

Roll No.

Total Pages : 4

GSE/M-20

1479

**PROPERTIES OF MATTER AND KINETIC
THEORY OF GASES
Paper-I**

Time : Three Hours]

[Maximum Marks : 40

Note : Attempt *five* questions in all, selecting *one* question from each unit. Q. No.1 is compulsory. Each question carries equal marks. Use of scientific non-programmable calculator is allowed.

Compulsory Question

1. (a) A sphere, a disc and a ring of same mass and radius are allowed to roll down an inclined plane simultaneously from the same height. Calculate their order of reaching the bottom. (2)
- (b) Why the steel girders are made in the form of I section? (2)
- (c) Name any four factors due to which Brownian motion decreases. (2)
- (d) What is mean free path and how it will be affected with the increase of
 - (i) Pressure
 - (ii) Temperature. (2)

UNIT-I

2. (a) Find an expression for the moment of inertia of a solid uniform bar of rectangular cross section about an axis perpendicular to its length and passing through the centre of mass. (5)
- (b) If you are given two spheres of same mass, size and appearance but one of them is hollow at the centre and the other is solid throughout. How will you distinguish which one is hollow and which one is solid? (3)
3. (a) Derive an expression for the moment of inertia of a solid sphere :
- (i) About its diameter
- (ii) About its tangent. (5)
- (b) Calculate the time taken by a spherical shell to roll down an inclined plane 6 m long and having a slope of 1 m in 20 m. (3)

UNIT-II

4. (a) Show that the bulk modulus K , Young's modulus Y and the Poisson's ratio σ are related as :

$$K = \frac{Y}{3(1-2\sigma)} \quad (5)$$

- (b) What is Poisson's ratio? Explain what can be its minimum and maximum values. (3)

5. (a) Derive an expression for couple per unit twist for a cylindrical wire of uniform cross-section. (5)
- (b) A cantilever of breadth 10 cm and depth 30 cm in 3 m long having Young's modulus of the material equal to $4 \times 10^{10} \text{ Nm}^{-2}$. Calculate the deflection produced :
- (i) When the load of 1.5 ton is suspended at its free end.
- (ii) When the load of 1.5 ton is suspended at its middle. (3)

UNIT-III

6. (a) Explain the term degrees of freedom. Using law of equipartition of energy, show that for a perfect gas :
- $$\frac{C_p}{C_v} = 1 + \frac{2}{n}. \quad (5)$$
- (b) Calculate the root mean square speed for hydrogen having density $8.9 \times 10^{-5} \text{ g/c.c.}$ at N.T.P. (3)
7. (a) Explain the reasons which led to modification of ideal gas equation and hence deduce the Van der Wall's real gas equation. (5)
- (b) Discuss kinetic interpretation of temperature. (3)

UNIT-IV

8. (a) Discuss graphical interpretation of Maxwell's distribution law of molecular speeds. Also give its experimental verification. (5)
- (b) Find the mean free path of helium molecules at a temperature of 0°C and a pressure of 760 mm Hg. Coefficient of viscosity is $1.3 \times 10^{-5} \text{ Nm}^{-2} \text{ s}$. Density of helium is 1.1786 kg m^{-3} . (3)

9. (a) On the basis of kinetic theory of gases deduce expression for coefficient of thermal conductivity of a gas. Also show that

$$K = \eta C_v$$

where the symbols have their usual meaning. (5)

- (b) Find the diffusion coefficient of nitrogen in standard condition, if the free path of the molecule is 1.6×10^{-8} m. (3)
