RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, MARCH 2022

FIRST YEAR [BATCH 2021-24]

Date : 12/03/2022 **PHYSICS (General)**

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

Answer **any five** questions of the following: [5×10]

1. a) A cylindrical vessel of radius 7 cm is filled with water to a height of 50 cm. It has a capillary tube 10cm long, 0.2 mm radius, protruding horizontally at its bottom. If the viscosity of water is 0.01 C.G.S. units and g=980 cm/s^2 , find the time in which the level will fall to a height of 25 cm.

   b) What couple must be applied to a wire one meter long, 1 mm in diameter in order to twist one end of it, through 90^0, the other end remaining fixed. Rigidity of material of the wire is 2.8×10^{10} N-m^{-2}.

   c) Compare the loads required to produce equal depressions for two beams made of the same material and having the same length and weight with only difference that one has circular cross-section while the cross-section of the other is square. [4+2+4]

2. a) A shaft of diameter 8 cm and length 5 meters is transmitting power of 8 kilowatts at 300 revolutions per minute. If the coefficient of rigidity of the material of the shaft be 8×10^{11} dynes/cm^2 , find the relative shift between the ends of the shaft.

   b) A train of simple harmonic waves is travelling in a gas along the positive direction of the x-axis, with an amplitude equal to 2 cm, velocity 300 meters/sec and frequency 400 Hz. Calculate the displacement, particle velocity and particle acceleration at a distance of 4 cm from the origin after an interval of 5 seconds.

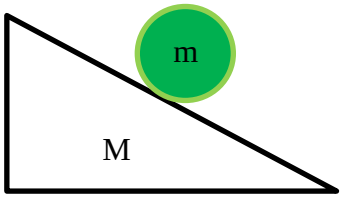
   c) Eight drops of water of the same size are falling through air with terminal velocity of 10 m/sec. If the eight drops combine to form a single drop what will the new terminal velocity? [4+4+2]

3. a) A wave of frequency 500 cycles/sec has a phase velocity of 360 meters/sec.

   i) How far apart are two points 60^0 out of phase ?

   ii) What is the phase difference between two displacements at a certain point at times 10^{-3} sec apart?

   b) As the figure states a ball of mass m is placed on a triangular inclined plane of mass M and angle φ. What force should you apply to the triangular inclined plane such that the ball should not move? [5+5]



4. Find moment of inertia of the followings

   a) Hollow and solid sphere with mass M and radius R
   b) Hollow sphere about axes at $\frac{R}{2}$ [6+4]

5. a) What is Fermat's principle.
   b) Prove law of refraction by Fermat's principle. [4+6]

6. a) What is achromatic doublet?
   b) How chromatic aberration can be removed by using achromatic doublet?
   c) What is eyepiece? Write two difference between Ramsden eyepiece and Huygen's eyepiece. [2+4+4]

7. a) How linearly polarized light can be produced?
   b) Prove $\tan i_p = \mu$ where i_p is the polarizing angle and μ is the refractive index for the denser medium.
   c) How dark and bright fringes can produce by young's double slit experiment. [2+2+(3+3)]

8. a) How dark and bright fringes are produced in Newton's ring experiment.
   b) How cutroll fringe is Newton's ring experiment can produce?
   c) Give two differences in Fresnul and Fraunhofer diffraction pattern? [(3+3)+2+2]

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