



SN – 235

I Semester B.Sc. Examination, November/December 2014  
(Semester Scheme) (CBCS / NS) (2011-12 and onwards)  
PHYSICS – I  
Mechanics, Oscillations and Properties of Matter

Time : 3 Hours

Max. Marks : 70

**Instruction :** Answer **five** questions from **each** Part.

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. (5×8=40)

1. a) Define static friction and kinetic friction.  
b) What is angle of repose ? Derive the relation between coefficient of static friction and angle of repose. (2+6)
2. a) Show that Newton's laws of motion are invariant under Galilean transformation.  
b) What is time dilation ? Explain. (6+2)
3. Obtain an expression for radial and transverse components of velocity and acceleration of a particle moving in a plane. 8
4. a) Distinguish between conservative and non-conservative forces with one example each.  
b) Define surface tension of liquid. What are the factors affecting surface tension ? (4+4)
5. a) Define centre of mass of system of particles. Derive an expression for burn-out velocity when the rocket starts from rest.  
b) What are elastic and inelastic collisions ? (6+2)
6. a) Obtain an expression for kinetic energy of rotation of the rigid body.  
b) State and explain the principle of conservation of angular momentum with an illustration. (3+5)
7. a) Define Simple Harmonic Motion. Give one example.  
b) Show that total energy of simple harmonic motion remains constant for all values of displacement. (2+6)
8. What is cantilever ? Obtain an expression for the depression at the free end of a thin light beam clamped horizontally at one end and loaded at the other. 8

P.T.O.



## PART – B

Answer **any five** of the following questions. **Each** question carries **four** marks. **(5×4=20)**

9. A trolley with wheels of mass 1.5 kg is pulled horizontally on a frictionless surface of a table by a string attached to a mass of 0.02 kg hanging vertically down over a pulley. If the trolley starts from rest. Calculate the distance travelled by the body in 5 s.
10. A particle of rest mass  $m_0$  moves with a speed  $0.6c$  where  $c$  is the velocity of light. Calculate its energy.
11. A satellite of earth revolves in a circular orbit at a height of 250 km above the earth's surface. What is the orbital velocity of the satellite ? Given radius of earth is 6400 km and acceleration due to gravity on the surface of the earth is  $9.8 \text{ ms}^{-2}$ .
12. Calculate the work done in blowing a spherical soap bubble of diameter 2 cm. Surface tension of soap solution is  $2 \times 10^{-2} \text{ Nm}^{-1}$ .
13. Two bodies of masses 10 kg and 2 kg are moving with velocities  $2\hat{i} - 7\hat{j} + 3\hat{k}$  and  $-10\hat{i} + 35\hat{j} - 3\hat{k}$  respectively. Find the velocity of centre of mass.
14. A solid sphere has mass 1 kg and radius 0.1 m. Calculate its moment of inertia about its (i) diameter and (ii) an axis tangential to its surface.
15. Two simple pendulums of length 1.44 m and 1 m start swinging at the same time. Calculate the ratio of their time periods.
16. What force is required to stretch a steel wire  $1 \text{ cm}^2$  in cross section to double its length ? Young's modulus of steel is  $20 \times 10^{10} \text{ N/m}^2$ .

## PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17.
    - a) It is impossible for us to walk without the presence of friction. Explain.
    - b) Will person inside a moving lift experience any change in his weight ? Explain.
    - c) Is the speed of a planet same at all points in its orbit ? Explain.
    - d) Soap solution is a better cleansing agent than ordinary water. Justify.
    - e) Can a body have momentum without energy ? Explain.
    - f) A man standing on a rotating table stretches his hands side ways. What would happen to the speed of rotation of table ?
    - g) Can a pendulum clock work inside an orbiting satellite ? Explain.
    - h) In automobiles, spring made of steel is preferred over copper. Explain.
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**I Semester B.Sc. Examination, November/December 2014**  
**(OS) (Semester Scheme)**  
**(Prior to 2011-2012)**  
**PHYSICS – I**  
**Mechanics, Oscillations and Waves**

Time : 3 Hours

Max. Marks : 60

**Instruction** : Answer **five** from Part **A**, **four** from Part **B** and **five** from Part **C**.

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

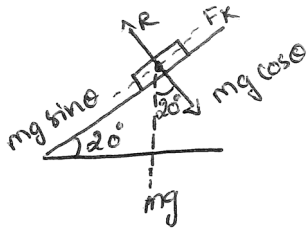
1. A particle is moving along a curve in a plane. Derive expressions for radial and transverse components of acceleration. 6
2. Show that an observer on different frames of reference that move with constant velocity relative to each other will measure the same acceleration for a particle in motion in one dimension. 6
3. a) Define i) Coefficient of static friction, and  
ii) Angle of friction.  
b) Derive an expression for the acceleration of a body sliding down an inclined plane. (2+4)
4. a) State and explain work-energy theorem.  
b) Deduce an expression for workdone by a variable force in one dimension. (2+4)
5. a) Distinguish between conservative and non-conservative forces. Give one example for each case.  
b) State the law of conservation of mechanical energy in case of a conservative force. (4+2)
6. What is centre of mass ? Show that linear momentum of a system of particles is equal to the product of mass of the system and velocity of the centre of mass. 6
7. a) Define moment of inertia of a body.  
b) State and prove the perpendicular axis theorem of moment of inertia of a planar body. (1+5)
8. Derive an expression for the instantaneous kinetic and potential energies for a particle executing simple harmonic motion and show that their sum is a constant. 6



PART – B

Solve **any four** of the following. **Each** problem carries **five** marks. **(4×5=20)**

- 9. Two trains 121 m and 99 m in length are running in opposite directions with velocities 40km/h and 32 km/h respectively. How long will they take to cross other completely ?
- 10. A block is pulled at constant velocity in a horizontal surface by a force of 10 N applied at an angle 30° to the horizontal. If the coefficient of friction is 0.5. Find the mass of the block.
- 11. A block of wood of mass 5 kg placed on an inclined plane moves down, the plane with constant speed when the angle of inclination 20°. Calculate the force of sliding friction between the block and surface of the plane. Given  $g = 9.8 \text{ m/s}^2$ .



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- 12. A block weighing 35.6 N slides on a horizontal frictionless table with a speed of 1.22 m/s. It is brought to rest in compressing a spring in its path. By how much is the spring compressed, if its force constant is 1.35 N/m ?
- 13. Two masses moving in a horizontal plane collide with each other. The masses  $m_1$  and  $m_2$  were 85 g and 300 g respectively and their velocities were  $U_1 = 6.48 \text{ cm/s}$ ,  $U_2 = - 6.78 \text{ cm/s}$ . Find the velocity of the centre of mass.
- 14. A string is stretched between two fixed supports 0.7 m apart and the tension is adjusted until the fundamental frequency of the string is 440 Hz . What is the speed of transverse wave on the string ?

PART – C

Answer **any five** of the following. **Each** question carries **two** marks. **(2×5=10)**

- 15. a) Can a body be said to be at rest as well as in motion at the same time ? Explain.
  - b) It is possible to have a single isolated force. Explain.
  - c) It is easier to roll than to pull a barrel along a road. Explain.
  - d) Does KE depend on the direction of the motion involved. Can it be negative ?
  - e) Is the collision of elementary particles elastic or inelastic ? Explain.
  - f) A swinging pendulum eventually comes to rest. Is this violation of the law of conservation of energy ?
  - g) Can the centre of gravity of a body be outside the body ? If so give example.
  - h) Are all periodic motions oscillatory ? Explain.
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