

**SECOND SEMESTER B.Sc. DEGREE (C.C.S.S. PROGRAMME)  
EXAMINATION, MAY 2010**

Complementary Course—Physics

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

Three Hours

Maximum Weightage : 30

I. Objective type questions. Answer *all* questions :

- 1 Name the force which does not really act on the particle but appears due to the acceleration of the frame.
- 2 How much is the acceleration of a body in an inertial frame of reference, if it is not experiencing any external force ?
- 3 Write the general equation representing a plane progressive wave.
- 4 The amount of energy equivalent to 1 amu = \_\_\_\_\_ eV.
- 5 Freely falling body deviates from their true vertical path. This is due to the effect of \_\_\_\_\_.
- 6 For a photon, the expression for relativistic momentum is  $P =$  \_\_\_\_\_.
- 7 If the work done by a force in moving a particle from one point to another point depends only on these points and not on the path followed, then the force is called \_\_\_\_\_.
- 8 The time dependent Schrodinger equation is :

$$(a) \left( \frac{\hbar}{2m} \nabla^2 + V \right) \psi = i\hbar \frac{\partial \psi}{\partial t}$$

$$(b) \left( \frac{-\hbar}{2m} \nabla^2 + V \right) \psi = i\hbar \frac{\partial \psi}{\partial t}$$

$$(c) \left( \frac{\hbar}{2m} \nabla^2 - V \right) \psi = i\hbar \frac{\partial \psi}{\partial t}$$

$$(d) \left( \frac{-\hbar}{2m} \nabla^2 - V \right) \psi = i\hbar \frac{\partial \psi}{\partial t}$$

9 Which of the following is not invariant under Galilean transformations ?

(a) Length.

(b) Velocity.

(c) Acceleration.

(d) none.

10 The working principle of rocket is based on :

(a) Law of conservation of linear momentum.

(b) Law of conservation of energy.

(c) Law of conservation of angular momentum.

(d) None of these.

Turn over

- 11 At what displacement the energy of a harmonic oscillator becomes half kinetic and half potential? ( $A$  = maximum amplitude)
- (a)  $A/2$ . (b)  $A^2/2$ .
- (c)  $A/\sqrt{2}$ . (d)  $A^2/4$ .
- 12 Which of the following is not an example for linear simple harmonic motion?
- (a) Vibrations of atoms and molecules.
- (b) Vibrations of a tuning fork.
- (c) Oscillations of a simple pendulum.
- (d) Oscillations of a freely suspended magnet in a uniform magnetic field.

(12 × 1)

II. Short answer type questions. Answer *all* questions :

- 13 What are inertial frames of references?
- 14 Define proper time interval.
- 15 Give the postulates of special theory of relativity.
- 16 Write the relativistic momentum - energy relation.
- 17 What do you mean by a linear harmonic oscillator?
- 18 Write down the differential equation for a damped harmonic oscillator.
- 19 State the law of conservation of angular momentum.
- 20 Define a wave function.
- 21 State Fourier's theorem.

(9 × 1)

III. Short Essay / Paragraph questions. Answer any *five* questions :

- 22 Show that in the central force field, the angular momentum of a particle is conserved.
- 23 Explain time dilation as a consequence of special theory of relativity.
- 24 How fast would a rocket have to go relative to an observer for its length to be contracted 99% of its length at rest?
- 25 Show that for a plane progressive wave, average kinetic energy is equal to average potential energy.
- 26 Find the period of oscillation and maximum acceleration of a simple harmonic motion represented by the equation  $x = 2 \sin(\pi t + \pi/2)$ .

- 27 If the propagation constant of a wave is 280 per cm and its velocity is 400 m/s, calculate its wavelength and frequency.
- 28 Calculate the de-Broglie wavelength of an  $\alpha$  - particle accelerated a potential difference of 25000 volts. Mass of Proton =  $1.67 \times 10^{-27}$  kg and charge of electron =  $1.6 \times 10^{-19}$  C.

(5 × 2 = 10)

IV. Essay questions. Answer any two questions :

- 29 Describe Michelson - Morely Experiment and discuss the importance of its negative result.
- 30 What are the basic postulates of wave mechanics ? Derive Schrodinger's time dependent wave equation.
- 31 Arrive at the differential equation for a damped harmonic oscillator. Give its solution.

(2 × 4 = 8)