

1601/102

1602/102

APPLIED SCIENCE, ELECTRICAL PRINCIPLES I
AND ELECTRONICS

June/July 2017

Time: 3 hours

15 AUG 2017



THE KENYA NATIONAL EXAMINATIONS COUNCIL

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

APPLIED SCIENCE, ELECTRICAL PRINCIPLES I AND ELECTRONICS

3 hours

INSTRUCTIONS TO CANDIDATES

*You should have the following for this examination:**Answer booklet;**Scientific calculator;**Drawing instruments.**This paper consists of EIGHT questions in THREE sections; A, B and C.**Answer ONE question from Section A, TWO questions from Section B and TWO questions from Section C in the answer booklet provided.**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

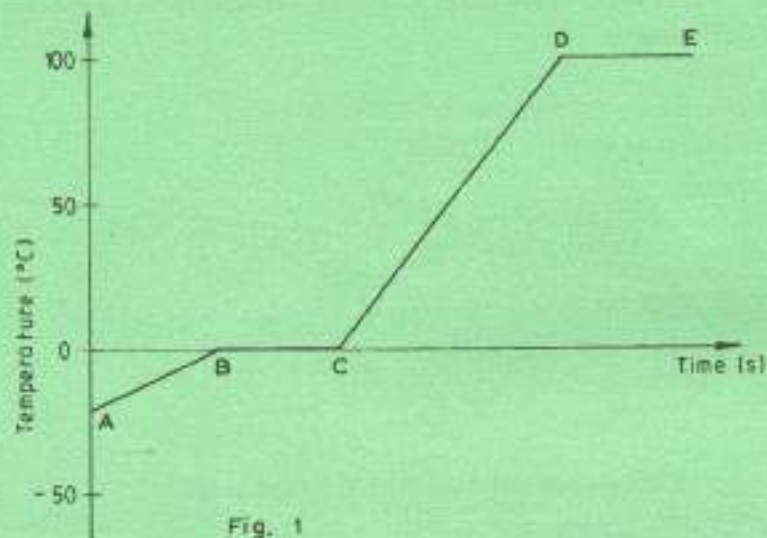
Answer any ONE question from this section.

1. (a) (i) State **two** conditions necessary for total internal reflection to occur when light travels from one optical medium to another.
- (ii) An object is placed on the principle axis of a convex lens of focal length 10 cm so that it is 15 cm from the lens. Determine the position of the image formed. (6 marks)
- (b) Complete table 1 by showing the colour of the acid-base indicators in basic and acidic solutions. (4 marks)

Table 1

Acid-base Indicator	Colour in acidic solutions	Colour in basic solutions
Litmus paper		
Phenolphthalein		

- (c) (i) State **four** temperature scales.
- (ii) Differentiate between vaporization and sublimation
- (iii) Figure 1 shows change of state graph when dry ice is heated. Explain the change taking place between:
- (I) BC;
- (II) CD. (10 marks)



2. (a) (i) State the;
- (I) Archimedes' principle;
- (II) Law of flotation.
- (ii) The density of lead is 11400 kg/m^3 . Determine its relative density. (8 marks)
- (b) (i) State the law of conservation of energy.
- (ii) Figure 2 shows a simple pendulum. The mass of the bob is 0.5 kg . Determine the maximum velocity attained by the bob. (Take $g = 10 \text{ N/kg}$) (7 marks)

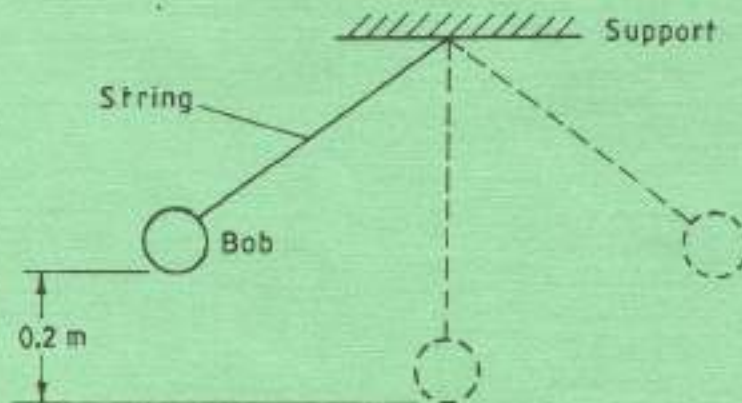


Fig. 2

- (c) (i) State the pressure law.
- (ii) A gas occupies a volume of 120 cm^3 at a temperature of 17°C . The gas is heated at constant pressure to a temperature of 34°C . Determine the new volume of the gas. (5 marks)

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SECTION B: ELECTRICAL PRINCIPLES

Answer any **TWO** questions from this section.

3. (a) (i) Define the following electrical units:

- (I) volt;
- (II) ohm.

(ii) Figure 3 shows an electric circuit.

Determine the:

- (I) total circuit resistance;
- (II) circuit current;
- (III) voltage across the parallel branch.

(12 marks)

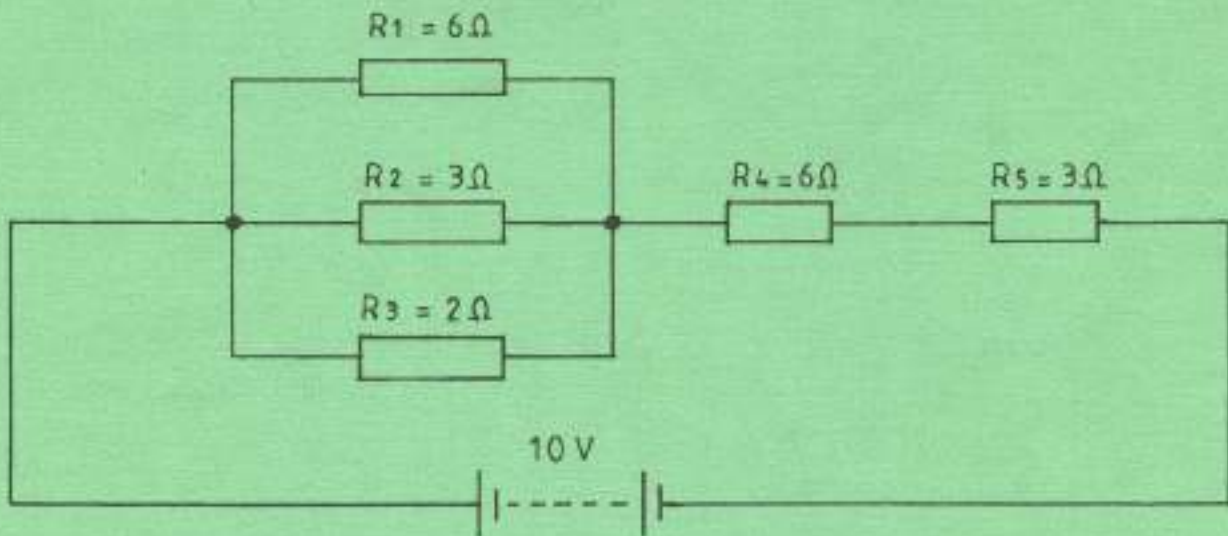


Fig. 3

(b) State:

- (i) Faraday's laws of electrolysis;
- (ii) two disadvantages of alkaline cells over lead-acid cells.

(4 marks)

- (c) (i) Explain the effects of temperature on resistance.
- (ii) A coil of copper wire has a resistance of 100Ω when its temperature is at 0°C . Determine its resistance at a temperature of 60°C . Take the temperature coefficient of resistance of copper at 0°C to be 0.0043°C . (4 marks)
4. (a) State two:
- (i) factors affecting capacitance of a capacitor;
- (ii) types of capacitors. (4 marks)
- (b) Distinguish between relative permittivity and permittivity of free space as used in electrostatics. (2 marks)
- (c) A capacitor is made of seven metal plates and separated by sheets of mica having a thickness of 0.4 mm and a relative permittivity of 6. The area of one side of each plate is $40,000 \text{ mm}^2$. A potential difference (p.d.) of 500 V d.c is maintained across the terminals of the capacitor, determine the:
- (i) total capacitance;
- (ii) charge;
- (iii) potential gradient;
- (iv) electric flux density. (8 marks)
- (d) With aid of a circuit diagram, derive an expression for the total capacitance for three capacitors C_1 , C_2 and C_3 connected in series across a d.c. source of v volts. (6 marks)
5. (a) Define the following terms as used in electromagnetism;
- (i) magnetomotive force;
- (ii) relative permeability. (4 marks)
- (b) A mild steel ring has a radius of 60 mm and a cross-sectional area of 600 mm^2 . A current of 0.5 A flows in a coil wound uniformly around the ring and the flux produced is 0.1 mWb . The relative permeability at this value of current is 200.
- Determine the:
- (i) reluctance of the mild steel;
- (ii) number of turns on the coil. (6 marks)

- (c) With the aid of a labelled diagram, describe the operation of a core-type single phase transformer. (5 marks)
- (d) A 5 KVA single phase transformer has a primary voltage of 2.5 kV, and turns ratio of 5:1. Neglecting core losses, determine the:
- (i) full load secondary current;
- (ii) minimum load resistance which can be connected across the secondary winding to give full load kVA. (5 marks)

SECTION C: ELECTRONICS

Answer any TWO questions from this section.

6. (a) (i) Differentiate between conductors and semi-conductors.
- (ii) Explain the term 'doping' as applied in a semi-conductor. (6 marks)
- (b) (i) State **three** applications of bipolar junction transistors.
- (ii) Describe the operation of a photo diode. (5 marks)
- (c) (i) Explain the term 'amplitude distortion' as applied in audio amplifiers.
- (ii) With the aid of waveform diagrams, explain the effect of incorrect transistor biasing on amplitude. (9 marks)
7. (a) (i) State the function of zener diode in power supply circuits.
- (ii) With the aid of a circuit diagram, explain the operation of a voltage doubler. (8 marks)
- (b) State:
- (i) **Four** types of negative feedback connections;
- (ii) **Two** applications of BCD coding system. (6 marks)
- (c) Convert 10011011_2 into:
- (i) decimal.
- (ii) BCD. (6 marks)

8. (a) (i) Using Karnaugh map, simplify the boolean expression:
$$f(A,B) = A\bar{B} + AB$$
- (ii) For an exclusive - NOR gate;
- (I) draw the symbol of the logic gate;
- (II) write its truth table. (10 marks)
- (b) (i) Define the term 'transducer'.
- (ii) State any two applications of inductive transducers. (4 marks)
- (c) With the aid of a diagram, explain the operation of the T-type flip flop. (6 marks)

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