THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR DIPLOMA IN SECONDARY EDUCATION EXAMINATION (DSEE) 2018

732 CHEMISTRY

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FOREWORD

The National Examinations Council of Tanzania has a great pleasure to issue this report on the analysis of candidates' responses on the Diploma in Secondary Education Examination (DSEE) 2018. DSEE is a summative evaluation with the function of demonstrating the effectiveness of the educational system in general; and the educational delivery system in particular. It is from statistics of examination results and the candidates' responses to the examination questions, which serve as indicators of what the educational system was able or unable to provide to the students in their two years of teacher education programme.

This Candidates' Items Response Analysis Report (CIRA) in Chemistry subject has been prepared in order to provide feedback to tutors, parents, students, policy makers, school quality assurers and other education stakeholders, on the candidates' performance in this subject.

Generally the report is intended to highlight the factors enhanced the observed performance of the candidates. For those who scored high marks, these factors include knowledge on concepts related to the subject, ability to identify the requirement of the questions and competence on expressing ideas clearly by using English language. Only few of the candidates scored low performance due to inability to use English language in presenting answers and to lesser extent, low mastery of content.

It is hoped that, the feedback provided will enable the educational administrators, school managers, tutors, school quality assurers and students to identify proper measures to be taken in order to improve the teaching and learning in secondary schools, and consequently improve the candidates' performance in future examinations administered by the Council.

The National Examinations Council of Tanzania will highly appreciate comments and suggestions from tutors, student teachers and the public in general, that aim at improving future reports.

Finally, the Council would like to thank all those who participated in processing and analyzing the data used in this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report on the analysis of candidates' performance aims at providing feedback about performance of the candidates who sat for the Diploma in Secondary Education Examination in May, 2018 in Chemistry subject. The number of candidates who sat for the examination was 830, out of which 683 were using University of Dodoma (UDOM) curriculum and 147 were using the Tanzania Institute of Education (TIE) curriculum. The examination tested the candidates' competences in using knowledge and skills gained in chemistry to solve daily life challenges, use and manage chemistry laboratory and assess learners' achievement objectively.

Table of Candidates' performance in Chemistry Examination

Candidates Type	Sat	Number of Candidates and Percentage					
			Grades				
			A	B	C	D	F
All	830	829	9	165	555	100	1
		99.88	1.08	19.88	66.87	12.05	0.12
UDOM Curriculum	683	682	1	110	475	96	1
		99.85	0.15	16.11	69.55	14.06	0.15
TIE Curriculum	147	147	8	55	80	4	0
		100.00	5.44	37.41	54.42	2.72	0.00

As shown in the Table, all (100%) candidates under TIE curriculum passed the examination, whereas 99.85% of the candidates under the UDOM curriculum passed with only one candidate (0.12%) failing.

For the purpose of this report, analysis of the performance in individual examination questions and their corresponding topics was done based on the candidates who sat for examination using TIE curriculum only. This is because the UDOM curriculum is in transition.

In the TIE curriculum, the Chemistry paper consisted of three sections, namely A, B and C. Section A consisted of ten short answer questions of which the candidates were required to attempt all. Section B and C had three questions each and the candidates were to answer only two questions from each section. The weight of each question in section A was 4 marks while in section B and C was15 marks.

This report is presented into four sections, namely introduction, analysis of the candidates' performance in each question, followed by analysis of performance in each topic. It finally gives conclusions and recommendations followed by the summary of performance of topics in the Appendix.

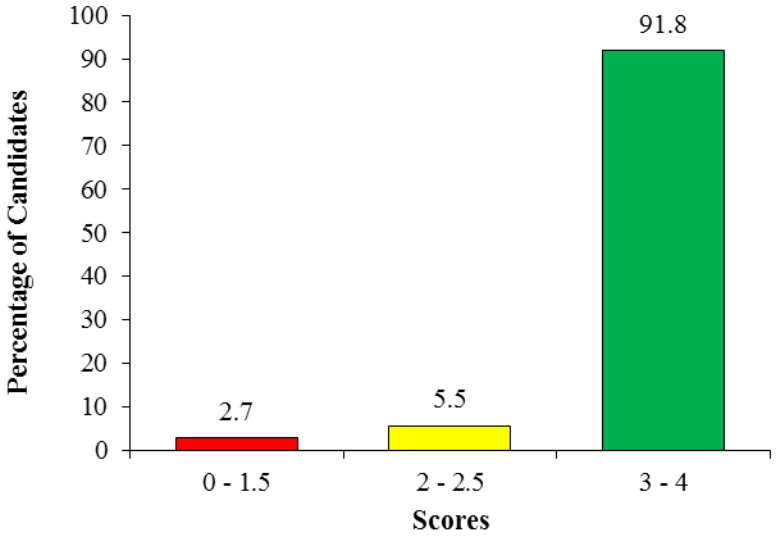
Throughout this report, the candidates' performance is categorized as *good*, *average* and *poor*. This performance grouping is based on the following percentage ranges: 70 – 100 = Good; 40 – 54 = Average; and 0 – 39 = Poor. The candidates' performance in each topic is summarized in Appendix.

2.0 ANALYSIS OF CANDIDATES' RESPONSES IN EACH QUESTION

This part analyses the performance of the candidates question wise and its corresponding topic. Statistics and extracts were used to justify the analysis made.

2.1 Question 1: Principles of Teaching and Learning Chemistry

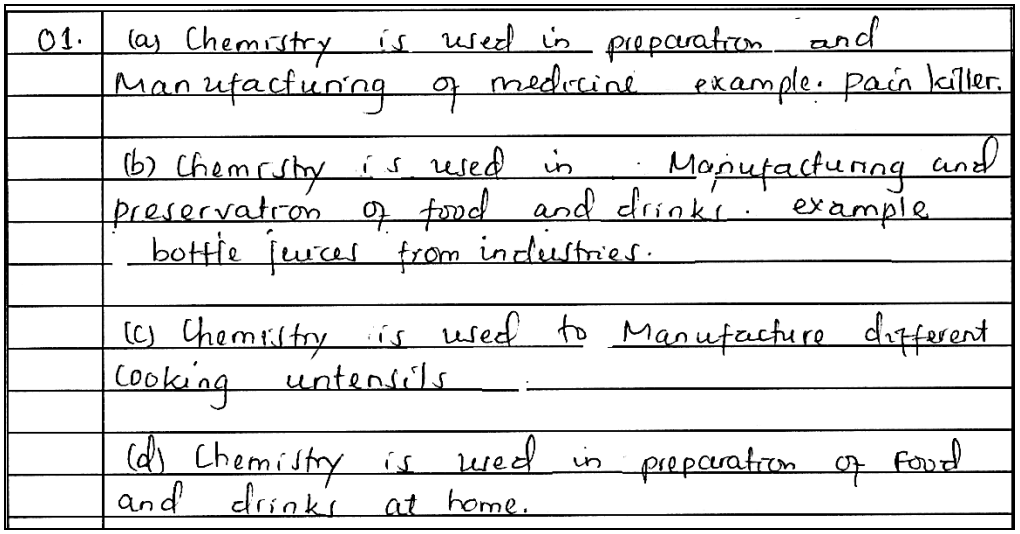
This question required the candidates to justify the relevance of chemistry subject in daily life. The question was attempted by 146 candidates, out of which 134 (91.8%) got 3 to 4 marks, including 97 (66.0%) candidates who got full marks. A few, 8 (5.5%) candidates scored 2 to 2.5 marks, and only 4 (2.7%) scored zero to 1.5 marks. The candidates' scores are summarized in Figure 1.



. **Figure 1:** *Distribution of candidates' scores in question 1.*

Analysis of the responses showed that those candidates who scored 3 to 4 marks managed to answer the question correctly by stating the relevance of chemistry subject in daily life. Some of the correct answers given by students include: *application in producing different medicine such as Panadol, to produce different professional (like doctors, pharmacist, teachers), to manufacture different fertilizers that are used in agricultural activities* and *used in home activities to produce different materials such as fuels and cooking pans*. However, their marks varied from 3 to 4 depending on the strength and accuracy of their answers, as some of them did not get all items correctly. Extract 1.1 is an example of appropriate responses.

Extract 1.1


01. (a) Chemistry is used in preparation and Manufacturing of medicine example. pain killer.

(b) Chemistry is used in Manufacturing and preservation of food and drinks. example bottle juices from industries.

(c) Chemistry is used to Manufacture different cooking untensils

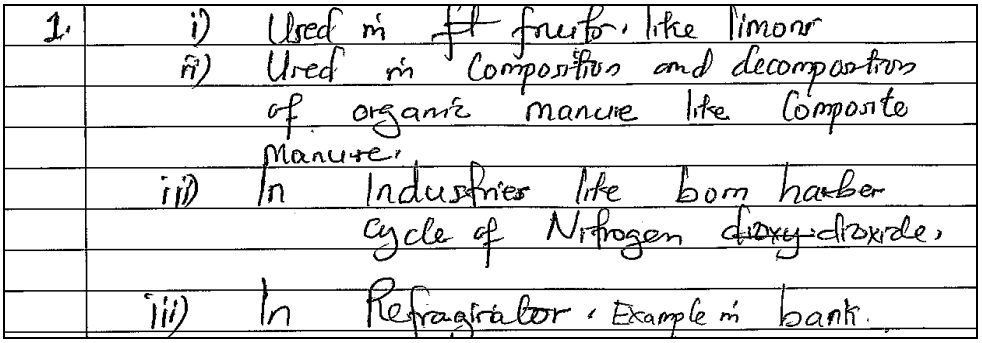
(d) Chemistry is used in preparation of food and drinks at home.

Extract 1.1: an example of a candidate who provided correct responses in question 1.

Furthermore, the analysis showed that, few candidates from who scored 2 to 2.5 marks had some strengths and weaknesses in their responses. Some of their responses were not detailed as one wrote: *it is relevant in increasing students' knowledge, in composition and decomposition of matter* and *in gaining skills and competences*.

On the other hand, of the few candidates who scored 0 to 1.5 marks, some of them failed to understand the demand of the question as they provided irrelevant responses which were not related completely to the demand of the question. Others had misconception of the question; they wrote less, yet irrelevant points. An example of irrelevant responses is shown in Extract 1.2.

Extract 1.2



Extract 1.2 represents incorrect responses in which the candidates provided irrelevant responses.

2.2 Question 2: Transition Metals

This question consisted of two parts, (a) and (b). Part (a) required candidates to define a transition metal whereas in part (b), they were required to explain why copper (I) compounds are coloured while copper (II) compounds are not.

Statistics show that the question was done by all 147 (100%) candidates. The performance was poor as 88 (61.1%) scored 0 to 1.5 marks, including half of them, 44 (29.9%) getting a 0 mark. Likewise, 42 (29.2%) of the total candidates got 3 to 4 marks while only 14 (9.7%) of them, scored average marks of 2 to 2.5. Figure 2 illustrates the performance in question 2.

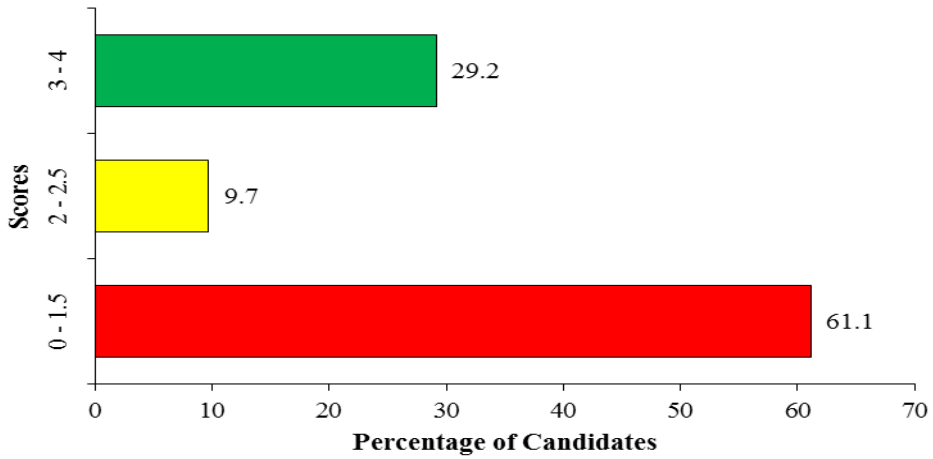
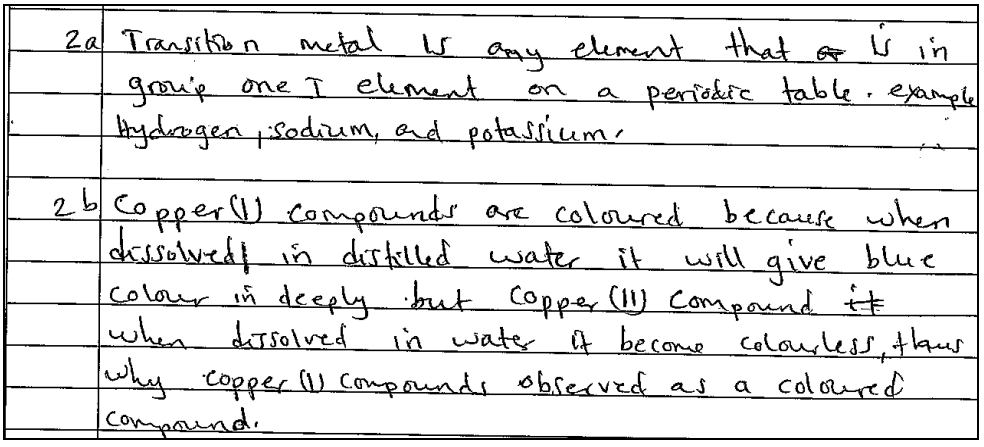


Figure 2: *Distribution of candidates' scores in question 2.*

Analysis of responses shows that, most of the candidates who scored 0 to 1.5 marks failed to provide correct responses due to simply lack of proper knowledge of transition metals. An example of poor responses is from one of the candidates who defined transition metals, thus: *"Transition metals are the elements that are coloured in nature"*. Others used the concept of grouping in the periodic table as shown in Extract 2.1. In part (b) where candidates were required to explain why Copper (I) compounds are coloured while Copper (II) compounds are not, the response of one candidate read: *Copper (I) seems to be coloured because of the position in the electrochemical series therefore Cu(I) is more reactive than copper (II).* Another candidate wrote: *Copper (II) compounds are coloured because it has partially filled d-orbital where it loses electron from 4s and 3d orbitals.* This candidate and others with irrelevant responses had misconception between electron filling in orbital and grouping of elements in a periodic table in part (b).

Extract 2.1


2a Transition metal is any element that ~~or~~ is in group one I element on a periodic table. example Hydrogen, sodium, and potassium.

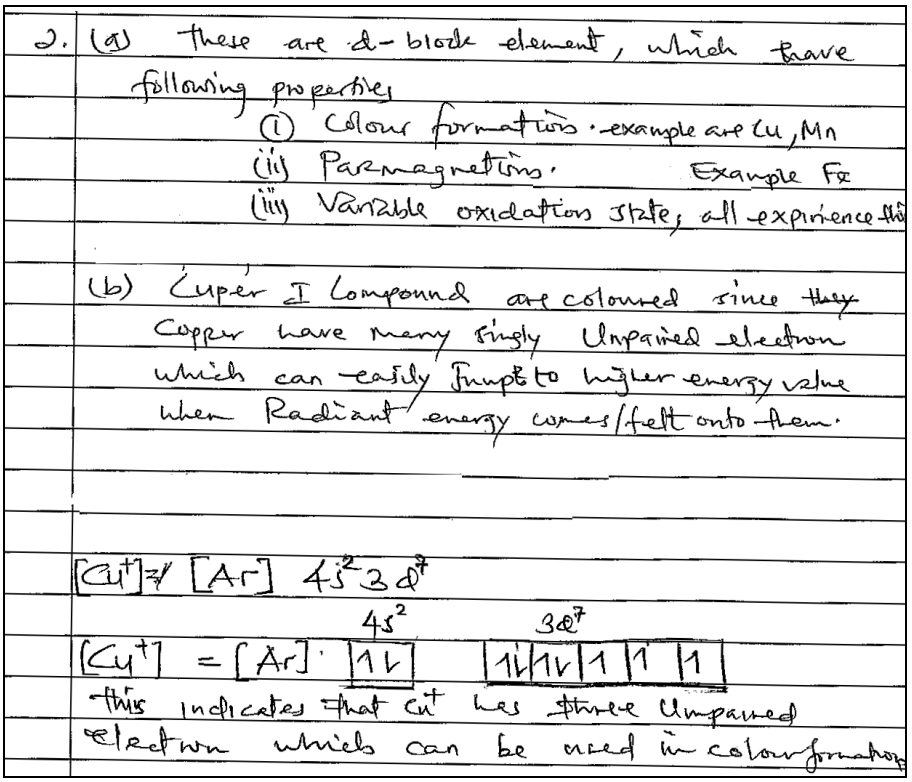
2b Copper(I) compounds are coloured because when dissolved in distilled water it will give blue colour in deeply but Copper (II) Compound ~~it~~ when dissolved in water it become colourless, thus why copper (I) compounds observed as a coloured compound.

Extract 2.1 is an example of a candidate's responses that used the concept of transition metal as the groups of periodic table, instead of writing "metals with partially filled d-orbitals". Irrelevant points were also given in part (b).

Further analysis of the responses revealed that most of the candidates who scored 3 to 4 marks managed to give the correct meaning of transition metal in part (a), such as *an element which has partially filled d-orbitals*. In part (b), they managed to provide clear explanation that, copper (I) compounds are coloured whereas copper (II) compounds are not by

writing: *copper (I) compounds (Cu^{+}) are coloured because of the presence of the unpaired electron in d-orbital. Such an electron is responsible for colour formation as it emits radiation with frequency corresponding to that of visible spectrum when falling to lower energy level. Copper (II) compounds (Cu^{2+}) on the other hand are white because they have a completely filled d-orbital, thus no transition of electron occurs.* Extract 2.2 shows correct responses of one of the candidates, despite the sentences having some grammatical errors.

Extract 2.2



Extract 2.2 is an example of appropriate responses from a script of a candidate who was able to explain well the concept of transitional metal.

In the last category, some of the candidates who scored partial marks from 2 to 2.5 managed to provide the correct definition of transition metals in part (a) such as: *metals which are partially filled d-orbital* while the same candidate in part (b) wrote irrelevant response like: *copper (I) compounds are colored because are more stable in their d-orbital, hence they cannot*

loose electron in 4s and 3d orbital. Thus, the candidate interchanged the facts. The stability is the property of copper (II) compounds and not for copper (I)'s.

2.3 Question 3: Chemistry Curriculum Material

This question instructed candidates to describe four criteria for choosing a chemistry textbook. Students' performance showed that, out of 147 (100%) candidates who attempted the question, (55.8%) scored 3 to 4 marks, (17.7%) scored 2.0 to 2.5 marks, and lastly 26.7% scored zero to 1.5 marks. The scores are summarized in Figure 3.

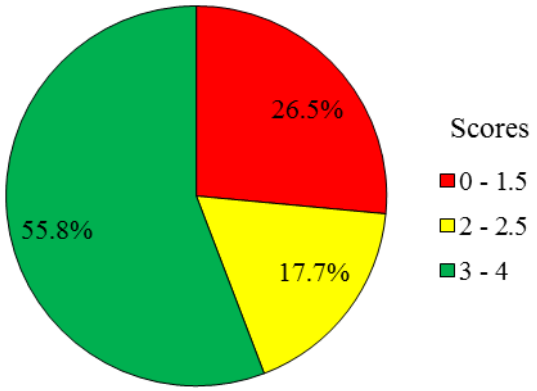
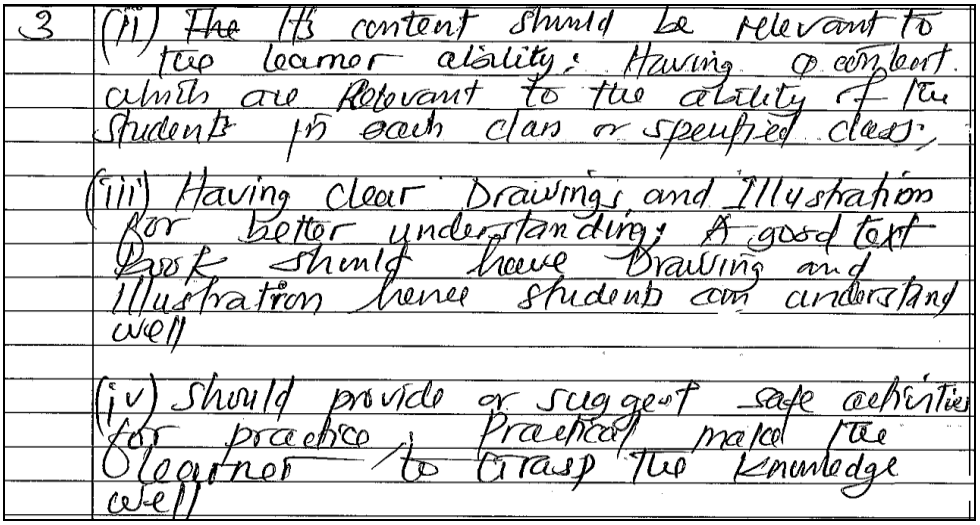


Figure 3: *Distribution of candidates' scores in question 3.*

The scores from 3 to 4 marks indicate that, the candidates concerned had enough knowledge of the concepts since they were able to meet the demands of the question. It was observed from the analysis that, some of those who showed high performance were able to describe the criteria as required, when choosing chemistry textbook. One of the candidates' responses were: *it should be appropriate for the level of the learner, relevant to the learners of different backgrounds* and *should realise the objectives stated in the syllabus.* Another response given was *textbook should include experiment to be performed by students during teaching session* and *lastly the content should conform to that of the syllabus.* Extract 3.1 is a sample of candidates' correct responses.

Extract 3.1


3 (ii) The Its content should be relevant to the learner ability; Having a content which are Relevant to the ability of the Students in each class or specified class;

(iii) Having clear Drawings and Illustration for better understanding; A good text Book should have Drawing and Illustration hence students can understand well

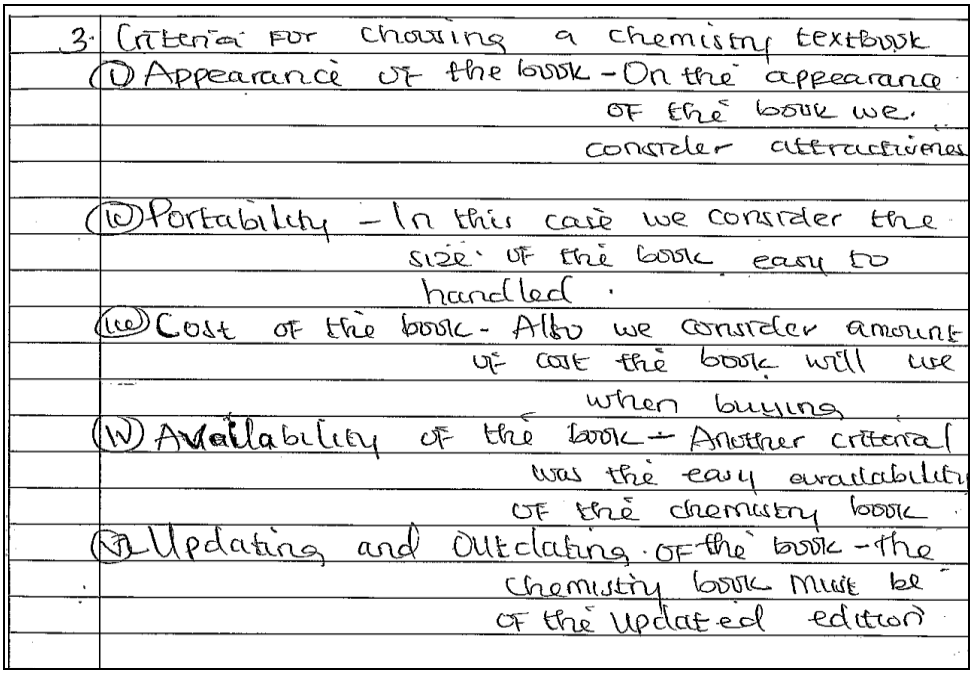
(iv) Should provide or suggest safe activities for practice; Practical make the learner to Grasp the knowledge well

Extract 3.1 is an example of correct responses from a candidate who was able to give correct response on criteria of choosing chemistry textbook.

Further analysis of responses indicates that, those who scored from 2 to 2.5 marks showed some strengths and weaknesses in their answers. For instance one candidate wrote only two out of four required criteria. In addition, some candidates mixed relevant and irrelevant responses together. For example one candidate wrote: *readability of the book, Author and year of publication, content organization of the book* and *mechanical features such as size, cover* and *its durability*. The first two responses were irrelevant while the last two were relevant.

On the other hand, the analysis shows that of the candidates who scored 0 to 1.5 marks, most of them did not understand the demand of the question while others lacked knowledge or inadequate skills on the subject matter. Example of the incorrect responses cited from one candidate are: *"Author of the book must be considered, relevant of the book* (not specified the area of relevance) and *should show tittle of the cover"* Additionally, one candidate indicated that *updating and outdating of the book, cost of the book, and year of publication* are important things to consider. Extract 3.2 is an example of wrong responses.

Extract 3.2


3. Criteria for choosing a chemistry textbook
(i) Appearance of the book - On the appearance of the book we consider attractiveness
(ii) Portability - In this case we consider the size of the book easy to handled.
(iii) Cost of the book - Also we consider amount of cost the book will use when buying
(iv) Availability of the book - Another criteral was the easy availability of the chemistry book
(v) Updating and Outdating of the book - the chemistry book must be of the updated edition

Extract 3.2 is a sample of incorrect responses from one candidate who outlined physical features instead of considering the technical features of the book.

2.4 Question 4: General Chemistry

In this question, candidates were asked to state four amendments made on Dalton's atomic theory. According to statistics, the performance of candidates showed that, out of 141 (95.9%) candidates who attempted the question, 49.6 percent scored 3 to 4 marks, 20.6 percent scored 2.0 to 2.5 marks and the ones who scored 0 to 1.5 marks were 29.8 percent. Basing on the statistics, the performance was good since 70.2% of the candidates scored above the average. Consider the illustration in Figure 4.

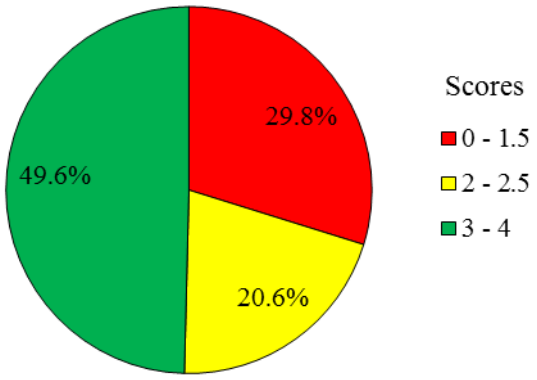
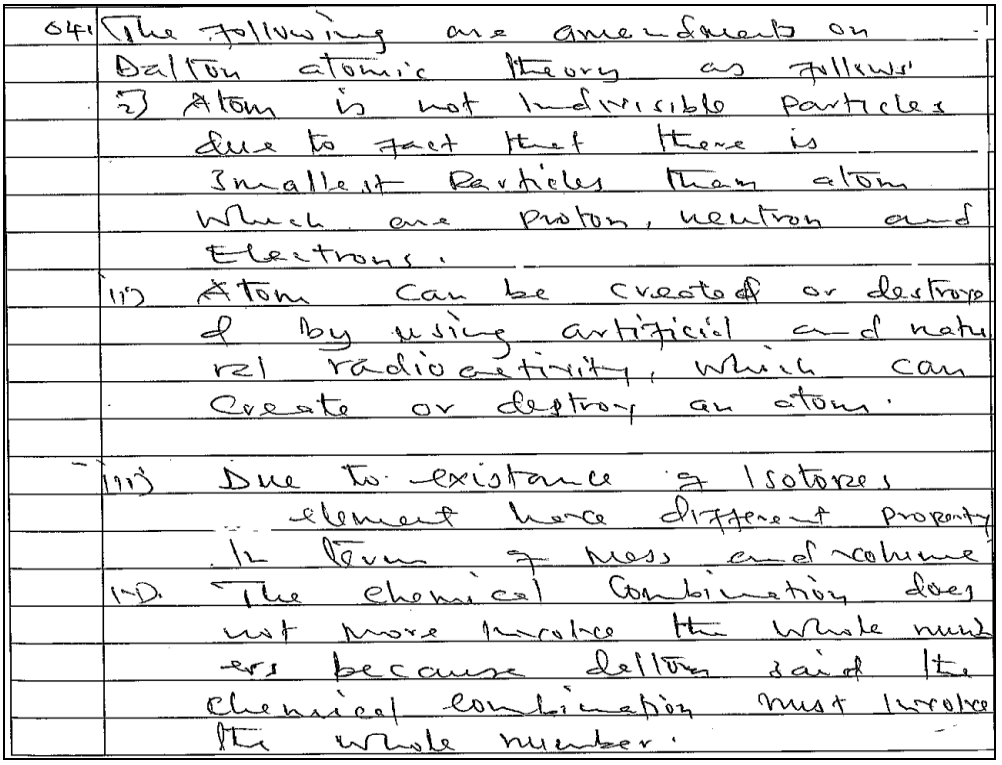


Figure 4: *Distribution of candidates' scores in question 4.*

Findings from candidates' responses analyzed indicate that, those who scored 3 to 4 marks had sufficient knowledge on the concept of the Dalton atomic theory, that is a reason why some of them were able to provide relevant and sound argument on the amendments of the atomic theory. One of such argument is that, the recent discovery shows the following: *Matter is made up of small sub-atomic particles which are electron, proton and neutrons; atoms of the same elements are not necessarily alike because there are some atoms of the same atomic number but differ in atomic mass, and atoms of the same element can combine together or combine with atoms of other element in a ratio of whole number and not necessary in small whole number.* Such correct responses show that, the majority of candidates had good knowledge on the concept of atomic theory. Extract 4.1 is a sample of such correct responses.

Extract 4.1


04. The following are amendments on Dalton atomic theory as follows:
2) Atom is not indivisible particles due to fact that there is smallest Particles than atom which are proton, neutron and Electrons.
iii) Atom can be created or destroyed by using artificial and natural radioactivity, which can create or destroy an atom.
iii) Due to existance of Isotores element have different property in term of mass and volume
iv) The chemical combination does not more involve the whole numbers because dalton said the chemical combination must involve the whole number.

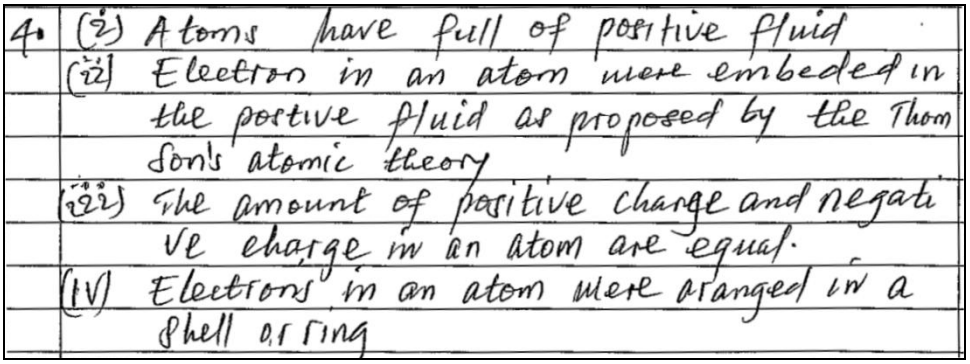
Extract 4.1 is a sample of correct responses from a candidate who was able to give four points as amendments made on Dalton's atomic theory.

Likewise, the candidates who scored from 2 to 2.5 marks demonstrated average level of understanding on the demands of the question, hence most of them mixed relevant and irrelevant points as one candidate wrote: *matter can neither be created nor destroyed; matter is made up of indivisible particles called atoms.* These responses show that the candidates lacked enough knowledge on the differences between Dalton atomic theory against its amendments.

On the last category, the candidates who scored from 0 to 1.5 marks failed to grasp the requirement of the question. Evidence from the scripts showed that majority of these candidates wrote about Dalton's atomic theory instead of writing amendments of Dalton's atomic theory. The responses of one of them were: *matter is made up of small indivisible particles called atom, atom can neither be created nor destroyed, atoms of the same element have the same masses* and lastly, *atom of different element have*

different masses. Some of responses of candidates who were unable to answer the question correctly are demonstrated in Extract 4.2.

Extract 4.2


4. (i) Atoms have full of positive fluid
(ii) Electron in an atom were embeded in the postive fluid as proposed by the Thomson's atomic theory
(iii) The amount of positive charge and negative charge in an atom are equal.
(iv) Electrons in an atom were aranged in a shell or ring

Extract 4.2 represents a response of a candidate who provided irrelevant responses.

2.5 Question 5: Environmental Chemistry

The question had two parts, (a) and (b). In part (a), they were required to list four gases which cause global warming while in part (b), they were required to differentiate greenhouse gases from photochemical smog. Performance indicates that, out of 146 (99.3%) who attempted the question, 3.4% scored 3 to 4 marks, 30.8% scored 2.0 to 2.5 marks and 65.8% scored 0 to 1.5 marks. Figure 5 summarizes distribution of scores.

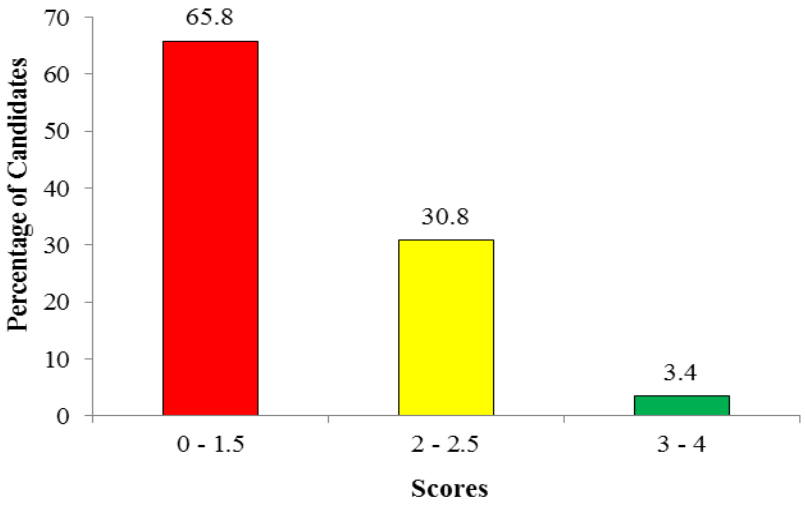
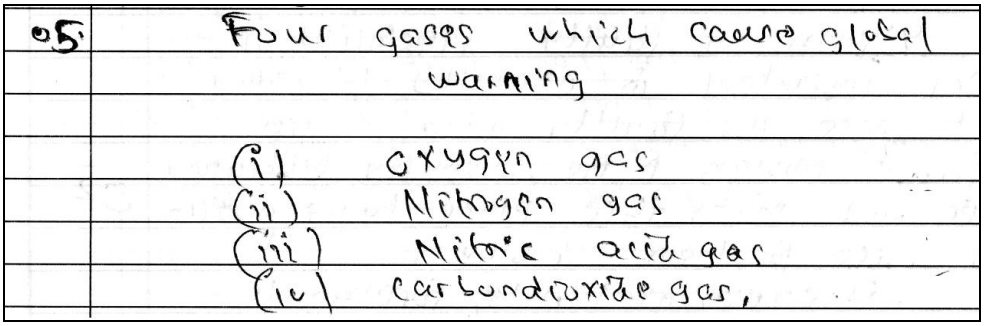


Figure 5: *Distribution of candidates' scores in question 5.*

From the analysis of the responses, it was observed that, the candidates who scored 0 to 1.5 marks had either failed to meet the requirement of the question, or had poor knowledge of environmental chemistry. One candidate for instance, cited the following irrelevant gases as causes of global warming: *carbon monoxide, hydrogen, greenhouse gases* and *nitrogen gas* .Extract 5.1 is another example of incorrect responses.

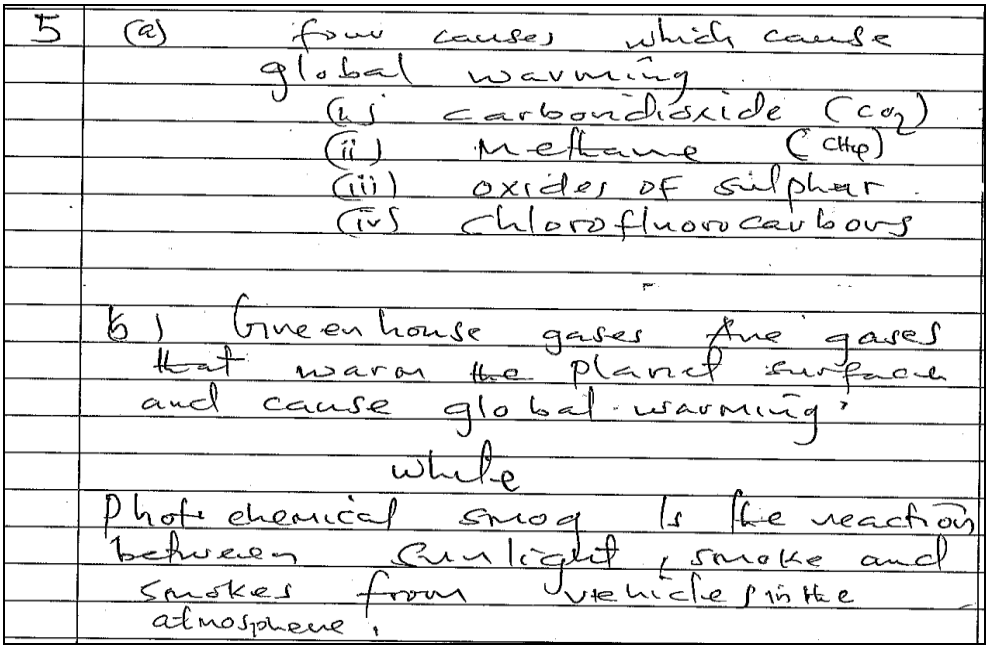
Extract 5.1



Extract 5.1 is an example of incorrect responses in which the gases indicated by the candidates do not cause global warming except carbon dioxide.

On the other hand, the candidates who scored 3 to 4 marks managed to provide correct responses on the four gases that cause global warming in part (a). They identified the gases as: *Water vapour, Carbon dioxide, Oxides of Nitrogen, Oxides of Sulphur, Methane* and *Chloro-floro carbons (CFCs*). In part (b), they managed to differentiate greenhouse gases from photochemical smog. A sample of the correct responses from the candidates is shown in Extract 5.2.

Extract 5.2


5 (a) four causes which cause global warming
(i) carbondioxide (CO_2)
(ii) Methane (CH_4)
(iii) oxides of sulphar
(iv) chlorofluorocarbons

b) Greenhouse gases the gases that waron the planet surface and cause global warming' while
Photochemical smog is the reaction between sunlight, smoke and smokes from vehicle's in the atmosphere.

Extract 5.2 is sample of the correct responses from a candidate who managed to identify gases causing global warming in part (a) and differentiating correctly the gases asked in part (b).

Results from the analysis reveal that, those who scored from 2 to 2.5 marks managed to provide partially correct responses based on the demand of the question. They either provided in part (a) few points out of four; or mixed up relevant and irrelevant points in their answers.

2.6 Question 6: Laboratory Management

The question had two parts (a) and (b). In part (a), the candidates were required to define standard solution whereas in part (b), they were required to outline four features of primary standard reagents. According to statistics, the question was attempted by all 147 (100%) candidates. The students' performance shows that, one third of the candidates who attempted it. (33.3%) scored 3 to 4 marks, another one third, (33.4%) scored 2.0 to 2.5 marks; and the last one third (33.3%) scored 0 to 1.5 marks. The summary of those data are presented in Figure 6.

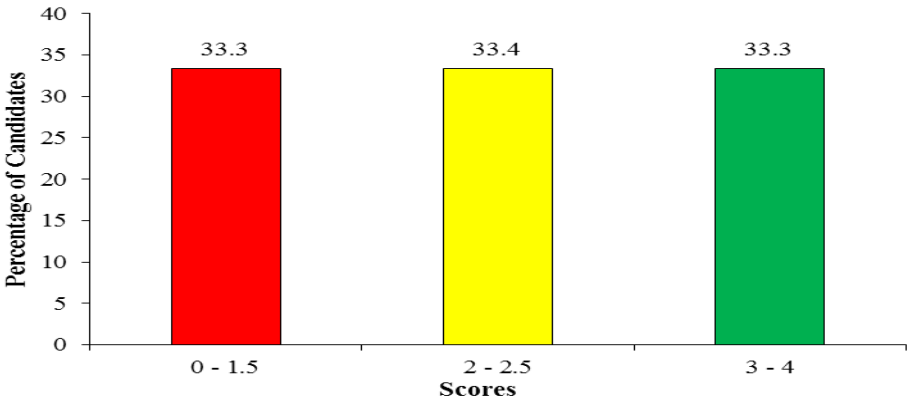
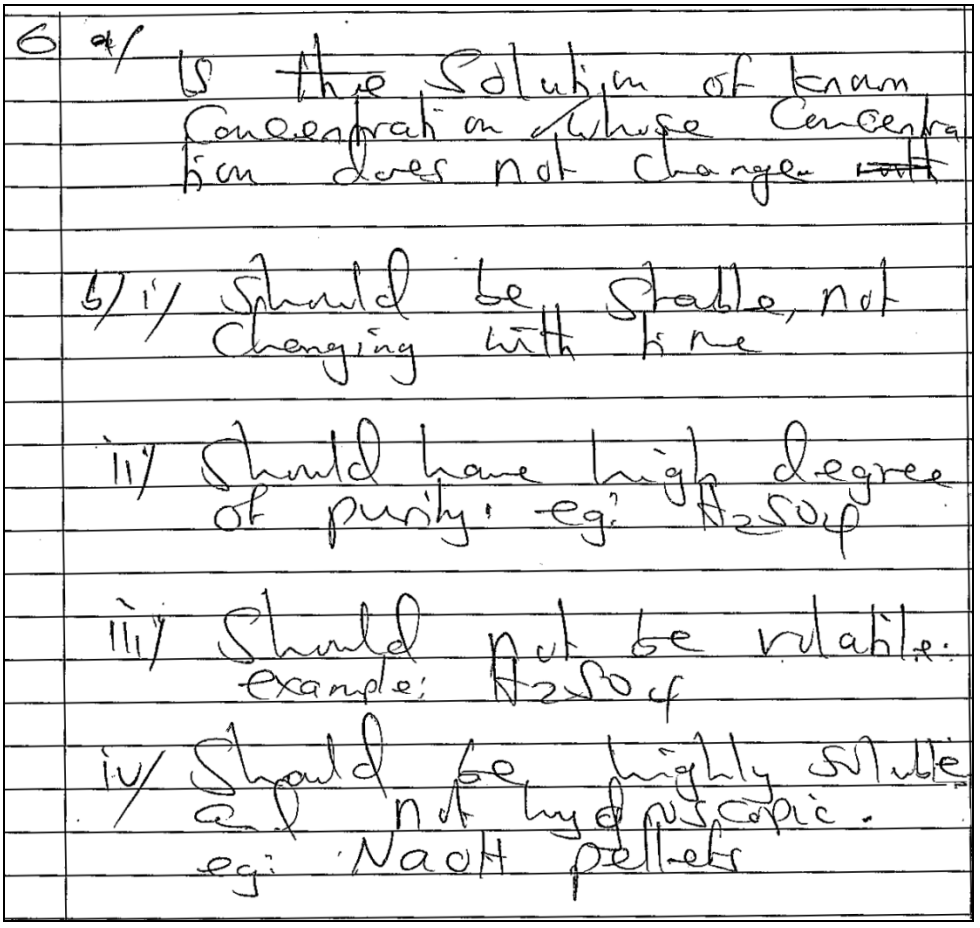


Figure 6: *Distribution of candidates' scores in question 6.*

Analysis of candidates' responses indicates that, those who scored 3 to 4 marks managed to provide correct definition of standard solution in part (a) by indicating that it is the *solution whose concentration (moles or mass) in a given volume is accurately known, that is moles or its mass in a given volume.* In part (b), they managed to state four characteristics of primary reagents in which the majority wrote such characteristics like; *being 100% pure or at least of known purity: not absorb water from the atmosphere or not react with atmospheric gases. Being stable at temperature ranging from* 100^0 *C to* 120^0 *C* and *it should not undergo reduction or oxidation reaction easily;* and lastly *it should be stable at U.V light.* Other correct responses are as appearing in Extract 6.1.

Extract 6.1



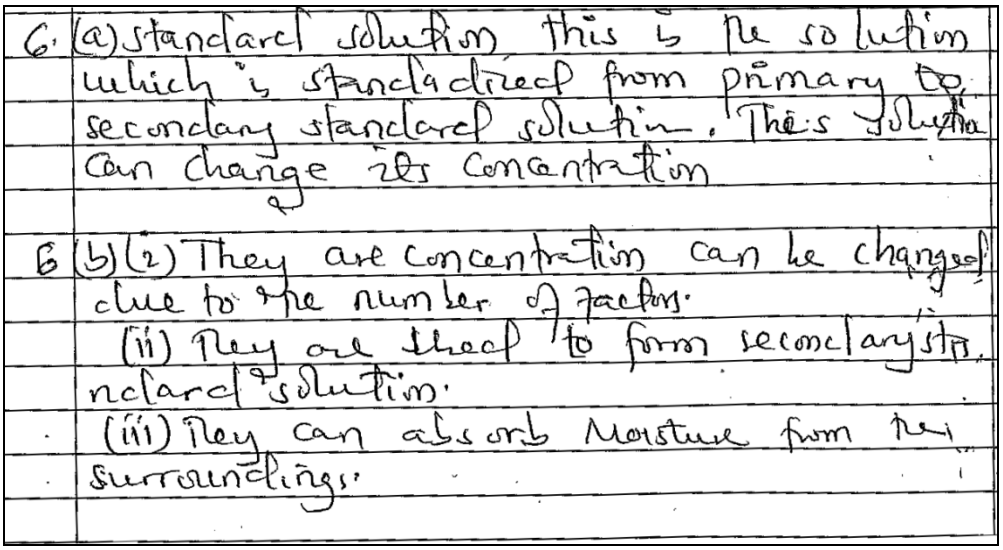
Extract 6.1 is an example of correct responses in which the candidate managed to define standard solution in part (a) and outlined correctly four features of primary standard solution.

The candidates who scored 2 to 2.5 marks wrote partial definition of standard solution as well as few characteristics of primary reagent in part (a). In part (b), they could not write either all the needed points or gave correct and incorrect points respectively.

On the other hand, the scores of 0 to 1.5 marks especially a 0 mark was obtained by candidates who failed completely to provide definition of standard solution and who gave wrong responses on the characteristics of primary reagents. For example, standard solution was wrongly defined as: *solution which contains equal amount of mixture and always contain standards reagents.* In part (b), the same candidate incorrectly wrote

characteristics of primary reagents as: *they are strong in terms of basicity and acidity, they have known concentration and they have equal value under standard temperature and pressure.* Such responses show that the candidate lacked proper knowledge of standard solution. A similar irrelevant response is attached in Extract 6.2.

Extract 6.2


6. (a) standard solution this is the solution which is standardized from primary to secondary standard solution. This solution can change its concentration

6 (b) (i) They are concentration can be changed due to the number of factors.
(ii) They are used to form secondary standard solution.
(iii) They can absorb Moisture from the surroundings.

Extract 6.2 is an example of wrong responses in which the candidate failed to provide a relevant definition of standard solution; and outlined incorrect features of primary standard solution.

2.7 Question 7: Planning and Preparation for Teaching

This question required candidates to describe four stages of the lesson development in the chemistry lesson plan. The statistical data presented a good performance of this question, in which, out of 147 (100%) who attempted it, 93.9% scored 3 to 4 marks, 3.4% scored 2.0 to 2.5 and those who scored below the average (0 to 1.5) were 2.7 percent. Figure 7 shows a summary of the scores.

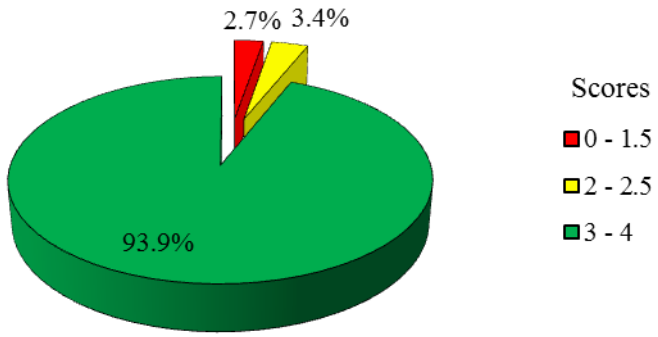


Figure 7: *Distribution of candidates' scores in question 7*

Results from the analysis reveal that candidates who got 3 to 4 marks described accurately all of the four stages of lesson development. Examples of appropriate responses include: *introduction, new knowledge Reinforcement and reflection.* Generally, out of 138 (93.9%) candidates whose scores range from 3 to 4 marks, 134 (91.2%) managed to score full allotted marks. Extract 7.1 is given as an example of correct responses.

Extract 7.1

7. Four stages of the lesson development in the chemistry lesson plan.

i/ Introduction.

This is the stage in which the teacher introduces the lesson to the students either by asking questions on the previous lesson or the new lesson.

ii/ New knowledge.

Is the stage where the actual teaching and learning takes place, where by a teacher can group learners into groups to discuss the hints given, and the teacher supervise them.

iii/ Reinforcement.
This is the cementing of the main idea of the Lesson.

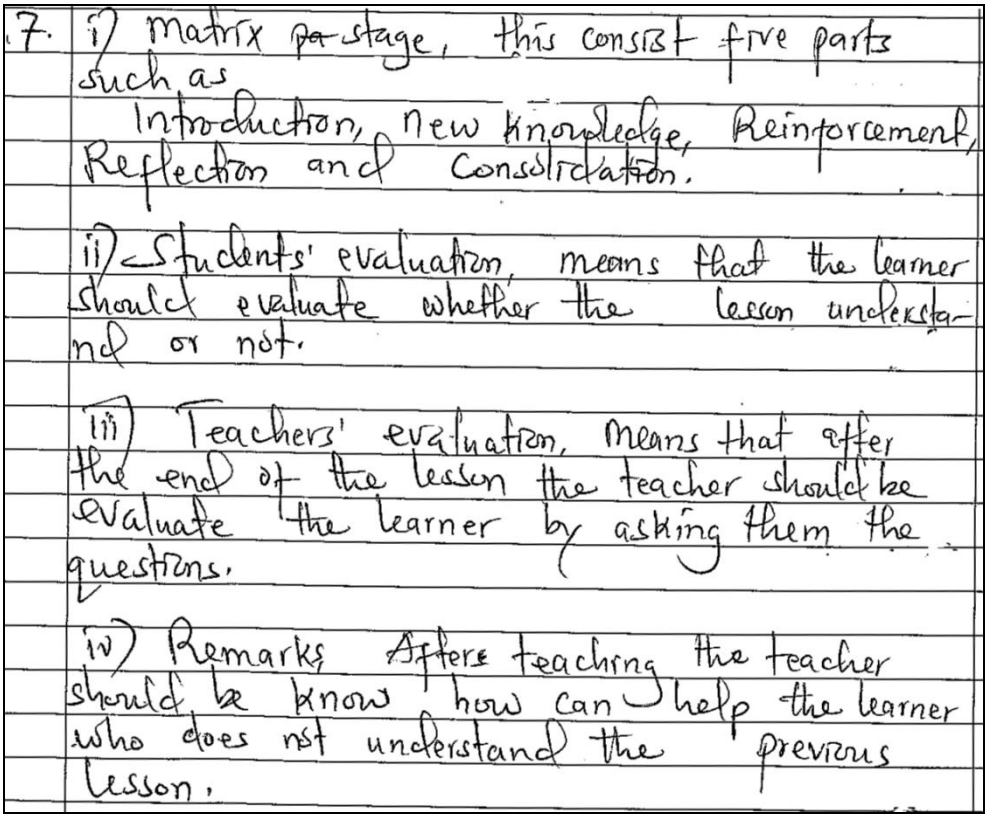
iv) Reflection.
- Is the stage where learners put the Lesson to their real environment or real life situation.

Extract 7.1 is a sample of correct responses in which a candidate described the four stages of lesson development correctly.

On the other hand, the candidates who scored 2.0 to 2.5 marks managed to list the four stages of lesson development like *introduction, new knowledge reinforcement and reflection* but they could not make any description, hence they got partial credit.

Furthermore, analysis showed that, most of the candidates who scored 0 to 1.5 marks mentioned *competences, objectives of the lesson, students' evaluation and teachers' evaluation* as the stages of the lesson development. Those are yes the components of lesson plan but not part of the stages of lesson development. This misconception might have been caused by lack of knowledge of planning and preparation for teaching. A similar example of irrelevant responses is illustrated in Extract 7.2.

Extract 7.2


7. i) Matrix pa stage, this consist five parts such as
Introduction, new knowledge, Reinforcement, Reflection and Consolidation.

ii) Students' evaluation, means that the learner should evaluate whether the lesson understand or not.

iii) Teachers' evaluation, means that after the end of the lesson the teacher should be evaluate the learner by asking them the questions.

iv) Remarks Afters teaching the teacher should be know how can help the learner who does nst understand the previous lesson.

Extract 7.2 is a sample of a response from a candidate who indicated matrix, evaluation (students and teachers) and remarks as the stages of lesson development instead of writing *introduction, new knowledge, reinforcement and reflection.*

2.8 Question 8: Assessment in Chemistry

This question required candidates to outline four features of a good chemistry test. According to statistics, the question was answered by all 147 (100%) candidates. Out of those, 53.1 percent scored 3 to 4 marks while 29.2 percent scored 2.0 to 2.5 marks; and 17.7 percent scored 0 to 1.5 marks. The summary of scores distribution is shown in figure 8.

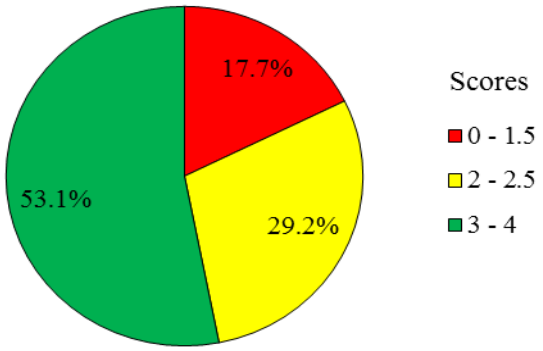
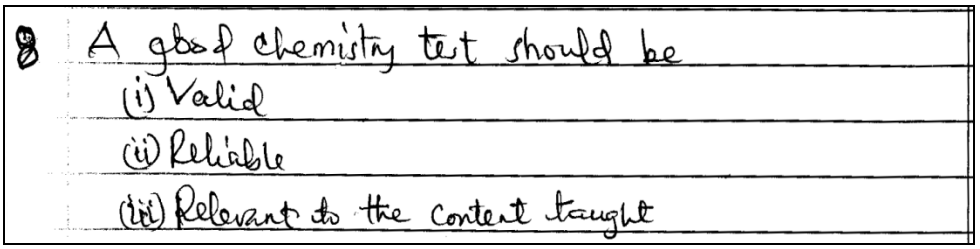


Figure 8: *Distribution of candidates' scores in question 8.*

The analysis of responses showed that, those who scored 3 to 4 marks managed to outline four characteristics of good chemistry test like the issue of *reliability, validity and discriminative properties and consideration of cognitive ability of learners.* Extract 8.1 is sample of such candidates' correct responses.

Extract 8.1


8 A good chemistry test should be
(i) Valid
(ii) Reliable
(iii) Relevant to the content taught

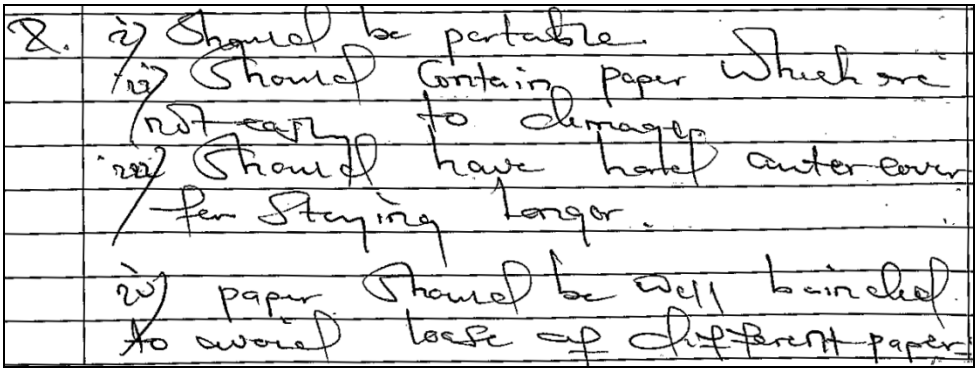
Extract 8.1 is part of a correct response from a candidate who gave characteristics of a good chemistry test.

Majority of candidates who scored partial marks of 2.0 to 2.5 managed to write only few correct characteristics of a good chemistry test.

On the other hand, candidates who scored 0 to 1.5 marks failed to outline all four features of a good chemistry test. One of them for example, listed incorrect responses, such as *should be short, no typing error, it should be more of objective rather than subjective questions* and lastly *questions should not be taken directly from the books.* These answers are contrary to the anticipated ones which are: *reliability, validity, fairness, practicability*

and lastly it should be discriminative. With those responses given by the candidates, it implies that the content of "Assessment in Chemistry" was either taught theoretically or was not completely covered by most candidates Moreover; there were few candidates who showed misconceptions with features of good chemistry textbook; hence they gave responses based on the quality of textbook instead of a test. Extract 8.2 is a sample of mixed responses provided by a candidate.

Extract 8.2



Extract 8.2 is an example of a response from a candidate who gave responses in the context of textbook instead of context of test in assessment.

2.9 Question 9: Environmental Chemistry

The question required candidates to describe four types of manures. Statistical data show that, out of 146 (99.3%) candidates who attempted the question, about one fifth, (20.6%) scored 3 to 4 marks, 30.2 percent scored 2.0 to 2.5 marks and lastly nearly a half (49.3%) scored 0 to 1.5 marks with 30 (20.4%) scoring a 0 mark. Figure 9 illustrates the performance scores in question 9.

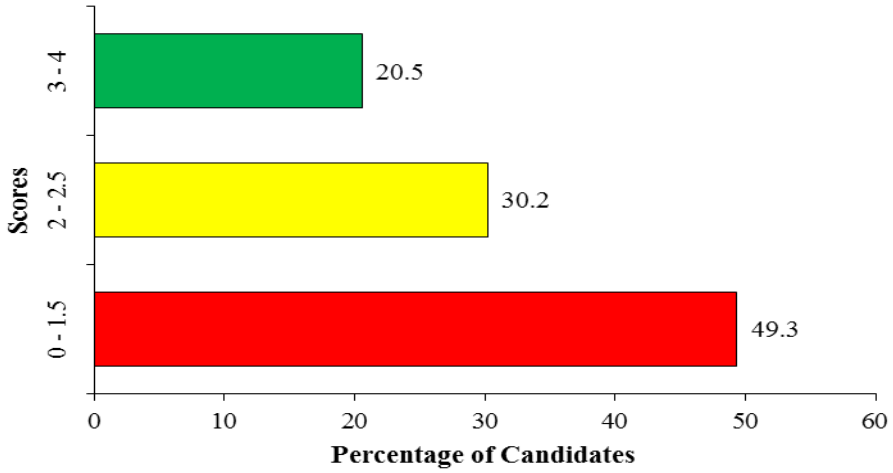
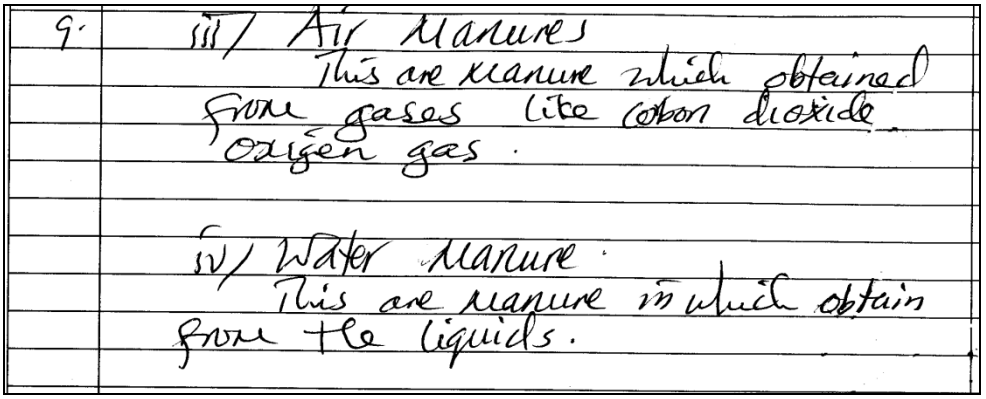


Figure 9: *Distribution of candidates scores in question 9.*

An in-depth analysis shows that some of those who scored 0 to 1.5 marks failed to describe at least four types of manures. Those candidates failed to provide the types of manure such as: *kraal manure from cattle kraal, biogas manures from effluent of biogas plants and farmyard manures from animal wastes*. Other correct responses could be: *compost manures from rotted organic matter mixed with soil and green manures from specific types of plants like leguminous crops.* On the contrary, most of the irrelevant responses provided by candidates were based on fertilizers such as Calcium Ammonium Nitrate (CAN), Sulphate of Ammonia (SA) and Urea.

Moreover, 30 (20.4%) candidates out of 72 (49.3%) whose scores range from 0 to 1.5 marks, particularly who got a zero mark failed to provide correct answers in all parts of the question as shown in Extract 9.1.

Extract 9.1


9. iii) Air Manures
This are manure which obtained from gases like carbon dioxide oxigen gas.

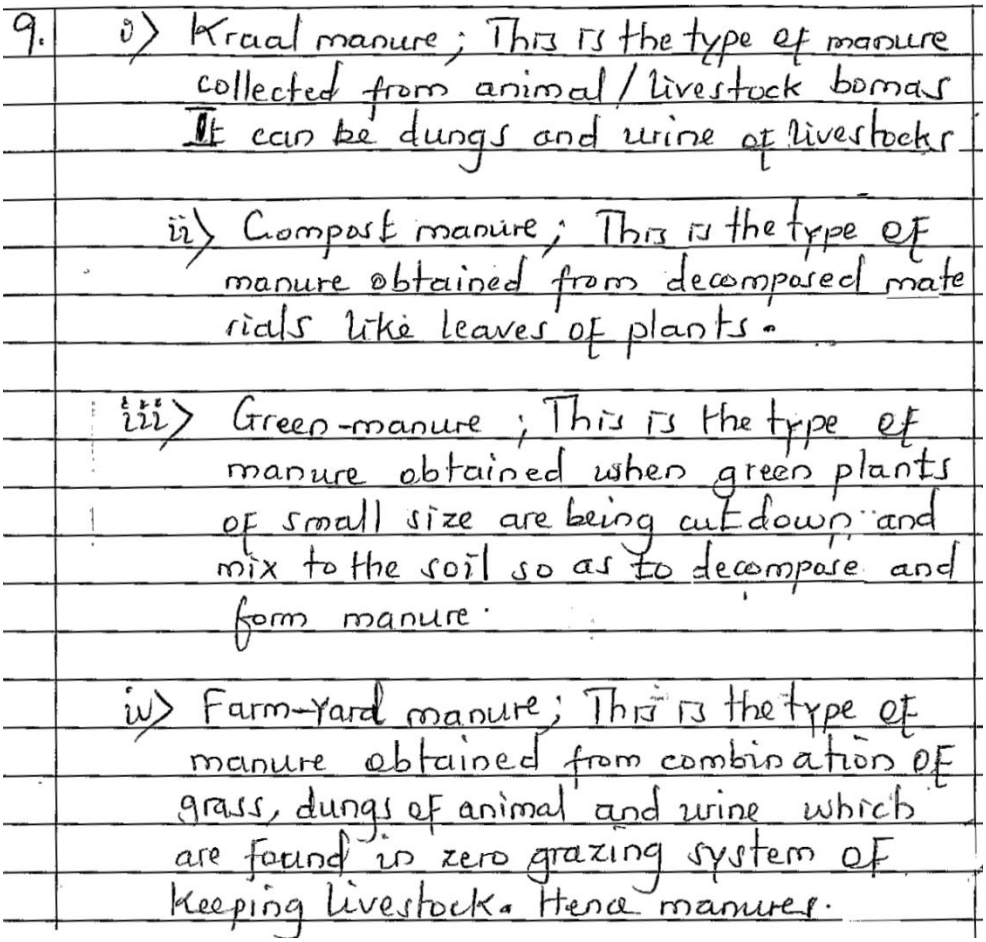
iv) Water manure.
This are manure which obtain from the liquids.

Extract 9.1 is a sample of incorrect responses in which the candidate indicated that, there is an air and water type of manure, the answer that is not appropriate.

Some of the candidates who got moderate performance ranging from 2.0 to 2.5 marks gave the responses which were either incomplete or they outlined without making any description on types of manure written. This reflects that, the teaching methods employed by teachers in classroom context might not cater for the nature of the topic.

Furthermore, the analysis shows that those candidates who scored 3 to 4 marks demonstrated high level of understanding of the subject matter as they managed to describe clearly the four types of manures. Most of them described the types of manures by giving relevant examples. Extract 9.2 is an example of correct responses provided by the candidate.

Extract 9.2


9. i) Kraal manure; This is the type of manure collected from animal/livestock bomas It can be dungs and urine of livestocks

ii) Compost manure; This is the type of manure obtained from decomposed materials like leaves of plants.

iii) Green-manure; This is the type of manure obtained when green plants of small size are being cut down and mix to the soil so as to decompose and form manure.

iv) Farm-yard manure; This is the type of manure obtained from combination of grass, dungs of animal and urine which are found in zero grazing system of keeping livestock. Hence manures.

Extract 9.2 is sample of a candidate who was able to describe correctly the types of organic manure like *kraal, compost, green and farm yard manures.*

2.10 Question 10: Organic Chemistry

The question had two parts, (a) and (b). In part (a), candidates were required to outline two uses of benzene. Part (b) had two items, (i) and (ii) in which candidates were instructed to give the meaning of electrophilic substitution in (b) (i), and in (b) (ii), they were required to demonstrate by using relevant reaction equation, how aromatic compounds undergo electrophilic substitution.

According to statistics, the performance of candidates was that, out of 136 (92.5%) candidates who attempted the question, 51.1% scored 0 to 1.5 marks including 22 (16.2%) who scored 0 mark. The percentage of the candidates who scored 2.0 to 2.5 marks was 28.6 and only 19.9% could score 3 to 4 marks, making a performance generally poor. Figure 10 summarizes the distribution of scores in question 10.

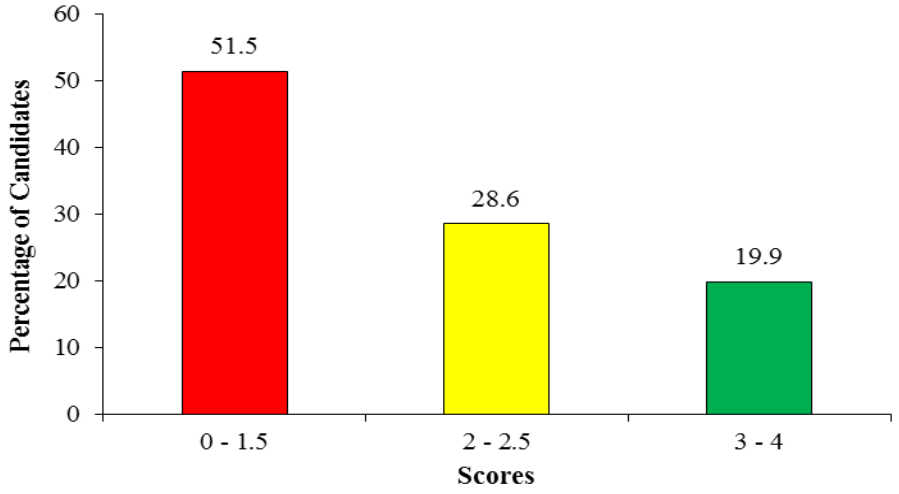


Figure 10: *Distribution of candidates' scores in question 10.*

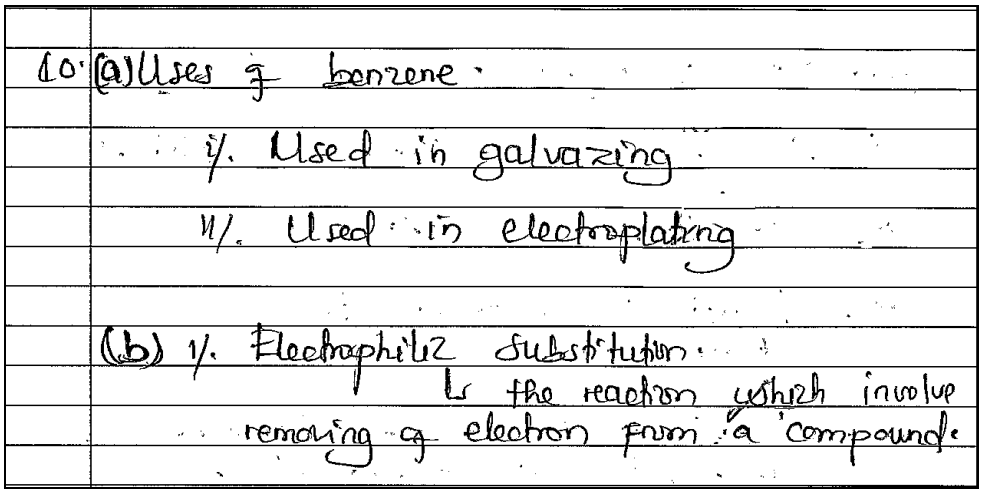
The analysis of responses showed that, majority of candidates who scored 0 to 1.5 marks had inadequate knowledge of benzene and its derivatives. For this reason, some of them provided correct applications of benzene in different context in part (a), but made no attempt in part (b), and vice-versa. On writing the application of benzene, they gave irrelevant responses such as *manufacture of clothes, in plant manures and in manufacture of tiles*. Such candidates failed to indicate that benzene is applied *as organic solvent; used in pharmaceutical industry as well as in manufacturing of dyes and plastics*.

In part (b)(i), there were at least three ways in which the candidates defined electrophilic substitution incorrectly. The first group defined electrophilic substitution as a *substitution in which electrons are removed from a compound.* The second group defined it as *the type of reaction in which the leaving electrophile is replaced by a nucleophile*. The third group wrote: *group of atoms (electrophiles) is taken away without replacement.*

The expected definition of electrophilic substitution was *type of substitution reaction where an atom or group of atoms leaves the compound and is replaced by another electrophile.* Moreover, in part (b (ii), candidates failed to provide relevant reaction equation on how aromatic compounds undergo electrophilic substitution reaction.

The irrelevant responses provided by candidates were possibly due to low knowledge on the concept of benzene, its derivatives and organic chemistry in general. Extract 10.1 is an example of incorrect responses.

Extract 10.1


10. (a) Uses of benzene.
i. Used in galvazing
ii. Used in electroplating
(b) i. Electrophilic substitution.
↳ the reaction which involve removing of electron from a compound.

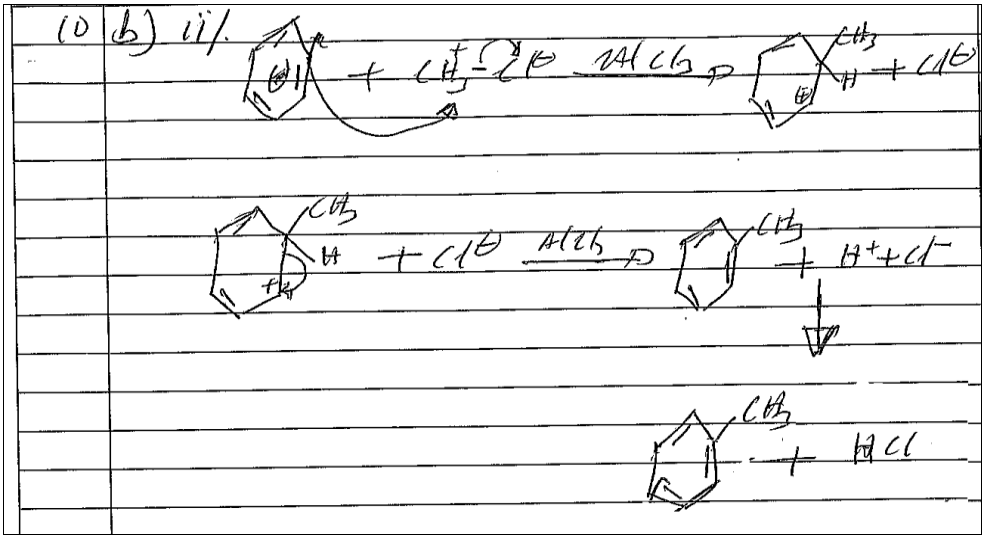
Extract 10.1: An example of a candidate who gave incorrect responses in both parts (a) and (b). The responses in (a) can be associated with the uses of *electrolysis*, and (b), the definition given is of *ionization* of metals.

On the other hand, those who scored 2 to 2.5 marks gave partial responses. For instance, some of them gave the correct definition in part (b), with slight mistakes in both parts (i) and (ii). Others attempted well in one part and failed in another. However, the majority attempted well in part (b), by providing relevant definition of electrophilic substitution reaction and application of benzene derivatives, but failed to describe uses of benzene as required in part (a).

Furthermore, the analysis showed that those who scored 3 to 4 marks demonstrated sufficient knowledge of the subject matter that enabled them to provide relevant responses in both parts of the question. In part (a), for instance, some of the candidates managed to describe correct application of

benzene in different areas such as in *hospitals, in drug manufacturing, in the manufacture of important derivatives of benzene like nitrobenzene or methyl benzene.* In part (b)(i), most candidates provided correct definition of electrophilic substitution reaction as *the one whereby an atom or group of atoms leaves the compound and is replaced by an electrophile*. In part (b) (ii), they showed accurately how benzene can undergo electrophilic substitution reaction by using either equation reaction for A*lkylation of benzene, Acylation of benzene, Sulphonation reaction of benzene* or *Nitration reaction of benzene.* Extract 10.2 shows a part of correct responses.

Extract 10.2



Extract 10.2 represents a part of a correct response given by a candidate who managed to answer well both parts (a) and (b). In part (b), the candidate used acylation and alkylation process.

2.11 Question 11: Chemical Kinetics, Energetic and Equilibrium

The question was as follows:

The experiment to investigate the factors affecting rate of chemical reaction was conducted by reacting 0.02M potassium permanganate solution and 0.05M oxalic acid in dilute sulphuric acid. The experiment was repeated four times using different temperatures and the data were collected as shown in Table 1.

Table 1: Experimental results

Temperature		$\frac{1}{T}$K	Time (sec)	$\frac{1}{t}$	$\log\frac{1}{t}$
C^0	K				
50	323	$3.10x10^{-3}$	50.2	0.019	-1.7212
60	333	$3.00x10^{-3}$	26.00	0.038	-1.4202
70	343	$2.92 x10^{-3}$	12.00	0.083	-1.0809
80	353	$2.82 x10^{-3}$	5.00	0.200	-0.6989

Questions

(a) What is the role of sulphuric acid in this experiment?

(b) Of the factors affecting rate of chemical reaction, which one was being investigated? Give a reason.

(c) Write
(i) the half reaction for the oxidized and reduced species.
(ii) overall reaction equation.

(d) Use equation: $\log\frac{1}{t} = \log A - \frac{Ea}{2.3RT}\frac{1}{T}$ in the form of y = mx + c to calculate the activation energy. Take the value of m = -9.112×10^3.

Statistics show that, the question was opted by 88 (59.9%) candidates, of whom 38.6 percent scored 0 to 5.5 marks, 38.7 percent scored 6 to 10 marks, and only 22.7 percent scored 10.5 to 15 marks. The overall performance of the question was good since the majority (77.3%) scored within the average range. Figure 11shows a summary of the scores of question 11.

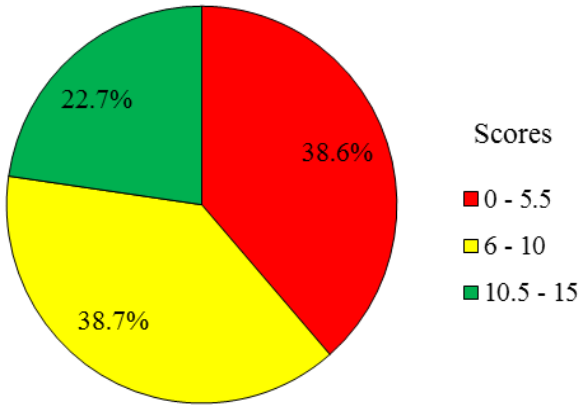
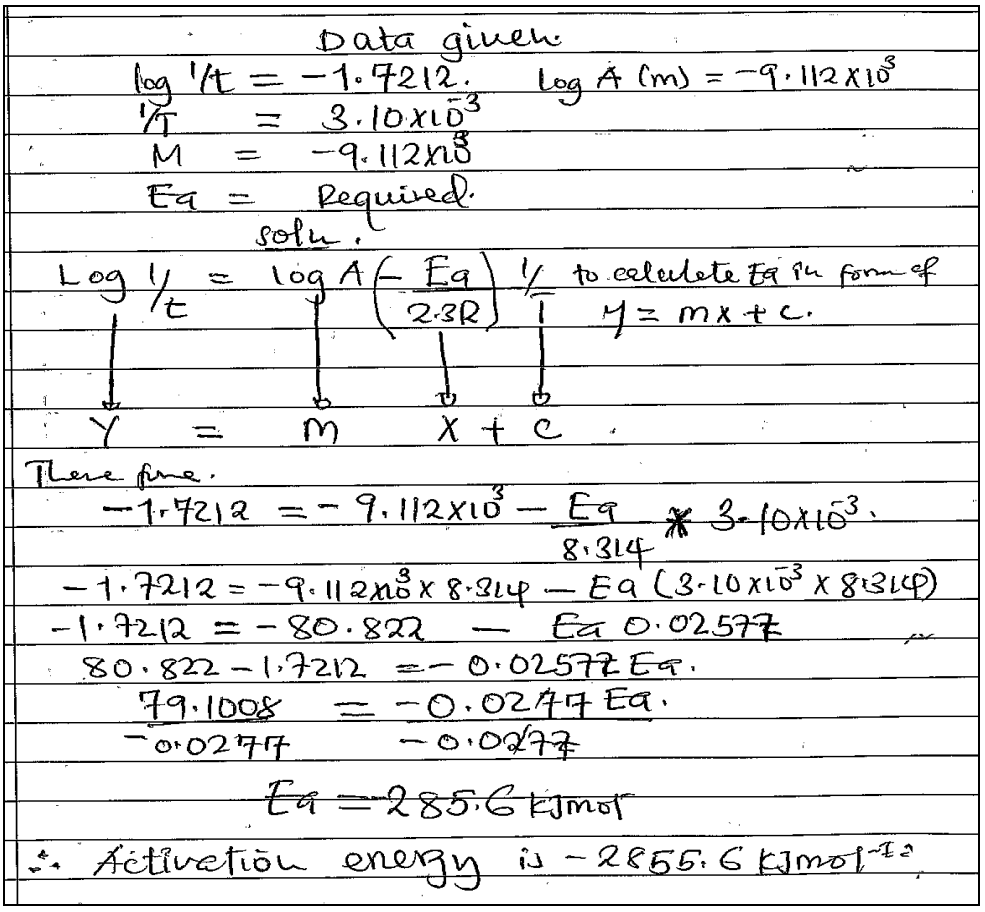


Figure 11: *Distribution of candidates' scores in question 11*

The analysis of candidates showed that, some of those who scored below 6 marks were able to attempt the question partially by providing both correct and incorrect points. Others answered parts of the question and left other parts unanswered. For instance, one candidate in part (a) described the role played by sulphuric acid in the experiment as *to provide acidic condition* in the solution but in part (b), the candidate wrongly mentioned pressure as the factor affecting rate of reaction, instead of mentioning temperature since the latter was the one which was being manipulated. In part (c), the candidate managed to write correctly oxidation and reduction reaction but failed to balance overall reaction equation. In part (d), the candidate failed to apply a relevant formula $\log \frac{1}{t} = \log A - \frac{Ea}{2.3RT}$ and other information to calculate activation energy. Extract 11.1 is given as an example of incorrect responses.

Extract 11.1



Extract 11.1 is sample of a wrong procedure shown by the candidate in calculating activation energy, hence wrong final answer.

Candidates who scored average marks of 6 to 10 had several strengths and weaknesses in answering the question as follows: In part (a), majority of candidates managed to write the role of H_2SO_4 in the experiment, which is to provide acidic condition in the solution for the reaction to take place. Others wrote to *absorb water or to eliminate water during the experiment in the reaction.* Few others wrote: *"to speed up the rate of chemical reaction, to raise the temperature.* The two latter responses are incorrect.

In part (b), the majority of candidates who attempted this question indicated temperature as a required factor that affects the rate of chemical reaction with its justification while few of them mentioned either pressure or

volume. This implies that majority of candidates are knowledgeable on the rate of chemical reaction.

The analysis further indicates that in part (c), some candidates mixed up half reaction for reduction and oxidation. Others managed to write correct half reaction for reduction and oxidation but not the overall reaction equation.

Lastly, in part (d), some of the candidates managed to calculate the required activation energy but skipped some steps, while others failed to get the exactly value of required activation energy despite that the procedures were well adhered to. The latter candidates lacked knowledge of simple arithmetic skills in calculating activation energy.

In the last category, candidates who scored 10.5 to 15 marks managed to provide correct responses in all parts of the question, though with few flaws. They were able to tell the role of sulphuric acid correctly in part (a), and showed correctly chemical reaction. In part (b) they pointed out the factor that affects the rate of chemical reaction. In part (c), candidates managed to write a balanced redox reaction correctly and in part (d), they managed to calculate the required activation energy by following all the necessary procedures. However, their marks varied from 10.5 to 15 depending on the strengths and accurateness on their answers as some candidates did not get all the items correctly. Extract 11.2 shows a sample of correct responses.

Extract 11.2

11. (a) Sulphuric acid used to provide the acid condition for the catalysit to work best.

(b) The factor that was investigated is Temperature.

reason: Because the exprriment al results provide temperature as the only factor that affect the rate of chemical reaction, while other factors like catalysit, concentration and pressure were ignored.

(c)

(i) Half reaction for reduced species

$MnO_4^- \longrightarrow Mn^{2+} +$

$MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$

$MnO_4^- + 8H^+ \longrightarrow Mn^{2+} + 4H_2O$

$\therefore MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O.$

Half reaction for oxidized specie

$C_2O_4^{2-} \longrightarrow CO_2$

$C_2O_4^{2-} \longrightarrow 2CO_2$

$\therefore C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-$

(ii) Overall reaction equation

$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-$

Extract 11.2 is a part of relevant answers provided by one of the candidates.

2.12 Question 12: Organic Chemistry

Question 12 had three parts, (a) - (c). The task of the question was as follows;

> Compound A, C_4H_8, and compound B, C_5H_{10}, give C_4H_{10} and C_5H_{12} respectively upon hydrogenation. When compound A reacts with water under acidic medium, it gives compound C, a primary alcohol. When C_5H_{12} reacts with nitric acid under heat, it gives D, $C_5H_{11}NO_2$.
>
> (a) Write the chemical reactions for the formation of A, B, C and D.
>
> (b) Name the structures of A, B, C and D.
>
> (c) Give a maximum of five isomers for each of compounds A, B and C.

According to statistics, the question was attempted by 94 (63.9%) candidates, out of whom 39.3 percent scored moderately from 6 to 10 marks and 36.2 percent scored the highest range from 10.5 to 15 marks; and lastly 24.5 percent scored 0 to 5.5 marks. Figure 12 shows the summary of how the scores were distributed.

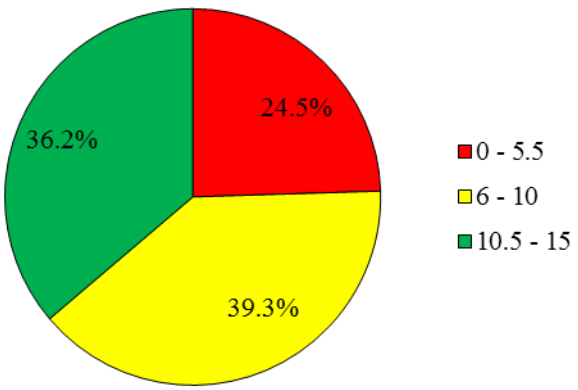
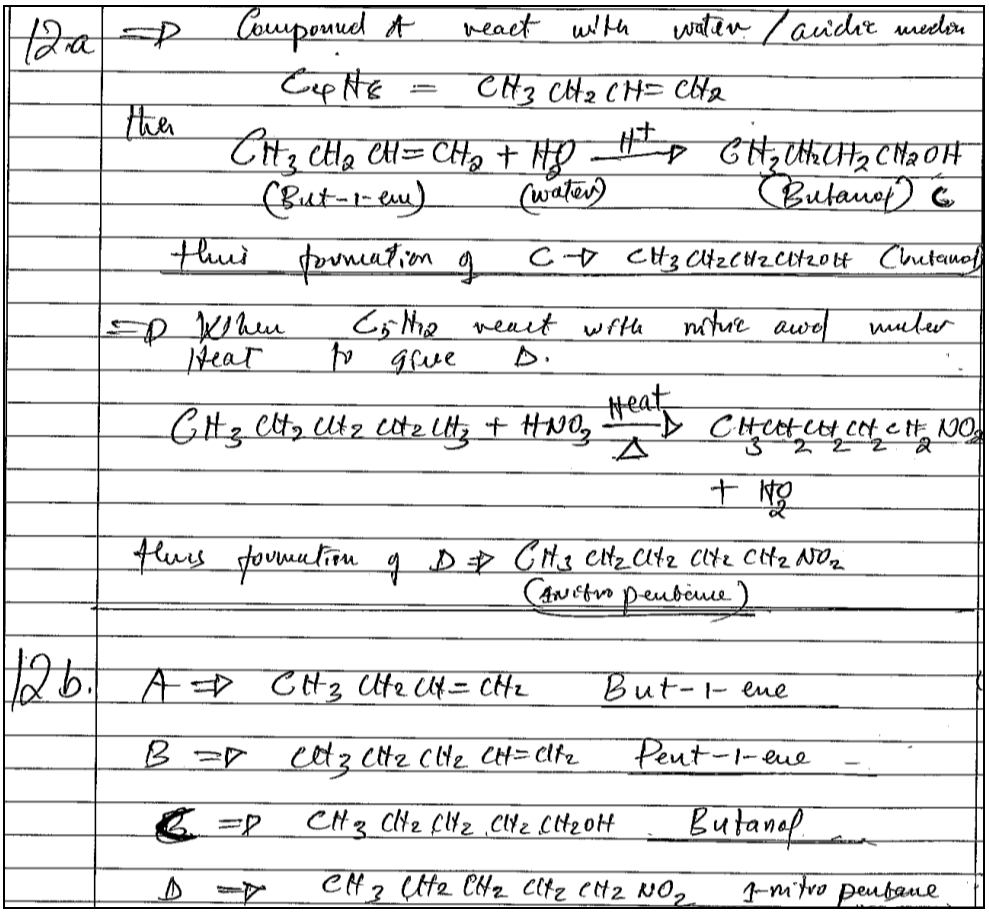


Figure 12: *Distribution of candidates' scores in question 12*

The analysis of the responses made from the candidates responses show that the candidates who scored 10.5 to 15 marks managed to attempt accurately all parts of the question. For example one candidate specified the compounds in part (a) as: *A ($CH_3CH_2CH=CH_2$), B ($CH_3CH_2CH_2CH=CH_2$), C ($CH_3CH_2CHCH_2OH$) and D ($CH_3CH_2CH_2CHCH_2NO_2$).* In part (b), the candidate named the structures correctly and in part (c), wrote the isomers

of A as *Butene, 2-butene, Cis-butene, Trans-butane and cyclobutene*. The observed good performance was influenced by the sufficient knowledge on the aliphatic compounds in organic chemistry. The variation of their scores from 10.5 to 15 was based on the strengths and clarity of their respective work. Extract 12 is a sample of correct responses.

Extract 12



Extract 12 is example of relevant response given by a candidate in all parts of the question.

Further analysis revealed that candidates who scored moderate marks, that is, 6 to 10 managed to provide only few responses to some parts of the question. In part (b) for instance, some of the candidates managed to write the structures of A to D but failed to name them; and in part (c), they failed to give the required isomers of each compound. Those candidates lacked knowledge of nomenclature and chemical reactions of organic compounds.

In the other observation, the analysis indicated that, the candidates who scored 0 to 5.5 marks failed to understand the demands of the question, hence most of them mixed up concepts. For example, in part (a) most of them wrote chemical reactions of isomers of compounds A, B, C and D, instead of writing the equation for the formation of those compounds.

2.13 Question 13: Electrochemistry

The question was divided into two parts, (a) and (b). In part (a), candidates were required to give three points to differentiate between strong and weak electrolyte. In part (b), they had to determine the concentration of aqueous ammonia as a result of the reaction with hydrochloric acid by using the given volumes.

Statistics show a moderate performance since 69.9% of those who opted for the question scored 6 to 10 marks. The data also shows that 24.8% scored 0 to 5.5 marks and a few candidates, (5.3%) scored 10.5 to 15 marks. Figure 13 illustrates distribution of such scores.

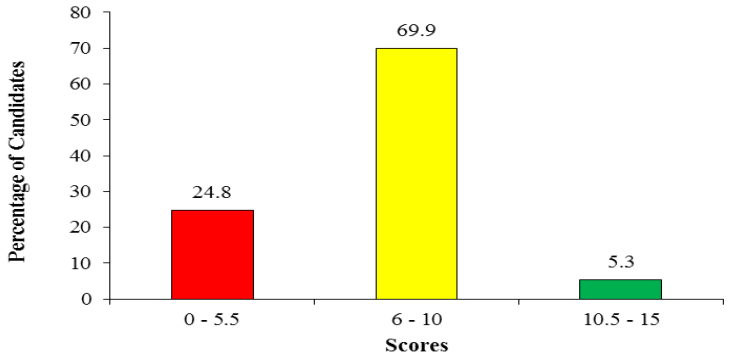


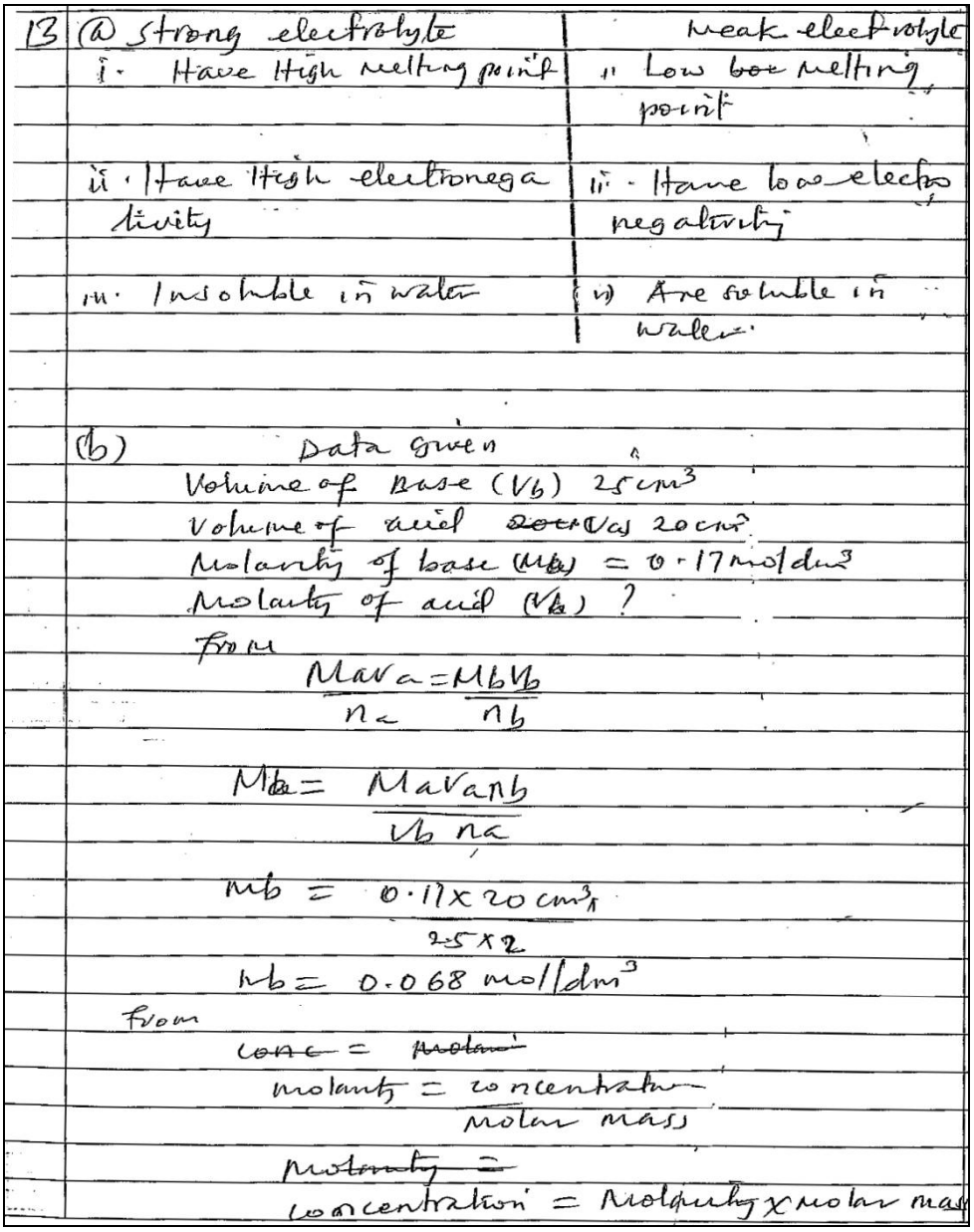
Figure 13: *Distribution of candidates' scores in question 13.*

An in-depth analysis showed that, those who scored moderate marks of 6 to 10 demonstrated some strengths and weaknesses in their responses. For instance the majority of them managed to differentiate strong electrolyte from weak electrolyte as follow: *strong electrolyte dissociates completely while weak electrolyte dissociates partially to form ions, secondly, strong electrolyte is a good conductor of electricity while weak electrolyte is a bad conductor.* In part (b), most candidates attempted well one among the two items (i) or (ii). In part (b) (i), for instance, some candidates managed to calculate the required concentration of the aqueous ammonia by following

all the required procedures and obtained the correct answer. In part (b) (ii), some of the candidates failed to utilize the given data to calculate the required pH of the solution at equivalent point.

It was further established that, the candidates who scored 0 to 5.5 marks either failed to answer the whole question or part of it. Those who got a 0 mark gave incorrect answers in all parts of the question while those who got up to 5.5 marks attempted either partially or wrote few responses contrary to the requirement of the question. In part (a), for instance, some candidates wrote one or two out of three required distinctions between strong electrolyte and weak electrolyte in which majority put it correctly that, *strong electrolyte dissociates completely in solvent while weak electrolyte dissociates partially*. Very few candidates added the second difference as *strong electrolyte has high conductivity* while *weak electrolyte has low conductivity*. In part (b), most candidates managed to attempt item (i) by calculating the required concentration of the aqueous ammonia of 0.12M. However, majority of them failed to attempt item (ii), suggesting that, they had insufficient knowledge of the content/concept of electrolysis. Extract 13 is a sample of the incorrect responses from one of the candidates.

Extract 13


13 (a) Strong electrolyte
i. Have High melting point
ii. Have High electronega tivity
iii. Insoluble in water

Weak electrolyte
i. Low boe melting point
ii. Have low electro negativity
iii. Are soluble in water.

(b) Data given
Volume of base (V_b) 25 cm^3
Volume of acid ~~Va~~ V_a 20 cm^3
Molarity of base (M_b) = 0.17 mol/dm^3
Molarity of acid (V_b) ?
From
$$\frac{M_a V_a}{n_a} = \frac{M_b V_b}{n_b}$$
$$M_b = \frac{M_a V_a n_b}{V_b n_a}$$
$$n_b = \frac{0.17 \times 20\ cm^3}{25 \times 2}$$
$$n_b = 0.068\ mol/dm^3$$
From
~~conc~~ = ~~molar~~
molarity = concentration / molar mass
~~molarity~~ =
concentration = Molarity x molar mas

Extract 13 is a part of incorrect responses in which a candidate made wrong distinction between strong and weak electrolytes and used inappropriate procedure to perform calculation.

Finally a few candidates (5.3%) who managed to score high marks at 10.5 to 15 were able to attempt accurately both parts of the question, as the majority managed to provide three distinctions between strong electrolyte

and weak electrolyte in part (a). Example of correct responses include: *strong electrolyte dissociates completely in solvent while weak electrolyte dissociates partially to form ions,* secondly, *strong electrolyte is a good conductor of electricity while weak electrolyte is a bad conductor,* and lastly, *strong electrolyte reacts fast while weak electrolyte reacts slowly.* In part (b), they could correctly work out for the required concentration of the aqueous ammonia, and the required pH of the solution at equivalent point as 0.12M and 6 respectively.

2.14 Question 14: Laboratory Management

The question instructed candidates to give short description on the six causes of danger in the chemistry laboratory. The statistical data revealed that, out of 142 (96.6%) who attempted the question, 69.7 percent got good scores of 10.5 to 15 marks, 28.2 percent got average scores of 6 to 10 marks and only insignificant figure, 3 (2.1%) got a score of 0 to 5.5 marks. In general, the performance was good since 97.9 percent scored above the average. The scores are shown in the Figure 14.

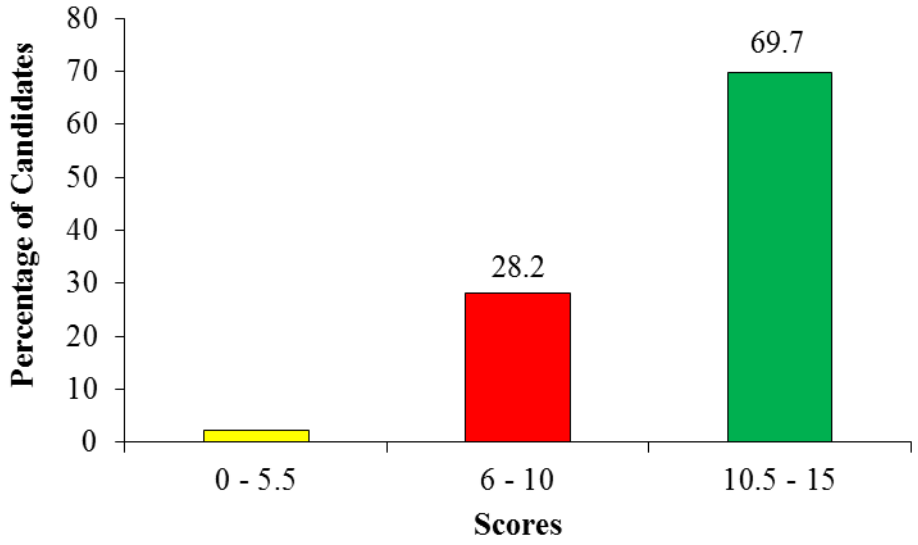
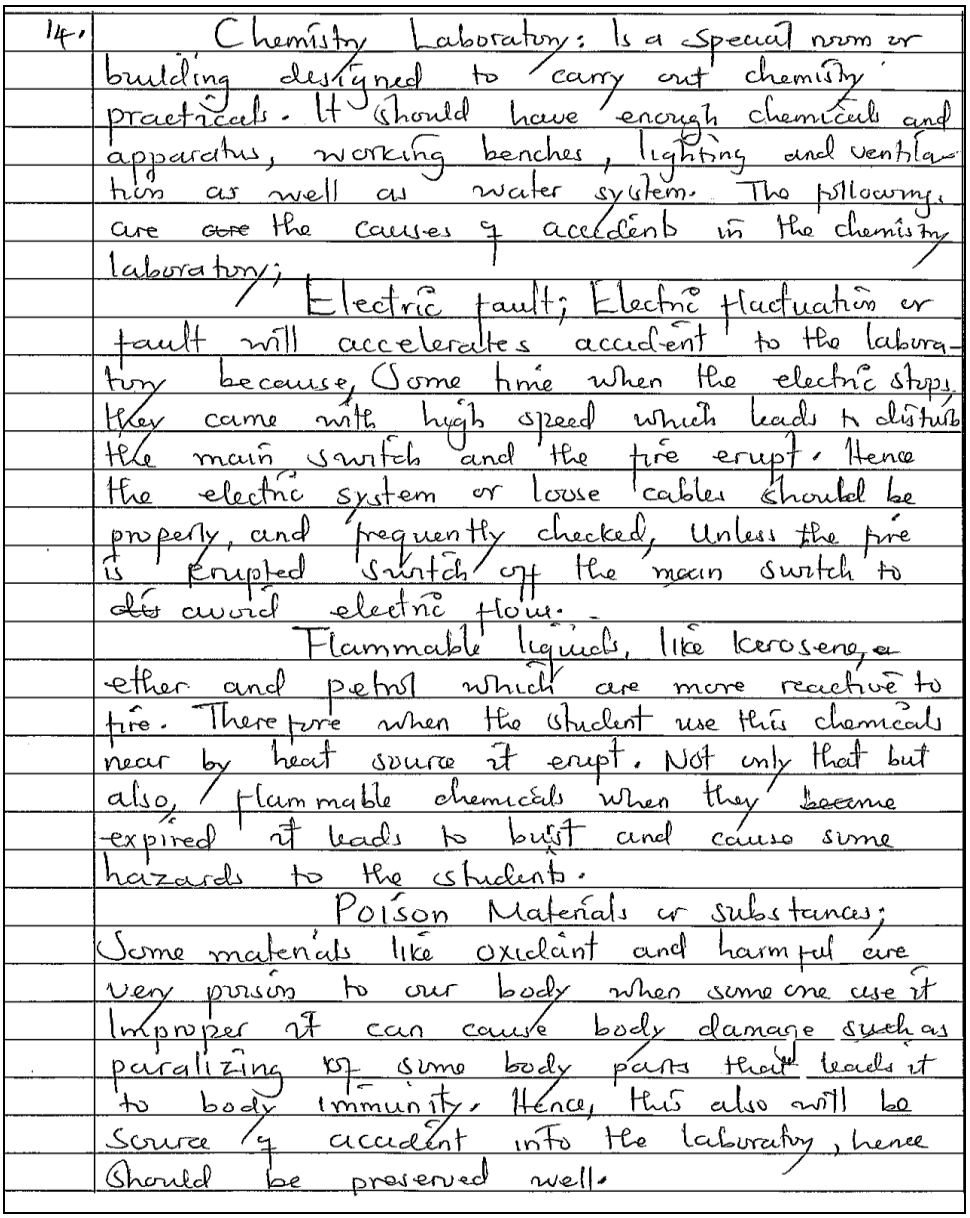


Figure 14: *Distribution of candidates' scores in question 14*

Results from the analysis of the candidates' responses reveal that those who scored 10.5 to 15 marks demonstrated high level of understanding of the subject matter. Examples of the correct responses given as the causes of danger in the laboratory are: *leakage of gas, electric faults, poor ventilation and lighting, use of unlabeled chemicals, flammable liquids and improper*

use and storage of mineral acids and bases like HCl, NaOH, H_2SO_4 and KOH. However, the variation of their scores was determined by clarity and strengths of descriptions provided. Extract 14.1 is an example of correct responses.

Extract 14.1



14. Chemistry Laboratory: Is a special room or building designed to carry out chemistry practicals. It should have enough chemicals and apparatus, working benches, lighting and ventilation as well as water system. The following are the causes of accidents in the chemistry laboratory;

Electric fault; Electric fluctuation or fault will accelerates accident to the laboratory because, some time when the electric stops, they came with high speed which leads to disturb the main switch and the fire erupt. Hence the electric system or loose cables should be properly, and frequently checked, Unless the fire is erupted switch off the main switch to avoid electric flow.

Flammable liquids, like kerosene, ether and petrol which are more reactive to fire. Therefore when the student use this chemicals near by heat source it erupt. Not only that but also, flammable chemicals when they became expired it leads to burst and cause some hazards to the students.

Poison Materials or substances; Some materials like oxidant and harmful are very prision to our body when some one use it Improper it can cause body damage such as paralizing of some body parts that leads it to body immunity. Hence, this also will be source of accident into the laboratory, hence should be preserved well.

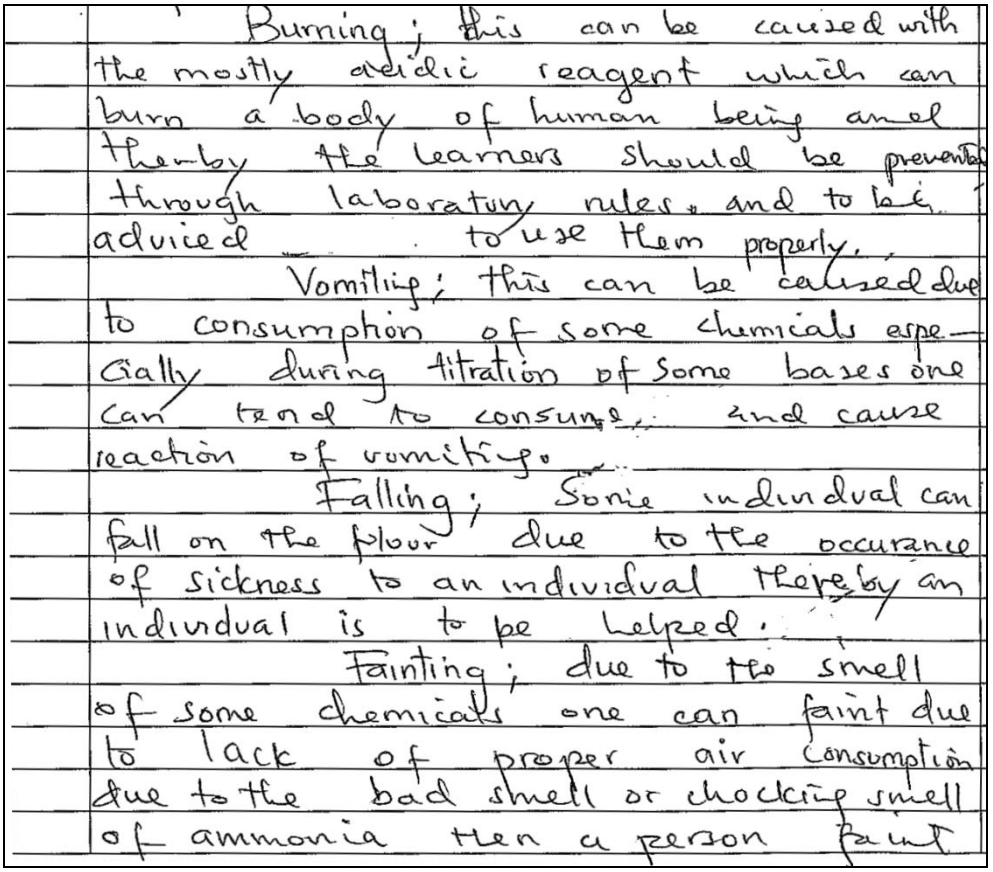
Extract 14.1 is an example of a response given by a candidate who, despite some grammatical errors, gave good description on the causes of danger in the chemistry laboratory.

On the other hand, candidates who scored average marks of 6 to 10 managed to describe few causes of danger in the chemistry laboratory and some of them mixed - up relevant and irrelevant points in the same answers. Example of relevant points are: *Gas leakage which is caused by damage of gas containers, electric faults due to poor wiring systems, poor ventilation and lighting due to presence of small windows and few bulbs.* The irrelevant responses described by most candidates were: *presence of concentrated acids and bases in laboratory, extraction of metals, and poor cooperation of students during the experiment and improper use of stop watch.* An example of a response given by a candidate who wrote the mixed responses, starting with relevant responses was: *the use of unlabeled chemicals due negligence of chemistry laboratory rules, poor ventilation, lighting due to presence of small windows and few bulbs and electric faults due to poor wiring systems extraction of metals, improper use of stop watch* and *poor cooperation of students during the experiments.* Out of the required six causes, the first three points were relevant while the last three points were irrelevant. This might be caused by both lack of understanding the demand of the question as well as inadequate knowledge on laboratory management.

Of the least group comprising of 3 (2.1%) candidates who scored from 0 to 5.5 marks, some of them failed to understand the requirement of the question hence described chemistry laboratory rules instead of explaining the possible causes of danger in the laboratory. Extract 14.2 is an example of wrong responses.

Extract 14.2

14 laboratory is a special building designed for the learners to perform experiments it is Contains with equipments and all systems and chemicals required. For the good laboratory it must have doors opening outwards, it must have large window, should have fume chamber and also should have the system supply Such as electricity supply, gas system supply. thereby it becomes very dangerous when the accidents happens in the room and the mainly accidents which can appear are as follows:


Burning; this can be caused with the mostly acidic reagent which can burn a body of human being and thereby the learners should be prevented through laboratory rules and to be advised to use them properly.

Vomiting; this can be caused due to consumption of some chemicals especially during titration of some bases one can tend to consume and cause reaction of vomiting.

Falling; Some individual can fall on the flour due to the occurance of sickness to an individual therefore an individual is to be helped.

Fainting; due to the smell of some chemicals one can faint due to lack of proper air consumption due to the bad smell or shocking smell of ammonia then a person faint

Extract 14.2 is a sample incorrect responses in which the candidate described the effects of the potential dangers in the chemistry laboratory instead of writing on the causes of danger in the laboratory.

2.15 Question 15: Principles of Teaching and Learning Chemistry

This question required the candidates to give four reasons, why inquiry is the best method of teaching and learning chemistry. According to statistics, the question was answered by 113 (76.9%) candidates, out of which, 53.9 percent scored 6 to 10 marks, 38.1 percent scored 10.5 to 15 marks, and only 8 percent scored 0 to 5.5 marks. The performance was good as the majority of the candidates (92.0%) passed the question. The distribution of scores is summarized in Figure 15.

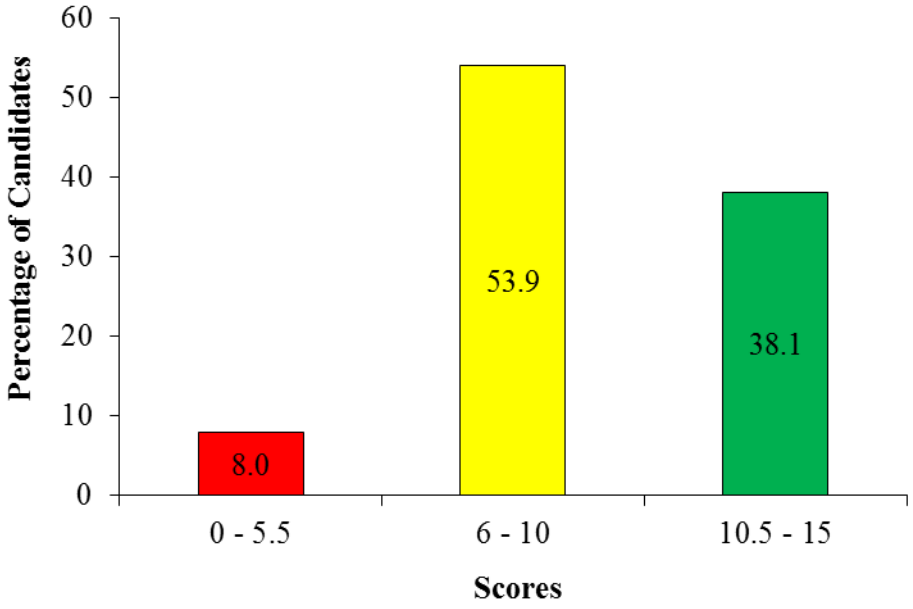
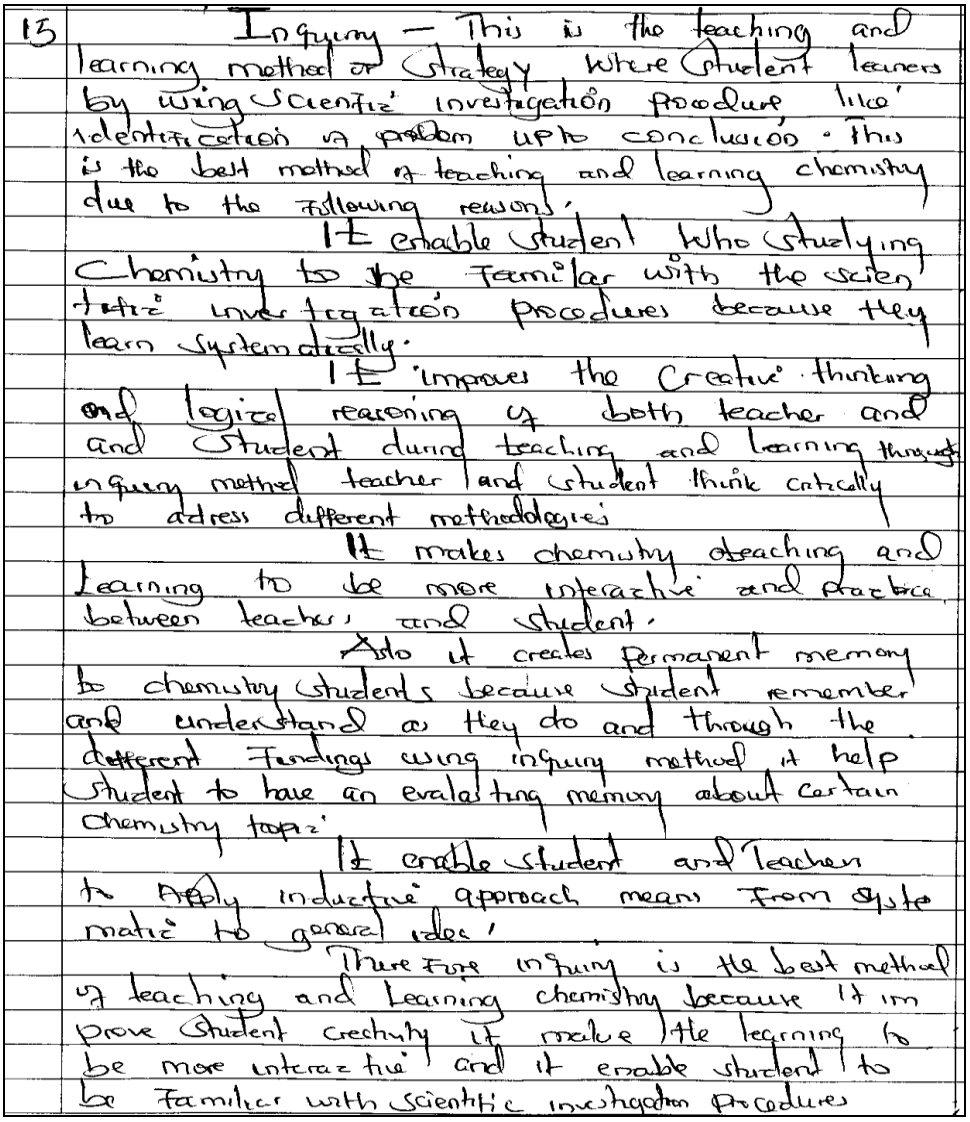


Figure 15: *Distribution of candidates' scores in question 15.*

The analysis of responses showed that most of who scored 6 to 10 marks provided partial responses relative to the demand of the question. The observed average performance was emanated from few points given in their answers, poor justification and they mixed up relevant and irrelevant points.

The candidates who scored 10.5 to 15 showed sufficient knowledge on the application of principles of teaching and learning of chemistry. They provided relevant and good arguments that justify the use of inquiry method in the teaching and learning of chemistry. For example one candidate pointed out: *In identification of problems like the effects of noise pollution in chemistry practical; experimental oriented as it focuses on testing the validity of the hypothesis in chemistry, it involves observation and data collection; and lastly analysis and interpretation of collected data.* Such correct responses show that these candidates were competent and conversant with the application of principles involved in the teaching and learning of chemistry. An example of correct responses is presented in the extract 15.1

Extract 15.1


13 Inquiry — This is the teaching and learning method or strategy where student learners by using scientific investigation procedure like identification of problem upto conclusion. This is the best method of teaching and learning chemistry due to the following reasons.

It enable student who studying Chemistry to be familiar with the scientific investigation procedures because they learn systematically.

It improves the creative thinking and logical reasoning of both teacher and and student during teaching and learning through inquiry method teacher and student think critically to address different methodologies

It makes chemistry teaching and learning to be more interactive and practical between teacher and student.

Also it creates permanent memory to chemistry students because student remember and understand as they do and through the different findings using inquiry method it help student to have an evalasting memory about certain chemistry topic.

It enable student and teacher to apply inductive approach means from systematic to general idea.

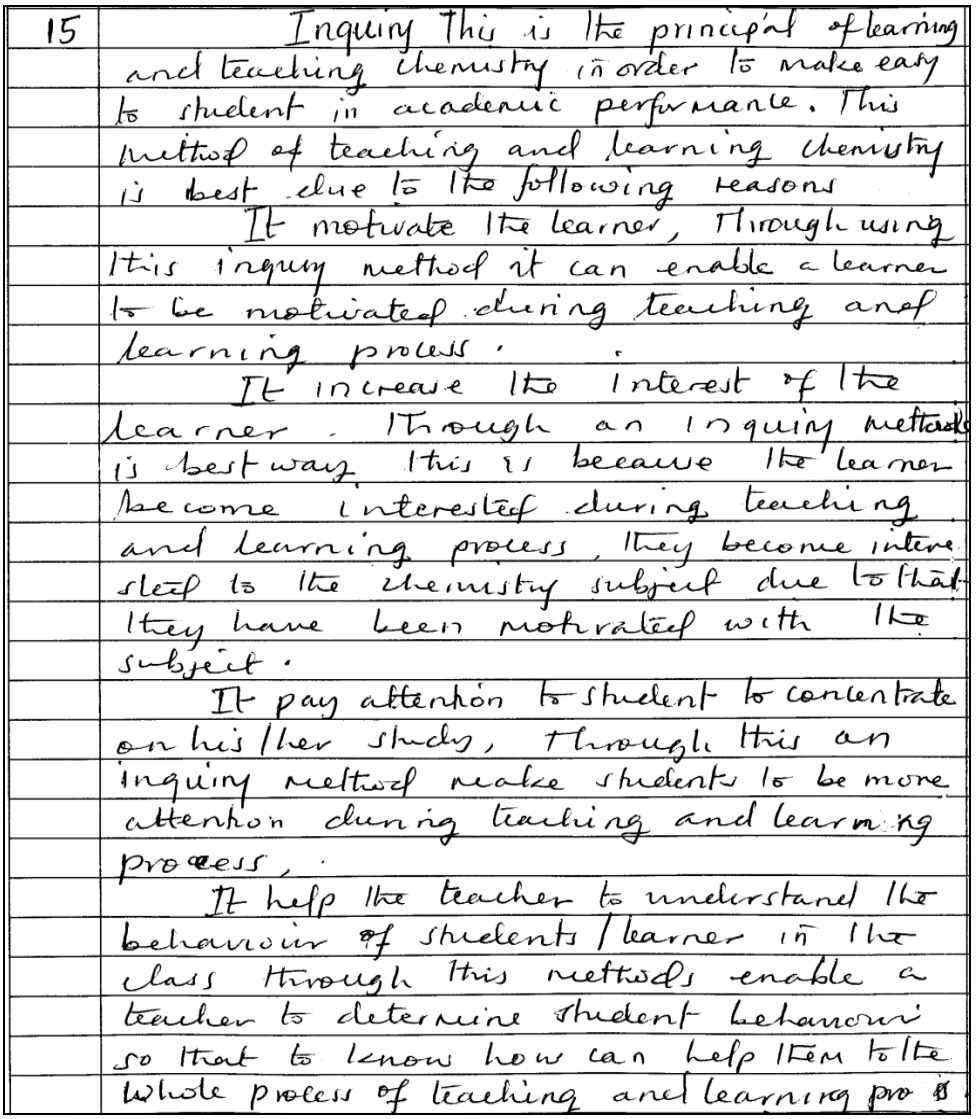
Therefore inquiry is the best method of teaching and learning chemistry because it improve student creativity it make the learning to be more interactive and it enable student to be familiar with scientific investigation procedures

Extract 15.1 is an example of relevant responses given by one of the candidates.

In addition to that, the 8 percent of the candidates whose scores were 0 to 5.5 marks had insufficient knowledge on the application of principle of teaching and learning chemistry. Their scores were obtained mainly from the introduction as one of candidate wrote: *chemistry teaching involves varieties of teaching methods including the inquiry method.* Then, the candidate defined inquiry method *as the one which involves probing questions that enable learners to discover knowledge by themselves*.

However, the following were irrelevant arguments that were given by the candidate to justify the relevance of inquiry method in teaching of chemistry: *it increases intrinsic motivation of learners to study; fosters cooperation and togetherness, it saves time and* lastly *it helps in retention of the learnt content.* Extract 15.2 is an example of wrong responses.

Extract 15.2


15

Inquiry This is the principal of learning and teaching chemistry in order to make easy to student in academic performance. This method of teaching and learning chemistry is best due to the following reasons

It motivate the learner, Through using this inquiry method it can enable a learner to be motivated during teaching and learning process.

It increase the interest of the learner. Through an inquiry methods is best way this is because the learner become interested during teaching and learning process, they become interested to the chemistry subject due to that they have been motivated with the subject.

It pay attention to student to concentrate on his/her study, Through this an inquiry method make students to be more attention during teaching and learning process,

It help the teacher to understand the behaviour of students/learner in the class through this methods enable a teacher to determine student behaviour so that to know how can help them to the whole process of teaching and learning pro

Extract 15.2 is an example of incorrect responses given by one of the candidates. The candidate wrote about advantages of interactive teaching and learning methods in general while the question was specifically for inquiry.

2.16 Question 16 Planning and Preparation for Teaching

The question asked the candidates to elaborate five programs in computer which are useful in teaching and learning chemistry. The statistical data presented a good performance, in which, out of 34 (23.1%) candidates who attempted the question, 47.1 % scored 6 to 10 marks, 38.2% scored 10.5 to 15 marks and 14.7% scored 0 to 5.5 marks. This implies that the question was well attempted as majority (85.3%) passed it. Figure 16 gives a summary of the scores in question 16.

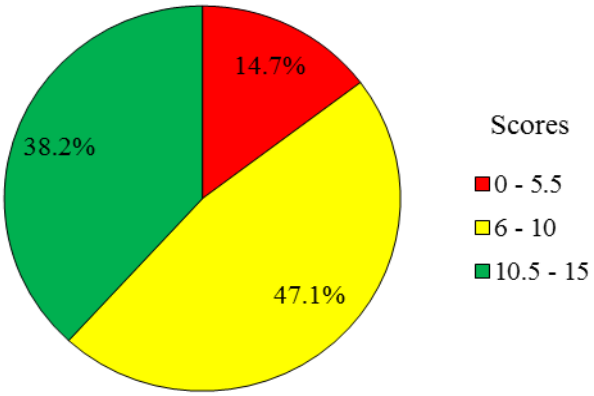


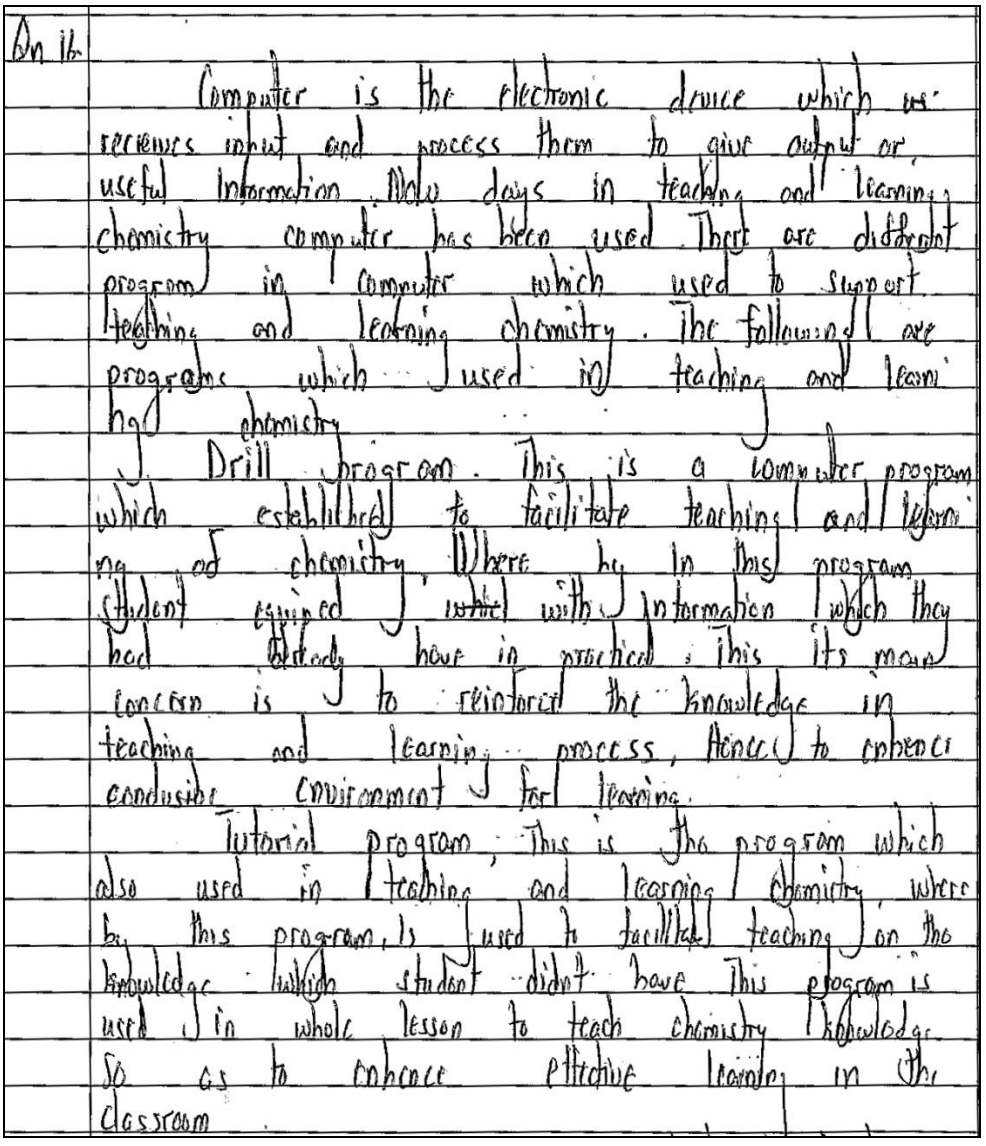
Figure 16: *Distribution of candidates' scores in question 16.*

The analysis of candidates' responses showed that some of those who scored 6 to 10 marks mixed up relevant and irrelevant points in their answers. For example, one candidate wrote: *computer database used in preparation of identity cards and storage purposes, search engines as used in searching of different materials like www.google.com, animation and simulation as mostly applied in demonstrating abstract concepts; games as it motivate and reinforce interest in learning, and Microsoft word as it contains application software like Microsoft word used in teaching and learning of chemistry*. The first two answers are irrelevant while the last three are relevant responses. This misconception might be caused by inadequate knowledge on open operating systems and application software that are suitable for teaching of chemistry.

Further, the analysis results revealed that, those who scored 10.5 to 15 marks demonstrated high level of understanding of the subject matter. For example one candidate delivered the following relevant responses: *drill*

used in learning chemistry concepts and problems solving skills; Simulation - replicates complex real life situation; Tutorial - replaces bulk of materials presented in the textbooks; games which provide conducive learning environment and microcomputer base laboratory which is used to overcome the barriers of learning chemistry. The observed performance was reinforced by the competences in Information and Communication Technology, ICT and its application in chemistry teaching and learning process. Extract 16.1 is an example of correct responses given by one candidate.

Extract 16.1



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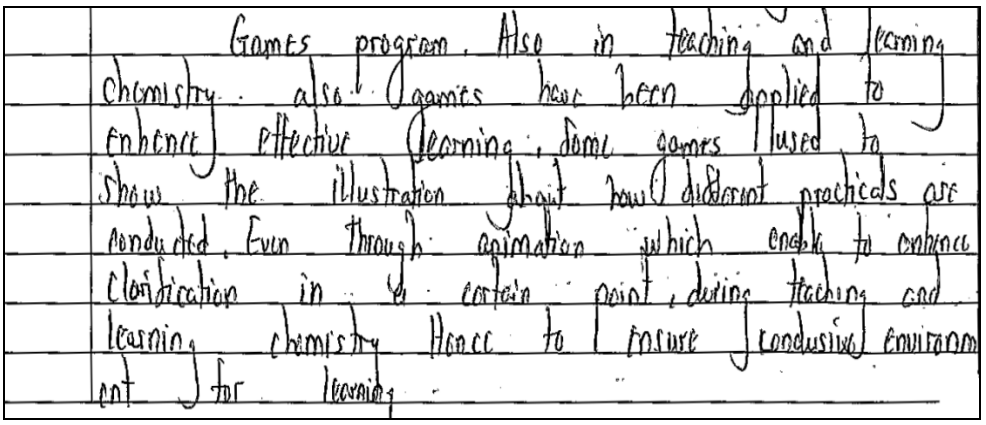
Computer is the electronic device which us receives input and process them to give output or useful information. Now days in teaching and learning chemistry computer has been used. There are different program in computer which used to support teaching and learning chemistry. The following are programe which used in teaching and learning chemistry

1. Drill program. This is a computer program which established to facilitate teaching and learning of chemistry. Where by in this program student equiped with information which they had already have in practical. This its main concern is to reinforce the knowledge in teaching and learning process, Hence to enhance conducive environment for learning.

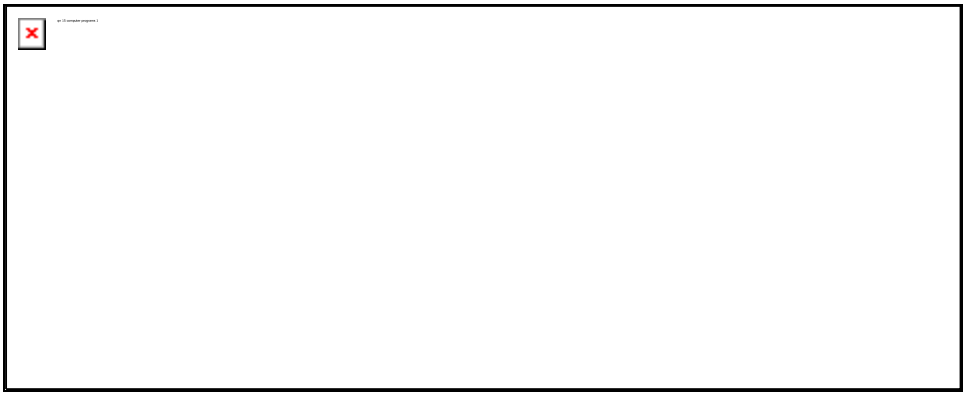
Tutorial program. This is the program which also used in teaching and learning chemistry, where by this program, is used to facilitate teaching on the knowledge which student didn't have. This program is used in whole lesson to teach chemistry knowledge. So as to enhance effective learning in the classroom.

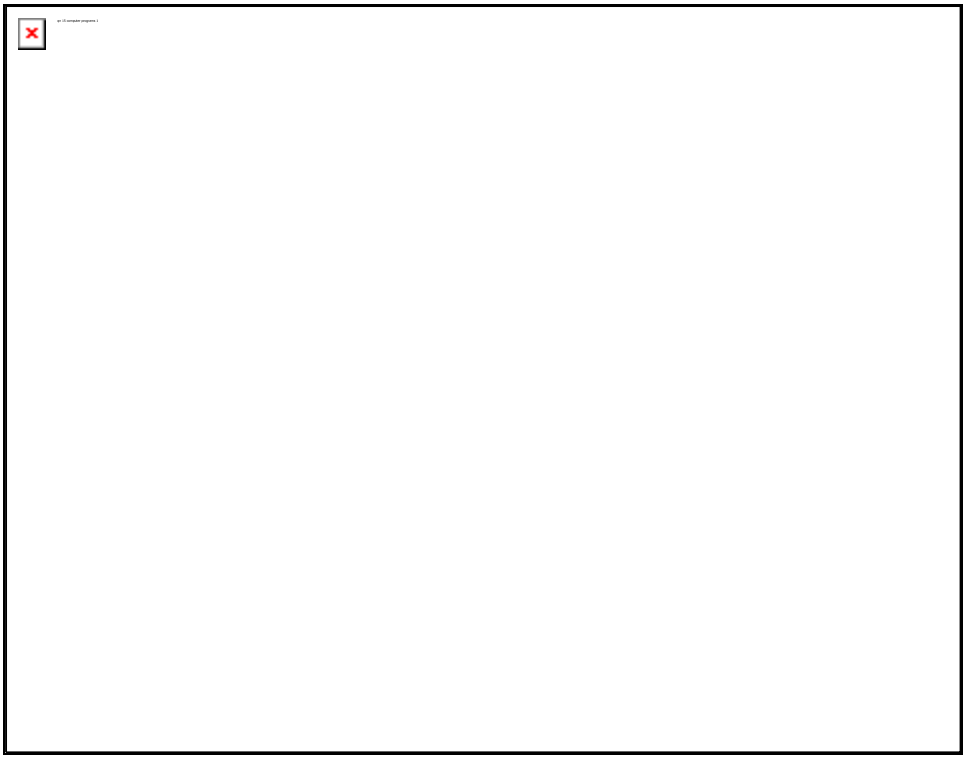


Extract 16.1: is sample of a relevant response given by a candidate. The candidate mentioned programs like Drill, tutorial, games, simulation and microcomputer base laboratory.

In the last category, candidates who scored 0 to 5.5 marks failed to elaborate the required computer programs that can be used in teaching and learning of chemistry. Most of them gave correct and incorrect responses but without elaboration. For example, one of the candidates wrote: *multimedia, Mozilla fire fox, internet browsers, games, simulation and games.* The first three points are relevant and the last three are irrelevant. Others named correct program but gave wrong description. For example, one named *"Microsoft word"* but gave description related to micro-soft power point. Moreover, some of them had misconception which led them to describe uses of computer in general like *searching chemistry materials.* The observed responses signified that, some candidates lacked enough knowledge on the topic and generally had no idea on the ICT. Extract 16.2: is an example of a candidate's incorrect response.

Extract 16.2





Extract 16.2 is an example of a response from a candidate who described the uses of computer in general like in storage of students' records instead of computer programs that are useful in teaching and learning chemistry.

3.0 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH TOPIC

The Chemistry examination had a total of 16 questions extracted from 11 chemistry topics. The lists of the topics were as follows; *Principles of Teaching and learning Chemistry, Planning and Preparation for Teaching, Laboratory Management, Assessment in Chemistry, Electrochemistry, General Chemistry, Chemistry Curriculum Materials and Organic Chemistry.* Others were *Chemical Kinetics Energetics and Equilibrium, Environmental Chemistry* and *Transition Metals.*

The analysis of statistical data indicated that, seven topics had high level of performance; three topics had average performance while only one topic was poorly performed. The topics that were well attempted are: *Principles of Teaching and Learning Chemistry* (94.6%), *Planning and Preparation for Teaching* (91.3%), *Laboratory Management* (82.3%), *Assessment in Chemistry* (82.3%), *General Chemistry*,(82.3%), *Electrochemistry (*75.2%) and *Chemistry Curriculum Materials (73.5%).*

The topics that showed average level of performance were *Organic Chemistry* (62%), *Chemical Kinetics, Energetics and Equilibrium* (61.4%) and *Environmental Chemistry* (45.5%). Only *General Chemistry* was poorly performed at 38.9 percent. The summary of the average performance of each topic is shown in the **Appendix**.

4.0 CONCLUSION

The candidates' general performance in Chemistry subject was good. This is demonstrated by both statistics and responses. The analysis shows that in most questions, candidates performed well by responding well as per question demand. This indicates that, they had good mastery of the content. Despite the good performance on some candidates, others got moderate performance and very few at poor performance level.

5.0 RECOMMENDATIONS

Based on the observation made through the Candidates' Items Response Analysis , the following recommendations are given in order to improve the performance of prospective candidates in this subject:

(a) The teaching and learning of all chemistry topics should be taught by using interactive teaching and learning methods. This will enable learners to reinforce engagement in doing various chemistry tasks. The engagement in such activities will enhance learners' critical thinking, discovery and innovation.

(b) Candidates should be guided on how to answer examination questions so as to improve their competences in identification of the technical terms based on the demand of the questions.

(c) Practical activities and academic visits should be encouraged in topics like *Environmental Chemistry* in order to equip candidates with necessary skills and competences on different chemistry concepts like related field or industrial application of Chemistry.

APPENDIX

ANALYSIS OF CANDIDATES' PERFORMANCE PER TOPIC

S/n	Topic	Question Number	The % of Candidates who Scored 40 Percent or Above	Average of % score per Topic	Remarks
1	Principles of Teaching and Learning Chemistry	1	97.3	94.6	Good
		15	92		
2	Planning and Preparation for Teaching	7	97.3	91.3	Good
		16	85.3		
3	Laboratory Management	14	97.9	82.3	Good
		6	66.7		
4	Assessment in Chemistry	8	82.3	82.3	Good
5	Electrochemistry	13	75.2	75.2	Good
6	Chemistry Curriculum Materials	3	73.5	73.5	Good
7	General Chemistry	4	70.2	70.2	Good
8	Organic Chemistry	12	75.5	62	Average
		10	48.5		
9	Chemical Kinetics, Energetics and equilibrium	11	61.4	61.4	Average
10	Environmental Chemistry	9	50.7	45.5	Average
		5	34.2		
11	Transition Metals	2	38.9	38.9	Poor