

**PHYSICS DEPARTMENT**

**BEGINNING-OF-TERM III EXAMINATIONS**

**September, 2015**

**S5 PHYSICS**

**Paper 2**

**2 hours 30 minutes**

**INSTRUCTIONS TO CANDIDATES:**

*Attempt* ***ALL*** *questions*

*Assume where necessary:*

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

**FOR EXAMINER’S USE ONLY**

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| --- | --- | --- | --- | --- | --- | --- |
| Question |  |  |  |  |  | Total |
| Marks scored |  |  |  |  |  |  |

1. (a) (i) State the properties of an image formed by a plane mirror. (2)

(ii) What is meant by the **radius of curvature** of a spherical mirror? (1)

(b) (i) Sketch a ray diagram to show how a spherical mirror forms a real image of an object of height h. (2)

(ii) Using the sketch in (i) derive an expression for the focal length of a spherical mirror. (4)

(c) You have a metre rule and you are provided with an optical pin, a small plane mirror and a convex mirror, all in their holders.

Describe an experiment, using only what you have, to determine the focal length of the convex mirror. (5)

(d) A spherical mirror forms a real image which is the same size as the object. When the object is shifted by 7cm along the principal axis, and the screen moved accordingly, the image becomes twice the size of the object. Find

(i) the focal length of the mirror (4)

(ii) the final object distance (2)

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

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

(b) 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)

(c) Describe how to determine the refractive index of a liquid using a concave mirror, explaining the theory involved. (6)

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

A

θ

Q

P

R

Air

A ray of light, incident from air 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

(i) **an equipotential**? (1)

(ii) **electric intensity** at a point. (1)

(b) Explain the fact that the electric potential over a charged conducting sphere is lowered when a neutral conductor is brought nearby. (3)

(c) (i) Explain **corona discharge** (3)

(ii) With the aid of a diagram describe how a Van de Graaf generator works (6)

(d) Q1 and Q2 are point charges of **-3μC** and **4μC** respectively, separated by a distance of 5cm

5cm

Q1

Q2

Determine

(i) the magnitude and direction of the electric force acting on Q2. (2)

(ii) the work done in increasing the separation of the charges to 8cm (4)

4. (a) (i) State the factors that determine the energy stored by a capacitor. (2)

(ii) A parallel-plate capacitor is charged and then isolated. When the separation of its plates is increased,account for the change in the energy stored by the capacitor. (2)

(b) (i) Using the same axes, sketch the graphs of p.d across the capacitor against time and charging current against time during the charging process.

(2)

(ii) Explain what happens to the p.d across an isolated charged capacitor when an insulating material is inserted between its plates. (2)

(c) Describe an experiment to measure the permittivity of air using the vibrating-reed switch arrangement. (5)

(d) In the circuit shown below are parallel-plate capacitors with air as the dielectric. C1 = 20μF, C2 = 30μF, and C3 = 10μF.

200V

C1

C2

C3

(i) Find the energy stored in the system. (3)

(ii) If now the space between the plates of C2 is filled with a substance of dielectric constant 2, what will be the change in the energy stored in the system? (4)

5. (a) (i) What is a **passive resistor**? (1)

(ii) Explain why the resistance of a metallic conductor increases with the temperature of the conductor. (2)

(iii) Sketch a graph of current against p.d for an ohmic resistor and another for a named non-ohmic resistor. (2)

(b) (i) What is meant by **terminal p.d** in a circuit? (1)

(ii) Explain why the terminal p.d falls as the current drawn from the source increases. (3)

(c) Describe an experiment you would perform to investigate the relationship between the length of a metallic wire and its resistance. (5)

2Ω

4Ω

3Ω

X

A

(d)

In the circuit shown, X is a source of emf 6V and internal resistance 1Ω. What is the reading of the ammeter A? (6)