

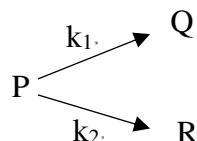
## Assignment 8

Indian Institute of Science Education and Research  
CHM202: Energetics and dynamics of chemical reactions

Instructor: Dr. Arijit K. De

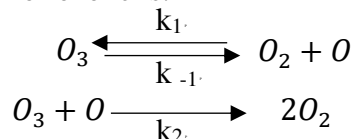
**Ques. 1** A reactant R undergoes three first-order parallel reactions to give three products P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub>. Write the expression for the rate equation of each species. Show that the products are formed in the ratio of the rate constants for respective reactions i.e. [P<sub>1</sub>]: [P<sub>2</sub>]: [P<sub>3</sub>] = k<sub>1</sub>: k<sub>2</sub>: k<sub>3</sub>

**Ques. 2** Consider the following two parallel irreversible first order reactions at temperature T,



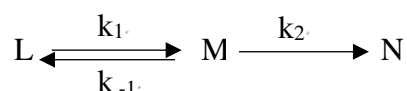
Where k<sub>1</sub> and k<sub>2</sub> are rate constants and their values are 5 × 10<sup>-2</sup> min<sup>-1</sup> and 15 × 10<sup>-2</sup> min<sup>-1</sup> respectively, at temperature T. If the initial concentration of the reactant 'P' is 4 mol L<sup>-1</sup> then calculate the concentration of product 'R' after 10 minutes of reaction.

**Ques. 3** The decomposition mechanism of ozone is:



If k<sub>-1</sub>[O<sub>2</sub>] << k<sub>2</sub>[O<sub>3</sub>], What will be order of the reaction with respect to ozone.

**Ques. 4** For a consecutive reaction in which first step is reversible and second step is irreversible.



Calculate the rate constant for formation of N. If k<sub>1</sub> is 10<sup>5</sup> L mol<sup>-1</sup> sec<sup>-1</sup>, k<sub>-1</sub> is 10<sup>4</sup> sec<sup>-1</sup> and k<sub>2</sub> is 10 sec<sup>-1</sup>.

**Ques. 5** Consider two consecutive first order reactions:  $\text{A} \xrightarrow{k_1} \text{B} \xrightarrow{k_2} \text{C}$

Assuming k<sub>1</sub> ≠ k<sub>2</sub> and at time t = 0, only A is present and [B] = [C] = 0.

a) Derive an expression for the t<sub>max</sub> (i.e. the time when [B] is maximum) in terms of rate constants k<sub>1</sub> and k<sub>2</sub>.

b) Derive an expression for [B<sub>max</sub>]. (i.e. maximum concentration of B)

c) Given k<sub>1</sub> =  $\left(\frac{\ln 2}{4}\right)$  and k<sub>2</sub> =  $\left(\frac{\ln 2}{4}\right)$ , calculate time taken by B to reach the maximum concentration.