Reg. No. : ....

Name : ....

First Semester B.Sc. Degree Examination, November 2019

First Degree Programme under CBCSS

Complementary Course for Home Science

PY 1131.5 : MECHANICS AND PROPERTIES OF MATTER

(2018 Admission Onwards)

Time : 3 Hours   Max. Marks : 80

SECTION – A

Answer **all** the questions. Answer should not exceed **2** sentences. Each question carries **1** mark :

1. Write an expression for the rotational kinetic energy of a body in terms of moment of inertia and angular velocity.

2. Write down the theorem of perpendicular axes in moment of inertia.

3. Write down the differential equation of a simple harmonic oscillator.

4. Define spherical wave.

5. What is meant by torsional rigidity?

6. What is the geometrical moment of inertia in the case of a rod of rectangular cross section?

7. Write down an expression for the excess pressure inside a soap bubble.

8. Define surface tension.

9. How does viscosity of liquids vary with temperature?

10. Define critical velocity.

(10 × 1 = 10 Marks)

SECTION – B

Answer **any eight** questions. Answer should not exceed **1** small Paragraph. Each question carries **2** marks :

11. Derive an expression for the moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane.

12. The mass of a flywheel is usually concentrated at the rim. Why?

13. Derive an expression for the energy density of a plane progressive wave.

14. Write down the equation of motion of two particles connected by a spring and derive the expression for its frequency.

15. Write down the equation of motion of simple pendulum and derive the expression for its time period.

16. Write down the expression to find the viscosity of a highly viscous liquid and explain the symbols.

17. What are the assumptions made in deriving Poiseuille's equation?

18. Derive an expression for the force between two glass plates, if a film of water of thickness 'd' is placed between it.

19. Explain why a drop of oil placed to over a clean surface of water spread out into a thin film, but floats as a globule upon a greasy surface?

20. Explain the terms neutral axis, plane of bending and bending moment.

21. Show that a hollow shaft is stronger than a solid shaft of the same mass.

22. Show that the radii of gyration of a circular disc and a circular ring of the same radius about a tangential axis are in the ratio $\sqrt{\dfrac{3}{2}}$.

(8 × 2 = 16 Marks)

SECTION – C

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

23. An annular disc of mass 2.4 kg and inner radius 12 cm and outer radius 15 cm makes 10 revolutions per second about its centre, axis of rotation being normal to the plane of the disc. Calculate the moment of inertia of the disc about this axis.

24. Calculate the work done in blowing a soap bubble of radius 4 cm. S.T. of soap solution = .025 Nm^{-1}.

25. The terminal velocity of a copper ball of radius 2 mm falling through a tank of oil is 6.5 cm/s. Find the viscosity of oil. Given density of copper = 8.9 × 10³ kgm^{-3}. Density of oil = 1.5 × 10³ Kgm^{-3}.

26. A liquid flows through two capillaries under the same pressure head. The length of the tubes are in the ratio 2 : 1 and their diameters in the ratio 2 : 3. Compare the rate of flow of the liquid in the two tubes.

27. A progressive harmonic wave is represented by the equation $y = 0.1 \sin 2\pi \ (0.2 \ x + 3t)$ distances are in centimetre and time in second. Find (i) the amplitude (ii) the wavelength (iii) the speed and (iv) frequency of the wave.

28. A weight of 10 kg is attached to one end of a copper wire for 4 m long and diameter 2 mm. Find the extension produced if Young's modulus of wire is 12.5 × 10¹⁰ N/m².

29. A wheel of mass 5 Kg and radius of gyration 40 cm is rotating at 500 r.p.m. Find the moment of inertia and kinetic energy of the wheel.

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30. A particle moving in SHM has a period of 0.001 sec and amplitude 0.5 cm. Find acceleration when it is 0.2 cm apart from its mean position and its maximum velocity.

31. Two plane pieces of glass have a water drop between them which is circular and of diameter 10 cm. If the glass plates are 0.05 mm apart, what force perpendicular to the plates will be required to separate them? Surface tension of water is 0.072 N/m.

(6 × 4 = 24 Marks)

SECTION – D

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

32. Describe Jaegar's experiment to determine the surface tension of a liquid. Give the advantages of the method.

33. State and prove parallel axis theorem. Derive the expression for moment of inertia of a solid cylinder about an axis passing through its centre and perpendicular to its length.

34. What is a cantilever? Derive an expression for the depression at the free end of a cantilever clamped at one end and loaded at the other end.

35. Derive an expression for the rate of flow of a liquid through a horizontal capillary tube. What are the limitations of Poiseuille's formula?

(2 × 15 = 30 Marks)

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