JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION

(SCIENCES)

3rd YEAR 1ST SEMESTER 2018/2019 ACADEMIC YEAR

MAIN REGULAR

COURSE CODE: SCH 301

COURSE TITLE: CHEMICAL THERMODYNAMICS

EXAM VENUE: STREAM: (Bed. Science)

DATE: EXAM SESSION:

TIME: 2.00 HOURS

Instructions:

1. **Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

IMPORTANT INFROMATION:

CONSTANT	VALUE
Universal gas constant, *R*	8.314 kJ/K/mol
Faraday's constant, *F*	96500 C
Avogadro's constant, *N*	6.02×10^{23}
Electronic charge, *e*	1.619×10^{-19} C

Section A   **This section contains ONE COMPULSORY question**

Question 1 (30 marks)

a. Briefly explain each of the following terms as used in thermodynamics:
  i. First law of thermodynamics
  ii. Entropy
  iii. Spontaneous change
  iv. A non- spontaneous change
  v. A phase change
  vi. Enthalpy change   (6 marks)

b. Why entropy is a major thermodynamic quantity.   (2 marks)

c. What is phase rule? Explain?   (2 marks)

d. Liquid carbon tetrachloride (CCL_4) has an entropy, S^0 of 216.4J/K at 25^0C .If its enthalpy of vaporization at 25^0C is 27.7KJ/Mol. Calculate the standard entropy, S^0 of CCL_4 at 25^0C.   (6 marks)

e. From the third law of thermodynamics, that pure, perfect crystalline substance have S=0 at T=0K. Taking Cyclopropane as an illustration show how the increase in entropy from absolute zero to a particular temperature is a function of temperature.   (10 marks)

f. Briefly describe the concept of spontaneity as envisaged in the second law of Thermodynamics   (4 marks)

Section B: **This section contains FOUR questions. Answer ONLY TWO questions.**

Question 2 (20 marks)

a. Given;

Substance	S^θ $(JK^{-1}mol^{-1})$
H_2 (g)	130.6
N_2 (g)	191.5
NH_3 (g)	192.3

Determine the entropy change for the reaction of nitrogen with hydrogen to form ammonia.   (4 marks)

b. Sketch the phase diagram for water and explain all the boundary lines.   (7 marks)

c. The vapor pressures of CCl_4 and $SiCl_4$ at 25 ^{o}C are 114.9 mmHg and 238.3 mmHg.

 Calculate:
  i. The total vapor pressure of the mixture of equal weights of the two liquids   (6 marks)

ii. The composition of the vapors at equilibrium at 25 °C of the mixture

(2 marks)

iii. Identify the more volatile component (1 marks)

Question 3 (20 marks)

a. By giving appropriate examples discuss how the knowledge of enthalpy and entropy in chemical system can help us in determining spontaneity. (7marks)

b. Using change G, summarize the criteria for spontaneity (7 marks)

c. Derive the Gibbs free energy equation (6 marks)

Question 4 (marks)

a. Discuss the importance of Gibbs free energy in thermodynamics transfer of temperature, pressure and entropy. (3 marks)

b. Derive a relationship which shows the variation of entropy with temperature reversibly.(5 marks)

c. Write notes on each of the following

i. The boiling point of the liquid (3 marks)

ii. The entropy of vaporization (3 marks)

iii. Reversible process (3 marks)

iv. Standard entropy (3 marks)

Question5 (20 marks)

a. Explain the nature of entropy change accompanying a phase (7 marks)

b. Based on the Gibbs equation for free energy, briefly discuss the enthalpy and entropy conditions that would result in spontaneous chemical change. (7 marks)

c. The enthalpy of vaporization of Benzene (C H_6) is 40.8KJ/Mol at the boiling point of 80.1^{0}C .Calculate the entropy change for Benzene going from

(i) Liquid to Vapor (2 marks)

(ii) Vapour to Liquid at 80.1^{0}C (2 marks)

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