1601/102
1602/102
APPLIED SCIENCE, ELECTRICAL
PRINCIPLES I AND ELECTRONICS
Oct./Nov. 2017
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** and **TWO** questions each from section **B** and **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: $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m
$\mu_o = 4\pi \times 10^{-7}$ 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.

Turn over

SECTION A: APPLIED SCIENCE

*Answer any **ONE** question from this section.*

1. (a) (i) List **two** properties of acids.

(ii) Differentiate between the following terms as used in chemistry:

(I) atomic number and mass number;
(II) period and group. (5 marks)

(b) (i) State **two** forms of heat transfer.

(ii) A steel boiler of mass 12 kg has 25 kg of water at 98° C. When 70 kg of water at 16° C was added to the boiler, a steady temperature of 38.5° C was obtained. The specific heat capacity of water is 4200 J/kg K. Determine the specific heat capacity of steel boiler. Assume heat loss to the surrounding is negligible. (7 marks)

(c) (i) State the energy conversion when:

(I) a simple pendulum bob is made to swing;
(II) solar battery is used to light a filament bulb.

(ii) A simple d.c generator produces 12000 joules of energy per minute. Determine its power. (5 marks)

(d) Explain how a glass rod acquires electrostatic charges when rubbed against fur. (3 marks)

2. (a) (i) Define:

(I) density;
(II) relative density.

(ii) The relative density of dam water is 1.13. Calculate its density in kg/m^3. (3 marks)

(b) (i) State **three** properties of electromagnetic waves.

(ii) Draw a labelled diagram of the electromagnetic spectrum. (6 marks)

(c) (i) Define the isothermal process.

(ii) Sketch graphs to represent each of the following:

(I) Boyle's law;
(II) Charles's law. (5 marks)

(d) A convex lens of focal length 10 cm is used to magnify an object placed at a distance 15 cm from it. Determine the:

(i) image distance;

(ii) magnification. (6 marks)

SECTION B: ELECTRICAL PRINCIPLES I

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

3. (a) State **two**:

(i) advantages of an alkaline cell over lead acid cell.

(ii) indications of a fully charged lead-acid cell. (4 marks)

(b) Draw a labelled diagram of a leclanche dry cell. (5 marks)

(c) Define the following terms as used in electrostatics:

(i) electric flux density;

(ii) relative permittivity. (4 marks)

(d) Figure 1 shows a capacitive circuit:

(i) Show that the potential difference across C_1 is given by:

$$V_1 = \left(\frac{C_2}{C_1 + C_2}\right)V$$

(ii) Determine the capacitance of capacitor C_2 if $C_1 = 20\ \mu F$ and total capacitance is $12\ \mu F$. (7 marks)

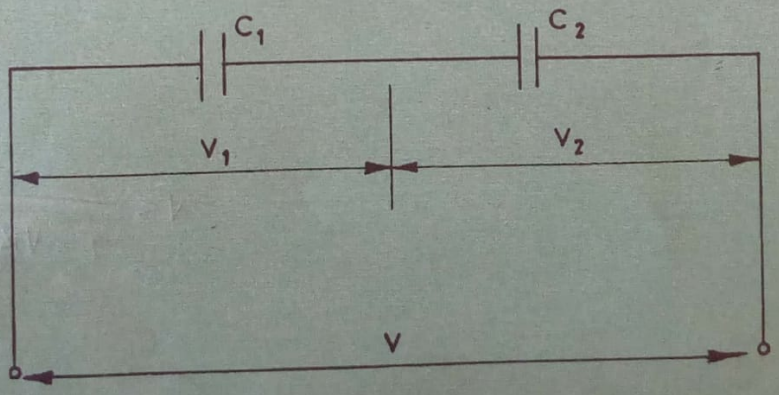

Fig. 1

$C = \frac{\varepsilon_0 \varepsilon_r A}{d}$

4. (a) State:

(i) **three** factors that determine the force on a current carrying conductor in a magnetic field.

(ii) Faraday's laws of electromagnetic induction. (5 marks)

(b) Outline **four** factors which affect the inductance of an inductor. (4 marks)

(c) A flux of 20 mwb links with a 1200 turns coil when a current of 2A passes through the coil. Determine the:

(i) inductance of the coil;

(ii) energy stored in the magnetic field;

(iii) average emf induced in the coil if current falls to zero in 120 ms. (7 marks)

(d) Sketch the following transformer construction:

(i) core type;

(ii) shell type. (4 marks)

(a) State:

(i) **three** effects of an electric current and **one** application of each;

(ii) **two** types of resistors. (5 marks)

(b) A wire of length 6 cm and cross-sectional area of $4\ mm^2$ has a resistance of $0.12\ \Omega$. If the wire is drawn out until its cross sectional area is $2\ mm^2$, determine the new resistance of the wire. (4 marks)

(c) Figure 2 shows an electric circuit. Show that by current division; $I_1 = \left(\frac{R_2}{R_1 + R_2}\right)I$. (5 marks)

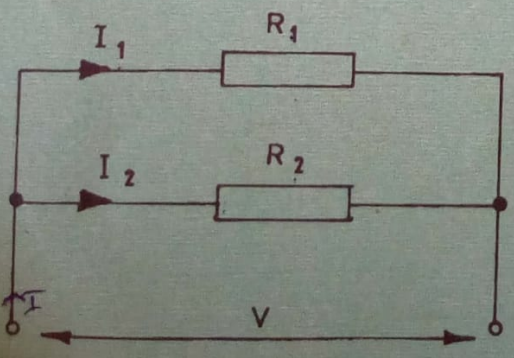

Fig. 2

(d) Figure 3 shows an electric circuit. When switch S is closed, the reading on the voltmeter V = 40 V and V_2 = 15 V. Determine the:

(i) reading on the ammeter;

(ii) value of R_2. (6 marks)

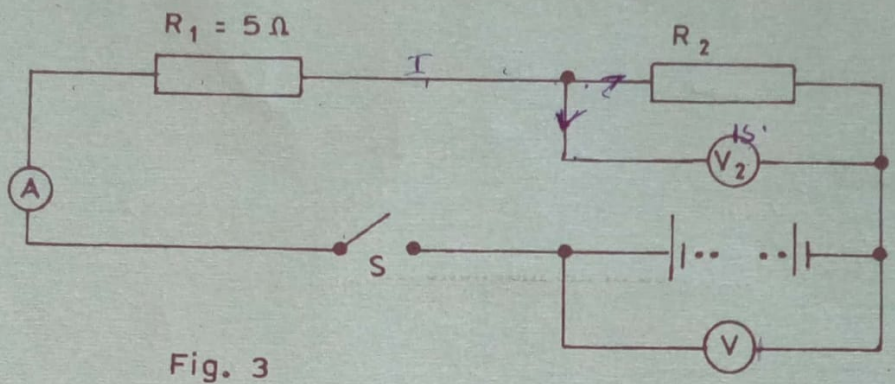

Fig. 3

SECTION C: ELECTRONICS

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

6. (a) Explain the term 'doping' as used in semi conductors. (2 marks)

(b) With aid of a diagram, describe the operation of a NPN bipolar junction transistor. (8 marks)

(c) Outline **three** tests that may be carried out on electronic components. (3 marks)

(d) With aid of circuit diagram and voltage waveforms, explain the operation of a half wave rectifier circuit. (7 marks)

7. (a) (i) State **four** types of negative feedback used in electronic amplifiers.

(ii) An amplifier has internal gain of 200. Determine the new gain if a negative feedback with feedback factor of 0.2 is introduced. (8 marks)

(b) (i) Determine the decimal number represented by $(0.10111)_2$.

(ii) Obtain decimal equivalent of hexadecimal number $(3A.3F)_{16}$.

(iii) Add binary numbers 1111 and 1100. (8 marks)

(c) Simplify the following boolean expression:
$(AB+C)(AB)$. $= AB + ABC \quad AB(1+C) = ABC$ (4 marks)

8. (a) (i) State **two** types of logic families.

(ii) Figure 4 shows a three input OR gate. Draw its truth table. (10 marks)

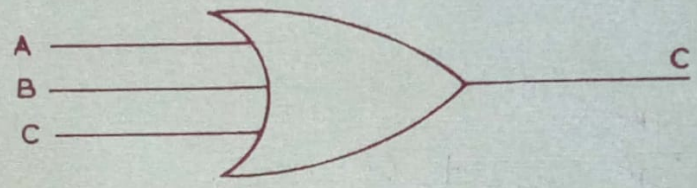

Fig. 4

(b) Draw the:

(i) diagram of a T-type flip-flop;

(ii) truth table of the flip-flop in b (i). (5 marks)

(c) (i) Sketch the ideal response curve of a low pass filter.

(ii) Draw an R-C high pass filter network. (5 marks)

THIS IS THE LAST PRINTED PAGE.