P510/2
PHYSICS

HeLP UACE PHYSICS 2 FACILITATION ON FRIDAY 19TH/07/2024

SECTION A

Question 1

(a) Define the following terms as applied to convex lens.
   (i) Principal axis (1 mark)
   (ii) Focal length (1 mark)

(b) A finite object is placed between the principal focus and optical centre of a converging lens.
   (i) Draw a ray diagram to indicate the image formed (2 marks)
   (ii) Use the ray diagram to derive the lens formula. (5 marks)

(c) Describe an experiment to determine the focal length of a concave lens using a plane mirror, a converging lens and an illuminated object. (5 marks)

(d) A point object is placed 20cm infront of a diverging lens and on other side of the lens is a concave mirror coaxial with it and of focal length 20cm. If the final image coincides with the object, calculate the focal length of concave lens. (4 marks)

(e) Explain why parabolic mirrors are used in car head lamps. (2 marks)

Question 2

(a) What is the eye ring of a telescope? (1 mark)

(b) Give one advantage and one disadvantage of each of the following telescope in their use as optical instruments.
   (i) Terrestrial telescope (2 marks)
   (ii) Galilean telescope (2 marks)

(c) (i) Draw a ray diagram and use it to derive an expression for angular magnification of a compound microscope in normal use. (5 marks)
   (ii) How can high magnification be achieved? (1 mark)

(d) Describe an experiment to determine the focal length of a convex mirror using a convex lens. (4 marks)

(e) A slide projector is required to produce a real image 648mm wide from an object 36mm wide. If the distance of the object from the screen is to be 2000mm, calculate:
   (i) The distance of the lens from the object (3 marks)
   (ii) The focal length of the lens required. (2 marks)

SECTION B

Question 3

(a) Define

(i) An overtone (1 mark)

(ii) Ultra sound (1 mark)

(b) (i) State one application of ultra sound. (1 mark)

(ii) Explain why the same note played on different instruments sounds different. (3 marks)

(c) A wire of length 400mm and mass $1.2\times10^{-5}kg$ is under tension of 120N. What is

(i) The fundamental frequency of vibration. (3 marks)

(ii) The frequency of the third harmonic (2 marks)

(d) Describe an experiment to determine the velocity of sound in air by the dust tube method. (5 marks)

(e) (i) Explain reverberation as applied to sound waves. (2 marks)

(ii) Explain how reverberation may be minimized in a large hall. (2 marks)

Question 4

(a) Distinguish between sound waves and light waves. (3 marks)

(ii) State two conditions necessary for interference patterns to be formed. (2 marks)

(b) A Plano convex lens is placed on top of a glass plate. When a traveling microscope is focused on the lens, alternate dark and bright rings are observed.

(i) Explain the formation of rings. (5 marks)

(ii) The space between the glass plate and the lens is filled with a liquid whose refractive index is higher that that of the lens but less than that of the glass plate. Explain what happens to the appearance of the rings. (4 marks)

(c) In Young's double slit experiment, the double slits are separated by 0.75mm and the screen is 80cm from the slits.

(i) Find the fringe width (3 marks)

(ii) One of the slits is covered with a glass material of thickness 3.6mm and refractive index 1.5. Calculate the displacement of the material of the central band. (3 marks)

SECTION C

Question 5

(a) Sketch the magnetic field pattern around a vertical current carrying straight wire in the earth's magnetic field and use it to explain the neutral point in a magnetic field. (3 marks)

(b) (i) Explain the factors that affect the magnitude of force on a conductor carrying current I in the region of magnetic field of flux density B. (4 marks)

(ii) A straight horizontal rod of mass 150g and length 0.5 m is placed in a uniform horizontal magnetic field of 0.2T perpendicular to it. Calculate the current through the rod if the force acting on it just balances its weight. (4 marks)

(c) A rectangular coil of N turns and area A m^2 is suspended in a uniform magnetic field of flux density B Tesla. Initially the plane of the coil is parallel to the magnetic field. Derive the expression for the initial couple on the coil when a current of I amperes flows through it. (5 marks)

(d) A narrow vertical rectangular coil is suspended from the middle of its upper side with its plane parallel to the uniform magnetic field of 0.05T. The coil has 20 turns and the length of its vertical and horizontal sides are 0.4cm and 0.3cm respectively.

(i) Calculate the torque on the coil when the current of 2A is passed through it. (3 marks)

(ii) Draw a sketch showing direction of current, field and torque. (1 mark)

Question 6

(a) (i) Derive the expression for the force experienced by an electron moving at an average velocity V in a wire placed at right angles to a magnetic field of flux density B. (4 mark)

(ii) An electron beam moving with velocity of 100ms^{-1} passes through a uniform magnetic field of flux density 0.02T which is perpendicular to the direction of the beam. Calculate the force on each of the electron. (3 marks)

(b) (i) Write the formula for the force between two parallel straight wires of infinite length carrying currents I_1 and I_2 in the same direction. (1 mark)

(ii) Use the formula above to define the ampere. (2 marks)

(ii) Two thin long parallel wires A and B carry currents of 2A and 3A respectively in opposite directions. If the wires are separated by a distance of 2.5cm in a vacuum. Calculate the force exerted by wire B on 1m of wire A. (3 marks)

(c) Describe the absolute measurement of current using an ampere balance. (5 marks)

(d) Write down the formula for magnetic flux density at the end of a solenoid of length L Currying current I and placed in a magnetic field in free space. Define all the terms. (2 marks)

Question 7

(a) Distinguish between electrical **resistance** and **reactance**. (2 marks)

(b) An alternating current I flows through a coil of inductance L. The instantaneous value of current is $I = I_o \sin 2\pi ft$, where I_o is the amplitude and f the frequency.

(i) Derive an expression for the voltage V across the coil. (4 marks)
(ii) State the phase of V relative to that of I. (1 mark)

(iii) If the coil is a pure inductor, explain why it is non-dissipative. (3 marks)

(c) With the aid of a diagram describe the structure and mode of operation of an a.c transformer. (5 marks)

(d) An 8.64kW transformer steps down Voltage from 240V to 30V. If the secondary coil has 150 turns and the transformer is 80% efficient, find;
(i) The number of turns in the primary coil. (2 marks)
(ii) The current flowing in the primary coil. (3 marks)

SECTION D

Question 8

(a) Define the term Dielectric. (1 marks)

(b) (i) Describe the charging and discharging process of a capacitor (5 marks).
(ii) Plot a graph of current against time for the charging and discharging process of a capacitor (2 marks)

(c) (i) Two concentric spheres A and B with radii a and b respectively are placed in free space. If A is charged Q+ and B is earthed. Show that the capacitance of the of the two concentric spheres is given by; $C = \frac{4\epsilon_0 \pi ab}{b-a}$ (4 marks)

(ii) Suppose $b = 5cm$ and $a = 2cm$ and the two concentric spheres are separated by a material of permitivity $8.0 \times 10^{-11} Fm^{-1}$. Find the capacitance of the concentric spheres. (2 marks)

(d) (i) State the law of force between two point charges. (1 mark)
(ii) Four charges of magnitude -4μC, +8μC, +3μC and +5μC act at corners A, B, C and D respectively of a square of sides 4cm. Find the resultant force on the charge at C. (4 marks)

Question 9

(a) (i) State Ohm's law. (1 marks)

(ii) Using a pair of dry cells, an ammeter, a switch, rheostat and a resistor and a voltmeter, describe an experiment to verify Ohm's law. (5 marks)

(b) (i) Explain why the temperature of a conductor increase when current passes through it. (3 marks)

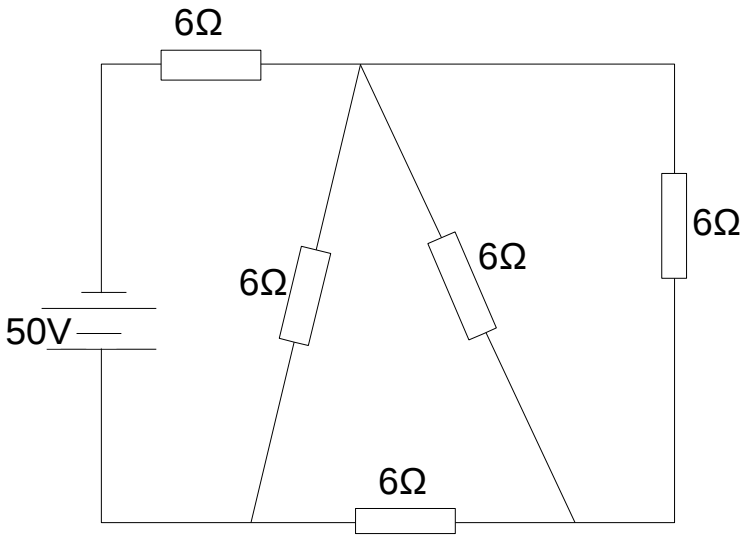
(ii) A conductor of length L and cross sectional area A has n free electrons per unit volume each of charge e. Show that the formula for the drift velocity of the electrons if a current I flows through the conductor is given by $v = \frac{I}{neA}$. (4 marks)

(c) (i) Write a formula for effective resistance R of three resistors arranged in parallel. (1 marks)

(d) The figure below shows a network of resistors connected to a battery of Emf 50V and internal resistance 0.4Ω calculate.

(i) Effective resistance in the circuit (4 marks)

(ii) Power dissipated in the battery. (2 marks)



Question 10

(a) (i) Define the term potential divider. (1 marks)

(ii) Derive the potential divider formula for two resistors of resistances R_1 and R_2 connected in series. (3 marks)

(b) A rheostat of resistance 100Ω is connected in series with a resistor of 20Ω and a battery of 10V. A voltmeter of resistance 5 is connected across a rheostat. If the slider is moved a quarter way the rheostat. Find the reading of the voltmeter. (5 marks)

(c) (i) With aid of a circuit diagram, explain how you would standardize a potentiometer using a standard cell. (4 marks)

(ii) Give any two advantages of a potentiometer over an ordinary voltmeter. (2 marks)

(d) With aid of a circuit diagram describe how a slide wire potentiometer can be used in the determinations of the internal resistance of a dry cell. (5 marks)

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