

Home Assignment
FYUGP Semester V
Subject: Chemistry
Paper: Reaction Dynamics
Session: 2026-27 (Odd semester)

1. Answer the following questions as directed: (1 mark each)

(a) Identify the order of the reaction for which the value of the rate constant is given as:

$$\text{rate constant} = 4.5 \times 10^{-3} \text{ dm}^3\text{mol}^{-1}\text{s}^{-1}$$

(b) The $t_{1/2}$ of a reaction is doubled as the initial concentration of the reactant is doubled.

The order of the reaction is:

(i) 1 (ii) 0 (iii) 2 (iv) $1\frac{1}{2}$ *(Choose the correct answer)*

(c) What is a limiting reagent?

(d) Under what condition would the Lindemann theory of unimolecular gaseous reactions show second-order kinetics?

(e) How does the rate of the ionic reaction $\text{S}_2\text{O}_8 + 2\text{I}^- \rightarrow \text{products}$ performed in aq. NaCl solutions change with the increasing concentration of NaCl in water? Explain.

2. Answer any following questions: (2 marks each)

(a) On the basis of the Arrhenius equation, answer the following:

(i) What is the limiting value of rate constant K as the temperature of the reaction becomes infinitely large?

(ii) Which reaction will have the greater temperature dependence for the rate constant—one with a small value of E_a or one with a large value of E_a ?

(b) The half-life for radioactive decay of ^{14}C is 5730 years. An archaeological find contained wood that had only 80% of ^{14}C activity found in living plants. Find the age of the sample.

(c) The conversion $\text{X} \rightarrow \text{Y}$ follows second-order kinetics. If the concentration of X increases 3 times, how will it affect the rate of formation of Y ?

(d) What are pseudo first-order reactions? Why are they so called? Give two examples of pseudo first-order reactions.

(e) Can the activation energy of a reaction be zero or negative? Explain.

(f) Why are enzymes highly specific in their action and each enzyme catalyzes a particular reaction?

(g) How can primary and secondary salt effects be differentiated?

(h) The rate constants of a reaction are $1.6 \times 10^{-3} \text{ s}^{-1}$ and $1.625 \times 10^{-2} \text{ s}^{-1}$ at 10°C and 30°C , respectively. Calculate the activation energy of the reaction.

(i) Discuss a method for experimentally determining the order of a reaction.

(j) Explain the concept of steady-state approximation.

3. Answer any following questions (5 marks each):

(a) For the second-order reaction $aA \rightarrow \text{products}$:

(i) Integrate the rate law;

(ii) On the basis of this integrated rate law, draw a plot of $\frac{[A]}{[A]_0}$ against t ;

(iii) Derive an expression for the half-life of the reaction in terms of K and $[A]_0$.

(b) How does the reaction rate depend on temperature? Show how the Arrhenius plot of a reaction can be obtained. What is the significance of the pre-exponential factor?

(c) For the consecutive reactions $A \rightarrow B \rightarrow C$, obtain the expressions for the concentrations of the species A, B, and C. Draw the plots of $[A]$, $[B]$, and $[C]$ against time.

(d) What are chain reactions? Discuss the kinetics of branching chain reactions.

(e) Discuss the kinetics of enzyme-catalyzed reactions with reference to the Michaelis-Menten equation. What do you mean by turnover number?

(f) Write the postulates of hard-sphere collision theory. On the basis of collision theory, find an expression for the rate constant of the elementary bimolecular gaseous reaction, $A + B \rightarrow \text{products}$.

(g) In what ways are encounters in solution different from those in the gas phase? Deduce the Bronsted-Bjerrum equation for reactions in solution.

(h) Write the mechanism of unimolecular reactions as proposed by Lindemann. Using this mechanism, deduce an expression for the rate of a unimolecular reaction.

(i) Calculate the activation Gibbs function, enthalpy, and entropy of the second-order hydrogenation of ethene at 327°C .

Given: $A = 1.24 \times 10^6 \text{ M}^{-1}\text{S}^{-1}$, $E_a = 180 \text{ kJmol}^{-1}$.

Note: 1. Submit the assignment to the department on or before 30th October, 2026.

2. Write your Name, Roll no in the front page of your assignment.

3. Don't copy from AI. Otherwise marks will be deducted accordingly.