NAME:…… index No……

Signature …… School ……

P525/2
CHEMISTRY
Paper 2
July/Aug 2023
2 ½ hours

BUGANDA EXAMINATION COUNCIL MOCKS 2023

UGANDA ADVANCED CERTIFICATE OF EDUCATION

CHEMISTRY PAPER 2

2 HOURS 30 MINUTES

INSTRUCTIONS TO CANDIDATES

- ✓ *Answer* **five** *questions, including* ***three*** *from section* ***A*** *and any* ***two*** *from section* ***B****.*
- ✓ *Additional questions answered will* ***not*** *be marked.*
- ✓ *Write the answers in the answer booklets provided.*
- ✓ ***Begin each question on a*** **fresh page.**
- ✓ *Mathematical tables and graph papers are provided.*
- ✓ *Non-programmable scientific electronic calculators may be used.*
- ✓ ***Use equations were necessary to illustrate your*** **answer.**

[$H = 1;\ N = 14; O = 16;\ Cl = 35.5;$ Pb=207*]*

SECTION A

*Answer **three** questions from this section.*

1. (a) Define the following terms:
   (i) **Relative atomic mass**. (01 mark)
   (ii) **Half-life** (01 mark)

   (b) Briefly describe how the relative atomic mass of copper can be determined using a mass spectrometer.

   (**Diagram not required**) (06 marks)

   (c) A naturally occurring copper consists of atoms whose isotopic masses are 62.93 and 64.93 respectively. Given that the relative atomic mass of copper is 63.5. Calculate the relative abundance of the isotopes of copper.
   (03 marks)

   (d) The table below shows how the mass of a radioactive substance **R** varies with time.

Mass (g)	48.2	38.5	31.5	26.0	21.0	17.2
Time (minutes)	20	40	60	80	100	120

   Plot a graph of log(mass) against time. (04 marks)

   (e) Using your graph, determine the:
   (i) initial mass of substance **R**. (01 mark)
   (ii) decay constant. (2½ marks)
   (iii) half-life of substance **R**. (1½ marks)

2. A compound **Q** contains 63.0% lead, 14.8% carbon, 1.8% hydrogen and the rest being oxygen. The relative molecular mass of **Q** is 325.
   (a) Determine the:
   (i) empirical formula of **Q**. (1½ marks)
   (ii) molecular formula of **Q**. (1½ marks)
   (b) When a sample of **Q** was warmed with concentrated sulphuric acid, a white precipitate **T** and a colourless sharp smelling liquid **N** were formed.
   (i) Identify **T** and **N**. (01 mark)

(ii) Write equation for the reaction leading to the formation of **T** and **N**. (01 mark)

(c) Using equations, show how:

(i) **N** can be converted to propene. (3½ marks)

(ii) **Q** can be converted to propan-2-ol. (02 marks)

(d) State what would be observed and write equation(s) for the reaction(s) that would take place when to an aqueous solution of **Q** is added:

(i) concentrated hydrochloric acid dropwise until in excess. (03 marks)

(ii) a solution of potassium chromate(VI). (1½ marks)

(e) Write equation and indicate the mechanism for the reaction that occurs when **N** is heated with ethanol in the presence of dry hydrogen chloride. (5½ marks)

3. (a) State:

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

(ii) *what is meant by the term* ***ideal solution.*** (02 marks)

(b) Liquids **P** (boiling point 80℃) and **Q** (boiling point 111℃) form liquid mixture that obeys Raoult's law.

(i) Calculate the vapour pressure of a liquid mixture containing 0.2 moles of **P** and 0.6 moles of **Q** at 25℃. [*The vapour pressures of pure **Q** and pure **P** at 25℃ are 570 mmHg and 1521 mmHg respectively.*] (03 marks)

(ii) Determine the mole fraction of each liquid in the vapour formed. (02 marks)

(c) Nitric acid and water form a non-ideal mixture that deviates negatively from Raoult's law. When the mixture was distilled, a constant boiling point mixture containing 68% nitric acid was obtained at 120℃. The constant boiling point mixture has a density of 1.42 gdm^{-3}. (The boiling point of pure water and nitric acid are 100℃ and 83℃)

(i) Explain why the mixture shows a negative deviation from Raoult's law. (03 marks)

(ii) Using a well labelled diagram, explain what would happen when a mixture containing 50% of water is fractionally distilled. (06 marks)

(iii) Calculate the volume of acid needed to prepare one litre of 2 M nitric acid. (03 marks)

4. (a) Beryllium, magnesium, calcium and barium are some of the elements in Group II of the Periodic Table.

Briefly describe how the elements react with:

(i) Water (3½ marks)

(ii) Dilute sulphuric acid. (3½ marks)

(b) Beryllium like aluminium can react with aqueous sodium hydroxide whereas other group (II) elements in the Periodic Table do not.

(i) List **three** other properties in which beryllium shows similarity to aluminium. (03 marks)

(ii) State **two** reasons why beryllium behaves differently from other group (II) elements. (03 marks)

(iii) Write ionic equations to show how aqueous sodium hydroxide and reacts separately with beryllium and aluminium. (03 marks)

(c) Name:

(i) the processes by which cement can be manufactured. (01 mark)

(ii) the main raw materials that are used in the cement manufacture. (1½ marks)

(b) Briefly describe how the named raw materials in (a)(ii) can be converted into cement. (03 marks)

SECTION B

Answer **two** questions from this section

5. Write equations to show how the following compounds can be synthesized.

(a) Ethanol to 2-hydroxypropanoic acid. (2½ marks)

(b) Iodobenzene from ethyne. (03 marks)

(c) Cyclohexane from methylbenzoate. (03 marks)

(d) Ethene to 1-aminopropane. (03 marks)

(e) Propan-2-ol to propan-1-ol (2½ marks)

(f) Ethene to propanone hydrazone (03 marks)

(g) 2-methylpropan-2-ol from methanol. (3½ marks)

6. Explain each of the following observations.

(a) 4-nitrophenol boils at a higher temperature than 2-nitrophenol. (03 marks)

(b) The dissociation constant of methanoic acid is higher than that of ethanoic acid. (03 marks)

(c) When concentrated hydrochloric acid is added to a solution of cobalt(II) chloride, the colour of the solution changes from pink to blue. When water is added to the resulting solution, it changes back to pink. (03 marks)

(d) Phenol reacts with bromine water readily to form a white precipitate whereas bromine reacts with benzene in the presence of a catalyst. (04 marks)

(e) Calcium phosphate is insoluble in water but dissolves in dilute nitric acid. (04 marks)

(f) Iodine is much more soluble in potassium iodide than in water. (03 marks)

7. (a) Describe with the aid of a labelled diagram how the standard electrode potential of a copper electrode can be determined. (07 marks)

(b) The electrode potential for some half-cell reactions are shown below:

$Cu^{2+}(aq) + 2e^{-} \rightleftharpoons Cu(s)$; $E^{\theta} = +0.34V$

$Ag^{+}(aq) + e^{-} \rightleftharpoons Ag(s)$; $E^{\theta} = +0.80V$

(i) Write the cell notation the cell formed when the two half-cells are combined. (01 mark)

(ii) Write the equation for the reaction. (01 mark)

(iii) Calculate the maximum obtainable energy from the cell. (1 F=96,500 C) (03 marks)

(iv) State whether the reaction in (b)(ii) is feasible or not and give a reason for your answer. (01 mark)

(c) A current of 2.0 A was passed for 30 minutes through a cell containing dilute sulphuric acid and the hydrogen evolved at the cathode collected. Calculate the volume of the hydrogen collected (in cm^3) at 23°C and 100kPa. (3 marks)

(d) State **two**:

(i) ways in which electrolytic cells differ from electrochemical cells. (02 marks)

(ii) applications of electrochemical cells. (01 mark)

8. (a) Differentiate between a **d-block element** and a **transition element**. (02 marks)

(b) State **two** properties of zinc as a transition element. (01 mark)

(c) (i) One of the ores from which zinc can be extracted is zinc blende. Write the formula of zinc blende. (01 mark)

(iii) Briefly describe how pure zinc can be obtained from zinc sulphide. (07 marks)

(d) Zinc powder was added to warm aqueous sodium hydroxide.

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

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

(e) 1.5 g of an impure ore of zinc was dissolved in a 0.02 M ammonia and the resulting solution shaken with trichloromethane and left to settle. 50.0 cm^3 of trichloromethane layer needed 30.0 cm^3 of a 0.062 M hydrochloric acid for complete neutralisation. 20.0 cm^3 of the aqueous solution were neutralised by 40.0 cm^3 of a 0.5 M hydrochloric acid. If the partition coefficient of ammonia between water and trichloromethane at 25°C is 25.0 and the reaction ratio between zinc(II) ions and ammonia is 1:4.

Calculate the percentage of zinc in the ore. (06 marks)

(f) State **one** large scale use of zinc. (0½ mark)

END