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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

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: 26TH JULY 2021 TIME: 2 – 5 PM

INSTRUCTION TO CANDIDATES

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CHE 103

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 $RX + OH^- \longrightarrow ROH + X^-$

The following rate data were obtained at constant temperature

Initial concentration of RX/moldm-^{3}	Initial concentration of OH/ moldm^{-3}	Initial rate/ moldm^{-3}s^{-1}
0.01	0.04	8×10^{-3}
0.01	0.02	4×10^{-3}
0.005	0.04	4×10^{-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: $6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$ $\Delta H =$ +2802 kJmol^{-1}

i) What will be the enthalpy change for the following reaction; (1 Mark)

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

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 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 (C_4H_9OH) was used to heat 200 cm^3 of water in a copper can by 20 °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:

$CuSO_{4(aq)} + Zn_{(s)} \longrightarrow Cu_{(s)} + ZnSO_{4(aq)}$.

If an excess of zinc powder is added to 50 cm^3 of 1.0$moldm^{-3}$ 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 $C_{(s)} + CO_{2(g)} \longrightarrow 2CO_{(g)}$ has a ΔH of +176 $kJmol^{-1}$ and a ΔS of +176 $Jmol^{-1}K^{-1}$. 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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