Assignment 11

Indian Institute of Science Education and Research
CHM202: Energetics and dynamics of chemical reactions
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Ques 1. In a sample of nitrogen (N_2, with a molar mass of 28.0 g mol^{-1}) at a temperature of 27°C, find the ratio of the number of molecules with a speed very close to 300 ms^{-1} to the number with a speed very close to 100 ms^{-1}.

Ques 2. Using collision theory**,** calculate the frequency factor 'A' for the following reaction $O_2 + H \longrightarrow OH + O$ at 273K. Given molecular diameter of H_2 and O_2 are 2.74 A^0 and 3.1 A^0 respectively.

Ques 3. For two reactions,
$X(g) + Y(g) \longrightarrow Z(g)$ …..(1)
$M(g) + N(g) \longrightarrow P(g)$ …...(2)
According to collision theory, calculate the ratio of squares of pre-exponential factors of reactions at the same temperature.

Species	Mass ($gmol^{-1}$)	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 K, assuming that it is elementary bimolecular. Take the collision cross-section as 0.30 nm^2, the reduced mass as 3.930 u, and the activation energy as 200 $kJmol^{-1}$.

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 27^0C.
b) Most probable speed for O_2 at 1 am having the density 0.0081 gm/ml.
c) Root mean square speed for ethane at 27^0C and 720 mm of Hg.