

1601/102
1602/102
APPLIED SCIENCE, ELECTRICAL
PRINCIPLES I AND ELECTRONICS
June/July 2020
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

*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 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.

SECTION A: APPLIED SCIENCE

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

1. (a) State
- (i) **one** application of polarized light in electronics. *x-rays for photography*
 - (ii) **two** methods of reducing effect of noise to a person in a noisy workshop. *(3 marks)*
- (b) An industrial electric boiler rated at 4 kW contains 612 kg of water at 80°C. To adjust boiler level to safe value, 78 kg of water at 26°C was added. Determine the:
- (i) new temperature of water in the boiler;
 - (ii) time required to restore water temperature to 80°C. *T = MΔθ* *(7 marks)*
- (c) (i) Define each of the following as used in simple machine.
- I. mechanical advantage;
 - II. velocity ratio;
 - III. efficiency.
- (ii) An inclined plane has a velocity ratio of 2 and efficiency of 95%. It is used to raise a load of 400 N. Determine the:
- I. mechanical advantage;
 - II. effort required. *(7 marks)*
- (d) State Fleming's right hand rule for electric generators. *(3 marks)*
2. (a) (i) State Boyle's Law.
- (ii) A fluorescent lamp tube is filled with a gas containing a mixture of mercury vapour and an inert gas. The gas pressure is 304 Pa at 23°C. Determine the gas pressure at 95°C. *(5 marks)*
- (b) A technician at a battery manufacturing plant has a liquid bottle labelled "inorganic acid". Outline **four** chemical methods used to verify the properties of the liquid. *(4 marks)*
- (c) A wooden packaging box of dimension 30 cm by 50 cm by 85 cm has a mass of 70 kg. Determine the:
- (i) maximum pressure;
 - (ii) minimum pressure it can exert on a horizontal surface. *(5 marks)*
- (d) Draw a labelled diagram of electromagnetic spectrum. *(6 marks)*

SECTION B: ELECTRICAL PRINCIPLES I

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

3. (a) Define the following terms as used in magnetism.
- (i) reluctance;
 - (ii) hysteresis.
- (5 marks)
- (b) An air cored toroidal coil has 3000 turns and carries current 0.1 A. the length of the magnetic circuit is 30 cm and the cross-sectional area of the coil is 4 cm^2 . Determine the:
- (i) magnetic field strength;
 - (ii) magnetic flux density.
- (6 marks)
- (c) Figure 1 shows B-H curves for various ferromagnetic materials. Determine the total flux produced by a magnetising force of 400 AT for a core of soft steel casting of cross-sectional area 6 cm^2 .
- (4 marks)



Fig. 1

- (d) Fig. 2 shows an electric circuit. Derive an expression for total resistance in the circuit. (5 marks)

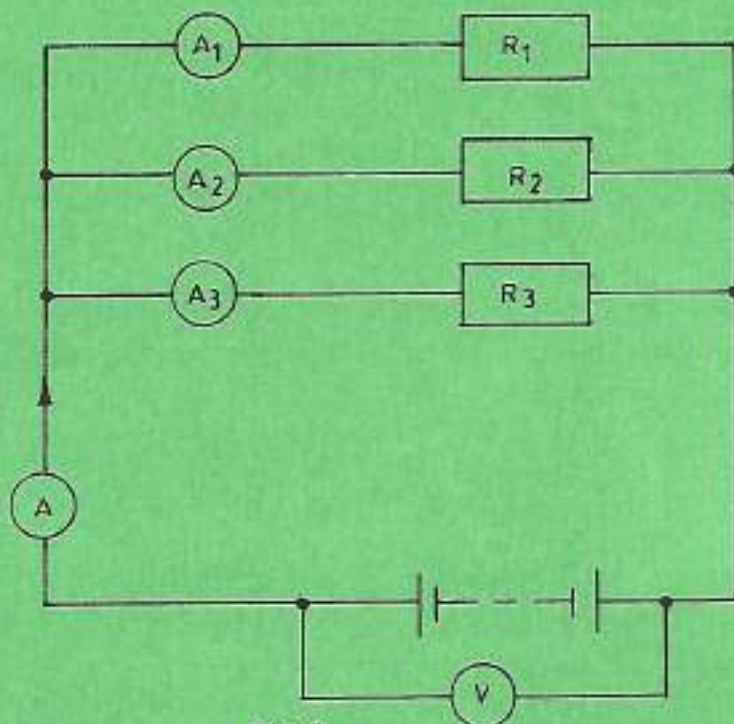


Fig.2

- (a) Table 1 shows basic quantities and their units of measurements. Complete the table. (4 marks)

Table 1

Quantity	Unit
Length	Meters
Heat	Kelvin
Light Intensity	Candela
	Amphere

- (b) (i) State two practical applications of heating effect of electric current.
 (ii) An electrical appliance is rated 2 kW and it is operated for 30 minutes. Determine the amount of heat produced. (5 marks)

$$\begin{aligned} \text{Energy} &= \text{Power} \times \text{Time} \\ 2000 \times 30 & \\ &= 60000 \text{ J} \end{aligned}$$

$$\begin{aligned} \text{Heat} &= Pt \\ \text{time} &= (60 \times 30) \text{ s} \\ &= 1800 \text{ s} \end{aligned}$$

$$\text{Power} = 2 \times 1000$$

$$\text{Heat} = (6000 \times 1800) \text{ J}$$

1601/102

1602/102

June/July 2020

- (c) (i) State **two**:
- (I) disadvantages of series connection of electric loads.
- (II) advantages of parallel connection of electric loads.
- (ii) Figure 3 shows an electric circuit. Using ohm's law, determine the voltage across the 2.5Ω resistor. (8 marks)

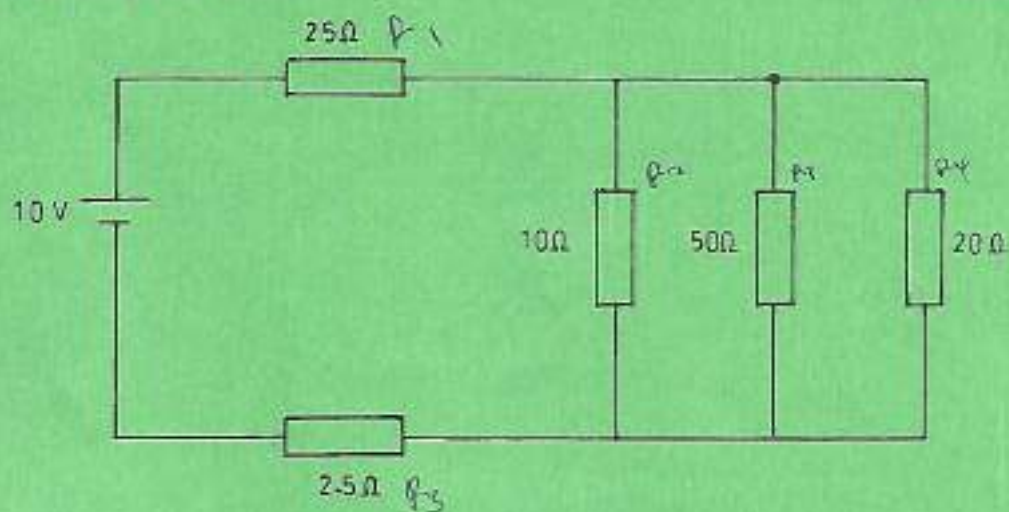


Fig. 3

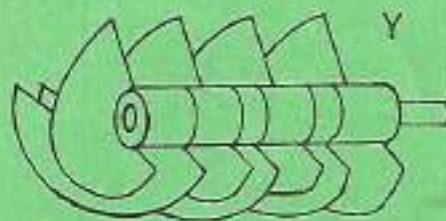
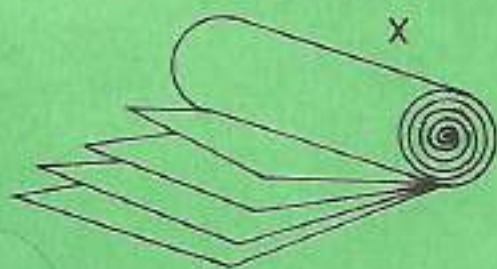
- (d) State **three** factors that determine the resistance of material. (3 marks)

5. (a) List **two**:

- (i) properties of primary cells: *Have higher capacity and initial voltage than secondary cell. They are not rechargeable. Do not require special disposal.*
- (ii) examples of secondary cells: *Lead acid accumulator, Lithium ion batteries.* (4 marks)

- (b) Draw a labelled construction diagram of a Leclanche cell. (5 marks)

- (c) (i) Name each of the following types of capacitors labelled *x* and *y*.



- (ii) A capacitor C_1 is charged to 100 V and the charge stored is $40 \times 10^{-6} \text{C}$. Another capacitor C_2 having a plate area four times that of the first one is connected across it. Determine the:

- (I) Voltage across the two capacitors.
- (II) Charge across each capacitor. (11 marks)

SECTION C: ELECTRONICS

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

6. (a) (i) Define harmonic distortion with reference to audio amplifiers.
(ii) State **two** causes of harmonic distortion in transistor amplifiers. (4 marks)
- (b) Sketch gain-frequency graph of a negative feedback amplifier. (4 marks)
- (c) Perform each of the following binary arithmetic:
(i) 1011×1101 ;
(ii) $11000 - 111$ (6 marks)
- (d) (i) State De Morgan's theorems.
(ii) Simply the Boolean expression:
$$Y = (A+B)(A+C)$$
 (6 marks)
7. (a) (i) Explain the term filter network.
(ii) Outline **three** areas of applications of filter networks. (5 marks)
power supply, Audio, Radio Communication
- (b) (i) Differentiate between N-type and P-type semiconductors.
(ii) Outline the procedure of testing P-N junction diode for defects. (8 marks)
- (c) (i) With the aid of a labelled circuit diagram, explain the operation of single phase bridge rectifier supplying a purely resistive load.
(ii) Draw the output waveform for the circuit in (c)(i). (7 marks)
8. (a) State **four** types of flip-flops. (4 marks)
SR, D, JK, T
- (b) (i) Draw a labelled symbol of silicon controlled rectifier (SCR).
(ii) Describe the operation of SCR. (6 marks)
- (c) With the aid of a labelled diagram, describe the operation of photo-electric transducers. (5 marks)
- (d) Draw the logic circuit for the Boolean expression:
$$Y = \overline{(A+B)CD}$$
 (5 marks)

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