

Physics Paper I
(Mechanics and Properties of Matter)

P. Pages : 4

Time : Three Hours

Max. Marks : 40

- Note : 1. All **five** questions are compulsory.
2. Draw neat and clean diagram wherever necessary.

Either

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|----|----|---|----------|
| 1. | a) | State Newton's laws of motion. | 3 |
| | b) | Obtain the components of velocity in Polar coordinate system. | 3 |
| | c) | Derive Kepler's law of Areal velocity. | 2 |

OR

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|----|----|---|----------|
| 2. | p) | State Keplers laws of planetary motion. | 3 |
| | q) | Derive Newton's first law of motion from second law. | 2 |
| | r) | Obtain the components of acceleration in polar co-ordinate system using components of velocity. | 3 |

Either

3. a) Define.

- i) Gravitational field.
- ii) Gravitational potential.

2

b) Derive an expression for gravitational potential at a point inside the spherical shell. 3

c) Define centre of mass and show that centre of mass moves with constant velocity, when no external forces act on the system of particles. 3

OR

4. p) State

- i) Law of conservation of energy.
- ii) Law of conservation of angular momentum.

2

q) Show that angular momentum of the system remains constant. 2

r) What is elastic collision. Derive an expression of velocity of particles after collision. 4

Either

5. a) Define moment of inertia and state it's C.G.S. unit. 2

b) Explain the physical significance of M.I. and radius of gyration. 3

c) State and prove the theorem of perpendicular axes for a plane lamina body. 3

OR

6. p) Derive the relative between moment of inertia and torque. 3

q) Derive an expression for moment of inertia of thin uniform rod about an axis passing through it's centre and perpendicular to it's length. 3

r) Derive an expression for moment of inertia of a circular disc about a tangent perpendicular to plane of disc. 2

Either

7. a) Define.

- i) Young's modulus.
- ii) Bulk modulus.
- iii) Modulus of rigidity.

3

b) Derive an expression for bending moment of a beam. 4

c) State Hooke's law of elasticity. 1

OR

8. p) Define modulus of rigidity state it's unit. 2

q) Derive an expression for depression of the beam supported at two ends and loaded at the middle. 3

- r) A cantilever of breadth and thickness both of 0.01m & 1m long is clamped horizontally at one end, when a load of 1Kg is applied to the free end, the depression of the free end is 4×10^{-2} m. Calculate Young's modulus of the material of cantilever ($g = 9.8\text{m/s}^2$). **3**

Either

9. a) Define coefficient of viscosity. State its unit and dimensions. **2**
- b) State and prove Bernoulli's theorem. **4**
- c) Define.
 i) Streamline flow.
 ii) Turbulent flow. **2**

OR

10. p) Define.
 i) Surface energy.
 ii) Angle of contact. **2**
- q) Explain the surface tension on the basis of molecular theory of matter. **3**
- r) What would be the pressure inside a small air bubble of 1mm radius, situated just below the surface of water? Surface tension of water is 70 dyne/cm and atmospheric pressure is $1.02 \times 10^6 \text{ dyne/cm}^2$. **3**
