KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION

SCH 305: CHEMICAL KINETICS

DATE: Tuesday 30th November, 2010 **TIME:** 8.00 a.m. – 10.00 a.m.

Useful Information

$R = 8.314\ JK^{-1}\ mole^{-1}$
$O^oC = 273.15\ K$

INSTRUCTIONS

Answer ALL FOUR questions.

Q1. (a) Write concisely on the terms: Order, molecularity and mechanism as used in chemical kinetics. [8 marks]

(b) Explain the concept of half-life, as used in chemical kinetics. [3 marks]

(c) For a second order reaction in a single substance A, one has:

$$\frac{-d}{dt}[A] = k[A]^2$$

Derive an equation to show the relationship between the half-life and the initial concentration of substance A. [7 marks]

Q2. (a) Explain the concept of 'activation' in chemical kinetics and hence explain the variation of reaction rate with temperature. [5 marks]

(b) The following values were obtained for the velocity constant, k, during the transformation of a substance:

Temp, ^oC	0	25	45	65
K, min^{-1}	4.7×10^{-5}	2.0×10^{-3}	3.0×10^{-2}	3.0×10^{-1}

Determine the value of the activation energy for the reaction by drawing the appropriate graph. [11 marks]

Q3. (a) For the reversible conversion of substance A to B through a first order mechanism, show that:

$$\mathrm{Ln}\left(\frac{\mathrm{Xe}}{\mathrm{Xe}-\mathrm{X}}\right)=\frac{\mathrm{kAo}}{\mathrm{Xe}}\,\mathrm{t}$$

where:

Ao = initial molar concentration of substance A

X = molar concentration of substance B at time t

Xe = molar concentration of substance B at equilibrium

k = velocity constant for the forward reaction. [10 marks]

(b) Derive the Langnuir absorption isotherm:

$$\theta=\frac{k_1 p}{k_2 p+1}$$

and use it to explain the orders of gaseous reactions on solid surfaces, at low and high pressures. [9 marks]

Q4. (a) The rate equation for a reaction of order n in substance A is represented thus:

$$\frac{-d}{dt}[A]=k[A]^n$$

Show that the half-life, $t_{½}$, is given by:

$$\mathrm{Ln}\ t_{½}=\mathrm{Ln}\left(\frac{2^{n-1}-1}{k(n-1)}\right)-(n-1)\,\mathrm{Ln}\ \mathrm{Ao},$$

such that:

Ao = initial molar concentration of substance A. [10 marks]

(b) The decomposition of a compound in solution gave the following data at 57.4°C:

Initral conc. (mole litre^{-1})	0.50	2.48
Time for half-decomposition (sec)	4280	174

Deduce the order of the reaction. [7 marks]

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