NAME .....

RANDOM/PERSONAL No. ...../..... SIGNATURE .....

P525/1
CHEMISTRY
Paper 1
Saturday 12th August 2023 (Morning)
2 hours 45 minutes

ACHOLI SECONDARY SCHOOLS EXAMINATIONS COMMITTEE

Uganda Advanced Certificate of Education

Joint Mock Examinations, 2023

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

- Answer **all** questions in section **A** and **six** questions in section **B**.
- All questions must be answered in the spaces provided.
- The Periodic Table, with relative atomic masses, is supplied.
- Mathematical tables (3-figure table) are adequate or non-programmable scientific electronic calculators may be used.
- Illustrate your answers with equations where applicable.

Where necessary, use the following:

- Molar gas constant, R = 8.31 $JK^{-1}mol^{-1}$.
- Molar volume of gas at s.t.p is 22.4 litres.
- Standard temperature = 273 K
- Standard pressure = 101325 Nm^{-2}

For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 marks)

Answer **all** questions in this section.

1. The standard electrode potentials for some redox systems are shown below.

	E^0 = +1.46V
	E^0 = +1.23V

(a) Write the:

(i) Cathode half-cell equation of reaction. (01 mark)

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(ii) Overall equation for the reaction. (1½ marks)

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(b) (i) Calculate the energy generated by the cell (2½ marks)

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(ii) State whether the cell reaction in (a) is feasible or not. (½ mark)

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2. Complete the following equations and in each case name the main organic product.

(a) $(CH_3)_2CH_2Br \xrightarrow[Dry\ ether]{Na}$ ..... (1½ marks)

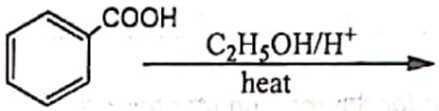
Name of product.....

(b) $CH_3CH{=}CH_2 + HBr(g) \xrightarrow{CH_3OOCH_3}$ .....(1½ marks)

Name of product.....

(c) $CH_3CHO \xrightarrow[H^+]{NH_2NHCONH_2}$ ..... (1½ marks)

Name of product.....

(d) 

..... (1½ marks)

Name of product.....

3. (a) Explain

(i) what is meant by the term **complex ion**? (01 mark)

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(ii) **two** factors that can favour formation of complexes. (1½ marks)

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(b) Complete the table below by providing the name of each of following complexes. (02 marks)

Complex	Name of complex
$[Fe(CN)_6]^{3-}$	
$[Cu(NH_3)_4(H_2O)_2]^{2+}$	

(c) A concentrated solution of sodium carbonate was added to a solution of potassium chromium(III) sulphate

(i) State what was observed. (01 mark)

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(ii) Write equation for the reaction that took place. (01 mark)

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4. (a)(i) Briefly describe how a sample of soap can be prepared. (2½ marks)

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(ii) Write equation leading to the formation of soap. (01 mark)

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(b) (i) Explain why small holes are formed on terylene shirts when placed in concentrated solution of soap (1½ marks)

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(ii) State **one** advantage of soap as compared to soapless detergents.

6. $30cm^3$ of a gaseous hydrocarbon **Q** was exploded with $200cm^3$ of oxygen which was in excess. On cooling to room temperature, the residual gases occupied 155 cm^3. When the residual gases were passed through potassium hydroxide, the volume decreased by 120 cm^3.

(a) Calculate the molecular formula of **Q.** (03 marks)

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(b) **Q** forms a red precipitate on treatment with a solution of copper (I) chloride in aqueous ammonia. Write

(i) the structural formula and IUPAC name of **Q.** (01 mark)

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(ii) equation for the reaction between Q and solution of copper(I) chloride in aqueous ammonia. (01 mark)

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7. Phosphorus (V) chloride decomposes at high temperatures according to the following equation.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g);$$

(a) Write an expression for the equilibrium constant, K_c. (0½ mark)

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(b) When 1 mole of phosphorus (V) chloride was placed in a 1 litre vessel and heated at 350°Cand at a certain pressure, the equilibrium mixture was found to contain 38.4% of chlorine.

(i) Calculate the equilibrium constant, K_c. (03 marks)

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(ii) The equilibrium constant for the above reaction at 250°C was found to be 1.54. State whether the reaction is exothermic or endothermic. Give a reason for your answer. (01 mark)

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(c) State what would happen to the concentration of chlorine if the pressure in the vessel was decreased while temperature is maintained at 350°C. Give a reason for your answer. (1½ marks)

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8. Name **one** reagent that can be used to distinguish between the following pairs of compounds. In each case, state what would be observed if each member of the pairs is separately treated with the reagent you have named and write equation for the reaction.

(a) C_6H_5CHO and CH_3CH_2CHO (03 marks)

Reagent(s)

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Observation(s)

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Equation of reaction(s)

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(b) $(CH_3)_2CHNH_2$ and $(CH_3)_2NH$ (03 marks)

Reagent(s)

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Observation(s)

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Equation of reaction(s)

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9. (a) Draw the structures and name the shapes of the following Ions. (03 marks)

Ions	Structure	shape
MnO_4^-		
NO_2^-		
SO_3^{2-}		

(b) Explain why nitrite ion adopts the named shape in (a) (1½ marks)

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(c) State what would be observed when sodium sulphite solution is added to acidified potassium manganate (VII) solution (02 marks)

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SECTION B (54 marks)

Answer **six** questions from this section.

10. State what would be observed and write equation for the reaction that would take place when:

(a) solid sodium iodide is heated with concentrated sulphuric acid. (02 marks)

Observation

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Equation

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(b) Methanoic acid is boiled with Fehling's solution. (02 marks)

Observation

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Equation

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(c) Sodium nitrite was added to acidified potassium dichromate (VI) solution. (2½ marks)

Observation

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Equation

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(d) Potassium chlorate (V) solution is added to acidified solution of iron (II) sulphate. (2½ marks)

Observation

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Equation

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11. Carbon, silicon, germanium and tin are some of the elements of group IV of the Periodic Table.

(a) Write the general outermost electronic configuration of the elements. (0½ mark)

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(b) State the trend in the metallic nature and explain your answer. (1½ marks)

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(b) State **two**

(i) reasons why carbon shows differences in its properties from the rest of the elements in the same group. (01 mark)

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(ii) properties in which carbon differs from the other elements. (02 marks)

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(d) (i) Write the formulae of hydride of each of the elements. (02 marks)

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(ii) Describe how each of the hydrides in (d) (i) react with water. (02 marks)

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12. Write equations to show how the following conversions can be carried out.

(a) Cyclohexanone from benzene and propene. (03 marks)

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(b) $HC \equiv CH$ to $C_6H_5CH_2Cl$ (03 marks)

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(c) Ethanol to 2-hydroxypropanoic acid. (03 marks)

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13. (a) Write the electronic configuration of manganese (II) ions and manganese. (01 mark)

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(b) Potassium manganate (VII) is commonly employed in volumetric analysis. However, it solution must be first standardized.

(i) State **two** disadvantages of using potassium manganate (VII) in volumetric analysis. (02 marks)

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(ii) Name **one** substance that can be used to standardized potassium Manganate (VII). (01 mark)

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(c) State what would be observed and write equation for the reaction that would take place when to acidified potassium manganate (VII) is added:

(i) Potassium iodide solution. (2½ marks)

Observation

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Equation

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(ii) ethane-1,2-dioic acid and mixture heated. (2½ marks)

Observation

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Equation

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14. (a) Define the term **common ion effect.** (01 mark)

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(b) Zinc hydroxide is sparingly soluble in water. Write the expression for the solubility product, Ksp, for zinc hydroxide. (0½ mark)

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(c) 5.0 g of zinc hydroxide was shaken in 1 dm^3 of water and the mixture filtered at 25 °C. 24.0 cm^3 of the filtrate required 5.6 cm^3 of a 0.1 M hydrochloric acid for complete reaction using phenolphthalein indicator.

Calculate the

(i) solubility product constant, K_{sp} of zinc hydroxide at 25°C. (2½ marks)

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(ii) percentage of zinc hydroxide that dissolved at 25°C (02 marks)

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(d) Explain how the solubility of zinc hydroxide would change if its saturated solution at 25°C is separately treated with zinc sulphate solution. (1½ marks)

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(e) Explain how solubility product, Ksp is used in prediction of precipitation. (1½ marks)

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15. Write a mechanism to show how each of the following conversions can be effected.

(a) Benzene to phenylethanone. (03 marks)

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(b) Benzoic acid to 3-nitrobenzoic acid. (03 marks)

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(c) Hydroxbenzene to phenyl ethyl ether. (03 marks)

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16. (a) State:

(i) **Raoult's law.** (01 mark)

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(ii) **Three** properties of an ideal solution. (1½ marks)

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(b) A solution of A and B with a vapour pressure of 11.999kPa is such that the mole fraction of A is 0.25 at 25°C. Showing your reasoning, state whether the solution is ideal and determine the percentage composition of the vapour. (The vapour pressure of pure A and pure B at 25°C are 8.000 kPa and 13.332 kPa respectively.) (03 marks)

(c) (i) Sketch a labelled boiling point-composition diagram for the mixture in (b) above. (2½ marks)

(ii) State what would be obtained as the distillate and the residue if a liquid mixture in (b) containing 40% A is fractionally distilled. (01 mark)

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17. (a) (i) Write the formula and the name of one ore from which zinc can be extracted. (01 mark)

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(II) State the method which can be used to concentrate the ore you have named in a(i). (0½ mark)

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(b) The concentrated ore in (a)(i) was converted to zinc oxide.

(i) State how the conversion was carried out. (0½ mark)

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(ii) Write the equation for the reaction to illustrate your answer in b(i). (01 mark)

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(c) The zinc oxide in (b) was mixed with limestone and coke and the mixture heated in air in a blast furnace.

(i) Explain the purpose of adding limestone. (1½ mark)

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(ii) Write equation for the reaction leading to the formation of zinc. (01 mark)

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(d) Zinc powder was added to solution of aluminium sulphate in a test tube.

(i) State what was observed. (1½ marks)

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(ii) Write equation for the reaction that took place. (1½ marks)

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