P510/2
PHYSICS
Paper 2
July./Aug. 2024
2½hours

WAKISO-KAMPALA TEACHERS' ASSOCIATION (WAKATA)

WAKATA MOCK EXAMINATIONS 2024

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Answer **five** *questions including at least* **one** *but not more than* **two** *from each of the sections* **A**, **B**, **C** *and* **D**.

Mathematical tables and squared paper will be provided.

Non – programmable scientific calculators may be used.

Assume where necessary

Acceleration due to gravity, g	=	$9.81 ms^{-2}$
Speed of light in a vacuum, c	=	$3.0 \times 10^{8} ms^{-1}$
Electron charge, e	=	$1.6 \times 10^{-9} C$
Electron mass	=	$9.11 \times 10^{-31} kg$
Plank's constant, h	=	$6.6 \times 10^{-34} Js$
Permeability of free space, μ_0	=	$4.0\pi \times 10^{-7} Hm^{-1}$
Permeability of free space, ε_0	=	$8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	=	$9.0 \times 10^{9} F^{-1}m$
One electron Volt (eV)	=	$1.6 \times 10^{-19} J$
A vogadro's number, NA	=	$6.02 \times 10^{23} mol^{-1}$
Resistivity of Nichrome wire at 25°C	=	$1.2 \times 10^{-6} \Omega m$
Specific heat capacity of water	=	$4.2 \times 10^{3} Jkg^{-1}K^{-1}$

SECTION A

1. (a) (i) What is meant by **reflection** of light? *(01mark)*

(ii) Show that the radius of curvature of a convex mirror is twice its focal length. *(04marks)*

(b) (i) Describe an experiment to determine the angle of minimum deviation of prism by non – parallax method. *(05marks)*

(ii) State why a prism is preferred to a plane mirror when used as a reflector. *(02marks)*

(c) A concave mirror forms a real image which is three times the line or size of its real object. When the object is displaced through a distance, d, the real image formed now is four times the linear size of the object. Given that the distance between the two image positions is 20.0cm; Find

(i) The focal length of the mirror. *(04marks)*

(ii) The distance d. *(04marks)*

(d) Explain the apparent shape of the bottom of a pool of water to an observer of the bank of the pool. *(02marks)*

2. (a) Define the terms

(i) Optical centre

(ii) Principal focus, as applied to a converging lens. *(02marks)*

(b) (i) Describe an experiment to determine the focal length of a concave lens using a convex lens and a plane mirror. *(05marks)*

(ii) Explain how chromatic aberration come about and how it can be reduced. *(03marks)*

(c) (i) Draw a diagram to illustrate the optical system of a cassegrain reflector telescope and briefly describe the passage of light. *(04marks)*

(ii) State two advantages of a reflecting telescope over refracting telescope. *(02marks)*

(d) A telescope has an objective of focal length 70.0cm and an eye piece of focal length 1.5cm. It is focused on the star whose diameter subtends an angle of 5.0×10^{-3} radians of the objective. The eye piece lens is adjusted so as to project a sharp image of the star onto a science placed 15.0cm from the eye piece tens.
Calculate the diameter of the image on the screen. *(04marks)*

SECTION B

3. (a) (i) What is meant by **wave front** as applied to waves. *(01mark)*

(ii) A progressive water is represented by the equation $y = 5sin(50t - x)$, where y is in cm and t in seconds. Find the speed of the wave. *(04marks)*

(b) (i) What is meant by the term Doppler effect? *(01mark)*

(ii) Briefly describe how the speed of a fast moving car can be determined using Doppler effect. *(06marks)*

(c) (i) What is meant **by beat frequency**? *(02marks)*

(ii) State the conditions necessary for the formation of audition beats from two separate sound sources. *(02marks)*

(d) Explain the effect of wind on the audibility of sounds transmitted through the atmosphere. *(04marks)*

4. (a) (i) What is meant by the term **polarized light**. *(02marks)*

(ii) Why is plane polarization observed with light and not with sound waves. *(03marks)*

(b) Describe with the aid of a labeled diagram experimental arrangement of observing the interference patterns known as Newton's sings. *(06marks)*

(c) Two microscope slides are in contact at one end and are separated by a thin foil at the other end. Monochromatic light is directed normally on the wedge.

(i) What type of fringe will be observed? *(01mark)*

(ii) What will be observed if a liquid is introduced between the slides. *(03marks)*

(d) The two slits in a young's experiment apparatus are 0.200mm apart. The interference Fringes for light of wave length 600nm are formed on a screen 80.0cm away. How far is the second dark bond from the central image? *(05marks)*

SECTION C

5. (a) Define **magnetic flux density** and **Tesla**, with respect to a straight conductor carrying current. *(02marks)*

(b) (i) Describe the structure and mode of operation of moving coil galvanometer. *(05marks)*

(ii) State and explain the modifications made to convert a moving coil galvanometer for measuring small currents into a ballistic galvanometer. *(03marks)*

(c) (i) Define the **ampere**? *(01mark)*

(ii) Derive an expression for the force, F per metre length, L between two long parallel wires, placed a distance, d apart and carrying current I_1 and I_2 in a vacuum. *(04marks)*

(d) Figure 1 shows a rectangular frame of 40cm by 10cm carrying a current of 5A in The direction shown

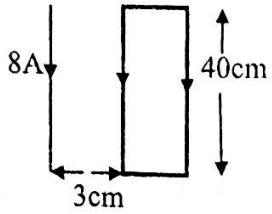

Fig. 1

If the side of the frame is 3cm from a bicycle spoke carrying a current of 8A in the direction shown, find the net force on a rectangular frame. *(05marks)*

6. (a) (i) What is meant by **root mean square value** of an alternating current. *(01mark)*

(ii) Show that the average power dissipated in a capacitor in a complete cycle is zero. *(04marks)*

(iii) Using the same axes, sketch graphs to show the variation of voltage, V and current I with time in a capacitor. *(02marks)*

(b) (i) Define **resonant frequency** as applied to a.c *(01mark)*

(ii) Describe how resonance circuits are applied in the tunning process of radio. *(04marks)*

(c) A capacitor, C, a coil of inductance, L and a lamp of resistance, R are connected in series with an alternating voltage V. The frequency of the a.c voltage is varied from a low to a high value while keeping the magnitude of V constant.
Explain how brightness of the lamp varies. *(03marks)*

(d) A circuit consists of a capacitor of 13μF and a resistor of 4000Ω. An alternating EMF of 24V and frequency, f is applied.
Find

(i) Current that flows. *(03marks)*

(ii) P.d across the capacitor. *(02marks)*

7. (a) What is meant by the following;

(i) Self induction *(01mark)*

(ii) Mutual induction *(01mark)*

(b) With the aid of a suitable diagram describe the structure and mode of operation of a machine that works on the principle of mutual induction. *(06marks)*

(c) Outline the causes of in efficiency in an a.c transformer and suggest ways of minimizing them. *(04marks)*

(d) Show that the total charge, Q which passes through a given coil, depends on the resistance R of the coil and the total flux, $\emptyset$ linked. *(04marks)*

(e) A metal spoke in a wheel is 40cm long. If the wheel makes 16 revolutions per minute in a plane perpendicular to the earth's magnetic field where the flux density is 4.8×10^{-5}T. Find the p.d induced between the axle and the rim of the wheel. *(04marks)*

SECTION D

8. (a) State the **coulombs law** of electrostatic?

(b) Two light metal balls of masses m_1 and m_2 are held vertically at two fixed supports A and B by light inextensible strings. When the balls are given equal opposite charges, they attract each other with the strings making angles of 30° and 60° respectively with their initial vertical positions as shown in figure 2.

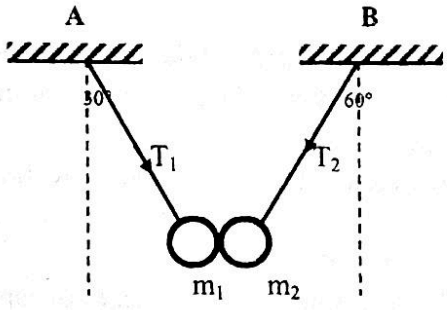

Fig. 2

Assuming T_1 and T_2 are the respective tensions in the strings supporting the masses, m_1 and m_2, show that $\mathbf{m_1 = 3m_2}$. *(06marks)*

(c) Explain why the electric field intensity close to the surface of charged conductor is always at right angles to the surface of the conductor. *(03marks)*

(d) Describe with the aid of a diagram the mode of operation of the vande Graff generator. *(06marks)*

(e) Two point charges of magnitude $+30\mu C$ and $+10\mu C$ are placed at the corners of a triangle right angled at P as shown in figure 3.

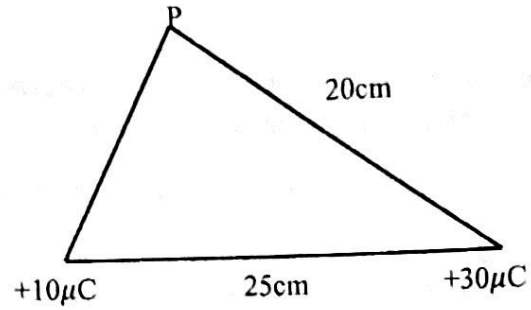

Fig.3

Find the electric potential at P. *(04marks)*

9. (a) Define the following;

(i) Capacitance of a capacitor. *(01mark)*

(ii) Afarad *(01mark)*

(b) Describe an experiment to show how capacitance of a capacitor depends on the area of overlap. *(05marks)*

(c) Two capacitors of capacitances 2μF and 3μF respectively are connected in parallel across a pd of 6V d.c supply.

(i) Calculate the magnitude of the charge on each of the capacitors when fully charged. *(03marks)*

(ii) The d.c supply is then disconnected and the space between the plates of the two capacitors is completely filled with the same dielectric material. On measuring the p.d across the capacitors, it is found to be 2.0V.
Explain why there is a reduction in p.d and calculate the dielectric constant of the dielectric. *(05marks)*

(d) Derive an expression for the energy stored in a capacitor of capacitance, C charged to a voltage, V. *(03marks)*

(e) State the function of a capacitor in a full wave rectifier. *(02marks)*

10. (a) Define the following;

(i) Electrical resistivity. *(01mark)*

(ii) Temperature coefficient of resistance. *(01mark)*

(b) Explain why the temperature coefficient of resistance is positive for metals *(04marks)*

(c) (i) State Kirchoff's laws of electrical network *(02marks)*

(ii) A battery of emf 6V and internal resistance 0.5Ω is connected as shown in the circuit in figure 4.

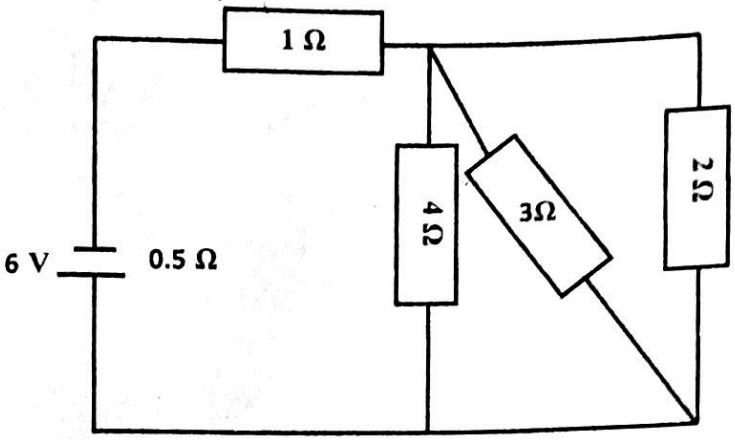

Fig.4

Find the power dissipated in the 2Ω resistor. *(04marks)*

(d) Explain why a metal wire becomes hot when an electric current is passed through it. *(03marks)*

(e) With the aid of a diagram, describe how you would determine the resistivity of a metal wire. *(05marks)*

END