

1601/102
1602/102
APPLIED SCIENCE, ELECTRICAL
PRINCIPLES I AND ELECTRONICS
June/July 2023
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONIC ENGINEERING
(POWER OPTION)
(TELECOMMUNICATION OPTION)

MODULE I

APPLIED SCIENCE, ELECTRICAL PRINCIPLES I AND ELECTRONICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Non-programmable scientific calculator;

Drawing instruments.

This paper consists of THREE sections; A, B and C.

Answer ONE question from section A, TWO questions each from section B and C in answer booklet provided.

All questions carry equal marks.

Maximum marks for each part of a question are indicated.

Candidates should answer the questions in English.

Take: $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$

$\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$

This paper consists of 6 printed pages.

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

SECTION A: APPLIED SCIENCE

Answer *ONE* question from this section.

1. (a) Describe the type of chemical bonding in each of the following:
- (i) metallic conductor;
 - (ii) PVC insulator.
- (6 marks)
- (b) (i) State **two** negative effects of noise to a machine operator.
(ii) Compare propagation of sound in air and solid.
- (4 marks)
- (c) (i) Explain the following heat transfer methods:
- (I) convection;
 - (II) conduction.
- (ii) A metallic substance of heat capacity 450 J/K is heated causing its temperature to rise from 30°C to 90°C . Determine the amount of heat absorbed.
- (7 marks)
- (d) A material has a mass of 36 kg and density of 0.12 g/cm^3 . Determine the volume occupied by the material.
- (3 marks)
2. (a) (i) Define the following with respect to simple machines:
- (I) mechanical advantage;
 - (II) velocity ratio.
- (ii) A force of 400 N is required to lift an object of 3800 N using a simple machine. The efficiency of the machine is 90% . Determine the:
- (I) mechanical advantage;
 - (II) velocity ratio.
- (9 marks)
- (b) (i) State 'pressure law' of a gas.
(ii) Draw and label graph representation of gas pressure law.
- (4 marks)
- (c) (i) Define electrostatics.
(ii) Explain how electrostatic charges are formed.
- (4 marks)

- (d) Figure 1 shows an electromagnetic spectrum.

Radio waves	X	Y	Visible light	Ultra violet (UV)	Z	Gamma rays
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Fig. 1

Name the electromagnetic waves labelled X, Y and Z.

(3 marks)

SECTION B: ELECTRICAL PRINCIPLES I

Answer *TWO* questions from this section.

3. (a) (i) Define 'temperature coefficient of resistance of a material.
(ii) Explain the effects of temperature on the conductivity of a material. (4 marks)
- (b) The resistance of copper coil at 18 °C is 180 Ω . Determine the resistance of the coil when temperature rises to 80 °C. Take temperature coefficient of resistance of copper as 0.0043/°C at 0 °C. (4 marks)
- (c) With aid of schematic diagram, describe the operation of auto-transformer. (6 marks)
- (d) A 100 kVA, 1100/400 V, 50 Hz single phase transformer has 100 turns on the secondary. Determine the:
(i) number of primary turns;
(ii) value of primary and secondary currents. (6 marks)
- ~~4.~~ (a) Define the following terms as used in electrostatics:
(i) dielectric;
(ii) capacitance. (4 marks)
- (b) State **three** factors that affect the capacitance of a capacitor. (3 marks)

(c) Figure 2 shows a D.C circuit.

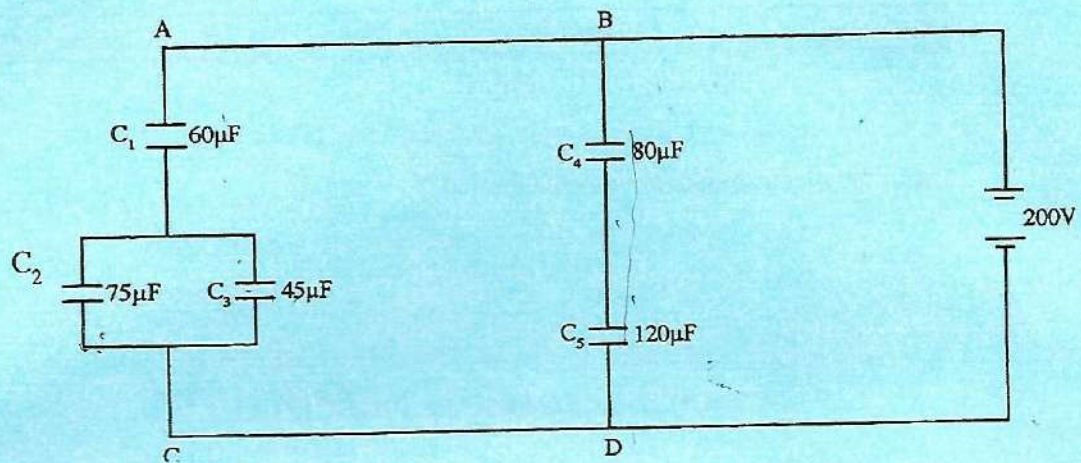


Fig. 2

Determine the:

- (i) total capacitance of the circuit;
- (ii) total charge in the circuit;
- (iii) charge stored by branch AC;
- (iv) energy stored by branch BD.

(9 marks)

(d) State **four** disadvantages of leclanche dry cells.

(4 marks)

(a) Define the following electrical quantities and state their units in each case:

- (i) electric charge;
- (ii) power.

(4 marks)

(b) State **two** differences between a series circuit and parallel circuit.

(4 marks)

- (c) Figure 3 shows an electric circuit.

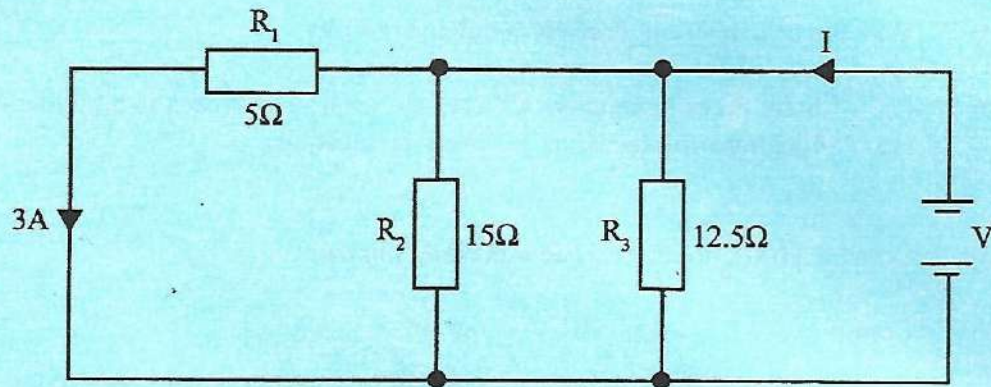


Fig. 3

Determine the:

- (i) supply voltage V ;
(ii) total resistance;
(iii) value of current I .

$\frac{V}{2}$

(6 marks)

- (d) Ten identical cells are connected across a load of 5Ω resistor. Each cell has internal resistance of 0.15Ω and emf of 2.2 V . Determine the:

- (i) current flowing in the 5Ω resistor;
(ii) P.d across the battery terminals.

(6 marks)

SECTION C: ELECTRONICS

Answer *TWO* questions from this section.

6. (a) Differentiate between insulators and conductors. (4 marks)
- (b) With aid of a labelled diagram, describe the operation of the P-N junction in the forward bias mode. (7 marks)
- (c) List **three** types of passive electronic components. (3 marks)
- (d) A transistor connected in common base configuration has $I_E = 2.2\text{ mA}$ and $I_B = 22\mu\text{A}$. Determine the value of:
(i) Collector current I_C ;
(ii) gain α .

(6 marks)

7. (a) List **three** types of power rectifiers used in d.c power suppliers. (3 marks)
- (b) With aid of a diagram, describe a voltage doubler. (7 marks)
- (c) (i) State **three** parameters affected by negative feedback in amplifiers.
(ii) Illustrate voltage shunt feedback connection. (6 marks)
- (d) Convert 11001_2 to its equivalent decimal number. (4 marks)

8. (a) Complete the following AND rules in Boolean algebra:

- (i) $A \cdot A = \underline{A}$;
- (ii) $A \cdot \bar{A} = \underline{0}$;
- (iii) $A \cdot 1 = \underline{A}$;
- (iv) $A \cdot 0 = \underline{0}$.

(4 marks)

(b) Simplify the following Boolean expression $(A + B)(A + C)$. (5 marks)

(5 marks)

(c) Draw the:

- (i) logic circuit for the following Boolean expression: $Y = AB + C$;
- (ii) truth table for logic gate shown in figure 4.

(7 marks)

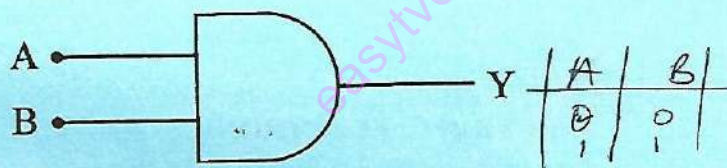


Fig. 4

- (d) (i) Define the term transducer;
- (ii) A resistance potentiometer has a sensitivity of 20 V/mm. Determine the output voltage for displacement of 1.8 mm.

(4 marks)

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