THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

STUDENTS' ITEMS RESPONSE ANALYSIS REPORT FOR THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2018

032 CHEMISTRY

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FOREWORD

This Students' Items Response Analysis Report has been prepared to provide feedback to students, teachers, parents, policy makers and the public in general on the performance of the students who sat for Chemistry in Form Two National Assessment (FTNA), 2018.

Form Two National Assessment is a two year formative evaluation which, among other things, shows the effectiveness of the education system in general and the 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 of some of the reasons behind the performance of the students in Chemistry subject. The report highlights some of the factors that made the students score high marks and also the factors that caused some of the students score low marks in each question. The factors which made some of them fail to score high marks include inadequate knowledge in the respective topics, inability to identify the demands of the questions, poor mathematical background, poor English proficiency and lack of adequate knowledge on laboratory equipment. The feedback provided will enable the education administrators, school managers, teachers and students to identify proper measures to be taken in order to improve students' performance in future assessments administered by the Council.

The Council would like to thank Chemistry Coordinators, Examiners and all others who participated in the preparation of this report. The Council would also like to express sincere appreciation to all staff members who participated in analysis of data used in this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report analyses the performance of the students who sat for the Form Two National Assessment (FTNA) 2018 in Chemistry. The 2018 Chemistry Assessment was set according to the FTNA format which was developed from the 2010 Chemistry syllabus for secondary education for Form I and II levels.

The paper was comprised of two sections, namely A and B. Section A consisted of ten multiple choice items, five matching items and five filling in the blanks items. Section B was comprised of eight short answer questions. Section A had a total of 20 marks whereas section B carried 80 marks. The students had to answer all the questions.

A total of 505,230 students sat for the assessment, and the analysis of the results shows that the overall performance was average (47.6%) as the students' scores were above 30 per cent in most of the questions. Furthermore, the results show that the students' performance in 2018 has improved as 53.22 per cent passed the assessment compared to 51.98 per cent who passed the assessment in the FTNA of 2017. Hence, the performance in 2018 has improved by 1.24 per cent.

This report is divided into four sections. The first section covers the introduction. The second section focuses on the analysis of the students' performance in each question, and the third section comprises the analysis of performance in each topic. Finally, conclusion and recommendations are given in the fourth section.

2.0 ANALYSIS OF STUDENTS' PERFORMANCE IN EACH QUESTION

In this analysis, students' performance has been categorized as poor, average or good on the basis of score intervals 0 - 29, 30 - 64 and 65 - 100 respectively (see Appendix 1).

2.1 SECTION A

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

2.1.1 Question 1: Multiple Choice Items

The items in this question were set from the following topics: Introduction to Chemistry; Matter; Air, Combustion, Rusting and Firefighting; Heat Sources and Flames; Atomic Structure; and Laboratory Techniques and Safety. The question was comprised of 10 items. In each item, students were required to choose the correct answer from alternatives A to D.

The question was attempted by 505,217 students, which is equivalent to 99.9%. The general performance in this question was good with 94.8% of the students scoring 3.0 marks and above. Further analysis of the performance is shown in Figure 1.

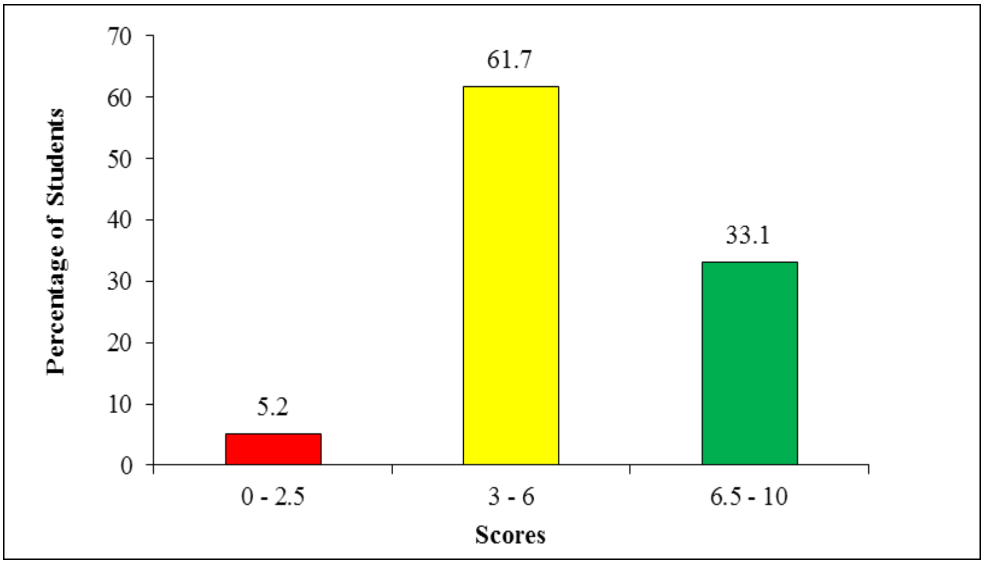


Figure 1: *Students' performance in question 1.*

Figure 1 shows that 61.7% of students scored 3.0 to 6.0 marks, 33.1% scored 6.5 to 10 marks while 5.2% scored 0 to 2.5 marks.

Students who scored high marks managed to answer most parts of the question correctly and a few others (0.8 %) scored full marks. Generally, the good performance of students in this category is a sign that they had good understanding of the subject matter on the topics assessed. However, majority of the students in this category gave incorrect answers for items (iv) and (vii). Item (iv) required the students to identify the process of removing solid contaminants from water. Most of the students opted for either *B* 'water solidification', *C* 'water purification', or *D* 'water sedimentation', leaving the correct answer A 'water decantation'. Item (vii) directed students to choose the mathematical expression for obtaining the number of neutrons by using mass number (Y) and atomic number (W). Majority of the students failed to identify the correct answer which was C 'Y-W', instead they opted for the distractors.

On the other hand, some students answered most of the items incorrectly as they were not conversant with the respective subject matter and they scored at most 2 marks in this question. For example in attempting item (ix) which read "Fainting is a sudden loss of", one student chose distractor *A* 'confidence'. Such an answer suggests that the student was not aware of the meaning of *fainting*. Moreover, in item (ii) which required them to identify the states of matter, one student opted for A 'Gas, liquid and mixture'. The student did not understand that *mixture* is not a state of matter. Such incorrect answers are an indication that the students lacked adequate knowledge of the various topics tested.

2.1.2 Question 2: Matching Items and Filling in the Blanks

The question comprised parts (a) and (b). Part (a) consisted of five matching items while part (b) had five filling in the blanks items. Part (a) was composed from the topics of Formula, Bonding and Nomenclature whereas part (b) was composed from the topics of Air, Combustion, Rusting and Firefighting; Laboratory Techniques and Safety.

The question was attempted by 505,221 students, which is equivalent to 99.9% and skipped by 9 students. Generally, the performance was good as 61% of the students scored 3.0 marks and above. Summary of the performance is presented in Figure 2.

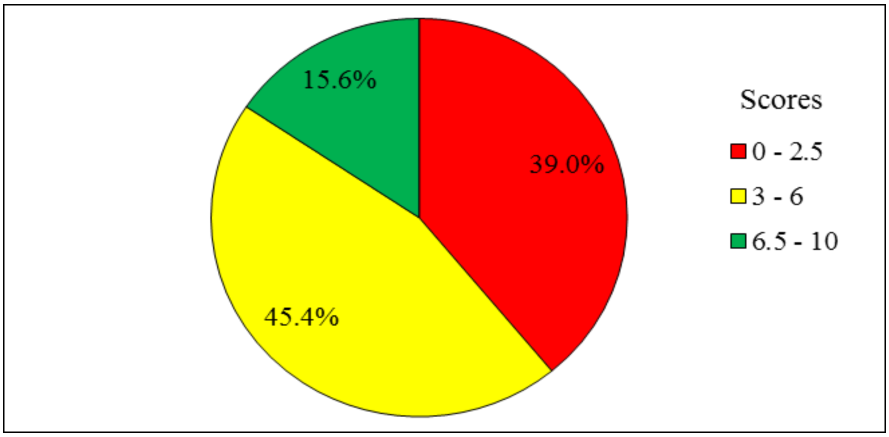


Figure 2: *Students' performance in question 2.*

Figure 2 shows that 45.4% of the students scored 3.0 to 6.0 marks, 39.0% scored 0 to 2.5 while 15.6% scored 6.5 to 10 marks.

Students who scored high in this question managed to do the matching correctly. This indicates that they had sufficient knowledge about the concept of bonding. Also students in this category answered correctly the other items in part (b) by filling in the blanks in (i), (ii), (iii), (iv) and (v) using the terms 'combustion', 'rusting', 'fire triangle', 'burns' and 'saturated solution' respectively. Some of the candidates in this category gave incorrect answers for (b) (i) by writing 'bruise' or 'injury' instead of 'burns'.

Contrary to that, there were students who scored below 3.0 marks because they could not correctly match the concepts. They also failed to fill in the blanks using the correct terms. In response to part (a), item (i) which enquired for a term that is used to describe a reaction that releases energy in form of light and heat, one student wrote 'nuclear energy' instead of 'combustion'. Other students wrote 'flame' because a combustion process is characterized by formation of a flame. Thus, these students lacked sufficient knowledge of the tested concepts.

2.2 SECTION B

This section consisted of eight (8) short answer questions. Each question carried a total of ten (10) marks. The pass score for each question was 3.0 marks and above.

2.2.1 Question 3: Laboratory Techniques and Safety

The question consisted of parts (a) and (b). Both parts were composed from the topic of Laboratory Techniques and Safety. In part (a), students were asked to indicate the meaning of the warning signs given. In part (b), they were asked to give the importance of First Aid in four points.

The question was attempted by 505,226 students which is equivalent to 99.9%. The general performance in this question was good with 73.8 % of the students scoring 3.0 marks and above. Further analysis of the performance is shown in Figure 3.

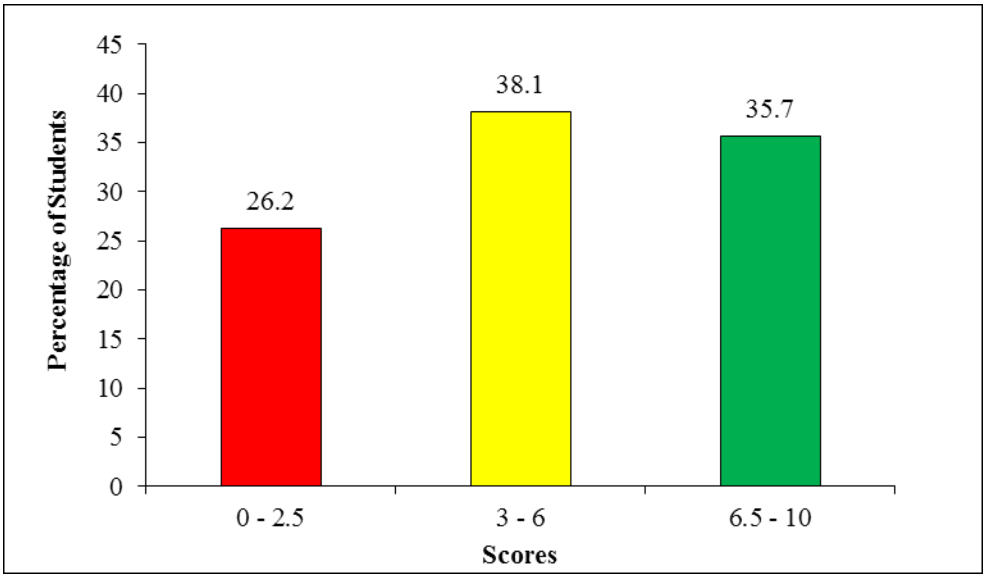


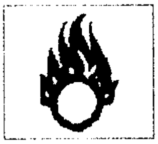
Figure 3: *Students' performance in question 3.*

Figure 3 depicts that 35.7% scored 7 to 10 marks with 8.4% scoring full marks. Students who scored 4 to 6 marks were 38.1 % while 26.2% scored 0 to 3.0 marks with 9.7% scoring zero.

Students who scored high marks in this question indicated the meaning of the warning signs as 'flammable', 'toxic', 'oxidant 'and 'irritant'. They also managed to correctly provide the importance of First Aid, indicating that they had adequate knowledge of the topic of Laboratory Techniques, Rules and Safety. Extract 3.1 is an example of good responses to this question.

Extract 3.1

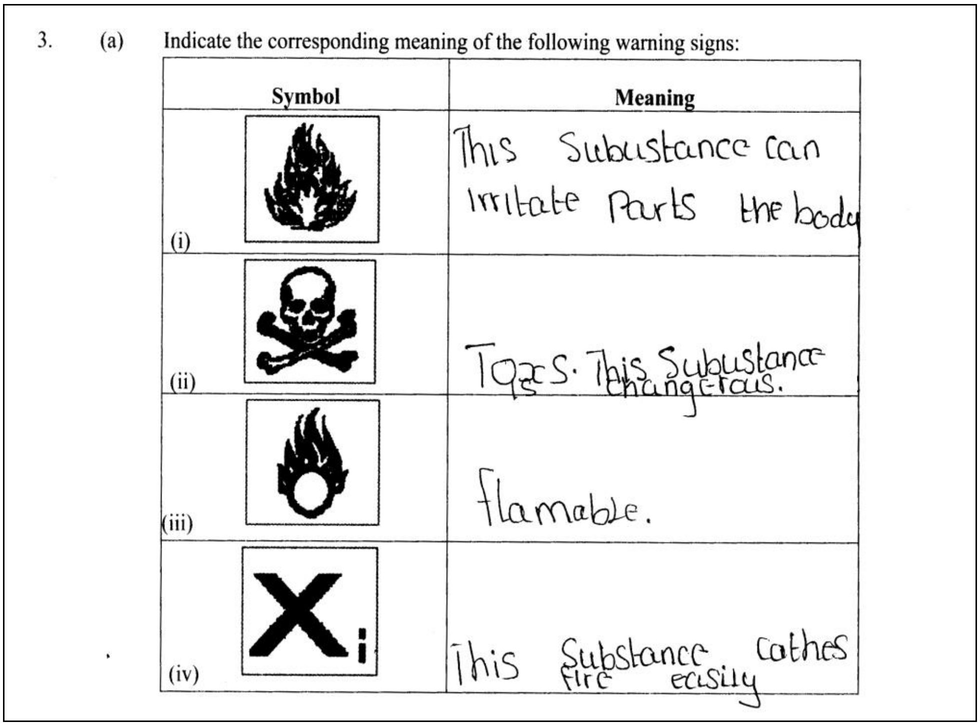
3. (a) Indicate the corresponding meaning of the following warning signs:

Symbol	Meaning
(i) 	Flammable Catches fire Easily.
(ii) 	Toxic this substance is dangerous and can cause death.
(iii) 	OXIDANT This substance can speed up the rate of burning.
(iv) 	IRRITANT this substance can irritate parts of the body.

In Extract 3.1, a student correctly indicated the corresponding meaning of the warning signs for flammable, toxic, oxidant and irritant.

On the other hand, students who scored low marks (0-2.5) failed to indicate the correct meaning of the given warning signs. Some of them confused the meanings of the given signs, for example one student swapped the meaning of flammable and toxic. In part (b), students in this category wrote irrelevant answers on the importance of First Aid. Others wrote meaningless sentences with serious grammatical errors. For example, one student wrote; “it help to produced of life”. Extract 3.2 is a sample of poor response.

Extract 3.2



3. (a) Indicate the corresponding meaning of the following warning signs:

Symbol	Meaning
(i)	This Subustance can irritate Parts the body
(ii)	Toxs. This Subustance changerous.
(iii)	flamable.
(iv)	This Substance cathes fire easily

Extract 3.2, shows a response of a student who gave incorrect meanings of the given warning signs instead of writing flammable, toxic, oxidant and irritant.

2.2.2 Question 4: Laboratory Techniques and Safety, Heat Sources and Flames

This question comprised three parts: (a), (b), and (c). In part (a), students were required to draw the diagram of a measuring cylinder and a conical flask and to state the function of each. In part (b), students were required to mention three heat sources found in the laboratory, excluding Bunsen burner. In part (c), students were required to give three reasons as to why a Bunsen burner is the best heat source in the laboratory compared to other heat sources.

This question was attempted by 505,214 students which is equivalent to 99.9%. The general performance in this question was average, with 39.5 % of the students scoring 3.0 marks and above. Further analysis of the performance is shown in Figure 4.

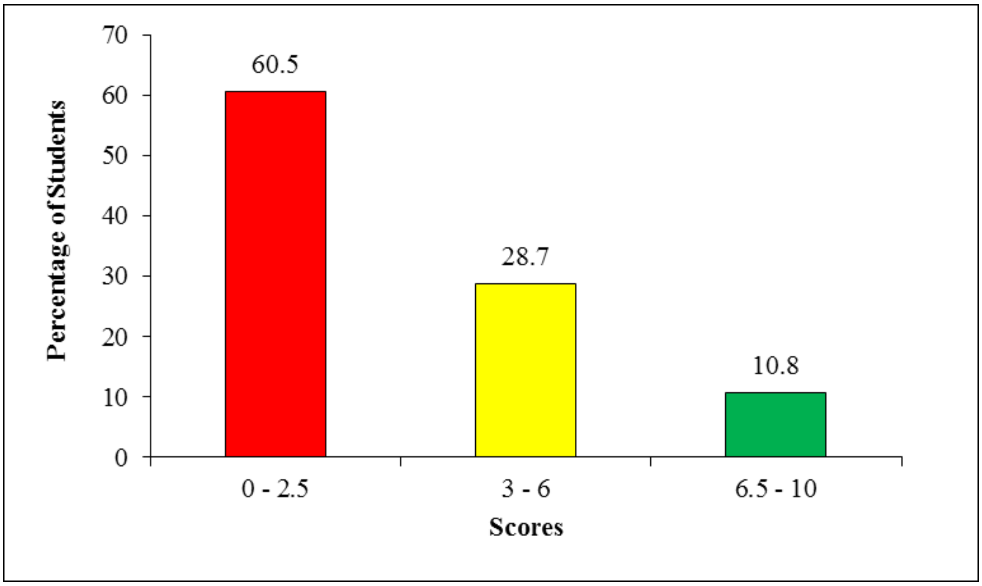


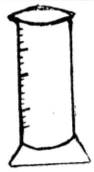
Figure 4: *Students' performance in question 4.*

Figure 4 shows that 10.8% of students scored 7 to 10 marks with 0.7% scoring full marks. Students who scored 4 to 6 marks were 28.7 % while 60.5% scored 0 to 3.0, with 37.6% scoring zero.

Students who scored high marks drew the diagrams of a measuring cylinder and a conical flask correctly and gave the appropriate function of each apparatus drawn. They correctly mentioned three heat sources in the laboratory excluding the Bunsen burner. They finally gave three correct reasons for the Bunsen burner to be regarded as the best heat source in the laboratory. This is an indication that such students had enough knowledge of the concept of *Laboratory Techniques, Heat Sources and Flames*. Extract 4.1 shows an example of a good response from a student.

Extract 4.1

4. (a) Draw and give one function of the following apparatus:

Apparatus	Drawing	Function
(i) Measuring cylinder		It is used to mea-sure the volume of liquids
(ii) Conical flask		It is used to hold and mix liquid chemicals in the laboratory.

(b) By excluding a Bunsen burner, mention other three sources of heat that can be used in the laboratory.

(i) Spirit burner

(ii) Gas stove

(iii) Kerosene burner.

In Extract 4.1, a student correctly drew the diagrams of a measuring cylinder and a conical flask and listed their functions. He/she also mentioned the sources of heat in part (b).

On the other hand, students who scored low marks in this question failed to draw and list the correct functions of the apparati stated. Most of them poorly drew diagrams resembling other apparati, such as beaker, round bottomed flask and flat bottomed flask. In part (b), some students stated features of the Bunsen burner instead of mentioning other sources of heat. For instance, one student wrote '*metal barrel and metal ring*'. In part (c), many students gave irrelevant answers such as *fire*, *gas* and *zones*. Other students indicated features of luminous and non-luminous flame. Such incorrect responses imply that the students had inadequate knowledge about heat sources and flames. Also they had inadequate knowledge about laboratory equipment. Extract 4.2 presents an example of poor response from a student.

Extract 4.2

4. (a) Draw and give one function of the following apparatus:

Apparatus	Drawing	Function
(i) Measuring cylinder		It used for puting chemical in the Loboratory.
(ii) Conical flask		It is is usude for bunining chemical.

(b) By excluding a Bunsen burner, mention other three sources of heat that can be used in the laboratory.

(i) It used for burning chemical.

(ii) It used for cooking Subustance.

(iii) It used For heat.

In Extract 4.2, a student drew a test tube and an unknown vessel instead of a measuring cylinder and a conical flask respectively. He/she also gave incorrect responses for the items in part (b).

2.2.3 Question 5: Matter

The question comprised parts (a), (b) and (c). In part (a), students were required to define the terms *Brownian motion* and *compound*. In part (b), the students were supposed to judge whether the processes of *cutting aluminium foil into pieces* and *lighting a match* are physical or chemical changes. Part (c) required the students to briefly explain how to separate the mixtures of *water and kerosene*, *salt and water* and the mixture of *ethanol and water*.

A total of 505,218 students, who are equivalent to 99.9% attempted this question. The general performance was poor as 71.7% of the students scored below 3.0 marks. This information is captured in Figure 5.

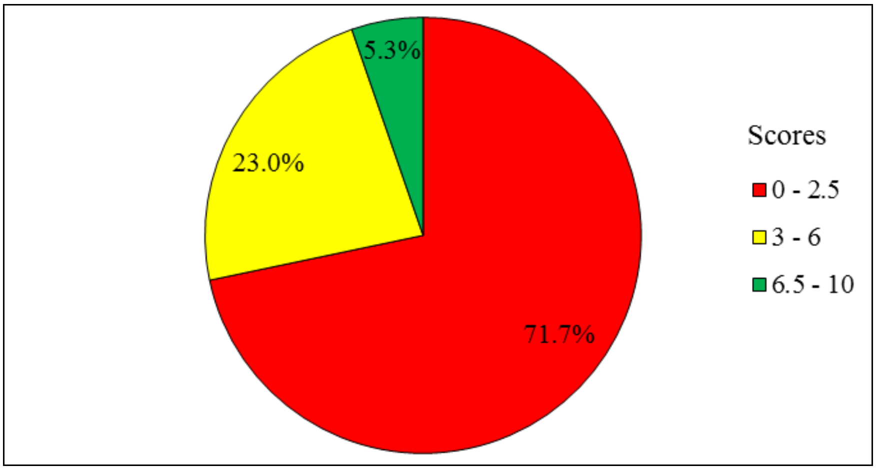


Figure 5: *Students' performance in question 5.*

Figure 5 shows that students who scored 0 to 2.5 marks were 71.7 per cent, those who scored 3.0 to 6.0 were 23.0 per cent and 5.3 per cent, scored 6.5 to 10 marks.

Most of the students who scored low marks failed to define the terms *Brownian motion* and *compound* in part (a). Some of them gave irrelevant and unclear answers. Some students wrote vague sentences. For example, one student defined *Brownian motion* as 'the motion with produced heating in motion beaning', and another student defined *compound* as 'the number of mass'. In part (b), most of them confused the concepts of physical and chemical changes. Others skipped some of the items. In part (c), the students listed separation methods that were not specific to the mixture concerned. This indicates that, the students did not understand how to apply the methods of separation. For example in response to item (iii), one student wrote 'Filtration method, this is because if separate the mixture on the same time to mix a liquid like water and solid like salt'. A sample of poor responses given by the students is shown in Extract 5.1.

Extract 5.1

5. (a) Define the following terms:

(i) Brownian motion

is the moving of the air in the atmosphere to do the motion.

(ii) Compound

is the element used to calculating mass number neutron number and melecules formula.

(b) Identify whether the following is a physical or chemical change:

(i) Cutting aluminium foil into pieces ... Chemical change

(ii) Lighting a match. ... physical change

Extract 5.1 shows a response from a student who incorrectly considered *compound* as an *element* in (a) (ii). The other responses given were incorrect as well.

Students who scored high marks in this question managed to define the terms *Brownian motion* and *compound* properly. They also identified correctly the process of *cutting aluminium foil* as a physical change and that of *lighting a match* as a chemical change. Finally, they suggested proper methods of separating each of the given mixtures in part (c). Extract 5.2 shows an example of good responses from one of the students.

Extract 5.2

5. (a) Define the following terms:

(i) Brownian motion

⇒ Is the irregular motion of tiny particles of matters suspended on a fluid.

(ii) Compound

⇒ Is the substance formed when two or more elements are chemically combined.

(b) Identify whether the following is a physical or chemical change:

(i) Cutting aluminium foil into pieces. Physical change.

(ii) Lighting a match. Chemical change.

(c) How can you separate the following mixtures? Briefly explain.

(i) Water and kerosene

⇒ It can They can be separated by using a separating funnel whereby water will start to be separated leaving the kerosene inside the funnel because water is more denser than kerosene.

Extract 5.2 shows a response from a student who correctly defined the two terms, identified the changes and explained how to separate a mixture of water and kerosene.

In general, majority of the students lacked adequate understanding of how to apply methods of separating mixtures based on their physical properties.

2.2.4 Question 6: Hydrogen

This question consisted of four parts: (a), (b), (c) and (d). In part (a), the students were required to provide the name and chemical formula of a solution formed when zinc granules reacted with dilute hydrochloric acid. Part (b) required students to explain how to test for hydrogen gas. In part (c) the students were required to provide four chemical properties of hydrogen gas and part (d) required students to list three uses of hydrogen gas.

This question was attempted by 505,213 students, which is equivalent to 99.9%. The general performance in this question was average, with 31.5% of the students scoring 3.0 marks and above. Further analysis of the performance in this question is displayed in Figure 6.

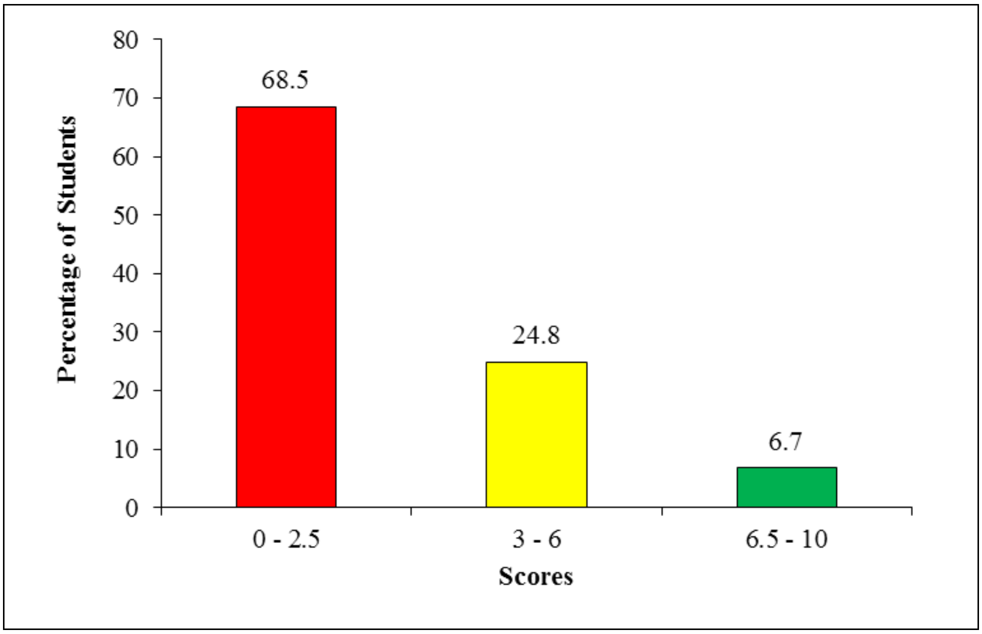


Figure 6: *Students' performance in question 6.*

As shown in Figure 6, the majority of students (68.5%) scored 0 to 2.5 marks with 48.2% scoring zero. Students who scored 3 to 6 marks were 24.8%, and those who scored 6.5 to 10 marks were 6.7%, of which 0.6% scored full marks.

Students who scored low marks in this question failed to give name and formula of solution X in part (a). Some of them incorrectly wrote zinc and hydrochloric acid instead of *zinc chloride* and $ZnCl_2$, which is an indication of inadequate knowledge on the concept of laboratory preparation of hydrogen gas. Furthermore, they failed to clarify how to test for hydrogen gas. Other students in this category responded by writing vague statements. For instance, there was a student who wrote 'it helps to dilute hydrochloric acid in the gas'. Such responses imply that the student lacked both understanding of content, and English language proficiency. In part (c), they hardly mentioned the chemical properties as some of them presented physical properties instead very few students managed to list one use of hydrogen gas in part (d). An example of a poor response is shown in Extract 6.1.

Extract 6.1

6. (a) During preparation of Hydrogen gas by the reaction between dilute Hydrochloric acid and Zinc granules, the granules slowly dissolve in acid to form solution X.

(i) Name solution X......zinc granules.

(ii) Write chemical formula of X...H

(b) How can hydrogen gas be tested?

Hydrogen gas be tested by hydrochloric acid.

(c) Mention four (4) chemical properties of hydrogen gas.

(i) It is the colourles, testiles and odorles.

(ii) It is soluble in water.

(iii) It is lighter than air.

(iv) It suport combustion.

(d) List three (3) uses of Hydrogen gas.

(i) used for fire extunguisher.

(ii) used to dilute hydrochloric acid.

(iii) used for burning charcoal.

In Extract 6.1, a student wrote 'zinc granules' instead of zinc chloride in part (a) (i). The rest of the responses in parts (b), (c) and (d) were incorrect as well.

The high achievers in this question correctly identified solution X as *zinc chloride* and its chemical formula as $ZnCl_2$. They also managed to explain the chemical test for hydrogen gas and its chemical properties. They further mentioned its uses correctly. Extract 6.2 is an example of a good response to this question.

Extract 6.2:

6. (a) During preparation of Hydrogen gas by the reaction between dilute Hydrochloric acid and Zinc granules, the granules slowly dissolve in acid to form solution X.

(i) Name solution X....Zinc chloride.......................................

(ii) Write chemical formula of X....$ZnCl_2$.......................................

(b) How can hydrogen gas be tested?

When a burning splint is brought near a gas jar containing hydrogen gas, the gas explodes with a 'pop' sound.

(c) Mention four (4) chemical properties of hydrogen gas.

(i) It does not support combustion

(ii) It is highly flammable

(iii) A mixture of hydrogen and air explodes when lit.

(iv) It is a reducing agent.

(d) List three (3) uses of Hydrogen gas.

(i) Is used in manufacture of margarine

(ii) Is used in manufacturing of hydrochloric acid.

(iii) Is used in filling weather balloons

In Extract 6.2, a student correctly named solution X, wrote its chemical formula, explained the test for hydrogen gas and mentioned the properties and uses of hydrogen gas as required.

2.2.5 Question 7: Atomic Structure and Periodic Classification

The question was comprised of parts (a), (b) and (c). In part (a), item (i) required students to give the number of electrons and protons in oxygen and aluminium elements while item (ii) required them to write the electronic configuration of chlorine ion. In part (b), the students were asked to identify both the most and the least electronegative element among P, S, and Cl. Also, they were supposed to identify the element with the largest atomic structure.

In part (c), students were provided with a table of atomic masses and atomic numbers of elements lettered F, G, L, M and J. The students were required to work out the neutrons in element L, give the group and period of element F in the Periodic Table and identify with a reason the element which does not readily form compounds.

The question was attempted by 505,220 (99.9%) students and the general performance was poor as shown in Figure 7.

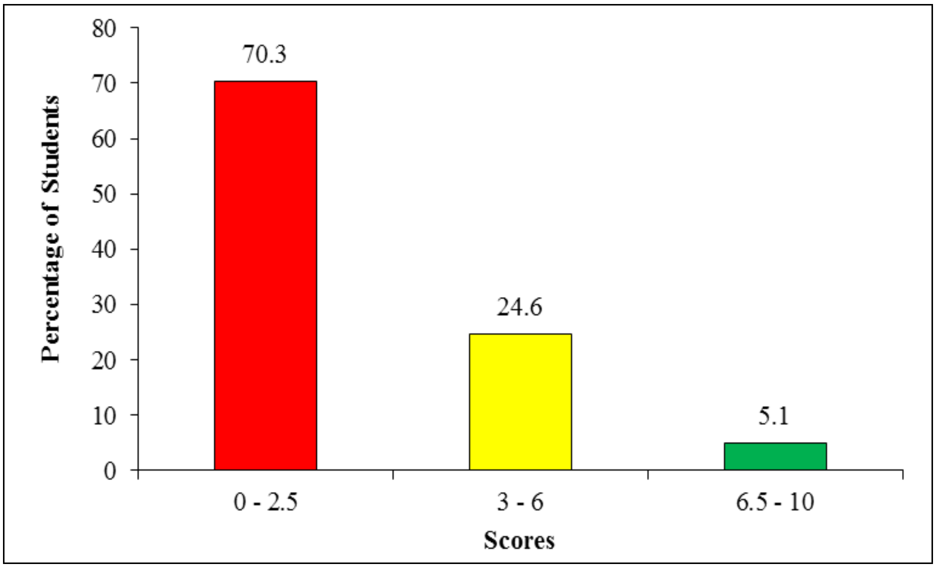


Figure 7: *Students' performance in question 7.*

Figure 7 depicts that majority of the students, equivalent to 70.3%, scored 0 to 2.5 marks, with 34.5% scoring zero. Moreover, 24.6% of the students scored 3 to 6 marks whereas 5.1% scored 6.5 to 10, with 0.1% scoring full marks. Thus it is only 29.7% of students who scored average and above.

Students who scored low marks in this question provided incorrect number of electrons and protons for both oxygen and aluminium elements in part (a). For example, several students wrote 'oxygen two, aluminium 3'. Those students wrote valencies instead of electron and proton number. In item (ii), some of them wrote the electronic configuration of chlorine atom (2:8:7) instead of chlorine ion (2:8:8). In part (b), most of the students cited incorrect elements, including those who mentioned elements that were not included in the table given. For example, one student mentioned magnesium and calcium in (b) (i). These incorrect responses imply that majority of the students had inadequate knowledge on the concept of *Atomic Structure*, and others did not understand the requirement of the question. Extract 7.1 shows an example of poor responses in this question.

Extract 7.1

7. (a) (i) How many electrons and protons are present in oxygen element and aluminum element?

8

(ii) Write the electronic configuration of chlorine ion.

8 : 8 : 1

(b) Use the elements with chemical symbols: P, S and Cl to answer the following questions:

(i) Which element is the most electronegative?

S

(ii) Mention the least electronegative element.

S, P

(iii) Which element has the largest atomic structure?

Cl

In Extract 7.1, a student wrote *8, 8:8:1, S, S, P* and *Cl* instead of *Oxygen-8/Al-13, 2:8:8, Cl, P* and *P* respectively in parts (a) and (b).

Students, who scored high marks in this question, provided the correct numbers of electrons and protons for both oxygen (8) and aluminium (13) elements. They also wrote the correct electronic configuration of chlorine ion which was 2:8:8. They also identified Cl (chlorine) as the most electronegative element. Most of them identified P (Phosphorus) as the least electronegative element having the largest atomic structure. In part (c), the students gave correct responses which were '(i) 12, (ii) Group VI-period 2 and (iii) element J because it has stable octet state'. These correct answers imply that the students had adequate knowledge of *Atomic Structure and Periodic Classification*. Extract 7.2 shows the sample of a good response to this question.

Extract 7.2

. (a) (i) How many electrons and protons are present in oxygen element and aluminum element?

...Oxygen element - 8 protons and 8 electrons........................

..Aluminium element - 13 protons and 13 electrons................

....

(ii) Write the electronic configuration of chlorine ion.

....Chlorine ion - 2:8:8..

....

....

(b) Use the elements with chemical symbols: P, S and Cl to answer the following questions:

(i) Which element is the most electronegative?

....Chlorine..

(ii) Mention the least electronegative element.

......Phosphorus..

(iii) Which element has the largest atomic structure?

...Phosphorus...

In Extract 7.2, a student gave correct numbers of electrons and protons present in oxygen (8) and aluminium (13). He/she wrote properly the electronic configuration of chlorine ion and attempted well part (b).

2.2.6 Question 8: Energy Sources and Fuels and Scientific Procedures

The question consisted of parts (a), (b), and (c). In part (a), students were required to provide four sources of energy used for cooking in most Tanzanian societies. Part (b) required students to list four characteristics of a good fuel while part (c) required them to list two areas where scientific procedure can be applied.

A total of 505,221 students, which is equivalent to 99.9%, attempted this question. The general performance was average as 59.8% of the students scored 3.0 marks and above. Further analysis of the performance is shown in Figure 8.

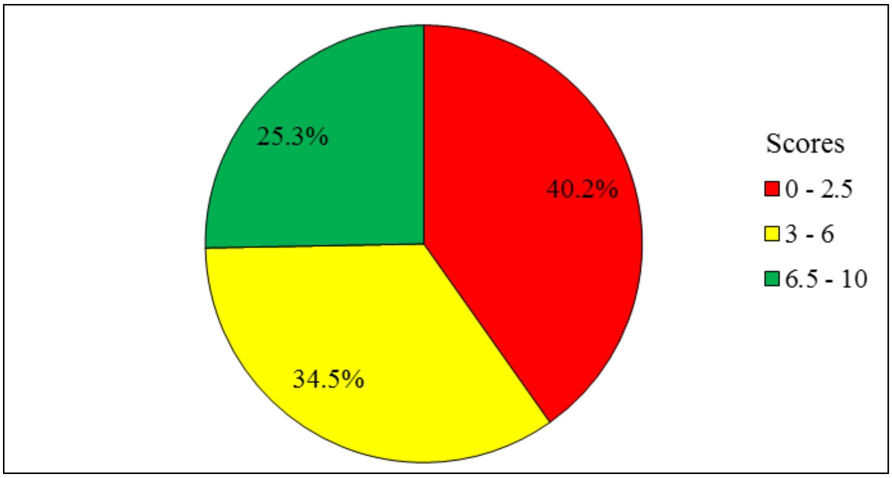


Figure 8: *Students' performance in question 8.*

Figure 8 indicates that 25.3% scored 6.5 to 10 marks, with 4.3% scoring full marks; 34.5% scored 3 to 6 marks; and 40.2% scored 0 to 2.5 marks, with 20.8% scoring zero.

Students who scored high marks managed to give four sources of heat used for cooking in Tanzanian societies and to list the correct characteristics of a good fuel. They also mentioned two areas/fields where the scientific procedure can be applied. However, some students in this group supplied incorrect answers to some of the items. The high scores earned by students in this category is an indication that they had adequate knowledge of *Scientific Procedures*, *Energy Sources* and *Fuels*. Extract 8.1 shows an example of a good response.

Extract 8.1

8. (a) Write four sources of energy used for cooking in most Tanzanian societies

(i). Firewood

(ii) Charcoal

(iii) Natural gas

(iv) Kerosene

(b) List four characteristics of a good fuel.

(i) Should not produce harmful byproducts /gases.

(ii) Should have little or no waste products like ashes.

(iii) Should produce high heat content.

(iv) Should be easily stored and transported.

(c) List two areas where scientific procedure can be applied.

(i) At schools

(ii) In hospitals

In Extract 8.1, a student listed the sources of energy, the characteristics of a good fuel and two areas where the scientific procedure can be applied.

Students who scored low marks gave incorrect sources of energy that are not mostly used for cooking in Tanzania. Others responded by listing burners instead of energy sources. For instance, some students mentioned ‘charcoal burner, gas cooker, stove and electric burner’. Such responses imply that the students misunderstood the requirements of the question. In part (b), there were students who stated the importance of fuels while others listed common fuels instead of giving the characteristics of a good fuel. For example, one student wrote ‘helps to transport’ while another one mentioned ‘(i) diesel and (ii) petrol’. Part (c) was left unanswered by many students in this category. Few students answered this part by mentioning events/accidents instead of citing fields of application of the scientific procedure. For example, one student wrote ‘(i) snake bite (ii) nose bleeding’. The students did not understand the requirement of the question, and consequently gave answers related to First Aid. Students in this group lacked understanding of *Energy Sources, Fuels* and the *Scientific Procedure*. Extract 8.2 shows an example of a poor response.

Extract 8.2

8. (a) Write four sources of energy used for cooking in most Tanzanian societies.

(i) Solar energy.

(ii) Knetic energy.

(iii) Chemical energy.

(iv) Light energy.

(b) List four characteristics of a good fuel.

(i) Heat

(ii) Light

(iii) Energy

(iv) Oxygen.

(c) List two areas where scientific procedure can be applied.

(i) Oxygen

(ii) Energy.

In Extract 8.2, a student incorrectly listed solar energy, kinetic energy, chemical energy and light energy (forms of energy) instead of sources of energy used for cooking. He/she also listed heat, light, energy and oxygen as characteristics of a good fuel incorrectly.

2.2.7 Question 9: Oxygen

This question was comprised of two parts (a) and (b). Part (a) required students to outline six common apparati used in the laboratory preparation of oxygen gas by decomposition of hydrogen peroxide. Part (b) required students to outline four uses of oxygen gas in everyday life situations.

The question was attempted by 505,222 students which is equivalent to 99.9% and the summary of performance is shown in Figure 9.

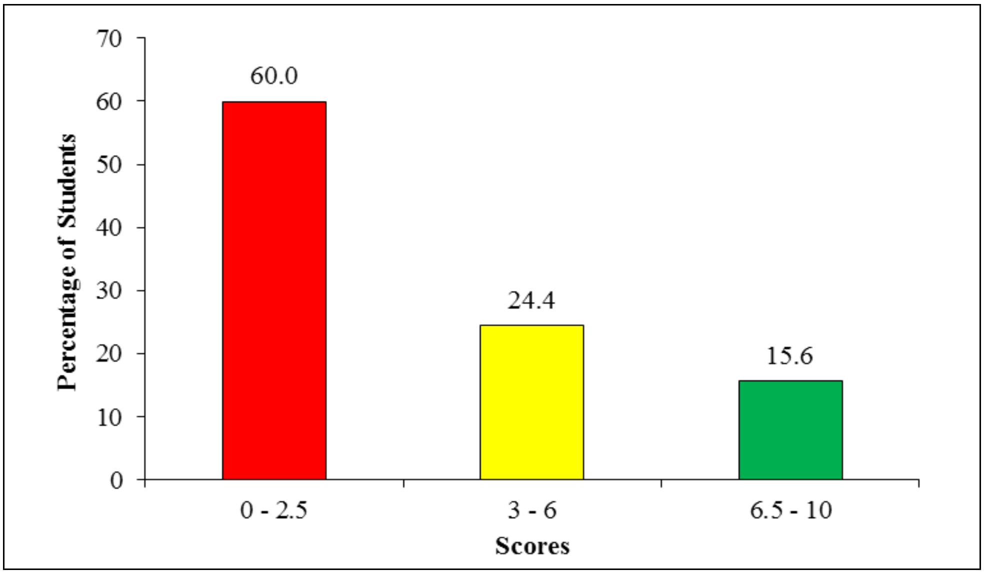


Figure 9: *Students' performance in question 9.*

As shown in Figure 9, majority of the students (60.0%) scored 0 to 2.5 marks, with 35.0% scoring zero. Moreover, 24.4% scored 3 to 6 marks and 15.6% scored 6.5 to 10 marks. Generally, this performance was average as 40% of all the students scored 3.0 marks and above.

Students who performed well in this question were able to outline six common apparati used in the laboratory preparation of oxygen gas using hydrogen peroxide and four uses of oxygen gas correctly. This implies that the students had sufficient knowledge of the laboratory preparation and use of oxygen gas. Extract 9.1 shows an example of a good response to this question.

Extract 9.1

9. (a) Outline six common apparatus used in the laboratory preparation of oxygen gas using hydrogen peroxide.

(i) A gas jar

(ii) Flat bottomed flask

(iii) Thistle funnel

(iv) Delivering tube

(v) Trough

(vi) Bee hive shelf.

(b) Outline four uses of oxygen in everyday life situations.

(i) Used by plants for germination process.

(ii) Used by mountain climbers.

(iii) Used by pre-mature babies in incubators.

(iv) Used by divers.

In Extract 9.1, a student correctly outlined six common apparati used in the laboratory preparation of oxygen gas and gave four uses of oxygen in everyday life situation.

Students who performed poorly in this question were unable to outline six common apparati which are used in laboratory preparation of oxygen gas. They also failed to outline four uses of oxygen in everyday life situations. In part (a), most of them outlined irrelevant laboratory apparati. For instance, one of the students mentioned '(i) test tube (ii) spring balance (iii) burette (iv) pipette' which are not applicable in the process. This indicates that the students understood the requirements of the question but lacked knowledge on the particular apparati. Likewise, in part (b), most of the students could not specify the use of oxygen gas in daily life. Others wrote the uses of hydrogen gas while some listed properties of oxygen gas. There were few students who mentioned physical areas such as 'schools, industries and hospitals' instead of the uses of oxygen. This implies that the students lacked sufficient knowledge about oxygen gas. Extract 9.2 shows an example of a poor response to the question.

Extract 9.2

9. (a) Outline six common apparatus used in the laboratory preparation of oxygen gas using hydrogen peroxide.

(i) Fire extinguisher

(ii) Thermometer

(iii) Hydrolic press

(iv) Temperature

(v) Test tube

(vi) Thermometer

(b) Outline four uses of oxygen in everyday life situations.

(i) It used in hospital

(ii) It used in Manufacturing Industry

(iii) It used in Industry

(iv) It used in ~~fuel~~ Laboratory.

In Extract 9.2, a student mentioned fire extinguisher, thermometer, hydrolic press, temperature and test tube instead of common apparati used in the laboratory preparation of oxygen gas. He/she also outlined places instead of uses of oxygen in everyday life situations.

2.2.8 Question 10: Formula Bonding and Nomenclature

Question 10 consisted of parts (a), (b) and (c). Part (a) required students to define valency, oxidation state, anion and cation. In part (b), the students were required to calculate oxidation state of elements N, S, and Cl, from the compounds $\underline{N}H_4^+$, $\underline{S}O_4^{2-}$ and $\underline{Cl}O_3^-$. Part (c) required students to calculate (i) empirical formula and (ii) molecular formula of a compound consisting of 40% carbon, 6.67% hydrogen and 53.3% oxygen. The relative molecular mass of the compound was 60.

A total of 505,030 (99.9%) students attempted this question. Generally, the performance in this question was average as 35% of the students scored 3.0 marks and above. A summary of performance in this question is presented in Figure 10.

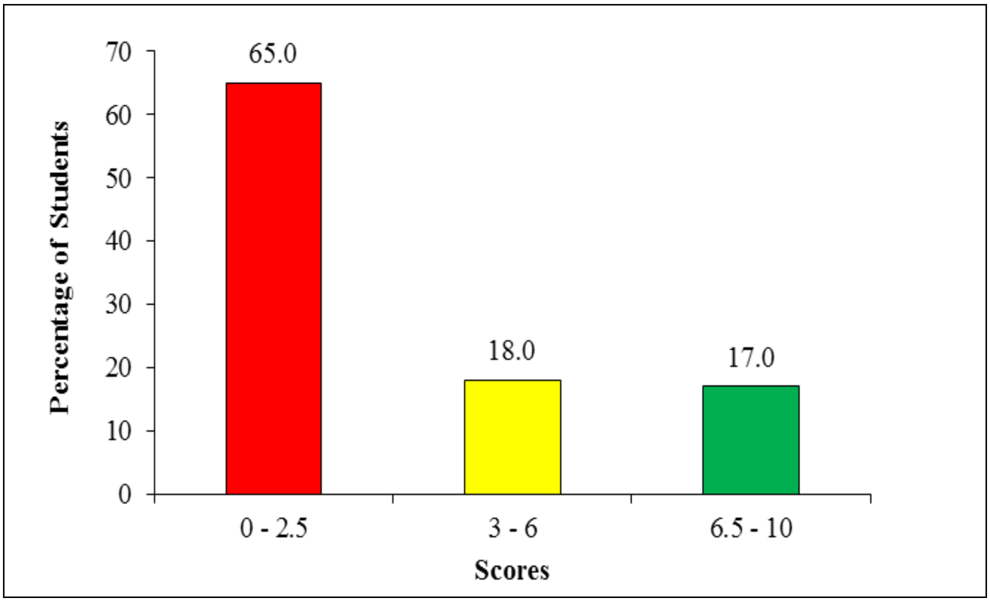


Figure 10: *Performance of the students in question 10.*

Figure 10 shows that 65% scored 0 to 2.5 marks, and among them 38.7 % scored zero. Moreover, 18% scored 3 to 6 marks while 17% scored 6.5 to 10 marks.

Students who scored high marks in this question managed to define the terms valency, oxidation state, anion and cation in part (a). They also calculated oxidation states (for nitrogen, sulphur and chlorine), empirical formula and molecular formula correctly. The correct definitions given and the appropriate procedures followed in calculations indicate that the students had adequate understanding of the concepts of formula and bonding. Similarly, the students had strong numerical background. Extract 10.1 shows an example of a correct response to this question.

Extract 10.1

10. (a) Define the following terms:

(i) Valency

Valency is the number of electrons that an atom can share, receive or donate during a chemical bonding.

(ii) Oxidation state

Is a measure of electron control that an atom has in a compound compared to the atom in pure element.

(iii) Anion

Is a negatively charged ion formed when non-metals gains electrons during a chemical bonding so as to gain a stable structure.

(iv) Cation

Is a positively charged ion fromed when a metal looses electrons during a chemical bonding so as to remain stable.

(b) Calculate the oxidation state of the underlined elements in the following radicals:

(i) $\underline{N}H_4^+$

$N + (1 \times 4) = 1$

$N + 4 = 1$

$N = 1 - 4$

$N = -3$

$\therefore$ Oxidation state of $\underline{N = -3}$

(ii) $\underline{S}O_4^{2-}$

Solution

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

$S - 8 = -2$

$S = -2 + 8$

$S = +6$

$\therefore$ Oxidation state of $\underline{S = +6}$

(iii) $\underline{Cl}O_3^-$

Solution

$Cl + (-2 \times 3) = -1$

$Cl - 6 = -1$

$Cl = -1 + 6$

$Cl = +5$

$\therefore$ Oxidation state of $\underline{Cl = +5}$

In Extract 10.1, a student correctly defined the four terms and calculated the oxidation states of N, S and Cl properly.

On the other hand, students who scored low marks in this question went astray in defining the terms valency, oxidation state, anion and cation. In one case for instance, in defining anion, a certain student wrote ‘Anion is a charged atom’. The student did not realize that always anions bear negative charge. In the part of calculation, other students incorrectly wrote the charge in the radicals as the oxidation state. Some used inappropriate formulae and approaches that were not conducive. For example, one student calculated the oxidation states of sulfur in $\underline{S}O_4^{2-}$ by taking ‘4-2 = 2’. The student did not understand that 2- is the net charge of the whole radical and thus it cannot be subtracted from the number of oxygen atoms (4). Part (d) was skipped by many students in this category. Even those few who attempted it could not arrive at the correct formulae. In one case for example, one student ended up writing the molecular formula as ‘CH_3O_2’ instead of ‘$C_2H_4O_2$’. The fact that many students could not give the correct answers for this question indicates that they had inadequate understanding of the concepts of formula and bonding. Extract 10.2 shows a sample of an incorrect response to this question.

Extract 10.2

10. (a) Define the following terms:

(i) Valency

It involve of sharing electrons between atom

(ii) Oxidation state

Is the number of electrons which show different shell.

(iii) Anion

It occur between two ions with opposite charge

(iv) Cation

A force of attraction that holds atoms together to form molecules

(b) **Calculate the oxidation state of the underlined elements in the following radicals:**

(i) **$\underline{N}H_4^+$**

Solution

$NH_4^+ = (2 \times 4^+) = 0$

$N = 2 \times 4^+ = 0$

$N = 2 \times 4^+ = 0 + 0 = 0$

$N = {}^-4$

(ii) **$\underline{S}O_4^{2-}$**

Solution

$S = (2^- \times 4) = 0$

$S = 2^- \times 4 = 0$

$S = 2^- \times 4 = 0 + 0 = 0$

$S = {}^+4$

(iii) **$\underline{Cl}O_3^-$**

Solution

$Cl = (2 \times 3^-) = 0$

$Cl = 2 \times 3^- = 0$

$Cl = 2 \times 3 = 0 + 0 = 0$

$Cl = {}^+3$

Extract 10.2 shows a sample of a response in which a student was not able to define valency, oxidation state, anion and cation. He/she also failed to calculate correct oxidation states of N, S and Cl.

3.0 ANALYSIS OF STUDENTS' PERFORMANCE IN EACH TOPIC

The 2018 Form Two National Assessment assessed students in 12 (out of 13) topics, which were *Formula, Bonding and Nomenclature; Oxygen; Energy Sources and Fuels; Scientific Procedures; Atomic Structure; Periodic Classification; Hydrogen; Matter; Heat Sources and Flames; Laboratory Techniques and Safety; Introduction to Chemistry* and *Air, Combustion, Rusting and Firefighting.*

The analysis shows that students had good performance in questions 1, and 2 whose performances were 94.8%, and 61% respectively. The students performed well in these questions because they had adequate knowledge of the concept assessed (from different topics).

On the other hand, students had an average performance in questions 3, 4, 6, 8, 9 and 10 with the majority scoring 3 to 6 marks. The average performance in these questions was due to the fact that they had limited knowledge on the assessed concepts and responded moderately to the questions.

Students performed poorly in questions 5 and 7 which were composed from the topics of *Matter; Atomic Structure* and *Periodic Classification.*

The poor performance in the stated topics was due to poor English language proficiency and inadequate knowledge in the concepts related to the topics of *Matter; Atomic Structure* and *Periodic Classification*.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The overall analysis shows that the general performance of the students was average. The analysis of the students' performance in each question revealed that the performance was good in two questions, average in six questions and poor in two questions (see appendix 1). The analysis also identified several factors that contributed to failure of some students to respond correctly to some of the questions. These factors include the following:

(a) Lack of knowledge in some topics as illustrated by the responses which did not meet the demand of the respective questions.

(b) Lack of adequate knowledge on laboratory equipment: Some of the students drew diagrams of irrelevant apparati and failed to outline six common apparati used in laboratory preparation of oxygen gas in question 9.

(c) Poor mathematical background: This was evident in the responses to question 10 parts (b) and (c) which required calculations based on chemistry principles and formulae. Many students failed to calculate the oxidation states, empirical formula and molecular formula.

(d) Poor English language proficiency: This was demonstrated by the failure to understand the demand of the questions and in ability to write grammatically meaningful sentences.

4.2 Recommendations

The following recommendations are offered in order to improve the candidates' performance in future assessments:

(a) Teachers should guide students to use various chemistry apparati properly in performing different activities and experiments. This will enable them to acquire practical skills to reinforce their understanding of concepts, theories and laws in science.

(b) Teachers should use models illustrating empirical and molecular formulae to enable students to calculate the empirical and molecular formulae of various compounds. They should also use wall charts showing oxidation state and lead students in groups to discuss the concept of oxidation state and present.

(c) Schools should implement the English speaking policy; Science teachers should ensure they use English in teaching in order to improve their students' English language proficiency.

(d) Students should take time to read thoroughly the instructions and questions before attempting any question and should proofread their work before submitting.

Appendix 1

ANALYSIS OF STUDENTS' PERFORMANCE PER TOPIC IN 2018

S/n	Topic	Question Number	Percentage of Students who Scored 30 Marks and Above	Remarks
1	Introduction to Chemistry; Matter; Heat Sources and Flames; Laboratory Techniques and Safety; Fuels and Energy; Air, Combustion, Rusting and Fire Fighting; Atomic Structure and Periodic Classification	1	94.8	Good
2	Techniques and Safety; Matter; Combustion, Rusting and Fire Fighting; Formula, Bonding and Nomenclature.	2	61.5	Good
3	Fuels and Energy	8	59.8	Average
4	Laboratory Techniques and Safety	3 & 4	56.7	Average
5	Oxygen	9	40.5	Average
6	Formula, Bonding and Nomenclature	10	35.5	Average
7	Hydrogen	6	31.5	Average
8	Atomic Structure and Periodic Classification	7	29.7	Poor
9	Matter	5	28.3	Poor