GARISSA UNIVERSITY

UNIVERSITY EXAMINATION 2017/2018 ACADEMIC YEAR ONE SECOND SEMESTER EXAMINATION

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

FOR THE DEGREE OF BACHELOR OF EDUCATION

COURSE CODE: CHE 103e

COURSE TITLE: INTRODUCTION TO KINETICS AND THERMODYNAMICS

EXAMINATION DURATION: 3 HOURS

DATE: 18/04/18 **TIME: 2.00-5.00 PM**

INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) 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)

(a) Define the following terms as applied to chemical kinetics **[5 marks]**

i. Rate laws

ii. Rate constant

iii. Half life

iv. Activation energy

v. Molecularity of a reaction

(b) Iodide Ion is oxidized in acidic solution to trilodide ion 1^{3-}, by hydrogen peroxide

$H_2O_{2(aq)} + 31^-_{(aq)} + 2H^+ag1^{3-}_{(aq)} \longrightarrow + \quad 2H_2O_{(1)}$

A set of four experiment were run at different concentrations and the initial rates of 1^{3-} formation were determined

	Initial Concentration (mo1/c			**Initial rates**
Exp No	**H_2O_2**	**I^-**	**H+**	**Moles $1^{-1}s^{-1}$**
1	0.010	0.010	0.00050	$1.15 x10^6$
2	0.020	0.010	0.00050	$2.30 x10^{-6}$
3	0.010	0.020	0.00050	$2.30 x 10^{-6}$
4	0.010	0.010	0.00100	$1.15 x10^{-6}$

i. From these data, obtain the reaction orders with respect to H_2O_2, 1^- and H^+ and comment on your answer **[7 marks]**

ii. Calculate the rate constant **[2 marks]**

iii. Write the expression for rate law **[1 mark]**

(c) State four factors which the " rate constant" of a chemical reaction depends on **[4 marks]**

QUESTIONS TWO

(a) State the Arrhenius equation and define all the terms **[5 marks]**

(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 $5.0 x 10^{13}s^{-1}$ at what temperature will be reaction have a half life of (i) I minute (ii) 30 days **[10 marks]**

QUESTIONS THREE

(a) Define zero – order reaction, and give one example **[2 marks]**

(b) The decomposition of NOBrto NO and $Br_{2\ ,g}$, is a second order, with rate constant of $0.810M^{-1}s^{-1}$ at $10^{o}c$

i. If the initial concentration is $7.5 \times 10^{-3}M$, what is the concentration after a reaction time of10 minutes? **[4 marks]**

ii. Determine the half life of this reaction **[2 marks]**

(c) Compare by derivation the integrated 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 **[7 marks]**

QUESTIONS FOUR

(a) Define the following terms in Thermodynamics **[5 marks]**

i. Path function
ii. Isobaric process
iii. Internal energy
iv. Exact differential
v. Adiabatic process

(b) State the first law of Thermodynamics **[2 marks]**

(c) 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 **[4 marks]**

(d) Starting from a weightless, frictionless piston, show that the work done in expansion of a Gas is given by $W = - P \Delta V$ **[4 marks]**

QUESTIONS FIVE

(a) Name and define the three Thermodynamics systems **[3 marks]**

(b) Name any three characteristics of an exact differential **[3 marks]**
Calculate the work done when 50g of iron reacts with dilute hydrochloric acid in an open beaker at $25^{o}c$ **[3 marks]**

i. ($R= 8.314\ JK^{-1}mol^{-1}$ $Fe = 55.85gmol^{-1}$)

(c) Given that $H = E + PV$ Derive the expression $C_p-C_v = R$ Apply the ideal gas equation for one mole of gas **[6 marks]**

QUESTIONS SIX

(a) State Hess[1] Law **[2 marks]**

(b) From the following equation and Enthalpy changes

Reaction equation			**ΔH^o reaction kJ**
$C_{(graphite)}$ +	$\longrightarrow$	$O_{2\,(g)}$ $C\,O_{2(g)}$	-393.5
$H_{2(g)} + ½\ O_{2(g)}$	$\longrightarrow$	$H_2O_{(1)}$	- 285.8
$2_{C2}H_{2\,(g)} + 5O_{2(g)}$	$\longrightarrow$	$4CO_{2(g)} + 2H_2O_{(1)}$	- 2598.9

Calculate the standard enthalpy of formation of acetylene (C_2H_2) from its elements

$2C_{(graphite)} + H_{2(g)} \longrightarrow C_2 \qquad H_{2(g)}$ **[6 marks]**

(c) 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: **[7 marks]**

Heat capacity of the calorimeter = $802J/^0C$

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

Specific heat of water = $4.184J/g^0C$