KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2009/2010

INSTITUTE OF OPEN LEARNING EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SCH 305: CHEMICAL KINETICS

DATE: Tuesday 16th February, 2010 **TIME**: 11.00 a.m. – 1.00 p.m.

INSTRUCTIONS

Answer all questions
Some constants R= 8.314 $Jk^{-1}mol^{-1}$

1. Explain briefly what is meant by the following: -

   i. Rate constant of a chemical reaction [3 marks]

   ii. Mechanism of a reaction [3 marks]

   iii. Molecularity of a reaction [3 marks]

   iv. Transition state [3 marks]

2. The rate of formation of a product P was studied and the following data was obtained at 25^0 C.

Concentration of P formed/ μ Mole dm^{-3}	0	34.3	56.8	71.6	81.7	88.0	92.1
Time/ Min	0	2.5	5.0	7.5	10.0	12.5	15.0

   Determine the order of reaction and evaluate the rate constant [12 marks]

3. The decomposition of N_2O_5 proceeds according to the equation

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

i. Using stochiometric coefficient, write down the rate expression for the equation. [3 marks]

ii. Determine the rate of appearance of both NO_2 and O_2 if the rate of disappearance of N_2O_5 at that instant is 4.2×10^{-7} in that reaction vessel [6 marks]

4. (a) Explain on the basis of collision theory why rise in temperature speed up the rate of a chemical reaction. [5 marks]

(b) A reaction for the rearrangement of methyl isonitrile was studied at various temperatures and the following data obtained.

Rate of reaction / S^{-1}	2.5×10^{-5}	5.25×10^{-5}	6.3×10^{-4}	3.16×10^{-3}
Temperature / K	462.7	471.9	503.3	524.3

Using the Arrhenius equation, $\ln K = \frac{E_a}{RT}$

i. Calculate the activation energy [5 marks]

ii. What will be the rate constant at 157^o C [5 marks]

5. The following mechanism has been proposed for the gas phase reaction of chloroform and chlorine.

Step I $Cl_{2(g)} \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2\,Cl^{\bullet}_{(g)}$ FAST

Step II $Cl^{\bullet}_{(g)} + CHCl_{3(g)} \xrightarrow{k_2} HCl + CCl^{\bullet}_{3(g)}$ SLOW

Step III $Cl^{\bullet}_{(g)} + CCl^{\bullet}_{3(g)} \xrightarrow{k_3} CCl_{4(g)}$ FAST

i. Which of the three is the rate determining step [2 marks]

ii. Write down the overall reaction [4 marks]

iii. Write down the rate expression for the reaction [4 marks]

6. State and briefly explain three methods of determining or measuring the rate of a given reaction. Use appropriate reaction examples in each method of your choice [12 marks]

……