEE1 TTLM 0919V1

LO2: Interpreting technical drawing

Page 14 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



This learning guide is developed to provide you the necessary information regarding the following learning outcome coverage:–

- Recognizing Components, and assemblies or objects as required.
- Identifying correct **Dimensions** of the key features of the objects depicted in the drawing.
- Identifying and interpreting **Symbols** correctly used in the drawing.
- Checking and validating drawing against job requirements or equipment in accordance with standard operating procedures.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to –**

- Recognize Components, and assemblies or objects as required.
- Identify correct **Dimensions** of the key features of the objects depicted in the drawing.
- Identify and interpret **Symbols** correctly used in the drawing.
- Check and validate drawing against job requirements or equipment in accordance with standard operating procedures.

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described below 3 to 6.
9. Read the information written in the information “Sheet 1, Sheet 2 , and Sheet 3
10. Accomplish the “Self-check 1, Self-check 2 and, Self-check 3 **in page -6, 9, 12 and 14** respectively.
11. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, **in page -15.**
12. Do the “LAP test” **in page – 16** (if you are ready)

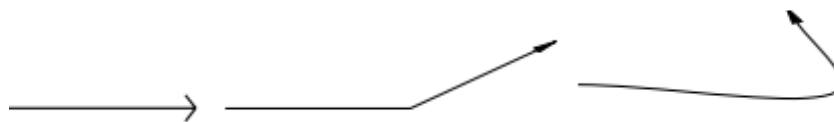


1.1 Types of Drawing Lines

The ability to read and interpret drawings and blueprints depends on the ability to recognize the different types of lines used in making the drawings, and to understand how these lines describe the object or parts represented. Lines used to represent an object and to aid in reading the drawing are made in definite standard forms. The relative thickness of a line, (thick or thin) and the line's composition: solid, broken, dashed have specific meanings.

Along with line weight and quality, there are standards for different types of lines. Each has a definite meaning and is recognized as a typical symbol or object within the building trades industry. Below are standard types of lines that will typically be used in design drawings.

- **Object lines:** are thick solid lines that outline all surfaces visible to the eye. Solid lines are also used for leader lines and dimension lines.
- **Hidden lines:** consisting of short, evenly-spaced dashes outline invisible or hidden surfaces. They are thin lines, about half as heavy as visible lines. They always begin with a dash in contact with the line from which they start, except when a dash would form a continuation of a solid line.
- **Movement, ghost or phantom line:** are thin lines used to indicate alternate positions of the parts of an object, repeated detail or the locations of absent parts. This can include bi-swing doors, the space needed for drawer and cabinet door openings, sliding door opening direction, hinge points for doors and windows in elevation. They are made by alternating one long and two evenly spaced, short dashes, with a long dash at each end.
- **Extension lines:** are short, solid lines used to show the limits of dimensions. They may be placed inside or outside the outline of an object. They extend from an outline or surface, but do not touch it. Extension lines are the same weight as invisible lines.
- **Leader line:** indicate the part or area of a drawing to which a number, note or other reference applies. They are solid lines and usually terminate in a single arrowhead.



- **Break lines:** are used when the extents of a drawing cannot fit on the size of paper being used for drawing. It can also be used when you only need to illustrate a portion of a design or a partial view.

There are long and short break lines. These indicate that a part is broken out or removed to show more clearly the part or the parts that lie directly below the broken out part. They also are used to reduce the size of the drawing of a long part having a uniform cross section so that it can be shown on a smaller sheet of paper. Short breaks are indicated by solid, thick, freehand lines. Long breaks are indicated by solid, thin, ruled lines broken by freehand zigzags. Breaks on shafts, rods, tubes, and pipes are curved.

- **Center lines:** are used to indicate the center of a plan, object, circle, arc, or any symmetrical object. Use a series of very long and short dashes to create a center line. If two center lines intersect use short dashes at the intersection.
- **Section line:** is used to show the cutaway view of a floor plan. A section cutting all the way through a floor plan is referred to as a full section. The direction of the arrows shows the direction of the section view.
- **Dimension line:** are short, solid lines that indicate the distance between two points on a drawing. They terminate or end in arrowheads at each end, and are broken to insert the dimension.
- **Cutting plane line:** consists of a heavy dash followed by two shorter dashes. At each end, it has a short line at right angles to the cutting plane line terminating with arrowheads pointing in the direction from which the cut surface is viewed.

Page 17 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Alphabet of Lines

BASIC LINES	LINE CHARACTERISTICS
① Visible (Object) Line	(THICK) —————
② Hidden Line	(THIN) - - - - -
③ Center Line	(THIN) - · - · -
④ Extension and Dimension Line	(THIN) —————
⑤ Cutting Plane Lines (Shows Direction of Viewing Plane)	(THICK) ↑ ——— ↑ (THICK) ↑ ——— ↑
⑥ Section Line	(THIN) —————
⑦ Break Lines	(THICK) ~~~~~ (FOR SHORT BREAKS) (THIN) - / - / - / - / -
⑧ Phantom Line	(THIN) - · - · -

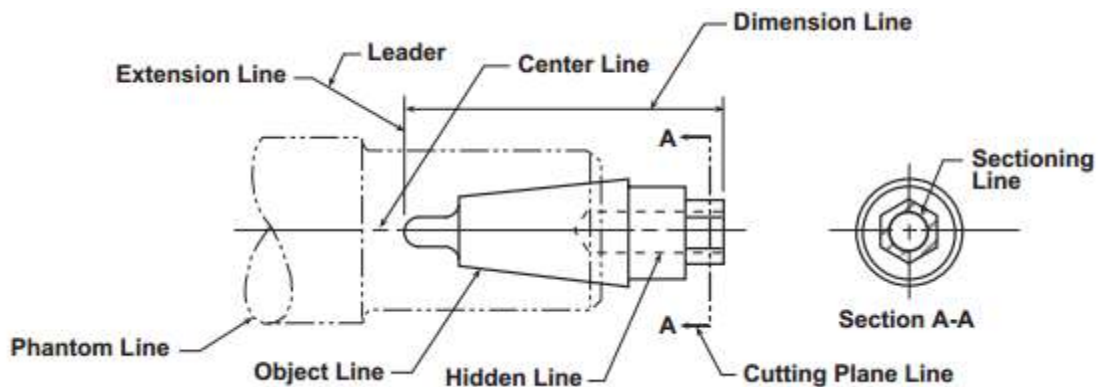
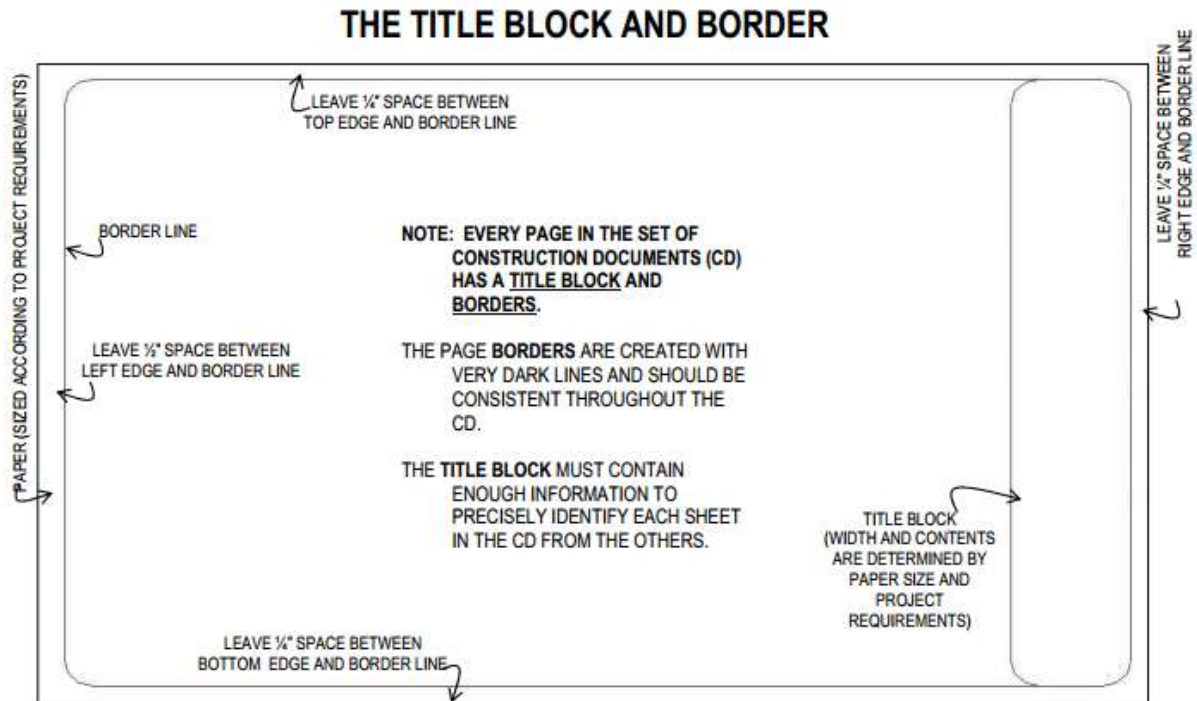


Fig.1.1. Example of line types

- **Phantom lines** shall be used to indicate the alternate position of parts of the item delineated, repeated detail, or the relative position of an absent part and shall be composed of alternating one long and two short dashes, evenly spaced, with a long dash at each end.
- **Border lines:** are most commonly used in drawing templates. It enclosed the boundaries of the drawing area and the title block. It has the heaviest line weight.
- **Title Block:** In every engineering drawing, a Title Block is included at the bottom right-hand corner. The Title Blocks are locally standardized but should be designed in such a way that it can be easily understood. The information needed in any standard Title Block is normally:



- Name of the Firm/School/College
- Name of the Object (Work piece)
- Number of the drawing (particularly useful for reference where more than one drawing are concerned --- typically in assembly drawings)
- Format of the paper used (paper size)
- Scale used
- Dimensioning unit (usually millimeters --- mm)
- Symbol for the method of projection used
- Date when the drawing was finished
- Name of the draftsman (draughtsman) --- e.g. student name if it is a normal class exercise
- Name of the person who checked the drawing
- Remarks





Self-Check -1	Written Test
----------------------	---------------------

Directions: Answer all the questions listed below.

I. Say True if the statement is correct and Say False if the statement is incorrect

1. Drawing is a graphic representation of a real thing, an idea, or a proposed design for later manufacture.
2. Artists some time take a subtle or abstract approach in communicating through their drawings
- 3 .A technical drawing is a means of clearly and concisely communicating all of the information necessary to transform an idea or a concept in to reality
4. Artistic drawings are used to express the feelings, beliefs, philosophies, and ideas of the artist.

Note: Satisfactory rating - 2 and 4 points

Unsatisfactory - below 2

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Name: _____

Date: _____



2.1. DIMENSIONS

A drawing without dimensions is meaningless. Dimensions are necessary to show the exact size of an object. Dimensioning refers to the act of giving dimensions, i.e., length, width, height, diameter, etc., of the object. This information is provided by giving numeric values to various features of the object on the drawing. A feature is an individual characteristic such as a flat or cylindrical surface, a slot or a groove, a taper, a shoulder, a screw thread, etc

- **Dimension** is a numerical value expressed in appropriate units of measurement and indicated graphically on technical drawings with lines, symbols and notes. The important aspects of dimensioning are as follows:
- **Units of Measurement :**

On technical drawing we need to show lengths and angles. The most convenient unit for length is millimeter. In civil engineering and architectural drawing, inch or foot is often used as a unit of length. Angles are shown in degrees.

- **Symbols** : Symbols are incorporated to indicate specific geometry whenever necessary.

Notes: Notes are provided to give specification of a particular feature or to give specific information necessary during the manufacturing of the object.

2.1.1. Elements of dimensioning

A line on the drawing whose length is to be shown is called and *objects line*. The object line is essentially an outline representing the feature(s) of the object. While showing an angle, the two lines forming the angle will be the object lines.

Dimensioning is often done by a set of elements, which includes ***extension lines***, ***dimension lines***, ***leader lines***, ***arrowheads*** and ***dimensions***.

- ***Extension line*** – is a short line drawn perpendicular to an object line. These line start immediately or a few millimeters from the ends of object lines and extend a few millimeters beyond a dimension line. Extension lines may be used to show an angle due to space constraint. In such case, extension lines are drawn parallel to and at the ends of object lines.
- ***Dimension line*** – is drawn between two extension lines parallel to the object line. As a rule, there must be one and only one dimension line between any two extension lines. One dimension line represents one dimension. While dimensioning an angle, a



curved dimension line is drawn by drawing a suitable arc having its center at the vertex of the angle.

- **Leader line** – is a line which connects a note or a dimension with the feature to which it applies. Leaders are drawn at suitable angles, preferably 30° , 45° or 60° , and are never drawn horizontal or vertical. One end of the leader carries an arrowhead which connects it to the outline of the object. A dot is used instead of an arrowhead, if the leader ends inside the object, figure 3.2(b). The other end of the leader is made horizontal. A note or dimension is placed above the horizontal portion of the leader. Leaders are frequently used to indicate the diameter or radius of a circular feature.

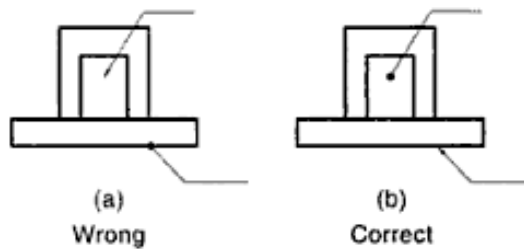


Fig.2.1. leader Line.

- **Arrowheads** – an arrowhead is drawn at each end of a dimension line. The tip of an arrowhead touches the extension line. An arrowhead is also drawn at the end of a leader, which points out the feature of an object. The various styles of drawing an arrowhead are shown in the figure below. The arrowheads may be open, closed, or closed and filled. The angle formed the barbs of the arrowhead usually varies from 15° to 90° . Sometimes, an oblique stroke drawn at 45° to the extension line is used instead of an arrowhead

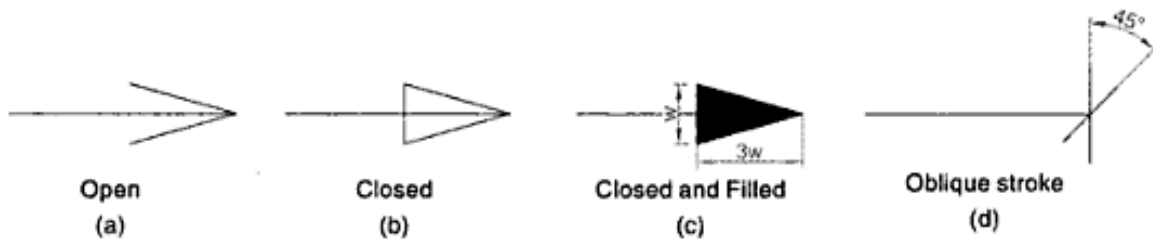


Fig.2.2. Arrow heads

The closed and filled arrowhead is most commonly adopted. It is the form of an isosceles triangle having a height three (3) times of its base. The space inside the triangle is uniformly filled in. The size of an arrowhead should be proportionate to the length of the dimension line. Too small or too large arrowheads should be avoided.

- ✓ **Dimension** – is a numeric value of length or angle expressed in a specified unit of measurement. Dimensions are placed near the middle and above dimension lines or at

Page 22 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



the center of dimension lines by breaking them. Since all dimensions of a drawing are expressed in the same unit (i.e., mm cm or in), the unit is not written after the dimension figure. Instead, a note “**ALL DIMENSIONS IN MM**” is written at a prominent place (preferably on the left hand side of the title block) on the drawing sheet. The dimension text should be same for all the dimensions on a drawing and should have a suitable size.

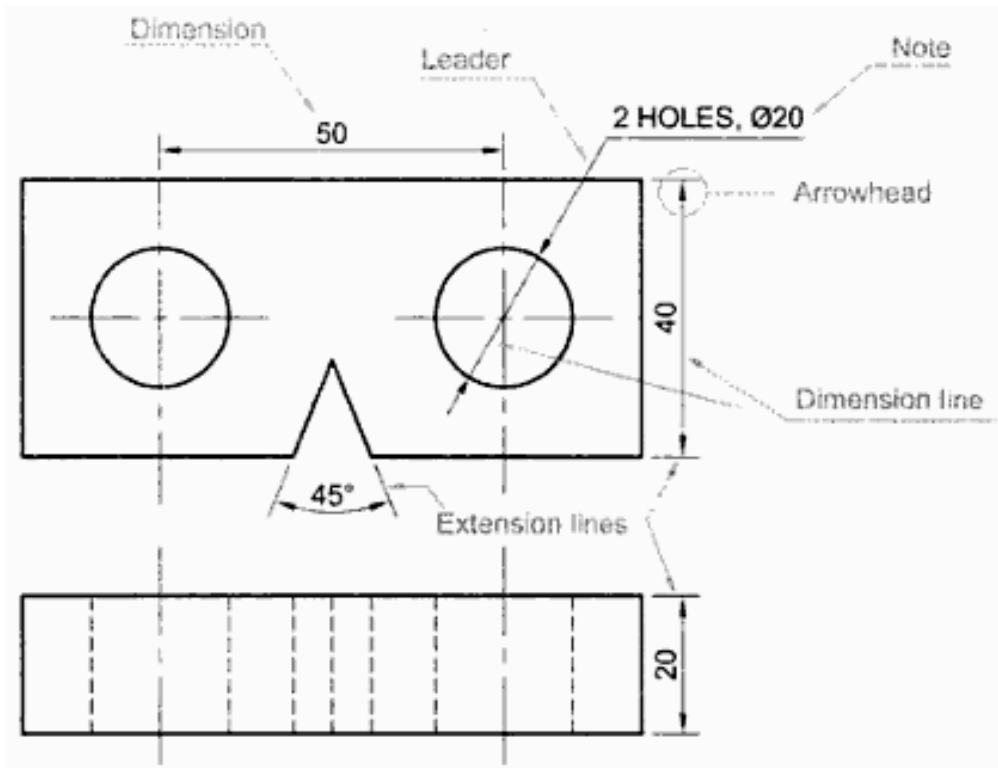


Figure A

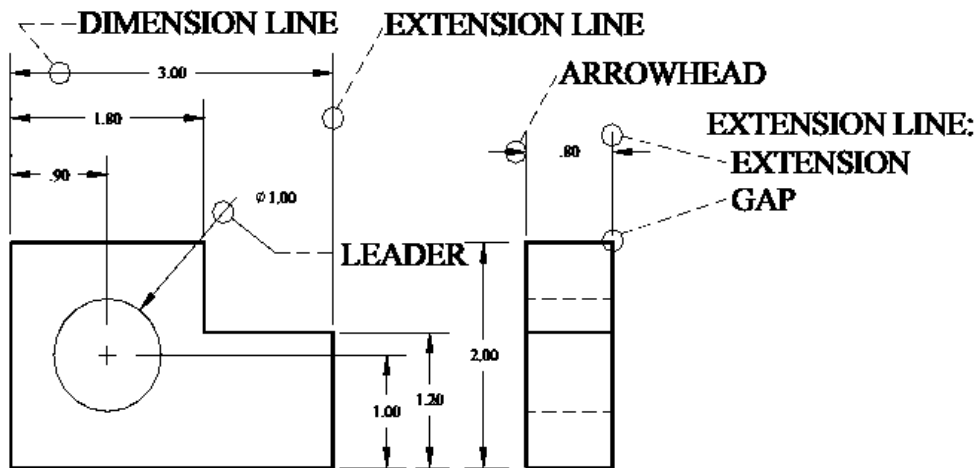
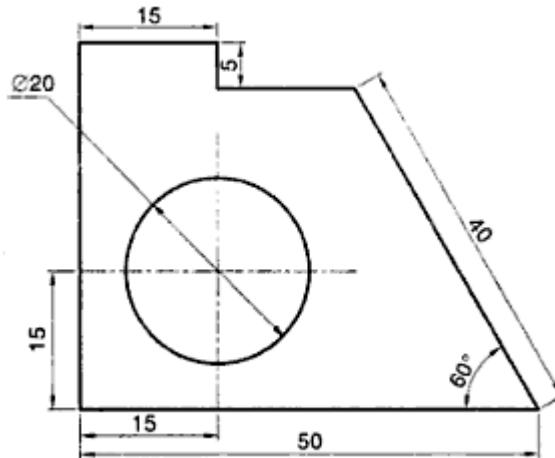


Figure B

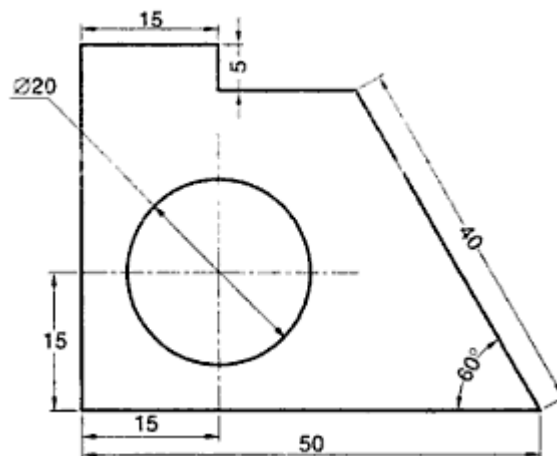
- For placing the dimensions on a drawing, of the two systems Elements of dimensioning is adopted.
- ✓ **Aligned system** – dimensions are placed perpendicular to the dimension line so that they may be read from the bottom or right-hand side of the drawing sheet. All horizontal and inclined dimensions can be read from the bottom, whereas vertical dimensions can



be read from the right-hand side of the drawing sheet. Dimensions are placed at the middle and on top of the dimension lines.



- ✓ **Unidirectional system** – dimensions are placed in such a way that they can be read from the bottom edge of the drawing sheet. All horizontal dimensions are placed at the middle and on the top of the dimension lines while vertical and inclined dimensions are inserted by breaking the dimension lines at the middle.



It should be noted that dimensioning leader for both system is the same.

• Rules for dimensioning

The following rules for dimensioning must be adopted to achieve the good dimensioning characteristics like clearness, completeness, readability and accuracy.

1. Between any two extension lines, there must be one and only one dimension line bearing one dimension.
2. As far as possible, all dimensions should be placed outside the views. Inside dimensions are preferred only if they are clearer and more easily readable.



- All dimensions on a drawing must be shown using either **aligned system** or **unidirectional system**. In no case should, the two systems be mixed on the same drawing.
- The same unit of length should be used for all the dimensions on a drawing. The unit should not be written after each dimension, but a note mentioning the unit should be placed below the drawing.

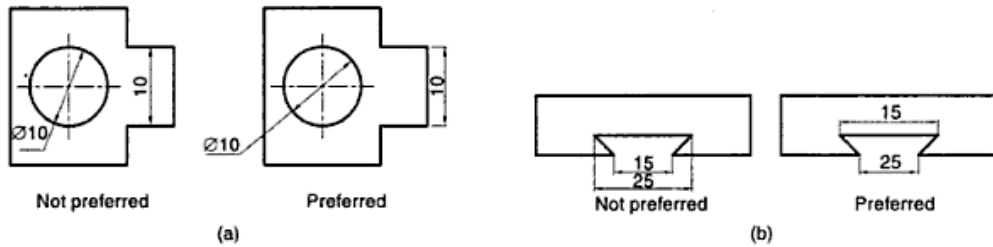
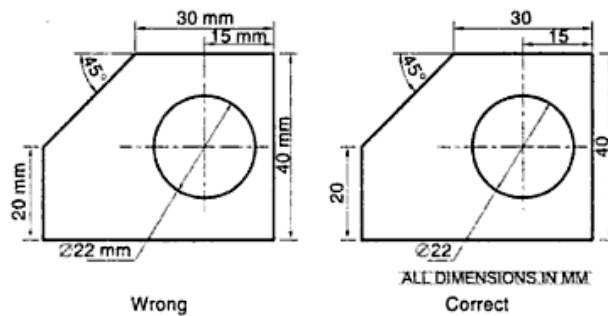


Fig. 3.6



- Dimensions lines should not cross each other, Dimension lines should also not cross any other lines of the object. However, extension lines may cross each other or outlines of the object.

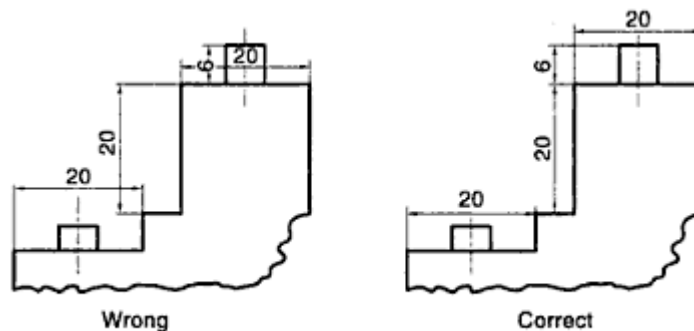


Fig. 3.8

- All dimensions must be given. As far as possible, there should not be need for calculation, assumption or direct measurement for any dimension.
- Each dimension should be given only once. No dimension should be redundant, i.e., no dimension should be repeated directly or indirectly. If a particular dimension is mentioned, directly or indirectly, in one view, it should not be repeated in other views.

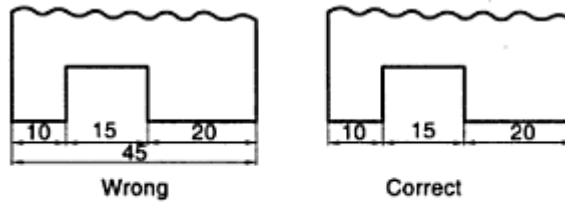
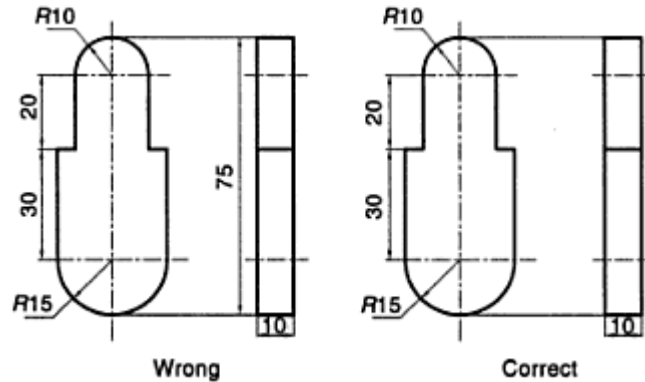


Fig. 3.9(a)



8. Do not use an outline or a centerline as a dimension line. A centerline may be extended serve as an extension line
9. When it is necessary to place a dimension within a sectioned area, leave a blank space for the dimension.

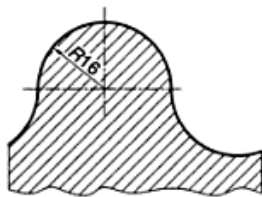


Fig. 3.10

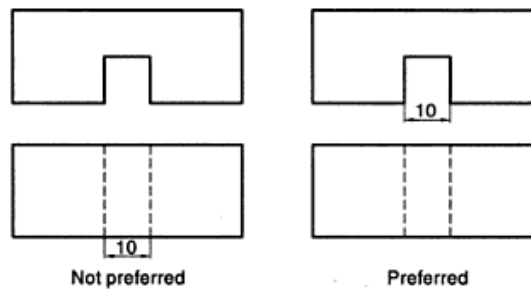


Fig. 3.11

10. Avoid dimensioning hidden lines.
11. Keep dimensions 6 – 8 mm away from the object line and also from each other.
12. If the space between two extension lines is too narrow to mark arrowheads and the dimension then one of the following ways, depending on space availability, should be adopted.
 - (i) Draw arrowheads touching the outsides of the extension lines and pointing toward each other. Place the dimension above the dimension line.
 - (ii) Draw arrowheads as in (i) above and place the dimension at one end of the dimension line outside of the extension line.

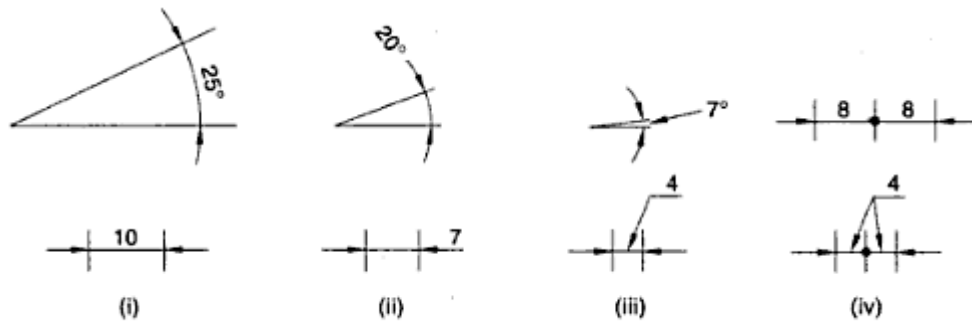


Fig. 3.12(a)

- (iii) Draw arrowheads as in (i) above and place the dimension at the end of the leader which terminates on the dimension line.
- (iv) For two consecutive dimensions, replace two intermediate arrowheads by a dot and place the dimensions as in (i) or (iii) above, depending on the space availability.

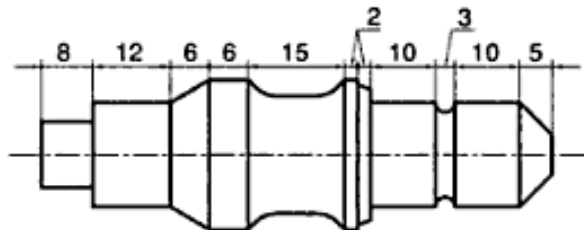


Fig. 3.12 (b)

13. For dimensions in series, adopt any one of the following ways :

- (i) **Chain dimensioning (continuous dimensioning)**: All the dimensions are aligned in such a way that an arrowhead of one dimension touches tip-to-tip the arrowhead of the adjacent dimension. The overall dimension is placed outside the other smaller dimensions.
- (ii) **Parallel dimensioning (progressive dimensioning)**: All the dimensions are shown from a common reference line. Obviously, all these dimensions share a common extension line. This method is adopted when dimensions have to be established from a particular datum surface.
- (iii) **Combined dimensioning**: When both the methods, i.e., chain dimensioning and parallel dimensioning are used on the same drawing, the method of dimensioning is called combined dimensioning.

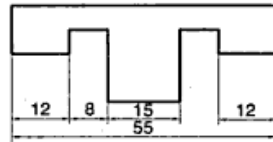


Fig. 3.13(a)

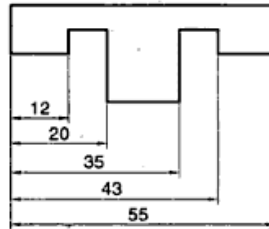


Fig. 3.13(b)

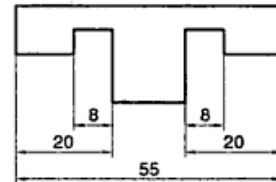
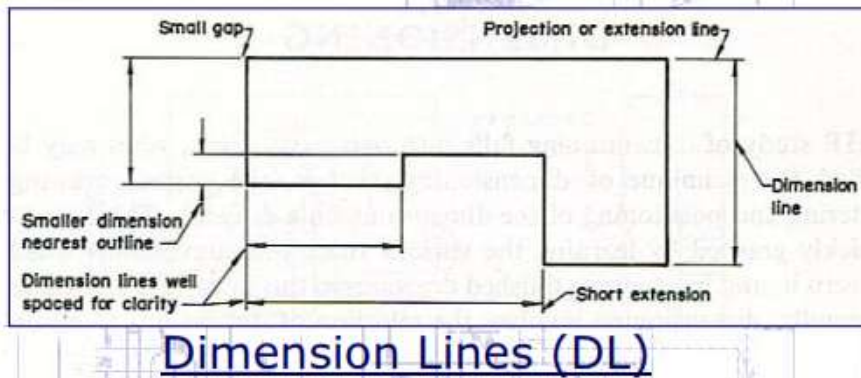


Fig. 3.13(c)

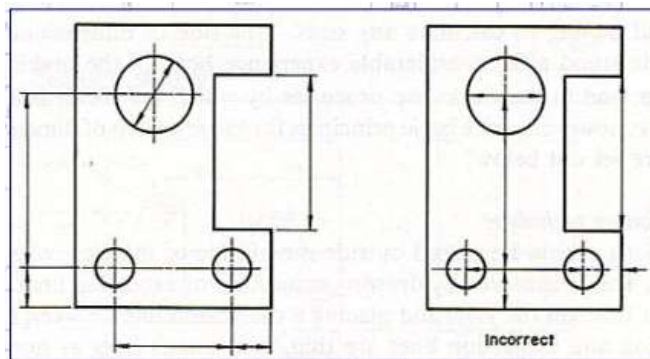
14. Smaller dimensions should always be placed nearer the view. The next dimension should be placed next and so on. The overall dimension should always be away from the view. This will avoid crossing of the extension lines and dimension lines.

15. All notes should be written horizontally

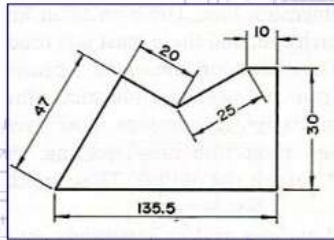
Below are samples figures on how to place dimensions in objects:



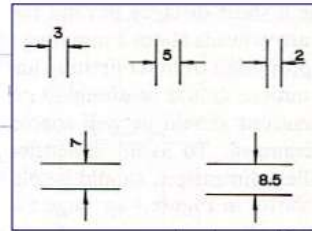
Dimension Lines (DL)



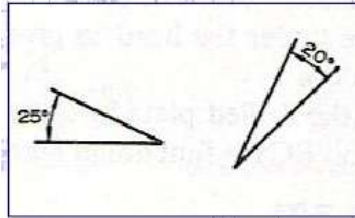
Position of DL



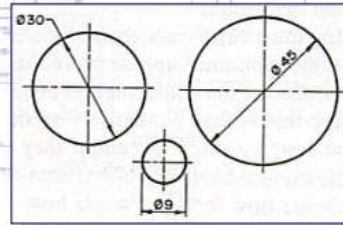
Alignment of DL



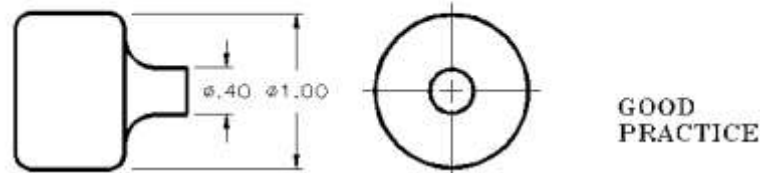
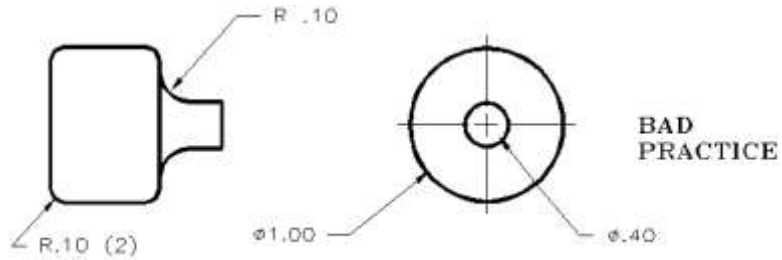
DL of Small Features



Dimensioning Angles



Dimensioning Circles





Correct Practice of Dimensioning

(a) Over-dimensioned. Overall dimension given in two different ways

(b) Correctly dimensioned. One intermediate dimension omitted

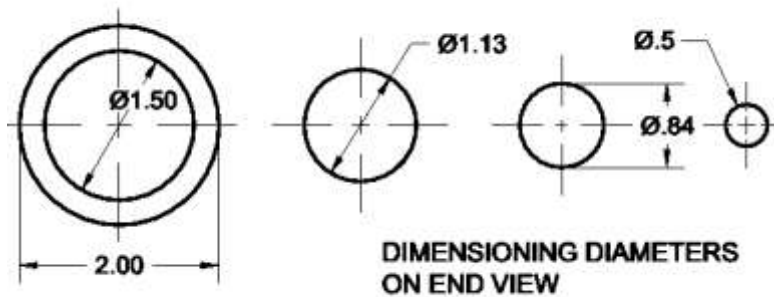
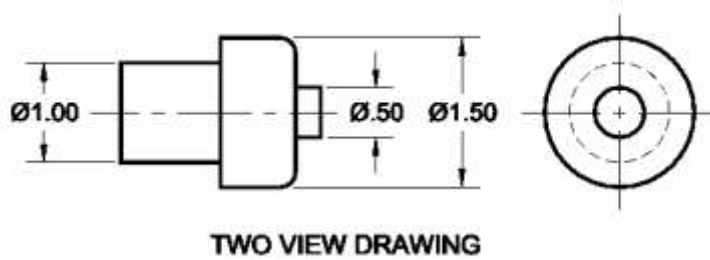
(c) Correctly dimensioned. Overall dimension given as an auxiliary dimension only

(c) Over-dimensioned

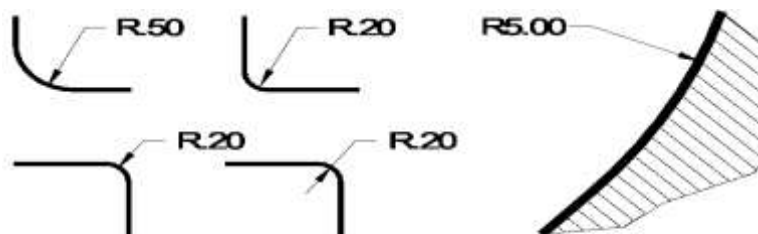
(d) Correctly dimensioned

Drawing should only carry dimensions needed to manufacture

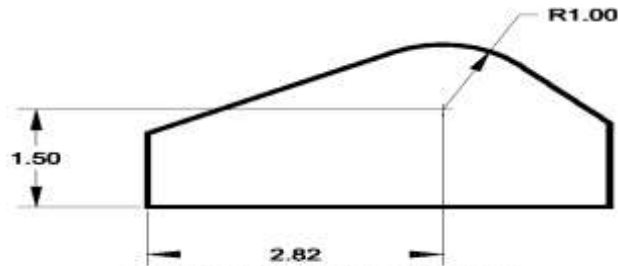
OSHA



DIMENSIONING DIAMETERS



DIMENSIONING RADII which do not need their centers located



**DIMENSIONING RADII
when locating the radius center.**

Metric

Decimal Inch

- Decimals are the ANSI standard.
- Decimals are easier to add, subtract, multiply and divide than fractions.
- Preferably, decimals should be rounded to two decimal places (Unless more precision is required).

- Where linear measurement are less than 10,000 millimeters, the millimeter is the standard unit of measure.
- The abbreviation for millimeters (mm) is usually omitted when all dimensions are in millimeters.
- The period is used as a decimal point only in English speaking countries, others use a comma.

Leading and Trailing Zeros

	Inches	Millimeters
Values less than one unit	Show trailing zeros Omit leading zeros .250 .500 .875	Show leading zeros Omit trailing zeros 0.25 0.5 0.875
Values greater than or equal to one unit	Show trailing zeros 1.000 1.500 1.875	Omit trailing zeros 1 1.5 15



Self-Check -2	Written Test
---------------	--------------

Directions: Answer all the questions listed below.

I. Say True if the statement is correct and Say False if the statement is incorrect

1. **Symbols** are incorporated to indicate specific geometry whenever necessary.
2. **Extension line** – is a short line drawn perpendicular to an object line.
3. **Dimension line** – is drawn between two extension lines parallel to the object line.
4. **Leader line** – is a line which connects a note or a dimension with the feature to which it applies
5. **Arrowheads** – an arrowhead is drawn at each end of a dimension line
6. **Aligned system** – dimensions are placed perpendicular to the dimension line so that they may be read from the bottom or right-hand side of the drawing sheet
7. **Unidirectional system** – dimensions are placed in such a way that they can be read from the bottom edge of the drawing sheet

Note: Satisfactory rating - 2 and 4 points

Unsatisfactory - below 2

You can ask you teacher for the copy of the correct answers.

Score = _____
Rating: _____

Name: _____

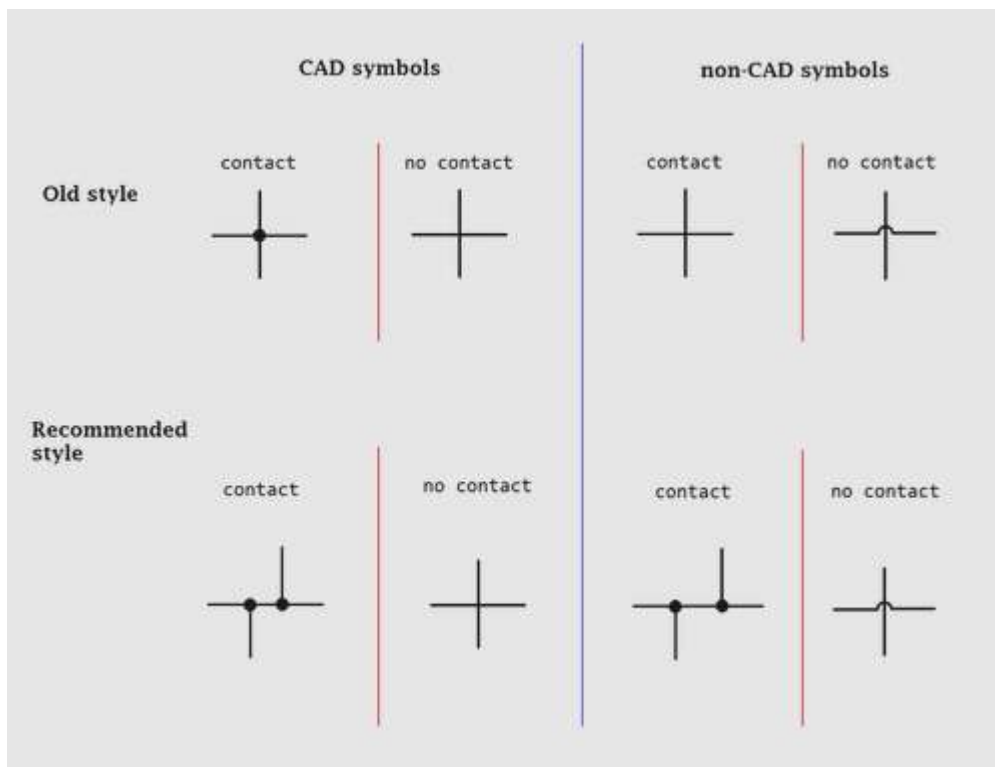
Date: _____



3.1. SYMBOLS

Symbols

A **less common symbol** is simply a series of peaks on one side of the line representing the conductor, rather than back-and-forth as shown here. Circuit diagrams are pictures with symbols that have differed from country to country and have changed over time, but are now to a large extent internationally standardized. Simple components often had symbols intended to represent some feature of the physical construction of the device. For example, the symbol for a resistor shown here dates back to the days when that component was made from a long piece of wire wrapped in such a manner as to not produce inductance, which would have made it a coil. These wire wound resistors are now used only in high-power applications, smaller resistors being cast from *carbon composition* (a mixture of carbon and filler) or fabricated as an insulating tube or chip coated with a metal film. The internationally standardized symbol for a resistor is therefore now simplified to an oblong, sometimes with the value in ohms written inside, instead of the zig-zag symbol.





Wire Crossover Symbols for Circuit Diagrams.

The CAD symbol for insulated crossing wires is the same as the older, non-CAD symbol for non-insulated crossing wires. To avoid confusion, the wire "jump" (semi-circle) symbol for insulated wires in non-CAD schematics is recommended (as opposed to using the CAD-style symbol for no connection), so as to avoid confusion with the original, older style symbol, which means the exact opposite. The newer, recommended style for 4-way wire connections in both CAD and non-CAD schematics is to stagger the joining wires into T-junctions

The linkages between leads were once simple crossings of lines. With the arrival of computerized drafting, the connection of two intersecting wires was shown by a crossing of wires with a "dot" or "blob" to indicate a connection. At the same time, the crossover was simplified to be the same crossing, but without a "dot". However, there was a danger of confusing the wires that were connected and not connected in this manner; if the dot was drawn too small or accidentally omitted (e.g. the "dot" could disappear after several passes through a copy machine). As such, the modern practice for representing a 4-way wire connection is to draw a straight wire and then to draw the other wires staggered along it with "dots" as connections (see diagram), so as to form two separate T-junctions that brook no confusion and are clearly not a crossover.

Electrical Symbols

The **American Society of Mechanical Engineers (ASME)** is a professional association that, in its own words, "promotes the art, science, and practice of multidisciplinary engineering and allied sciences around the globe" via "continuing education, training and professional development, codes and standards, research, conferences and publications, government relations, and other forms of outreach. ASME is thus an engineering society, a standards organization, a research and development organization, a lobbying organization, a provider of training and education, and a nonprofit organization. Founded as an engineering society focused on mechanical engineering in North America, ASME is today multidisciplinary and global.










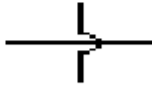


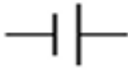

- **COMMON ELECTRICAL SYMBOLS**

Electrical Symbols are small drawings or pictograms used to represent various electrical devices in a diagram or plan of an electrical circuit. These symbols are used in sketching schematic diagrams and electrical plans for numerous types of electrical works. Practically any electrical fixture found in a house has a symbol that coincides to said fixture on an electrical wiring diagram. These are very useful guide for an electrician or electrical contractor, thus, making the wiring easier to install as well.

The following are common electrical symbols used in sketching wiring plan and diagram.

Page 34 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Symbol	Description	Symbol	Description
	Conductor/Wire		Ammeter
	Terminal		Voltmeter
	Switch		Galvanometer
	Fuse		Wattmeter
	Connected Wires		Wires Not Connected
	Circuit Breaker		Push Button
	Cell		Bell



	Battery		Buzzer
	Resistor		Speaker
	Capacitor		Antenna
	Diode		Male plug
	Ground		Service Entrance (3 wires)
	Lightning Arrester		Duplex Convenience Outlet
	Kilowatt-Hour Meter		Range Outlet
	Power Panel Board		Special Purpose Outlet
	Lighting Panel Board		Weatherproof Outlet



- ELECTRICAL SIGNS**

Your power tool with its manual may contain "WARNING ICONS" (a picture symbol intended to alert you to, and/or to instruct you how to avoid a potentially hazardous condition). Knowing and understanding these symbols will help you operate your tool better and more safely. Electrical signs and stickers alert students, workers, and visitors to electrical hazards in the area. Alerting workers to high voltage areas, electrical hazards, power lines and other electrical equipment in the area, can help prevent fires and injuries. Proper electrical signs can inform workers of the dangers in the area.


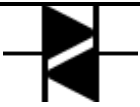
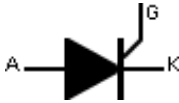
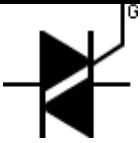
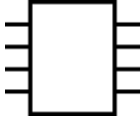
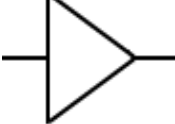
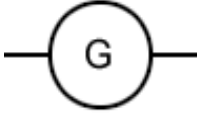
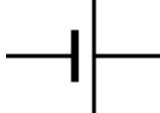
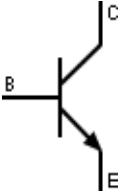
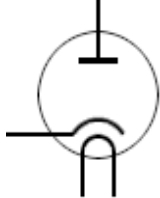


	<p>CAUTION indicates some precautionary measures against potential hazardous situation which, if not avoided, may result to a minor or moderate injury.</p>
	<p>SAFETY ALERT indicates that a person should observe extra awareness</p>
	<p>PROHIBITION means that any activity is not allowed as stated by the symbol.</p>
	<p>DANGER specifies hazardous situation which, if not avoided, will result to a serious injury or even death.</p>
	<p>WARNING specifies a potentially hazardous situation which, if not avoided, could result to serious injury or even death.</p>
	<p>READ AND UNDERSTAND INSTRUCTION MANUAL means that a person should make some reading before doing any activity.</p>
	<p>WEAR EYE PROTECTION indicates that a person should wear safety goggles or any related protection for the eyes.</p>







	<p>ELECTRICAL HAZARD indicates that electrical hazard is present in the area.</p>
	<p>VOLTAGE DANGER indicates high voltage in the area and surrounding equipment.</p>

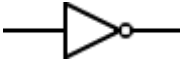
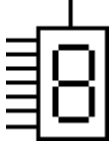
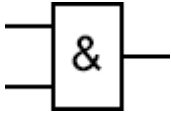
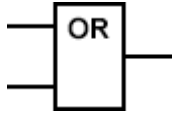
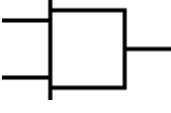

• **Symbols Pass components**

	Diode		Diac
	Thyristor		Triac
	IC / Chip		Amplifier
	Electric generator		Battery
	Transistor		Vacuum tube / Electron tube Example: Diode









• **Symbols active components (Digital electronic)**

	AND gate ANSI system		OR gate ANSI system
	NAND gate ANSI system		NOR gate ANSI system




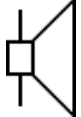







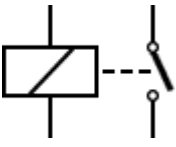
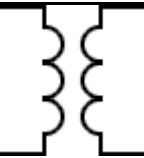
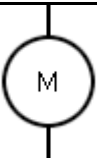
	Logic inverter		Display 7-segment LED
	AND gate British system		OR gate British system
	AND gate NEMA system		OR gate NEMA system

• **Instrumentation symbols**





	Ammeter		Voltmeter
	Ohmmeter		Frequencymeter
	Wattmeter		Electric clock
	Electrical counter / Integrator The asterisk is replaced by the letter or symbol for the quantity count		Recording instrument The asterisk is replaced by the letter or symbol of the magnitude recorded







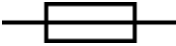
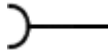



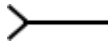
- **Other Basic Electrical and Electronic Symbols**

	Antenna / aerial		Speaker
	Microphone		Lamp / Light Bulb
	Direct current, DC		Alternating current, AC
	Positive polarity		Negative polarity
	Piezoelectric crystal		Relay (Coil and Switch)
	Electric transformer		Electric motor



	Resistor IEC system		Resistor NEMA system
	Inductor / Coil		Capacitor



	Switch		Circuit switch
	Pushbutton		Plug IEC system
	Fuse		Female plug IEC system
	Electric line		Plug NEMA system
	Ground		Female plug NEMA system



Self-check -2

Written Test

Direction I.

I. Write Short Answer for the Following Questions.

1. Draw symbols of the following electronic components. (4 points)

- Resistor
- Inductor
- Push button
- Fuse

Note: Satisfactory rating –11points

Unsatisfactory - below 11 points. You

can check the correct answers at the end of the Learning Guide



3.1 Checking and validating drawing version

Drafting standard and drawing management system has been established, a drawing validation process must exist to ensure compliance with corporate standards.

Oftentimes this consists of one or more drafters or checkers performing drawing audits from within AutoCAD software using various tools like Check Standards,

This process can be time-consuming and costly especially when a large amount of drawings must be processed within a short time period.

Several third-party applications exist to assist with this process but most require an extensive setup and an external database.

Validation should take place from the early to the final stages of our product lifecycle and even after the release of the final solution.

The most commonly used methods are surveys/questionnaires, usability tests, card sorting, eye-tracking, A/B tests and a continuous monitoring of how users are responding and interacting with your product even after every release.



1. Set up the drawing paper on top of the drawing board.
2. Check to see that the paper edges are parallel to the left and bottom edges of the board respectively.
3. Properly secure the paper on top of the table by using masking tape or tacks or the likes.
4. Using the set of triangles and T-square, draw the border line around the drawing paper, leaving area for the title block at the bottom part.
5. Divide the effective drawing area into nine (9) equal parts as shown in the figure template below.
6. Be sure to check the sharpness of your pencil lead. Use standard sharpening for good aesthetic result of your work.
7. For normal drafting or lettering use the soft lead pencil (**HB**) for final results. Use the harder lead pencil (**4H**) for guidelines drawing only.
8. Fill the each box with alphabet of lines according to each respectively examples. Observe approximately uniform spacing of your work.
9. This is not a work of speed but a work of accuracy and aesthetics, so do your work with quality.
10. You may submit your finish work once you are true but should be within the time specified for submission.



LAP TEST

Alphabet of Lines

Name: _____

Date: _____

Time started: _____

Time finished: _____

Instructions:

1. Using freehand sketching, you are required to do the following:
Request from your teacher the following materials.
 - ✓ HB drawing pencil lead
 - ✓ 4H drawing pencil lead
 - ✓ 45° x 90° triangle
 - ✓ 30° x 60° triangle
 - ✓ Eraser
 - ✓ T-square
 - ✓ Drawing table
 - ✓ Drawing papers
2. Draw and fill each box with the respective given sample alphabet of lines. See Figure 1 below.
3. Label each line type in the drawing below (Figure 2) within the guidelines.
4. You are given 1 hour to accomplish the task
5. Ask your teacher for an evaluation and feedback

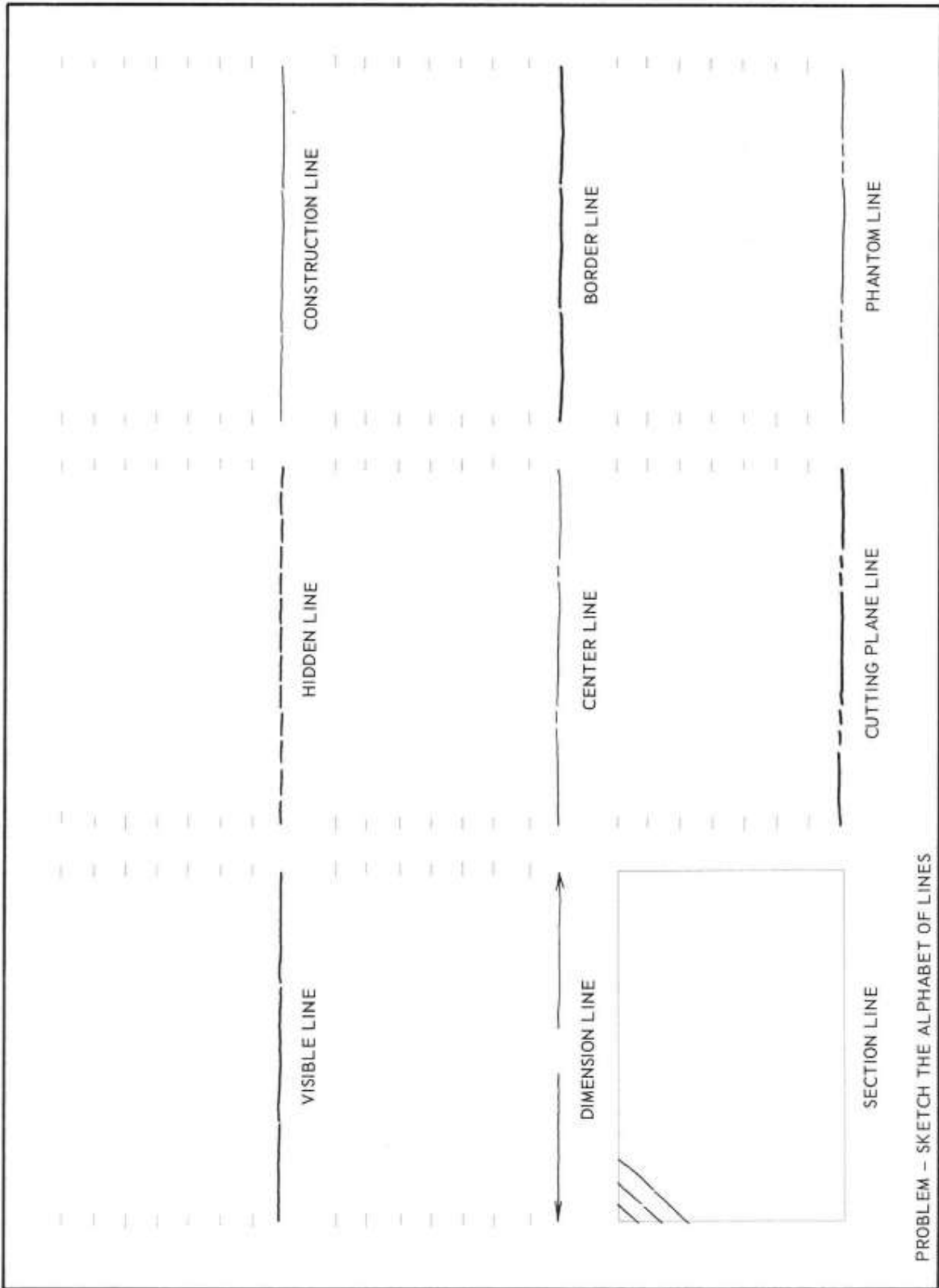


Fig. 1

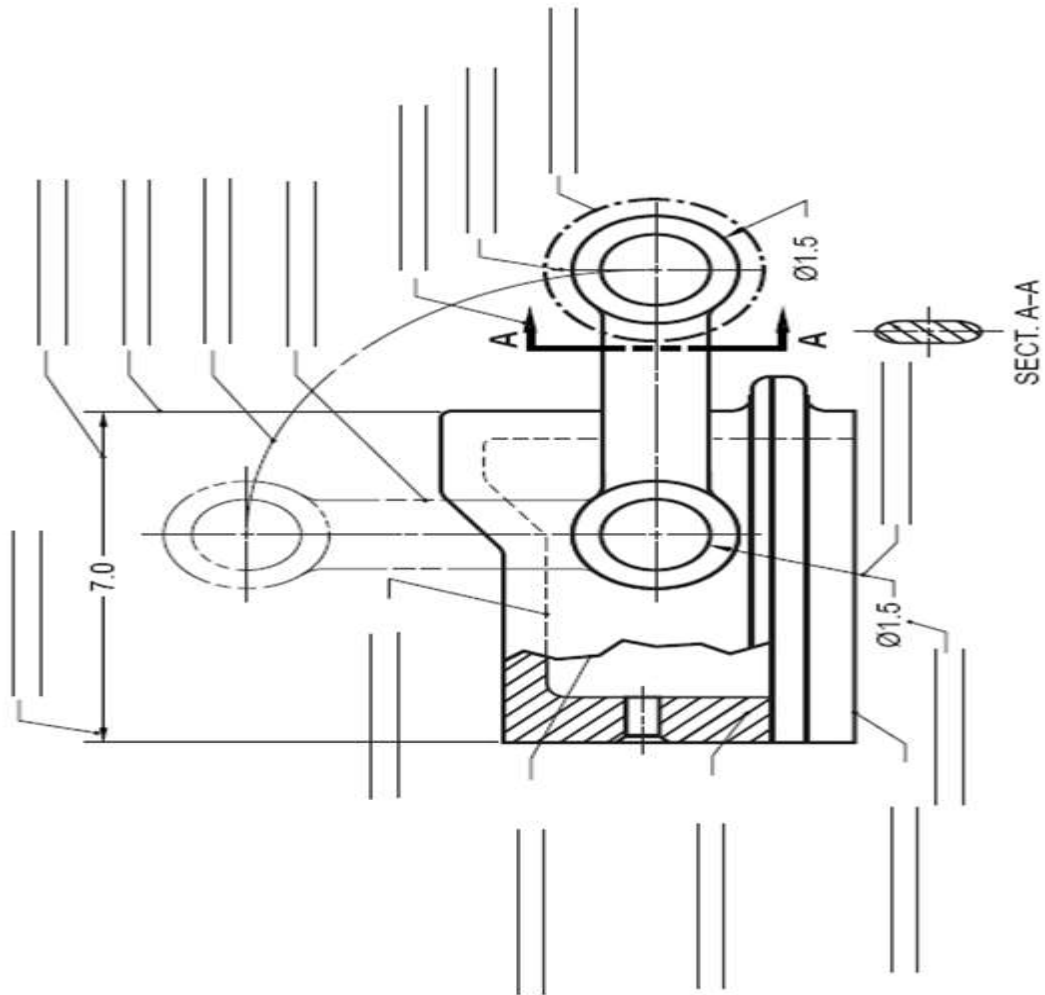


Fig. 2

Basic Electrical Electronics Equipment Servicing Level - I Learning guide- 34



Unit of Competence: **Prepare and Interpret
Technical Drawing**

Module Title: **Preparing and Interpreting
Technical Drawing**

LG Code: EEL BEE1 M08 Lo3-LG34

TTLM Code: EEL BEE1 TTLM 0919V1

LO3: Prepare/make changes to schematics and drawings

Instruction Sheet

Learning Guide # 34

This learning guide is developed to provide you the necessary information regarding the following learning outcome coverage:–

- Identifying Electrical/electronic schematic drawn correctly.
- Identifying and selecting Correct drawing equipment used in accordance with job requirements

Page 50 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to –**

- Identify Electrical/electronic schematic drawn correctly.
- Identify and select Correct drawing equipment used in accordance with job requirements

Learning Instructions:

13. Read the specific objectives of this Learning Guide.
14. Follow the instructions described below 3 to 6.
15. Read the information written in the information “Sheet 1, Sheet 2 , and Sheet 3
16. Accomplish the “Self-check 1, Self-check 2 and, Self-check 3 **in page -6, 9, 12 and 14** respectively.
17. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, **in page -15.**
18. Do the “LAP test” **in page – 16** (if you are ready

Information Sheet -1

Identifying Electrical/electronic schematic drawn correctly.

1.1. TYPES OF ELECTRICAL/ELECTRONIC DIAGRAMS

There are many kinds of electrical/electronic diagrams. Each kind of diagram suits its purpose.

- **ELECTRICAL WIRING DIAGRAM**



The flow of current in a conductor or wire can be represented by diagram. There are two types of diagram: pictorial diagram and schematic diagram.

- **Pictorial diagram** is a sketch of electrical circuit that shows the external appearance of each component. It is much like a photograph of the circuit and uses simple images of parts.

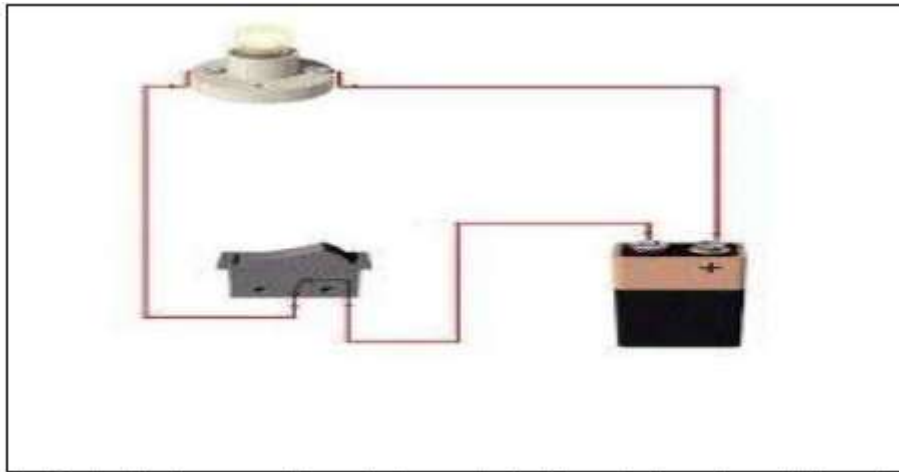
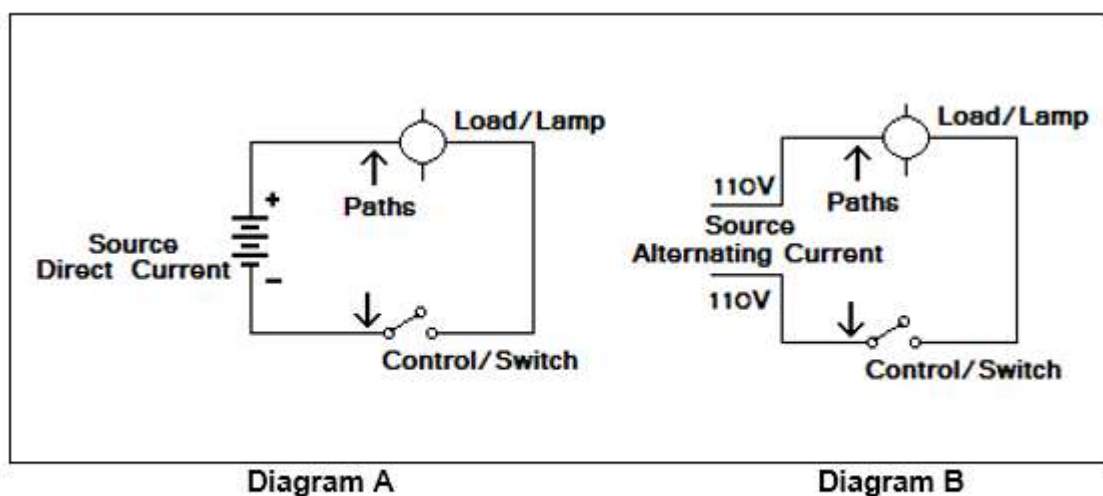


Fig.1.1. Pictorial diagram

Sample Pictorial diagram of one bulb controlled by single pole switch using 9 volt battery source.

- **Schematic diagram** is a sketch showing the components of the circuit using standard electrical symbols. It shows the actual number of components and how the wiring is routed but not the actual location



Sample schematic diagrams of one bulb controlled by single pole switch using *direct current* (Diagram A) and *alternating current* (Diagram B) source.

Fig.1.2. Schematic diagram

Page 52 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



1.2. Types of Circuit

A. Series Circuit is a circuit in which lamps are arranged in a chain, so that the current has only one path to take. The current is the same through each load. Example of this is the Christmas lights. It consists of a number of bulbs that are connected side by side to meet the voltage requirement which is 220 volts for alternating current.

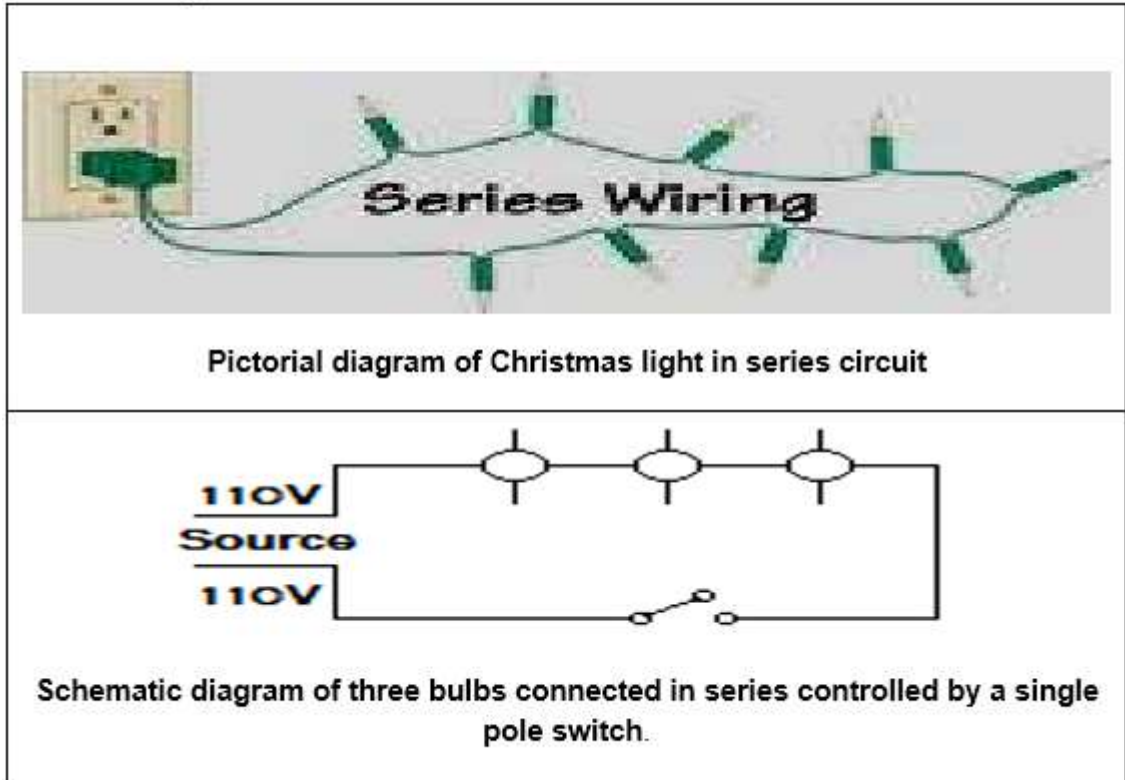


Fig.1.3. Series Circuit

B. Parallel Circuit is a circuit in which lamps are connected across the wires. The voltage across each load on parallel circuit is the same. The advantage of using parallel circuit is that even if one of the lamps fails, still the remaining lamps will function.

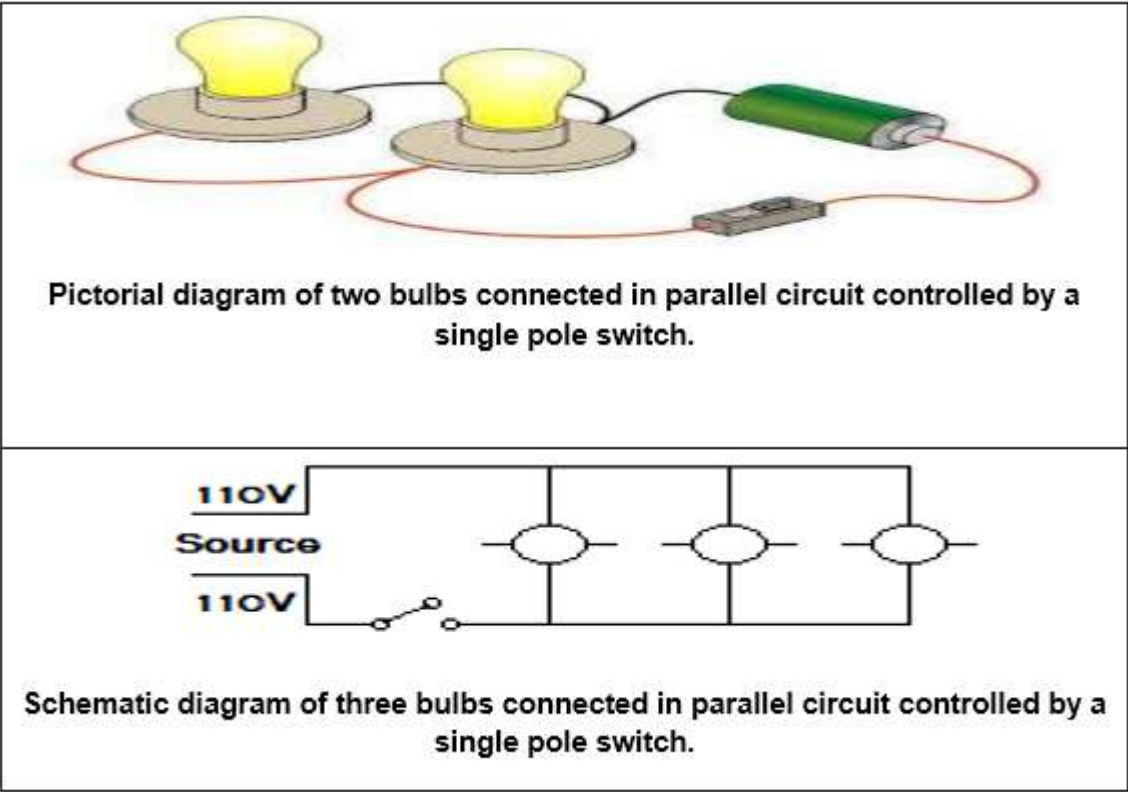


Fig.1.4. parallel Circuit

• **SINGLE-LINE DIAGRAM**

The single-line diagram is used basically for the same purpose as the block diagram. When used with text material, it gives you a basic understanding of the functions of the components of a system.

There are two major differences between the single-line diagram and the block diagram. The first difference is that the single-line diagram uses symbols, rather than labeled blocks, to represent components. Second, the single-line diagram shows all components in a single line. There are no interconnections shown for selected components as were shown on the block diagram (for example, alternator to voltage regulator and back to the battery). The single-line diagram is very simplified and should be used primarily to learn (in very broad terms) the function of each of the various components as a part of the total system.

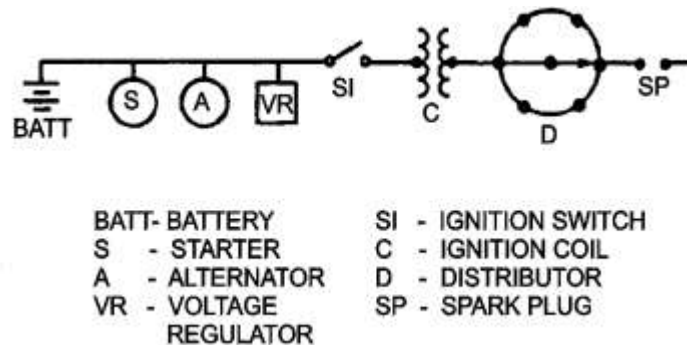




Fig. 1.5. Single line diagram

- **SCHEMATIC (ELEMENTARY) DIAGRAM:** Shows the ways a circuit is connected and what the circuit does using graphic symbols. The schematic does not have to show the size or shape of the parts of the circuit. It does not have to show where the parts of the circuit actually are.

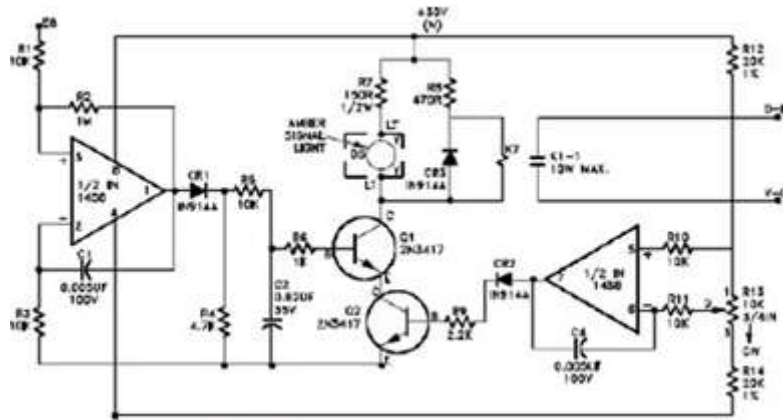


Fig. 1.6. Schematic diagram

1.3. Connection Or Wiring Diagram:

Shows how the components of a circuit are connected. It may cover connections inside or outside the components. It has as much detail as is needed to make or trace connections. The connection diagram usually shows how a component looks and where it is placed.

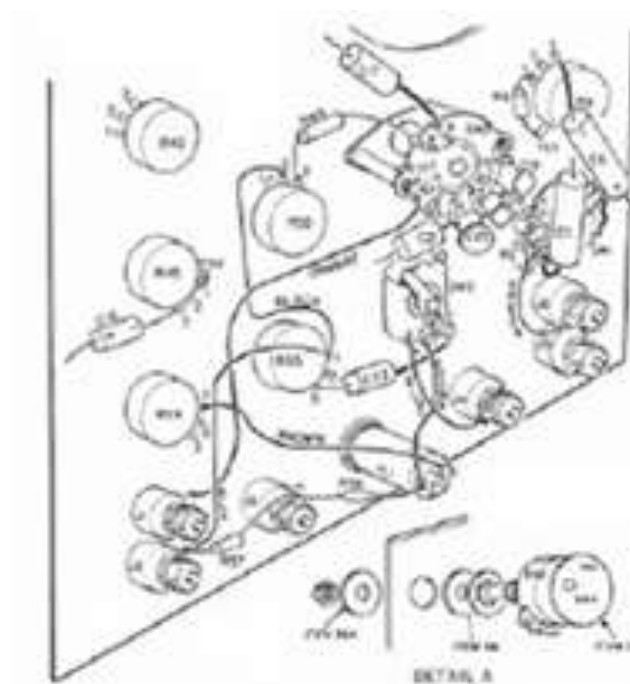




Fig.1.7. Installation assembly drawing

- LAY OUT DIAGRAM:** Is a pictorial representation of how the electronic circuit actually looks. These drawings show the actual lay out of the components on the circuit board. This provides a two dimensional drawing, usually looking down from the top, detailing the components in their location. Figure below shows the schematic for the circuit and the same circuit drawn in pictorial or lay out format for comparison. Normally the pictorial layout would be accompanied by a parts list.

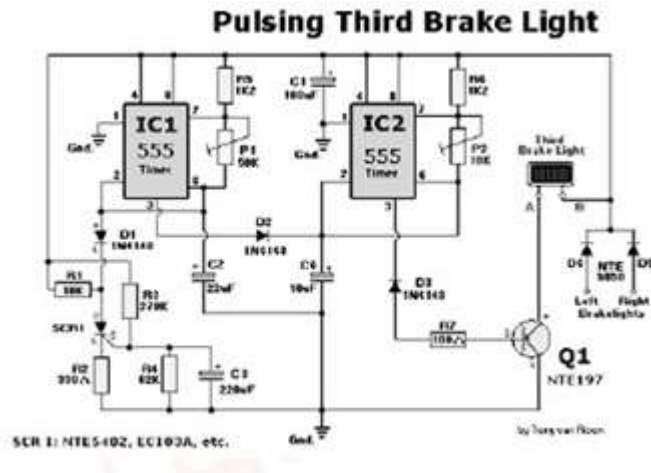
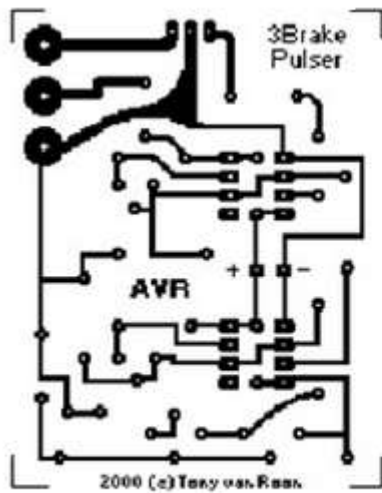
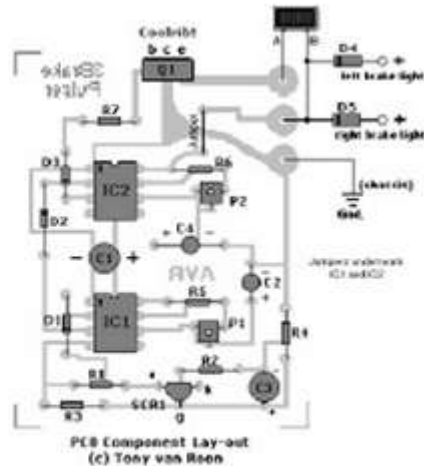


fig. 1.8. Schematic (elementary) of a pulsing third brake light diagram



B. Layout Diagram



C. Layout, component side

Fig.1.9. diagram of a pulsing third brake light

- BLOCK DIAGRAM**



A **block diagram** is used primarily to present a general description of a system and its functions. This type of diagram is generally used in conjunction with text material. A block diagram shows the major components of a system and the interconnections of these components. All components are shown in block form, and each block is labeled for identification purposes.

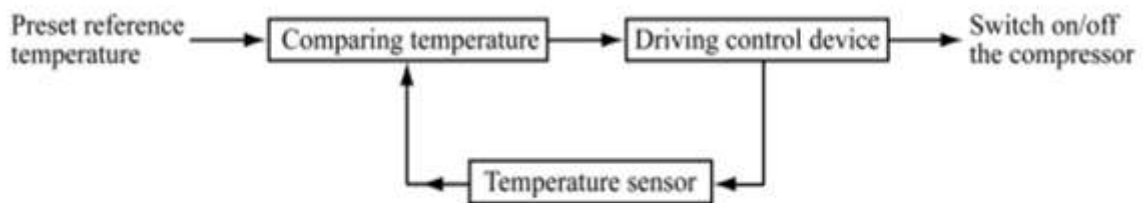


Fig. Block diagram of the closed loop control system of the washing machine

• CHART

A chart, also called a graph, is a graphical representation of data, in which "the data is represented by symbols, such as bars in a bar chart, lines in a line chart, or slices in a pie chart". A chart can represent tabular numeric data, functions or some kinds of qualitative structure and provides different info.

The term "chart" as a graphical representation of data has multiple meanings:

A data chart is a type of diagram or graph that organizes and represents a set of numerical or qualitative data.

Maps that are adorned with extra information (map surround) for a specific purpose are often known as charts, such as a nautical chart or aeronautical chart, typically spread over several map sheets.

Other domain specific constructs are sometimes called charts, such as the chord chart in music notation or a record chart for album popularity.

• LOCATION PLAN

- ✓ A location plan shows the proposed development in relation to its surrounding properties
- ✓ It must be based on an up-to-date map and at an identified standard metric scale (typically 1:1250 or 1:2500)

Page 57 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



- ✓ The site of the proposed development needs to be outlined in red and any other land owned by the applicant that is close to or adjoining the site needs to be outlined in blue

- **Choose from 2 scales:**

1. 1:1250 Location Plan: for urban areas and small properties within 200 x 200m
2. 1:2500 Location Plan: for rural areas and large properties within 400 x 400m

1.4. Instrument Loop Diagram

Loop diagram represents detailed drawing showing a connection from one point to control system. It could be connection between:

- Field instrument to control system (or vice versa)
 - Signal from Control Panel to control system (or vice versa)
 - Signal from MCC to control system (or vice versa)
 - Signal from one control system to another system

Loop diagram shows instrument (in a symbol) and its terminal numbers which are to be connected, instrument cable number, junction box number, terminal number assigned for the specified instrument, multi-pair cable and pair number, marshaling cabinet number, terminal number in marshaling cabinet, control system details (rack, slot, I/O channel). It also clearly indicates location of each equipment by means of border line as a limit.

Loop Diagram usually shows a single control loop which means it could only contains just one input (sensor to control system), just one output (control system to final element) or combination of both

Page 58 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Information Sheet -2	Identifying and selecting Correct drawing equipment used in accordance with job requirements
-----------------------------	--

2.1 Identifying and selecting correct drawing equipment and Reference drawing

To have the loop diagram completed and provide complete information, the following are list of data required along with its source/reference:

- Instrument Terminal number. Most instrument could be assumed to use (+) and (-). Terminals. Instrument which needs special arrangement such as

Page 59 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



smoke detector or instrument which in series loop, requires manufacturer connection detail to make the cable is properly connected.

- Junction box terminal number, this information could be obtained from JB wiring connection
- Marshaling terminal number, this information could be obtained from marshaling wiring connection.
- I/O point detail information. Obtain this information from I/O assignment which is produced by system integrator or control system vendor.

2. 2. The purpose of instrument loop diagram

It is used in checking of a correct installation and connection when tested during pre-commissioning, commissioning and also for trouble shooting during operation.

- **Piping and instrumentation diagram/drawing**

A diagram which shows the interconnection of process equipment and the instrumentation used to control the process. In the process industry, a standard set of symbols is used to prepare drawings of processes. The instrument symbols used in these drawings are generally based on International Society of Automation (ISA) Standard S5. 1.

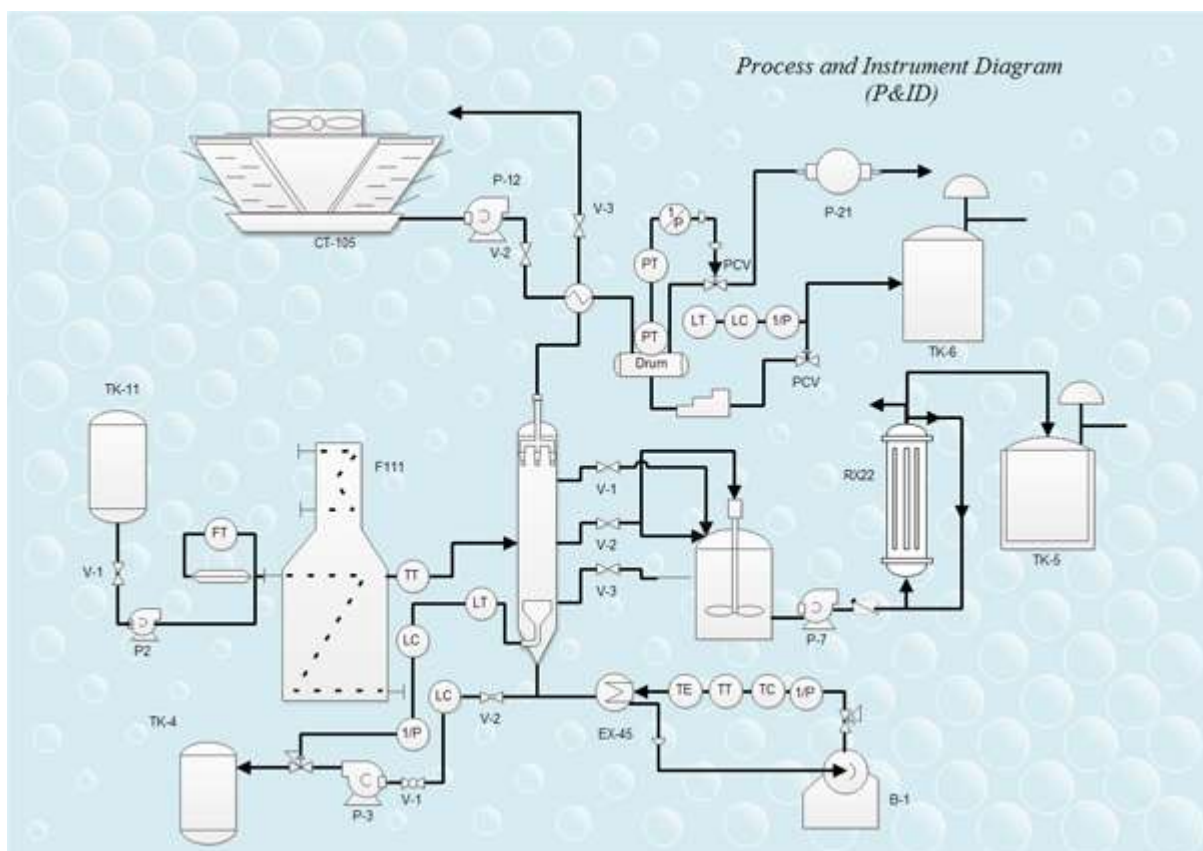


Fig. 2.2. Piping and Instrumentation Diagram

Page 60 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



2.3. SYSTEM CONTROL DIAGRAM

The SCD concept returns to the basis of the P&ID, the process schematic. Information not required for the design of the control system is removed. The SCD shall focus on representing systems and functional relationships, not individual physical equipment. The SCD combines all functional design requirements into a common unambiguous document and represents a top-down approach to the design of the system. The process schematic includes a simplified representation of process lines and equipment. Instrumentation & control objects are represented by simplified symbols only. The automation functions are represented by a limited number of high-level function templates. Each template represents a specific control philosophy selected for a class of objects. The control philosophy is defined /limited by a general range of attributes made available for the specific application. The application level is defined by using the applicable attributes. Complex control and interlocking strategies are developed by inter-connecting templates. Additional logic and arithmetic functions may be used.

- **POWER CIRCUIT**

The power circuit shows all the components or parts of components required to handle the load current of the motor. Remember that the motor in question may be a small 1.5 kW (2 HP) or a large 225 kW (300 HP). As the motor power rating increases so too must the current rating of the contactor, overload relay and supply cables.

N.B. When wiring circuits, the supply should be fed in on the low number terminal and out on the high number terminal.

Page 61 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------

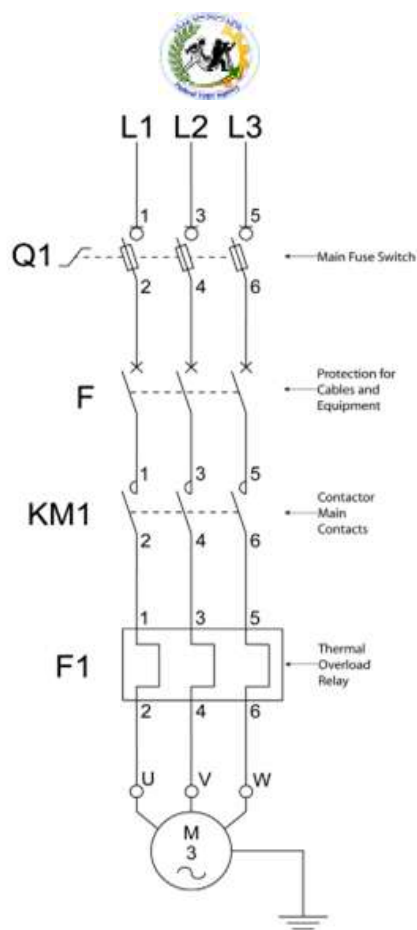


Fig. 2.3. Power Circuit

- **CONTROL CIRCUIT**

The control circuit shows all the components or parts of components required to control the motor. These components are basically the same regardless of the power rating of the motor in question. Note when wiring circuits, the supply should be fed in on the low number terminal and out on the high number terminal.

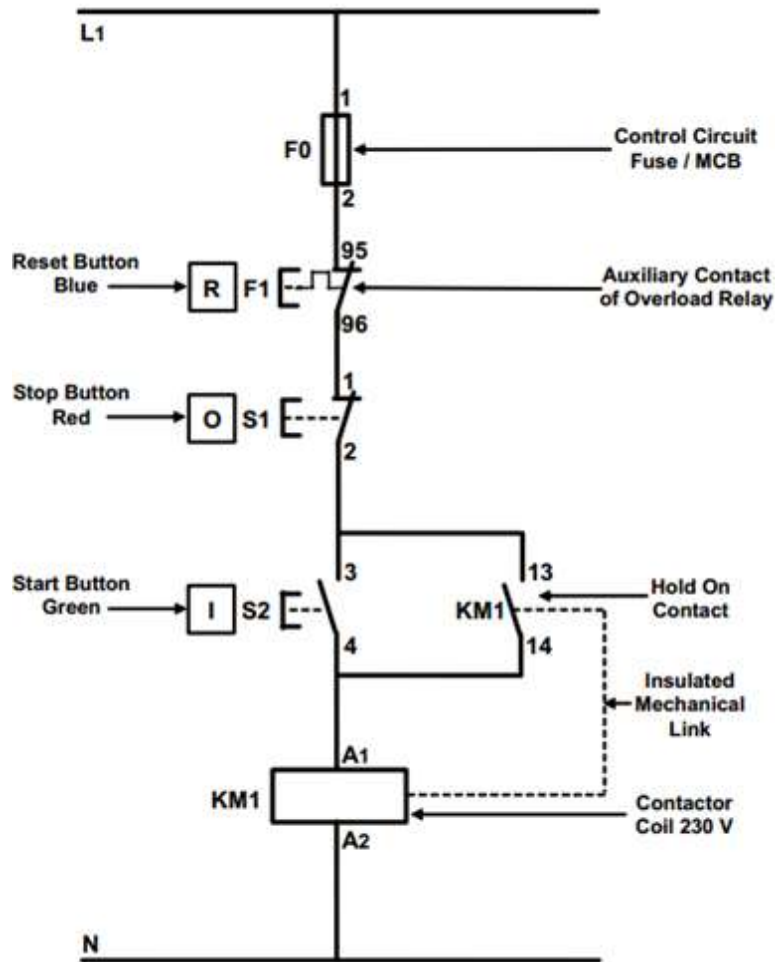


Fig.2.4. Control circuit

WIRING DIAGRAM: is a detailed diagram of each circuit installation showing all of the wiring, connectors, terminal boards, and electrical or electronic components of the circuit. It also identifies the wires by wire numbers or color coding. Wiring diagrams are necessary to troubleshoot and repair electrical or electronic circuits.

You should use the schematic diagram previously discussed to determine where the trouble might be in the circuit when a malfunction occurs. The schematic diagram does not show the terminals, connector points, and so forth, of the circuit. Therefore, you must go to the circuit wiring diagram to determine where to make the voltage or resistance checks in the circuit when troubleshooting.

Schematics and wiring diagrams are the written language of control circuits. Before a technician can become proficient in troubleshooting control circuits, he or she must learn how to read and interpret schematic and wiring diagrams.

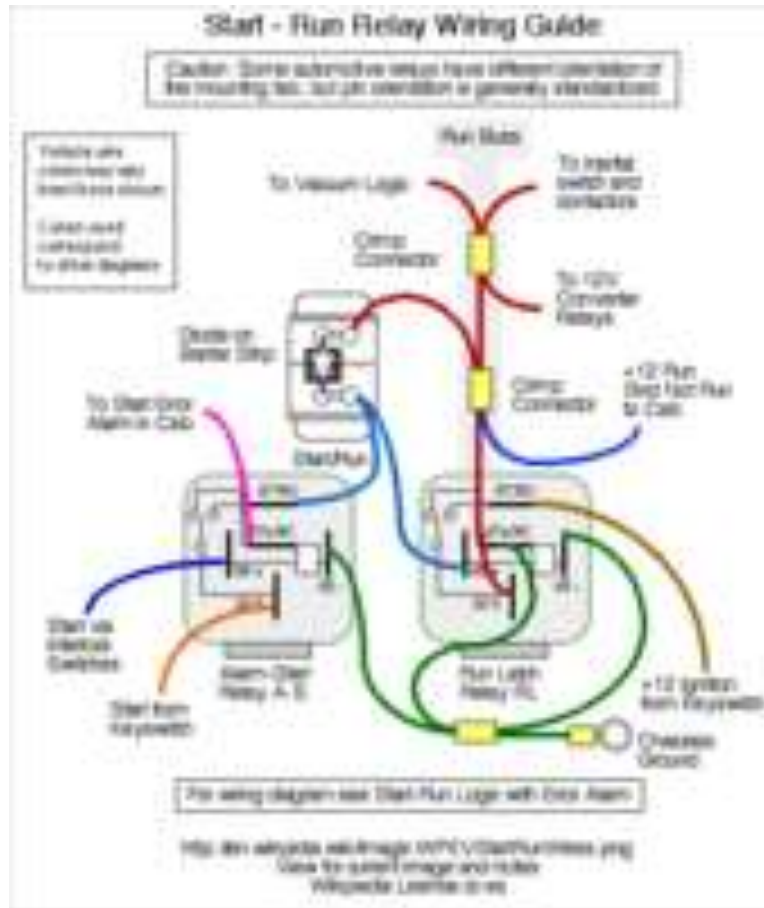


Fig.2.5. Wiring Diagram



Self-Check -2	Written Test
----------------------	---------------------

DIRECTION I: WRITE SHORT ANSWER FOR THE FOLLOWING QUESTIONS.

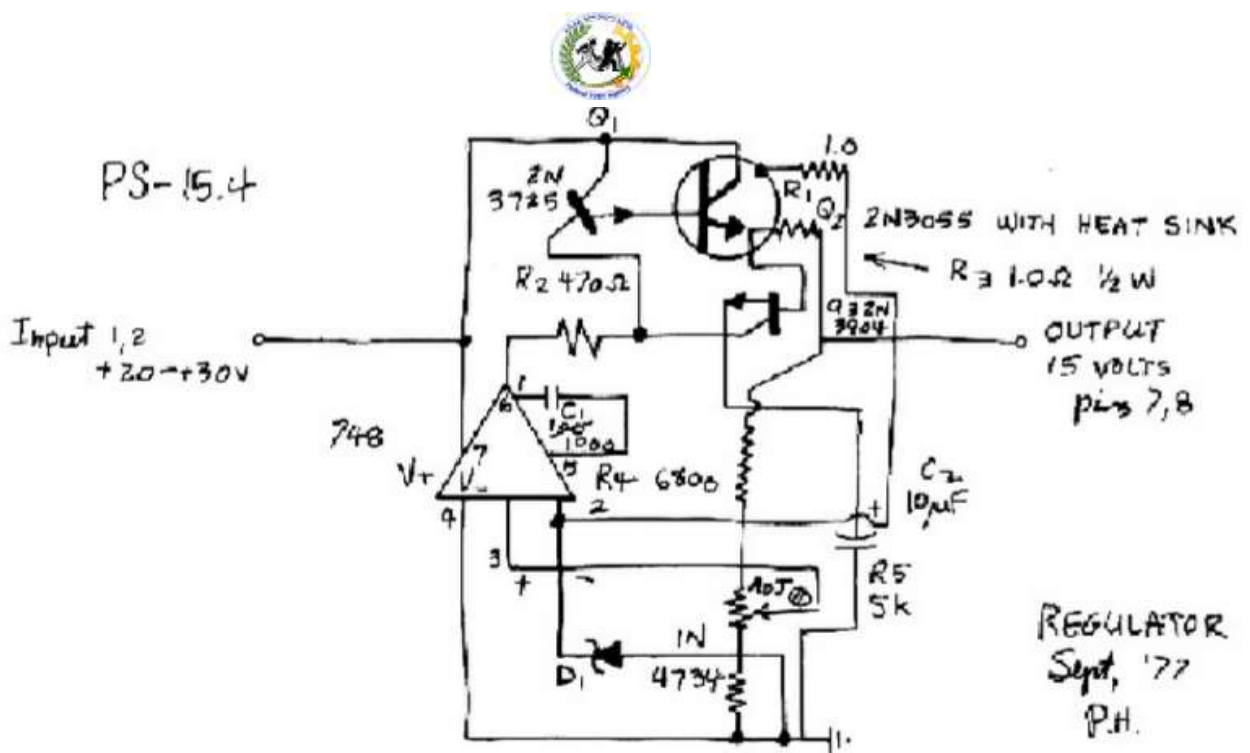
1. What are two major differences between the single-line diagram and the block diagram? (4 Points)
2. Define loop diagram. (3 points)
3. Explain the importance of instrument loop diagram. (3 points)
4. What is system control diagram? (2 points)
5. Define piping and instrument diagram. (3 points)

Note: Satisfactory rating –7.5points **Unsatisfactory - below 7.5 points.** *You can check the correct answers at the end of the Learning Guide*



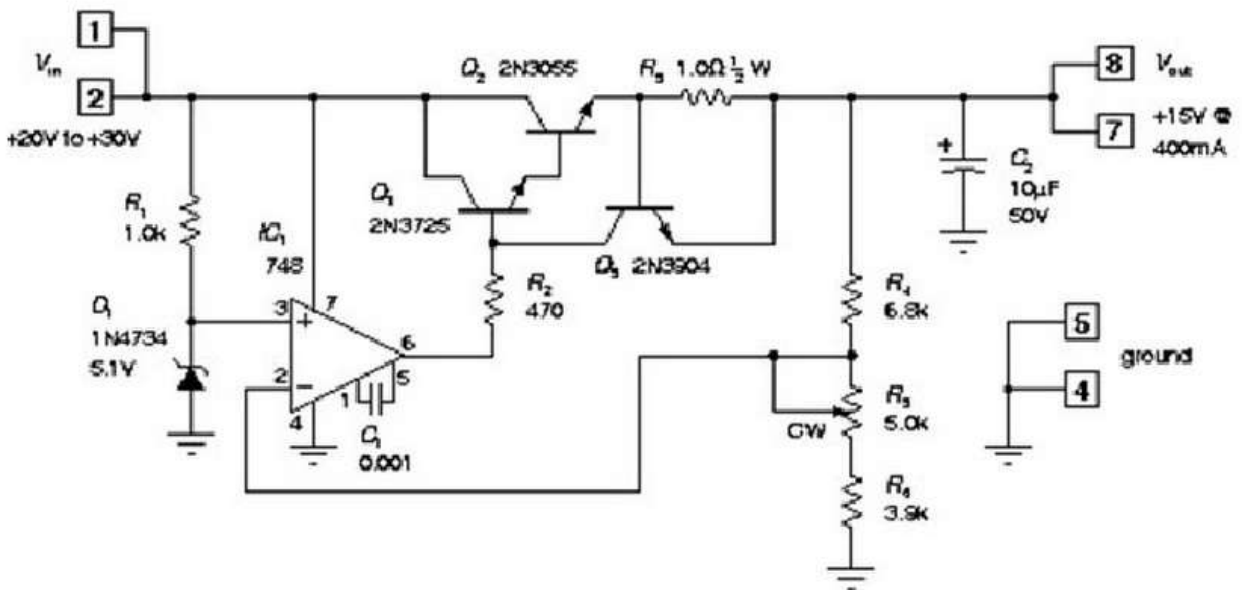
Operation Sheet -1

1. Prepare your paper to draw electrical diagram.
2. Study the schematic diagram drawn in free hand below.
3. Estimate the size of your drawing. Make sure that the schematic diagram is placed in the center of the drawing paper.
4. Lay out the diagram with proper spacing b/n components for notes and reference information.



An illustration showing "awful" schematics of a circuit which violates nearly every rule and is almost impossible to understand.

PROBLEM:



Precautions:

1. Identify parts immediately adjacent to the symbol, forming a distinct group giving symbol, label, and type or value.
2. In general, signals go from left to right; don't be strict about this, though, if clarity is sacrificed.
3. Put positive supply voltages at the top of the page, negative at the bottom. Thus, npn transistors will usually have their emitter at the bottom, whereas pnp's will have their emitter topmost.



4. Don't attempt to bring all wires around to the supply rails, or to a common ground wire. Instead, use the ground symbol(s) and labels like $+V_{cc}$ to indicate those voltages where needed.
5. It is helpful to bring leads away from components a short distance before making connections or jogs.
6. Leave some space around circuit symbols.
7. Use small rectangles, ovals, or circles to indicate card edge connections, connector pins, etc. Be consistent.
8. Power supply connections are normally assumed for op-amps and logic devices.

Page 68 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



LAP Test	Practical Demonstration
-----------------	--------------------------------

Name: _____ Date: _____

Time started: _____ Time finished: _____

***Instructions:* Given necessary templates, instruments and materials you are required to perform the following tasks within 1 hour.**

Task 1: Prepare the work station. Select materials and instruments needed.

Task 2: Draw power and control circuit.

Task 3: Draw the layout diagram of the schematic diagram given below.



Basic Electrical Electronics Equipment Servicing Level - I Learning guide- 34

Unit of Competence: **Prepare and Interpret
Technical Drawing**

Module Title: **Preparing and Interpreting
Technical Drawing**

LG Code: EEL BEE1 M08 Lo4-LG-35

TTLM Code: EEL BEE1 TTLM 0919V1

**LO4: Store technical drawings
and equipment /instruments**

Page 70 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



This learning guide is developed to provide you the necessary information regarding the following learning outcome coverage:–

- Undertaking Care and maintenance of drawings according to company procedures
- preparing technical drawings recorded and inventory in accordance with company procedures
- undertaking Proper storage of instruments according to company procedures

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to –**

- Undertaking Care and maintenance of drawings according to company procedures
- preparing technical drawings recorded and inventory in accordance with company procedures
- undertaking Proper storage of instruments according to company procedures

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2 , and Sheet 3
4. Accomplish the “Self-check 1, Self-check 2 and, Self-check 3 **in page -6, 9, 12 and 14** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, **in page -15.**
6. Do the “LAP test” **in page – 16** (if you are ready



1.1. *STORING EQUIPMENT AND DRAWINGS*

When a session of drawing is finished, it is important that the equipment, which has been in use, is stored neatly in clean and dry conditions. Dirty and damaged equipment does not help in the production of good, neat and clean drawings. Drawing boards can be either placed in purpose-made racks or stacked one on top of the other. Tee squares should be placed in properly made racks, which make sure that the drawing edges are not damaged and that their two parts do not become separate. Set squares must be kept in a clean condition. They may pick up dust and erasing particles and if they are stored in such a condition other equipment becomes dirty. Pencils can be placed in racks made from blocks of wood with appropriately sized holes. Compasses are easily damaged if not stored properly.

The best method of storing drawings is for each pupil or student to have a folder in which his or her drawings can be placed without their being folded. Other drawings, such as those used to demonstrate the principles of working should be stored flat in drawers large enough to take them unfolded. Take care when placing drawings in folders or drawers. Careless handling can easily cause them to become damaged, even to be torn. Drawings must be kept clean if they are to be read easily.

A SUGGESTED EQUIPMENT TIDY BOX

Figure below shows a box, made from wood and hardboard and designed to hold a set of technical drawing equipment. The main dimensions of the box are:

- Overall length: 330 mm
- Overall depth: 270 mm
- Height: 25 mm
- Thickness of sides: 10 mm

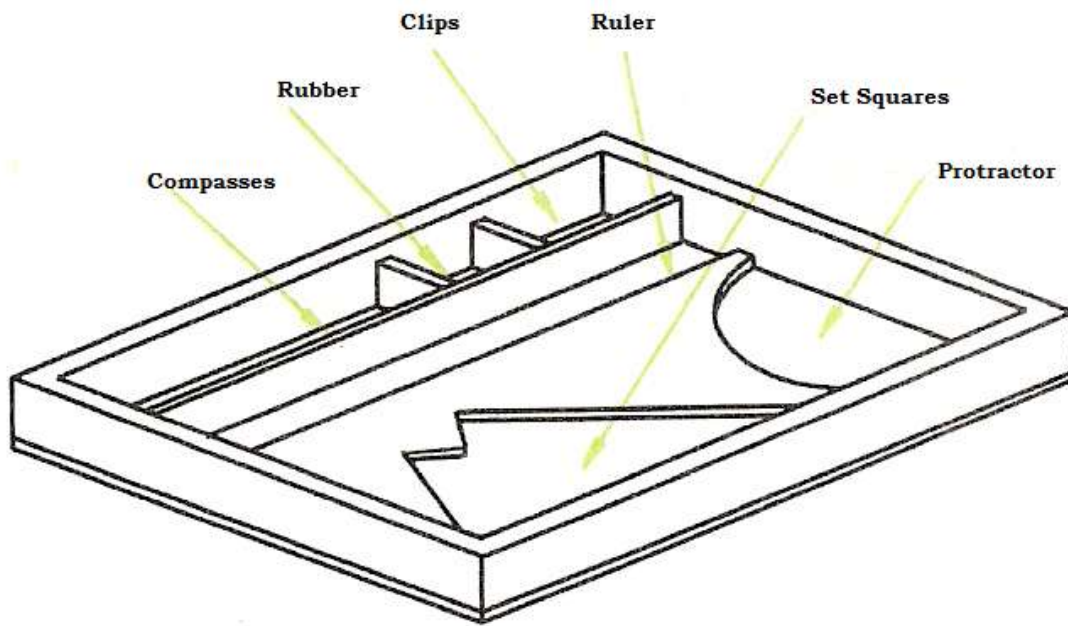


Fig. Suggested Technical Drawing Equipment Tidy Box

Page 73 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Self-Check 4	Written Test
---------------------	---------------------

Direction I. Give short answer to the following questions.

1. What is the need of storing drawing equipments safely? (4 points)
2. State the best method of storing drawings. (4 points)
3. Explain how T-square is stored. (2 points)

Note: Satisfactory rating –5points Unsatisfactory - below 5 points. You can check the correct answers at the end of the Learning Guide

LAP Test	Practical Demonstration
----------	-------------------------

Name: _____ Date: _____

Time started: _____ Time finished:

Instructions: Given necessary instrument and materials you are required to perform the following tasks within 1 hour.

Task 1: identify and store the equipment that we used?

Task 2: clean and lubricate the hand tools?



ANSWER KEYS FOR MODULE #03

(Preparing and interpreting) technical drawing

SELF CHECK 1

1. Drawing Table
2. Divider
3. T-Square
4. Ruler
5. Set-Square
6. Scale
7. Pencil Sharpener
8. Paper Types
9. Protractor

Page 75 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



- 10. Tracing Paper
- 11. Eraser
- 12. Pencil
- 13. French Curve

SELF CHECK 2

Alphabet of Lines

BASIC LINES	LINE CHARACTERISTICS
① Visible (Object) Line	(THICK)
② Hidden Line	(THIN)
③ Center Line	(THIN)
④ Extension and Dimension Line	(THIN)
⑤ Cutting Plane Lines (Shows Direction of Viewing Plane)	(THICK)
⑥ Section Line	(THIN)
⑦ Break Lines	(THICK) (FOR SHORT BREAKS)
⑧ Phantom Line	(THIN)

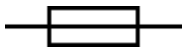


10. Clearness, completeness, readability and accuracy.

11. Dimension is a numerical value expressed in appropriate units of measurement and indicated graphically on technical drawings with lines, symbols and notes.

- Dimensions lines should not cross each other, Dimension lines should also not cross any other lines of the object. Do not use an outline or a center line as a dimension line.
- Avoid dimensioning hidden lines.

13. 



SELF CHECK 3

1. the single-line diagram uses symbols, rather than labeled blocks, to represent components.

- the single-line diagram shows all components in a single line.

2. Loop diagram is a diagram that represents detailed drawing showing a connection from one point to control system.

3. In order to check a correct installation and connection when tested during pre-commissioning, commissioning and also for trouble shooting during operation.

4. System Control Diagram combines all functional design requirements into a common unambiguous document and represents a top-down approach to the design of the system. It includes a simplified representation of process lines and equipment.

5. A diagram which shows the interconnection of process equipment and the instrumentation used to control the process.

SELF CHECK 4

Page 77 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



1. To prepare good, neat and clean drawings.
2. To prepare a folder in which drawings can be placed without being folded.
3. In properly made racks, which make sure that the drawing edges are not damaged and that their two parts do not become separate.

REFERENCES

1. ANSI/ISA Standard S-5.01 "instrumentation Symbols and Identification"
2. Technical Drawing Grade 11, Grade 12 book.

Page 78 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Page 79 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Page 80 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Information Sheet-3	Checking and validating drawing version
----------------------------	--

3.1 Checking and validating drawing version

Drafting standard and drawing management system has been established, a drawing validation process must exist to ensure compliance with corporate standards.

Oftentimes this consists of one or more drafters or checkers performing drawing audits from within AutoCAD software using various tools like Check Standards,

This process can be time-consuming and costly especially when a large amount of drawings must be processed within a short time period.

Several third-party applications exist to assist with this process but most require an extensive setup and an external database.

Validation should take place from the early to the final stages of our product lifecycle and even after the release of the final solution.

The most commonly used methods are surveys/questionnaires, usability tests, card sorting, eye-tracking, A/B tests and a continuous monitoring of how users are responding and interacting with your product even after every release.



Self-Check -3	Written Teste
----------------------	---------------

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

choose the correct answer from the following Questions

2. Drafting standard and drawing management system has been establish to

A.validation process must exist to ensure standards.

B.fortime-consuming

C.A&B

D all

2. one or more drafters or checkers performing drawing audits By using

A.AutoCAD software B.drawing C. using various tools like Check Standards

D.A&C E all

3.Validation should not take place from the early to the final stages of our product lifecycle

A. True B.False C. A&B are not answer D. none

Page 82 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Information Sheet-4	Confirming and following Instructions
---------------------	---------------------------------------

4.1. Confirming and following Instructions

- **Title Blocks**

The Title block is a boxed area containing general information about the part in the drawing. The main purpose of the title block is that it contains important text information about the part such as company name, drawing number, part number and other pertinent information. Different companies may have somewhat different formats for their title blocks, but most of the time the title block is located in the lower right corner of the drawing sheet

- **Standards**

BS ISO 7200 Technical Drawings- Title Blocks identifies the title block requirements to be used on engineering drawings. the drawing sheet size should be in accordance with "BS EN ISO5457 TD- Sizes and layout of drawingsheets

A title block is the form on which the actual drawing is a section. The title block includes the border & the various sections for providing quality, administrative and technical information. The importance of the title block cannot be minimized as it includes all the information which enables the drawing to be interpreted, identified and archived

The title should include sufficient information to identify the type of drawing e.g. general arrangement, or detail. It should also clearly describe in a precise way what the drawing portrays

The notes below relate to the title boxes included on in the title block to convey the necessary

Page 83 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



information the standard drawing sizes and layouts are described elsewhere. The basic requirements for a title block located at the bottom right hand corner of a drawing are

1. The registration or ID number
2. The drawing title
3. The Legal Owner of the Drawing

These items should be written in a rectangle which is at the most 170mm wide

The title block should also include boxes for the legal signatures of the originator and other persons involved in the production of the drawing to the required quality

In other forms of title block, the title block contains 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 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

Page 84 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------

- other information as required



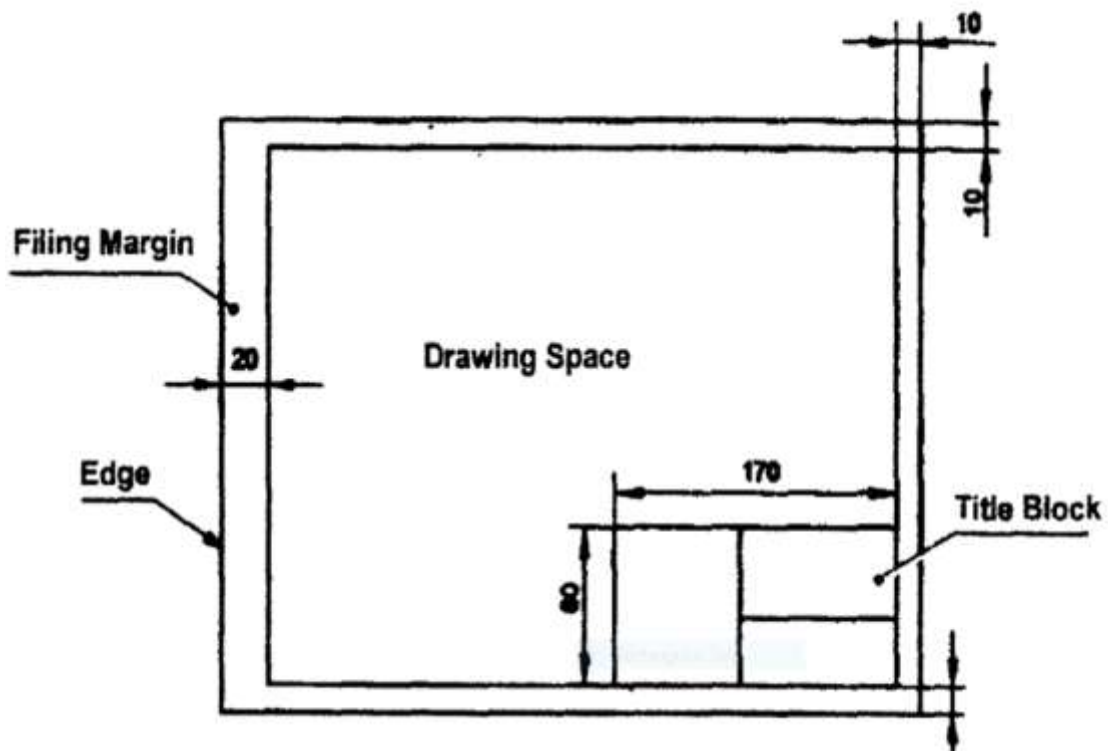
The drawing should also include a symbol identifying the projection. The main scale and the linear dimension units if other than "mm" Mechanical drawings should list the standards use for: indicating the surface texture: welds general tolerances and geometric tolerances, as notes

referring directly the the relevant standards or a general note referring to the BS 8888. (BS 8888 lists all of the relevant standards.) BS 8888 should really only be referenced if the drawing is in full accordance

Page 85 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



The drawing title block should indicate the date of the first revision. In separate boxes to the title block the current revision with an outline description of the revision should be



see Figure. 1:1

Page 86 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Self-Check -1	Written Teste
----------------------	---------------

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

choose the correct answer from the following Questions

1.The main purpose of the title block is

- A. it contains Information Company name
- B. it contains information drawing number
- C. A&B are correct
- D. none

2. The basic requirements for a title block located at the bottom right hand corner of a drawing are

- A.The registration or ID number
- B. The drawing title
- C.The Legal Owner of the Drawing
- D.All

3, which one is true information about a title block from the listed blow ?

- A. the name of the company or organization

Page 87 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



B.the title of the drawing

C.the drawing number

D.all

Answer Sheet

Score = _____

Rating: _____

Page 88 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Operation Sheet	Drawing Template and Title Block
-----------------	----------------------------------

Operation Title: Drawing Template and Title Block

Procedure:

Step1 .Set up your drawing paper on top of the drawing board.

Step2.Use the drawing template format given to you by your teacher.

Step3.Be sure to check the sharpness of your pencil lead. Use standard sharpening for good aesthetic result of your work.

Step4.Using the basic drawing instruments and materials, perform the drawing task in the given following problems given in the Lap Test below.

Step5.Use appropriate pencil lead in your drafting works.

Step6.You may submit your finish work once you are true but should be within the time specified for submission.

Page 89 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



LAP Test	Drawing Template and Title Block
----------	----------------------------------

Name: _____ Date: _____

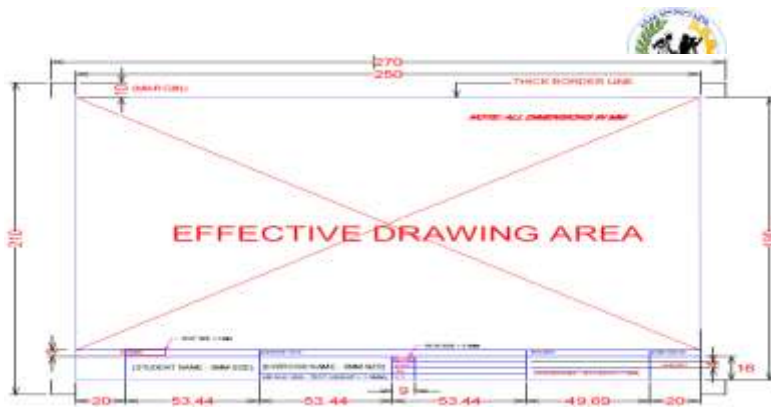
Time started: _____ Time finished: _____

Instructions:

6. Using the drawing instrument, you are required to do the following exercises:

- Exercise 1 : Create the drawing template shown with the following dimensions

Page 90 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



- Section Lines = 0.5 mm HB
- Visible Lines = 0.7 mm HB
- Hidden Lines = 0.5 mm HB
- Centerlines = 0.5 mm HB
- Construction Lines = 0.5 mm 2H

7. Request from your teacher the following materials.

- HB drawing pencil lead
- 4H drawing pencil lead
- 45° x 90° triangle
- 30° x 60° triangle
- Eraser
- T-square
- Drafting pens
- Drawing table

- Drawing papers

8. You are given 1 hour to accomplish the above activity.

9. Request to your teacher for evaluation and feedback.

Page 91 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Referance

- **Jenson,Cecil**Howard,Engineeringdrawing and design,1925,4th ed.,Macmillan/McGram-Hill
- . **Louis Gary Lamit**, Descriptive Geometry,1981,1st ed.,Prentice-Hall
- Frederick E.,Technical Drawing,1958,4thed.,The Macmillan Company
- David L.Goetsch et al, Technical drawing,1994,3rd ed., Delmar Publishers Inc.
- A text book of engineering drawing, B.Gupta. Nasaka Pashakar publisher
- V.B. Sikka ,A course in civil engineering drawing ,1998,4th ed.
- T. Jeyapooan, Engineering Drawing with autocad 2000, Vikas publishing

BASIC METAL WORKS

Level-I

Page 92 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Learning Guide 23

Unit of Competence Interpret Drawings & Sketches

Module Title Interpreting Drawings and Sketches

LG Code: IND BMW1 M07 LO2-LG-23

TTLM Code: IND BMW1 M07 TTLM 1019v1

LO2: Identify views, standard symbols and line

Instruction Sheet	Learning Guide 23
--------------------------	--------------------------

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

Page 93 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



- Identifying alphabet of lines
- Explaining uses of the alphabet of lines
- Identifying and explaining symbols & Codes
- Identifying Orthographic and isometric drawing

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to:

- Orthographic and isometric drawing are identified.
- Orthographic and isometric views are explained.
- Alphabets of line are identified.
- Uses of the alphabet of lines are explained.
- Codes and symbols are correctly identified and explained according to drawing standards.

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page ---
---, -----, ----- and -----**respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -----**.
6. Do the “LAP test” **in page – ----** (if you are ready).

Page 94 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



1.1. Identifying alphabet of lines

The Alphabet of Lines in Technical Drawing

Lines in technical drawings are part of a specialized graphic language that is standardized throughout industry. Each type of line has a very precise symbolic meaning.

Types of lines in order of preference

Visible (object/feature) lines – Section lines/crosshatch line

- Break lines
 - Dimension lines
 - Extension lines/lead lines
- Cutting plane lines
 - Hidden lines
 - Centerlines

Line type	Thickness		Example	Application
	Fine	Thick		
Continuous thick	0.35	0.50		Visible outlines, existing features, cut edges, general line work
Continuous medium	0.25	0.35		Used where another level of line weight would assist the delineation e.g. internal line work, notes
Continuous thin	0.18	0.25		Fictitious outlines, imaginary intersections and projections, hatching, dimensions, break lines
Dashed thick	0.35	0.50		Hidden outlines and edges
Dashed thin	0.18	0.25		
Chain thick	0.35	0.50		Indication of special surface requirements or (sometimes with a text component) to indicate pipelines and services
Chain thin	0.18	0.25		Center lines, motion paths, indication of repeated detail

Figure 2: 1 of line styles




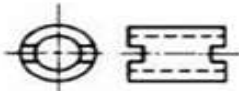



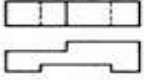

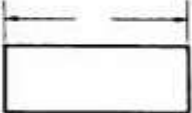

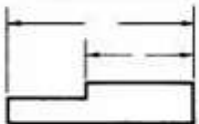
2.2 Explaining uses of the alphabet of lines

Correct usage of this "alphabet of lines" is essential whether you use traditional drafting methods or CAD. Line weight is the thickness of the line. Construction lines and guide lines are very light, easily erased lines used to block in the main layout. Visible lines are the edges or "outlines" of an object. They are drawn as solid lines with a thick/heavy weight.

All other lines contrast with the visible lines by having either a thinner weight and/or a combination of dashes.

Lines are straight elements that have no width, but are infinite in length (magnitude), and they can be located by two points which are not on the same spot but fall along the line. Lines may be straight lines or curved lines. A straight line is the shortest distance between two points. It can be drawn in any direction.

If a line is indefinite, and the ends are not fixed in length, the actual length is a matter of convenience. If the end points of a line are important, they must be marked by means

NAME	CONVENTION	DESCRIPTION AND APPLICATION	SAMPLE
CENTER LINES		THIN LINES MADE UP OF LONG AND SHORT DASHES ALTERNATELY SPACED AND CONSISTENT IN LENGTH USED TO INDICATE SYMMETRY ABOUT AN AXIS AND LOCATION OF CENTERS	
VISIBLE LINES		HEAVY UNBROKEN LINES USED TO INDICATE VISIBLE EDGES OF AN OBJECT	
HIDDEN LINES		MEDIUM LINES WITH SHORT EVENLY SPACED DASHES USED TO INDICATE CONCEALED EDGES	
EXTENSION LINES		THIN UNBROKEN LINES USED TO INDICATE EXTENT OF DIMENSIONS	
DIMENSION LINES		THIN LINES TERMINATED WITH ARROWS HEADS AT EACH END USED TO INDICATE DISTANCE MEASURED	



Information Sheet-2	Identifying and explaining symbols & Codes
----------------------------	---

2.3 Identifying and explaining symbols & Codes

Symbols

Permit consistency in the way dimensions and tolerances are specified, and each symbol has a clearly defined meaning. Symbols take less time to apply on a drawing than would be required to state the same requirements with words. The symbols also require considerably less space.

The symbols are presented in two groups for easier use of this section as a reference. General dimensioning symbols are shown first. Some of these symbols are also used in tolerance specifications. The second sets of symbols are used for tolerances.

Symbol sizes are shown in the figures as values proportional to the letter 'h'. The letter 'h' represents the predominant character height on a drawing. If a symbol dimension is shown

as 1.5h, and the predominant character height on the drawing is to be 3mm, then the symbol dimension is 4.5mm (1.5 x 3mm).

Symbol proportions defined in the standard are recommendations.

Some companies find it desirable to vary from the recommended proportions for improved microfilm reproduction capability. Symbol proportions within a company, and certainly within a single drawing, should be consistent

Symbols are not generally used in text or notes lists. Abbreviations and symbol names are used in text or notes li

General symbols

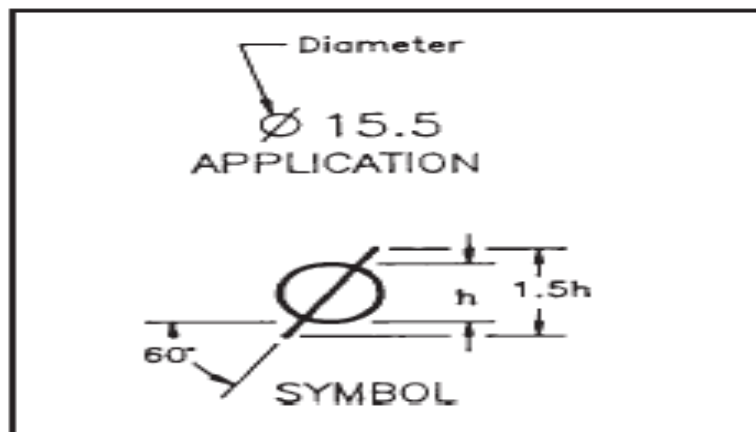
General symbols are used with dimensions to clarify the requirement defined by a dimension value and to minimize the number of words or abbreviations placed on a drawing.

Page 98 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------



Diameter- ;

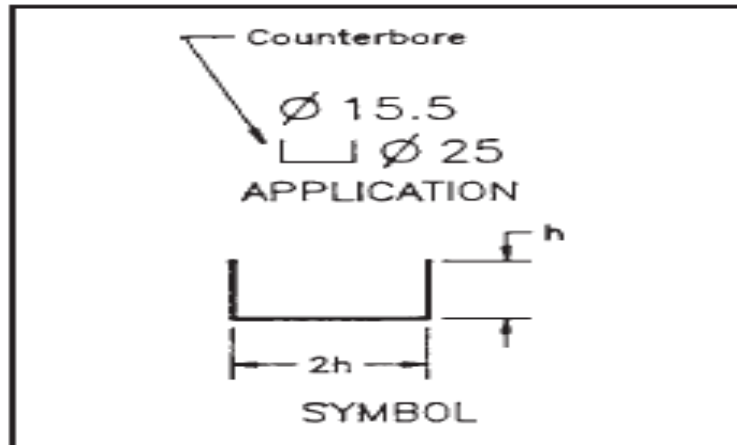
A diameter symbol is placed in front of any dimension value that is a diameter.



Counter bore Symbol- ;

A counter bore symbol combined with a diameter symbol is placed in front of a specified counter bore or spot face diameter.

Page 99 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
----------------	---	---	----------------------------

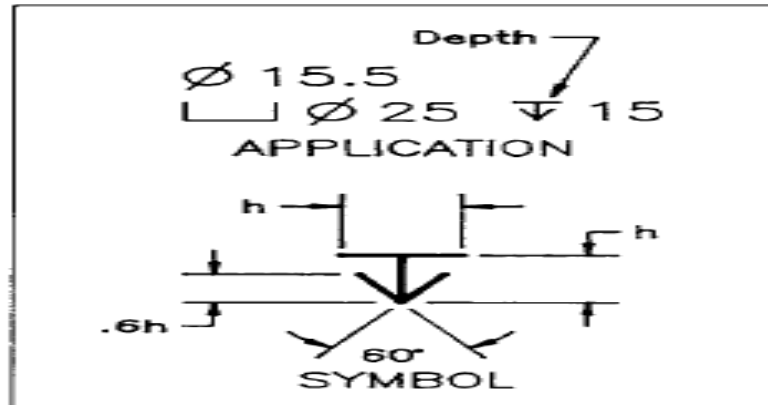


Counter bore Symbol

Depth—;

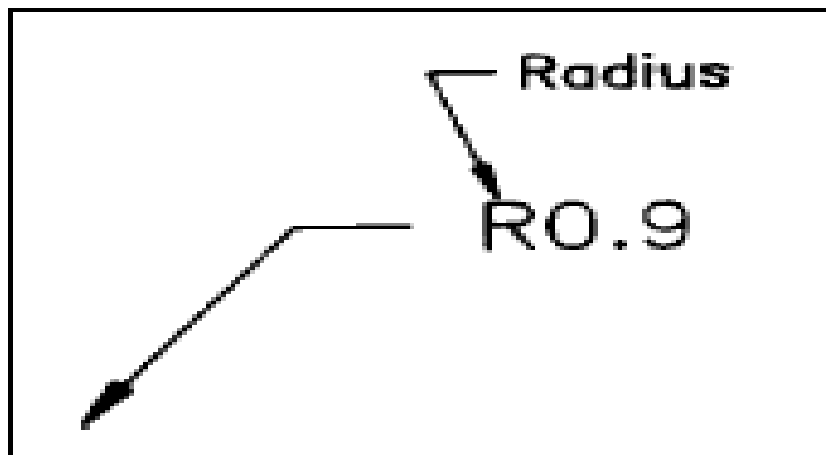
A downward-pointing arrow is used for the depth symbol, and it is placed in front of the depth value in such applications as for counter bore and hole depths.

Page 100 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Radius-

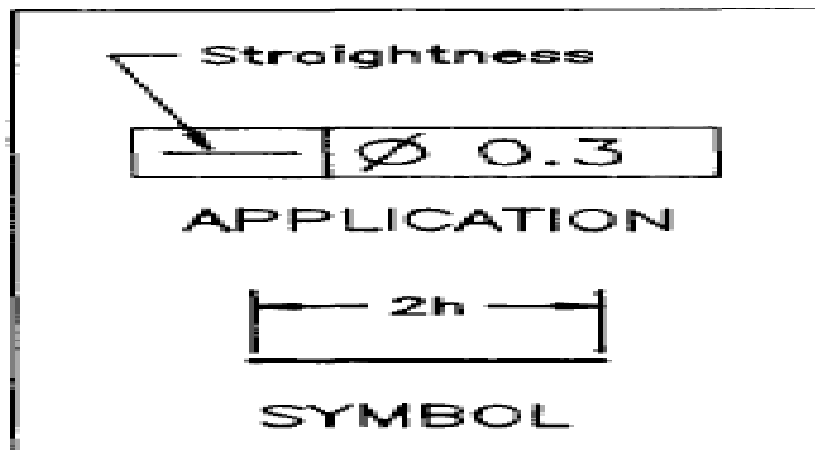
The letter **R** is placed in front of any value that indicates a radius dimension.





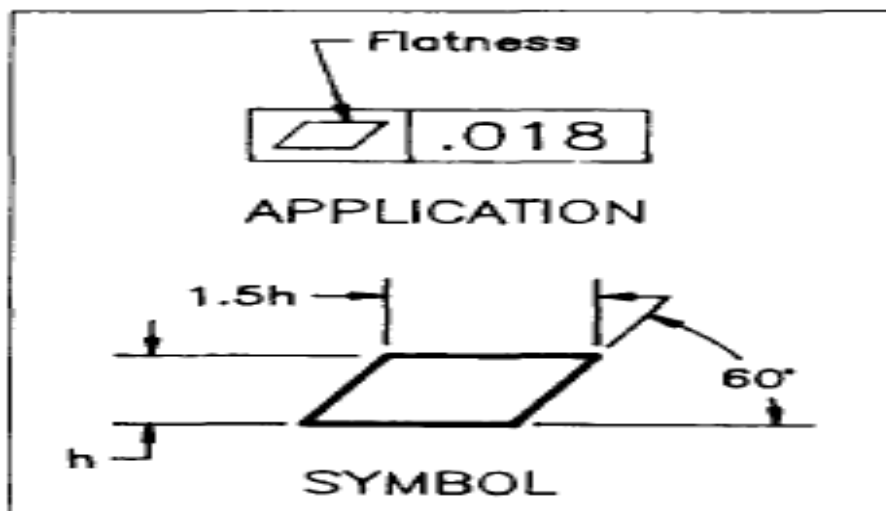
Straightness—;

A straight line is used to indicate a Straightness requirement. It is only applied in a feature control frame, and maybe used to control straightness of surface elements. It may also be used to control the straightness of an axis or center plane.



Flatness— ;

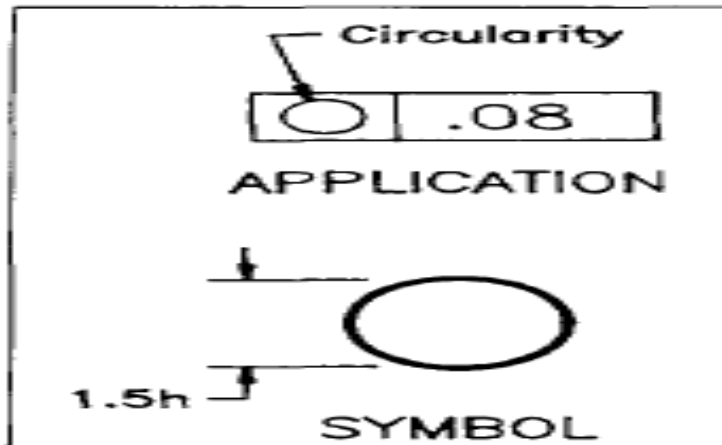
The flatness symbol appears as an oblique view of a square surface. See Figure 13. This symbol is used in feature control frames and is only used to control the form variations on flat features.





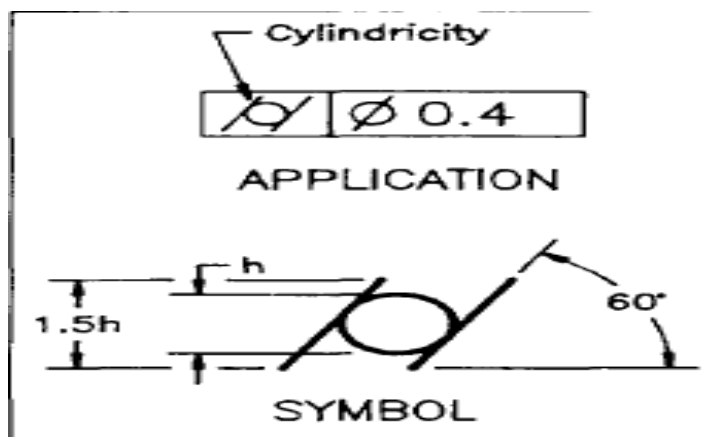
Circularity–

Circularity is indicated by a circle. It controls the amount of form error permitted on the surface of a circular feature at individual cross sections.



8. Cylindricity–

This symbol is a circle with two parallel lines drawn tangent to the circle. It is used to control the surface errors on a cylindrical feature. It simultaneously

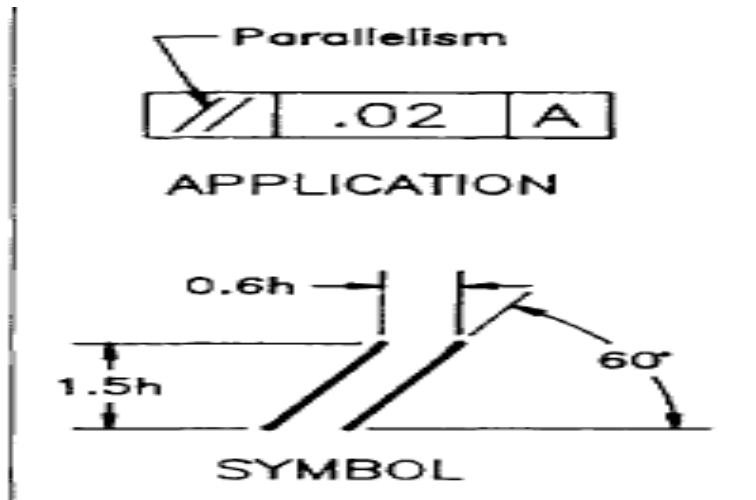


9. ORIENTATION - Orientation tolerance symbols include **parallelism, perpendicularity, and angularity.**



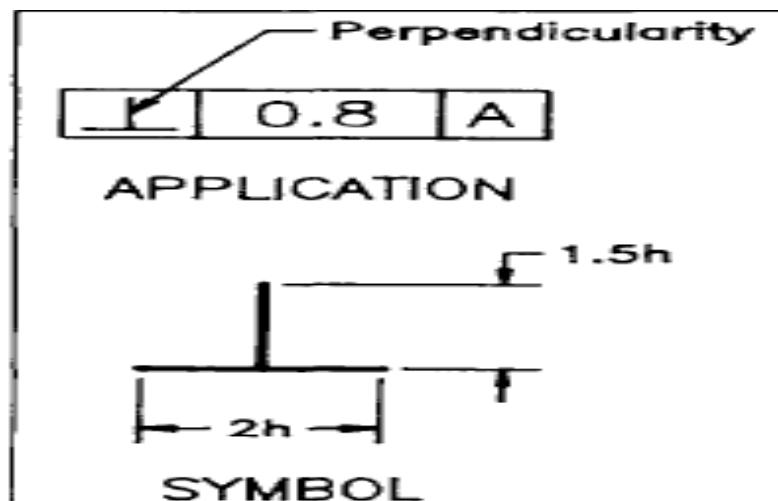
10.Parallelism–;

Parallelism is indicated by two parallel straight line



11.Perpendicularity–

Perpendicularity is indicated by two perpendicular lines





Self-Check -2	Written Teste
---------------	---------------

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page: choose the correct answer from the following Questions

1. _____ is used to control the surface errors on a cylindrical feature

- A. Cylindricity C. angularity.
B. perpendicularity D. all

2. _____ IS clarify the requirement defined dimension value and minimize the number of words or abbreviations place on a drawing.

- A. Cylindricity B. angularity.
C. General symbols D . none

3. Counter bore symbol combine with a diameter symbol is place in _____ of a specified counter bore.

- A. Front B. Spot
C. Top D . A&B

4. Orientation tolerance symbol includes:

- A. Parallelism C. angularity.
B. perpendicularity D. all



Name: _____

Date: _____

Answer Sheet

Score = _____

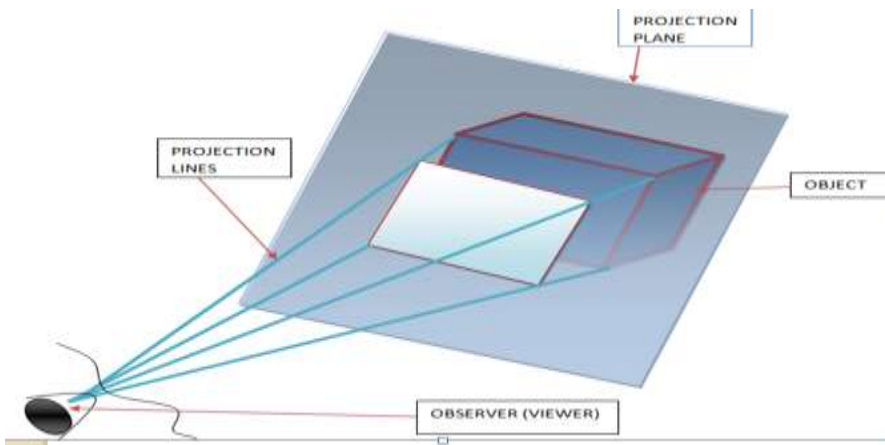
Rating: _____

Page 106 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



PROJECTION

A projection is a drawing or representation of an entity on an imaginary plane or planes. It consist four components: The actual object that the drawing or projection represents
The eye of the viewer looking at the object
The imaginary projection plane (Viewers drawing paper
Imaginary lines of sight called projectors



Classification of projections

Two broad projection types are viable with different further classifications. These are:

Parallel projection

Perspective projection

Parallel projection:

It is a projection where imaginary projection lines will not converge as a point on the viewer's eye. This implies that, all projection lines are either parallel or perpendicular to each other



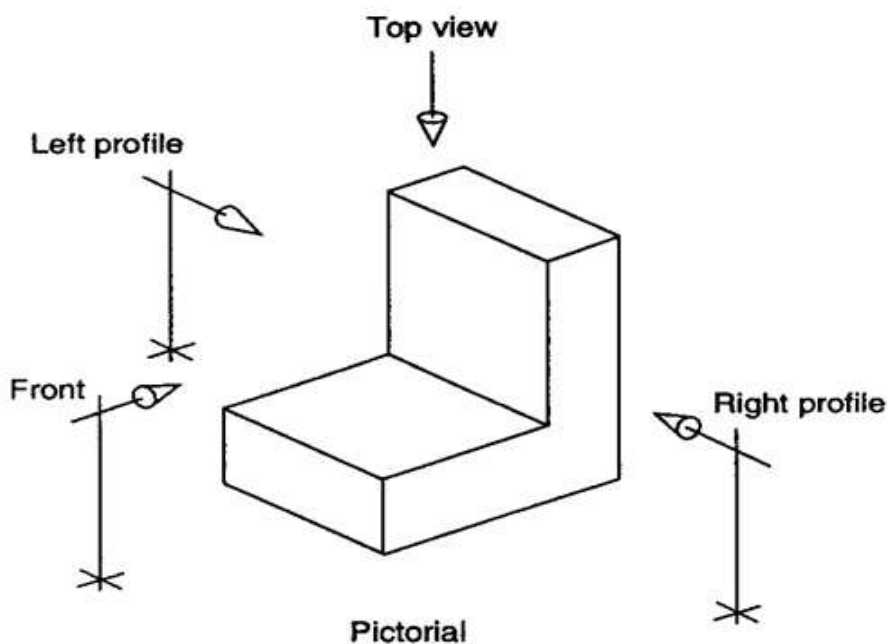
There are three main types of parallel projection system illustrated below:

1. Orthographic projection
2. Isometric projection.
3. Oblique projections

- **Orthographic projection**

Is a system of views of an object formed by projectors from the object perpendicular to the desired planes of projection. Here we have three principal projection Profile projection plane (P

For example:



For the above object we can have orthographic projection as follow

Page 108 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------

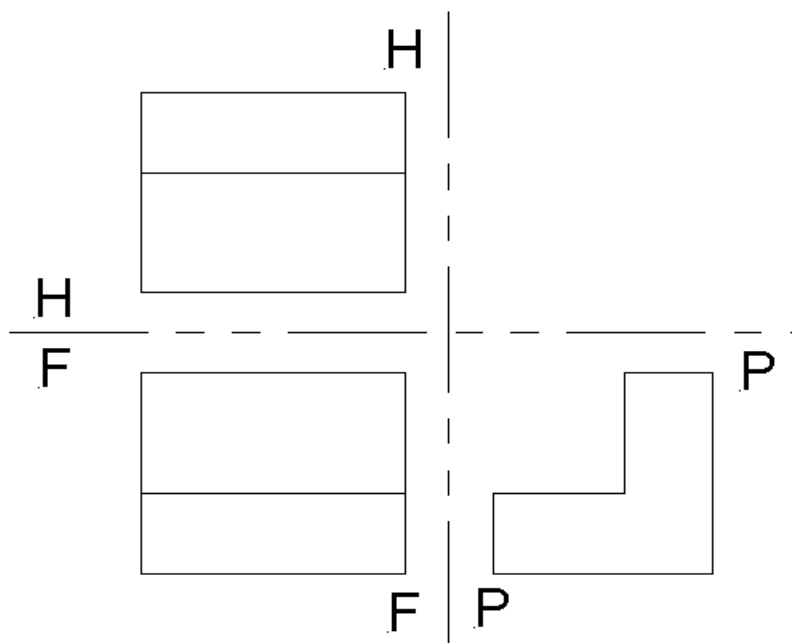


Figure (Multi-view drawing)

Orthographic projection could be defined as any single projection made by dropping perpendiculars to a plane. In short, orthographic projection is the method of representing the exact shape of an object by dropping perpendiculars from two or more sides of the object to planes, generally at right angles to each other; collectively, the views on these planes describe the object completely.

Descriptive geometry is basically the use of orthographic projection in order to solve for advanced technical data involving the spatial relation ship of points, lines, planes, and solid

Page 109 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



shapes. The most common means of understanding these types of orthographic projection is The Glass Box method.

- **The Glass Box method,**

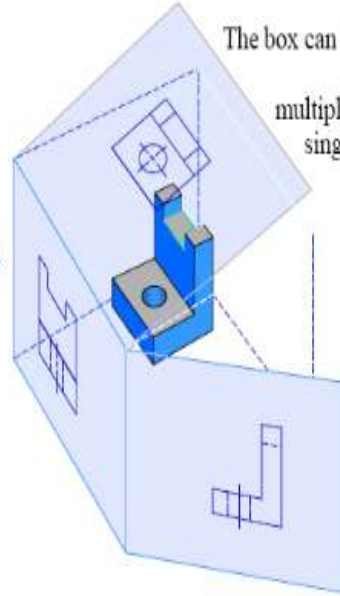
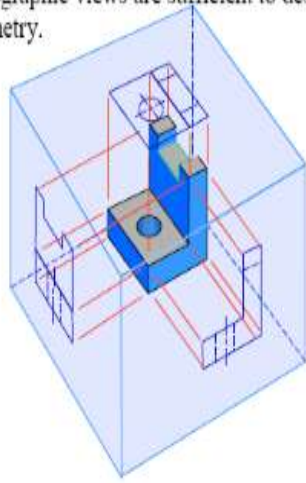
primarily for descriptive geometry problems, requires that the user imagine that the object, points, lines, planes etc are enclosed in a transparent “box”. Each view of the object is established on its corresponding glass box surface by means of perpendicular projectors originating at each point of the object and extending to the related box surface. The box is hinged so that it can be unfolded on to one flat plane (the paper).

Page 110 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Glass-box approach

For many three-dimensional objects, two to three orthographic views are sufficient to describe their geometry.



The box can be unfolded to show the multiple views in a single x-y plane

Figure.1 Glass box methods



Glass-box approach

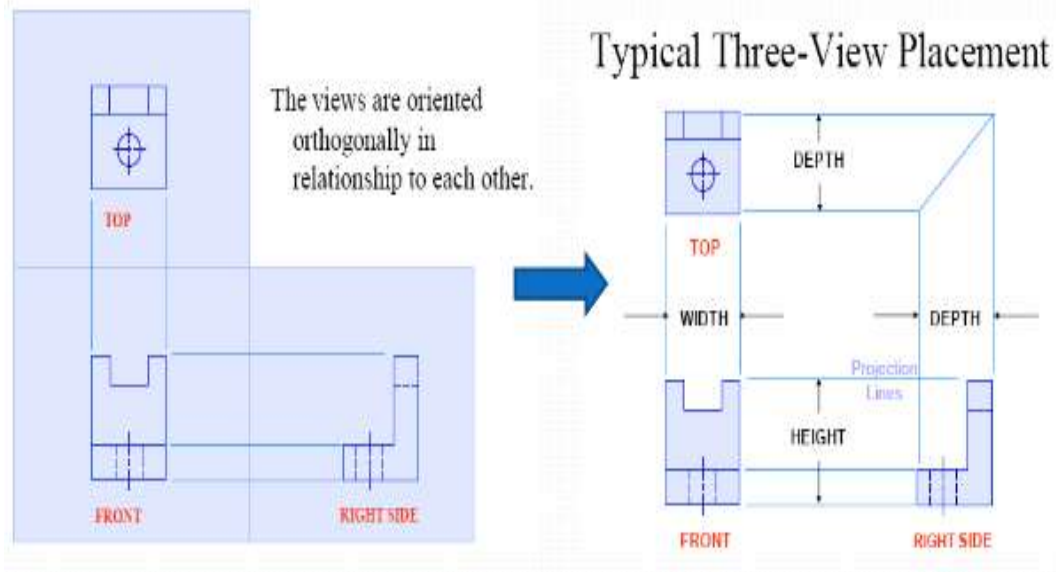


Figure .2Orthographic projection of objects

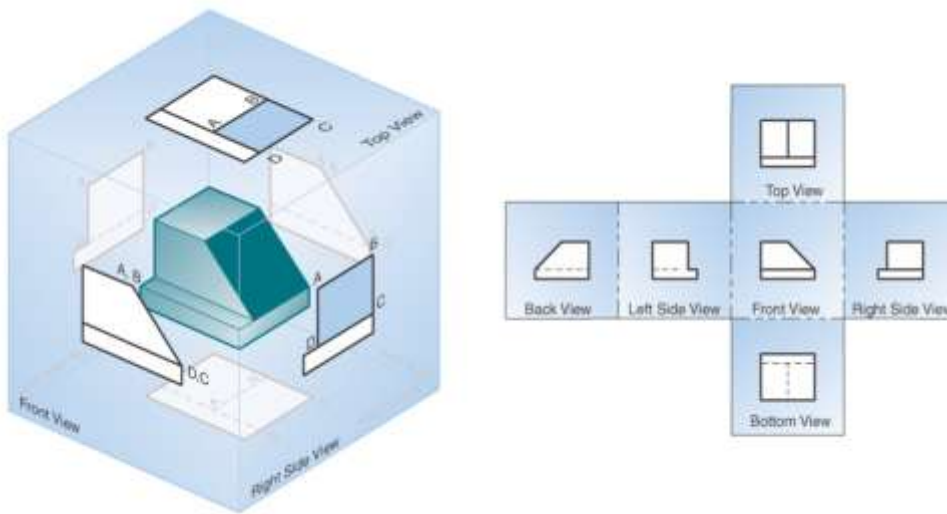
- **The Six Principal Views**

Page 112 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Let us surround the object entirely by a set of six planes, each at right angles to each other. On these planes, views of the object can be obtained as is seen from the top, front, and right side, left side, bottom and rear. Think now of the six sides, or the plane of the paper. The front is already in the plane of the paper, and the other sides are, as it were, hinged and rotated in position as shown

The projection on the frontal plane is the front view vertical projection, or front elevation, that on the horizontal plane, the top view, horizontal projection, or plan, that on the side, profile view, side view, profile projection, or side elevation. By reversing the direction of sight, a bottom view is obtained instead of a top view, or a rear view instead of a front view.



Figure; 3Six Principal Views

Page 113 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------

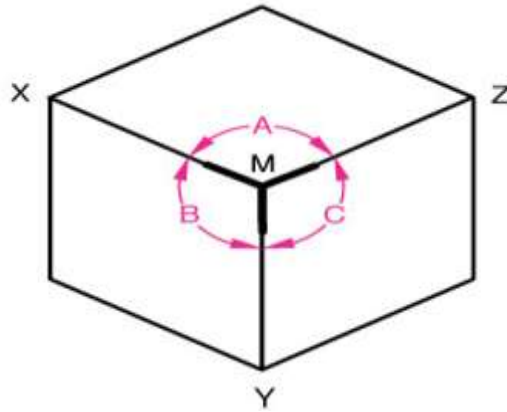


- **Isometric Drawing**

The representation of isometric drawing. is one of a family of three-dimensional views called pictorial drawings. In an isometric drawing, the object's vertical lines are drawn vertically, and the horizontal lines in the width and depth planes are shown at 30 degrees to the horizontal. When drawn under these guidelines,

the lines parallel to these three axes are at their true scale) lengths. (Lines that are not parallel to these axes will not be of their true length. Any engineering drawing should show everything: a complete understanding of the object should be possible from the drawing. If the isometric drawing can show all details and all dimensions on one drawing, When all three angles are equal the drawing is classified as a isometric

Page 114 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Figure;4

Isometric

Angles A,B and C are equal corners MZ MY and MX are equal in length

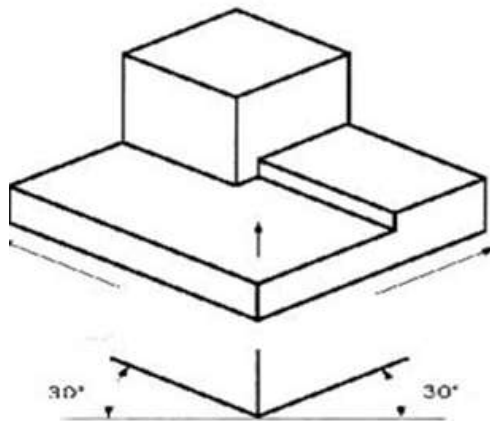


Figure . Isometric drawing



Perspective

Pictorial drawings used to represent 3-D forms on 2-D media in a manner closest to how we perceive the objects with our eyes

Terms to be familiar with include horizon line (HL), ground line (GL), station point (SP), picture plane (projection plane), and vanishing point (VP)

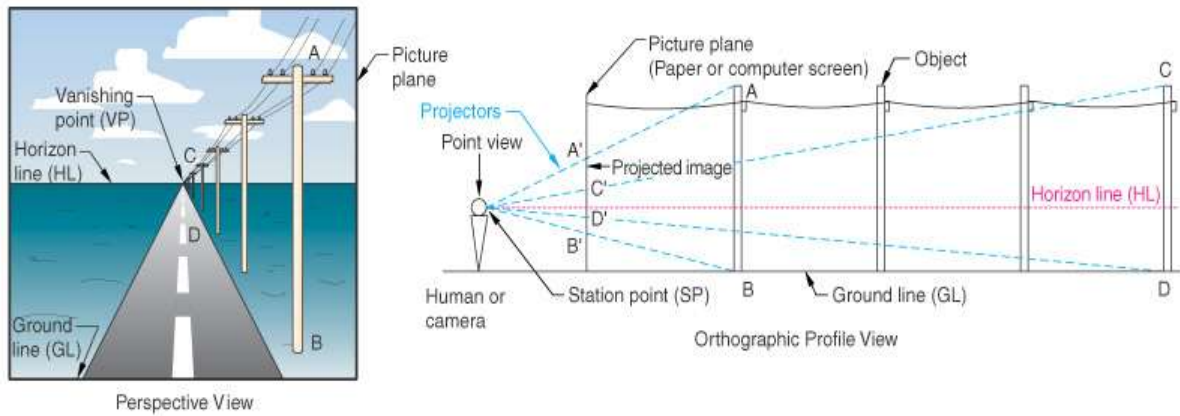


Figure:1

Perspective projections are drawings which attempt to replicate what the human eye actually sees when it views an object. There are three types of perspective projections: One-point, Two-point and Three-point Projections.

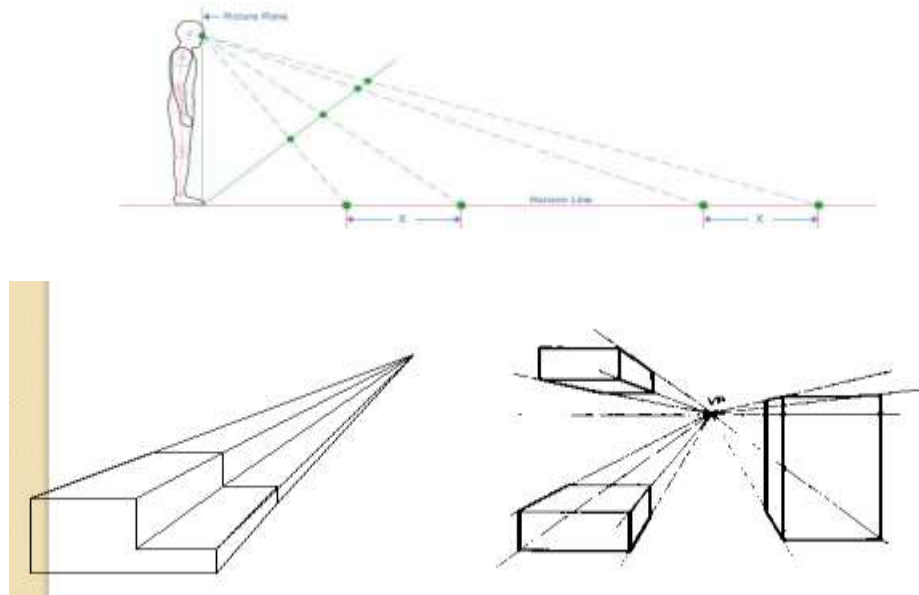


Figure : 2

Page 116 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Two Point perspective projection

The object is placed so that one set of parallel edges is vertical and has no vanishing point, while the two other sets each have vanishing points two point perspective represents a turning or moving aside, a glance to the left or right, an approach to the primary form that is more informal, idiosyncratic and complex, composed as it is two adjacent sides of every object woven into a single perspective view. This view is usually associated with the orientation of the objects, which are simply turned at an angle to the image plane. The two direction points are used for two of the directions it is pointing away from us, giving us ***two point perspective***.

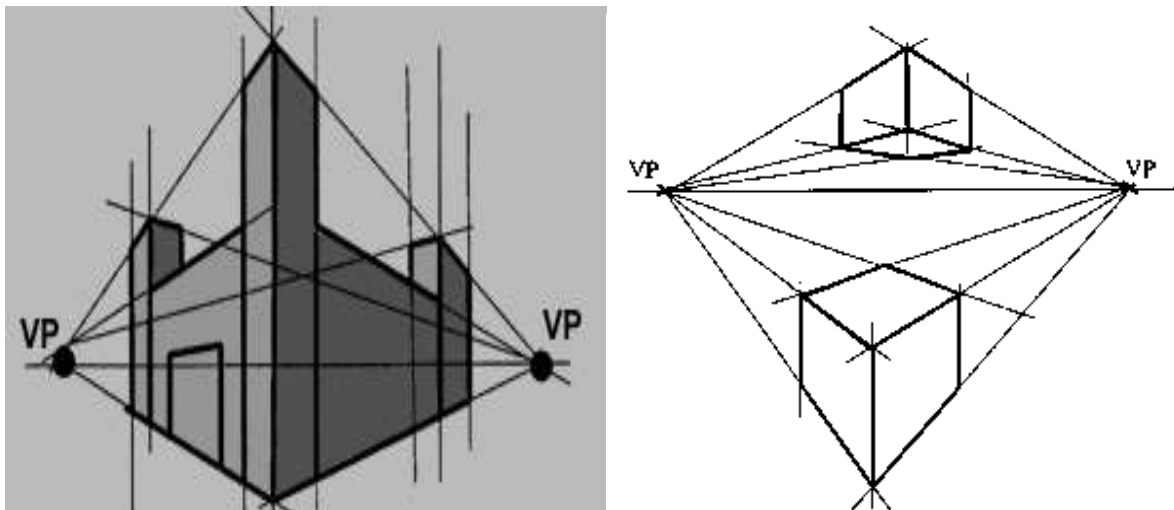


Figure :3

- ***Three point perspective projection:***

The object is placed so that none of its principal edges is parallel to the picture plane. Hence, each of the three sets of principal edges will have a separate vanishing point.

Page 117 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------

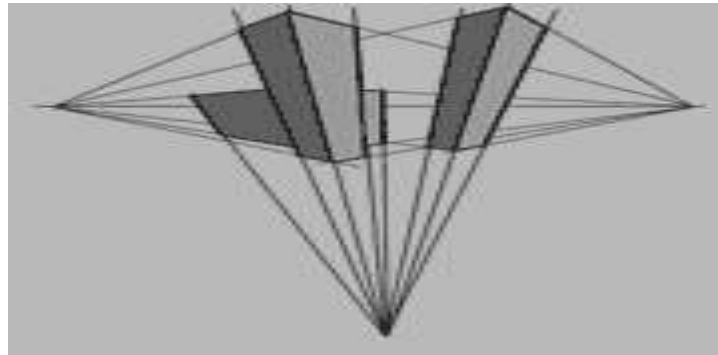


Figure :4

- **Exploded view**

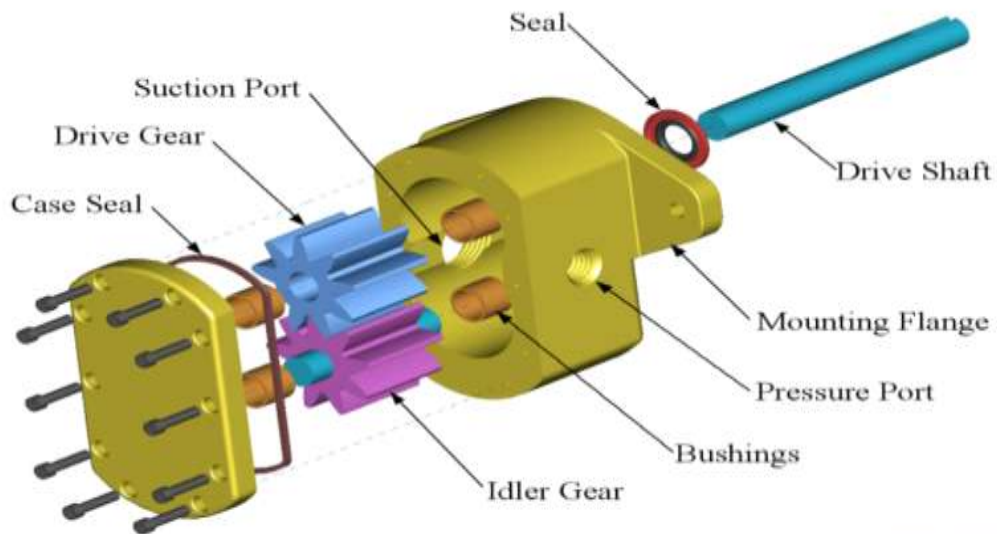
Exploded view drawing is a diagram, picture, schematic or technical drawing of an object, that shows the relationship or order of assembly of various parts.

It shows the components of an object slightly separated by distance, or suspended in surrounding space in the case of a three-dimensional exploded diagram. An object is represented as if there had been a small controlled explosion emanating from the middle of the object, causing the object's parts to be separated an equal distance away from their original locations.

The exploded view drawing is used in parts catalogs, assembly and maintenance manuals and other instructional material.

The projection of an exploded view is usually shown from above and slightly in diagonal from the left or right side of the drawing. (See exploded view drawing of a gear pump to the right: it is slightly from above and shown from the left side of the drawing in diagonal).

Page 118 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



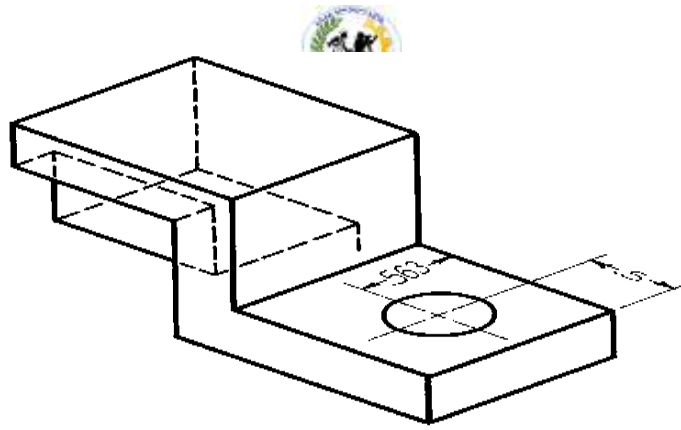
Figure; 1

- **Hidden view technique**

Hidden lines are not usually shown in isometric sketches unless they are needed to show a feature that would be unclear. Usually the orientation for the isometric drawing should be chosen so that hidden lines

aren't needed. Holes are assumed to go completely through the object unless their depth is indicated with a note or with hidden lines.

Page 119 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Figure;2

Information Sheet-2	Explaining Orthographic & Isometric views
---------------------	---

2.4. Explaining Orthographic & Isometric views

They are Two common standards use in orthographic projection of drawings;

The First Angle Projection (European projection) and

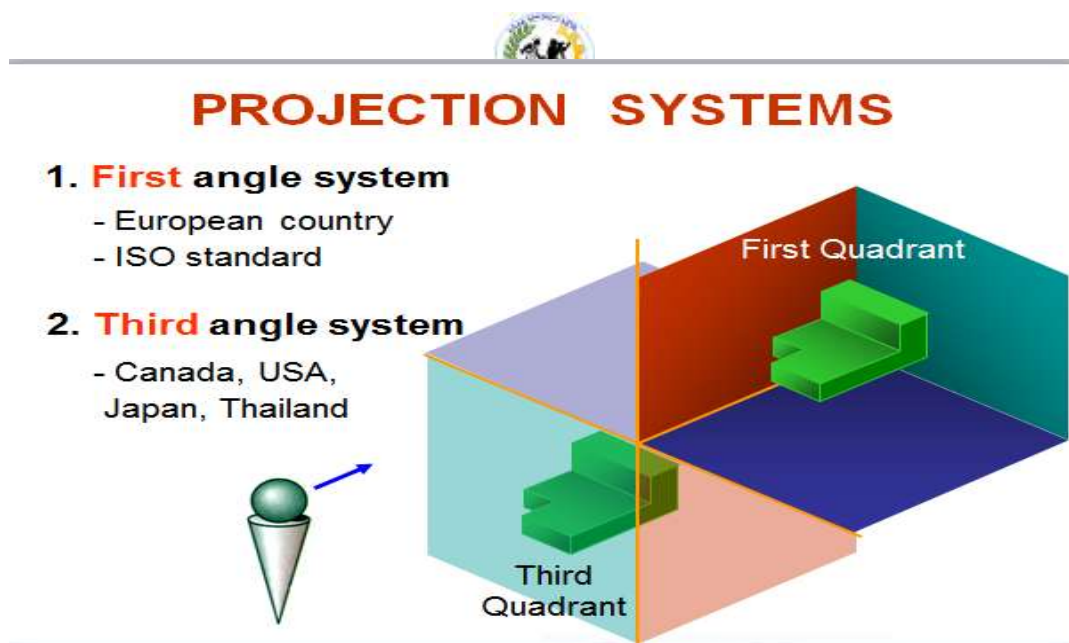
The Third Angle Projection (American projection).

It should be noted that corresponding views are identical in both methods of projection except for their relative positions on the drawing paper.

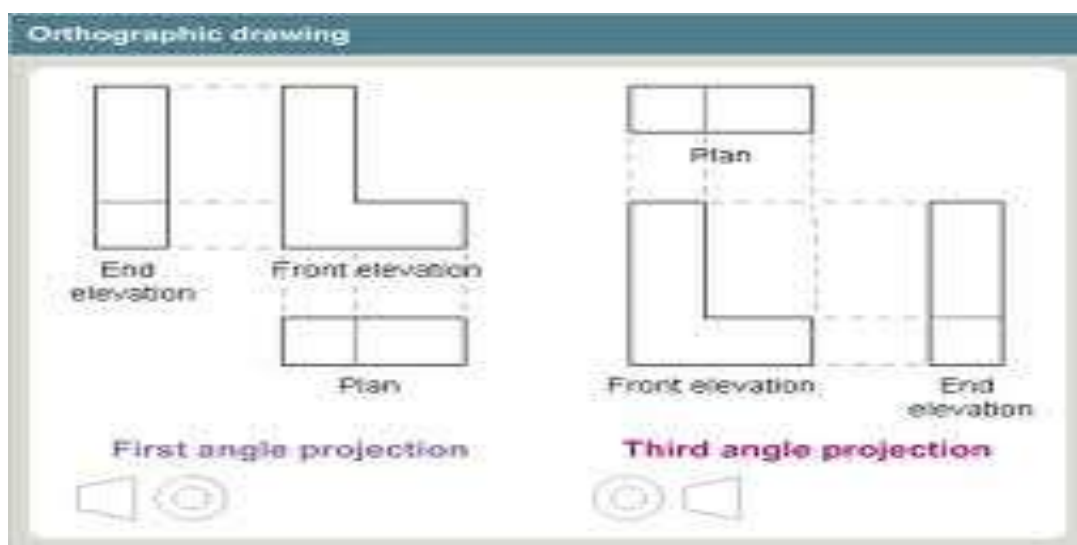
The following principles of orthographic views are considered in making the drawings:

- **In first angle projection;** the Front view on the above and the Top view at the bottom are always in line vertically.
- The front view and the side view are always in line horizontally.
- **Each view gives two dimensions;** usually the front view gives length and height, top view gives length and width and side view gives height and width.
- **When the surface is parallel** to a plane its projection on that plane will show its true shape and sizes. When the surface is inclined its projection will be for shortened

Page 120 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Figure;1



Figure;2

Selection of views

- The number of orthographic views required for clear description of the object is taken as the criteria to select the views. As far as possible least number of views is drawn.
- While selecting the views; the object is placed in such a way the numbers of hidden lines are kept to minimum.

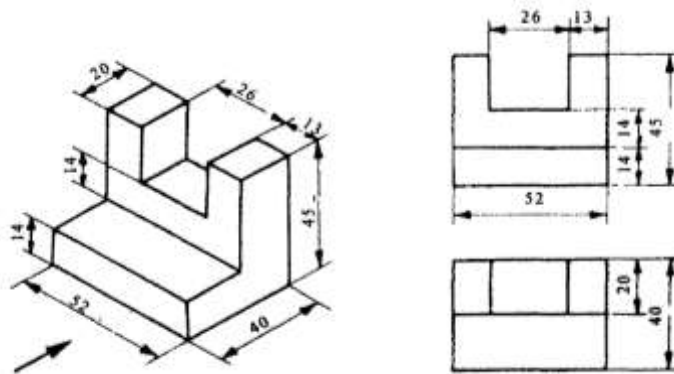
Page 121 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



- Front view is drawn seeing the object in a direction in which its length is seen. It is also chosen such that the shape of the object is revealed. The direction of the view is indicated by arrows.

Examples

The isometric views of some objects and their orthographic views are shown in Figure below drawn as per the principles indicated above.



Figure;3



C.Third Angle Projection D.all are answer

3 which orthographic views principles are correct in making drawing In first angle projection

- B. Front view on the above and the Top view at the bottom
- C. front view and the side view are always in line horizontally
- D. Front view is drawn seeing the object in a direction is which its length is seen.
- E. All above answer are correct

Name: _____

Date: _____

Answer Sheet

Score = _____

Rating: _____

Operation Sheet 2	Identify views,standard symbols and line
--------------------------	---

Operation Title:

One Point Perspective

Procedure:

Step1.Set up the Oslo drawing paper on top of the drawing board.

Step2.Check to see that the paper edges are parallel to the left and bottom edges of the board respectively.

Step3.Properly secure the paper on top of the table by using masking tape or tacks or the likes.

Step4.Using the set of triangles and t-square, draw the border line around the drawing paper, leaving area for the title block at the bottom part.

Step5.Be sure to check the sharpness of your pencil lead. Use standard sharpening for good aesthetic result of your work.

Step6.For normal drafting or lettering use the soft lead pencil (**HB**) for final results. Use the harder lead pencil (**4H**) for guidelines drawing only.

Page 124 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Step7.For inking, drafting pens of 0.1, 0.3 and 0.5 pen points are needed.

Step8Use the set of triangles, t-square and lead pencil this activity.

Step9. Always remember that construction lines and guidelines are necessary in sketching and drafting, so utilize this knowledge.

Step10.Apply the knowledge on line quality in your work.

Step11. Accuracy and aesthetics always go hand in hand with drafting, so do your work with quality.

Step12. You may submit your finish work once you are true but should be within the time specified for submission.

LAP Test	3D Views – Isometric Problem
-----------------	-------------------------------------

Name: _____

Date: _____

Time started: _____

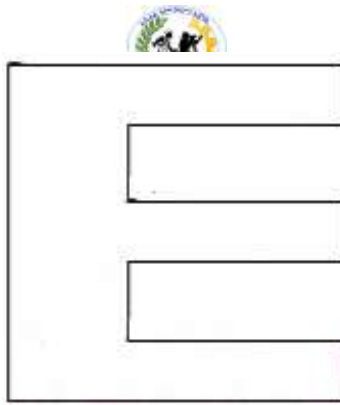
Time finished: _____

Instructions:

11. You are required to do the following activities as required in the problem.

- **Activity 1:** Draw the one point perspective view of letter “ E “ below. (10points)

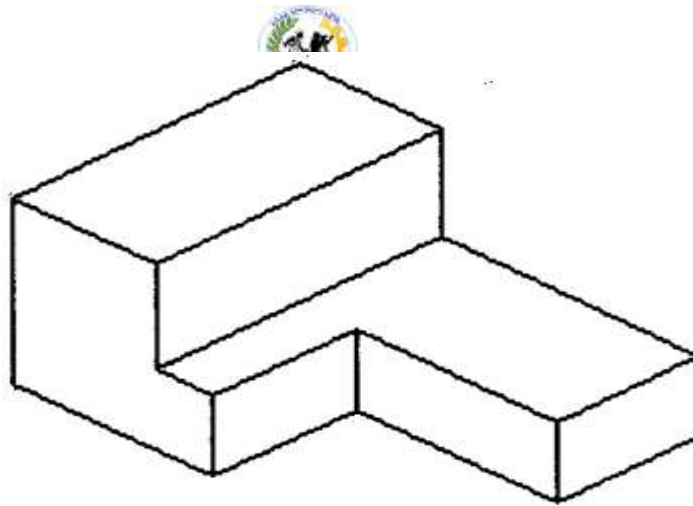
Page 125 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



- **Activity 2:** Given the picture below, find the VP (vanishing point) by drawing orthogonal rays. Draw only the rays bounded by the ceiling lines, window lines below and floor lines. (10 points)



- **Activity 3:** Draw the one point perspective view of the isometric figure below. (10 points)



- **Activity 4** : Using the concept of one point perspective and your creativity, make a simple perspective drawing which would apply the “ Single Point Perspective with Diminishing Spaces “. (See illustrative example on page 14, example no. 4) (20 points)

12. Request from your teacher the following materials.

- HB drawing pencil lead
- 4H drawing pencil lead
- 45° x 90° triangle
- 30° x 60° triangle
- Eraser
- T-square
- Drafting pens
- Drawing table
- Drawing papers

13. You are given 2 hours to accomplish the above activity. (1 Hr for Act. 1 and 2, 1 Hr for Act. 3)

14. Request your teacher for evaluation and feedback.

Page 127 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Referance

- **Jenson,Cecil** Howard,Engineeringdrawing and design,1925,4th ed
.,Macmillan/McGram-Hill
- . **Louis Gary Lamit**, Descriptive Geometry,1981,1st ed.,Prentice-Hall
- Frederick E.,Technical Drawing,1958,4thed.,The Macmillan Company
- David L.Goetsch et al, Technical drawing,1994,3rd ed., Delmar Publishers Inc.
- A text book of engineering drawing, B.Gupta. Nasaka Pashakar publisher
- V.B. Sikka ,A course in civil engineering drawing ,1998,4th ed.
- T. Jeyapoovan, Engineering Drawing with autocad 2000, Vikas publishing

Page 128 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



BASIC METAL WORKS

Level-I

Learning Guide :24

Unit of Competence Interpret Drawings & Sketches

Module Title Interpreting Drawings and Sketches

LG Code: IND BMW1 M07 LO3-LG-24

TTLM Code: IND BMW1 M07 TTLM 1019v1

LO3: Interpret technical drawing

Page 129 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Instruction Sheet	Learning Guide 24
-------------------	-------------------

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Recognizing Component, assembly or object projections
- Identifying dimensions and material requirements
- Interpreting dimensional *tolerances* and notations.

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to:

- Component, assembly or object is recognized as required.
- Drawing symbols and codes are interpreted appropriately.
- Dimensions and material requirements are identified, understood and followed as required.

Dimensional tolerances, notations are interpreted according to specifications.

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” in page ----
--, -----, ----- and -----respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” in page ----.
6. Do the “LAP test” in page – ---- (if you are ready).

Page 130 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



3.1 Recognizing Component, assembly or object projections

Assembly Drawings: A complete assembly drawing is presentation of the product or structure put together, showing all parts in their operational positions. The separate parts come to the assembly department after their manufacturing processes are finished and in this department they are put together according the assembly drawings. Small machining operations may be necessary during assembly process such as drilling, reaming, or hand finishing. For such cases, assembly drawings include a note explaining the required operation and give the dimensions for the alignment or location of the pieces. **Assembly drawings** should include reference letters and numbers representing the different parts.

- **A unit assembly (subassembly)** is a drawing of a related group of parts and used to show the assembly of complicated machinery for which it would be practically impossible to show all the features on one drawing. To illustrate; headstock, tailstock, and gearbox unit assemblies should be included in the drawing of a lathe.
- **An outline assembly is used** to describe the exterior shape of a machine or structure, so it contains only the primary dimensions. If it is made for catalogs or illustrative purposes, dimensions are often omitted. They are also called as installation drawings.
- **An assembly working drawing** includes all the necessary information for producing a machine or structure on one drawing. This requires providing adequate orthographic views together with dimensions.
- **A diagram drawing is an assembly showing**, symbolically, installation of equipment and often made in pictorial form.
- The bill of material is a tabulated list placed either on the assembly drawing or on a separate sheet. The list gives the part numbers, names, quantities, material and sometimes stock sizes of raw material, detail drawing number, etc. The term "bill of



- "material" is usually used in structural and architectural drawing whereas the term "part list" is used in machine-drawing practice

Assembly drawing

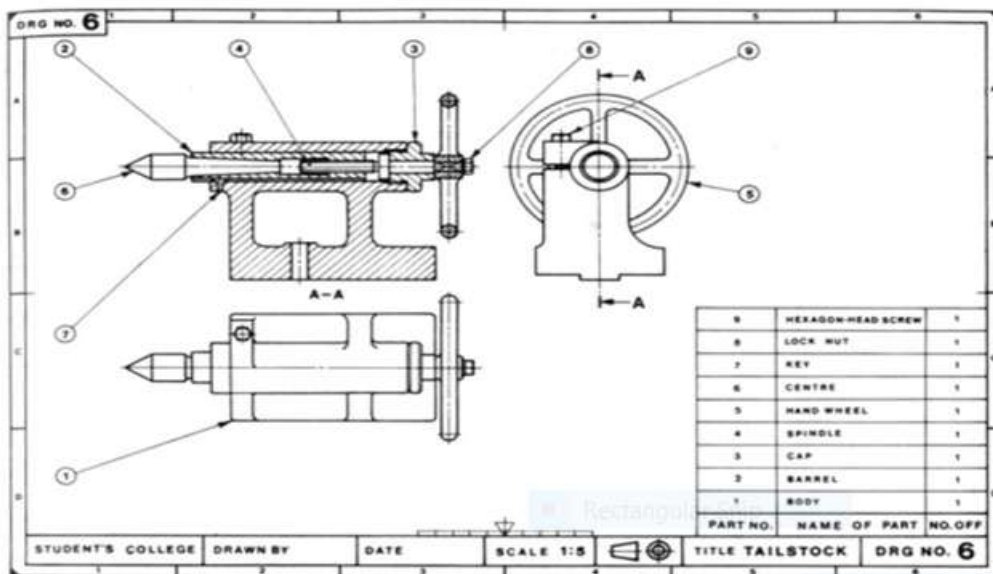


Fig 3:1

Self-Check -1	Written teste
---------------	---------------

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

Write the correct answer if it is True say True if it is False say False

1. Assembly drawings should include reference letters and numbers representing the different parts.

2. **A unit assembly** is a drawing of a related group of parts and used to show the assembly of complicated machinery for which it would be practically impossible to show all the features on one drawing.

Page 132 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



3 .Assembly Drawings: A complete assembly drawing is presentation of the product or structure explod each other

Name: _____

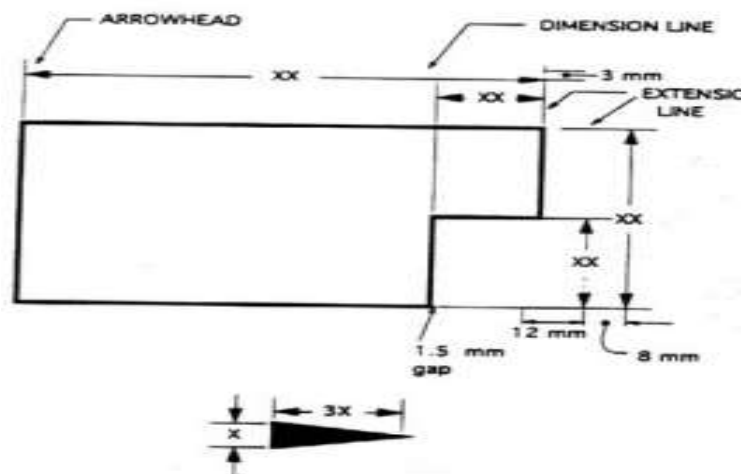
Date: _____

Answer Sheet

1. True
2. True
- 3.False

3.2 Identifying dimensions and material requirements

Detail drawing is expected to provide not only the complete shape description of the part, but also furnish size description. This is provided in the form of distance between the surfaces, location of holes, kind of finish, type of material, etc. These features are illustrated on a drawing by the use of lines, symbols, figures, and notes, called dimensioning. Proper dimensioning requires engineering judgment and thorough knowledge of the practices and requirement of the production department.



Page 133 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Self-Check -1	Written teste
----------------------	----------------------

Directions: Answer all the questions listed below. Use the Answer sheet provided in the nextpage **Write the correct answer if it is True say True if it is False say False**

1. Detail drawing is expected to provide only the complete shape description of the part. F
2. The features are illustrated on a drawing by the use of lines, symbols, figures, and notes, called dimensioning. T
3. Dimensioning not requires engineering judgment . F
- 4.

3.3 Interpreting dimensional *tolerances* and notation

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 or legibility.
- **Dimension** line is a thin line, broken in the middle to allow the placement of the dimension value, with arrowheads at each end.

Arrowhead is approximately 3mm long and 1 mm wide That is, the length is roughly three times the width.

Page 134 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



- An extension line extends a line on the object to the dimension line. The first dimension line should be approximately 12 mm (0.6 in) from the object. Extension lines begin 1.5mm from the object and extend 3 from the last dimension line.
- A leader is a thin line used to connect a dimension with particular area.

Self-Check -1	Written teste
----------------------	----------------------

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

Write the correct answer if it is True say True if it is False say False

1. Dimensioning is to provide a clear and complete description of an object. T
2. Complete set of dimensions will permit only one interpretation needed to construct the part. T
3. extension line is not extends a line on the object to the dimension line. F
4. leader is a thin line used to connect a dimension with particular area. T
5. Dimension line is a thin line, broken in the middle to allow the placement of the dimension value, with arrowheads at each end. T

Page 135 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------

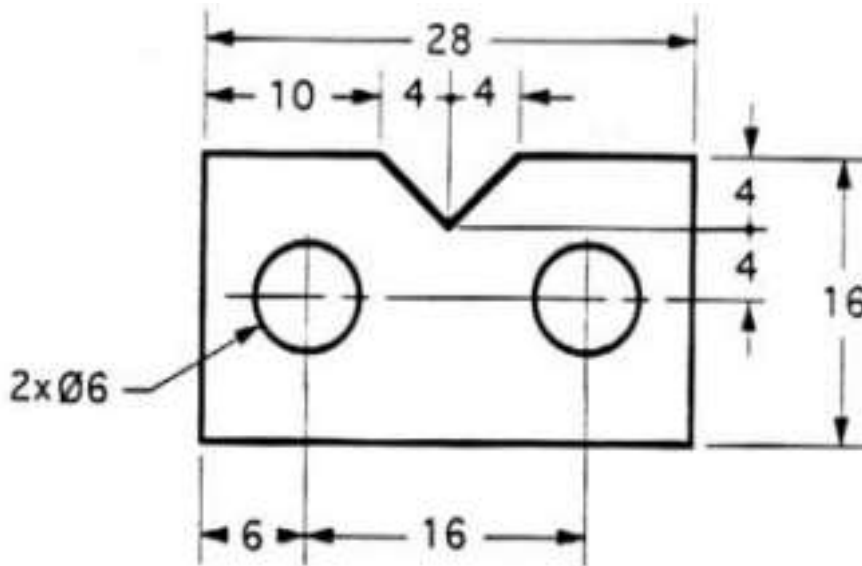


Fig :3

Two approved

systems indicate dimensions on drawings: the **aligned dimension** and the **unidirectional dimension system**. Select one system of dimensioning to use throughout the drawing. You may show dimensions with either whole numbers and fractions, decimals, or metric units of measure. **ALIGNED DIMENSIONS:** Drawings made with aligned dimensions have all figures and notes aligned with a dimension line so that all read from the sides or edges of a drawing. The most common are read from the bottom and right side. Aligned dimensions are sometimes referred to as pictorial dimensions.

Page 136 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



- **General tolerance**

If no tolerances are specified at the dimension level, then general tolerances may be applied by deliberately controlling the number of values past the decimal point on each dimension.

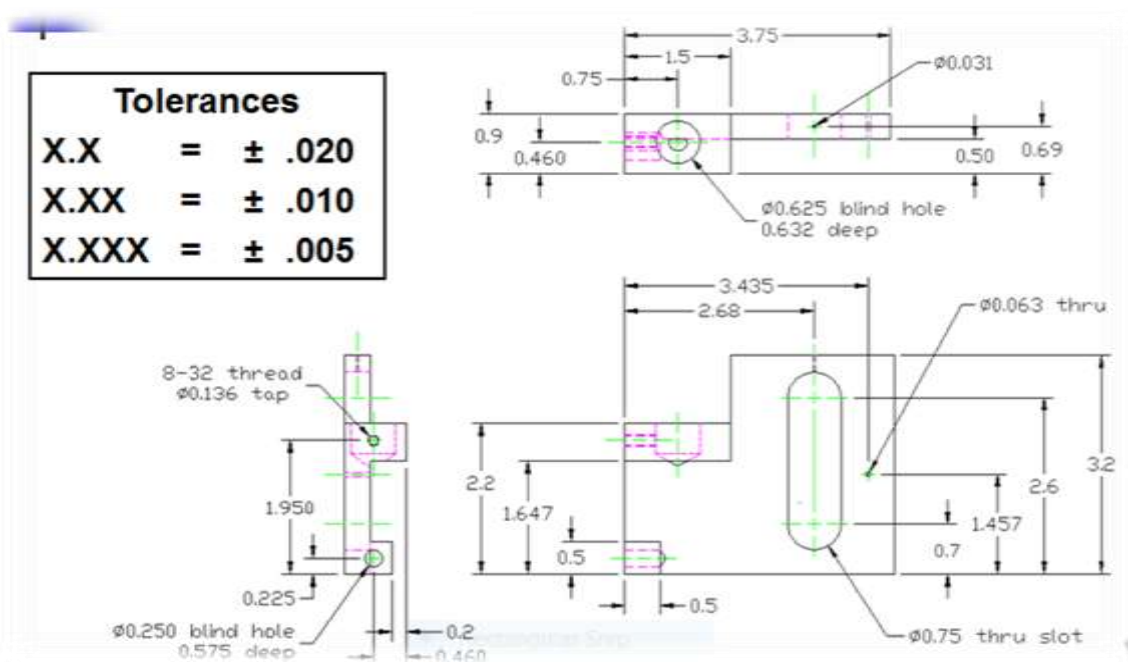


Fig :4

No two manufactured objects are identical in every way. Some degree of variation will exist. Engineers apply tolerances to part dimensions to reduce the amount of variation that occurs. The tolerance may be applied directly to the dimension or indicated by a general note located in the title block of the drawing

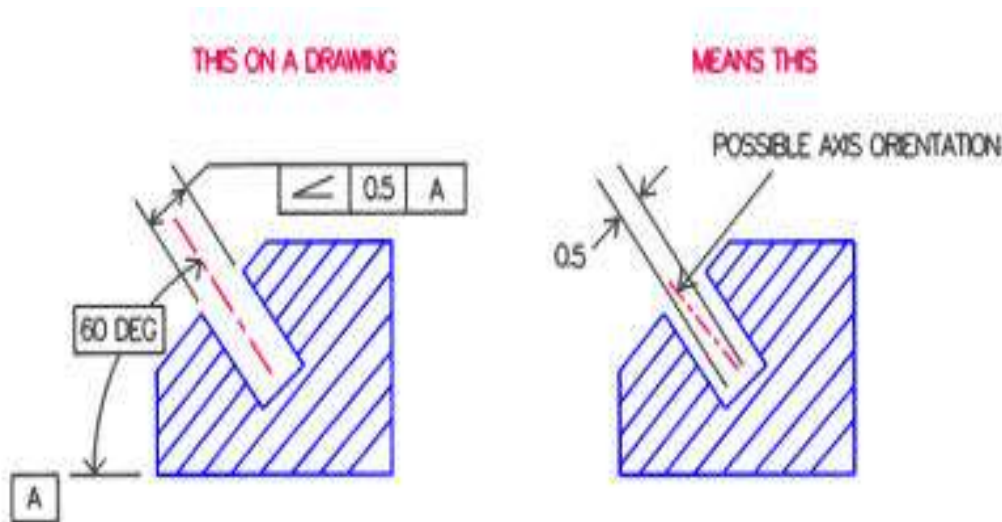
A tolerance is an acceptable amount of dimensional variation that will still allow an object to function correctly



- **Angular tolerance**

In a mechanical drawing of a part, angularity tolerance allows the designer to specify the degree to which the orientation of an angled part feature may vary.

The angularity symbol is often used to insure that the part can properly mate with another. In GD&T, the degree of permissible variation is not specified as a tolerance on the angle. Rather an indirect method is used where one specifies a tolerance zone at a specified angle from a datum, within which a part feature, axis, or center plane must lie.



Figures: 5 Angular tolerance

In the left figure above, the boxed angularity symbol, tolerance and datum are used to control the center axis of an angled hole. The boxed symbols can be read “This axis must lie within two planes 0.5 apart , the planes inclined 60° to surface A”.

In the right figure above, the tolerance zone created is indicated by the parallel lines.

Page 138 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



This form of angularity tolerance applies only in the drawing view in which the tolerance is specified, and requires the permissible variation to be defined for other views. However, if a

diameter symbol were placed in front of the boxed 0.5, this would create a cylindrical tolerance zone which would then apply to all drawing views.

Angularity is used in a tolerance stack when applied to a surface or line element. Angularity refines the orientation of the surface or line element, acting like a flatness control for the purposes of performing a tolerance stack

- **Geometric tolerance**

In a typical engineering design and production environment, the designer of a part rarely follows the design to the shop floor, and consequently the only means of communication of the design intent are the design drawings. Problems of validation and interpretation of design arise when the drawings do not clearly reflect what the designer intended, when they do not communicate to manufacturing how the design should be implemented and when the drawings are subjected to a number of different interpretations

The use of linear tolerances when dimensioning the part can control the size of a product. It is however possible for limits of size to be maintained while the shape of a part or feature deviates significantly from the intended form. To control this deviation, a method of specifying the acceptable tolerance of form is required and this is done using

geometric dimensioning and tolerancing symbols. These enable the designer to specify on the drawing, the geometry or shape of a component and they provide a precise definition of what constitutes a functionally good part.

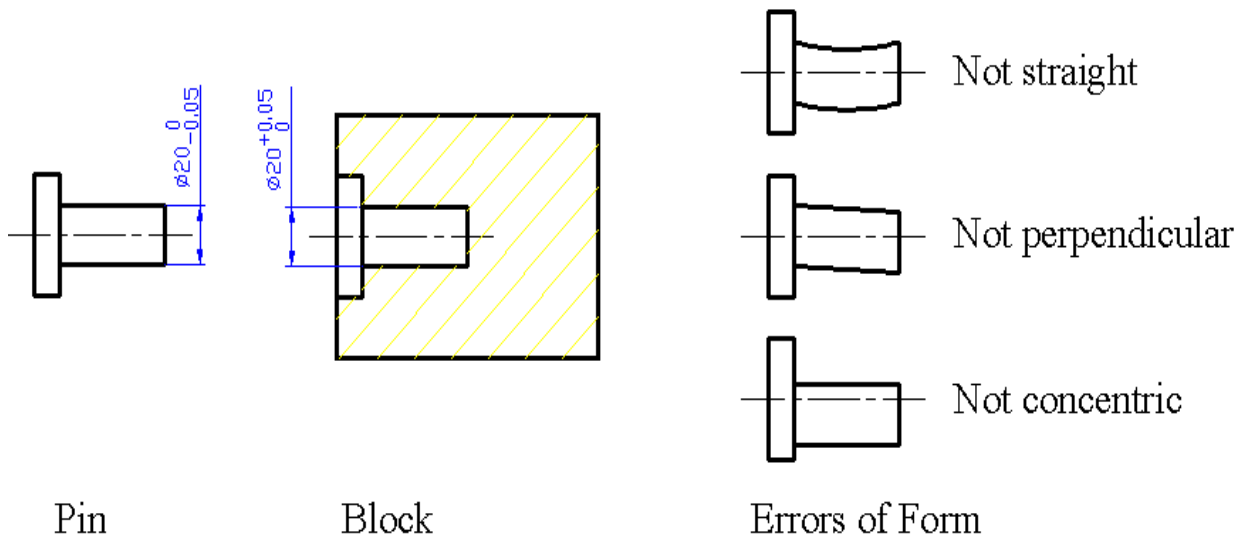
- **Geometrical and Dimensional Tolerances**

An example is given in **Fig 1** of a Pin, which must fit in the bored hole on the Block as shown. It is possible to manufacture the part to the dimensional tolerances specified, and still discover that the parts will not fit together as intended. Some examples, shown greatly

Page 139 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------

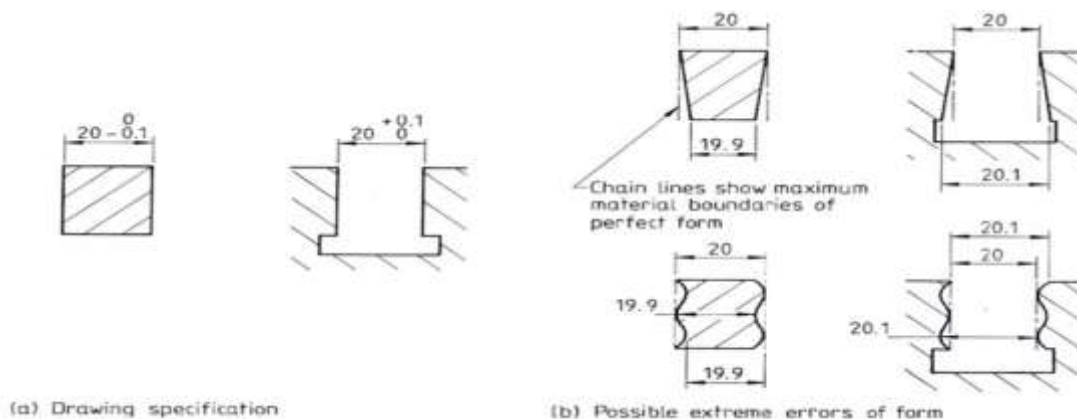


exaggerated, of possible errors of form arising from production



• **Example showing Errors of Form**

In the example shown in **Fig 2** the block will fit in the T-slot, even at the extremes of fit, however across the length of the fit, the mating conditions (clearance) may vary significantly more than the designer desired.



Figure;2

When it is considered essential to place controls on the production process to ensure

Page 140 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



that the problems shown above can be avoided, this can be done using geometrical tolerances symbol

done using geometrical

When Geometrical Tolerances are Used

Geometrical tolerances should be specified for all requirements critical to functioning and interchangeability, except when it is known that the machinery and manufacturing techniques that will be used can be relied on to achieve the required standard of accuracy.

Geometrical tolerances should be specified only where they are essential, otherwise the manufacturing and inspection costs may be increased.

In any case tolerances should be as large as possible, subject to the design requirements being met. As geometrical tolerancing symbols are internationally agreed (see ISO 1101), language difficulties cannot occur

The use of geometrical tolerances does not imply that any particular method of production or inspection should be used

• Features of a Component

Fig; 3 illustrates some of the single features that may be present on a component. Geometrical tolerances may be applied to these features.

For example, an axis may have straightness or positional tolerance, a face may have a flatness tolerance and a cylindrical surface may have a circularity tolerance.

They may be combined to form other features such as slots, grooves and tongues. Thus, a tongue consists of a pair of parallel planes surfaces with another plane surface at right angles to

them, and a median plane. Slots, grooves and tongues may need tolerances of position or symmetry.

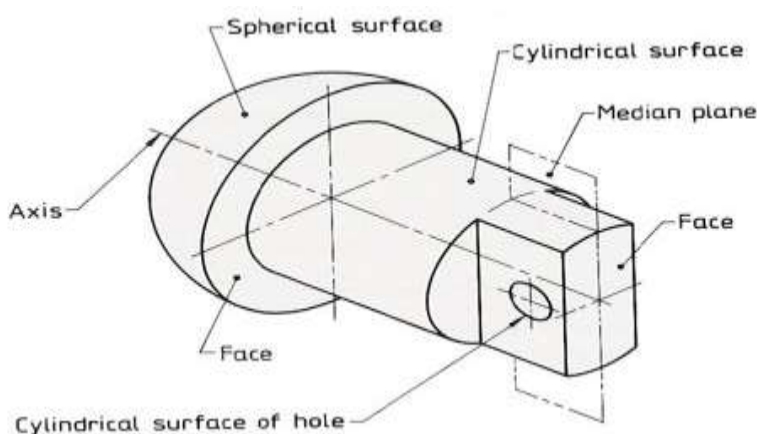




Figure3:Featureofa Component

- **ToleranceFrame:**

Geometricaltolerancesareplacedinrectangular framesthataredividedinto compartmentsas shownin**Fig 4**.

Inthefirstcompartmentfromthelleftthesymbolfor thecharacteristic beingtolerancedis given Thenextcompartmentcontainsthetolerancevaluein theunitsusedforlineardimensions.

Ifthetolerance zoneiscircularorcylindricalthesymbol \varnothing appears beforethe tolerancevalue Thethirdandsucceedingcompartmentscontain

the. letterswhichidentifythedatumfeatureorfeatures, where appropriate

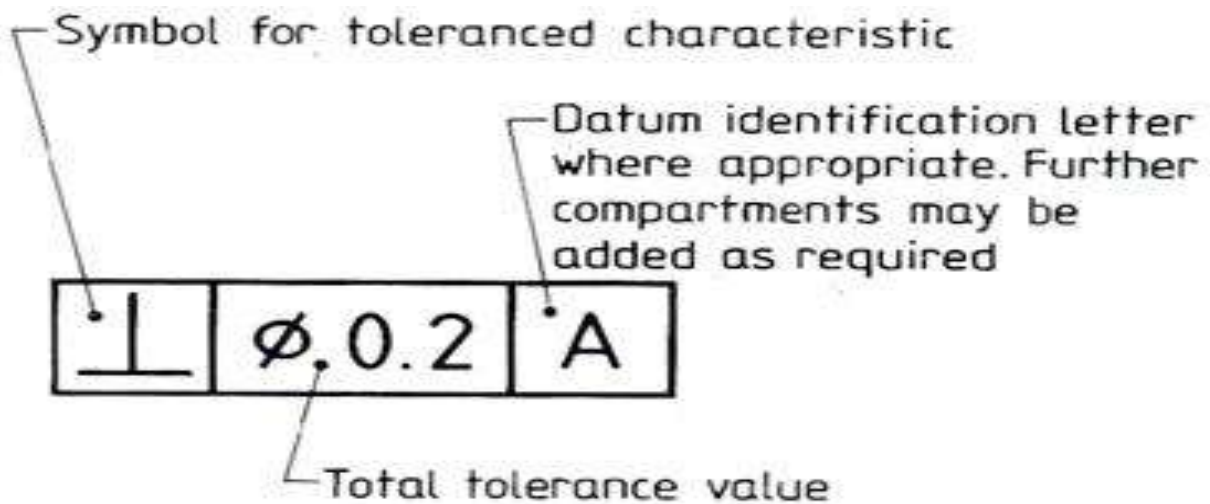


Figure4 ToleranceFrame

Page 142 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



The capital letter “M”, “P” or “E” may appear in the tolerance frame as appropriate, to indicate

- Maximum Material Condition qualification
- Projected Tolerance Zone
- Envelope Requirement

• **Tolerance Characteristic Symbol:**

The straightness of an axis, the flatness of a face, etc., are characteristics of features and these are indicated on drawings using the symbols shown in **Fig:5**

Page 143 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



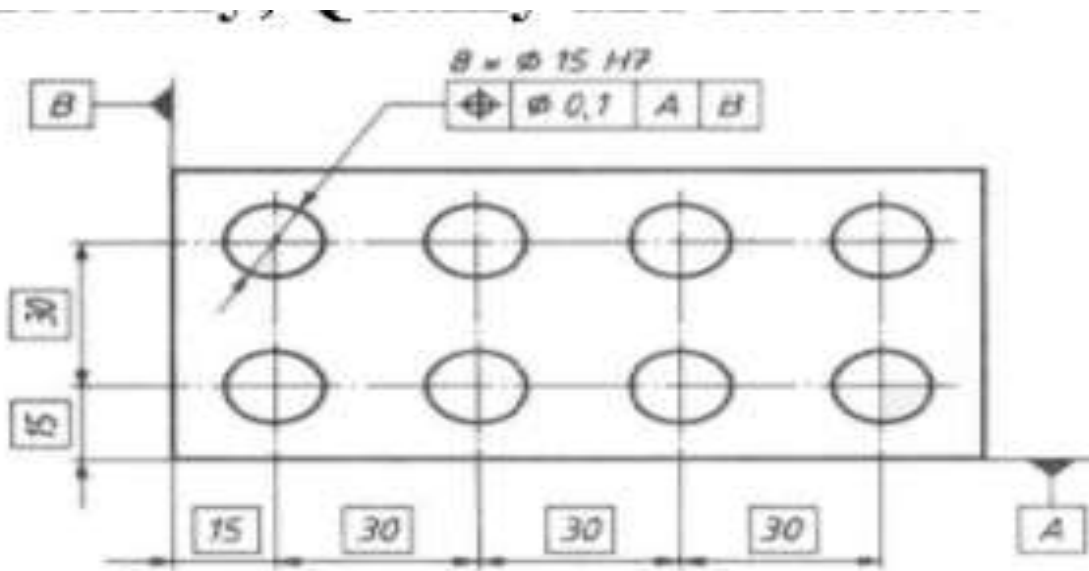
Features and tolerances		Toleranced characteristics	Symbols	
Single features	Form tolerances	Straightness	—	
		Flatness	▭	
		Circularity	○	
		Cylindricity	∅	
Single or related features		Profile of any line	⤿	
		Profile of any surface	⤿	
Related features		Orientation tolerances	Parallelism	//
			Perpendicularity	⊥
	Angularity		∠	
	Location tolerances	Position	⊕	
		Concentricity and coaxiality	◎	
		Symmetry	≡	
	Run-out tolerances	Circular run-out	↗	
		Total run-out	↗↗	

Figure5: ToleranceCharacteristic Symbols



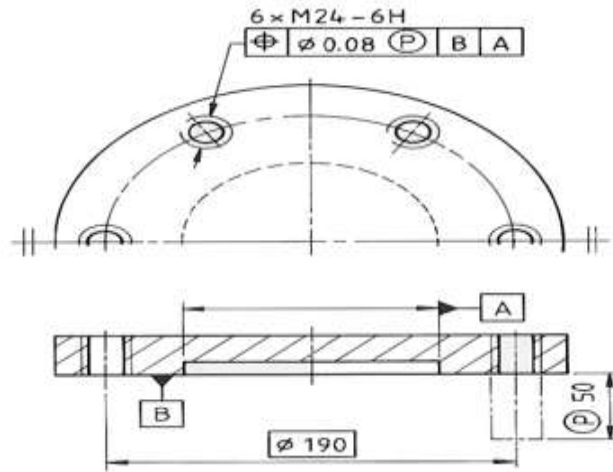
Theoretically Exact Dimensions:

When tolerances of position, profile or angularity are specified for a feature, the ideal position or angle is defined by theoretically exact dimension. These dimensions are enclosed in a rectangular frame, called a box as shown using **the example opposite**



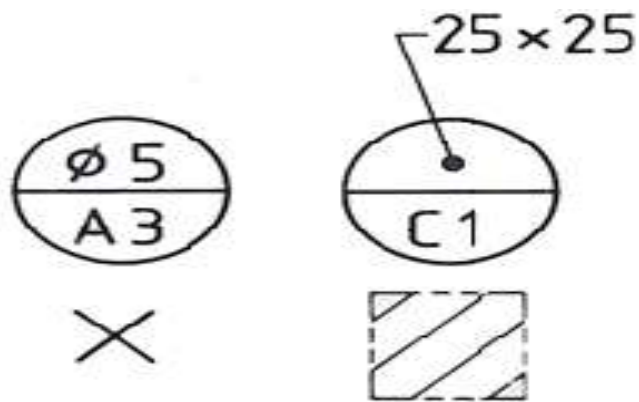
- **Projected Tolerance Zone:**

When indicating the positional tolerance zone for the axis of a hole, the perpendicularity deviations of the axis may be specified also. If the hole is to be used to secure a cylindrical part such as a press-fit pin, the maximum permitted perpendicularity deviation of the hole axis could cause the pin to interfere with the clearance hole in the mating part. This may be avoided by specifying a projected tolerance zone for the axis of the securing hole, as shown opposite.



• Datum Targets

If a feature is large, geometrical imperfections may make it impracticable to use its entire surface to establish a datum. To establish practical datums, suitable locations on the part, called datum targets, may be selected and indicated on the drawing.





Self-Check -1	Write Tests
----------------------	--------------------

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page
Write the correct answer if it is True say True if it is False say False

The purpose of dimensioning is to provide a clear and complete description of an object. T
Complete set of dimensions will permit only different interpretation needed to construct the part. F
Geometrical tolerances should be specified for all requirements critical to functioning and interchangeability. T
Suitable locations on the part, called datum targets. T

Name: _____

Date: _____

Answer Sheet

- 1. _____
- 2. _____
- 3. _____

Score = _____

Rating: _____

Page 147 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------

**Operation Title: Dimensional Views**

Step1 Set up your drawing paper on top of the drawing board.

Step2 Use the drawing template format given to you by your teacher.

Step3 Be sure to check the sharpness of your pencil lead. Use standard sharpening for good aesthetic result of your work.

Step4 Using the basic drawing instruments and materials, perform the drawing task in the given following problems 1 to ___ below.

Step5 Use appropriate pencil lead in your drafting works.

Step6 There are two part of problem exercises, Part A – complete the st

Step7 orthographic views by finding the missing line/s given the orthographic views and isometric view;

Step8 Part B – provide the 3 basic orthographic views (top, front and side/end views) given the isometric view.

Step9 You may submit your finish work once you are true but should be within the time specified for submission.



Lap test

2D Views

Name: _____

Date: _____

Time started: _____

Time finished: _____

Instructions: Provide or accomplish what is/are required in the following drawing problems.

15. Request from your teacher the following materials.

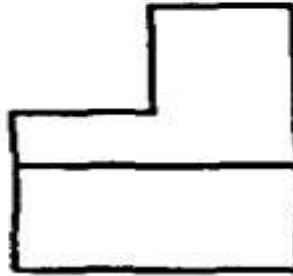
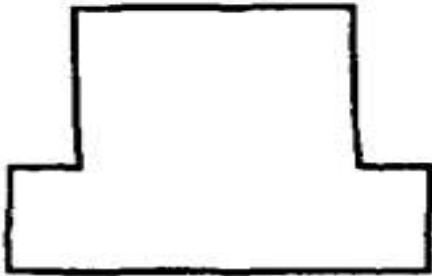
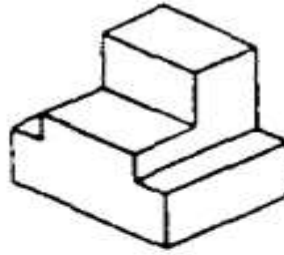
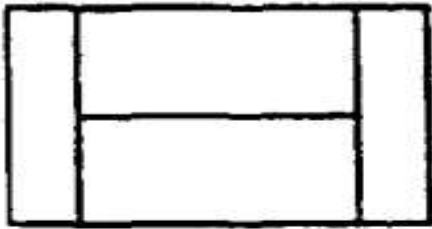
- HB drawing pencil lead
- 4H drawing pencil lead
- 45° x 90° triangle
- 30° x 60° triangle
- Eraser
- T-square
- Drawing table
- Drawing papers

16. You are given 3 hours to accomplish the above activity.

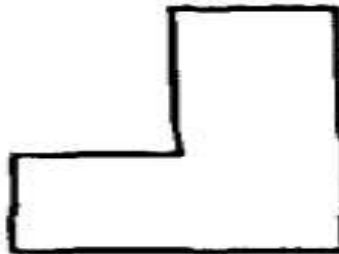
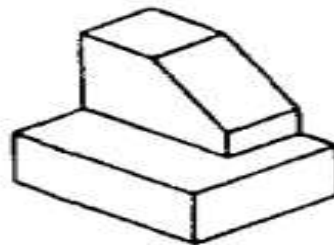
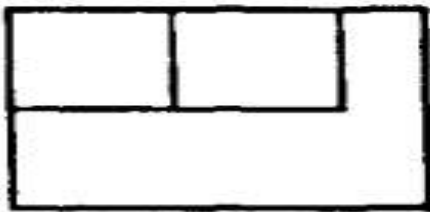
17. Request your teacher for evaluation and feedback.

Part A

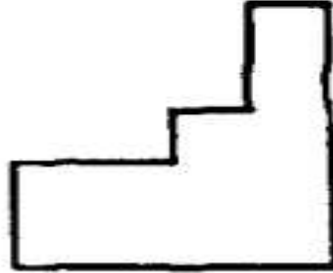
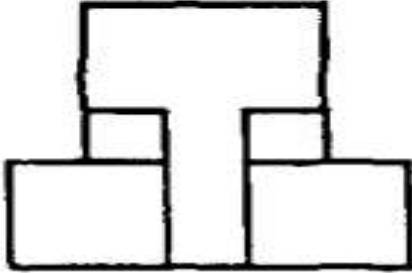
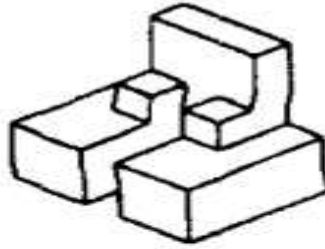
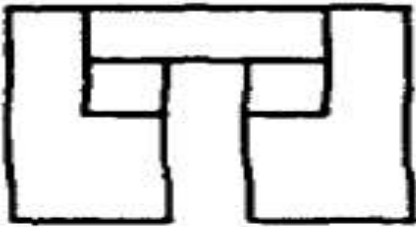
Problem 1 : Find the missing line/s, given the following views:



Problem 2: Find the missing line/s, given the following views:



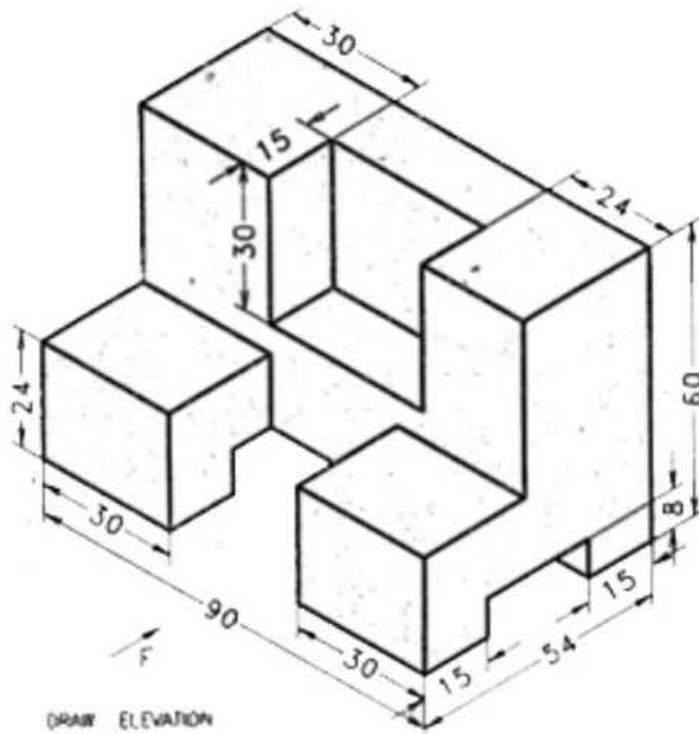
Problem 3: Find the missing line/s, given the following views:



Part B

Problem 1:

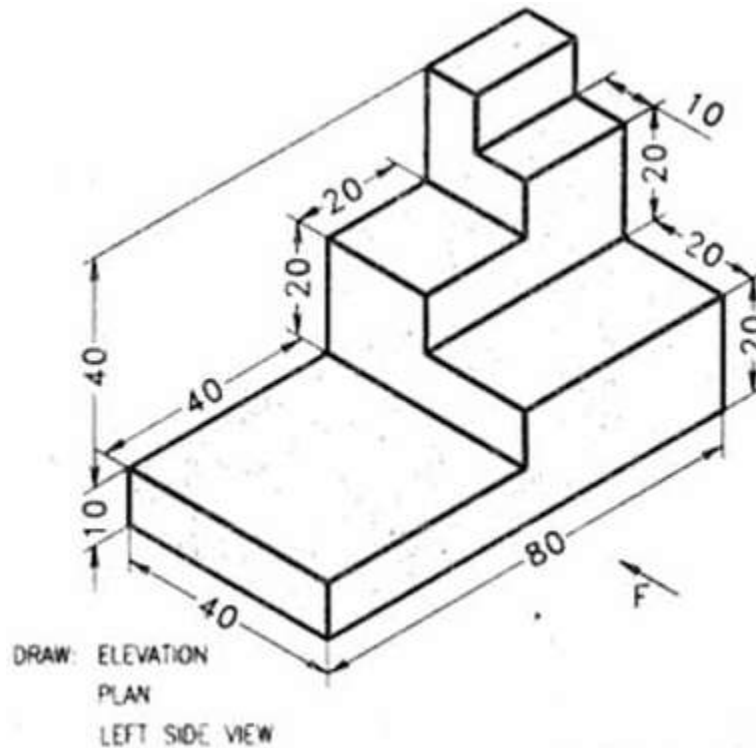
Draw the orthographic projections needed to fully describe the part. Choose the best view for the front view. Use a scale of 1:1 with 50 mm spacing between the views. *Note: All Dimensions in mm.* (15 points)





Problem 2: Draw the orthographic projections needed to fully describe the part. Choose the best view for the front view. Use a scale of 1:1 with 50 mm spacing between the views. *Note: All Dimensions in mm.* (15 points)

Page 152 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



Problem 3: Draw the orthographic projections needed to fully

Reference materiales

- **Jenson,CecilHoward**,Engineering drawing and design,1925,4th ed.,Macmillan/McGram-Hill
- . **Louis Gary Lamit**, Descriptive Geometry,1981,1st ed.,Prentice-Hall
- Frederick E.,Technical Drawing,1958,4thed.,The Macmillan Company
- David L.Goetsch et al, Technical drawing,1994,3rd ed., Delmar Publishers Inc.
- A text book of engineering drawing, B.Gupta. Nasaka Pashakar publisher
- V.B. Sikka ,A course in civil engineering drawing ,1998,4th ed.
- T. Jeyapoovan, Engineering Drawing with autocad 2000, Vikas publishing

Page 153 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



ACKNOWLEDGEMENT

The **FTVET AGENCY** wishes to extend thanks and appreciation to the many representatives of business, industry, academe and government agencies who donated their time and expertise to the development of this Model Curriculum for the TVET Program **Basic Electrical/Electronic Equipment Servicing Level-1** We would like also to express our appreciation to the following Officials and Staff of Ministry of Education who made the development of this curriculum possible.

Page 154 of 155	Federal TVET Agency Author/Copyright	TVET program title: Basic Electrical/Electronic Equipment Servicing L - 1	Version -1 October 2019
-----------------	---	---	----------------------------



The trainers who developed the TTLM

No	Name	work Place/Region	Edu. Background	Experience in TVET	Addresses
1	Tesfahun Ayalew	BGRS /Assosa polytechnic College	Msc in El.Comm.En	10 Year	Technogps44@gmail.com / 0912132308
2	Ayano Assefa	Dabube /Arbaminchi polytechnic College	Msc in pow.En	9 Year	assefahule@gmail.com 0920062670
3	Zekairas Sisay	Harari -polytechnic College	Bsc in Cont and pow.En	6 year	gselam17@gmail.co 0913344201
4	Gashaew Nugisue	Addise Ababa /akaki polytechnic College	Msc in Cont.En	9 Year	Kena1445@gmail.com /0911982009
5	Mokennen G/Hawariat	Oromia / Adama polytechnic College	Msc in control technology	27 years	Leulmoke45@gmail.com 0911027886
6	Yohannise Fetene	ANRS /Kombolcha Industrial poly TVET College	Msc in El.Comm.En	12 Year	0991642905