



ZIMBABWE

**MINISTRY OF HIGHER AND TERTIARY EDUCATION,
INNOVATION, SCIENCE AND TECHNOLOGY
DEVELOPMENT**

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL DIPLOMA

**IN
MECHANICAL ENGINEERING**

**MODULE: Electrical and Electronics
Technology**

PAPER NO: 539/23/M03

DURATION: 3 Hours

NOVEMBER/DECEMBER 2025 EXAMINATION

REQUIREMENTS

1. Answer booklet
2. Formula booklet
3. Non programmable scientific calculator

INSTRUCTIONS TO CANDIDATE

1. Answer any five (5) questions.
2. Start each question on a fresh page.
3. Do not write your name inside or outside the answer script.
4. Do not write on the question paper
5. Take $\epsilon_0 = 8,85 \times 10^{-12} \text{ F/m}$ and $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$

This paper consists of 6 printed pages.

QUESTION 1

- (a) Determine the resistance of 1200m of copper cable having a diameter of 12mm if its resistivity is $1.7 \times 10^{-8} \Omega\text{m}$. (5 marks)
- (b) Some copper wire has a resistance of 200Ω at 20°C . A current is passed through the wire and the temperature rises to 90°C . Determine the resistance of the wire at 90°C correct to the nearest ohm assuming the temperature coefficient of resistance is $0.004/^\circ\text{C}$ at 0°C . (7 marks)
- (c) State four factors which affect the resistance of any material. (4 marks)
- (d) Define the following electrical units of measurements
- (i) Ampere (1 mark)
 - (ii) Coulomb (1 mark)
 - (iii) Volt (1 mark)
 - (iv) Ohm (1 mark)

QUESTION 2

- (a) State Kirchhoff's
- (i) Current law (2 marks)
 - (ii) Voltage law (2 marks)
- (b) Using Kirchhoff's current law calculate I_1 , I_2 , and $I_1 + I_2$ in Fig QN2. Find also the voltage across the 20Ω resistor. (16 marks)

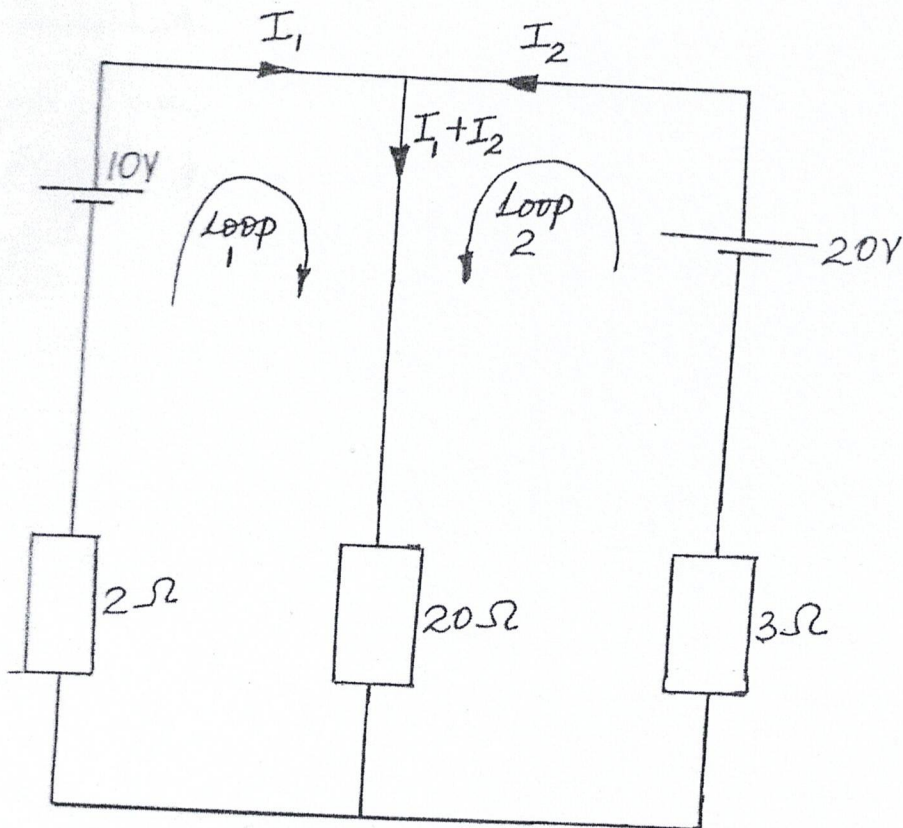


Fig QN2

QUESTION 3

- (a) Capacitors of $1\mu F$, $3\mu F$, $5\mu F$ and $6\mu F$ are connected in parallel to a DC supply of 100V. determine the following:
- (i) Equivalent circuit capacitance. (3 marks)
 - (ii) Total charge (3 marks)
 - (iii) Charge on each capacitor (8 marks)
- (b) Show the symbols used in electrical circuits to represent the following:
- (i) Fixed resistor (1 mark)
 - (ii) Two conductors joined together (1 mark)
 - (iii) Capacitor (1 mark)
 - (iv) Fuse (1 mark)
 - (v) D.c motor (1 mark)
 - (vi) Siren (1 mark)

QUESTION 4

For the series parallel arrangement shown in Fig QN4, find the following: -

- (a) the supply current (7 marks)
- (b) The current flowing through each resistor (5 marks)
- (c) the p.d across each resistor (8 marks)

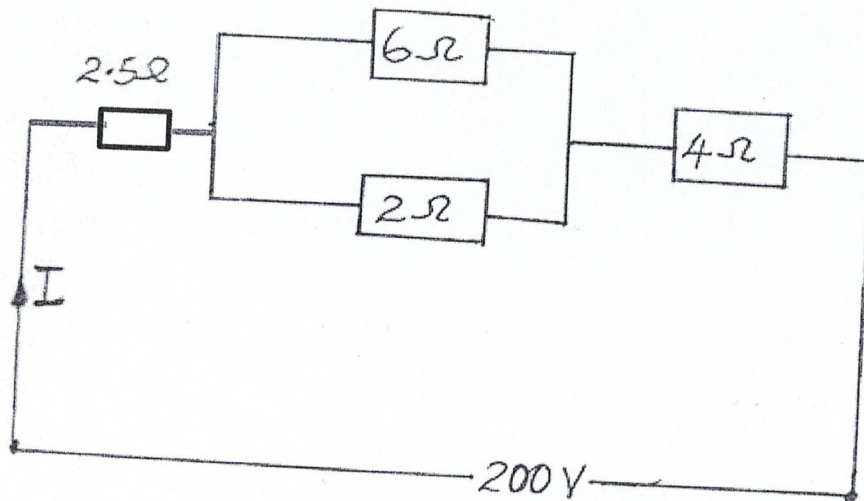


Fig QN4

QUESTION 5

- (a) A mild steel ring has a radius of 50mm and a cross-sectional area of $400 \times 10^{-6} \text{ m}^2$. A current of 0.5A flows in a coil wound uniformly around the ring and the flux produced is 0.1mWb. If the relative permeability at this value of current is 200, find
 - (i) The reluctance of the mild steel (5 marks)
 - (ii) The number of turns on the coil (4 marks)
- (b) A transformer has a voltage ratio of 240/12V. If there are 1500 turns on the primary winding, calculate the number of secondary turns. (6 marks)
- (c) A single phase transformer supplied a load current of 9.5A. If the primary to secondary turns ratio is 12:1, calculate the value of the primary current. (5 marks)

QUESTION 6

- (a) Briefly explain the following terms with reference to single phase circuits
- (i) Active power (2 marks)
 - (ii) Reactive power (2 marks)
 - (iii) Apparent power (2 marks)
 - (iv) Power factor (2 marks)
- (b) State the reason for doping semiconductor materials. (2 marks)
- (c) Explain inductor specification. (2 marks)
- (d) Explain the following terms in relation to A.C theory.
- (i) Cycle (1 mark)
 - (ii) Frequency (2 marks)
 - (iii) Periodic time (2 marks)
 - (iv) Instantaneous value (1 mark)
 - (v) Root mean square (2 marks)

QUESTION 7

- (a) Briefly explain the following terms:-
- (i) Valency electrons (2 marks)
 - (ii) Covalent bonding (2 marks)
 - (iii) Intrinsic conduction (2 marks)
 - (iv) Extrinsic conduction (2 marks)
 - (v) Doping (2 marks)
- (b) State the difference between donor atoms and acceptor atoms . (4 marks)
- (c) With the aid of clearly labelled sketches, explain the meaning of forward bias and reverse bias in relation to diodes. (6 marks)

QUESTION 8

(a) Define the following electronic devices

(i) Inductor

(2 marks)

(ii) Resistor

(2 marks)

(iii) Capacitor

(2 marks)

(iv) Diode

(2 marks)

(b) Fig QN8 shows a block diagram of a circuit. Replace the box with appropriate symbols and state the function of each device in the circuit. (12 marks)

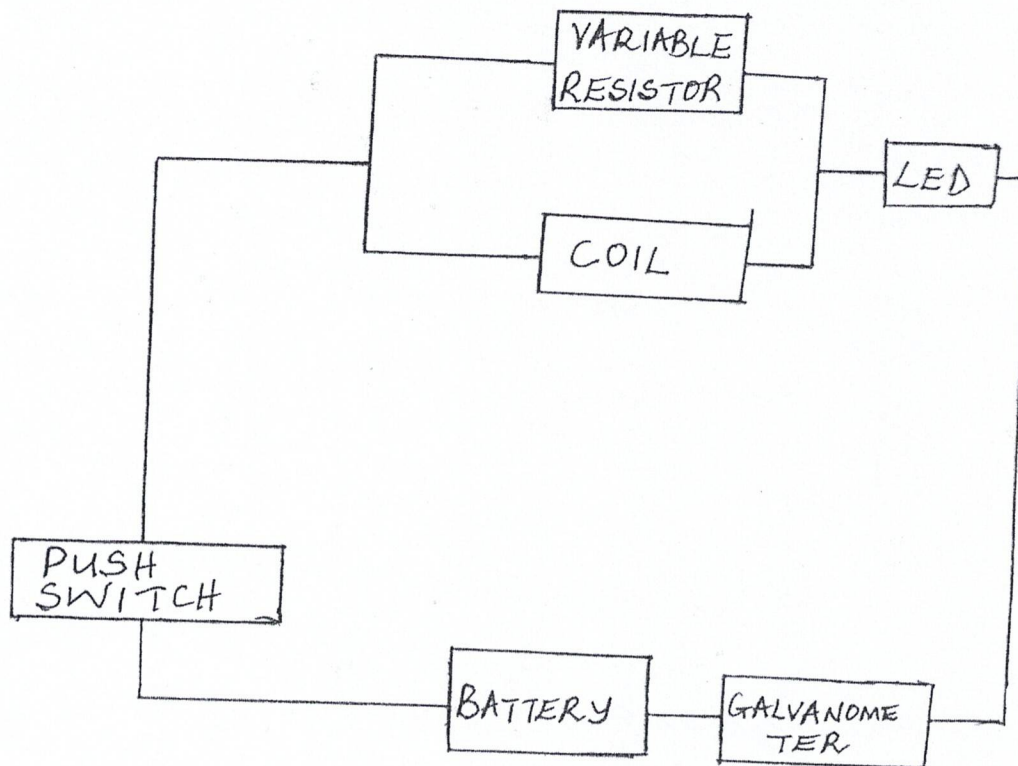


Fig QN 8

...../cn