THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2010

(CCSS)

Physics—Core Course

PH3 B05—MECHANICS

: Three Hours Maximum Weightage : 30

I. Answer *all twelve* questions :

1 A lift is moving down with acceleration a. A man in the lift drops a ball inside lift. Acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are :

(a) g, g. (b) $g-a, g-a$.

(c) $g-a, g$. (d) a, g.

2 When a U^{238} nucleus originally at rest, decays by emitting an α particle having speed u. The recoil speed of residual nucleus is :

(a) $\frac{-4u}{238}$. (b) $\frac{4u}{238}$.

(c) $\frac{-4u}{234}$. (d) $\frac{4u}{234}$.

3 Two spherical bodies of masses in the ratio 1 : 5 and radii R : 2R are in free space with initial separation 12R. They attract each other due to gravitational attraction. Then distance travelled by smaller body before collision is :

(a) 1.5 R. (b) 2.5 R.

(c) 4.5 R. (d) 7.5 R.

4 For same value of KE, momentum shall be maximum for :

(a) a proton. (b) an electron.

(c) a deutron. (d) an α-particle.

5 Two identical particles move towards each other with velocity 2V, V respectively, the velocity of centre of mass is :

(a) V. (b) $\frac{V}{3}$.

(c) $\frac{V}{2}$. (d) 0.

6 A solid sphere is rotated in free space. If radius of sphere is increased keeping mass same, which one of the following will not be affected ?

(a) moment of inertia. (b) angular momentum.

(c) angular velocity. (d) rotational KE.

7 KE needed to project - a body of mass m from earth to the infinity is :

(a) $\frac{mgR}{2}$. (b) mgR.

(c) $\frac{mg}{R}$. (d) $\frac{mgR}{4}$.

8 The time period of satellite of earth is shown. If separation between earth and satellite is increased to 4 times the previous value, the new time period will become :

(a) 24 hours. (b) 10 hours.

(c) 8 hours. (d) 40 hours.

9 Which of the following is holonomic constraint ?

(a) motion of a body on an inclined plane under gravity.

(b) a bead on a circular wire.

(c) a particle moving on an ellipsoid under gravity.

(d) a pendulum with variable length.

10 Which of the following is not Galilean invariant ?

(a) length. (b) velocity.

(c) acceleration. (d) laws of conservation of energy.

11 A particle is constrained to move along the inner surface of a fixed hemispherical bowl. T number of degree of freedom of particle is :

(a) one. (b) four.

(c) three. (d) two.

12 If the Lagrangian does not depend on time explicitly :

(a) Hamiltonian is constant. (b) Hamiltonian is not constant.

(c) Kinetic energy is constant. (d) Potential energy is constant.

(12 × ¼ = 3 weights

Answer all *nine* questions :

13 Show that conservative force is negative gradient of potential.

14 What is meant by inertial frames ? How will you realise an inertial frame in practice ?

15 Show that total linear momentum of a system of particles about centre of mass is zero.

16 Show that internal force in a system of particles are central in nature.

17 What are constraints ? Classify constraints.

18 What are generalised co-ordinates ? Give the advantage of using them.

19 What is Hamiltonian function ?

20 Under what circumstances would your weight be zero ?

21 What are Galilean transformations ?

(9 × 1 = 9 weightage)

Answer any *five* questions from seven questions :

22 A beam of particles of half life 2×10^{-3} S travels in the laboratory with speed 0.73 C. Calculate observed half life.

23 When a particle moves under central force prove that areal velocity remains constant.

24 Find the position of C in C–0 molecule if bond length of this molecule is 1.2 A°.

25 Derive an expression for escape velocity.

26 A stone 100 g is rotated at the end of a string of length 50 cm at the rate 2 rot.p.s. Determine the angular momentum.

27 Find the magnitude of coriolis force on a train of mass 10^6 kg moving north to south with a speed 72 km/hr at latitude of 30°. Angular velocity of earth's rotation = 7.3×10^{-5} rad/s.

28 The maximum and minimum distance of a comet from sun are 1.62×10^{12} m and 8×10^{10} m. Its velocity when nearest to sun is 6×10^4 m/s. What is the velocity when it is farthest ? Assume orbit is circular.

(5 × 2 = 10 weightage)

Answer any *two* from three questions :

29 Develop Lagrange's equation of motion from D' Alembert's principle.

30 State and prove Keplers laws of planetary motion.

31 What do you understand by time dialation ? Derive an equation for proper time.

(2 × 4 = 8 weightage)