**PHYSICS DEPARTMENT**

**BEGINNING-OF-TERM II EXAMINATIONS**

**May, 2015**

**S5 PHYSICS**

**Paper 2**

**2 hours**

**INSTRUCTIONS**

*Attempt* ***ALL*** *questions   
Assume where necessary:*

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

1. (a) (i) State the laws of reflection. (2)

(ii) Distinguish between **regular reflection** and **diffuse reflection**. (3)

(b) (i) Show that if the incident ray is kept constant but the mirror is rotated, the reflected ray is rotated by twice the angle. (4)

(ii) Mention one application of the principle in (a)(ii). (1)

(c) (i) Distinguish between **glancing angle** and **angle of incidence**. (2)

(ii) Two plane mirrors A and B are inclined at right angles to each other. A ray of light is incident on A. Show that after the subsequent reflection on B it will emerge parallel to its original path. (3)

(d) The figure shows a pair of parallel plane mirrors X and Y.

X

Y

O

A

A ray OA is incident at A on mirror X.

(i) Copy the diagram and show how the ray finally emerges from mirror second mirror Y. (1)

(ii) Mention and describe one application of the arrangement in (c)(i). (4)

2. (a) (i) For a spherical mirror, what is meant by **radius of curvature**? (1)

(ii) Show that the focal length of a spherical reflector is half the radius of curvature. (3)

(b) Sketch a ray diagram to show how a concave mirror forms a real

(i) diminished image of a real object (1)

(ii) magnified image of a real object (1)

(c) (i) State the sign convention applied in ray optics. (1)

(ii) By referring to a convex spherical mirror, derive the mirror formula.

(5)

(d) A concave mirror forms an image on a screen 60 cm from the mirror. When the mirror is shifted backwards by 7.0 cm, the screen has to be placed 33.8 cm from the mirror for a sharp image of the object.

Find

(i) thedistance of the object from the mirror in each case. (6)

(ii) the focal length of the mirror (2)

3. (a) What is meant by the following?

(i) Electric charge (1)

(ii) Electric field (1)

(b) (i) What is electrostatic induction? (1)

(ii) Describe how a positively charged conductor may be kept at zero potential. (3)

(iii) Explain how an electrophorus acts as an almost inexhaustible source of charge, pointing out the energy conversion it employs. (5)

(c) Describe an experiment to investigate the charge distribution over a conductor, showing how the conclusion is arrived at. (5)

(d) The diagram shows two conductorsQ and R placed apart and each held by an insulating handle. A positively charged plate P is placed mid-way between them but without touching them.

P

Q

R

The conductors, Q and R, are momentarily earthed in the presence of P. Finally P is withdrawn.

(i) Draw the conductors at the end of the operation and show the charge distribution over them. (2)

(ii) On the same diagram sketch the electric field pattern in the region of Q and R. (2)

4. (a) (i) Define electric potential (1)

(ii) Derive an expression for the electric potential at a point d metres from an isolated point charge Q in a medium of permittivity ε. (5)

(b) In the figure below, Q1 and Q2 are point charges. Q1 = **3** μC and

P

Q1

Q2

10cm

10cm

10cm

Q2 = **-4**μC

Find

(i) the electric potential at point P (4)

(ii) themagnitude of the electric intensity at point P (5)

(iii) the electric potential energy of Q2 (2)

(iv) the location of a point A between Q1 and Q2 where the electric intensity will be zero (3)