KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

FIRST YEAR EXAMINATION FOR THE AWARD OF
THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)
FIRST SEMESTER 2015/2016
(SEPTEMBER - DECEMBER, 2015)

CHEM 110: INORGANIC CHEMISTRY

STREAM: Y1S1   **TIME: 2 HOURS**

DAY: TUESDAY, 8.00 AM - 10.00 AM   **DATE: 08/12/2015**

INSTRUCTIONS

1. *Do not write anything on this question paper.*
2. *Answer ALL Questions in section A and any other TWO in section B.*

SECTION A: marks 40%

1. (i) Describe three observations that were made from the Rutherford's alpha-particle scattering experiment.   (3 marks)
   (ii) What did the above observations prove?   (3 marks)

2. (a) Differentiate between
   (i) Nucleon and nuclide   (2 marks)
   (ii) Atomic number and Mass number   (2 marks)
   (iii) Isotope and Avogadro's constant   (2 marks)

3. (a) A sample of naturally occurring silicon consists of ^{28}Si (mass=27.9769 a.m.u.), ^{29}Si (mass=28.9756 a.m.u.), ^{30}Si (mass=28.9738 a.m.u.). If the atomic mass of silicon is 28.0855 a.m.u. and the natural abundance of ^{29}Si is 4.67%.
   (i) Explain what is meant by the statement 'the atomic mass of silicon is 28.085 a. m.u'.
                                                              (1 marks)
   (ii) Determine the natural abundance of ^{28}Si and ^{30}Si (3 marks)
   (iii) Given that 1 amu = 1.6605×10^{-24} g, calculate the number of silicon atoms that are present in 1.50 mg of silicon. (Avogadro's number = 6.0220×1023)   (2 marks)

4. Draw Lewis (dot - cross) structures of the following NH_3, SO_2, O_3, NH_2, NO^+ and CO_3^{2-}.
   (Atomic numbers=1, N= 7, O =8, S=16, C = 6) (6marks)

5. (a) A sample of K_2CO_3 weighing 10.60g is dissolved in water and the solution is made up to 250ml. (R.A.M of K= 39.001, C= 12.001, O= 16.0)
   (i) Calculate the molarity and normality of K_2CO_3 solution.   (3 marks)
   (b) What is the final concentration of 2.5 ml of a 1.5 M glucose solution is diluted to a volume of 50 ml.   (2 marks)

6. (a) Explain why first ionization energy of beryllium is greater than that of boron
   (R.A.M. No. Be=4, B=5)   (2 marks)
   (a) What is the shortest wavelength line in (nm) in the Layman series of hydrogen spectrum? ($n_2=1$, $n_1 = \infty$, RH=1.097×10^{-2})   (3 marks)

7. (a) Discuss at least three of Bohr's postulates   (3 marks)

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(b)Give three shortcomings of Bohr's atom

(3 marks)

SECTION B: marks 30%   (Attempt two questions)

8. (a)Discuss the significance of quantum numbers.   (3 marks)

(b)List and identify the possible values of L and M_L that an electron can have when it is in the principal quantum level (i) n=2 (ii) n=3   (3 marks)

(c)Describe the following terms: (i) Photon (ii) Quantum (iii) Ground stae   (3 marks)

(d) The elements, magnesium, oxygen and aluminium have atomic number 12, 8 and13. What are the electronic configuration of Mg, Mg^{2+}, O, O^{2-}, Al and Al^{3+}?   (6 marks)

9. (a)Distinguish between empirical and molecular formulae.   (2 marks)

(b)A compound consists only carbon, hydrogen and oxygen. Combustions of 10.68 mg of the compound yield 16.01 mg of CO_2 and 4.37 mg H_2O. The molar mass of the compound is 176.1 g / mol. What is the empirical and molecular formula of the compound? (R. A. M. of C= 12.001, H= 1.008, O= 16.0).   (3 marks)

(c) Draw the Lewis structure and work out formal charges of all elements in NO^{3-} .(3 marks)

(d)Describe the following terms: (i) Electron affinity   (2 marks)

(ii) Electronegativity`.   (2 marks)

(iii)Discuss the factors that influence the ionization energy of an element.   (3 marks)

10. (a) Define each of the following terms:

(i)Limiting reagent (ii) theoretical yield (iii) actual yield and (iv) percentage yield (4 mark)

(b) Ozone (O_3) in the stratosphere can react with nitric oxide, (NO) that is discharged from the high altitude planes according to the following equation.

$O_{3 (g)} + NO_{(g)} \longrightarrow O_{2 (g)} + NO_{2 (g)}$
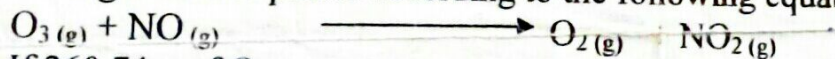
If 260.74 g of Ozone gas were reacted with 0.67 g of nitrogen (ii) oxide, NO.

(i)Determine the mass (in grams) of NO_2 that would be produced. (N =14 , O = 16) (2 marks)

(iii)Calculate the number of moles of the excess reagent remaining at the end of the reaction.   (2 marks)

(iv) If 60 g of NO_2 is actually produced. Calculate the percentage yield of NO_2. (2 marks

(c)How does the atomic and ionic radius change as we move from (i) Left to right across the period and (ii) from top to bottom in a group? Use the second and the third periods in the periodic table and the group IA and 7A as examples to illustrate your explanation. (3 marks)

(d) Arrange the following atoms, cations, and anions in order of decreasing atomic and anionic radius (i)Na, AL, P, Cl, Mg (ii) N^{3-}, Na^+, F^-, O^{2-} (2 marks)