KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: SCH 224

COURSE TITLE: CHEMICAL KINETICS

DATE: 15/2/2021 **TIME:** 2:00-4:00PM

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. Chemical kinetics **(2Marks)**
ii. Elementary reaction **(2Marks)**
iii. Molecularity **(2Marks)**
iv. Complex reactions **(2Marks)**

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

(c) Explain why High Molecularity Reactions are Rare **(5marks)**

(d) State the four assumptions of collision theory **(4 marks)**

(e)From the following data for the decomposition of N_2O_5 in CCl_4 solution at 48°C, show that the reaction is of the first order**(5marks)**

t(minutes)	10	15	20	∞
Vol of O_2 evolved	6.30	8.95	11.40	34.75.

(f) i) Define heterogeneous catalysis (1 mark)
(ii) Give anytwo examples of heterogeneous catalysis **(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) State any five postulates of collision theory **(5marks)**
(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 complex reactions **(3 marks)**

Question three (20 marks)

(a) For the following reaction:

$$2\ HgCl_{2(aq)} + C_2O_4^{2-}{}_{(aq)} \rightleftharpoons Hg2Cl_{2(s)} + 2\ Cl^-_{(aq)} + 2\ CO_{2(g)}$$

Experiment	Initial Concentration of $HgCl_2$ (M)	Initial Concentration of $C_2O_4^{2-}$ (M)	Initial Rate of Reaction (M /sec)
1	0.096	0.13	2.1×10^{-7}
2	0.096	0.21	5.5×10^{-7}
3	0.171	0.21	9.8×10^{-7}

(i) Determine the order of the reaction with respect to $HgCl_2$ and with respect to $C_2O_4^{2-}$.**(6 marks)**

(ii) Write the rate law for this reaction**(1 mark).**
(iii) Calculate the rate constant and give its units**(2 marks).**
(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 ln 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)**
(Where K =rate constant, E_a =activation energy, R= gas constant (8.314j/mol/k) and T= temperature in Kelvin)

(d)There are not many reactions showing third order kinetics. Write down chemical equations of any three of those reactions**(3marks)**

Question Four (20 marks)

(a) Describe the Differential 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) Define the term catalyst **(1 mark)**.
ii) State the four common characteristics of catalytic reactions **(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)**