THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

080 ELECTRICAL ENGINEERING

Time: 2:30 Hours **ANSWERS** **Year: 2023**

Instructions

1. This paper consists of Section **A, B** and **C** with a total of **ten (10)** questions
2. Answer **al**l questions.
3. Section **A** and **C** carry **fifteen (15)** marks each and section **B** carries **seventy (70)** marks
4. Cellular phones and unauthorized materials are not allowed in the assessment room
5. Write your **Assessment Number** at the top right-hand corner of every page.

FOR ASSESSOR'S USE ONLY

QUESTION NUMBER	SCORE	ASSESSOR'S INITIALS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL		
CHECKER'S INITIALS		

Prepared by: Maria Marco for TETEA

SECTION A (15 Marks)

Answer all questions in this section.

1. Choose the correct answer from alternatives (A to D) by writing its letter in the box provided:

(i) A car battery has an accumulation of white paste in its terminals which is a sign that the battery undergoes sulphation. What does this phenomenon imply?

A. Sulphur in the sulphuric acid combines with lead on the plates.

B. Sulphur in the sulphuric acid combines with copper on the plates.

C. Sulphur in the sulphuric acid combines with oxygen on the plates.

D. Sulphur in the sulphuric acid combines with zinc on the plates.

Sulphation in a lead-acid battery occurs when sulphur from the sulphuric acid electrolyte combines with lead on the battery plates, forming lead sulphate, which appears as a white paste and reduces battery efficiency.

Answer: A

(ii) You are provided with an electric circuit which consists of two resistors with different values connected in series. What will be the behavior of the circuit?

A. The voltage across each resistor will be the same.

B. The same value of current will pass through each resistor.

C. There will be same current division for each resistor.

D. All resistors will have the same power loss.

In a series circuit, the same current flows through all resistors, while the voltage divides across them proportional to their resistances.

Answer: B

(iii) What are the responsibilities of an electrical technician in a manufacturing company?

A. To interpret the customers' requirements.

B. To prevent random movement of employees.

C. To study theories, design and application of electrical equipment.

D. To study manufactured electrical equipment and devices.

An electrical technician's primary role involves practical work, such as installing, maintaining, and studying manufactured electrical equipment and devices to ensure proper operation.

Answer: D

(iv) Which name is given to a triangle with two equal sides?

A. Equilateral

B. Isosceles

C. Obtuse scalene

D. Acute scalene

A triangle with two equal sides is called an isosceles triangle.

Answer: B

(v) The resistance of a conductor is 0.05 Ω. What will be the current passing through it to give a voltage drop of 6 V?

A. 0.3 A

B. 120 A

C. 12 A

D. 3 A

Using Ohm's Law, I = V / R:

I = 6 V / 0.05 Ω = 120 A

Answer: B

(vi) Which electrical instrument would you use to measure voltage, current, and resistance?

A. Ohmmeter

B. Voltmeter

C. Ammeter

D. Multimeter

A multimeter can measure voltage, current, and resistance, unlike the other instruments, which are limited to specific measurements.

Answer: D

(vii) If two conductors are placed parallel to one another and the current is applied on one side of those conductors; what happens to the conductors?

A. Force of repulsion will occur between conductors.

B. Force of attraction will occur between conductors.

C. No force will occur between conductors.

D. Force of gain and lose to the conductors will occur.

When current flows in the same direction through parallel conductors, they experience a force of attraction due to the magnetic fields generated. If currents are in opposite directions, repulsion occurs. Assuming the question implies same-direction current (common in such contexts), the answer is attraction.

Answer: B

(viii) What are the three different ways of expressing electrical quantities?

A. Ampere, Ohm, and Volt.

B. Ampere, Watt, and Volt.

C. Ohm, Volt, and Second.

D. Meter, Ampere, and Volt.

The fundamental electrical quantities are current (Ampere), resistance (Ohm), and voltage (Volt).

Answer: A

(ix) What could be the main causes of electrical accidents in workshops?

A. Lack of protective equipment

B. Carelessness and inexperience

C. Students' lack of technical skills

D. Bad rules of working area

Carelessness and inexperience are primary causes of electrical accidents, as they lead to unsafe practices and errors in handling equipment.

Answer: B

(x) You are required to remove sharp edges on a metal conduit. Which tool would you use?

A. Chisel

B. Gas Plier

C. Reamer

D. Punch

A reamer is used to smooth and remove sharp edges from metal conduits, ensuring safe installation.

Answer: C

2. Match the functions of the protective equipment in List A with their respective protective equipment in List B by writing a letter of the correct response.

List A

(i) It safeguards the head from falling objects and from bangs against obstruction.

(ii) It is used to protect the eyes from injury when drilling and grinding any materials.

(iii) It is applied when working close to noisy machinery or work operations.

(iv) It protects hands from injury, cuts, abrasions, and burns.

(v) It is used when working on poisonous gases and in dusty environment.

List B

A. Gloves

B. Headphone

C. Goggles

D. Full-face respirator

E. Helmet

F. Hat

G. Overall

H. Boot

(i) Safeguards head from falling objects → E (Helmet)

(ii) Protects eyes during drilling/grinding → C (Goggles)

(iii) Used near noisy machinery → B (Headphone)

(iv) Protects hands from cuts/burns → A (Gloves)

(v) Used in poisonous gases/dusty environments → D (Full-face respirator)

SECTION B (70 Marks)

Answer all questions from this section.

3. (a) A good indication of a fully charged lead acid cell is a colour change in both positive and negative plates.

(i) Which colour will be produced in each plate that will indicate if the battery is fully charged?

In a fully charged lead-acid battery, the positive plate (lead dioxide) is dark brown, and the negative plate (sponge lead) is grey.

Answer: Positive plate: Dark brown; Negative plate: Grey.

(ii) Suggest four things which should be done before charging the lead acid cell to increase its life span.

Check electrolyte levels and top up with distilled water if low.

Clean terminals to remove corrosion or sulphation.

Ensure proper ventilation to avoid gas buildup.

Inspect for physical damage or leaks to prevent short circuits.

(b) Calculate the value of resistance required to give the charging current of 10 A if a battery of 12 cells is charged from a 30 Vdc supply. The terminal voltage (E) per cell is 1.9 V and the internal resistance being neglected.

Total battery voltage = 12 cells × 1.9 V/cell = 22.8 V

Voltage across resistor = Supply voltage - Battery voltage = 30 V - 22.8 V = 7.2 V

Resistance R = V / I = 7.2 V / 10 A = 0.72 Ω

Answer: Resistance = 0.72 Ω

4. (a) Two capacitors C_1 and C_2 are connected in parallel, across a supply of 'V' volts and a charge of 'Q' coulombs is produced. With the aid of a circuit diagram, show the equivalent capacitance given by $C = C_1 + C_2$.

In a parallel capacitor circuit, the equivalent capacitance is the sum of individual capacitances: $C = C_1 + C_2$.

Circuit Diagram (Text Description): Two capacitors, C_1 and C_2, are connected across a voltage source V, with their top plates joined and bottom plates joined, forming a parallel configuration. The total charge Q is shared across the capacitors.

Answer: Equivalent capacitance $C = C_1 + C_2$ (Diagram: C_1 and C_2 connected in parallel across V).

(b) Suppose you need 10 μF capacitance of a certain application and the available capacitance in store is of value 0.05 μF only, how would you make that you get the total capacitance?

To achieve 10 μF using 0.05 μF capacitors in parallel, calculate the number of capacitors needed:

Number of capacitors = Desired capacitance / Capacitance per unit = 10 μF / 0.05 μF = 200

Connect 200 capacitors of 0.05 μF in parallel, as C_total = $C_1 + C_2 + \ldots + C200$.

Answer: Connect 200 capacitors of 0.05 μF in parallel.

5. The resistance of the ammeters and voltmeters in diagrams (a) and (b) are 0.05 Ω and 350 Ω respectively. If the ammeter and voltmeter reading are 5 A and 35 V respectively, calculate the value of resistance R in diagram (a) and (b).

Diagram (a): Ammeter in series with resistor R, voltmeter across R.

Diagram (b): Voltmeter across R, ammeter in series, possibly with meter resistances affecting readings.

For Diagram (a):

Voltmeter measures voltage across R = 35 V, ammeter measures current through R = 5 A.

R = V / I = 35 V / 5 A = 7 Ω (ammeter resistance 0.05 Ω is small and often negligible unless specified).

For Diagram (b):

Assuming a similar setup but accounting for meter resistances:

Voltmeter (350 Ω) is in parallel with R, and ammeter (0.05 Ω) is in series. The voltmeter reading (35 V) is across R, and ammeter reading (5 A) includes current through R and voltmeter.

Current through voltmeter = V / R_voltmeter = 35 V / 350 Ω = 0.1 A

Current through R = 5 A - 0.1 A = 4.9 A

R = V / I_R = 35 V / 4.9 A ≈ 7.14 Ω

Answer:

Diagram (a): R = 7 Ω

Diagram (b): $R \approx 7.14\ \Omega$

Note: Exact calculations depend on the diagrams. Please provide diagrams for precise answers.

6. (a) Why dimensions are very important in engineering drawings?

Dimensions ensure accurate fabrication, assembly, and functionality of components by specifying exact sizes and tolerances, preventing errors and ensuring compatibility.

Answer: Dimensions ensure accuracy, functionality, and compatibility in fabrication.

(b) With the aid of a diagram, describe how the following types of lines are used in a drawing:

(i) An extension line.

(ii) A dimension line.

(iii) A leader.

Text Description of Diagram: A simple rectangular object with:

Extension lines extending from object edges outward.

Dimension lines with arrows between extension lines, showing measurements.

A leader line pointing to a feature (e.g., a hole) with a note.

(i) Extension Line: Extends from the object's edges to define the points between which a dimension is measured, typically thin and solid.

(ii) Dimension Line: Indicates the distance between two extension lines, drawn with arrows at ends and a numerical value, usually thin and solid.

(iii) Leader: A line with an arrow pointing to a feature (e.g., a hole), ending with a note or label to provide additional information, often thin and solid.

7. (a) You are in a workshop and you have been given several measuring instruments.

(i) How will you categorise the instruments as either analog or digital instruments?

Analog instruments display readings via a moving needle or dial (e.g., analog ammeter). Digital instruments display readings numerically on a screen (e.g., digital multimeter).

Answer: Analog: Needle/dial display; Digital: Numerical screen display.

(ii) Assume some of the instruments given are the KVA meter and Clamp meter. In which circumstance would you need to use these instruments?

KVA Meter: Used to measure apparent power (kVA) in AC systems, typically in power distribution or generator systems to monitor load capacity.

Clamp Meter: Used to measure current in a conductor without breaking the circuit, ideal for troubleshooting live circuits or monitoring high-current systems.

Answer:

KVA Meter: Measure apparent power in AC systems.

Clamp Meter: Measure current in live conductors non-intrusively.

(b) Suppose you are provided with an electric circuit as shown in the figure and you are tasked to measure the electric current (I_5) and load resistance (R_L) of the circuit.

(i) What measuring instruments will you use to accomplish the assigned task?

To measure current (I_5): Ammeter (connected in series).

To measure load resistance (R_L): Ohmmeter (circuit disconnected) or calculate using voltmeter (across R_L) and ammeter (through R_L) with R = V / I.

Answer: Ammeter for I_5; Voltmeter and Ammeter (or Ohmmeter) for R_L.

(ii) Redraw the circuit and show how you will position the meters to measure the current (I_5) and load resistance (R_L) of the given circuit.

Since the circuit diagram is not provided, assume a simple series circuit with a load resistor R_L and current I_5.

Redrawn Circuit:

Ammeter in series with R_L to measure I_5.

Voltmeter in parallel with R_L to measure voltage across it (for R_L = V / I).

Answer: Ammeter in series with R_L for I_5; Voltmeter across R_L for voltage to calculate R_L = V / I.

Note: Please provide the circuit diagram for a precise redraw.

8. (a) Give two differences between magnetic and electric circuits.

Medium: Magnetic circuits involve flux through magnetic materials (e.g., iron); electric circuits involve current through conductors (e.g., copper).

Energy Storage: Magnetic circuits store energy in magnetic fields; electric circuits dissipate or transfer energy via current flow.

Answer:

Magnetic: Flux in magnetic materials; Electric: Current in conductors.

Magnetic: Stores energy in fields; Electric: Transfers/dissipates energy.

(b) A coil of 150 turns is linked with a flux of 0.01 Wb when carrying a current of 10 A. If the current is uniformly reversed in 0.01 seconds, calculate:

(i) Inductance of the coil.

Inductance $L = N \times \Phi / I$

$= 150 \times 0.01$ Wb / 10 A = 1.5 H

Answer: Inductance = 1.5 H

(ii) Induced electromotive force.

$EMF = L \times (\Delta I / \Delta t)$

$\Delta I = 10$ A - (-10 A) = 20 A (current reverses from +10 A to -10 A)

$\Delta t = 0.01$ s

EMF = 1.5 H × (20 A / 0.01 s) = 1.5 × 2000 = 3000 V

Answer: Induced EMF = 3000 V

9. (a) You have been provided with tools such as plier, pocket knife, chisel, hand drill, and center punch for doing electrical lighting and wiring. Why are these tools important for such work?

(i) Pliers: Used to grip, bend, or cut wires and components during wiring installations.

(ii) Pocket Knife: Used to strip insulation from wires or cut cables for connections.

(iii) Chisel: Used to chip or cut channels in walls for conduit or cable installation.

(iv) Hand Drill: Used to drill holes for mounting fixtures or running cables through walls.

(v) Center Punch: Used to mark precise drilling points on surfaces to prevent drill bit slipping.

(b) What safety precautions should you observe in handling each tool mentioned in (a) (i) - (v)?

(i) Pliers: Use insulated pliers for live circuits; avoid using on oversized objects to prevent slipping.

(ii) Pocket Knife: Keep blade retracted when not in use; cut away from the body to avoid injury.

(iii) Chisel: Wear goggles to protect eyes from chips; ensure handle is secure to avoid slipping.

(iv) Hand Drill: Wear goggles; ensure drill bit is secure and surface is stable to prevent accidents.

(v) Center Punch: Wear gloves to protect hands; strike accurately to avoid damaging the tool or surface.

SECTION C (15 Marks)

Answer all questions from this section.

10. The following object is presented to you for the development. Produce the following views in full scale size by using third angle projection.

(a) Front view in direction of Z.

(b) End view.

(c) Plan view.

All dimensions are in mm. Construction lines must not be erased and all drawings should be neatly shown.

Front View: Shows the object as seen from direction Z.

End View: Shows the side profile (e.g., left or right).

Plan View: Shows the top view.