THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

STUDENTS' ITEM RESPONSE ANALYSIS REPORT FOR THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2015

032 CHEMISTRY

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C O N T E N T S

FOREWORD

The Students' Items Response Analysis Report in Chemistry subject in Form Two National Assessment (FTNA) 2015 was prepared in order to provide feedback to students, teachers, parents, policy makers and other education stakeholders on the performance of students in this level of education.

The Form Two National Assessment is a two years formative evaluation which among other things shows effectiveness of education system in general and education delivery system in particular. Essentially, students' responses to the assessment questions is a strong indicator of what the education system was able or unable to offer to students in their two years of secondary education.

The analysis presented in this report is intended to contribute towards understanding some of the reasons behind the observed performance of students in Chemistry subject. The report highlights some of the factors that made students fail to score high marks in the questions. Such factors include; lack of knowledge in relation to a particular concept, failure to interpret the requirement of the questions and poor command of English Language.

The feedback provided will enable school administrators, school managers, teachers and students to find proper measures to be taken in order to equip students with appropriate knowledge and skills intended for Form Two, before sitting for Form Four National Examination.

The National Examinations Council will highly appreciate comments and suggestions from education stakeholders that can be used to improve future Items Response Analysis Reports. The Council would like to thank the Chemistry Coordinators, Assessors and all others who participated in the preparation of this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report on the performance of students in Form Two National Assessment (FTNA) 2015 is based on the Chemistry paper. The paper assessed students' competences in accordance with 2010 Chemistry syllabus for secondary education, for Form I and II levels.

The paper consisted of three sections, namely A, B and C with a total of 28 items. Section A consisted of ten multiple choice items, section B comprised of ten matching items and section C had eight short answer questions. The students were asked to answer all questions. Section A had a total of 10 marks, whereas sections B and C had 20 and 70 marks respectively.

In 2015 a total of 362,884 students sat for the Chemistry assessment, of which 146,123 students equivalent to 40.27 percent passed. In 2014, a total of 399,725 students sat for the assessment in which 38.43 percent passed. Hence, these data show that, there is a drop of 36,844 (9.0%) students who sat for this paper in 2015 and an increase of 1.84 percent of students who passed compared to 2014.

The following section provides the analysis of the students' performance in each question.

2.0 ANALYSIS OF STUDENTS' PERFORMANCE IN EACH QUESTION

For each question analyzed, an overview of what the students were required to do, general performance and the possible reasons for the observed performance have been provided. Samples of extracts of students' responses have also been inserted in appropriate sections to illustrate the cases presented.

All questions were attempted by almost all (100%) students who sat for the assessment. The analysis categorizes the performance as either poor/weak, average and good, if the percentage of students who scored 30 percent or more of the marks allocated to a particular question ranges from 0 - 29%, 30 - 49% and 50 - 100% respectively. Furthermore, three colours have been used in different figures, where green, yellow and red denote good, average and poor performance respectively.

2.1 Question 1: Multiple Choice Items

This question consisted of ten (10) multiple choice items composed from different topics in the syllabus. Students were required to choose the correct response from the given four alternatives. The weight of each item was one (1) mark.

Almost all students responded to this question. Statistics indicate that, one third, (33.0%) of the students scored 0 to 2 marks, 39.9 percent scored 3.0 to 4.0 marks and 27.1% scored 5.0 to 10 marks. The graphical representation of these data is as shown in the Figure 1.

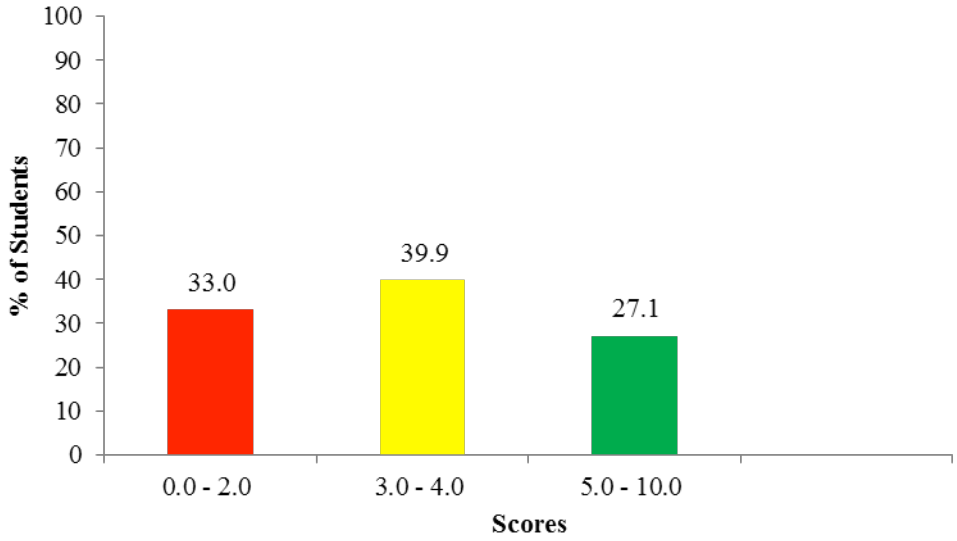


Figure 1: Students' performance in question 1.

Figure 1 indicates that, the general performance was good as the percentage of students who scored 3 to 10 marks was 67.0. The analysis revealed that, although many students answered well most of the items of the question, most of the students (33.0 %) who scored low marks faced challenges in responding to items (iii), (v), (vi), (viii) and (ix).

Item (iii) required the students to identify from the given alternatives a specie which is formed when an atom loses or gains electron. The correct response was 'A' (an ion), but most of the students were attracted to option 'B' (anion) and 'D' (Charged ion). The choice of the incorrect responses indicates that, students might have misconception on proper term given to an atom when it loses or gains electrons.

Item (v) was based on the topic of Air, Combustion, Rusting and Firefighting. The students were demanded to choose the type of fire which is associated with electrical equipment. The correct alternative was 'A' (Class E), but students opted wrongly to either alternative; 'B', 'C' or 'D' (Class C, Class F and Class B) respectively. Failure of students in this item might have been contributed to lack of sufficient knowledge on the classification of fires. These students did not realize that fires, are classified depending on the burning materials. Therefore, they ended up in guessing the correct answer.

In item (vi), the students were asked to identify the two processes involved during distillation. This item was based on the topic of Matter, and the correct response was 'C' (Evaporation and condensation). However, most of the students opted for either 'A', 'B' or 'D' (evaporation and sublimation, evaporation and crystallization, evaporation and decantation) respectively. Such students were attracted by these options because all the options started with the process 'evaporation', therefore, ended up in guessing the second process. The failure could have been attributed to lack of sufficient laboratory practice on different methods of separating mixtures.

Item (viii) was from the topic of Water and it enquired the students to identify the chemical used to test for water in a substance. The correct answer was 'C' (Cobalt chloride), but most of the students selected option 'D' (Copper (II) chloride). They failed to understand that when, water reacts with cobalt chloride paper, the paper changes from blue to pink whereas the reaction with copper (II) chloride has no such effect. These students might have confused the chemical, copper (II) chloride with anhydrous copper (II) sulphate which is a common chemical used to test for water in which it changes from white to blue.

Item (ix) was on the concept of heat sources and flames. The students were required to identify from the given alternatives what it means when a burning fuel produces a blue colour. The correct response was 'D' (adequate supply of oxygen with production of more heat). Nevertheless, students opted randomly to any of the four alternatives; that is: 'A' (adequate supply of oxygen with production of soot); 'B' (inadequate supply of oxygen with production of more heat) and 'C' (inadequate supply

of oxygen with production of soot). Guessing of the correct answer signifies that, the students had insufficient knowledge on the types and characteristics of flames.

2.2 Question 2: Matching Items

This question was aimed at assessing students' knowledge on the Periodic table. It consisted of List A and B. List A comprised of ten (10) items which were to be matched with the correct responses in List B.

This question was allocated 20 marks. Statistics show that, 51.7 percent of students scored from 0 to 5 marks while 27.2 percent and 21.1 percent scored 6 to 9 and 10.0 to 20.0 marks respectively. The pie chart in Figure 2 is a pictorial representation of these data.

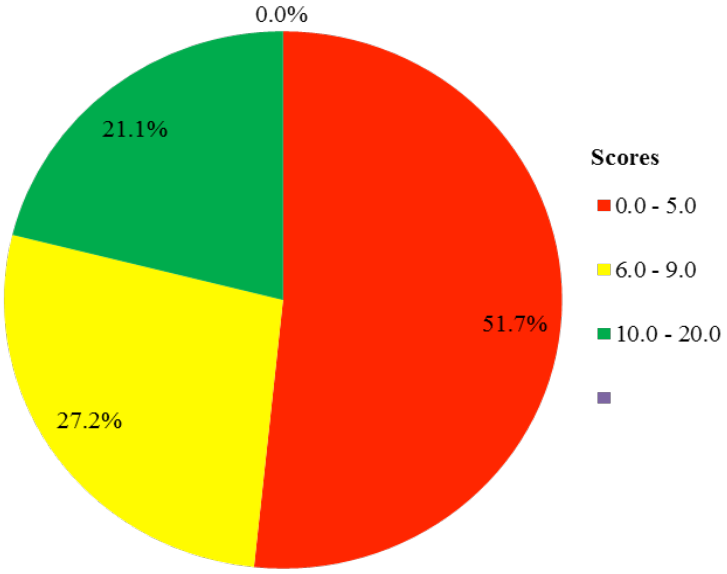


Figure 2: Students' performance in question 2

Figure 2 shows that, a total of 48.3 percent of the students scored from 6 to 20 marks and therefore the performance was average. The analysis of students' responses revealed that, most of the students who scored low marks (51.7%) matched wrongly items (i), (v), (ix) and (x).

Items (i) and (v) read: 'Group of elements which react quickly with water to form alkaline solution' and 'Group of elements which react slowly with water to form alkaline solution' respectively. The correct matches were 'F'

Alkali metals and 'I' Alkali earth metals correspondingly. It was noted that, many students interchanged the matches, 'F' in place of 'I' and vice versa.

Item (x) required the students to choose the response from List B which matched correctly with the 'Group of elements which have both metallic and non-metallic characteristics'. While the correct response was 'A' Metalloids; a good number of students matched it with 'D' Transition elements. Students could have been attracted by the word 'transition' which means 'change', with wrong conception that the elements can 'change' from metal to non-metal and vice versa.

Failure of the students in the stated items is an indication of inadequate knowledge on general trends on the periodic table since it is the one which explains change in properties of elements.

2.3 Question 3: Laboratory Rules and Safety, Matter; Formula, Bonding and Nomenclature

This question had two parts; (a) and (b). In part (a), the students were required to define the terms: oxidation state, an element, a compound and fainting. In part (b), they were required to write the chemical formulae of each of the following compounds; sodium sulphate, sodium chloride, calcium nitrate and calcium oxide.

The performance in this question was poor since only 27.0 percent scored 3.0 marks or more, out of 8 marks for this question. Statistics show that, 10.4 percent of students scored 3.0 marks, whereas 16.6 percent scored 4 to 8 marks. On the other hand, 73.0% scored from 0 to 2.0 marks in which more than one third (38.7%) scored 0 marks. These data can be visualized more easily in Figure 3.

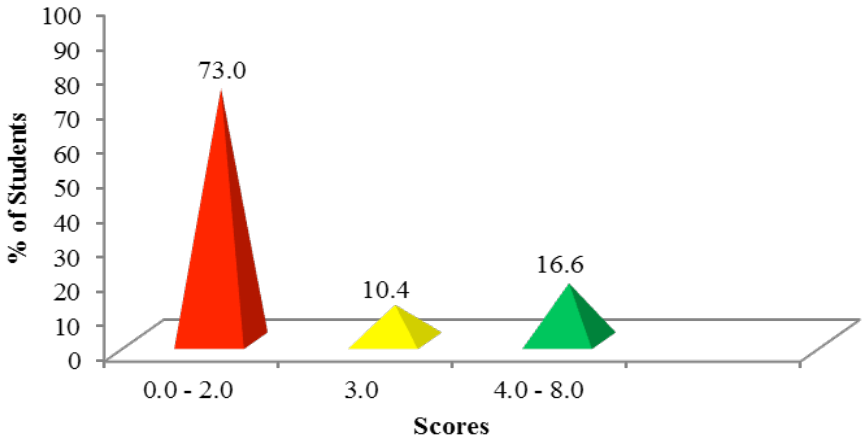


Figure 3: Students' performance in question 3.

Figure 3 shows that, many students (73.1%) scored low marks, (0 – 2). These students encountered difficulties in responding to both parts of the question. In part (a), they failed to give definitions of an element and a compound while they extremely omitted the definition of oxidation state. In part (b), they failed to write correct chemical formulae of almost all the given compounds. The analysis revealed that, students had inadequate knowledge on the rules of writing chemical formulae which involves exchange of valency and chemical symbols of the involved elements and radicals. Extract 3.1 shows an example of poor responses.

Extract 3.1

3. (a) Define the following terms:
(i) Oxidation state..... is the + Compound is the Substance element.....
(ii) An element. Is the Substance Pore Spilt the Substance the element. Process.....
(iii) A compound..... is the Substance which element Compound Substance in element.....
(iv) Fainting..... is the Substance element..... fainting ~~acorus~~ Calcuim.....

(b) Write the chemical formula for each of the following compounds:
(i) Sodium sulphate..... is the Calcuim is the Substance element
(ii) Sodium chloride. Is the element calcin.....
(iii) Calcium nitrate. Is the element no rray.....
(iv) Calcium oxide... is the oxide oxgen element Substance

In Extract 3:1, the student failed to define terms in part (a) and to write chemical formulae in part (b). In part (b), for example, he/she wrote inappropriate descriptions of the given compounds instead of writing chemical formulae. Moreover, the sentences are grammatically incorrect, implying that the student had poor English Language command.

Unlike the students who scored low marks, the students with good performance gave proper definitions of most of the given terms and wrote correctly the chemical formulae of the given compounds. The students who scored all marks were able to answer properly all parts of the question as Extract 3.2 shows.

Extract 3.2

3. (a) Define the following terms:

(i) Oxidation state... Is the measure of electron control that an atom has in a compound compared to the pure element

(ii) An element... Is a pure chemical substance which cannot be split in a simpler substance by simple chemical process.

(iii) A compound... Is the chemical substance that is made up of two or more substance in chemical combination.

(iv) Fainting... Is the failure of breathing due to low of oxygen in the brain.

(b) Write the chemical formula for each of the following compounds:

(i) Sodium sulphate... Na_2SO_4

(ii) Sodium chloride... NaCl

(iii) Calcium nitrate... $Ca(NO_3)_2$

(iv) Calcium oxide... CaO

In Extract 3.2 the student answered correctly all parts of the question.

2:4 Question 4: Oxygen

Question 4 stated; 'Gas 'X' can be prepared in the laboratory by the decomposition of hydrogen peroxide'. From this statement, the students were required to: (a) identify gas 'X', (b) state three physical properties of gas 'X', (c) mention three chemical properties of gas 'X' and (d) state three uses of gas 'X'.

More than one third (39.0%) of the students scored 3 marks or more out of 10 marks signifying an average performance in this question. The data indicate that, 14.3 percent scored 3 to 4 marks, 15.0 percent scored 5 to 7 marks and 14.0 percent scored 8 to 10 marks. On the other hand, 61.0 percent scored 0 to 2 marks with 37.1 percent scoring 0 marks.

Some of the students who performed poorly, incorrectly named the gas , as a result they failed to respond correctly to the other parts of the question [see Extract 4.1(a)], while others confused between the chemical properties with physical properties of the gas. Furthermore, several gave answers which were not related to the demand of the question. These students lacked both practical skills and theoretical knowledge of preparation and properties of oxygen.

The analysis also revealed that, students with moderate performance managed to correctly identify gas 'X' as oxygen, but failed to exhaust all the required properties and uses of the gas. Extract 4.1(b) is a sample answer illustrating this case.

Extract 4.1(a)

4. Gas X can be prepared in the laboratory by the decomposition of hydrogen peroxide.

(a) Identify gas X.
Hydrogen

(b) State three physical properties of Gas 'X'.
(i) Pop sound
(ii) A fuel
(iii) Help the rocket

(c) Mention three chemical properties of gas 'X'.
(i) Help the rocket
(ii) Help the cars.
(iii) Pop sound

(d) State three uses of gas 'X'.
(i) Used as a fuel
(ii) Used to make petrol
(iii) Used

In Extract 4.1(a), the student wrongly identified the gas as hydrogen (may be because the stem of the question bears the word 'hydrogen peroxide'). This led him/her to give properties and uses of hydrogen, contrary to the requirement of the question.

Extract 4.1(b)

4. Gas X can be prepared in the laboratory by the decomposition of hydrogen peroxide.

(a) Identify gas X.

Oxygen

(b) State three physical properties of Gas 'X'.

(i) It is colourless, odurless and tasteless

(ii) It is metal

(iii) It is non-metal

(c) Mention three chemical properties of gas 'X'.

(i) It is a reducing agent

(ii) It form metals

(iii) It form non-metals

(d) State three uses of gas 'X'.

(i) It used in breathing proces

(ii) It used in heating proces

(iii) It used as a fuel

In Extract 4.1(b) the student identified correctly the gas as oxygen but managed to write only few correct properties and uses of it.

However, the students who performed well in the question gave the proper answers by identifying the gas, stating both its physical and chemical properties and three uses of the gas. Extract 4:2 is one of the good responses.

Extract 4.2

4. Gas X can be prepared in the laboratory by the decomposition of hydrogen peroxide.

(a) Identify gas X.

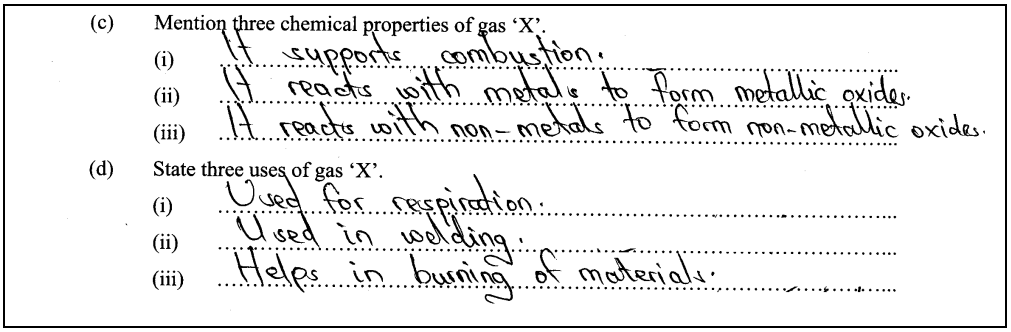
Oxygen

(b) State three physical properties of Gas 'X'.

(i) It is neutral to litmus paper.

(ii) It is colourless, odourless and tasteless

(iii) It is slightly soluble in water.


(c) Mention three chemical properties of gas 'X'.
(i) It supports combustion.
(ii) It reacts with metals to form metallic oxides.
(iii) It reacts with non-metals to form non-metallic oxides.
(d) State three uses of gas 'X'.
(i) Used for respiration.
(ii) Used in welding.
(iii) Helps in burning of materials.

The responses shown in Extract 4.2 fulfill the demand of the question. All parts are correctly answered.

2.5 Question 5: Matter; Formula, Bonding and Nomenclature

This question had parts (a) and part (b). Part (a) required the students to give the names of chemical compounds $(NH_4)_2CO_3$, $CaCl_2$, Na_2SO_4 and $KClO_3$ while in part (b), the students were required to differentiate electrovalent from covalent compounds and solution from suspension. The question was allocated a total of ten marks.

Statistics show that, 68.5 percent of the students scored 0 to 2 marks with 40.3 percent scoring 0 marks. The percentage of the students who scored 3 to 4 marks was 12.8 while 11.4 percent and 7.3 percent scored 5 to 7 and 8 to 10 marks respectively.

Majority of the students (40.3%) who scored a 0 mark gave incorrect answers while some of them left some blank spaces. In part (a), the pattern of the students' answers was of two main categories: first category included students who didn't know names of the constituent atoms or radicals; for example carbonate was named as sulphate. The second category was students who lacked knowledge of combining power of different atoms or radicals and therefore named the compounds wrongly, for example Na_2SO_4 was incorrectly named as Sodium II sulphate IV. Such answers suggest that, these students had insufficient knowledge of chemical formulae. Furthermore, in part (b) they failed to differentiate electrovalent compounds from covalent compounds and solution from suspension Extract 5:1 illustrates one of the cases of poor performance.

Extract 5:1

5. (a) Write the name of each of the following compounds:

(i) $(NH_4)_2CO_3$ Carbon IV oxide

(ii) $CaCl_2$ chalcium II oxide

(iii) Na_2SO_4 Sodium oxide

(iv) $KClO_3$ Chalcium oxide

(b) Give three differences between the following:

(i) Electrovalent compounds and covalent compounds.

Electrovalent Compounds	Covalent Compounds
Use electro compounds	Use covalent compound
Has hig P.D	Has low P.D
It is not uniform	It is uniform

(ii) Solutions and suspensions.

Solutions	Suspensions
New substance is formed	New substance is not formed
Chemical reaction take place	Physical reaction take place.
Under go compound	Undergo element.

In Extract 5:1, the student's responses in part (b)(ii) are focused on the differences between chemical and physical changes instead of solution and suspension. However, all answers given are not correct.

On the other hand, students who performed well gave correct chemical names of the given compounds and properly differentiated electrovalent compounds from covalent compounds and solutions from suspensions. Extract 5.2 shows an example of good response.

Extract 5.2

5. (a) Write the name of each of the following compounds:

(i) $(NH_4)_2CO_3$ Ammonia Carbonate

(ii) $CaCl_2$ Calcium chloride

(iii) Na_2SO_4 Sodium sulphate

(iv) $KClO_3$ Potassium Chlorate (V)

(b) Give three differences between the following:

(i) Electrovalent compounds and covalent compounds.

Electrovalent Compounds	Covalent Compounds
Involve transfer of electron	Involve sharing of electrons
Are electrolytes.	Are non-electrolytes.
Have high boiling and melting points.	Have low boiling and melting points.

(ii) Solutions and suspensions.

Solutions	Suspensions
Are transparent.	Are opaque.
Are homogeneous	Are heterogenous.
Particles are completely dissolved.	Particles are not completely dissolved.

In Extract 5.2 the student gave the correct names of the compounds and properly differentiated the given terms.

2.6 Question 6: Matter; Water; Formula, Bonding and Nomenclature

The question consisted of three parts; (a), (b) and (c). In part (a), the students were required to state two chemical properties of water. In part (b), they were required to calculate the molar mass of each of: (i) $Al_2(SO_4)_3$, (ii) $NaHCO_3$ and (iii) Fe_2O_3. Part (c) of the question required the students to state whether the burning of charcoal and rusting of iron sheets is a physical or a chemical change.

The performance in this question was not good as many students (82.3%) scored 0 to 2.0 marks of the 7 marks allocated, with 32.5 percent scoring a zero mark. The percentage of the students who scored from 2.5 to 3.0 marks was 9.5 and from 3.5 to 7 marks was 8.2 percent. Only 0.4 percent managed to score full marks. Figure 4 gives the summary of these data.

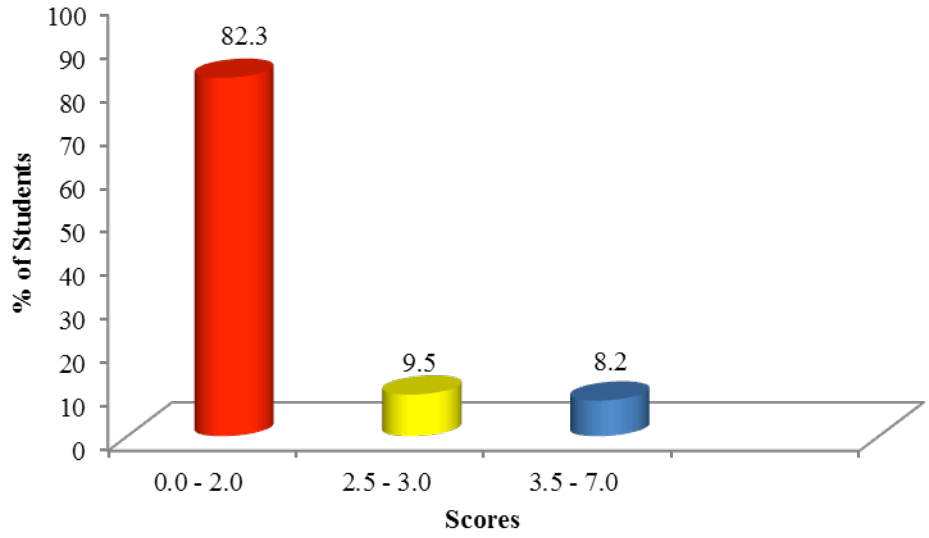


Figure 4: Students' performance in question 6.

As Figure 4 shows, many students (82.3%) scored low marks in this question. Students with low scores performed poorly in both parts of the question. Despite the displayed atomic masses on the question paper, these students failed to perform the required calculations. This shows that, the students had poor knowledge on molar masses and computational skills. Extract 6.1 shows a sample of poor responses.

Extract 6:1

6. (a) State two chemical properties of water.

(i) It occurs naturally in all three states of matter

(ii) Is the solvent that can dissolve many solutes.

(b) Calculate the molar mass of each of the following compounds:

(i) $Al_2(SO_4)_3$.

$= Al_2(SO_4)_3$

$(2\times3)+5O_{12}=0$

$6+SO_{12}$

$6+-2+-2\times12$

$6+-2+-24$

$6+-26$

-26

$\therefore = -26gms$

(ii) $NaHCO_3$.

$NaHCO_3$

$1+1+4+(-2\times3)$

$6+-6$

$\therefore = 0$

(iii) Fe_2O_3.

Fe_2O_3

$= Fe_2+-2\times3$

Fe_2+-6

$2F=6$

$F=3$

$\therefore = Fe(III)$

$\therefore =$ Iron (III)

(c) State whether each of the following is a chemical or physical change:

(i) Burning of charcoal..Solid to gas

(ii) Rusting of iron sheets..solid to Liquid

In Extract 6.1 the student failed to give the chemical properties of water and to calculate the molar masses. He/she attempted to calculate oxidation number instead of mass number.

On the other hand, a few students who scored high marks were able to; state chemical properties of water, calculate molar masses of the given compounds and identify the type of change which occurs during burning a charcoal and rusting of iron sheets. Extract 6.2 shows one of the good responses.

Extract 6:2

6. (a) State two chemical properties of water.

(i) It changes anhydrous copper (II) sulphate from white to blue.

(ii) It changes anhydrous cobalt (II) chloride from blue to pink.

(b) Calculate the molar mass of each of the following compounds:

(i) $Al_2(SO_4)_3$.

M·M = (27 x 2) + (32 x 3) + (16 x 12)
= (54 + 96 + 192) g/mol
Molar mass = 342 g/mol

(ii) $NaHCO_3$.

M·M = 23 + 1 + 12 + (16 x 3)
= 23 + 1 + 12 + 48
= 24 + 60
Molar mass = 84 g/mol

(iii) Fe_2O_3.

M·M = (56 x 2) + 16 x 3
= 112 + 48
Molar mass = 160 g/mol

(c) State whether each of the following is a chemical or physical change:

(i) Burning of charcoal..... Chemical change .....

(ii) Rusting of iron sheets..... Chemical change .....

In Extract 6.2, the student correctly presented the chemical properties of water and accurately calculated the molar masses of the given compounds. Finally, he/she identified the type of changes of matter that were asked.

2.7 Question 7: Introduction to Chemistry; Atomic Structure; Periodic Classification

The question had two parts; (a) and (b). In part (a), the question tested students' skills on electronic configurations and knowledge of periodic table in which some elements were represented by arbitrary letters. The students were required to write collective names of elements in group II and VIII and to name the elements that were represented by the letters A, B, C and D on the periodic table. They were also required to write the electronic configurations of the elements that were represented by letters E, F, G and H. In part (b), the students were assessed on the applications of Chemistry in daily life in the fields of medicine and food and beverage industry.

Statistics show that, about half (47.0.0%) of the students scored from 0 to 2.0 marks out of the 10 marks allocated to this question. The students who scored 3.0 to 4.0 marks were 27.4 percent, while those who scored 5.0 to 10 marks were 25.6 percent.

The percentage of students who scored 3.0 to 10.0 marks was 53.0. These students showed a good mastery of general knowledge of the features of the periodic table as they managed to write collective names of the elements in group II and VIII and the names of the elements represented by the given letters. Similarly, they had enough skills in electronic arrangements as they correctly wrote the electronic configurations of the elements E, F, G and H. Furthermore, they were able to mention the products made in the fields of medicine and food and beverage industry, which are the results of daily life application of Chemistry. Extract 7.1 shows an example of good responses.

Extract 7:1

7. (a) Study the following Periodic Table and then answer the questions that follow.

I	II	III	IV	V	VI	VII	VIII
A							B
	C		D		E		
F	G					H	

(i) Write the collective name of elements in:

Group II ....Alkaline earth metals....

Group VIII ....Noble gases....

(ii) Name the elements which are represented by the following letters:

A ....Hydrogen.... B ....Helium....

C ....Beryllium.... D ....Carbon....

(iii) Write the electronic configuration of the following elements:

E ....$_8$E → 2:6.... F ....$_{11}$F → 2:8:1....

G ....$_{12}$G → 2:8:2.... H ....$_{17}$H → 2:8:7....

(b) Name two products in each of the following fields made by the application of chemistry.

Field	Products
(a) Medicine	Panadol and Chloroquen
(b) Food and beverage industry	Baking powder and drinks such as soda

The answers illustrated in Extract 7.1 are indication that, the student was competent on electronic configurations, periodic classification and applications of Chemistry. However, the word chloroquine is misspelt.

The students with low scores (47.0%) had inadequate knowledge, particularly on the aspects of electronic configurations, periodicity, and the general periodic trends as they failed to respond well on the demand of the question. They failed also to name at least two products which are the results of application of Chemistry. For example, one of the students wrote crops such as *tobacco, beans and cocoa* as products which are made by the application of Chemistry. Extract 7.2 is one of the poor responses.

Extract 7.2

7. (a) Study the following Periodic Table and then answer the questions that follow.

I	II	III	IV	V	VI	VII	VIII
A							B
	C		D		E		
F	G					H	

(i) Write the collective name of elements in:

Group II ....Ca.....

Group VIII .....Ba.....

(ii) Name the elements which are represented by the following letters:

A ....Al..... B .....Berilium.....

C .....carbon..... D .....Dre hydrogen.....

(iii) Write the electronic configuration of the following elements:

E .....Element..... F .....Fe.....

G .....Cle..... H .....He.....

(b) Name two products in each of the following fields made by the application of chemistry.

Field	Products
(a) Medicine	Tobacco
(b) Food and beverage industry	~~bean~~ beans ~~cocoa~~ and cocca

In Extract 7.2 the student associated arbitrary letters with real names of elements in the periodic table whose initial alphabet resemble the given ones and wrote its name. For example, letter A = Al; B = Berilium; C = carbon.

2.8 Question 8: Formula, Bonding and Nomenclature; Laboratory Techniques and Safety

The question had two parts; (a) and (b). In part (a), the students were required to calculate the oxidation number of the underlined elements in $K_2\underline{C}_2O_4$ and $\underline{S}O_3^{2-}$. In part (b), they were demanded to explain the uses of each of the following laboratory apparatus: thistle funnel, pipette, wire gauze and burette.

The general performance in this question was poor as 81.9 percent of the students scored 0 to 2.5, out of 9 marks that were allocated to the question. The data further show that, many students scored low (0 to 2.5) marks out of which 61.1 percent scored a zero mark. On the other hand, students who scored from 3 to 9 marks were 18.1 percent, out of which only 0.1 percent scored all 9 marks. The summary of these data is presented in Figure 5.

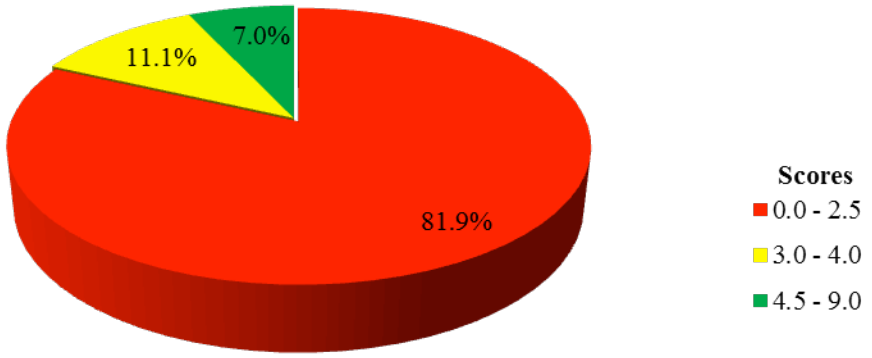


Figure 5: Students' performance in question 8.

Figure 5 indicates that, many students (81.9%) scored low marks. These students had a problem in calculating the oxidation numbers. For example, some of them used atomic masses of elements in calculating oxidation numbers instead of oxidation states of the elements, while others misunderstood the use of negative and positive signs in the concept of oxidation. The students also failed to give proper uses of the given laboratory equipment. This implies that, the students had insufficient laboratory practical knowledge and skills on the basic laboratory apparatuses and their uses. Extract 8.1 illustrates a sample of a poor response.

Extract 8.1

8. (a) Calculate the oxidation number of the underlined elements:

(i) $K_2\underline{C}_2O_4$	(ii) $\underline{S}O_3^{2-}$
$K_2+C_2+O_4 = 0$ $(39)2+C_2+(16)4 =$ $78+C_2+64=0$ $C_2+78+64=0$ $2(c)+142=0$ $\frac{2}{2}(c) = \frac{-142}{2}$ $c=-71$	$S+O_3=-2$ $32+O_3=-2$ $3(0)=-2-32$ $\frac{3(0)}{3} = \frac{-34}{3}$ $0=-11\frac{1}{3}$

(b) What is the use of each of the following apparatus?

(i) Thistle funnel ..It.is.used.for...Separating.heterogenious..mixture

(ii) Pipette ...It.is.used.for.Sucking.a.fluids.....

(iii) Wire gauze ..To.heat...heavenly...under...the...container....

(iv) Burette..It.is.used.to.measure...volume.of...specific.liquids.

In Extract 8.1, the student used atomic masses of elements instead of oxidation states in calculating oxidation numbers of underlined elements. Similarly, the student failed to state the uses of the given laboratory apparatuses.

The few students (18.1%) who scored relatively high marks were able to calculate the oxidation numbers of C and S in the $K_2\underline{C}_2O_4$ and $\underline{S}O_3^{2-}$ respectively. Moreover, they correctly stated the uses of the given laboratory apparatuses. These students showed to have mastered well the concepts of oxidation states and the basic chemistry laboratory apparatuses. Extract 8.2 shows a correct answer from one of students.

Extract 8.2

8. (a) Calculate the oxidation number of the underlined elements:

(i) $K_2\underline{C_2}O_4$	(ii) $\underline{S}O_3^{2-}$
Soln $K_2C_2O_4 = 0$ $(1\times2)+(C\times2)+(-2\times4) = 0$ $2+2C+(-8) = 0$ $2C = +8-2$ $\frac{2C}{2} = \frac{6}{2}$ $C = +3$	Soln $\underline{S}O_3^{2-}$ $\underline{S}O_3 = -2$ $S+(-2\times3) = -2$ $S-6 = -2$ $S = 6-2$ $S = +4$ $\therefore S = +4$

(b) What is the use of each of the following apparatus?

(i) Thistle funnel ..Used when dropping or adding liquids in an experiment..

(ii) Pipette ....Used to measure specific volume of liquids.....

(iii) Wire gauze ....Used for traping soot when heating a substance.....

(iv) Burette..Used for measuring and dispensing liquids.....

In Extract 8.2, the student applied appropriate formula, carried out proper calculations and eventually obtained correct oxidation number of C and S. Similarly, he/she correctly stated the uses of the given laboratory apparatuses.

2.3 Question 9: Hydrogen

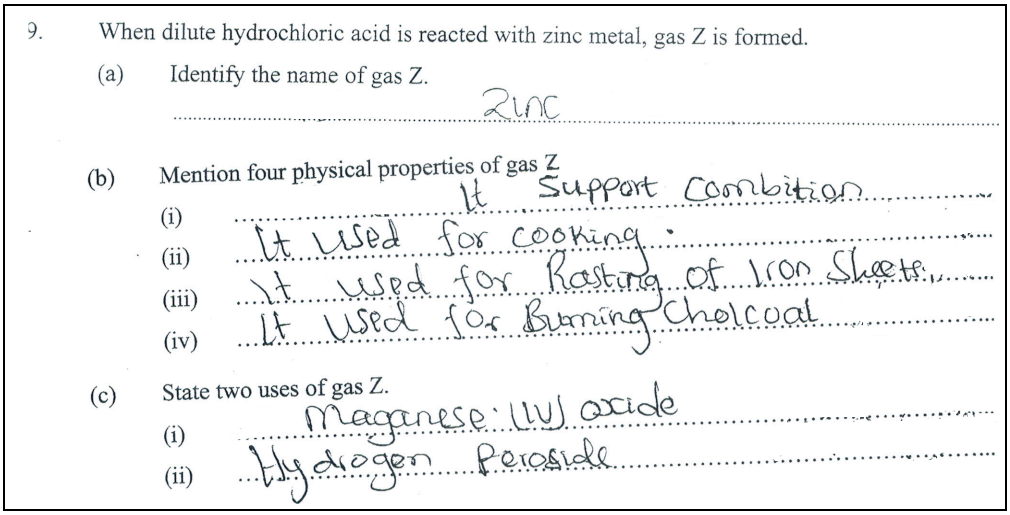
The question had three parts; (a), (b) and (c). In part (a), the students were required to identify the name of gas Z which is produced when dilute hydrochloric acid is reacted with zinc metal. In part (b), they were asked to mention four physical properties of gas Z while in part (c), the students were enquired to state two uses of gas Z.

In this question, 68.8 percent of the students scored from 0 to 2.0 out of 7 marks, out of which 44.3 percent scored a zero mark. The percentage of the students who scored from 3 to 7 marks was 31.2 of which 22.9 percent

scored from 4 to 7 marks. Only 3 percent of the students scored full marks. These data indicate an average performance in the question.

The students who scored low marks had insufficient knowledge on the hydrogen gas. For example, some of them named carbon dioxide and oxygen as the gases which are prepared in the laboratory when zinc granules react with dilute hydrochloric acid. They failed to reason out that HCl is constituted by hydrogen and chlorine, therefore, the reaction with zinc could not produce either CO_2 or O_2 gases. Extract 9.1 present similar poor response.

Extract 9.1


9. When dilute hydrochloric acid is reacted with zinc metal, gas Z is formed.

(a) Identify the name of gas Z.

Zinc

(b) Mention four physical properties of gas Z

(i) It Support Combition

(ii) It used for cooking

(iii) It used for Rasting of Iron Sheets

(iv) It used for Burning Charcoal

(c) State two uses of gas Z.

(i) Maganese (IV) oxide

(ii) Hydrogen Peroxide

In Extract 9.1, the student wrongly identified gas Z as "zinc" and instead of writing physical properties of hydrogen gas, he/she wrote the uses which do not relate to the gas.

The few students who scored high marks adhered to the demands of the question. They presented proper answers, showing that they had enough knowledge on the Hydrogen gas. Extract 9.2 shows the responses from a student who performed well in this question.

Extract 9.2

9. When dilute hydrochloric acid is reacted with zinc metal, gas Z is formed.

(a) Identify the name of gas Z.

Oxygen.

(b) Mention four physical properties of gas Z.

(i) Used in welding

(ii) Used in Respiration.

(iii) Used in flying ballon

(iv) Shake the It is friendly to the fuel

(c) State two uses of gas Z.

(i) Used by a human being in the body.

(ii) Used in ma bollowing the wind vane

Extract 9.2 shows the student's good responses which meet the demand of the question.

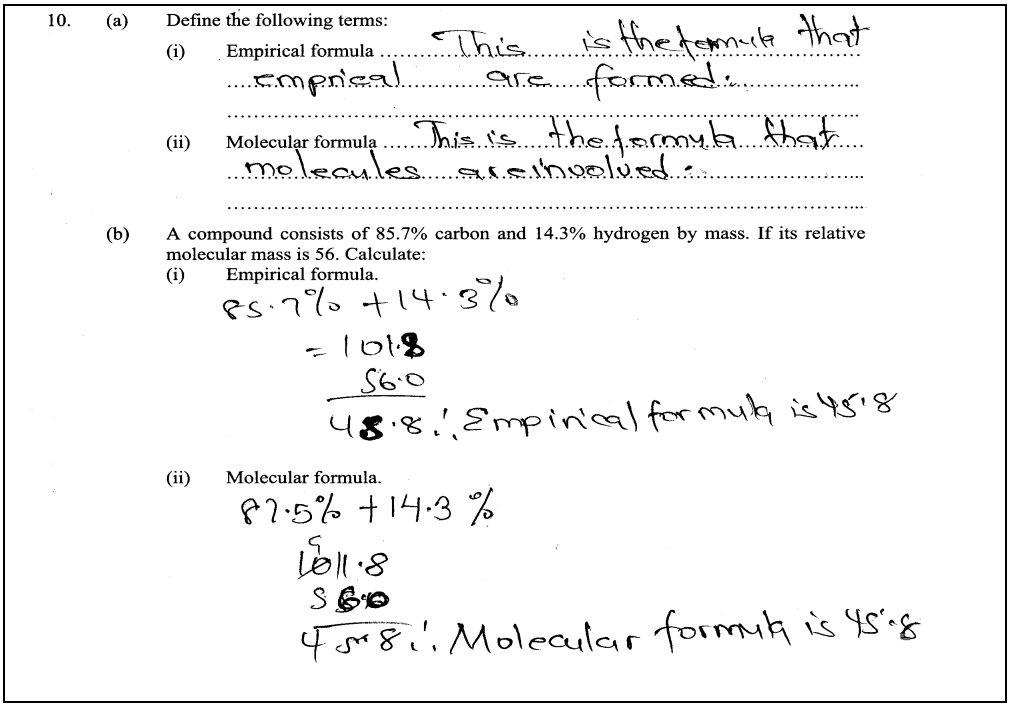
2.10 Question 10: Formula, Bonding and Nomenclature

This question aimed at assessing students' knowledge and skills on the concepts of empirical and molecular formulae; and how to compute them from percentage composition of a given compound. In part (a), students were required to define the terms empirical formula and molecular formula. In part (b), they were required to calculate empirical formula and molecular formula of a compound which consisted of 85.7% carbon and 14.3% hydrogen by mass, given that the compound's relative molecular mass was 56.

The question was attempted by almost all students where 69.2 percent scored below 3 out of 9 marks. About half of the students (50.8%) scored a zero mark. The statistics further show that, the percentage of the students who scored from 3 to 9 marks was 30.8, out of which only 5.8 percent scored all 9 marks. These data implies average performance in this question.

The analysis of the students' responses showed that the students who had low scores failed to calculate empirical and molecular formula of the given compound. Most of these students had also computation skills. Moreover, some failed to define both empirical and molecular formulae. For example, one of the students wrote *"Empirical formula is formula where by elements are added in a compound* and *Molecular formula is formula where by elements are removed in a compound''*. Similar inadequate responses are shown in Extract 10.1. Such inadequate answers imply that, students had insufficient knowledge and skills on the concept of valence and chemical formulae.

Extract 10.1


10. (a) Define the following terms:

(i) Empirical formula ... This is the formula that empirical are formed. ...

(ii) Molecular formula ... This is the formula that molecules are involved. ...

(b) A compound consists of 85.7% carbon and 14.3% hydrogen by mass. If its relative molecular mass is 56. Calculate:

(i) Empirical formula.

85.7% + 14.3%

= 101.8

56.0

4 5.8 ∴ Empirical formula is 45.8

(ii) Molecular formula.

87.5% + 14.3 %

5

1011.8

5 6.0

4 5.8 ∴ Molecular formula is 45.8

In Extract 10.1, the student was unable to define the terms and to calculate empirical and molecular formulae.

However, a few students who scored high marks were able to present clear and correct definitions of empirical formula and molecular formula. They also managed to calculate both empirical and molecular formula. This implies that, these students were knowledgeable on the relationship

between percentage compositions; atomic masses and the relative molecular mass of the compound in calculating both its empirical and molecular formula. Extract 10.2 illustrates a sample of good responses.

Extract 10.2

10. (a) Define the following terms:

(i) Empirical formula ...is the simplest formula expressing it composition by mass.....

.....

(ii) Molecular formula ...is the formula of compound showing number of each kind of atom in present of one molecule to form compound.....

(b) A compound consists of 85.7% carbon and 14.3% hydrogen by mass. If its relative molecular mass is 56. Calculate:

(i) Empirical formula.

Element	C	H
Percentage given	85.7	14.3
Percentage given / R.A.m	85.7 / 12 = 7.14	14.3 / 1 = 14.3
Divide smallest ratio	7.14 / 7.14 = 1	14.3 / 7.14 = 2

E.F = CH_2

(ii) Molecular formula.

soln

$(E.F)_n = M.F$

$(E.F)_n = R.M.M$

$(CH_2)n = 56$

$12n + 2n = 56$

$\frac{14n}{14} = \frac{56}{14}$

$n = 4$

$(CH_2)4 = C_4H_8$

Molecular formula = C_4H_8

In Extract 10.2, the student provided the correct definitions and calculated both empirical and molecular formulae as required.

3.0 PERFORMANCE OF STUDENTS IN DIFFERENT TOPICS

The question wise analysis of the students' responses revealed that question 1 which was multiple choice items was performed well. The items of the question were from different topics which were: Air, Combustion, Rusting and Firefighting, Matter, Scientific Procedures, Heat Sources and Flames and Laboratory Techniques and Safety. Question 7 which was from the topics of Periodic Classification, Atomic Structure and Introduction to Chemistry had also good performance. Good performance was attributed to sufficient knowledge on the items tested in these topics.

The questions number 2, 4, 5, 9 and 10 had average performance. These questions were set from the topics of Periodic Classification, Oxygen, Formula, Bonding and Nomenclature, Hydrogen and Matter. Average performance in the stated topics was due to partial knowledge of students on the concepts tested in these topics.

Further analysis showed that, question 3, 6 and 8 were performed poorly by most students. In these questions most students experienced difficulties in answering items from the topic of Formula, Bonding and Nomenclature particularly, on writing chemical formulae of the given compounds, naming chemical compounds and calculation of molar mass of compounds and oxidation number of elements. This indicates that, the students had inadequate knowledge on the rules of writing chemical formulae, which involves exchange of valency and chemical symbols of the involved elements and radicals. Further, they had poor computational skills. However, students' performance in terms of the assessed topics in 2015 is as seen in the Appendix.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The overall analysis showed that, the general performance of the students in this paper was average as 38.0 percent passed the assessment. However there is an increase in performance by 1.84% in 2015 as compared to 2014.

The analysis revealed that poor performance in different questions could be attributed to students' insufficient of both theoretical and practical experiences in the classroom and laboratory works, hence failed to obtain necessary Chemistry knowledge, skills, and principles. Poor mastery of English Language was also an obstacle that hindered them in understanding the demand of the question and presenting clear and correct points to the specific questions.

Apart from that, inadequate preparation of students for mastering the subject might be another reason that led to poor performance. This could be either due to the shortage of Chemistry professional personnel and facilities or negligence of some learners and implementers in effecting their teaching and learning responsibilities accordingly. These discrepancies' can be cleared out during teaching and learning process.

The National Examinations Council of Tanzania hopes that, the feedback given in this report will enable educational stakeholders to take appropriate actions to bring positive and progressive changes towards raising the standard of performance of FTNA in Chemistry subject.

4.2 Recommendations

Based on the observations made through this Report, it is recommended that:

(a) Teachers should devote more time and special attention in enabling students to achieve all the objectives stipulated in the syllabus.

(b) Students should be motivated through various approaches such as reading different novels, practicing in writing and speaking so that they develop competences in English Language.

(c) Since the periodic table is the building block of the entire Chemistry, teachers should give special attention to enable students to develop basic skills on the periodic classification.

(d) Schools should ensure that laboratory activities are properly administered so that students can acquire practical skills.

Appendix

ANALYSIS OF STUDENTS' PERFORMANCE PER TOPIC IN 2015

S/n	Topic	Question Number	The % of Students Who Scored 30 % or Above	Remarks
1.	Multiple Choice Items (The Scientific Procedure; Formula, Bonding and Nomenclature; Air Combustion, Rusting and Fire Fighting; Heat Sources and Flames; Matter; Laboratory Techniques and Safety; Water)	1	67.0	Good
2.	Periodic Classification; Introduction to Chemistry, Atomic Structure.	7	53.0	Good
3.	Periodic Classification,	2	48.3	Average
4.	Oxygen	4	39.0	Average
5.	Formula, Bonding and Nomenclature; Matter	5	31.5	Average
6.	Hydrogen	9	31.2	Average
7.	Formula, Bonding and Nomenclature	10	30.8	Average
8.	Laboratory Rules and Safety, Formula, Matter, Bonding and Nomenclature	3	27.0	Weak
9.	Formula, Bonding and Nomenclature; Laboratory Techniques and Safety	8	18.1	Weak
10.	Water; Formula, Bonding and Nomenclature; Matter	6	17.7	Weak