JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS AND ACTUARIAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE, AGRICULTURAL EXTENSION (AGED)

1ST YEAR 1ST SEMESTER 2021/2020

RESIT

COURSE CODE: SPB 9101

COURSE TITLE: PHYSICAL CHEMISTRY/BASIC CHEMISTRY III

EXAM VENUE: **STREAM: (AGED)**

DATE: **EXAM SESSION:**

TIME: 2:00 HRS
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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**

Useful data

R= 0.0821 L atm. K-1mol-1
Molar mass N = 14 g.mol^{-1}
Molar mass O = 16 g.mol^{-1}
Molar mass C = 12 g.mol^{-1}
Molar mass H = 1.01 g.mol^{-1}
Molar mass of He = 4 g.mol^{-1}

INSTRUCTIONS: Answer Question 1 and any other TWO questions

QUESTION ONE (30 marks)

a. State Boyle's law   2 marks

b. If the volume of a sample of helium is 0.0227 M3 at 273 K and 1.00 x 10^5 Pa, what is its volume at 293K and 1.04 x 10^5 Pa (4 marks)

c. Explain what is meant by, a stoichiometric equation (2 marks)

d. Zinc reacts with hydrochloric acid according to the equation;

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

What mass of zinc is required to react completely with $30.0\, cm^3$ $1.00\, M$ hydrochloric acid?

(4 marks)

e. Explain the terms; (3 marks)
   i.   Redox reactions
   ii. oxidation
   iii. reduction

f. Determine the oxidation number of each element in these compounds (6 marks)
   i.   CaO
   ii. KNO_3
   iii. $NaHSO_4$
   vi. $CaCO_3$
   v. N_2
   vi. H_2O

g. Use the oxidation number method to balance the following equations (4 marks)

i) $Al + H_2SO_4 \quad Al_2(SO_4)_3 + H_2$

ii) $PbS + O_2 \quad PbO + SO_2$

h. Define the term 'Colligative Properties' and describe four types of colligative properties (5 marks)

QUESTION TWO (20 marks)

a. State Charles law (1 marks)

b. The pressure of a 0.0239 M^3 sample of N2 is 1.02 x 10^5 Pa. The gas is compressed to a volume of 0.0210 m^3 while the temperature remains constant at 293 K. What is the new pressure of the gas (5 marks)

c. Using relevant examples, distinguish between a physical and chemical equilibria (5 marks)

d. Write the equilibrium constant expression for a simple gas phase isomerization reaction involving the conversion of cis-2-butene to trans-2-butene (3 marks)

e. The equilibrium concentrations for the reaction between carbon monoxide and molecular chlorine to form $COCl_2$g at 74°C are CO=0.012 M, Cl_2 =0.054 M and $COCl_2$ =0.14 M. Calculate the equilibrium constants K_c and K_p (6 marks)

QUESTION THREE (20 marks)

a. 50g (0.146 mole) of solute sugar is placed in 117 g (6.5 mole) of the solvent water. The vapor pressure for pure water at 25°C is 23.8 torr.

i.   What is the mole fraction of sugar in water (2 marks)
ii.   What is the molality of sugar in water (3 marks)
iii.   What is the molarity of sugar in water (3 marks)
iv.   Calculate the vapor pressure depression (3 marks)
v.   Calculate the boiling point elevation (the boiling point elevation constant for water is 0.512 oC/molal (3 marks)
vi.   Calculate the freezing point depression (3 marks)
vii.   Calculate the osmotic pressure change (3 marks)

QUESTION FOUR (20 marks)

a. Write the oxidation and reduction half reactions for the following reaction Zn (s) + Cu^{2+} (aq) ====> Zn^{2+} + Cu (s)   [2 marks]

b. Calculate the volume occupied by one mole of CO2 at 300 K and 1 bar pressure. (4 marks)

c. Balance the following chemical equations.
  i. CO_2 + H_2O ----> $C_6H_{12}O_6$ + O_2
  ii. $Pb(NO_3)_2$ + KI -----> PbI_2+ KNO_3 [3 marks]

d. Briefly describe any three types chemical reactions.   [3 marks]

e. A quantity of cis-2-butene is added to a 2 liter flask and heated to 400 Oc for 2 years. The concentration of trans-2-butene was then determined to be 0.5 M. What is the concentration of cis-2-butene in the flask (3 marks)

f. Abottle of metal hydrate $BaCl_2.2H_2O$ is mixed with an unknown amount of KCl. In order to find the purity of the $BaCl_2.2H_2O$, we heat 9.51g of the metal hydrate mixture to remove water from the sample. After heating, the sample has a reduced mass of 9.14g.
i) calculate change in sample mass (1 mark)
ii) Calculate the moles of evaporated water (1 mark)
iii) calculate moles of $BaCl_2.2H_2O$ (1 mark)
iv) calculate mass of $BaCl_2.2H_2O$ in grams (1 mark)
v) calculate the mass percent of $BaCl_2.2H_2O$ in the original sample (1 mark)

QUESTION FIVE (20 marks)

a). State Dalton's Law of Partial Pressures (2 marks)

b). Discuss any THREE factors that affect the position of a chemical equilibrium.
[6 marks]

c). Write the expression for Nernst equation and explain the terms in it
[4 marks]

d). Define the following terms; [4 marks]

    i.   Physical chemistry.

    ii. Grahams law of effusion

e). Differentiate between an ideal gas and real gas.[4 marks]