THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION
EXAMINATION

132/1   **CHEMISTRY 1**

(For Both School and Private Candidates)

Time: 2:30 Hours   Thursday, 10th February 2011 p.m.

INSTRUCTIONS

1. This paper consists of **fourteen (14)** questions in sections A, B and C.

2. Answer **four (4)** questions from section A and **three (3)** questions from each of sections B and C.

3. Each question carries **ten (10)** marks.

4. Mathematical tables and non-programmable calculators may be used.

5. Cellular phones are **not** allowed in the examination room.

6. Write your **Examination Number** on every page of your answer booklet(s).

7. For calculations you may use the following constants:

Rydberg's constant $R_H = 1.09678 \times 10^7 \, m^{-1}$

Gas constant, $R = 8.31 \, Jmol^{-1} \, K^{-1}$ or $0.082 \, atm \, mol^{-1} \, K^{-1} \, dm^3$

GMV = $22.4 \, dm^3$

1 litre = $1 dm^3$ = $1000 \, cm^3$

Temperature = 273 K

Pressure = 760 mmHg

Planck constant, $h = 6.63 \times 10^{-34} \, Js$

Velocity of light, $C = 3.0 \times 10^8 \, m/s$

Atomic masses: H = 1,   O = 16,   Na = 23

This paper consists of 6 printed pages.

SECTION A (40 marks)

Answer **four (4)** questions from this section.

1. (a) Define the following terms:
   (i) Alpha particles
   (ii) Beta particles
   (iii) Isotope
   (iv) Nuclear fission. **(2 marks)**

   (b) A radioactive isotope of polonium, $^{218}_{84}Po$ decays according to the following scheme:

   $$^{218}_{84}Po \xrightarrow{\alpha - emission} X \xrightarrow{\beta - emission} Y \xrightarrow{\beta - emission} Z.$$

   (i) Deduce the mass numbers and atomic numbers of X, Y and Z.
   (ii) What is the relationship between the elements Po and Z? **(4 marks)**

   (c) The element europium, Eu exists in nature as two isotopes; ^{151}Eu with a mass of 150.9196 a.m.u and ^{153}Eu with a mass of 152.9196 a.m.u. If the average atomic mass of europium is 151.96 a.m.u, calculate the percentage relative abundances of the two isotopes. **(4 marks)**

2. (a) What is the meaning of the following quantum numbers?
   (i) m (ii) s **(2 marks)**

   (b) List all possible values of ℓ and m when n is 3. **(2 marks)**

   (c) When an electron jumps from a certain higher energy level E_2, to its ground state E_1, green light in the Balmer series is emitted. If the energy released during this transition is 4.071 x 10^{-19}J, determine the:
   (i) Wavelength of the green light.
   (ii) Higher energy level, E_2, from which the electron jumps to the ground energy level E_1. **(6 marks)**

3. (a) What do you understand by the following types of bonds?
   (i) Dative covalent bond.
   (ii) Inter - molecular hydrogen bond.
   (iii) Covalent bond.
   (iv) Intra - molecular hydrogen bond. **(4 marks)**

   (b) (i) At 110 °C and 454 mmHg, 0.11 g of ethanoic acid vapour occupies 63.7 cm^3. At 156°C and 458 mmHg, 0.081 g of ethanoic acid vapour occupies 66.4 cm^3. Calculate the molar mass of ethanoic acid in the vapour phase at each temperature.
   (ii) Give the interpretation of the results in 3 (b) (i) above. **(6 marks)**

4. (a) State the following:
   (i) Graham's law of gas diffusion
   (ii) Dalton's law of partial pressures. **(2 marks)**

   (b) A 3.20 m^3 vessel contains a mixture of 86.2 g of oxygen and 1.5 g of hydrogen at 88 °C. Calculate the total pressure in the vessel. **(4 marks)**

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(c) Gas A of a certain volume diffuses for 580.8 s while the same volume of gas J diffuses for 300 s under identical experimental conditions. Calculate the relative molecular mass of J if the relative molecular mass of gas A is 120. **(4 marks)**

5. (a) (i) State the partition law.
   (ii) Explain the meaning of miscible solutions. **(4 marks)**

   (b) 18 g of compound X distribute themselves between water and equal volume of an immiscible solvent Y so that 2 g of X are in water. Calculate to the nearest integer, the percentage of X left in water if 1000 cm^3 of water containing 1 g of X are extracted by one litre of Y. **(6 marks)**

6. (a) State the following:
   (i) Equilibrium law
   (ii) Le Chaterlier's principle. **(2 marks)**

   (b) In the preparation of ethylethanoate shown in the equation below, concentrated H_2SO_4 is often added to the mixture.

   $$C_2H_5OH_{(l)} + CH_3COOH_{(l)} \xrightarrow[\text{H}_2\text{SO}_4]{\text{Conc.}} CH_3COOC_2H_{5(l)} + H_2O_{(l)}$$

   (i) State two (2) functions of concentrated H_2SO_4 in the production of the compound.
   (ii) What will be the effect of adding $NaOH_{(aq)}$ instead of conc. H_2SO_4 in the production of the compound? **(3 marks)**

   (c) (i) When 1.00 mol/dm^3 of CH_3COOH were heated with 0.18 mol. of C_2H_5OH in a 1 dm^3 closed vessel, 0.829 mol. CH_3COOH remained at equilibrium. Calculate the value of Kc.
   (ii) What mass of ethylethanoate should be present in the equilibrium mixture formed under the same experimental conditions as 6 (b) (i) above if 0.30 moles of ethanol were heated with 0.20 moles of ethanoic acid in 1.0 dm^3 closed vessel? **(5 marks)**

SECTION B (30 marks)

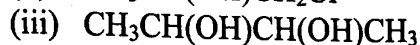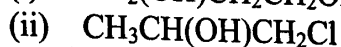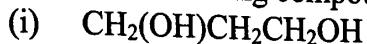Answer **three (3)** questions from this section.

7. (a) Explain why the first element in each group of the main periodic table shows properties which are not exhibited by other group elements. **(2 marks)**

   (b) Account for the following observations and give chemical reactions whenever necessary:

   (i) The second electron affinity is always positive.
   (ii) Magnesium carbonate decomposes readily when heated while sodium carbonate has no action to heat.
   (iii) Aluminium utensils rust quite easily.
   (iv) Water is a covalent compound but has a high boiling point.
   (v) Hydrogen gas is evolved when magnesium metal is placed in a beaker containing ammonium chloride. **(5 marks)**

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(c) (i) Justify the periodicity of properties of elements in the periodic table based on electronic configuration.

(ii) What are s, p and d block elements of periodic table? **(3 marks)**

8. (a) Account for the following:

(i) Zinc and iron are both d- block elements but iron can be magnetized while zinc cannot.

(ii) Iron (III) sulphate is green while zinc sulphate is white. **(4 marks)**

(b) (i) Manganese is said to exhibit variable oxidation numbers. List them.

(ii) Write the electronic configuration of manganese. (Atomic number = 25)

(iii) Give examples of compounds in which manganese exhibits different oxidation state. (Give example in each case.) **(6 marks)**

9. (a) State the following:

(i) Zeeman effect

(ii) Pauli's exclusion principle

(iii) Hund's rule of maximum multiplicity. **(3 marks)**

(b) (i) What is effective nuclear charge?

(ii) The first ionization energy of aluminium is less than that of magnesium. Giving reasons, compare the second ionization energy of aluminium to that of magnesium. **(3 marks)**

(c) Explain why the Cl-C-O bond angle in Cl_2CO is 124° and not 120°. **(4 marks)**

10. (a) Account for the uniqueness of hydrogen in the periodic table. **(2 marks)**

(b) (i) List all the isotopes of hydrogen and explain how they differ from one another.

(ii) Give the products of the following reactions:

$NaOH + D_2O \rightarrow$

$NH_4Cl + D_2O \rightarrow$

$NH_4Cl + H_2O \rightarrow$

$D + H \rightarrow$

$H + H \rightarrow$ **(5 marks)**

(c) Distinguish between ortho and para hydrogen. **(3 marks)**

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Answer **three (3)** questions from this section.

11. (a) Name the following compounds according to the IUPAC system.
    (i) $CH_2(OH)CH_2CH_2OH$
    (ii) $CH_3CH(OH)CH_2Cl$
    (iii) $CH_3CH(OH)CH(OH)CH_3$ **(3 marks)**

    (b) Compound X containing a carbon- carbon double bond would react with the following reagents:
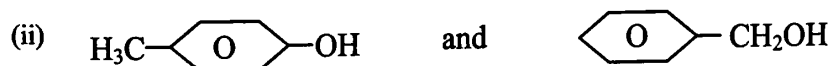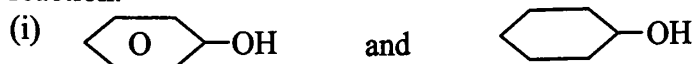   (i) Y to form 2 – bromo – 2- methylbutane
    (ii) Z to form $(CH_3)_2CHC(OH)(CH_3)_2$
    (iii) W to form 2 – chloro – 2 –methylbutane.
    Name compound X and reagents Y, Z and W.   **(3 marks)**

    (c) Indicate a chemical test which may be used to distinguish the members of each of the following pairs. Indicate the member of the pair that gives the positive test or greater reaction.
    (i) and

    (ii) and   **(4 marks)**
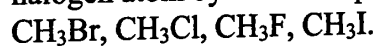
12. (a) Explain briefly the following terms:
    (i) Nucleophiles
    (ii) Nucleophilic substitution.   **(3 marks)**

    (b) Arrange the following compounds in order of increasing easiness in substitution of the halogen atom by an electrophile. Give reasons for your arrangement.
    CH_3Br, CH_3Cl, CH_3F, CH_3I.   **(4 marks)**

    (c) Explain the fact that nucleophilic substitution reaction in 1-bromobutane is bimolecular whereas nucleophilic substitution reaction in 2-methyl-2-bromopropane is monomolecular.   **(3 marks)**

13. (a) Write the structural formulae of the following compounds:
    (i) 2,4-dinitrophenol
    (ii) p-aminophenol.   **(1 mark)**

    (b) Give the names and structures of dimethyl benzenes.   **(3 marks)**

    (c) Explain with the help of chemical equations which dimethyl benzene in 13 (b) above will yield
    (i) one (1) mononitro product
    (ii) two (2) mononitrito products.   **(6 marks)**