THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

STUDENTS' ITEM RESPONSE ANALYSI REPORT ON THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2023

CHEMISTRY

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032 CHEMISTRY

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FOREWORD

This report presents analysis of performance of students in Chemistry subject on Form Two National Assessment (FTNA) which was conducted in November 2023. The report aims to provide feedback to all educational stakeholders on the factors that contributed to the students' performance in Chemistry assessment.

The Form Two National Assessment (FTNA) is a formative evaluation which intends to monitor students' learning in order to provide feedback to teachers, students and other education stakeholders so as to improve teaching and learning in secondary schools. This analysis shows justification for the students' performance in the Chemistry subject.

The students who performed well demonstrated mastery of the basic concepts, theories, terminologies, experiments and principle in Chemistry. Conversely, those who scored low marks lacked adequate knowledge hence, failed to demonstrate mastery of concepts, theories, terminologies, experiments and principles. Likewise, the students failed to respond according to the demands of the questions in justifying scientific facts. Furthermore, some of them demonstrated poor skills in numerical manipulation.

The National Examinations Council of Tanzania (NECTA) expects that, this report will help to explain the challenges for which education stakeholders should take appropriate measures to improve teaching and learning in Chemistry subject. Consequently, students will acquire knowledge, skills and competences indicated in the syllabus for better performance in future assessments and examinations.

Finally, the Council extends its gratitude to examination officers who participated in preparing this report.

Dr. Said Ally Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents a detailed Students' Item Response Analysis on each question in the Chemistry Subject in the Form Two National Assessment (FTNA) 2023. The analysis focused on the assessment results and performance in each question.

The question paper consisted of ten (10) questions divided in three sections: A, B and C. Students were required to attempt all questions in all sections. In section A, there were two questions which weighted 15 marks. Question 1 had ten (i – x) multiple choice items while question 2 had five (i – v) matching items. Each item in section A weighed 1 mark making a total of fifteen (15) marks. Section B consisted of seven short response questions from question 3 to 9. Each question in section B weighted 10 marks making a total of 70 marks. Lastly, in Section C there was one structured question (question 10) which carried fifteen (15) marks.

In this report, students' performance has been categorized into the score intervals of 0 - 29, 30 - 64 and 65 - 100 per cent, which are classified as weak, average, and good, respectively.

In the year 2023, a total of 694,343 students (317,982 males and 376,361 females) sat for the 032 Chemistry Form Two National Assessment (FTNA). Out of the 694,343 students who sat for FTNA, 108,154 (34.01%) males and 87,352 (23.21%) females passed the assessment. The overall performance of the students was weak as 28.16 per cent of them passed the assessment. The students' performance in each grade (A to F) is shown in Table 1.

Table 1: The Performance of Students in Each Grade

Grade	Number of Students			Percentage of Students		
	Males	Females	Total	Males	Females	Overall
A	8,432	5,307	13,739	61.37	38.63	1.98
B	8,583	5,442	14,025	61.20	38.80	2.02
C	33,638	23,994	57,632	58.37	41.63	8.30
D	57,501	52,609	110,110	52.22	47.78	15.86
F	209,828	289,009	498,837	42.06	57.94	71.84

Table 1 shows that the number of students who failed the assessment amounts to 71.84 per cent in which the percentage of males who scored grades A, B and C outweigh that of females.

In the FTNA 2022, a total of 211,702 (33.45%) students out of 632,840 passed the 032 Chemistry assessment. Relatively, students' performance in the year 2023 has dropped by 5.29 per cent compared to the performance in 2022.

2.0 ANALYSIS OF STUDENTS' PERFORMANCE IN EACH QUESTION

The analysis for each question has been done based on the demands of the question, expected correct responses, observed misconceptions and sample extracts showing students correct and poor responses. Statistics on students' scores form an integral part in the analysis. Due to withheld results, the number of students who sat for the assessment may seem less than those who attempted each question. This is because the number of students whose results were no withheld (clean) has been considered as the total number of students who sat for the assessment whereas the statistics of performance in each question included data of students whose results were withheld.

2.1 Section A: Objective Questions

This section consisted of two objective questions, namely multiple choice and matching items.

2.1.1 Question 1: Multiple Choice Items

This question consisted of ten (10) multiple choices items, (i) to (x) with a weight of one (1) mark each. The students were required to choose the correct answer from the given alternatives and write its letter in the box or space provided. The question items were set from seven (7) topics which are: *Laboratory Techniques and Safety; Matter; Air, Combustion, Rusting and Fire Fighting; Hydrogen; Water; Fuels and Energy* and *Formula, Bonding and Nomenclature.*

This question was attempted by 695,207 (100%) students, out of these 8.87 per cent scored from 0 to 2 marks, 77.30 per cent scored from 3 to 6 marks and 13.83 per cent scored from 7 to 10 marks. The performance of students in this question was good since 91.13 per cent of students scored 3 marks or above. Figure 1 shows the distribution of the students' scores in question 1.

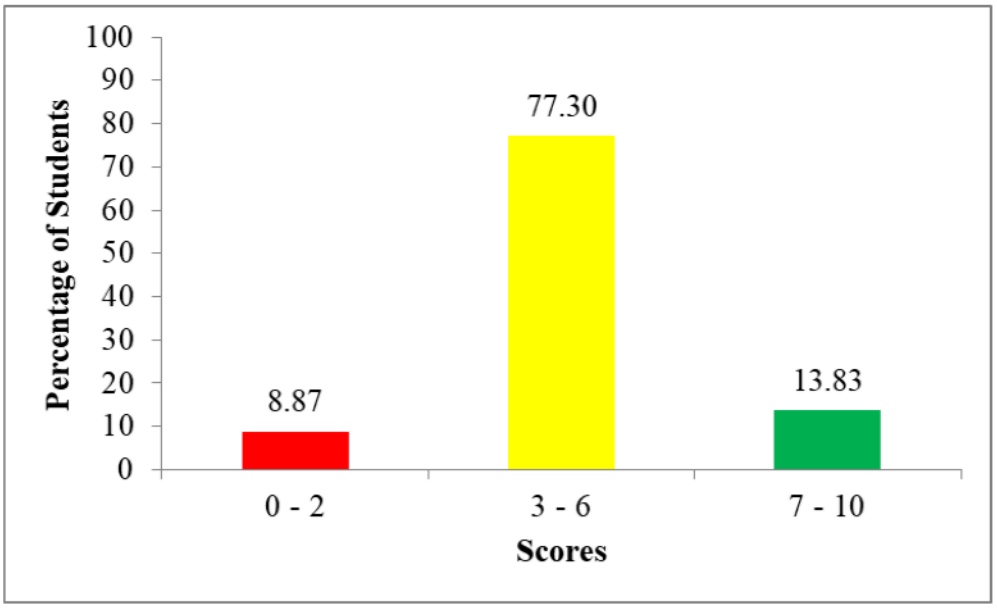


Figure 1: *Students' Performance in Question 1*

The students who scored high marks (13.83%) responded to most items of the question correctly. This indicates that, students had mastered concepts tested based on topics from which the items were composed.

On the other hand, students who scored low marks (8.87%) failed to attempt most of the items correctly. Some of them wrote responses which were not among the given alternatives. This shows that, they had insufficient knowledge on the basic concepts, theories, terminologies, experiments and principles in chemistry based on topics from which the items were composed. Overall analysis of the students' responses to each item was as follows:

In item (i), students were asked to identify the common activities done in the chemistry laboratory. The most correct response was *D, Experiments.* Students who chose the correct response had ample knowledge on the scientific activities done in the chemistry laboratory. The students who chose either alternative *A, Exhibition; B, Demonstrations* and *C, Exercises* failed to realize that, such activities can be suitably conducted in classes and museums rather than in the chemistry laboratory.

In item (ii), the students were required to identify a substance which is not a component of the first aid kit. The correct response was *D*, *Plaster of Paris*. Students who opted for the correct response realized that the plaster of Paris

is found in hospital and used to immobilize fractured bones after a patient has been attended by a doctor. The students who chose alternative *A, Petroleum Jelly* had inadequate knowledge that petroleum jelly is a component of first aid kit used to smooth dry, cracked and sore skin. Those who opted for *B, Iodine Tincture* were not aware that iodine tincture is used to prevent infection in fresh cuts, burns and scrapes before going to the hospital. Students who chose alternative *C, Cotton Wool* had insufficient knowledge that cotton wool is used to clean and dry wounds.

In item (iii), the students were required to identify the suitable method for separating a mixture of sand and ammonium chloride. The correct response was *C, Sublimation*. Students who chose the correct response realized that when such a mixture is heated, ammonium chloride changes directly from solid to gas and escapes from the container leaving sand remains. Those who chose *A, Magnetization* failed to realize that neither ammonium chloride nor sand have magnetic property thus, cannot be separated by using a magnet. Those who opted for distracter *B, Decantation* did not understand that both ammonium chloride and sand are solids and could not be separated by decantation as it is a process of separation of liquid from solid and other immiscible (non-mixing or heterogeneous mixture). Those who opted for *D, Simple distillation* had inadequate knowledge of the fact that simple distillation is used to separate liquid mixture with wide difference in boiling point. When ammonium chloride and sand are mixed together, they do not form a liquid mixture. Hence this option was not the correct answer.

In item (iv), the students were tasked to identify an example of solutions. The correct response was *D, Vinegar.* Students who wrote the correct response had adequate knowledge about the classification of mixtures into solutions, emulsions and suspensions. Students who opted for distractor *A, Dental amalgam* were not aware that dental amalgam is a solid mixture which consists of different metals primarily mercury, silver, tin and copper. Those who chose *B, Fresh milk* failed to understand that fresh milk is an emulsion containing two immiscible liquids (drops of butterfat in water). Those who opted for *C, Alloys* had insufficient knowledge that alloys are solid mixtures formed when different metals are mixed together.

In item (v), the students were asked to justify why ships often have blocks of magnesium attached to their hull. The correct response was *C, To give sacrificial protection to the hull*. Students who got the correct response had

adequate knowledge that magnesium is more reactive than iron. Thus, in the presence of water and air, magnesium will react with them instead of iron. This prevents the hull from rusting. Those who opted for *A, To improve appearance of hull*; *B, To make the hull stronger; D, To weigh down the ship in the water* had insufficient knowledge about the methods of preventing rusting.

In item (vi), the students were asked *Given a task of preparing hydrogen gas in the laboratory, which complete set of apparatuses will you use?* The correct response was C*, Thistle funnel, flat-bottomed flask, delivery tube, water trough, beehive stand and a gas jar.* Students who chose the correct response were aware of setup of apparatuses used in preparation of hydrogen gas in the laboratory. Those who opted for the distractors A *Thistle funnel, flat-bottomed flask, pipette, water trough, beehive stand and a gas jar;* B *Thistle funnel, flat-bottomed flask, delivery tube, water trough, beehive stand and burette* or D*, Thistle funnel, flat-bottomed flask, delivery tube, measuring cylinder, beehive stand and a gas jar* lacked adequate knowledge on the apparatuses used for preparation of gases.

In item (vii), the students were required to point out the role of charcoal in filter elements. The most correct response was D*, To trap dust particles.* Either option A*, To kill germs* was also awarded. Students who chose correct response had adequate knowledge about the pore sizes in charcoal which are so small that charcoal prevents the passage of dust particles and micro-organism. Students who chose either alternative B*, To sediment impurities* and C*, To coagulate impurities* had incorrect notion that coagulation and sedimentation of impurities is done by positive charged particles such as aluminium ion (alum/aluminium sulphate).

In item (viii) students were asked *Why is wind considered a promising source of energy for the future?* The correct responses were A, *it does not produce harmful gases* and D*, It is renewable source of energy.* Students who gave either of the correct responses had adequate understanding that wind turbine converts kinetic energy of wind into mechanical energy which later produce electricity without producing harmful gases. Likewise, it is renewable source of energy as it is continuously replenished within short period of time. Therefore, the future generation will be safe as the environment would be affected. Those who chose either distractor B, *It is easily stored* or C*, It is harnessed without chemical reaction* had inadequate knowledge on various stages of obtaining energy from wind and its storage.

In item (ix), students were asked *Given that, the amount of heat gained by water after a complete combustion of 46 g of ethanol (C_2H_5OH) is 8.4 kJ, what is the energy value of ethanol in J/g?* The correct response was C, *182.6*. Students who opted for the correct response had adequate knowledge of the subject matter and mathematical skills. Thus, they manage to calculate and manipulate units based on calorific value, correctly. Those who chose for either A, *182.0;* B, *182.7 or* D, *182.8* lacked appropriate knowledge of the concept and mathematical skills on the conversion of kJ to J as well as dividing the numerical values in Joule by mass in gram.

In item (x), the students were asked *The following sets of radicals have oxidation state of either -1 or -2 except __* The correct response was A, *Hydroxide, carbonate, nitrate, phosphate, chlorate and sulphite.* Students who chose the correct response had adequate knowledge that a radical is a chemical entity that contain at least one unpaired electron or a group of atoms of element with a common charge. Those who opted for either distractor B, *Hydroxide, sulphate, carbonate, nitrate, nitrite, chlorate* or *sulphite;* C, *Hydroxide, carbonate, nitrate, chlorate and hydrogen carbonate* and D, *Hydroxide, carbonate, nitrite, chlorate, sulphate and nitrate* lacked sufficient knowledge on assigning oxidation states of various radicals.

2.1.2 Question 2: Matching Items

Question 2 consisted of five (5) matching items (i) to (iv) weighting one (1) mark each. For each item, students were required to match the chemical constituents in List A with the corresponding types of fire extinguisher in List B by writing the letter of the correct response beside the item number in the table provided. The items to be matched were as shown in the following Table:

List A	List B
(i) Bromochloro-difluoro-methane	A Dry powder
(ii) Sodium bicarbonate and urea complex	B Wet chemical
(iii) Potassium acetate	C Foam
(iv) Mono ammonium phosphate with nitrogen carrier	D CO_2
(v) Proteins and fluoro proteins	E Sand
	F Halon
	G ABC

The question was attempted by 695,199 (100%) students. The percentage of students who scored from 0 to 1 mark was 82.46, from 2 to 3 marks was 15.36 and from 4 to 5 marks was 2.18. Generally, the students' performance in this question was weak as only 17.54 per cent scored 2 marks or above. Summary of the students' performance in this question is shown in figure 2.

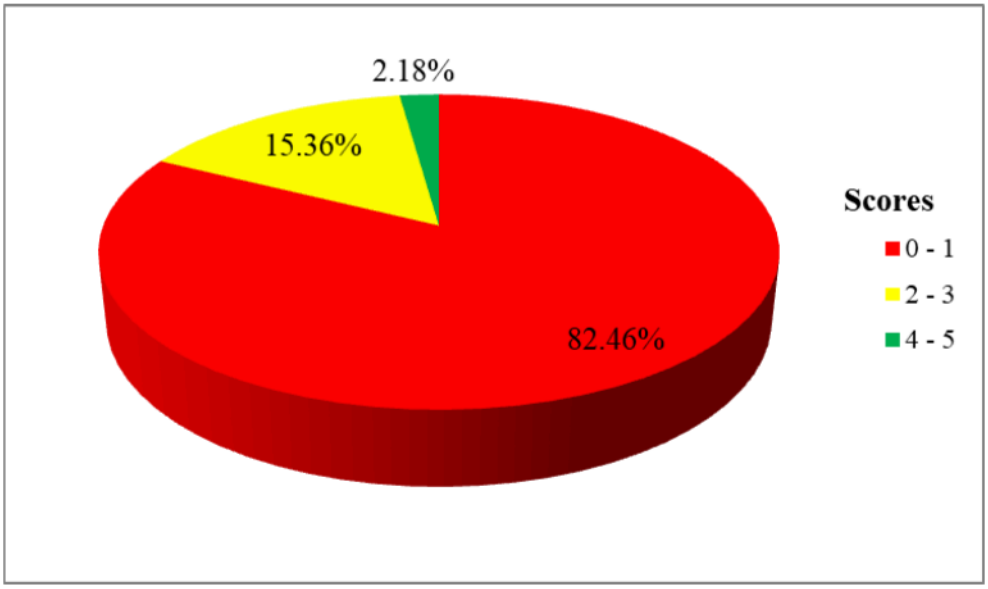


Figure 2: *Students' Performance in Question 2*

Students who scored low marks (82.46%) failed to attempt most of the items in this question. The students related chemical composition with inappropriate type of fire extinguisher. For instance, some incorrectly opted for B, *Wet Chemicals,* as a type of fire extinguisher in item (i). These students incorrectly considered bromochloro-difluoro-methane as the chemical component in halon fire extinguisher which is suitable to extinguish fire caused by electrical faults because it is poor electrical conductors. Some of the students opted for choice E, *Sand*. These students failed to realize that sodium bicarbonate and urea complex are constituent of the dry powder fire extinguisher whereby during extinguishing fire sodium bicarbonate prevents contact between oxygen and fuel while sand contains silicon dioxide. Some of the students opted for choice *G, ABC* in item (iii). They were not aware that, potassium acetate is the chemical constituent of wet chemical which is used to extinguish fire class F by reacting with oil to form soapy substance through a process called saponification. Other students incorrectly identified types of fire extinguishers in *items (iv)* and *(v)* by choosing C, *Foam* and D, CO_2 respectively. Generally, these students

had insufficient knowledge about chemical constituents of different types of fire extinguisher. Extract 2.1 indicates a sample of incorrect responses from one of the students.

List A	(i)	(ii)	(iii)	(iv)	(v)
List B	G	D	A	B	F

Extract 2.1: A sample of incorrect responses to question 2

In extract 2.1, the student incorrectly matched the chemical constituents in List A with the types of fire extinguisher from List B. This indicates that the students lacked adequate knowledge on the chemical composition of different types of fire extinguishers, hence made guess work in matching the items.

On the other hand, students who scored high marks (2.18%) correctly matched the chemical constituents with corresponding type of fire extinguisher. This indicates that, they had sufficient knowledge on most convenient types of fire extinguishers based on chemical composition. Extract 2.2 shows a sample of correct responses given by one of the students in question 2.

List A	(i)	(ii)	(iii)	(iv)	(v)
List B	F	A	B	G	C

Extract 2.2: A sample of correct responses to question 2

In Extract 2.2, the student matched correctly chemical constituents in List A with corresponding types of fire extinguisher in List B**.** This shows that the student had sufficient knowledge about the types of fire extinguishers.

2.2 Section B: Short Response Questions

This section consisted of seven (7) short response questions, weighing ten (10) marks each. Students were required to response all questions. The pass score for each question was 3 marks.

2.2.1 Question 3: Matter

In this question the students were required to compare the properties of gaseous and solid states of matter based on the following aspects: (a) Shapes of particles (b) Volume (c) Compressibility (d) Ability to flow and (e) Arrangement of particles.

The question was attempted by 695,196 (100%) students out of which 84.57 per cent scored from 0 to 2 marks, 8.44 per cent scored from 3 to 6 marks and 6.99 per cent scored from 7 to 10 marks. The general performance in this question was weak as only 15.43 per cent of the students scored 3 marks or above. The distribution of students' scores in question three (3) is shown in Figure 3.

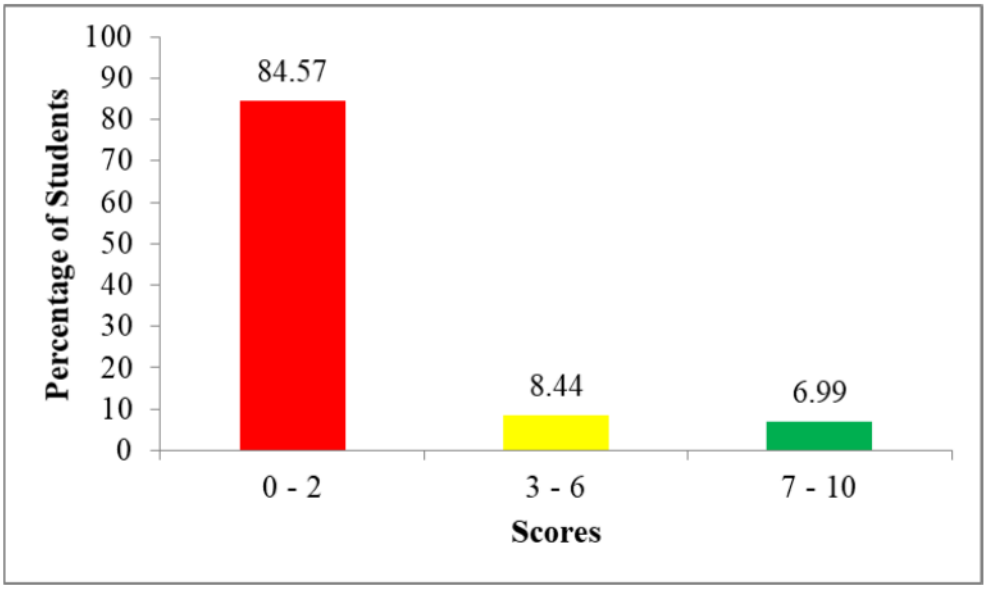


Figure 3: *Students' Performance in Question 3*

Figure 3 shows that 84.57 per cent of the students did not perform well in this question correctly. These students failed to attempt most parts of the question. In part (a), some students interchanged the properties of gas and solid. For instance, one of the students wrote "gas has fixed shape and solid has no definite shape". Likewise, in aspect (b), one of the students wrote "gas has large volume and solid has small volume" while other students in aspect (c) wrote compressibility in gases occur slowly while in solid part occurs faster. Generally, students in this category had insufficient knowledge on the different properties of gaseous and solid states of matter. A sample of incorrect responses in question 3 is shown in Extract 3.1.

3. Compare the properties of gaseous and solid states of matter based on the following aspects:

(a) Shapes of particles

Gaseous particles are spherical in shape.
while,
Solid particles are of irregular shape.

(b) Volume

Solid state have high volume capacity but,
Gaseous state have low volume capacity.

(c) Compressibility

Solid state can be compressed easily compared to Gaseous state, Gaseous state can not be compressed.

(d) Ability to flow

Solid state matters are flowing easily but,
Gaseous state of matter can not flow easily.

(e) Arrangement of particles

This was the arrangements of particles which was they have the arrangements of the particles in the states.

Extract 3.1: A sample of incorrect responses to question 3

In Extract 3.1, the student considered solid particles being irregular, an indication that he/she confused shape of container with shape of particles in part (a). In parts (b), (c) and (d), the student interchanged the properties of solid with those of gaseous state, thus gave wrong responses. In part (e), the student gave a statement that does not reflect the desired arrangement.

Conversely, the students who scored high marks (6.99%) in this question demonstrated adequate knowledge about the properties of gases and solid. Extract 3.2 shows a sample of correct responses from one of the students.

3. Compare the properties of gaseous and solid states of matter based on the following aspects:

(a) Shapes of particles

In gaseous state particles make a substance with indefinite shape while in solid state a substance has definite shape.

(b) Volume

In gaseous state particles lack definite volume while in solid state particles have definite volume.

(c) Compressibility

Gaseous substances can be compressed while solid so substances cannot be compressed.

(d) Ability to flow

In gaseous state particles can flow via each other while in solid state particles don't flow past each other.

(e) Arrangement of particles

In gaseous state particles are arranged very far from one another while in solid state particles are arranged close (Very close) to each other.

Extract 3.2: A sample of correct responses to question 3

In Extract 3.2, the student was able to supply the required comparison of properties of gaseous and solid state based on the aspect provided. This shows that the student mastered the competence in the concept of the states of matter.

2.2.2 Question 4: Matter

This question comprised of three parts, namely (a) , (b) and (c). In part (a), students were required to state by giving two reasons whether a mixture or a compound would form when sodium chloride is dissolved in distilled water. In part (b), the students were asked to identify the method that could be used to separate each of the following components from their mixtures. (i) Pure

water from tea (ii) Oil from mixture of oil and water (iii) Ethanol from a mixture of water and ethanol (iv) Nail from a mixture of nail and flower and (v) Salt from sea water. In part (c) students were asked to identify change of state of matter applied in the following processes; (i) Metallurgy and (ii) Drying of material.

This question was attempted by 695,200 (100%) students, out of these, 76.06 per cent scored from 0 to 2 marks, 19.62 per cent scored from 3 to 6 marks and 4.32 per cent scored from 7 to 10 marks. The performance of students in this question was weak as only 23.94 per cent of the students scored 3 marks or above. The distribution of students' scores is summarized in Figure 4.

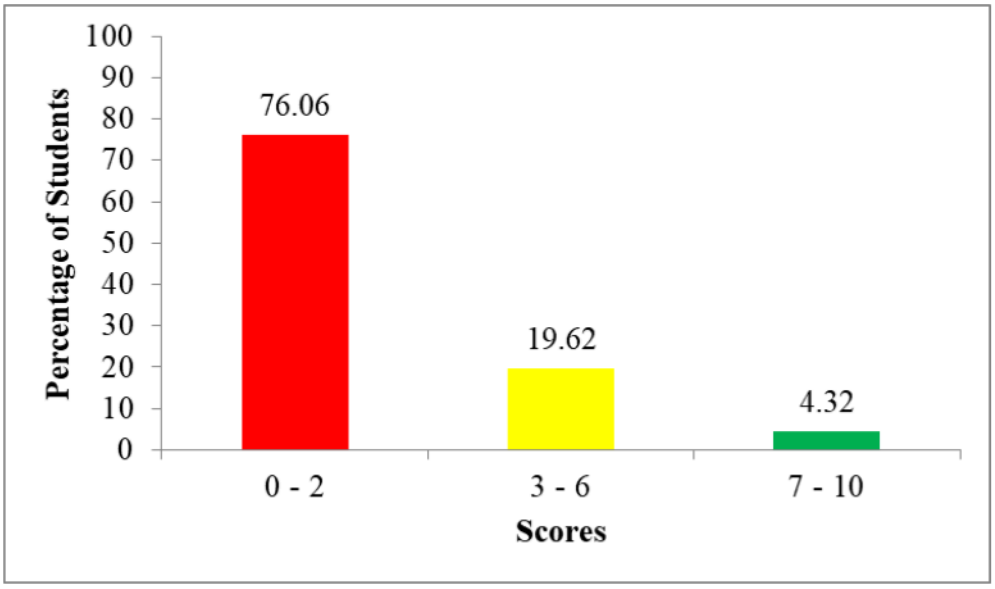


Figure 4: *Students' Performance in Question 4*

Students who scored low marks (76.06%) wrote compound instead of mixture in part (a). Some of them gave incorrect reasons while others did not give reasons. In part (b), the students gave inappropriate methods of separating mixtures or the substances given. For instance, some students responded to part (b) (i) by writing decantation instead of simple distillation. Similarly, there were students who wrote evaporation instead of fractional distillation in part (b) (iii). In item (b) (v), some students wrote layer separation instead of evaporation. Additionally, a few students included simple separation among the methods of separating mixtures while in real sense such method does not exist. In part (c), most students in this category

wrote physical and chemical changes instead of giving a specific change of state of matter in item (c) (i) and (ii). Extract 4.1 shows a sample of incorrect responses from one of the students.

4. (a) A laboratory technician instructed Form Two students to dissolve sodium chloride in distilled water. Giving two reasons, state whether a mixture or a compound was formed in the process.

It is a compound formed in this process because:

- It is chemically combined.

- It can be separated by chemical means.

(b) Which method can be useful in separating each of the following components from their mixtures?

(i) Pure water from tea.

Simple Solution

(ii) Oil from a mixture of oil and water.

Simple distillation

(iii) Ethanol from a mixture of water and ethanol.

Magnetization

(iv) Nail from a mixture of nail and flower.

Decantation.

(v) Salt from sea water.

Sublimation

(c) Which change of state of matter is applied in the following processes?

(i) Metallurgy
Physical Change

(ii) Drying of material
Chemical change

Extract 4.1: A sample of incorrect responses to question 4

In Extract 4.1, the student wrote compound instead of mixture in part (a). Likewise, in part (b) he/she gave incorrect methods of separating the mixtures. Moreover, in part (c), the student gave types of change of matter instead of changes in state of matter.

However, some students (4.32%) who scored high marks wrote correct responses to all parts of the question. This indicates that, the students had enough knowledge about the basic principles applied in compounds and mixtures, methods of separating mixtures and changes of states of matter. Extract 4.2 shows a sample of correct responses from one of the students.

4. (a) A laboratory technician instructed Form Two students to dissolve sodium chloride in distilled water. Giving two reasons, state whether a mixture or a compound was formed in the process.

A mixture was formed in the process
Reasons:
i) It can be separated by physical means
ii) The properties of a mixture are the properties of individual components

(b) Which method can be useful in separating each of the following components from their mixtures?

(i) Pure water from tea.
Simple distillation

(ii) Oil from a mixture of oil and water.
Layer separation

(iii) Ethanol from a mixture of water and ethanol.

Fractional distillation

(iv) Nail from a mixture of nail and flower.

Magnetization

(v) Salt from sea water.

Evaporation

(c) Which change of state of matter is applied in the following processes?

(i) Metallurgy

The change of state from solid to liquid and back to solid.

(ii) Drying of material

The change of liquid state to gaseous state

Extract 4.2: A sample of correct responses to question 4

In Extract 4.2, the student attempted correctly all parts of the question. The explanations given in part (a) and responses in part (b), signify adequate knowledge on the topic.

2.2.3 Question 5: Formula, Bonding and Nomenclature

This question comprised two parts, namely (a) and (b). In part (a), the students were required to differentiate oxidation state from valency. In part (b), the students were supposed to write the chemical formula, valency and oxidation state for each radical shown in the following table.

Radical	Formula	Valency	Oxidation State
Nitrate			
Hydrogen sulphate			
Phosphate			
Carbonate			
Sulphite			

The question was attempted by 695,199 (100%) students out of which 90.34 per cent scored from 0 to 2 marks, 8.45 per cent scored from 3 to 6 marks and 1.21 per cent scored from 7 to 10 marks. The general performance of the students in this question was weak as only 9.66 per cent of the students who attempted this question scored 3 marks or above. The distribution of students' scores in this question is summarized in Figure 5.

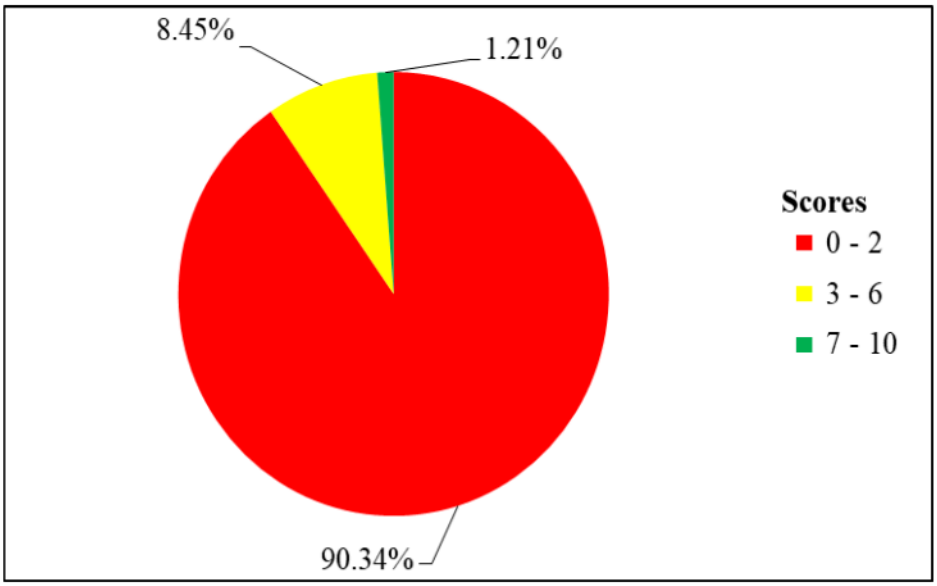


Figure 5: *Students' Performance in Question 5*

Students who scored low marks (90.34%) failed to differentiate oxidation state from valency in part (a). For example, one student wrote "oxidation state is the combining power of an atom in element while valency is the number of electrons in an atom lost or gained during formation of chemical bonds with other atom". This response was not correct because the student interchanged the descriptions for valency with those of oxidation states. Yet other students described oxidation state as total number of protons and neutrons in the nucleus of an atom which can be transferred or gained. In part (b), the students filled the table incorrectly due to inadequate knowledge on the concepts of formula and oxidation.

Generally, students in this category had insufficient knowledge about chemical formulae, valency and oxidation states of various radicals. Extract 5.1 shows a sample of incorrect responses from one of the students.

5. (a) Differentiate oxidation state from valency.

Oxidation state is the number of an element shared or gained by another element. WHILE: valency is the number loosed or gained by an element.

(b) For each of the radicals given in the following table, write its chemical formula, valency and oxidation state.

Radical	Formula	Valency	Oxidation state
Nitrate	NH_4^+	4	$+2$
Hydrogen sulphate	HSO_3^+	3	$+6$
Phosphate	PO_4^{3-}	4	$+1$
Carbonate	CO_3^{4-}	3	$+3$
Sulphite	SO_4^{-3}	4	$+5$

Extract 5.1: A sample of incorrect responses to question 5

In Extract 5.1, the student wrote oxidation state as the number of elements instead of number of valence electrons in part (a). Likewise, in part (b), though the student had partial ideas on the atoms forming the radicals, he/she did not understand the correct charges of radicals. As a result, he/she gave incorrect chemical formulas of the radicals, respective valency and oxidation states.

On the other hand, students who scored high marks (1.21%), correctly differentiated oxidation state from valency in part (a). Likewise in part (b), the students filled the table correctly by indicating the formula, valency and oxidation state. The students in this category showed to have mastered well the concepts of oxidation state and valency. Extract 5.2 shows a sample of correct responses from one of the students.

5. (a) Differentiate oxidation state from valency.

1. Oxidation state is the total number of electrons that an atom gains or loose while Valency is the combining power/capacity of element
2. Valency has no charge while oxidation state has charge.

(b) For each of the radicals given in the following table, write its chemical formula, valency and oxidation state.

Radical	Formula	Valency	Oxidation state
Nitrate	NO_3^-	1	-1
Hydrogen sulphate	HSO_4^-	1	-1
Phosphate	PO_4^{3-}	3	-3
Carbonate	CO_3^{2-}	2	-2
Sulphite	SO_3^{2-}	2	-2

Extract 5.2: A sample of correct response in question 5

2.2.4 Question 6: Atomic Structure

This question comprised two parts, namely (a) and (b). Part (a) had three sub parts (i), (ii) and (iii). In part (a) (i), the students were given the following explanation; *One gram of hydrogen atoms mixes with 35.5 g of chlorine atoms to give 36.5 g of hydrogen chloride. Use this experimental fact to prove the Dalton atomic theory.* In part (a) (ii), they were asked *with reasons, give two statements of the Dalton's atomic theory that were later corrected.* In part (a) (iii), the students were asked; *Why is the nuclide notation* $^{12}_{6}C$, ^{14}C *is allowed, but* $^{12}_{6}C$, $_{6}C$ *is not allowed?* In part (b), the students were asked to complete the following table by filling the properties of sub-atomic particles.

Sub-atomic particle	Symbol	Location	Charge	Relative mass
Protons				
Neutrons				
Electrons				

The question was attempted by 695,206 (100%) students, out of which 75.18 per cent scored from 0 to 2 marks, 21.50 per cent scored from 3 to 6 marks, while 3.32 per cent scored from 7 to 10 marks. The general performance of students in this question was weak since only 24.82 per cent of the students scored 3 marks or above. The students' performance in this question is summarized in Figure 6.

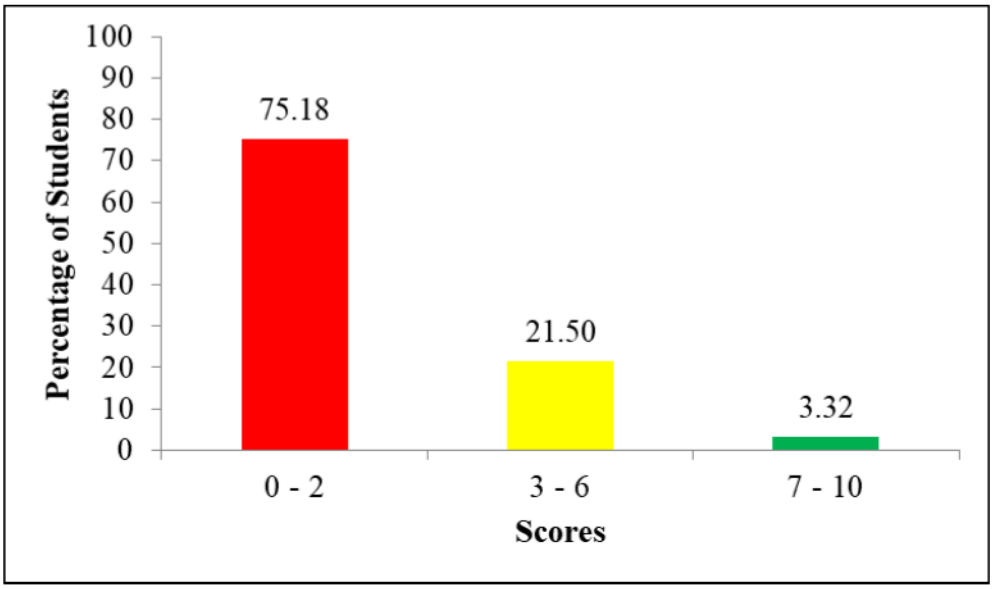


Figure 6: *Students' Performance in Question 6*

Students who scored low marks (75.18%) failed to give a proof for the Dalton's atomic theory in part (a) (i). Similarly, in item (a) (ii), they failed to identify two ideas of the Dalton's atomic theory that were modified later. For example, one student incorrectly wrote ''atoms of different element have same properties such as mass". Likewise, other students in item (ii), wrote the statements of Dalton's atomic theory but failed to give reasons for the amendment of the theory. In part (a) (iii) the students gave responses as "nuclide notation $^{12}_{6}C$, ^{14}C is allowed because it has similar neutron but $^{12}_{6}C$, $_{6}C$ this is not allowed because it has different neutron. However, such responses were not correct. In part (b) some students interchanged location of nucleons and electron. For instance, one student wrote that protons and neutrons are found in shell while electrons are found in the nucleus. This was again in contrary to the fact.

Other students interchanged the charge of protons and electrons. For example, one student wrote;

Sub-atomic particle	Charge
Proton	-1
Electron	+1

Generally, students in this category had inadequate knowledge about isotope, postulates of Dalton's atomic theory and its amendments. Extract 6.1 shows a sample of incorrect responses from one of the students.

6. (a) (i) One gram of hydrogen atom mixes with 35.5 g of chlorine atom to give 36.5 g of hydrogen chloride. Use this experimental fact to prove the Dalton atomic theory.

Some elements can combine to form a complex compound.

(ii) With reasons, give two statements of the Dalton atomic theory that were later corrected.

① An atom is made up of three individual atoms at the nucleus which are proton, neutron and electron.

② Some atoms have the same Atomic number and same Atomic Mass.

(iii) Why is the nuclide notation $^{12}_{6}C$, ^{14}C is allowed, but $^{12}_{6}C$, $_{6}C$ is not allowed?

Because the nuclide notation are written in atomic number

(b) Complete the following table by filling in the properties of sub-atomic particles.

Sub-atomic particle	Symbol	Location	Charge	Relative mass
Proton	P	middle	-1	21
Neutron	N	middle	-3	11
Electrons	E	out	+4	10

Extract 6.1: A sample of incorrect responses to question 6

In Extract 6.1, the student gave incorrect explanation in part (a) and cited incorrect symbols, locations, charge and relative masses of the three subatomic particles in part (b).

On the contrary, the students who scored high marks (3.32%) managed to give correct reasons for explanation concerning postulates of Dalton's atomic theory in part (a) (i) and (ii). Also, in part (b) they cited correct symbols, locations, charge and relative masses of the three subatomic particles. Generally, students in this category had sufficient knowledge on the postulates of Dalton's atomic theory and its amendments. Likewise, they were knowledgeable on sub-atomic particles based on their symbols, charges and arrangement within an atom. Extract 6.2 shows a sample of correct responses from one of the students.

6. (a) (i) One gram of hydrogen atom mixes with 35.5 g of chlorine atom to give 36.5 g of hydrogen chloride. Use this experimental fact to prove the Dalton atomic theory.

Compounds are formed by combination of two or more atoms. Hydrogen atom and chlorine atom combined to form a compound that is called hydrogen chloride.

(ii) With reasons, give two statements of the Dalton atomic theory that were later corrected.

1 Dalton's atomic theory: All matter are made up of small particles called atoms.
Modifications: Atoms are made up of smaller sub-atomic particles which are protons, neutrons and electrons.

2 Dalton's atomic theory: Atoms can neither be created nor destroyed.
Modifications: Atoms can either be created or destroyed by means of nuclear reactions which are nuclear fission and fussion.

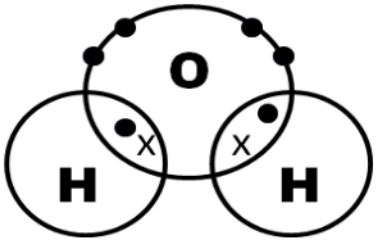
(iii) Why is the nuclide notation $^{12}_{6}C$, ^{14}C is allowed, but $^{12}_{6}C$, $_{6}C$ is not allowed?

In isotopes atomic number is the same but mass number is different therefore in $^{12}_{6}C$ and ^{14}C is allowed because the atomic number is already known but in $^{12}_{6}C$, $_{6}C$ it is difficult to determine the mass number.

Extract 6.2: A sample of correct responses to question 6

2.2.5 Question 7: Formula, Bonding and Nomenclature

This question comprised parts (a) and (b). In part (a), the students were asked to identify the types of bond in the following compounds: (i) Magnesium oxide (ii) Table salt (iii) Drinking water (iv) Ammonia and (v) Calcium chloride. In part (b) the students were asked to consider the following molecule of a certain compound then responds to the questions that follow:



The students were then required to

(i) name the molecule?

(ii) give the molecular formula of the compound?

(iii) name the type of bond holds the molecule?
(iv) give any other two compounds with the same type bond identified in (b)(iii).

This question was attempted by 695,205 (100%) students. Statistics show that 67.75 per cent of the students scored from 0 to 2 marks, 23.86 per cent scored from 3 to 6 marks and 8.39 per cent scored from 7 to 10 marks. Generally, students' performance in this question was weak as 32.25 per cent of the students scored 3 marks or above. The students' performance in this question is summarized in Figure 7.

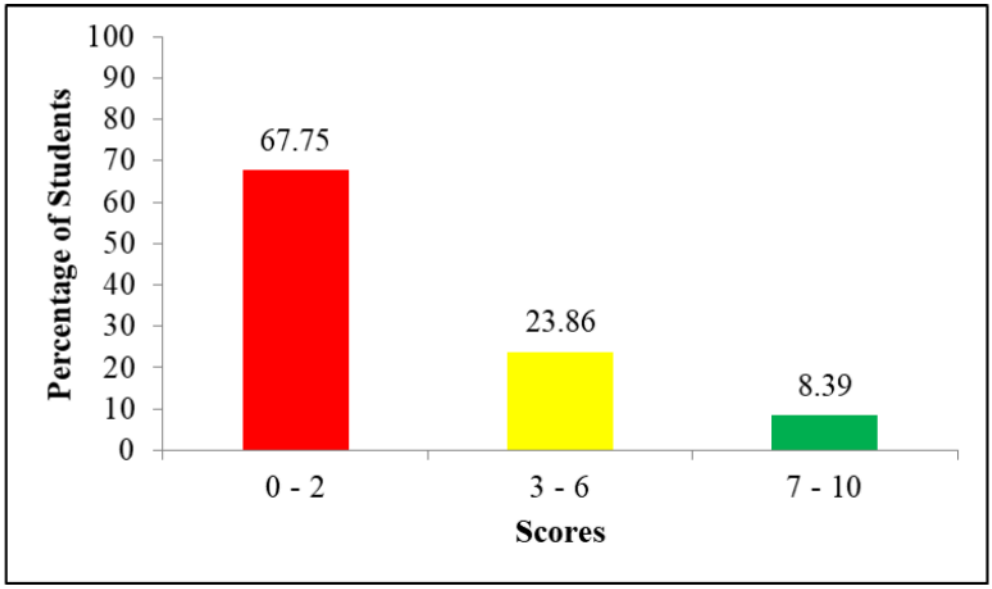


Figure 7: *Students' Performance in Question 7*

Students who scored high marks attempted correctly all parts of the question. Those students correctly identified the type of bonds in part (a) and interpreted the diagram in part (b) appropriately. This shows that the students had satisfactory knowledge on the concept of covalent and electrovalent/ionic bonding. A sample of correct responses is provided in Extract 7.1.

7. (a) Identify the type of bond found in the following compounds:

(i) Magnesium oxide

Electrovalent / ionic bond

(ii) Table salt

Electrovalent / ionic bond

(iii) Drinking water

Covalent bond

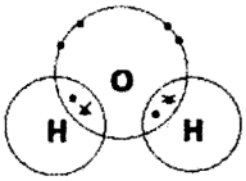
(iv) Ammonia

Covalent bond

(v) Calcium chloride

Electrovalent / ionic bond

(b) Consider the following molecule of a certain compound then answer the questions that follow:



(i) What is the name of the molecule?

Water - Dihydrogen monoxide

(ii) What is the molecular formula of the compound?

H_2O

(iii) What type of bond holds the molecules?

Covalent bond. Because it is between non-metals and involve sharing of electrons.

(iv) Give any other two compounds with the same type of bond identified in (b)(iii).

a: Methane (CH_4)

b: Carbon dioxide (CO_2)

Extract 7.1: A sample of correct responses to question 7

Conversely, students who scored low marks (67.75%) failed to identify the correct type of the bond in part (a). For instance, one student wrote covalent bond in (i) and (ii). Another student wrote ionic bond in part (iii) and (iv). In part (b) (i) some students gave incorrect name of the molecule. For example, one student wrote the molecule was "ammonia". Moreover, in part (b) (ii) some students gave inappropriate molecular formula of water molecule. One student wrote H_3O. In part (c) (ii) they described incorrect type of bond that holds the water molecule. For instance, one student wrote ionic bond. Furthermore, in part (b) (iv) they gave incorrect example of molecules which reassemble type of bond found in water molecule. Example one student wrote NaCl. Generally, these students had inadequate knowledge on the concept of bonding and electronic arrangement (shell diagram) representing different molecules. Extract 7.2 is a sample of incorrect responses.

7. (a) Identify the type of bond found in the following compounds:

(i) Magnesium oxide

Covalent bond

(ii) Table salt

Covalent bond

(iii) Drinking water

Electrovalent bond

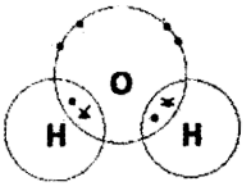
(iv) Ammonia

Electrovalent bond

(v) Calcium chloride

Covalent bond

(b) Consider the following molecule of a certain compound then answer the questions that follow:



(i) What is the name of the molecule?

The molecule is gases which are Hydrogen and oxygen.

(ii) What is the molecular formula of the compound?

The molecular formula is H_2O_6

(iii) What type of bond holds the molecules?

→ Electrovalency bond.

(iv) Give any other two compounds with the same type of bond identified in (b)(iii).

→ Carbon and nitrogen.

→ Chlorine and oxygen.

Extract 7.2: A sample of incorrect responses to question 7

In Extract 7.2, the student wrote incorrect types of bonds in parts (a). For example, he/she interchanged between covalent and electrovalent bonds in items (i) to (v). In part (b) (i) the student named the atoms constituting H_2O instead of water itself. Similarly, the rest of responses were incorrect.

2.2.6 Question 8: Atomic Structure

In this question, students were asked as follows: *Study the hypothetical elements given in the following table then answer the questions that follow:*

Element	***Atomic Number***
A	*3*
C	*12*
D	*16*
E	*18*
F	*20*

(a) With reason(s), explain which of these elements:

(i) qualifies as a noble gas.

(ii) functions as a halogen.

(iii) serves as an alkali metal.

(b) By giving reason(s), indicate elements which are;

(i) placed in the same group.

(ii) placed in the same period.

This question was attempted by 695,209 (100%) students out of which 87.29 per cent scored from 0 to 2 marks, 9.38 per cent scored from 3 to 6 marks and 3.33 per cent scored from 7 to 10 marks. Students who scored 3 marks or above were 12.71 per cent, indicating weak performance. The performance of students in this question is summarized in Figure 8.

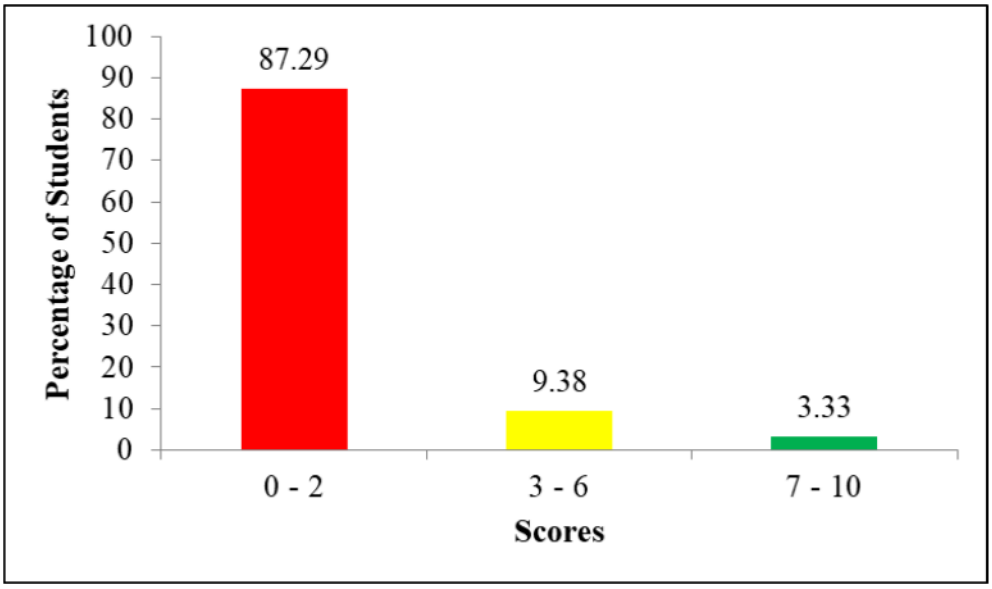


Figure 8: *Students' Performance in Question 8*

Students who scored low marks (87.29%) failed to identify groups of elements with reasons. For instance, in part (a) (i), some students identified the element F as a noble gas instead of a metal. This implies that, the students had insufficient knowledge about electronic configuration. This is because they did not understand that the outer most shell of element F is not full of eight electrons hence, cannot be termed among the noble gases. Other students responded in part (a) (ii) by writing element D as halogen with atomic number 16 instead of member of group VI. In part (b), some students wrote element A and C as members of the same group which is not true.

This shows that, students lacked understanding about application of electronic structure and configuration. Extract 8.1 shows an example of incorrect responses from one of the students in question 8.

(a) With reason(s), explain which of these elements:

(i) qualifies as a noble gas.

Element F qualifies a noble gas because element in a noble gas they are stable and they do not need any other electrons and they do not remove electrons

(ii) functions as a halogen.

Halogen are group of element that are Alkaline mekals.

(iii) serves as an alkali metal.

Element D serves as an alkali metal because they react with oxygen to form Alkaline mekals.

(b) By giving reason(s), indicate elements which are;

(i) placed in the same group.

Element that are place in the same group they are equal or gaseous element and a stable element are placed in a same group

(ii) placed in the same period.

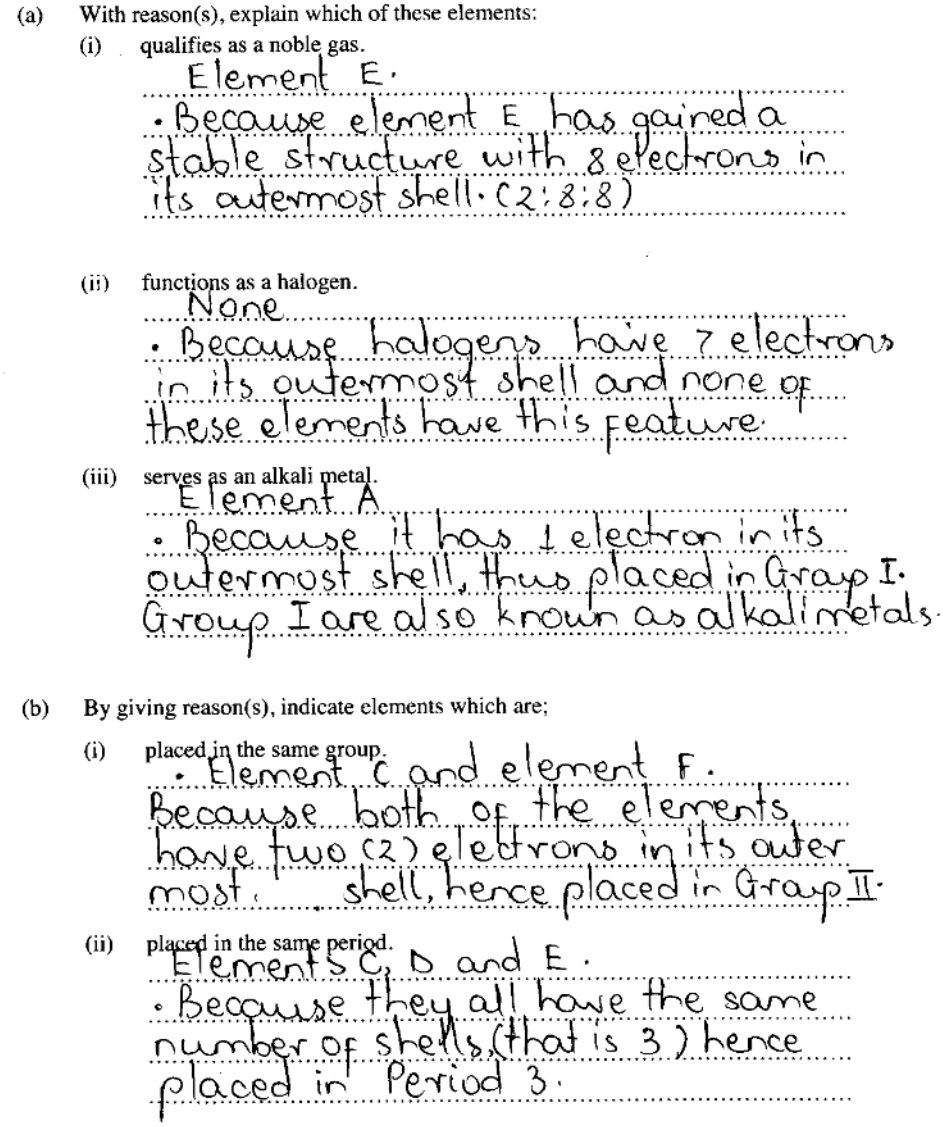
Element that are placed in a same period they will have the same Outershell that help to know about an element is in which group.

Extract 8.1: A sample of incorrect responses to question 8

In Extract 8.1, the student identified elements F and D as a noble gas and halogen, respectively in part (a). In item (a) (ii), the student described

halogens instead of identifying an element which is halogen. In part (b) he/she gave incorrect explanations instead of mentioning elements.

On the contrary, students who scored high marks (3.33%) identified the groups of given elements with support of reasons correctly in part (a). Likewise, in part (b), they indicated correctly periods of elements. Generally, the students who performed well had sufficient knowledge about the concept of electronic configuration in an atom which can be used to deduce the group number, period and valency. Extract 8.2 is a sample of correct responses from one of the students in question 8.


(a) With reason(s), explain which of these elements:

(i) qualifies as a noble gas.

Element E.
• Because element E has gained a stable structure with 8 electrons in its outermost shell. (2:8:8)

(ii) functions as a halogen.

None
• Because halogens have 7 electrons in its outermost shell and none of these elements have this feature.

(iii) serves as an alkali metal.

Element A
• Because it has 1 electron in its outermost shell, thus placed in Grayp I. Group I are also known as alkali metals.

(b) By giving reason(s), indicate elements which are;

(i) placed in the same group.

• Element C and element F.
Because both of the elements have two (2) electrons in its outer most shell, hence placed in Grayp II.

(ii) placed in the same period.

Elements C, D and E.
• Because they all have the same number of shells, (that is 3) hence placed in Period 3.

Extract 8.2: A sample of correct responses to question 8

2.2.7 Question 9: Atomic Structure and Periodic Classification

This question consisted of two parts, namely (a) and (b). The question was as follows:

(a) (i) What is the name of the arrangement of electrons around the nucleus.

(ii) What is the name of the layers in which the electrons are arranged?

(iii) If each layer in (a) (ii) can hold a maximum number of electrons given by the formula $2n^2$, what does n represent?

(iv) By using formula present in (a) (iii), calculate the number of electrons in the layer layers K, L, M and N.

(b) A sample of bromine contains 55% of the isotopes with mass number 79 and 45% of the isotopes with the mass number 81. Calculate the relative atomic mass of bromine.

The question was attempted by 695,209 (100%) students. Students who scored from 0 to 2 marks were 79.38 per cent, from 3 to 6 marks were 14.34 per cent and those who scored from 7 to 10 marks were 6.28 per cent. These data show that the general performance in this question was weak as only 20.62 per cent of the students scored 3 marks or above. The students' performance is summarized in Figure 9.

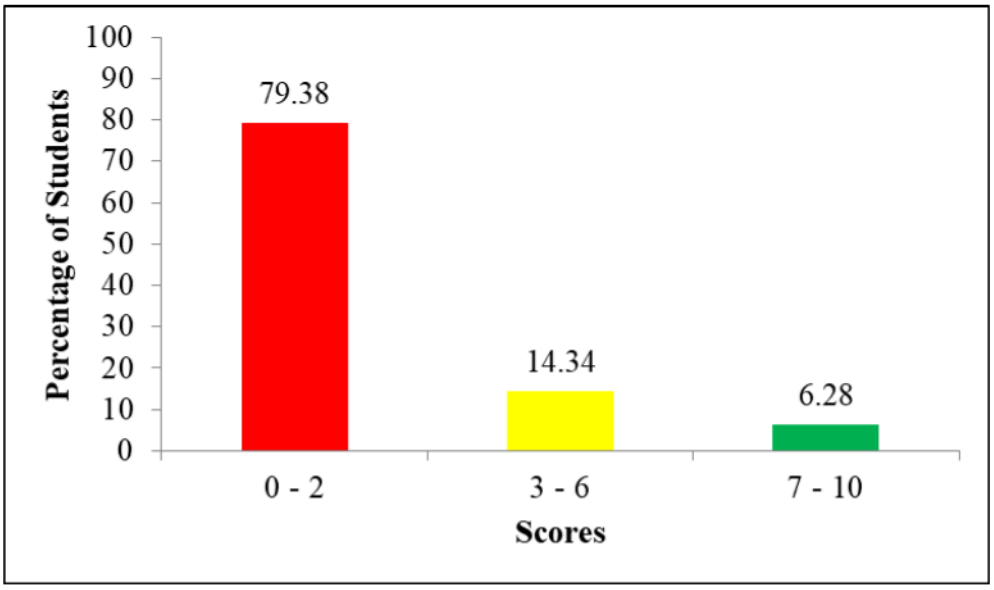


Figure 9: *Students' Performance in Question 9*

Students who scored low marks (79.38%) failed to identify the term which describe the name of the arrangement of electrons around the nucleus in part (a). For example, one of the students wrote *shell*. However, this was not correct. The students were expected to write the term "electronic configuration". In part (a) (ii) they failed to give correct term in which electrons are located. For example, one of the students wrote "*the name of the layers in which the electrons are arranged is nucleus"*. In part (a) (iii), some students failed to cite the correct abbreviation of "n" in $2n^2$. For instance, one candidate incorrectly wrote "nucleus". In item (iv) the students failed to calculate maximum number of electrons present in shells. For example, one candidate in layer K calculated number of electrons as follows:

From n=3, the number of electrons is calculated as $2n^2 = 2\times3^2 = 18$. *Therefore, there will be 18 electrons*. This indicates that, the students had inadequate knowledge on what the letter n represents and hence could not use the given formula appropriately. Likewise, students in part (b) calculated the relative atomic mass of bromine as follows:

$$\text{RAM} = \frac{(\text{Mass of isotope A} + \text{percentage of isotope A}) + (\text{Mass of isotope B} + \text{percentage of isotope B})}{100}$$

$$\text{RAM} = \frac{(79+55)+(81+45)}{100} = 2.6$$

The student arrived to a value of 2.6 for RAM which was not correct because he/she applied a wrong formula. The student was supposed to multiply the mass of an isotope with its percentage instead of adding them. Such responses from students signify that they had insufficient skills of computing the relative atomic mass. Extract 9.1 shows a sample of incorrect responses to this question.

9. (a) (i) **What is the name given to the arrangement of the electrons around the nucleus?**

- Electronegativity charge

(ii) **What is the name of the layers in which the electrons are arranged?**

- Electronegativity

(iii) **If each layer in (a) (ii) can hold a maximum number of electrons given by the formula $2n^2$, what does n represent?**

n - neutrons

(iv) **By using the formula presented in (a) (iii), calculate the number of electrons in the layers K, L, M and N.**

K: 2 x 19 L: 2 x 3

= 38 = 6

N: 2 x 7

= 14

b) A sample of bromine contains 55% of the isotope with mass number 79; and 45% of the isotope with the mass number 81. Calculate the relative atomic mass of bromine.

$= \frac{(55 \times 79 + 45 \times 81)}{100}\%$

$= \frac{4035 + 3645}{100}$

$= \frac{7680}{100}$

$= 76.80$

Extract 9.1: A sample of incorrect responses to question 9

In Extract 9.1, the student gave periodic trend (electronegativity) instead of electronic configuration and shell respectively in part (a) (i) and (ii). In part (a) (iii) and (iv), the students misinterpreted the letter n, thus, wrote neutrons instead of number of shells. In part (b), though the student had the idea of the steps used to calculate the relative atomic mass of an atom, he/she failed in mathematical manipulations hence got 4035 instead of 4345 following multiplying the mass of isotope A with its abundance. As a result, the student got incorrect value of RAM as 76.80 instead of 79.9.

However, students who scored high marks (6.28%) gave correct terms in parts (a) (i), (ii) and (iii). Likewise, in part (a) (iv), they calculated correctly the number of electrons present in shell K, L, M and N. This indicates that, the students had sufficient knowledge on the concept of electronic arrangement. Furthermore, in part (b) they calculated correctly the relative atomic mass of bromine. This was also attributed to adequate mathematical skills and the knowledge on the concepts of relative atomic mass. A sample of correct responses from one of the students in this question is shown in Extract 9.2.

9. (a) (i) What is the name given to the arrangement of the electrons around the nucleus?

Electronic configuration

(ii) What is the name of the layers in which the electrons are arranged?

The layers are known as shells

(iii) If each layer in (a) (ii) can hold a maximum number of electrons given by the formula $2n^2$, what does n represent?

n represent a number of shell that an atom has

(iv) By using the formula presented in (a) (iii), calculate the number of electrons in the layers K, L, M and N.

$K = 2n^2$
$= 2 \times (1)^2$
$= 2 \times 1$
$= 2$ electrons

$L = 2n^2$
$= 2 \times (2)^2$
$= 2 \times 4$
$= 8$ electrons

$M = 2n^2$
$= 2 \times (3)^2$
$= 2 \times 9$
$= 18$ electrons

$N = 2n^2$
$= 2 \times (4)^2$
$= 2 \times 16$
$= 32$ electrons

A sample of bromine contains 55% of the isotope with mass number 79; and 45% of the isotope with the mass number 81. Calculate the relative atomic mass of bromine.

$$R.A.M = \left(\frac{A \times P_1}{100}\right) + \left(\frac{A \times P_2}{100}\right)$$
$$= \left(\frac{79 \times 55}{100}\right) + \left(\frac{45 \times 81}{100}\right)$$
$$= \frac{4345}{100} + \frac{3645}{100}$$
$$= \frac{4345 + 3645}{100}$$
$$= \frac{7990}{100}$$
$$= 79.9$$

∴ Relative atomic mass of bromine is 79.9

Extract 9.2: A sample of correct responses to question 9

2.3 Section C: Essay/Structured Question

This section consisted of one (1) structured question, which carried fifteen (15) marks. This question was compulsory.

2.3.1 Question 10: The Scientific Procedure

The question was asked as follows:

An experiment was conducted to find out the relationship between solubility of potassium nitrate salt in water against temperature. The results were recorded as shown in the following table:

Mass of the salt(g)	*10*	*30*	*50*	*65*	*87*	*113*
Mass of water (g)	*100*	*100*	*100*	*100*	*100*	*100*
Temperature (°C)	*0*	*20*	*30*	*40*	*50*	*60*

With reference to the experiment:

(a) provide the statement of the problem

(b) give the hypothesis

(c) identify;

- *(i) the dependent variable*
- *(ii) the dependent variable*
- *(iii) the controlled variable*

(d) present the data in tabular form

(e) make an interpretation of the data given

(f) make an inference and conclusion.

A total of 695,153 (100%) students attempted this question. Students who scored from 0 to 5.5 marks were 96.84 per cent, from 6 to 10 marks were 2.21 per cent and those who scored from 10.5 to 15 marks were 0.95 per cent. The general performance of the students was weak as only 3.16 per cent of the students scored 6 marks or above. The summary of performance of the students is shown in Figure 10.

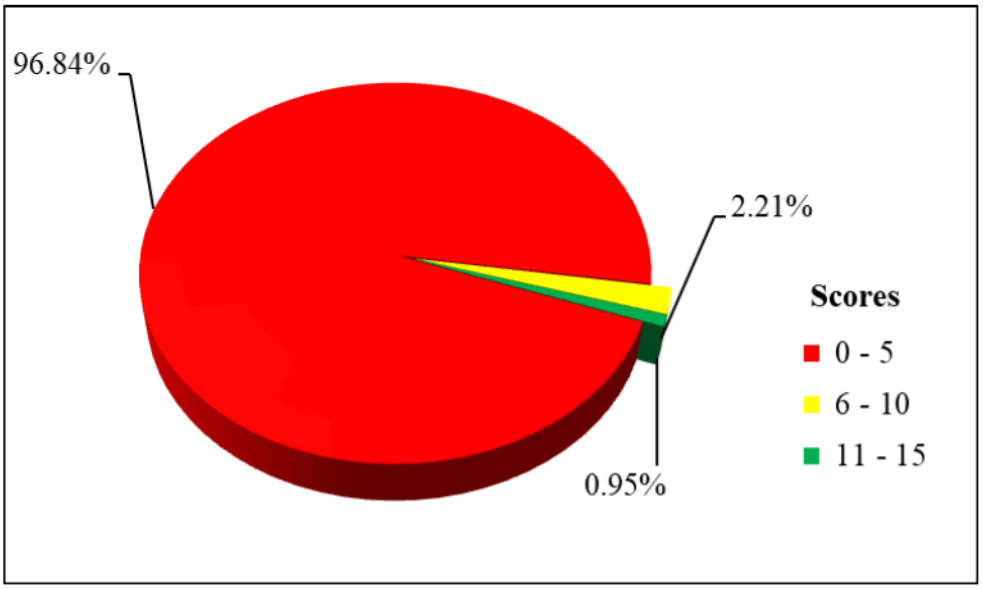


Figure 10: *Students' Performance in Question 10*

Students who scored low marks (96.84%) failed to identify the problem and hypothesis of the experiment in part (a) and (b). Likewise, in part (c), they identified incorrectly the required variables. For example, in part (c) (i) some wrote that the dependent variable is water. Those students did not understand that water acted as a controlled variable since it remained constant throughout the experiment. In part (e) and (f) the students failed to interpret the data hence they gave inappropriate conclusions. For example, some of the students wrote inference and conclusion regarding that temperature has no effect on solubility because the amount of water remained constant. This indicates that, the students lacked understanding on both factors affecting solubility of salts and how to use scientific procedures to carry out investigation in chemistry. Extract 10.1 shows a sample of incorrect responses from one of the students.

10. An experiment was conducted to find out the relationship between solubility of potassium nitrate salt in water against temperature. The results were recorded as shown in the following table:

Mass of the salt (g)	10	30	50	65	87	113
Mass of water (g)	100	100	100	100	100	100
Temperature (°C)	0	20	30	40	50	60

With reference to the experiment:

(a) Provide the statement of the problem.

The problem is that the mass of the solute is exiding the mass of the solvent and this may lead not to form a mixture.

(b) Give the hypothesis.

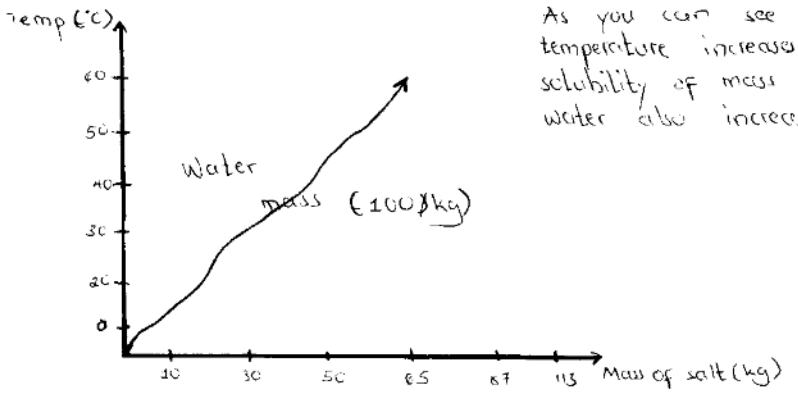
My hypothesis is that maybe the increase in mass of salt reduces the amount of water because salt is a solute and water is a solvent and cause the inbalance to occur

(c) Identify;

(i) the dependent variable.

The dependent variable is temperature
Dependent variable are the variable which change when other variables do ~~not~~ change and temperature has changed when mass of salt increases

(d) Present the data collected in a tabular form.



As you can see when the temperature increase also the solubility of mass of salt in water also increases.

(e) Make an interpretation of the data given.

The experiment to find out the relationship of solubility of potassium nitrate salt in water against temperature has come to an end after the experimentation and the conclusion agrees with the hypotesis therefore the guese for the hypothesis was correct.

(f) Make an inference and conclusion.

Due to the experimentation and the accepting of the hypotesis I have reached the conclusion of my experiment by agreeing of the hypotesis which I wrote by saying that "The mass of the solute is exeeding the mass of the solvent and therefore I need to increase the mass of the solvent in order the solute to dissolve in water.

Extract 10.1: A sample of incorrect responses to question 10

In Extract 10.1, the student identified the problem as mass instead of solubility in part (a). Likewise, in part (b), he/she cited the hypothesis as the increase of mass of salt instead of solubility of salt increases as temperature increases. Similarly, in part (c) (i), the student incorrectly identified the dependent variable as temperature instead of mass of solute. In part (d), the student misinterpreted the question and presented the data in form of graph instead of tabular form. The rest of the responses given in part (e) and (f) were incorrect as well.

On the contrary, few students who scored average marks or above (3.16%) gave correct explanation of the problem and hypothesis in part (a) and (b). Also, in part (c) identified correctly all variable in (i), (ii) and (iii). Moreover, in part (e) and (f) they gave correct interpretation and conclusion. Generally, the students demonstrated satisfactory knowledge about the use of scientific procedure to carry out investigation in chemistry. Extract 10.2 shows a sample of relatively correct responses to some parts of question 10 from one of the students.

(d) **Present the data collected in a tabular form.**

Mass of salt (g) / y-plane	Temperature (°C) / x-plane	Mass of water (g) / constant (K)
10	0	100
30	20	100
50	30	100
65	40	100
87	50	100
113	60	100

(e) **Make an interpretation of the data given.**

The mass of salt is affected by the amount of temperature. When the temperature increases the amount of potassium nitrate salt dissolves more in water provided that the mass of water is constant. In which the temperature if it decreases it will also decrease the amount of potassium nitrate salt which dissolves in the constant amount of water.

(f) **Make an inference and conclusion.**

Therefore, the amount of potassium nitrate salts dicolved in water depends on the amount of temperature it is. Example at high temperatures high amount of potassium nitrate salts likely to dissolve in water and at low temperature of water low amount of potassium nitrate salts is likely to dissolve

In conclusion " The solubility of potassium nitrate salts is directly propotional to the temperature of water when the amount of water is kept constant "

Extract 10.2: A sample of correct responses to question 10

3.0 ANALYSIS OF STUDENTS' PERFORMANCE IN EACH TOPIC

In the 2023 Form Two National Assessment (FTNA), a total of 10 topics were assessed in Chemistry subject. Those topics were: Laboratory Techniques and Safety; Matter; Air, Combustion, Rusting and Fire Fighting; Hydrogen; Water; Fuels and Energy; Formula, Bonding and Nomenclature; Atomic Structure; Periodic Classification and The Scientific Procedure.

The analysis shows that, question 1 which was comprised of 10 multiple choice items from different topics had good performance of 91.13 per cent. The question was set from the following topics: Laboratory Techniques and Safety; Matter; Air, Combustion, Rusting and Fire Fighting; Hydrogen; Fuels and Energy; and Formula, Bonding and Nomenclature.

Conversely, students' performance was weak in six topics. Those topics were Atomic Structure (24.82%); Formula, Bonding and Nomenclature (20.96%); Matter (19.66%); Air, Combustion, Rusting and Fire Fighting (17.54%); Periodic Classification (16.67%) and The Scientific Procedure (3.16%). The weak performance of students in those topics was mainly caused by inadequate knowledge of the subject matter assessed as well as failure to explain and interpret scientific facts and results. A summary of the performance of students in different topics is presented in the Appendix.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Generally, the performance of students who sat for Chemistry paper in the Form Two National Assessment 2023 was weak. The percentage of students who passed the assessment was 28.16. The performance of students in 2023 has decreased by 5.29 per cent compared to the performance in 2022. The analysis of students' performance in terms of topics showed that students achieved weak performance in six topics due lack of adequate knowledge of the subject matter, failure to interpret scientific facts and inability to apply numerical skills to solve problems in Chemistry.

4.2 Recommendations

In order to improve the students' performance in Chemistry subject in future, it is recommended that:

(a) teachers should guide students to discuss and practice the procedure for carrying out the following separation processes: decantation, filtration, evaporation, simple distillation, fractional distillation, sublimation, chromatography, layer separation and solvent extraction by using resources such as coloured flower, table salt, iodine crystals, water, muddy water, filter paper and heat source.

(b) teachers should improvise models in teaching atomic structures specifically during discussion of the modifications of Dalton's atomic theory.

(c) teachers should supervise students to apply the scientific procedure to carry out a project on a chemistry problem

(d) teachers should guide students to determine the calorific values of fuels experimentally. For instance, students may burn kerosene, charcoal and firewood for the purpose of comparing the calorific values of those fuels.

(e) students should practice solving various problems which require interpreting scientific results or processes such as rusting and experiment to prevent rusting.

(f) students should practice solving questions which require description and computation skills such as calculating relative atomic mass.

Appendix

Performance of Students in Each Topic

S/n	Topic	Question Number	Percentage of Students who Scored 30% or Above	Average	Remarks
1	Laboratory Techniques and Safety; Matter; Air, Combustion, Rusting and Fire Fighting; Hydrogen; Water; Fuels and Energy; Formula, Bonding and Nomenclature	1	91.13	91.13	Good
2	Atomic Structure	6	24.82	24.82	Weak
3	Formula, Bonding and Nomenclature	5	9.66	20.96	Weak
		7	32.25		
4	Matter	3	15.43	19.66	Weak
		4	23.94		
5	Air, Combustion, Rusting and Fire Fighting	2	17.54	17.54	Weak
6	Periodic Classification	8	12.71	16.67	Weak
		9	20.62		
7	The Scientific Procedure	10	3.16	3.16	Weak