RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER TAKE-HOME TEST / ASSIGNMENT, JULY 2020

Date : 08/07/2020 **PHYSICS (General)**

Time : 11 am – 2 pm **Paper : II (Arrear)** Full Marks : 50

Answer all the questions from each group

Group – A [10×5]

1. a) Define angular momentum and torque on a particle. [.5+.5]

   b) Using these definitions determine the angular momentum and torque on a rigid body. [2+2]

2. A wheel of radius R=30 cm, mass M=2kg and moment of inertia I=0.09 kgm^2 is mounted on a frictionless, horizontal axle. A light cord wrapped around the wheel supports an object of mass m=0.5 kg. Calculate the angular acceleration of the wheel, the linear acceleration of the object and the tension in the cord. [5]

3. a) Show that the moment of inertia of a uniform solid sphere about an axis passing through its center is $(2/5)MR^2$ using the fact that the moment of inertia of a uniform hollow sphere about the same axis is $(2/3)MR^2$ [3]

   b) The center of mass of a baseball (3.8 cm radius) moves at 38 m/s. The ball spins about an axis through its center of mass with an angular speed of 125 rad/s. Calculate the ratio of the rotational energy to the translational kinetic energy. Treat the ball as a uniform sphere. [2]

4. a) Define central force. Show that the angular momentum of a particle moving under central force is conserved. [1+2]

   b) The Explorer VII satellite, placed into orbit to investigate the ionosphere, had the following orbit parameters: perigee = 459 km, apogee = 2289 km (both distances above the Earth's surface), and period = 112.7 min. Find the ratio v_p/v_a of the speed at perigee to that at apogee. [2]

5. a) What do you mean by acceleration due to gravity? When a falling meteoroid is at a distance above the Earth's surface of a 3 times the Earth's radius, what is its acceleration due to the Earth's gravity. [1+2]

   b) Find the gravitational field at a distance *r* along the axis of a thin ring of mass *M* and radius *a*. [2]

6. a) How do transverse wave differ from longitudinal waves? [2]

   b) Two sinusoidal waves are described by the equations: $y_1=5\ sin[\pi(4x-1200t)]$ and $y_2=5\ sin[\pi(4x-1200t-0.25)]$ where *x*, y_1 and y_2 are in m and *t* is in s. (i) What is the amplitude of the resultant wave? (ii) What is the frequency of the resultant wave? [1.5+1.5]

7. a) Explain why two flashlights held close together do not produce an interference pattern on a distant screen. [2]

b) A viewing screen is separated from a double-slit source by 1.2 m. The distance between the two slits is 0.03 mm. The second-order bright fringe is 4.5 cm from the center line. (i) Determine the wavelength of the light (ii) Calculate the distance between adjacent bright fringes. [1.5+1.5]

Group B

8. In a Newton's ring experiment, the diameter of the 15^{th} ring was found to be 0.590cm and that of the 5^{th} ring was 0.336cm. If the radius of the plano-convex lens is 100cm, calculate the wavelength of the light used. [5]

9. 550nm light falls normally on a slit of width 2.2 μm. Determine the angular position of second minima. [5]

10. Determine the Brewster's angle for glass of refractive index 1.5 immersed in water of refractive index 1.33. [5]

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