KISII UNIVERSITY
FIRST YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE IN PUBLIC HEALTH
PHES 100: ORGANIC AND INORGANIC CHEMISTRY
Special Exam

INSTRUCTIONS

1. ***Do not write anything on the question paper***
2. ***You should have the following for this paper***
   - ***Answer booklet***
3. ***Answer ALL Questions in Section A and any TWO questions from Section B***

SECTION A: ATTEMPT ALL QUESTIONS (40 MARKS)

QUESTION 1

1. Define the following: (6 mks)
   (i) Stereoisomers
   (ii) Homologous series
   (iii) Catenation
   (iv) Hybridization
   (v) Functional group
   (vi) Standard solution
2. State 2 key postulates of Bohr theory (2 mks)
3. Answer TRUE or FALSE to each of the following statements. (2 mks)
   i) The hydrogen atom absorbs light when an electron is excited into a higher energy orbit.
   ii) The Bohr model only works for one electron species.
   iii) The ground state electronic configuration for chromium-24 has six unpaired electrons.
   iv) The wavelength of light emitted when an electron in hydrogen drops from the n = 5 to the n = 3 level is smaller than the wavelength of light emitted when the electron in the n = 5 level drops to the ground state.
4. State the Heisenberg uncertainty principle (1 mk)
5. Write the electronic configuration for: Cr^{+} (Cr =24,) (1 mk)
6. Determine the number of unpaired electrons and state whether the ion in (5) above is paramagnetic or diamagnetic (1 mk)

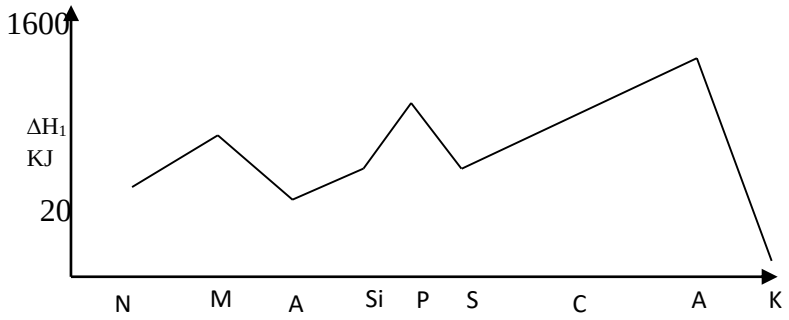
7. Given the following electronic configurations identify the group and period of elements A, $A=[Ne]3s^2 3p^2$ (1 mk)

8. Determine the following information about shells, sub-shells, and orbitals. (4 mks)
   i) The number of orbitals in a 2p sub-shell
   ii) The maximum number of electrons that could be contained in a 4d sub-shell
   iii) The maximum number of electrons that could be contained in a 3p orbital
   iv) Number of electrons in n=3

9. What designation are given to the orbital having n=3 l=0 (1 mk)

10. Comment on the magnitude of the second ionization for Magnesium relative to its 1st ionization energy. (1 mk)

11. The graph below represents the trend in the first ionization energy ΔH_1 for some elements



   i) State one possible factor which would influence the magnitude of ΔH_1 of an element (1 mk)
   ii) Explain the sudden drop in ΔH_1 after Argon. (1 mk)
   iii) Why is ΔH_1 for magnesium greater than that of aluminium? (1 mk)

12. State and explain the periodic trends of Electronegativity (2 mks)

13. How many milliliters of 3.5 M NaOH are needed to prepare 200 mL of 1.2 M NaOH? (1 mk)

14. Magnesium has three naturally occurring isotopes: ^{24}Mg (23.985 amu) with 78.99% abundance, ^{25}Mg (24.986 amu) with 10.00% abundance, and a third with 11.01% abundance. If the atomic mass of magnesium is 24.308 amu, calculate the mass of the third isotope. (3 mks)

15. 2.0 g sample of a compound Z was burned in Oxygen to give 3.0g of Carbondioxide and 0.82 g of water. Its relative molecular mass was found to be 176 g/mol. Determine the empirical and molecular formula of Z. (3 mks)

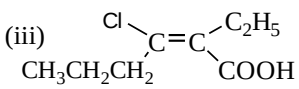
16. Balance the following equation: (1 mk)

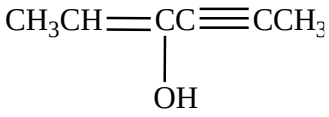
$(NH_4)_3PO_4 + Pb(NO_3)_4 \rightarrow Pb_3(PO_4)_4 + NH_4NO_3$

17. Write the structural formula of the following organic molecules. (3mks)

i) But-3-yn-2-ol
ii) 4-Methoxyhex-2-yne
iii) Methyl propanoate

18. Give the IUPAC names for the following compounds. (2 mks)

(i) 

(ii) 

19. In a class, the teacher named a compound 2-Ethyl-3-methyl-pentene. One student politely pointed out that although a correct structure could be drawn using the teacher's name; it was not the correct IUPAC name for the compound. Give the structure and the correct name. (2 mks)

20. Which of the following pair would have higher boiling point? Explain your answers: 1-butanol and propanoic acid (1mk)

21. State at least one use of esters (1 mk)

SECTION B

QUESTION 2

A. Balance the redox reaction showing clearly all the steps: (4 mks)

$$MnO_4^- + I^- \rightarrow I_2 + Mn^{2+}$$

B. A 0.0484M standard solution of potassium permanganate was titrated against 25.00 mL of an iron (II) sulfate solution. The equivalence point, as indicated by a faint pink colour, was reached when 15.50mL of potassium permanganate solution had been added. Calculate the concentration of the iron (II) sulfate solution. (4 mks)

A. Describe the successes of Bohr theory and its limitations (5 mks)

B. The first ionization energies of $_3Li$, $_4Be$, $_5B$, $_9F$ and $_{11}Na$ are 495, 520, 801, 899, and 1681 KJ/mole (not in any particular order). Match the ionization energies to the elements (2 mks

QUESTION 3

A. Describe Rutherford's model of atomic structure, the findings and its drawbacks (7 mks)

B. A flask contains a solution with unknown amount of HCl. This solution is titrated with 0.207M NaOH, and it takes 4.47mls of NaOH to complete reaction. What is the mass of HCl? (4 mks)

C. Which of the following sets of quantum numbers are not allowed and why?

i) n=1 l=1 ml=+1 ms=+ ½
ii) n=2 l=0 ml=-1 ms=0
iii) n=3 l=1 m=0 s=- ½
iv) n = 2, l = 0, ml = 0, ms = 1 (4 mks)

QUESTION 4

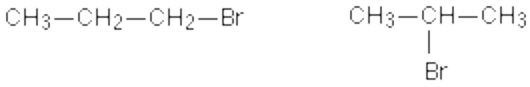
A. 1.4g of pure M_2CO_3 were dissolved in water and made up to 250cm^3 of solution. 25.0 cm^3 of this solution required 25.0 cm^3 0f 0.1M Hydrochloric acid to reach the end point. (Atomic mass H=1, C=12, O= 16)

i. Write a balanced equation for the reaction (1 mk)
ii. How many moles of HCl acid are there in 25.0 cm^3 of 0.1M HCl? (2 mks)
iii. Calculate the number of moles of M_2CO_3 that reacted with 25.0cm^3 of 0.1M HCl. (2 mks)
iv. What is the concentration of M_2CO_3 in moles/litre (M)? (2 mks)
v. What is the relative formula mass of M_2CO_3? (1 mk)
vi. What is the relative atomic mass of M? (1 mk)

B. Identify the type of isomerism in each of these compounds (3 mks)

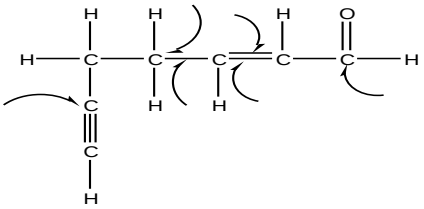
i)

ii)



iii)

C. Write the correct type of hybridization in the case of selected atoms and the type of bonding (sigma, pi or both) for the selected bonds. (3 mks)



QUESTION 5

A. There are four alkylbromides with the formula C_4H_9Br. Write their structural formulas and classify each as whether is primary, secondary or tertiary (6 mks

B. Describe simple chemical tests you can use to distinguish each the following pair of compounds in the laboratory (5mks)

i. Pentane and 2-hexyne

ii. $CH_3CH_2CH_2OH$ and CH_3CH_2COOH

iii. $CH_3CH{=}CHCH_3$ and $CH_3CH_2CHOHCH_3$

iv. $CH_3CH_2CHOHCH_3$ and $CH_3CH_2CH_2OH$

v. $HC{\equiv}CCH_2CH_2OH$ and $CH_3CH{=}CC{\equiv}CCH_3$

C. The unsaturation in alkenes is due to the presence of sp^2 hybridized carbon atoms. Use a suitable illustration focusing only on the valence shell orbitals of the carbon atom to show how sp^2hybridization occurs starting from the ground state electronic configuration. (4 mks)