

071606T4AUT

AUTOBODY TECHNOLOGY LEVEL 6

ENG/OS/ABT/CC/08/6/A

APPLY ELECTRICAL AND ELECTRONICS PRINCIPLES

July/Aug 2023



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

WRITTEN ASSESSMENT

Time: 3 Hours

INSTRUCTIONS TO CANDIDATE

1. The paper consists of **TWO** Sections; **A** and **B**.
2. Attempt **ALL** questions in Section **A** and any **THREE** questions from Section **B**.
3. Marks for each question are indicated in the brackets.
4. Do not write on the question paper.
5. A separate answer booklet will be provided.

This paper consists of FIVE (5) printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

Turn over

SECTION A: (40 Marks)

Attempt ALL questions in this section

1. Define the following terms with reference to electrical materials giving **one** example for each:
 - a) Semiconductor. (2 Marks)
 - b) Insulator. (2 Marks)
2. Different types of capacitors are used in electrical engineering. State any **three** types. (3 Marks)
3. A current of 5A flows in the winding of an electric motor, the resistance of the winding being 100 Ω . Determine:
 - a) The potential difference across the winding. (2 Marks)
 - b) The power dissipated by the coil. (2 Marks)
4. Convert the following number systems
 - a) 10110_2 into a base 10 number. (2 Marks)
 - b) 426_{10} into a base 8 number. (2 Marks)
5. State any **four** main types of lightning arresters. (4 Marks)
6. A coil has an inductance of 40mH and negligible resistance. Calculate its inductive reactance and the resulting current if connected to a 240V, 50 Hz supply. (4 Marks)
7. With aid of a diagram, explain the operation of Half-Wave rectifier. (5 Marks)
8. Outline any **three** reasons for earthing of electrical systems. (3 Marks)
9. A coil of copper wire has a resistance of 10 Ω at 20°C. If the temperature coefficient of resistance of copper at 20°C is 0.004/°C, determine the resistance of the coil when the temperature rises to 100°C. (4 Marks)

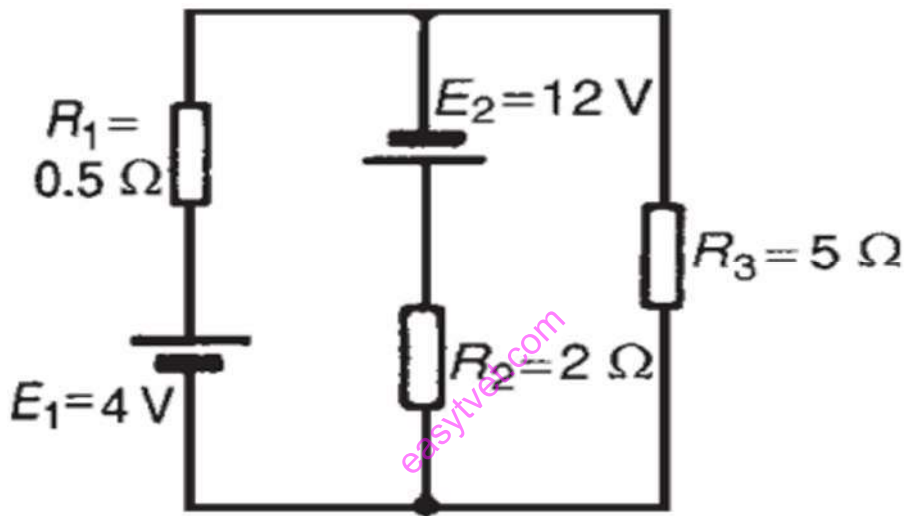
10. a) Define power factor in reference to electrical installation and state **one** main cause of low power factor in electrical systems. (2 Marks)
- b) List any **three** power factor improvement equipment that can be used by a factory to reduce its power losses. (3 Marks)

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SECTION B (60 MARKS)

Attempt any THREE questions in this section

11. a) State Kirchhoff's Voltage law. (2 Marks)
- b) Determine, using Kirchhoff's laws, current through each resistor in the circuit below: (8 Marks)



- c) i) Define the term lightning. (2 Marks)
- ii) Describe **two** types of lightning strokes. (8 Marks)
12. a) A coil consists of a resistance of **100 Ω** and an inductance of **200 mH**. If an alternating voltage, v , given by $v = 200 \sin 500t$ volts is applied across the coil, calculate:
- the circuit impedance,
 - the current flowing,
 - the p.d. across the resistance,
 - the p.d. across the inductance, and
 - the phase angle between voltage and current. (10 Marks)
- c) i) Define personal protective equipment giving **one** example. (2 Marks)
- ii) Explain **two** dangers of electricity. (4 Marks)
- iii) Outline **four** ways one can maintain safety at work place. (4 Marks)

13. a) A shunt generator supplies a 20kW load at 200 V through cables of resistance, $R=100\text{ m}\Omega$. If the field winding resistance, $R_f = 50\ \Omega$ and the armature resistance, $R_a = 40\text{m}\Omega$, determine:
- i) The terminal voltage. (4 Marks)
 - ii) The e.m.f. generated in the armature. (4 Marks)
- b) Distinguish between an intrinsic and an extrinsic semiconductor. (4 Marks)
- c) Explain the function of the following parts of solar installation. (6 Marks)
- i) Charge controller.
 - ii) Solar battery.
 - iii) Inverter.
- d) Multimeters are essential measuring instruments. Name **two** main types of multimeters. (2 Marks)
14. a) With aid of a diagram, illustrate the TT earthing system. (6 Marks)
- b) A 12 kW, six-pole DC generator develops an emf of 240 at 1500 rpm. The armature has a lap connected winding. The average flux density over the pole pitch is 1.0 T. The length and diameter of the armature is 30 cm and 25 cm respectively. Calculate flux per pole, total number of active armature conductors. Power generated in the armature and torque developed when the machine is delivering 50 A current to the load. (8 Marks)
- c) Simplify the Boolean function $F = AB + (AC)' + AB'C(AB + C)$. (6 Marks)