

**W1-2-60-1-6**

**JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2014/2015**

**THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN INDUSTRIAL CHEMISTRY/CHEMISTRY**

**SCH 2305: REACTION KINETICS**

# DATE: April 2015 TIME: 2 HOURS

**INSTRUCTIONS: Answer question ONE and any other TWO questions**

**R=8.314 JK-1mol-1**

**F=96500 Cmol-1**

**QUESTION ONE**

1. With examples, explain each of the following:
2. A catalyst (2 marks)
3. Relaxation (2marks)
4. Molecularity of a reaction (2marks)

(b) The half-life of a first-order chemical reaction is 10 minutes. Calculate the percentage of A remaining after one hour. (3marks)

(c) Under certain conditions it is found that ammonia is formed from its elements at a rate of 0.10 moldm-3s-1.

1. Determine the rate of the reaction (2marks)
2. Determine the value of d[N2]/dt and d[H2]/dt (2marks)

(d) A reaction $2A\rightarrow P $has a second-order rate law with K=4.30x10-4dm3mol-1s-1. Calculate the time required for the concentration of A to change from 0.210 mol dm-3 to 0.010 mol dm-3 (3marks)

(e) i. State any three methods for determining the order of a chemical reaction. (3marks)

 ii. A reaction obeys the Stoichiometric equation A+2B→2Z

 Rates of formation of Z at various concentrations of A and B are given in the following table:

|  |  |  |
| --- | --- | --- |
| [A]/mol dm-3 | [B]/mold m-3 | Rate/mold m-3s-1 |
| 3.5x10-27.0x10-27.0x10-2 | 2.3x10-24.6x10-29.2x10-2 | 5.0x10-72.0x10-64.0x10-6 |

 Determine the rate law and calculate the rate constant (5marks)

(f) The rate constant for a reaction at 300c is found to be exactly twice the value at 200c. Calculate the activation energy. (3marks)

(g) A reaction of Stoichiometry  occurs via the mechanism

  (very slow)

  (very fast)

 Where x is an intermediate. Write an expression for the rate of formation of Y (3marks)

**QUESTION TWO**

1. With examples, explain the following:
2. Rate determining step. (2marks)
3. Complex reaction (2marks)
4. Pseudo first order reaction (2marks)
5. The reaction  is believed to occur by the mechanism







1. Assume $N\_{2}O\_{2}$ to be a steady state and derive the rate equation (4marks)
2. Under what conditions does the rate equation reduce to second-order kinetics in NO and first order kinetics in $O\_{2}$? (2marks)
3. Differentiate between a reaction intermediate and a catalyst (4marks)
4. Using examples differentiate between stepwise polymerization and chain polymerization. (4marks)

**QUESTION THREE**

1. i. With examples, distinguish between homogenous and heterogenous catalysis (4marks)

ii. Explain what is meant by the turnover of an enzyme. (2marks)

iii. The initial rate of O2 production by the action of an enzyme on a substrate was measured for a range of substrate concentration and the data show below:

 [s] 0.050 0.017 0.010 0.005 0.002

 Rate/mm3 min-1 16.6 12.4 10.1 6.6 3.3

 Evaluate the Michael’s constant for the reaction. (6marks)

1. Derive the rate law for the decomposition of ozone in the reaction $2O\_{3(g)}\rightarrow 3O\_{2(g)}$ on the basis of the incomplete mechanism (5marks)







1. Show that the pre-equilibrium mechanism in which





results in an overall third order reaction. (5marks)

**QUESTION FOUR**

a) From the Arrhenius equation of the dependence of the rate constants with temperature, explain the meaning of the frequency factor and the exponential factor. (3marks)

b) The following data have been obtained for the hydrolysis of adenosine triphosphate catalyzed by hydrogen ions.

 Temp/0c 39.9 43.8 47.1 50.2

 K/s-1x10-6 4.67 7.22 10.0 13.9

 Use the graphical method to determine $E\_{a}$ (7marks)

c) State and explain five factors upon which the rate of a reaction depends. (10marks)