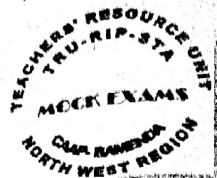


REPUBLIQUE DU CAMEROUN  
Paix-Travail-Patrie  
MINISTRE DES ENSEIGNEMENTS SECONDAIRES



REPUBLIC OF CAMEROON  
Peace-Work-Fatherland  
MINISTRY OF SECONDARY EDUCATION

CELLULE D'APPUI A L'ACTION PEDAGOGIQUE  
ANTENNE REGIONALE DU NORD OUEST

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**A**

MARCH 2023

The Teachers' Resource Unit and the Regional Inspectorate of Pedagogy in collaboration with NWAPT	SUBJECT CODE NUMBER 0780	PAPER NUMBER 2
	SUBJECT TITLE PHYSICS	
GENERAL CERTIFICATE OF EDUCATION REGIONAL MOCK EXAMINATION		
ADVANCED LEVEL		

Time Allowed: **THREE** hours  
**INSTRUCTIONS TO CANDIDATES**

Mobile phones are **NOT ALLOWED** in the examination room.

Answer **ALL** questions

Section I is designed to be answered in 1 hour 15 minutes, Section II in 45 minutes and Section III in 1 hour.

You are advised to divide your time accordingly.

You are reminded of the necessity for good English and orderly presentation in your answers.

In calculations you must show all the steps in your working, giving your answer at each stage.

Calculators and formulae booklet are allowed.

**SECTION I (One hour)**

**Answer all Questions**

1. (a) State two ways in which units are important in measurements.  
 (b) The charge stored in a capacitor,  $Q$ , at time,  $t$ , from the start of the charging process is given by

$$Q = \alpha \left( 1 - e^{-\frac{t}{\beta R}} \right)$$

where  $R$  is the resistance of a resistor in series with the capacitor and  $\alpha$  and  $\beta$  are constants.

(6 marks)

2. (a) State Newton's third law of motion.  
 (b) A helicopter hovers in still air well away from the ground. The mass of the helicopter is 5000 kg and the diameter of the rotor blades is 8 m. Calculate the speed of the air projected downwards by the blades given that the density of air is  $1.3 \text{ kg m}^{-3}$ .

(5 marks)

3. (a) What is the difference between boiling and evaporation?  
 (b) A wet piece of cloth is hung on a line at  $0^\circ\text{C}$  in a wind current. Some of the water in the cloth freezes while the rest evaporates. Estimate the fraction of water initially in the cloth that freezes.

(6 marks)

4. (a) State two ways in which a capacitor is similar to a semiconductor diode.  
 (b) A fine layer of silver is deposited on each side of a sheet of mica  $2.4 \text{ cm}^2$  in area to form a capacitor of capacitance  $1.2 \times 10^{-4} \mu\text{F}$ . If the dielectric constant of mica is 6.0,  
 (i) Calculate the thickness of the sheet of mica.  
 (ii) The insulation of the mica breaks down when subjected to an electric field strength of  $4.5 \times 10^5 \text{ V cm}^{-1}$  and it is desirable in practice never to exceed half of this strength. Calculate the maximum allowed working voltage of the capacitor.

(8 marks)

4. (a) The isotope Sodium-24 is radioactive. A sample of a solution containing Sodium-24 is to be used to estimate the volume of blood in a patient. The half-life of the isotope is 15 hours. The initial activity of the isotope is 200 Bq when it was injected into the blood stream of the patient. After 30 hours,  $1.0 \text{ cm}^3$  of the patient's blood had an activity of  $8.3 \times 10^{-3} \text{ Bq}$ . Estimate the volume of blood in the patient.  
 (b) State the observations from Rutherford's alpha-particle scattering experiment and the corresponding conclusions that were drawn about the atom from each of them in a tabular form.

(7 marks)

**Answer EITHER 5 (a), (b) and (c) OR 6 (d), (e) and (f).** (4 marks)

5. (a) (i) State the assumptions of the kinetic theory for an ideal gas.  
 (ii) Use the assumptions to derive an expression for the pressure,  $P$ , exerted by an ideal gas of density,  $\rho$ , on the walls of its container if the mean square speed of the molecules is  $\overline{c^2}$ . (4 marks)  
 (b) Eight gas molecules have the following speeds in  $\text{ms}^{-1}$ : 20, 20, 40, 50, 60, 70, 80, 90. Calculate the mean square and the root mean square speeds of the molecules. (3 marks)  
 (c) (i) State Kirchhoff's circuit laws, (4 marks)  
 (ii)

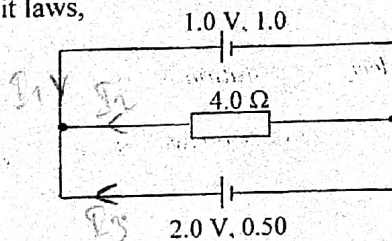


Figure 1

Calculate the potential difference across the  $4.0 \Omega$  resistor in figure 1. Why is the potential difference across the terminals of the 1.0 V cell higher than its electromotive force? (5 marks)

**OR 6 (d), (e) and (f).**

6. (d) (i) State the experimental results of the photoelectric effect. (4 marks)  
 (ii) Use Einstein's photoelectric equation to explain each of the observations (4 marks)  
 (e) A composite bar is made of materials X and Y, 25.0 cm and 75.0 cm long respectively of the same cross-sectional area. The ends X and Y are placed in contact with water at  $100^\circ\text{C}$  and pure melting ice at standard atmospheric pressure respectively. Calculate the ratio of the thermal conductivity of Y to that of X if the junction temperature is  $60^\circ\text{C}$ . (4 marks)  
 (f) (i) State Coulomb's law of electrostatics and Faraday's law of electromagnetic induction. (4 marks)

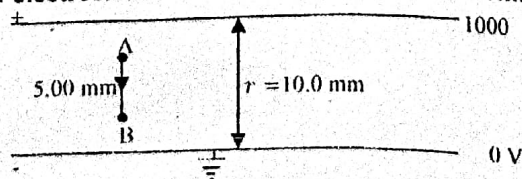


Figure 2



An oil drop moves between the plates shown in figure 2 from point A to B at right-angles to the plates.

(ii) Define the electric potential  $V$  at a point in an electric field. (2 marks)

(iii) The oil drop carries 10 electron charges. How much energy is transferred as it moves from A to B? (2 marks)

**SECTION II (30 minutes)**  
**DATA ANALYSIS**

7. The relativistic mass of a body,  $m$ , is related to its rest mass by the equation

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where  $v$  is the speed of the body and  $c$  is the speed of light in vacuum. Table 1 below shows corresponding values of  $m$  and  $v$  in one experiment where electrons were accelerated to high speeds.

$v/10^8 \text{ m s}^{-1}$	0.29	0.44	0.54	0.72	1.02	1.14	1.32	1.41
$m/10^{-31} \text{ kg}$	4.5	4.7	4.8	5.1	6.1	6.9	9.3	12.9

(a) Plot a suitable graph from which the values of  $c$  and  $m_0$  could be obtained. (12 marks)

(b) Use the graph in (a) to determine the values of  $c$  and  $m_0$ . (6 marks)

(c) Comment on the values of  $c$  and  $m_0$  obtained. (2 marks)

**SECTION III (1 hour)**  
**OPTIONS**

Answer any two questions from the four options

**OPTION 1: ENERGY RESOURCES AND ENVIRONMENTAL PHYSICS**

8. (a) Differentiate between:

(i) Energy resources and energy reserves. (2 marks)

(ii) Primary energy and functional energy (2 marks)

(iii) Energy farming and energy harvesting. (2 marks)

(b) An electric motor is run from the mains supply and is used to lift a 45 kg mass through 9 m vertically. The Motor is 60 % efficient and the electrical supply system is 90 % efficient. The electricity is generated by a gas powered station with an efficiency of 40 %, calculate:

(i) The overall efficiency of the system.

(ii) The energy input from the primary fuel required to lift the load. (5 marks)

(c) (i) What is climate change? (2 marks)

(ii) State two things that can be done to reduce the effects of climate change. (2 marks)

**OPTION 2: COMMUNICATION.**

9 (a) Define the following terms:

(i) Multiplexing.

(ii) Retrieval.

(4 marks)

(b) Figure 3 shows the frequency spectrum of the signal from a radio transmitter

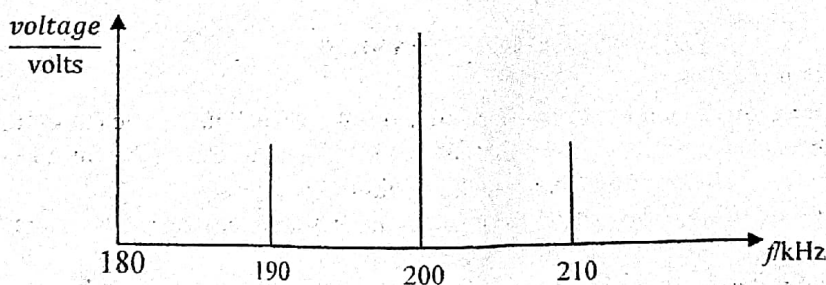


Figure 3

(i) What type of transmission is this?

(ii) State the frequencies of the carrier wave and the signal wave.

(iii) Calculate the bandwidth of the signal.

(5 marks)

An optical fibre line has to be installed between two cities distant  $3.00 \times 10^7 \text{ m}$  from each other. The noise power in the fibre is  $5.0 \times 10^{-19} \text{ W}$ . The refractive index of the core of the fibre is 1.48. The optical fibre has an attenuation of  $1.5 \text{ dB km}^{-1}$ .

(i) The signal-to-noise ratio must not fall below 25 dB. Calculate the smallest effective power that can be detected in the fibre. (3 marks)

- (ii) Calculate the maximum uninterrupted length of the fibre through which a signal can be transmitted for an input signal of power 5.0 mW. (2 marks)
- (iii) How many retransmitters are needed for the entire line? (1 mark)

**OPTION 3: ELECTRONICS**

(2 marks)

10. (a) (i) what are transistor characteristics?  
 (ii) The graphs in figure 4 show the output characteristics of an n-p-n transistor in the commonemitter mod

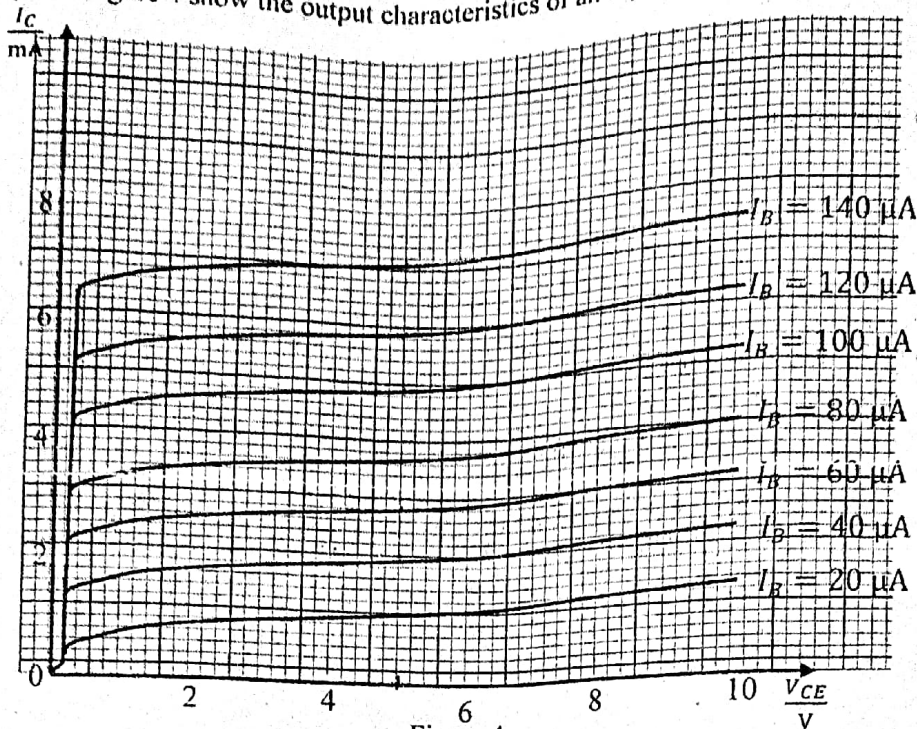


Figure 4

- (iii) Construct a table of values which would enable you to draw the transfer characteristics of the transistor at a constant VCE of 5 V. Use the transfer characteristics to obtain the forward current gain of the transistor. (7 marks)
- (b) (i) What is thermal runaway?  
 (ii) State one way of stabilizing a transistor against thermal runaway. (2 marks)
- (c) In a car, a red warning light comes on when the ignition is switched on if the door is not closed properly or the seat belt is not fastened, or both door and seat belt are not properly secured.  
 (i) Construct the truth table, showing the door and seat belt inputs to a logic gate system as high (1) if properly secured and low(0) otherwise, the ignition input as high (1) if ON and low (0) otherwise and for the red warning light, the output as high (1) if ON and low(0) otherwise.  
 (ii) Draw a suitable logic gate system for operating the red warning light. (4 marks)

**OPTION 4: MEDICAL PHYSICS**

- 11 (a) (i) What is meant by the term intensity?  
 (ii) The threshold of hearing is reached for sound with an intensity of  $10^{-12} \text{ W m}^{-2}$ . The ear of a particular person collects sound from an effective area of  $14 \text{ cm}^2$ . What is the power detected by the ear?  
 (iii) What happens if sound of a higher intensity than the threshold is detected? (5 marks)
- (b) Name three imaging techniques in medicine and for each technique state one part of the body that it is most suitable for. (4 marks)
- (c) (i) Draw a well-labelled diagram of the human eye.  
 (ii) What is astigmatism and how is it corrected? (6 marks)