বিদ্যাসাগর বিশ্ববিদ্যালয়

VIDYASAGAR UNIVERSITY

B.Sc. Honours Examination 2021

(CBCS)

1st Semester

PHYSICS

PAPER—C2T & C2P

MECHANICS

Full Marks : 60

Time : 3 Hours

The figures in the right-hand margin indicate full marks.

*Candidates are required to give their answers in their
own words as far as practicable.*

THEORY : C2T

Group – A

Answer any *three* questions.   3×12

1. (a) Suppose you have two objects of mass m and M (M > m), distance between them being L. No other external force is present except the gravitational force between the two objects. Will both the masses move or any one of the masses move about the other or both of them will remain stationary ? Explain the motion.   4

(b) Mount Fuji has approximately the shape of a cone. The half-angle at the apex of this cone is 65 degrees, and the height of the apex is 3800m. At what height is the centre of mass? Assume that the material in Mount Fuji has uniform density. 5

(c) Is centre of mass always inside the object or can it be found outside the body? Give an example. 3

2. (a) Show that for a rigid body rotating uniformly, total angular momentum is equal to its moment of inertia about the rotation axis times the angular frequency of rotation. 5

(b) An ice dancer rotates herself while dancing in various postures. What happens if the dancer is rotating with extended hands and suddenly folds her hands as shown in the picture? 3
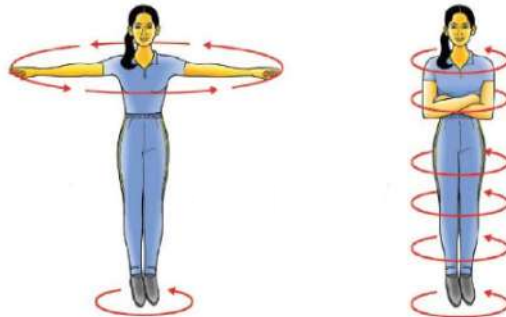
(c) Show that the moment of inertia of a solid sphere about its diameter is $(2/5)$ MR^2. 4

3. (a) Define stress and strain. What is Young's modulus? How will the Young's modulus of an iron rod change if the length is doubled?
2+2+2+2

(b) The earth and sun are 8.3 light-minutes apart. Ignore their relative motion for this problem and assume they live in a single inertial frame, the Earth-Sun frame. Events A and B occur at t = 0 on the earth and at 2 minutes on the sun respectively. Find the time difference between

the events according to an observer moving at u = 0.8c from Earth to Sun. Repeat if the observer is moving in the opposite direction with same speed. 4

4. (a) Find the centre of mass of the mosquito coil given below in the figure. The spiral is given by the equation: $r = r_0 (\exp(b\theta) - 1)$. Assume linear mass density of the coil to be λ. How will the centre of mass shift when the coil starts to burn? 4+4

(b) A spherical ball of ice has radius R_0 and is rotating with an angular speed ω about an axis passing through its centre. At time t = 0, it starts acquiring mass because the moisture (at rest) around it starts to freeze on it uniformly. As a result, its radius increases as R(t) = $R_0 + \alpha t$, where α is a constant. Show that, angular frequency varies inversely as the square of time. 4

5. (a) State the condition for an over damped oscillator and show that under this condition, any initial displacement of the system will die out without any oscillation. 5

(b) Establish the condition for critical damping. 3

(c) A particle of mass m moves along the x-axis with potential energy :

$$V(\mathrm{x}) = \frac{E_0}{a^4} x^4 + 4ax^3 - 8a^2 x^2 .$$

Find the position at which the particle will be in stable equilibrium. Find the angular frequency of small oscillation about each stable equilibrium position. 4

6. (a) Is it possible to derive Newton's 1st law from Newton's 2nd law ?

3

(b) Define pseudo-force. Is earth an inertial frame or a non-inertial frame ? Justify your answer.

4

(c) If we fill a bucket with water and spin it, the surface of water assumes a concave shape. What is the shape ?

5

Group – B

Answer any *two* questions.

2×2

7. What was the aim of Michelson Morley experiment ? Was it successful ?

8. Determine the dimension of coefficient of viscosity using Poiseuille's formula.

9. What are the factors which influence the sharpness of resonance ?

10. What is the origin of "Tension" force in a string ?

PRACTICAL : C2P

Answer any *one* question.

1×15

1. Suppose you have 10 measurements and obtained following values of "g" in m/s^2 unit:

9.81268712, 9.82268734, 9.7999204, 9.81154367, 9.8133542, 9.798657, 9.824532, 9.8076578, 9.8156734, 9.7992543. Then how would you report your result ? Upto how many significant figures should you report your result ?

12+3

2. Write down the working principle of the process of measurement of moment of inertia of a flywheel.

15

3. Explain how you would calculate the value of "g" of a bar pendulum.

15

Answer any *one* question. 1×5

4. Explain the procedure to determine the elastic constants of a wire by Searle's method. 5

5. Discuss briefly the procedure to measure the length (or diagram) of a rod using vernier caliper, screw guage and travelling microscope. 5

6. LNB / Viva-voce.

———