



ALUPE UNIVERSITY  
ODI  
*Bastion of Knowledge*

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OFFICE OF THE DEPUTY PRINCIPAL  
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

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## UNIVERSITY EXAMINATIONS

### 2020/2021 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF  
EDUCATION SCIENCE

COURSE CODE: CHE 103

COURSE TITLE: INTRODUCTION TO KINETICS AND  
THERMODYNAMICS

DATE: 26<sup>TH</sup> JULY 2021

TIME: 2 – 5 PM

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### INSTRUCTION TO CANDIDATES

- SEE INSIDE

THIS PAPER CONSISTS OF 4 PRINTED PAGES

PLEASE TURN OVER

REGULAR – MAIN EXAM

STREAM: BED (Science)

DURATION: 3 Hours

INSTRUCTIONS TO CANDIDATES*Answer ALL questions.***Question One**

- a) Distinguish between an ideal gas and a real gas (2 Marks)
- b) Derive the following gas equations;
- i) An ideal gas equation (3 Marks)
  - ii) Van der Waals equation (3 Marks)
- c) List factors that cause a gas not to be ideal (3 Marks)
- d) Write down the first law of thermodynamics and define the terms (3 Marks)
- e) Distinguish between the following thermodynamic processes
- i) Closed system (1 Mark)
  - ii) Adiabatic system (1 Mark)
  - iii) Isolated system (1 Mark)
- f) What are;
- i) Extensive variables (1 Mark)
  - ii) Intensive variables (1 Mark)

**Question Two**

- a) Define the following chemical terms;
- i) Collision frequency of the system (1 Mark)
  - ii) Activation energy (1 Mark)
- b) Explain how the following factors affect the rate of reaction;
- i) Concentration (2 Marks)
  - ii) Pressure (2 Marks)
  - iii) Temperature (2 Marks)
  - iv) Catalysts (2 Marks)

c) Consider the reaction  $\text{RX} + \text{OH}^- \rightarrow \text{ROH} + \text{X}^-$

The following rate data were obtained at constant temperature

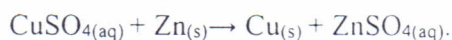
Initial concentration of RX/mol $\text{dm}^{-3}$	Initial concentration of OH $^-$ / mol $\text{dm}^{-3}$	Initial rate/ mol $\text{dm}^{-3}\text{s}^{-1}$
0.01	0.04	$8 \times 10^{-3}$
0.01	0.02	$4 \times 10^{-3}$
0.005	0.04	$4 \times 10^{-3}$

- i) What is the order of reaction with respect to OH $^-$  (1 Mark)
  - ii) What is the order of reaction with respect to RX $^-$  (1 Mark)
  - iii) Write the rate equation (1 Mark)
  - iv) Calculate the rate constant (2 Marks)
- d) Using relevant example illustrate how first order, second and third order reactions can be determined using graphical method (3 Marks)

### Question Three

a) Photosynthesis is an endothermic reaction:  $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$   $\Delta H = +2802 \text{ kJmol}^{-1}$

- i) What will be the enthalpy change for the following reaction; (1 Mark)  
 $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
  - ii) Calculate the amount of light energy required to make 1000 g of glucose (3 Marks)
  - iii) Calculate the amount of light energy required to absorb 500  $\text{cm}^3$  of carbon dioxide is at 298 K and 100kPa (3 Marks)
  - iv) Calculate the mass of glucose which can be made when a tree absorbs 10,000 kJ of light energy (2 Marks)
- b) A spirit burner containing butan-1-ol ( $\text{C}_4\text{H}_9\text{OH}$ ) was used to heat 200  $\text{cm}^3$  of water in a copper can by 20  $^\circ\text{C}$ . As a result, the mass of the spirit burner decreased by 0.81 g. Calculate the molar enthalpy of combustion of butan-1-ol (3 Marks)
- c) Zinc will displace copper from copper (II) sulphate solution according to the following equation:



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If an excess of zinc powder is added to 50 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> copper (II) sulphate, the temperature increases by 6.3 °C. Calculate the molar enthalpy change for the reaction

(4 Marks)

d) Distinguish between homogeneous and heterogeneous catalysis

(2 Marks)

**Question Four**

a) Define entropy

(2 Marks)

b) Write the thermodynamic expression of determining entropy and Gibbs free energy (3 Marks)

c) The reaction  $C_{(s)} + CO_{2(g)} \rightarrow 2CO_{(g)}$  has a  $\Delta H$  of +176 kJ mol<sup>-1</sup> and a  $\Delta S$  of +176 J mol<sup>-1</sup> K<sup>-1</sup>. What is the free change for this reaction at 298 K?

(3 Marks)

d) Briefly explain the importance of Maxwell-Boltzmann distribution of molecular energies in thermodynamic process

(7 Marks)

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