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Reg. No. : .....

Name : .....

First Semester B.Sc. Degree Examination, June 2022

First Degree Programme under CBCSS

Physics

Complementary Course for Mathematics

PY 1131.1 : MECHANICS AND PROPERTIES OF MATTER

(2020 Admission Onwards)

Time : 3 Hours Max. Marks : 80

SECTION – A

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

1. Why does the flywheel be made with the whole mass being concentrated in its rim?

2. What are the factors on which the kinetic energy of a rotating body about an axis depends?

3. Why does a periodic motion be called harmonic motion?

4. What is a torsion pendulum?

5. Prove that the time period of a compound pendulum is the maximum when the length is zero.

6. What is a cantilever?

7. Write down the expression for the strain energy of a twisted cylinder.

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8. Does surface tension of liquids change with temperature? Give details.

9. Write down the dimension and unit of coefficient of viscosity.

10. According to Newton, what are the factors on which the viscous force on a fluid layer depends?

(10 × 1 = 10 Marks)

SECTION – B

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

11. Mention the features of a rigid body.

12. How do you identify a solid sphere from a hollow sphere of same size and mass?

13. Determine the moment of inertia of a uniform rod of length l and mass m about an axis through its centre and perpendicular to its length.

14. List out the features of a progressive simple harmonic wave.

15. Draw the energy diagram of a simple harmonic motion and explain it.

16. Can we consider a diatomic molecular as coupled oscillator? Explain.

17. Which are the characteristics of a wave motion?

18. What are energy density and energy current of progressive wave? How are they related?

19. What is compound pendulum? What are centre of suspension and centre of oscillation?

20. Distinguish between angle of twist and angle of shear.

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

22. What are the differences between uniform and non-uniform bending?

23. Explain torsional rigidity.

24. Mention the principle and applications of Jaeger's method.

25. Mention the limitations of Poiseuille's formula.

26. Differentiate between cohesive and adhesive forces.

(8 × 2 = 16 Marks)

SECTION – C

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

27. Determine the moment of inertia of earth about its axis of rotation by assuming earth as a solid sphere of uniform density 5520 kgm^{-3} and radius 6400 km. Also find the radius of gyration.

28. A rigid body is spinning with an angular velocity of 4 radians per second about an axis parallel to $3i - k$. passing through the point $i + 3j + k$. Find the velocity of the particle at the point $4i - 2j + k$.

29. A spring whose force constant is 100 Nm^{-1}, hangs vertically supporting a 1 kg mass at rest. Find the distance by which the mass should be pulled down so that on being released it may pass the equilibrium position with a velocity of 1 m/s. Find the frequency of oscillations.

30. A harmonic wave is given by $y = 10\sin 2\pi(0.4t - 0.5x)$. Find the amplitude, frequency, wavelength and velocity if x is in metres and t is in second.

31. Derive the expression for the period of oscillations of a torsion pendulum.

32. A uniform spring of force constant k is cut into two pieces whose lengths are in the ratio 1 : 3. Calculate the force constants of each piece.

33. A cantilever of length 1 m and uniform cross section shows a depression of 1 cm at the loaded end. Calculate the depression at a distance 50 cm from the fixed end.

34. A body suspended symmetrically from the lower end of a wire of length 1 m and diameter 3.14 mm oscillates about the wire as axis with a period of 1.57s. If the rigidity modulus of the material of the wire is 8 GPa. Calculate the moment of inertia of the body about the axis of rotation.

35. Find the force required to separate two thin circular glass plates of diameter 1.2 cm, which have a thin layer of water of thickness 1.2 μm in between them. Given the surface tension of water 72 mNm^{-1}.

36. Water is flowing through a horizontal pipe of 10 cm in diameter and 1 km in length at a rate of 10 litres per second Calculate the pressure difference required to maintain the flow in terms of the height of mercury if the coefficient of viscosity of water is 10^{-3} Nsm^{-2}.

37. A paint drop of radius 1 cm sprayed into one million droplets of the same size. Calculate the energy used if the surface tension of the paint is 35×10^{-3} Nm^{-1}.

38. The viscosity of water at 20°C is $10^{-3}Nsm^{-2}$. If its viscosity at 40°C is 0.65×10^{-3} Nsm^{-2} and at 80°C is $10^{-3}/3$ Nsm^{-2}, determine the values of the empirical constants used.

(6 × 4 = 24 Marks)

SECTION – D

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

39. Stare and explain the general theorems on moment of inertia. How are they useful in finding out the moment of inertia of rectangular lamina?

40. Discuss the oscillations of two particles connected by a spring and explain this can be extended to find out the vibrational states of a diatomic molecule.

41. Discuss 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 a symmetric compound bar pendulum.

42. Discuss the theory of the bending of beams and derive the expression for bending moment and flexural rigidity.

43. Deduce an expression for the difference in pressure on the two surfaces of a curved liquid film. Discuss its various cases.

44. Describe the working of Ostwald's viscometer with necessary theory. Explain the effect of temperature on the viscosity of liquids.

(2 × 15 = 30 Marks)
