Assignment-1

Year: 2017, Semester: Fall, Course: PHY-105, Title: Physics

1. Calculate the mean free path and the collision frequency for air molecules at 0°C and 1 atm pressure. Given the effective diameter of air molecule=2Å, the r.m.s speed of air molecules at N.T.P is about $1x10^5$ cm/sec and the number of air molecules per c.c.=$3x10^{19}$.

2. Estimate the size of a helium atom, assuming its mean free path at N.T.P to be $28.5x10^{-6}$ cm. Given that the density of helium at N.T.P is 0.178 g/liter and the mass of the helium atom is $6x10^{-24}$g.

3. Calculate the r.m.s speed of hydrogen and air at 0°C and atmospheric pressure. Given at N.T.P. $\rho_H = 0.000089$ gm/cm^3 and ρ_{air} =0.001293 gm/cm^3.

4. At what temperature, pressure remaining constant, will the r.m.s. velocity of a gas molecule be half its value at 0°C?

5. Calculate the mean translational kinetic energy per molecule of a gas at 727°C, given R=8.32 J/mol-k.

6. Calculate the r.m.s velocity of a molecule of mercury vapour ($M_{H_g} = 221\ gm$) at 300 K.

7. A particle of mass $6.2x10^{-27}$ kg is suspended in a liquid at 27°C and the r.m.s speed is found to be $1.4x10^{-2}$ m/s. If R=8.31 J/K-mol, find the Avogadro's number from the equipartition theorem.

8. Calculate the values of the molar heat capacities C_v and C_p of a gas, if the ratio of heat capacities is 1.33. What is the degrees of freedom/atomicity of the gas? Given R=8.31 J/k-mol.

9. The Brownian motion of some suspended particles inside a cylinder of radius is 30 cm is moving randomly at 20°C. The time needed to diffuse the particles is 2 sec. If viscosity co-efficient of the suspended fluid is 0.01 dynes-sec/cm^2 and R=$8.31x10^7$ erg/k-mol, calculate the diffusive coefficient using Einstein's Brownian motion theory. [Hint: Here, first calculate $\Delta^2 = \frac{RT}{N}\left(\frac{1}{3\pi\eta a}\right)\tau$ where, η=co-efficient of viscosity. Then find diffusive coefficient.]

10. Calculate the diffusivity of the Brownian gas following 5 sec requires to diffuse the gas particles along a cylinder of length 35 cm.