

BOWEN UNIVERSITY, IWO, OSUN STATE
COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE
INDUSTRIAL CHEMISTRY PROGRAMME

2022/2023 SESSION B.SC DEGREE FIRST SEMESTER EXAMINATION

Course Code: CHM 323 Courses Title: Physical Chemistry II Credit: 2

Date: /02/2023

Time Allowed: 1h 30min

-
- INSTRUCTIONS: I. QUESTION ONE IN SECTION A IS COMPULSORY
 II. ANSWER ONE QUESTION EACH FROM SECTIONS B AND C
 III. ANSWER EACH QUESTION ON A FRESH PAGE
-

USEFUL PHYSICAL CONSTANTS

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 0.0821 \text{ Latm mol}^{-1} \text{ K}^{-1}$$

SECTION A

QUESTION ONE (30 MARKS)

- a. Briefly explain Raoult's law? **3 marks**
- b. Sketch the diagram showing negative deviation from Raoult's law **7 marks**
- c. What mass of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) in grams, must be added to 1.0 kg of water to produce a solution that boils at 105.0°C ? for water is 0.152°C/m . **4 marks**
[C = 12.01 g, H = 1.00; O = 16.00]
- d. Which antifreeze is used to prevent the freezing of engine blocks in cold climates? **1 mark**
Using (a) Maxwell-Boltzman distribution (b) Fermi-Dirac distribution and (c) Bose-Einstein distribution, how can two submersible pumping machines be place in three (3) bore holes. **15 marks**

SECTION B

QUESTION TWO (20 MARKS)

- a. What are colligative properties? **4 marks**
- b. Briefly explain ideal solutions? **4 marks**
- c. List four conditions that must be satisfied by an ideal solution? **4 marks**
- d. In a Cottrell determination, 22 g of benzene was used as solvent. The reading on the differential thermometer before and after adding 0.586 g of naphthalene ($C_{10}H_{18}$) were 1.262 and 1.799 respectively. In a separate experiment, using the same amount of benzene but this time adding 0.627 g of an organic compound X, the temperature readings were 1.269 and 1.963. Calculate
- i.** the ebullioscopic constant from the results of the first experiment [$C = 12.0$, $H = 1.00$, $O = 16.00$]. **4 marks**
- ii.** Calculate the molar mass of X. **4 marks**

QUESTION THREE (20 MARKS)

- a. What is osmotic pressure? **3 marks**
- b. List three uses of osmotic pressure. **3 marks**
- c. A solution is prepared by dissolving 50 g of haemoglobin in enough H_2O to make 1.00 L of solution. Measurement of the osmotic pressure was carried out and found to be 14.3 mmHg at $28^\circ C$. Calculate the molar mass of haemoglobin. (Assume there is no change in volume when the haemoglobin is added to the water). **5 marks**
- d. What is van't Hoff factor? **4 marks**
The freezing point of an aqueous 0.060 m solution is $-0.31^\circ C$. What is the van't Hoff factor for $CaCl_2$ at this concentration? **4 marks**
- e. State one difference between hypotonic and hypertonic solutions. **1 mark**

SECTION C

QUESTION FOUR (20 MARKS)

a. A 10.40g sample of silver was heated to 100.0°C. It was then added to 28.0 g of water in an insulated cup. The water temperature rose 25.0 to 26.48°C. What is the specific heat capacity of silver? [Specific heat capacity of water = 4.2Jg⁻¹K⁻¹]. **8 marks**

b. Briefly discuss standard enthalpy changes **6 marks**

c. If the molecular heat of transition that accompanied the transition below at 60°C is 95.8 kJmol⁻¹. $\text{CO}_{(g)} \rightleftharpoons \text{CO}_{(s)}$

Calculate the standard entropy change (ΔS°) accompanying the transition. **6 marks**

QUESTION FIVE (20 MARKS)

a. What is the entropy change when 6.02×10^{21} atoms of CO₂ is allowed to expand isothermally from a volume of 25 cm³ to 750 cm³ at 27°C. **9 marks**

b. Briefly explain the appropriate law involved in the interconvertibility of matter and energy. **5 marks**

c. Briefly explain the followings: (a) Open system (b) Closed system and (c) Isolated System. **6 marks**