KISII UNIVERSITY
UNIVERSITY EXAMINATIONS
SPECIAL/SUPPLEMENTARY EXAMINATIONS
FIRST YEAR EXAMINATION FOR THE AWARD OF THE
DEGREE OF BACHELOR OF EDUCATION
FIRST SEMESTER, 2022/2023
(NOVEMBER/DECEMBER, 2022)

CHEM 111: INORGANIC AND PHYSICAL CHEMISTRY EXAMINATION (CHEM III)

STREAM: Y1 S1   **TIME: 2 HOURS**

DAY: **DATE: 00/12/2022**

INSTRUCTIONS
1. Do not write anything on this question paper.
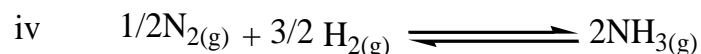*2. Answer ALL the questions in section A and any TWO questions in section B.*
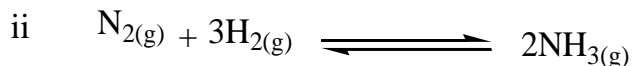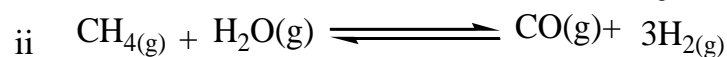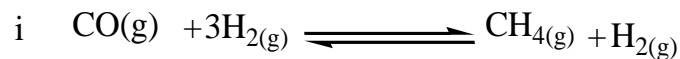
SECTION A (40MKS). Answer all the questions

1.(a) Define a Lewis acid and give an example   (1mark)

   (b) State the three common forms of stoichiometry   (3 marks)

.   (c) Zinc powder was reacted with copper (ii) sulphate solution. Briefly explain the observation that was made.   (1mark)

  (d) (i) Using the information above write the stoichiometric equation for the reaction (1mk)

  (ii) State the; oxidizing agent and the reducing agent.   (1mark)

       (iii) State the substance being oxidized and the one which is being reduced   (2 marks)

2. State the five main parts of Dalton's theory   (5 marks)

3.a) What is the difference between an isotope and a nuclide?   (1 mark)

b) Write the equilibrium constant expression K_c for;   (4 marks)

   i $CO(g) + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_{2(g)}$

   ii $CH_{4(g)} + H_2O(g) \rightleftharpoons CO(g) + 3H_{2(g)}$

   ii $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

   iv $1/2N_{2(g)} + 3/2 H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

4. a) Briefly explain the dual nature of an electron   (2 marks)

   b) (i) Define the term hybridization.   (1 mark)

   (ii) Draw the structure and state the hybridization found in;   (6 marks)

        (i) BF_3 (ii) CH_4 (iii) BeF_2
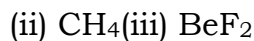
5. a) State the five basic assumptions of the kinetic molecular theory of gases?   (3 marks)

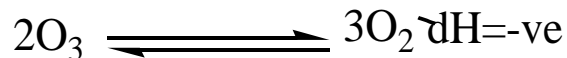   b) Differentiate between oxidation and reduction   (2 marks)

   c) Using the reaction;

$4HCl + MnO_2 \rightarrow Cl_2 + 2H_2O + MnCl_2$

   (i) What substance is reduced?
(1mk)

   (ii) What substance is oxidized?
(1mk)

6.a) Consider the reaction in equilibrium;

$$2O_3 \rightleftharpoons 3O_2 \quad dH=\text{-ve}$$

What would be the effect on the position of equilibrium upon?

i.   Decreasing the volume of the
       container
ii.   Adding O_2
iii.   Decreasing the temperature
iv.   Adding the catalyst to the reaction
       mixture.   (4 marks)

b) State two characteristics of a buffer solution.
(1mks)

SECTION B (30mks)ANSWER ANY TWO QUESTIONS.

7. State the significance of the following in relation to atomic structure (6mks)

 (a) (i) Hund's rule

     (ii)Pauli Exclusion Principle

     (iii)Aufbau principle

(b) Put the following sample of elements in groups and periods that they would
otherwise occupy were they to be fitted in the periodic table.   (5 marks)

     (i)$1s^2 2s^2 2p^6 3s^2 3p^5$

     (ii) $1s^2 2s^2 2p^6 3s^2$

     (iii) $1s^2 2s^2 2p^3$

(iv) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

     (v) $1s^2 2s^2$

     (vi)$1s^2 2s^2 2p^6$

     (Vii)$1s^2 2s^2 2p^6 3s^2 3p^3$

     (viii) $1s^2 2s^2 2p^5$

 (c) Use the above information to;

   (i) List elements that belong to the same group   (2 marks)

   (ii) List elements that belong to the same period   (2 marks)

8. (a) 1.00g of air consist of approximately 0.76g of nitrogen and 0.24g of oxygen. Calculate the partial pressures and the total pressure when this sample occupies a 1.00Lvessel at 20⁰C.   (5 marks)

   (b) How many grams of oxygen are there in a 50.0L tank at 21⁰C when the oxygen pressure is 15.0atm?   (4 marks)

   (c) Write short notes on;

i)Dependence of percentage ionization on initial concentration of ;

a weak acid   and   a strong acid

ii) Characteristics and preparation of a buffer solution   (6 marks)

9. (a) what are the five basic assumptions of the kinetic molecular theory of gases.   (5 marks)

   (b) Van der Waals equation is given as:

$$[P+ a (n/v)^2][V-nb]=nRT$$

Where p=pressure, v=volume, n=moles of **a** and**b** constants; R=gas constant, T=temperature.

   i) Explain the physical meaning of the constants **a** and **b**

ii) What are the derived units for **a** and b**?**   **(**5marks)

(c)Calculate the pressure of water at 120⁰C if 2.00 moles of water vapour occupies 32.00L using;

i) The Van der Waals equation

ii) Ideal gas equation

iii) Compare the results obtained in (i) and (ii) and state which is close to the experimental value.

a=5.464   b=0.03049   R=0.08206L.atm/K.mol   (5 marks)