THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEMS RESPONSE ANALYSIS REPORT ON THE CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (CSEE 2023)

CIVIL ENGINEERING SURVEYING

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073 CIVIL ENGINEERING SURVEYING

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FOREWORD

This report presents Candidates' Items Response Analysis (CIRA) on Secondary Education Examination in the subject of Civil Engineering Surveying conducted in November 2023. The report aims to provide feedback to all education stakeholders on the factors that contributed to the candidates' performance in Civil Engineering Surveying subject.

The Certificate of Secondary Education Examination (CSEE) is a comprehensive evaluation that intends to measure the four years learning outcomes and provide feedback that teachers, future candidates and other education stakeholders can use to improve the teaching and learning process respectively. This analysis shows justification for the candidates' performance in the Civil Engineering Surveying subject. The candidates who attained high scores demonstrated their ability to understand the demands of the questions as well as adequate knowledge, skills and competence in the subject matter. Candidates who scored low marks lacked adequate knowledge on the concepts tested and failed to respond according to the demands of the questions.

The report identifies candidates' strengths and weaknesses, which, in return, will help to improve learning before sitting for their Certificate of Secondary Education Examination (CSEE). It will also help teachers to identify challenging areas and take appropriate measures during the teaching and learning process.

The National Examinations Council of Tanzania (NECTA) expects that feedback provided in this report will enable education stakeholders to take proper measures to improve teaching and learning of the Civil Engineering Surveying subject. Consequently, candidates will be able to acquire knowledge, skills and competence indicated in the syllabus for better performance in future assessments and examinations.

The Council appreciates the contribution of all who participated in preparing this report.

Dr. Said Ally Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

The Candidates Item Response Analysis report provides an analytical evaluation on performance of the Certificate of Secondary Education Examination (CSEE) 2023 in Civil Engineering Surveying. The candidates sat for Civil Engineering Surveying examination for the first time after reviewing the syllabus for Technical Secondary School Education. The examination adequately covered the new syllabus issued in 2019 and as per the examination format issued in 2021.

The Civil Engineering Surveying examination consisted of three sections namely A, B and C with a total of 11 questions. Section A consisted of two (2) questions (1 and 2) which weighed 10 and 6 marks respectively, to make a total of 16 marks. Question one was constructed from various topics namely: *Introduction, Chain survey and linear measurement, Introduction to surveying method, Surveying Techniques for small areas, Surveying Technique for Small Area (Practice), Surveying techniques practices, Surveying Tools and Equipment* and *Civil engineering surveyor*. Question 1 consisted of ten multiple-choice items (i - x). Question 2 had six matching items (i - vi) drawn from the topic of '*Safety management and rules.*

Section B consisted of six (6) questions, from Question 3 to Question 8. The questions required the candidates to provide short answers and were derived from various topics namely: *Compass Surveying, Theodolite surveying, Surveying practice, Line levelling, Introduction to Computer Aided Draughting (CAD), Chain Surveying, and Linear Measurement.* Each question carried 9 marks, making a total of 54 marks. Section C had three (3) structured questions derived from the topics of *Levelling, Contouring* and *Area and volume.* The candidates were instructed to attempt only two (2) questions from this section which had 15 marks for each question making a total of 30 marks. Therefore, the paper weighted 100 marks.

A total of 133 candidates sat for this examination. The performance was generally good, whereby 113 (84.96%) of the candidates passed with average and good performance while 20 (15.04%) of the candidates failed. The candidates' performance in CSEE 2023 is illustrated in Table 1 and Figure 1.

Table 1: The Candidates' Performance in Civil Engineering Surveying

Scores	Remarks	General Candidates Performance	
		Number	Percentage (%)
0 – 29	Weak	20	15.04
30 - 64	Average	110	82.70
65 – 100	Good	03	2.26
Total		**133**	**100**

The distribution of scores and candidates' performance in the Civil Engineering Surveying subject is shown in Figure 1.

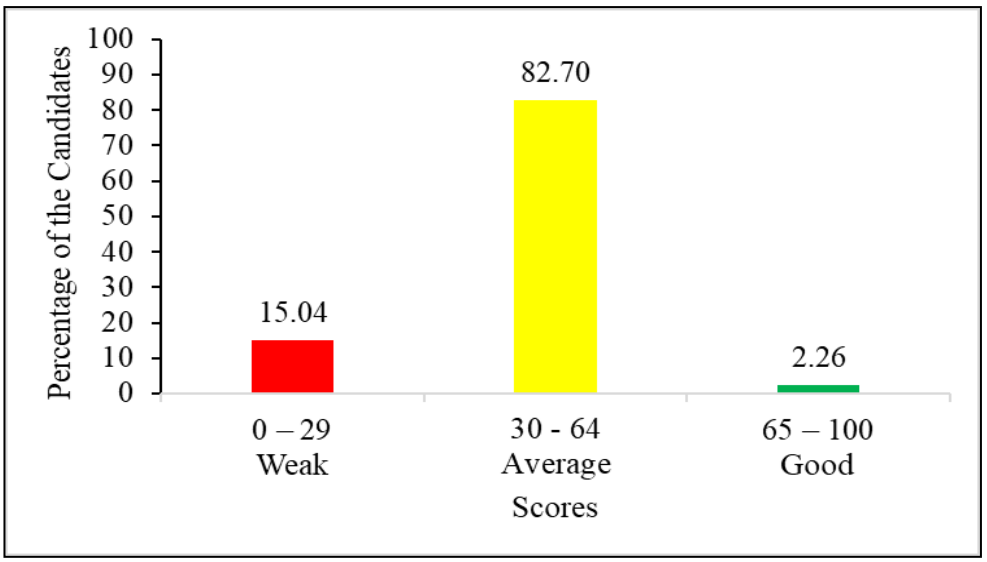


Figure 1: *The Distribution of Candidates' Performance in Percentage.*

The grading system in the CSEE is five categories' grades: Grades A, B, C, D and F. Grade A is awarded to candidates who score from 75 to 100 marks indicating excellent performance. Grade B is from 65 to 74, standing for very good, C from 45 to 64 denoting good performance, D from 30 to 44 satisfactory and F from 0 to 29 fail. Thus, the lower boundary of the pass grade is 30 marks. In this report, the scores ranging from 65 to 100 marks show good performance, 30 to 64 marks is average performance while 0 to 29 marks indicate weak performance. The performance of candidates in each question is presented in tables and figures.

Among the candidates who sat for the Civil Engineering Surveying examination in the year 2023, 03 (2.26%) scored grade B, 52 (39.10%) scored grade C, 58 (43.60%) candidates scored grade D, and the remaining

20 (15.04%) candidates failed by scoring grade F.

The range of the candidates' performance for each question was determined and analysis of the strengths and weaknesses of the candidates' responses was done. Extracts of candidates' good and poor responses are used to illustrate the cases presented. At the end of this report, conclusion and recommendations are made to help candidates, teachers, parents and other education stakeholders to take necessary measures in order to improve the teaching and learning process in the Civil Engineering Surveying subject.

2.0 ANALYSIS OF THE CANDIDATES' RESPONSES TO EACH QUESTION

2.1 SECTION A: Multiple-Choice and Matching Items

This section had two questions 1 and 2. Question 1 required the candidates to choose the correct response from among the given alternatives and write its letter in their answer booklet provided. Question 2 required the candidates to match the application of safety gears described in List A corresponding to the list of safety gears in List B by writing the letter of the correct response beside the item number in the answer booklet provided.

2.1.1 Question 1: Multiple Choice Items

The question consisted of ten items (i) to (x), which carried one mark each, making a total of 10 marks for the question. The score intervals used for grading candidates' performance on this question are shown in Table 2.

Table 2: The Score Intervals of Candidates' Performance in Question 1

Scores Range (marks)	General Performance	
	Remark	**Grade**
0 - 2	Weak	F
3 - 6	Average	C – D
7 - 10	Good	A - B

This question was attempted by all 133 (100%) candidates, whereby 15 (11.28%) scored from 0 to 2 marks, 98 (73.68%) scored from 3 to 6 marks and 20 (15.04%) scored from 7 to 10 marks.

The performance of candidates in this question was good, as 118 (88.72%) of candidates scored from 3 to 10 marks and the remaining 15 (11.28%) of the candidates scored from 0 to 2 marks. The performance of candidates in

this question is summarized in Figure 2.

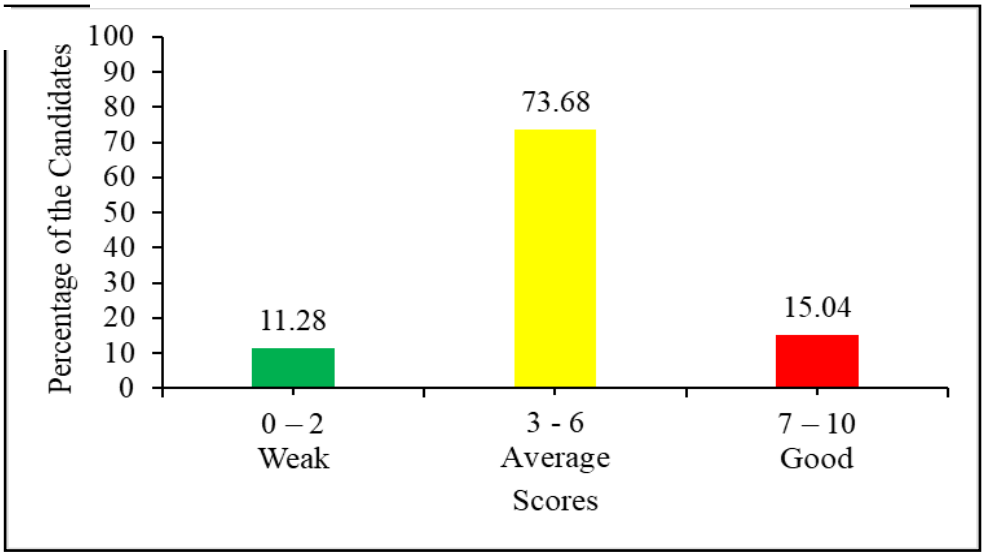


Figure 2: *The Candidates' Performance in Question 1*

The following is analysis of candidates' strengths and weaknesses in choosing responses for individual items of question 1 from (i) to (x).

Item (i) was developed from the topic of *Introduction*; candidates were required to identify the type of survey that determines the natural and artificial features of the land. The item is intended to measure candidates' awareness on two major categories of surveying and the determination of natural and artificial features of the landfall under what category. The question was:

Identify the type of survey which determines the natural and artificial features of the land.

A Cadastral surveying *B Engineering surveying*
C Geological surveying *D Topographical surveying*
E Archaeological surveying

Surveying is the process of determining the relative position of natural and man-made features on or under the earth's surface, due to this fact plane surveying is more suitable rather than Geodetic Surveying. Therefore, the response from alternative D "*Topographical surveying"* is the correct answer. Topographic Surveys are concerned with measurement and mapping of physical features on the earth surface. These features are all natural and man-made features. Some of the candidates opted for the

alternative A *"Cadastral surveying"* but failed to remember that cadastral surveying is concerned more with the measurement, definition, mapping and recording of property boundaries. Other alternatives B, C and E, are special surveying performed with special and systematic examination for the proposed works.

Item (ii) was set from the topic of *Chain Surveying and Linear Measurement*, whereby candidates are given the surveying equipment and asked to eliminate one piece of equipment that is not required when conducting chain surveying. The item intended to measure both the candidates' understanding of surveying tools and their uses. The question was:

Which equipment is not required when conducting chain survey?

A Metallic Tape B Target Staff C Clinometer
D Cross Staff E Plumb Bob with Thread

The correct alternative was B, '*target staff*'. The candidates who opted for alternative B were aware that the *target staff* is not required in chain survey. Target staff is a circular or oval shape, painted red and white in alternate quadrants. It is fitted with a vernier at the centre and the instrument man directs the person holding the target staff to move the target, till its centre is in the horizontal line of sight. If the sighting distance is greater, the instrument man finds it difficult to read the self-reading staff, in such case a target staff may be used. Target staff is similar to self-reading staff but provided with a movable target. Other remaining alternatives such as A "*Metallic Tape",* C *"Clinometer",* D *"Cross Staff"* and E *"Plumb Bob with Thread"* are not correct because those might be used in chain surveying, specifically in measuring distance.

Item (iii) was constructed from the topic of *Introduction to Surveying Methods*, whereby candidates were required to identify the minimum interior angles required for a well-conditioned triangle. The item intended to measure the candidates' awareness and understanding of the different types of triangles specifically well-conditioned triangles. The question was as follows:

The triangle formed by survey lines should be well conditioned. Identify minimum interior angles required for a well-conditioned triangle?

A 10º B 20º C 30º

D 40º E 50º

One of the principles of chain surveying is triangulation, which means that the area to be surveyed is divided into several small triangles, but triangles should be well conditioned. The correct alternative for this item is alternative C "*30º"*. Candidates who opted for this alternative were aware of the properties of triangles, there are different types of triangles but the triangle used in chain surveying is well-conditioned triangle. A triangle in which no angle is less than 30° and greater than 120° is known as well conditioned triangle. Alternatives A and B have angles less than 30º and alternatives D and E have angles greater than 30º, therefore the correct answer is alternative C as demanded by the question. The minimum angles in well-conditioned triangles should be 30º.

Item (iv) was developed from the topic of *Surveying Techniques for small areas (practice)*, whereby candidates were required to identify the true representation of a diagonal scale. The item is intended to measure candidates' awareness on property of diagonal scale. The question was:

Which of the following is true about diagonal scale?

A It is used to read one unit.
B It is used to read two consecutive units.
C It is used to read four consecutive units.
D It is used to read three consecutive units.
E It is used to read five consecutive units.

Diagonal Scale is used to represent three consecutive units i.e. a unit and its immediate two sub-divisions. For example, (a) metre, decimetre and centimetre (b) kilometre, hectometre and decametre (c) yards, feet and inches. In a diagonal scale, the short length is divided into several parts in which sides are proportionally divided into the required number of equal parts. Therefore, the correct alternative is alternative D "*It is used to read three consecutive units".* The candidates who opt for this he/she is aware of the scales used in surveying, most of survey works cannot be represented directly in the working sheets, therefore the use of scale helps to represent large land areas in the small working sheet. Other alternatives are distractors. Those who opted for other alternatives lacked knowledge of the scales and thus failed to select the correct answer.

Item (v) was set from the topic of *Surveying Technique for Small Area*

(Practice), whereby, candidates were required to identify the type of error incorporated on measured length due to incorrect holding of chain. The item is intended to measure candidates' ability to differentiate errors associated with chain surveying. The question stated as follows:

Identify the type of error incorporated on measured length due to incorrect holding of chain.

A	*Compensating error*	*B*	*Cumulative error*
C	*Instrumental error*	*D*	*Negative error*
E	*Total error*		

The error incorporated on measured length due to incorrect holding of the chain is associated with the skills and experience of the surveyor. This error is called a random error or compensating error (sometimes known as an accidental error). This error is due to human weakness either tiredness, experience, skills, etc. For this item, the correct response was alternative A, '*Compensating error*'. Candidates who opted for this alternative were aware that, this error is associated with human performance, and poor or incorrect holding of the chain is among the sources of this error.

Candidates who opted for alternative B, '*Cumulative error'*, were incorrect because cumulative errors (systematic errors) are the errors that are liable to occur in the same direction and tend to accumulate. These errors thus considerably increase or decrease the actual measurements. The cumulative errors are proportional to the length of the line and may be positive or negative. Candidates who opted for alternative C, '*Instrumental error*', were incorrect because instrumental errors are caused by imperfectly constructed, adjusted, or calibrated surveying equipment. Candidates who opted for alternative D, '*Negative error*' and E '*Total error*' were incorrect because these errors associated with the length of the chain or theoretical frame for optimizing surveys by maximizing data.

Item (vi) was developed from the topic of *Surveying techniques practices*, whereby candidates were required to select the surveying instrument used to mark the position of stations, for sightings of those stations, as well as for ongoing straight lines. This item is intended to measure candidates' awareness of the surveying instrument. It was as follows:

Which surveying instrument is used to mark the position of stations, for sightings those stations, as well as for ongoing straight lines?

A	*Plaster lath*	*B*	*Arrows*	*C*	*Pegs*
D	*Offset rods*	*E*	*Ranging rods*		

In surveying, it is essential to mark the position of stations in the closed areas or in straight lines in the field accurately. To do so, surveyors use different types of instruments and tools. One of the commonly used tools to mark the position of stations in that situation is ranging rods. Therefore, the correct response was alternative E, '*Ranging rods*'. Candidates who opted for this alternative were familiar with surveying instruments and were able to differentiate between the instruments. A ranging rod (or range rod) is a surveying instrument used for marking the position of stations and for sightings of those stations, as well as for ranging straight lines. Initially, these were made of light, thin and straight bamboo, or of well-seasoned wood such as teak, pine, or deodar.

They are also used to mark points that must be seen from a distance, in which case a flag may be attached to improve the visibility. In this item, the candidates failed to differentiate between arrows, pegs, offset rods and ranging rods; corresponding with alternatives B, C, D and E respectively. These tools are very similar and they seemed to be performing the same activity but they differ in use, so they failed to give correct answers due to their inability to discover which correct tool can be used for the particular work.

Item (vii) was constructed from the topic of *Surveying Tools and Equipment*. Candidates were required to select appropriate type of tape that might be used in ordinary survey work. The item is intended to measure candidates' skills on measuring tapes and their uses. The item was:

What type of tape is appropriate to use in ordinary survey work?

A	*Invar tape*	*B*	*Steel tape*	*C*	*Metric tape*
D	*Linen tape*	*E*	*Cloth or linen tape*		

Surveying tapes are measuring tools used in land surveying to measure distances. Most of the time, these tapes are made of soft materials like steel, fiberglass, cloth, etc. Tapes come in different lengths and have measurements written on them. In surveying and mapping, tapes are used to take accurate measures. There are different kinds of tapes used in

surveying, depending on how accurate the work needs to be and other things. In this item, alternatives D and E appeared as the correct answer but most of the candidates selected alternatives B and C as the correct answer which is not true this is due to its popularity, it is mostly used in our daily life. Invar tape from alternative "A", is commonly used in surveying work but it differs from linen tape due to its length, it is too long compared with linen tape for ordinary survey work.

Item (viii) was extracted from the topic of *Surveying Tools and Equipment,* whereby candidates were required to analyse the main difference between the ranging poles and ranging rods. This item is intended to measure the understanding of candidates on surveying instrument, especially on differentiating it in different aspects. The item was:

Select the main difference between the ranging poles and ranging rods.

A *Ranging rods are less than 12 feet while ranging poles are longer than 12 feet.*

B *Ranging rods are longer and have smaller diameter while ranging poles are shorter with great diameter.*

C *Ranging rods are painted in black and white pattern while ranging poles are painted in white and red pattern.*

D *Ranging rods are blunt at the bottom while ranging poles are sharp at the bottom.*

E *Ranging rods are straight grained timber while ranging poles are of aluminium.*

The correct alternative was A, *"ranging rods are less than 12 feet while ranging poles are longer than 12 feet"*. Ranging poles are survey instruments that are used for spotting and marking the position of survey stations. They can also be used to range straight lines. If a range rod is longer than 12 feet, it's called a ranging pole. And it can be used for measuring long survey lines along property boundaries. Those candidates who scored this item had enough knowledge of the surveying tools and were able to provide correct differences from these two ranging instruments in the survey. Other alternatives are distractors; some of it does not give a specific reason for its difference. For example, alternative B *"Ranging rods are longer and have smaller diameter while ranging poles are shorter with great diameter",* this statement is too general, it does not mention a correct specific length which should be ranging rods and ranging poles are possessed.

Item (ix) was developed from the topic of *Civil engineering surveyor*, whereby intended to measure candidates' awareness on the branches of surveying and its uses. The question was as follows:

Two neighbors were quarrelling about the position of the fences of their plots. Each of them claimed to construct the fence in his own land. What type of survey can be conducted to resolve such disputes?

A Mining survey *B Aerial survey* *C Cadastral survey*
D Topographical survey *E Engineering survey*

The quarrel of two neighbors about the position of the fences of their plots can be solved by a surveyor through cadastral survey. The major function of this type of survey is to define, measure, map and record boundaries and properties of the plot. Candidates who select alternative C, *Cadastral Surveys* show enough knowledge on the survey branches and were able to recognize that the cadastral survey may solve that problem. Other alternatives deal with specific tasks contrary to cadastral survey which deals with natural and artificial features of the land.

Item (x) was set from the topic of *surveying technique for small area (Practice)*, whereby candidates were required to analyze the importance of cross-staff in surveying work. The item is intended to measure candidates' awareness on the importance of cross-staff in surveying work. The question asked:

Why cross-staff is important in surveying work?

A It is used for marking survey station.
B It is used to set perpendicular line to survey line.
C It is used to align a survey line.
D It is used for setting a line at an angle to a survey line at a point.
E It marks a reference of every peg during survey process.

Cross-staff is an instrument used to measure altitudes and angles, it consisting of a trigonometrically graduated staff and over it, one or more perpendicular vanes are moving. From its look and shape the cross-staff gets its name and it was with four different sized movable crosspieces and about 3 feet long. It is used to measure the altitude or distance of an object above sea level or the horizon and set out a perpendicular on a given chain line. Therefore, the correct answer was B, '*It is used to set perpendicular line to survey line*'. The candidates who pass this item portray enough

knowledge on the surveying tools and equipment and can differentiate cross-staff with other tools.

2.1.2 Question 2: Matching Items

The question consisted of six (6) items (i) to (vi) in which the candidates were required to match items (i - vi) described in List A with responses in List B by writing the letter of the corresponding correct response beside the item number, the question was extracted from the topics of *safety management and rules*. Each item in this question carried 01 mark, making a total of 06 marks. The question was designed to test the candidates' ability to control risks when operating surveying equipment.

The score ranges used to grade candidates' performance in this question are presented in Table 3.

Table 3: The Score Intervals of Candidates' Performance in Question 2

Scores Range (marks)	General Performance	
	Remark	**Grade**
0 – 1	Weak	F
2 - 3	Average	C – D
4 - 6	Good	A - B

This question was attempted by 133 candidates, whereby 1 (0.75%) candidate scored from 0 to 1 mark, 9 (6.77%) candidates scored from 2 to 3 marks, and 123 (92.48%) candidates scored from 4 to 6 marks.

Performance on this question was good because most of the candidates scored from 2 to 3 marks, followed by those who scored from 4 to 5 marks and the last group comprised of those students who scored from 0 to 1 mark. Table 4 and Figure 3 show the overall trend of candidates' performance in question 2.

Table 4: The General Candidates' Performance in Question 2

Scores Range	Remark	General Performance	
		Number of Candidates	**Percentage**
0 – 1	Weak	1	0.75
2 – 3	Average	9	6.77
4 - 6	Good	123	92.48
Total		**133**	**100**

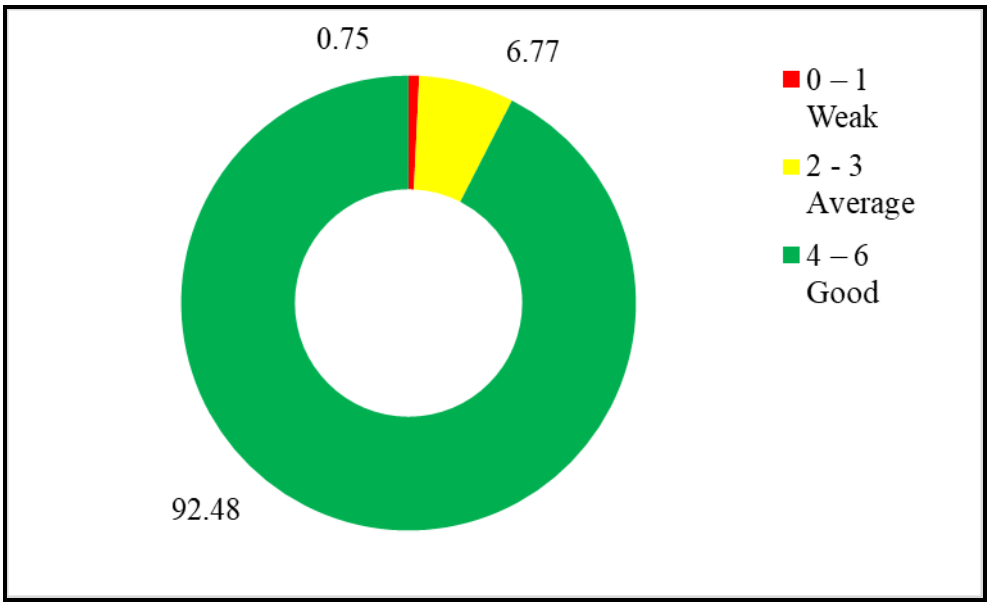


Figure 3: *The Candidates' Performance in Question 2*

The candidates' strengths and weaknesses in choosing responses for individual items of question 2 are analyzed as follows:

The question was;

List A	***List B***
(i) It provides protection of our eyes.	*A Overall*
(ii) It provides protection against injury caused by objects falling from scaffolding.	*B Glove*
(iii) It provides protection of our hands when handling materials with sharp edges like glass and sheet metals.	*C Safety helmet*
(iv) It provides protection of our feet in case something falls on them or standing on sharp objects.	*D Hat*
(v) It provides moderate protection against general dust inhalation.	*E Safety goggle*
(vi) It protects everyday clothing from becoming contaminated by the oils, grease, fluxes or general dust.	*F Sun screen*
	G Face mask
	H Safety boot

Item (i): The candidates were required to provide the correct response that matches correctly with the description "*It provides protection of our eyes"*.

The correct response was C "*safety goggle",* candidates who were able to select the response correctly understood clearly the implication of safety goggles. Safety goggles are tight-fitting eye protection that completely cover the eyes, eye sockets and the facial area around the eyes and provide protection from impact, dust, mists, and splashes. Safety goggles can be worn over prescription lenses. But some of the candidates selected responses F, "*Sun Screen"* and G, *"Face mask"* which was wrong. *Sunscreen,* also known as sunblock or sun cream, is a photo-protective topical product for the skin that helps protect against sunburn, and *Face mask* is a protective cover for the face or part of the face for medical or sports purposes. These candidates had no sufficient knowledge and skills because this distractor was closely related but not correct.

Item (ii): The candidates were required to choose the correct match of the description "*It provides protection against injury caused by objects falling from scaffolding.*". The correct response was C, *"Safety helmet".* Normally falling objects on construction site hit the workers on his/her heads, therefore the correct safety gear is a safety helmet. Most of the candidates were able to match this item correctly because the helmet is the right device that can protect workers from getting injured by objects falling on his/her head from above.

Item (iii): The candidates were required to match correctly safety gear listed from List B with this statement "*It provides protection of our hands when handling materials with sharp edges like glass and sheet metals."*. The correct response was B, "*glove*", most of the candidates selected the correct responses because the function of gloves is very well understood in our society, so it does not become a problem for the candidates to determine the correct answers to this item. Glove keeping users' hands safe and healthy in working conditions, especially where hazards are common in the workplace. The best gloves to survey are preferably ones that are tough and can be beaten up but also slim enough to be easily functioning on equipment operating.

Item (iv): The candidates were required to choose correct match of description in list A, "*It provides protection of our feet in case something falls on them or standing on sharp objects*" with the correct safety gear that might be used to protect the workers' feet. The correct response was H, "*Safety boot*". Candidates who selected this match understood that when workers are on a construction site, they need various equipment to help

them to avoid an accident, including wearing special shoes to protect their feet when they are in working areas. Therefore, it is easier for them to select the correct response for that description which is safety boot.

Item (v): The candidates were asked to match correctly the statement "*It provides moderate protection against general dust inhalation*" with acceptable safety gear. The correct response was G, "*Face mask*". Wearing Personal Protection Equipment (PPE) during construction work was strongly advised due to the number of contaminants released during construction and improvement projects. One among the equipment (safety gear) worn on the site is Respiratory Protective Equipment (RPE) to protect against dust inhalation. Therefore, the *face mask* is the respiratory protective equipment to protect the workers from dust inhalation. Most of the candidates opted correctly and showed sufficient understanding of the PPE specifically Respiratory Protective Equipment (RPE). However, few candidates confused the statement by matching with E, "*Safety goggle*" which is incorrect because safety goggle is used only to protect the eye contrary unlike face masks.

Item (vi): The candidates were required to match correctly safety gear listed from List B with this statement "*It protects everyday clothing from becoming contaminated by the oils, grease, fluxes or general dust"*. The correct response was A, "*Overall*", most of the candidates selected the correct responses because the function of overall is very well understood by candidates, so it does not become a problem for the candidates to determine the correct answers to this item. Overall is a loose-fitting coat or one-piece garment worn over ordinary clothes for protection against dirt, such as oil, grease, or heavy wear. Wearing overall protects the worker from various hazards and helps them do their job better with security and safety. These coats (clothes) are often referred to as "overalls" and help the workers protect themselves from various mishappenings.

2.2 SECTION B: Short Answers

This section consisted of six (6) questions including questions number 3 to 8, each carrying 9 marks making a total of 54 marks. The candidates were considered to pass if they scored a grade D and above. The score ranges used for grading candidates' performance in this section are indicated in Table 5.

Table 5: The Score Intervals for Questions 3 to 8

Scores Range (marks)	General Performance	
	Remark	**Grade**
0 - 2.5	Weak	F
3 - 5.5	Average	C – D
6 - 9	Good	A - B

2.2.1 Question 3: Compass Surveying

This question was extracted from the topic of *Compass Surveying*. This question required the candidates to identify the features of secular and irregular variations declination that occurred due to magnetic properties appearing in the compass and intended to measure the awareness of candidates on the capacity and properties of surveying equipment. It stated as follows:

'*When using a magnetic compass in the field, irregular and secular variations are likely to occur in the declination due to magnetic properties appeared in the compass. What are the six features of secular variation and three features of irregular variations might occur?'*

The question was attempted by 133 candidates, whereby 127 (95.49%) candidates scored from 0 to 2.5 marks, and 6 (4.51%) candidates scored from 3 to 5.5. These data are summarized in Table 6 and Figure 4.

Table 6: The General Candidates' Performance in Question 3

Scores Range	Remark	General Performance	
		Number of Candidates	**Percentage**
0 – 2.5	Weak	127	95.49
3 – 5.5	Average	6	4.51
6 - 9	Good	0	0
Total		**133**	**100**

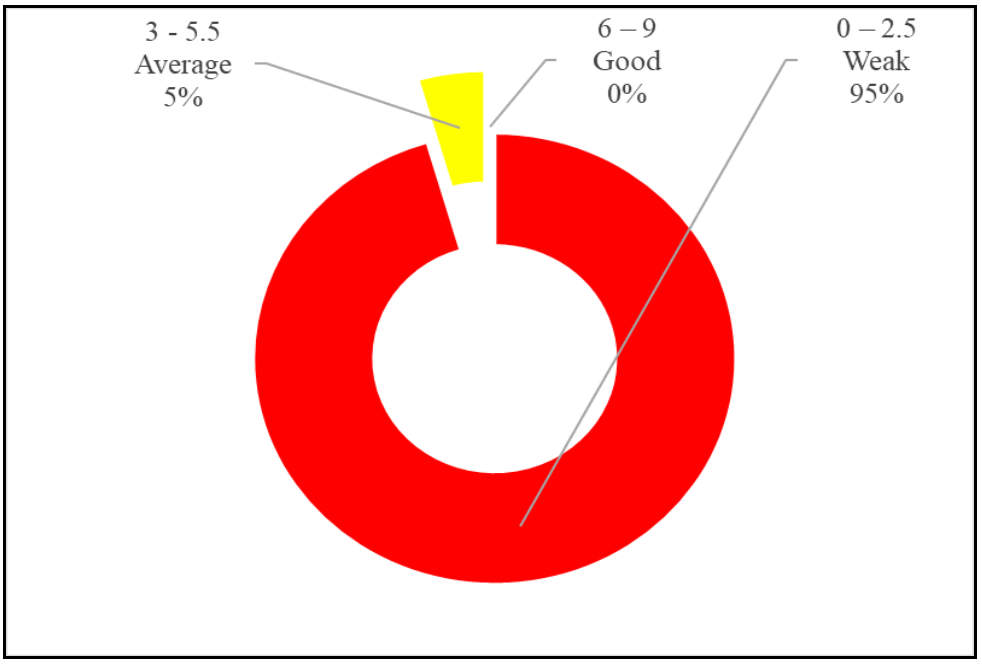
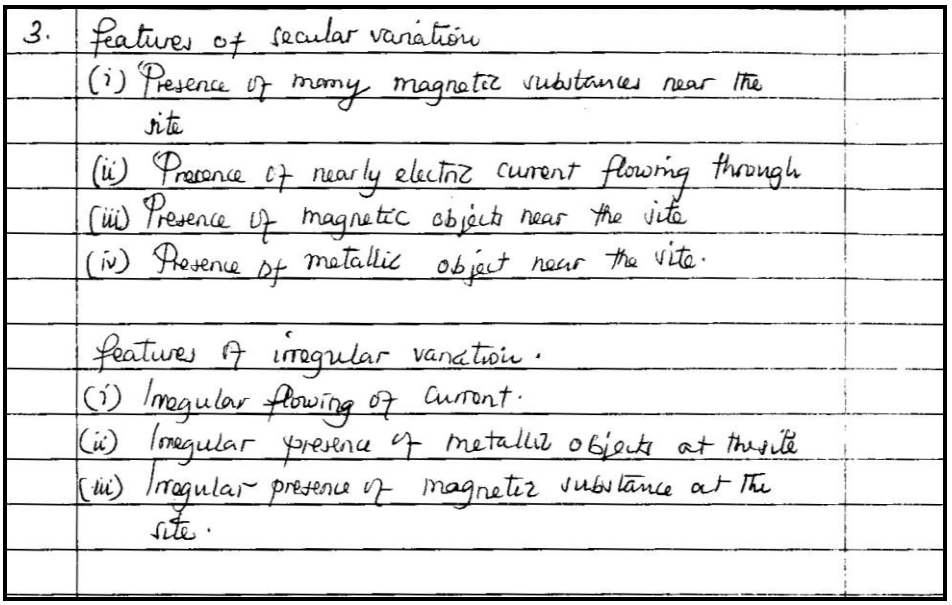


Figure 4: *The Candidates' Performance in Question 3*

The performance in this question was poor as 127 (95.49%) of all candidates scored between 0 to 2.5 marks while only 6 (4.51%) of the candidates scored from 3 to 5.5 marks, and no any candidate who scored from 6 to 9 allotted full marks.

Based on Table 6, the majority of candidates failed to score pass marks in this question. Changes in the direction of the magnetic meridian at any place are not constant, thus, some variations might occur due to magnetic properties. These variations in magnetic declination can be categorized as daily, annual, secular and irregular variations. The candidates are required to identify features of secular and irregular variation alone. Many candidates portray insufficient knowledge in this area on the topic of *compass Surveying*. They provided irrelevant responses in all variations and scored a zero mark. The candidates relate with Earth's magnetic field properties which is similar to that of a bar magnet tilted 11 degrees from the spin axis of the Earth. The candidates should remember that magnetic declination is the angle between the direction of the Earth's magnetic field and true north. It is important to take magnetic declination into account when using a magnetic compass because the needle of the compass points to the Earth's magnetic field, not true north. The amount of magnetic declination varies depending on your location on the Earth's surface. The majority of candidates failed to remember that idea and therefore wrote

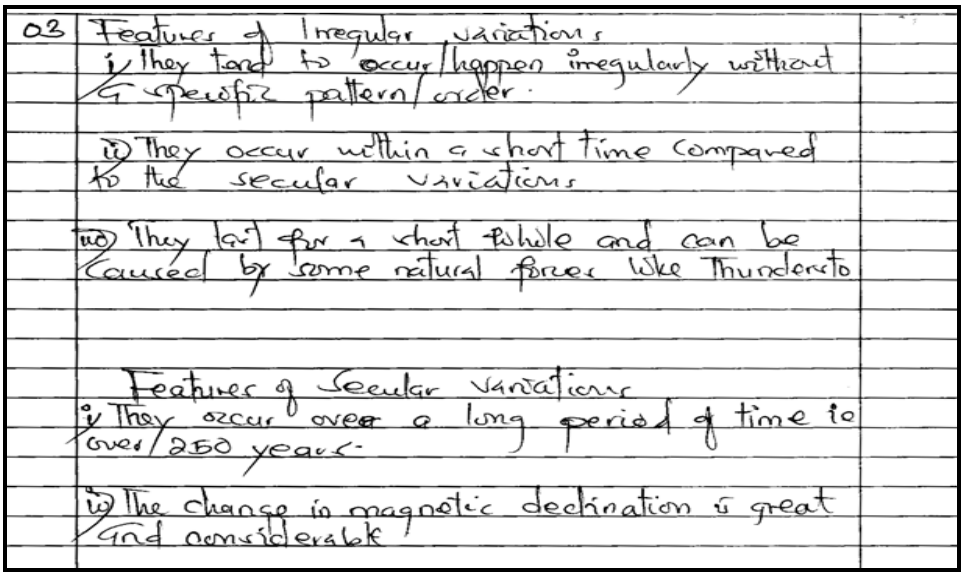
irrelevant responses in all variations. Extract 1.1 is a sample of incorrect responses to question 3.


3. features of secular variation
(i) Presence of many magnetic substances near the site
(ii) Presence of nearly electric current flowing through
(iii) Presence of magnetic objects near the site
(iv) Presence of metallic object near the site.

features of irregular variation.
(i) Irregular flowing of current.
(ii) Irregular presence of metallic objects at the site
(iii) Irregular presence of magnetic substance at the site.

Extract 1.1: A sample of candidate's incorrect responses to Question 3

Despite the huge failure of the candidates in this question, some of them scored at least half allotted marks in this question. In this group, the majority of candidates who reached at least half of the marks were able to explain the important features of secular variation, such as; most important variation in declination on the work of the surveyor due to its magnitude, it appears to be of a periodic character and follows a roller-coaster pattern, it swings like a pendulum for a given place, the compass needle after moving continuously for a period of the year in one direction with respect to the true north, gradually come to stand and then begins to move in the opposite direction, secular change from year to year is not uniform for any given locality and is different for different places and its period is approximately 250 years. Extract 1.2 demonstrates a sample of a candidate script who was able to respond correctly and scored some good marks.



Extract 1.2: A sample of the candidate's correct responses to Question 3

2.2.2 Question 4: Theodolite Surveying

The question was prepared from the topic of "*Theodolite surveying"* which required the candidates to illustrate how they could measure vertical angles by using a theodolite. The question was designed to test ability of the candidates on how they can use a theodolite to measure angles. The question stated that;

"Theodolite is mainly used for measuring horizontal and vertical angles. Illustrate how you could measure vertical angles by using theodolite".

This question was attempted by 133 (100%) candidates, whereby 121 (90.98%) candidates scored from 0 to 2.5 marks. The candidates who scored from 3 to 5.5 marks were 10 (7.52%) while 02 (1.50%) candidates scored from 6 to 9 marks. The scoring data for this question is summarized and presented in Table 7 and Figure 5.

Table 7: The General Candidates' Performance in Question 4

Scores Range	Remark	General Performance	
		Number of Candidates	Percentage
0 – 2.5	Weak	121	90.98
3 – 5.5	Average	10	7.52
6 - 9	Good	2	1.50
Total		**133**	**100**

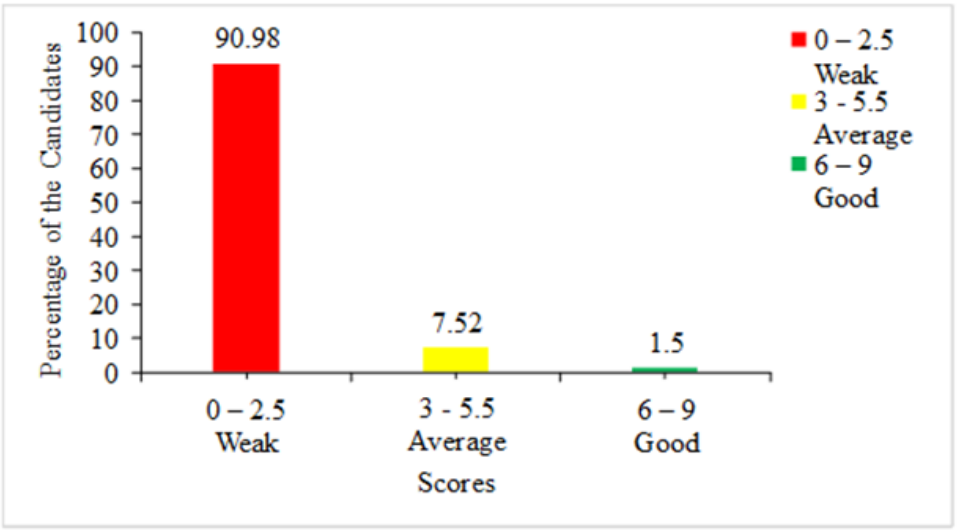
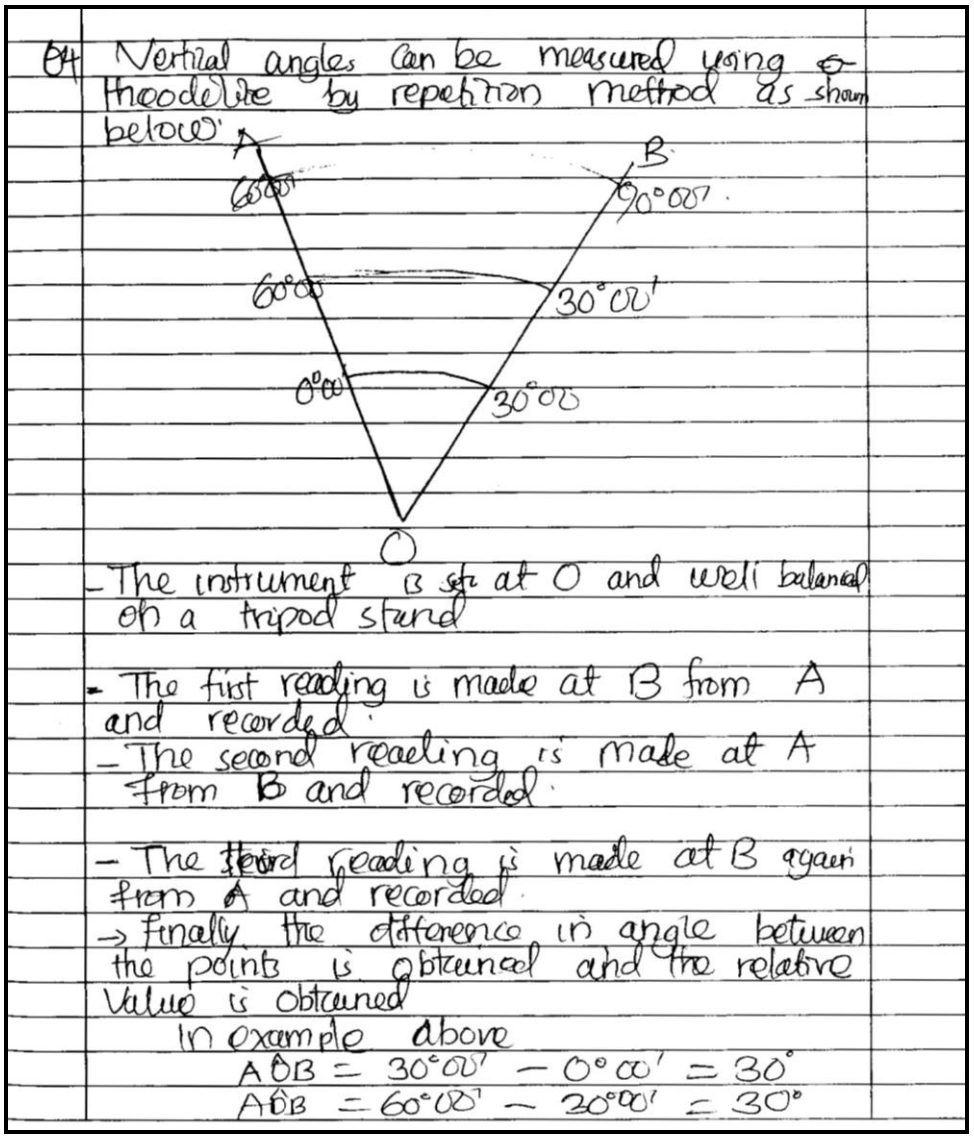


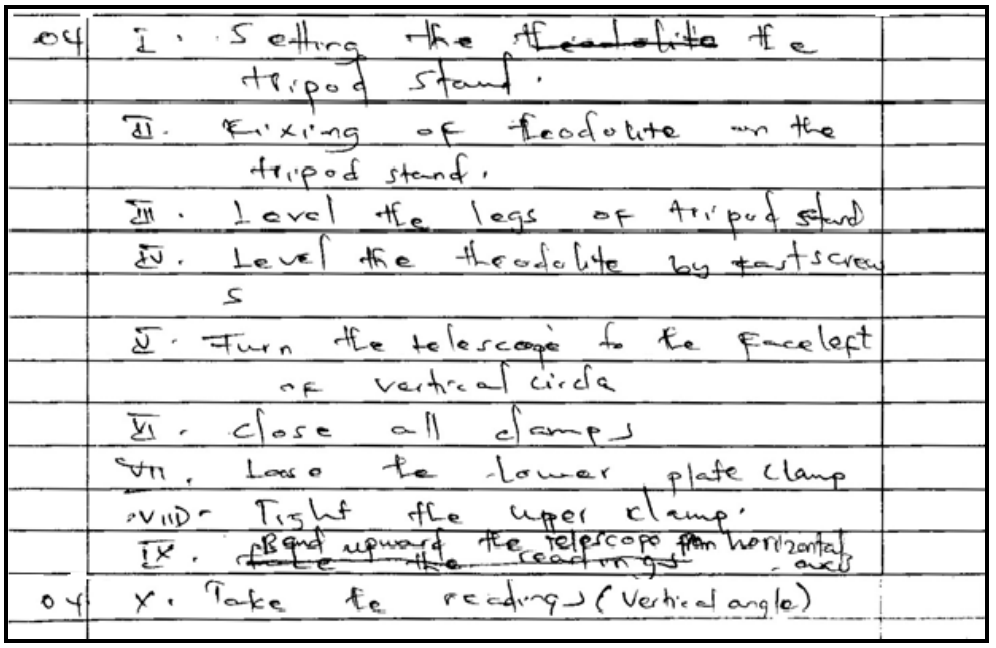
Figure 5: *The Candidates' Performance in Question 4*

The analysis of candidates' performance in this question shows that about 121 (90.98%) among 133 of the candidates who attempted this question failed to score a pass mark. Their massive failure is an indication that they had insufficient knowledge on the uses of theodolite. Lack of field practical skills in their training has led the candidates to fail completely to score passing marks on this question, if the candidates were trained in the field practical skills on using theodolite, they would have been able to answer this question well because they would be able to remember step by step how to use the theodolite to measure the horizontal and vertical angles. The main drawbacks of using a theodolite are that, it demanding a skilled and experienced operator, who can read the graduated circles, align the telescope, and adjust the level. Most of the candidates in this category wrote irrelevant responses and some of them copied some words or phrases from other questions and wrote them as their responses, other candidates failed to comprehend the demands of the question by providing inappropriate responses or writing incorrect procedures used to measure the vertical angle by using a theodolite. Extract 2.1 demonstrated a sample of the candidate's incorrect response to question 4.



Extract 2.1: A sample of candidates' incorrect responses to Question 4

Moreover, few candidates managed to score average and good marks in this question, such candidates were able to demonstrate a certain understanding of the topic. The good performance was triggered by their ability to comprehend the demand of the question by providing appropriate responses. Extract 2.2 demonstrated samples of candidates correct responses to the question asked.



Extract 2.2: A sample of the candidate's correct responses to Question 4

2.2.3 Question 5: Surveying Practice

In this question, candidates were required to provide nine precautions that should be observed during the process of data recording for the best results. This question is intended to measure the ability of candidates to avoid errors during data recording in the notebook by applying appropriate precautions for better results in the data analysis. The question stated that;

When taking readings in the field, various precautions should be taken from the beginning. Suggest nine precautions which should be observed during recording for best result.

The analysis of candidates' performance in this question shows that 118 (88.72%) candidates out of 133 scored from 0 to 2.5 marks. The candidates who scored from 3 to 6 marks were 13 (9.78%), while 2 (1.5%) candidates scored from 6.5 to 10 marks.

The general analysis of candidates' performance in this question was weak as 118 (88.72%) of the candidates scored from 0 to 2.5 marks. The analysis is illustrated in Table 8 and Figure 6.

Table 8: The General Candidates' Performance in Question 5

Scores range	Remark	General Performance	
		Number of Candidates	Percentage
0 – 2.5	Weak	118	88.72
3 – 5.5	Average	13	9.78
6 - 9	Good	2	1.50
Total		**133**	**100**

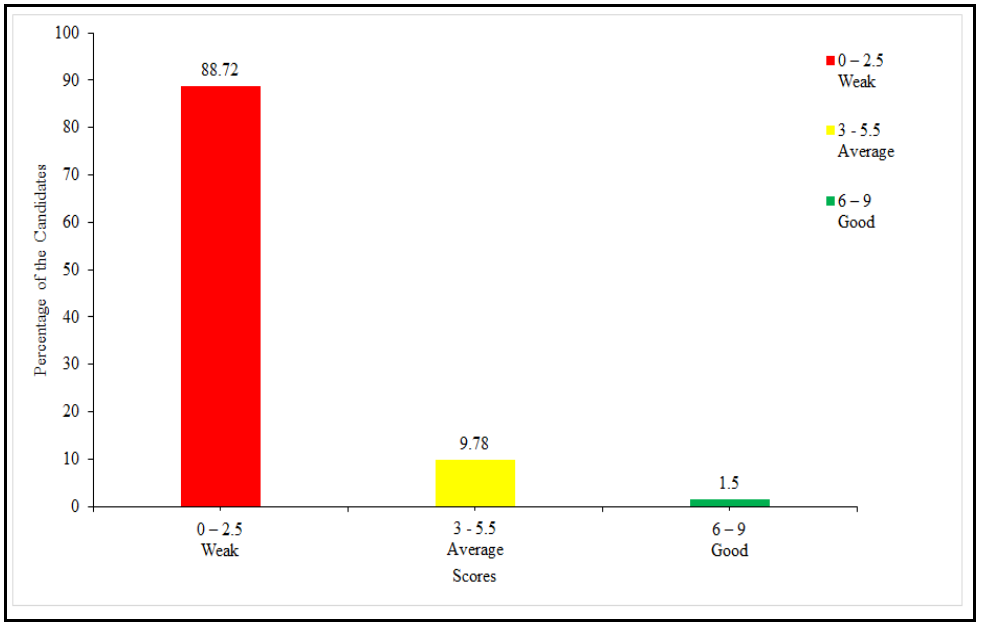
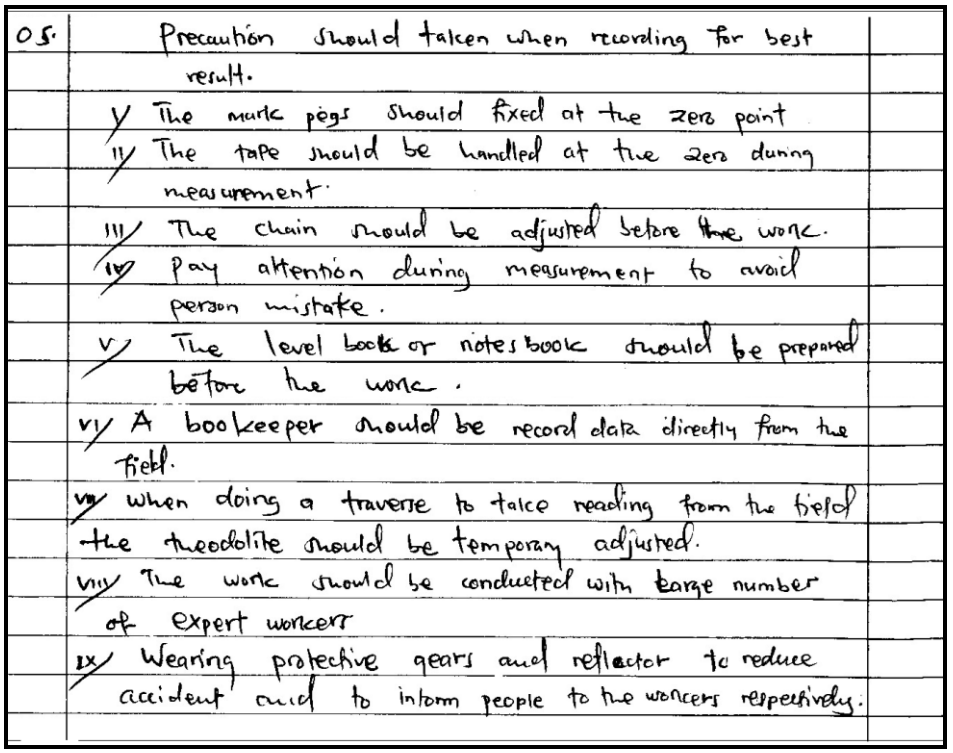


Figure 6: *The Candidates' Performance in Question 5*

Analysis in Table 8 shows that 88.72% of the candidates scored below pass marks. Field readings or notes are prepared to record all pertinent information, measurements, calculations, sketches, and observations made by the surveyor during surveying work. Notes should be examined and checked for accuracy, legibility, completeness, and clarity before leaving the field. They must be recorded in such a way that someone outside the original crew could clearly understand how, when, where, for what purpose and by whom the original survey was done. Thus, precaution must be observed to avoid misunderstanding of data recording and producing poor results in the data analysis. The poor performance, such as; many candidates could not grasp the knowledge from the topic concerned. This response indicates that the candidates did not understand the question and lacked mastery of the subject matter. Extract 3.1 shows a sample of the candidate's poor response to this question.


05. Precaution should taken when recording for best result.

I/ The mark pegs should fixed at the zero point

II/ The tape should be handled at the zero during measurement.

III/ The chain should be adjusted before the work.

IV/ Pay attention during measurement to avoid person mistake.

V/ The level books or notes book should be prepared before the work.

VI/ A bookkeeper should be record data directly from the field.

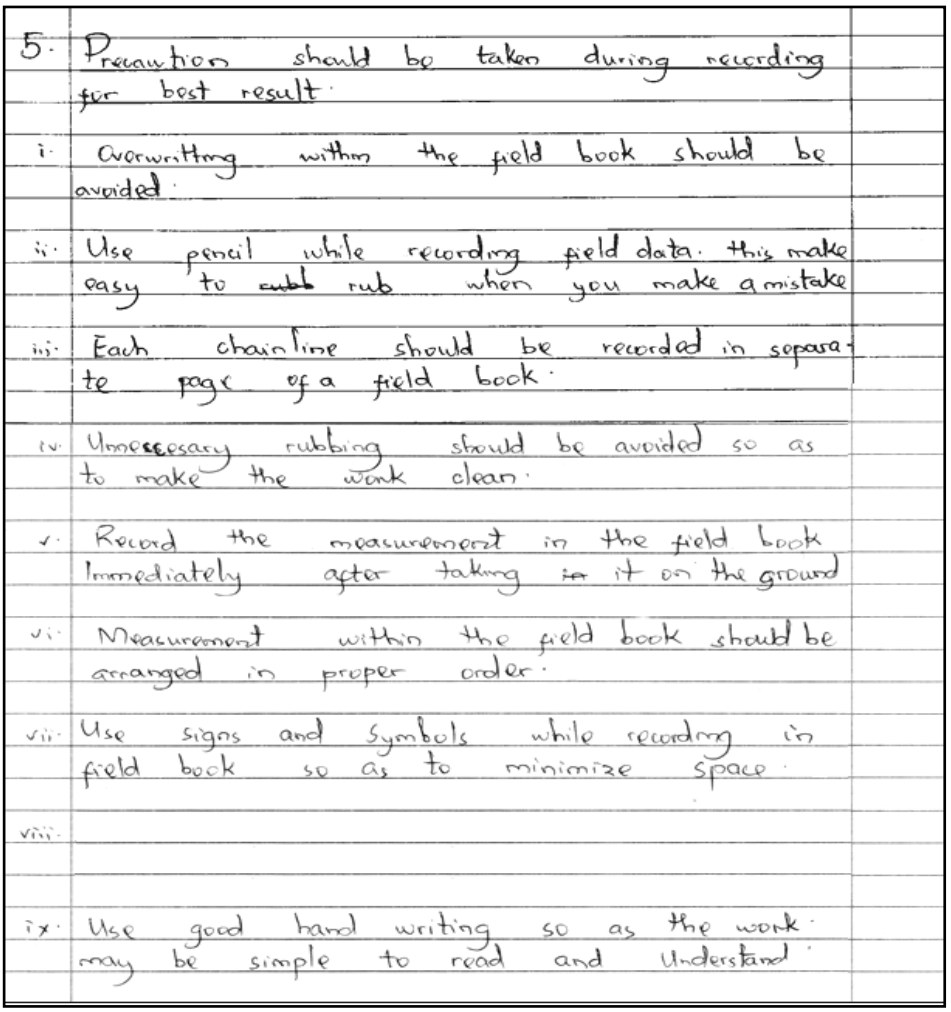
VII/ when doing a traverse to take reading from the field the theodolite should be temporary adjusted.

VIII/ The work should be conducted with large number of expert workers

IX/ Wearing protective gears and reflector to reduce accident and to inform people to the workers respectively.

Extract 3.1: A sample of the candidate's incorrect responses to Question 5

On the other hand, few candidates 15 (11.28%) who scored between 3 to 9 marks had sufficient knowledge of the field notes. These candidates also demonstrated adequate skills and may recall some of the precautions observed during the recording of field data and scored good marks. Extract 3.2 gives a picture of a sample of correct responses from one of the candidates who attempted this question.


5. Precaution should be taken during recording for best result.

i. Overwritting within the field book should be avoided.

ii. Use pencil while recording field data. this make easy to ~~rubb~~ rub when you make a mistake

iii. Each chainline should be recorded in separate page of a field book.

iv. Unnecessary rubbing should be avoided so as to make the work clean.

v. Record the measurement in the field book Immediately after taking ~~in~~ it on the ground

vi. Measurement within the field book should be arranged in proper order.

vii. Use signs and symbols while recording in field book so as to minimize space.

viii.

ix. Use good hand writing so as the work may be simple to read and Understand.

Extract 3.2: A sample of the candidate's correct responses to Question 5

2.2.4 Question 6: Line levelling

The demand of this question to the candidates is to observe the guidelines for the staff man and the level man that should be considered during the surveying measurements for the construction of a road. This question is intended to measure the ability of students to recognize the duty of a surveyor for specific persons such as staff holders (staff man) and machine operators (level man). The question stated that;

During the surveying measurements for construction of road, the staff man holds the stuff and the level man read, measure and record the data. Explain four points that must be considered by staff man and five points by level man during surveying.

The analysis of candidates' performance in this question shows that 86 (64.66%) candidates out of 133 scored from 0 to 2.5 marks, 40 (30.08%) candidates scored from 3 to 5.5 marks and 7 (5.26%) candidates scored 6 to 9 marks. Table 9 and Figure 7 summarize the performance of the candidates in this question.

Table: 9: The Candidates' Performance in Question 6

Scores Range	Remark	General Performance	
		Number of Candidates	Percentage
0 – 2.5	Weak	86	64.66
3 – 5.5	Average	40	30.08
6 - 9	Good	7	5.26
Total		**133**	**100**

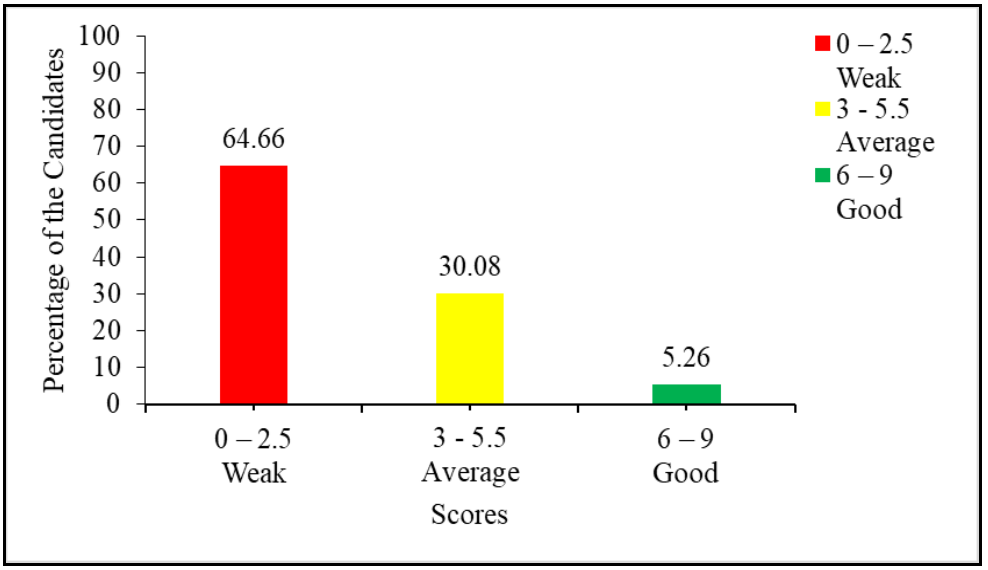


Figure 7: *The Candidates' Performance in Question 6*

The general performance of candidates for this question was average whereby the majority 47 (35.34%) of the candidates who attempted this question scored pass and above pass marks. However, analysis shows that 86 (64.66%) of the candidates scored below pass marks. The majority of the candidates in this group did not comprehend the demand of the question. They tried to explain the terms used in the procedures of taking levelling instead of the key consideration during levelling for both staff man and level man. The candidates explained the terms such as backsight, foresight, stations, changing point, etc. Insufficient knowledge of the concepts test might be the cause of this failure, the candidates failed to

differentiate between the procedures of levelling with the points to be considered by the staff man and level man during surveying. Extracts 4.1 illustrate a sample of poor responses from one of the candidates who attempted this question.

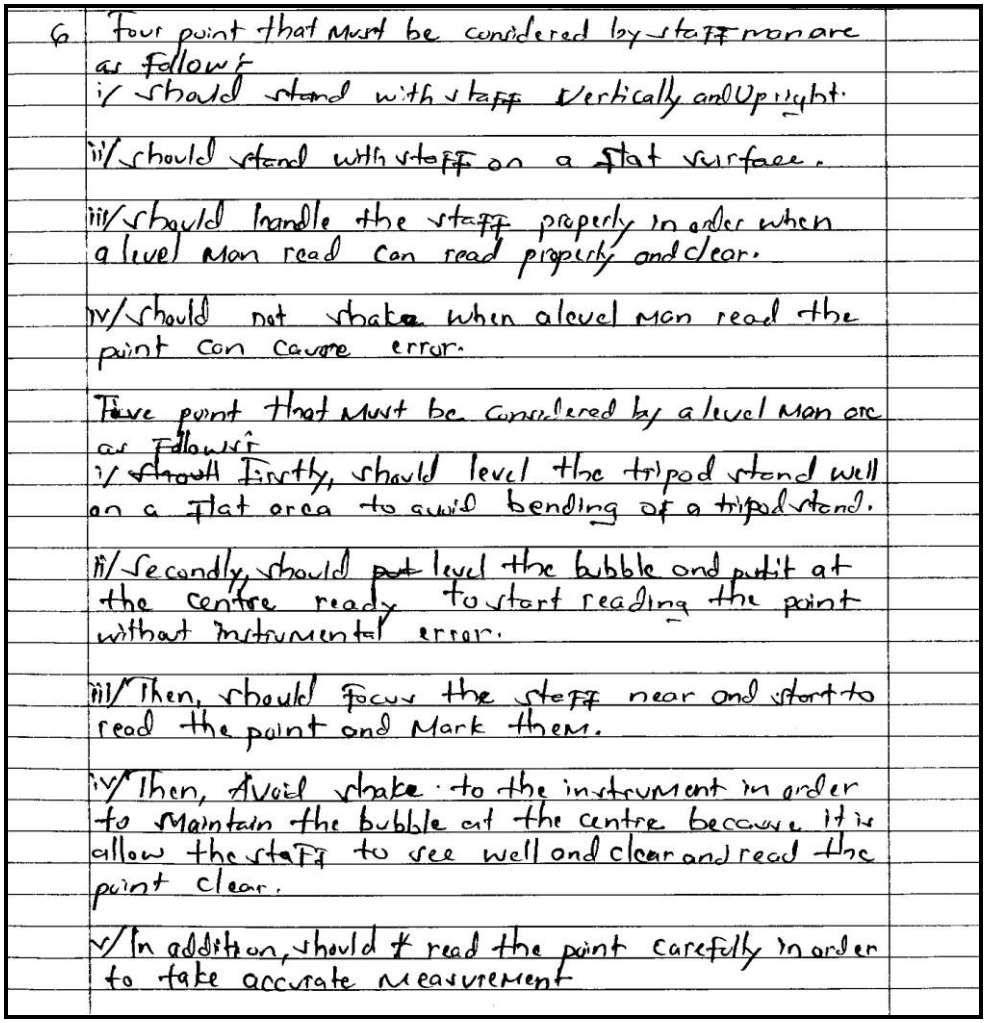
06 i) the point which Staff man Consider.
- Back site; this it is the first point where the Staff man can Consider inorder the level man to take the reading.
- intermediate Site; when after the back site the staff man should be do shift their staff up to the point of intermediate site before fore site.
- Foresite; this point it is a final point when take the measurement during Surveying.
- Station; this point it is a point in which the Staff man can put their Staff in order for a level man to take the measurement during Surveying.
ii) the point which the level man can Consider.
- Change point; this it is a point inwhich the machine Can Shifted from one point to another point So that the level man Can Consider.
- Back site reading; the level man Should be Consider the point of the back site So that at this point the level man can take the first reading.
- Intermediate Site reading; so that for a level man the point of the intermediate Should Consider during the Surveying.
- Fore site reading; after the intermediate site the level man Can read the point which it is a fore so that this it is a point which level man Can Consider.
- Bench mark; this point the level man Should be Consider when take the reading so that this it is among of the point to be Considered.

Extract 4.1: A sample of candidate's incorrect responses to Question 6

In Extract 4.1, the candidate provided irrelevant responses by explaining backsight, foresight, station, change point, benchmark etc. These terms are not supposed to be explained or defined as key points to consider during levelling. Therefore, the candidates scored a zero mark.

Moreover, some candidates were able to write the correct points for both staff man and level man, this group portrays that they had sufficient knowledge to the question. The Staff man should make the staff vertical by holding it with both arms while standing behind it, holding the staff on firm

ground, keeping the bottom of the staff clean and extending the staff carefully when the telescopic staff is to be extended so that it is perfectly stretched and held properly on the spring catcher. Also, a level man ensures that; levelling should be done perfectly, the levelling instrument should be placed at a position suitable for the greatest number of observations to be taken, the parallax should be eliminated, the objective should be focused by pointing the telescope towards the staff and the verticality of the staff should be verified by observing the two vertical hairs and by noting the minimum reading on the staff when it is moved along the line of sight. Extracts 4.2 illustrate a sample of the best response from one of the candidates who attempted this question.


6 Four point that Must be considered by staff man are as follow;
i/ should stand with staff Vertically and Upright.

ii/ should stand with staff on a flat surface.

iii/ should handle the staff properly in order when a level man read can read properly and clear.

iv/ should not shake when a level man read the point can cause error.

Five point that Must be considered by a level man are as follow;
i/ should Firstly, should level the tripod stand well on a flat area to avoid bending of a tripod stand.

ii/ Secondly, should level the bubble and put it at the centre ready to start reading the point without instrumental error.

iii/ Then, should focus the staff near and start to read the point and Mark them.

iv/ Then, Avoid shake to the instrument in order to Maintain the bubble at the centre because it is allow the staff to see well and clear and read the point clear.

v/ In addition, should it read the point carefully in order to take accurate Measurement

Extract 4.2: A sample of the candidate's correct responses to Question 6

2.2.5 Question 7: Surveying Introduction to Computer-Aided Draughting (CAD)

The question had three (3) parts; (a), (b) and (c) in which the candidates were required to give the long term of the word 'CAD' in part (a). In part (b) (i) the candidates were asked to explain the instrument used to facilitate 'CAD' in civil engineering surveying and in (ii) the candidates were required to mention 'CAD' software that can facilitate the civil engineering surveying works. Part (c) required to state the source of power of this software. Generally, this question is intended to measure the candidates' awareness on the CAD software as used in civil engineering survey works. It was stated that;

'CAD' software is an essential tool for drawing practice on topographic map in surveying works.

(a) What is the long term of the word 'CAD'?

(b) (i) Explain the instrument used to facilitate 'CAD' in civil engineering surveying?

(ii) Mention six 'CAD' software which can facilitate the civil engineering surveying works.

(c) What is the source of power of this software?

The analysis of candidates' performance in this question shows that 46 (34.59%) candidates out of 133 (100%) scored from 0 to 2.5 marks, 48 (36.09%) candidates scored from 3 to 5.5 marks, and 39 (29.32%) candidates scored from 6 to 9 marks. This analysis is illustrated in Table 10 and Figure 8.

Table 10: The Candidates' Performance in Question 7

Scores Range	Remark	General Performance	
		Number of Candidates	Percentage
0 – 2.5	Weak	46	34.59
3 – 5.5	Average	48	36.09
6 - 9	Good	39	29.32
Total		**133**	**100**

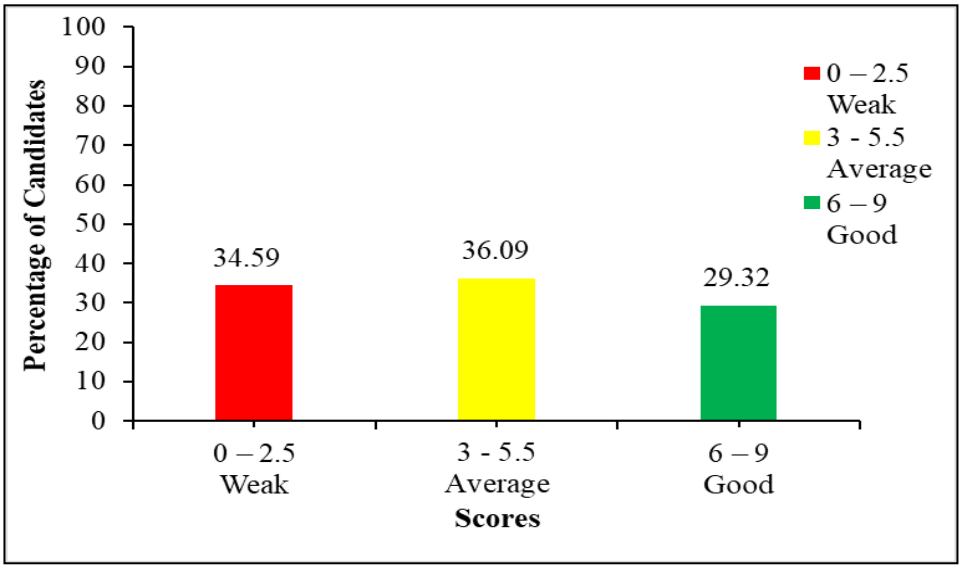
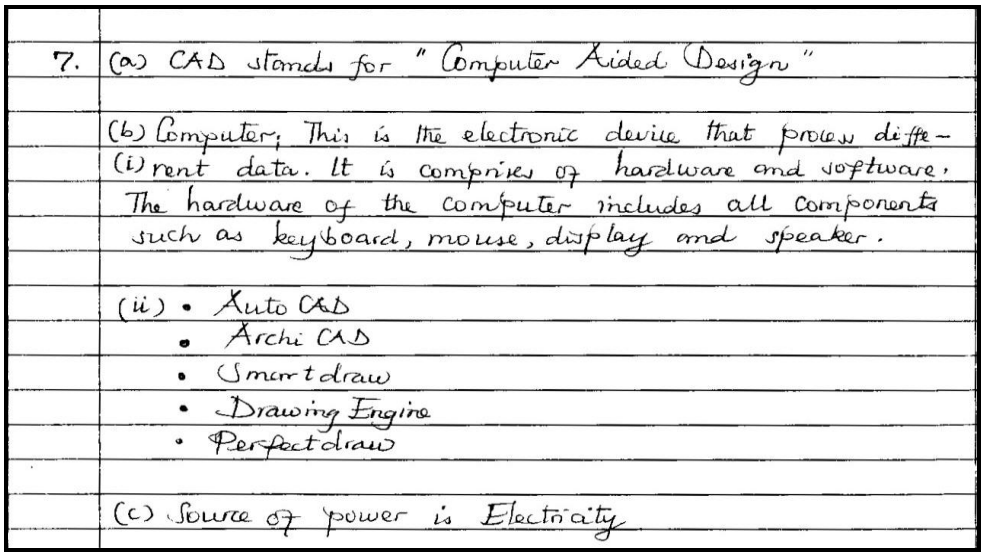


Figure 8: *The Candidates' Performance in Question 7*

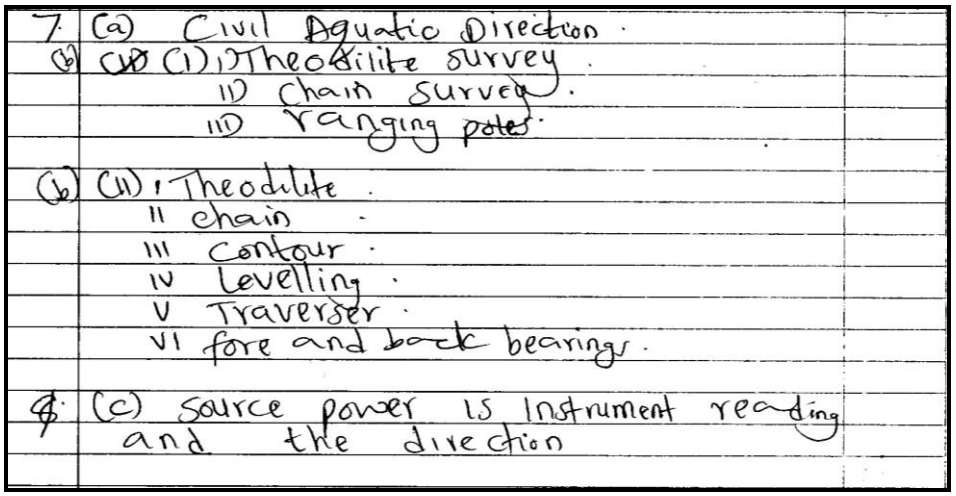
The general performance in this question was good as 87 (65.41%) candidates who attempted this question scored pass marks from 3 to 9 marks. The rest 46 (34.59%) candidates scored between 0 to 2.5 marks.

Based on Figure 8, the candidates' good performance in this question was contributed by their ability to meet the requirements of the question and sufficient knowledge of CAD software. CAD/CAM (computer-aided design (draughting)/computer-aided manufacturing) is a software used to design products such as electronic circuit boards and other products in computers and other devices. CAD (computer-aided design/draughting) uses computer-based software to aid in the design and processing of different things or thoughts. CAD is supported by computer software which is a set of instructions, data, or programs used to operate computers and execute specific tasks. Components such as; Processor, RAM, Display, input devices, Output devices and Storage devices are used to facilitate CAD. According to the great existing understanding of computer literacy nowadays, many candidates were able to answer this question well and scored good marks. Extract 5.1 shows a sample of the candidate's correct response to question 7.



Extract 5.1: A sample of the candidate's correct responses to Question 7

Further analysis shows that despite the fact that the majority of the candidates had performed well, other candidates did not score passing marks. Statistics show that 46 (34.59%) candidates in this question scored from 0 to 2.5 marks. Candidates' poor performance was attributed to irrelevant responses and lack of sufficient basic computer knowledge, other candidates failed to meet the requirements of the question. These candidates also demonstrated that they had inadequate practical skills. In this question, a few candidates who scored a zero mark either attempted only part (a) and scored zero or wrote irrelevant responses in all parts. Extract 5.2 is a sample of incorrect responses to question 7.



Extract 5.2: A sample of the candidate's incorrect responses to Question 7

2.2.6 Question 8: Chain Surveying and Linear measurement

In this question, the candidates were required to classify all the errors that might affect the company's works when establishing a location of building structure and to provide causes for each class of errors classified in part (a). This was intended to assess the candidates' ability to classify the types of errors and their causes. It was stated that;

A survey work was performed by a construction company to establish the location of the building structure. The work is delayed for some days due to some errors appeared and hence effected the commencement of construction works.

(a) Classify all the errors that might affect the company works during the process.

(b) Provide three causes for each class of errors in (a).

The candidates' performance in this question shows that 47 (35.34%) candidates scored from 0 to 2.5 marks, 52 (39.10%) candidates scored from 3 to 5.5 marks and 34 (25.56%) candidates scored from 6 to 9 marks. This analysis is illustrated in Table 11 and Figure 9 respectively.

Table 11: The Score Intervals of Candidates' Performance in Question 8

Scores Range	Remark	General Performance	
		Number of Candidates	Percentage
0 – 2.5	Weak	47	35.34
3 – 5.5	Average	52	39.10
6 - 9	Good	34	25.56
Total		**133**	**100**

The general performance in this question was average because 86 (64.66%) candidates who attempted this question scored pass marks.

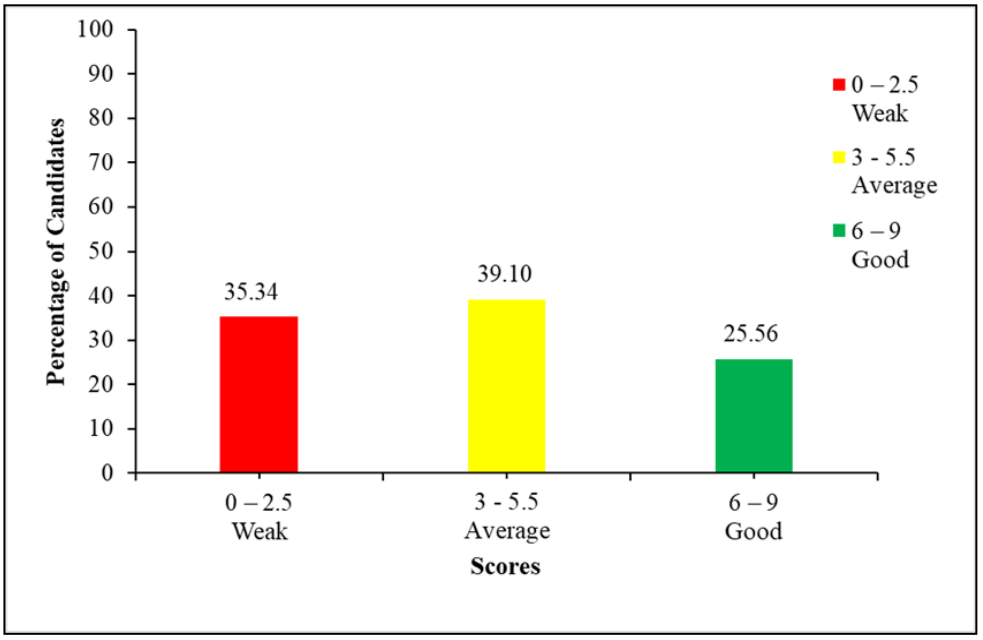
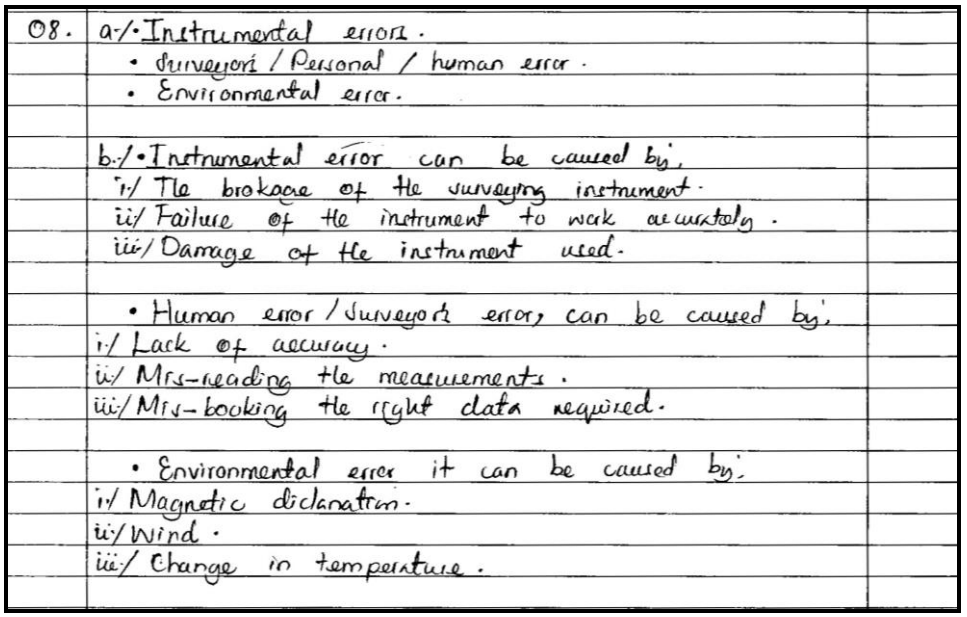


Figure 9: *The Candidates' Performance in Question 8*

Based on Figure 9 and Table 11, the performance of candidates in this question was average. Among those, 86 (64.66%) candidates provided correct responses to question 8. Candidates who answered this question correctly demonstrated a good understanding of the topic that assessed candidates' learning process. They were able to classify accurately all the errors that might affect the company's works during the process, this includes giving correct common errors in surveying such as *Instrumental errors* caused by; *if pivot being bent, improper balancing weight, the needle not being perfectly straight, plane the sight not being vertical* and *sluggish needle.* Secondly, *Personal errors* caused by; *Inaccurate levelling of the compass box, Carelessness of reading and recording, Inaccurate bisection of signals and Inaccurate centering* and lastly *Natural errors* caused by; *Variation of declination, Local attraction forces, Magnetic changes in the atmosphere* and *Irregular variations*. Extract 6.1 shows a sample of correct responses to question 8.


08. a./ • Instrumental errors.
• Surveyors / Personal / human error.
• Environmental error.

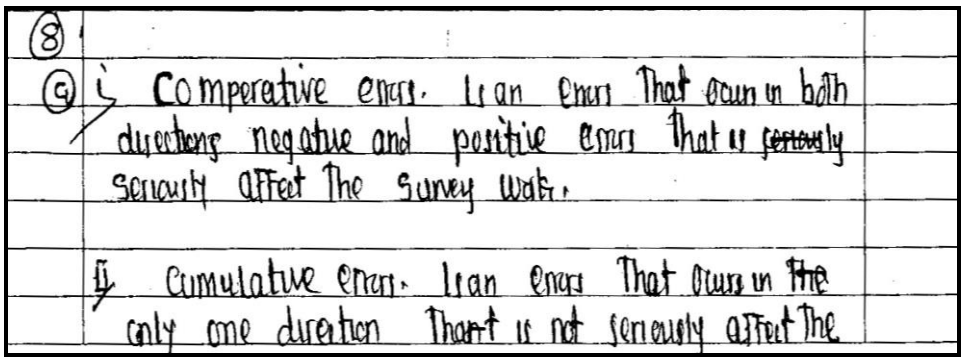
b./ • Instrumental error can be caused by,
i./ The brokage of the surveying instrument.
ii./ Failure of the instrument to work accurately.
iii./ Damage of the instrument used.

• Human error / Surveyors error, can be caused by,
i./ Lack of accuracy.
ii./ Mis-reading the measurements.
iii./ Mis-booking the right data required.

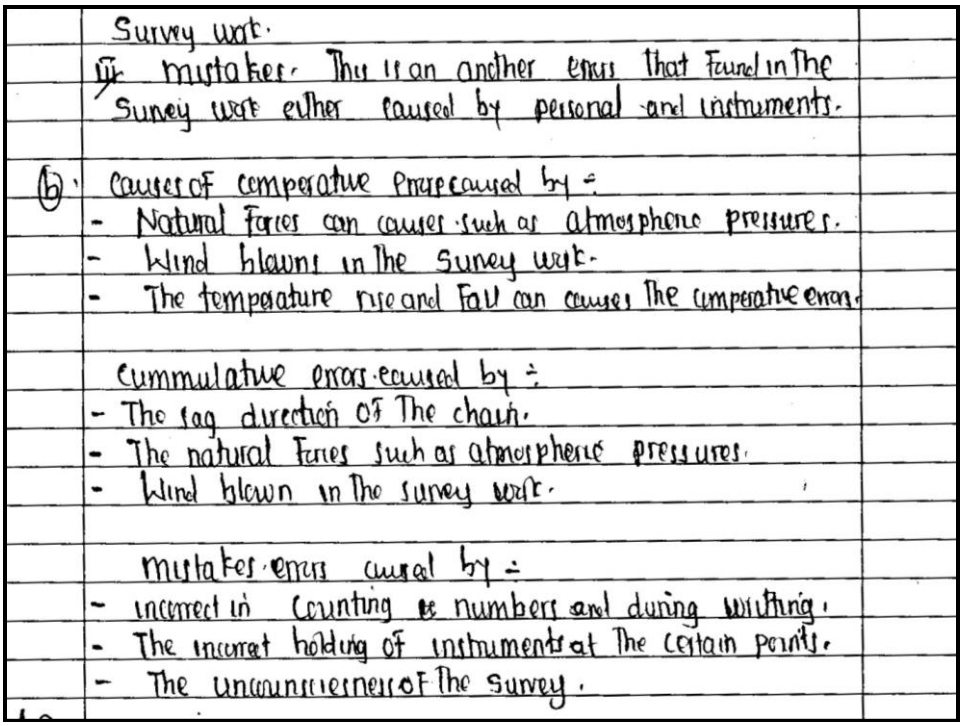
• Environmental error it can be caused by;
i./ Magnetic declination.
ii./ Wind.
iii./ Change in temperature.

Extract 6.1: A sample of the candidate's correct responses to Question 8

The same to other questions, some of the candidates were discriminated against from the first discussed group due to their failure in this question. As was analyzed earlier there were 47 (35.34%) candidates scored from 0 to 2.5 marks. This group of candidates had inadequate knowledge and skills of the topic of *Chain Surveying and Linear measurement.* Another factor for their poor performance was contributed by misconception of the demand for the questions. Most of the candidates they confused instead of writing the three main sources of errors wrote the errors associated with common errors of either Natural errors, Instrumental errors, or Personal errors. The candidates wrote mistakes, accidental errors, systematic or cumulative errors and compensating errors which are wrong answers. Extract 6.2 shows a sample of candidates' incorrect responses to question 8.


(8)
(a) i Comperative errors. Is an errors That occurs in both directions negative and positive errors That is ~~seriously~~ seriously affect The survey work.

ii Cumulative errors. Is an errors That occurs in The only one direction Thant is not seriously affect The


Survey work.
(i) mistakes. This is an another errors that found in the Survey work either caused by personal and instruments.

(b) causes of comperative error caused by :
- Natural Forces can causes such as atmosphere pressures.
- Wind blowns in the survey work.
- The temperature rise and fall can causes the comperative error.

Cummulative errors caused by :
- The sag direction of the chain.
- The natural Forces such as atmospheric pressures.
- Wind blown in the survey work.

mistakes errors caused by :
- incorrect in counting of numbers and during writhing.
- The incorrect holding of instruments at the certain points.
- The unconsciesness of the survey.

Extract 6.2: A sample of the candidate's incorrect responses to Question 8

2.3 SECTION C: Structured Question

This section consisted of three (3) questions 9 to 11, in which the candidates were required to attempt only two questions which weighed 15 marks each making a total of 30 marks. The score ranges used for grading the performance of the candidates for the questions are indicated in Table 12. The candidates with average to good performance were considered to have passed a particular question.

Table 12: The Scores Range for Candidates' Performance for Questions 9 to 11

Scores Range	General Performance	
	Remark	**Grade**
0 – 4	Weak	F
4.5 – 9.5	Average	C – D
10 – 15	Good	A - B

2.3.1 Question 9: Levelling

This question had two parts: (a) and (b) wherein (a) the candidates were required to determine *the true Reduced Level (RL) of a certain point, the combination correction for curvature and refraction* and *the collimation*

error. In part (b) candidates were required to conclude whether; *the line of collimation inclined upward or downward.* The question was intended to measure the candidate's ability in data collection, data interpretation and simple calculation of the reduced level through collected data. The question stated that;

A surveyor has just conducted a field operation involving reciprocal levelling on a certain site from point A to B, and the information collected has been presented in Table 1.

Table 1: Reducing level

Instrument at		***A***	***B***	***Remarks***
Staff reading on	*A*	*2.675*	*3.685*	*Distance = 400 m*
	B	*1.295*	*2.565*	*Reduced Level (RL) of A = 430.50 m*

(a) Review the information given in Table 1 and determine;
- *(i) The true Reduced Level (RL) of B.*
- *(ii) The combination correction for curvature and refraction.*
- *(iii) The collimation error.*

(b) Is the line of collimation inclined upward or downward?

The analysis of candidates' performance in this question shows that 41 (82.00%) candidates out of 50 (100%) who attempted this question scored from 0 to 4.5 marks, 09 (18.00%) candidates scored from 5 to 9.5 marks, and none of the candidates scored from 10 to 15 marks. This analysis is summarized in Table 13 and illustrated in Figure 10.

Table 13: The Candidates' Performance in Question 9

Scores Range	**Remark**	**General Performance**	
		Number of Candidates	**Percentage**
0 – 4	Weak	41	82.00
4.5 – 9.5	Average	09	18.00
10 - 15	Good	00	0.00
Total		**50**	**100**

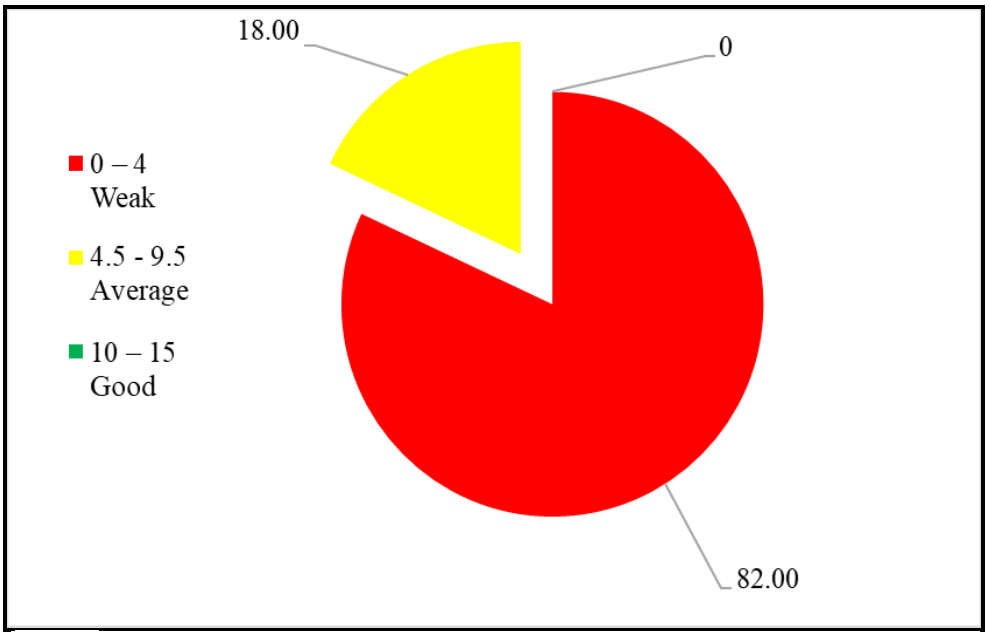
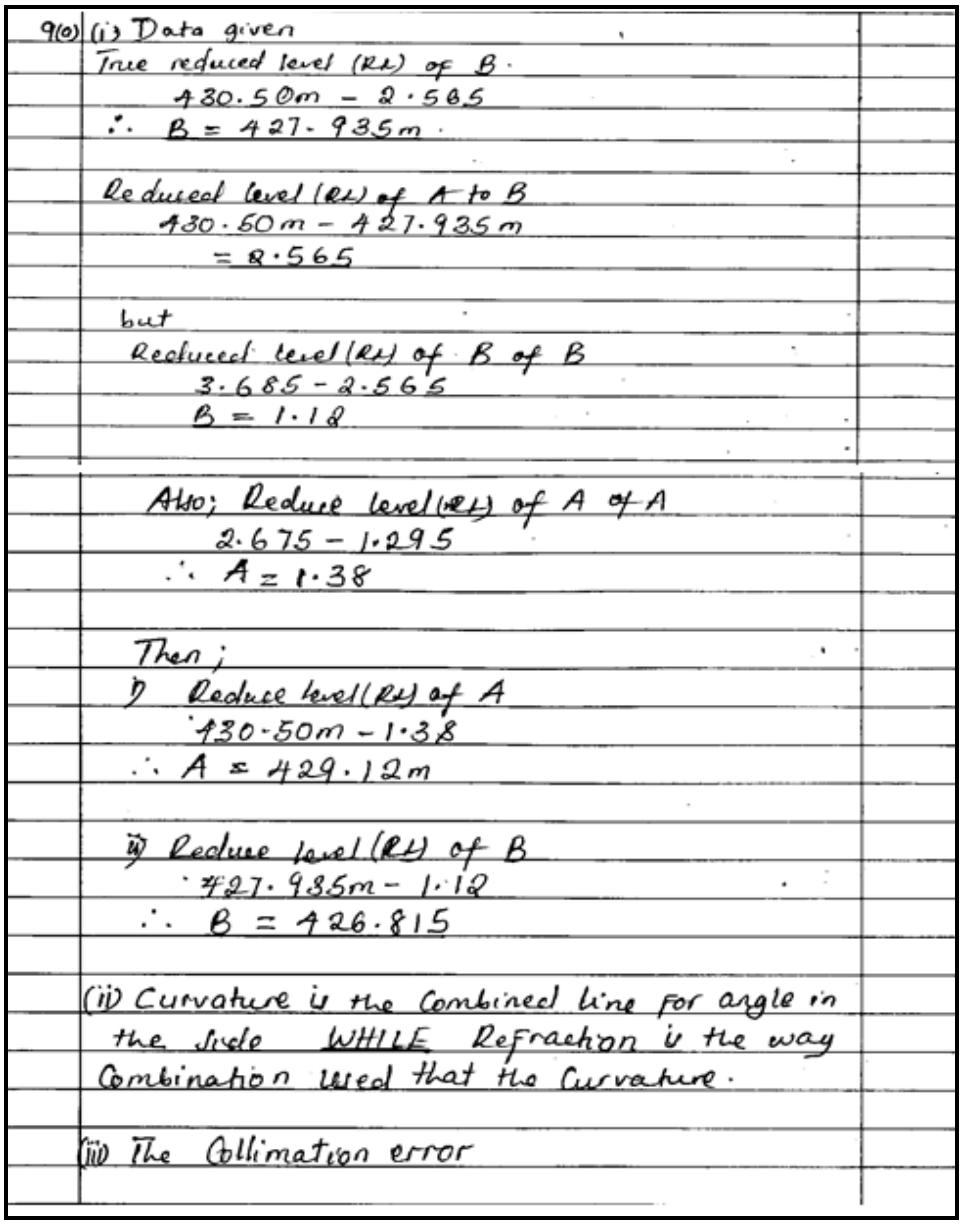


Figure 10: *The Candidates' Performance in Question 9*

The general performance of candidates in this question was poor as 41 (82.00%) out of 50 candidates who attempted this question failed to score pass mark. This is the most omitted question in this section where the candidates are instructed to attempt only two out of three questions. The low marks portrayed a lack of knowledge in levelling, most of the candidates failed to calculate the true Reduced level of a given point, the combination correction for curvature and refraction and the collimation error in part (a). In part (b) the candidates also failed to make any conclusion after the calculation, either the line of collimation inclined upward or downward. If the value of collimation error was positive the line of collimation is inclined upward and if collimation error was negative the line of collimation is inclined downward. Most of the candidates ended by writing a formula for a reduced level but failed to substitute a correct value. On the other hand, those who were able to provide the correct value failed to use the data for other steps. Extract 7.1 is a sample of incorrect responses to question 9.


9(a) (i) Data given
True reduced level (RL) of B.
430.50m - 2.565
∴ B = 427.935m.

Reduced level (RL) of A to B
430.50m - 427.935m
= 2.565

but
Reduced level (RL) of B of B
3.685 - 2.565
B = 1.18

Also; Reduce level (RL) of A of A
2.675 - 1.295
∴ A = 1.38

Then;
i) Reduce level (RL) of A
430.50m - 1.38
∴ A = 429.12m

ii) Reduce level (RL) of B
427.935m - 1.12
∴ B = 426.815

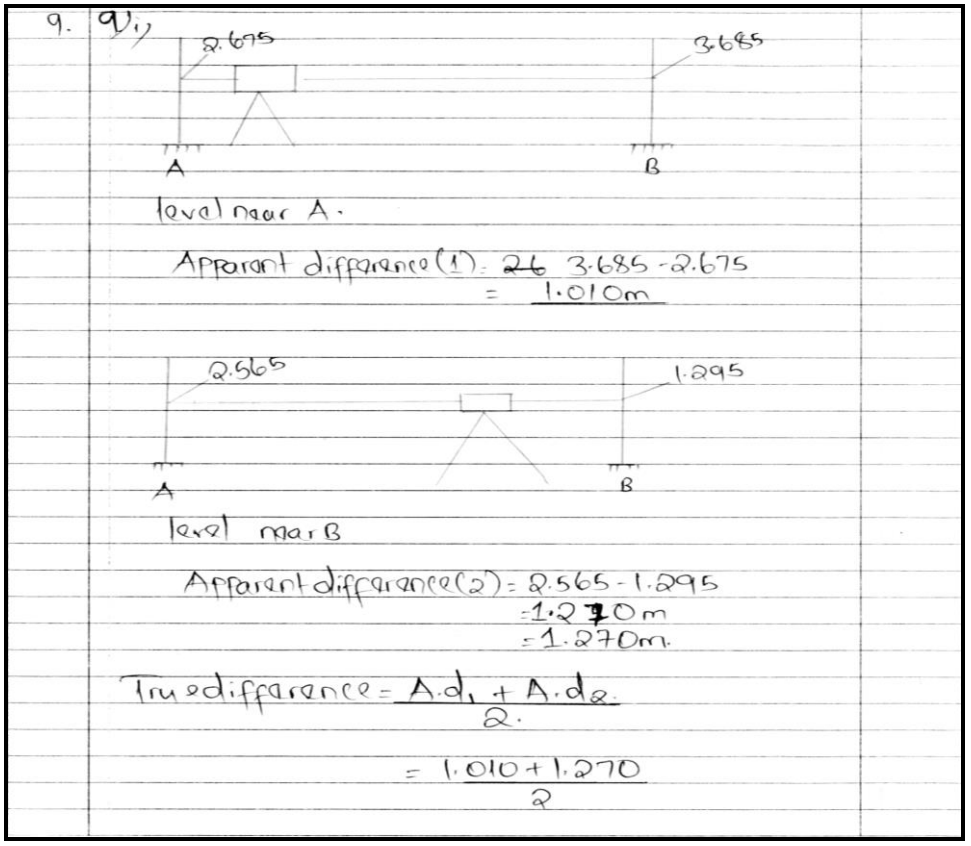
(ii) Curvature is the combined line for angle in the side WHILE Refraction is the way Combination used that the Curvature.

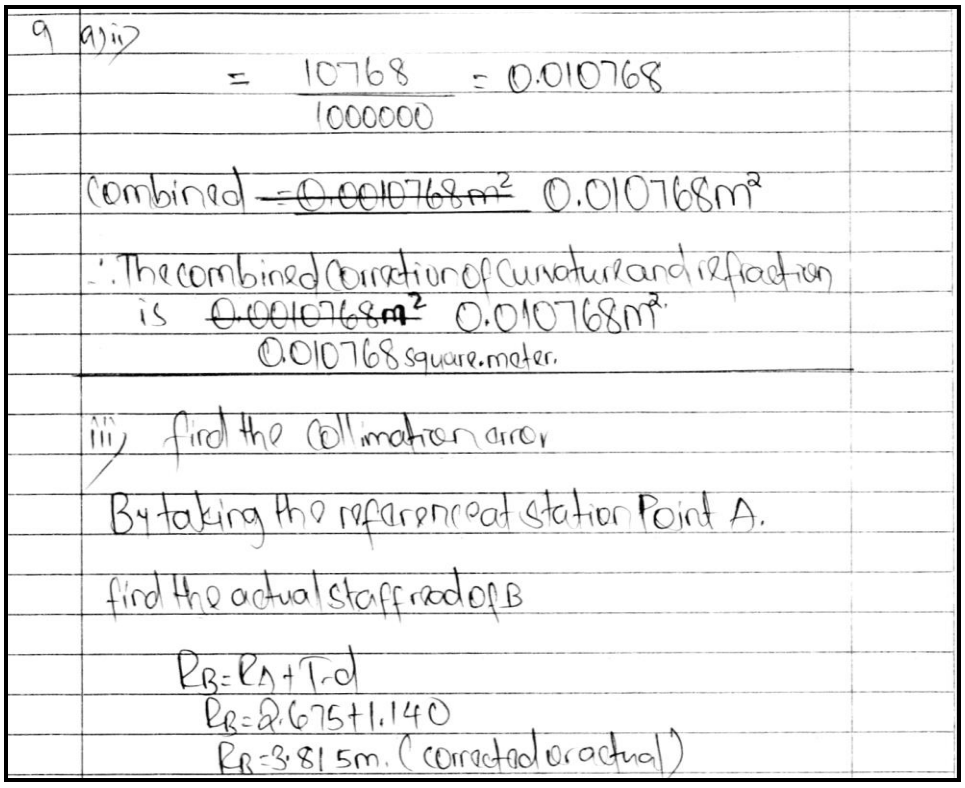
(iii) The Collimation error

Extract 7.1: A sample of the candidate's incorrect responses to Question 9

As shown in table 13, there were 9 (18.00%) candidates who understood the demand of the question and wrote a correct response. The candidates who were able to pass this question at least at an average level, managed to answer some of the aspects. This group of candidates at least had a little technical ability and memory of formula or procedure that can be used to calculate the value of various terms in levelling. The majority of candidates failed to make a conclusion on either the line of collimation inclined upward or downward and to use the formula for calculation of the

reduced level at a specific point. Therefore, they failed to score the allotted full marks on this question. Extract 7.2 is a sample of some correct responses to question 9.





Extract 7.2: A sample of the candidate's correct responses to Question 9

2.3.2 Question 10: Contouring

The question had three (3) parts; (a), (b) and (c) in which the candidates were required to explain the meaning of contour interval in part (a). Part (b) to evaluate four conditions that make contour interval proper and lastly part (c) was to provide six uses of contour map. Generally, this question is intended to measure the candidates' ability to provide valuable information about the terrain through contour skills. It was stated that;

For contour map to be presented well and interpreted easily by an interpreter, the contour interval must be in a proper form during the plotting of the contour.

(a) What does the contour interval mean?

(b) Evaluate four conditions that make contour interval proper.

(c) Provide six uses of contour map.

The analysis of candidates' performance in this question shows that 38 (29.69%) candidates out of 128 (100%) who attempted this question scored from 0 to 4.5 marks, 46, (35.94%) candidates scored from 5 to 9.5 marks, 44 (34.37%) candidates scored from 10 to 15 marks. This analysis is

summarized and presented in Table 14 and illustrated in Figure 11.

Table 14: The Candidates' Performance in Question 9

Scores Range	Remark	General Performance	
		Number of Candidates	Percentage
0 – 4	Weak	38	29.69
4.5 – 9.5	Average	46	35.94
10 - 15	Good	44	34.37
Total		**128**	**100**

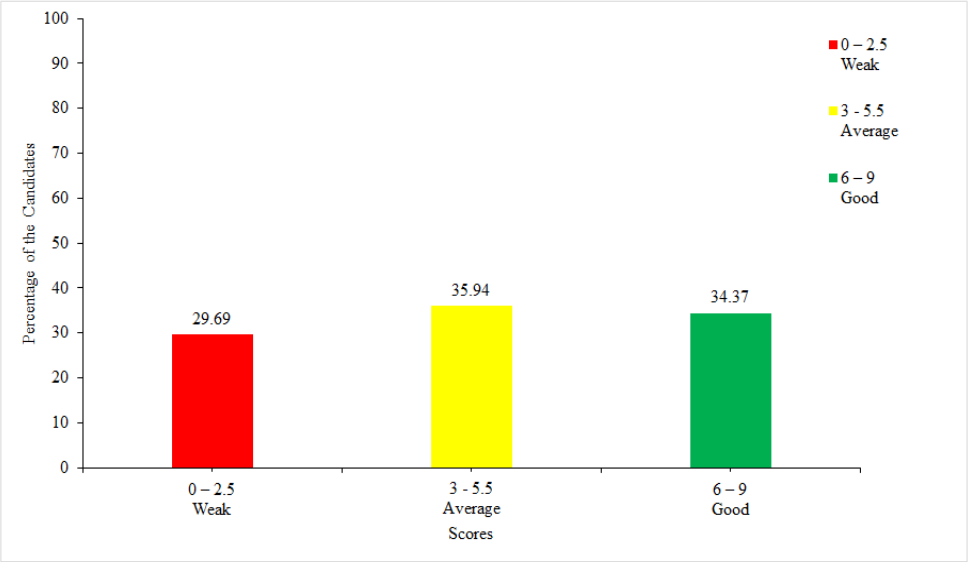


Figure 11: *The Candidates' Performance in Question 10*

As presented in Figure 11, the general performance of candidates in this question was good as 90 (70.31%) candidates scored pass and above pass marks and the remaining 38 (29.69%) candidates scored below pass marks.

The question attracted many candidates to attempt and most of them scored good marks. These results are based on the fact that candidates have knowledge of the topic of contour and they can give good answers to all items of this question. Further analysis revealed that most of the candidates managed to define the meaning of contour interval by providing the correct statement which is the vertical distance between any two consecutive contours. Also, the candidates managed to evaluate four conditions that make contour interval proper by looking at the time and expense of field and office work, the purpose and extent of the survey, the nature of the ground and lastly when looked at the scales of the map presented. Finally,

the candidates provided six uses of a contour map which includes the earthwork calculations for a given communication line in the direction of the section through a drawing of a section, and determination of Intervisibility between two points. Also, a contour map helps to determine the intervisibility of the triangulation stations and the location of the route, as well as in tracing lines used to separate basin areas from others (measurement of drainage areas). Lastly, it helps to calculate the capacity of the reservoir. Extract 8.1 shows a sample of the candidate's best response to this question.

10. (a) Contour interval is the constant vertical distance between two consecutive contours. These are arranged in either descending or ascending depending on the nature of the ground.

(b)(i) The scale of the map. The contour intervals always depending on the scale that is used to draw the given map. The higher scale of the map makes the lower contour interval.

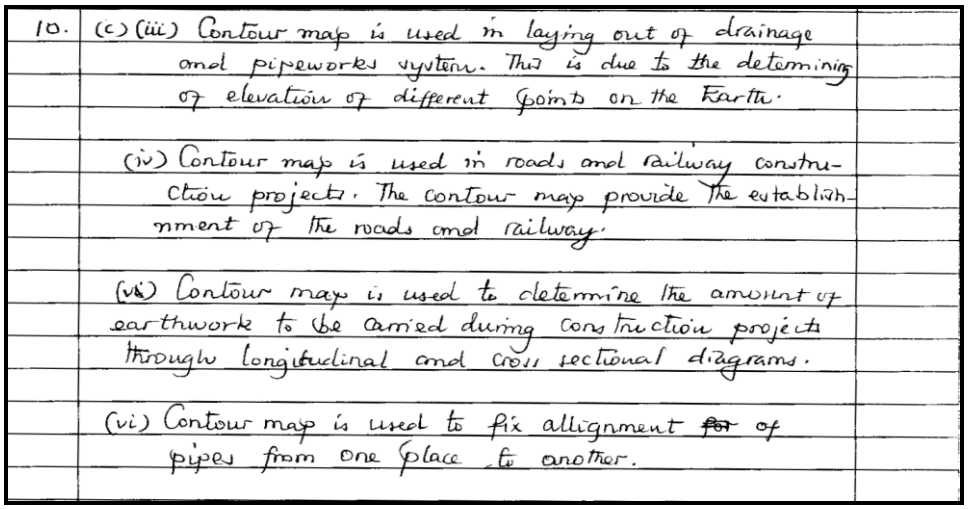
(ii) Nature of the ground. The contour intervals depending on the nature of the map. The increase in flatness of the ground makes the decrease in contour interval.

(iii) Purpose of contouring. Each purpose has its own favourable contour interval to be used in countouring

(iv) Time and Expenses. The contour interval depend on the time and expenses given to conduct contouring, The higher time makes the ~~large~~ small contour interval be used.

(c)(i) Contour map is used to show the features that found in a given place, these features includes hills, valley and others

(ii) Contour map is used to show the points of the same elevation. The contour maps determine those points that have the same elevation from mean sea level (MSL)


10. (c) (iii) Contour map is used in laying out of drainage and pipeworks system. This is due to the determining of elevation of different points on the Earth.

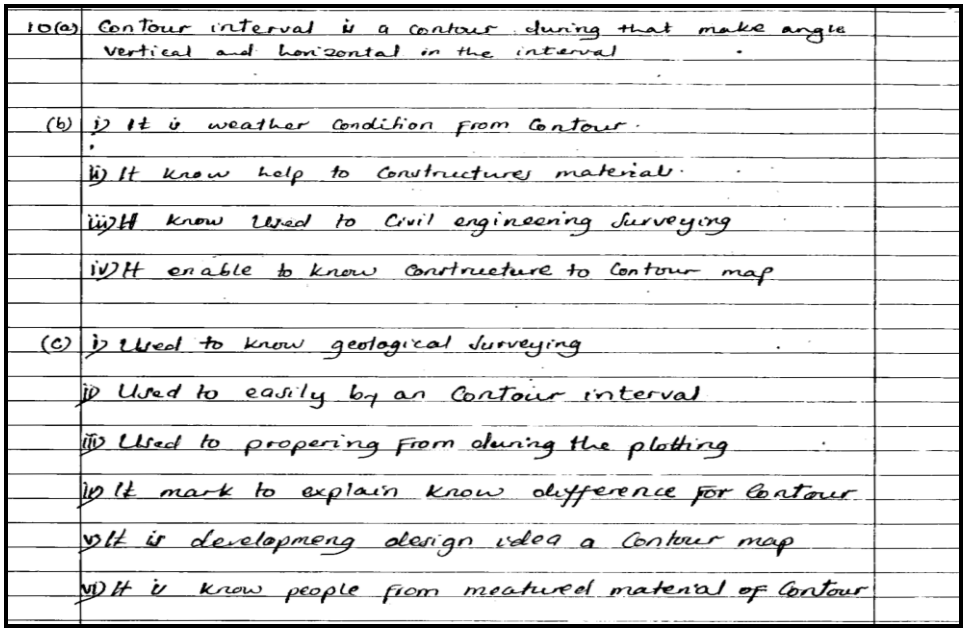
(iv) Contour map is used in roads and railway construction projects. The contour map provide the establishment of the roads and railway.

(v) Contour map is used to determine the amount of earthwork to be carried during construction projects through longitudinal and cross sectional diagrams.

(vi) Contour map is used to fix allignment ~~for~~ of pipes from one place to another.

Extract 8.1: A sample of the candidate's correct responses to Question 10

Even though, the majority of the candidates had performed well, other candidates were not able to score pass marks. Statistics show that 38 (29.69%) candidates in this question scored from 0 to 4 marks. Candidates' poor performance was attributed to irrelevant responses and lack of sufficient knowledge on contouring, other candidates failed to meet the requirements of the question. These candidates also demonstrated that they had inadequate skills in contour lines on topographical maps. Extract 8.2 is a sample of incorrect responses to question 10.


10(a) Contour interval is a contour during that make angle vertical and horizontal in the interval

(b) i) It is weather condition from Contour.

ii) It know help to constructures material.

iii) It know used to Civil engineering surveying

iv) It enable to know constructure to Contour map

(c) i) Used to know geological surveying

ii) Used to easily by an Contour interval

iii) Used to propering from during the plotting

iv) It mark to explain know difference for Contour

v) It is developmeng design idea a Contour map

vi) It is know people from meatured material of Contour

Extract 8.2: A sample of the candidate's incorrect responses to Question 10

2.3.3 Question 11: Area and Volume

The question was prepared from the topic of "*Area and Volume"* in which the candidates were required to calculate the volume of soil excavated by using a prismoidal formula. The question was designed to test the ability of candidates to deal with uneven ground or topography. The question stated that;

"The ground level along the centerline of a road from point A to B is; 117.50, 116.25, 115.95, 116.65, 117.20, 117.85, and 115.75 with chainage (m) 0, 50, 100, 150, 200, 250, and 300 respectively. It is proposed that the formation level of reduced level (RL) is 115.00 and should be kept constant as starting from the chainage 'zero'. If the ground level is transverse to the centre line, the formation width of the road is 8 m, and the side slope is 1:1. Calculate the volume of soil excavated by prismoidal formula."

This question was attempted by 88 (100%) candidates, whereby 53 (60.23%) candidates scored from 0 to 4 marks. The candidates who scored from 4.5 to 9.5 marks were 15 (17.04%) while 20 (22.73%) of candidates scored from 10 to 15 marks. The scoring data for this question is summarized and presented in Table 15 and Figure 12.

Table 15: The General Candidates' Performance in Question 11

Scores Range	Remark	General Performance	
		Number of Candidates	Percentage
0 – 4	Weak	53	60.23
4.5 – 9.5	Average	15	17.04
10 - 15	Good	20	22.73
Total		88	100

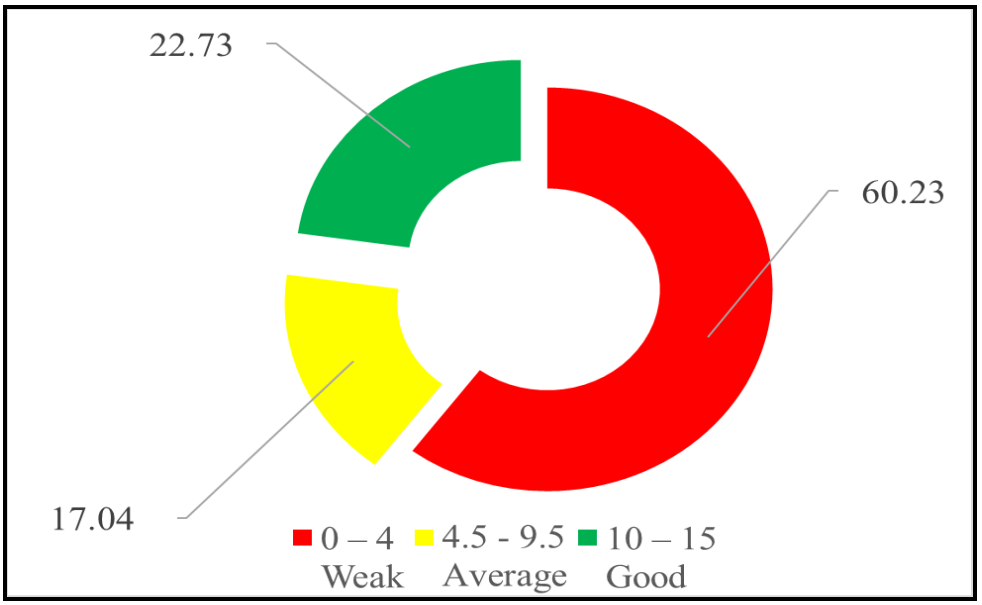


Figure 12: *The Candidates' Performance in Question 11*

Based on Figure 12, the general performance of the candidates in this question was low as 53 (60.23%) of candidates scored below pass marks. The prismoidal formula applies to volumes of all geometric solids that can be considered prismoids. In order to use the prismoidal formula, it is necessary to know the area of the section halfway between the stations. This is found by the usual computation after averaging the heights and widths of the two end sections. Apparently, the middle area is not the average of the end areas, since there would then be no difference between the results of the end-area formula and the prismoidal formula. Most of the candidates were able to write the correct formula of the volume computation but failed to substitute the correct value of the area. In case, the data substituted is wrong, also the final answer usually should be wrong. The candidates depicted a lack of knowledge of the topic and failure to understand the required steps of the question. Extract 9.1 demonstrated samples of candidates' incorrect responses to the question asked.

11 Soln

Common distance (d) = 50m.

From $V = \frac{d}{3}(A_1 + A_n + 4(\text{even Areas}) + 2(\text{odd Area}))$

Now;

$A_1 = 117.5 - 115.00 \times \text{width}$
$= 2.5m \times 8m$
$= 20m^2$

$A_2 = 116.25 - 115.0 \times \text{width}$
$= 1.25m \times 8m$
$= 10m^2$

$A_3 = (115.95 - 115.0) \times \text{width}$
$= 0.95m \times 8m$
$= 7.6m^2$

$A_4 = (116.65 - 115.0) \times 8m$
$= 1.65m \times 8m$
$= 13.2m^2$

$A_5 = (117.2 - 115.0) \times 8m$
$= 2.2m \times 8m$
$= 17.6m^2$

$A_6 = (117.85 - 115.0) \times 8m$
$= 2.85m \times 8m$
$= 22.8m^2$

$A_7 = (115.75 - 115.0) \times 8m$
$= 0.75m \times 8m$
$= 6m^2$

Now; $V = \frac{d}{3}(A_1 + A_n + 4(\text{even } A) + 2(\text{odd } A))$

$V = \frac{d}{3}(20+6 + 4(10+13.2+22.8)+2(7.6+17.6)$

$V = \frac{50}{3}(26 + 4(46) + 2(25.2)$

$= 16.67(26 + 184 + 50.4)$
$= 16.67(260.4)$
$= 4340.868m^3$

∴ The volume of soil excavated is 4340.868 m^2

Extract 9.1: A sample of candidates' incorrect responses to Question 11

At the same time, other candidates scored average and good marks because, not only that, they had adequate knowledge of the topic, but also, they had sufficient skills of being able to transfer knowledge obtained in other courses such as; mathematics and engineering science used to attempt this question. Extract 9.2 demonstrated a sample of the candidate's correct response to the question.

11. Data given

Reduced level (RL) = 115.000m.

Interval (Δh) = 50−0 = 100−50 = 150−100 = 200−150 = 250−200 = 300−250 = 50m.

Formation width (b) = 8m.

Side slope (t:1) = 1:1

Then; The height of the point: $h_n = MI_n - RL$

h_1 = 117.50m − 115.000m = 2.5m

h_2 = 116.25m − 115.000m = 1.25m

h_3 = 115.95m − 115.000m = 0.95m

h_4 = 116.65m − 115.000m = 1.65m

h_5 = 117.20m − 115.000m = 2.20m

h_6 = 117.85m − 115.000m = 2.85m

h_7 = 115.75m − 115.000m = 0.75m.

Hence: In order to get the volume, we need to calculate the volume Area of the point

from $A = h(b + th)$.

then

$A_1 = h_1(b + th_1)$.

$= 2.5m(8m + 2.5m \times 1)$.

$= 2.5m \times 10.5m$

$= 26.25m^2$

$A_2 = h_2(b + th_2)$

$= 1.25m(8m + 1 \times 1.25m)$.

$= 1.25m \times 9.25m$

$= 11.5625m^2$

11.

$A_3 = h_3 (b + th_3)$

$= 0.95m (8m + 1x\ 0.95m)$.

$= 0.95m \times 8.95m$

$= 8.5025m^2$

$A_4 = h_4 (b + th_4)$.

$= 1.65m (8m + 1x\ 1.65m)$.

$= 1.65m \times 9.65m$

$= 15.9225m^2$

$A_5 = h_5 (b + th_5)$.

$= 2.20m (8m + 1x\ 2.20m)$.

$= 2.20m \times 10.20m$

$= 22.4400m^2$

$A_6 = h_6 (b + th_6)$.

$= 2.85m (8m + 1x\ 2.85m)$.

$= 2.85m \times 10.85m$

$= 30.9225m^2$

$A_7 = h_7 (b + th_7)$

$= 0.75m \times (8m + 1x\ 0.75)$

$= 0.75m \times 8.75m$

$= 6.5625m^2$

Then consider below

Offsets	A_1	A_2	A_3	A_4	A_5	A_6	A_7
Area (m^2)	26.2500	11.5625	8.5025	15.9225	22.4400	30.9225	6.5625
Δheight (km)	50	50	50	50	50	50	50

Therefore

11.

From:

$V = \frac{\Delta h}{3}\left[A_1 + A_n + 4(\Sigma \text{even areas}) + 2(\Sigma \text{odd areas})\right]$

$= \frac{50m}{3}\left[A_1 + A_7 + 4(A_2 + A_4 + A_6) + 2(A_3 + A_5)\right]$

$= \frac{50m}{3}\left[26.2500 + 6.5625 + 4(11.5625 + 15.9225 + 30.9225) + 2(8.5025 + 22.4400)\right]$

$= \frac{50m}{3}\left[32.8125 + 233.6300 + 61.885\right]$

$= \frac{50m}{3} \times 328.3275m^3$

$= 5472.125m^3$

$\therefore$ The volume of soil excavated is $5472.125m^3$

Extract 9.2: A sample of candidate's correct responses to the Question 11

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE PER TOPIC

The candidates' performance in CSEE 2023 was good as shown in the analysis of each question. The paper covered seventeen topics including *Introduction, Chain survey and linear measurement, Introduction to surveying methods, Surveying Techniques for small areas, Surveying Techniques for Small Areas (Practice), Surveying techniques practices, Surveying Tools and Equipment, Civil engineering surveyor, Safety management and rules, Compass Surveying, Theodolite surveying, Surveying practice, Line levelling, Introduction to Computer Aided Draughting (CAD), Levelling, Contouring* and *Area and volume.* However, eight (8) topics were tested in the multiple-choice items.

Among the topics tested, four had a poor performance, three topics had an average performance and lastly, three topics had good performance. The topics that tested question 1 had good performance with 88.72% of all candidates who attempted the question.

The highest performance featured in the question that tested the topics of Civil Engineering Surveying; *Safety management and rules was 92.48%, Contouring 70.31%* and *Introduction to Computer Aided Draughting (CAD) 65.41% followed by; Chain Surveying and Linear Measurements 64.66%, Area and Volume 39.77%* and *line levelling 35.34%.* Lastly, the lowest-performed topics were *levelling 18.00%, Surveying Practice 11.28%, Theodolite Surveying 9.02%* and *Compass Surveying 4.51%.* The summary of performance in each question and per topic is appended at the end of this report as Appendix.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The performance of the candidates in Civil Engineering Surveying subject in 2023 CSEE was good, given that 113 (84.96%) candidates were able to score pass marks and above.

In general, candidate's performance in questions 1, 2, 7 and 10 was good while the performance in questions 6, 8, and 11 was average. The poorly performed questions were 3, 4, 5 and 9 from the topics of *Compass Surveying, Theodolite Surveying, Surveying Practice* and *Levelling.*

Most candidates who performed poorly failed to understand the questions' requirements, and had inadequate knowledge of the topics tested. Moreover, they had incompetent skills and practical experience, especially in the topics of *Compass Surveying*, which hindered them from providing good answers. Therefore, candidates need to put more effort into studying Civil Engineering Surveying Subject to improve their competencies.

4.2 Recommendations

Based on the performance observed in this analysis, the following recommendations are worth noting for students and teachers:

Recommendations for Students

(a) Should be committed to studying with more effort and carefully reading the instructions before attempting the questions so as to understand the demands of the questions.

(b) Encouraged to search and study relevant materials from books or internet sources in order to widen their knowledge. This will help them to grasp relevant and modern concepts and theories applied in Surveying.

(c) Should be involved in practical work (activities) whenever they get any chance to participate. This will lead them to learn by doing.

Recommendations for Teachers

(a) Should provide more exercises, homework, and assignments and provide feedback to the candidates on time for further learning and preparation for assessments.

(b) Should help students to develop practical skills so as to be able to integrate theories with practical experiences, hence acquiring the expected competencies.

(c) Should seek pedagogical skills and knowledge on how to teach Civil Engineering subjects based on a competence-based curriculum, Civil Engineering Surveying subject and examination format.

(d) May use interactive projectors during teaching to make learning more active and productive. Through this method, candidates can see visual aids, like colorful charts, diagrams and videos which help them acquire the expected skills of the subject matter.

Appendix

Analysis of the Candidates' Performance in Each Question and Per Topic

S/N	Topics	Question Number	Percentage of Candidates who Scored 30% or More	Remarks
1	Safety management and rules	2	92.48	Good
2	Civil Engineering Surveyor Surveying Practice Surveying Tools and Equipment Safety Management and Rules, Introduction to Surveying Methods, Chain Surveying and Linear Measurements, Compass Survey, Surveying Techniques Practice, and Introduction to Surveying.	1	88.72	Good
3	Contouring	10	70.31	Good
4	Surveying Introduction to Computer Aided Draughting (CAD)	7	65.41	Good
5	Chain Surveying and Linear Measurements	8	64.66	Average
6	Area and Volume	11	39.77	Average
7	Line levelling	6	35.34	Average
8	Levelling	9	18.00	Poor
9	Surveying Practice	5	11.28	Poor
10	Theodolite Surveying	4	9.02	Poor
11	Compass Surveying	3	4.51	Poor