



## **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**

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### **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***

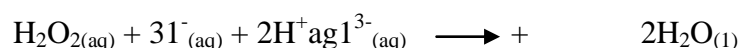


**QUESTION ONE (COMPULSORY)**

(a) Define the following terms as applied to chemical kinetics

**[5 marks]**

- Rate laws
- Rate constant
- Half life
- Activation energy
- Molecularity of a reaction

(b) Iodide Ion is oxidized in acidic solution to triiodide ion  $I_3^-$ , by hydrogen peroxide

A set of four experiment were run at different concentrations and the initial rates of  $I_3^-$  formation were determined

Exp No	Initial Concentration (mol/c)			Initial rates
	$H_2O_2$	$I^-$	$H^+$	Moles $l^{-1}s^{-1}$
1	0.010	0.010	0.00050	$1.15 \times 10^{-6}$
2	0.020	0.010	0.00050	$2.30 \times 10^{-6}$
3	0.010	0.020	0.00050	$2.30 \times 10^{-6}$
4	0.010	0.010	0.00100	$1.15 \times 10^{-6}$

- From these data, obtain the reaction orders with respect to  $H_2O_2$ ,  $I^-$  and  $H^+$  and comment on your answer **[7 marks]**
  - Calculate the rate constant **[2 marks]**
  - 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  $104500 J mol^{-1}$  and the pre-exponential factor A in the Arrhenius equation has a value of  $5.0 \times 10^{13} s^{-1}$  at what temperature will be reaction have a half life of (i) 1 minute (ii) 30 days **[10 marks]**



### QUESTIONS THREE

- (a) Define zero – order reaction, and give one example [2 marks]
- (b) The decomposition of  $\text{NOBr}$  to  $\text{NO}$  and  $\text{Br}_2$ , is a second order, with rate constant of  $0.810\text{M}^{-1}\text{s}^{-1}$  at  $10^\circ\text{C}$
- If the initial concentration is  $7.5 \times 10^{-3}\text{M}$ , what is the concentration after a reaction time of 10 minutes? [4 marks]
  - 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]
- Path function
  - Isobaric process
  - Internal energy
  - Exact differential
  - Adiabatic process
- (b) State the first law of Thermodynamics [2 marks]
- (c) One mole of an ideal gas at  $300\text{K}$  is allowed to expand Isothermally against a constant external pressure of  $1\text{atm}$  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]

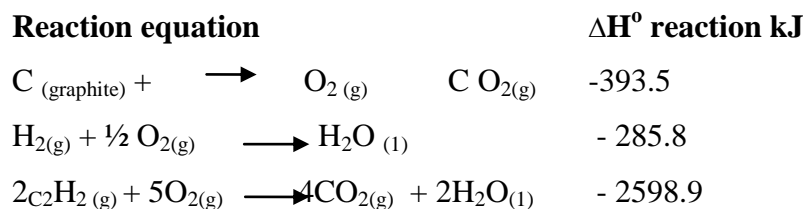
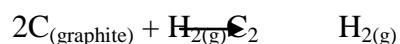
### QUESTIONS FIVE

- (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  $50\text{g}$  of iron reacts with dilute hydrochloric acid in an open beaker at  $25^\circ\text{C}$  [3 marks]
- ( $R = 8.314\text{ JK}^{-1}\text{mol}^{-1}$ ,  $\text{Fe} = 55.85\text{g mol}^{-1}$ )
- (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<sup>1</sup> Law**[2 marks]**

(b) From the following equation and Enthalpy changes

Calculate the standard enthalpy of formation of acetylene ( $\text{C}_2\text{H}_2$ ) from its elements**[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/ $^\circ\text{C}$ Heat of combustion of the sample = -5.15 x 10<sup>3</sup>KJ/molSpecific heat of water = 4.184J/g $^\circ\text{C}$ 