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KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF BSC (CHEMISTRY)

COURSE CODE: SCH 224

COURSE TITLE: CHEMICAL KINETICS

DATE: 28/07/2022 **TIME: 2:00PM-4:00PM**

INSTRUCTIONS TO CANDIDATES:

TIME: 2 Hours

Answer **question ONE** and **any TWO** of the remaining

Question one (30 Marks)

(a) Define the following terms as used in this course
i. Rate of reaction **(2Marks)**
ii. Half-life **(2Marks)**
iii. Molecularity **(2Marks)**
iv. Complex reactions **(2Marks)**
(b) State the three types of complex reactions **(3marks)**
(c) Explain why High Molecularity Reactions are Rare **(5marks)**
(d) State the four assumptions of collision theory **(4 marks)**
(e) State any five postulates of collision theory **(5marks)**
(f) i) Define heterogeneous catalysis **(1 mark)**
(ii) State the two common characteristics of catalytic reactions **(2 marks)**
(g) State any two methods of determining order of a reaction **(2 marks)**

Question Two (20 marks)

(a) The rate law for the decomposition of N_2O_5 (l) is: rate = k [N_2O_5] where $k = 6.22 \times 10^{-4}$ sec^{-1}. Calculate half-life of N_2O_5 (l) and the number of seconds it will take for an initial concentration of N_2O_5 (l) of 0.100 M to drop to 0.0100 M. **(8 marks)**

(b) Show that he hydrolysis of ethyl acetate in the presence of a mineral acid as catalyst with data provided below is a first order reaction. **(5marks)**

t (secs)	0	4500	7140	∞
ml alkali used	24.36	29.32	31.72	47.15

(c) Compound A decomposes to form B and C the reaction is first order. At 25°C the rate constant for the reaction is 0.450 s^{-1}. What is the half-life of A at 25°C? **(4 marks)**

(d) State the three types of elementary reactions **(3 marks)**

Question three (20 marks)

(a) Determine the rate law and evaluate the rate constant for the following reaction **(8marks)**

2 NO(g) + Br2(g) ⇔2 NOBr(g)

Experiment	$(NO)_o$ (M)	$(Br_2)_o$ (M)	Initial Rate of Reaction (M/min)
1	0.10	0.10	1.30×10^{-3}
2	0.20	0.10	5.20×10^{-3}
3	0.20	0.30	1.56×10^{-2}

(b) i)Using Arrhenius equation $K = Ae^{-E_a/RT}$ show that $Lnk = \frac{-E_a}{R}\left(\frac{1}{T}\right) + \ln A$ **(2 marks)**

(ii) The values of the rate constant (k) for the reaction $2N_2O_5\ (g) \longrightarrow 4NO_2\ (g) + O_2\ (g)$ were determined at several temperatures. A plot of 1n k *versus* $1/T$ gave a straight line of which the slope was found to be -1.2×10^4 K. What is the activation energy of the reaction? **(3 marks)**

(R= gas constant (8.314j/mol/k) **(4marks)**

(c) Explain why high Molecularity reaction are rare **(3marks)**

(d) There are not many reactions showing third order kinetics. Write down chemical equations of any three of those reactions

Question Four (20 marks)

(a) Describe the half-life method of determining order of reaction **(10 marks)**

(b) Show that the half-life of a second order reaction of the form 2A → Products is

$t_{½} = \frac{1}{k[A]_0}$ **(5 marks)**

(c) (i) State the steady state approximation **(1 mark).**

ii) Using sequential reactions $A \underset{k_1}{\rightarrow} B \underset{k_2}{\rightarrow} C$, show that $\frac{d[c]}{dt} = k_1[A]$ **(4 marks)**

Question Five (20 marks)

(a) Describe the graphical method of determining order of a reaction of the type A → products

(i) First order **(5 marks)**

(ii) Second order **(5 marks)**

(b) Explain the Michaelis-Menten mechanism **(10 marks)**