THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

ANDIDATES' ITEMS RESPONSE ANALYSIS REPORT FOR THE CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (CSEE) 2017

032 CHEMISTRY

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FOREWORD

The Report on the Candidates' Items Response Analysis in Chemistry subject in the Certificate of Secondary Education Examination (CSEE), 2017 has been prepared in order to provide a feedback to students, teachers, parents, policy makers and public in general about the performance of the candidates and challenges they face in attempting the examination.

The Certificate of Secondary Education Examination is a summative evaluation which, among other things, shows the effectiveness of the education system in general and the education delivery system in particular. Essentially, the candidates' responses to the examination questions indicate what the education system has been able or unable to offer to the candidates in their four years of Ordinary Secondary Education.

The analysis presented in this report is intended to contribute towards understanding of possible reasons behind the candidates' responses in Chemistry Subject. The report highlights the factors that made the candidates perform well in the examination. Such factors include ability to write chemical equations, clarity in explanation of concepts and masters of the basic mathematical skills in calculating the physical quantities in Chemistry subject. On the other hand, the report highlights the factors that made some of the candidates fail to score high marks in the questions. Such factors include inadequate knowledge across various topics, inadequate computation skills, poor proficiency of English Language and incompetence in writing chemical equations. The feedback provided will enable the educational administrators, school managers, teachers, students and other educational stakeholders to take appropriate measures in order to improve the candidates' performance in future examinations administered by the Council.

The National Examinations Council of Tanzania will highly appreciate comments and suggestions from teachers, students, school quality assurers, curriculum developers and the public in general, that can be used in improving future CSEE reports as well as candidates performance. Finally, the Council would like to thank the Chemistry Subject Coordinators, Examiners and others who participated in processing and analysing the data used in this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report gives an analysis of the performance of candidates who sat for the Certificate of Secondary Education Examination (CSEE), 2017 in Chemistry subject. The examination paper was set according to the 2008 examination format developed from the 2010 Chemistry syllabus for Secondary School Education.

The paper consisted of sections A, B and C. Section A consisted of two (2) objective questions, Section B had nine (9) short answer questions while Section C comprised of two (2) essay type questions. The candidates were required to answer all questions.

The number of candidates who sat for Chemistry examination in 2017 was 160,126 of which 53.39 percent passed with different grades as shown in Table 1. (see also appendix 2).

Table 1: Candidates' grades in CSEE 2017 Chemistry Examination.

Grade	**A**	**B**	**C**	**D**	**F**
% of Candidates	0.61	2.87	19.00	30.91	46.61

The 2017 Chemistry performance has decreased by 5.83 percent when compared to the 2016, where 59.22 percent of 163,864 candidates passed with different grades, as shown in Table 2 below.

Table 2: Candidates' grades in CSEE 2016 Chemistry Examination.

Grade	**A**	**B**	**C**	**D**	**F**
% of Candidates	0.89	3.12	21.53	33.68	40.78

This report is presented in four sections. The first section being an introduction, the second one is the analysis of the candidates' performance in each question and the third section is the analysis of performance in each topic. The fourth section is the conclusion and recommendations given for action and follow up.

The following section presents the analysis of candidates' performance in each question.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH QUESTION

2.1 SECTION A

This section consisted of two (2) questions. Each question carried a total of ten (10) marks. The pass score for each question was 3.0 marks.

2.1.1 Question 1: Multiple Choice Items

The items in this question were composed from the following topics: *Heat Sources and Flames; Air, Combustion, Rusting and Fire Fighting; Periodic classification; Compounds of metals; Matter; Organic chemistry* and *Atomic structure*. The candidates were required to choose the correct answer from the given five alternatives (A to E) and write its letter beside the item number in the provided answer booklet.

Many candidates (99.92%) attempted this question. The analysis of the candidates' performance indicates that 67.25 percent scored from 3 to 6 marks, 9.72 percent scored from 7 to 10 with 0.12 percent scoring all 10 marks. The candidates who scored from 0 to 2 marks were 23.03 percent of which 1.91 percent scoring a zero mark. Figure 1 shows the distribution of the candidates' scores.

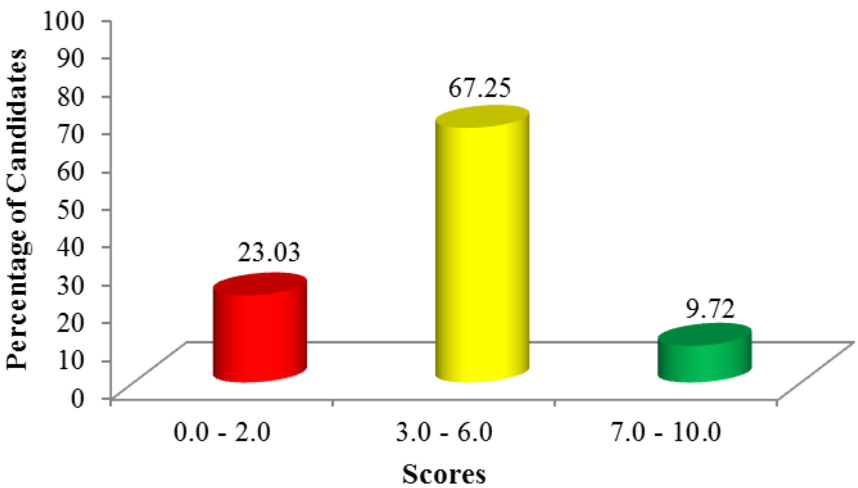


Figure 1: *Performance of the candidates in question 1.*

Figure 1 shows that 76.97 percent of the candidates scored 3 to 10 marks, which indicates good performance in this question. However, 23.03 percent scored low (1 to 2) marks as they faced difficulties in answering items (iii), (v) and (viii), hence chosing incorrect answers.

The analysis of the three items in which the candidates faced difficulties is as follows:

Item (iii) was from the topic of periodic classification and the candidates were required to identify the electronic configurations of an element Y found in period 3 and group II of the Periodic table. In order to identify the correct option, the candidates were supposed to realize that the number of period is equivalent to the number of shells. The group is equivalent to the total number of electrons in outer most shell of an atom. However, most of the candidates chose incorrect option ‘A’ (2:8). This is an indication of inadequate knowledge on the concept of periodicity. The correct response was ‘B’ (2:8:2) that means, the element possess three shells and has two electrons in the outermost shell.

Item (v) was from the topic of matter where the candidates were required to select the correct method that could be used to separate the products in the following equation:

$$Pb(NO_3)_2(aq) + 2KI(aq) \longrightarrow PbI(s) + 2KNO_3(aq)$$

colourless colourless yellow colourless.

In order to select the correct option, the candidates were supposed to have the knowledge on the concept of the methods of separating mixtures. This concept could have led them to choose the correct response ‘D’ (Filtration). Most of the candidates chose ‘A’ (Chromatography) which suggests that they realized that chromatography is used to separate colored mixtures. Unfortunately they did not realize that, the reaction produce insoluble solids which are separated by filtration.

Item (viii) was from the topic of Air, Combustion, Rusting and Fire Fighting. The candidates were required to choose a gas which is not among the composition of air. The correct answer was ‘D’ (Hydrogen) but most of the candidates gave assorted incorrect answers. Those candidates failed to realize that, hydrogen is the lightest gas, hence cannot exist mixed in the normal atmospheric air.

2.1.2 Question 2: Matching Items

The question was composed from two related topics: *Atomic Structure and Periodic Classification.* The question consisted of List A and List B. List A comprised ten (10) items which were to be matched with the corresponding ten correct responses from List B.

The question was attempted by 99.91 percent of the candidates and the performance is as shown in Figure 2.

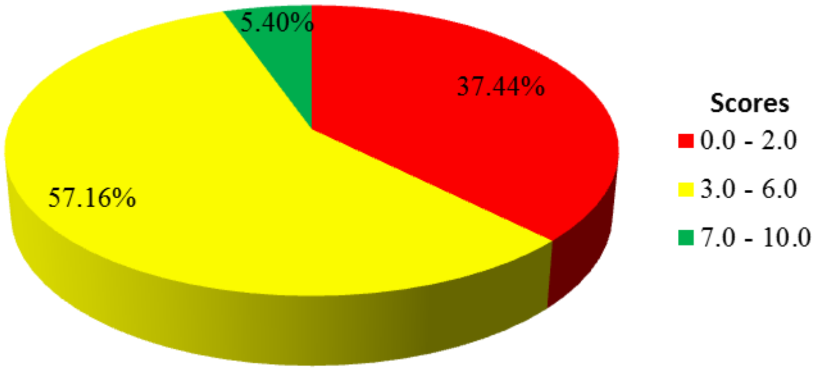


Figure 2: *Performance of the candidates in question 2.*

As it is seen from Figure 2, the percentage of the candidates who scored from 3 to 6 was 57.16 percent, those who scored from 7 to 10 marks was 5.40 percent, an indication of average performance. Figure 2 also shows that 37.44 percent scored low marks (0 to 2). These candidates faced difficulties in answering most of the items especially items (ii), (iii) and (v). The analysis of the items in which the candidates faced difficulties is as follows:

Item (ii) required the candidates to choose the response from List B, which matched correctly with "an element in which its oxide can be prepared by the action of nitric acid and heat". The correct response was 'F' (zinc) but most of the candidates chose various responses an indication of lack of knowledge about the concepts of basic oxides.

Item (iii) required the candidates to identify a response which corresponded with the phrase 'an element which acts as an oxidant or reductant'. The correct response was 'L' (sulphur) but most of the candidates matched it with 'O' (chlorine). Those candidates failed to realize that sulphur can lose electrons or gain electrons during chemical reactions. In doing so it acts as an oxidant or reductant. The failure to choose the correct response suggests that the candidates did not have adequate knowledge about the concepts of oxidation and reduction.

Item (v) required the candidates to identify a response which matched with the phrase 'a gas which is prepared in the laboratory by isolation from air'. In answering this item, only few candidates chose the correct answer 'H' (Nitrogen) whilst a large number thought that oxygen is prepared by the isolation from air and so chose option M. The candidates selected the incorrect option due to the fact that oxygen is used in daily life including breathing. The candidates did not realize that, nitrogen occupies 78 percent by volume in the atmosphere hence it can be prepared in the laboratory by isolation from air.

2.2 SECTION B: Short Answer Questions

This section consisted of nine (9) short answer questions. Each question carried a total of six (6) marks. The pass score for each question was 2.0 marks. The candidates were required to answer all nine questions.

2.2.1 Question 3: Soil Chemistry and Hardness of water

The question consisted of parts (a) and (b). In part (a), the candidates were required to define the terms: (i) soil, (ii) leaching and (iii) denitrification. In part (b), the candidates were required to explain briefly with the aid of a chemical equation how: (i) temporary hardness of water can be removed by boiling and (ii) permanent hardness of water can be removed by chemical means.

The question was attempted by 98.07 percent of the candidates, of which majority (74.38%) scored from 0 to 1.5 marks with 20.88 percent scoring a zero mark. The candidates who scored from 2 to 3.5 marks were 22.85 percent and those who scored from 4 to 6 marks were 2.77 percent. This trend of statistics indicates that the performance in this question was poor.

The candidates who scored low marks in this question failed to give the correct definitions of soil, leaching and denitrification. In defining the denitrification, some of the candidates incorrectly gave responses related to the destruction of the soil. Others defined it in a reverse way by indicating that it is the process of fixing nitrogen in the soil. For example, one candidate wrote '*denitrification is the conversion of atmospheric nitrogen into useful nitrogen for plants done by bacteria.'* Another candidate wrote *'Is process in which the excess nitrogen in the soil is released back to the atmosphere'.* This implies that, the candidate had a misconception that nitrogen released in that process must escape into the atmosphere. He/she did not understand that even in the soil there are air spaces in which nitrogen gas can be found. In defining leaching, some of the candidates regarded it as the type of soil, hence gave definitions on the basis of the type of soil. Others defined leaching as the process of soil formation. In other cases, some gave answers which were far too vague or not related to what was expected from the stem of the question. The candidate lacked ability to distinguish denitrification from nitrification.

In answering part (b), some of the candidates wrote incorrect chemical formula of sodium carbonate and calcium sulphate. They failed to interchange the correct valency or charge(s) of the elements or radicals. For example, one candidate wrote $NaCO_3$ and Ca_2SO_4 for sodium carbonate and calcium sulphate respectively. Other candidates used the term soluble and insoluble carbonates interchangeably in explaining hardness of water which led to incorrect explanations. This implies that the candidates had inadequate knowledge about the concept of chemical formula and hardness of water. Extract 3.1 illustrate the case.

Extract 3.1

3\. i/. Soil - Is the procese of organic and anorganic matricel of the earth crust.

ii/. Leaching Is the reaction substance of matter

iii/. Denitrification Is the process of chemical reaction which contraction was pass through in the chemical reaction.

b/. i/ temporary hardness of water can be removed by boiling that is because temporary hardness water was the solibity in oil

ii/. Permanent hardness of water can be removed by chemical means. ~~Chemi~~ that is because hardness of water was remove by chemical reaction because of water was get ~~Conress~~ colouress in ~~wat~~ ~~par~~. chemical reaction.

3. b) i/ Ca2 + H2O → Ca2H + O2.

ii/ Fe2 + Ca2 → Fe2 + Ca2

iii/ ~~H2SO4 + →~~ Ca2 + H2SO4 → ~~Cu2SO2 + H2O~~ Ca2 SO2 + H2O

Extract 3.1 shows a response of the candidate who gave incorrect definitions of soil, leaching and denitrification. His/her explanations about removal of hardness of water with the corresponding chemical equations were also incorrect.

Further analysis showed that the candidates who scored high (4 to 6) marks gave correct definitions of soil, leaching and denitrification. They explained correctly with the aid of chemical equations the concept of removing hardness of water by boiling and by chemicals means. Extract 3.2 is an example of good responses.

Extract 3.2

3(a) iii) Denitrification is the process throught which nitrates and nitrogen compounds in the soil are converted into ~~fre-~~ free nitrogen by denitrifying bacteria and released to the atmosphere.

(b) i) Temporary hard water is usually caused due to the presence of calcium hydrogen carbonate. When the water is heated the calcium hydrogen carbonate is decomposed into calcium carbonate which is insoluble. Calcium carbonate being insoluble is removed from the water leaving the water soft.

The equation:

2 CaHCO3 (aq) —Δ→ CaCO3 (s) + H2O (l) + CO2 (g)

ii) Permanent hardness of water is caused due to the presence of sulphates of calcium or magnesium. By taking an example of calcium sulphate (CaSO4) the permanent hardness of water can be removed by adding chemicals such as sodium carbonate. Sodium carbonates react with the soluble sulphates to form insoluble salts which can be removed leaving the water soft.

The equation;

$CaSO_{4(aq)} + Na_2CO_{3(aq)} \rightarrow CaCO_{3(s)} + Na_2SO_{4(aq)}$

The calcium carbonate so formed is then removed since it is insoluble. Also incase of magnesium ions-

$MgSO_{4(aq)} + NaCO_{3(aq)} \rightarrow MgCO_{3(s)} + NaSO_{4(aq)}$

The magnesium carbonate is then removed leaving the water soft.

In Extract 3.2, the candidate gave correct definitions of soil, leaching and denitrification and also explained appropriately how temporary and permanent hardness of water can be removed with the aid of chemical equations

2.2.2 Question 4: Extraction of Metals; Non-Metals and their Compounds

The question consisted of parts (a) and (b). In part (a), the candidates were required to state four steps employed in the extraction of moderate reactive metals. In part (b), the candidates were required to write balanced chemical equations to show how chlorine reacts with the following;

(i) water,

(ii) aqueous iron (II) chloride solution, and

(iii) hydrogen sulphide.

The statistics show that, the question was attempted by 92.56 percent of the candidates where by the percentage of the candidates who scored from 0 to 1.5 marks was 70.05 with 56.20 percent scoring a zero mark. The candidates who scored from 2 to 3.5 marks were 16.35 percent and those who scored from 4 to 6 marks were 13.6 percent with 0.80 percent scoring all 6 marks. Figure 3 summarizes the performance in this question.

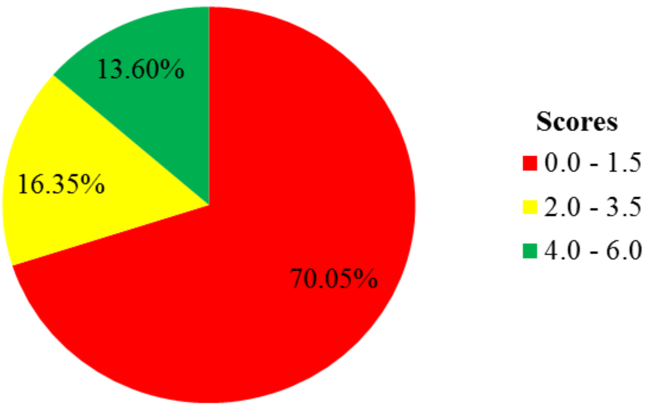


Figure 3: *Performance of the Candidates in Question 4.*

Figure 3 indicates that 70.05 percent of the candidates scored marks below 2.0, an indication of poor performance in this question. Analysis of the candidates' responses indicates that most of the candidates who scored low marks failed to state the steps employed in the extraction of moderate reactive metals in part (a). Most of the candidates gave the general main processes involved in extraction of metals instead of the steps employed in extraction of the moderate reactive metals.

Similarly in part (b), the candidates failed to write balanced chemical equations showing the reaction of chlorine with; water, aqueous iron (II) chloride solution and hydrogen sulphide. The candidates had no idea that chlorine gas dissolves in and reacts with water to form a pale yellow solution known as chlorine water. A significant proportion of the candidates did not realize that, chlorine is a strong oxidizing agent which oxidises iron (II) chloride to iron (III) chloride. Furthermore, it oxidises hydrogen sulphide gas to sulphur and itself become reduced to hydrogen chloride gas. Extract 4.1 is a response of the candidate whose performance was poor.

Extract 4.1

4. (a) four step employed to the extration of moderate reactive of metals.

i) Sulphur oxide
ii) chlorine oxide
iii) magnesium oxide
iv) Flourine oxide.

(b) to write balanced chemical equation to show chlorine

i) Water

$H_2O_{(l)} + Cl_{2(g)} \rightarrow 2HCl_{(l)} + HO_{2(g)}$

ii) aqueous iron (II) chloride solution

$Fe^{2+} + Cl \rightarrow 2FeCl_{(aq)}$

$Fe^{2+} + Cl \rightarrow 2FeCl_{(aq)}$

iii) hydrogen sulphide

$HSO_{4(l)} + Cl_{2(g)} \rightarrow H_2O_{(l)} + SO_4Cl_{(Aq)}$

In Extract 4.1, the candidate listed oxides instead of the steps employed in the extraction process and wrote incorrect chemical equations involving chlorine.

On the other hand, the candidates who scored high marks managed to state the steps employed in extracting the moderate reactive metals. They wrote balanced chemical equations showing how chlorine reacts with water, aqueous iron (II) chloride solution and hydrogen sulphide. Extract 4.2 shows the responses of a candidate who performed well in this question.

Extract 4.2

4\. a, The steps which used to extract moderate reactive metals.

i. Concentration of the ore.
- Here we remove earth impurities.

ii. Roasting of the ore
- Here the ore is heated in presence of oxygen inorder to get metal oxide and remove sulphides

iii. Reduction of the ore.
- The obtained ore is reduced by using carbon monoxide and other agents in order to get free element.

$Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(aq)} + 3CO_{2(g)}$

iv. Purification of the metal.
- The obtained metal is purified to remove remained contaminants inorder to make it pure.

b, chlorine reacts with water to form Chloric (1) acid and Hydrogen chloride gas.

$Cl_{2(g)} + H_2O_{(l)} \rightarrow HOCl_{(aq)} + HCl_{(g)}$

4	b, ii. The gas reacts with aqueous iron (II) chloride
	by oxidizing it to iron (III) chloride and colour
	turns from light green to reddish brown.
	$Cl_{2(g)} + 2FeCl_{2(aq)} \rightarrow 2FeCl_{3(aq)}$
	(Light green) (reddish-brown)
	iii. The gas reacts with hydrogen sulphide by
	~~reducing~~ oxidizing ~~to~~ soth sulphur to element and it self
	reduced to Hydrogen chloride gas. Yellow precipi
	tate is observed of sulphur metal.
	$Cl_{2(g)} + H_2S_{(g)} \rightarrow 2HCl_{(g)} + S_{(s)}$
	(Yellow ppt)

In Extract 4.2, the candidate correctly listed the steps employed in the extraction of moderate reactive metals and gave appropriate chemical equations involving chlorine.

2.2.3 Question 5: The Mole Concept and Related Calculation; Formula, Bonding and Nomenclature

The question was as follows:

(a) *Copper can be obtained from the ore, copper pyrites $4CuFeS_2$. The ore is heated in a limited amount of air giving the following reaction:*

(b) $4CuFeS_2 + 11O_2 \longrightarrow 4Cu + 2Fe_2O_3 + 8SO_2$.

(i) *Calculate the maximum mass of copper that can be obtained from 367 kg of copper pyrites.*

(ii) *State why the gaseous product from this reaction must not be allowed to escape into the atmosphere.*

(c) *Find the oxidation state of sulphur in the sulphate ion,* SO_4^{2-}

The question was attempted by 84.36 percent of the candidates and the performance is as shown in Figure 4.

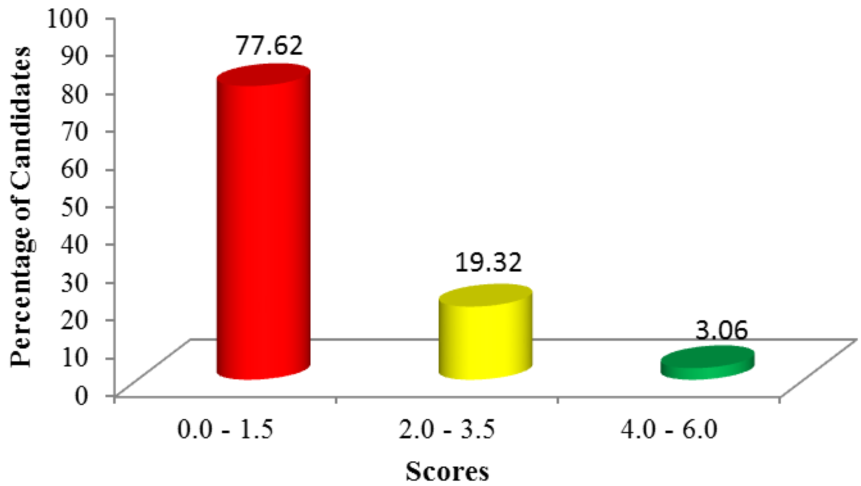
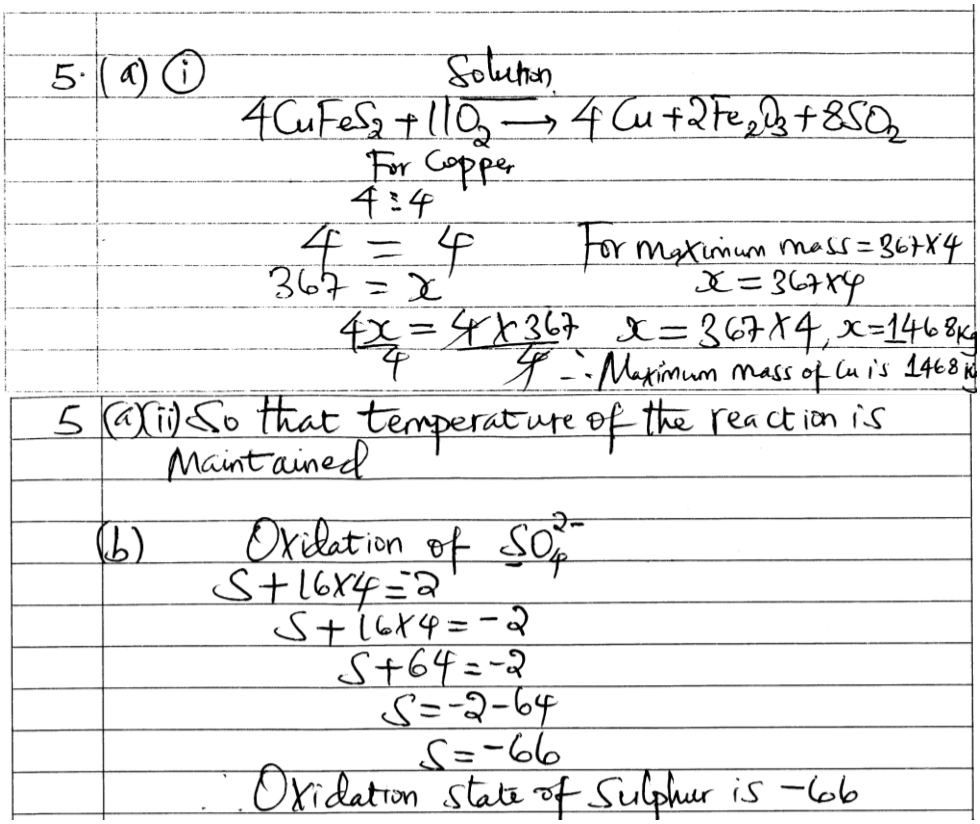


Figure 4: *Performance of the candidates in question 5.*

Figure 4 shows that, the majority of the candidates, 77.62 percent scored from 0 to 1.5 marks. The candidates who scored from 2 to 3.5 marks were 19.32 percent and those who scored from 4 to 6 marks were 3.06 percent. According to the statistics, only 0.03 percent scored all the 10 marks allocated to the question. Such a trend shows that the general performance was poor.

Analysis indicates that, most of the candidates who scored low (0 to 1.5) marks failed to use the stoichiometric coefficients in calculating the mass of copper. Other candidates could not relate the mole ratios properly. For instance, they related copper and iron (III) oxide as $2Fe_2O_3$ = 4CU instead of relating the ore and copper as $4CuFe_3S_2$ = 4CU. Others used incorrect mathematical manipulation in calculating the oxidation state of sulphur. For example, one candidate calculated as: S + (-2x4) = 0 and ended up with an incorrect oxidation state of sulphur as +8 instead of +6. Apart from that, some of the candidates failed to identify the gas among the products obtained after thermal decomposition of copper pyrites. Subsequently, failure to identify the gas led them to give improper explanation about it. Extract 5.1 illustrate the case.

Extract 5.1



5· (a) (i) Solution

$4CuFeS_2 + 11O_2 \longrightarrow 4Cu + 2Fe_2O_3 + 8SO_2$

For Copper

4 : 4

$\frac{4}{367} = \frac{4}{x}$ For maximum mass = 367×4

$x = 367 \times 4$

$\frac{4x}{4} = \frac{4 \times 367}{4}$ $x = 367 \times 4$, $x = 1468$ kg

∴ Maximum mass of Cu is 1468 kg

5 (a)(ii) So that temperature of the reaction is Maintained

(b) Oxidation of SO_4^{2-}

$S + 16 \times 4 = 2$

$S + 16 \times 4 = -2$

$S + 64 = -2$

$S = -2 - 64$

$S = -66$

∴ Oxidation state of Sulphur is −66

In Extract 5.1, the candidate used incorrect approach to calculate the mass of copper and gave irrelevant reason about the gas. She/he also used atomic mass instead of valency to calculate the oxidation state of sulphur.

However, a few candidates (3.06%) who scored high (4 to 6) marks managed to calculate the mass of copper (127.65 kg) that was obtained from 367 kg of copper pyrites. They also identified that; SO_2 must not be allowed to escape into the atmosphere because it is a greenhouse gas. Furthermore, they managed to calculate the oxidation state of sulphur in the sulphate ion, SO_4^{2-}. Extract 5.2 shows one of the good responses.

Extract 5.2

5 a) Soln

i) $4CuFeS_2 + 11O_2 \rightarrow 4Cu + 2Fe_2O_3 + 8SO_2$

Mass of $CuFeS_2$ = 367kg

↳ (64 + 56 + 64) = 184 g/mol

Cu = 64 g/mol

∴ 4(184 g/mol) of $CuFeS_2$ ⟶ 4(64) g/mol of Cu.

∴ 367,000g of $CuFeS_2$ ⟶ x ?

$\Rightarrow \frac{367,000 \times 4(64)}{4(184)}$

= 127,652.2g = 127.65kg

∴ Maximum mass of copper = 127.65 kg.

ii) This is because the gas is harmful to the environment; that is it is a green house gas which leads to green house effect hence global warming due to trapping of solar radiations preventing them from escaping to outer space thus warming the earth's surface (the lower atmosphere).

b) Soln

SO_4^{2-}

$\Rightarrow (S \times 1) + (-2 \times 4) = -2$

$\Rightarrow S - 8 = -2$

$S = -2 + 8$

$S = +6.$

∴ Oxidation state of sulphur is +6.

In Extract 5.2, the candidate correctly calculated the mass of copper, indicated the harmful effect of the gaseous product and used valencies to compute the oxidation state of sulphur exactly.

2.2.4 Question 6: Compounds of Metals; Non-Metals and their Compounds; Formula, Bonding and Nomenclature

This question consisted of parts (a) and (b). In part (a), the candidates were required to list two classes of oxides and give one example in each case. Part (b) required the candidates to write the chemical formula of tetrachloromethane and state the type of bond that exists.

The question was attempted by 83.75 percent of the candidates and the general performance was average as 35.84 percent scored from 2.0 marks or above. The candidates who scored from 2 to 3.5 marks were 22.55 percent while 13.29 percent scored from 4 to 6 marks with 2.74 percent scoring all the 6 marks. On the other hand the candidates who scored 0 to 1.5 marks were 64.16 percent with 46.63 percent scoring a zero mark.

The candidates who scored high (4 to 6) marks, were able to list with examples the classes of oxides which include basic, acidic and amphoteric oxides. They also wrote the chemical formula of tetrachloromethane and stated the type bond in the molecule. Extract 6.1 illustrate the case.

Extract 6.1

6(a)	Classes of oxides include:
	- Basic oxides
	Example; Calcium oxide (CaO)
	- Acidic oxides.
	Example; Carbondioxide (CO_2).
(b)	Tetrachloromethane = CCl_4.
	The type of bond in CCl_4 is
	- Covalent bond.

In Extract 6.1, the candidate correctly cited basic and acidic oxides with examples. Also the chemical formula for tetrachloromethane and covalent bond that exists were correctly shown.

On the contrary, the candidates who scored low marks failed to list the classes of oxides. In listing the classes of oxides, most of the candidates resorted to writing anything regardless whether it is meaningful or not, while others left the question unanswered. In other cases, some of the candidates failed to write the chemical formula of tetrachloromethane and the type of bond that existed. This is an indication of lack of knowledge about the concept of formula and bonding. Extract 6.2 provides a sample of a candidate's poor response.

Extract 6.2

6\. (a) Two classes of oxides
(i) metal oxides: example magnesium
(ii) Non metal oxides example chroline

(b) 3- chloro- methane is electrovalent bond.

In Extract 6.2, the candidate listed incorrect types of oxides as metal and non-metal. He/she wrote incorrect name instead of the chemical formula and the bond stated was also incorrect written.

2.2.5 Question 7: Water; Ionic Theory and Electrolysis

Part (a) of the question required the candidates to state the three main physical properties of water and show the usefulness of each property. In part (b), the candidates were required to state three industrial applications of electrolysis.

The majority of the candidates (95.25%) attempted the question and the general performance was average. Statistics show that 25.38 percent of the candidates scored from 2 to 3.5 marks, 5.32 percent scored from 4 to 6 marks while 69.30 percent scored from 0 to 1.5 marks.

The candidates who scored high marks (4 to 6) managed to state the three main physical properties of water and were able to show the usefulness of each property correctly. They were also able to state three industrial applications of electrolysis appropriately. This shows that the candidates had adequate knowledge about the applications of water and electrolysis. Extract 7.1 shows an example of good responses from one of the candidates.

Extract 7.1

7\. (a) i/ Water dissolves most of solutes/substance than any other solvents (Universal solvent). This property help in the Separation of different Mixtures.

ii/ Water has a very high heat capacity and specific heat capacity: This property Makes water a good coolant liquid in car engines and other Machines

iii/ Water freezes at 0°C and boils at 100°C. This property helps in fractional distillation of miscible liquid which Contain water. For instance Separation of alcohol and water.

(b) Application of electrolysis

i/ Electrolysis is used in production of gases like oxygen and hydrogen gases

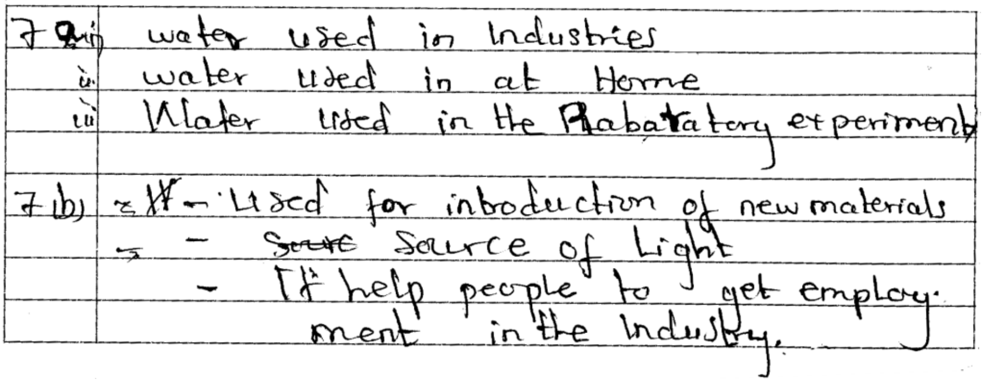
ii/ Electrolysis is used in purification of Metals such as Copper and Zinc.

iii/ Electrolysis is used in electroplating different Metals to avoid rusting and to Make them attractive.

Extract 7.1 shows a response of a candidate who specified the utility of the main physical properties of water correctly. Moreover, he/she properly stated the industrial applications of electrolysis.

The candidates who scored low marks (0 to 1.5) failed to differentiate the physical properties of water from its chemical properties, hence stated the chemical properties in place of physical properties. Although some few candidates mentioned the physical properties of water correctly, they could not show the usefulness of each. Other candidates stated the properties of electrolytes and methods of preventing rusting instead of the industrial applications of electrolysis. Generally, the candidates had inadequate knowledge about the industrial applications of electrolysis and the main physical properties of water. Extract 7.2 illustrates one of the poor responses.

Extract 7.2



7 (a) (i) water used in Industries
(ii) water used in at Home
(iii) Water used in the Labaratory experiment

7 (b) - Used for introduction of new materials
- Source of Light
- It help people to get employment in the Industry.

In Extract 7.2, the candidate stated places where water is normally used instead of stating the properties of water. He/she gave statements which are not linked to the industrial application of electrolysis.

2.2.6 Question 8: Chemical Kinetics, Equilibrium and Energetics; and Organic Chemistry

The question was as follows:

(a) You are provided with CH_3CH_2OH, $CH_3CH_2CH_3$, CH_3COOH, and $CH_2{=}CH_2$.

(i) Which compounds are gases at room temperature?

(ii) How can you distinguish compound $CH_3CH_2CH_3$ and $CH_2{=}CH_2$?

(iii) Which compound would react with sodium carbonate? Write the balanced chemical equation for the reaction.

(b) Hydrogen peroxide breaks down slowly to form water and oxygen; the reaction can be speed up by using a catalyst.

(i) How does the catalyst speeded up the rate of the reaction?

(ii) Name a possible catalyst that can be used to speed up the reaction.

(iii) Show that the catalyst always remains unchanged at the end of the reaction.

The question was attempted by 84.58 percent of the candidates out of which 77.46 percent scored from 0 to 1.5 marks, 19.72 percent scored from 2 to 3.5 marks and 2.82 percent scored from 4 to 6 marks. Figure 5 is a representation of the candidates' scores.

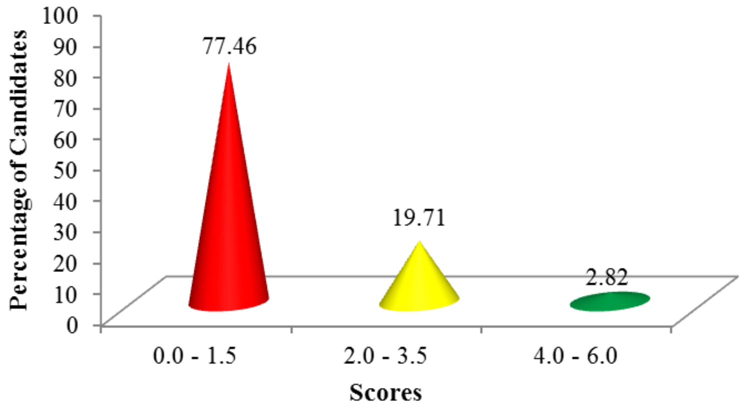


Figure 5: *Performance of the Candidates in Question 8.*

Figure 5 indicates that more than three quarters of the candidates scored from 0 to 1.5 marks meaning that the general performance was poor. On the other hand, only 2.82 percent of the candidates scored from 4 to 6.

The candidates who scored low (0 to 1.5) marks failed to recognize the existence of propane in gaseous state at room temperature. Some of the candidates mentioned properties of $CH_2=CH_2$ (ethene) and $CH_3CH_2CH_3$ (propane) separately instead of distinguishing the two molecules. Other candidates suggested incorrectly that sodium carbonate would react with CH_3CH_2OH (ethanol) instead of CH_3COOH (ethanoic acid). The candidates lacked adequate knowledge on how functional groups determine the properties of organic molecules.

In part (b), majority of the candidates named incorrectly the catalyst for the decomposition of hydrogen peroxide. For instance, the candidates mentioned magnesium oxide instead of manganese oxide. In another case, the candidates failed to explain how the catalyst increases the rate of the reaction by lowering the activation energy. The candidates in this category wrote incomplete or irrelevant chemical equation for the decomposition of hydrogen peroxide. For example, one candidate wrote the equation as *hydrogen plus oxygen to form hydrogen peroxide*. The incorrect responses imply that the candidates lacked adequate knowledge on the concept of catalysts in chemical reactions. Extract 8.1 is a sample of the poor responses.

Extract 8.1

8 i) The guse at room temperature is Oxygen
ii) We can / I can distinguish for this Compound
$CH_3CH_2CH_3$ is Isomarism
and $CH_2 = CH_2$ is the double bond
iii) The Compound it can react with the Sodium Carbonate is Chloride

b) i) The Catalyst their speed it can be to the speed to the way of Water where
ii) The possible Catalyst of this is peroxide
iii) The Catalyst remain unchanged at the end of the reaction x that
The 0.H ≠ C(20

In Extract 8.1, the candidate incorrectly cited oxygen and chloride which were not given in the stem of the question. He/she failed to distinguish ethane from propane and also gave irrelevant answers to the rest of the question.

The candidates who scored high (4 to 6) marks, were able to identify correctly $CH_3CH_2CH_3$ and $CH_2{=}CH_2$ as the compounds which exist as gases at room temperature. The most able candidates gave appropriate explanation chemical tests which can be used to distinguish $CH_3CH_2CH_3$ and $CH_2{=}CH_2$. Some of the candidates correctly identified CH_3COOH as the compound that would react with sodium carbonate and wrote the required balanced chemical equation. Furthermore, they managed to name the catalyst as manganese oxide and that it increases the rate of the reaction by lowering the activation energy. Only few candidates managed to show that the catalyst always remains unchanged at the end of reaction because its mass remains the same after the reaction. Extract 8.2 is a response from one of the candidates who performed well.

Extract 8.2

8 a) i) Compounds which are gaseous at room temperature are $CH_2=CH_2$ and $CH_3CH_2CH_3$

ii) $CH_3CH_2CH_3$ can be distinguished from $CH_2=CH_2$ as $CH_2=CH_2$ decolorises Potassium permanganate solution forming CH_2OHCH_2OH whereas $CH_3CH_2CH_3$ can not decolorize the $KMnO_4$ solution

iii) A compound which will react with Na_2CO_3 is CH_3COOH as per equation

$$2CH_3COOH_{(aq)} + Na_2CO_{3(s)} \rightarrow 2CH_3COONa_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

b) i) The catalyst speeds up the rate of reaction by lowering the activation energy, that is the minimum amount of energy required to start ~~at~~ a reaction. Since the activation energy is lowered, the rate of reaction increases.

8 b) ii) The possible catalyst is MnO_2 (Manganese(IV) oxide)

iii) The possible catalyst used remains unchanged chemically as the amount of catalyst (MnO_2) before reaction is the same even at the end of reaction as per equation

$$2H_2O_{2(aq)} + MnO_{2(s)} \rightarrow 2H_2O_{(l)} + O_{2(g)} + MnO_{2(s)}$$

Overall reaction: $2H_2O_{2(aq)} \xrightarrow{MnO_2} 2H_2O_{(l)} + O_{2(g)}$

Hence the catalyst remains unchanged.

In Extract 8.2, the candidate correctly answered the items about the organic compounds in part (a) and also gave proper answers about catalysis of the decomposition of hydrogen peroxide in part (b).

2.2.7 Question 9: Atomic structure; The Mole concept and Related calculations

The question comprised of two main parts as follows:

(a) *An atom M has an atomic number 14 and mass number 28.*

   (i) *What is the number of protons and neutrons?*

   (ii) *Write the electronic configuration of atom M.*

(b) *Calculate the volume of water which was produced when 1120 cm^3 of oxygen at s.t.p was liberated during the decomposition of hydrogen peroxide. The density of water = 1.0 g/cm^3.*

Many candidates (93.58%) attempted this question and the scoring was as shown in Figure 6.

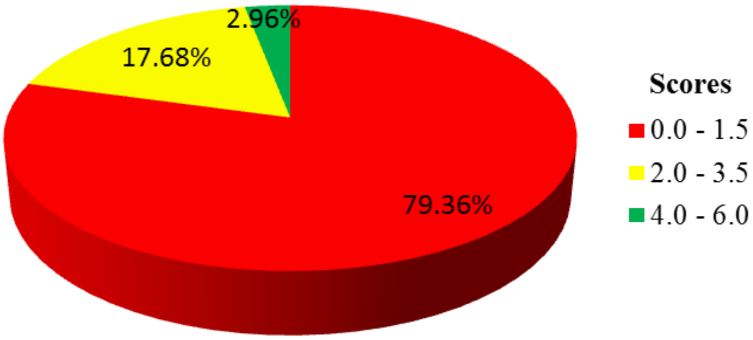


***Figure 6**: Performance of the Candidates in Question 9.*

The analysis shows that 79.36 percent of the candidates scored from 0 to 1.5 marks, 17.68 percent scored from 2 to 3.5 marks whereas 2.96 percent scored from 4 to 6 marks. These statistics imply that the performance was poor in this question.

On the other hand, most of the candidates who scored low marks (0 to 1.5) failed to recall the relationship between atomic number, number of protons and mass number of atom M. For instance, a certain candidate incorrectly computed the number of neutrons by taking sum of the mass number and the atomic number. Some of the candidates had the idea on how to present the electronic configuration they indicated incorrect number of shells. For example, one candidate wrote the electronic configuration as M = 2:8:8:2. It was also noted that other candidates assumed the atom to have 28 electrons rather than 14 electrons. Similarly, many candidates incorrectly calculated the volume of water at s.t.p as they considered water being a gas instead of a liquid. Others ended up by writing the data without any further attempt to carry out the calculation. In general, the candidates lacked adequate knowledge in carrying out calculations related to mole concept and atomic structure. Extract 9.1 shows an example of the poor responses.

Extract 9.1

9 a) i) Number of proton and neutrons is 4.

ii) Electronic configuration of atom M is 2:5.

b). Data given

Volume liberated 1120 cm³

Density of water = 1.0g/cm³

Atomic number of hydrogen = 1

Volume of water = ?

R.A.M = (A₁ × M₁) + (A₂ M₂) / 1120cm³ + 1 + 1.0gcm³

= 1120cm³ = 1 + 1.0gcm³

2.0 = 420cm³ (560)

V. water = 560

In Extract 9.1, the candidate wrote incorrect number of protons, neutrons and electronic configuration of atom M. He/she also applied unsuitable formula to compute the volume of water.

However, the candidates who scored high (4 to 6) marks managed to give the number of protons (14) and neutrons (14) separately and wrote the proper electronic configuration of the metal being M = 2:8:4. They also used a correct procedure and step-by-step approach to calculate the volume of water during the decomposition of hydrogen peroxide. The candidates in this category had adequate knowledge and skills of mole concept and its related calculations. Extract 9.2 is an example of the good responses.

Extract 9.2

09. a) i, The number of

- Protons is 14
- Neutrons is 14

ii, Electronic configuration of M is 2 : 8 : 4

09. b) Reaction equation for the decomposition is

$[2H_2O_{2(aq)}] \longrightarrow [2H_2O_{(l)}] + [O_{2(g)}]$

From the equation.

2 moles of H_2O_2 produced 1 mole of O_2

2 moles of H_2O_2 ≡ 1 mole of O_2

But 1 mole of a gas at s.t.p = $22.4dm^3$

∴ 2 moles of H_2O_2 ≡ $22.4dm^3$

n ≡ $1.12dm^3$

$n = \frac{1.12 \times 2\text{moles}}{22.4}$

n = 0.1 mole.

∴ The amount of H_2O_2 decomposed was 0.1 mole.

Then: 2 moles of H_2O_2 ≡ 2 moles of $2H_2O$.

2 moles of H_2O_2 ≡ 2 (2(H) + O)

≡ 2 (18)

= 36g.

2 moles of H_2O_2 = 36g

0.1 mole of H_2O_2 ≡ g

$g = \frac{0.1\text{mole} \times 36g}{2\text{ moles}}$

∴ g = 18g mass of water produced

09	b) But from;
	Density = mass where density of water = 1g/cm^3
	volume
	volume = mass
	density
	Volume = 1.8g
	1g/cm^3
	= 1.8 cm^3
	∴ The volume of water produced was 1.8cm^3

In Extract 9.2, the candidate managed to write the number of protons, neutrons and presented the electronic configuration of atom M correctly. He/she also acceptably calculated the volume of water.

2.2.8 Question 10: Chemical Equations; Ionic Theory and Electrolysis.

The question had two parts, (a) and (b). In part (a), the candidates were required to complete the following equations and determine the type of chemical reaction involved in each case:

(i) $Zn(s) + H_2SO_4(aq) \longrightarrow$

(ii) $AgNO_3\ (aq) + NaCl(aq) \longrightarrow$

(iii) $N_2(g) + H_2(g) \longrightarrow$

Part (b) required the candidates to calculate the time needed to deposit 3.24 g of silver metal at the cathode when a current of 5A is passed through a solution of silver chloride. (Given that, the electrochemical equivalent of silver = 1.118×10^{-3} gc^{-1})

The question was attempted by 96.09 percent of the candidates. The candidates who scored from 4 to 6 marks were 23.9 percent, 32.72 percent scored from 2 to 3.5 marks while 43.38 percent scored from 0 to 1.5 marks. Generally, the performance in this question was average.

The candidates who scored high marks (4 to 6) managed to complete the equations by supplying the missing products in part (a). Most of them were able to identify the type of the chemical reactions represented by the equations (i), (ii) and (iii) as displacement reaction, precipitation reaction and synthesis reaction, respectively. They also used the correct formula to calculate the required time (579.6 sec) to deposit 3.24 g of silver. The candidates had adequate knowledge and skills in writing chemical equations and applying Faraday's first law of electrolysis. Extract 10.1 is an example of good responses.

Extract 10.1

10. (a) (i) $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$

This is displacement reaction

(ii) $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

This is precipitation reaction.

(iii) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

This is Combination reaction

10 (b) Given values

Electric current (I) = 5A

Mass of deposited metal of Silver (m) = 3.24g

Electrochemical equivalent of Silver (Z) = $1.118 \times 10^{-3} gC^{-1}$

time taken (t) = ?

Solution:

$Q = It$

$m = ZIt$ where m = Mass of Silver

Z = Electrochemical equivalent of Silver

I = Current

t = time taken

$\frac{M}{ZI} = \frac{ZIt}{ZI}$ $t = M/ZI$

$t = \frac{3.24g}{1.118 \times 10^{-3} g/C \times 5A}$

$t = \left(\frac{3.24}{5.590 \times 10^{-3}}\right)s$

$t = \left(\frac{3.24 \times 10^{0}}{5.590 \times 10^{-3}}\right)s$

$t = (0.5796 \times 10^{3})s$

$t = 579.6s$

∴ time taken is 579.6 seconds

In Extract 10.1, the candidate completed the equations, categorized each of the reactions suitably and used proper formula to calculate the time required to deposit of 3.24 g of silver.

On the other hand, the candidates who scored low marks (0 to 1.5) failed to complete the equations properly and were unable to identify the type of each of the reactions in part (a). Some of them gave irrelevant products such as NH_4, AgO and O_2 to complete the equations while few others gave partial answers to this part. Similarly, they identified the type of reactions incorrectly as they mixed up the categories. For instance, one of the candidates identified the reactions represented in (i) and (ii) as *neutralization* and *double reaction*, respectively. Furthermore, in part (b), some of the candidates used incorrect formula and substituted data incorrectly. Basically, the candidates lacked adequate knowledge on understanding chemical equations and how to apply Faraday's first law of electrolysis. They also had inadequate mathematical skills to carry out the calculation involved. Extract 10.2 is an example of the poor responses.

Extract 10.2

10. a/ i/ $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnH_{2(g)} + SO_{4(aq)}$

ii/ $AgNO_{3(aq)} + NaCl_{(aq)} + AgNa_{(aq)} + O_{3(g)}$

iii/ $N_{2(g)} + H_{2(g)} \rightarrow 4NH_{(g)}$

b/ Soln

Data =

Carrent 5A

silver chloride = 3.24g

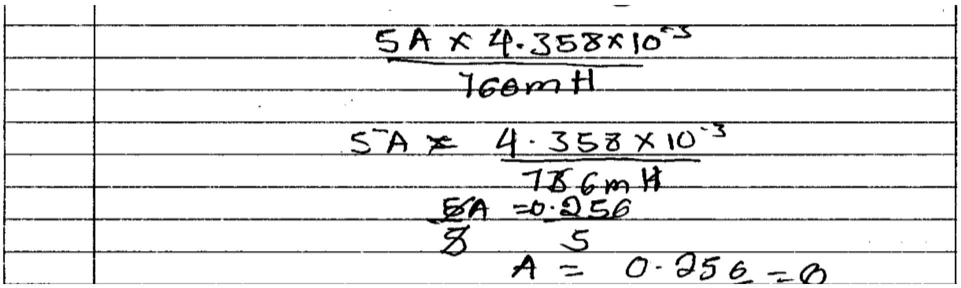
cathod = ?

electrochemical equivalent of silver

1.118×10^{-3} gc^{-1}

$$\frac{5A \times 3.24g + 1.118 \times 10^{-3}}{766mHg}$$

$$\frac{5A \times 4.358 \times 10^{-3}}{766mHg}$$



$\frac{5A \times 4.358\times10^{-3}}{760mH}$

$5A \times \frac{4.358\times10^{-3}}{786mH}$

$\frac{5A}{5} = \frac{0.256}{5}$

$A = 0.256 = 0$

In Extract 10.2, the candidate incorrectly completed the chemical equations. He/she lacked basic mathematical skills and did not indicate the parameter of interest in the calculation.

2.2.9 Question 11: Matter; Non-Metals and their Compounds

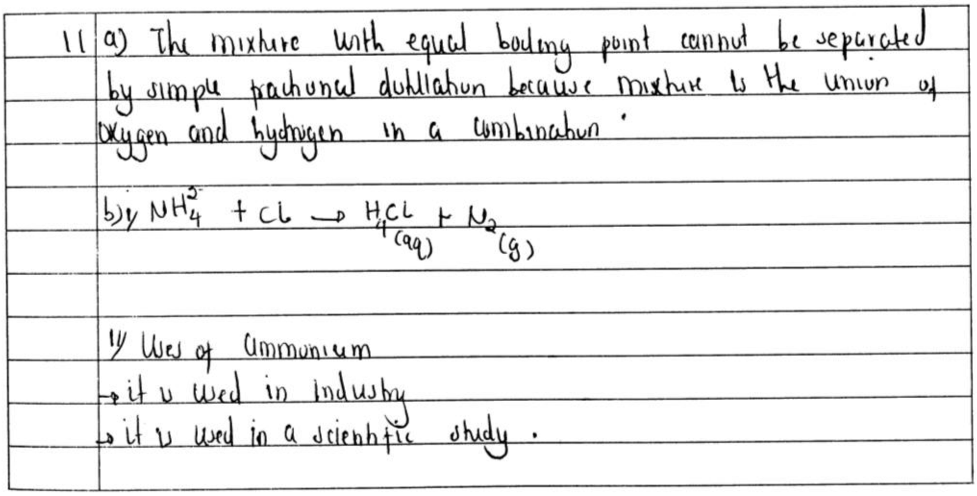
Part (a) of the question required the candidates to explain briefly why the components of a mixture with equal boiling point cannot be separated by simple fractional distillation.

In part (b), the candidates were required to write a balanced chemical equation for the preparation of ammonia by heating any ammonium salt with an alkali and state two uses of ammonia.

The question was attempted by 85.31 percent of the candidates. The performance was poor in which 73.55 percent of the candidates scored from 0 to 1.5 marks with 49.65 percent scoring a zero mark. The candidates who scored from 2 to 3.5 marks were 18.31 percent while those who scored from 4 to 6 marks were 8.14 percent.

In most cases, the candidates who scored low marks (0 to 1.5) incorrectly associated the technique of separating the mixture with melting point. For instance, one of the candidates stated that: *The mixture cannot be separated because fractional distillation is used to separate mixture with the same melting point and not boiling point*. The candidates in this category were not able to relate evaporation and boiling point of the mixture with the composition of the distillate formed in part (a). Some of the candidates sketched diagrams showing simple fractional distillation process indicating that they did not understand the requirement of the question. Similarly in part (b), other candidates suggested the uses of hydrogen gas rather than the uses of ammonia. For instance in part (b) (ii) one of them wrote: *"used as a fuel rocket and used to filling balloons."* The candidates in this category had inadequate knowledge about ammonia gas and the simple fractional distillation technique. Extract 11.1 illustrates an example of the poor responses.

Extract 11.1



11 a) The mixture with equal boiling point cannot be separated by simple fractional distillation because mixture is the union of oxygen and hydrogen in a combination.

b) i) $NH_4^{2} + CL \rightarrow H_4CL_{(aq)} + N_{2(g)}$

ii) Uses of ammonium

→ it is used in industry

→ it is used in a scientific study.

In Extract 11.1, the candidate gave incorrect explanation about simple fractional distillation, wrote the equation incorrectly and stated improper uses of ammonia.

On the contrary, the candidates who scored high marks (4 to 6) correctly associated the composition of the distillate with the boiling point the mixture in part (a). They also gave the required balanced chemical equation for the preparation of ammonia in part (b). Furthermore, they stated correctly that ammonia is used in *cleaning, refrigeration* and *manufacture of nitric acid*. In some cases, the most able candidates showed relevant examples and chemical reactions. The ability of the candidates to answer the question correctly is an indication that they had adequate knowledge concerning fractional distillation process, preparation and importance of ammonia. The candidates who performed well in this question had adequate knowledge about separation of mixtures and ammonia. Extract 11.2 represents an example of the good responses.

Extract 11.2

11. a, A mixture with equal boiling point cannot be separated by simple fractional distillation because both liquids will evaporate and condense at same temperature hence they will not be separated successfully.

b, i, $2NH_4Cl_{(aq)} + Ca(OH)_{2(aq)} \rightarrow CaCl_{2(aq)} + 2H_2O_{(l)} + 2NH_{3(g)}$

ii, Uses of Ammonia

I. In production of nitrogenous fertilizers like urea

II. In manufacture of nitric acid

Extract 11.2 shows response of the candidate who correctly related boiling point with condensation of the mixture. The candidate also wrote the balanced chemical equation for the preparation of ammonia and correctly stated the uses of ammonia.

2.3 Section C: Essay Questions

This section was comprised of two questions carrying 13 marks each. The pass score in each question was 4.0 mark or above.

2.3.1 Question 12: Chemical Kinetics and Equilibrium; Mole Concept and Related Calculations

The question was as follows:

A student attempted to prepare hydrogen gas by reacting zinc metal with dilute sulphuric acid. In this experiment zinc metal granules of about 0.5cm diameter and 0.20 moles of acid were used. The rate of formation of hydrogen gas was found to be slow.

(a) *Explain three ways in which the rate of hydrogen gas could be increased.*

(b) *If the student wanted 36 cm^3 of hydrogen gas at s.t.p, what amount of the acid would be required?*

The question was attempted by 73.49 percent of the candidates, whereby 75.14 percent scored from 0 to 3.5 marks with 36.26 percent scoring a zero mark. The candidates who managed to score from 4 to 8 marks were 22.79 percent, while 2.07 percent scored from 8.5 to 13 marks. Generally the performance in this question was poor with only 0.07 percent of the candidates scoring a full mark.

The candidates who scored low marks (0 to 3.5) specifically those who scored a zero mark, were unable to explain the way concentration and temperature can be used to increase the rate of the reaction. The candidates also failed to suggest the use of powdery zinc as one way of increasing the rate of the reaction. In part (b), many candidates failed to relate the volume of hydrogen with molar volume of gases as an important stage towards calculating the amount of the acid. Moreover, the candidates applied inappropriate formula to calculate the number of moles of the acid. For instance, one of the candidates used incorrect approach and ended up getting an incorrect answer of 10 moles of the acid. Other candidates just copied the data and failed to carry out any intended calculations. Generally, the candidates lacked both adequate knowledge about factors affecting the rates of chemical reactions and skills of solving problems related to mole concept. Extract 12.1 illustrates the case.

Extract 12.1

12	a) To explain three ways in which the rate of for
	mation of hydrogen gas could be increased.
	i) concentration when the rate of formation
	of hydrogen gas could be increased because the
	rate of concentration is increase while the
	rate of hydroge decrease.
	Water when the rate of formation of
	hydroge gas could be increase because the
	rate of hydrogen gas will be show at a
	preparation of a gas.
	Heat when the rate of formation of
	heat in ahydrogen gas could be increase
	because the rate of hydrogen gas will be
	decrease in the preparation of a gas.
	All of all are the three ways in which the
	rate of formation of hydrogen gas could be incre
	ased.

Extract 12.1 shows the response of the candidate who incorrectly related concentration, water and heat with the rate of formation of hydrogen gas.

The candidates who scored high marks (8.5 to 13) in this question were able to explain the three ways to increase the rate of formation of hydrogen gas. Those ways include increasing the concentration of sulphuric acid, raising the temperature and the use of powdered zinc. Some of the candidates used proper formula to calculate the amount of sulphuric acid which was supposed to be 0.0016 moles. The candidates' scores in this category varied depending on the magnitude of the shortfalls encountered by individual candidates. The good performance of the candidates is an indication that they had adequate knowledge on factors affecting rates of chemical reactions and calculations related to molar volume of gases. Extract 12.2 illustrates a sample of the good responses.

Extract 12.2

12. a) The rate of formation of hydrogen gas could be increased by;

i) Increasing the temperature.

As you increase the temperature in the reaction, the particles gain kinetic energy which inturn makes the particles to move side to side and collide therefore increasing the rate of hydrogen gas produced.

ii) Increasing the concentration of the acid.

The sulphuric acid used once increased its concentration more hydrogen gas would be produced at a time. Example the use of concentrated sulphuric acid would increase the rate of formation of hydrogen gas.

12a) iii) Increasing the surface area of the zinc granules.

As you increase the surface are of the zinc granules, more of the zinc would react easily with the acid hence formation of more hydrogen gas. This can be done by decreasing the diameter of the zinc granules.

b) Data given;

number of moles of acid = 0.20 moles.

Volume of hydrogen gas = 36 cm^3.

Equation;-

$Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$

number of moles $= \frac{\text{Volume of } H_2}{G \cdot M \cdot V}$

$= \frac{36 cm^3}{22 \cdot 4 dm^3/mol}$

$= \frac{0 \cdot 036 dm^3}{22 \cdot 4 dm^3/mol}$

$= \left(\frac{36}{22400}\right)$ moles

$= 0 \cdot 0016$ moles of $H_{2(g)}$

1mole $H_2SO_4 \longrightarrow$ 1 mole of $H_{2(g)}$

1 : 1.

number of moles of H_2SO_4 is $0 \cdot 0016$

In Extract 12.1, the candidate correctly explained three ways to increase the rate of formation of hydrogen gas and plausibly managed to calculate the amount of the acid required in the reaction.

2.3.2 Question 13: Acid, Bases and Salts

The question required the candidates to use four examples to explain how the process of neutralization is important in day to day life.

The question was attempted by 77.02 percent of the candidates and the general performance was average. The candidates who scored from 8.5 to 13 marks were 16.50 percent with 4.07 percent scoring all 13 marks. The percentage of candidates who scored from 4 to 8 marks was 23.42 whereas, 60.08 percent scored from 0 to 3.5 marks.

The candidates who scored high marks (8.5 to 13) wrote impressive essays with a relevant introduction and well elaborated points on the importance of neutralization in daily life experiences. They also provided relevant examples supporting each of their points. Furthermore, the candidates concluded by giving suitable remarks. The candidates were awarded marks depending on the number of relevant points provided and the clarity of explanation according to the marking scheme. Extract 13.1 is an example of the good responses.

Extract 13.1

13. Neutralization is the reaction between acid and base to produce salt and water only. The process of neutralization is important in our daily life since it assists in finding solutions to different problems occuring in our society. These situations include:

Treating insect stings some insects such as wasps or bees can injuire a person by injecting its sting into the body. The wasp sting has acidic components that can harm the body therefore a base is used to neutralize the action of the acid. The base commonly used in baking powder. When the sting is basic, the acid used to neutralize is vinegar.

Treating stomach pains after eating. The pains in the stomach are a result of excessive production of hydrochloric acid in the body. Therefore antacids are normally used to neutralize the hydrochloric acid. The antacids are taken at a calculated amount to ensure that the neutralization process ~~in~~ is balanced. The antacids include

hydroxides of aluminium and magnesium. The
hydroxide of Magnesium is commonly known as Milk of
13. Magnesia.
Regulating soil pH for the proper growth of
crops. Most crops grow well in soil with moderate pH.
Some soil lower the pH due to acidic rains hence
causing them to acidic soils. The acid soils can be
treated by putting ashes, dry grasse and leaves.
The basic components from ashes, and dry vegetation will
neutralize the acidity in the soil to normal neutral pH.
Treating accidental spills most especially in
the ~~laborat~~ laboratory. When acids such as
sulphuric or hydrochloric acid have fallen down on
the floor, a base can be used to neutralize the
acids so that it ~~we~~ will not be having any effect when
a person passes there. The bases that are commonly
used include ammonium hydroxide and sodium hydroxide.
Conclusively, a ~~neup~~ neutral pH is 7.0. The
acidic range of pH is from 0 to 6.5 while the
basic range of pH is from 7.5 to 14. In the
universal indicator, the acidic pH is characterized with
red, orange or yellow colour depending with the strength
while the basic pH is having blue, indigo or violet
according to the strength of the base. The neutral colour in
the universal indicator is Green.

In Extract 13.1, the candidate wrote a good introduction, gave clear explanation of the points and concluded with a notable remark.

However, most of the candidates who scored low (0 to 3.5) marks failed to give relevant introduction. For example one candidate wrote, *Neutralization is the process when a motor bike move free*. Others outlined their relevant and irrelevant points without elaborating them. In some of the responses. The candidates wrote their ideas using sentences which lacked coherence.

They also lacked coherence of ideas and could not cite relevant examples on the importance of neutralization in day to day life. Some of them incorrectly included circumstances in which either acids or bases are utilized, but where neutralization does not apply. Such circumstances include *the manufacturing of soap, ceramics* and *the synthesis of nylon*.

Other candidates resorted into writing the importance of chemistry instead of the importance of neutralization. The weak responses indicate that the candidates had inadequate ability to relate neutralization process to real life situations. The performance is also attributed to poor proficiency of English Language.

Extract 13.2 shows an example of poor responses.

Extract 13.2

13 The neutralization is the very importa nce to day life this is because it help the people from pleace different different so impor- ntant of process neutralization are the following

Fistly: To neutralization of agricultu- re, that is help us to neutralization agricullo ure like fertalizers and soon..

Secondly: It help to neutralization of fertaliza, this It help to fertility because among the fertality have more chemical so must the neutralization

Secondly: It help to industry; among the importance of neutralization It hep to industry because the industry it use the for food, chemical to low high amount of chemical That is importance of neutralization today life.

Threedly: It help to market; and also the importance of neutralization it help to market that is good because among the food is high amount of chemical but the process of neutralization is neutral the food.

So, the process of neutralization is important in day today life because the people have live however must be among the something to the industry, market, or to agriculture to neutralization.

In Extract 13.2, the candidates resorted his/her time writing anything regardless whether it is meaningful or not. All the explanation are irrelevant an indication of lack of knowledge about the concept of neutralization.

3.0 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH TOPIC

A total of 18 topics were examined in the 032 Chemistry 1 paper. The analysis shows that the candidates had good performance in question 1 with performance of 76.97 percent. The question comprised the topics of *Heat sources* and *flames; Air, combustion, rusting* and *firefighting; Periodic classification; Compounds of metals; Matter; Organic chemistry* and *Atomic structure*.

Analysis shows that, the candidates had an average performance in questions 2, 6, 7, 10 and 13. The questions were composed from the topics of *Acid, bases* and *salts; Atomic Structure; Chemical equations; Compounds of metals; Ionic theory* and *electrolysis; Periodic Classification; Water; Formula, bonding* and *nomenclature.*

Furthermore, the candidates had weak performance in the topics of *Atomic structure; Extraction of Metals; Non-Metals and their Compounds; Matter; Soil chemistry; Hardness of Water; Chemical Kinetics Equilibrium and Energetics; The mole concept* and *related calculations; Organic Chemistry; Formula, bonding and nomenclature.* These topics were examined in question 3, 4, 5, 8, 9, 11 and 12. *The mole concept* and *related calculations* was the most poorly performed, whereby only 20.64 percent of the candidates scored the pass mark or above.

In an attempt to find out the solution to improve performance in the topics having poor performance, our deliberate efforts focused on the skills examined in each of the topics and the findings were summarized and presented in Table 1.

Table 1: Skills which were Examined in the Topics with Poor Performance

QUESTION NUMBER	CATEGORY OF THE SKILL EXAMINED		
	Explanations of Concepts	Writing Chemical Equations	Calculations
3	✓	✓	X
4	✓	✓	X
5	✓	X	✓
8	✓	✓	X
9	X	X	✓
11	✓	✓	X
12	✓	X	✓

Key:
✓ = Skill examined
X = Skill not examined

For convenience, Appendix 1 can be referred so as to have an understanding of the topics with their respective question numbers. The findings in table 1 indicate that the candidates faced much difficulty in answering questions which required them to explain concepts, write chemical equations and carry out calculations. The most difficult skill to the candidates was that one which involved calculations ranging from simple to complex. For instance, the performance of the candidates was the least in question 9 which was entirely based on calculations. Furthermore, question 5 which mainly involved calculations, became the second from the least in performance. In most cases, the candidates failed to calculate parameters related to mole concept.

On the other hand, the candidates faced difficult to explain concepts and principles as required in the examination. For instance, performance of candidates was poor in questions 3, 4, 8, 11 and 12 which required explanation of concepts and application of principles. Also the candidates found it hard to write a variety of chemical equations which were required in the examination. In most cases, the candidates supplied incorrect products whenever required to complete chemical equations. In question 11 for example, most of them failed to give the correct equation for the preparation of ammonia.

The analysis indicates that the poor performance of the candidates was attributed by lack of basic skills to calculate, inability to write chemical equations and inability to explain concepts and principles. Appendix 1 illustrates analysis of candidates' performance per topic in each question.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The general performance of the candidates in Chemistry subject in CSEE 2017 was average since 36.54 percent of the candidates who sat for the examination passed. The analysis of the candidates' performance in each question showed that the performance was good in one question, average in five questions and poor in seven questions (Refer to appendix 1). The good performance of the candidates was contributed by adequate knowledge and skills of the basic concepts in Chemistry subject. The analysis also identified several factors that contributed to failure of some candidates to respond correctly to some of the questions. These factors include:

(a) Lack of enough knowledge and skills across some of the topics. This was illustrated by the candidates who responded by giving partial answers.

(b) Failure to understand the requirements of the questions. This was manifested by the irrelevant responses of the candidates and those who skipped some of the questions.

(c) Poor proficiency of English Language. In some of the responses there were sentences with incorrect tenses, grammar and spelling errors.

(d) Lack of individual skill to organize ideas and concepts when giving explanation.

(e) Failure to use appropriate formulae and inadequate ability to operate numbers during calculations.

4.2 Recommendations

Based on the analysis of candidates' performance in each topic and question in Chemistry subject, the following are recommended:

4.2.1 Recommendations to learners

Students are recommended to;

(a) practice speaking and writing English Language in order to become competent in using the language to answer questions in examinations.

(b) dedicate their spare time for studying Chemistry especially practicing solving problems related to mole concept and writing chemical equations.

(c) take all assignments, tests and examinations administered at school and do all the necessary corrections thereafter to improve learning.

(d) establish study groups for sharing knowledge and skills in Chemistry subjects especially in those difficult areas.

(e) read materials published in English Language such as short story books, newspapers, magazines and dictionaries.

4.2.2 Recommendations to teachers and stakeholders

(a) The ministry of Education, Science and Technology should continue to ensure that only the high quality Chemistry teaching and learning materials, such as books are allowed for teaching and learning in schools.

(b) Managers and heads of schools should equip Chemistry teachers and students with facilities, chemicals and other relevant materials for effective teaching and learning.

(c) Teachers to regularly make use of models of molecules and wall charts showing formula of reaction equations in teaching the topic entitled Chemical equations.

(d) Teachers are advised to provide students with a variety of question related to mole concept and guide them to solve them for efficient understanding of the topic entitled The mole concept and related calculations.

(e) Tests and examinations administered to students should be of acceptable standards so as to well prepare them for the final National Examination.

(f) Students should be trained to read and identify the demands of the questions and specific skills on how to respond to respective questions, for example essay writing in Chemistry subject.

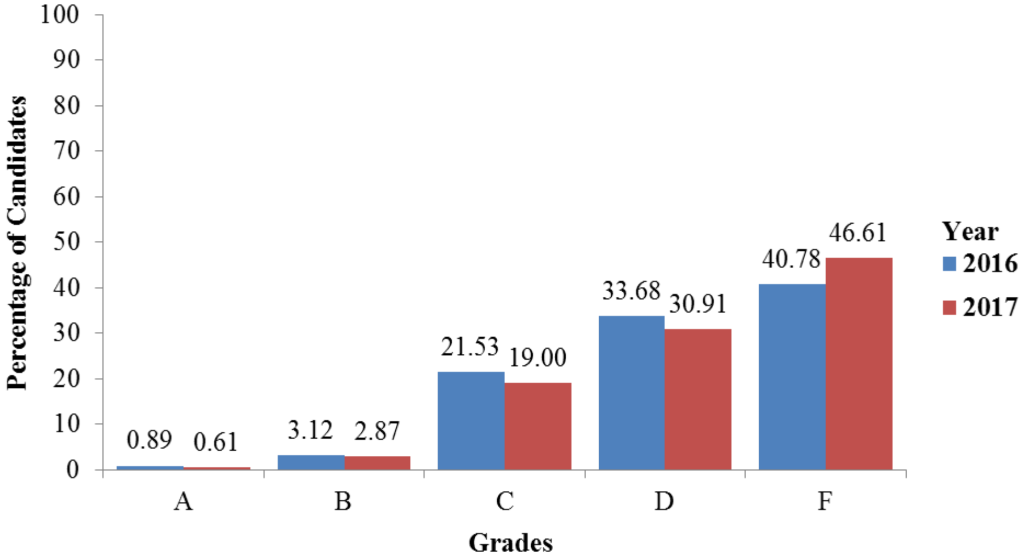
(g) Students should be highly inspired to sincerely practice speaking English Language as it is the medium of instruction in Secondary Schools.

Appendix 1

ANALYSIS OF CANDIDATES' PERFORMANCE PER TOPIC

S/N	Topic	Question Number	The % of Candidates who Scored 30 Percent or Above	Remarks
1	*Heat sources* and *flames; Air, combustion, rusting* and *firefighting; Periodic classification; Compounds of metals; Matter; Organic chemistry* and *Atomic structure.*	1	76.97	Good
2	*Matching Items*	2	62.56	Average
3	*Chemical equations; Ionic theory* and *electrolysis*	10	56.62	Average
4	*Acid, bases* and *salts*	13	39.92	Average
5	*Compounds of metals; Formula, bonding* and *nomenclature*	6	35.84	Average
6	*Water; Ionic theory* and *electrolysis*	7	30.7	Average
7	*Extraction of Metals; Non-Metals* and *their Compounds*	4	29.95	Weak
8	*Matter; Non-metals* and *their compounds*	11	26.45	Weak
9	*Soil Chemistry,* and *Hardness of water*	3	25.62	Weak
10	*Chemical kinetics equilibrium and energetics; The mole concept* and *related calculations*	12	24.86	Weak
11	*Organic Chemistry; Chemical kinetics, equilibrium* and *energetics*	8	22.54	Weak
12	*The mole concept* and *related calculation; Formula, bonding and nomenclature*	5	22.38	Weak
13	*Atomic structure; The mole concept* and *related calculations*	9	20.64	Weak

Appendix 2



The difference in performance in the year 2016 and 2017