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**GARISSA UNIVERSITY**

**UNIVERSITY EXAMINATION 2019/2020 ACADEMIC YEAR TWO**

**SECOND SEMESTER EXAMINATION**

**SCHOOL OF SCHOOL OF PURE AND APPLIED SCIENCES**

**FOR THE DEGREE OF BACHELOR OF EDUCATION**

**COURSE CODE: CHE 103e**

**COURSE TITLE: INTRODUCTION TO KINETICS AND THERMODYNAMICS**

**EXAMINATION DURATION: 2 HOURS**

**DATE: 17/12/2020 TIME: 12.00-2.00 PM**

**INSTRUCTION TO CANDIDATES**

* **The examination has FIVE (5) questions**
* **Question ONE (1) is COMPULSORY**
* **Choose any other TWO (2) questions from the remaining FOUR (4) questions**
* **Use sketch diagrams to illustrate your answer whenever necessary**
* **Do not carry mobile phones or any other written materials in examination room**
* **Do not write on this paper**

**This paper consists of FOUR (4) printed pages *please turn over***

**QUESTION ONE (COMPULSORY)**

1. Define the following terms as applied to chemical kinetics **[4 marks]**
2. Zero-order reaction
3. Reaction rate
4. Molecularity of a reaction
5. Activation energy
6. Consider the reaction of persulfate ion and iodide ion

S2O8 2- (aq) + 21- (aq  → 2SO42- + I2

These substances were mixed in various quantities at 25oC and the following rate data obtained

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Initial Concentration (mo1/c** | | | **Initial rates** |
| **Exp No** | **S2O82-** | **I-** |  | **× 103 (moldm-3s-1** |
| 1 | 0.10 | 0.01 |  | 1.2 |
| 2 | 0.10 | 0.04 |  | 4.8 |
| 3 | 0.20 | 0.01 |  | 2.4 |

1. Use the method of initial rate to find the order of reaction with respect to the consideration of persulfate ion and iodide ion **[6 marks]**
2. Calculate the rate constant **[2 marks]**
3. Write the rate equation for the reaction [**1 mark]**
4. Calculate the rate of the reaction if the concentration of persulfate ion is 93.68x10-3 M and that of iodide ion is 1.73x10-3 M **[3 marks]**
5. State the first law of Thermodynamics **[1 mark]**
6. Name and define the three Thermodynamics systems **[6 marks]**
7. Calculate the work done when 50g of iron reacts with dilute hydrochloric acid in an open beaker at 25oc **[3 marks]**

(R= 8.314 JK-1mol-1 Fe = 55.85gmol-1)

1. Suggest whether the following statements are true or false **[4 marks]**
2. In a first order reaction, doubling the initial concentration of the reactant quadruples the rate
3. Order and molecularity of a reaction are always identical
4. The exponents of concentrations terms in the rate law are the stoichiometric coefficients of reactants in the balanced chemical equation
5. The dimensions of k for a first order reaction is (time)-1 while that for a second order it is (time)-1(concentration)-1

**QUESTIONS 2**

1. State the Arrhenius equation and define all the terms **[5 marks]**
2. (b) If a first order reaction has an activation energy of 104500Jmo1-1 and the pre-exponential factor A in the Arrhenius equation has a value of 5.0 x 1013 s-1 at what temperature will be reaction have a half-life of
   1. 60 seconds
   2. 30 days [**10 marks]**
3. The following reactions show the combination of oxygen molecules to form UV light protective zone, 3O2(g) → 2O3(g). At given instant the rate of consumption of oxygen is 2.17 Χ 10-5 M. What is the rate at which ozone is forming **[5 marks]**

**QUESTIONS 3**

1. Define half-life in relation to reaction kinetics **[2 marks]**
2. The decomposition of NOBrto NO and Br2 ,g, is a second order, with rate constant of 0.810M-1 s-1 at 10oc
3. If the initial concentration is 7.5 x 10-3M, what is the concentration after a reaction time of 10 minutes? **[4 marks]**
4. Determine the half-life of this reaction **[4 marks]**
5. Compare by derivation the integrated rate law and the half-life equations for a first order and second Order reaction. For which reaction is the half-life independent of the reactant concentration [**10 marks]**

**QUESTIONS 4**

1. Define the following terms in Thermodynamics **[5 marks]**
2. Thermodynamic System
3. Heat capacity
4. Isothermal process
5. Path function
6. Irreversible process
7. One mole of an ideal gas at 300k is allowed to expand Isothermally against a constant external pressure of 1atm from a volume of 1.0 litres to a volume of 5.0 litres. Calculate the work done by the gas **[3 marks]**
8. Three moles of an ideal monoatomic gas at 300K expand isothermally and reversibly from 10dm3 to 30dm3. Calculate W,Q ΔE and ΔH **[5 marks]**
9. Starting from a weightless, frictionless piston, show that the work done in expansion of a gas is given by W = - P ΔV **[7 marks]**

**QUESTIONS 5**

1. Define heat of formation of a substance **[2 marks]**
2. State Hess’s law **[2 marks]**
3. From the following equation and Enthalpy changes

Reaction equation ΔHo reaction kJ

C (graphite) + O2 (g) CO2(g) -393.5

H2(g) + ½ O2(g) H2O (1) - 285.8

2C2H2 (g) + 5O2(g) 4CO2(g) + 2H2O(1) - 2598.9

Calculate the standard enthalpy of formation of acetylene (C2H2) from its elements

2C(graphite) + H2 (g) C2 H2 (g)  **[8 marks]**

1. A 0.242g of sample is burned in a bomb calorimeter containing 1025g of water.

The molecular mass of the sample is given as 128gmol. Calculate the rise in temperature given that: **[8 marks]**

Heat capacity of the calorimeter = 802J/0C

Heat of combustion of the sample = -5.15 x 103KJ/mol

Specific heat of water = 4.184J/g0C