Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY (ANALYTICAL OPTION)
BACHELOR OF SCIENCE IN FOOD QUALITY
BACHELOR OF SCIENCE IN MEDICAL LABORATORY SCIENCES
BACHELOR OF TECHNOLOGY IN RENEWABLE AND APPLIED PHYSICS
BACHELOR OF SCIENCE IN MARINE RESOURCE MANAGEMENT

BTAC 13S/BSFQ13S/BMLS13S/BTRE 13S, BTAP13S , BMRM 13S (YI SI)

ACH 4101 : FUNDAMENTAL OF INORGANIC CHEMISTRY

SEMESTER EXAMINATION

DECEMBER 2013 SERIES 2 HOURS

Instructions to candidates:

This paper consist of **FIVE** questions
Answer question **ONE** (compulsory) and any other **TWO** questions

QUESTION ONE

a) (i) State Rutherford's Nuclear model of the atom **(3marks)**

(ii) Outline Bohr's theory of hydrogen atom **(4marks)**

b) Briefly discuss the principles and rule governing the distribution of electrons in an orbital **(6marks)**

c) Write down the electronic box configuration for the following elements with atomic number given as Z.

(i) Cu(Z =29

(ii) Sc(Z =21)
(iii) Cr (Z=24) **(3marks)**

d) The energy of one mole of photons of radiation emitted from a certain source is 239.4 KJmol-1. What is the wavelength of this radiation?

(h=6.626 x 10^{-34}J.S, L=6.022 x $10^{23}$$mol^{-1}$, C= 3.0 x $10^{8}$$ms^{-1}$) . **(2marks)**

e) (i) List FOUR factors that influence ionization energy **(4marks)**

(ii) Explain why group IA elements:

I. Are good conductors of heat **(2marks)**
II. Have lower melting points than group 2A elements **(2marks)**
III. Have larger atomic size than group 2A **(2marks)**

f) Distinguish between covalent and polar-covalent bonds **(2marks)**

QUESTION TWO

a) (i) Briefly discuss the formation of a chemical bond using orbital theory **(4marks)**

(ii) Using the following data, calculate the lattice energy of KCl.

Enthalpy of sublimation of potassium = 90.9 $KJmol^{-1}$

Ionization energy of potassium = 418.7$KJmol^{-1}$

Enthalpy of dissociation of chlorine = 240$KJmol^{-1}$

Electron affinity of chlorine = -348.7$KJmol^{-1}$

Enthalpy of formation of KCl = -440.3$KJmol^{-1}$ **(10marks)**

b) (i) Explain how:

I. A hydrogen bond is formed
II. Vander Waal's forces occur

(3marks)

(ii) Using examples, give the types of hydrogen bonds and Van der Waals forces **(3marks)**

QUESTION THREE

a) (i) State Heinsenberg's uncertainty principle **(1mark)**

(ii) The uncertainty principle in the momentum of a particle is found to be $2.5 \times 10^{-16} gcms^{-1}$. With what accuracy can its position be determined? (plank's constant = $6.626 \times 10^{-34} J.S = 3.98 \times 10^{-13} KJ\ mn^{-1}s$) **(5marks)**

b) Differentiate the following terms:

(i) Electromagnetic spectra and atomic spectra
(ii) Wavelength and wave number

(4marks)

c) The frequency of a wave of light is $5 \times 10^{14} S^{-1}$. Calculate the wavelength and wave number associated with the light (C= speed of light = $3 \times 10^{8} ms^{-1}$) **(6marks)**

QUESTION FOUR

a) Define oxidation number **(1mark)**
b) Determine the oxidation number of nitrogen in each of the following :

N_2H_4, NO, N_2, NO_3^-, NO_2^-, NH_3 **(6marks)**

c) Balance the following redox equations, inserting state symbols where necessary

$Zn(s) + H^+(aq) \rightarrow Zn^{2+} + H_2(g)$ **(2marks)**

$Fe^{2+}(aq) + Br_2(g) \rightarrow 2Fe^{3+} + Br^-$ **(2marks)**

$Mg(s) + O_2(g) \rightarrow Mg^{2+}O^{2-}$ **(2marks)**

d) For each of the following redox processes, write the half equations which represent oxidation and reduction.

$H_2S + Cl_2 \rightarrow 2HCl + S$ **(2marks)**

$Fe_2O_3 + Al \rightarrow Al_2O_3 + 2Fe$ **(2marks)**

e) State any THREE applications of redox reactions **(3marks)**

QUESTION FIVE

a) Define standard molar enthalpy of formation of a compound. **(1mark)**

b) The standard molar enthalpy of formation, $\Delta H^{\circ}f$, of diborane (B_2H_6) cannot be determined directly because the compound cannot be prepared by reaction of boron and hydrogen. However, the value can be calculated. Calculate the standard enthalpy of formation of gaseous diborane (B_2H_6) using the following thermo chemical information: **(5marks)**

$4B(s) + 3O_2(g) \rightarrow 2B_2O_3(s)$ $\Delta H^{\theta} = -2509.1KJ$

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ $\Delta H^{\theta} = -571.7KJ$

$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(s) + 3H_2O(l)$ $\Delta H^{\theta} = -2147.5KJ$

c) Describe how you would prepare 250ml of a 0.2M HCl solution, starting with a 10M stock solution of HCl. **(4marks)**

d) (i) Give FOUR differences between chemical reactions and nuclear reactions **(4marks)**

(ii) Determine the values of *x* and *y* by balancing the nuclear equations given below. A and B represent radiation particles **(4marks)**

(I) $^{212}_{84}Po \rightarrow {}^{208}_{82}Pb + {}^{x}_{y}A$

(II) $^{137}_{55}Cs \rightarrow {}^{137}_{56}Ba + {}^{x}_{y}B$

(iii) Identify the particles A and B **(2marks)**