KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SCH 210: CHEMISTRY IV

DATE: Monday 28th November, 2011 **TIME:** 8.00 a.m. – 10.00 a.m.

Section A: Main group elements:

Instructions: Answer all the questions

1 Suggest reasons for the following observations

a) The first ionization energy of group 15 elements is higher than those of group 16. (2 marks)

b) The diagonal relationship between Lithium and magnesium (2 marks)

c) Nitrogen cannot form pentahalide like phosphorous (2 marks)

d) H_2O is a liquid of high boiling point while H_2S is a gas (2 marks)

e) Lithium have a greater tendency to form covalent compounds than the other elements in the group? (2 marks)

f) Only binary compounds of the noble gases are fluorides and oxides of Kr, Xe and Rn are known (2 marks)

Total **(12 marks)**

2 a) Briefly discuss the bonding in diborane (4 marks)

b) Describe how you would prepare a Grignard reagent from Mg, and list two different uses of the reagent in preparative reactions (3 marks)

c) Give reasons for trivalency and monvalency in group 13 elements and comment on the validity of divalent compounds such as $GaCl_2$ (3 marks)

d) Using inert pair effect or otherwise, explain why Pb(II) compounds are more stable than the Pb(IV) compounds. (3marks)

Total **(13 marks)**

3 a) State one biological or medical/pharmaceutical use of:

i) Boron compounds

ii) aluminium compounds

iii) $Mg(OH)_2$

iv) $Ba(OH)_2$ (4 marks)

b) The table below gives reduction electrode potential for carbon and germanium solutions

$$CO_2 \xrightarrow{-0.12} CO \xrightarrow{+0.50} C \xrightarrow{+0.13} CH_4$$

$$GeO_2 \xrightarrow{-0.30} Ge^{+} \xrightarrow{0.00} Ge \xrightarrow{-0.30} GeH_4$$

i) Plots in the same axes the graph the Gibbs free energy against oxidation state diagram for carbon and germanium (given $\Delta G=-nFE$) (4 marks)

ii) Comment on the relative stability and properties of the oxidation states of carbon and germanium. (3 marks)

Total **(11 marks)**

4 Draw the structure of:

i) XeO_6^{4-} (2 marks)

ii) $B_3N_3H_6$ (Boraxole) (2 marks)

b) Using balanced equation outline how the following is prepared

i) $Xe^{+}PtF_6^{-}$ (2 marks)

ii) SCl_4 (2 marks)

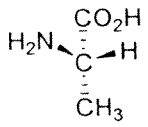
Total **(8 marks)**

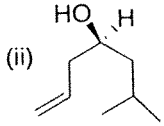
Section B: Stereochemistry , Conformational Studies And Reactions

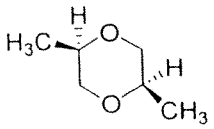
Q1. (a) Define the following terms as used in stereochemistry 3 mks

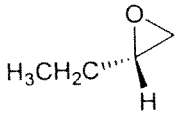
(i) Epimers (ii) Resolution (iii) Prochiral centre

(b) Assign R or S configuration to all the chiral centres in each of the following 4 mks

(i) 

(ii) 

(iii) 

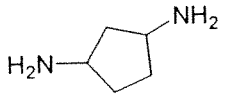
(iv) 

Q2 (a) Using compound **1** below

(i) Determine the maximum number of stereoisomers possible for this compound. 1 mks

(ii) Draw all the possible stereostructures of compound 1 3 mks

(iii)Which isomer(s) in (ii) above are optically active? 2 mks



1

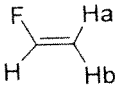
(b) A sample of synthetic 2-hydroxy-2-phenylacetic acid has a specific roration of +134 . The specific rotation of an enantiomerically pure sample of the (S)-acid is -158 .

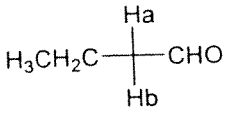
Calculate

(i) The percentage enantiomeric excess of the (R) –acid 2 mks

(ii) The percentage of (S) and (R)-acid in the sample 3mks

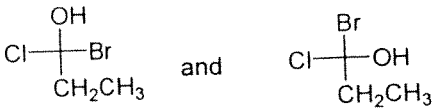
(b) Specify with reasons the Ha and Hb atoms in each of the following compounds as enantiotopic or homotopic or diasteotopic. 2 mks

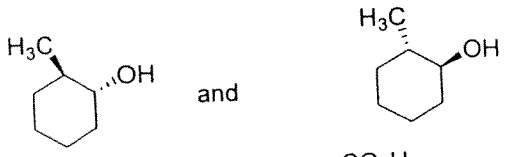
(i) 

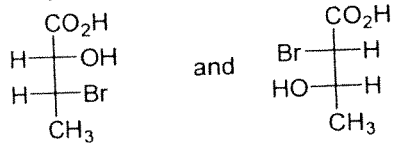
(ii) 

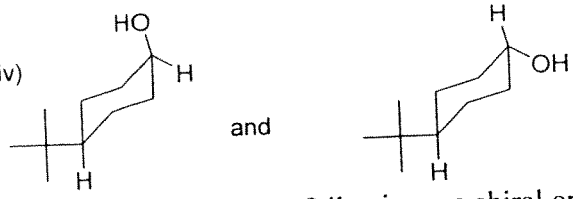
3.(a) Indicate whether each of the following pairs of compounds are enantiomers, identical, diastereomers or constitutional isomers.

4 mks

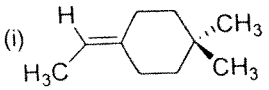
(i) 

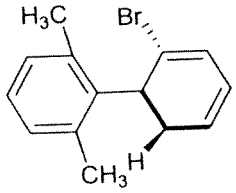
(ii) 

(iii) 

(iv) 

(b) Indicate whether the following are chiral or achiral. 2 mks

(i) 

(ii) 

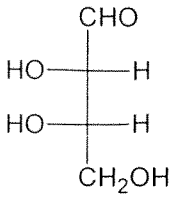
(c) Draw with reasons the most stable conformations of each of the following molecules 4 mks

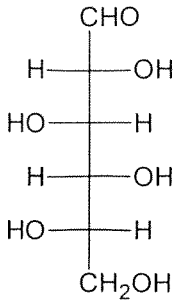
(i) Trans- 1,4 –dimethylcyclohexane

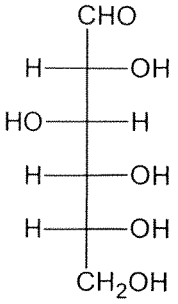
(ii) $HOCH_2CH_2OH$

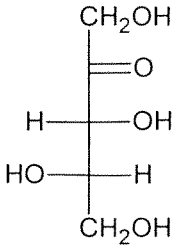
Answer ALL questions.

1. (a) Assign **D-** or **L-** configuration to the following sugars: [2 Marks]

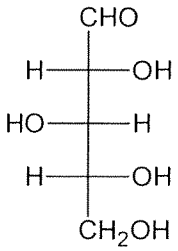
(i) 

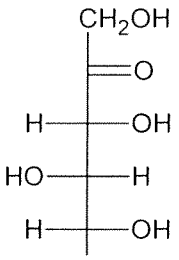
(ii) 

(iii) 

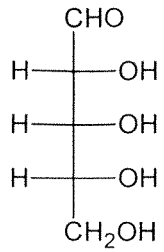
(iv) 

(b) What are enantiomers? Draw enantiomers (structures and names) of the following sugars: [3 Marks]

(i) 

(ii) 

(c) (i) Taking an example of D-ribose (**A**), explain how four cyclic structures of furanose or pyranose are formed. [2 Marks]



A

(ii) What basic reaction takes place in formation of these cyclic structures? [1 Marks]

(iii) Will the same reaction takes place in the formation of fructofuranose from D-fructose? Explain. [2 Marks]

(d) Draw two possible conformational structures each for β-D-glucose and α-D-fructose. Which of these conformational structures for each is more stable and why? [3 Marks]

2. (a) Give structures for **any two** of the following disaccharides and indicate the glycosidic bonds involved in their formation: [2 Marks]
   (i) Sucrose
   (ii) Lactose
   (iii) Maltose

   (b) Name the enzymes by which the above sugars could be hydrolyzed to corresponding monosaccharides. [1 Marks]

   (c) Write conformational structures for **any two** of the following: [2 Marks]
   (i) amylopectin (ii) sucrose
   (iii) lactose (iv) maltose

   (d) Draw structure of an unbranched polymer of glucose. Indicate its glycosidic bond and importance. [3 Marks]

3. (a) Write the name and structure of compounds formed when β-D-glucose is treated with
   (i) Tollens reagent (ii) Br_2/H_2O (pH 5-6)
   (iii) hot dil HNO_3 (iv) Periodic acid
   (v) $(CH_3)_2SO_4/NaOH$ [5 Marks]

   (b) A fresh aqueous solution of α-D-glucopyranose has a specific rotation +112o but on standing it changes to an equilibrium value $+52.6^o$. Explain. [3 Marks]

   (c) Write synthesis of vitamin C from L-sorbose indicating all the reagents involved and the structure of intermediates formed. [5 Marks]

4. (a) Describe why peptides cannot be synthesized by the direct method of acid chloride and amine? [3 Marks]

   (b) Define blocking groups with suitable examples? [3 Marks]

   (c) Write the equations illustrating the addition of alanine to the amino-blocked glycine-phenylalanine. [3 Marks]

   (d) List the amino acids and peptides formed when the polypeptide trp-met-gly-gly-phe-arg-phe-trp-val-lys-ala-gly-ser is treated with pepsin. [3 Marks]