

ST. HENRY'S COLLEGE KITOVU
PRE-MOCK EXAMS TERM II – 2004
PHYSICS PAPER 2

Time: 2 ½ Hours

S.6B/M

INSTRUCTIONS:

- Attempt five questions with at least **ONE** question but **NOT MORE** than **TWO** questions from each of the Sections A, B and C.
- Assume the following constants where necessary.
 - Permittivity of free space $\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$
 - The constant $\frac{1}{4\pi\epsilon_0} = 9.0 \times 10^9 \text{ mF}^{-1}$
 - Permeability of free space $\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}$.

SECTION A

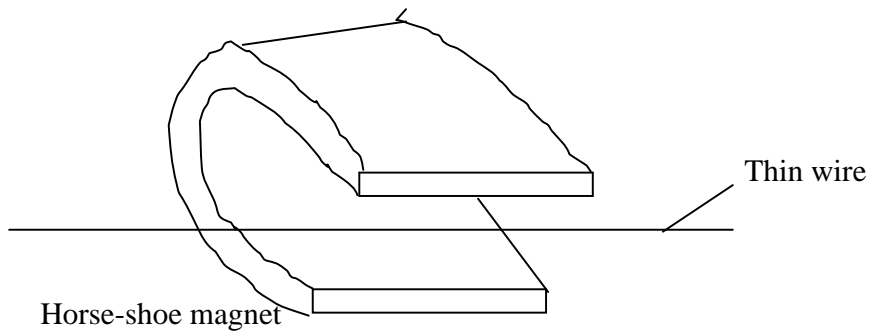
1. (a) (i) Explain the term reflection of light. (1)
- (ii) State the laws of reflection of light. (2)
- (iii) A ray of light falls on a plane mirror so that the reflected ray makes an angle of 30° with the incident ray. The mirror is turned about an axis at right angles to the plane of the rays through angles of 20° . What are now the possible angles between the incident ray and the new reflected ray? (6)
- (b) (i) What is the principle focus of a concave mirror? (1)
- (ii) With reference to a concave mirror, explain what is meant by spherical aberration. (3)
- (c) A finite object is placed perpendicularly to the principal axis of a concave mirror of focal length, **f**, at a distance, **u**, from the mirror. An erect image of the object is formed at a distance **v** from the mirror.
- (i) Draw a ray diagram to show the formation of an image. (2)
- (ii) Use the diagram in (i) above to show that $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ (5)
2. (a) State the laws of refraction of light (2)
- (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 with each other. Prove that if **β** is the deviation of the ray caused by its passage through the sphere then,
- $$\cos \frac{1}{2} (\alpha - \beta) = n \cos \frac{1}{2} \alpha \quad (5)$$

- (c) (i) A ray of monochromatic light is incident of an angle of 30° on a prism of which the refractive index for the given light is 1.52 what is the maximum refracting angle that the prism might have if the light is just to emerge from the opposite face? (4)
- (ii) Explain why white light is dispersed by a transparent medium. (4)
- (d) (i) Define angular magnification of an optical instrument. (1)
- (ii) Explain why the farthest vertical pole in line with others of equal height looks shorter. (2)
- (e) A telephoto lens in a camera consists of a convex lens of focal length 10 cm with a concave lens of focal length 5cm placed 7cm behind it. The object to be photographed is 5cm in front of the convex lens.
- (i) What is the total length of the camera from the convex lens to the film when the image is in focus on the film?
- (ii) What is the magnification produced? (4)

3. (a) What are the necessary conditions for the production of:

- (i) Stationary waves. (2)
- (ii) Beats. (2)

(b) A thin wire is stretched between the poles of a horseshoes magnet as shown in the diagram below,



- (i) Explain why the wire vibrates when an alternating current is passed through it. (3)
- (ii) At what frequencies will the amplitude of vibration be at its maximum? (1)
- (c) Describe with the aid of a diagram, an experiment for determining the velocity of sound in a column of air. (6)

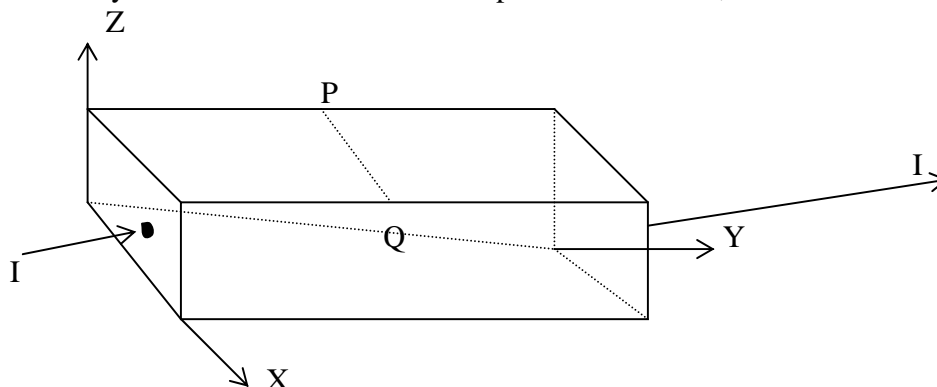
- (d) Sound wave from a stationary source is reflected by a distant wall. A sound detector is moved along a line from the source and perpendicular to the wall. Maximum sound intensities (maxima) are recorded at distances of 20, 40 and 60m from the wall.
- (i) Explain the occurrence of the observed maxima. (2)
- (ii) Assuming that the speed of sound in air is 330ms^{-1} , calculate the frequency of the sound source. (4)
4. (a) (i) What is sound? (1)
- (ii) What is musical sound? (1)
- (iii) In what ways do musical sounds differ from one another (1)
- (b) With the aid of a labeled diagram, describe an experiment to demonstrate interference of sound waves. Give the relevant theory. (6)
- (c) A glass tube, open at the top, is held vertically and filled with water. A tuning fork vibrating at 264Hz is held above the tube and water is allowed to flow out slowly. The first resonance occurs when the water level is 31.5cm from the top while the second resonance occurs when the level is 96.3cm from the top. Find,
- (i) the speed of sound in air column (4)
- (ii) the end correction. (2)
- (d) Why is sound propagation in air considered to be an adiabatic process?(4)

SECTION B:

5. (a) (i) With the aid of a diagram, describe an experiment to determine how the e.m.f induced in a metal rod moving in a magnetic field depends on the rate of change of the magnetic flux. (6)
- (ii) Explain how Lenz's law is an example of energy conservation (3)
- (b) (i) A square coil of sides 20.0cm has 100 turns. The coil is arranged to rotate at 240 revolutions per minute about a vertical axis perpendicular to a horizontal uniform magnetic field of flux density 1.5T. The axis of rotation passes through the Mid-points of a pair of opposite sides of the coil. Calculate the e.m.f induced in the coil when the plane of the coil makes an angle of 35° with the field. (5)
- (ii) On the same axes sketch graphs to show the variations of the induced e.m.f and flux change with time in the coil. (2)
- (c) (i) What are eddy currents? (1)
- (ii) Explain briefly one application of eddy currents. (3)

6. (a) Describe with the aid of a diagram, the three quantities which specify the earth's magnetic field at any point on its surface. (4)
- (b) Describe an experiment to determine the horizontal component of the earth's magnetic flux density at a point on the earth's surface. (6)
- (c) Two parallel straight conductors X and Y are 0.1m apart. Conductor X is a long conductor and carries a downward current of 9A while conductor Y is 0.04m long and carries a current of 5A in the opposite direction to that in X.
- (i) Calculate the force on Y. (3)
- (ii) Draw a sketch of the arrangement and show the direction of the force on Y. (2)

- (d) A steady current I flows in a metal strip as shown below,



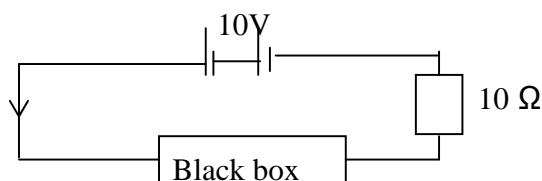
A magnetic field of flux density 0.6T is applied across the strip in the positive Z-direction.

- (i) Account for the occurrence of a p.d between P and Q. (3)
- (ii) Determine the magnitude and direction of the electric field intensity between P and Q when the drift velocity of the conduction electron is $3.5 \times 10^{-4} \text{ ms}^{-1}$. (2)
7. (a) (i) Describe, with the aid of a labeled diagram, the mode of operation of a simple a.c generator. (5)
- (ii) Explain the structural modifications that are made to the generator described in (a) (i) above in order to obtain a d.c generator. (2)
- (b) (i) Define the terms **peak value** and **root mean square (r.m.s)** values of alternating voltage. (2)
- (ii) An electric kettle draws 1.5kW from a 240 V r.m.s main supply. Find the peak value of the current drawn by the kettle, if the voltage is sinusoidal. (3)
- (c) A sinusoidal alternating voltage of 12 Vr.m.s of frequency f is connected in series with a capacitor of capacitance C.
- (i) Explain, using suitable sketch diagrams, why current apparently flows through the capacitor. (5)

- (ii) Calculate the r.m.s value of the current in the circuit when $f=1000\text{Hz}$ and $C=500\text{nF}$. (2)

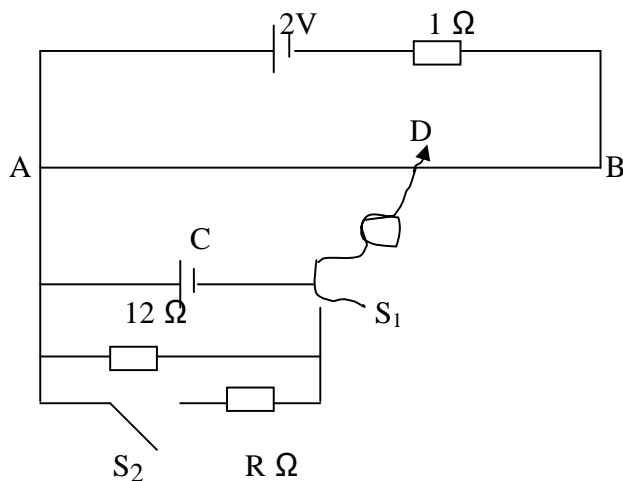
SECTION C

8. (a) A steady current of I amperes is maintained in an ohmic resistor of R ohms for time t seconds. Derive, in terms of I , R and t , the expression for the thermal energy dissipated in the resistor. (3)
- (b) In the figure below; a 10V d.c supply is connected in series with a resistor of 10Ω and black box containing a source of e.m.f and another electrical component.



The p.d across the 10Ω – resistor is 5V . Electrical energy is dissipated in the black box at the rate of 1.5W as thermal energy. Determine

- (i) the other electrical component in the black box (4)
- (ii) the e.m.f and polarity of the source in the black box. (3)
- (c) In the figure below, AB is a uniform wire of length 1.0m and of resistance 4Ω . C is a cell of unknown e.m.f and unknown internal resistance.



When switches S_1 and S_2 are open, the galvanometer G shows no deflection where $AD = 93.8\text{cm}$. When S_1 is closed and S_2 open, the galvanometer shows no deflection for $AD = 86.5\text{cm}$. With both S_1 and S_2 closed, the galvanometer shows no deflection when $AD = 75.0\text{cm}$. Find

- (i) the e.m.f of cell C , (3)

- (ii) the internal resistance of cell C. (4)
- (iii) the value of R. (4).
9. (a) Define the following terms;-
- (i) electric field intensity (1)
- (ii) capacitance. (1)
- (b) (i) Describe an experiment to investigate the distribution of the electric charge on a conductor using gold leaf electroscope, (3)
- (ii) What would be the distribution of charge on a spherical conductor with a pointed rod attached to it? (2)
- (iii) Explain one application of pointer conductors (4)
- (c) What factors determine the capacitance of a capacitor? (2)
- (d) A capacitor consists of two concentric spheres. The inner sphere of radius r_1 , carries a positive charge Q while the outer sphere of radius r_2 is earthed.
- (i) Derive an expression for the capacitance of the capacitor. (3)
- (ii) Calculate the energy stored in the capacitor if $r_1 = 20\text{cm}$, $r_2 = 50\text{cm}$ and $Q = 8 \times 10^{-7}\text{C}$. (4)

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