KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2008/2009
INSTITUTE OF OPEN LEARNING

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

SCH 305 :   CHEMICAL KINETICS

DATE: WEDNESDAY 12TH AUGUST 2009   TIME: 11.00 A.M. – 1.00 P.M.

INSTRUCTIONS

Answer ALL questions.

Constants R = 8.314Jk^{-1} mol^{-1}

1.   a)   What do you understand by the term rate of a chemical reaction?   (2 marks)

The table shows what happens to the concentration of phenolphthalein in a solution that was initially 0.005M phenolphthalein in 0.61 M sodium hydroxide.

| Conc. of phenolphthalein/M x 10^{-4}	50.0	45.0	40.0	35.0	30.0	25.0	20.0	15.0	10.0	5.0	2.50	1.50	1.00
Time/Min	0.00	0.175	0.371	0.595	0.851	1.16	1.52	2.00	2.68	3.83	4.98	583	6.51

i)   What is the average rate of reaction?

ii)   What will be the rate at 3.00 minutes?

iii)   Give reasons as to why the sign is negative?   (6 marks)

b)   The rate of disappearance of ozone is related to the appearance of oxygen as shown below.

$$2\,O_{3\,(g)} \rightleftharpoons 3\,O_{2\,(g)}$$
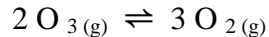
If the appearance of oxygen is $6.0 \times 10^{-5}\,MS^{-1}$ at a particular instant, what will be the rate of disappearance of ozone at that time.   (2 marks)

2.   The data below was for the gas- phase reaction between nitric oxide and bromine at $273^{\circ}C$.

$$Br_{2\,(g)} + 2\,NO_{(g)} \rightleftharpoons 2\,NOBr_{(g)}$$
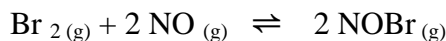
[NO]/Mol dm^{-1}	0.10	0.10	0.2	0.30
[Br$_2$]/Mol dm^{-1}	0.10	0.20	0.10	0.10
Rate of appearance of NOBr M S^{-1}	12	24	48	108

i)   Determine the rate law.   (2 marks)

ii)   Calculate the value of the rate for the appearance of NOBr. (2 marks)

iii)   How is the rate of appearance of NOBr related to the rate of disappearance of bromine.   (3 marks)

3.   a)   what is half-life and what is unique about the half-life of a second order reaction?   (3 marks)

        b)   The thermal decomposition of $N_2O_{5\,(g)}$ to form $NO_{2\,(g)}$ and $O_{2\,(g)}$ is a first order reaction. The rate constant for the reaction is 5.1×10^{-4} at 318 K. What is the half-life of the process?   (2 marks)
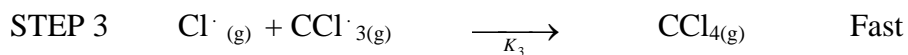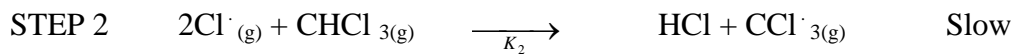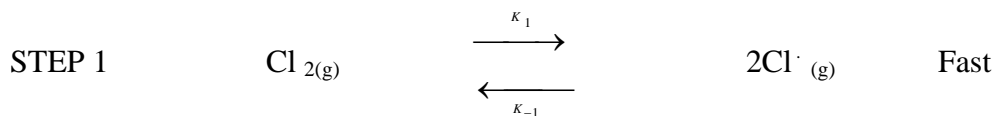
4. a)   Write an expression of the Arrhenius equation.   (2 marks)

The following kinetic data is for the reaction,

$$2N_2O_{5\,(g)} \rightleftharpoons 2NO_{2\,(g)} + 3O_{2\,(g)}$$
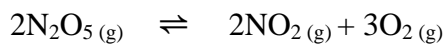
Temperature / K	195	230	260	298	369
Rate M S^{-1} x 10^9	1.08	5.19	7.89	12.0	35.5

i)   Plot a graph of ln K against $\dfrac{1}{T}$.

ii)   Determine the activation energy at 300 K.   (4 marks)

5. The following mechanism has been proposed for the gas-sphere reaction.

STEP 1 $Cl_{2(g)}$ $\xrightarrow{K_1}$ $\xleftarrow{K_{-1}}$ $2Cl^{\cdot}_{(g)}$ Fast

STEP 2 $2Cl^{\cdot}_{(g)} + CHCl_{3(g)}$ $\xrightarrow{K_2}$ $HCl + CCl^{\cdot}_{3(g)}$ Slow

STEP 3 $Cl^{\cdot}_{(g)} + CCl^{\cdot}_{3(g)}$ $\xrightarrow{K_3}$ $CCl_{4(g)}$ Fast

i)   What is the overall reaction?   (1 mark)

ii)   Which are the intermediates in the mechanism?   (2 marks)

iii) Write the rate determining step.   (1 mark)

iv)   What is the rate law predicted by the mechanism.   (3 marks)