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Reg. No. : .....

Name : .....

First Semester B.Sc. Degree Examination, January 2024

First Degree Programme under CBCSS

Physics

Complementary Course for Mathematics

PY 1131.1 : MECHANICS AND PROPERTIES OF MATTER

(2018-2022 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences. Each question carries **1** mark.

1. Explain moment of inertia in terms of torque.
2. What is the moment of inertia of a circular disc of 100 g and radius 10cm about its diameter?
3. When does a periodic motion become oscillatory?
4. Explain the principle employed for the determination of acceleration due to gravity by the compound pendulum.
5. Can we consider water waves and sound waves as mechanical waves? Explain.
6. Draw the diagram showing angle of twist and angle of shear.
7. Does the excess pressure inside a soap bubble be different from dimension?

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8. Does viscosity vary with temperature? Give details.

9. Explain the expression for torsional rigidity.

10. What is a beam?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions, not exceeding a paragraph. Each question carries **2** marks.

11. State and explain parallel axes theorem.

12. What are the factors on which the radius of gyration depends?

13. Show that the centres of suspension and oscillation are interchangeable in a compound pendulum.

14. Why does a compound pendulum be preferred to a simple pendulum for the determination of the value of acceleration due to gravity?

15. Define a wave motion. Give its one dimensional differential equation.

16. Compare linear and angular SHMs with example.

17. Show that $Ae^{i\omega t}$ satisfied the simple harmonic motion.

18. Explain neutral surface.

19. How does the internal bending moment of a beam originate?

20. Explain the experimental arrangement to find out the Young's modulus of a material of rectangular bar arranged in non-uniform bending using pin and microscope.

21. What are the essential requirements necessary for measuring the surface tension of a liquid?

22. How do you measure the coefficient of viscosity of a liquid using Ostwald's viscometer if another liquid with known coefficient or viscosity is given in sufficient amount?

(8 × 2 = 16 Marks)

SECTION – C

Answer any **six** questions. Each question carries **4** marks.

23. A rectangular lamina with 40cm length and 8cm breadth has 100 g mass. Find its moment of inertia

    (a) about an axis through its centre and parallel to breadth and

    (b) about an axis passing through one of its corners and perpendicular to its plane.

24. A uniform spring of normal length l has a force constant k. It is cut into two pieces of lengths l_1 and l_2, such that $l_1 = nl_2$ where n is an integer. What are the force constants k_1 and k_2 of the two pieces respectively in terms of n and k?

25. Show that the energy density of a plane progressive wave is independent of distance x from the origin and time t.

26. Draw the distance versus period graph for a symmetric compound pendulum. Explain the determination of acceleration due to gravity at the place using it.

27. The depression of 3.6 cm is produced at the free end of a cantilever of circular cross section with diameter 1 cm when loaded with 200 g. Given the Young's modulus of the material of the rod 1 GPa. Find the length of the cantilever.

28. Determine the force required to separate two plates of glass of area 2.4 cm^2 each with a layer of water 1.2 μm thick. Surface tension of water= 70×10^{-3} N/m.

29. A spherical soap bubble of radius r is formed inside another bubble of twice the radius of the first. Calculate the radius of a single bubble which will have an excess of pressure equal to the difference of pressure between the inside of the inner bubble and the outside of the larger bubble.

30. A metal plate of area 10^{-2} m^2 rests on a castor oil layer of 2 mm thickness. Its coefficient of viscosity is 1.55 Nsm^{-2}. Calculate the force required to move the plate with a uniform speed of 3 cms^{-1}.

31. A small air bubble is rising from the bottom of jar containing mercury. If the radius of the bubble is 10 μm at a depth of 1 m, calculate the depth when its radius is 12.6 μm. Given the surface tension of mercury 567×10^{-3} Nm^{-1}, relative density of mercury = 13.6, atmospheric pressure 76 cm of mercury.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. **Each** question carries **15** marks.

32. Explain the simple harmonic oscillations of a coupled oscillator. Analyse whether this theory can be extended to a diatomic molecule.

33. Describe the theory of a compound pendulum and derive the equation of the period of oscillations. Hence explain the method of finding the acceleration due to gravity at a place using asymmetric compound bar pendulum.

34. Can we consider our finger as a cantilever? Explain. Derive the expression for the depression at the free end of a thin light beam clamped horizontally at one end and loaded at the other.

35. Derive the Poiseuille's formula. What are its limitations?

(2 × 15 = 30 Marks)
