

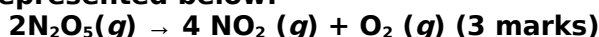


NATIONAL OPEN UNIVERSITY OF NIGERIA
14-16 AHMADU BELLO WAY, VICTORIA ISLAND, LAGOS
SCHOOL OF SCIENCE AND TECHNOLOGY
JANUARY/FEBRUARY 2013 EXAMINATION

CHM 407 - REACTION KINETICS
Answer any four questions

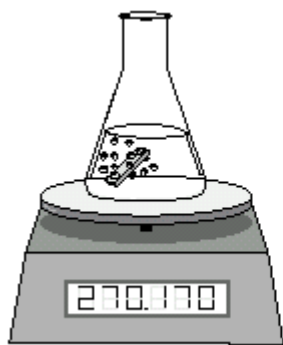
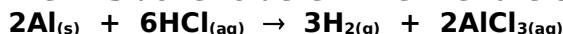
Q1

(a) (i) At 323 K, the rate of reaction for the decomposition of N_2O_5 at a particular instant is $2.74 \times 10^{-4} \text{ M s}^{-1}$. Calculate the rate of formation of O_2 . The reaction is represented below:



(ii) In the decomposition of hydrogen iodide, what is the relationship between the rate of decomposition of HI and the rate of formation of H_2 ? (2 marks)

(b) An experiment is done to determine the rate of the following reaction:



The following data are collected:

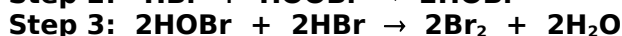
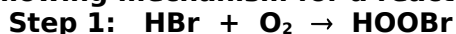
TIME (s)	MASS OF FLASK PLUS CONTENTS (g)
0.0	270.230
30.0	270.200
60.0	270.170

(i) Calculate the rate of formation of H_2 in g/sec (3 marks)

(ii) Calculate the rate of formation of H_2 in mol/min. (3 marks)

(iii) Calculate the rate of consumption of Al in g/sec. (3 marks)

(c) Consider the following mechanism for a reaction:



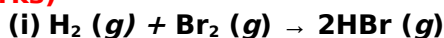
Identify the (i) reactant, (ii) product, (iii) catalyst and (iv) intermediate in the reaction.

(4 marks)

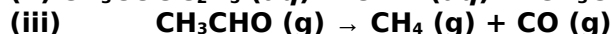
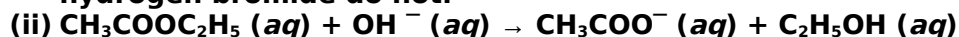
Q2

(a) Discuss briefly any FOUR experimental methods of rate studies ($2\frac{1}{2}$ marks each; = 10 marks)

(b) State the name of a suitable experimental method that can be used to monitor the reaction rate in each following cases. ($1\frac{1}{2}$ marks each; = $4\frac{1}{2}$ marks)



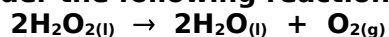
Hint: Bromine absorbs strongly in the visible region, while hydrogen and hydrogen bromide do not.



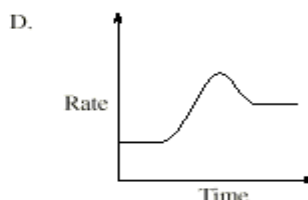
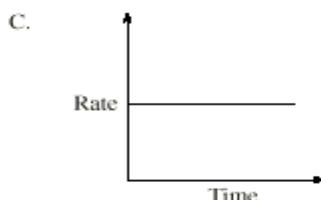
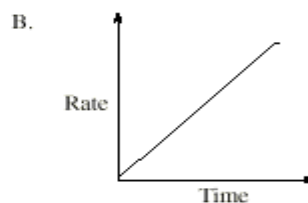
(c) An **elementary** reaction, $2A + C \rightarrow D$, is second order in A and first order in C. The rate of this reaction is $2.5 \times 10^{-1} \text{ M/s}$ when the concentrations of A, C, and D are all 1.00 mM. What is the rate constant for the reaction? (3 marks)

Q3

(a) Consider the following reaction:



Identify the graph that shows the relationship between rate of consumption of H_2O_2 and time; explain your answer (5 marks).



(b) On heating cyclopropane to 770 K, it is converted into propene. In one experiment, the following data were obtained:

$T \text{ (secs)}$	0	300	600	900
$[\text{Cyclopropane}] \text{ (M)}$	1.50×10^{-3}	1.24×10^{-3}	1.00×10^{-3}	8.3×10^{-4}

(i) Using graphical method, test whether the above data satisfy first order rate equation. (6 marks)

(ii) Calculate the rate constant (2 marks).

(c) Consider the first order reaction

$A \rightarrow \text{products}$, which has a rate constant, $k = 2.95 \times 10^{-3} \text{ s}^{-1}$. What percent of A remains after 150 s? (5 marks)

Q4

(a) Explain how a catalyst affects the rate of a reaction. (4 marks)

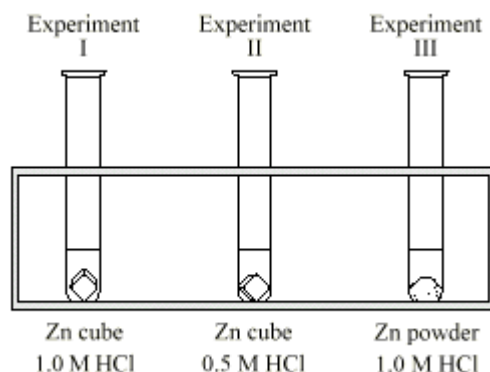
(b) The decomposition of hydrogen iodide on gold at 323 K is zeroth order reaction and the rate constant is $1.20 \times 10^{-4} \text{ M s}^{-1}$

(i) If the initial concentration of hydrogen iodide is 0.500 M, calculate its concentration after $3.00 \times 10^3 \text{ s}$. (4 marks)

(ii) How long will it take for all of the hydrogen iodide to decompose? (5 marks)

(c) Consider the following experiments, each involving equal masses of zinc and

10.0 mL of acid:



Identify the fastest and the slowest reactions. Explain your answer. (5 marks)
Q5

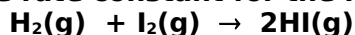
(a) What do you understand by the terms: order and molecularity. Distinguish between the two. (5 marks)

(b) (c) Consider the following reaction:



(i) List and discuss briefly (using collision theory), four factors that would increase the rate of the above reaction. (2 marks each; = 8 marks)

(c) The rate constant for the reaction



is $5.4 \times 10^{-4} \text{ M}^{-1}\text{s}^{-1}$ at 326°C . At 410°C the rate constant was found to be $2.8 \times 10^{-2} \text{ M}^{-1}\text{s}^{-1}$.

Calculate

(i) the activation energy (ii) the pre-exponential factor, A (5 marks)

Q6

(a) What do you understand by the following terms?

(i) Physisorption (ii) Chemisorption (5 marks)

(b) List any THREE assumptions of the Langmuir Adsorption Isotherm (4½ marks)

(c) List THREE modern methods of surface studies (3 marks)

(d) (i) What is a catalyst? (2 marks)

(ii) List the three known types of catalysts (3 marks)