

**PHYSICS DEPARTMENT**

**S 5 END OF YEAR EXAMINATION**

**November 2011**

**Paper 2**

**2 hrs 40 min**

Attempt **ALL** the questions.

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| Questions Attempted |  |  |  |  |  |
| Marks obtained |  |  |  |  |  |

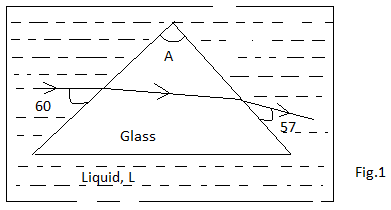
Where necessary, use the following constants:

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

1. (a) (i) State the laws of refraction of light. (2 marks)

(ii) With the aid of ray a diagram, explain why a pond appears to be shallow when viewed directly from above. (3 marks)

(b) Draw a well-labelled diagram of the telescope part of the spectrometer and describe how it can be adjusted. (4 marks)



In Fig. 1, a ray of light passing through a liquid of refractive index 4/3 is incident on a prism of refractive index 3/2. Find the refracting angle, A, of the prism. (4 marks)

(d) Describe an application of a convex mirror. (2 marks)

(e) A window of area 1.44m2 is 100cm in front of a curved mirror. If an image of area 36cm2 forms on a screen in front of the mirror, find the:

(i) Magnification of the image. (2 marks)

(ii) Focal length of the mirror. (3 marks)

2. (a) Define principal focus of a diverging lens. (1 mark)

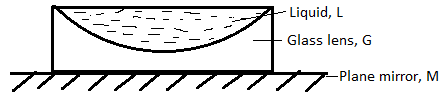
(b) Explain the effect of a convex lens on a parallel beam of light. (3marks)

(c) (i) Draw a ray diagram to show how a bi-convex lens forms an image of an object placed perpendicular to its principle axis and between the focal plane and the pole. (2 marks)

(ii) Describe how the set-up in 2 (b) (i) above can be used. (2 marks)

(d) A lens is fixed in a tube opened at both ends. Describe an experiment to measure the focal length of the lens. (6 marks)

(e) A plano-concave glass lens of refractive index 3/2 and surface radius 12 cm filled with a liquid, L, is placed on a plane mirror facing up as shown in figure 2. A horizontal pin, viewed from above the combination coincides with its image at 72cm from the mirror.

 Fig. 2

Find the refractive index of liquid L. (6 marks)

3. (a) Explain how objects get charged by rubbing. (3 marks)

(b) The diagram shows two metallic spheres A and B placed apart and each supported on an insulating stand. A positively charged plate C is placed mid-way between them but without touching them.

A

C

B

A +

+

B is momentarily earthed in the presence of C. Finally C is withdrawn.

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

(ii) On the same diagram sketch the electric field pattern in the region of the spheres. (2 marks)

(iii) Explain the change in p.d between the spheres as the spheres are moved further apart. (2 marks)

(c) (i) Describe an experiment to investigate the distribution of charge over a conductor. (5 marks)

(d) In the figure below Q1 = **-2C**, Q2 = **+2C** and Q3 = **+3C**

20cm

Q1

Q2

Q3

Find the resultant electric field intensity at point P, midway between Q1 and Q2, due to the charges. (6 marks)

4. (a) (i) State Kirchhoff’s circuit laws. (2 marks)

(ii) In the circuit shown below find the current through the 10 Ω resistor.

(4 marks)

5Ω 4Ω

3V

10Ω

1V

2V

3Ω 4Ω

(b) (i) Explain the principle of a slide wire potentiometer. (4 marks)

(ii) State one advantage of using a potentiometer over a moving-coil voltmeter. (1 mark)

(c) In a potentiometer experiment the following circuit was set up.

A

G

R

y

M

N

2V

The ammeter, A, reads 0.1 A and the balance length, y, found for the 2V cell is 30 cm. MN is a uniform wire of length 100 cm.

When the 2V cell is replaced with another cell, X, the balance length becomes 50 cm and when the two cells are connected in series the combination gives a balance length of 90 cm.

Determine the

(i) resistance per cm of MN. (5 marks)

(ii) value of resistance R (2 marks)

(iii) emf of cell X. (2 marks)

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

(ii) Distinguish between **dielectric constant** and **dielectric strength** of a substance (2 marks)

(iii) Describe an experiment to determine the dielectric constant of a substance by the vibrating-reed switch method. (6 marks)

(b) Derive an expression for the energy stored in a capacitor. (6 marks)

(c) The following operations were carried out on two parallel-plate capacitors A and B, each of capacitance 6µF, having air as the dielectric.

I: Each was separately charged to a p.d of 120 V and then isolated

II: A substance of dielectric constant 3 was inserted in between the plates of B to completely fill the space.

III: The capacitors were finally connected in parallel, similar charged plates being connected together.

Find the final p.d across the combination. (5 marks)