NATIONAL OPEN UNIVERSITY OF NIGERIA
Plot 91, Cadastral Zone, Nnamdi Azikiwe Expressway, Jabi, Abuja
FACULTY OF SCIENCE

OCTOBER/ NOVEMBER 2016 EXAMINATION

COURSE CODE: CHM 407
COURSE TITLE: REACTION KINETICS
COURSE UNIT: 2 Units
TIME: 2 hours
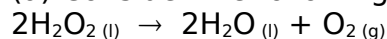INSTRUCTION: Answer question one (1) and any three (3) questions

Question 1
a) What is meant by the term Fluorescence? (3 mark)
b) In the photochemical decomposition of acetone using a 315 nm light, 8.15×10^{-6} mol of carbon   monoxide is formed in 21 minutes. If the light absorbed corresponds to 2.75×10^{-3} Js^{-1}, calculate the quantum efficiency for the formation of carbon monoxide.   (14 ½ Marks)

Question 2
(a) Consider the following reaction:
$2H_2O_{2\,(l)} \rightarrow 2H_2O_{\,(l)} + O_{2\,(g)}$
Identify the graph that shows the relationship between rate of consumption of H_2O_2 and time; explain your answer (5 marks).
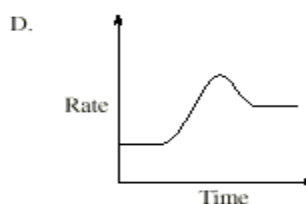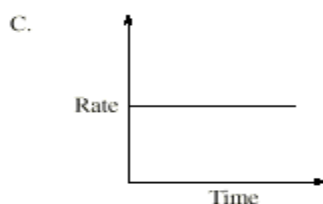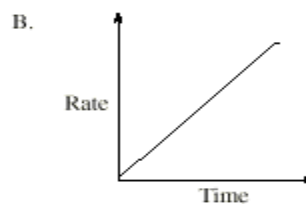
   (b) On heating cyclopropane to 770 K, it is converted into propene. In one experiment, the following data were obtained:

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 satisfies a first order rate equation.

(6 marks)
(ii) Calculate the rate constant (2 marks).
 (c) Consider the first order reaction
A → products, which has a rate constant, k = 2.95 x10^{-3} s^{-1}. What percent of A remains after 150 s ? (4 ½ marks)

Question 3
a) State three factors that influence the amount of a gas adsorbed on to a solid. (3 marks)
b) Consider the following mechanism for a reaction:
(i) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$
(ii) $HCOOH(g) \rightarrow H_2O(g) + CO(g)$
(iii) $NH_2CONH_2 + H_2O \rightarrow 2NH_3 + CO_2$
For each reaction i), ii), iii), Identify the (I) reactant, (II) product,   (III) type and example of catalyst used in the reaction.
(4 ½ marks)
c) What are the two vital reaction sequences involved in the mechanism of an enzymes-catalyzed reaction.   (3 marks)
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 4
(a) What do you understand by each of 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)

QUESTION 5
 (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)
   (i) H$_2$ (g) + Br$_2$ (g) → 2HBr (g)
Hint: Bromine absorbs strongly in the visible region, while hydrogen and hydrogen bromide do not.
     (ii) CH$_3$COOC$_2$H$_5$ (aq) + OH ⁻ (aq) → CH$_3$COO⁻ (aq) + C$_2$H$_5$OH (aq)
     (iii)CH$_3$CHO (g) → CH$_4$ (g) + CO (g)

(c) An elementary reaction, 2 A + C → D, is second order in A and first order in C. The rate of this reaction is 2.5 x 10^{-1} 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 6
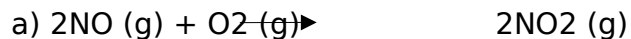
a) $2NO_{(g)} + O_{2(g)} \rightarrow 2NO2_{(g)}$
If the volume of reaction vessel is diminished to one-third of its initial value, what will be the rate of reaction?   (4 marks)

b) Suppose the rate law of the reaction; $Aa + Bb \rightarrow$ products, is
Rate $= K[A]^{1/2} [B]^2$
Evaluate the order of the reaction and the unit of the rate constant.   (6 marks)

c) The half-life t ½ of a chemical reaction is 37.24 minutes. Find the first order constant for the reaction.   (3 ½ marks)

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

$H_2SO_4 \longrightarrow H^+ + HSO^-_4$ - - - slow
$HSO^-_4 \longrightarrow H^+ + SO^{2-}_4$ ----fast
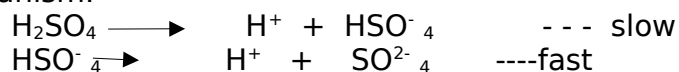
The experimentally determined rate law is given as Rate $= k[H_2SO_4]$. Is this an acceptable mechanism?   (4 marks)