

SECOND SEMESTER B.Sc. DEGREE [SUPPLEMENTARY/IMPROVEMENT]
EXAMINATION, APRIL/MAY 2015

(UG—CCSS)

Core Course—Physics

PH 2B 03—PROPERTIES OF MATTER WAVES AND ACOUSTICS

(2013 Admissions)

Time : Three Hours

Maximum : 30 Weightage

Part A*Answer all questions.*

1. When an elastic material with Young's modulus Y is subjected to a stretching stress x , the elastic energy stored per unit volume is :

(a) $\frac{2y}{x}$

(b) $\frac{x^2}{2y}$

(c) $\frac{y^2}{2x}$

(d) $\frac{2x}{y^2}$

2. A spring of force constant k is cut into two equal parts. The force constant of each part is :

(a) $2K$.

(b) $\frac{K}{2}$.

(c) $\frac{K^2}{2}$.

(d) $4K$.

3. A material has Poisson's ratio $\sigma = 0.5$. If a uniform rod of it suffers a longitudinal strain of 2×10^{-3} , the percentage change in volume is :

(a) 0.2.

(b) 0.6.

(c) 0.4.

(d) Zero.

4. Which of the following substance has the highest elasticity ?

(a) Sponge.

(b) Copper.

(c) Steel.

(d) Rubber.

5. A person measures the period of a simple pendulum inside a stationary lift and finds it to be T . If the lift starts accelerating upwards with an acceleration of $g/3$, the time period of the pendulum will be :

(a) $\frac{\sqrt{3}}{2} T$.

(b) $\frac{T}{2}$.

(c) $2T$.

(d) T .

Turn over

6. A circuit contains $L = 10\text{mH}$, $C = 1\mu\text{F}$ and $R = 1\Omega$. The frequency of damped oscillations in rad/sec is :
- (a) 10^2 , (b) 10^3 ,
(c) 10^4 , (d) 10^5 .
7. The motion of a particle executing SHM, is given by $x = 0.01 \sin 100 \pi (t + .05)$ where x is in meter and t in second. The period is :
- (a) .01 sec. (b) 0.1 sec.
(c) 0.02 sec, (d) 0.2 sec.
8. A damped oscillator loses 4% of its energy in each cycle. The cycle elapse before half of its initial energy dissipated is :
- (a) 8.6. (b) 21.4.
(c) 11.3. (d) 17.3.
9. Ripples on the surface of water is an example of :
- (a) Non mechanical waves. (b) Transverse waves.
(c) Electromagnetic waves. (d) Longitudinal waves.
10. When a compression is incident on rigid wall it is reflected as :
- (a) Compression with a phase change of π .
(b) Compression with no phase change.
(c) Rarefaction with a phase change π .
(d) Rarefaction with no phase change.
11. The velocity of sound is maximum in :
- (a) Water. (b) Vacuum.
(c) Metal. (d) Air.
12. The minimum audible wavelength at room temperature is approximately :
- (a) 0.2 A degree. (b) 5 A degrees.
(c) 5 cm to 2 meter. (d) 20 mm.

(12 \times $\frac{1}{4}$ = 3 weight)

Part B

Answer all questions.

13. What do you mean by braking stress?
14. What is plasticity?
15. Why is a cantilever of uniform cross section more likely to break near the fixed end?
16. What does the mechanical energy of an oscillating particle consist of?
17. What is relaxation time?
18. Give two effects of damping.

19. Distinguish between wave velocity and phase velocity.
20. What are the factors governing loudness of sound ?
21. What is acoustic grating ?

(9 × 1 = 9 weightage)

Part C

*Answer any five questions.
Each question carries 2 weightage.*

22. Prove that the strain energy per unit volume is $\frac{1}{2}$ stress \times strain. What is the work done in stretching a wire of cross section one square mm and length 2m through 0.1 mm. $Y = 2 \times 10^{11} \text{ N/m}^2$.
23. What is the criteria for a periodic motion to be simple harmonic ? A horizontal platform with an object placed on it is executing SHm in the vertical direction. If the amplitude of oscillation is 2.5 cm what must be the least period of these oscillations so that the object is not detached from the platform ?
24. Explain what is meant by anharmonic oscillations. How are the anharmonic terms calculated ?
25. What are torsional oscillations ? A 2 kg mass extends of a spring by 10 cm from its unstretched position. The mass is replaced by a body of mass 80 gm which is pulled and released. Calculate the period of oscillation.
26. Derive an expression for the energy density of a plane progressive wave.
27. What is reverberation ? How can it be minimized ?
28. What are ultrasonic waves ? A quartz crystal of thickness 1 mm is vibrating at resonance. What is the fundamental frequency of vibration if Young's modulus of quartz is :

$$7.9 \times 10^{10} \text{ N/m}^2 \text{ and density} = 2.65 \times 10^3 \text{ kg/m}^3.$$

(5 × 2 = 10 weightage)

Part D

*Answer any two questions.
Each question carries 4 weightage.*

29. What is a cantilever ? Derive an expression for the depression at the free end of a cantilever in the form of : (a) Rectangular cross ; and (b) Circular cross section.
30. Describe a method of determining the rigidity modulus of a wire using torsion pendulum. Derive the necessary theory.
31. Obtain the differential equation of a vibrating string and hence derive the expression for the fundamental frequency of vibration. A wire of mass 1 gm and length 75 cm is vibrating with a frequency of 256 Hz under a certain tension. Estimate the mass attached to the wire that causes the tension.

(2 × 4 = 8 weightage)