

P510/2

PHYSICS

JUNE/JULY 2024

2 ½ HOURS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

RESOURCE MOCK EXAMINATION

PHYSICS

PAPER TWO

2 HOURS 30 MINUTES

INSTRUCTIONS:

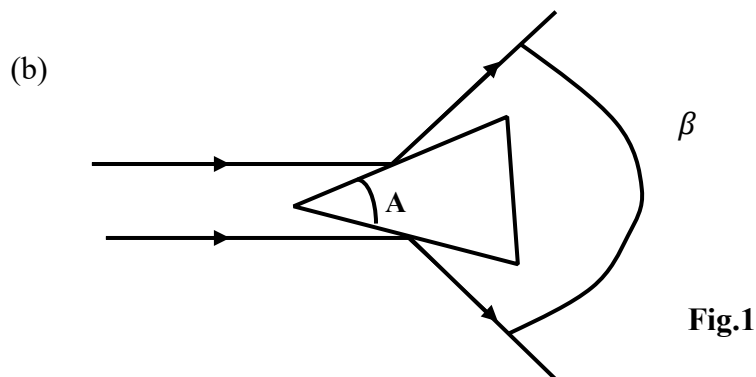
Attempt **five** questions, including at least **one** from each of the sections **A**, **B**, **C** and **D**, but not more than **one** question from either **Sections A** or **B**.

Assume where necessary:

Acceleration due to gravity, g	=	9.81 ms^{-2}
Speed of light in a vacuum, c	=	$3.0 \times 10^8 \text{ ms}^{-1}$
Electron charge, e	=	$1.6 \times 10^{-19} \text{ C}$
One electron volt, $e\text{V}$	=	$1.6 \times 10^{-19} \text{ J}$
Electron mass, m_e	=	$9.11 \times 10^{-31} \text{ kg}$
Permeability of free space, μ_0	=	$4\pi \times 10^{-7} \text{ Hm}^{-1}$
Permittivity of free space, ϵ_0	=	$8.85 \times 10^{-12} \text{ Fm}^{-1}$
The constant, $\frac{1}{4\pi\epsilon_0}$	=	$9.0 \times 10^9 \text{ F}^{-1} \text{ m}$

SECTION A

- 1(a) (i) Define refraction and refractive Index of a material (02 marks)
 (ii) Describe how you would measure the refractive index of a liquid using a plane mirror and a convex lens. (05 marks)



A parallel beam of light is incident onto a prism of refracting angle A as shown in Figure 1.

Show that $\beta = 2A$ (03 marks)

- (c) A glass prism of refractive index 1.52 and refracting angle 60° is completely immersed in a liquid of refractive index 1.4. If a ray of light passes symmetrically through the prism.

Calculate (i) angle of incidence (03 marks)

(ii) the angle of deviation (02 marks)

- (d) (i) With aid of a ray diagram, explain how a blurred image is formed in a concave mirror.

(03 marks)

(ii) Explain two ways of reducing the effect in d(i).

(02 marks)

- 2(a) (i) With aid of ray diagrams, distinguish between virtual and real images in plane mirror.

(03 marks)

(ii) Describe an experiment to investigate the relationship between object and image distance in a plane mirror. (04 marks)

- (b) Define angular magnification of an optical instrument. (01 mark)

- (c) A convex lens of focal length 60cm is arranged co-axially with a diverging lens of focal length 5cm, to view a distant star.

(i) If the final image is at infinity, draw a ray diagram to show the formation of the image of the star. (03marks)

(ii) Calculate the magnifying power obtained if the image of the star is formed at a distance of 25cm in front of the eye piece. (04 marks)

- (iii) List one advantage and one disadvantage of this type of arrangement over the astronomical telescope. (02 marks)
- (d) Explain why cameras on spy satellites have wide aperture lenses. (02 marks)

SECTION B

- 3 (a)(i). Define frequency and amplitude as applied to waves. (02marks)
- (ii). With aid of a graph, explain how pressure varies along a longitudinal wave. (04 marks)
- (b) Define Doppler effect. (01 mark)
- (c)(i) Explain how Doppler's effect as used to determine the direction of rotation of a star. (04 marks)
- (ii) A motor cyclist and a police car are approaching each other. The motor cyclist is moving at 15ms^{-1} and the police car at 22ms^{-1} . If the police siren is sounded at 490Hz , find the frequency of the note heard by the cyclist after police car passes by. Take speed of sound in air to be 330m/s . (04 marks)
- (d) Describe how you can determine the frequency of a tuning fork using an audio oscillator. (04 marks)
- (e) Give one use of Ultrasonic sounds. (01 mark)
- 4 (a) (i) State Huygens's principle (02 marks)
- (ii) Use Huygens's principle to derive the relation between critical angle and refractive indices of two media in contact. (04 marks)
- (b) (i) What meant by coherent sources of waves (03 marks)
- (ii) Distinguish between interference and diffraction of light. Give one example of each. (04 marks)
- (c) With the aid of suitable sketches, explain the following
 - (i). division of wave front. (02 marks)
 - (ii) division of amplitude (02 marks)
- d(i) Define polarized light (01 mark)
- (ii). Describe one method of producing plane polarized light (03 marks)

- e.) Two glass sides in contact at one end are separated by a metal foil 12.50cm from the line of contact to form an air-wedge when the air – wedge is illuminated normally by light of wave length $5.4 \times 10^{-7} \text{m}$ interference fringes of separation 1.5mm are found in reflection. Find the thickness of the metal foil. (04 marks)

SECTION C

- 5a(i). Distinguish between a generator and a motor (02 marks)
- (ii) With the aid of a labeled diagram describe the structure and mode of operation of a.d.c motor (05 marks)
- (iii) Sketch a graph of the output voltage against time for a.d.c motor (01 mark)
- (iv). Explain why on switching on a.d.c motor the initial current decreases to a steady value when the motor is run at a constant speed. (02 marks)
- (b) A flat circular coil with 500 turns each of radius 10cm is rotated at angular velocity 12rads^{-1} about its diameter at right angles to a uniform magnetic flux density of 0.16T. Calculate (i) maximum magnetic flux linking the coil (02 marks)
- (ii) Emf induced in the coil when the plane of the coil makes an angle of 60° with the normal to the coil. (02 marks)
- (ii) Root mean square value of emf induced in the coil (03 marks)
- (c) Explain why Non-inductive coils are used in a resistance box (03 marks)
- 6 (a) Define the following terms applied to a.c circuits
- (i). Reactance (01 mark)
- (ii) resonance (01 mark)
- (b) (i) Derive the relationship between peak value and root – mean square value of a sinusoidal current . (04 marks)
- (ii) Find the r.m.s value of current in a heating coil immersed in a liquid in a colorimeter if the initial rate of rise in temperature is two times the rate at which d.c of 5A would if passed through the same coil under the same condition. (03 marks).

- (c) A source of sinusoidal voltage of amplitude V_0 and frequency f is connected across a capacitor of capacitance C .
- (i) Without using any formula explain why current apparently flows through a capacitor of capacitance C and is out of phase with voltage. (04 marks)
- (ii) Find the amplitude of the current which flows and sketch a graph of the amplitude against frequency of the resistance of the connecting wires is negligible (03 marks)
- (d) Describe how an ac transformer works. (04 marks)

7 (a). Define magnetic flux and one ampere as applied to magnetism (02 marks)

(b) A circular coil of N turns, each of radius R carries current I .

(i). Write an expression for magnetic flux density at the centre of coil and state its direction (02 marks)

(ii) Describe a simple experiment to investigate the variation of magnetic flux density at centre of a coil with current when N and R are constant. (05 marks)

(c) A wire PQ rests on a horizontal non conducting table and another wire XY of length 16.0cm is free to move vertically in the guides provided at the ends X and Y above wire PQ as shown in Fig. 2.

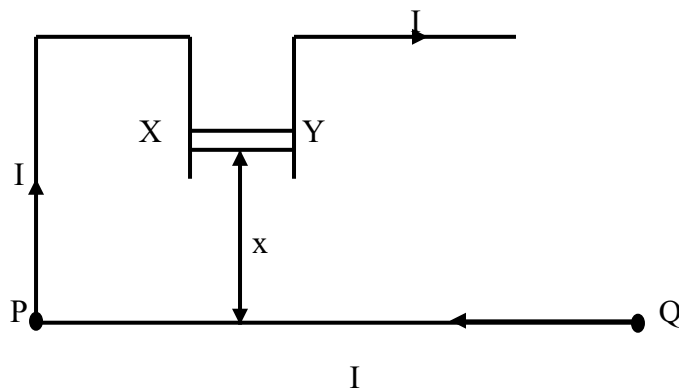


Fig.2

The mass per unit length of wire XY is 2.4mgcm^{-1} . A current of 3.0A passing through the wire is just enough to maintain wire XY at distance x above PQ . Calculate the;

- (i) value of x . (04 marks)
- (ii) magnetic flux density of XY on wire PQ (03 marks)
- (d) With aid of a graph, explain the variation of intensity of magnetization with magnetizing current. (04 marks)

SECTION D

- 8(a) (i) Define electrostatic induction. (01 mark)
- (ii) Explain why electrostatic induction leads to attraction (03 marks)
- (b) (i) What is an equipotential surface? Give one example (02 marks)
- (ii) Describe how a metal sphere can be charged positively and remains at zero potential. (04 marks)
- (c) An electroscope has a capacitance of 20PF and the leaves diverge through 25 divisions when charged to a potential of 600V. If in this position, divergence reduces at a rate of one division on one minute owing to imperfect insulation. Find the leakage current. (04 marks)
- (d)(i). Explain why the metal cap of a gold leaf electroscope is always made smooth and circular (02 marks)
- (ii). Explain how electrostatics is applied in an oil spray gun. (04 marks)
- 9(a)(i) Define emf of a cell and electrical resistivity as applied to current electricity. (02 marks)
- (b)(i) Explain why terminal p.d is always less than emf . (03 marks)
- (ii) Sketch a graph to show how terminal p.d varies with the load. Explain the features of the graph. (02 marks)
- (c) Describe with the aid of a circuit diagram an experiment to investigate the relationship between resistance of a wire and its thickness. (05 marks)
- (d) Two wires w_1 and w_2 have length in ratio 4:5, diameters in the ratio 4:3 and have their resistance in the ratio 3:20 respectively. Determine the ratio of the corresponding resistivity's of their materials. (04 marks)
- 10 (a) (i) Define capacitance of a capacitor and dielectric field strength as applied to capacitor (02 marks)
- (ii) Explain why work must be done during charging process of a capacitor (03 marks)
- (b) Describe an experiment to determine dielectric constant of silk using a reed switch. (05 marks)

- (c) The figure 3 shows a metal disc P suspended by a spring so that its plane is horizontal. The disc is placed above a similar earthed disc Q distance, a apart.

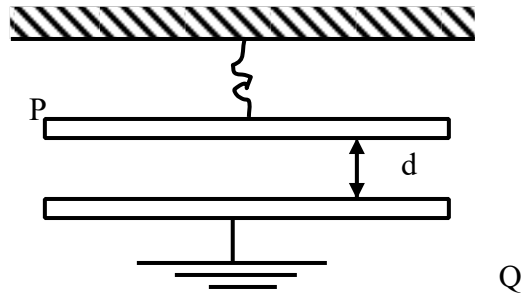


Figure.3

When disc P is connected to a p.d, V , the separation of the plates reduces by x

(i) Show that $V = \sqrt{\frac{2kx(d-x)^2}{\epsilon_0 A}}$

where k is the force per unit extension of the spring. (04 marks)

ϵ_0 = Permittivity of free space and A is overlapping area of the plates

- (ii) Explain why the separation reduces. (02marks)
- (c) Two capacitors of $6\mu\text{F}$ and $3\mu\text{F}$ are connected in series across a 12V dc battery. After a short time, the battery is replaced with un charged $5\mu\text{F}$ capacitor. Find the charge that will stored by the $5\mu\text{F}$. (04 marks)

END