



- Notes : 1. All questions are compulsory.
2. Draw neat and well labelled diagrams wherever necessary.

1. Either
- a) i) Explain the terms: Gravitational field and Gravitational potential. 2
- ii) Derive an expression for the gravitational potential due to thin spherical shell at a point 6
- i) Outside ii) On the surface and
- iii) Inside the shell.
- iii) A uniform hollow sphere has a radius 0.4m and a mass of 10kg. calculate the gravitational potential at a point on its surface and at a point 0.2m outside from the surface. 2

OR

- b) a) Deduce an expression for gravitational self energy of any uniform solid sphere. 2½
- b) Find the mass of sun from the following data: Radius of earth's orbit $r = 1.5 \times 10^8$ km 2½
 $G = 6.67 \times 10^{-11} \text{ Nm}^2 \text{ Kg}^{-2}$
- c) Explain the term 'Global Positioning System' (GPS). 2½
- d) Derive an expression for critical velocity required to set a satellite in a circular orbit. 2½
2. Either
- a) i) Derive a general differential equation of motion of a simple harmonic oscillator. and obtain its solutions. 5
- ii) If the amplitude of a simple harmonic oscillator is doubled, how does this affect the time period, total energy and maximum velocity of the oscillator. 3
- iii) A particle of mass 5 kg lies in a potential field $V = 8x^2 + 200$ Joules/kg. Calculate its time period. 2

OR

- b) a) Distinguish clearly between free, damped and forced harmonic oscillations. 2½
- b) Obtain an expression for the power dissipated in damped harmonic oscillator. 2½
- c) A mass of 25×10^{-3} kg is suspended from the lower end of a vertical spring having a force constant 25 N/m. The mechanical resistance of the system is 1.5 Ns/m. The mass is displaced vertically and released. Find whether the motion of the mass is oscillatory? If so calculate period of oscillation. 2½

- d) The quality factor Q is a measure of sharpness of resonance in case of a forced oscillator? Explain. Give the physical significance of Q-value. 2½

3. Either

- a) i) What is difference between angle of twist and angle of shear? 2
- ii) Deduce an expression for the couple required to twist a uniform solid cylinder by an angle. 4
- iii) What is the value of the couple for a hollow cylinder of inner radius r_1 and outer radius r_2 ? 2
- iv) What couple must be applied to a wire one metre long, 1 mm in diameter in order to twist one end of it, through 90° , the other end remaining fixed. 2
(Rigidity of material of the wire is $2.8 \times 10^{10} \text{ N/m}^2$).

OR

- b) a) Estimate the Workdone in stretching a wire. 2½
- b) Obtain a relation between elastic coefficients Y, η and σ . 2½
- c) Explain the terms 2½
i) Elastic limit ii) Elastic fatigue
iii) Yield point.
- d) What force is required to stretch a steel wire $\frac{1}{2}$ square' cm in cross-section to double its length? ($Y = 2 \times 10^{11} \text{ N/m}^2$) 2½

4. Either

- a) i) Define coefficient of viscosity of a liquid. 1
- ii) Describe with necessary theory Poiseuille's method of determining the coefficient of viscosity of a liquid. State clearly the assumptions made. 6
- iii) Give an account of molecular theory of surface tension. 3

OR

- b) a) Water flows through a horizontal pipe line of varying cross-section. At a point where the pressure of water is 0.05 m of mercury the velocity of flow is 0.25 m/s. Calculate the pressure at another point where velocity of flow is 0.4 m/s. 2½
(Density of water = 10^3 kg/m^3)
- b) Distinguish between stream line flow and turbulent flow of a liquid. 2½
- c) Deduce an expression for the difference of pressure on the two sides of a spherical drop. 2½

d) Explain what do you understand by the angle of contact in the case of a liquid. **2½**

5. Solve **any ten** of the following.

a) State Newton's law of gravitation. **1**

b) State Kepler's laws of planetary motion. **1**

c) What is a central force? Give examples. **1**

d) A mass of 1 kg is attached to a spring of stiffness constant 16 N/m. Find its natural frequency. **1**

e) Are all periodic motions simple harmonic? Is the reverse true? Explain. **1**

f) What is resonance? Explain sharpness of resonance. **1**

g) Define Poisson's ratio? **1**

h) What is torsional pendulum. **1**

i) Prove that glass is more elastic than rubber. **1**

j) What do you mean by Reynold's number? **1**

k) Calculate the excess pressure inside a soap bubble of radius 3×10^{-3} m.
(Surface tension of soap solution is 20×10^{-3} N/m) **1**

l) Explain wetting of a solid with a liquid. **1**
