1601/102
1602/102
APPLIED SCIENCE, ELECTRICAL PRINCIPLES I
AND ELECTRONICS
June/July 2017
Time: 3 hours

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: $\varepsilon_o = 8.85 \times 10^{-12}$ F/m
$\mu_o = 4\pi \times 10^{-7}$ 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)

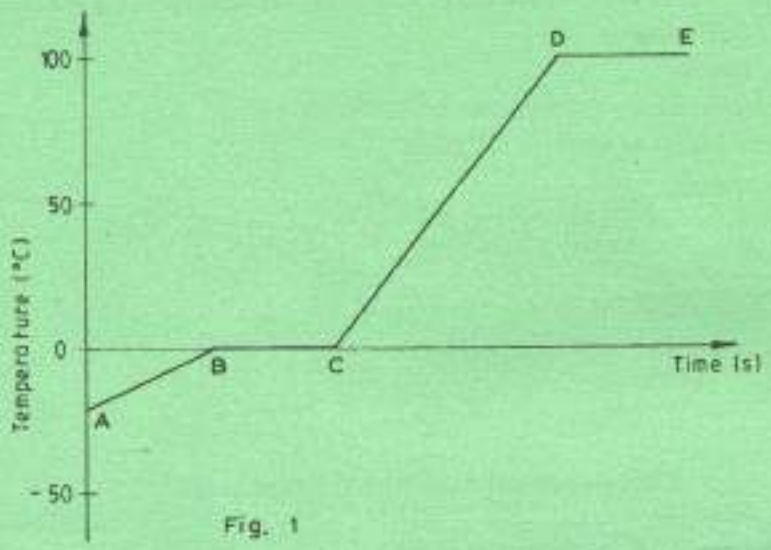

Fig. 1

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 N/kg) (7 marks)

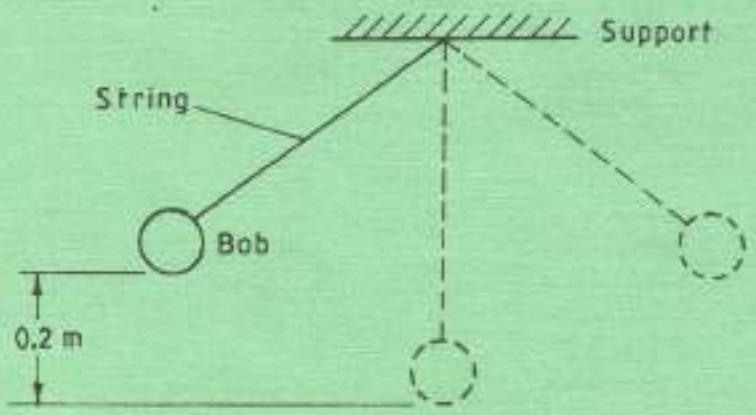

Fig. 2

(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)

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)

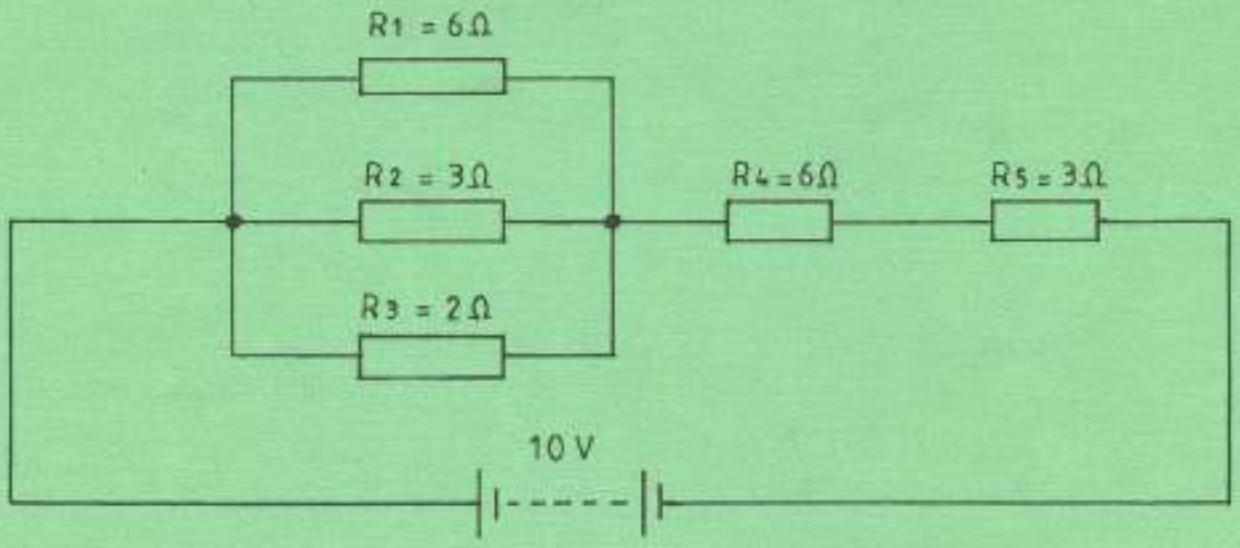

Fig. 3

(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 100 Ω 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 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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