

Course: CHM202

Energetics and dynamics of chemical reactions

Assignment –X

- Q.1** Calculate the collision frequency (z) and the collision density (Z) in carbon monoxide. Given: $r = 180$ pm at 25 °C and 100 kPa. What is the percentage increase when the temperature is raised by 10 K at constant volume?
- Q.2** Use the collision theory of gas-phase reactions to calculate the theoretical value of the second-order rate constant for the reaction $D_2(g) + Br_2(g) \rightarrow 2DBr(g)$ at 450 K. Assuming that it is elementary bimolecular. Take the collision cross-section as 0.30 nm², the reduced mass as 3.930 u, and the activation energy as 200 kJ mol⁻¹.
- Q.3** Calculate the collision frequency per unit area for nitrogen at 25 °C and 1 bar.
- Q.4** Calculate the mean free path of a hydrogen molecule at 25 °C and 10^{-5} torr. Given $\sigma = 0.230 \times 10^{-5}$ m².
- Q.5** Calculate the frequency of nitrogen-nitrogen collisions in one cubic centimetre of air at 20 °C and 1 bar. Assume that 80% of the molecule are nitrogen molecules. Given: $\sigma_{N_2} = 4.5 \times 10^{-19}$ m².
- Q 6.** Draw the Maxwell-Boltzmann distribution of speeds for Hydrogen and Helium gases (in one graph) at the same temperature.
- Q 7.** (a) Does the Maxwell Boltzmann distribution apply to imperfect gas or condensed phase system? (b) A gas is obeying the Maxwell Boltzmann distribution law, what will happen if pressure is tripled?