



SN – 328

I Semester B.Sc. Examination, November/December 2017
(Repeaters) (CBCS/NS 2011-12 and Onwards)
(Prior to 2016-17)

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** questions. **Each** question carries **eight** marks.

(5×8=40)

1. a) State and explain Newton's second law of motion.
b) Define coefficient of static friction and angle of repose. Derive the relation between them. (3+5)
2. a) State the postulates of special theory of relativity.
b) Derive Einstein's mass-energy equivalence relation. (2+6)
3. Obtain expressions for the radial and transverse components of velocity and acceleration of a particle moving along a curve in a plane using plane polar coordinates. 8
4. a) What are conservative and non-conservative forces ?
b) Derive an expression for excess pressure across a curved liquid surface. (2+6)
5. a) Define centre of mass of a system of particles. Arrive at an expression for the position vector of the centre of mass of a system of particles.
b) What are elastic and inelastic collisions ? Give an example for each. (4+4)
6. a) Derive an expression for the moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane.
b) State and explain the principle of conservation of angular momentum. Give an illustration. (5+3)



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7. a) Define simple Harmonic Motion. Give an example.
b) What is a simple pendulum ? Show that small amplitude oscillations of a simple pendulum are simple harmonic and hence derive an expression for the time period. (2+6)
8. a) Define the following terms :
1) Young's modulus
2) Rigidity modulus
3) Bulk modulus
4) Poisson's ratio.
b) Derive an expression for the work done in stretching a wire. (4+4)



PART - B

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

9. A force of 12 N acts horizontally on a body of mass 2 kg lying on a rough table. If the coefficient of static friction is 0.3, calculate the normal force and acceleration of the body.
Given $g = 9.8 \text{ ms}^{-2}$.
10. A rocket is 100 m long on the ground. When it is in flight, its length is 99 m to an observer on the ground. With what speed is the rocket moving ?
Given $C = 3 \times 10^8 \text{ ms}^{-1}$.
11. The gravitational force of attraction between two spheres of masses 40 kg and 80 kg is equal to $86 \times 10^{-8} \text{ N}$. If the distance between the spheres is 0.5 m, calculate the universal gravitational constant.
12. Calculate the work done in lifting a stone of mass 10 kg from the surface of the earth to a height 8 m above the earth's surface. Given $g = 9.8 \text{ ms}^{-2}$.
13. A rocket of mass 20 kg has 180 kg fuel. The exhaust velocity of the fuel is 1600 ms^{-1} . The rate of consumption of the fuel is 2 kgs^{-1} . Assuming the rocket starts from rest, calculate the final speed gained by the rocket at burn-out.





14. A solid sphere has a mass of 8 kg and radius 0.4 m. Calculate the moment of inertia about its diameter.
15. Calculate the total energy of a simple harmonic oscillator of mass 0.025 kg, amplitude 0.2 m and frequency of oscillation 10 Hz.
16. The rigidity modulus of the material of a wire is $2.87 \times 10^{10} \text{ Nm}^{-2}$ and its Poisson's ratio is 0.38. Calculate the Young's modulus of the material of the wire.

PART – C

Answer **any five** of the following. **Each** question carries **two** marks.

(5×2=10)

17. a) Two identical sheets of paper, one crumpled into a ball and the other plane, are dropped down vertically from the same height simultaneously through a resistive medium. Which one reaches the ground first ? Why ?
- b) Is the earth an inertial frame of reference ? Justify.
- c) Is the speed of a planet same at all points in its elliptic orbit round the sun ? Explain.
- d) Can work done be negative ? Explain.
- e) Can a body have energy without momentum ? Explain.
- f) Is the collision of two identical spheres elastic or inelastic ? Explain.
- g) For a particle executing simple harmonic motion about an equilibrium position, at which position is its potential energy (1) maximum ? (2) minimum ?
- h) Springs are made of steel instead of copper. Why ?

