MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

P.O. Box 972-60200 – Meru-Kenya.
Tel: 020-2069349, 061-2309217. 064-30320 Cell phone: +254 712524293,
+254 789151411
Fax: 064-30321
Website: www.must.ac.ke Email: info@must.ac.ke

University Examinations 2013/2014

FIRST YEAR, SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF
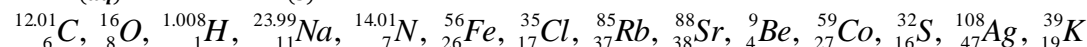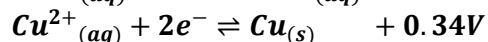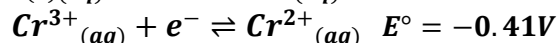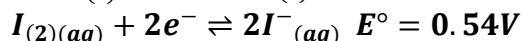BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE
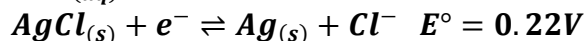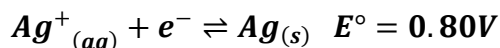
SCH 2110: CHEMISTRY

DATE: APRIL 2014   **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

Useful Date

$Ag^+_{(aq)} + e^- \rightleftharpoons Ag_{(s)} \quad E° = 0.80V$

$AgCl_{(s)} + e^- \rightleftharpoons Ag_{(s)} + Cl^- \quad E° = 0.22V$

$I_{(2)(aq)} + 2e^- \rightleftharpoons 2I^-_{(aq)} \quad E° = 0.54V$

$Cr^{3+}_{(aq)} + e^- \rightleftharpoons Cr^{2+}_{(aq)} \quad E° = -0.41V$

$Cu^{2+}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)} \quad + 0.34V$

$^{12.01}_{6}C, \ ^{16}_{8}O, \ ^{1.008}_{1}H, \ ^{23.99}_{11}Na, \ ^{14.01}_{7}N, \ ^{56}_{26}Fe, \ ^{35}_{17}Cl, \ ^{85}_{37}Rb, \ ^{88}_{38}Sr, \ ^{9}_{4}Be, \ ^{59}_{27}Co, \ ^{32}_{16}S, \ ^{108}_{47}Ag, \ ^{39}_{19}K$

## QUESTION ONE – (30 MARKS)

(a) Distinguish between the end point and the stoichiometric point of an acid-base titration.
                                                                    (2 Marks)

(b) Convert each of the following pH values to the molarity of H_2O^+ ions
   (i)   3.3
   (ii)   6.7   (3 Marks)

(c) Using the data given above, determine the standard potential of the galvanic cell with the following cell reaction:
   (i) $2Cr^{2+}_{(aq)} + Cu^{2+}_{(aq)} \longrightarrow 2Cr^{3+}_{(aq)} + Cu_{(s)}$ (1 ½ Marks)

   (ii) $Ag^+_{(aq)} + Cl^-_{(aq)} \rightleftharpoons AgCl_{(s)}$ (1 ½ Marks)

(d) A compound that assists in the coagulation of blood has the mass percentage composition 76.71% C, 7.02% H and 16.27% N. Determine the empirical formula of the compound.

(3 marks)

(e) Methane, CH_4 is the main ingredient of natural gas. When methane burns in air it combines with oxygen to form an oxide of Carbon and an oxide of hydrogen. Write a balanced equation for the combustion assuming a plenty of oxygen was used and hence determine number of moles of methane that will combine with 5g of oxygen gas.

(3 Marks)

(f) Which do you expect to be the stronger oxidizing agent? Explain your answer in each case:

(i) Cl_2 or Cl^- (2 Marks)

(ii) N_2O or N_2O_5 (2 Marks)

(g) Giving ground state electron configuration, explain why Fe^{2+} is less stable than Fe^{3+} ion. (3 Marks)

(h) Draw Lewis structures that contribute to resonance hybrids of:

(i) NO_3^- (3 Marks)

(ii) O_3 (2 Marks)

(i) Arrange the cations Rb^+, Be^{2+}, Sr^{2+} in order of increasing polarizing power. Explain your answer. (2 Marks)

(j) Explain why electron affinity of chlorine is greater than that of Bromine. (2 Marks)

QUESTION TWO – (20 MARKS)

(a) Discuss factors that affect solubility. (6 Marks)

(b) A 1M $CuSO_4 {}_{(aq)}$ solution was electrolyzed using inert electrode. Write:
(i)   The cathode reaction (½ Marks)
(ii)   The anode reaction (½ Marks)

(c) Write the reduction half-reaction for
(i)   Zinc metal in contact with Zn^{2+} ions in solution. (½ Marks)
(ii)   Chlorine gas in contact with Cl^- ions in solution. (½ Marks)

(d) The following half-reactions are joined to form a gamamic cell that generates a current under standard conditions. Identify the oxidizing agent and the reducing agent, write a cell diagram and calculate the standard cell potential.

(i) $Pt^{2+}{}_{(aq)} + 2e^- \longrightarrow Pt_{(s)}$ $(E° = +1.20)$ and
$AgF_{(s)} + e^- \longrightarrow Ag_{(s)} + F^-{}_{(aq)}(E° = +0.78V)$ (4 Marks)

(ii) $Cr^{2+}{}_{(aq)} + e^- \longrightarrow Cr^{2+}{}_{(aq)}$ $(E° = -0.41V)$ and
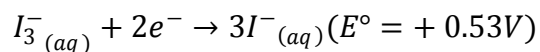
$$I_3^-{}_{(aq)} + 2e^- \rightarrow 3I^-{}_{(aq)} (E° = +0.53V)$$
(4 Marks)

(e) Decide whether a precipitate will form when the following solution are mixed.
   (i) 27.0m. of 0.0010M $NaCl_{(aq)}$ and 73.0ml of 0.0404M $AgNO_{3\,(aq)}$
   $(KspAgCl = 1.6 \times 10^{-10})$ (2 Marks)

   (ii) 1.0ml of 1.0M $K_2SO_{4(aq)}$ 10.0ml of 0.0030m $CaCl_2$ and enough water to dilute the solution to 1000.0ml.   (2 Marks)

QUESTION THREE – (20 MARKS)

(a) Define the term conjugate base.   (1 Mark)
(b) A 1000ml buffer solution is 0.10m $CH_3COOH_{(aq)}$ and 0.10m $NaCH_3CO_{2(aq)}$ ($P_{ka} = 4.75$)
   (i)   What is the PH of the buffer solution?   (5 Marks)
   (ii)   What is the PH and PH change resulting from the addition of 3.0 mmol NaOH to the buffer solution?   (4 Marks)

(c) A 112.56 ml sample of 1.345 M $K_2SO_{4(aq)}$ is diluted to 250.0ml. What is the molar concentration of K_2SO_4 in the diluted solution?   (4 Marks)

(d) When water is added to calcium oxide a vigorous reaction takes place and calcium hydroxide is formed. Describe the reaction in terms of the formation of a Lewis acid – base complex.   (6 Marks)

QUESTION FOUR – (20 MARKS)

(a) State the following rule and principle as used in inorganic chemistry
   (i)   Hund's rule   (1 Mark)
   (ii)   Pauli's exclusion principle   (1 Mark)

(b) The two quantum numbers for an electron in hydrogen atom in a certain state are
   $n = 4$ and $l = 1$
   (i)   What type of orbital is the electron located.   (1 Mark)
   (ii)   Draw all the angular wave functions of the orbital named in b(i) above.   (3 Marks)

(c) In terms of electron configuration obtained from the building up principle explain why the ionization energies of group 16 elements are smaller than those of group 15 elements.   (3 Marks)

(d) Describe the correlation in periodic trends of atomic radii and ionization energies both across a period and down a group.   (4 Marks)

(e) Identify the group in the periodic table for which the members have the following
    ground-state valence electron configurations

      (i) ns^2np^3 (½ Mark)

      (ii) $ns^2(n-1)d^{10}$ (½ Mark)

      (iii)$ns^/$ (½ Mark)

      (iv)ns^2np^6 (½ Mark)

(f) (i) In which of the following compounds do the bonds have greater ionic character, ClO_2
    or SCl_2 (electronegativity of $S = 2.6, O = 3.4\ and\ Cl = 3.2$)   (3 Marks)

    (ii) Indicate which atom in each compound has the partial negative charge. (2 Marks)