3.5 CHEMISTRY (233)

Chemistry is tested in three papers, paper 1 (233/1), paper 2 (233/2) and paper 3 (233/3). Paper 1 and paper 2 are theory papers while paper 3 is a practical. Paper 1 (233/1) tests Forms 1, 2, 3 and 4 content whereby each question carries a maximum of 3 marks while paper 2 tests content from specific topics from forms 1, 2, 3, and 4 and assesses a wide range of skills. A question in paper 2 can carry up to a minimum of 10 and a maximum of 14 marks. Paper 3 tests in depth both quantitative and qualitative practical skills attained by the candidates from Forms 1, 2, 3 and 4 and assesses a wide range of skills. This report is based on the analysis of performance of candidates who sat the year 2021 KCSE Chemistry.

3.5.1 Candidates General Performance

The following table shows the performance of Chemistry in the last five years.

Table 11: Candidates Performance in Chemistry for the last five years: 2017, 2018, 2019, 2020 and 2021

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2017	1		80	17.03	14.67
	2		80	17.97	14.32
	3		40	14.1	6.11
	Overall	**606,515**	**200**	**48.09**	**32.87**
2018	1		80	19.36	14.57
	2		80	16.96	14.17
	3		40	14.44	6.45
	Overall	**656,163**	**200**	**53.76**	**33.45**
2019	1		80	20.00	14.98
	2		80	18.00	13.07
	3		40	13.00	6.70
	Overall	**691,802**	**200**	**52.17**	**32.71**
2020	1		80	15.02	14.28
	2		80	12.05	10.9
	3		40	17.95	7.47
	Overall	**740,831**	**200**	**45.01**	**30.19**
2021	1	**820,765**	80	12.11	10.93
	2		80	14.79	12.6
	3		40	15.43	6.85
	Overall		**200**	**42.02**	**28.01**

From the table, it is observable that:

(i) Candidature for chemistry increased from **740,831** in 2020 to **820,765** in 2021 an increment of about 10.79 %. Candidature has been improving over the years.

(ii) Performance in paper 1 declined considerably with 2.91 points from a mean of 15.02 to a mean of 12.11. The decrease was equivalent to 19.37%.

(iii) Performance in paper 2 improved considerably with 2.74 points from a mean of 12.05 in 2020 to 14.79 in 2021. This was an improvement of 18.53%.

(iv) Performance in paper 3 declined with 2.52 points from a mean of 17.95 in 2020 to 15.43 in 2021, an equivalence decrease of 16.33%.

(v) The standard deviation for paper 1 declined from 14.28 to 10.93 indicating that majority of the candidates' performance was clustered around the mean due to the low standard deviation. The standard deviation for paper 2 was 12.6 an improvement from 10.9. This means that the candidates' scores were well dispersed although the SD was still below the ideal. The standard deviation of the practical paper declined 7.47 to 6.85 indicating poor spread of the candidates' scores as majority of the scores were clustered around the mean

3.5.6 The overall performance in Chemistry declined from a mean of 45.01 (22.51) in 2020 to 42.02 (21.01) in 2021, a decrease of 2.99 points equivalent to 6.64%. Teachers are advised to teach to the demands of the syllabus but not the textbooks to cover the expected content as specified in the syllabus in good time to allow for extensive revision. A variety of textbooks authorized by the KICD should be used for instruction but not one recommended textbook.

3.5.2 ANALYSIS OF QUESTIONS PERFORMED POORLY

Questions which were performed poorly are analysed and briefly discussed below. The discussion is based on comments from the chief examiners reports and analysis of the candidates' responses from the sampled answer scripts. The discussion aims at pointing out candidates' weaknesses and proposed suggestions on the measures which if put in place the performance would improve.

3.5.3 Chemistry paper 1 (233/1)

The questions which were reported to have been poorly performed are briefly discussed below in view of pointing out the candidates' weaknesses and the proposed suggestions on the measures to be put in place to improve performance in future.

Question 8

Compound **D** with formula $C3H4$, was reacted with excess hydrogen chloride gas.

(a) Give the name of compound **D**. (1 mark)

(b) Draw **two** possible structures of the products formed. (2 marks)

Requirements

Candidates were required to draw the strucral formulae and name some organic compounds.

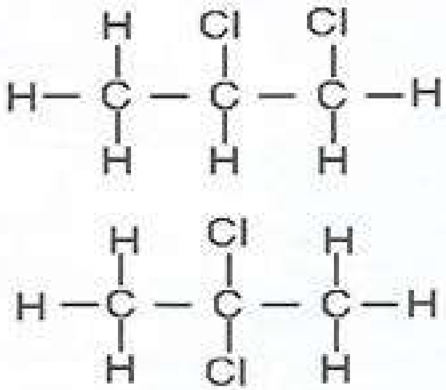
Weaknesses

Most candidates were unable identify the products of an addition reaction and draw an open structural formulae of compounds.

Expected Response

(a) Propyne/Prop-1-yne / prop-1,2- diene (1 mark)

(b)



(2 marks)

Advice to teachers
Teachers should expose students to more practice in drawing open structural formulae and naming of organic compounds.

Question 10
Consider the following reaction:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The enthalpy change is –92.4 kJ per mole of nitrogen.

(a) Give the enthalpy change per mole of ammonia. (1 mark)
(b) State and explain how each of the following affects the yield of ammonia:
 (i) Increase in temperature. (1 mark)
 (ii) Finely divided iron. (1 mark)

Requirements
In this question, candidates were required to determine the molar enthalpy change per mole of ammonia. Candidates were also expected to explain the effects of increase in temperature and use of a catalyst on the yield of ammonia.

Weaknesses
Majority of the candidates could not use the given equation to determine molar enthalpy change of ammonia and inability to explain the effect of increased temperature and use of a catalyst on the yield of ammonia.

Expected Response
(a)

$$\frac{-92.4\ kJmol^{-1}}{2} = -46.2\ kJmol^{-1}$$

(b) (i) It lowers (½) the yield of ammonia since the forward reaction is exothermic (½).
(ii) No effect (½) on yield since use of a catalyst has effect position of the equilibrium (½).

Advice to teachers

Teachers should make use of the practical approach to teaching e.g on effect of temperature and pressure on nitrogen(IV) oxide so that the students can be able to relate theory to practice and be able to make correct inferences.

Question 15

(a) State Gay-Lussac's law. (1 mark)

(b) 180 cm^3 of nitrogen(II) oxide gas was reacted with 400 cm^3 of oxygen gas.

(i) Write an equation for the reaction. (1 mark)

(ii) Calculate the total volume of the gases at the end of the reaction. (1mark)

Requirements

This question required candidates to state Gay Lussac's law and to apply the same in calculating volumes of gases involved in the reaction with help of equations.

Weaknesses

Most of the candidates could not correctly state the law and apply it in the calculation.

Expected Responses

(a) When gases react, they do so in volumes that bear a simple ratio to one another and to the products if gaseous at constant temperature and pressure (1 mark)

(b) (i) $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ (1 mark)

(ii) $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

Initial volume	180 cm^3	400 cm^3	0 cm^3
Final volume	0 cm^3	310 cm^3 (½)	180 cm^3

Total volume = 310 cm^3 remaining O_2 + 180 cm^3 NO_2 formed

= 490 cm^3 (½)

Advice to teachers

Teachers should emphasize on correct statement of the laws and expose the students to more examples on calculations related to various laws.

Question 20

Figure 5 shows part of a radioactive decay series.

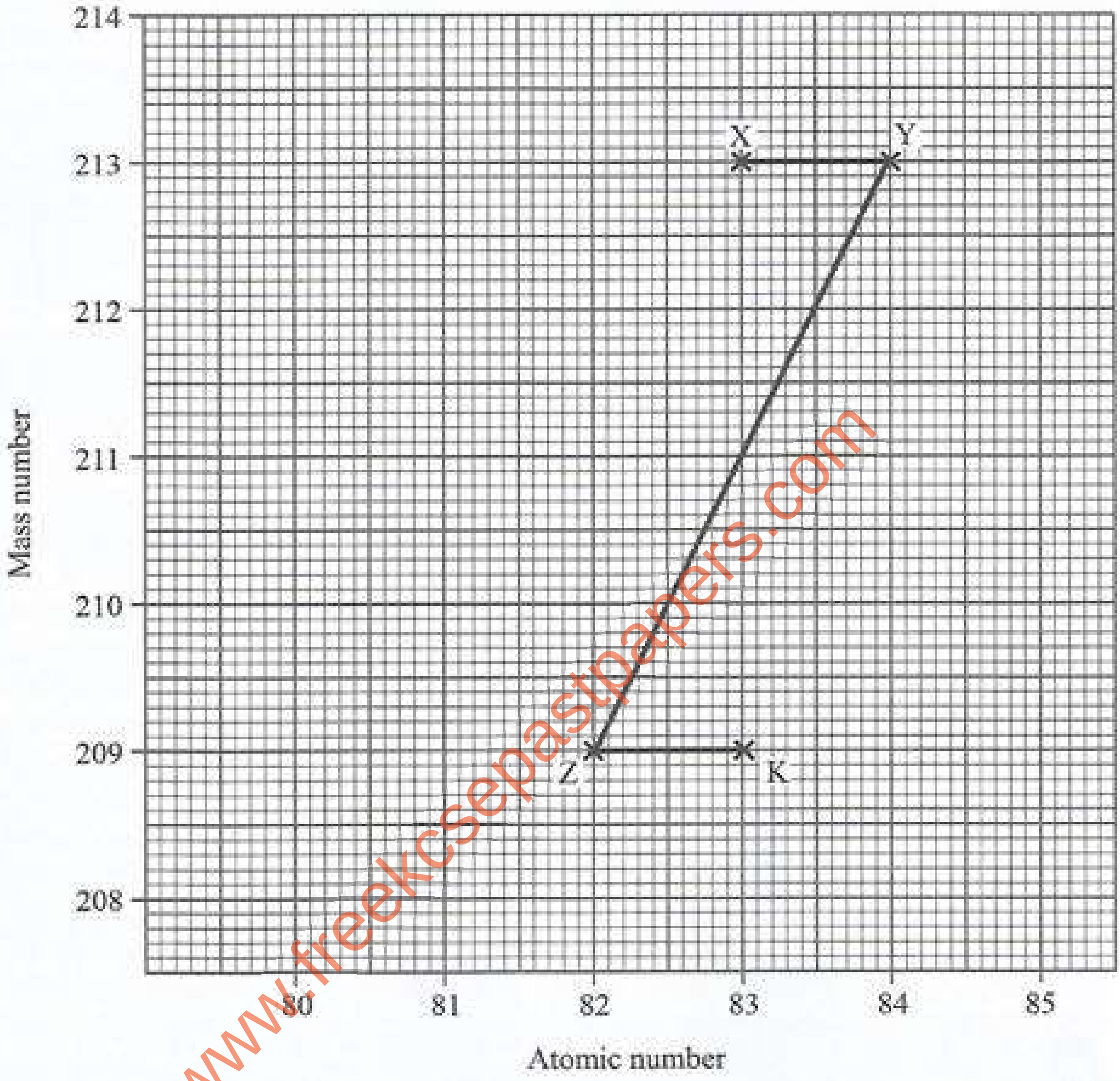


Figure 5

(a) Write a nuclear equation for the formation of nuclide **K** from nuclide **X**. (1 mark)

(b) The half-life of nuclide **X** is 47 minutes. Determine the percentage of nuclide **X** that remains after 188 minutes. (2 marks)

Requirements

This question required candidates to interpret a graph of decay series and write a nuclear equation on formation of nuclides and hence determine the percentage of a nuclide that remains after disintegration for some time given the half-life.

Weaknesses

Majority of the candidates were unable to interpret the graph accurately and determine the percentage that remains after decay given the half-life of the nuclide.

Expected Responses

a) $^{213}_{83}X \rightarrow ^{209}_{83}K + 2^{0}_{-1}e + ^{4}_{2}He$ (1 mark)

b) half –lives ($^1/_2$ mark)

100%X 50%X 25X%

6.25%X (1 mark)

6.25% remains after the 4 half-lives (½ mark)

OR

$$X \xrightarrow{1^{st}\text{Half-life}} \frac{1}{2}X \xrightarrow{2^{nd}\text{Half-life}} \frac{1}{4}X \xrightarrow{3^{rd}\text{Half-life}} \frac{1}{8}X \xrightarrow{4^{th}\text{Half-life}} \frac{1}{16}X$$

% of nuclide X remaining after 4^{th}half-life = $\frac{1}{16} \times 100\%$

= 6.25%

Advice to teachers

Teachers should expose students to more revision questions involving radioactivity and the related calculations and nuclear equations.

Question 26

Hydrazine, N_2H_4 is used as a fuel in rockets. Using the bond energies in **Table 2**, calculate the enthalpy change for combustion of hydrazine.

$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$

Table 2

Bond	Bond Energy Kj/mol
N — H	388
N — N	163
O = O	496
N ≡ N	944
O — H	463

(3 marks)

Requirements

The question required candidates to identify the bonds broken and those formed during combustion, then use knowledge of bond energies to determine the enthalpy change for combustion of hydrazine.

Weaknesses

Most of the candidates were unable to identify bonds broken and those formed from the equation, hence inability to calculate the enthalpy change of combustion of hydrazine.

Expected Responses

$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$

Bonds broken

4 x 388 = 1552
1 x 163 = 163
1 x 496 = +496
2211 kJ (1 mark)

Bonds formed

1 x 944 = 944
(2 x 463) x 2 = +1852
2796 kJ (1)

Enthalpy of combustion = -2796 kJ + 2211 kJ = -585 $kJmol^{-1}$ (1 mark)

Advice to teachers

Teachers should expose students to more questions involving bond energies.

Question 27

(a) **Table 3** gives the standard reduction potentials of some group VII elements.

Table 3

Reduction equations	E^θ /V
$Cl_2 + 2e \rightarrow 2Cl^-$	+1.36
$Br_2 + 2e \rightarrow 2Br^-$	+1.07
$I_2 + 2e \rightarrow 2I^-$	+0.54

State and explain the reactions that take place when aqueous bromine is added to a sample of sea water containing both chloride and iodide ions. (2 marks)

(b) Give a reason why potassium iodide is added to table salt. (1 mark)

Requirements

Candidates were required to use the standard electrode potentials of halogens to explain the reactions that take place when aqueous bromine is added to a sample of sea water containing both chloride and iodide ions and give a reason why potassium iodide is added to table salt.

Weaknesses

Many candidates used reactivity series of halogens and did not relate to E° values to the reactivity of halogens.

Expected responses

(a) $Br_2(aq) + 2I^-(aq) \rightarrow 2Br^-(aq) + I_2(aq)$

$Br_2(aq) + 2Cl^- \rightarrow$ No reaction

Bromine will oxidize iodide ions to iodine since it has a more positive E^θ (1 mark).

Bromine will not displace chlorine since E^θ for chlorine is more positive (1 mark).

(b) Potassium iodide is a source of iodine. Iodine is needed to regulate functioning of thyroid gland/ iodine is used to prevent goitre (1).

Advice to teachers

Teachers should emphasize on use of E^θ values to determine feasibility of reactions

3.5.4 Chemistry paper 2 (233/2)

Question 2

The flow chart in **Figure 2** shows the processes involved in the manufacture of sulphuric(VI) acid.

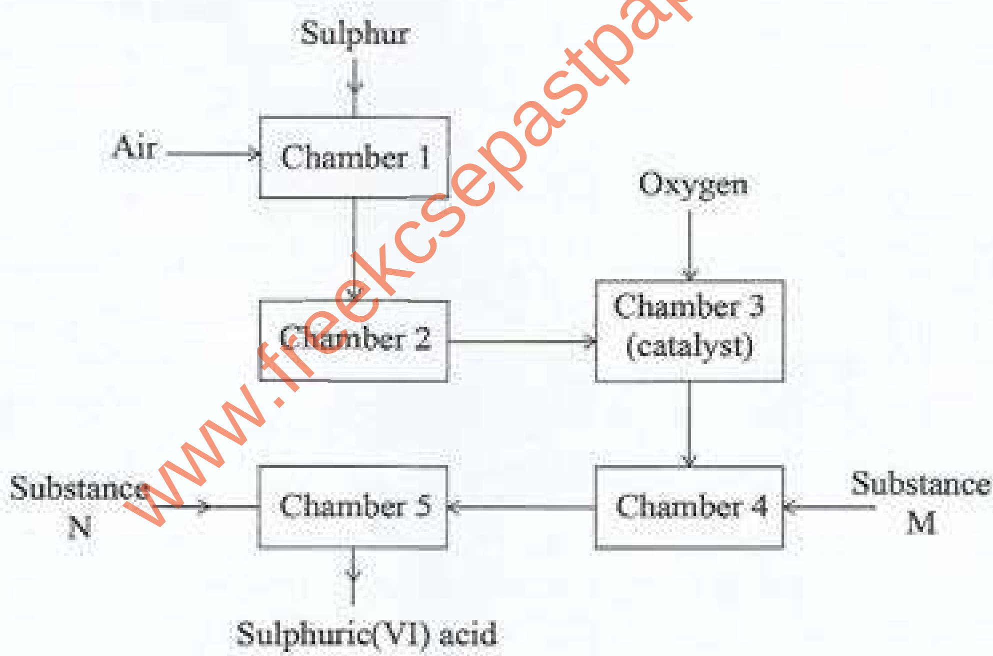


Figure 2

(a) Explain how the sulphur used in this process is obtained. (2 marks)

(b) Give **one** advantage of using air in chamber **1** instead of using oxygen gas. (1 mark)

(c) Identify substances:

(i) **M** (1 mark)

(ii) **N** (1 mark)

(d) (i) In chamber **2**, drying and purification take place. Give a reason why this is necessary. (1 mark)

(ii) The reaction in chamber 3 is highly exothermic.

I. Explain why high temperature is required for the reaction in chamber 3. (1 mark)

II. State how the heat produced in chamber 3 can be utilised in this process. (1 mark)

(e) Give a reason why this method of manufacture is known as "*Contact process*". (1 mark)

(f) Emission of gases in the sulphuric(VI) acid plant may lead to environmental pollution.

(i) State the evidence that could be used to show that the sulphuric(VI) acid plant causes pollution. (1 mark)

(ii) Explain how the pollution identified in 2(f)(i) can be controlled. (1 mark)

Requirements

This question required candidates to apply the knowledge of extraction of sulphur by the Frasch process and to demonstrate knowledge of the contact process by interpreting a flow chart on manufacture of sulphuric(VI) acid, stating and explaining the environmental effects of the Contact process.

Weaknesses

Majority of the candidates were not able to explain how Frasch process works. They were also unable to explain environmental effects of the Contact process.

Expected Responses

(a) Sulphur is obtained from underground sulphur deposits where it is mined using Frasch process where three concentric pipes are drilled into the sulphur deposits ($^1/_2$ mark). Superheated water is pumped through the outer pipe to melt the sulphur deposits ($^1/_2$ mark). Hot compressed air is used forced through the inner pipe which pushes the molten sulphur through the middle pipe (1) to the surface. (2 marks).

(b) Air is cheap source of oxygen gas (1 mark)

(c) (i) **M** - concentrated sulphuric(VI) acid (1mark)
(ii) **N** - water (1mark)

(d) (i) Impurities in the gas poisons the catalyst (1).

(ii) I. High temperatures increase the rate of the reaction as the particles gain kinetic energy resulting to frequent fruitful collisions (1).

II. Can be recycled to preheat SO_2 and O_2 gases (1).

(e) The formation of SO_3 in chamber 3 occurs when SO_2 and O_2 come into contact with each other on the surface of the catalyst (1).

(f) (i) - Metallic structures near the plant are rusted (corroded) (1 mark);
- Vegetation near the plant changes from green to yellow or dries up.

(ii) Passing the gaseous emissions through alkaline or basic substances such as calcium hydroxide/scrubbing the gas (1mark).

Advice to teachers

Teachers should guide students in discussions involving flow charts of various processes with emphasis on comprehending all the steps in the flow chart.

Question 7

(a) Using the oxidation numbers of chlorine, explain why the following is a redox reaction.

$HClO_3(aq) + 5HCl(aq) \rightarrow 3Cl_2(g) + 3H_2O(l)$ (2 marks)

(b) Use the following standard reduction potentials to answer the questions that follow:

	Half cell reactions	E^0/V
I	$PbSO_4(s) + 2e \rightarrow Pb(s) + SO_4^{2-}(aq)$	- 0.36
II	$PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e \rightarrow PbSO_4(s) + 2H_2O(l)$	+1.69
III	$Fe^{3+}(aq) + e \rightarrow Fe^{2+}(aq)$	+0.77
IV	$Zn^{2+}(aq) + 2e \rightarrow Zn(s)$	- 0.76
V	$MnO4^-(aq) + 8H^+(aq) + 5e \rightarrow Mn^{2+}(aq) + 4H_2O(l)$	+1.51
VI	$O_2(g) + 2H^+(aq) + 2e \rightarrow H_2O_2(aq)$	+0.68
VII	$Fe^{2+}(aq) + 2e \rightarrow Fe(s)$	- 0.44
VIII	$Cu^{2+}(aq) + 2e \rightarrow Cu(s)$	+0.34

(i) The half cells **I** and **II** are combined to form an electrochemical cell.

I. Write an equation for the cell reaction. (1 mark)

II. Calculate the e.m.f of the cell. (1 mark)

(ii) Draw a labelled diagram for the electrochemical cell formed using half cells **III** and **IV**. (3 marks)

(iii) State and explain the observations made when a few drops of acidified potassium manganate(VII) are added to hydrogen peroxide. (3 marks)

(iv) Coating iron with zinc is a more effective way of corrosion prevention than coating it with copper. Explain. (2 marks)

Requirements

Candidates were required to apply the knowledge of oxidation numbers and reduction potentials to write equation for a cell reaction, construct electrochemical cells and calculate e.m.f of a cell. They were also expected to explain some observations using the standard electrode potentials.

Weaknesses

Majority of the candidates were unable to write redox reactions correctly, calculate e.m.f and explain the concept of sacrificial protection.

Expected Responses

(a) $HCLO_3(aq) + 5HCL(aq) \rightarrow 3CL_2(g) + 3H_2O(l)$

Oxidation No. of chlorine	+5	-1	0	(1 mark)

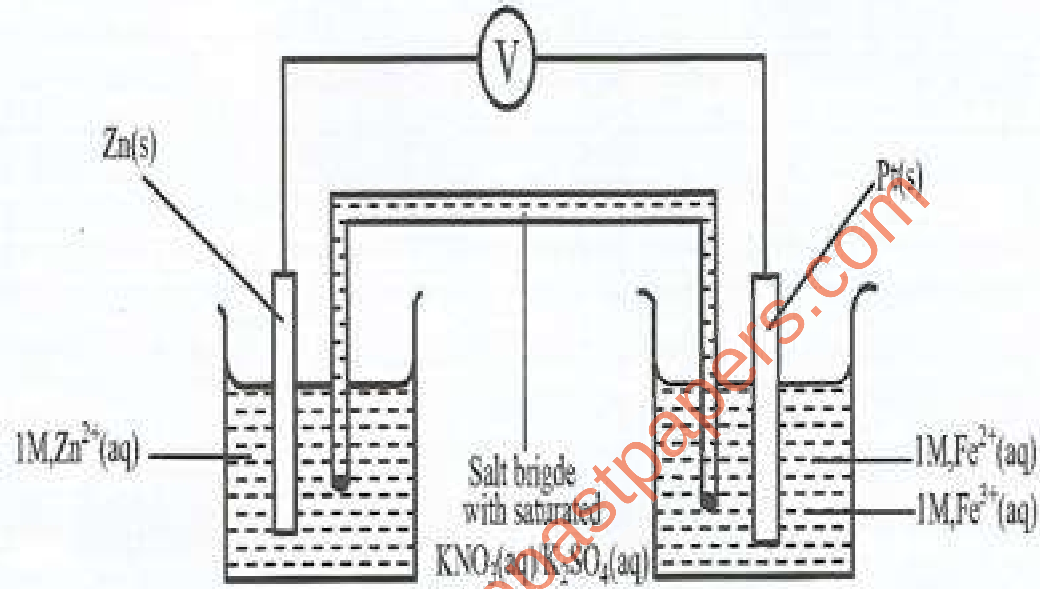
Chlorine in $HClO_3$ is reduced from +5 to 0 while chlorine in HCl is oxidised from -1 to 0 (1 mark) / oxidation number of chlorine in $HClO_3$ reduces from +5 too hence reduction while the oxidation number of chlorine in HCl increases from -1 to o hence oxidation.

(b) (i) I. $PbO_2(s) + 2SO_4^{2-}(aq) + 4H^+(aq) + Pb(s) \rightarrow 2PbSO_4(s) + 2H_2O(l)$ (1 mark)

II. E^θ of the cell = +1.69 - (-0.36) (1 mark)

= +2.05V

(ii)



Each label ½ mark to a maximum of 2½ marks, Workability – ½ mark

(iii) Purple/pink acidified potassium manganate(VII)/ $KMnO_4$ is decolourised (1). MnO_4^- is reduced to Mn^{2+} (1) while H_2O_2 is oxidised to O_2 hence effervescence/bubbles of a colourless gas (1).

(iv) Zinc is more reactive than iron so when coated iron is exposed, zinc reacts with oxygen (corrodes) leaving iron intact (1). On the other hand, Iron is more reactive than copper, hence it will react (corrode) leaving copper intact (1).

Advice to teachers

Teachers should expose students to many questions on calculations of oxidation numbers, construction of cells from given reduction potentials and calculating e.m.f of cells. Teachers to use ICT to teach electrochemical cells.

The practical paper was tested using three questions. Question 1 tested skills and competencies on titration reaction.

Question 1 tested Knowledge, skills and competencies on:

- Measuring and recording volumes of solutions;
- Manipulation of apparatus;
- Calculations involving moles and molarity of solutions.

Question 2 assessed knowledge, skills and competencies on the following:

- Measuring, reading and recording temparature using a thermometer;
- Measuring time using a stopwatch/wall clock;
- Manipulation of apparatus;
- Drawing a graph of temperature against time;
- Graph interpretation.

Question 3 assessed qualitative analysis of an inorganic compound. The question required candidates to perform experiments using appropriate apparatus and chemicals, make correct observations, record the observations and inferences correctly, and to follow instructions. Majority of the candidates were able to make correct observations with a good number of them not able to write the correct formulae of ions and use scientific language in reporting the results. In addition, the candidates experienced challenges in making inferences where they had difficulties in writing the correct inferences. Also many candidates had challenges in making thee correct colour of the precipitates.

Questions 2 and 3 were reported to have posed a challenge among most of the candidates.

Question 2

You are provided with **solid D**.

You are required to determine the freezing point of **solid D**.

PROCEDURE

(i) Fill a 250 ml beaker with about 200 cm3 of tap water and heat the water until it boils.

(ii) Place all **solid D** provided in a **dry** test tube and insert a thermometer into the solid.

(iii) Place the test tube in the boiling water and allow the solid to heat until it all melts.

(iv) When the temperature of the melted solid is approximately 90 °C, remove the test tube, wipe the sides with tissue paper and then place the test tube into an empty 250 ml beaker.

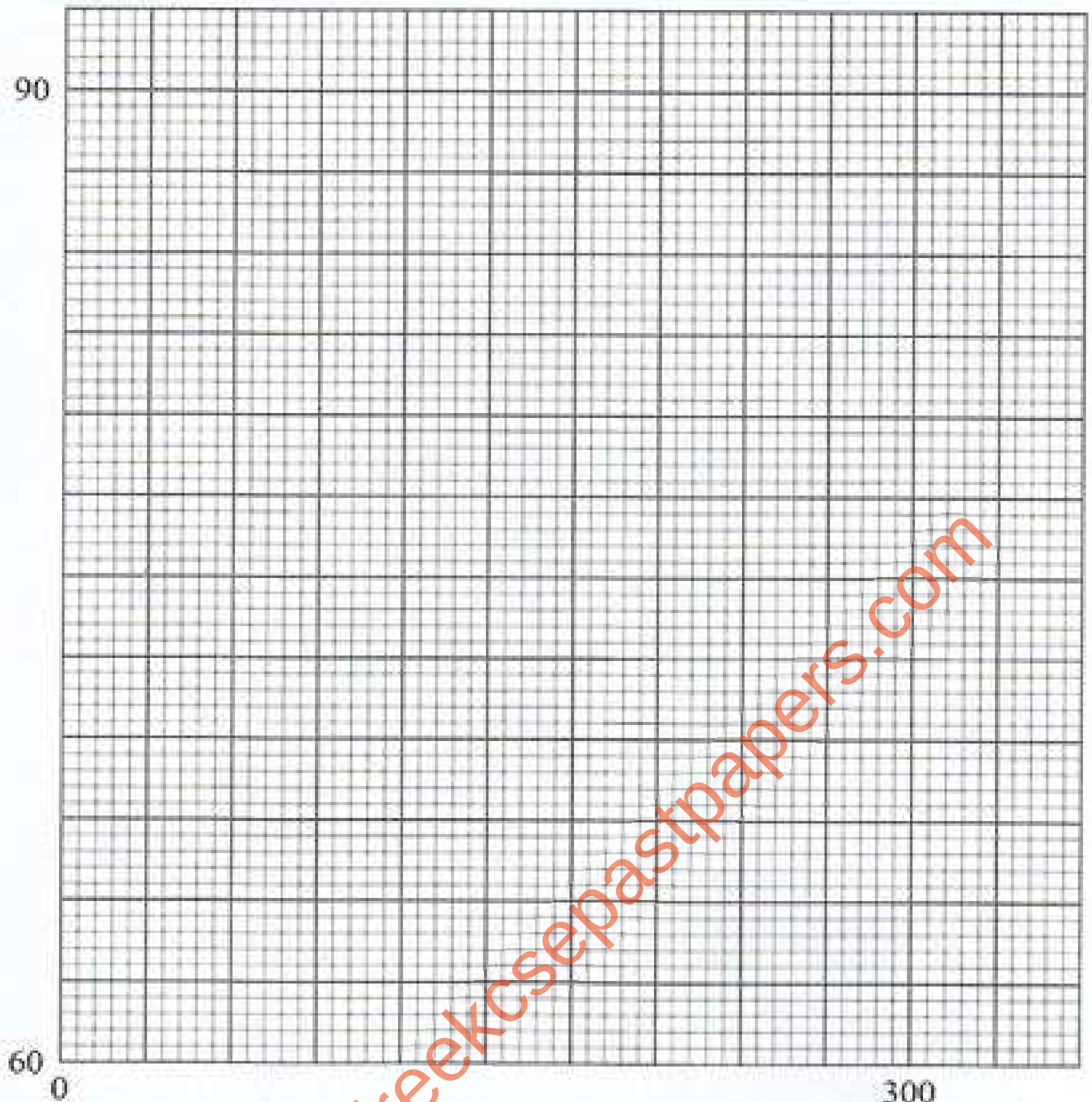
(v) Start the stop watch or clock when the temperature of the melted solid is 85.0 °C.

(vi) As the solid cools, measure and record its temperature every 30 seconds and complete **Table 3.**

(a) **Table 3**

Time, seconds	0	30	60	90	120	150	180	210	240	270	300
Temperature C°											

(b) On the grid provided, plot a graph of temperature (vertical axis) against time.



(3 marks)

(c) Using the graph in (b), determine the freezing point of **solid D**. (1 mark)

Requirements
Candidates were required to manipulate apparatus, measure and record volumes of solutions, read and record time using wall clocks /stop watches, measure and record temperature, manipulate data, plot a graph of temperature against time and interpret the graph.

Weaknesses
Most of the candidates could not choose appropriate scale for the grapy. Some of the candidates used a ruler to draw the graph while others could not record temperature appropriately.

Table 3

Time, sec	0	30	60	90	120	150	180	210	240	270	300
Temperature C°	85.0	79.0	75.0	73.0	71.0	70.0	69.0	69.0	69.0	68.5	68.0

A) Complete table...(1 mark)
B) Use of decimal places ....($^1/_2$ mark)
C) Trend...(1 mark)
D) Accuracy compared to the 1st S.V ....($^1/_2$ mark)

(b)

(3 marks)

A) Labelling (½)
B) Scale (½)
C) Plots (1)
D) Shape of curve (1)

(c) Freezing point of solid **D** = 69.0 C°✓ 1mark

Question 3

You are provided with **solid E**. Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Place **all** the **solid E** in a boiling tube. Add about 10 cm^3 of dilute nitric(V) acid, warm the mixture and then allow to stand until all the solid dissolves. Add about 10 cm_3 of distilled water to the solution and shake. Retain the solution for tests **(b)** and **(c)**.

Observations	Inferences
(2 marks)	(1 mark)

(b) Use about 2 cm^3 portions of the solution obtained in 3(a) for each of the following tests.
(i) To the **first portion** add 2 or 3 drops of aqueous barium nitrate.

Observations	Inferences
(1 mark)	(1 mark)

(ii) To the **second portion** add 2 or 3 drops of aqueous lead(II) nitrate.

Observations	Inferences
(1 mark)	(1 mark)

(iii) To the **third portion** add aqueous sodium hydroxide dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

(iv) Place about 3 cm^3 of aqueous ammonia in a test tube. To the **fourth portion**, add all the aqueous ammonia from the test tube dropwise.

Observations	Inferences
(1 mark)	(1 mark)

(c) To the remaining solution of **solid E** in the boiling tube, add all the **solid G** provided. Shake the mixture for about 2 minutes. Filter the mixture into a boiling tube. Retain the filtrate for tests (i) and (ii) below.

Observations	Inferences
(1 mark)	(1 mark)

(i) To about 2 cm^3 portion of the filtrate, add aqueous ammonia dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

(ii) To about 2 cm^3 portion of the filtrate add 2 or 3 drops of dilute hydrogen peroxide Solution.

Observations	Inferences
(1 mark)	(1 mark)

Requirements

This question rquired candidates to carry out the tests on an organic solid E and make observations and inferences.

Weaknesses

Majority of the candidates were unable to differentiate between precipitate, residue, solid ans suspension. Candidates were also unable to identify colours of solutions, and precipitates and inability to make the correct inferences.

Expected Responses

3 (a)

Observations	Inferences
- No effervescence/no bubbles/no fizzing✓ - Black solid dissolves to form a blue solution.✓ ½ **Note:** Penalise ½ mark for any contradictory colour of the solution	- SO_3^{2-} (sulphite) and CO_3^{2-} (carbonate) ions✓ ½ absent **(tied to no effervescence)** - Probably Cu^{2+} (copper II) ions present✓ ½ **(tied to blue solution)** **Note:** penalize ½ mark for each contradictory ion to a maximum of 1 mark
(2 marks)	**(1 mark)**

(b) (i)

Observations	Inferences
No white precipitate formed✓ 1/ no white suspension/ no white solid formed	- SO_4^{2-} (sulphate) ions absent ✓ 1 **Note:** Penalise fully for any contradictory ion
(1 mark)	**(1 mark)**

(ii)

Observations	Inferences
No white precipitate formed✓ 1/ no white suspension/ no white solid formed	- SO_4^{2-} (sulphate) ions absent ✓ 1 **Note:** Penalise fully for any contradictory ion
(1 mark)	**(1 mark)**

(iii)

Observations	Inferences
- Blue precipitate ✓ ½ insoluble in excess✓ ½	- Cu^{2+} (Copper (II)) ions present✓ 1 **Note:** Penalise fully for any contradictory ion
(1 mark)	**(1 mark)**

(iv)

Observations	Inference
- Blue precipitate ✓ ½ which dissolves in excess to form a deep blue solution. ✓ ½	- Cu^{2+} (Copper (II)) ions confirmed ✓ (tied to the correct observation)
(1 mark)	(1 mark)

(c)

Observations	Inference
- Brown residue ✓ ½ - Green filtrate ✓ ½ / blue solution changes to green/the boiling tube becomes warm	- Cu^{2+} (Copper(II))ions are displaced by G✓ ½/ Cu^{2+} ions are reduced to Cu - G is probably Iron powder. ✓ ½/ G is more reactive or above Cu in the reactivity series/ G is oxidised by Cu / Cu^{2+} ions are displaced by iron (tied to brown residue and green filtrate)
(1 mark)	(1 mark)

(i)

Observations	Inference
- Green precipitate ✓ ½ insoluble in excess. ✓ ½ - Turns brown on standing **Note:** Penalise fully for any contradictory colours	- Fe^{2+} (Iron(II)) ions present. ✓ 1 **Note:** Penalise fully for any contradictory ions
(1 mark)	(1 mark)

(ii)

Observations	Inference
- The green solution turns/ changes to brown/ yellow ✓ ½ - Effervescence/bubbles/fizzing/colourless gas evolved. ✓	- Fe^{2+} (Iron(II)) ions are oxidized to Fe^{3+} (Iron(III)) ions . ✓ 1/ Fe^{3+} ions formed
(1 mark)	(1 mark)

Advice to teachers

Teachers should make use of the practical approach to teaching and learning of Chemistry. Emphasis should be made on calculations relating to making observations and inferences, data manipulation, skills of drawing graphs, graph interpretation and the use of correct scientific terms in reporting observations and inferences. Teachers are advised to expose learners to as many practicals as possible to give them an opportunity to interact with apparatus and chemicals with emphasis on following the procedure to avert accidents in the laboratory.

CONCLUSION

There was a decline in performance in the Chemistry Paper 1 and Paper 3 as opposed an improvement in the Paper 2. It is worth noting that part of the practical examination involves the ability of the students to follow instructions in carrying out all the experiments. Teachers should therefore train students to perform experiments with strict adherence to the instructions provided. This will enable them get the expected results without challenges.