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**END-OF-YEAR EXAMINATIONS**

**November 2010**

**PHYSICS**

**Paper 2**

*2 hours 30 minutes*

**INSTRUCTIONS TO CANDIDATES**

*Attempt* ***FIVE*** *questions only*

*Assume where necessary:*

*Acceleration due to gravity, g = 9.81 ms-2*

*Speed of light in vacuum, c = 3.0 x 108 ms-1*

*Electron charge, e = 1.6 x 10-19 C*

*Electron mass, me = 9.11 x 10-31 kg*

*Permeability of free space, µ0 = 4.0 π x 10-7 Hm-1*

*Permittivity of free space, ε0 = 8.85 x 10-12 Fm-1*

1. (a) (i) Distinguish between ***angle of incidence***  and ***glancing angle*** for a ray that is incident on a surface. (2)

(ii) A ray is incident on a plane mirror. The ray is kept fixed in direction while the mirror is rotated through an angle α. Derive the relationship between the rotation of the reflected ray and the angle α. (3)

(iii) Explain the action of a device that applies the principle in (a)(ii) above. (5)

(b) Opio, whose height is 172 cm, plans to fix a plane mirror on a vertical wall in his room so that he sees the image of the whole of himself.

If his eyes are 12 cm below the highest point of his head, find

(i) how high above the floor the lowest edge of the mirror should be. (3)

(ii) the minimum height of the mirror. (2)

(c) You are provided with a small plane mirror, a metre rule, an optical pin and a convex mirror. Describe an experiment to determine the focal length of the convex mirror using the given apparatus. (5)

2. (a) (i) State the conditions for total internal reflection. (2)

(ii) Draw a labeled diagram of a named device to show(without description) an application of total internal reflection. (2)

(b) Explain how a fish in a pond is able to enjoy a 180o field of view. (3)

(c) Show that when a ray of light passes through different media separated by plane boundaries

***n sin i* = constant**

where ***n*** is the absolute refractive index of a medium and ***i*** is the angle made by the ray with the normal in the medium. (4)

(d) Describe an experiment to measure the refractive index of glass of rectangular shape by the apparent depth method. (4)

(e) The figure below shows a liquid of refractive index 1.33 enclosed by glass of uniform thickness.

A

θ

Q

P

R

A ray of light, incident on face PQ at an angle of incidence, θ, emerges through face QR. As the angle θ is reduced, suddenly the emergent ray disappears when θ = 16o.

Find the angle A. (5)

3. (a) What is meant by

(i) focal length of a diverging lens. (1)

(ii) conjugate points for a lens. (1)

(b) Draw a ray diagram to show how a converging lens forms a real image of a virtual object. (2)

(c) Two lenses of respective focal lengths f1 and f2 are placed coaxially in contact.

Derive an expression for the focal length of the combination. (5)

(d) Describe an experiment to determine the refractive index of a liquid using a plane mirror and a converging lens. (5)

(e) A lens L1 forms a real image, at A, of a distant object.

A

L1

When another lens, L2, is placed between L1 and point A, at a distance of 10 cm from L1, the image shifts by 4 cm towards L1. When L2 is placed 5 cm from L1, the image shifts further by 3.5 cm towards L1. Find the focal length of each lens. (6)

4. (a) (i) What is meant by ***electrostatic induction***? (1)

(ii) State the advantages of charging by induction. (2)

(b) Explain why a neutral conductor is attracted by charged body nearby. (3)

(c) Describe an experiment to investigate the charge distribution over a conductor, showing how the conclusion is arrived at. (4)

(d) (i) Derive an expression for the electric potential at a distance d from a point charge Q in a medium of permittivity ε. (4)

(e) In the figure below, Q1 and Q2 are point charges of 3.0 µC and -2.0 µC respectively.

X

Q1 3 cm Q2

4 cm

Find

(i) the electric potential energy of Q2. (2)

(ii) the magnitude of the electric intensity at point X

(4)

5. (a) (i) Define ***capacitance***. (1)

(ii) What is meant by ***dielectric strength***? (1)

(iii) Explain the action of a dielectric. (4)

(b) Describe an experiment to show the relationship between capacitor charge and potential difference. (5)

(c) Derive an expression for the energy stored in a capacitor of capacitance, C, charged to a voltage V. (5)

(d) In the figure below calculate the energy stored in the system.

(4)

22 V

40 µF

20 µF

10 µF

30 µF

6. (a) (i) What is meant by ***potential difference***? (1)

(ii) Define a ***volt***. (1)

(b) Explain why the terminal p.d across a source decreases when a bigger current is drawn from the source. (3)

3 Ω A 2 Ω

4 Ω

1 Ω B 5 Ω

2V

2V

3V

(c)

In the circuit shown above, find

(i) the current flowing in the 4-ohm resistor. (4)

(ii) the p.d between points A and B. (2)

(d) Describe an experiment to measure the internal resistance of a cell. (5)

(e) When a battery of emf 3 V is connected in series with a cell C, the combination gives a balance length of 90.0 cm. When cell C is reversed, the balance length falls to 18.0 cm. What is the emf of cell C? (4)