TB252347P

Reg. No :.....

Name :.....

BACHELOR'S DEGREE (C.B.C.S) EXAMINATION, MARCH 2025

2023 ADMISSIONS SUPPLEMENTARY

CHEMISTRY SEMESTER II - COMPLEMENTARY COURSE 2

PH2B02B23 - Mechanics and Crystallography

Time : 3 Hours **Maximum Marks : 60**

Part A

I. Answer any Ten questions. Each question carries 1 marks **(10x1=10)**

1. Relate angular acceleration, moment of inertia and torque.
2. A woman sits on a spinning stool with her arms folded. When she extends her arms, which of the following occurs? (a) She increases her moment of inertia, thus increasing her angular speed. (b) She increases her moment of inertia, thus decreasing her angular speed. (c) She decreases her moment of inertia, thus increasing her angular speed. (d) She decreases her moment of inertia, thus decreasing her angular speed. (e) Her angular speed remains constant by conservation of angular momentum.
3. A uniform square lamina has a moment of inertia I with respect to an axis passing through its center and perpendicular to its plane. What is its moment of inertia about an axis passing through an edge and perpendicular to the plane?
4. Define Piezo electric effect
5. Explain any two outcomes of superposition of waves.
6. A source moves towards a stationary observer with a speed of 10m/s. If the frequency of the source is 10Hz what will be the wavelength of sound heard by the observer? Speed of sound = 330m/s. a) 32m b) 34m c) 33m d) 31m
7. Describe briefly the phase of a harmonic motion.
8. Outline the process of un-damped oscillations. Give suitable example.
9. Draw graphs representing damped oscillations and forced oscillations.
10. Explain interplanar spacing in crystals.
11. Explain the most unsymmetrical and symmetrical crystal systems.
12. Aluminium has FCC structure with atomic radius r. Estimate the unit cell volume in terms of r.

Part B

II. Answer any Six questions. Each question carries 5 marks **(6x5=30)**

13. A jester in a circus is standing with his arms extended on a turn table rotating with angular velocity ω. He brings his arms closer to his body so that his moment of inertia is reduced to one third of the original value. Find his new angular velocity. Assume there is no external torque.
14. Calculate the moment of inertia of a copper sphere of radius 10 cm, about a tangent to the plane. Density of Copper is $8.9 \times 10^3 kgm^{-3}$.
15. Ultrasonic waves are to be produced by a magnetostriction oscillator using either iron or nickel rod of the same length 10 cm. Which one is suitable for the production of ultrasonic waves. Justify your answer. Given, density of iron = 7.8 x 10^3 Kg/m^3, Young's modulus of iron = 11.5 x 10^10 N/m^2, Density of Nickel = 8.9 X 10^3 Kg/m^3, Young's modulus of Nickel = 20.7x10^10 N/m^2.
16. An ambulance moves at 72 km/hour while sounding a siren with a frequency of 1500 Hz. Motorcyclists move at speeds of 20 m/s in opposite directions with ambulances. If the speed of sound in air is 340 m/s, then obtain the ratio of frequencies heard by motorcyclists when approaching and moving away from the ambulance.

17. A particle of mass 0.5 kg is executing SHM of amplitude 0.03m. When the particle passes through the mean position its kinetic energy is 10×10^{-3}J. Obtain the equation of motion of this particle of the initial phase of oscillation in 45°?

18. A spring with a spring constant of 1500N/m is compressed 0.87m. How much potential energy has been generated?

19. The equation of motion is $2 \times 10^{-4}\frac{\partial^2 x}{\partial t^2} + 4 \times 10^{-2}\frac{\partial x}{\partial t} + 5x = 0.124 sin 100t$ where, all quantities are in S.I units. Find the natural frequency of oscillation.

20. Explain any three types of simple crystal structure. For BCC iron, compute the interplanar spacing of the planes (220). The lattice parameter of iron is 0.2866 nm.

21. A beam of X-rays of wavelength 0.071 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the second-order diffraction.

Part C

III. Answer any Two questions. Each question carries 10 marks **(2x10=20)**

22. State and prove the theorem of (i) parallel axes (ii) perpendicular axes.

23. Describe in detail, any two methods for producing ultrasonic waves and mention two applications.

24. Set up the differential equation of forced oscillations and discuss its solution.

25. State and explain Bragg's law. Derive it and explain its application in crystal studies.