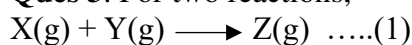


**Assignment 11**  
**Indian Institute of Science Education and Research**  
**CHM202: Energetics and dynamics of chemical reactions**  
**Instructor: Dr. Arijit K. De**

**Ques 1.** In a sample of nitrogen ( $N_2$ , with a molar mass of  $28.0 \text{ g mol}^{-1}$ ) at a temperature of  $27^\circ\text{C}$ , find the ratio of the number of molecules with a speed very close to  $300 \text{ ms}^{-1}$  to the number with a speed very close to  $100 \text{ ms}^{-1}$ .

**Ques 2.** Using collision theory, calculate the frequency factor 'A' for the following reaction  $O_2 + H \longrightarrow OH + O$  at  $273\text{K}$ . Given molecular diameter of  $H_2$  and  $O_2$  are  $2.74 \text{ \AA}$  and  $3.1 \text{ \AA}$  respectively.

**Ques 3.** For two reactions,



According to collision theory, calculate the ratio of squares of pre-exponential factors of reactions at the same temperature.

Species	Mass ( $\text{gmol}^{-1}$ )	Diameter (nm)
X	5	0.3
Y	20	0.5
M	10	0.4
N	10	0.4

**Ques 4.** 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  $450 \text{ K}$ , assuming that it is elementary bimolecular. Take the collision cross-section as  $0.30 \text{ nm}^2$ , the reduced mass as  $3.930 \text{ u}$ , and the activation energy as  $200 \text{ kJmol}^{-1}$ .

**Ques 5.** Calculate the following:

a) Temperature at which the root mean square velocity of  $SO_2$  molecules is equal to that of  $O_2$  molecules at  $27^\circ\text{C}$ .

b) Most probable speed for  $O_2$  at  $1 \text{ am}$  having the density  $0.0081 \text{ gm/ml}$ .

c) Root mean square speed for ethane at  $27^\circ\text{C}$  and  $720 \text{ mm of Hg}$ .