Board – CBSE	Class – 11	Topic – Kinetic Theory

1 marks Question

1. Find out the ratio between most probable velocity, average velocity and root Mean square velocity of gas molecules?
2. What happens when an electric fan is switched on in a closed room?
3. Why the temperature less than absolute zero in not possible?
4. What is an ideal perfect gas?

2 marks Question

5. If a certain mass of gas is heated first in a small vessel of volume v_1 and then in a large vessel of volume v_2 draw the $\mathrm{P}-\mathrm{T}$ graph for two cases?
6. At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the r.m.s speed of a helium gas atom at $-20°\mathrm{C}$? Given atomic mass of $\mathrm{Ar}=39.9$ and of $\mathrm{He}=4.0$?
7. Determine the volume of 1 mole of any gas S.T.P., assuming it behaves like an ideal gas?

3 marks Question

8. Two perfect gases at absolute temperature T_1 and T_2 are mixed. There is not loss of energy. Find the temperature of the mixture if the masses of molecules are m_1 and m_2 and number of molecules in n_1 and n_2?
9. Estimate the fraction of molecular volume to the actual volume occupied by oxygen gas at STP. Take the diameter of an oxygen molecule to be 3Å.
10. Derive Avogadro's law?

4 marks Question

11. A metre-long narrow bore held horizontally (and closed at one end) contains a 76 cm long mercury thread, which traps a 15 cm column of air. What happens if the tube is held vertically with the open end at the bottom?

12. Estimate the average thermal energy of a helium atom at
    (i) room temperature $(27℃)$,
    (ii) the temperature on the surface of the sun (6000 K).
    (iii) the temperature of 10 million kelvins (the typical core temperature in the case of a star)
13. At what temperature is the room mean square speed of an argon gas cylinder equal to the rms speed of a helium gas atom at $-20℃$? (atomic mass of Ar= 39.9 u, of He=4.0 u)

5 marks Question

14. An oxygen cylinder of volume 30 liters has an initial gauge pressure of 15 atm and a temperature of $27℃$. After some oxygen is withdrawn from the cylinder, the gauge pressure drops to 11 atm and its temperature drops to $17℃$.Estimate the mass of oxygen taken out of the cylinder $(\mathrm{R} = 8.31\ \mathrm{J\ mol^{-1}\ K^{-1}}, \mathrm{molecular\ mass\ of\ O_2} = 32\ \mathrm{u})$.
15. A gas equilibrium has uniform density and pressure throughout its volume. This is strictly true only if there are no external influences. A gas column under gravity, for example, does not have uniform density (and pressure). As you might expect, its density decreases with height. The precise dependence is given by the so-called law of atmospheres

    $$\mathrm{n_2} = \mathrm{n_1} \exp\left[-\frac{\mathrm{mg(h_2 - h_1)}}{\mathrm{k_B T}}\right]$$

    Where $\mathrm{nl}, \mathrm{n_1}$ refer to number density at heights $\mathrm{h_2\ and\ h_1}$ respectively. Use this relation to derive the equation for sedimentation equilibrium of a suspension in a liquid column:

    $$\mathrm{n_2} = \mathrm{n_1} \exp\left[-\mathrm{mg\ N}\ \frac{(\rho - \mathrm{P'})(\mathrm{h_2 - h_1})}{\rho \mathrm{RT}}\right]$$

    Where ρ is the density of the suspended particle, and ρ' that of surrounding medium. $[\mathrm{N_A}$ is Avogadro's number, and R the universal gas constant.] [Hint: use Archimedes principle to find the apparent]