CHUKA UNIVERSITY

SUPPLEMENTARY / SPECIAL EXAMINATIONS

FOURTH YEAR EXAMINATION FOR THE AWARD OF BACHELOR DEGREE IN

CHEM 323: CHEMICAL KINETIC

STREAMS:

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 18/11/2020 **8.30 A.M - 10.30 A.M.**

INSTRUCTIONS:

- Answer all questions

QUESTION ONE (30 MARKS)

1a (i). For the reaction

$$2NO + 2H_2 \xrightarrow{K} N_2 + 2H_2O$$

Following mechanism has been proposed:

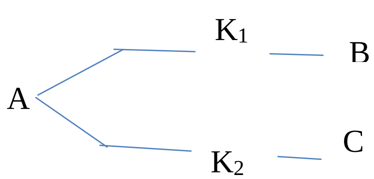
NO +NO $\rightleftharpoons$ N_2O_2; with K_1 as the rate of forward reaction and K_{-1} as the rate of the reverse reaction

$$N_2O_2 \xrightarrow{K_2} N_2O + H_2O$$

$$N_2O + H_2 \xrightarrow{K_3} N_2 + H_2O$$

On the basis of the above mechanism, derive the rate law of N_2 (12 marks)

(ii) Consider the parallel reaction



In an experiment, it was observed that 80% decomposition of A takes place in 40 minutes and analysis of product showed that 60% of B and 40% of C are present. Calculate K_1 and K_2.

(6 marks)

(b) Write short notes on catalytic poisoning (8 marks) (c). Predict how the total pressure varies during the gas phase decomposition in a constant volume container (4 marks)

$2N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$

QUESTION TWO (20 MARKS)

2a(i). An actinometer uses a solution of $K_3\left[Fe\left(C_2O_4\right)_3\right]$in which Fe^{3+} is reduced and the oxalate ion is oxidized. Assuming Ø = 1.24 at 310nm. Calculate the intensity of the incident light which produces 1.3 ×10^{-5} moles of Fe^{2+} in 36.5 min.

(9 marks)

(ii). The same light source is used to irradiate a sample of CH_2CO for a period of 15.2 min. If the quantum yield of C_2H_2 is 1.0 and that of CO is 2.0, determine the amount of each gas produced by the photochemical reaction. (h = 6.62608 × 10^{-34} JS, NA= 6.02214 × 10^{23} mol^{-1}, C=2.99792558 × 10^8 ms^{-1}, 1nm = 10^{-9} M) (5 marks)

(b) An aqueous solution of a compound A of concentration 10^{-3} moles/litre absorbs 50% of incident radiation in a cell length 1cm and another compound B of concentration 2 × 10^{-3} moles/litre absorbs 60% of the incident radiation at a particular wavelength. Calculate the percentage absorbed in a solution containing 10^{-3} moles/litre of A and Beach in the same cell at the wavelength. (6 marks)

QUESTION THREE (20 MARKS)

3a. A undergoes two simultaneous reactions to produce Band C according to

$A \xrightarrow{K_1} B,\ A \xrightarrow{K_2} C,$

Show that Ea, the observed activation energy for the disappearance of A is given by the equation:

$Ea = \dfrac{K_1E_1 + K_2E_2}{K_1 + K_2}$ (7 marks)

(b). The decomposition of PH3 at 950 K is observed and noting the change in total pressure as a function of time. The reaction is;

$4PH_{3(g)} \rightarrow P_{4(g)} + 6H_{2(g)}$

The following measurements were made on the system containing only PH_3 initially

Time (sec)	0	50	100
P $_{(total)}$ mmHg	200	299	332

Show that, it is a first order reaction and also calculate the rate constant (8 marks)

(c) Derive the Michaelis- Menten equation (5 marks)

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