



NATIONAL OPEN UNIVERSITY OF NIGERIA
14-16 AHMADU BELLO WAY, VICTORIA ISLAND LAGOS
SEPTEMBER/OCTOBER 2015 EXAMINATION

SCHOOL OF SCIENCE AND TECHNOLOGY

COURSE CODE: CHM 407

COURSE TITLE: REACTION KINETICS

INSTRUCTION: Answer any four (4) questions.

QUESTION 1

a) How will the rate of reaction change if the volume of reaction vessel is diminished to one-third of its initial value? (4 marks)



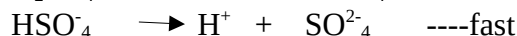
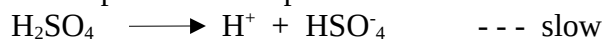
b) Assuming a reaction of the form, $\text{Aa} + \text{Bb} \longrightarrow \text{products}$, and if the rate law for this reaction is given as,

$$\text{Rate} = K[\text{A}]^{1/2} [\text{B}]^2$$

Find the order of the reaction and the unit of the rate constant. (6 marks)

c) The half-life $t_{1/2}$ of a chemical reaction is 2234 seconds. Find the first order constant for the reaction. (3 ½ marks)

d) The decomposition of sulphuric acid occurs according to the following mechanism:

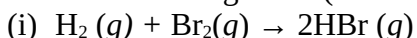


The experimentally determined rate law is given as $\text{Rate} = K [\text{H}_2\text{SO}_4]$ since $[\text{H}_2\text{SO}_4] = 1$. Is this an acceptable mechanism? (4 marks)

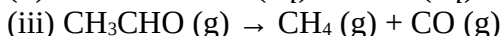
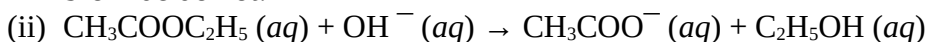
QUESTION 2

(a) Discuss briefly any FOUR experimental methods of rate studies (2½ marks each; = 10 marks)

2 (b) State the name of a suitable experimental method that can be used to monitor the reaction rate in each following cases. (1½ marks each; = 4½ marks)



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



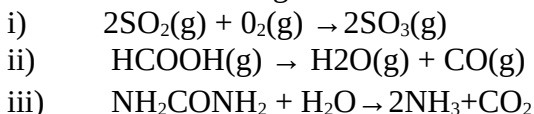
(c) An **elementary** reaction, $2A + C \rightarrow D$, is second order in A and first order in C. The rate of this reaction is $2.5 \times 10^{-1} \text{ M/s}$ when the concentrations of A, C, and D are all 1.00 mM. What is the rate constant for the reaction? (3 marks)

QUESTION 3

- (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 ($4\frac{1}{2}$ 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)

Question 4

- a) State three factors in which the amount of a gas adsorbed by a solid depends on.
 b) Consider the following mechanism for a reaction:



Identify the (i) reactant, (ii) product, (iii) type and example of catalyst used in the reaction.
 (4 marks)

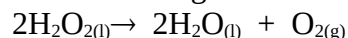
c) What are the two vital reaction sequence involved in the mechanism of enzymes catalyzed reaction.
 (6marks)

d) 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)

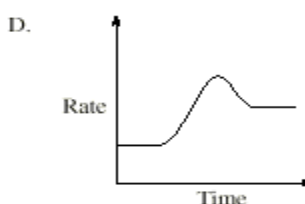
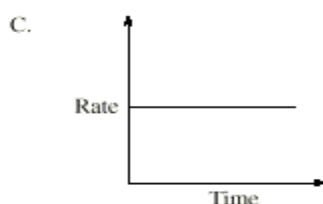
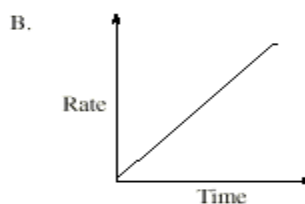
e) Define the term promoter and discuss the role of a promoter in the industrial preparation of hydrogen gas through Haber process.
 (5 marks)

Question 5

- (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 (secs)	0	300	600	900
[Cyclopropane] (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)

Question 6

a) What is meant by the term Fluorescence (3 mark)

b) In photochemical decomposition of acetone using 315 nm light, $8.15 \times 10^{-6} \text{ mol}$ of carbon monoxide is formed in 21 minutes. If the light absorbed corresponds to $2.75 \times 10^{-3} \text{ Js}^{-1}$, calculate the quantum efficiency for the formation of carbon monoxide. (14 ½ marks)