MENGO SENIOR SCHOOL

END OF TERM 1 2003

S.6 PHYSICS

PAPER 2

TIME: 2 HOURS

INSTRUCTIONS:
-Attempt any four questions
-The following constants may be assumed
Acceleration due to gravity g= 9.81m/s^2
Electron mass m= 9.11 x 10^{-31} kg
Electron charge e=1.6 x 10^{-19}C
The constant $\frac{1}{4\pi\Sigma o}$ = 9.0 x 10^9 F^{-1}m

QN.1

(a)(i) State the laws of refraction of light.

(ii) Monochromatic light incident from a vacuum onto a glass block of thickness t and refractive index n, making an angle of refraction .

Show that the time taken for the light to propagate through the block is given by

Time = $\frac{nt \sec}{C}$

Where C is the velocity of light in a vacuum.

(b)(i) With aid of suitable diagrams, explain the terms critical angle and total internal reflection.

(ii) Light from a luminous point on the lower face of a rectangular glass slab 2.0cm thick, strikes the upper face and the totally reflected rays outline a circle of 3.2cm radius on the lower face.

What is the refractive index of the glass.

(c) The figure below shows two transparent plates x and y between which is a layer of liquid.
The refractive indices of x and y are 1.54 and 1.44 respectively.

A ray of light from x propagates just as shown. Find the,

(i) Refractive index of the liquid.
(ii) Angle of refraction r in medium y
(iii) The minimum angle of incidence in medium x for which the light will not emerge from medium y.

QN.2

(a)(i) Differentiate between the terms Dispersion and deviation of light by a prism.

(ii) A Converging lens of focal length 6cm is placed 10cm from screen. A diverging lens of focal length 12cm is now placed between the converging lens and the screen such that, an image of an object 24cm from the converging lens if focused on the screen.
Find the distance between the two lenses and sketch a ray diagram to show the formation of the final image.

(b)(i) Explain the terms spherical and chromatic aberration as applied to a converging lens.

(ii) The curved surface of a planoconvex lens has a radius of curvature of 4cm and is made of crown glass whose refractive index is 1.515 and 1.520 for red and blue light respectively.
Calculate the longitudinal chromatic aberration for the lens.

(c) A Concave lens of focal length 20 cm is placed 45cm to the right of a convex lens of focal length 30cm. A small object is placed 50cm to the left of the converging lens. Find:

(i) The position and nature of the final image.

(ii) The linear magnification.

(iii) The magnification produced by a thin converging lens is m. When the lens is moved a distance d towards the object, the magnification becomes m^1. Show the focal length f, of this lens is given by,

$$F = \frac{dmm^1}{M^1 - m}$$

QN.3

(a)(i) Define the term angular magnification as applied to optical instruments.

(ii) Sketch the path of three rays through a Galilean telescope in normal adjustment.

(iii) List two advantages and two disadvantages of this telescope over the astronomical telescope in the same adjustment.

(b)(i) Galilean telescope has an objective and eye piece of focal lengths 25cm and 5cm respectively. Calculate the angular magnification produced when the system is used to view an object a distance of 4m from the objective if the final image is formed at least distance for distinct vision (25cm) from the eye piece.

(ii) A compound microscope has an objective and eyepiece of focal lengths 2cm and 5cm respectively. It forms an image of an object placed 2.5cm in front of the objective at the near point. Find the lens separation.

(c) Mono chromatic light is incident at an angle of 45^0 on a glass prism of refracting angle 70^0 in air. The emergent light grazes the other reflecting surface of the prism. Find the refractive index of the glass.

(d) Lens L_1 costs a real image of a distant object on a screen 15cm away. Another lens L_2 is placed 5cm beyond L_1 such that the screen needs to be shifted 10cm further away in order to locate the real image formed. Determine the focal length of L_2.

QN.4

(a)(i) State Coulomb's law of electrostatics.

(ii) Define the terms electric field intensity and electric potential at a point in space.

(b) An electron is situated in an electric field of intensity 1.2×10^5v/m. Find:

(i) The force on it

(ii) It's acceleration

(iii) The time it takes to travel 20mm from rest.

(c)(i) Derive the relationship between the potential difference in a electric field and the electric field intensity.

(ii) An oil drop of mass 2×10^{-4} kg carries a charge Q. The drop is plates 20mm apart with a p.d of 500v between them. Find the value of charge Q.

(iv) Three charges of -3×10^{-9}C, $^{+}4 \times 10^{-9}$C and 3×10^{-9}C are placed in a vacuum at the corners P,Q and R respectively of a rectangle PQRS of sides 3cm and 4cm as shown below:

Find the electric field intensity at S.

QN.5

(a) State Kirchh off's laws for electrical circuit networks.

(b) In the circuit shown below, Find:

(i) The value of the current I.
(ii) The power dissipated by the 4 resistor.

(c)(i) State the term ohm.

(iii) State the ohm's law for electrical resistance.

(iii)

In the circuit shown above, find the value of R and the potential drop across AC.

(d)

In the circuit above, find the directions and magnitudes of the currents i_1, i_2 and i_2

QN.6

(a)(i) Define the term capacitance of capacitor.

(ii) Explain the action of a dielectric material placed between plates of a charged capacitor.

(b)

A battery of e.m.f 200v is connected across a system of capacitors shown above.

(i) Find the p.d across the 2 F capacitor when it's fully charged.

(ii) Calculate the total energy stored in the system of capacitors.

(iii) If the space between the plates of the 4 F capacitor is now filled with a material of dielectric constant 4, what is the charge in the energy stored in the system of capacitors.

(c)(i) Define the term electrical resistivity and temperature coefficient of resistance of a material.

(ii) A battery of e.m.f 12v and negligeable internal resistance is connected to the ends of a metal of length 50cm and cross-sectional area 2×10^{-7}m. If the resistivity of the material of the wire is 1.2×10^{-6} m, at what rate is heat generated in the wire.

Derive the balance condition for the wheat stone bridge circuit.

(d)

The figure shows an unbalanced bridge. P is a coil of resistance 30 and 0^0C.

(i) Calculate the current through the 8 resistor and that through the 4 resistor.

(ii) The potentials at A and B.

(iii) If a galvanometer is placed between A and B. What will be the direction of current flow through the galvanometer.

(iv) If the t.c.r of the material of coil is $4 \times 10^{-3}K^{-1}$, to what temperature must the coil be raised for the bridge.

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