EXTRA

Name: _____ Index No: _____/____

1601/102
1602/102
APPLIED SCIENCE, ELECTRICAL PRINCIPLES I AND ELECTRONICS
June/July 2015
Time: 3 hours

Candidate's Signature: _____

Date: _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

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

APPLIED SCIENCE, ELECTRICAL PRINCIPLES I AND ELECTRONICS

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of examination in the spaces provided above.
You should have a Scientific calculator and drawing instruments for this examination.
*This paper consists of **EIGHT** questions in **THREE** sections; **A**, **B** and **C**.*
*Answer **ONE** question from section **A**, **TWO** questions from sections **B** and **TWO** questions from section **C** in the spaces provided in this question paper.*
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
*Do **NOT** remove any pages from this booklet.*
Candidates should answer the questions in English.
Take $\varepsilon_0 = 8.85 \times 10^{-12} F/m$, $\mu_0 = 4\pi \times 10^{-7} H/m$ *and* $g = 9.81\, m/s^2$

For Examiner's Use Only

Section	Question	Maximum Score	Candidate's Score
A		20	
B		20	
		20	
C		20	
		20	
		TOTAL SCORE	

This paper consists of 20 printed pages.

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

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Turn over

SECTION A: APPLIED SCIENCE

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

1. (a) State the **two** laws of refraction of light. (4 marks)

(b) An object of height 10 cm is placed at a distance of 15 cm in front of a concave mirror whose radius of curvature is 40 cm. Determine:-

(i) the distance of the image from the mirror;

(ii) whether the image formed is real or virtual;

(iii) the magnification.

(7 marks)

(c) Explain why metals have higher melting points than nonmetals. (3 marks)

(d) (i) State Boyle's Law for a gas.

(ii) An electric light bulb with a volume of 200 cm^3 contains argon gas at a pressure of 300 mm of mercury, when the gas temperature is 25 °C. When the bulb is switched on, it is found that the pressure of the gas in the bulb reaches a steady value of 520 mm of mercury.

Determine the temperature of the argon gas in the bulb, in °C.

(6 marks)

2. (a) List any **two** instruments used for pressure measurement. (2 marks)

(b) A metal cuboid measures 20 cm x 15 cm x 10 cm. The relative density is 8.5. If the metal block rests on a flat surface with its 10 cm side on the vertical, determine the pressure exerted on the support. (7 marks)

(c) An industrial product has a melting point of 46 °C and a boiling point of 85 °C. If the specific heat capacity of the product is 3.18 kJ/kg °C, determine the quantity of heat required to raise the temperature of 0.2 tonne of the product, from −2 °C to 30 °C.

(3 marks)

(d) (i) Define the term "mechanical advantage".

(ii) A machine whose velocity ratio is 4.5 has an efficiency of 68% at a load of 100 N and 70% at a load of 200 N. Determine the law of the machine.

(8 marks)

SECTION B: ELECTRICAL PRINCIPLES I

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

3. (a) (i) With the aid of a labelled diagram, explain the operation of a variable air capacitor.

(ii) With the aid of a circuit diagram show that the total capacitance C of three capacitors connected in series given by:

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

(8 marks)

(b) Capacitances of $4\ \mu F$, $6\ \mu F$ and $12\ \mu F$ are connected in series across a 360 V d.c. supply. Determine the:-

(i) total circuit capacitance;
(ii) charge on each capacitor;
(iii) energy stored in the $6\ \mu F$ capacitor.

(7 marks)

(c) State **two** factors that affect the resistance of an electrical wire. (2 marks)

(d) A copper wire has a resistance of 250 ohms at 25 °C. When a current is passed through the wire, the temperature rises to 95 °C. If the temperature coefficient of the resistance is 0.004/°C at 0°C, determine the resistance of the wire at 95 °C.

(3 marks)

4. (a) State Lenz's Law. (2 marks)

(b) With reference to magnetic circuits, define the following terms:

(i) magnetomotive force;
(ii) magnetic flux density;
(iii) reluctance.

(6 marks)

(c) (i) State the purpose of performing open circuit test on a single phase transformer.

(ii) With the aid of a circuit diagram, explain how to perform the open-circuit test on a single phase transformer.

(9 marks)

(d) A 40 kVA transformer has 400 turns on the primary and 100 turns on the secondary. The primary is connected to 2000 V, 50 Hz supply. Determine the secondary voltage on open circuit.

(3 marks)

5. (a) State the **two** Kirchoff's laws. (4 marks)

(b) List **three** differences between primary cells and secondary cells. (3 marks)

(c) Twelve dry cells, each of e.m.f. 1.5 volts and internal resistance of $0.5\,\Omega$, are connected in series - parallel as shown in figure 1. The terminals are connected to a circuit of resistance 12 Ohms. Determine the:

(i) current flowing through the $12\,\Omega$ resistance;

(ii) current flowing in each cell;

(iii) terminal voltage of the voltage source (battery).

(6 marks)

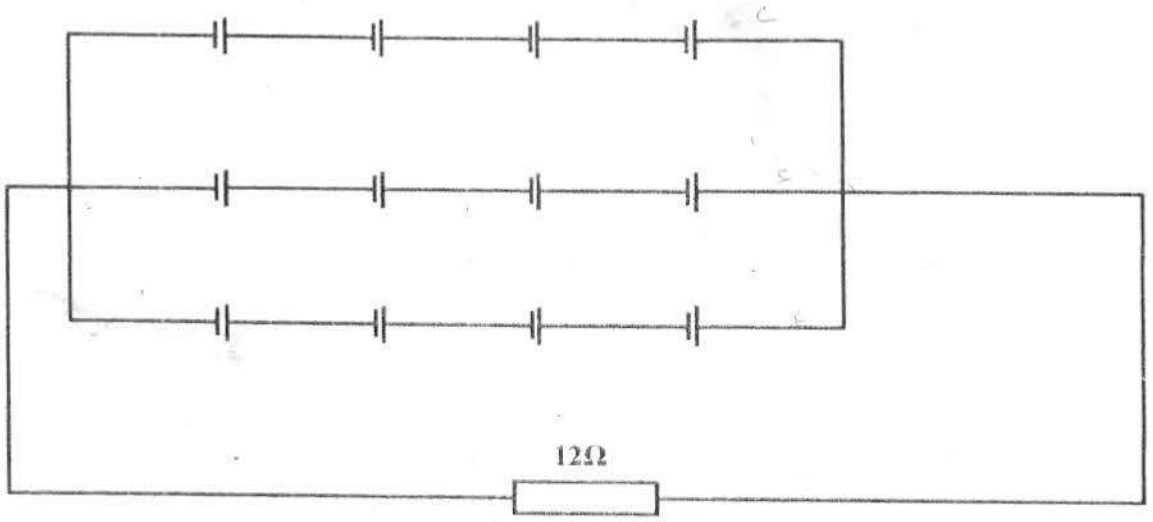

Fig. 1

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(d) For the circuit in figure 2, use Kirchoff's laws to determine the current flowing in the 10 Ω resistor. (7 marks)

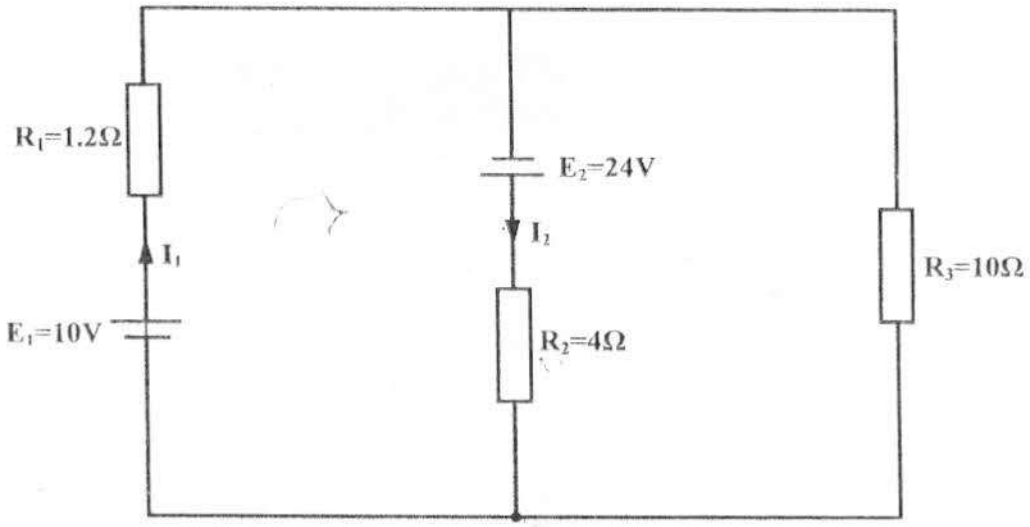

Fig. 2

SECTION C: ELECTRONICS

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

6. (a) (i) Determine the decimal equivalent of 1101101.111_2.

(ii) Convert 1427_{10} into BCD code.

(7 marks)

(b) Draw the symbols and write the truth tables for the following "TWO-input" logic gates:-

(i) NAND;
(ii) XOR;
(iii) XNOR;

(6 marks)

(c) (i) State Demorgan's theorems.

(ii) For the logic circuit shown in figure 3:

I. determine the boolean expression for the circuit;

II. simplify the boolean expression using boolean laws and Demorgan's theorems;

III. redraw the logic circuit using the simplified boolean expression.

(7 marks)

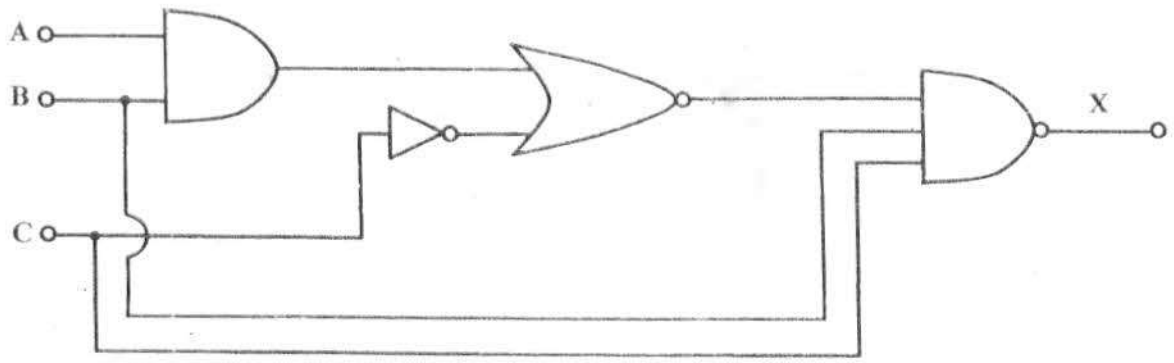

Fig. 3

7. (a) (i) Name **two** common semi-conductor materials.

(ii) With reference to semiconductors, explain the term "Doping".

(4 marks)

(b) Explain, with the aid of a diagram, the operation of an NPN transistor.

(6 marks)

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(c) Figure 4 shows a transistor amplifier circuit. Determine the following:-

(i) base current;

(ii) collector current;

(iii) collector to emitter voltage.

(6 marks)

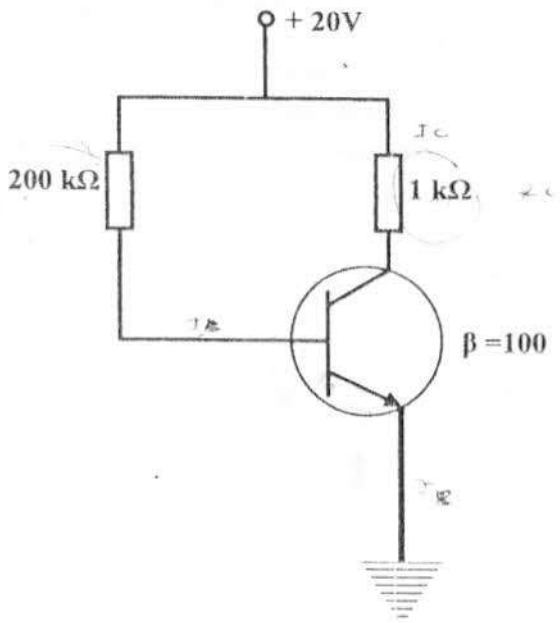

Fig. 4

(d) (i) With the aid of circuit symbol, explain the operation of a photo conductive cell.

(ii) State **one** application of LCD.

(4 marks)

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8. (a) With the aid of a circuit and waveform diagrams describe the operation of a single phase half-wave rectifier feeding a resistive load.

(8 marks)

(b) (i) State the main function of a filter circuit in power supplies.

(ii) A 24 V, 600 mW Zener diode is to be used for providing a 24 V stabilized supply to a variable load as shown in figure 5. If the input voltage is 32 V, determine the series resistance R required.

(5 marks)

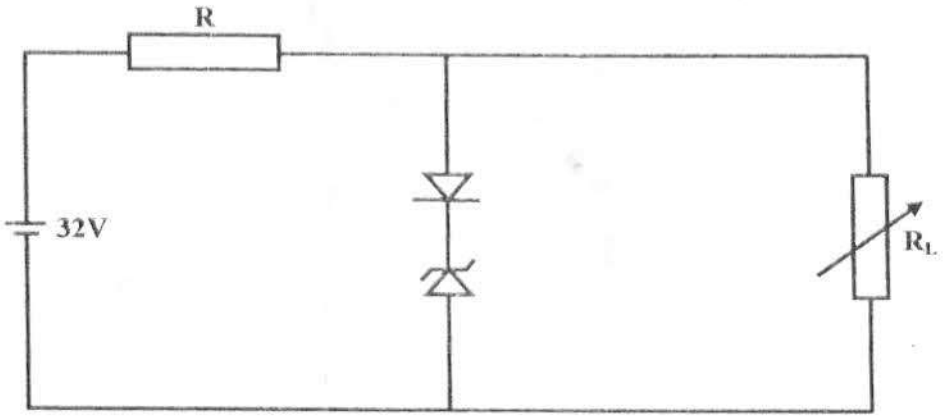

Fig. 5

(c) (i) State **three** advantages of negative feedback in amplifiers.

(ii) With the aid of a diagram, explain the operation of a tuned collector oscillator.

(7 marks)

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