THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

STUDENTS' ITEM RESPONSE ANALYSIS REPORT FOR THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2019

032 CHEMISTRY

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Published by:
The National Examinations Council of Tanzania,
P. O. Box 2624,
Dar es Salaam, Tanzania

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FOREWORD

The National Examinations Council of Tanzania has prepared this Students' Items Response Analysis (SIRA) report in order to give feedback to the stakeholders such as students, teachers, parents, policy makers and the general public, on the performance of the students who sat for Chemistry in the Form Two National Assessment (FTNA) in November 2019.

The Form Two National Assessment marks the end of two years of Ordinary Level of Secondary Education. It is an assessment which, among other things, shows the effectiveness of the education system in general and education delivery system in particular. Essentially, the students' response 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 Ordinary Level Secondary Education.

The analysis presented in this report is intended to contribute towards understanding some of the reasons behind the performance of the students in Chemistry Subject. The report highlights some of the factors that contributed to the students to score low marks in each question. Some of these factors are inadequate ability to apply principles in interpreting scientific observations and improper approaches in carrying out calculations. The feedback provided in this report will enable the educational administrators, school managers, teachers and students to identify proper measures to be taken in order to improve the students' performance in future assessment administered by the Council.

The Council would like to thank Chemistry Coordinators, Assessors and all stakeholders who participated in the writing of this report. The Council would also like to express sincere appreciation to all staff members who participated in analyzing the data used in this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report analyses the performance of students who sat for the Form Two National Assessment (FTNA) in Chemistry paper conducted in November 2019. The paper examined students' competences and skills as stipulated in the chemistry syllabus of 2010 which adhered to the 2011 Form Two National Assessment format.

The paper consisted of ten questions which were organised into two sections A and B. Section A was consisted of two questions while section B was composed of eight questions. Students were required to answer all ten questions in both sections. Questions in section A were objective and short answer type. Question 1 comprised 10 multiple choice items and question 2 comprised 5 matching items and five short answer items. On the other hand, in section B there were short answer questions. However, all questions in the paper carried equal weight of ten marks.

A total of 570,891 students who sat for Form Two National Assessment, (FTNA) in 2019 did Chemistry. Analysis of the results showed that the overall performance was good as the students' scores in most of the questions were above 30 per cent of the marks allocated. In 2019, 44.79 per cent of the students passed the assessment compared to 53.22 per cent of students who passed in 2018. This reveals that the performance of students in 2019 decreased by 8.41 per cent.

This report is organised into four sections. The first section gives the introductory part while the second section focuses on the analysis of students' performance in each question. The third section provides analysis of performance per topic. Lastly, the fourth section gives the conclusion of the overall performance and offers recommendation for future improvement.

2.0 ANALYSIS OF STUDENTS' PERFORMANCE IN EACH QUESTION

In this section, analysis of students' performance in each question has been done focusing on the demand of the question, students' responses and figures such as graphs and charts for more clarification. Samples of extracts of students' responses have also been inserted in appropriate questions to illustrate the cases presented. However, highlights of misconceptions

observed and reasons behind the students' performance has been included as well. The students' performance in each question has been categorized as good, average or weak.

2.1 Section A: Objective and Short Answer Questions

This section consisted of two questions. Question 1 carried a total of 10 marks whereas question 2 carried 5 marks.

2.1.1 Question 1: Multiple Choice Items

The question had ten items which were composed from eight topics. The topics were *Laboratory Techniques and Safety; Water; Hydrogen; Heat Sources and Flames; Air, Combustion, Rusting, and Fire Fighting; Bonding, Formulae and Nomenclature; Periodic Classification* and *Matter*. In each item, students were required to choose the correct answer from four alternatives (A to D) and write its letter beside the item number in the spaces provided.

The statistical analysis shows that 570,870 students attempted this question. The analysis of performance indicates that, 20.9 per cent of the students scored 0 to 2 marks, 67 per cent scored 3 to 6 marks and 12.1 per cent scored 7 to 10 marks. The summary of performance is shown in figure 1.

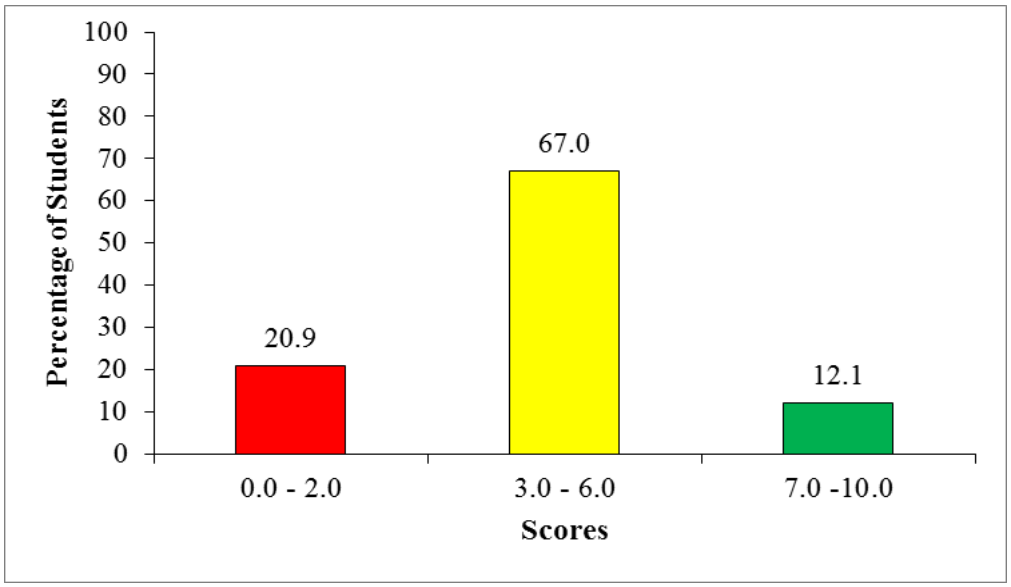


Figure 1: *Students' performance in question 1.*

Figure 1 shows that, 79.1 per cent of students scored from 3.0 to 10 marks, an indication of good performance in this question. The correct responses provided by majority of the students showed that they had adequate knowledge on the subject matter assessed.
However, 20.9 per cent of students scored low marks following their partial understanding of concepts especially in items (iii), (v) and (ix).
Item (iii) required students to choose the property of hydrogen gas which disqualify it to be among the constituents of air. The correct option was C *because of being very light* although most of the students in this category selected distractors A, B and D. Distractor A 'because of being water soluble' is not an answer as hydrogen gas is not soluble in water. Distractor B *because of being denser than air* attracted students who assumed air to be lighter than hydrogen gas which is not true. Those who chose distractor D *because of being highly flammable* did not understand that the property of being flammable has nothing to do with the composition of air. In order to identify the correct alternative, students were required to have the understanding that hydrogen gas is lighter than the constituents of air and hence it exists above air.

Item (v) required students to select the group and period of the Periodic Table to which the element whose number of electrons is 11 belongs. The correct alternative was A *Group I and period 3* because the electronic configuration of the element is 2:8:1. The three numbers separated by : indicate the number of period (shells) and the valence electron, 1 imply Group 1. Students who chose distractors B, C and D lacked understanding of electronic configuration. Distractors B *Group II and period 1* and D *Group II and period 3* indicate Group II instead of I whereas distractor C *Group I and period* 1 indicate incorrect period.

Item (ix) required students to show the net charge of radicals. The alternatives were A *Zero* B *Positive or negative* C *Neutral* and D *Positive and negative*. The correct option was B 'Positive or negative' however some students opted for the distractors. Those students lacked understanding that neutral radicals do not exist.

2.1.2 Question 2: Matching Items and Short answer Questions

The question had parts (a) and (b) consisting of five matching items and short answer questions respectively. The question was derived from the topic on *Matter*.

The question was attempted by 570,875 students. The general performance was average as 38 per cent of the students scored 3 marks and above. Analysis in figure 2 shows that students who scored 0 to 2.5 marks were 62.0 per cent; those who scored 3 to 6 marks were 36.2 per cent and 1.8 per cent scored from 7 to 10 marks. The summary of performance in question 2 is shown in figure 2.

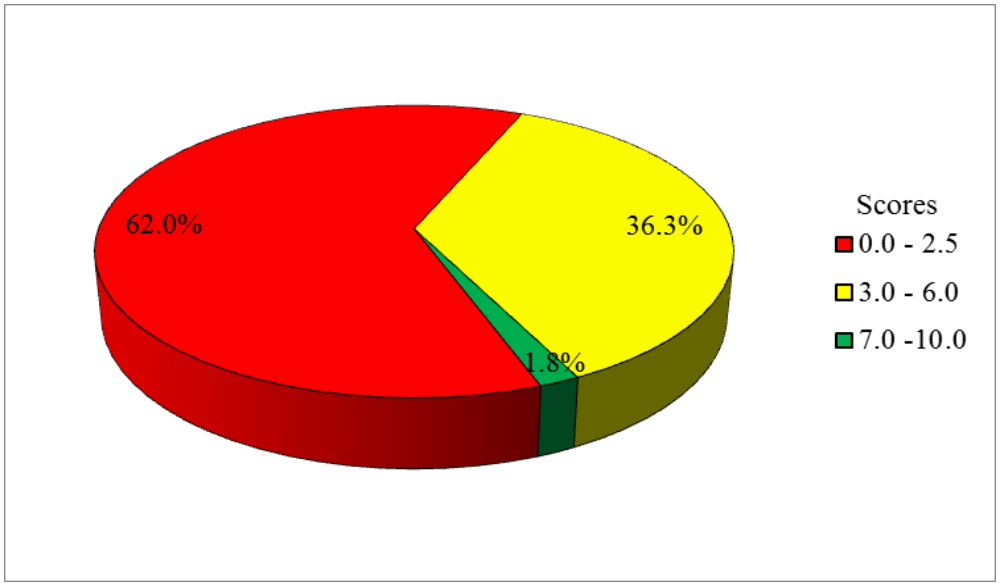


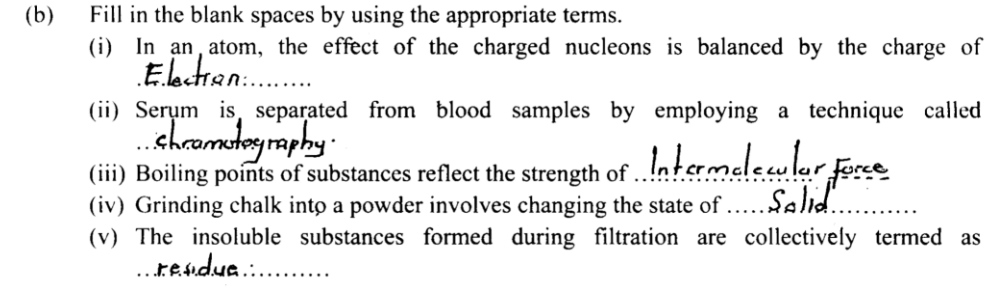
Figure 2: *Students' performance in question 2.*

Students who scored high marks correctly related statements in List A with the responses in List B. Similarly, they provided correct answers in part (b), an indication that they had adequate knowledge about the concept of matter. For example, in part (a) (iv) students were required to match with list B a substance whose components can be separated by physical means. Most of the students responded by writing A *solid* instead of H *air*. Solid is a substance with definite shape and size while air is the mixture whose components can be separated by physical means. That is why they made misconception of the term *solid* with *air* (mixture) which was an incorrect response.

Part (a) (v) required students to match a substance that was a homogenous mixture of two or more substances from List B. The correct match was B *Solution* but some responded by writing C *Water*. They did not recognize that water is a compound with a specific formula though it possesses homogeneity in looking. This implies that the students lacked knowledge on properties of mixtures.

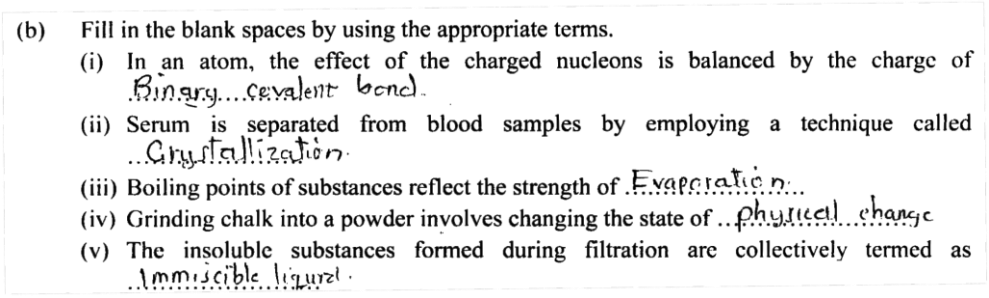
In part (b) (iii) the students were required to give the physical property which determines the boiling points of substances. Most students responded with incorrect answers. For example, some responded as *boiling*, instead of the correct responses which are *forces holding its particles together, bond, cohesion, intermolecular forces* or *adhesive forces*. Failure of the students to give correct responses indicates that they had insufficient knowledge specifically on chemical bonds and bonding in general.

Part (b) (iv) required the students to give the change of state which involves grinding chalk into a powder. The correct response was *aggregation or solid*, but majority gave incorrect responses as they associated the question with the change of state of matter. Moreover, some responded by writing that grinding chalk into a powder is a *state of matter*. They could not know that grinding of chalk does not involve change of state but it is the form of matter. This indicates that the students had inadequate knowledge on states of matter. The students who scored 10 marks in this question showed adequate skills and understanding of the topics: *Elements, Compounds and Mixtures; Matter* and *Atomic Structure*. The good understanding shown by the students was revealed by their responses on the question. The responses given were clearly presented indicating that they had relevant knowledge on the subject matter for the topics involved. Extract 2.1 illustrates a sample of good responses from a student who scored all the marks allocated.


(b) Fill in the blank spaces by using the appropriate terms.
(i) In an atom, the effect of the charged nucleons is balanced by the charge of Electron.....
(ii) Serum is separated from blood samples by employing a technique called ..chromatography.
(iii) Boiling points of substances reflect the strength of ..Intermolecular Force
(iv) Grinding chalk into a powder involves changing the state of .....Solid.....
(v) The insoluble substances formed during filtration are collectively termed as ..residue.....

Extract 2.1: A sample of correct responses in question 2.

The students who scored low marks in this question showed little or no basic knowledge on the topics *Elements, Compounds and Mixtures; Matter* and *Atomic Structure*. They provided irrelevant responses. This generally indicates inadequate knowledge on the content assessed. Extract 2.2 provides a sample of incorrect responses from one of the students.


(b) Fill in the blank spaces by using the appropriate terms.
(i) In an atom, the effect of the charged nucleons is balanced by the charge of ...Binary...covalent bond...
(ii) Serum is separated from blood samples by employing a technique called ...Crystallization...
(iii) Boiling points of substances reflect the strength of ...Evaporation...
(iv) Grinding chalk into a powder involves changing the state of ...physical change
(v) The insoluble substances formed during filtration are collectively termed as ...Immiscible liquid...

Extract 2.2: *A sample of incorrect responses in question 2.*

In part (b) (iii), students were required to give the physical property which determines boiling points of substances. Most of students responded by giving incorrect answers. For example, one student gave the response *boiling*: however the correct responses were *forces holding its particles together, bond, cohesion, intermolecular forces* or *adhesive forces*. Failure of students to give correct responses indicates that they had insufficient knowledge especially on chemical bonds and bonding in general.

2.2 Section B: Short Answer Questions

This section comprised question 3 up to 10 making a total of eight questions. The questions were composed from the following topics: - *Laboratory Techniques and Safety; Oxygen; Hydrogen; Water; Scientific procedure; Air, Combustion, Rusting and Fire Fighting; Bonding, Formulae and Nomenclature* and *Fuels and Energy*.

2.2.1 Question 3: Laboratory Techniques and Safety

This question had two parts (a) and (b). Part (a) required students to state the use of the components of First Aids Kit while in part (b) students were required to state the functions of laboratory apparatuses.

The question was attempted by 570,879 students of which 72.1 per cent scored 0 to 2.5 marks; 21.2 per cent scored 3 to 6 marks; 6.7 per cent scored

from 7 to 10 marks. Students' performance in this question is summarized in figure 3.

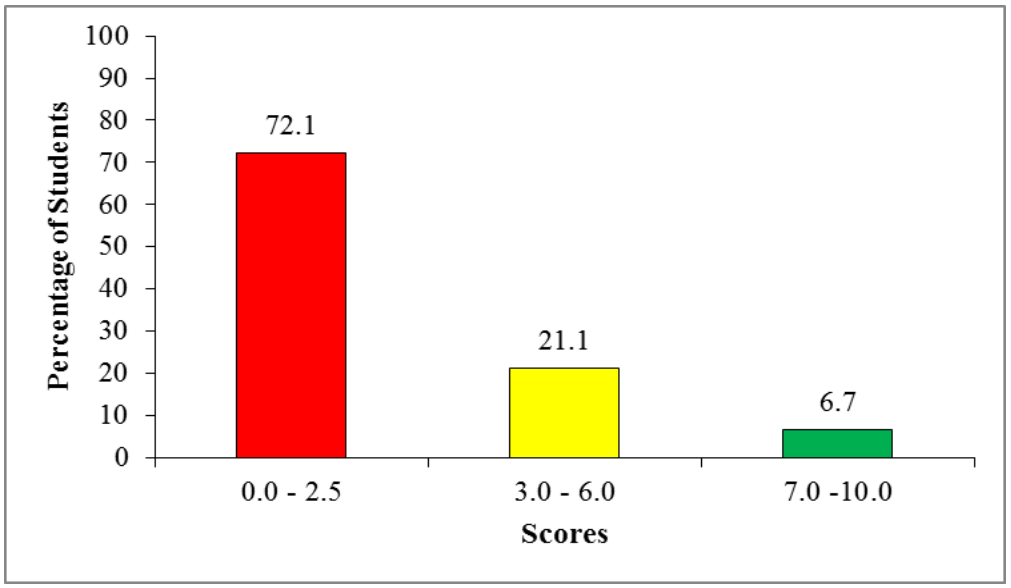


Figure 3*: Students' performance in question 3.*

The analysis reveals that 27.7 per cent of the students scored 3 marks and above. Therefore, the general performance in this question was poor.

Students with poor performance in this question hardly stated the uses of the different components of the First Aid Kit. Others could not give the functions of laboratory apparatuses; they even skipped some parts of the question. Likewise, a few students failed to state both uses and functions of the components of the First Aid Kit and laboratory apparatus respectively in English. Instead, they used Kiswahili language. Moreover, some wrote irrelevant answers which sounded meaningless. For example, in answering part (a) (ii), one of the students wrote the use of bandage as; *it is used to recovered and pain* while in part (b) (iv) another student responded by writing: *motor and pestle is the suitable alternative heat source to be used in absence of bunsen burner*. This signifies little mastery of the subject content and poor communication skills. Extract 3.1 shows a sample of poor responses from one of the students who scored low marks.

3. (a) State one use of each of the items (i) - (v) in administering First Aid.

S/N	Item	Use
(i)	Soap	used fo storing bound (burn
(ii)	Bandage	used por soap of hospital
(iii)	Sterile gauze	used per sterile Bandage
(iv)	Iodine tincture	used for tincture bound
(v)	Petroleum jelly	used For Iodic bound

(b) Give one function of each of the following apparatuses in the chemistry laboratory.

(i) Spatula .....
used por changing Sature
.....

(ii) Gas jar .....
Used for Oxygen in the diagram

(iii) Lie-big condenser .....
Used in the Condenser For the diagram
In the bunsen burner

(iv) Motor and pestle .....
Used For Motor In follow In the laboratory
.....

(v) Wire gauze .....
Used por full in gauze in the laboratory

Extract 3.1: A sample of poor responses in question 3.

Students who scored high marks gave the correct use of the components of the First Aid Kit and managed to state the function of the given laboratory apparatuses. This indicates they had sufficient knowledge on the subject matter. Extract 3.2 illustrates a sample of good responses from a student who scored high marks.

3. (a) State one use of each of the items (i) - (v) in administering First Aid.

S/N	Item	Use
(i)	Soap	It is used for washing hands, wounds as well as equipments.
(ii)	Bandage	It is used for covering wounds so as to protect it from microorganism and dust conditions
(iii)	Sterile gauze	It is used for washing and drying wounds
(iv)	Iodine tincture	It is usually applied on fresh cuts and wounds.
(v)	Petroleum jelly	It is used for smoothening or soothing chapped skin and wounds.

(b) Give one function of each of the following apparatuses in the chemistry laboratory.

(i) Spatula ... It an apparatus used for scooping powdered chemicals and substances in the laboratory

(ii) Gas jar ... It an apparatus for collecting gases in the laboratory. It is normally assisted with delivery tubes and beehive shelf for collecting different gases.

(iii) Lie-big condenser ... It an apparatus used for cooling water vapour. It is normally applied in distillations such as fr simple and fractional distillation.

(iv) Motor and pestle ... It an apparatus used for crushing and grinding substance into powder form, which are then scooped by spatula.

(v) Wire gauze ... It is used for spreading flame, preventing direct heat to reach apparatus as well as preventing soot during heating.

Extract 3.2: A sample of correct responses in question 3.

2.2.2 Question 4: Oxygen and Hydrogen

This question had three parts (a), (b) and (c), in part (a) (i) students were required to explain why manganese dioxide is added to hydrogen peroxide during laboratory preparation of oxygen gas. In part (a) (ii), students were asked to explain how fish can obtain oxygen for respiration while they spend

their lives in water. In part (a) (iii), they were required to explain how oxygen gas can be used for welding activities although it does not burn. Part (b) required students to explain the properties of hydrogen which enable it to be used in weather balloons and in production of oxy-hydrogen flame while part (c) required students to give two domestic uses of oxygen gas.

The question was attempted by 570,895 students. The analysis showed that 84.9 per cent of the students scored 0 to 2.5 marks, 12.1 per cent scored 3 to 6 marks and 3.0 per cent scored 7 to 10 marks. Generally the performance of students in this question was poor with only 15.1 per cent of the students scoring 3 marks and above. Figure 4 summarizes performance in question 4.

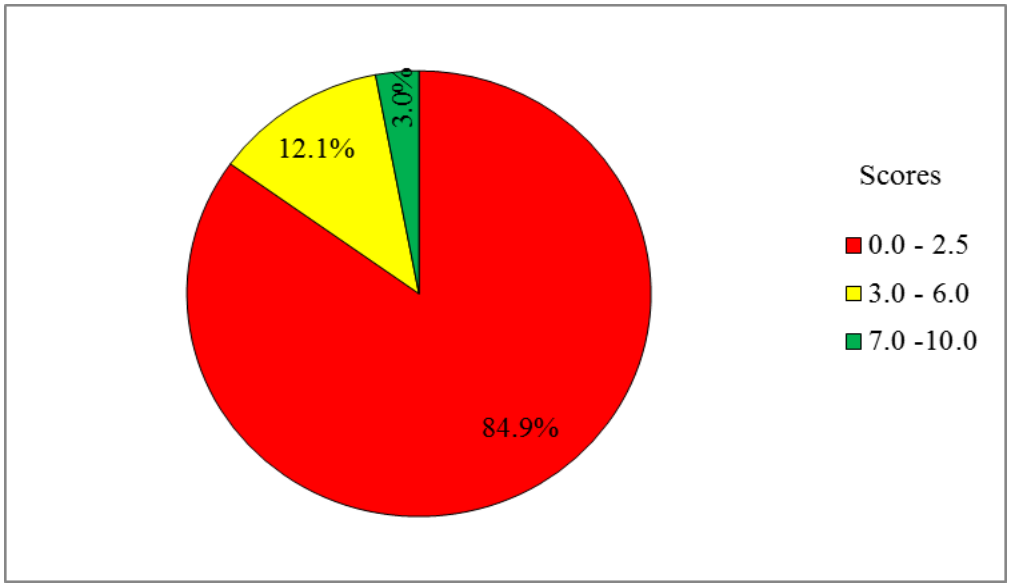
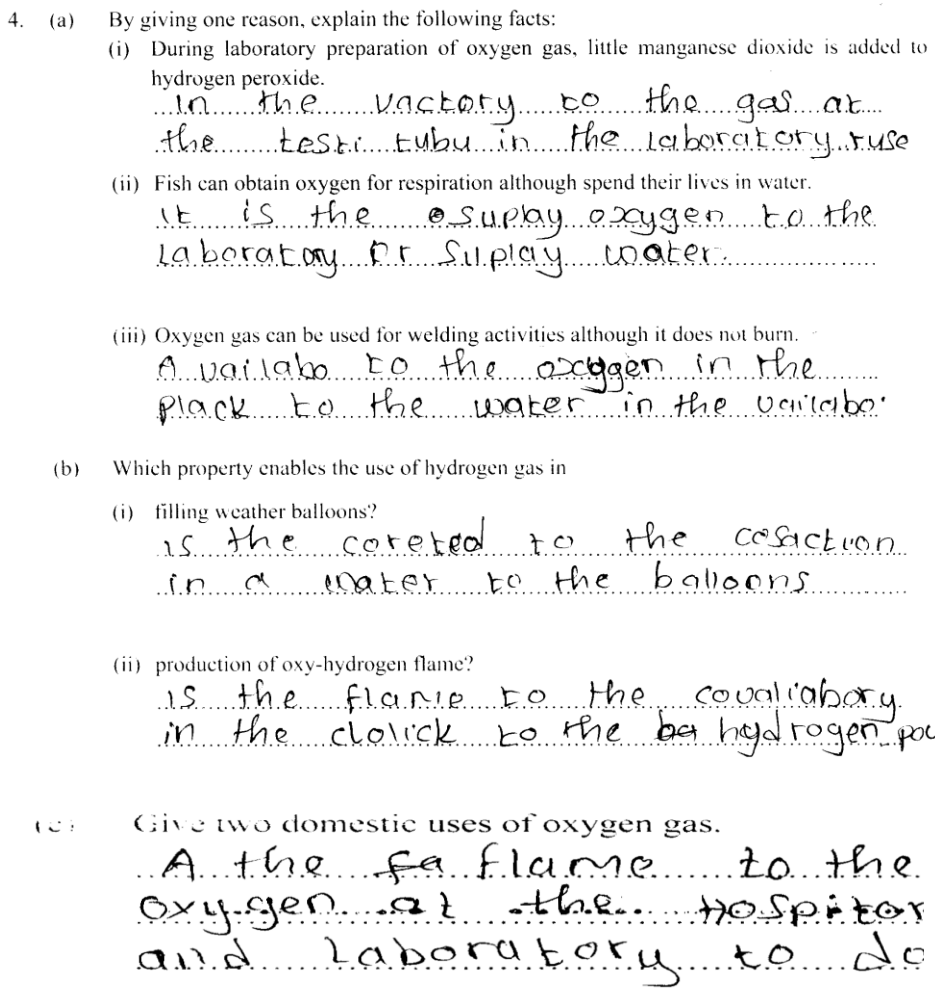


Figure 4.0: *Students' performance in question 4.*

Students who scored low marks failed to explain correctly the reasons that were required. Some showed misconception as they explained the role of oxygen instead of manganese dioxide in laboratory preparation of oxygen gas from hydrogen peroxide. Others failed to account for solubility of oxygen in water rather explained the role of gills in fish for respiration. For example, one wrote: *fish obtains oxygen for respiration because uses gill in water*. Some few could not associate properties of hydrogen with its application in balloon and in production of oxy-hydrogen flames while others failed to distinguish domestic use of oxygen. Principally poor performance of students in this question was attributed to inadequate knowledge on the topics about

Oxygen and *Hydrogen* and poor English language competence. Extract 4.1 illustrates a sample of poor answer from one of the students.


4. (a) By giving one reason, explain the following facts:

(i) During laboratory preparation of oxygen gas, little manganese dioxide is added to hydrogen peroxide.

In the vactory to the gas at the testi tubu in the laboratory ruse

(ii) Fish can obtain oxygen for respiration although spend their lives in water.

It is the suplay oxygen to the laboratory or suplay water

(iii) Oxygen gas can be used for welding activities although it does not burn.

Available to the oxygen in the plack to the water in the variabo

(b) Which property enables the use of hydrogen gas in

(i) filling weather balloons?

is the covered to the coaction in a water to the balloons

(ii) production of oxy-hydrogen flame?

is the flame to the covaliabory in the clolick to the ~~be~~ hydrogen power.

(c) Give two domestic uses of oxygen gas.

A the ~~fa~~ flame to the oxygen at the hospitor and laboratory to do

Extract 4.1: A sample of poor responses in question 4.

However, students who scored high marks provided correct responses in various parts of the question as they were not only knowledgeable enough to apply the assessed skills but also they had good English language proficiency. Extract 4.2 provides a sample of good answers from one of the students who scored high marks.

4. (a) By giving one reason, explain the following facts:

(i) During laboratory preparation of oxygen gas, little manganese dioxide is added to hydrogen peroxide.

Little manganese oxide is added in preparation of oxygen so as to act as a catalyst for speeding up the rate of chemical reaction so as to produce oxygen.

(ii) Fish can obtain oxygen for respiration although spend their lives in water.

Fish have organs specialized for respiring oxygen and because oxygen is slightly soluble in water the fish are able to use their gills to breath that oxygen contained in water

(iii) Oxygen gas can be used for welding activities although it does not burn.

Oxygen gas easily combines with hydrogen or other gases at high temperatures to form flames that are hot and can be used in welding.

(b) Which property enables the use of hydrogen gas in

(i) filling weather balloons?

Hydrogen is less denser than air so when it is filled in balloons it make them to float in air.

(ii) production of oxy-hydrogen flame?

Hydrogen gas is flammable thus combines with oxygen at high temperatures up to 3000°c so as to form oxy-hydrogen flame used in welding.

(c) Give two domestic uses of oxygen gas.

- Oxygen is used for respiration by living organisms without oxygen living organisms will not survive.
- Oxygen gas is used for cooking or heating, this is because oxygen supports combustion.

Extract 4.2: A sample of good responses in question 4.

2.2.3 Question 5: Water

This question had two parts (a) and (b). Part (a) required students to give three tests for water. Part (b) had three items where item (i) required students to differentiate *water treatment* from *water purification*; part (b) (ii) required students to give reasons why drinking water must be treated and purified and item part (b) (iii) required a student to explain three ways by which water can be treated and purified.

Statistical data reveals that 570,880 students attempted this question. The analysis of the students' performance indicates that 76.4 per cent of students scored 0 to 2.5 marks; 17.0 per cent scored 3.0 to 6.0 marks and 6.6 per cent scored 7.0 to 10 marks. Generally, the question was performed poorly whereby only 23.6 per cent of students scored 3 marks and above. Summary of the performance is shown in figure 5.

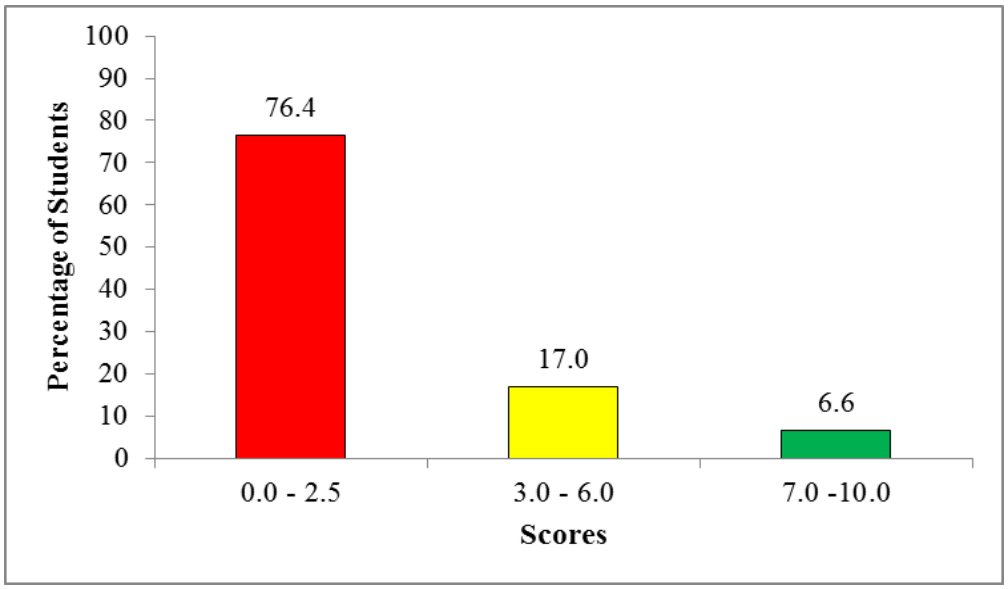


Figure 5: *Students' performance in question 5.*

A few students who got high scores were able to give three proper chemical tests for water and showed appropriate results of each test. Likewise, they correctly differentiated water treatment from water purification. They further explained reasons why drinking water should be treated and purified. They also explained how water is treated or purified. This indicates that they had good understanding of the subject matter. Extract 5.1 illustrates a sample of good answer from one of the students who scored all the marks.

5 (a) Give three chemical tests for water and show the results obtained in each.

(i) Water turns a white anhydrous copper (II) sulphate ($CuSO_4$) into blue.

(ii) Water turns blue cobalt chloride paper into a pink.

(iii) Water is neutral on litmus paper because it is neither acidic or basic, so when tested on litmus, the litmus turns neither blue nor red.

(b) (i) Differentiate water treatment from water purification.

Water treatment refers to the process in which dust and microorganisms are removed from water so as to make it safe for use. It can be domestic treatment of water or urban treatment of water while water purification is the process in which dust and microorganisms are removed from treated water soas to make it pure and safe for drinking and water treatment makes water pure for domestic, industrial or medical purposes.

(ii) Why drinking water should be treated and purified? Give two reasons.

- Drinking water should be treated and purified because it helps to remove microorganisms that could have caused diseases if were taken with it.
- Treating and purifying water makes it suitable for domestic uses example in cooking it is safe for use or in washing and cleaning purposes

(iii) How can drinking water be treated or purified?

- By boiling, water is boiled for sometime to kill germs
- By filtration, putting a cloth on top of container and filtering
- By using purifiers example aqua guard

Extract 5.1: A sample of good responses in question 5.

However, students who scored low marks gave incorrect responses. Some failed to identify the proper chemical tests for water. Instead, they mentioned physical properties of water while others gave the three states of water; ice (solid), liquid (water) and gas (vapour). Moreover, others confused chemical tests for water with hard water and soft water.

A few students failed to differentiate water treatment from water purification. Instead, they gave uses of water, mentioning some names of local drinking water and explained importance of water. For example one student differentiated water treatment from water purification as "*water treatment is*

the very important in the communities and in the domestic for example cooking, drinking, cleaning, washing etc. water purification is the water of the river". Generally the performance of students is associated with the lack of adequate knowledge on the subject content and poor English language proficiency since they lacked knowledge on water treatment and purification. Extract 5.2 provides a sample of poor response from one of the students.

5. (a) Give three chemical tests for water and show the results obtained in each.
(i) Colourless
(ii) Odourless
(iii) Testless.

(b) (i) Differentiate water treatment from water purification.
Water treatment is the processing of making water for domestic use. While Water purification is a water which ~~is~~ is to taken the Contamination of the medi cal in order to ~~no~~ will you safety water.

(ii) Why drinking water should be treated and purified? Give two reasons.
- Because is water safety very clear
- Because if you drinking wade should be treated and purified didnot Suffering from Stomach.

(iii) How can drinking water be treated or purified
- Uhai water
- Kilimanjaro water
- fresh water.

Extract 5.2: A sample of incorrect responses in question 5.

2.2.4 Question 6: Scientific Procedure

The question was organised into two parts (a) and (b). Part (a) required a student to differentiate hypothesis from analysis while part (b) required a student to explain how senses are used as tools of observation during experimentation.

The question was attempted by 570,879 students, of whom only 12.2 per cent scored 3 to 10 marks, an indication of poor performance. The students who scored 0 - 2.5 marks were 87.8 per cent, while 6.3 per cent scored 3 to 6 marks and 5.9 per cent scored 7 to 10 marks. Figure 6 shows the distribution of the students' scores in this question.

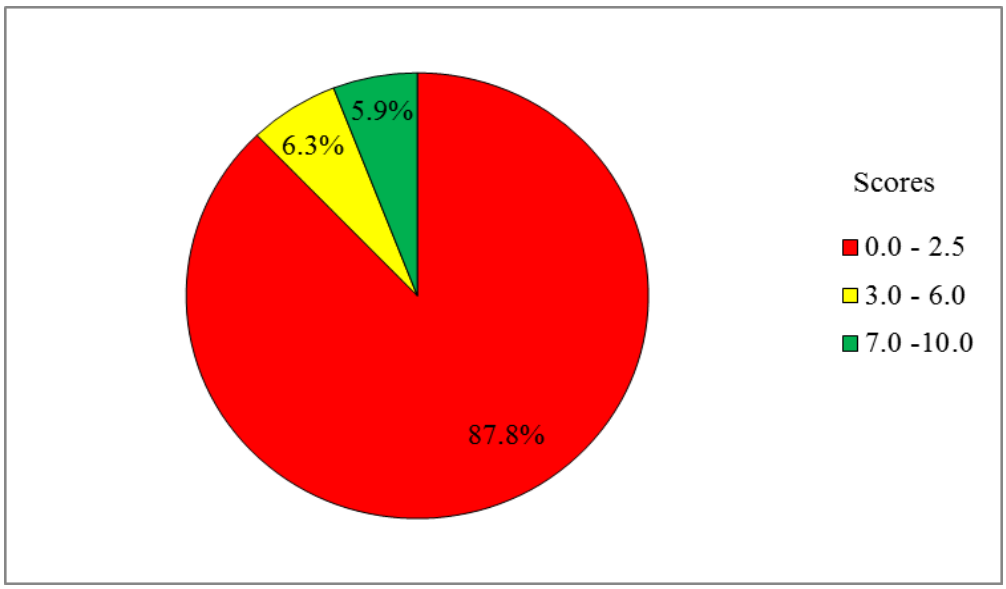


Figure 6: *Students' performance in question 6.*

Poor performance in question 6 was a result of inadequate understanding of subject matter in the topic *scientific procedure*.

Most of the students failed to differentiate hypothesis from analysis. They gave stages of carrying out scientific experiments while others went as far as listing and stating the use of laboratory apparatus in place of senses as tools of observation during experimentation. For instance, one student incorrectly wrote; *observation*, *experimentation*, *data interpretation* and *data analysis* instead of senses as tools of observation. This implies that those students lacked basic knowledge regarding the use of senses as tools in a scientific study. Extract 6.1 shows a sample of poor responses from one of the students.

6. (a) Differentiate hypothesis from analysis.

is the study of a plant to being in the process of going to became a big on that grou nd or place because of using for hypothesis e or analysisses on that place by guiet: water light from the sun rise

(b) Effective use of the four senses of observation is important before a chemist can make conclusion. With four points, show how the senses are used as tools of observation during experimentation by giving one example for each.

(i) the accident which will be formuded in the laboratory when the time are those people heating things in that

(ii) laboratory whe the are doing experimantion so the have fobe carefulling because on of people deaded

(iii) because of the chemicals which are those who are contanded on

(iv) that laboratory whe the buring the chemicals ande the air its goes out of the laboratory.

Extract 6.1: A sample of poor responses in question 6.

Conversely, a few students who scored high marks managed to differentiate the terms *hypothesis* and *analysis* correctly and showed how the four senses are used as tools of observation during experimentation. Some students went a step further by giving appropriate examples of each sense relating to scientific study. Generally, these students had adequate knowledge on scientific studies and enough skills on how to use the four senses during experimentation. Extract 6.2 shows a sample of good responses from one of the students.

6. (a) Differentiate hypothesis from analysis.

Hypothesis is an intelligent scientific guess which tries to answer or solve the problem BUT Data analysis is the process of arranging the data collected in a certain format such as table format or graph format

(b) Effective use of the four senses of observation is important before a chemist can make conclusion. With four points, show how the senses are used as tools of observation during experimentation by giving one example for each.

(i) Sight: this is a sense that helps as see. It helps to observe how an experiment occurs. For example: While measuring volume we use our eyes to know the volume of a substance in the measuring cylinder.

(ii) Hearing: this sense helps to know what sound is produced when a certain experiment occurs. Eg: Hearing helps to test hydrogen because it burns with a pop sound.

(iii) Smell: this sense helps to know how something smells in an experiment. For example: Water is odourless so you can easily identify it in an experiment

(iv) Touch: this sense helps to know how the substance is in an experiment. For example: When you touch concentrated sulphuric acid with your bare hands you may easily identify it as you may feel it corroding your hand

Extract 6.2: A sample of good responses in question 6.

2.2.5 Question 7: Laboratory techniques and Safety

This question required students to give two precautions to be taken when handling chemicals based on their warning signs. Figures of five warning signs were given in five different parts of the question.

The question was attempted by 570,887 students, of whom 93.5 per cent scored 0 to 2.5 marks indicating a poor performance. Students who scored 3 to 6 marks were 5.2 per cent and those who scored 7 to 10 marks were only 1.3 per cent. The distribution of students' scores is shown in Figure 7.

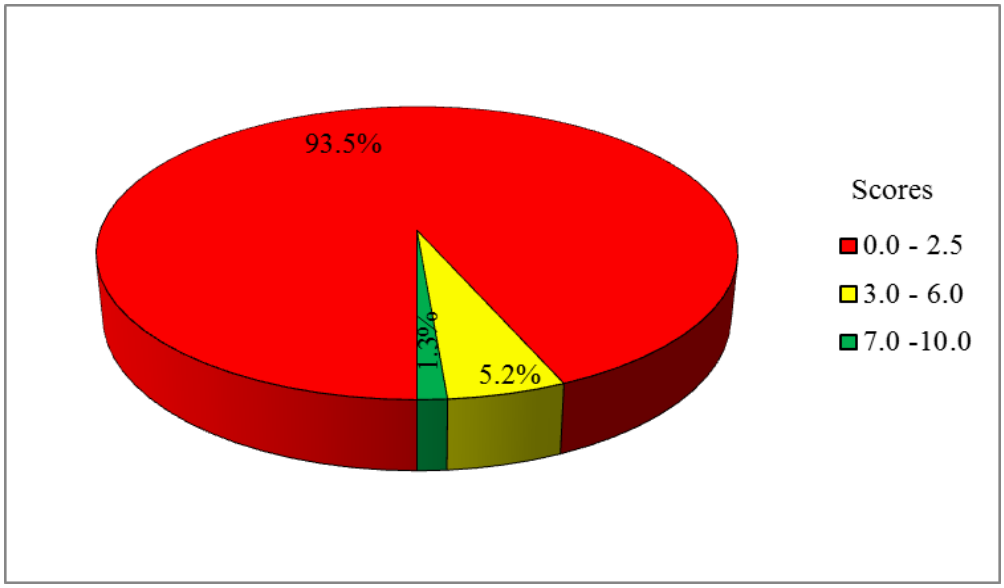


Figure 7: *Students performance in question 7.*

Most of the students who scored low marks in this question failed to give the appropriate precautions for each of the five warning signs of chemicals.
Some of them responded by stating the meaning of the warning signs which was a result of not understanding the demand of the question. Some failed to identify the warning signs and a few skipped some portions of the question. Similarly, some students provided laboratory rules instead of the precautions to be taken when handling chemicals with various warning signs while others gave the hazardous implications of the warning signs. For instance, one student responded to toxic sign as: *do not taste anything in the laboratory*. This implies that the student had insufficient knowledge on the topic about *Laboratory Techniques and Safety*. Extract 7.1 shows a sample of poor responses from one of the students.

7. What precautions will you take in handling chemicals having the warning signs shown in the table? Give two precautions in each sign.

S/N	Sign	Relevant Precaution
(a)		(i) It precaution Fire fighting (ii) It precaution to explaid
(b)		(i) catch fire easily (ii) It precaution catch fire
(c)		(i) It precaution ~~dead~~ danger (ii) it precaution death
(d)		(i) It precaution burn of skin (ii) It precaution of be aware for burn of skin
(e)		(i) It precaution burning of gas (ii) It precaution oxidizing

Extract 7.1: A sample of poor responses in question 7.

On the other hand, students who scored high marks provided appropriate precautions for each of the five warning signs. In addition, they managed to give meanings of the warning signs. This proved that they had enough knowledge and skills on the subject matter. Extract 7.2 illustrates a sample of good responses from one of the students.

7. What precautions will you take in handling chemicals having the warning signs shown in the table? Give two precautions in each sign.

S/N	Sign	Relevant Precaution
(a)		(i) Handle with care and do nd heat such substance on fire directly. (ii) Avoid exposing it to any heat apart from the limited heat degree of storage and usage because it can explode.
(b)		(i) Avoid exposing such substance to fire because it is highly flammable. (ii) Avoid storing such substances in places where you are heating other substances.
(c)		(i) Avoiding drinking or tasting such substance because they are poisonous (ii) Avoid such substances storing it or placing it open because it can fall on any other chemical and cause trouble
(d)		(i) Handle with care by making sure that I don't come into any contact with it because it is corrosive. (ii) Preventing such substances from coming into contacts with things like a wooden material or which can be corroded
(e)		(i) Precaution taken is exposing such substance to a burning material or to fire because it support burning (ii) Store such substances with care and do not heat such substance of fire directly.

Extract 7.2: A sample of good responses in question 7.

2.2.6 Question 8: Air, Combustion, Rusting and Fire Fighting

The question required students to explain with examples five classes of fires based on the nature of the burning material and the appropriate fire extinguisher for each class of fire.

The question was attempted by 570,889 students, out of whom 38.0 per cent scored 0 to 2.5 marks, 41.9 per cent scored 3.0 to 6.0 marks and 20.1 per cent scored 7 to 10 marks. Those who scored 3 marks and above were 62 per cent, an indication that the general performance in this question was average. Pictorial presentation of performance in this question is shown in figure 8.

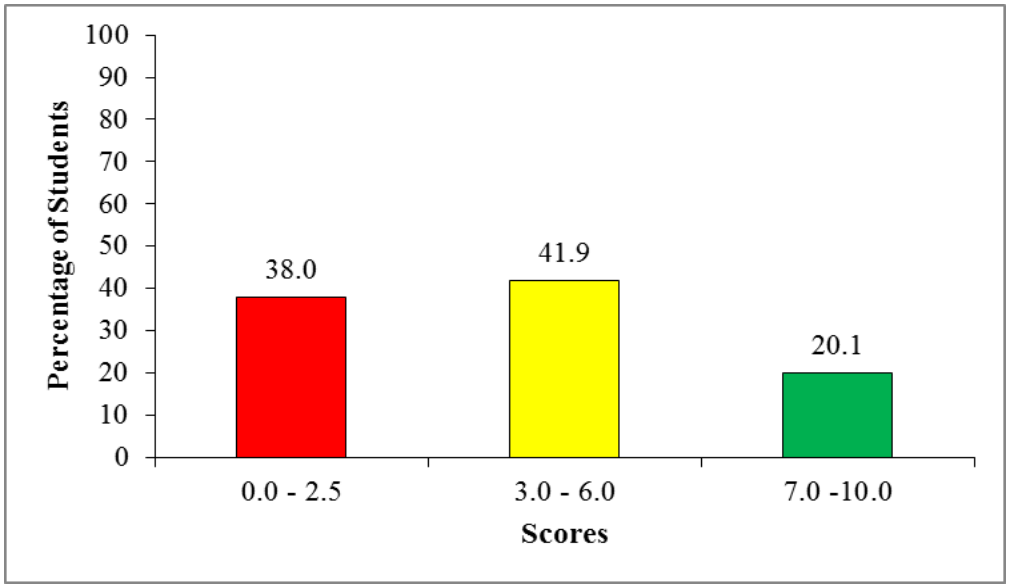


Figure 8: *Students' performance in question 8.*

Students who scored high marks managed to explain with examples the five classes of fires and gave the appropriate fire extinguisher for each. The responses given by students in this category met the demands of the question. Most of them explained the classes of fire by giving more than one example of the burning materials. This gives crucial evidence that they had sufficient knowledge on fire fighting. Extract 8.1 illustrates a sample of correct responses from one of the students.

8. Briefly explain the five classes of fires based on the nature of the burning material and the extinguisher required. Give one example for each class.

(a) Class A fire
Materials that burn are ordinary solids
Extinguisher required is dry powder extinguisher.

(b) Class B fire
Materials that burn are flammable liquids
Fire extinguisher required is dry powder extinguisher.

(c) Class C fire
Material that burns is flammable gas
Fire extinguisher required is foam extinguisher

(d) class D fire
Material that burns is combustible metals
Fire extinguisher required is dry powder extinguisher

(e) Class E fire
Material that burns is electrical equipment
Fire extinguisher required is carbon dioxide extinguisher

Extract 8.1: A sample of good responses in question 8.

On the contrary, students who scored low marks could not provide correct answers to most parts of the question. Most of them mistakenly interchanged both the meaning of the classes of fires and the extinguishers. A few of them correctly stated classes of fire though they failed to match with the proper burning material. Additionally, others confused by giving types of flames produced when a material burns such as luminous flame and non-luminous flame. Students who scored zero gave unrelated responses according to the demand of the question. They mentioned process by which matter changes from one state to another. For example, one student wrote *melting, freezing, evaporation, condensation, sublimation.* This is an implication that the student lacked adequate knowledge of fire fighting. Extract 8.2 illustrates a sample of poor responses in question 8.

8. Briefly explain the five classes of fires based on the nature of the burning material and the extinguisher required. Give one example for each class.

(a) fi fire extinguisher - this is the people of middle use fire there is stone age.

(b) I Blanket extinguisher. There are types of extinguisher that used to show from the malarity is called anerspheres living thing according the organism.

(c) Water extinguisher. There are types of extinguisher that is formed by the other organism from the water mineral from the sun.

(d) Blood extinguisher. There are types of food which used to the domestic chemical for water drinking atom. effect of other..

(e) Charcoal extinguisher There are the people from one place to another and their own people and the water body from the environment.

Extract 8.2: A sample of poor responses in question 8.

2.2.7 Question 9: Bonding, Formulae and Nomenclature

This question required students to calculate molecular formula from percentage abundances and molar mass. Percentages of abundances by mass of the compound were 30.4% nitrogen and 69.6% oxygen and the molar mass given was 92. They were required to procedurally calculate the compound's molecular formula. All steps involved in the calculation were to be shown.

The question was attempted by 570,892 students out of whom 66.6 per cent scored 0 to 2.5 marks, 13.1 per cent scored 3.0 to 6.0 marks and 20.3 per cent scored 7.0 to 10 marks. Students who scored 3 marks and above were 33.4 per cent, implying that the overall performance was average. Figure 9 gives a summary of performance on question 9.

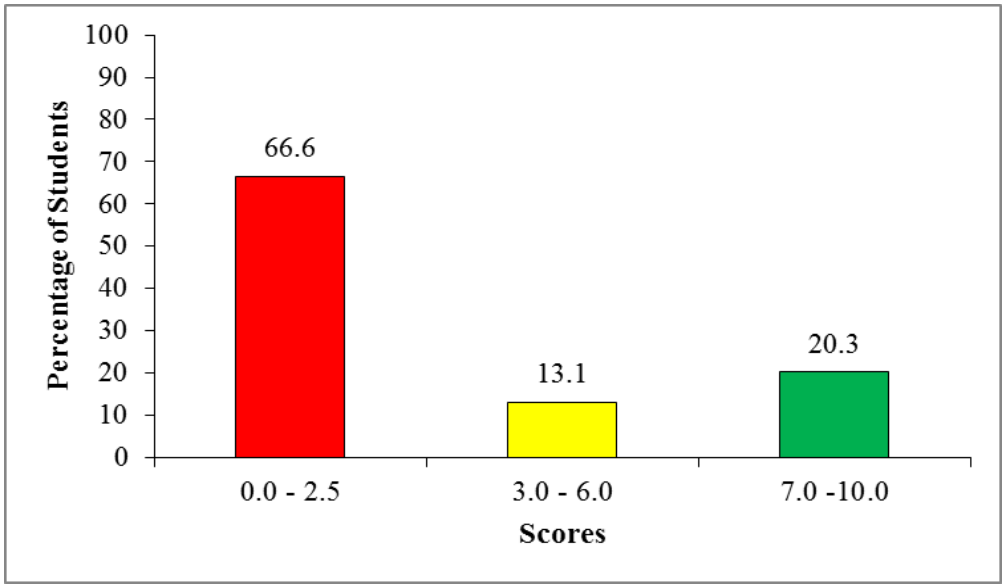


Figure 9: *Students performance in question 9.*

Students who scored high marks on the question managed to calculate the molecular formula. Most of them followed the proper steps to calculate the empirical formula and finally the molecular formula. This means that the students had adequate knowledge on the relationship between atomic masses and empirical formulae. They carried out the calculation properly by following all the necessary steps. Extract 9.1 illustrates a sample of one of the students with a good answer.

9. A certain gaseous compound contains 30.4% of nitrogen and 69.6% of oxygen by mass. If the molar mass of the compound is 92, calculate its molecular formula.

Stage	Nitrogen	Oxygen
Element	N	O
Percentage	30·4	69·6
Relative Atomic mass (R.A.M)	14	16
$\frac{\text{Percentage}}{\text{R.A.M}}$	$\frac{30.4}{14} = 2.17$	$\frac{69.6}{16} = 4.35$
Divide by the smallest to both.	$\frac{2.17}{2.17} = 1$	$\frac{4.35}{2.17} = 2.0$
Ratio	1	2

Empirical formula is NO_2

Molecular formula = n(Empirical formula)

Molar mass = $n(NO_2)$

$92 = n(N + 2\times O)$

$= n(14 + 2\times 16)$

$= n(14+32)$

$\frac{92}{46} = \frac{46n}{46}$

$n = 2$

Molecular formula = $2(NO_2)$

$= N_2O_4$

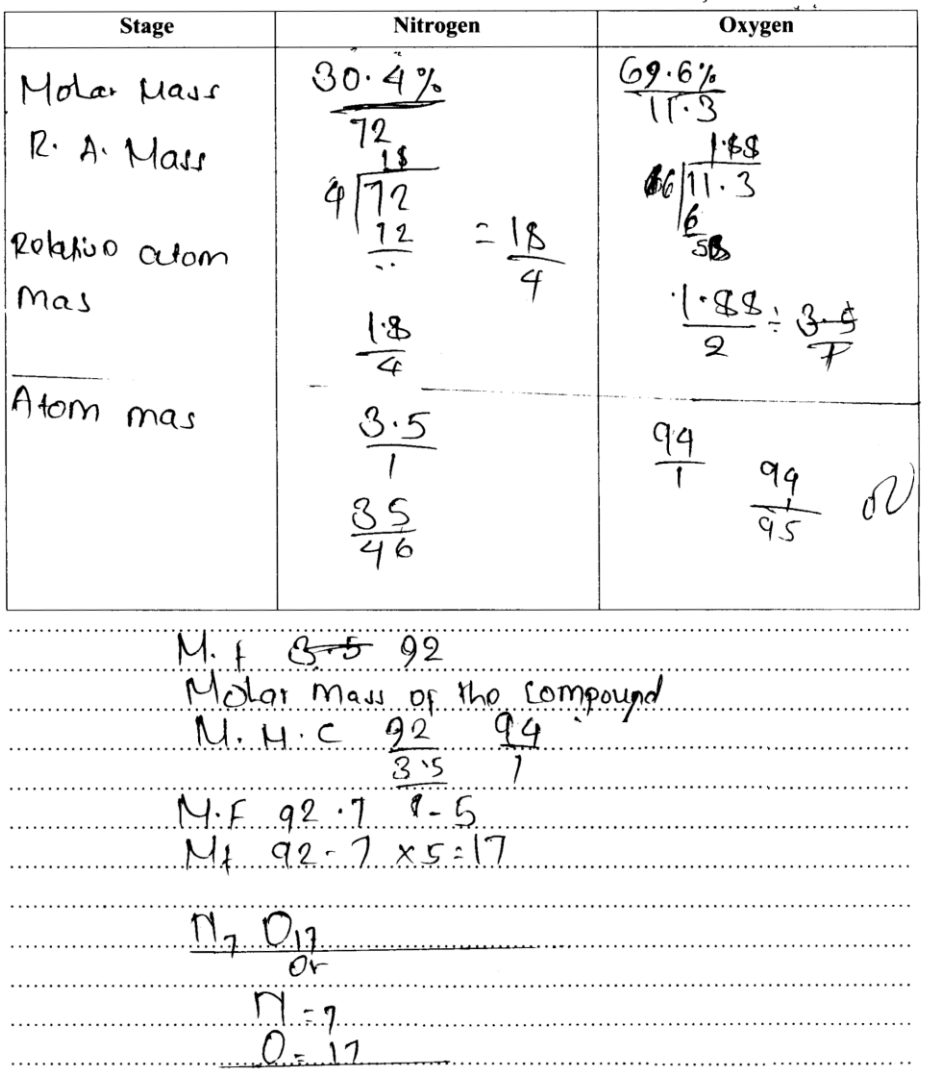
∴ The molecular formula is N_2O_4

Extract 9.1: A sample of good responses in question 9.

On the contrary, the low achievers did not manage to calculate the correct molecular formula. Most of them followed improper approach and used improper formula. For instance, some students divided the relative atomic masses by the percentages instead of dividing the percentages by the relative atomic masses. Similarly, there were cases of students who used atomic numbers instead of relative atomic masses. Poor performance of students in

this question was attributed to lack of adequate knowledge on the concept of molecular formula and poor arithmetic skills. Extract 9.2 illustrates a sample of the poor students' response.

9. A certain gaseous compound contains 30.4% of nitrogen and 69.6% of oxygen by mass. If the molar mass of the compound is 92, calculate its molecular formula.



Extract 9: A sample of poor responses to question 8.

2.2.8 Question 10: Fuels and Energy

The question required students to explain five characteristics to be considered when looking for a good fuel.

This question was attempted by 570,704 students, out of whom 59.5 per cent scored 0 to 2.0 marks, 19.5 per cent scored 3.0 to 6.0 marks and 21.0 per cent scored 7.0 to 10 marks. Generally, the performance was average with 40.5 per cent scoring 3 marks and above. Figure 10 gives a summary of the performance in question 10.

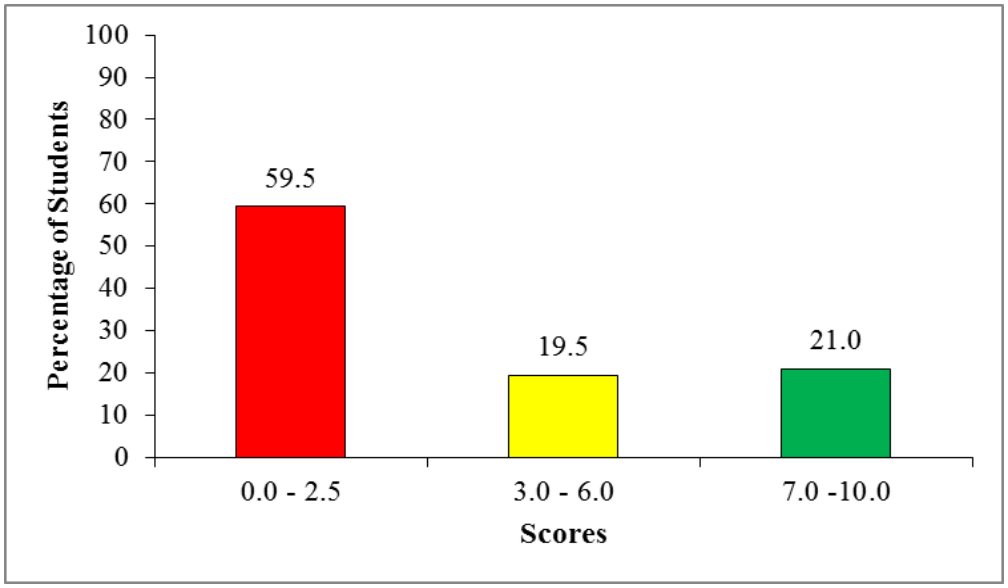


Figure 10: *Students performance in question 10.*

Students who scored high marks managed to state all the five characteristics of a good fuel. They managed to explain using technical terms with logical presentation. For example, one student stated that *a good fuel has high calorimetric value and it should burn with moderate velocity*. Extract 10.1 illustrates a sample of the correct responses in question 10.

10 Briefly explain five characteristics to be considered when looking for a good fuel.

(i) It must be easily affordable to many people. A good fuel like wood it is not expensive to afford and many people can acquire it and get it.

(ii) It must not give off any poisonous gases. A good fuel is not harmful or should not endanger the lives of people by producing harmful gases instead it should be harmless to the ones using it.

(iii) It must be easily stored and transported. A good fuel should not be heavy that it can not be moved from one place to another and it should be easy to store it.

(iv) It must be cheap. A good fuel must not be expensive that many people can not buy it instead it should have an affordable price and not cost much.

(v) It must be easy to control. A good fuel is easy to control when you want to put it off it can be easy to put it off and it does not require alot of energy to burn it.

Extract 10.1: A sample of good responses in question 10.

On the other hand, students who scored low marks could neither state nor explain the characteristics to be considered when looking for a good fuel. Majority of them stated the uses of fuels instead of the characteristics of good fuel asked. For instance, one student responded that *a good fuel can be used in domestic purpose, used in biogas, gives out and light.* Other students listed and explained the effects of fuels instead of characteristics. This is an indicator of inadequate knowledge on fuel and energy. Extract 10.2 shows a sample of poor responses.

10. Briefly explain five characteristics to be considered when looking for a good fuel.

(i) It is separation and chemical of ~~chi~~ test ~~ba~~ tube and chemical change

(ii) It is used good laboratory

(iii) It used ~~good~~ of oxygen and chemical physical

(iv) It used of ~~P~~ Apprication of the opperation in the laboratory

(v) It use of experiment of the direct and labratory in burning

Extract 10.2: A sample of poor responses in question 10.

3.0 ANALYSIS OF STUDENTS' PERFROMANCE IN EACH TOPIC

A total of 12 topics were assessed in FTNA 2019. The analysis of students' performance on each topic shows that none of the topics was well performed. Students' performance was average in five topics and poor in three topics.

The topics which attained average performance were *Air, Combustion and Fire Fighting* (62.0%); *Fuels and Energy* (40.5%); Matter (38.0%); *Laboratory Techniques and Safety* (34.4%); and *Bonding, Formula and Nomenclature* (33.4%).

The students who performed averagely on those topics, apart from showing a good mastery of the content regarding the topic in question, they provided partial answers. Most of them seemed not to capture all the requirements of the questions.

The topics which were poorly performed were *Water* (23.6%); *Oxygen and Hydrogen* (15.1%); and *The Scientific Procedure* (12.2%). The poor performance of students on the stated topics indicates inadequate knowledge

on the subject matter assessed and student's inability to apply scientific concepts. The poor performance observed also signalled incompetence in tackling problems involving calculations. These factors, together with lack of the aforementioned attributes, contributed to an unsatisfactory performance. Furthermore, topics which appeared in question 1 only have not been rated because they contributed very little with respect to others in the assessment.

The comparison of the students' performance between the year 2018 and 2019 shows that, the performance in 5 topics has increased, while it has decreased in 6 topics. More details on the performance on different topics are presented in the appendix.

4.0 CONCLUSION

Analysis of performance per question in Chemistry for the FTNA 2019 has shown that the overall students' performance was good.

The analysis shows that 1 topic had good performance, 4 topics had an average performance and 3 topics had poor performance. Good performance was attributed to good mastery of the concepts tested in the respective topics and understanding of the demands of different questions.

However, the analysis on individual items indicated that some of the students experienced difficulties in answering the questions due to inadequate knowledge. This poor performance was specifically attributed to:

(a) Lack of adequate numerical skills and inadequate knowledge on the tested topics. This was evident in some of the students who gave responses which did not relate to the questions asked.

(b) Failure of the students to understand the requirements of the questions. Some students were unable to identify the key words used in the questions. For example, there were students who gave explanations instead of calculations.

(c) Lack of English language proficiency. This was manifested by the students who gave incorrect sentences that could not enable them to communicate their answers.

5.0 RECOMMENDATIONS

In order to improve performance of students in Chemistry, the following measures are recommended:

(i) Teachers to guide students demonstrate treatment and purification of water for domestic use. This will help to improve performance in the topic of *Water*.

(ii) Students should be advised to take part in projects that make use of the scientific procedure in solving Chemistry problems in the society. This will enhance performance in the topic about *The Scientific Procedure*.

(iii) Students are advised to carry out experiments on how to produce oxygen gas by using manganese oxide. They are also advised to identify the uses and properties of gas properties. As a result, performance in the topics of *Oxygen* and *Hydrogen* will be improved.

(iv) More emphasis should be put on teaching English as some students demonstrated inability to use English. Instead, they used Kiswahili language in answering some questions while they were ought to answer all questions in English.

(v) Students should be emphasized to read questions carefully before attempting them. This will solve the challenge of misunderstanding questions in future assessments.

Appendix

ANALYSIS OF STUDENTS' PERFORMANCE PER TOPIC IN 2019

S/n	Topic	Question Number	Per centage of Students who Scored 30 Marks and Above	Remarks
1	*Laboratory Techniques and Safety; Heat sources and Flame; Air, Combustion and Fire Fighting; Hydrogen; Water; Periodic Classification; Matter* and *Bonding, Formula and Nomenclature*	1	79.1	Good
2	*Air, Combustion and Fire Fighting*	8	62.0	Good
3	*Fuels and Energy*	10	40.5	Average
4	*Matter*	2	38.0	Average
5	*Laboratory Techniques and Safety*	3&7	34.4	Average
6	*Bonding, Formula and Nomenclature*	9	33.4	Average
7	*Water*	5	23.6	Poor
8	*Oxygen and Hydrogen*	4	15.1	Poor
9	*Scientific Procedure*	6	12.2	Poor