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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

KIBU observes **ZERO** tolerance to examination cheating

Question one (30 Marks)

(a) Define the following terms as used in this course

- Chemical kinetics (2Marks)
- Elementary reaction (2Marks)
- Molecularity (2Marks)
- 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 $48^\circ C$, 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 any two 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: $\text{rate} = k [N_2O_5]$ where $k = 6.22 \times 10^{-4} \text{ sec}^{-1}$. 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)

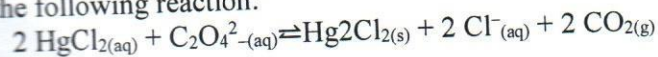
b) State any five postulates of collision theory (5marks)

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

(d) State the three types of complex reactions (3 marks)

Question three (20 marks)

(a) For the following reaction:



Experiment	Initial Concentration of HgCl_2 (M)	Initial Concentration of $\text{C}_2\text{O}_4^{2-}$ (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 $\text{C}_2\text{O}_4^{2-}$. (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 $\ln k = \frac{-E_a}{R} \left(\frac{1}{T}\right) + \ln A$ (2 marks)

(ii) The values of the rate constant (k) for the reaction $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ 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 $2A \rightarrow$ Products is

$$t_{1/2} = \frac{1}{k[A]_0} \text{(5 marks)}$$

(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 $A \rightarrow$ products

(i) First order (5 marks)

(ii) Second order (5 marks)

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