P510/2
PHYSICS
PAPER 2
July/August 2023
2½hours

PROVINCIAL - NAMIREMBE DIOCESE
COUHEIA SECONDARY
MOCK EXAMINATIONS 2023

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UGANDA ADVANCED CERTIFICATE OF EDUCATION
PHYSICS
Paper 2
2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Answer **five** *questions, taking at least* **one** *from each of the sections* **A**, **B**, **C** *and* **D** *but* **not** *more than* **one** *question should be chosen from either section* **A** *or* **B**.

Any additional question(s) answered will **not** *be marked.*

Non-programmable scientific calculators may be used.

Mathematical tables and squared paper will be provided.

Assume where necessary;

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of sound in air	$= 330 ms^{-1}$
Speed of light in vacuum, c,	$= 3.0 \times 10^{8} ms^{-1}$
Electronic charge, e,	$= 1.6 \times 10^{-19} C$
Electron mass	$= 9.11 \times 10^{-31} kg$
Plank's constant, h,	$= 6.63 \times 10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi \times 10^{-7} Hm^{-1}$
Permittivity of free space, ε_0,	$= 8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9 \times 10^{9} F^{-1} m$
One electron volt, (eV)	$= 1.6 \times 10^{-19} J$
Avogadro's number, N_A	$= 6.02 \times 10^{23} mol^{-1}$
Specific heat capacity of water	$= 4200 Jkg^{-1} k^{-1}$

SECTION A

1(a) (i) state the laws of reflection of light [02marks]

(ii) With the aid of a diagram explain the term diffuse reflection [03 marks]

(b) When a plane mirror is turned through an angle α, the reflected ray turns through an Angle β. Derive the relationship between α and β [05 marks]

(c) Describe an experiment to determine the focal length of a convex mirror using a Converging lens [05 marks]

(d) (i) A point object is placed on the axis and 3.6 cm from a thin converging lens L of focal length 3.0 cm. A second thin converging lens M of focal length 16.0cm is placed coaxial with L and 26.0cm from it on the side remote from the object. Find the distance M must be moved from its initial position for the arrangement of the lens to form a compound microscope in normal adjustment of least distance 25.0cm. [03 marks]

(ii) Explain the twinkling effect of stars [02 marks]

2. (a) (i)Distinguish between ***principal focus*** and ***focal plane*** of a convex lens. [02 marks]

(ii)Derive an expression for the focal length, f of two thin lenses, a convex lens of focal length f_1 and a concave lens of focal length f_2 placed in contact with each other. [4marks]

(b) (i) Describe an experiment to determine the refractive index of a liquid using a convex lens. [05 marks]

(ii) A thin equi-convex glass lens has radius of curvature 24.0cm and refractive index 1.50. When a small quantity of a liquid is placed on the reflecting surface of a horizontal plane mirror and the lens placed on top of the liquid, a pin held 40.0 cm vertically above the lens coincides with its own image. Find the refractive index of the liquid. [04 marks]

(c) (i) Define the terms ***angular magnification*** and ***the near point*** of an a compound microscope [02 marks]

(ii) Figure 1 shows a prism of refracting angle 30^0 and refractive index 1.41 silvered on one face. At what angle must a ray of light fall on the un-silvered surface for it to retrace its path?

[03 marks]

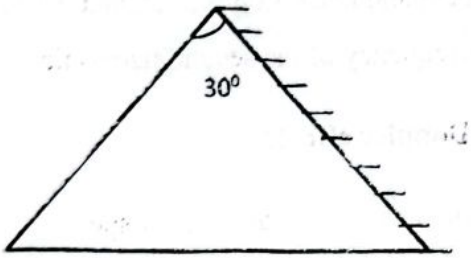


Fig.1

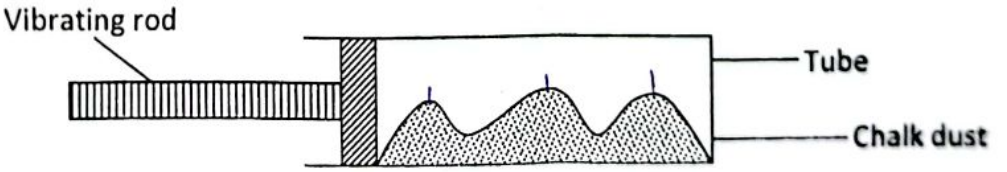
SECTION B

3.(a) What is meant by the following terms as applied to sound?

(i) Resonance. **[01 mark]**

(ii) Fundamental frequency. **[01 mark]**

(b) In an experiment to determine the speed of sound in air in a tube, chalk dust settled in heaps as shown in the diagram below:-



If the frequency of the vibrating rod is 220Hz and the distance between three consecutive heaps is 1.50m, calculate the speed of sound in air. **[03 marks]**

(c) (i) State the principle of superposition of waves. **[01 marks]**

(ii) Explain using the principle of superposition of waves, the formation of beats. **[03 marks]**

Explain what would be observed when;

(i) Switch K is closed. [02 marks]

(ii) A soft iron rod is inserted into coil X and then K is closed. [03 marks]

(c) (i)A uniform copper coil of radius r, is span at a uniform angular speed ω About an axis through its center in a uniform magnetic field of flux density B, normal to its plane. Derive an expression for the e.m.f. generated between its axis and the rim. [04 marks]

(ii) The coin in (i) has a radius of 1.0 cm and is span at 1200 revolutions per minute in the magnetic field of flux density 2.5×10^{-2} T. Find the magnitude of e.m.f. generated between the rim and the axis of rotation. [03 marks]

(d) Describe the structure and mode of operation of an a.c. generator. [05 marks]

7. (a) Define root mean square value of alternating voltage. [01 mark]

(b) An alternating current I = 2.0 sin 120πt is passed through a *pure inductor* of inductance 0.4 H.

(i) What is the meaning of the term *pure inductor*? [01 mark]

(ii) Find the reactance of the inductor. [03 marks]

(iii) Determine the root mean square voltage of the inductor [03 marks]

(c) With the aid of a labelled diagram describe how an attraction type of moving iron ammeter can be used to measure current. [05 marks]

(d) (i) A current $I = I_o \sin 2\pi ft$ is passed through a resistor of resistance R ohms. Derive an expression for the average power expended in the device. [03 marks]

(ii) The current in (i) is subjected to a series combination of a pure capacitor of capacitance C and a pure inductor of inductance L, and the circuit resonates at frequency f_o. Derive the expression for f_o. [02 marks]

(iii) Sketch using the same axes, graphs of reactance against frequency for both inductor and capacitor in (ii) above. [02 marks]

SECTION D

8(a)(i) State Coulomb's law of electrostatics. **[01 mark]**

(ii)Three charges of magnitudes +4.0μC, -2.0μC and P are placed along a horizontal line as shown.

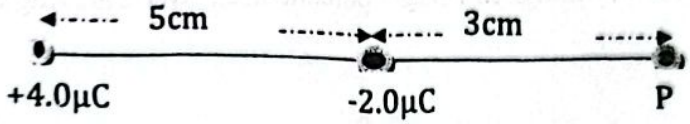


Fig. 5

Find the magnitude of charge P if the resultant force on the -2.0μC charge is zero.

[03 marks]

(iii)Explain the attraction of uncharged body by a charged body brought near it.

[03 marks]

(b)(i)What is meant by action at sharp points? **[02 marks]**

(ii)Describe an experiment to show the distribution of charge density around a charged conductor. **[04 marks]**

(c)(i)Distinguish between electric field intensity and electric potential. **[02 marks]**

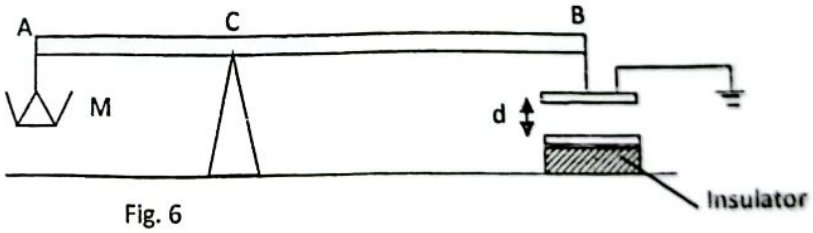


Fig. 6

(ii) Figure 6 above shows plates of parallel plate capacitor suspended at one end of a light uniform rod AB of length 50.0 cm at end B. AB is pivoted at C where AC = 20.0 cm and carrying a mass M = 2.65 x10^{-3} kg at t end A. The plates have an area of 120 cm^2 and a separation d = 4.0 mm. Calculate the p.d across the plates required to balance the rod horizontally. **[05 marks]**

9.(a) (i) Define the terms electromotive force and internal resistance of a cell [02 marks]

(ii) Explain why the terminal p.d is usually less than the e.m.f of a cell. [03 marks]

(b) (i) Briefly describe how a slide wire potentiometer works [05 marks]

(ii) Explain one advantage of using a potentiometer over a moving coil galvanometer [02 marks]

(c)

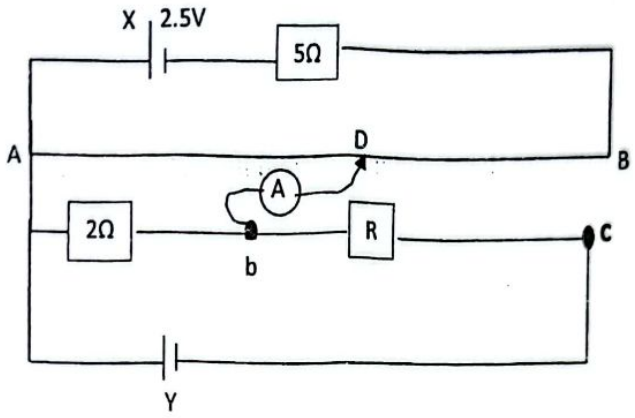


Fig 8

In the figure 8, AB is a uniform wire of length 1m and resistance 10Ω. X is a driver cell of e.m.f 2.5V and negligible internal resistance. When the galvanometer G is connected in turn to the point b and c, the balance lengths are 0.640m and 0.900m respectively. Calculate the

(i) Current flowing through the resistor R [03 marks]

(ii) E.m.f of cell Y given that the cell has negligible internal resistance [03 marks]

(d) (i) Define the term temperature coefficient of resistance [01 mark]

(ii) Give one example of a material with negative temperature coefficient [01 mark]

10 a) (i) Define the terms **dielectric constant** and **dielectric strength** of a capacitor. [02marks]

(ii) Briefly descibe how reducing area of overlap of capacitor plates affects capacitance of a capacitor. [03 marks]

b) Explain why the energy stored by the charged capacitor increases when a dielectric material is placed between its plates. **[04 marks]**

c) The figure 7 below shows a network of three identical capacitors C_1, C_2 and C_3 each of capacitance C connected to a battery of e.m.f, ε. A dieclectric material of dielectric constant ε_r is inserted between the plates of C_2.

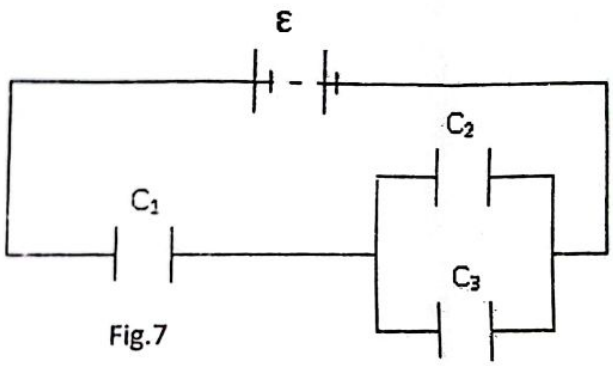


Fig.7

(i) Show that the energy E stored by a capacitor C_2 with a dielectric is given by

$$E = \frac{C\ \varepsilon_r\ \varepsilon^2}{2(\varepsilon_r+2)^2}$$ **[04 marks]**

(ii) Determine the total charge stored by the network if C= 2.0 μF, ε_r = 2.0 and ε = 12V. **[03 marks]**

d) Describe an experiment to determine the capacitance of capacitor using a ballistic galvanometer. **[04 marks]**

END