

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, APRIL/MAY 2013

(CCSS)

Physics

PH 2C 03—MECHANICS, RELATIVITY, WAVES AND OSCILLATIONS

Time : Three Hours

Maximum : 30 Weightage

Section I

*Answer all questions.**Each question carries $\frac{1}{4}$ weightage.*

- The transformation of Co-ordinates of a particle from one inertial frame to another is known as :
 - Relativistic transformations.
 - Galilean transformations.
 - Lorentz transformations.
 - Newtonian transformations.
- The fictitious or Pseudo force on a particle is mathematically :
 - $F_0 = -m a_0$.
 - $F_0 = m a_0$.
 - mrw^2 .
 - None of the above.
- For conservative forces, the sum of potential and kinetic energies is :
 - Zero.
 - Infinity.
 - Constant.
 - Negative.
- In planetary motion, for the conservation of angular momentum the planet must move _____ at the point of closest approach to the sun.
- The life time of high energy particles in flight is always greater than the time measured in a decay at rest. This is because of :
 - Length contraction.
 - Time dilation.
 - Doppler effect.
 - Relativistic Doppler effect.
- Identify the particle having zero rest mass :
 - Neutron.
 - Proton.
 - Photon.
 - Electron.
- A pendulum suspended from the ceiling of a train has a period T when the train is at rest. When the train is accelerating with a uniform acceleration, the period of oscillation will :
 - Increase.
 - Decrease.
 - Not change.
 - Become infinite.

Turn over

8. In a SHM, when **the** displacement is one half the amplitude, what fraction of the total energy is kinetic ?
- (a) Zero. (b) $\frac{1}{4}$.
- (c) $\frac{1}{2}$. (d) $\frac{3}{4}$.
9. Which of the following is transmitted by a wave ?
- (a) Amplitude. (b) Velocity.
- (c) Energy. (d) Momentum.
10. Which of the following expressions is that of a progressive wave ?
- (a) $a \sin(\omega t - kx)$. (b) $a \sin \omega t$.
- (c) $a \cos kx$. (d) $a \sin(\omega t) \cos(kx)$.
11. Wave function has no direct ———.
12. The allowed values of energies of a particular system are called :
- (a) Eigenvalues. (b) Eigenfunctions.
- (c) Hamiltonian. (d) Wave function.

(12 × $\frac{1}{4}$ = 3 weightage)

Section II

Answer **all** questions.

Each question carries 1 weightage.

13. State the hypothesis of Galilean invariance. Is it consistent with the theory of special relativity ?
14. Explain the basic principle of rocket propulsion.
15. What is a centrifugal force ? How does it affect the acceleration due to gravity ?
16. What is a **centre of mass** frame of reference ? Is it an inertial frame or non-inertial frame ?
17. What is meant by length contraction ?
18. What is anharmonic oscillator ?
19. Give the general equation of wave motion. What is its significance ?
20. Give the limitations of classical mechanics.
21. Explain probability density.

(9 × 1 = 9 weightage)

Section III

Answer any five questions.

Each question carries 2 weightage.

22. Calculate the fictitious and total force on a body of mass 2.5 kg. relative to a frame moving vertically upwards on earth with an acceleration of 10 m/sec^2 .
23. Prove that if no external force is acting on a system of particles its linear momentum remains constant.
24. What do you understand by the potential energy curve? What are the positions of stable or unstable equilibrium and why? What is neutral equilibrium?
25. A meson has a speed of $0.8c$ relative to the ground. Find how far the meson travels relative to the ground, if its speed remains constant. The time of flight relative to the system is $2 \times 10^{-8} \text{ sec}$.
26. Two masses 0.01 kg. and 0.09 kg. are connected by a spring of length 0.1 m. If the force constant of the spring is 10^3 N/m , calculate the frequency of oscillation.
27. Derive an expression for the energy density of a plane progressive wave.
28. Find the energy of an electron moving in one dimension in an infinitely high potential box of width 1 \AA . mass of electron = $9.1 \times 10^{-31} \text{ kg}$, $h = 6.6 \times 10^{-34} \text{ J-S}$.

(5 × 2 = 10 weightage)

Section IV

Answer any two questions.

Each question carries 4 weightage.

29. Describe the Michelson Morley experiment and discuss the importance of the null result.
30. Set up the differential equation of a harmonic oscillator and solve it to find the velocity, displacement and period.
31. Derive the Schrödinger time dependent equation. What is a Hamiltonian operator? Express the motion of a material particle in terms of the Hamiltonian operator.

(2 × 4 = 8 weightage)