MURANGA UNIVERSITY COLLEGE

(CONSTITUENT COLLEGE OF JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY)

MAIN EXAMINATION
DIPLOMA IN FOOD SCIENCE

SCH 1104: CHEMISTRY

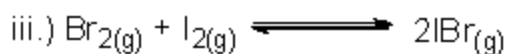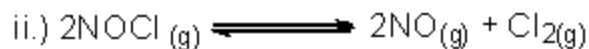**DATE: 14TH DECEMBER, 2015**   **TIME: 2 HOURS**

Instruction to the Candidate

  i.   Answer Question **ONE** and any other **two** questions
  ii.   Question one carries **30 marks** and while other questions carry **20 marks**

QUESTION 1 (30 MARKS)

a.) Define acids and bases according to;
   i.)   Arrhenius   (1 mark)
   ii.)   Bronsted-Lowry   (1 mark)
   iii.) Lewis   (1 mark)

b.) Name four (4) types of electrodes   (4 marks)

c.) State the following principles;
   i.)   Le Chatelier's Principle   (1 mark)
   ii.)   Pauli Exclusion Principle   (1 mark)
   iii.) Hund's Rule   (1 mark)

d.) Write equilibrium constant expressions for the following gas-phase reactions;
                                                       (6 marks)

$$\text{i.) } PCl_{5\,(g)} \rightleftharpoons PCl_{3\,(g)} + Cl_{2(g)}$$

$$\text{ii.) } 2NOCl_{(g)} \rightleftharpoons 2NO_{(g)} + Cl_{2(g)}$$

$$\text{iii.) } Br_{2(g)} + I_{2(g)} \rightleftharpoons 2IBr_{(g)}$$

e.) Briefly discuss the working of an Indicator   (4 marks)

f.) Name and briefly discuss the four principle quantum numbers (4 marks)

g.) The pH of some Grape juice at 25°C is found to be 3.45. Calculate;
   i.) $[H_3O^+]$ (2 marks)
   ii.) $[OH^-]$ (2 marks)
   iii.)   pOH   (2 marks)

QUESTION 2 (20 MARKS)

a.) State one limitation each of acid and base definition according to;
   i.)   Arrhenius   (2 marks)
   ii.)   Bronsted-Lowry   (2 marks)

b.) Formation of Phosgene ($COCl_2$) from CO and Cl_2 at 600°C follows the reaction below;

$$CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$$

Suppose initial partial pressure of CO is 0.6 atm and 1.0 atm for Cl_2. At equilibrium the partial pressure of $COCl_2$ is found to be 0.1 atm. Calculate;
   i.)   Partial pressures of CO and Cl_2 at equilibrium   (4 marks)
   ii.)   Equilibrium constant   (4 marks)

c.) The atomic numbers of the elements X and Y are 38 and 51 respectively.
   i.) Write the electronic configurations of X, X^+, Y^- and Y,   (4 mark)
   ii.) State the period and group to which X and Y belong   (2 marks)
   iii.) Predict the formulas of oxides of X and Y   (2 marks)

QUESTION 3 (20 MARKS)

a.) Define the following terms:
   - i.)   Diamagnetism   (1 mark)
   - ii.)   Paramagnetism   (1 mark)
   - iii.)   Ferromagnetism   (1 mark)

b.) Calculate the pH of a buffer solution containing 0.4M CH_3COOH and 0.6M CH_3COONa at 25°C   (K_a of CH_3COOH is 1.8×10^{-5} at 25°C)   (4 marks)

c.) State the following terms;
   - i.) Isothermic process   (1 mark)
   - ii.) Isobaric process   (1 mark)
   - iii.) Adiabatic process   (1 mark)

d.) Calculate the relative atomic mass of chlorine from the following data;

Isotope	Relative isotopic mass	Fractional abundance
$^{35}_{17}Cl$	34.97	0.7553
$^{37}_{17}Cl$	36.95	0.2447

                                                          (2 marks)

e.) The following set of quantum numbers are either acceptable or unacceptable, Explain;
   - i.) (4, 3, +1/2, +1/2)   (2 marks)
   - ii.) (1, 1, 0, -1/2)   (2 marks)
   - iii.) (2, 0, 0, 1)   (2 marks)
   - iv.) (3, 1, 1, 0)   (2 marks)

QUESTION 4 (20 MARKS)

a.) State two properties each of;
   - i.)   Acid   (2 marks)

ii.)   Base   (2 marks)

b.) Consider the following equilibrium equation

$$4NO_{2(g)} \rightleftharpoons 2N_2O_{(g)} + 3O_{2(g)}$$

The three gases are introduced into a reaction vessel at partial pressures 3.6atm, 5.1atm and 8.0atm for NO_2, N_2O and O_2 respectively. At equilibrium, the partial pressure of NO_2 is found to be equal to 2.4atm. Calculate the equilibrium constant
(6 marks)

c.) i.) Explain the term reduction in terms of electron movement   (2 marks)
ii.) Consider the following standard electrode potentials;

$$Fe^{2+} + 2e \rightarrow Fe_{(s)} + E^{\circ}/v = -0.44$$
$$Zn^{2+}_{(aq)} + 2e \rightarrow Zn_{(s)} + E^{\circ}/v = -0.76$$
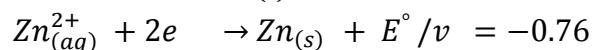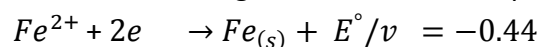
Deduce with reasons, the species reduced if the two half cells are connected in a electrochemical cell.   (4 marks)

d.) Draw the shapes of s and p orbitals   (4 marks)