



UNIVERSITY OF NAIROBI

SECOND SEMESTER EXAMINATIONS 2014/2015

FIRST YEAR EXAMINATIONS FOR THE DEGREES OF:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING
BACHELOR OF SCIENCE IN ENVIRONMENTAL & BIOSYSTEMS ENGINEERING

FCE 181/FME 151/FEB 105: GENERAL & INORGANIC CHEMISTRY

DATE: JANUARY 13, 2015

TIME: 9.00 A.M. – 11.00 A.M.

IMPORTANT CONSTANTS

$K_w = 1.0 \times 10^{-14}$; Na (A = 23); C (A = 12); O (A = 16); N (A = 14); Ag (Z = 47); Ag (A = 108); W (Z = 74); S (Z = 16); S (A = 32); P (Z = 15); O (Z = 8); W (Z = 74); N (Z = 7);
 $K_{sp}(Ag_2S) = 6.3 \times 10^{-50}$

INSTRUCTIONS

Answer ALL Questions

QUESTION 1

- a) Briefly explain the difference between the following concepts below:
- Order of chemical reaction and bond order.
 - Solubility and solubility product.
 - Ionization energy and lattice energy.
 - Paramagnetic and diamagnetic compounds. (8 Marks)
- b) Using Valence Shell Electron Repulsion Theory predict the hybridization scheme, Geometry and molecular shapes of the following molecules.
- $S_2O_4^{2-}$
 - H_3PO_4 (6 Marks)
- c) Calculate the effective nuclear charge on electron in the last s and d orbitals electron in Tungsten (W) atom. (4 marks)
- d) Based on the values of Z_{eff} obtained in 1c) write the correct stable electron configuration for W^{2+} . (2 Marks)

QUESTION 2

- a) Different compounds of sulphur are listed below.
 $S_2O_6^{2-}$; H_2SO_3 ; S; SO_4^{2-} ; $S_4O_6^{2-}$; H_2S ; $S_2O_3^{2-}$; $HS_2O_4^-$;
Draw the Latimer diagram for sulphur using these compounds. (4 Marks)

- b) Describe the major reactions leading to the formation of peroxyacetyl nitrate (PAN) in the troposphere. **(4 Marks)**
- c) Using an illustration of the Earth's surface, explain the origin of greenhouse effect and global warming. **(3 Marks)**
- d) With the help of chemical reactions explain how carbon monoxide pollution can lead to the net accumulation or elimination of ozone in the troposphere. **(4 Marks)**

QUESTION 3

- a) Describe four factors that one can be altered to move the reaction at equilibrium forward. **(4 Marks)**
- b) Using a hypothetical chemical reaction below.

$${}_aA + {}_bB \rightleftharpoons {}_cC + {}_dD$$
 Show the relationship between equilibrium constants K_c , K_p and K_x . Under what conditions will the values of K_c , K_p and K_x be the same? **(4 Marks)**
- c) Using a hypothetical salt A_xB_y , show the relationship between solubility product and solubility of the salt. **(4 Marks)**
- d) A first year Engineering student mixed 200 ml of $1.3 \times 10^{-3} M$ $AgNO_3$ with 100 ml of $4.5 \times 10^{-5} M$ Na_2S solution in a conical flask. Determine whether precipitation will occur. **(3 Marks)**

QUESTION 4

- a) The Table below shows the results obtained during the reaction of ammonium nitrite in an inert solvent. Study the results and answer the questions that follow.



T (sec)	0	300	600	900	∞
Volume of N_2 evolved (m^3)	0	3.42	6.30	8.95	34.75

- i) Determine the order of the reaction. **(4 Marks)**
- ii) Using the order obtained from part i) above derive the expression for integrated rate law for the reaction. **(4 Marks)**
- iii) Calculate the value of the rate constant, K . **(2 Marks)**
- b) Describe four factors that can be altered the change the rate of a chemical reaction. **(4 Marks)**
- c) Describe the effect of hard water in the following applications:
 i) Cement industry.
 ii) Steam generation. **(2 Marks)**
- d) Using chemical reactions show how soda-lime can be used to remove permanent hardness of water. **(4 Marks)**

End