

P525/2

Chemistry

(Theory)

Paper 2

June, 2023

2 hours

WAMATOVU MUSLIM SEED SECONDARY SCHOOL

MID TERM EXAMINATIONS, 2023

Uganda Advanced Certificate of Education

S.5 CHEMISTRY

(Theory)

PAPER 2

Time: 2 hours

INSTRUCTIONS TO CANDIDATES

*Answer any **four** questions in all.*

All questions must be answered on the answer booklets provided.

Begin the answer to each question on a fresh page.

Illustrate your answers with equations where applicable.

Where necessary, use the following:

Molar gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

Molar volume of gas at s.t.p is 22.4 litres.

Standard temperature = 273K.

Standard pressure = 101325 N m^{-2}

$C = 12$ $H = 1$ $Al = 27$ $S = 32$ $Cl = 35.5$ $Br = 79.9$

1.

(a) State what is meant by the following terms;

(i) first ionization energy

(ii) second ionization energy

(iii) enthalpy of solution

(03 marks)

(b) The first ionization energy of an element is always less than the second ionization energy. Explain.

(02 marks)

(c) Describe an experiment to determine the enthalpy of neutralisation of hydrochloric acid by sodium hydroxide.

(05 marks)

(d) Some thermochemical data calcium, calcium chloride and chlorine are given below;

Enthalpy of formation of calcium chloride -763 kJmol^{-1} .

Enthalpy of atomization of chlorine $+121 \text{ kJmol}^{-1}$.

Enthalpy of atomization of calcium $+193 \text{ kJmol}^{-1}$.

First ionisation energy of calcium $+590 \text{ kJmol}^{-1}$.

Second ionisation energy of calcium $+1145 \text{ kJmol}^{-1}$.

Electron affinity for chlorine -348 kJmol^{-1} .

(i) Draw an energy level diagram for the formation of calcium chloride. **(04 marks)**

(ii) Calculate the lattice energy of calcium chloride. **(02 marks)**

(ii) Comment on the stability of calcium chloride. **(01 mark)**

(i) Calculate the enthalpy of solution of calcium chloride (*the hydration energy of Ca^{2+} and Cl^- are -1689.6 and $-383.7 \text{ kJmol}^{-1}$ respectively*).

(01½ marks)

(ii) Comment of the solubility of calcium chloride in water.

(01½ marks)

2.

(a) Using equations only, describe how aluminium is extracted from bauxite. **(07½ marks)**

(b) Write equations and state the conditions under which aluminium reacts with;

(ii) sodium hydroxide and

(iii) hydrochloric acid.

(05 marks)

(c) When 0.1g of aluminium chloride was vapourised at 350°C and a pressure of 1 atmosphere, 19.2 cm^3 of vapour was formed.

(i) Calculate the relative molecular mass of aluminium chloride. **(03½ marks)**

(ii) Write the molecular formula of aluminium chloride in the gaseous state at 350°C .

(01 mark)

(c) Explain why aluminium fluoride is ionic whereas aluminium bromide is covalent.

(04 marks)

3.

(a) With examples explain the following types of structural isomerism.

(i) Position isomerism (03 marks)

(ii) Functional group isomerism (03 marks)

(iii) Chain isomerism (03 marks)

(b) 6.20g of a bromoalkane W, $C_n H_{2n+1} Br$ contains 65.04% by mass bromine. Determine the molecular mass of W, and hence write the structural formulae and possible isomers of W.

(05 marks)

(c) **10.0cm³** of a hydrocarbon **P (C_xH_y)** was exploded in **90.0cm³** of oxygen gas. On cooling to room temperature, the residual gases occupied **70.0cm³**, when the residual gases were passed through potassium hydroxide solution, the volume reduced to **40.0cm³**.

(i) Determine the **molecular formula** of hydrocarbon P. (04 marks)

(ii) Write structural formula and name of P. (02 marks)

4.

(a) Explain what is meant by the term **colligative property**. (02 marks)

(b) Describe the limitations of colligative properties. (04 marks)

(c) State Raoult's law of vapour pressure lowering. (02 mark)

(d) Explain why addition of a non – volatile solute lowers the vapour pressure of the solution over that of the pure solvent. (03 marks)

(e) The Vapour pressure of carbon disulphide at a certain temperature is 53,330Pa, at the same temperature, a solution of 5g of sulphur in 63 cm³ of Carbon disulphide has a vapour pressure of 52340 Pa. The density of carbon disulphide at this temperature is 1.27gcm⁻³. Calculate the:

(i) R.F.M of Sulphur. (03 marks)

(ii) Molecular formula of sulphur in carbon disulphide (C = 12, S = 32) (02 marks)

(f) Explain how association and dissociation of the solute affects the colligative properties. (04 marks)

5.

(a) Define the term **atomic radius**. **(02 marks)**

(b) The table below shows variation in atomic radius across Period 3 elements

Element	Na	Mg	Al	Si	P	S	Cl
Atomic radius(nm)	0.156	0.136	0.125	0.117	0.110	0.104	0.099

(i) Draw a graph to show the trend of the atomic radius of period 3 elements. **(03 marks)**

(ii) Describe and explain the trend shown by the graph you have drawn. **(05 marks)**

(c) State and explain the trend in atomic radius of elements down a group. **(05 marks)**

(d) Explain why the ionic radii of Na^+ , Mg^{2+} and Al^{3+} are smaller than those of the corresponding atoms.

(05 marks)

END

The ladder to success is never crowded at the top...