P510/2
PHYSICS
Paper 2
2½ hours

MASAKA DIOCESAN EXAMINATIONS BOARD

JOINT MOCK EXAMINATIONS 2024

Uganda Advanced Certificate of Education

PHYSICS

Paper 1

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

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

Assume where necessary

Acceleration due to gravity g	=	$9.81 m s^{-2}$
Speed of light in a vacuum c	=	$3 \times 10^{8} m s^{-1}$
permeability of free space μ_0	=	$4\pi \times 10^{-7} H m^{-1}$
Permittivity of free space ε_0	=	$8.88 \times 10^{-12} F m^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	=	$9 \times 10^{9} F' m$

SECTION A:

1. (a) Define the following as applied to optical instruments

(i) Near point ring. (01 mark)

(ii) Eye ring. (01 mark)

(b) (i) Describe the structure and mode of operation of astronomical telescope not in normal use. (03 marks)

ii) In normal adjustment, the angular magnification of astronomical telescope is $\frac{f_o}{f_e}$ show that its angular magnification increases by the ratio of $(1 + \frac{f_e}{D})$ when not in normal adjustment. (04 marks)

(c) A point object is placed in front of thin converging lens L_1 of focal length 3 cm at distance of 3.6 cm. A second thin converging lens L_2 of focal length 16 cm is placed coaxial with lens L_1 and 26 cm from it on the side remote from the object.

(i) Find the position and magnification of final arrangement. (05 marks)

(ii) Explain why the above arrangement is not suitable for a compound microscope in normal use for a normal eye. (01 mark)

(d) Describe an experiment to determine the focal length of diverging lens by using a concave mirror. (05 marks)

2. (a) (i) Define **principal focus of a lens**. (01 mark)

(ii) Show that the least distance between object and real image formed by converging lens is $4f$ where f is the focal length of the lens. (04 marks)

(b) Describe an experiment to determine the minimum deviation of light caused by a glass prism by using optical pins and involve graphical analysis. (05 marks)

(c) A thin equi-convex lens of glass of refractive index 1.5 with radius of curvature 24 cm is placed on a horizontal plane mirror. When the space between the lens and the mirror is filled with a liquid. A pin held 40 cm vertically above the lens coincides with its own image. Calculate;

(i) the power of the lens (02 marks)

(ii) critical angle of liquid-air boundary. (03 marks)

(d) i) What is meant by **chromatic aberration**? (03 marks)

(ii) State properties of lenses used in an achromatic doublet. (02 marks)

SECTION B:

(a) (i) Distinguish between **pitch** and **loudness of sound.** (02 marks)

(ii) Describe an experiment to show that sound obeys the laws of reflection. (05 marks)

(b) (i) What is meant by **Doppler effect** in waves? (01 marks)

(ii) A stationary observer is in front of vertical wall. A police car moving at 20 ms^{-1} sounds a siren of frequency 1000 Hz as it recedes the observer and approaches the vertical wall. Find the beat frequency of sound hard by the observer (take speed of sound in air as 340 ms^{-1}). (04 marks)

(c) Describe an experiment to determine end correction of an open pipe. (05 marks)

(d) Two loud speakers A and B producing sound of slightly different frequencies faced each other. A boy moves along the line joining the two speakers. Explain what the boy observes. (03 marks)

(a) What is meant by **diffraction**? (01 mark)

(b) Explain using Huygen's principle the diffraction pattern produced by a single slit. (06 marks)

(c) Light of wave length 5×10^{-7}m falls on a grating with 600 lines per mm. Determine the highest order of diffraction that can be observed. (04 marks)

(d) (i) Explain what is meant by the plane of polarization of light? (02 marks)

(ii) A liquid of refractive index 1.3 is used to produce polarized light by reflection. Find the angle of incidence on the liquid surface. (03 marks)

(b) State three uses of polarized light. (02 marks)

SECTION C:

5. (a) Define magnetic flux linkage and its S.1 unit. (02 marks)

(b) (i) Write down expression for magnetic flux density due to circular coil. (01 mark)

(ii) Draw magnetic field patters around a circular coil. (02 marks)

(c) Explain why a piece of metal carrying current placed in solenoid carrying current experiences force. (03 marks)

(d) (i) Derive the expression for the force per unit length between two parallel straight current carrying conductors. (04 marks)

(ii) Describe absolute method of measuring current. (05 marks)

(e) A conducting disc of radius 0.04 m with its plane perpendicular to the field of density 0.2 T rotates at 120 revolutions per minute. Find e.m.f induced between the disc and its rim.

6. (a) (i) What is meant by **eddy current**? (03 marks)

(ii) Explain one practical application of eddy currents. (04 marks)

(b) (i) Given that an alternating current $V = V_0 \sin 2\pi ft$ is connected across an inductor. Show that voltage leads current by $\frac{\pi}{2}$. (04 marks)

(c) (i) Describe the structure and mode of operation of moving iron meter repulsive type. (05 marks)

(ii) State two advantages of the A.C meter in (c) (i) over ordinary moving coil ammeter. (01 mark)

7. (a) Distinguish between **self-induction** and **mutual induction**. (02 marks)

(b) Describe the structure and mode of operation of **steep up transformer**. (04 marks)

(c) A search coil 50 turns and radius 0.5 m is arranged such that its plane is perpendicular to the magnetic meridian. The coil connected a balistic galvanometer of sensitivity 5.7×10^4 rad C^{-1} and resistance 100 Ω. When the coil is rotated through 180^0 about the vertical axis, the balistic galvanometer deflects through 0.8 rads. Find:

(i) the horizontal component of the Earth magnetic flux density. (03 marks)

(ii) the resultant magnetic flux density of the Earth if the angle of dip is 70^0. (03 marks)

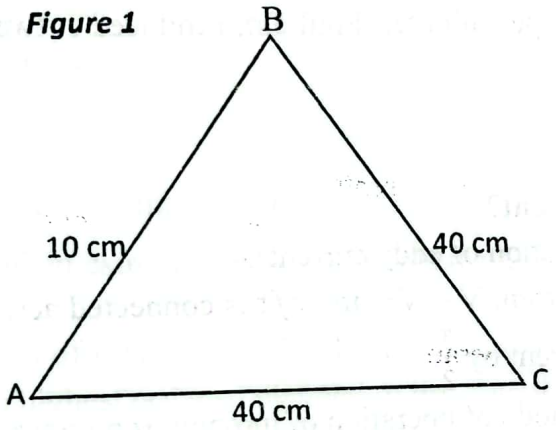
(d) (i) Explain why sparks are produced between the contacts of the switch in an inductive circuit when the switch is closed and re-opened. (02 marks)

(ii) Explain how sparks in (d) (i) reduced. (02 marks)

SECTION D:

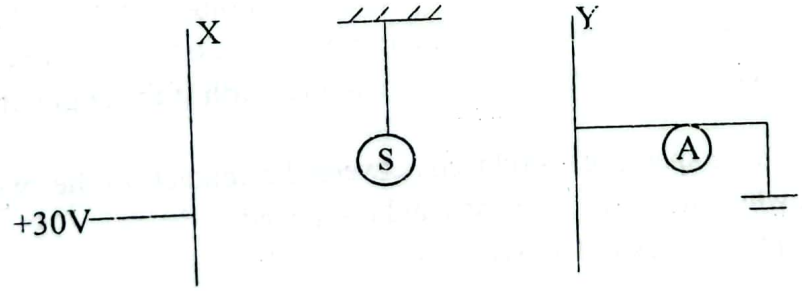
8. (a) (i) Explain what is meant by **action at point.** (03 marks)
   (ii) State two practical applications of action at a point. (01 mark)
   (b) (i) Draw a graph showing variation of electric field intensity due isolates point charge. (02 marks)
   (ii) Prove that $\Phi = \frac{Q}{\varepsilon_0}$ where Φ is electric flux, Q is charged and ε_0 is permittivity of free space. (04 marks)
   (b) Explain what is observed when positively charged body is slowly brought near the cap of negatively changed gold lead electro scope. Assume the body has a large charge than gold leaf electroscope. (03 marks)
   (c) Charges of -20 μC and +20 μC are placed at points A and B as shown in Figure 1.

Figure 1



Find electric field intensity at C hence find the magnitude force acting on charge of 60 pC when placed at C

9. (a) (i) Define **nano farad.** (01 mark)
   (ii) Draw electric field pattern due to charged parallel plate capacitor. (02 marks)
   (b) Explain what happens when a conductor is inserted between plates of a charged capacitor. (02 marks)
   (c) Describe an experiment to determine **dielectric constant** by using vibrating reed switch circuit. (04 marks)
   (d) Figure 2 shows a parallel plate capacitor of plates X and Y. Plate Y is earthed and Y is connected to positive potential of +30V. The distance of separation between the plates is 10 mm the plates have area of 0.00045 m^2.



i) Explain why a small uncharged metal sphere suspended between the plates oscillates continuously between the plates. (03 marks)

ii) Find the capacitance of the capacitor. (02 marks)

iii) If the sphere makes 50 oscillations per second find the reading of ammeter A. (06 marks)

(e) Two capacitors of $2\mu F$ and $3\mu F$ are charged to 50 V and 100 V respectively. The capacitors are then disconnected from the batteries and then they are connected together. Find:

(i) the common p.d between the capacitors. (02 marks)

(ii) the energy stored in the $2\mu F$ capacitor after connecting them together. (02 marks)

10. (a) (i) Define **temperature coefficient** of resistance of a conductor. (01 mark)

(ii) Explain why temperature coefficient of resistance for conductors is positive. (03 marks)

(b) i) Describe an experiment to determine **electrical resistivity** of wire by using meter bridge. Involve graphical analysis in your explanation. (05 marks)

(ii) State the precautions taken when performing experiment in (b) (i) above. (01 mark)

(c) (i) Outline the principle of potentiometer. (03 marks)

(ii) State the advantages of potentiometer as p.d measuring instrument. (01 mark)

(d) Figure 3 shows a potentiometer with slide wire AB of uniform resistance 4Ω and length 100cm. D is driver cell of negligible internal resistance. E is a cell of e.m.f 1.5V when k_1 open the balance length AJ is 60cm.

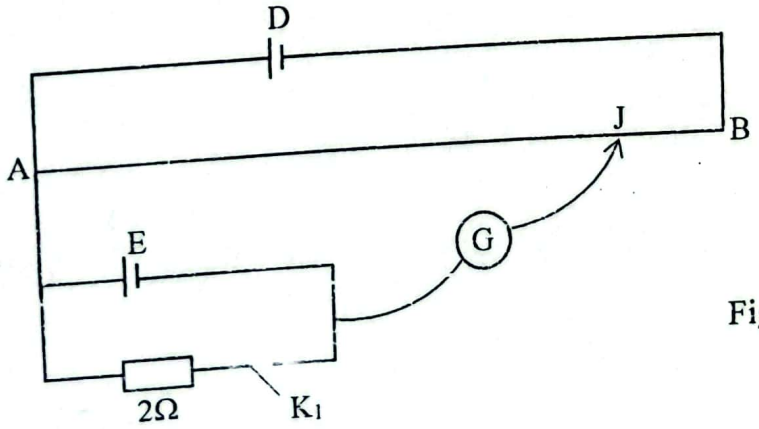


Figure 3

(i) If the internal resistant of E is 1.4 Ω, find the balance length AJ when K_1 is closed. (03 marks)

(ii) e.mf of D (03 marks)

*** END ***