

SECOND SEMESTER B.Sc. DEGREE (SUPPLEMENTARY)
EXAMINATION, MAY 2016

(UG-CCSS)

Complementary Course

PH 2C 03—MECHANICS, RELATIVITY WAVES AND OSCILLATIONS

Time : Three Hours

Maximum : 30 Weightage

Section I (Objective Type Questions)

Answer all questions.

Each question carries a weightage of $\frac{1}{4}$.

- Write the Schrödinger's time-independent wave equation.
- If a particle could move with the velocity of light, how much kinetic energy would it possess?
- Write the expression for relativistic length of a body in terms of its proper length.
- "Under Galilean transformation, velocity remains invariant." Is this true?
- Force, which does not really act on the particle but appears due to the acceleration of the frame is called _____.
- The energy equivalent to 1 amu = _____ eV.
- Freely falling bodies deviate from their true vertical path. This is due to the effect of _____.
- The angular momentum of a particle is conserved, if torque acting on the particle is _____.
- The working principle of Rocket is based on the law of conservation of :
 - Linear momentum.
 - Energy.
 - Angular momentum.
 - Electric charge.
- Which of the following is not an example for linear simple harmonic motion :
 - Vibrations of atoms and molecules.
 - Vibrations of a tuning fork.
 - Oscillations of a simple pendulum.
 - Oscillations of a freely suspended magnet in a uniform magnetic field.
- The pressure variation in the case of a longitudinal progressive wave travelling through a gas is given by, $\left(\frac{dy}{dx}$ is the volume strain):
 - $P = -E \frac{dy}{dx}$
 - $P = \frac{-1}{E} \frac{dy}{dx}$
 - $P = +E \cdot \frac{dy}{dx}$
 - $P = \sqrt{E} \frac{dy}{dx}$

Turn over

12. The acceleration of a particle executing simple harmonic motion at any instant is :

(a) $-wx$.

(b) $-w^2x$.

(c) $w\sqrt{A^2 - x^2}$.

(d) $w\sqrt{A^2 + x^2}$.

(12 × ¼ = 3 weightage)

Section II (Short Answer Type Questions)

Answer all the questions.

Each question carries 1 weightage.

13. Distinguish between an inertial frame and non-inertial frame of references.
14. Define proper time interval.
15. Write the Galilean transformation equations.
16. What is quality factor associated with a damped harmonic oscillator ?
17. Obtain the differential equation representing a simple harmonic motion.
18. What is meant by centre of mass frame of reference ?
19. State Fourier's theorem.
20. Define eigen values and eigen functions.
21. "Simultaneity is relative." Explain.

(9 × 1 = 9 weightage)

Section III (Short Essay/Paragraph Questions)

Answer any five questions.

Each question carries 2 weightage.

22. Show that in a central force field, the angular momentum of a particle is conserved.
23. Explain the working principle of an electron microscope.
24. If in air a planewave of frequency 256 Hz and amplitude $\frac{1}{1000}$ mm. is produced, calculate the radiated energy per unit volume and the energy current velocity of sound = 332 m/s, density of air is 1.29 kg/m^3 .
25. Obtain the equation representing the oscillations of a loaded spring.
26. Check whether the following are eigen functions of the operator $\frac{d^2}{dx^2}$:
(a) $\sin x$; (b) e^x ; (c) $\sin^2 x$; (d) $\cos x$.
27. A particle of mass 1 kg. executes simple harmonic motion of amplitude 25 cm. and time period 2 s. Calculate its total energy and kinetic energy when $x = 12.5 \text{ cm}$.
28. Calculate the rest energy of an electron in joules.

(5 × 2 = 10 weightage)

Section IV (Essay Questions)

Answer any two questions.

Each question carries 4 weightage.

29. Define angular momentum of a particle about a point. Derive a relation between the torque applied on a rotating body and its angular momentum. Hence state the law of conservation of angular momentum.
30. Derive Einstein's mass-energy equivalence. Illustrate any *two* examples for mass-energy equivalence.
31. Arrive at the differential equation for a damped harmonic oscillator. Give its solution.

(2 × 4 = 8 weightage)