RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. FIRST SEMESTER EXAMINATION, DECEMBER 2013

FIRST YEAR

Date : 21/12/2013 **PHYSICS (General)**

Time : 11 am – 1 pm Paper : I Full Marks : 50

[Use a separate answer book for each group]

Group – A

(*Answer **any two** questions*)

1. a) Define rigidity modulus. Obtain the relation between rigidity modulus and bulk modulus. [2+3]

   b) Show that the torsional couple per unit twist of a wire of length ℓ and radius r is $\frac{n\pi r^4}{2\ell}$ where n is the rigidity modulus of the material of the wire. [5]

2. a) A piece of camphor placed on water moves to and fro. Explain the phenomenon. [2]
   b) Deduce an expression of excess pressure over a curved liquid surface. [5]
   c) Two soap bubbles of radii 4 cm and 5 cm are joined together so as to have common surface. Find the radius of this common surface. [3]

3. a) Water meniscus in a glass capillary tube is concave while that of mercury in the same tube is convex. Explain the reason. [2]
   b) Obtain an expression for the rise of liquid in a capillary tube in terms of surface tension and angle of contact. [5]
   c) A small hollow sphere has small hole in it. Keeping the hole uppermost, the sphere is immersed in water and it is found that water starts penetrating into the hole when the sphere is at a depth of 0·36 m. If the surface tension of water is 0·072 Nm^{-1}, find the diameter of the hole. [3]

4. a) Write down the assumptions made to obtain Poiseuille's equation for liquid flow in narrow tube. [2]
   b) Deduce the Poiseuille's equation for streamline flow of liquid in a narrow tube. [5]
   c) A flat plate of area 20 cm^2 is separated from a large flat plate by a layer of glycerine 2 mm thick. What force is required to keep the upper plate sliding with respect to the lower plate with a speed of 1·5 $cm.s^{-1}$? Coefficient of viscosity of glycerine = 20 Poise. [3]

Group – B

(*Answer **any three** questions*)

5. What is chromatic aberration? Find the condition of achromatism of two thin lenses in contact with each other. [1+4]

6. Establish Fermat's principle from the laws of reflection at a plane surface. [5]

7. Two thin double convex lenses are placed in contact with a drop of water between them, so that the water forms a double concave lens. If each of the four surfaces has a radius of curvature 24 cm, what is the nature of the combination and its focal length? R.I of water = $\frac{4}{3}$, R.I of glass $= \frac{3}{2}$. [5]

8. Establish the relation $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{r}$ for any spherical surface. The symbols have the usual meanings. [5]

9. Describe Ramsden's eye-piece. Write down its advantage and disadvantage. [3+2]

Group – C

(*Answer **any three** questions*)

10. a) Explain the meaning of coherent sources. [1]

    b) The distance between two holes in Young's double slit experiment is 0·02cm. Find the distance of 5^{th} bright interference fringe on the screen from the central fringe when the system is illuminated with a monochromatic light of wavelength 600 nm. The distance between the screen and the light source is 80 cm. [4]

11. a) What do you mean by damping of oscillation? [1]

    b) Deduce an expression for the displacement of a damped oscillation. [4]

12. a) Establish the relation between particle velocity and wave velocity of a plane progressive wave. [3]

    b) The frequency of a tubing fork is 256 Hz. The amplitude of the wave produced by it is 5 mm. If the velocity of wave be 330 ms^{-1}, find the intensity of the propagated wave in air. The density of air is 1·29 kgm^{-3}. [2]

13. Obtain an expression for the velocity of longitudinal wave in a gaseous medium. [5]

14. When a man weighing 60 kg gets into a car, the centre of gravity of the car is depressed by 0·3 cm. If the mass of the car is 1000 kg, find the frequency of the vibration of the car when it is empty. [5]