

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)

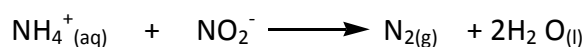
- a) Define the term 'order of a reaction'. (2 marks)
- b) What do you understand by the term 'rate law'? (2 marks)
- c) Write the equation relating the half-life of a first order reaction to the rate constant. (3 marks)
- d) The thermal decomposition of $\text{N}_2\text{O}_5(\text{g})$ obeys first-order kinetics. At 45°C , a plot of $\ln [\text{N}_2\text{O}_5]$ versus t gives a slope of $-6.18 \times 10^{-3} \text{ min}^{-1}$. 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.

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

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

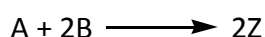
Question Two (Optional, 20 marks)

a) The rate law for the reaction



Is given by rate = $k [\text{NH}_4^+] [\text{NO}_2^-]$. At 25°C, the rate constant is 3.0×10^{-4} /M.S. Calculate the rate of the reaction at this temperature if $[\text{NH}_4^+] = 0.26\text{M}$ and $[\text{NO}_2^-] = 0.080\text{M}$ (8 marks)

b) A certain chemical reaction follows the stoichiometric equation



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}

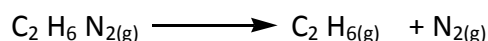
Assuming a differential rate law of the form

$$\text{rate} = k [\text{A}]^a [\text{B}]^b,$$

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 $\text{C}_2\text{H}_6\text{N}_2$ decomposed at 300°C in the gas phase



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

$[\text{C}_2\text{H}_6\text{N}_2]$ and rate constant. (10 marks)

Time(s)	in $[\text{C}_2\text{H}_6\text{N}_2]$
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°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 = H₃COC₆H₄CNO 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;



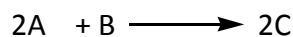
- c) Describe homogenous catalysts (4 marks)

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)

	[A]/ mol m ⁻³	[B]/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



With a rate of reaction given as

$$\text{Rate} = k [A]^2 [B]$$

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

=END=