



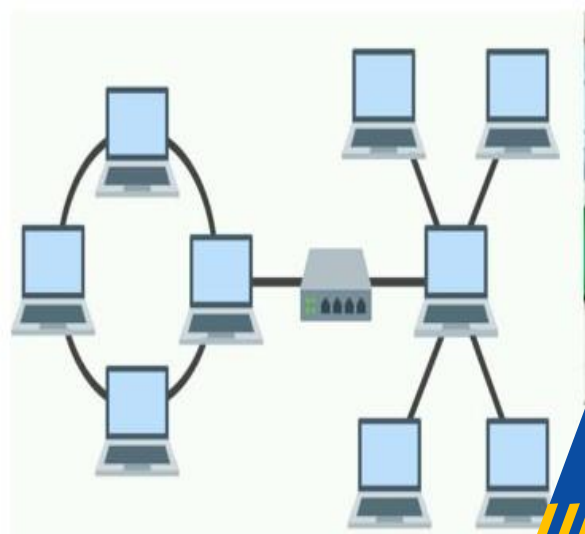
RQF LEVEL 4



GENTD401

**NETWORKING
AND INTERNET
TECHNOLOGIES**

Basics of Technical Drawing



TRAINER'S MANUAL

October, 2024



BASICS OF TECHNICAL DRAWING

KOICA
Korea International
Cooperation Agency

TQUM
TVET Quality Management Project

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TABLE OF CONTENT

AUTHOR'S NOTE PAGE (COPYRIGHT)-----	iii
ACKNOWLEDGEMENTS -----	iv
TABLE OF CONTENT-----	vii
ACRONYMS -----	viii
INTRODUCTION -----	1
MODULE CODE AND TITLE: GENTD401 BASICS OF TECHNICAL DRAWING-----	2
Learning Outcome 1: Identify Drawing Materials, Instruments and Equipment-----	3
Key Competencies for Learning Outcome 1: Identify Drawing Materials, Instruments and Equipment	4
Indicative content 1.1: Identification of Drawing Materials	7
Indicative content 1.2: Identification of Drawing Instruments.....	10
Indicative content 1.3: Identification of Drawing Equipment	13
Learning outcome 1 end assessment	16
Further information to the trainer.....	18
Learning Outcome 2: Draw Symbols, Geometric Figures and Solids used in Technical Drawing -----	19
Key Competencies for Learning Outcome 2: Draw Symbols, Geometric Figures and Solids used in Technical Drawing	20
Indicative content 2.1: Description of Drawing Sheet	22
Indicative content 2.2: Identification of Symbols and Geometric Figures in Engineering Drawing .	25
Indicative content 2.3: Drawing Lettering	28
Indicative content 2.4: Application of Drawing Scale	31
Indicative content 2.5: Application of Drawing Dimensioning	34
Learning outcome 2 end assessment	37
Further information to the trainer.....	41
Learning Outcome 3: Apply 2 and 3 Dimension -----	42
Key Competencies for Learning Outcome 3: Apply 2 and 3 Dimensions.....	43
Indicative content 3.1: Description of 2D and 3D	45
Indicative content 3.2: Identification of Types of Projections	48
Indicative content 3.3: Description of Views and Sections of Objects	51
Learning outcome 3 end assessment	53
Further information to the trainer.....	56

ACRONYMS

2D: Two Dimensions

3D: Three Dimensions

ASME: American Society of Mechanical Engineering

CAD: Computer Aided Design

ISO: International Standards Organization

KOICA: Korea International Cooperation Agency

RTB: Rwanda TVET Board

TQUM: TVET Quality Management

INTRODUCTION

This trainer's manual encompasses all methodologies necessary to guide you to properly deliver the module titled: **Basics of Technical Drawing**. trainees undertaking this module shall be exposed to practical activities that will develop and nurture their competences. The writing process of this training manual embraced Competency-Based Training (CBT) philosophy by providing enough practical opportunities reflecting real life situations.

The trainer's manual is subdivided into Learning Outcomes, each learning outcome has got various topics, you will start guiding a self-assessment exercise to help trainees rate themselves on their level of skills, knowledge and attitudes about the unit. The trainer's manual will give you the information about the objectives, learning hours, didactic materials, proposed methodologies and crosscutting issues.

A discovery activity is followed to help trainees discover what they already know about the unit.

This manual will give you tips, methodologies and techniques about how to facilitate trainees to undertake different activities as proposed in their trainee's manuals. The activities in this training manual are prepared such that they give opportunities to trainees to work individually and in groups. After going through all activities, you shall help trainees to undertake progressive assessments known as formative and finally facilitate them to do their self-reflection to identify your strengths, weaknesses and areas for improvements. Remind them to read the point to remember section which provides the overall key points and takeaways of the unit.

MODULE CODE AND TITLE: GENTD401 BASICS OF TECHNICAL DRAWING

Learning Outcome 1: Identify drawing materials, instruments and equipment

Learning Outcome 2: Draw symbols, geometric figures and solids used in technical drawing.

Learning Outcome 3: Apply 2 and 3 dimensions.

Indicative contents

1.1 Identification of drawing materials

1.2 Identification of drawing instruments

1.3 Identification of drawing equipment

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

● Knowledge	● Skills	● Attitudes
● Descriptions of technical drawing terminologies. ● Identification of drawing materials ● Identification of drawing instruments ● Identification of drawing equipment	● Selecting technical drawing materials used in technical drawing ● Selecting technical drawing instruments used in technical drawing ● Selecting technical drawing equipment used in technical drawing	● Having analytical skills while selecting technical drawing materials, instruments and equipment ● Prioritization while selecting technical materials, instruments and equipment.



Duration: 10 hrs

Learning outcome 1 objectives:



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

1. Identify correctly drawing materials used in technical drawing according to their uses.
2. Identify correctly drawing instruments used in technical drawing according to their uses.
3. Identify correctly drawing equipment used in technical drawing according to the task assigned.
4. Select properly drawing materials used in technical drawing according to their uses.
5. Select properly drawing instruments used in technical drawing according to their uses.
6. Select properly drawing equipment used in technical drawing according to the task assigned.



Resources

Equipment	Tools	Materials
● Drawing board ● Mini-drafter	● Ink-pen ● Paper cutter ● One-meter straight drawing ruler with handle ● Right angle ruler ● Protractor ● Drawing compass ● Engineering pencils ● Drawing template ● French curves ● Set squares ● T square	● Paper ● Rubber ● Pen ink ● Propelling pencil

**Advance Preparation:**

Before delivering this learning outcome, you are recommended to:

- Avail technical drawing materials, instrument and equipment



Indicative content 1.1: Identification of Drawing Materials



Duration: 4 hrs



Theoretical Activity 1.1.1: Identification of technical drawing



Notes to the trainer:

- Trainer may use small groups for describing technical drawing materials
- Trainer may use images and videos illustrating technical drawing materials
- Trainer may avail technical drawing materials



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- What do you understand by the following technical drawing terminologies?
 - Technical drawing
 - Point
 - Line
 - Plane
 - Projection
- Identify the drawing materials based on their uses.

Step2: Ask trainees to write their findings on papers or flipcharts

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 1.1.1, in the trainee manual



Points to Remember

- It is essential to know some technical drawing terminologies before starting to perform technical drawing such as: technical drawing, line, point, and projection
- Before performing technical drawing, is better to be able to identify the following drawing materials: pencils, charcoal, crayon, marker, paper, eraser, and sharpener.



Practical Activity 1.1.2: Selecting technical drawing materials



Notes to the trainer

- Prepare a workshop equipped with technical drawing materials
- Avail images and videos illustrating technical drawing materials



Key steps:

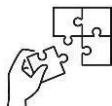
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- i. You are requested to go to the workshop and select technical drawing materials according to the assigned task.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to select technical drawing materials, explain all criteria to be followed.
- Step 4:** Ask trainees to select technical drawing materials and monitor the activity.
- Step 5:** Verify whether technical drawing materials are properly selected.
- Step 6:** Ask trainees to read the key readings 1.1.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 1.1.



Points to Remember

- While selecting technical drawing materials, take consideration of the following criteria:
 - Prioritize durability and quality to ensure longevity and precision of materials.
 - Choose materials that suit the specific project requirements, such as medium and scale.
 - Consider comfort and ease of use, especially for materials that will be used for long.



Application of learning 1.1.

Suppose that there is an ABC company that wishes to draw a detailed blueprint of a LAN network. Ask your trainees to help that company select technical drawing materials that will be used to draw the aforementioned drawing.

Checklist

SN	Criteria	Indicators	Yes	No
1	Technical drawing materials are properly selected based on their uses	1.1. Size is considered		
		1.2. Purpose is considered		
		1.3. Durability is considered		
		1.4. Application is considered		
		1.5. Convenience is considered		
		1.6. Quality is considered		



Indicative content 1.2: Identification of Drawing Instruments



Duration: 4 hrs



Theoretical Activity 1.2.1: Identification drawing instruments



Notes to the trainer:

- Trainer may use small groups for describing drawing instruments
- Trainer may use images and videos illustrating drawing instruments
- Trainer may avail technical drawing instruments



Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the activity and ask trainees to answer the following questions:

- What is the difference between drawing board and protractor?
- Identify the drawing instruments based on their uses.

Step2: Ask trainees to write their findings on papers or flipcharts.

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 1.2.1, in the trainee manual



Points to Remember

- While identifying drawing Instruments it is better to consider instruments such as: T-square, set square, compass, protractor, scale ruler, French curve, drawing board.



Practical Activity 1.2.2: Selecting technical drawing instruments



Notes to the trainer

- Prepare a workshop equipped with technical drawing instruments

- Avail images and videos illustrating technical drawing instruments



Key steps:

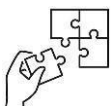
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- You are requested to go to the workshop and select technical drawing instruments according to the assigned task.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to select technical drawing instruments, explain all criteria to be followed.
- Step 4:** Ask trainees to select technical drawing instruments and monitor the activity.
- Step 5:** Verify whether technical drawing instruments are properly selected.
- Step 6:** Ask trainees to read the key readings 1.2.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 1.2.



Points to Remember

- While selecting technical drawing instruments, take consideration of the following criteria:
 - Choose durable and stable instruments
 - Consider portability and ease of storage for items
 - Select instruments that provide clear visibility



Application of learning 1.2.

Suppose that there is an XYZ institution that wishes to draw a detailed blueprint of a LAN network. Ask your trainees to help that institution select technical drawing instruments that will be used to draw the aforementioned drawing.

Checklist

SN	Criteria	Indicators	Yes	No
1	Technical drawing instruments are properly selected based on their uses	1.1. Purpose is considered		
		1.2. Application is considered		
		1.3. Accuracy is considered		
		1.4. Durability is considered		
		1.5. Usability is considered		
		1.6. Precision is considered		
		1.7. Quality is considered		
		1.8. Comfort is considered		



Indicative content 1.3: Identification of Drawing Equipment



Duration: 2 hrs



Theoretical Activity 1.3.1: Identification of drawing equipment



Notes to the trainer:

- Trainer may use small groups for describing drawing equipment
- Trainer may use images and videos illustrating drawing equipment
- Trainer may avail technical drawing equipment



Key steps:

While delivering this activity, pass through the following steps:

Step1: Introduce the session, engage trainees in groups and ask them to answer the following question:

- i. Define the term drawing Equipment
- ii. Identify the drawing equipment based on their uses.

Step2: Ask trainees to write their findings on papers or flipcharts

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 1.3.1, in the trainee manual



Points to Remember

- While Identifying drawing equipment take into consideration the following equipment: drafting table, light box, computer (with cad software), plotter, printer (for large formats), scanner, cintiq tablet, cutting mat, projector, CAD workstation, plotting arm, whiteboard, blackout blinds (for light-sensitive work), measuring tape.



Practical Activity 1.3.2: Selecting technical drawing equipment



Notes to the trainer

- Prepare a workshop equipped with technical drawing equipment
- Avail images and videos illustrating technical drawing equipment



Key steps:

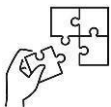
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- You are requested to go to the workshop and select technical drawing equipment according to the assigned task.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to select technical drawing equipment, explain all criteria to be followed.
- Step 4:** Ask trainees to select technical drawing equipment and monitor the activity.
- Step 5:** Verify whether technical drawing equipment are properly selected.
- Step 6:** Ask trainees to read the key readings 1.3.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 1.3.



Points to Remember

- While selecting technical drawing Equipment, take consideration of the following criteria:
 - Ensure durability, reliability and performance of equipment
 - Ensure accessibility and ease of procurement when needed



Application of learning 1.3.

Suppose that ABC school wishes to draw a detailed blueprint of a LAN network. Referring to the key readings 1.3.2. Ask your trainees to select technical drawing equipment that will be used to draw the aforementioned drawing.

Checklist

SN	Criteria	Indicators	Yes	No
1	Technical drawing equipment are properly selected	1.1. Purpose is considered		
		1.2. Use is considered		
		1.3. Compatibility is considered		
		1.4. Ergonomics is considered		
		1.5. Quality is considered		
		1.6. Budget is considered		
		1.7. Durability is considered		



Learning outcome 1 end assessment

Written assessment

Q1. Read the following questions then answer by TRUE if a statement is correct or FALSE if the statement is incorrect.

- i. Tracing paper is used to make transparent copies of technical drawings.
Answer: True
- ii. Graphite pencils are used in technical drawing for shading only.
Answer: False
- iii. Ink is often used for permanent technical drawings that require high precision.
Answer: True
- iv. Polyester drafting film is a type of drawing paper used for rough sketches.
Answer: False

Q2. Match the following technical drawing materials, instruments and equipment (in column B) with their corresponding uses (in column C). Write the letter of the correct answer in the provided blank space (in column A)

Column A	Column B	Column C
Answers	Materials/instruments/equipment	Uses
1:d	1. T-Square	a. Used to measure angles in degrees
2:a	2. Compass	b. Used for drawing straight, horizontal lines
3:b	3. Protractor	c. Used to withdraw circles
		d. Used to draw circles and arcs

Q3. Fill in the blanks with the appropriate words. Select from the given choices in the box

Set squares, drawing board, drafting machine , plotter, light box

- i. **A drawing board** is used to provide a flat, stable surface for technical drawings.
- ii. **A drafting machine** is a piece of equipment that combines the functions of a T-square and protractor for precise angle measurements and straight lines.

- iii. **Set squares** are triangular-shaped instruments that are used for drawing standard angles, typically 30°, 45°, 60°, and 90°.

Practical assessment

ABC School wants to upgrade its network to support its digital learning. The school wants to design a network blueprint outlining equipment placement: (routers, switches, and access points). Ask your trainees to help the school to perform the following task:

- a) Select the technical drawing materials, instruments and equipment that will be used to draw the aforementioned drawing

Checklist

SN	Criteria	Indicators	Yes	No
1	Technical drawing materials are properly selected	Crayon is selected		
		Marker is selected		
		Papers are selected		
		Erasers are selected		
2	Technical drawing instruments are properly selected	Protractor is selected		
		Scale ruler is selected		
		French curve is selected		
		Drawing board selected		
3	Technical drawing equipment are properly selected	Computer is selected		
		Plotter is selected		
		Printer is selected		
		Scanner is selected		

END



Further information to the trainer

Books

Ching, F. D. K. (2015). Architectural Graphics (6th ed.). Wiley.

Giesecke, F. E., Mitchell, A., & Spencer, H. (2016). Technical Drawing with Engineering Graphics (15th ed.). Pearson.

Leake, J., & Borgerson, J. (2012). The Engineering Design Graphics Sketching Workbook (4th ed.). Wiley.

Madsen, D. A., & Madsen, D. P. (2016). Engineering Drawing and Design (6th ed.). Cengage Learning.

Simmons, C. H., & Maguire, D. E. (2012). Manual of Engineering Drawing (4th ed.). Elsevier.

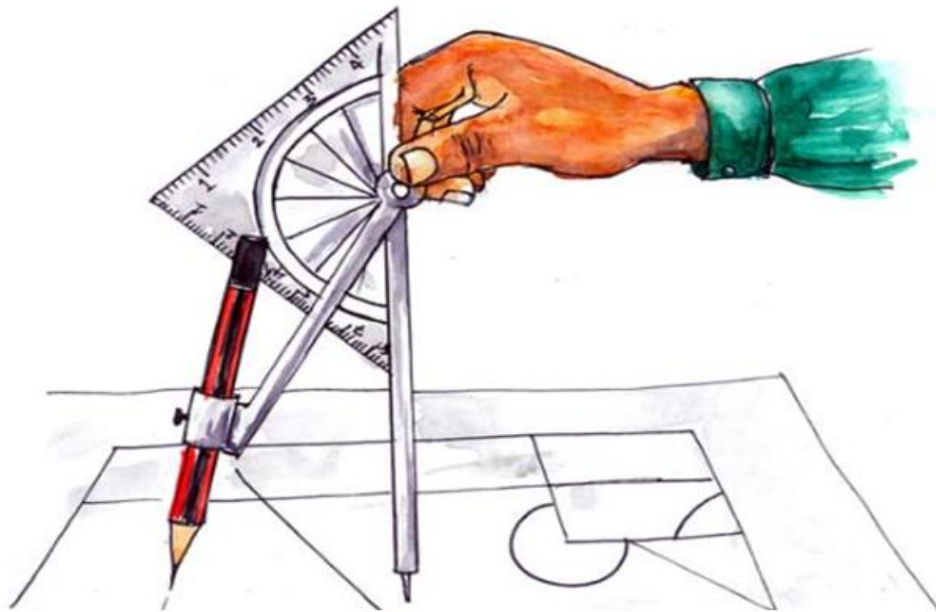
Web Links

<https://www.google.com/search?q=Apply+basic+concepts+of+technical+drawing>

<https://www.google.com/search?q=Apply+lines+and+symbols+used+in+drawing>

<https://www.google.com/search?q=Perform+dimensional+drawing>

Learning Outcome 2: Draw Symbols, Geometric Figures and Solids used in Technical Drawing



Indicative contents

2.1 Description of drawing sheet

2.2 Identification of symbols and geometric figures in engineering drawing

2.3 Drawing Lettering

2.4 Application of drawing scale

2.5 Application of drawing dimensions

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

Knowledge	Skills	Attitudes
• Description of drawing sheet • Identification of symbols and geometric figures in engineering drawing • Description of lettering drawing • Description of scale • Description of dimensioning	• Selecting drawing sheet series • Drawing geometric figures • Drawing lettering • Applying drawing scale • Dimensioning the drawing	• Paying attention to details on drawings required for better precision and accuracy • Having clarity and legibility to ensure that all drawings are easy to read • Being consistent to ensure that all elements in your drawing are proportional and consistent in scale



Duration: 20 hrs

Learning outcome 2 objectives:



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

1. Describe properly drawing sheet layout according to the ISO standards.
2. Identify accurately symbols and geometric figures according to their style.
3. Select properly drawing sheet series according to the ISO standards
4. Draw properly lettering drawing according to the user need.
5. Apply adequately drawing scale according to the ISO standards.
6. Apply appropriately drawing dimensions according to technical drawings standards.



Resources

Equipment	Tools	Materials
• Drawing board • Calculator • Mini drafter	• Ink-pen • Paper cutter • One-meter straight drawing ruler with handle • Right angle ruler • Protractor • Drawing compass • Engineering pencils • Drawing template • French curves • Set squares • T square	• Paper • Rubber • Pen ink • Propelling pencil



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Avail a workshop equipped with drawing symbols, geometric figures and solids



Indicative content 2.1: Description of Drawing Sheet



Duration: 2 hrs



Theoretical Activity 2.1.1: Description of drawing sheet



Notes to the trainer:

- Trainer may use small groups for describing drawing sheet
- The use of drawing sheets as didactic materials is recommended



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by asking trainees to answer the following questions:

- What do you understand by the term drawing sheet?
- Why is title block important in technical drawing?
- List the elements of drawing sheet layout.

Step 2: Ask trainees to write their answers on papers or flipchart.

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 2.1.1, in the trainee manual



Points to Remember

- Use different types of paper in order to clarify clearly the drawing sheets.
- Remember to organize and align elements on the drawing sheet.
- Leave sufficient margins and borders around the drawing to create a clear and uncluttered layout.



Practical Activity 2.1.2: Selecting drawing sheet series



Notes to the trainer

- Prepare a workshop equipped with drawing sheets
- Use images and videos illustrating drawing sheets
- Avail samples of drawing sheets



Key steps:

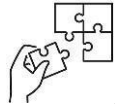
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- i. You are requested to go to the workshop and select drawing sheets according to the assigned task.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to select drawing sheets, explain all criteria to be followed.
- Step 4:** Ask trainees to select drawing sheets and monitor the activity.
- Step 5:** Verify whether drawing sheets are properly selected.
- Step 6:** Ask trainees to read the key readings 2.1.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 2.1.



Points to Remember

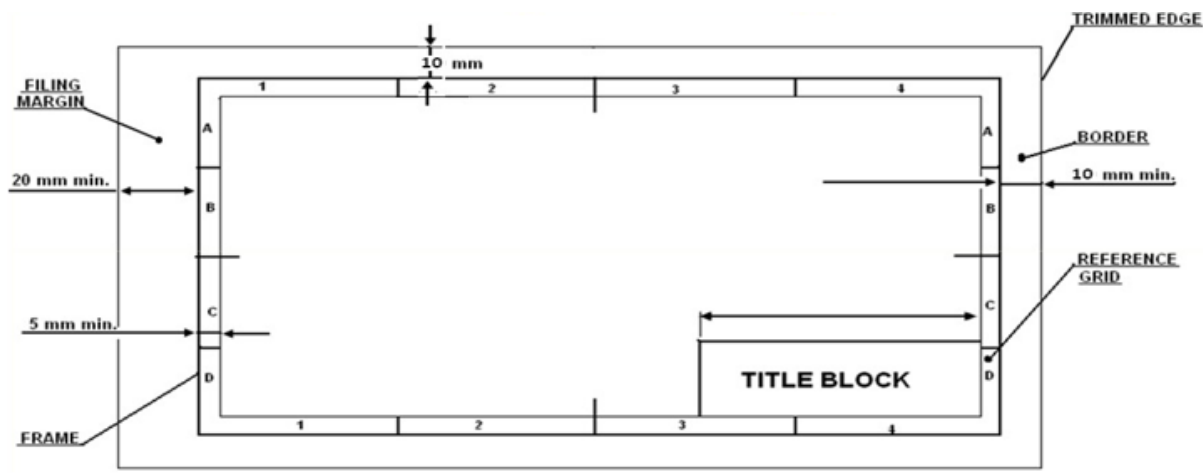
- While selecting drawing sheets, take into consideration the following criteria:
 - Ensure the size of sheet
 - Considering the level of detail required and the space needed to effectively communicate the design.



Application of learning 2.1.

As Technician in Networking, draw a specified drawing sheet layout on a landscaping paper by showing each element location.

Solution:



Checklist

SN	Criteria	Indicators	Yes	No
1	Drawing sheet layout is properly presented	1.1 Drawing sheet is selected		
		1.2 Border line is mentioned		
		1.3 Title block is located according to the rules		
		1.4 Size of title block is respected		
		1.5 Margin is measured		
		1.6 Title block is filled according to the information's required		



Indicative content 2.2: Identification of Symbols and Geometric Figures in Engineering Drawing



Duration: 6 hrs



Theoretical Activity 2.2.1: Description of geometric figures



Notes to the trainer:

- Trainer may use small groups for describing geometrical figures
- Avail images and videos of geometric figures



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity by asking trainees answer the following questions:

- i What do you understand by the term drawing line?
- ii Why is angle important in technical drawing?
- iii Identify the types of drawing triangle.
- iv Enumerate different uses of drawing symbols.

Step 2: Ask trainees to write the answer on papers, flipcharts.

Step 3: Engage trainees in presentation of their findings.

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 2.2.1, in the trainee manual



Points to Remember

- While describing geometric figures Consider the main key points: Point, Types of lines and their uses, Angles and their types, Triangles and their types, Quadrilaterals and their properties



Practical Activity 2.2.2: Drawing geometric figures



Notes to the trainer

- Trainer may avail a workshop equipped with geometric figures
- Trainer may use images and videos as didactic material.



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the task described below:

- i. You are requested to go to the workshop and draw geometrical figures, symbols according to their style

Step 2: Explain the task and provide clear work instructions (task, PPE, time allocated)

Step 3: Demonstrate how to draw geometrical figures, symbols, explain all the steps to be followed.

Step 4: Ask trainees to draw geometrical figures, symbols and monitor the activity.

Step 5: Verify whether the drawing of geometrical figures and symbols are properly performed.

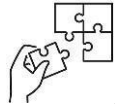
Step 6: Ask trainees to read the key readings 2.2.2. in the trainee manual.

Step 7: Ask trainees to perform the application of learning 2.2.



Points to Remember

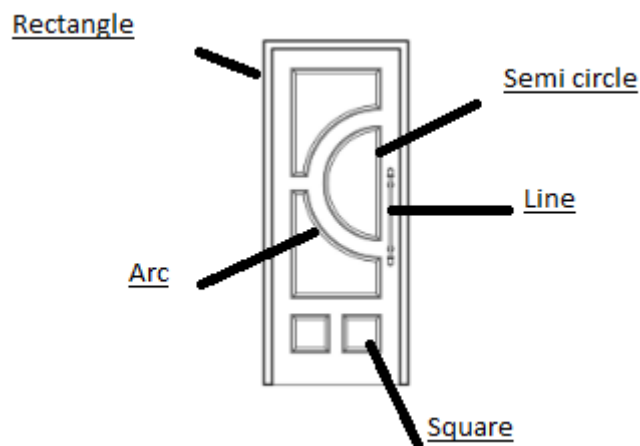
- While drawing Geometric figures pay attention to the relationships between angles, and how they interact with each other. And Use lines to define the form of the symbol, including its edges, contours, and surfaces.



Application of learning 2.2.

By using lines, rectangles, squares, circle and semi-circle, try to Draw a door of Networking Workshop which comprises all of the geometrical figures listed above.

Solution:



Checklist

SN	Criteria	Indicators	Yes	No
1	Drawing geometric figures are appropriately used	1.1 Point is located		
		1.2 Lines are used		
		1.3 Triangles are selected		
		1.4 Angles are measured		
		1.5 Quadrilaterals are identified		



Indicative content 2.3: Drawing Lettering



Duration: 4 hrs



Theoretical Activity 2.3.1: Description of drawing lettering



Notes to the trainer:

- Trainer may use small groups for describing lettering
- Avail images and videos illustrating drawing lettering



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and asking trainees to answer the following questions:

- What do you understand by the term drawing lettering?
- What are the features of Lettering in Technical drawing?
- Identify the application of Lettering in Technical drawing
- Give three types of lettering in Technical drawing

Step 2: Ask trainees to write the answers on papers, flipchart

Step 3: Engage trainees in presentation of their findings.

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 2.3.1, in the trainee manual



Points to Remember

- While describing drawing lettering make sure you keep in mind the key points like: Features of lettering, Classification of lettering and Style of freehand lettering



Practical Activity 2.3.2: Applying drawing lettering



Notes to the trainer

- Trainer may avail a workshop equipped with drawing lettering
- Trainer may use images and videos illustrating lettering as didactic materials



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the task described below:

- i. You are requested to go to the workshop and draw lettering according to their style and size.

Step 2: Explain the task and provide clear work instructions (task, PPE, time allocated)

Step 3: Demonstrate how to draw lettering, explain all the steps to be followed.

Step 4: Ask trainees to draw lettering and monitor the activity.

Step 5: Verify whether the lettering drawing is properly performed.

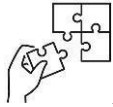
Step 6: Ask trainees to read the key readings 2.3.2 in the trainee manual.

Step 7: Ask trainees to perform the application of learning 2.3.



Points to Remember

- While applying lettering in drawing remember to use style of lettering that is created by hand, using a variety of techniques and tools and maintain a consistent line width throughout the lettering to create a cohesive look.



Application of learning 2.3.

ABC Network business company wants to advertise its products and services by marketing with wallpaper letterings on their building. It wishes to use this word: "NETWORKING ". Draw that name by using double stroke vertical gothic lettering. The height of capital letter must be 20mm

Solution:

NETWORKING

Checklist

SN	Criteria	Indicators	Yes	No
1	Requirements of good lettering are properly applied	1.1 Different lettering styles are used		
		1.2 Drawings are clean		
		1.3 Different types of lettering are utilized		
		1.4 Size of letters are respected		
		1.5 Letters are visible		



Indicative content 2.4: Application of Drawing Scale



Duration: 4 hrs



Theoretical Activity 2.4.1: Description of drawing scale



Notes to the trainer:

- Trainer may use small groups for describing drawing scale
- Avail drawing sheets, calculator as didactic materials



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- i. What do you understand by the term drawing scale?
- ii. Why scale is important in technical drawing?
- iii. Identify the types of drawing scale.

Step2: Ask trainees to write the answers on papers, flipchart

Step 3: Engage trainees in presentation of their findings.

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 2.4.1, in the trainee manual



Points to Remember

- In description of scale used in drawing take into consideration of the following key points: Types of Scale such as full scale, enlarging scale, and reducing scale in addition Scale Representation



Practical Activity 2.4.2: Applying drawing scale



Notes to the trainer

- Avail a well-prepared workshop
- Trainer may use images and videos as didactic material



Key steps:

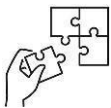
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- You are requested to go to the workshop and calculate scale to be applied on drawing according to the drawing standards.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to calculate scale, explain all the steps to be followed.
- Step 4:** Ask trainees to calculate scale and monitor the activity.
- Step 5:** Verify whether the scale is properly perfectly calculated.
- Step 6:** Ask trainees to read the key readings 2.4.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 2.4.



Points to Remember

- While Applying Scale on Drawing ensure that the drawing is accurate, precise and check the proportions of the drawing regularly to ensure its consistent



Application of learning 2.4.

A model car is made using the model to an actual distance of 1:40. The height of the car is 170cm. Calculate the height of the model car.

Solution:

Given data:

1) The scale to be used: 1cm:40cm

2) The height of car: 170cm

Unknown: The height of the model car?

Formula:

Scale = Drawing size/Actual size

Height of the model car = Scale * Height of car = $(1/40) * 170\text{cm}$

Answer: 4.5cm



Indicative content 2.5: Application of Drawing Dimensioning



Duration: 4 hrs



Theoretical Activity 2.5.1: Description of drawing dimensioning



Notes to the trainer:

- Trainer may use small groups for describing drawing dimensioning
- The use of drawing sheets as didactic materials is recommended



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- What do you understand by the term drawing dimensioning?
- Why is dimensioning drawing important in technical drawing?
- Identify the arrangement of dimensioning.
- What are the element of drawing dimensioning?

Step 2: Ask trainees to write their answers papers or flipchart.

Step 3: Engage trainees in presentation of their findings.

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 2.5.1, in the trainee manual



Points to Remember

- In description of drawing dimensioning consider the main key points like: types of dimensions, method of dimensioning, elements of dimensioning, function of dimensions and rules of dimensioning



Practical Activity 2.5.2: Applying drawing dimensioning



Notes to the trainer

- Avail a well-prepared workshop equipped with drawing materials, tools and equipment for drawing dimensioning
- Trainer may use images and videos illustrating drawing dimensioning



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to do the task described below:

- i. You are requested to go to the workshop and trace dimensions to be applied on drawing according to the drawing size.

Step 2: Explain the task and provide clear work instructions (task, PPE, time allocated)

Step 3: Demonstrate how to trace dimensions, explain all the steps to be followed.

Step 4: Ask trainees to trace dimensions and monitor the activity.

Step 5: Verify whether the dimensions are properly applied.

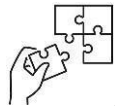
Step 6: Ask trainees to read the key readings 2.5.2 in the trainee manual.

Step 7: Ask trainees to perform the application of learning 2.5.



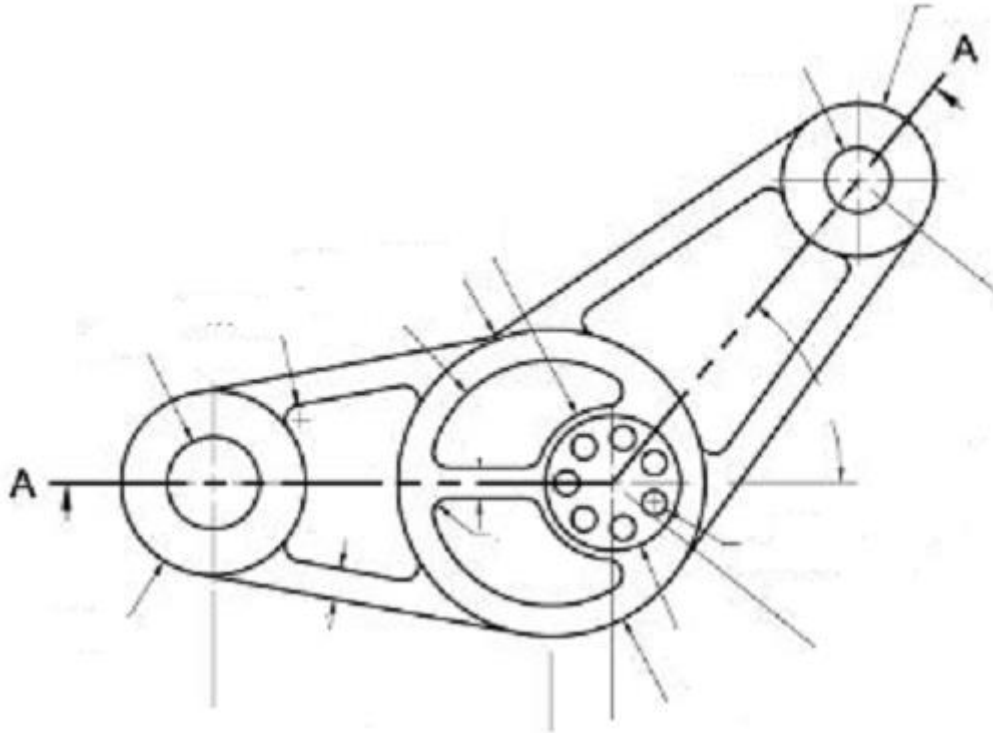
Points to Remember

- While applying Dimension on drawing ensure that the unit of measurement is clearly indicated on the drawing and use standard dimensioning symbols, abbreviations, and notation.

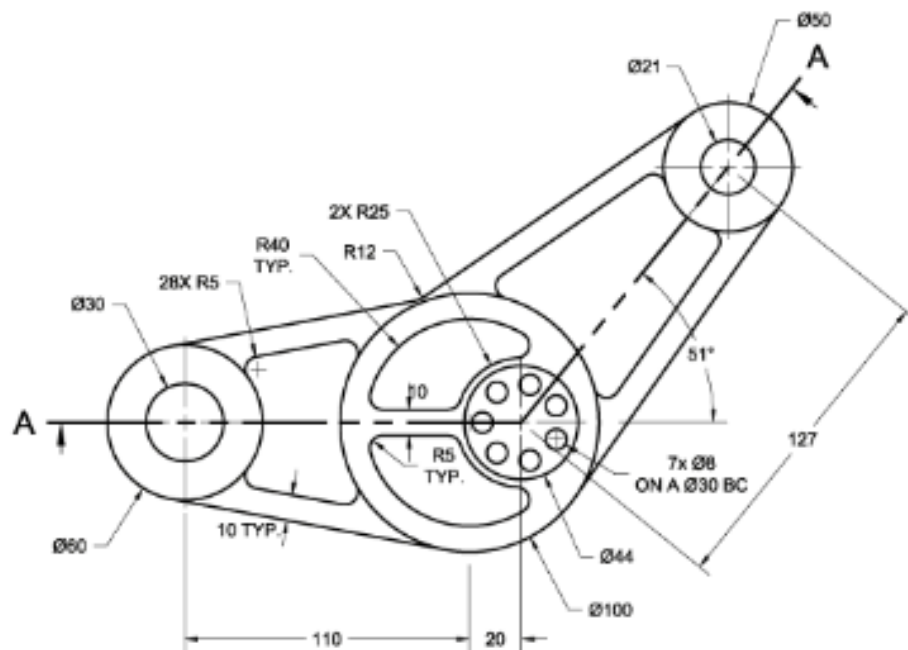


Application of learning 2.5.

Suppose that the following figure is a spiral part needed to be attached on a machine. As a designer in drawing, try to put dimensions on it in order to help mechanical technicians



Solution:





Learning outcome 2 end assessment

Written assessment

Q1. From the following questions, answer by TRUE if the statement is correct or by FALSE if it the statement is incorrect.

- i. A drawing that is twice as large as the original object is said to be drawn to scale.
Answer: False
- ii. A scale drawing is always smaller than the original object.
Answer: true
- iii. A line is a continuous mark made on a surface by a drawing tool.
Answer: true
- iv. All lines in drawing are straight.
Answer: false

Q2. Match the following technical drawing lines (column B) with their corresponding uses/description (Column C). Write the letter of the correct answer in the provided blank space (column A)

Column A	Column B	Column C
Answers	lines	Uses/description
1.....C.	1) object lines	a) These lines are thin, alternating long dashes separated by two short dashes used to show alternate positions for moving parts and the positions of related or adjacent parts, and to eliminate repeated details
2.....E	2) center lines	b) line is a dashed line that represents an edge or outline of an object that is not visible from the current viewpoint.
3.....A	3) phantom lines	c) These lines are thick, solid lines used to show the visible edges, corners, and surfaces of an object.
		d) line is a solid line with arrowheads at both ends that represents the size of an object or a feature.

		e) These lines are thin, alternating long and short dashes used to show hole center and center positions of rounded features, such as arcs and radii.
--	--	---

Q3. Read and answer the following questions:

i. What are some common mistakes to avoid in lettering?

Answer:

- Inconsistent spacing: Make sure to leave consistent space between letters and words.
- Poor proportions: Make sure the letters are proportional to each other and to the rest of the drawing.
- Lack of contrast: Use a variety of line weights and styles to create visual interest and hierarchy.
- Illegibility: Make sure the letters are clear and easy to read.

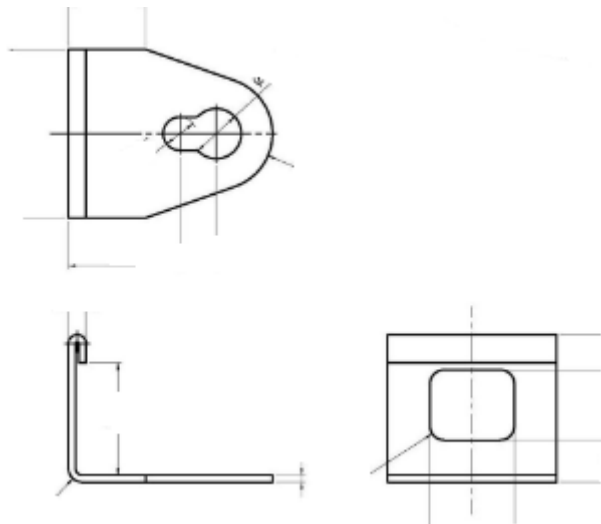
ii. What are different types of angles in drawing?

Answer: Acute Angle, right angle, obtuse angle, straight angle, reflex angle

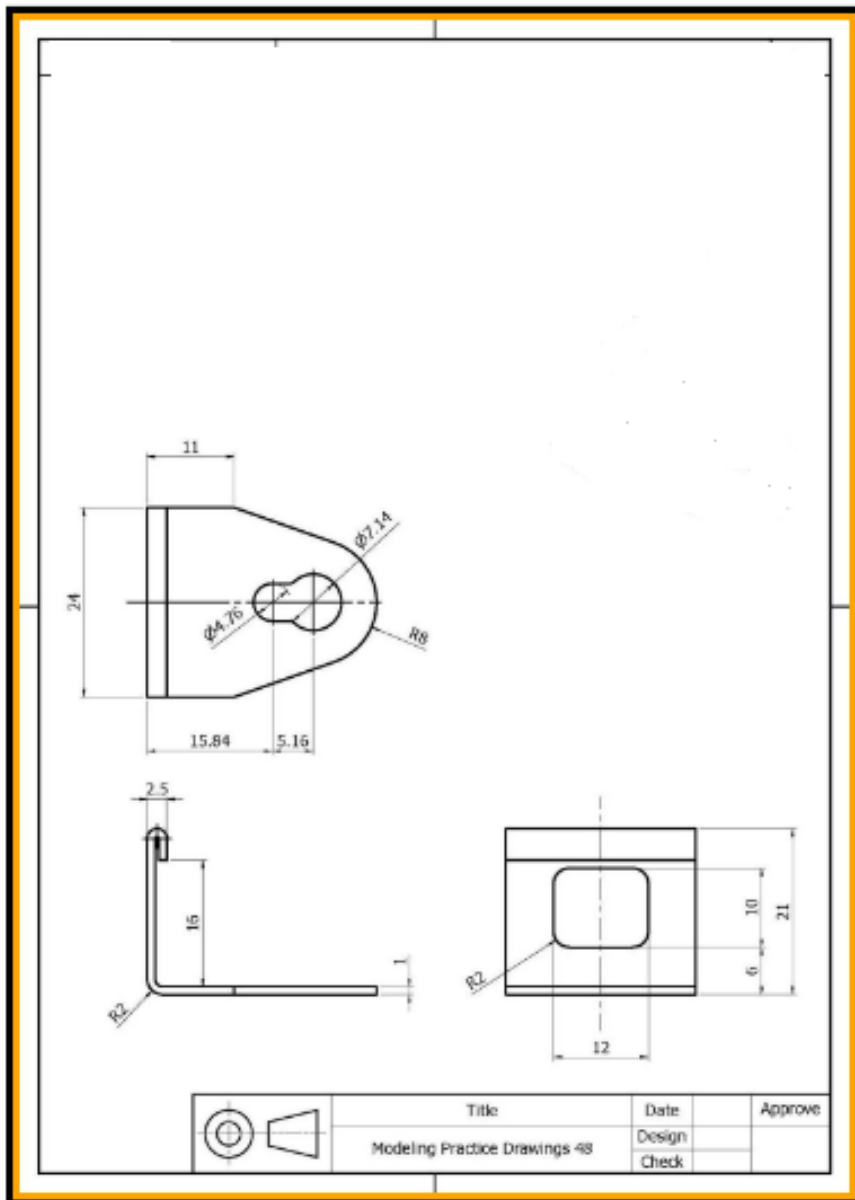
Practical assessment

The drawings below are the spiral parts of networking objects. As a technician, you are hired to draw the following:

- a) Drawing sheet layout needed for aforementioned drawing.
- b) The aforementioned drawing by respecting the geometrical figures shape
- c) Dimensions
- d) Title block
- e) Lettering of the names in the title block



Solution:



Checklist

SN	Criteria	Indicators	Yes	No
1	Elements of drawing sheet layout needed are correctly drawn	1.1. Title block is presented		
		1.2. Elements in title block are selected		
		1.3. Border lines of drawing sheet are measured		
		1.4. Drawing sheet is identified		
		1.5. Size of drawing sheet is respected		
2	The use of symbols is well respected	2.1 Symbols are selected according to their uses		
		2.2 .The use of symbols are properly utilized		
3	The use of drawing materials and instruments for writing and tracing lines, angles, letters and dimensions are properly utilized	3.1 The use of drawing lines are respected		
		3.2 The use of drawing angles are respected		
		3.3 Lettering drawings are drawn		
		3.4 Dimensions are measured		
		3.5 Drawing is cleaned		
4	The use of scale is properly applied	4.1 Standard scale are utilized according to drawing sheet selected		
		4.2 The type of scale used is appropriate to the drawing illustrated		

END



Further information to the trainer

Books

Ching, F. D. K. (2015). Architectural Graphics (6th ed.). Wiley.

Giesecke, F. E., Mitchell, A., & Spencer, H. (2016). Technical Drawing with Engineering Graphics (15th ed.). Pearson.

Leake, J., & Borgerson, J. (2012). The Engineering Design Graphics Sketching Workbook (4th ed.). Wiley.

Madsen, D. A., & Madsen, D. P. (2016). Engineering Drawing and Design (6th ed.). Cengage Learning.

Simmons, C. H., & Maguire, D. E. (2012). Manual of Engineering Drawing (4th ed.). Elsevier.

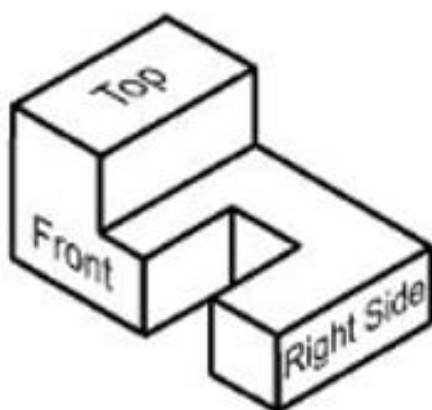
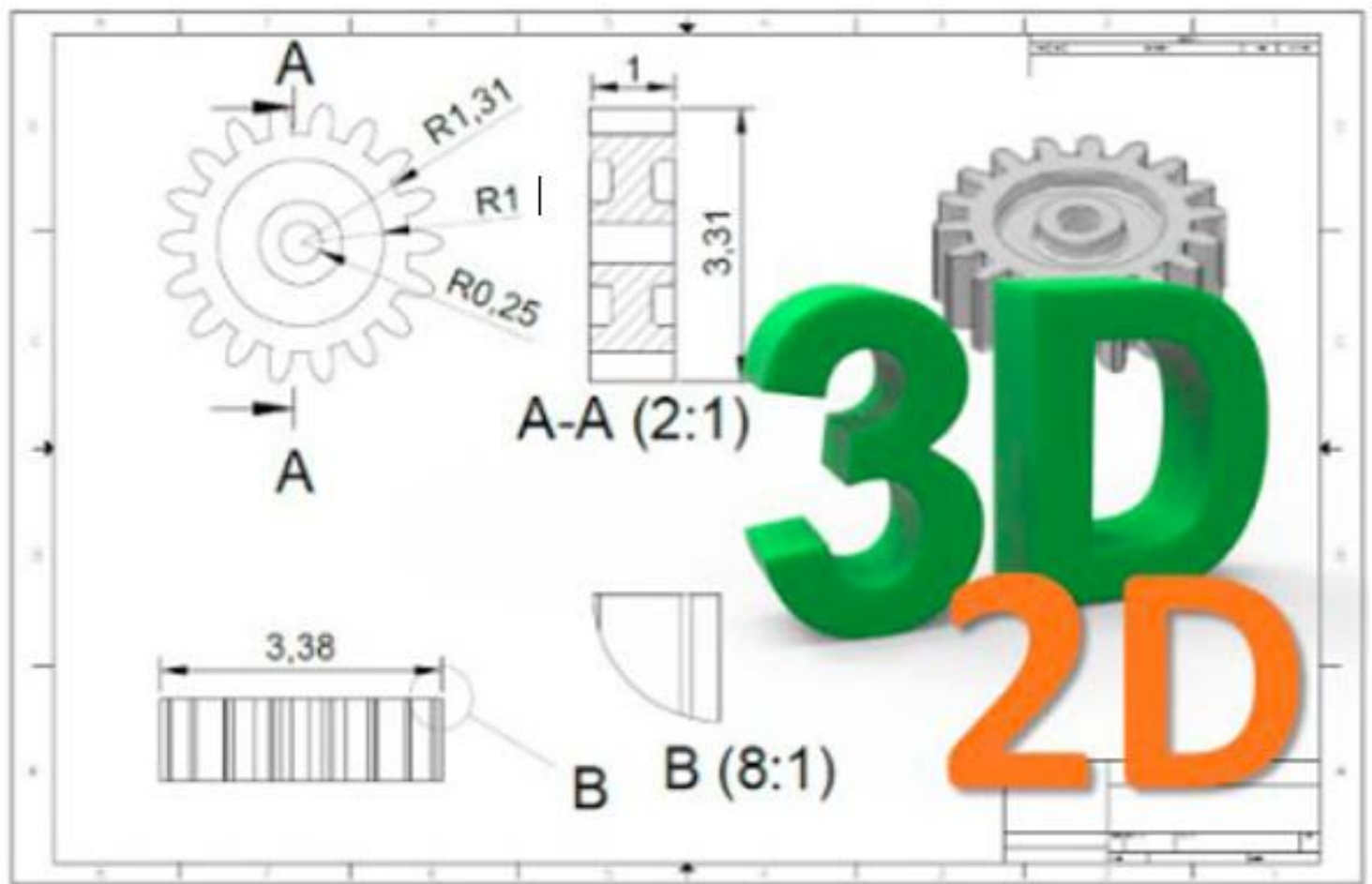
Web Links

<https://www.google.com/search?q=Apply+basic+concepts+of+technical+drawing>

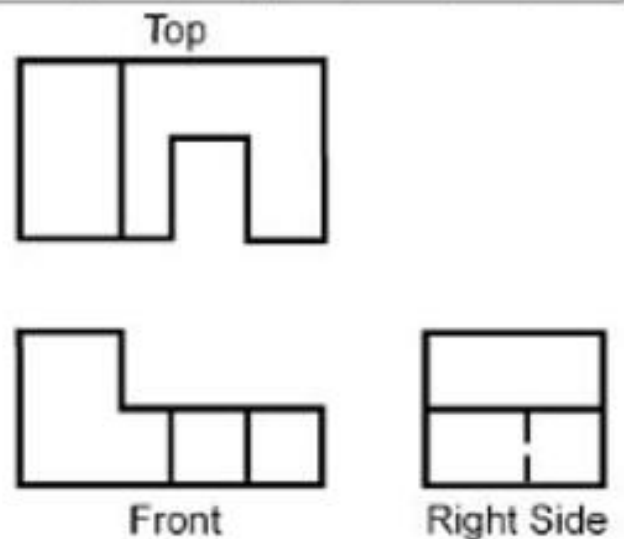
<https://www.google.com/search?q=Apply+lines+and+symbols+used+in+drawing>

<https://www.google.com/search?q=Perform+dimensional+drawing>

Learning Outcome 3: Apply 2 and 3 Dimension



3D Representation



2D Orthographic Projection

Indicative contents

3.1 Description of 2D and 3D

3.2 Types of Projections

3.3 Views and Sections of objects

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

Knowledge	Skills	Attitudes
● Description of 2 and 3 dimensions. ● Differentiation of various types of projections. ● Interpretation of views and sections of an object.	● Creating views of the object ● Creating sections of the object	● Having curiosity and willingness to learn how 2D and 3D objects in real-world are designed ● Adaptability to new drawing tools and techniques



Duration: 20 hrs

Learning outcome 3 objectives:



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

1. Describe properly 2D and 3D based on the object.
2. Differentiate properly the types of projections based on their standards.
3. Create correctly views and sections according to the object.



Resources

Equipment	Tools	Materials
• Drawing board • Drawing table	• White boards • Marker pens • Calculator • Scale rulers • Rubber • Drawing Compass • T square • Protractor • Pencil sharpener • Mathematical set instruments	• Paper • Rubber • Pencils



Advance Preparation:

Before delivering this learning outcome, you are recommended to:

- Have didactic materials: instruments and equipment used in drawing like Bristol, technical pencil, eraser, set square, T square, protractor, compass and drawing board
- Avail the workshop for technical drawing



Indicative content 3.1: Description of 2D and 3D



Duration: 6 hrs



Theoretical Activity 3.1.1: Description of 2D and 3D



Notes to the trainer:

- Trainer may use small groups for describing 2D and 3D
- Trainer may use images and videos illustrating 2D and 3D shapes



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- Describe the following terms:
 - 2D shape
 - 3D shape

Step 2: Ask trainees to write their findings on papers or flipcharts.

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 3.1.1, in the trainee manual



Points to Remember

- In description of 2D and 3D ensure that 2D shapes have only length and width, while 3D shapes have length, width, and height (or depth).



Practical Activity 3.1.2: Using formula of 2D and 3D shape



Notes to the trainer

- Trainer may use small group to describe the formulas of 2D and 3D shapes
- Trainer may use images and videos illustrating 2D and 3D shapes.



Key steps:

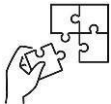
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- You are requested to go to the workshop and use the formula of 2D and 3D shapes according to the assigned task.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to use the formulas of 2D and 3D shapes.
- Step 4:** Ask trainees to use the formulas according to the task and monitor the activity.
- Step 5:** Verify whether the formulas were used correctly.
- Step 6:** Ask trainees to read the key readings 3.1.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 3.1.



Points to Remember

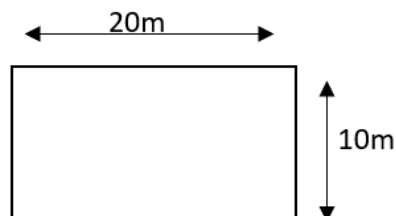
- While using the formula of 2D shape, be familiar with specific area formulas, know how to calculate the perimeter and always pay attention to units.
- While using the formula of 3D shape, understand the surface area calculations and the volume formulas.



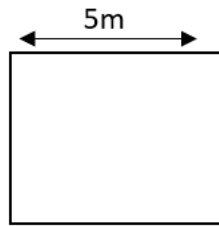
Application of learning 3.1.

Kamana is a business man who wants to build a new restaurant in your area. Based on the key readings 3.1.2, help Kamana to calculate the area of the restaurant with the shapes below:

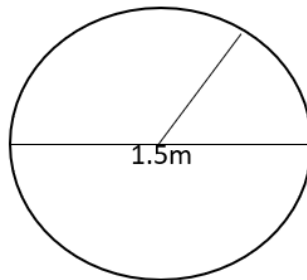
- Dining Area (Rectangular):** Length = 20 m, Width = 10 m



- Kitchen (Square):** Side = 5 m



Bathroom (Circular): Diameter = 3 m (Radius **Solution:**



1. **Dining Area (Rectangular):** Length = 20 m, Width = 10 m
 - **Area:** $20\text{ m} \times 10\text{ m} = 200\text{ m}^2$
2. **Kitchen (Square):** Side = 5 m
 - **Area:** $(5\text{ m})^2 = 25\text{ m}^2$
3. **Bathroom (Circular):** Diameter = 3 m (Radius = 1.5 m)
 - **Area:** $\pi \times (1.5\text{ m})^2 \approx 7.07\text{ m}^2$

Total Area:

- **Total Area** = $200\text{ m}^2 + 25\text{ m}^2 + 7.07\text{ m}^2 \approx 232.07\text{ m}^2$



Indicative content 3.2: Identification of Types of Projections



Duration: 7 hrs



Theoretical Activity 3.2.1: Description of the types of projections



Notes to the trainer:

- Trainer may use small groups to describe the types of projections
- Trainer may use images and videos illustrating different types of projections



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity and ask trainees to answer the following questions:

- What do you understand by the following terms?
 - Perspective projection
 - Axonometric projection
 - Oblique projection
- Explain the three types of perspective projections.

Step 2: Ask trainees to write their findings on papers or flipcharts.

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 3.3.2, in the trainee manual



Points to Remember

- While describing the types of projections know that in orthographic and isometric projections, lines are parallel, while in perspective projections, lines converge.
- Isometric and oblique projections use foreshortening for depth, whereas orthographic does not.
- Choose the appropriate projection based on accuracy (orthographic), visual clarity (isometric/oblique), or realism (perspective)



Practical Activity 3.2.2: Drawing a projection of an object



Notes to the trainer

- The trainer may avail objects based on the types of projections



Key steps:

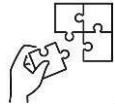
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- i. You are requested to go to the workshop and draw the projection of an object according to the assigned task.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to draw the projection of an object.
- Step 4:** Ask trainees to draw the projection of an object and monitor the activity.
- Step 5:** Verify whether the projection of an object is properly drawn.
- Step 6:** Ask trainees to read the key readings 3.3.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 3.2.



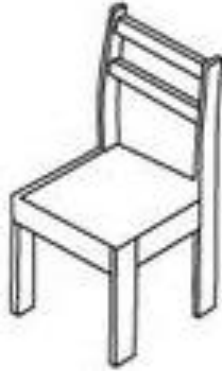
Points to Remember

- While drawing the projection of an object, you have to be familiar with the specific characteristics of the projection type you are using (orthographic, isometric, axonometric, oblique, or perspective).

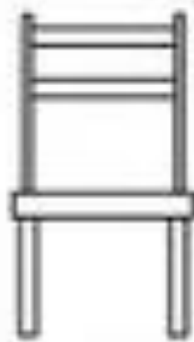


Application of learning 3.2.

AXZ school wants to make chairs for its workshop. Help the school to obtain an orthographic drawing for the sample of the chair shown in the image below:



Solution:



Front view



Plan view



Side view



Indicative content 3.3: Description of Views and Sections of Objects



Duration: 7 hrs



Theoretical Activity 3.3.1: Descriptions of views and sections of objects.



Notes to the trainer:

- Trainer may use small groups for describing views and sections of the object.
- Trainer may use images and videos illustrating the views and sections of objects.
- Trainer may avail samples of views and sections of objects



Key steps:

While delivering this activity, pass through the following steps:

Step 1: Introduce the activity, and ask trainees to answer the following questions:

- i. What is front view?
- ii. Differentiate real view from side view.
- iii. What is the difference between longitudinal section and transversal section?

Step2: Ask trainees to write their findings on papers or flipcharts.

Step 3: Engage trainees in presentation of their findings

Step 4: Provide an expert view for more clarifications.

Step 5: Address any questions or concerns from the trainees

Step 6: Ask trainees to read the key readings 3.3.1, in the trainee manual



Points to Remember

- While describing section and views of objects in technical drawing it is essential to know different types of views and sections of objects.



Practical Activity 3.3.2: Creating views and sections of the object



Notes to the trainer

- Trainer may use images and videos illustrating views and sections of the objects.



Key steps:

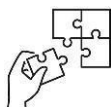
While delivering this activity, pass through the following steps:

- Step 1:** Introduce the activity and ask trainees to do the task described below:
- You are requested to go to the workshop and create orthographic views according to the assigned task.
- Step 2:** Explain the task and provide clear work instructions (task, PPE, time allocated)
- Step 3:** Demonstrate how to create orthographic views, explain all the steps to be followed.
- Step 4:** Ask trainees to create orthographic views and monitor the activity.
- Step 5:** Verify whether orthographic views are properly created.
- Step 6:** Ask trainees to read the key readings 3.3.2 in the trainee manual.
- Step 7:** Ask trainees to perform the application of learning 3.3.



Points to Remember

- Before creating views of object, you should know different types of views and section of objects



Application of learning 3.3.

Suppose that there is a local Networking workshop located in your area that needs to create detailed orthographic views of a new machine part. Refer to the key readings 3.3.2 and create the orthographic views of a new machine part to show its internal components.

Checklist

SN	Criteria	Indicators	Yes	No
1	Orthographic views are properly created	1.1. Front view is created		
		1.2. Rear view is created		
		1.3. Side view is created		
		1.4. Top view is created		
		1.5. Bottom view is created		



Learning outcome 3 end assessment

Written assessment

Q1. From the following questions, answer by TRUE if the statement is Correct or by False if the statement is incorrect

- i. In a 2D view, all objects are represented using width and height only.

Answer: True

- ii. A 3D view allows you to see the depth of an object, in addition to its height and width.

Answer: True

- iii. Orthographic projections are a type of 3D representation.

Answer: False

- iv. 3D models provide more information about the internal structure of an object than 2D drawings.

Answer: False

Q2. Match the types of views (in column B) with their descriptions (in column C). Write the letter of the correct answer in the provided blank space (in column A)

Column A	Column B	Column C
Answers	Types of view	Descriptions
1 D	1. Isometric view	A. A view from one side or angle, usually showing width and height
2 B	2. Perspective view	B. A 3D drawing where lines converge to a point in the distance
3 A	3. Plan view	C. A 4D drawing where lines converge
		D. A 2D drawing representing a horizontal cut through an object

Q3. Fill in the blanks with the appropriate words. Select from the given choices in the box

width and height, shape and structure, internal features

- i. In a 2D projection, an object's dimensions are shown as _____.

Answer: width and height

- ii. 3D models are commonly used in design because they provide a complete view of an object's _____.

Answer: shape and structure

- iii. A sectional view is used in 2D drawings to display _____ of an object.

Answer: internal features

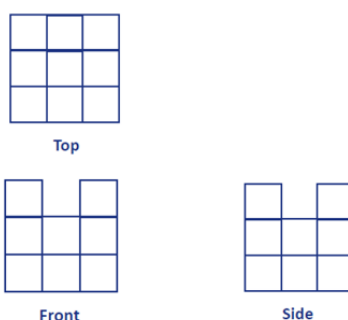
Practical assessment

Q1. Suppose that TXY network company wishes to upgrade its network infrastructure by installing custom server racks. You are tasked to prepare detailed orthographic views of the racks including sectional views to show internal cable routing, power distribution units, and airflow management.

Checklist

SN	Criteria	Indicators	Yes	No
1	Orthographic views are properly created	Front view is created		
		Rear view is created		
		Side view is created		
		Top view is created		
		Bottom view is created		
2	Sectional views are properly created	Full section is created		
		Half section is created		
		Offset section is created		
		Broken out section is created		
		Aligned section is created		

Q2. Given the 2D drawings below:



Draw a 3D corresponding to the above mentioned drawing.

Solution:





Further information to the trainer

Books

Ching, F. D. K. (2015). Architectural Graphics (6th ed.). Wiley.

Giesecke, F. E., Mitchell, A., & Spencer, H. (2016). Technical Drawing with Engineering Graphics (15th ed.). Pearson.

Leake, J., & Borgerson, J. (2012). The Engineering Design Graphics Sketching Workbook (4th ed.). Wiley.

Madsen, D. A., & Madsen, D. P. (2016). Engineering Drawing and Design (6th ed.). Cengage Learning.

Simmons, C. H., & Maguire, D. E. (2012). Manual of Engineering Drawing (4th ed.). Elsevier.

Web Links

<https://www.google.com/search?q=Apply+basic+concepts+of+technical+drawing>

<https://www.google.com/search?q=Apply+lines+and+symbols+used+in+drawing>

<https://www.google.com/search?q=Perform+dimensional+drawing>

