

1601/102
1602/102
APPLIED SCIENCE, ELECTRICAL
PRINCIPLES I AND ELECTRONICS
June/July 2021
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONIC TECHNOLOGY
(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 from section **B** and **TWO** questions from section **C**.

All questions carry equal marks.

Maximum marks for each part of a question are as 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 7 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) State **two** methods of noise reduction in a workshop. (2 marks)
- (b) (i) List **two** types of chemical bonding of elements.
- (ii) Explain the electrical conductivity of each of the following:
- (I) ammonium chloride solution;
- (II) zinc. (6 marks)
- (c) A dry ice at -12°C is heated causing it to melt reaching a final temperature of 60°C .
- (i) Sketch a graph of the ice change of state;
- (ii) Explain the graph during the melting process. (6 marks)
- (d) Figure 1 shows an object of mass 80 kg resting on a flat surface.

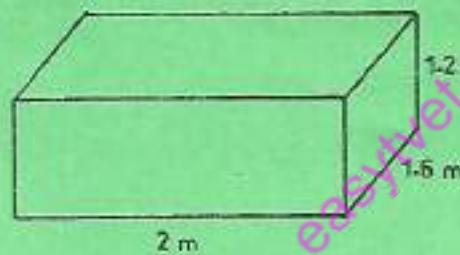


Fig.1

Determine the:

- (i) density of the object;
- (ii) minimum pressure the object exerts on the flat surface. (6 marks)
2. (a) State **three** properties of X-rays. (3 marks)
- (b) Illustrate the electromagnetic spectrum. (6 marks)

- (c) (i) State the law of conservation of energy.
- (ii) Figure 2 shows a simple pendulum. The mass of the bob is 2 kg.

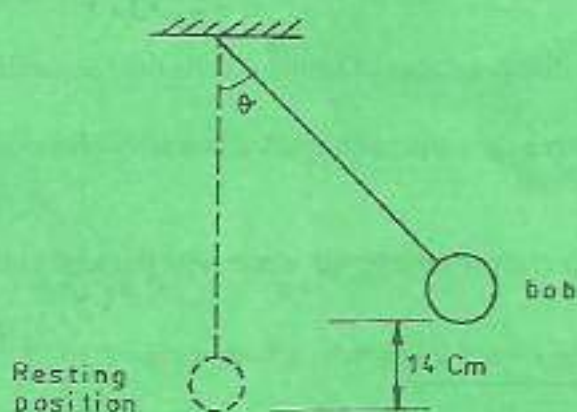


Fig.2

The bob is displaced by an angle θ to a height of 14 cm above the resting position. Determine the:

- (I) gravitational potential energy possessed by the bob;
- (II) maximum velocity the bob can attain when released to swing freely. (6 marks)
- (d) The pressure of a gas of volume 180 cm^3 is constant. Determine the change in volume when the gas temperature increases from 75°C to 98°C . (5 marks)

SECTION B: ELECTRICAL PRINCIPLES I

Answer TWO questions from this section.

3. ✓
- (a) (i) ✓ State **two** disadvantages of primary cells over secondary cells. (5 marks)
- (ii) ✓ Outline **three** care and maintenance practices observed when handling a secondary cell. (3 marks)
- (b) Figure 3 shows an electric circuit. Illustrate how the load voltages and current can be measured. (3 marks)

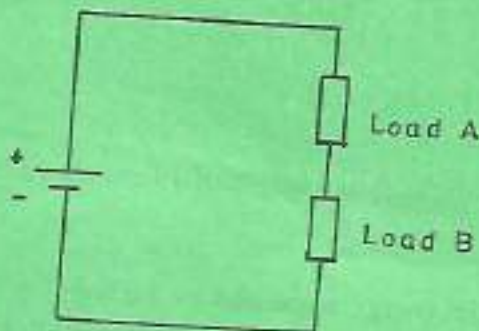


Fig. 3

- (c) (i) ✓ Compare the effect of temperature on electrical resistance of conductors and insulators. (5 marks)
- (ii) ✓ A carbon resistor has a resistance of $3.3\text{ K}\Omega$ at 0°C . The temperature coefficient of resistance of carbon at 0°C is $-0.00052/^\circ\text{C}$. Determine its resistance at 26°C . (5 marks)
- Handwritten calculation:*
 $R_t = R_0 [1 + \alpha (t - t_0)]$
 $R_{26} = 3300 [1 + (-0.00052)(26 - 0)]$
 $R_{26} = 3300 [1 - 0.01352]$
 $R_{26} = 3300 \times 0.98648$
 $R_{26} = 3264.584\ \Omega$
- (d) A single core aluminium cable of diameter 2 cm and length 4100 m has a resistivity of $2.65 \times 10^{-8}\ \Omega\text{m}$. Determine its: (7 marks)
- (i) resistance;
- (ii) conductivity. (4 marks)

4. ✓
- (a) Define each of the following with reference to electrostatics: (4 marks)
- (i) electric field intensity: *the force per unit charge exerted on a small positive charge placed in the field*
- (ii) electric flux density: *the rate of flow of electric flux through a unit area perpendicular to the direction of the flux*

- (d) Figure 5 shows a magnetic circuit.

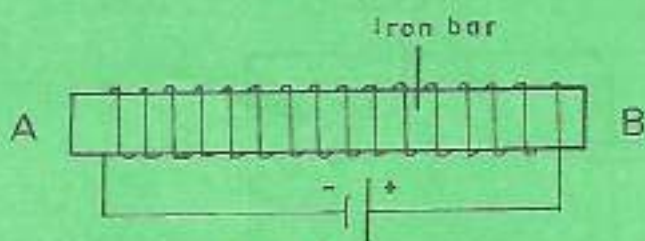


Fig. 5

- (i) identify the polarity of the ends A and B.
 (ii) draw the magnetic field pattern around the iron bar.

(6 marks)

SECTION C: ELECTRONICS

Answer *TWO* questions from this section.

6. (a) With the aid of labelled schematic circuits, compare the depletion layers of forward biased and reversed biased P-N junction. (6 marks)
- (b) Describe the construction of N-channel JFET. (5 marks)
- (c) Convert the binary number 110001101001_2 to its equivalent:
- (i) BCD;
 (ii) gray code. (6 marks)
- (d) Determine the binary equivalent of 463_{10} . (3 marks)
7. (a) State **three** types of transistor configurations. (3 marks)
- (b) With the aid of a labelled circuit, describe fixed biasing method of a transistor. (5 marks)
- (c) Figure 6 shows a logic circuit.

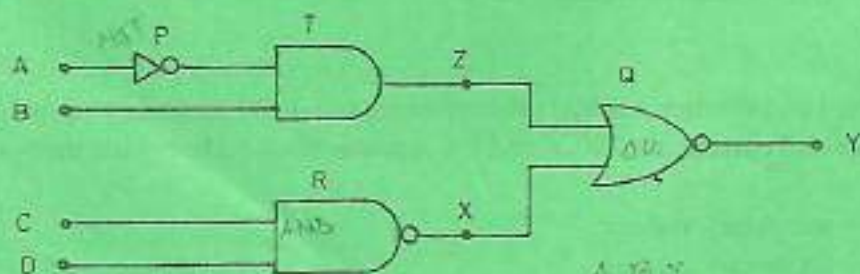


Fig. 6

A	B	Y
1	0	0
0	1	0
0	0	1
1	1	1
0	1	0
1	0	0

- (i) identify the logic gates P, Q and R.
- (ii) draw the truth table for the output Z. (6 marks)
- (d) (i) Define a 'transducer'.
- (ii) Draw a circuit consisting of a thermistor and a fixed resistor to give output voltage proportional to the surrounding temperature. (6 marks)
8. ✓ (a) (i) State two types of feedback connections. Positive & Negative
- (ii) Differentiate between positive and negative feedback. (6 marks)
- (b) Describe the operation of a triac. (2 marks)
- (c) Simplify the Boolean expression:
- $$Y = ABC + \bar{A} + A\bar{B}C. \quad (4 \text{ marks})$$
- (d) (i) With the aid of labelled circuit, describe half-wave power rectification.
- (ii) Draw the input and output waveforms of the circuit in (d) (i). (8 marks)

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