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Name.....

Reg. No.....

**THIRD SEMESTER B.Sc. DEGREE (SUPPLEMENTARY/IMPROVEMENT)  
EXAMINATION, NOVEMBER 2015**

(UG—CCSS)

Core Course—Physics

PH 3B 05—MECHANICS

(2013 Admissions)

Time : Three Hours

Maximum : 30 Weightage

**Section A**

*Answer all questions.*

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

1. If a co-ordinate corresponding to a rotation is cyclic, rotation of the system about given axis remains invariant then the following quantity is conserved.
  - (a) Linear momentum.
  - (b) Angular momentum.
  - (c) Kinetic energy.
  - (d) Potential energy.
2. In the case of elliptic orbits, the energy is proportional to :
  - (a) A.
  - (b)  $1/a$ .
  - (c)  $1/a^2$ .
  - (d)  $1/a^3$ .
3. Lorentz transformations assume :
  - (a) Space and time are both relative.
  - (b) Space is relative.
  - (c) Space is absolute but time is relative.
  - (d) Space and time are both absolute.
4. Freely falling bodies deviate from their true vertical path due to the effect of :
  - (a) Gravitational force.
  - (b) Centripetal force.
  - (c) Centrifugal force.
  - (d) Coriolis force.
5. For a system of particles when the P.E. is translationally invariant then the momentum is :
  - (a) Conserved.
  - (b) Not conserved.
  - (c) Zero.
  - (d) Infinite.
6. The shape of the galaxy is :
  - (a) Elliptical.
  - (b) Convex.
  - (c) Concave.
  - (d) Spherical.

Turn over

7. The escape velocity of a body projected in the upward direction on the earth is :  
 (a) 9.8 km/hr. (b) 11.2 km/hr.  
 (c) 11.2 km/sec. (d) 7.98 km/sec.
8. The force on a point mass  $m$  placed at the centre of a sphere is :  
 (a) Infinity. (b)  $4/3$  Newtons.  
 (c) Zero. (d) 9.8 Newtons.
9. Absolute motion is :  
 (a) Imaginary.  
 (b) Real.  
 (c) Sometimes imaginary and sometimes real.  
 (d) None of these.
10. The maximum height attained by a rocket is :  
 (a)  $R$ . (b)  $2R$ .  
 (c)  $3R$ . (d)  $4.3R$ .
11. When a particle moves under the action of a central force, its angular momentum is :  
 (a) Not conserved. (b) Conserved.  
 (c) Zero. (d) Infinite.
12. Constraints which can be written in the form of inequality are called :  
 (a) Holonomic. (b) Lagrangian.  
 (c) Hamiltonian. (d) Non-holonomic.

(12 × 1/4 = 3 weight)

### Section B

*Answer all questions.  
 Each question carries 1 weightage.*

13. What is frame of reference? Give example.
14. Give two important properties of conservation laws.
15. What is energy function? Give its property.
16. Define areal velocity.
17. Explain superposition principle.
18. Is the Lagrangian formulation more advantageous than the Newtonian formulation. Why?
19. Give the postulates of a special theory of relativity.
20. What is Coriolis acceleration?
21. What is virtual work?

## Section C

Answer any five questions.  
Each question carries 2 weightage.

22. What is a Foucault's Pendulum? Prove that the plane of oscillation of Foucault's pendulum rotate  $15^\circ \sin Q$  per hour where  $Q$  is the latitude of the place.
23. Prove that the work done around a closed path is zero for conservative force.
24. State and explain D' Alembert's principle. Is D' Alembert's equation true for real or virtual displacement.
25. What is gravitational potential? Calculate the change in PE if a mass of 500 kg is raised through a height twice the radius of the earth.
26. Calculate the mass and momentum of a proton of mass  $1.6 \times 10^{-27}$  kg moving with a speed of  $2 \times 10^8$  m/s. If the proton coalesces with a stationary nucleus of mass  $2.5 \times 10^{-25}$  kg. Calculate the velocity the combined particle.
27. Prove that the work done around a closed path is zero for conservative forces.
28. The maximum and minimum distance of a comet from the sun are  $1.4 \times 10^9$  km and  $7.0 \times 10^7$  km. If its velocity closest to the sun is  $6.0 \times 10^4$  m/s what is its velocity when farthest?

(5 × 2 = 10 weightage)

## Section D

Answer any two questions.  
Each question carries 4 weightage.

29. Deduce the Lorentz transformation equations. How is it superior to Galilean transformations?
30. Prove that the velocity of escape of the body from the earth's surface is times the velocity for a circular orbit is just above the earth's surface. Explain why the atmosphere is rare at the moon's surface.
31. State and derive Kepler's laws of planetary motion from Newton's law of gravitation.
32. Derive the relationship  $H = \sum_j q_j \frac{\partial L}{\partial q_j} - L$  from the properties of Lagrangian.

(2 × 4 = 8 weightage)