

## 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 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 :
  - $\mathbf{F}_0 = -m \mathbf{a}_0$
  - $\mathbf{F}_0 = m \mathbf{a}_0$
  - $m \mathbf{w}$
  - 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) .

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 x = 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 x 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** .
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  $2 \times 10^{-8}$  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 Å. mass of electron =  $9.1 \times 10^{-31}$  kg,  $h = 6.6 \times 10^{-34}$  J-S.

(5 x 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 x 4 = 8 **weightage**)