P510/2
PHYSICS
PAPER 2
July/Aug 2023
Time: 2 ½ hours.

UGANDA ADVANCED CERTIFICATE OF EDUCATION

MOCK EXAMINATIONS

PHYSICS

Paper 2

2hours 30minutes

INSTRUCTIONS TO CANDIDATES:

*Attempt any **five** questions including one question from sections A & B and at least **one** but not more than **two** from each of the sections **C** and **D**.*

The following physical constants may be assumed where necessary:

Acceleration due gravity, g	=	$9.81 ms^{-2}$
Speed of light in vacuum, C	=	$3.0x10^{8}\ ms^{-1}$
Speed of sound in air	=	$340\ ms^{-1}$
Charge on an electron, e	=	$1.6x10^{-19}C$
Electron mass	=	$9.1x10^{-31}kg$
Permeability of free space, μ_o	=	$4\pi\ x10^{-7}Hm^{-1}$
Permittivity of free space, ε_o	=	$8.85x10^{-12}Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_o}$	=	$9.0x10^{9}F^{-1}m$
Plank's constant, h	=	$6.63x10^{-34}Js$
One electron volt, (eV)	=	$1.6x10^{-19}J$
Avogadro's number N_A	=	$6.02x10^{23}mol^{-1}$

SECTION A

1. (a) (i) Define the **principal focus** and **power** of a convex lens. (02 marks)

(ii) Describe an experiment to determine focal length of a convex mirror using a convex lens. (04 marks)

(b) A convex lens is moved between the object and a screen so that two clear images are obtained on the screen. In one case the height of the image of the object is h_1 and in the other case it is h_2. Derive the expression of the actual height, h, of the object in terms of h_1 and h_2. (04 marks)

(c) Light from a distance object is incident on a concave mirror M_1 of radius of curvature 2.0m and having a small hole at its pole. A small convex mirror M_2 is arranged coaxially at a distance of 0.6m from the pole so that a real image is formed in the plane of the hole.

(i) Sketch a ray-diagram to shown how the image is formed (02 marks)

(ii) Calculate the radius of curvature of the convex mirror (04 marks)

(d) With the aid of a diagram, explain why a parabolic mirror is used in search lamp. (03 marks)

2. (a) (i) Define refractive index of the material. (01 mark)

(ii) Explain the twinkling effect of stars (03 marks)

(b) A ray of light is refracted through a sphere, whose material has a refractive index **n**, in such a way that it passes through the extremities of two radii which make an angle, **α**, with each other. Prove that if **β** is the deviation of the ray caused by its passage through the sphere then, $\text{Cos } ½ (\alpha - \beta) = \mathbf{n} \cos ½ \alpha$. (04 marks)

(c) What is meant by the following;

(i) near point

(ii) magnifying power, of a telescope (02 marks)

(d) (i) Describe with aid of a ray diagram , the working of a Galilean telescope under normal adjustment. (04 marks)

(ii) State one advantage and one disadvantage when using the microscope set so that the final image is at infinity. (02 marks)

(e) A lens forms the image of a distant object on a screen 30cm away. Find where the second lens of focal length 30cm should be placed so that the screen has to be moved 8 cm towards the first lens for the new image to be in focus. (04 marks)

SECTION B

3 (a) (i) State the principle of superposition of waves? (1mark)

(ii) Use the principle of superposition to derive an expression for bear frequency. (4 marks)

(b) Beats of frequency 18Hz are heard in a note of frequency 306Hz when two notes of frequency f1 and f2 are sounded together. Calculate values of f1 and f2. (3 marks)

(c) (i) What is Doppler effect? (1mark)

(ii) Explain how Doppler effect is used to determine the direction of movement of a star. (3 marks)

(d) A source of sound generates waves of frequency 500Hz. If the speed of sound in air is 340m/s, find the frequency of the waves detected by the observer when, the source moves towards the observer who is also moving away at a speed of 20m/s. consider speed of the source to be 16m/s. (3marks)

(e) With the aid of a diagram, describe an experiment to investigate the dependence of fundamental frequency on thickness of a vibrating wire. (5marks)

4 (a) (i) What is meant by coherent sources of waves? (1 mark)

(ii) Distinguish between interference and diffraction of light. (02 marks)

(b) With the aid of suitable sketches, explain the following;

(i) Division of wave front (02 marks)

(ii) Division of amplitude (02 marks)

(c) In young's two slits experiment;

(i) State the conditions necessary for an interference fringes to be visible and explain why these conditions are necessary. (03 marks)

(ii) Monochromatic light of wavelength $5x10^{-7}$m is incident on two slits of separation $4x10^{-4}$m. Calculate the;

fringe separation on a screen placed 1.5m from the slit. (03 marks)

(d) **)** (i) State one application of polarized light. (01mark)

(ii) Describe one method of producing plane polarized light. (03 marks)

(iii)A narrow parallel beam of light is incident at angle on a surface of a glass block of refractive index 1.62 such that the reflected light is completely plane polarized.

Calculate the angles of reflection and refraction of the beam. (03 marks)

SECTION C

5 (a) What is meant by the following?

(i) electromagnetic induction? (01 mark)

(ii) Angle of dip? (01 mark)

(b) Describe an experiment to demonstrate Lenz's law of electromagnetic induction. (05 marks)

(c) A metal aircraft with a wing span of 40m flies with a ground speed of 1500kmh^{-1} in a direction due east at constant altitude in a region of northern hemisphere where the horizontal component of the earth's magnetic field is $1.6\text{x}10^{-5}$T and the angle of dip is 71.6^{o}.

(i) Find the p.d in volts between the wing tips. (04 marks)

(ii) State with reasons, which tip is at the higher potential? (01mark)

(d) (i) What is meant by Back emf. (01 mark)

(ii) A shunt wound dc electric motor takes a current of 100A from 200volts mains. The shunt – field coils have a resistance of 40 ohms; the armature has a resistance of 0.5 ohm. Find the back emf and electrical energy converted into mechanical work per second. (04 marks)

(f) A magnet dropped in a vertical copper pipe experiences a retarding force while falling but such a force is not experienced while falling down in a plastic pipe. Explain the observation. (03 marks)

6 (a) From the first principles, show that the force F acting on a wire of length L carrying current I and placed perpendicular to a magnetic field of flux density B is given by F=BIL. (04 marks)

(b)

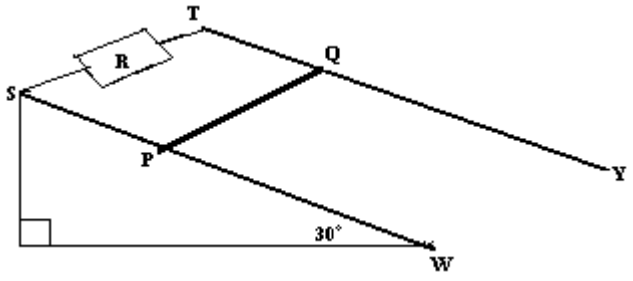

Fig1

In figure 1, WS and TY are frictionless conducting rails inclined at 30^{o} to the horizontal and connected to a resistor R of 5Ω. The rails lie in a vertical magnetic field of flux density $4.0\text{x}10^{-3}$ T. the conducing rod PQ of length 0.2m and mass 2.4kg is let to slide down the rails.

(i) Indicate and describe the forces acting on PQ. (02 marks)

(ii) Find the maximum speed attained by the rod. (04 marks)

(iii) Explain what would happen to the motion of the rod if the end ST is open. (02 marks)

(c) (i) write down the expression for the magnetic flux density at the centre of a circular coil of N turns each of radius r and carrying current I. (01 mark)

(ii) Describe how you would determine the horizontal component of earth's magnetic flux density using a search coil and a calibrated Ballistic galvanometer. (05 marks)

7(a)(i)What is meant by root-mean-square value of an alternating voltage? (01 mark)

(ii) Describe, with the aid of a labeled diagram the structure and the mode of operation of repulsion moving iron meter. (04 marks)

(iii) Explain why the meter in a(ii) is not suitable for measurement of high frequency ac. (02 marks)

(b) (i) Define reactance as applied to alternating current (01 mark).

(ii) A sinusoidal alternating voltage V= $V_0 \sin \omega t$ is connected across a pure capacitor of capacitance C. Derive an expression for capacitive reactance of the capacitor. (04 marks)

(c) Explain why grid power is transmitted at high voltage and in form of alternating current. (04 marks)

(d) A transformer connected to an ac supply of peak voltage 240V is to supply a peak voltage of 9V to a mini-lighting system of resistance 5Ω.

Calculate;

(i) The r.m.s current supplied by the secondary. (02 marks)

(ii) The average power delivered to the lighting system. (02 marks)

SECTION D

8 (a) Define the following terms as applied to voltaic cell:

(i) Electromotive force of a source. (01 mark)

(ii) Internal resistance. (01 mark)

(b) Explain the advantages, and precautions taken when using a metre bridge to measure resistance of a resistor. (03 marks)

(c) (i) Define temperature coefficient of resistance. (01 mark)

(ii) State one material for which this coefficient is negative. (01 mark)

(iii) Describe an experiment to determine the temperature coefficient of resistance of a given wire using a metre bridge. (05 marks)

(d) The driver circuit of a potentiometer arrangement contains a resistor R of a fixed resistance in series with the slide wire. The resistance per metre of the slide wire is 5 ohms. A constant current of $4x10^{-3}$A flows through the slide wire. A balance point is obtained when a cell of e.m.f 1.5V is connected across R and 140cm length of the slide wire. When a 1 ohm resistor is connected across the cell a balance point is obtained with a 110cm length of the slide wire.

Calculate;

(i) the resistance of R (03 marks)

(ii) the internal resistance of the cell (02 marks)

(e) Account for the variation of the electric resistance of metals with temperature. (03 marks)

9(a) (i) Define the capacitance of a conductor (01mark).

(ii) Explain how the capacitance of a conductor is affected by bringing uncharged conductor in its neighborhood**.** (03 marks)

(b) A light metal disc of area A is suspended by a spring so that its plane is horizontal. The disc is placed immediately above a similar disc B which is earthed and the distance between them is d. the suspended disc is connected to a potential V and this causes the separation d to decrease by *x*.

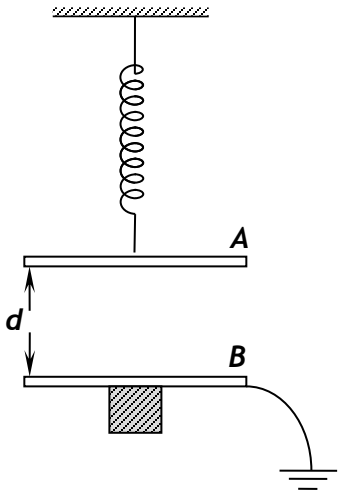

Fig. 2

(i) Show that $V^2 = \frac{2kx(d-x)^2}{A\varepsilon_0}$ where k is the force unit extension of the spring. (04 marks)

(ii) Explain why the separation decreases. (2 marks)

c) Four capacitors C_1, C_2, C_3, and C_4 each of capacitance 4 μ F are connected in the circuit shown in fugure3.

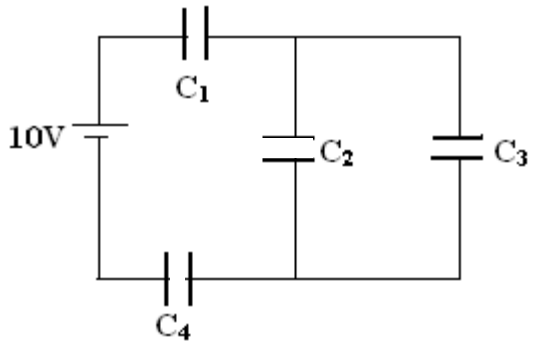

Fig3.

Calculate: (i) the P.d across C_4. (04 marks)

(ii) energy stored in C_3 (03 marks)

(d) Why is the energy supplied by the source is always greater than energy stored in the capacitor. (02 marks)

10 (a) (i) State coulomb law of electrostatics. (01 mark)

(ii) Explain why a charged body attracts an uncharged body. (03 marks)

(b) Define **charge density** and **electric potential**. (02 marks)

(c) Describe an experiment to show that there is high concentration of charge at sharp point (04 marks)

(d) Charges Q_1, Q2 and Q_3 of magnitude 2 μ C, -3 μ C and 5 μ C respectively are situated the corners of an equilateral triangle of side 20cm as shown in the fig. 3.

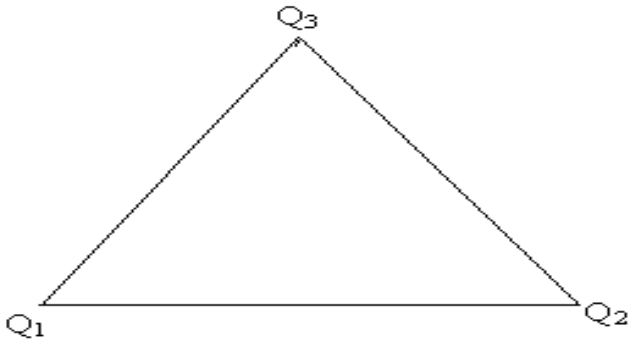

Fig3

Calculate; (i) the net force on Q_3 (04 marks)

(ii)the potential energy Q_3 (03 marks)

(e) With a suitable diagram, explain how electrostatic precipitation is used to protect environment from pollution. (03 marks)

END