BONDO UNIVERSITY COLLEGE

UNIVERSITY EXAMINATION 2012/2013

3RD YEAR 2ND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE WITH IT (REGULAR)

COURSE CODE: SCH 308

TITLE: KINETICS OF CHEMICAL REACTIONS

DATE: 27/11/2012 **TIME: 10.00-12.00PM**

DURATION: 2HOURS

INSTRUCTIONS

1) **This paper contains TWO sections.**
2) **Answer ALL questions in section A COMPULSORY and ANY other TWO [2] questions in section B.**
3) **Write ALL answers in the booklet provided.**

Section A This section contains ONE COMPULSORY question

QUESTION 1 (Compulsory -30 marks)

a) Define the term 'order of a reaction'. (2 marks)

b) What do you understand by the term 'rate law'? (2 marks)

c) Write the equation relating the half-life of a first order reaction to the rate constant. (3 marks)

d) The thermal decomposition of $N_2O_{5(g)}$ obeys first-order kinetics. At 45^0 C, a plot of ln $[N_2O_5]$ verses t gives a slope of -6.18 x 10 min. What is the half life of the reaction? (5 marks)

e) If a reaction in which Z is converted to Y is a first order reaction, write down the integrated rate law for a first order reaction kinetics. (4 marks)

f) What are the characteristics of an elementary step in a chemical reaction profile? (5 marks)

g) What is a catalyst and how does it aid in reaction kinetics? (2 marks)

h) The Arrhenius Equation is given below. Define all the terms in the equation.

$$k = A.e^{-\frac{E_a}{RT}}$$ (7 marks)

Section B: This section contains FOUR questions. Answer ONLY TWO questions.

Question Two (Optional, 20 marks)

a) The rate law for the reaction

$$NH_4^+{}_{(aq)} + NO_2^- \longrightarrow N_{2(g)} + 2H_2O_{(l)}$$

Is given by rate = K $[NH_4^+]$ $[NO_2^-]$. At 25^0C, the rate constant is 3.0×10^{-4} /M.S. Calculate the rate of the reaction at this temperature if $[NH_4^+]$ = 0.26M and $[NO_2^-]$. = 0.080M (8 marks)

b) A certain chemical reaction follows the stoichiometric equation

$$A + 2B \longrightarrow 2Z$$

Measured rates of formation of the product, Z, are shown for several concentrations of reactants, A and B:

[A]/mole liter^{-1}	[B]/mole liter^{-1}	rate/mole liter^{-1} sec^{-1}
2.5×10^{-2}	3.3×10^{-3}	1.0×10^{-2}
5.0×10^{-2}	6.6×10^{-3}	4.0×10^{-2}
5.0×10^{-2}	1.32×10^{-2}	8.0×10^{-2}

Assuming a differential rate law of the form

rate = k $[A]^a$ $[B]^b$,

what is the value of *a* (the order of reaction with respect to A), what is *b* (the order of reaction with respect to B) and what is the value of k (the rate constant). (12 marks)

Question Three (Optional, 20 marks)

a) Azomethane $C_2H_6N_2$ decomposed at 300^0 in the gas phase

$$C_2H_6N_{2(g)} \longrightarrow C_2H_{6(g)} + N_{2(g)}$$

From the data in the following table determine the order of the reaction in

$[C_2H_6N_2]$ and rate constant. (10 marks)

Time(s)	in $[C_2H_6N_2]$
0	0.36
15	0.30
30	0.25
48	0.19
75	0.13

b) The activation energy of a first order reaction is 50.2 kJ/mol at 25^0 C. At what temperature will the rate constant double? (5 marks)

c) Describe the factors that affect reaction rates. (5 marks)

Question Four (Optional, 20 marks)

a) Solutions of A = $H_3COC_6H_4CNO$ in carbon tetrachloride dimerize slowly as shown by the following data

t/hr	0	3.5	7	10.5	14	17.5	21	24.5	28	31.5	35
[A]/mole/liter	0.995	0.745	0.595	0.494	0.424	0.370	0.330	0.295	0.270	0.247	0.229

Determine the order of the reaction and find the rate constant. (10 marks)

b) Write the differential rates equation of the following reactions;

$2S + B \longrightarrow C + 3D$ (3 marks)

$3A + B \longrightarrow 2C + D + 2E$ (3 marks)

c) Describe homogenous catalysts (4 marks)

Question Five (Optional, 20 marks)

a) Describe heterogeneous catalysts. (4 marks)

b) Using two reaction vessels of differing surface material, the reaction between A and B in the gaseous phase was investigated. The initial rate refers to the rate of removal of A (mol m^{-3} s^{-1}) in the experimental data set out below. Deduce the rate equation in each case and explain your deduction. (10 marks)

	χA_Z/ mol m^{-3}	χB_Z/mol m^{-3}	Relative rate (initially)
Experiment I	0.15	0.15	1
	0.30	0.15	4
	0.15	0.30	2
Experiment II	0.15	0.15	1
	0.30	0.30	4
	0.60	0.30	16

c) In a certain experiment the reaction was found to be

$2A + B \longrightarrow 2C$

With a rate of reaction given as

Rate= $k [A]^2 [B]$

Work out a proposed mechanism for this reaction. (6 marks)

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