P525/2
CHEMISTRY
PAPER 2
(Theory)
JULY/AUG/2024
2 ½ hours

ASSHU ANKOLE JOINT MOCK EXAMINATIONS 2024

Uganda Advanced Certificate of Education

CHEMISTRY

PAPER 2

(THEORY)

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Answer **five** questions including **three** questions from section **A** and any **two** from section **B**.

Write the answers in the answer booklets provided

Begin each question on a fresh page.

Mathematical tables and squared papers are provided.

Silent non-programmable scientific electronic calculators may be used.

Use equations where necessary to illustrate your answers.

Where necessary use the following.

$(H = 1, C = 12, O = 16, I = 127, S = 32, N = 14)$

SECTION A (60 MARKS)

Answer any three questions from this section.
Any additional question(s) answered will not be marked.

1. (a) Explain why a 0.2M barium chloride solution has the same freezing point as a 0.6M solution of glucose   (2 ½ marks)

(b)(i) Describe an experiment that can be carried out in the laboratory to determine the formula mass of sulphur in naphthalene. (6 marks)

(ii) 3.5g of Sulphur in 100g of naphthalene lowered the melting point of the later by 0.87^0C, while 3.2g of iodine in 100g of same solvent lowered the melting point by 0.80^0C.
Calculate the freezing point constant for naphthalene and hence determine the molecular formula of sulphur in naphthalene.
(5 marks)

(c) The table below shows the freezing points of different concentrations of solute T in water

Concentration of T(gdm^{-3})	0	30	60	90	120	150
Freezing point (^0C)	0	-0.16	-0.32	-0.49	-0.65	-0.81

i) Plot a graph of freezing point depression against concentration of T
(4 marks)

ii) Use the graph you have drawn to determine the relative molecular mass of T (The cryoscopic constant for water is 1.86^0C per 1000g per mole)
(2 ½ marks)

2. (a) An organic compound W contains 58.9% of carbon, 9.8% of hydrogen and the rest being oxygen. Determine the
i) Empirical formula of W.
(2 marks)

ii) Molecular formula of W. The vapour density of W is 51.
(1 mark)

(b) When W was heated with dilute sulphuric acid compounds X, C_3H_8O and Y, $C_2H_4O_2$ were formed. X reacts with sodium metal to liberate hydrogen gas but has no effect on litmus.
i) Write the structural formulae of all isomers of X (2 marks

ii)   Name a reagent that can be used to distinguish between the isomers of **X** and state what is observed if the isomers are separately treated with the reagent.   *(2 marks)*

(c) X reacts with acidified potassium manganate(VII) solution on heating to give compound **Z**, which forms a pale yellow precipitate with alkaline iodine solution.

   i)   Identify substances **X, Z** and yellow precipitate *(3 marks)*

   ii)   Write equation for the reaction leading to the formation of the pale yellow precipitate.   *(1 mark)*

(d) Write a mechanism for the reaction that would take place between;

   i)   **X** and ethanoyl chloride   *(3 marks)*

   ii)   **Z** and 2, 4 – dinitrophenyl hydrazine   *(4 marks)*

(e) Compound **Y** reacts with magnesium powder with effervescence of a colourless gas.

   i)   Name the functional group in **Y**   *(1 mark)*

   ii)   Write the structural formula of **W**   *(1 mark)*

3. (a) Define the following terms

   i)   PH   *(1 mark)*

   ii)   Molar conductivity   *(1 mark)*

   (b) $25cm^3$ of 0.1M ammonia solution was titrated with hydrochloric acid from the burette and $12.5cm^3$ of 0.2M hydrochloric acid was used for complete neutralization.

   i)   Calculate the pH of the resultant solution formed ($Kw = 1.0 \times 10^{-14}$ and $Kb = 1.75 \times 10^{-5}$)   *(5 marks)*

   ii)   Sketch a graph to show the change in pH when 0.2M hydrochloric acid was added to $25cm^3$ of 0.1M ammonia solution until the end point.   *(3 marks)*

   iii) Explain the shape of your sketch graph in b(ii) above. *(4 marks)*

   (c) State Kohlrauch's law of independent migration of ions   *(1 mark)*

   (d) A 298K, a solution containing 3.3g per litre of ammonium sulphate has an electrolytic conductivity of $7.675 \times 10^{-3}\Omega^{-1}$ cm^{-1}. Determine the molar concentration of ammonium ions in the solution. (The molar conductivity of sulphate ions at infinite dilution is $160\Omega^{-1}cm^2mol^{-1}$, (N =14, S = 32, O = 16, H = 1)   *(5 marks)*

4. Beryllium, calcium and barium are some of the elements that belong to group(II) of the periodic table
   a) (i) Write the electronic configuration of beryllium ions and barium ions in +2 oxidation state. *(1 mark)*
   (ii) Explain why beryllium chloride is more soluble in ethanol than water while barium chloride is more soluble in water than ethanol. *(4 marks)*
   b) Describe the reactions of beryllium and barium with;
   i) Oxygen *(3 marks)*
   ii) Dilute sulphuric acid *(4 marks)*
   c) Briefly explain the reactions that take place during the manufacture of cement. *(3 ½ marks)*
   d) Potassium chromate (VI) solution was added to barium nitrate solution followed by dilute nitric acid. Explain what was observed. *(4 ½ marks)*
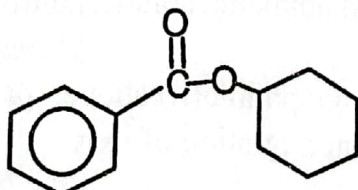
SECTION B (40 MARKS)

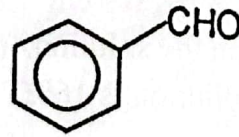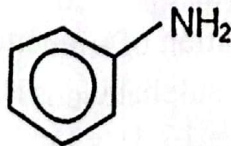Answer any two questions from this section
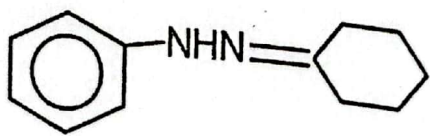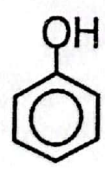Any additional question(s) answered will not be marked

5. Write equations to show how each of the following compounds can be synthesized. Indicate reagents and conditions for the reactions in each case.
   a) Propanone from bromoethane *(4 marks)*
   b)

 from chlorobenzene *(3 marks)*

   c) CH_3CONH_2 from butan-2-ol *(5 marks)*
   d)

 from *(4 marks)*

   e)

 from *(4 marks)*

6. (a) The first and the third ionization energies of element R are 845 and 7780 KJmol⁻¹ respectively.

   i) Define the term first ionization energy. *(1 mark)*

   ii) The frequency of element R at the point of second ionization is 3.58×10^{15} Hz. Calculate the value of the second ionization energy of element R (Planck's constant = 6.626×10^{-34} Js and Avogadro's number $N_A = 6.02 \times 10^{23}$) *(3 marks)*

   iii) State the group in the periodic Table to which R belongs and give a reason for your answer. *(3 marks)*

   (b) The mass spectrum of bromine shows peaks at mass to charge ratios of 158, 160 and 162 and bromine has two isotopes, Br – 79 and bromine – 81.

   i) Briefly describe how the mass spectrum of bromine can be obtained *(6 marks)*

   ii) Write the formulae of the ions corresponding to the peaks. *(3 marks)*

   iii) Calculate the percentage abundance of each isotope of bromine and hence sketch the mass spectrum of bromine. (The relative atomic mass of bromine is 79.91) *(4marks)*

7. (a) State the difference between soap and a non-soapy detergent. *(1 mark)*

   (b)(i) Write equations to show how a non-soapy detergent can be prepared from benzene and but-l-ene. *(4 marks)*

   (ii) Explain the cleansing action of the non-soapy detergent formed in b(i) above. *(4 marks)*

   (iii) State two advantages of using non-soapy detergents over soap. *(2 marks)*

   (c) Distinguish between addition and condensation polymerization. *(2 marks)*

   (d) Write equations to show how each of the following polymers is formed.

   i) Perspex *(1 ½ marks)*

   ii) Nylon – 6, 10 *(1 ½ marks)*

   (e) Polytetrafluoroethene is formed by addition polymerization. In an experiment, the osmotic pressure of a 3.0% solution of polytetrafluoro ethene in toulene was found to be 46.77mmHg at 27⁰C. Determine the number of monomer units in the polymer. (R = 8.31, C = 12, F = 19)

8. In the extraction of zinc from zinc blende, the ore is first concentrated and then extraction follows.

a) Name the;
   i)   Method by which the ore of zinc is concentrated   *(1 mark)*
   ii) Two main impurities present in the ore of zinc named above.

   (1 mark)

b) Describe how zinc is extracted from the concentrated ore.

   (5 marks)

c) Explain the reactions of zinc and the following substances.
   i)   Potassium hydroxide   *(2 ½ marks)*
   ii) Concentrated sulphuric acid.   *(2 ½ marks)*

d) Zinc ethanoate dissolves in water to form a colourless solution and decomposes on heating to give a gas which forms a yellow precipitate with 2, 4-dinitrophenyl hydrazine solution. Explain;
   i)   What is observed when sodium hydrogen carbonate solution is added to the colourless solution.   *(4 marks)*
   ii) What happened when zinc ethanoate is heated and the gas passed through 2, 4-dinitro phenylhydrazine solution.

   (4 marks)