P525/1

CHEMISTRY

PAPER 1

JUNE/JULY 2024

2¾ Hours

# ASSHU-KYENJOJO JOINT MOCK EXAMINATIONS 2024

## Uganda Advanced Certificate of Education

## CHEMISTRY

## Paper 1

## 2 Hours 45 Minutes

Name:………………………………………………………….Index Number……..………

School……………………………………..……………………….Signature………………..

**INSTRUCTIONS TO CANDIDATES:**

➢ Attempt all questions in section A and any six from section B

➢ All questions are to be answered in the spaces provided

➢ A periodic table with relevant atomic masses is supplied at the end of the paper.

<table>
<tr><th colspan="18">FOR EXAMINER'S USE ONLY</th></tr>
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**SECTION A [46 MARKS)**

*Answer **all** questions in this section*

1.  a) Write nuclear equations for the

i) Alpha – decay of radium – 226 ($^{226}_{88}Ra$)                    [1 mk]

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ii) Beta decay of strontium – 90                    [1 mk]

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b) Cobalt – 60 undergoes radioactive decay. When 1.0g of the isotope decays in 10.4 years, 0.25g of the isotope remains. Determine half – life of the isotope                    [4 mks]

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2.  Complete the table below

| Structure of monomer (s) | Name of the monomer | Structure of the polymer | Type of the polymer |
|---|---|---|---|
| | | $(-CH_2C = CHCH_2-)_n$<br>$|$<br>$CH_3$ | |
| $HOCOCH_2COOH$ | | | |
| $HOCH_2CH_2OH$ | | | |

3.  $10cm^3$ of a gaseous hydrocarbon, Q, were mixed with $33cm^3$ of oxygen which was in excess. The mixture was exploded and after cooling to room temperature, the residual volume of gas occupied $28cm^3$. On adding concentrated potassium hydroxide the volume decreased to $8cm^3$

a) Determine the molecular formular of Q                              [3½ mks]

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b) Q reacts with ammonical silver nitrate solution

i) State what is observed                                             [½ mk]

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ii) Write the equation for the reaction that occurs                   [1½ mks]

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iii) Name the organic product formed                                 [½ mks]

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4.  a) State one way in which hydrogen behaves as a                   [1 mk]

i) Group I element

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ii) Group VII element

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b) Write the equation for the reaction that occurs when:

i) Chlorine is bubbled through sodium bromide solution               [1½ mks]

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ii) Sodium iodate solution is added to sodium hydrogen sulphite solution (show half equation if any) [3½ mks]

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5.   a) Ethene was added to acidified potassium manganite (VII) solution

i) State what was observed [½ mk]

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ii) Write equation for the reaction that occurred [1½ mks]

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iii) Name the organic product formed [½ mk]

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b) Ethane can be converted to chloroethane. Outline the mechanism for the reaction that occurs [2 mks]

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6.   a) You are given the following standard electrode potentials

| Reaction | $E^{\varnothing}$/volts | Number |
|---|---|---|
| $MnO_4^{-}(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$ | + 1.51 | (I) |
| $Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}$ | + 0.77 | (II) |
| $Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$ | + 0.34 | (III) |
| $Fe^{2+}(aq) + 2e^- \longrightarrow Fe(s)$ | −0.44 | (IV) |

i) Write cell notation for the cell formed reactions (I) and (II) [1 mk]

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ii) Write equation for the reaction that occurs at

Cathode: [1 mk]

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Anode: [1 mk]

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iii) Write the equation for the overall cell reaction [1 mk]

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b) An iron tablet containing iron (II) sulphate was analyzed using 0.005M potassium manganate (VII) solution. The iron tablet (mass 0.65g) was dissolved in 100cm$^3$ of dilute sulphuric acid. 10cm$^3$ of this solution required 6cm$^3$ of 0.005M potassium manganate (VII) solution to produce a faint pink colour. Calculate the percentage of iron in the tablets [4 mks]

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c) Comparing iron and copper, which one is a stronger oxidizing agent? Give a reason for your answer [1 mk]

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7.    a) Give two reasons why beryllium a group II element resembles aluminium a group III element [1 mk]

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b) Write equation for the reaction that occurs between

i) Beryllium and sodium hydroxide solution [1½ mks]

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ii) Calcium carbide and water [1½ mks]

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8.    Name the reagent that can be used to distinguish between the following pair of compounds and in each case state what will be observed when each compound is treated separately with reagent $C_6H_5Br$ and $C_6H_5CH_2Br$ [3 mks]

Reagent:

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Observations:

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9.    Hydration energy of sodium chloride is $-771kJmol^{-1}$ while its lattice energy is $-776kJmol^{-1}$ Draw an energy level diagram that can be used to determine enthalpy of solution of sodium chloride [3 mks]

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## SECTION B [54 MARKS]

*Answer any six questions in this section. Any extra question (s) will not be marked*

10.     a) An organic compound Y has a relative molecular mass of 74 and contains the following;

carbon 64.9%, hydrogen 13.5% and oxygen 21.6%. Determine the

i) Empirical formula of Y                                                                                          [2 mks]

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ii) Molecular formula of Y                                                                                     [1½ mks]

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iii) Write structural formula of two possible isomers of Y                              [1 mk]

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b) Compound Z, one of the isomers of Y can be oxidized to form a neutral compound W which does not react with Fehling's solution.

i) Identify compound W                                                                                       [½ mk]

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ii) Outline a mechanism for the reaction that occurs between W and hydrazine     [4 mks]

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11.     a) The first electron affinities of the elements in a period III of the periodic table are given in the table below

| Element | Na | Mg | Al | Si | P | S | Cl |
|---|---|---|---|---|---|---|---|
| First electron affinity ($kJmol^{-1}$) | -20 | +67 | -30 | -135 | -60 | -200 | -364 |

i) State the general trend in the electron affinities from sodium to chlorine          [1 mk]

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ii) Explain the general trend noticed in (a) (i) above                                        [1½ mks]

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iii) Why is the first electron affinity of magnesium more positive than one might expect from the general trend in the given values                                        [2½ mks]

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iv) Why is the first electron affinity of silicon more exothermic than that of phosphorus?

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b) Write the equation to show first electron affinity of magnesium [1 mk]

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12.  a) Ammonium chloride was added to water. The solution was tested with red litmus paper and sodium carbonate solution added to ammonium chloride solution separately.

i) Write equation for the reaction between water and ammonium chloride solution [1½ mks]

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ii) Write the expression for hydrolysis constant, $K_h$ of ammonium chloride [1 mk]

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iii) State what was observed when the litmus paper was added to the solution [1 mk]

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iv) State what was observed and write the equation for the reaction that occurred when sodium carbonate solution was added to ammonium chloride solution [2½ mks]

Observation:

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Equation:

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b) Calculate the pH of a 0.1M solution of ammonium chloride at room temperature. Hydrolysis constant of ammonium chloride at that temperature is 5.65 x $10^{-12}$ moldm$^{-3}$ [3 mks]

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13. a) Explain why carbon trichloride molecule is polar [4½ mks]

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b) Methane was exposed to chlorine in presence of ultraviolet light

i) Write the equation for the reaction that occurred [1 mk]

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ii) Outline a mechanism for the reaction that occurred [2 mks]

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c) Draw the structure and name the shape for carbon trichloride [1½ mks]

Structure:




Name of the shape:

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14. a) Write the equation for the reaction that occurs when:

i) Heated silicon reacts with steam [1½ mks]

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ii) Tin reacts with dilute sulphuric acid [1½ mks]

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iii) Silicon reacts with concentrated hydrofluoric acid [1½ mks]

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iv) Silicon tetrachloride reacts with water [1½ mks]

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b) Explain why the reaction in (a) (iv) is possible while carbon tetrachloride cannot undergo the same reaction [1½ mks]

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c) Write equation for the reaction between aluminium chloride and water [1½ mks]

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15.     a) A mixture of sodium propanoate and propanoic acid acts as a buffer solution

i) Define the term buffer solution [1 mk]

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ii) Explain how the mixture acts as a buffer solution when a small amount of sodium hydroxide solution is added to it [3½ mks]

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iii) Calculate the pH of the solution formed by adding 15cm$^3$ of 0.1M sodium hydroxide to 30cm$^3$ of 0.1M propanoic acid                                    [3 mks]

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b) Name a buffer solution found in a biological system and explain its importance [1½ mks]

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16.     a) Using equations only, show how sodium hydroxide can be prepared on industrial scale

[4½ mks]

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b) Write equation (s) for the reaction (s) between sodium hydroxide and

i) Chlorine                                                              [3 mks]

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ii) Phosphorus [1½ mks]

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17. Phosphorus (V) chloride dissociates at high temperatures according to the equation;

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$
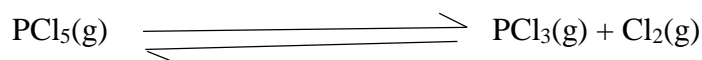
83.4g of phosphorus (V) chloride are placed in a vessel of volume $9.23dm^3$. At equilibrium at a certain temperature, 1.11g of chlorine are produced at a total pressure of $250kNm^{-2}$. Use these data, where relevant to answer the questions that follow;

a) Calculate the number of moles of each of the gases in the vessel at equilibrium [3 mks]

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b) i) Write an expression for the equilibrium constant, $K_c$, for the above equilibrium [1 mk]

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ii) Calculate the value of the equilibrium constant, $K_c$ [3 mks]

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c) Calculate the partial pressure of phosphorus (V) chloride present in the equilibrium mixture [2 mks]

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PERIODIC TABLE

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