



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR**

**FIRST YEAR SECOND SEMESTER
MAIN EXAMINATIONS
FOR THE DEGREE OF MSc. (CHEMISTRY)**

COURSE CODE: SCH 852E

COURSE TITLE: ADVANCED CHEMICAL KINETICS

DATE: 13/12/2022

TIME: 2:00-4:00PM

INSTRUCTIONS TO CANDIDATES:

TIME: 2 HOURS

ANSWER ANY THREE QUESTIONS

THIS PAPER CONTAINS 3 PRINTED PAGES

KIBU OBSERVES ZERO TOLERANCE TO examination cheating

QUESTION ONE (20 MARKS)

- (a) Suppose we have equation of the form $A \rightarrow \text{Products}$ for first order reaction. Show that its integrated rate law is $K = \frac{1}{t} \ln \frac{[A]_0}{[A]_t}$ (5 marks)
- (b) Show that the half-life for 2nd order reaction is given by $t_{1/2} = \frac{1}{K[A]_0}$ (5 marks)
- (c) Define order of reaction (2 marks)
- (d) State any four methods used in measuring the reaction rate (4marks)
- (e) Considering reaction of the form $aA + bB \rightleftharpoons cC + dD$, deduce the rate law for the reaction (4marks)

QUESTION TWO (20 MARKS)

- (a) State the three types of complex reactions (3 marks)
- (b) Considering $A \xrightleftharpoons[k_{-1}]{k_1} B$ as an example of first order opposing reaction show that $\frac{K_1 a}{X_e} = \frac{1}{t} \frac{\ln X_e}{X_e - X}$ (7 marks)
- (c) Describe the Michaelis-Menten mechanism (10 marks)

QUESTION THREE (20 MARKS)

- (a) State the two types of parallel complex reactions (2 marks)
- (b) State the steady state approximation (2 marks)
- (c) Decomposition of $2N_2O_5 \rightarrow 4NO_2 + O_2$ follows a four step mechanisms as shown
- (i) $N_2O_5 \xrightarrow{k_1} NO_2 + NO_3$
- (ii) $NO_2 + NO_3 \xrightarrow{k_2} N_2O_5$
- (iii) $NO_2 + NO_3 \xrightarrow{k_3} NO_2 + O_2 + NO$
- (iv) $NO + N_2O_5 \xrightarrow{k_4} 3NO_2$
- Using steady state approximation, deduce the rate law of the decomposition of N_2O_5 (10 marks)
- (d) State three assumptions of simple collision theory (3 marks)
- (e) State any three drawbacks of collision theory (3 marks)

QUESTION FOUR (20 MARKS)

- (a) Poisons are classified based on whether they undergo competitive, uncompetitive or non-competitive inhibition. Briefly discuss what you understand by each of the classification (10 marks)
- (b) Explain the theory of chemical adsorption as per Langmuir (7marks)
- (ii) List some of experimental conditions to support the theory of chemical adsorption (3 marks)

QUESTION FIVE (20 MARKS)

- (a) (i) Hydrolysis of ethyl acetate by NaOH using equal concentration of the reactants was studied by titrating 25ml of the reaction mixture at different time intervals against standard acid. From the data given below, establish that this is a second order reaction. (8 marks)

t (minutes)	0	5	15	25
ml acid used	16.00	10.24	6.13	4.32

- (ii) Calculate the half-life of this reaction (5 marks)

(b) Let σ be fraction of unit surface area covered by adsorbed molecules as shown in the figure given below.



Show that $\sigma = \frac{aP}{d+aP}$

(7 marks)