

CHUKA



UNIVERSITY

## SUPPLEMENTARY/ SPECIAL EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF  
BACHELOR OF

## CHEM 323: CHEMICAL KINETICS

STREAMS:

TIME: 2 HOURS

DAY/DATE: MONDAY 01/02/2021

8.30 AM – 10.30 AM

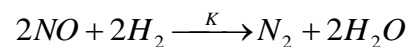
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INSTRUCTIONS:

Answer ALL Questions

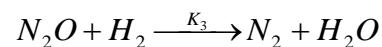
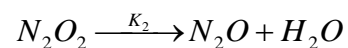
## QUESTION ONE (30 Marks)

1a (i). For the reaction

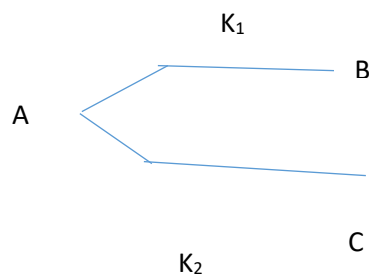


Following mechanism has been proposed:

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

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  $K_2$ .

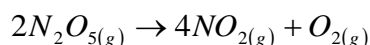
(6 marks)

(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)



### QUESTION TWO (20 MARKS)

2a (i). An actinometer uses a solution of  $K_3[Fe(C_2O_4)_3]$  in which  $Fe^{3+}$  is reduced and the oxalate ion is oxidized. Assuming  $\phi = 1.24$  at 310 nm. Calculate the intensity of the incident light which produces  $1.3 \times 10^{-5}$  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. ( $h = 6.62608 \times 10^{-34}$  JS,  $N_A = 6.02214 \times 10^{23}$  mol $^{-1}$ ,  $c = 2.99792558 \times 10^8$  ms $^{-1}$ ,  $1\text{nm} = 10^{-9}$  M)

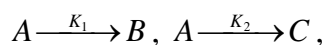
(5 marks)

(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  $2 \times 10^{-3}$  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 B each in the same cell at the wavelength.

(6 marks)

### QUESTION THREE (20 MARKS)

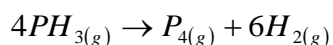
3a. A undergoes two simultaneous reactions to produce B and C according to



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

$$E_a = \frac{K_1 E_1 + K_2 E_2}{K_1 + K_2} \quad (7 \text{ marks})$$

(b). The decomposition of  $PH_3$  at 950 K is observed and noting the change in total pressure as a function of time. The reaction is;



The following measurements were made on the system containing only  $\text{PH}_3$  initially

<b>Time (sec)</b>	0	50	100
<b>P<sub>(total)</sub> mmHg</b>	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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