P525/2
Chemistry
Paper 2
July – August 2025
2 ½ Hours

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS – 2025

UGANDA ADVANCED CERTIFICATE OF EDUCATION

Chemistry

Paper 2

2 Hours 30 Minutes

INSTRUCTIONS TO CANDIDATES

- *This paper consists of **two** Sections **A** and **B**.*
- *Attempt **five** questions including **three** from Section **A** and any **two** from Section **B**.*
- *Answers to the question**(s)** **must** be on the answer sheets provided.*
- *Begin **each** question on a fresh page.*
- *Extra question**(s)** attempted will **not** be marked.*
- *Mathematical tables and graph papers are provided.*
- *Non-programmable scientific electronic calculators may be used.*
- *Use equations where necessary to illustrate your answers.*

$(H = 1; C = 12; O = 16)$

Molar gas volume $= 22.4dm^3$ *at s.t.p*

Faraday's constant is $96500C$

For Examiners Use Only						
Question						**Total**
Marks						

1. (a) Explain what is meant by the term;

(i) Solvation energy. (01 mark)

(ii) Order of reaction. (01 mark)

(b) Describe an experiment that can be used to determine the solvation energy of **copper(II) chloride. (Diagram not required).** (06 marks)

(c) Some thermochemical data for **copper(II) chloride, copper** and **chlorine** are given below.

Enthalpy of formation of copper(II) chloride	=	**$-220.0 kJmol^{-1}$**
First ionization energy of copper	=	**$+745.0 kJmol^{-1}$**
Enthalpy of sublimation of copper	=	**$+338.3kJmol^{-1}$**
Solvation energy of copper (II) chloride	=	**$-65.6kJmol^{-1}$**
First election affinity of chloride	=	**$-364.0kJmol^{-1}$**
Atomization energy of chloride	=	**$+60.5kJmol^{-1}$**
Second ionization energy of copper	=	**$+1958.0kJmol^{-1}$**

(i) Draw an energy level diagram and use the data to determine the heat of hydration of **copper (II) chloride.** (06 marks)

(ii) From the data above, state the effect of increasing temperature on the solubility of **copper(II) chloride** and give a reason for your answer. (02 marks)

(d) The data below was recorded for the reaction.

A + B ⟶ products.

Experiment	[A] *($moldm^{-3}$)*	[B] *($moldm^{-3}$)*	Rate *($moldm^{-3}s^{-1}$)*
1	**2.5×10^{-4}**	**3.0×10^{-4}**	**5.0×10^{-4}**
2	**5.0×10^{-4}**	**6.0×10^{-4}**	**4.0×10^{-3}**
3	**1.0×10^{-4}**	**6.0×10^{-4}**	**1.6×10^{-2}**

(i) Calculate the order of the reaction. (2 ½ marks)

(ii) Determine the rate constant and state its units. (1½ marks)

2. Write down a pair of classes of compounds with the same functional group that can be distinguished using the following reagents. In each case state what would be observed if each member of the pair was separately treated with reagent and write the equation if any for the reaction that would take place;

(a) Nitrous acid. (04 marks)

(b) Fehling's solution. (04 marks)

(c) Hot sodium hydroxide solution and acidified silver nitrate. (04 marks)

(d) Lucas' reagent. (04 marks)

(e) Ammoniacal copper(I) chloride. (04 marks)

3. Fluorine, chlorine, bromine and iodine are elements in group VII of the periodic table;

(a) Explain why iodine sublimes when heated the rest of the elements do not. (04 marks)

(b) The table below shows the melting points of the magnesium halides.

Formula of halides	MgF_2	$MgCl_2$	$MGBr_2$	MgI_2
Melting point (^{0}C)	1263	714	711	634

(c) Describe the reactions of the elements with;

(i) Sodium thiosulphate solution. (3½ marks)

(ii) Iron(II) sulphate. (2½ marks)

(iii) Water. (04 marks)

(d) State what would be observed and write the equation for the reaction that would take place when sodium iodine is added to acidified sodium chlorate(I) solution. (02 marks)

4. (a) Define the following terms as used in acid-base titration;

(i) Titrand. (01 mark)

(ii) Acid base indicator. (01 mark)

(b) Methyl orange is one of the commonly used indicators in acid base titrations;

(i) Explain the action of the indicator. (04 marks)

(ii) The dissociation constant, K_i, of methyl orange indicator is 1.995×10^{-4} **moldm^3.**

Deduce the working **pH** range of the indicator. (03 marks)

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(c) Describe an experiment that can be carried out to determine the solubility product of barium iodate(V) in the laboratory by titrimetric method. (06 marks)

(d) Predict whether precipitation of barium iodate will occur when a **0.005M** of solution of barium nitrate is mixed with an equal volume of a **0.003M** solution of potassium iodate(V) at 25^0C.

(Solubility product of barium iodate is 4.9×10^{-9} mol^3dm^{-9} at 25^0C)

(i) Show your working. (03 marks)

(ii) State **two** applications of common ion effect. (02 marks)

SECTION B (40 MARKS)

*Attempt any **two** questions from this section.*

5. (a) Explain what is meant by the term;

(i) Standard electrode potential. (01 mark)

(ii) Specific conductance. (01 mark)

(b) With aid of a labelled diagram, describe how the standard electrode potential of a Chlorine electrode can be determined. (06 marks)

(c) Electrode potentials of some half cells are given below;

A. $MnO_4^-(aq) + 8H^+(aq) + 5e^- \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$ +1.52V

B. $2H^+(aq) + 2e^- \longrightarrow H_2(g)$ 0.00V

C. $Mg(s) \longrightarrow Mg^{2+}(aq) + 2e^-$ +2.40V

(i) Which of the species is a;

Strong oxidizing agent. (01 mark)

Strong reducing agent. (01 mark)

(ii) State and explain whether the reaction between cells **B** and **C** will occur. (04 marks)

(d) Write down the cell notation for the cell formed when half cells **A** and **C** are combined. (01 mark)

(e) A cell consisting of **0.1M** solution of magnesium chlorine which is **35%** dissociated has a molar conductivity at infinite dilution of $25.885 cm^2 mol^{-1}$ and a resistance of **724Ω**.

Determine the;

(i) Specific conductance.

(ii) Cell constant of the cell. (05 marks)

6. Sodium, aluminium, silicon, phosphorous and chlorine are some of the elements in period 3 of the periodic table.

(a) Describe briefly how the hydrides of the elements can be prepared and in each write the equation for the reaction. (08 marks)

(b) Discuss the reactions of the chlorides of the elements with water. (07 marks)

(c) Sodium hydroxide solution was separately added dropwise until in excess to a solution of aluminium chloride and magnesium chloride.

(i) State what was observed in each case. (02 marks)

(ii) Write the equation for the reaction in each case. (03 marks)

7. (a) When **7.5g** of an organic compound **Y** was burnt in excess oxygen **4.5g** of water and **11200cm^3** of carbon dioxide were formed at **s.t.p.**

When **Y** was steam distilled at **767.75mmHg** at **120^{0}C**, the distillate contained **Y** and water in a ratio of **1:4** respectively.

(Vapour pressure of water at 120^{0}C is 740mmHG)

(i) Calculate the empirical formula of **Y**. (03 marks)

(ii) Determine the molecular formular of **Y**. (03 marks)

(b) **Y** burns with a yellow sooty flame, forms a yellow precipitate with Brady's reagent and a pale-yellow precipitate with iodine solution in sodium hydroxide solution. Name compound **Y**. (01 mark)

(c) Write the equation and suggest a mechanism for the reaction between **Y** and;

(i) Brady's reagent. (05 marks)

(ii) Acidified potassium cyanide. (02 marks)

(d) Using equations only show how **Y** can be;

(i) Synthesized from hydroxybenzene. (03 marks)

(ii) Converted to an alkene. (03 marks)

8. (a) Name and write the formula of **one ore** from which zinc can be extracted. (02 marks)

(b) Describe how zinc can be extracted from the ore named above. (08 marks)

(c) **1.5g** of an impure ore of zinc was dissolved in **0.02M** ammonia and the resulting solution shaken with trichloromethane after equilibrium was established, **50cm^3** of organic layer needed **30cm^3** of **0.062M** hydrochloric acid for complete neutralization **20cm^3** of the aqueous layer were neutralized by **40cm^3** of **0.5M** hydrochloric acid. If the reaction ratio between **Zinc(II)** ions and ammonia is 1:4 and partition coefficient of ammonia between water and trichloromethane at **25^{0}C** is **25.0 (Zn = 65).**

(i) Determine the percentage of Zinc in the ore. (08 marks)

(ii) Explain why it is advisable to have a Sulphuric acid manufacturing plant near a zinc extraction plant. (02 marks)

END