

## 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  $25\text{ }^{\circ}\text{C}$  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  $0.30\text{ nm}^2$ , the reduced mass as  $3.930$  u, and the activation energy as  $200\text{ kJ mol}^{-1}$ .
- Q.3** Calculate the collision frequency per unit area for nitrogen at  $25\text{ }^{\circ}\text{C}$  and  $1$  bar.
- Q.4** Calculate the mean free path of a hydrogen molecule at  $25\text{ }^{\circ}\text{C}$  and  $10^{-5}$  torr. Given  $\sigma = 0.230 \times 10^{-5}\text{ m}^2$ .
- Q.5** Calculate the frequency of nitrogen-nitrogen collisions in one cubic centimetre of air at  $20\text{ }^{\circ}\text{C}$  and  $1$  bar. Assume that  $80\%$  of the molecule are nitrogen molecules. Given:  $\sigma_{N_2} = 4.5 \times 10^{-19}\text{ m}^2$ .
- 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?