

1601/102

1602/102

APPLIED SCIENCE, ELECTRICAL
PRINCIPLES I AND ELECTRONICS

Oct. /Nov. 2021

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 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 **ONE** question from this section.

1. (a) (i) List **two** examples of carbon compounds.
- (ii) Identify the products of combustion of carbon compounds in the presence of excess oxygen. (4 marks)
- (b) Sketch a labelled ray diagram of light reflected on a plane mirror, indicating the ray angles. (5 marks)
- (c) Define each of the following:
- (i) latent heat of vaporization;
- (ii) density. (4 marks)
- (d) A 5000 cm^3 of water at 18°C is turned into vapour by heating. Determine the:
- (i) mass of water; *dr*
- (ii) amount of heat used.
- Take: Specific latent heat of vaporization of water = $2,260 \text{ kJ/kg}$;
Specific heat capacity of water = 4200 J/kgK ;
Density of water = 1 g/cm^3 *dr*
- ex* (7 marks)
2. (a) (i) State the law of electric charges.
- (ii) Identify the type of charge acquired by each of the following when rubbed with fur:
- (I) glass rod;
- (II) ebony. (4 marks)
- (b) Differentiate between absolute pressure and atmospheric pressure. (4 marks)
- (c) (i) Draw a labelled diagram of a block and tackle pulley system whose velocity ratio is 5. (5 marks)
- (ii) State **two** factors that contribute to loss of efficiency for the pulley system in c(i).

- (d) (i) List **three** renewable sources of energy. — coal
- (ii) A force of 250 N is applied to an object causing it to move for 6 m at a uniform velocity of 32 m/s. Determine the:
- (I) work done;
- (II) power developed.

(7 marks)

SECTION B: ELECTRICAL PRINCIPLES I

Answer **TWO** questions from this section.

3. (a) (i) State Ohm's law. $I = \frac{V}{R}$
- (ii) Sketch a labelled graph of potential difference (V) against current (I) for an electrical material that obey Ohm's law.

(5 marks)

- (b) **Figure 1** shows an electric circuit.

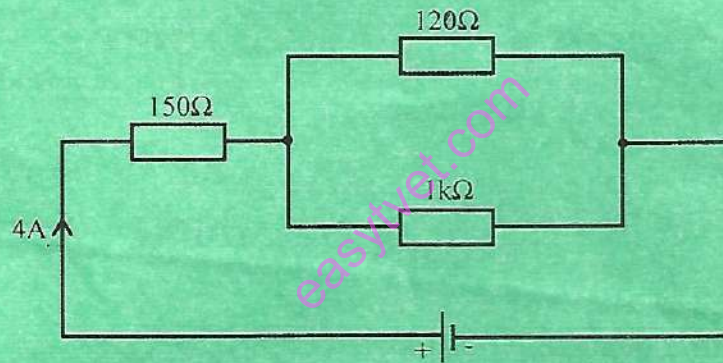


Fig. 1

Determine the:

- (i) power consumed by 150 Ω resistor.
- (ii) energy dissipated by the 150Ω resistor in 15 minutes;
- (iii) total resistance of the circuit.

(7 marks)

- (c) Describe each of the following types of capacitors citing one area of application:

- (i) ceramic capacitor;
- (ii) variable capacitor.

(6 marks)

(d) List **two** tests done to determine the type of fault in a capacitor. (2 marks)

4. (a) (i) State **three** merits of alkaline cells.

(ii) Draw a labelled diagram showing constructional parts of a dry leclanche cell. (8 marks)

(b) **Figure 2** shows an electric circuit. Each cell has an e.m.f of 1.5 V and internal resistance of 0.3Ω .

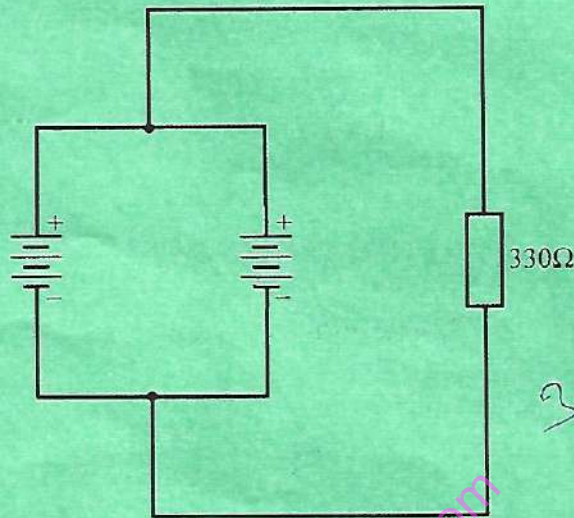


Fig. 2

Determine the:

- (i) total internal resistance of the cells;
(ii) current through the 330Ω resistor.

(6 marks)

(c) A coil has inductance of 18 H. A current changing at 13.5 A/s flows through the coil. Determine the:

- (i) e.m.f induced in the coil;
(ii) maximum energy stored in the coil.

(6 marks)

5. (a) (i) State **three** power losses in a transformer on load.

(ii) A transformer has full-load losses of 2.1 kW and output power of 155 kW. Determine the:

- (I) input power;
(II) transformer efficiency.

(8 marks)

(b) (i) Sketch a hysteresis loop for a magnetic material.

(ii) Indicate the following on the loop in (b)(i):

- (I) remnant flux;
- (II) coercive force;
- (III) saturation flux density.

Handwritten note: $\frac{d\phi}{dt}$ electrons cut flux can same being date.

(6 marks)

(c) A 3A electric motor has a rotor winding of length 400 mm. The windings make right-angle to a magnetic field of flux density 1.6 T. Determine the force exerted on the rotor.

(2 marks)

(d) Differentiate between self-inductance and mutual inductance with reference to electromagnetism.

(4 marks)

SECTION C: ELECTRONICS

Answer **TWO** questions from this section.

6. (a) (i) Define 'covalent bond'.

(ii) Differentiate between electron and hole with reference to intrinsic semiconductor conduction.

(6 marks)

(b) **Figure 3** shows a Bipolar Junction Transistor (BJT) circuit.

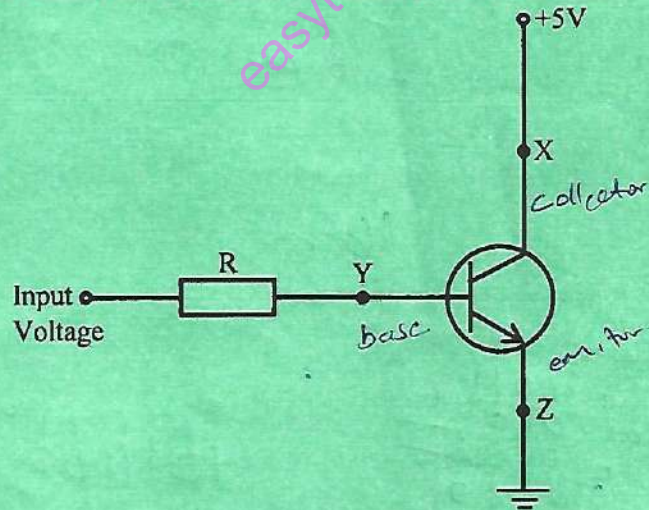


Fig. 3

(i) Identify the terminals of the transistor labelled X, Y and Z.

Handwritten note: C.E. type

(ii) Describe the operation of the circuit.

(6 marks)

- (c) (i) Draw and label symbol of operational amplifier.
 (ii) State **two** areas of application of operational amplifier.

(4 marks)

(d) Write the equivalent Boolean identity for each of the following:

- (i) $\overline{AB} = \overline{A}(\overline{B})$
 (ii) $\overline{A+B} = \overline{A}\overline{B}$
 (iii) $A+1 = 1$
 (iv) $A+\overline{AB} = A+\overline{B}$

(4 marks)

7. (a) State **three** areas of application of logic gates.

(3 marks)

(b) State the effect of negative feedback on each of the following:

- (i) noise and distortion; — distortion & noise.
 (ii) bandwidth; — width band.
 (iii) stability. — ability.

(3 marks)

(c) Describe the function of each of the following electronic components in a d.c power supply unit:

- (i) electrolytic capacitor; — It capacitates electrolyte
 (ii) zener diode; — It diodes the zener.
 (iii) power diode. — diodes the power.

(6 marks)

(d) Perform each of the following number translations:

- (i) $5A_{16}$ to decimal; $16A_{16}$
 (ii) 10111001_2 to hexadecimal. $2_{10111001}$

(8 marks)

0	0000	0011
1	0001	0100
2	0010	0101
3	0011	0110
4	0100	0111
5	0101	1000
6	0110	1001
7	0111	1010
8	1000	1011
9	1001	1100
A	1010	1101
B	1011	1110
C		

$7 \quad 6 \quad 5 \quad 4 \quad 3 \quad 2 \quad 1 \quad 0$
 $1 \quad 0 \quad 1 \quad 1 \quad 1 \quad 0 \quad 0 \quad 1$
 $2^7 + 2^5 + 2^4 + 2^3 + 2^0$
 $128 + 32 + 16 + 8 + 1$
 185
 185_{10}

8. (a) (i) Explain 'flip flop' with respect to digital electronics.

(ii) **Figure 4** shows NAND gate SR flip flop circuit while table 1 shows its truth table for the set-Reset operation. Complete the table.

(8 marks)

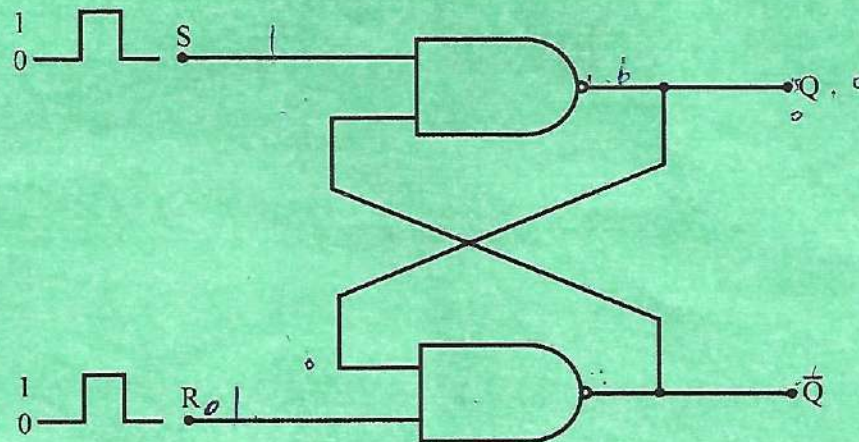


Fig. 4

Table 1

State	S	R	Q	\bar{Q}	Description
Set	1	0	0	1	<i>0 -</i>
	1	1	1	1	No change of state
Reset	0	1	1	0	
	1	1	-	-	
Invalid	0	0	-	-	Invalid condition

(b) With the aid of response curve, describe low pass filter.

(6 marks)

(c) Explain the principle of operation of each of the following types of transducers:

- (i) inductive transducers;
- (ii) acoustic transducers.

(6 marks)

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