THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

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

ELECTRONICS AND COMMUNICATION ENGINEERING

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

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

081 ELECTRONICS AND COMMUNICATION ENGINEERING

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

Table of Contents

LIST OF SYMBOLS AND ABBREVIATIONS

NECTA	National Examination Council of Tanzania
RF	Radio Frequency
A.C	Alternating Current
D.C	Direct Current
CSEE	Certificate of Secondary Education Examination
Hz	Hertz
TV	Television
UHF	Ultra-High Frequency
AM	Amplitude Modulation
FM	Frequency Modulation
V	Volts
MATV	Master Antenna Television
M	Mega
Ω	Ohm
k	Kilo
H	Henry
R	Resistance
A	Ampere
pF	Pico Farad
CRT	Cathode Ray Tube
CATV	Cable Television
IC	Integrated Circuit
TBC	Tanzania Broadcasting Corporation
PAM	Pulse Amplitude Modulation
PW	Pulse Width
PCM	Pulse Code Modulation
PPM	Pulse Position Modulation

FOREWORD

This report presents Candidates' Items Response Analysis (CIRA) on Form Four National Examination in Electronics and Communication Engineering subject which was conducted in November 2023. The report aims to provide feedback to all educational stakeholders on the factors that contributed to the candidates' performance in Electronics and Communication Engineering subject.

The Form Four National Examinations (CSEE) is a summative evaluation which intends to measure the knowledge, skills and competences acquired by the candidates in four years of instructional period of ordinary level of secondary education. The report therefore, provides feedback that teachers, candidates and other educational stakeholders can use to improve teaching and learning process. This analysis justifies the candidates' performance in the Electronics and Communication Engineering subject. The candidates who attained high scores demonstrated their ability to understand the requirement of the questions, their knowledge, skills and competence in the subject matter, and their mastery of calculation skills. However, candidates who scored low marks faced difficulties in responding to the questions due to their insufficient knowledge of the tested concepts.

The National Examinations Council of Tanzania (NECTA) expects that the feedback provided in this report will enable teachers and other education stakeholders to take proper measures to improve teaching and learning process in Electronics and Communication Engineering subject. Consequently, prospective candidates will acquire knowledge, skills and competence indicated in the syllabus for better performance in future examination.

The Council appreciates the contribution of all those who prepared this report.

Dr. Said Ally Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents the analysis of the performance of candidates who sat for the Certificate of Secondary Education Examination (CSEE) 2023 in Electronics and Communication Engineering. The paper consisted of eleven (11) questions which were categorized into three sections; A, B and C. Section A had two (2) questions: one (1) multiple choice question with 10 items set from the topics of *Introduction on Electricity, Repair and Maintenance of TV Receiver, Electronics Drawing, Communication System, Television Receiver, Consumer Electronics, Electronics Components and Communication System.* Question two (2) was a matching items with 6 corresponding items set from the topic of *Cable Television*. The candidates were required to answer all the items in this section. Each item carried 1 mark, making a total of 16 marks. Section B consisted of six (6) short answer questions. The candidates were required to answer all the questions in this section. Each question carried 09 marks, making a total of 54 marks. Section C consisted of three (3) structured questions. The candidates were required to answer two questions from this section. Each question carried 15 marks, making a total of 30 marks.

In this report, the analysis of candidates' performance is categorized into three categories; good, average and weak, indicated by green, yellow and red colors, respectively. In each question the performance is regarded as good if a candidate scores ranges from 65 to 100 per cent, average if the scores range from 30 to 64 per cent and weak if the scores range from 0 to 29 per cent as illustrated in Table 1.

Table 1: The Grade Ranges of the Candidates' Performance

Range in Percentage	**0 – 29**	**30 – 64**	**65 – 100**
Remark on performance	Weak	Average	Good

The report also presents the requirement of each question, the percentage of the candidates who attempted the question with their scores and the possible reasons for their performance. Extracts from the candidates' examination scripts, graphs indicating distribution of candidates' scores and appendices are presented for illustrations.

A total of 215 candidates sat for the CSEE in the Electronics and Communication Engineering subject in the year 2023. Among them, 196

(91.16%) candidates passed while 19 (8.84%) candidates failed. Generally, the candidates' performance in this paper is good. The candidates' grade scores are presented in Table 2.

Table 2: The Candidates' Grade Scores in 2023

Year	Total Number of Candidates	Passed		Failed		Candidates Grade of Scores				
		No.	%	No.	%	A	B	C	D	F
2023	215	196	91.16%	19	8.84%	1	11	103	81	19

2.0 THE ANALYSIS OF THE CANDIDATES' RESPONSES TO EACH QUESTION

2.1 Section A: Objective Questions

This section consisted of two (2) compulsory objective type questions. Question 1 consisted of ten (10) multiple choice items, each carrying a weight of 1 mark, totaling to ten (10) marks and question 2 consisted of six (6) matching items, each carrying 1 mark totaling to six (6) marks. The cumulative score for the entire section was 16 marks.

2.1.1 Question 1: Multiple Choice Items

The question consisted of 10 multiple choice items (i-x) derived from the following topics: *Introduction on Electricity, Repair and Maintenance of TV Receiver, Electronics Drawing, Communication System, Television Receiver, Consumer Electronic, Electronics Components and Communication System.* The candidates were required to choose the most correct answer from the given five alternatives (A to E).

A total of 214 (99.53%) candidates attempted this question, while 1 (0.47%) candidate didn't attempt this question. Out of those who attempted, 24 (11.16%) candidates scored from 0 to 2 marks; 181 (84.19%) scored from 3 to 6 marks and 10 (4.65%) scored from 7 to 10 marks. The candidates' performance on this question is summarizes in Figure 1.

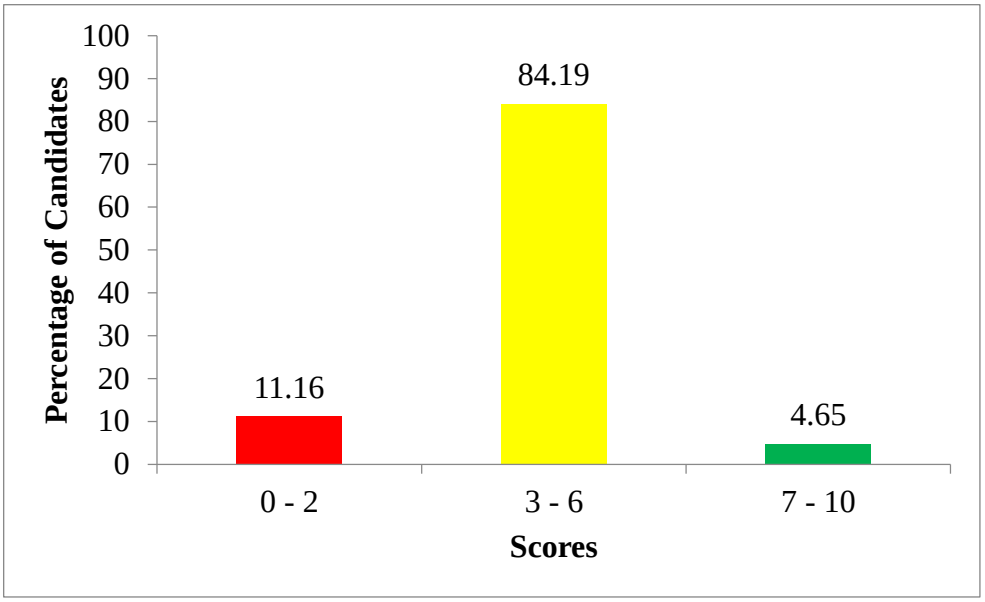


Figure 1: *The Candidates' Performance in Question 1*

Generally, the candidates' performance was good, since 191 (88.84%) of them passed. The following is the analysis of the candidates' responses to each item.

Item (i): This item was constructed from the topic of *Introduction to Electricity.* It was intended to measure the candidates' understanding of parallel networks characteristics. The question was as follows:

A candidate used an ammeter as a measuring instrument and realized that the circuit current is 2 A. What will be the effect on the circuit current when two parallel resistors of the same value are connected to the circuit?

A Circuit current will increase *B Circuit current will decrease*
C Circuit current will be infinite *D Circuit current will remain the same*
E Circuit current will be doubled.

Few candidates opted for the correct answer which was B, *Circuit current will decrease.* An equivalent resistance *of* $R_T = \frac{R_1 R_2}{R_1 + R_2}$ will result after connecting the two resistance in parallel. From Ohms law $I = \frac{V}{R}$, provided V is constant, current is inversely proportional to resistance, hence the current will decrease as resistance increases. Also, the candidates who opted for alternative B knew that the circuit current will be divided into

two, since they had same resistances, hence, individual currents can be calculated from Ohms law: $I_1 = \frac{V}{R_1}$ and $I_2 = \frac{V}{R_2}$. For those who opted for options A, *Circuit current will increase*, C, *Circuit current will be infinite*, D, *Circuit current will remain the same* and E, *Circuit current will be doubled;* failed to realize that, the current is inversely proportional to individual resistance, hence it will decrease and not increase.

Item (ii): This item was set from the topic of *Repair and Maintenance of TV Receiver.* It aimed to test the candidates' understanding of the functions of the cathode ray tube (CRT). The question was as follows:

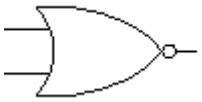
A focusing plate in electron gun is an important part in the Cathode Ray Tube (CRT). Which of the following is the major function of that part in CRT?

A To accelerates electrons *B To generates electrons*
C To deflects electrons *D To attracts electrons*
E To diverge electrons

The item was performed well by most of the candidates, as they selected the correct alternative, which was A, *To accelerate electrons.* Those who opted for other alternatives failed to relate different parts of CRT with their corresponding function. For example, those who opted alternative *B, To generates electrons* confused electron gun, which is used in generating electrons with a focusing plate used to accelerate the electrons.

Item (iii): This item was constructed from the topic of *Electronics Drawing*. The item tested the candidates' knowledge on logic gate symbols. The question was:

You are provided with electronics circuit whose symbol is shown in the figure below. Identify the correct name of the symbol?



A Single – output AND gate *B NAND gate–two inputs*
C NAND gate used as NOT gate *D NOR gate-two input*
E Double – output NOR gate

Most of the candidates correctly selected alternative *D, NOR gate-two input.* Those who opted for alternatives; A, *Single – output AND gate, B, NAND gate–two inputs,* and E, *NAND gate used as NOT gate;* confused the symbol of OR gate with that of AND gate. However, the one who opted for alternative *E, Double – output NOR gate,* confused the inputs and outputs of the logic gates.

Item (iv): This question was set to assess the candidates' knowledge and understanding of the communication system topic. Specifically, the item was constructed to test the candidates' knowledge of frequency modulation (FM). The question was as follows:

What maximum modulating frequency is allowed in commercial FM broadcasting?

A 60kHz B 15 kHz C 20 kHz D 40 kHz E 50 kHz

An average number of candidates opted for correct response which was *B, 15 kHz.* Frequency modulation (FM) is more favorable than AM since it is immune to noise, has higher signal quality and the maximum allowable carrier frequency for FM broadcasting is 15 kHz. Those candidates who opted for alternative A, *60 kHz*, C, *20 kHz*, D, *40 kHz* and E, *50 kHz* failed to recall the maximum allowed frequency for FM broadcasting.

Item (v): This question intended to measure the candidates' understanding of Television Receiver, specifically the picture frame. The question was as follows:

Aspect ratio of a TV is a ratio of width to height of a rectangular picture frame. Which one is correct ratio?

A 3:4 B 4:4 C 3:6 D 4:3 E 5:6

The correct alternative was *D, 4:3.* The picture frame specifies the space where the picture will be displayed. This is to ensure that the images are appropriately sized and presented without unintended cropping or stretching. It is at this frame ratio 4:3 where the picture will be appropriately presented at the display. Those who opted for option *A, 3:4*, *B, 4:4*, C, *3:6*, and *E, 5:6* failed to recall the correct standard aspect ratio.

Item (vi): This item was constructed from the topic of Consumer Electronics. The question tested the candidates' knowledge on the effects of magnetic field on electronic components. The question was as follows:

A student was recording the music from a radio receiver using a tape recorder. During recording, a tape was attracted to the head of the radio recorder using attraction field of force. Identify the field of force which was applied.

A Electrodynamics field *B Electrical field*
D Magnetic field *E Electromagnetic field*
E Electrostatic field

Most of the candidates opted for alternative C, *Magnetic field*, which was the correct answer. These candidates knew that the tape recorder and play back sounds use magnetic tape for storage. Also, they understood that magnetic coating is what allows information to be recorded onto the tape, hence it will be attracted to magnetic field since it is magnetic in nature. These candidates had sufficient knowledge on the operation of a tape recorder. Those who opted for alternative B, *Electrical field* and D, *Electromagnetic field*, recalled the theory of transformer and relay/contactor operations. Those who opted for alternative E, *Electrostatic field* recalled the concept of static electricity, while, those who opted for alternative A, *Electrodynamics field* failed to understand the properties of tape recorder and its effect on magnetic field.

Item (vii): The item was constructed from the topic of Electronic Components. It was intended to test the candidates' knowledge on determining the value of a resistor based on band colors. The question was as follows:

One of the resistors in a TV set with a color code of red, violet, orange, gold was found to be burned. Point out the value of burned resistor.

A 27 Ω ± 10% *B 2.7 Ω ± 5%* *C 27 kΩ ± 5%*
D 27 kΩ ± 10% *E 270 Ω ± 10%*

The analysis shows that, many candidates responded correctly by selecting alternative C, *27 kΩ ± %*. These candidates demonstrated competence on determining resistor's value using color code. The candidates correctly

recalled the digits of red, violet and orange colors, as well as gold color for tolerance. Those who opted for alternative A, *27* Ω ± *10%,* B, 2.7Ω ± *5%,* D*, 27 k*Ω ± *10%,* and E, *270* Ω ± *10%* failed to relate the color bands for digits, multiplier and for tolerance.

Item (viii): This question assessed the candidates' ability to recognize and understand the fundamental of *Oscillators* from the topic of Communication System. The question was as follows:

A radio receiver uses an oscillator circuit to generate high frequency. What type of oscillator among the following can possibly produce that frequency?

A	*Wein bridge oscillator*	*B*	*RC phase shift oscillator*
C	*Colpitts oscillator*	*D*	*Transistor crystal oscillator*
E	*Hartley oscillator*		

An average number of candidates opted for the correct response which was E, *Hartley oscillator*. These candidates knew that, Hartley Oscillators are made up of capacitors and inductors designed for frequency ranging from few hundred kilohertz to several megahertz and that, they are commonly used in radio frequency circuits. Those who opted for alternative A, *Wein bridge oscillator,* B, *RC phase shift oscillator,* C, *Colpitts oscillator* and D, *Transistor crystal oscillator;* failed to correctly identify and distinguish between the types of Oscillators. For instance, Colpitts oscillator produces a more powerful sinusoidal waveform due to low impedance path of capacitor at high frequency, but its frequency is less than that of Hartley oscillator.

Item (ix): This item assessed the candidates' knowledge on communication system, specifically on frequency modulation. The question was as follows:

Which of the following ranges of modulating frequency is used to avoid signal interference?

A	*30 Hz to 3 kHz*	*B*	*30 Hz to 15 kHz*	*C*	*30 Hz to 30 kHz*
D	*30 Hz to 20 kHz*	*E*	*30 Hz to 40 kHz*		

The correct response was B, *30 Hz to 15 kHz*. However, few candidates responded incorrectly by taking option A, *30 Hz to 3 kHz*, C, *30 Hz to 30 kHz*, D, *30 Hz to 20 kHz* and E, *30 Hz to 40 kHz.* Those who opted for these range of frequencies had knowledge that frequency modulation is immune

to noise but failed to understand that at particular frequency range, noise interference can be attained.

Item (x): This item assessed the candidates' ability to recognize the color mixing ratio to produce good quality picture and was set from the topic of television receiver. The question was as follows:

When two primary colours are mixed in a good proportion and percentage you obtain secondary colours. Recommend the appropriate proportion and percentage of the mixture.

A 30% B 11% C 89% D 41% E 70%

The correct response was C, *89%*. Most of the candidate failed to opt for this correct answer and hence demonstrated to have inadequate knowledge of the topic. Those who opted for alternative *A, 30%, B, 11%, D, 41%* and *E, 70%;* failed to understand that at these percentages the image will be saturated.

Extract 1.1 shows the good response of question one from one of the candidates.

1.		i.	ii.	iii.	iv.	v.	vi.	vii.	viii.	ix.	x.
		B	A	D	B	D	C	C	E	C	E

Extract 1.1: A sample of good response to Question 1

In Extract 1.1 the candidate chose correct response for eight items and failed to choose correct response for two items, (ix) and (x). This indicate that the candidates had adequate knowledge on the topics tested in items (i to Viii) but, lack some knowledge on principle of color mixing in TV operations and ranges of modulating frequency used to avoid signal interference.

On the other hand, some of the candidates failed to choose correctly for at least three items. This signifies that, the candidates were not competent in the topics tested in the respective items. Extract 1.2 illustrates the poor response to question one from one of the candidates.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
	D	C	B	A	B	D	E	B	B	A

Extract 1.2: A sample of poor response to Question 1

In Extract 1.2, the candidate opted correctly in only one item (ix). This indicates that the candidate had insufficient knowledge in most of the tested topics.

2.1.2 Question 2: Matching Items

The question was set from the topic of Cable Television. The question required the candidates to match the functions in List A with the corresponding device in List B by writing a letter of the correct response. The question was intended to test the candidates' ability to relate the functions of some parts of the cable television system with the respective parts. The question was as follows;

*Match the functions in **List A** with their corresponding device in **List B** as used in cable television by writing a letter of the correct response against the item number in the answer booklet(s) provided.*

List A	***List B***
(i) It is inserted at regular interval along the trunk route to make up for cable losses.	*A Coaxial cable*
(ii) It is used in a branch from the main trunk to feed a particular extension in the cable system.	*B R.F tuner*
(iii) It is used for additional amplification of the signals to counter cable losses.	*C UHF oscillator*
(iv) It is used to feed trunk amplifier.	*D Bridging amplifier*
(v) It is used to keep signal power from the trunk very small so that the line is not loaded.	*E Splitters*
(vi) It is used with a TV set for reception from community cable TV (CATV).	*F Band pass filter*
	G Trunk amplifier
	H Line amplifier

A total of 215 (100%) candidates attempted this question. Out of those who attempted 151 (70.23%) candidates scored from 0 to 2 marks, 45

(20.93%) scored from 3 to 4 marks and 19 (8.84%) candidate scored from 5 to 6 marks. The candidates' performance on this question is summarizes in Figure 2.

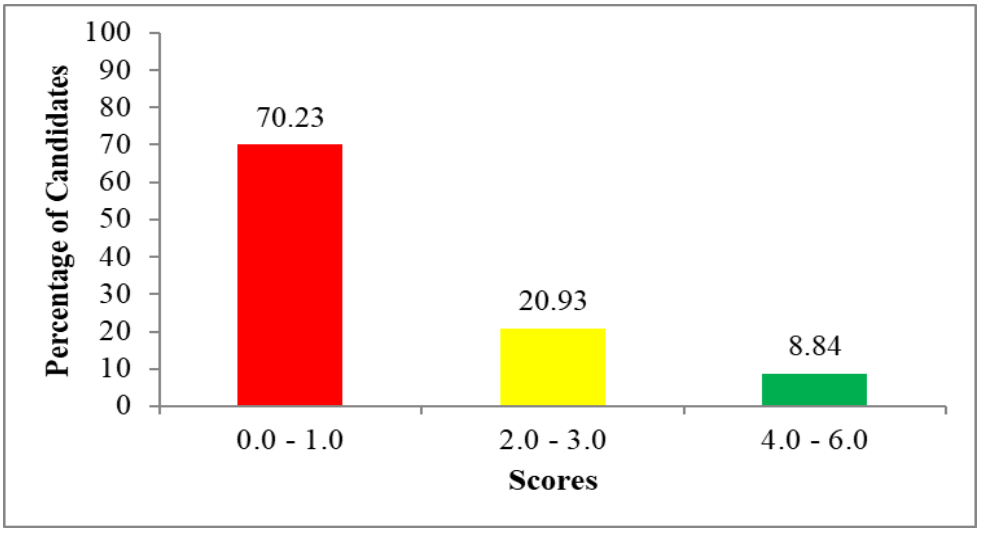
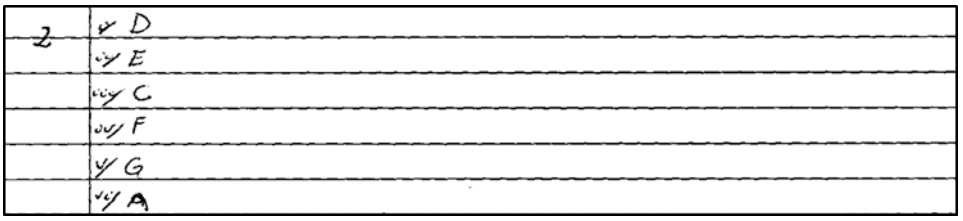


Figure 2: *The Candidates' Performance in Question 2*

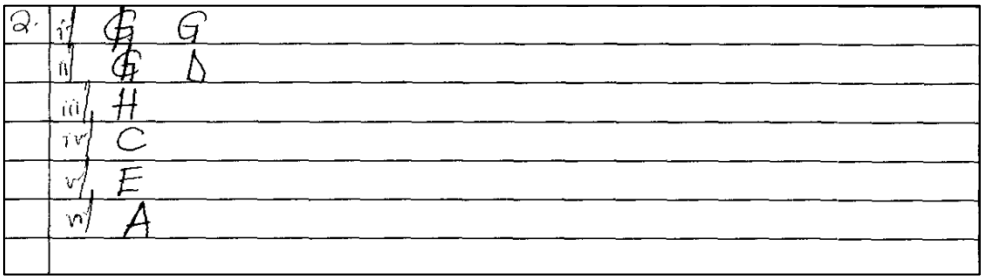
Generally, the candidates' performance was poor since 151 (70.23%) candidates scored below average. From the analysis it is clear that a large number of candidates failed to correctly relate the functions with their corresponding parts in the cable television system. Generally, they failed to demonstrate their knowledge on the function of devices listed in column B. This depicts that the candidates had inadequate knowledge on the *Cable Television* topic. Extract 2.1 demonstrate the incorrect response from one of the candidates.



Extract 2.1: A sample of the incorrect responses to Question 2

In Extract 2.1, the candidate failed to match correctly all the items. This implies that the candidate had insufficient knowledge of the topic of cable television.

In contrast to Extract 2.1, few candidates, 64 (29.77%) scored from 2 to 6 marks. This means they correctly matched at least two items of the question. This indicates that, the candidate had sufficient knowledge regarding the topic of Cable Television. Extract 2.2 illustrates the best response to question 2 from one of the candidates.



Extract 2.2: A sample of the best responses to Question 2

In Extract 2.2, the candidate correctly matched five items out of six. This shows that the candidate had adequate knowledge in the topic of cable television, especially the functions of the tuner circuit.

2.2 Section B: Short Answer Questions

This section consisted of six (6) short-answer questions; 3 to eight 8. Each question carried a weight of nine (9) marks. The cumulative score for the entire section was 54.

2.2.1 Question 3: Communication System

The question consisted of three parts: (a), (b) and (c). Part (a) tested the candidates' understanding of different types of digital modulation techniques; part (b) tested candidates' knowledge of identifying type of oscillator that can produce pulses and part (c) required the candidates to demonstrate their skills on drawing pulses of a given binary code. The question was as follows;

A radio transmitter employs special pulse oscillator to generate carrier frequency for modulation process of PAM, PW, PPM and PCM.

(a) Give the long form of modulation processes used by the radio.

(b) What branch of oscillator produces pulses?

(c) Draw the pulse whose binary code are 001, 000, 011 and 111.

The analysis shows that 215 (100%) attempt this question. Out of those who attempted the question, 155 (72.09%) candidates scored between 0 -

2.5 marks, while, 43 (20.00%) candidates scored between 3 - 5.5 marks, and only 17 (7.91%) scored between 6 - 9 marks. These performance trend depicts that most of the candidates (72.09%) had a weak performance. The candidates' performance in this question is summarized in Figure 3.

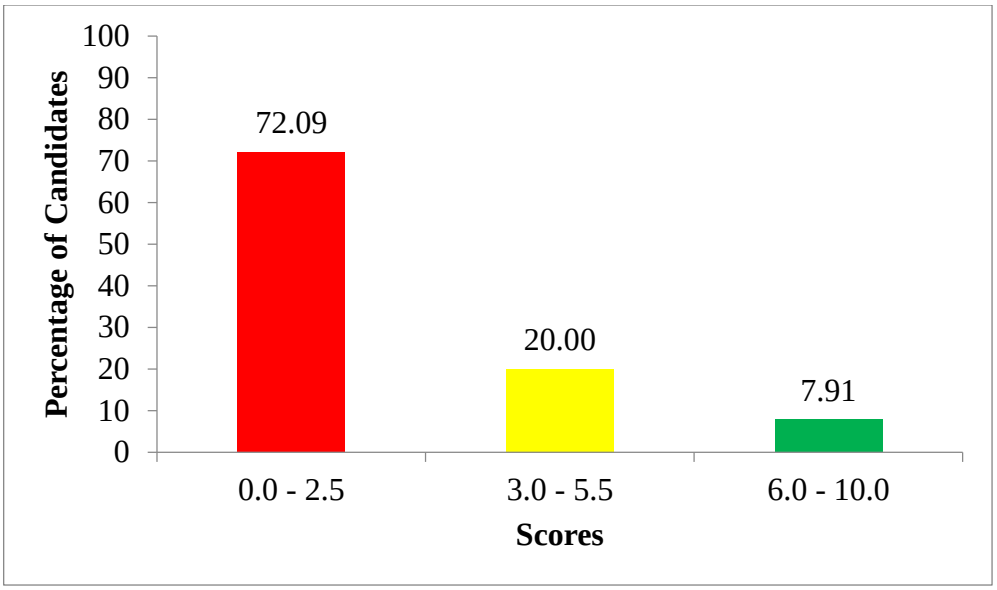
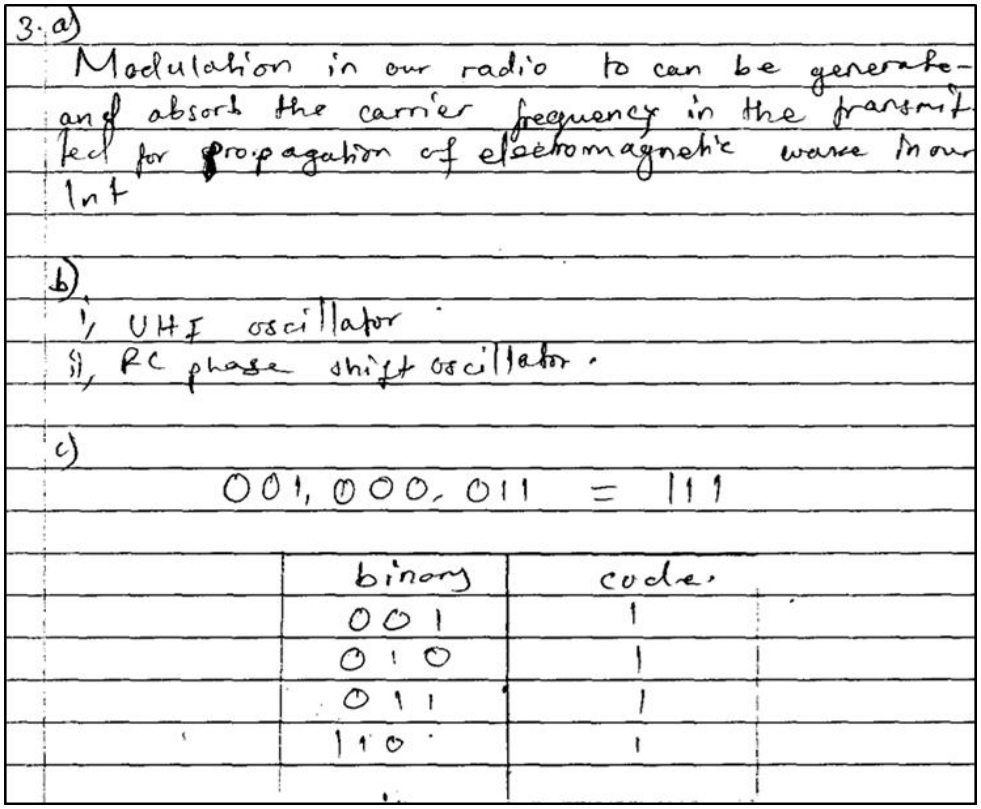


Figure 3: *The Candidates' Performance in Question 3*

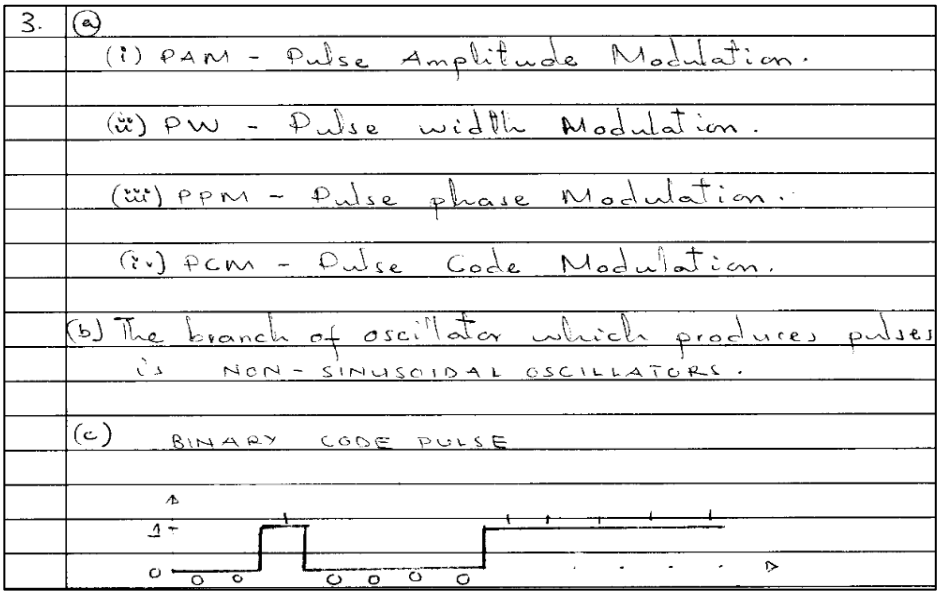
From the analysis, it is evident that, majority of the candidate 155 (72.09%) performed poorly due to lack of knowledge on the tested topic. For instance, one of the candidates tried to incorrectly state how digital modulation is done, instead of writing the long form of the given abbreviations of the modulation techniques. Another candidate drew a line graph similar to that of a rectifier diode. This candidate recalled an idea of the rectifier diode graph after failing to draw the required pulse wave. Furthermore, one of them drew saw-tooth waveform and square pulses with negative part, this candidate recalled the idea of sketching different wave shapes, without relating with what was required by the question. This is an indication that the candidates had insufficient knowledge on representing binary codes diagrammatically. A clear example of poor response is provided in Extract 3.1



Extract 3.1: A sample of incorrect responses to Question 3

In Extract 3.1, the candidate failed to understand the demand of the question. For example, in part (a), instead of writing the long form of digital modulation technique, the candidate defined the term modulation incorrectly, although was not the demand of the question. In part (b), the candidate failed to state the branch of oscillator which produces pulses, instead the candidate wrote *UHF oscillator* which produces high frequency signal and *RC phase shift oscillator* which produces sinusoidal signal, Furthermore, in part (c), the candidate failed to draw the pulses of the given binary code, instead the candidate copied the same binary code, as observed in the question. This shows the incompetency of the candidate in the tested topic.

On the other hand, the statistical data analysis shows, 17 (7.91%) candidates performed well by scoring from 3 to 9 marks. Some of them responded well to good number of the items of this question. Extract 3.2 provides an example of correct responses to Question 3 from one of the candidates.



Extract 3.2: A sample of the correct responses to Question 3

In Extract 3.2, the candidate correctly gave the long forms of the given digital modulation techniques, stated branch of oscillator which produces pulses and correctly drew pulse signal for the given codes. This candidate had adequate knowledge of digital modulation techniques and demonstrated ability to represent the digital codes diagrammatically.

2.2.2 Question 4: Communication System

The question comprised of two parts: (a) and (b). Part (a) required the candidates to demonstrate their understanding on the difference between Frequency and Amplitude modulation. Part (b) (i) tested the candidates' knowledge on Frequency Modulation wave equations. Part b (ii) required the candidates to explain reasons of FM being mostly preferred than AM in transmission of signals. The question was:

Candidates visited two radio stations and learn about the process of Frequency Modulation (FM) and Amplitude Modulation (AM) used for transmission of radio waves.

(a) Which type of modulation process is mostly preferred for transmission of signals?

(b) (i) Write a modulating and carrier waves equation of modulation process mentioned in

(ii) Why the modulation process mentioned in (a) is mostly preferred. Give five reasons.

This question was attempted by 215 (100%) candidates whom 51 (23.72%) scored 0 - 2.5 marks, 90 (41.86%) scored 3 - 5.5 marks and 74 (34.42%) scored 6 - 9 marks. In general, the performance was good since 164 (76.28%) candidates passed. The candidates' performance in this question is summarized in Figure 4.

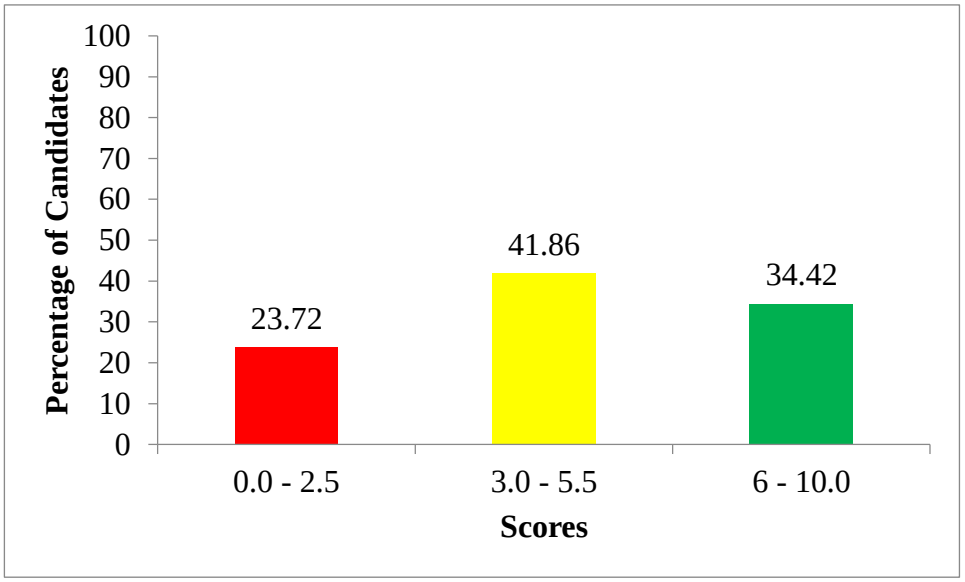
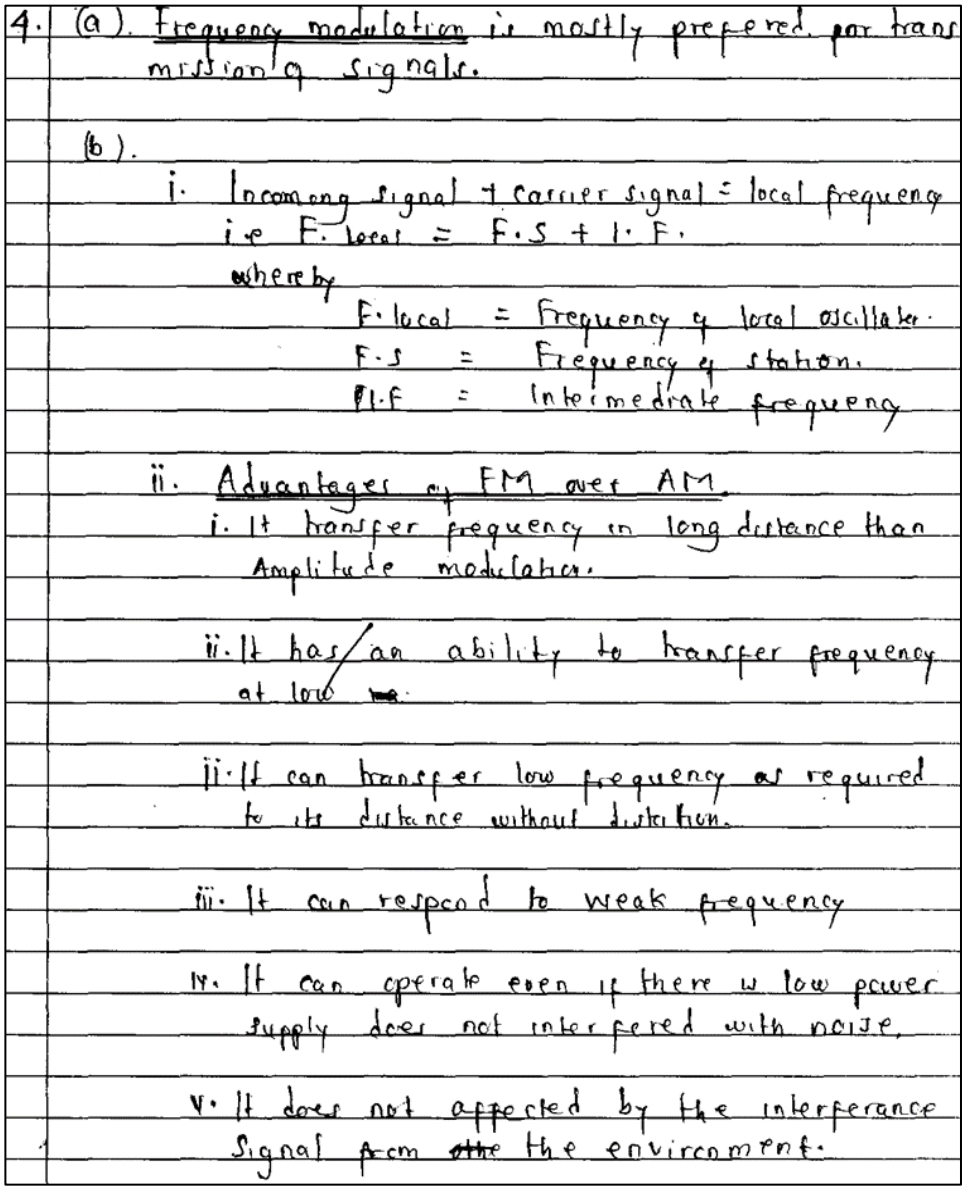


Figure 4: *The Candidates' Performance in Question 4*

The analysis reveals that 76.28% of the candidates scored from 3 to 9 marks as they demonstrated their ability to the tested topic. These candidates responded correctly to majority parts of the question. Extract 4.1 shows a sample of correct response from one of the candidates.


4. (a). Frequency modulation is mostly prefered for transmission of signals.

(b).

i. Incoming signal + carrier signal = local frequency
i.e F. local = F.S + I.F.
where by
F. local = Frequency of local oscillator.
F.S = Frequency of station.
I.F = Intermedrate frequency

ii. Advantages of FM over AM.

i. It transfer frequency in long distance than Amplitude modulation.

ii. It has an ability to transfer frequency at low.

iii. It can transfer low frequency as required to its distance without distortion.

iv. It can respond to weak frequency

v. It can operate even if there w low power supply does not interfered with noise.

vi. It does not affected by the interferance Signal from the environment.

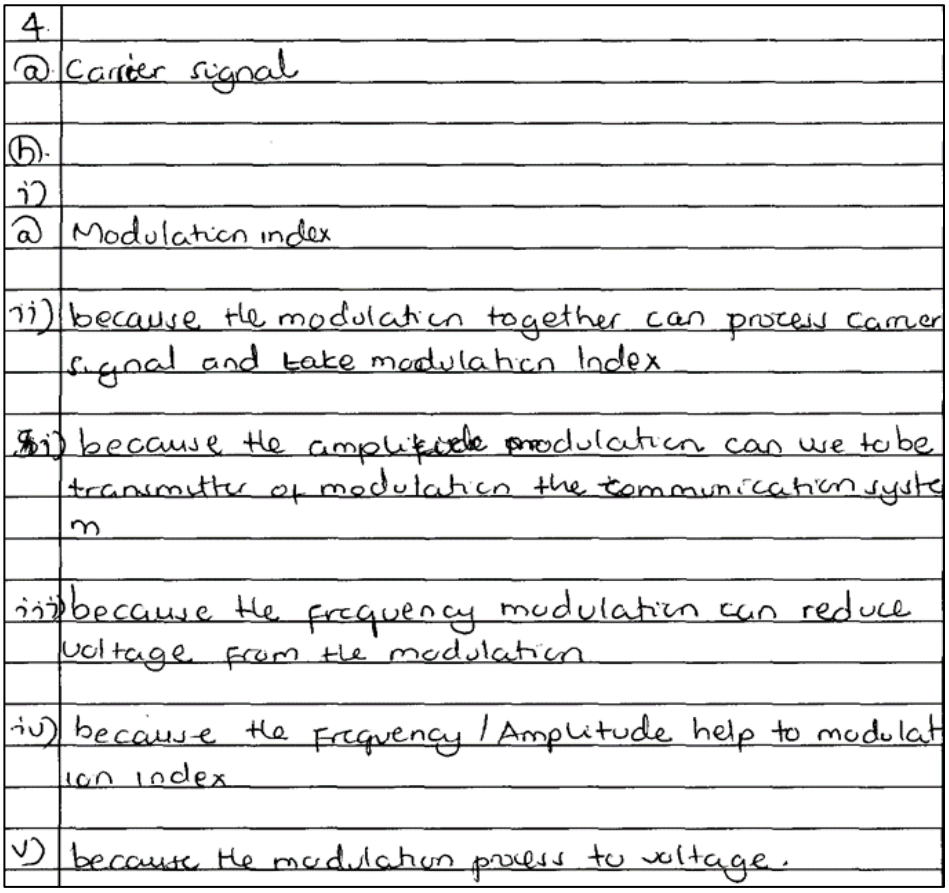
Extract 4.1: A sample of correct responses to Question 4

In Extract 4.1 the candidate correctly identified the type of modulation process which is mostly preferred for transmission of signal and gave five reasons for frequency modulation being mostly preferred. Although, the candidate failed to correctly write the modulating and carrier wave equation. This implies that the candidate had moderate knowledge of communication system.

In spite of the good performance in this question, 51 (23.72%) candidates scored below average. These candidates failed to correctly

respond to majority of the requirements of the question. For instance, one of the candidates wrote the *Modulation = Signal Amplitude / Carrier amplitude*, as the equation for part (b) of the question. This candidate failed to recall the correct equation for this part. Another candidate wrote the carrier equation as *Modulation (M) = Frequency Modulation (FM) x Amplitude Modulation (AM)*. This signifies that, these candidates had insufficient knowledge of the *Communication System* Topic.

Extract 4.2 shows an example of a poor response on question 4, from one of the candidates.


4.
(a) Carrier signal
(b).
i)
(a) Modulation index
ii) because the modulation together can process carrier signal and take modulation index
iii) because the amplitude modulation can use to be transmitter of modulation the communication system
iii) because the frequency modulation can reduce voltage from the modulation
iv) because the Frqvency / Amplitude help to modulation index
v) because the modulation proces to voltage.

Extract 4.2: A sample of incorrect responses to Question 4

In Extract 4.2, the candidate wrongly attempted the question by providing the incorrect answers to all parts of the question. For example, in part (a) the question demanded types of modulation process mostly

preferred for transmission of signal, the candidate wrote *carrier signal.* This response is too far from the correct answer because carrier signal is not even the type of modulation. Part (b) had two items (i) and (ii). Item (i) demanded the candidate to write a modulating and carrier waves equation of the modulation process mentioned in part (a). The candidate's response was *modulation index* which is not the correct answer. In item (ii), the question demanded the reasons for modulation process mentioned in (a) being mostly preferred. The candidate provided wrong answers which include voltage in some points, such as in item (v*)*, the candidate answered *"because the modulation process to voltage"*. This signifies that the candidate had insufficient knowledge in the topic of communication system.

2.2.3 Question 5: Radio Communication

The question comprised of two parts, (a) and (b). It required the candidates to state three types of wave propagation used in television broadcasting and determine the wavelength of the radio waves with a frequency of 30 MHz. It measured the candidates' ability to apply knowledge and concepts of *Radio Communication*: The question was:

You are among the candidates who paid visit to Tanzania Broadcasting Corporation (TBC) to learn about three methods of propagation of electromagnetic wave in a space. The transmitted frequency by TV was 30 MHz.

(a) What are the three types of wave propagation used in Television broadcasting?

(b) Determine the wavelength of the radio waves.

This question was attempted by 215 (100%) candidates. Out of them, 53 (24.65%) scored 0 - 2.5 marks; 38 (17.67%) scored 3 - 5.5 marks and 124 (57.68%) scored 6 - 9 marks. The candidates' performance in this question is summarized in Figure 5.

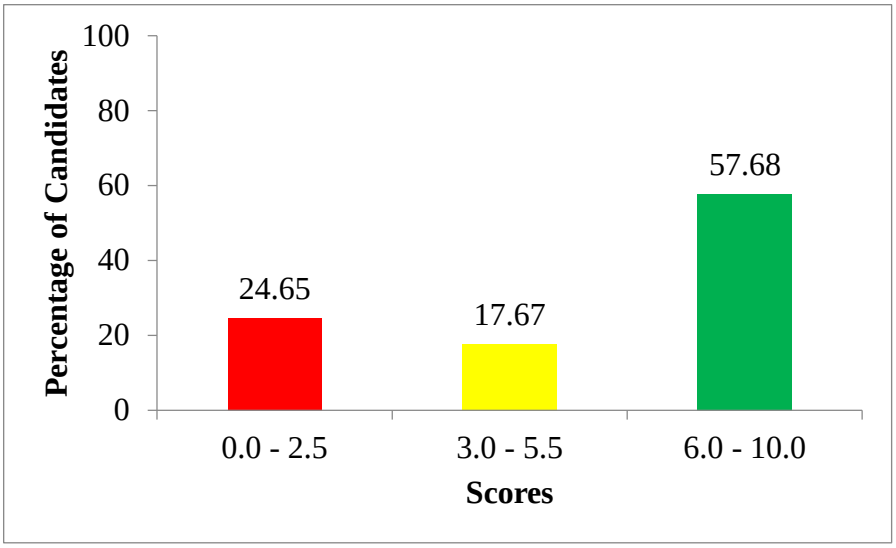
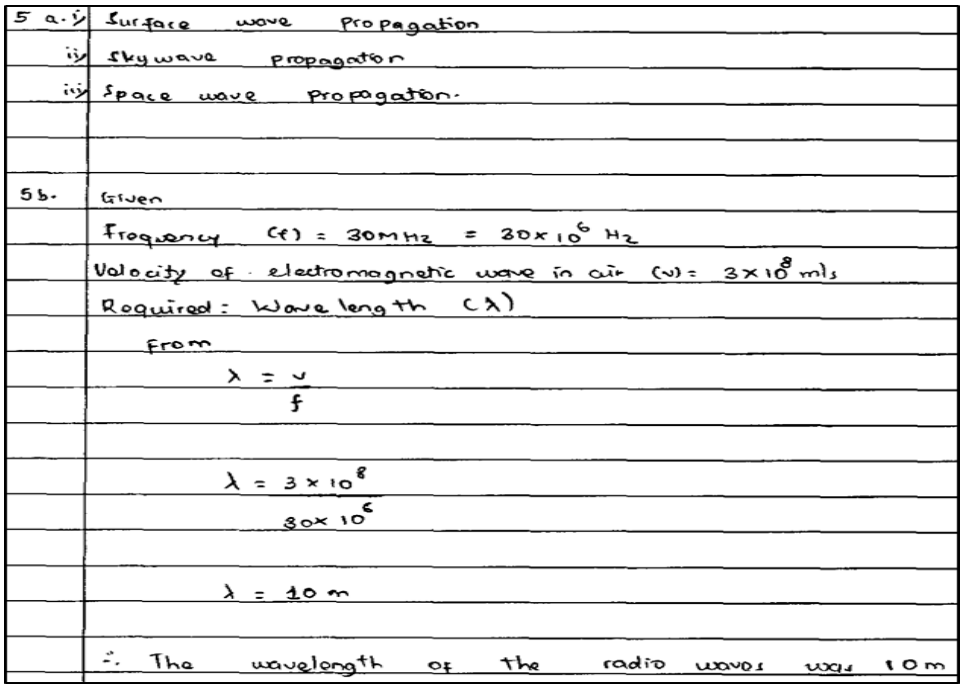


Figure 5: *The Candidates' Performance in Question 5*

From Figure 5, the candidate's general performance on this question was good, since 162 (75.35%) candidates scored from 3 to 9 marks. These candidates justified their competencies in the topic of Radio communication by correctly responding to most of the questions. Extract 5.1 shows the correct response to the question from one of the candidates who correctly responded to this question.


5 a. i) Surface wave Propagation

ii) Sky wave Propagation

iii) Space wave Propagation.

5b. Given

Frequency (f) = 30MHz = 30×10^6 Hz

Velocity of electromagnetic wave in air (v) = 3×10^8 m/s

Required: Wave length (λ)

From

$$\lambda = \frac{v}{f}$$

$$\lambda = \frac{3 \times 10^8}{30 \times 10^6}$$

$$\lambda = 10 \text{ m}$$

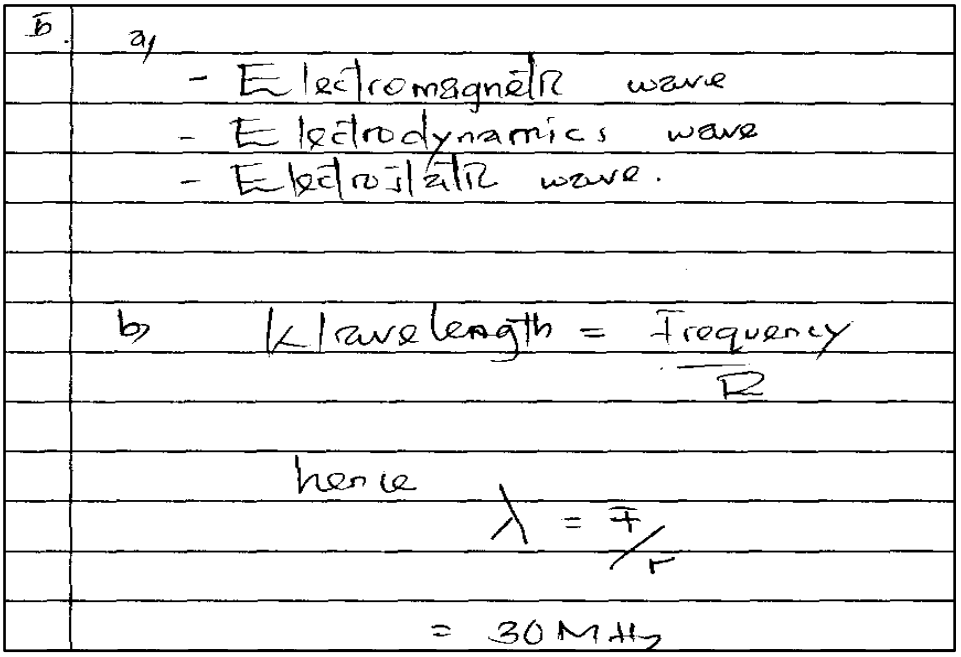
∴ The wavelength of the radio waves was 10 m

Extract 5.1: A sample of correct responses to Question 5

In Extract 5.1, a candidate stated three types of wave propagation used in television broadcasting and determined the wavelength of the radio waves with a frequency of 30 MHz.

However, 53 (24.65%) candidates scored below average in this question. They failed to state three types of wave propagation used in television broadcasting and to determine the wavelength of the radio waves with a frequency of 30 Mhz. For instance, one of the candidates wrote the types of wave propagation used in TV broadcasting as *(i) Sine wave propagation (ii) square wave propagation (iii) triangular wave propagation.* This candidate mixed the concept of types of signal waveforms obtained from the signal generator with the types of wave propagation. Another candidate gave the range of frequencies as the types of wave propagation in TV broadcasting (*3 Hz – 30 Hz, 30 Hz – 3 kHz, 3 kHz – 30 kHz*). These candidates had insufficient knowledge in the topic of *Radio Communication*, particularly in subtopic of TV broadcasting.

Extract 5.2 shows an example of the incorrect responses to the question from one of the candidates.



Extract 5.2: A sample of incorrect responses to Question 5

Extract 5.2 shows the candidate incorrect response. The candidate failed to write three types of wave propagation used in Television broadcasting as it was asked in part (a) of the question, instead, the candidate copied the responses from one of the multiple choice items of question 1, 1 (vi), Electromagnetic *wave, electrodynamics wave* and *electrostatic wave*. This indicates that the candidate was unaware of what was asked in the question. In part (b) the candidates use the incorrect formula to determine the wavelength of the radio wave and wrote 30 MHz, which was one of the given data in the question as an answer, without any data substitution to the incorrect formula. This shows that the candidate was incompetent in the topic of Radio Communication.

2.2.4 Question 6: Cellphone Repair and Service

The question consisted of two parts (a) and (b). It required candidates to explain why JIG box is used during mobile phone diagnosis, and to outline seven procedures to be followed while jumpering. The competence tested in this question was the ability of the candidates to understand the uses of JIG box in repairing mobile phone and procedures to be followed while jumpering. The question was;

During mobile phone diagnosis, JIG box was used and it was realized that the only solution to have the phone back working is to use jumpers.
(a) Why JIG box was used?
(b) Outline seven procedures you should follow while jumpering.

The question was attempted by 215 (100%) candidates. The data analysis shows that 79 (36.74%) candidates scored from 0 to 2.5 marks, 49 (22.79%) scored from 3 to 5.5 marks, and 87 (40.47%) scored from 6 to 9 marks. The candidates' performance in this question is summarized in Figure 6.

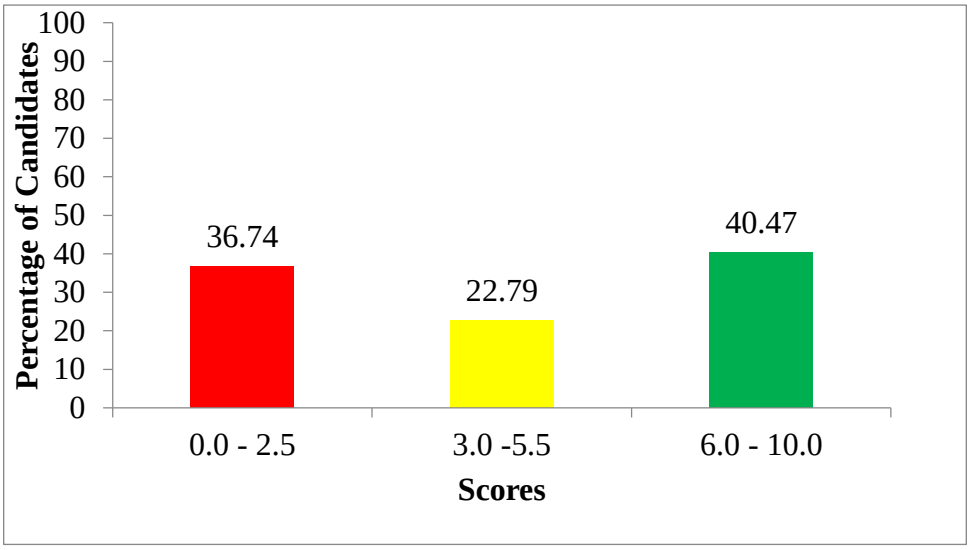
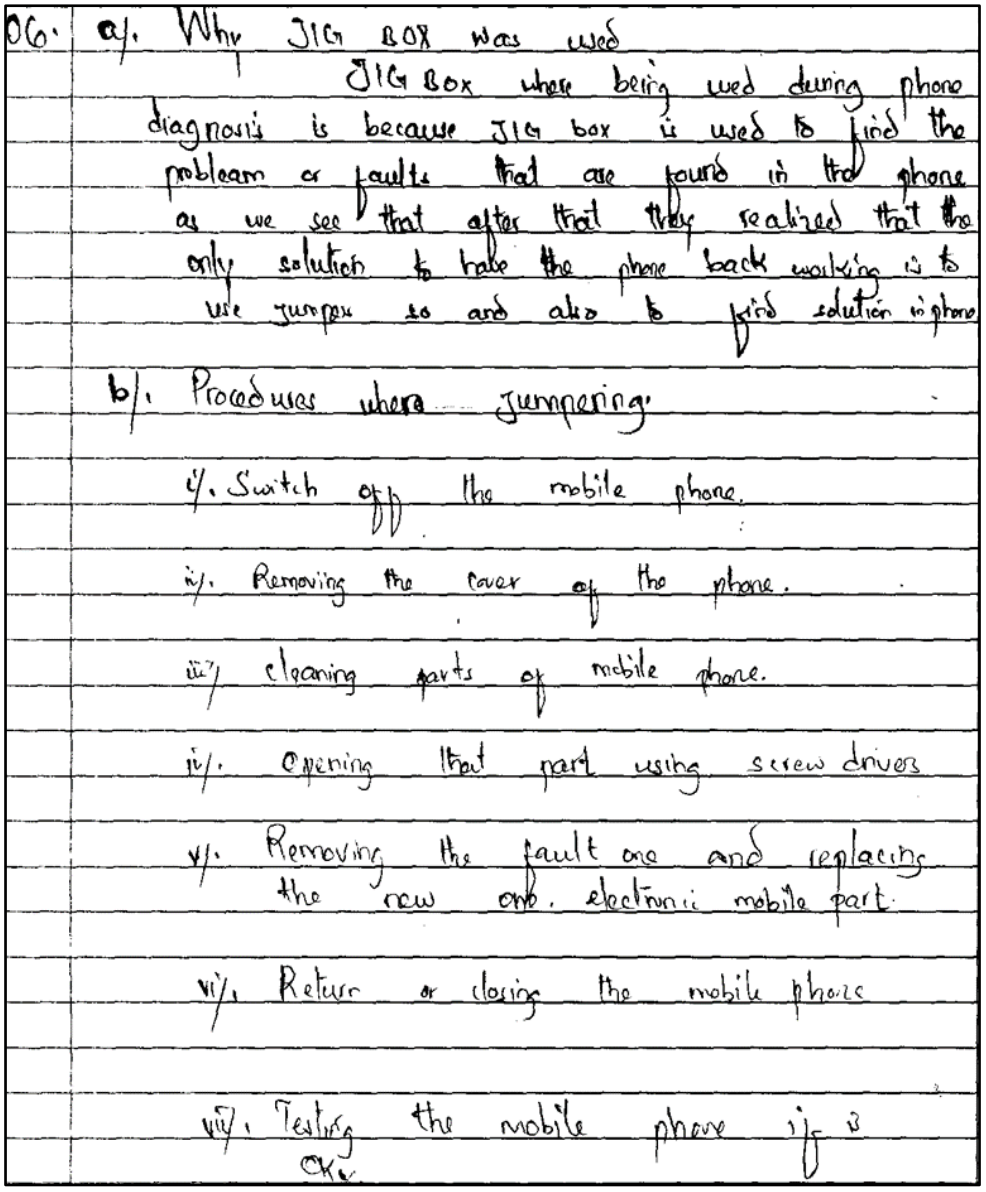


Figure 6: *The Candidates' Performance in Question 6*

The performance in this question was good, since 136 (63.26%) candidates passed by scoring from 3 to 9 marks. Extract 6.1 shows an example of the correct responses to the question from one of the candidates.



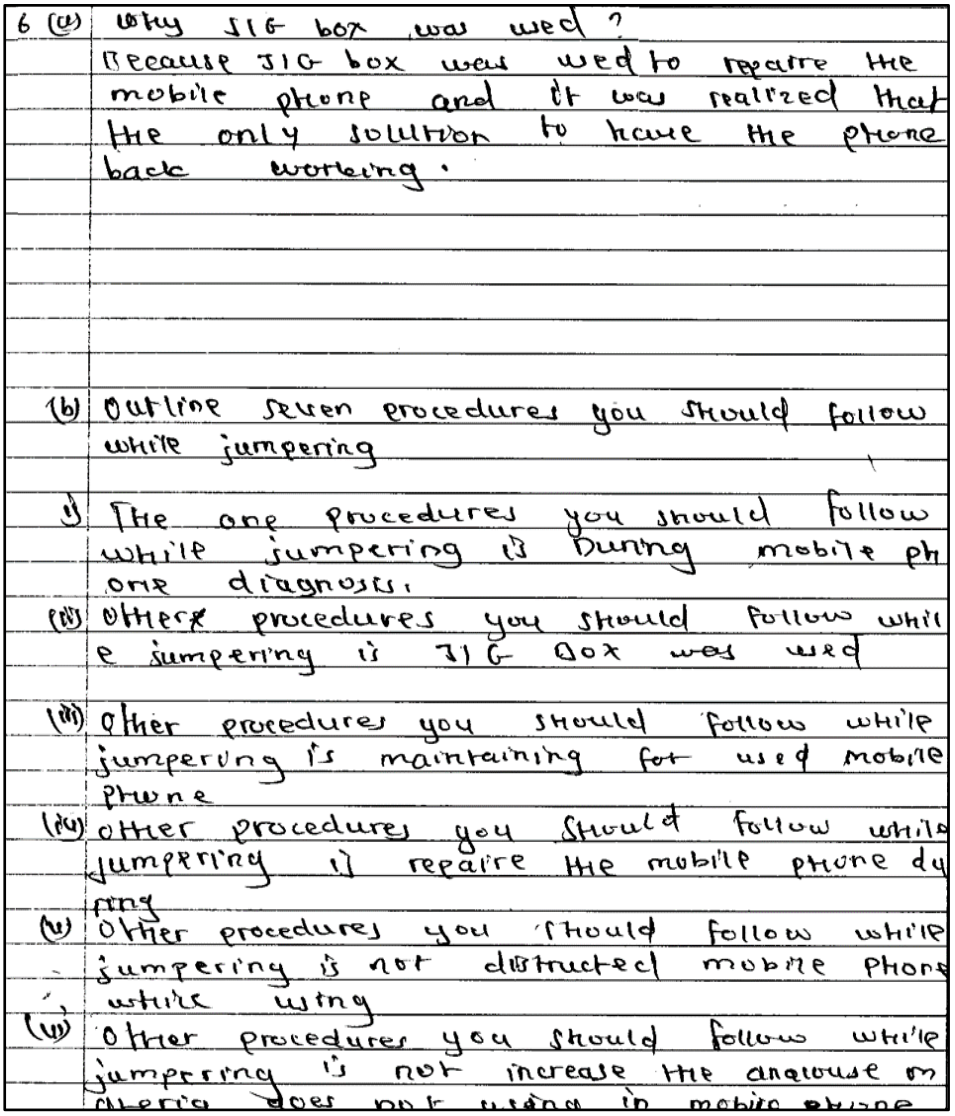
Extract 6.1: A sample of correct responses to Question 6

In Extract 6.1, the candidate correctly explained the uses of JIG box during mobile phone diagnosis and correctly outlined seven procedures to be taken while jumpering. These candidates had sufficient knowledge and skills in the concept tested within the topic of *Cellphone Repair and Service*.

However, there are some candidates who performed poorly in this question. These candidates failed to correctly respond to majority parts of the question. For instance, one of the candidates responded to part (a) *that JIG Box was used because to take information from one place to another*. This

candidate referred to the function of transmitter or antenna, although, there is no relation with what has been asked in the question. In response to part (b) of the question, the candidate wrote the procedures used in jumpering as; *i) Senders, ii) Transmitter, iii) Receiver, iv) Information, v) Telephone, vi) Sound (Dialogue) and vii) Communication.* In this part, the candidate mentioned the parts of communication system, which has no relationship with the requirement of the question. This indicates that, the candidate had inadequate knowledge of the tested concepts of the topic of *Cellphone Repair and Service*, although, the candidate has some knowledge of communication system, which does not relate with the requirement of the question. Another candidate responded to part (a) as; "*because JIG Box of the phone contain serial number or IMEI number in which that number is used to search to the lost phone"*, which is very far from the demands of the question. In response to part (b), the candidate wrote the procedures of tracking the lost mobile phone, instead of procedures used during jumpering. This indicates that the candidate did not understood the requirement of the question.

Extract 6.2 shows one of the incorrect responses to question 6 from one of the candidates.



Extract 6.2: A sample of incorrect responses to Question 6

In Extract 6.2, the candidate explained that *JIG box is used to repair mobile phone,* while the JIG box is used to diagnose and find fault or problems in mobile phone outside its case. Also, in part (b) the candidates outlined seven incorrect procedures. For example, in b (i) the candidates' response was; *The one procedure you should follow while jumpering is during mobile phone diagnosis.* The candidate was only formulating some sentences from the stem of the question, just to get seven phrases to write. This indicates that the candidate had insufficient knowledge and skills in the topic of cellphone repairing and service.

2.2.5 Question 7: Communication System

The question comprised of two parts (a) and (b), which assessed the candidates' ability to draw a well labelled LC tuned circuit, mention two uses of the circuit and compute its resonant frequency. The question was:

A tuned circuit of a radio receiver with a variable capacitance of 100 pF and inductance of 100 µH was used by electronics candidates in selecting a signal at resonant frequency.

(a) (i) Draw a well labeled circuit used by the candidates to accomplish the task.

(ii) Mention two uses of the circuit in (a) (i).

(b) Calculate the resonant frequency used.

A total of 215 (100%) candidates attempted this question. The data analysis indicates that 73 (33.95%) candidates scored from 0 to 2.5 marks, 67 (31.16%) scored from 3 to 5.5 marks and 75 (34.89%) scored from 6 to 9 marks. The performance was good, since 142 (66.05%) candidates passed by scoring from 3 to 9 marks. The candidates' performance in this question is summarized in Figure 7.

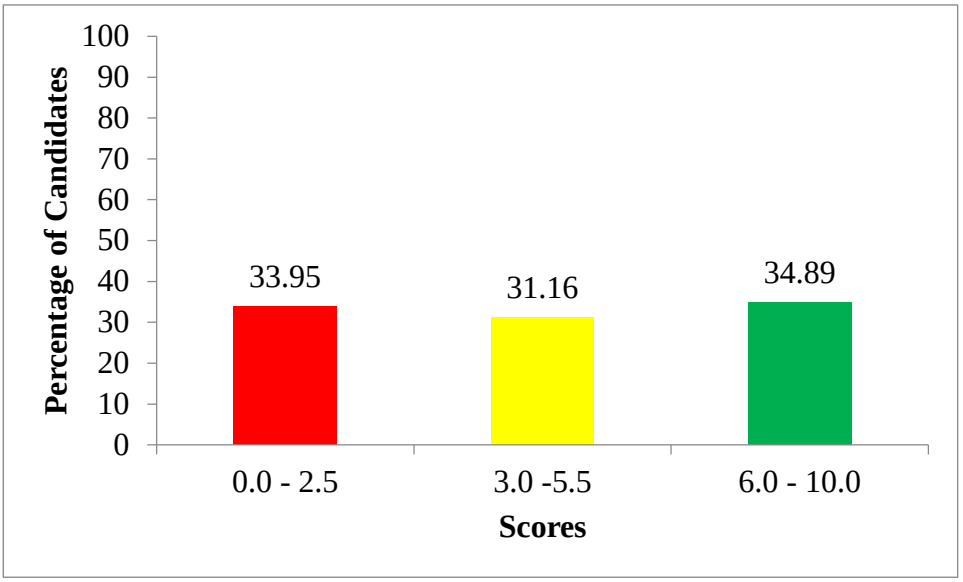
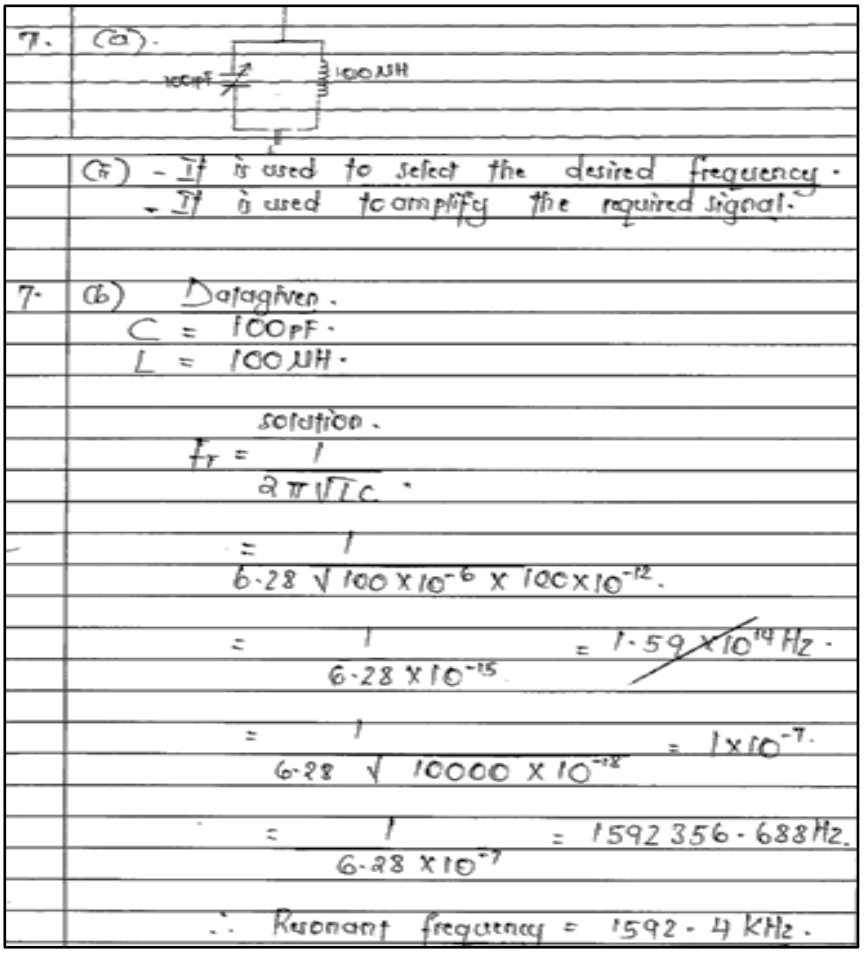


Figure 7: *The Candidates' Performance in Question7*

Most of candidates performed well on this question, indicating that they had adequate knowledge regarding the tested topic. Extract 7.1 illustrates a sample of a correct response in this question.



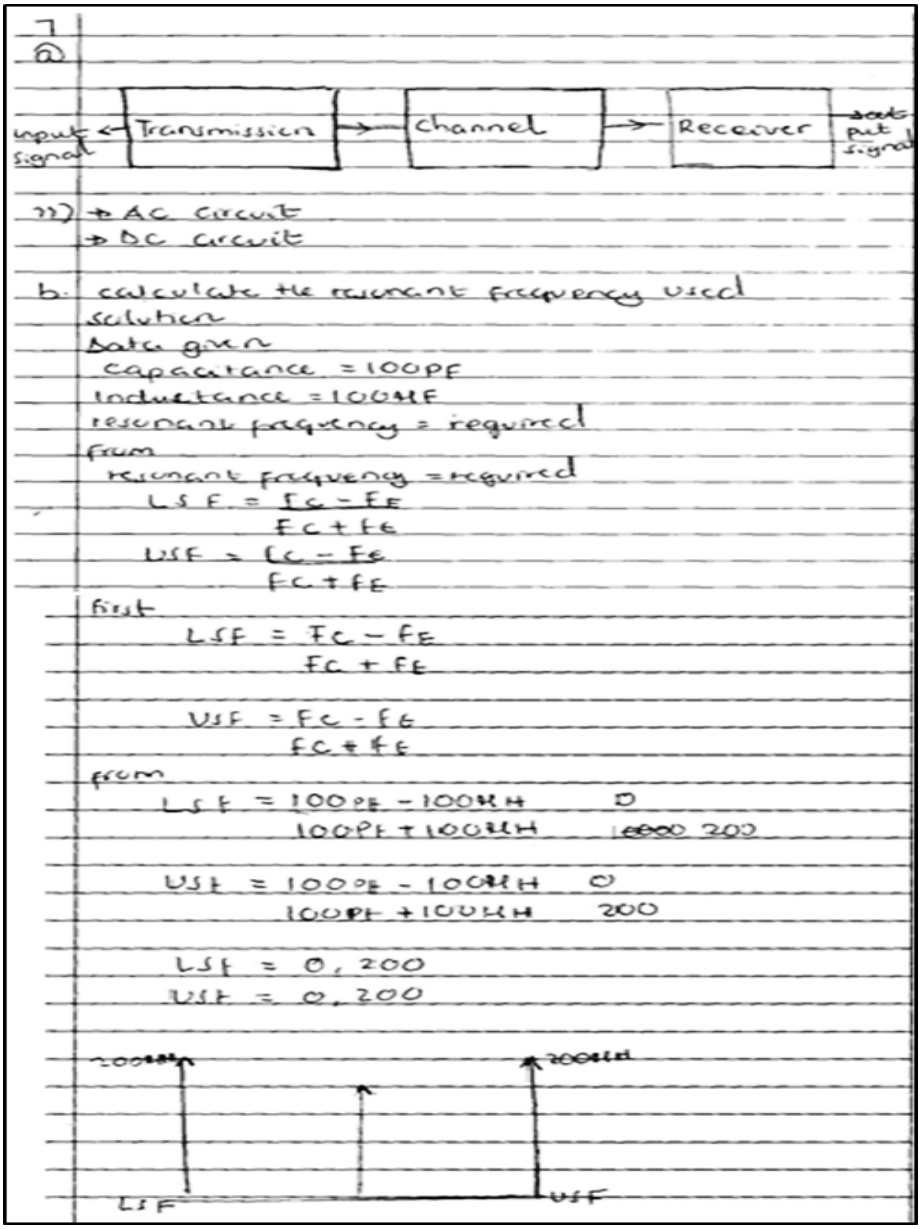
Extract 7.1: A sample of the correct responses to Question 7

In Extract 7.1, the candidate correctly drew a well labeled diagram of a tuned circuit of a radio receiver and mention its two uses. In part (b), the candidate applied the right formula and calculated correctly the required resonant frequency. This signifies that the candidate was competent in the topic tested.

However, the analysis indicates that the performance of 73 (33.95%) candidates was weak in this question. This signifies that the candidates had inadequate knowledge on the tested topic. One of the candidates responded to part (a), the candidate sketched a diode in series with a fuse and a capacitor instead of the tuned circuit of a radio as required by the question. In part (b) the candidate wrote a wrong formula "*resonant*

frequency = variable capacitor + inductor". Another candidate responded to part (a) by sketching a bridge rectifier circuit instead of resonant circuit and applied wrong formula in calculating resonant frequency for part (b).

Extract 7.2 is an example of incorrect response from one of the candidates whose performance was weak.



Extract 7.2: A sample of the incorrect responses to Question 7

In Extract 7.2, the candidate drew a bock diagram of main stages in communication system which was not the demand of the question and mentioned the uses of tuned circuit as "AC circuit" and "DC circuit" which was wrong. In part (b) the candidate incorrectly wrote the equations for calculating resonant frequency as $\text{LSF} = \frac{\text{FC} - \text{FE}}{\text{FC} + \text{FE}}$ and $\text{USF} = \frac{\text{FC} - \text{FE}}{\text{FC} + \text{FE}}$. This implies that the candidate had insufficient knowledge in this topic. The candidate confused the demand of the question with finding the upper and lower frequencies in obtaining and drawing frequency bandwidth in communication system. Although, the formula was also incorrect to candidate's interpretation.

2.2.6 Question 8: Digital Electronics

The question comprised of two parts (a) and (b). It required candidates to mention four electronics components needed for construction of both discrete component circuit and Integrated Circuit (IC) circuit, differentiate analog linear IC from digital IC, and give five reasons IC circuit being preferred over discrete component circuits. The question was intended to test the candidates' ability to distinguish between discrete component circuit and IC circuit, hence, being able to select among the two during the application. The question was:

Both discrete components circuit and IC circuits are used in electronics systems but differ in size and ability to work.

(a) (i) Mention four electronics components you will need to construct both discrete component circuits and IC circuits.

(ii) Differentiate analogue linear IC from digital IC.

(b) Why IC circuit is preferred over discrete components circuits? Give five reasons.

The question was attempted by 215 (100%) candidates. The data analysis depicts that 38 (17.67%) candidates scored from 0 to 2.5 marks, 74 (34.42%) scored from 3 to 5.5 marks, and 103 (47.91%) scored from 6 to 9 marks. The performance was good, since 177 (82.33%) candidates passed by scoring from 3 to 9 marks. The candidates' performance in this question is summarized in Figure 8.

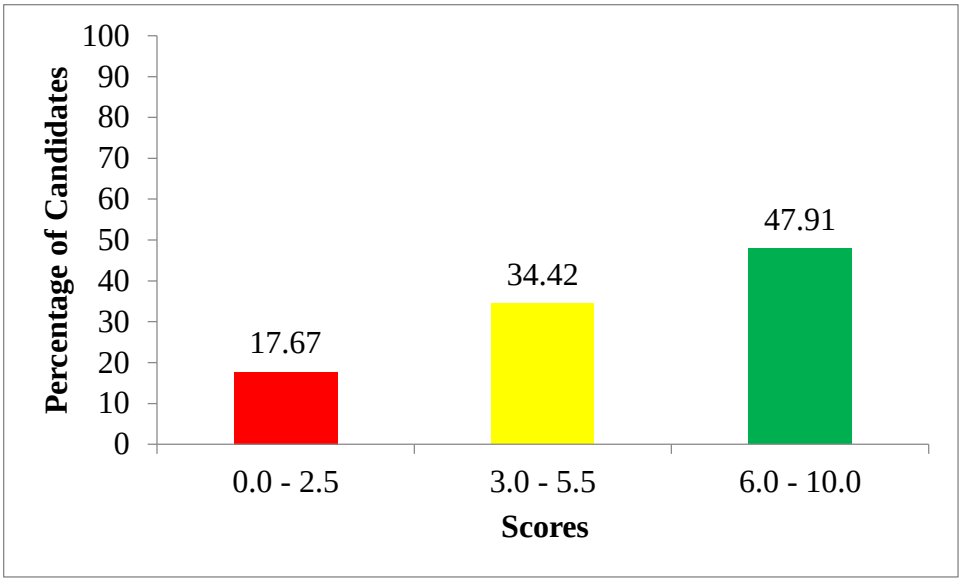


Figure 8: *The Candidates' Performance in Question 8*

Based on the data analysis, 82.33% of the candidates scored from average to good marks, this justified that these candidates had sufficient knowledge on the tested concepts about Digital Electronics. Extract 8.1 presents good responses from one of the candidates.

8 (a) (i)
- Resistor
- Transistor
- Diode
- Capacitor

(ii)

Analogue linear IC	Digital IC
▸ Comprises of large components hence large in size	▸ It is portable due to use of small component
▸ Less efficiency than digital ICs	▸ More efficient compared to analogue linear ICs

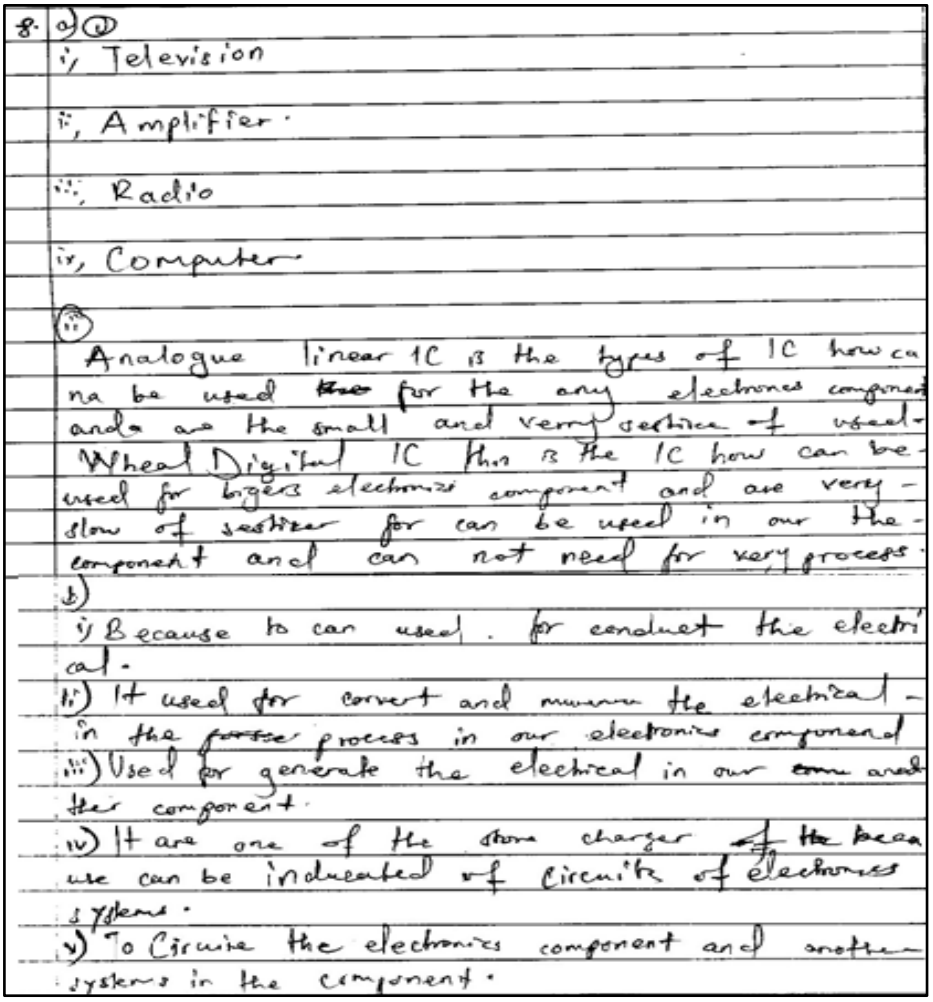
(b) Reasons to why IC is preffered over discrete components circuits
(i) They are portable, small in size
(ii) They are more efficient than discrete component circuits
(iii) They are cheap compared to this circuits.
(iv) Use less energy to operate
(v) Signal produced are stables.

Extract 8.1: A sample of correct responses to Question 8

In Extract 8.1, the candidate managed to mention four components needed to construct both discrete component circuit and IC circuit, differentiate linear IC from digital IC and give five reasons for IC circuit being preferred over discrete component circuit. This indicates that the candidate had sufficient knowledge and skills regarding the topic of digital electronics.

However, the analysis indicates that there were 38 (17.67%) candidates who poorly performed this question. They scored below average marks in this question. This depicts that these candidates had inadequate knowledge on *Digital Electronics*. To justify this, one of the candidates mentioned electronics tools such as; *Soldering gun, Circuit board, Soldering wire* and *Tester*, instead of electronics components. Furthermore, another candidate mentioned *soldering iron, multimeter, Regenerator* and long nose plier as electronic components, while these are tools and equipment. In response to part (b), the candidate stated that, "*Analogue IC uses electronic system while Digital IC uses signal system*" as difference between Analogue and Digital ICs. These responses imply that the candidates were unable to distinguish between the components, tools and equipment, as well as between analogue and Digital ICs. Hence, they had insufficient knowledge of the Integrated Circuits (ICs), in the topic of *Digital Electronics*.

Extract 8.2 presents incorrect response from one of the candidates who poorly performed question 8.


8. a) (i)
i, Television
ii, Amplifier.
iii, Radio
iv, Computer.
(ii)
Analogue linear IC is the types of IC how ca
na be used ~~the~~ for the any electronics componen
ands are the small and very sertica of used-
Wheal Digital IC this is the IC how can be-
used for bigers electronics component and are very -
slow of sertica for can be used in our the-
component and can not need for very process.
b)
i) Because to can used. for conduct the electri
cal.
ii) It used for convert and muuuu the electrical -
in the ~~purpose~~ process in our electronics componend
iii) Used for generate the electrical in our ~~com~~ and
ther component.
iv) It are one of the store charger ~~of~~ the beca
use can be indicated of circuits of electronics
systems.
v) To Circuit the electronics component and another
system in the component.

Extract 8.2: A sample of incorrect responses to Question 8

In Extract 8.2 the candidate failed to mention the required electronics components in part a (i), instead, the candidate mentioned electronics devices; *Television, Amplifier, Radio and Computer*. This indicates that, the candidate failed to distinguish between electronics components and electronics devices. In part a (ii), the candidate stated that *analog linear IC used for any electronic components and are the small, while, digital IC are used bigger electronic components* as the difference between the linear IC and the digital IC which is not correct. This indicates that the candidate had inadequate knowledge and skills in digital electronics, especially in Integrated Circuits topic.

2.2.7 Section C: Structured Questions

This section consisted of three (3) structured questions; 9 to 11. Each question carried a weight of fifteen (15) marks. The candidates were required to answer two (2) questions from this section, hence, the cumulative score for the entire section was 30 marks.

2.2.8 Question 9: Cable Television

The question required candidates to draw a well labeled block diagram of a Master Antenna Television (MATV) system including two off points and two television receivers. This question was intended to test the candidates' ability to recall the parts of MATV and demonstration on how the two television receivers can be connected. The question was:

The Master Antenna Television (MATV) is used to receive and deliver a strong signal from one or more antennas to every television receiver connected to the system. Using only two antennas located at the roof top, draw a well labeled block diagram of an MATV system including two top off points and two television receivers

The question was attempted by 137 (63.72%) candidates while 78 (36.28%) did not attempt this question. The data analysis indicates that, among those who attempted this question, 123 (89.78%) candidates scored from 0 to 4.5 marks, 13 (9.49%) scored from 5 to 9.5 marks and 1(0.73) candidate whose scored is within 10 to 15 marks. The candidates' performance in this question is summarized in Table 3.

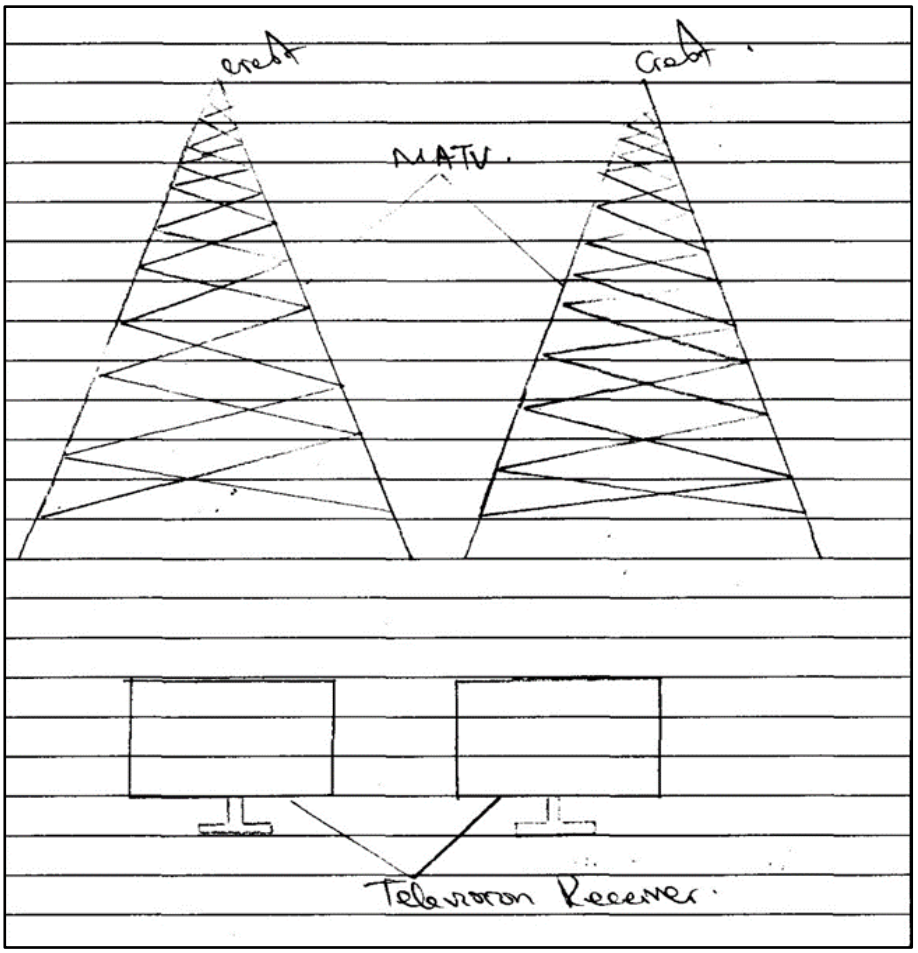
Table 3: The Candidates' Performance in Question 9

Range	Performance		
	Number of Candidates	**Percentage (%)**	**Remark**
0 – 4.5	123	89.78	Weak
5 – 9.5	13	9.49	Average
10 - 15	1	0.73	Good

The performance for this question was poor, since 123 (89.78%) candidates failed. Most of the candidates failed to, draw a well labeled block diagram of a Master Antenna Television (MATV) system including two top off points and two television receivers using only two antennas located at the roof top. Most of them sketched block diagram of communication system and some of them sketched satellite dish antennas, fixed on building. These

candidates had some ideas of communication systems, except for the tested concept of MATV.

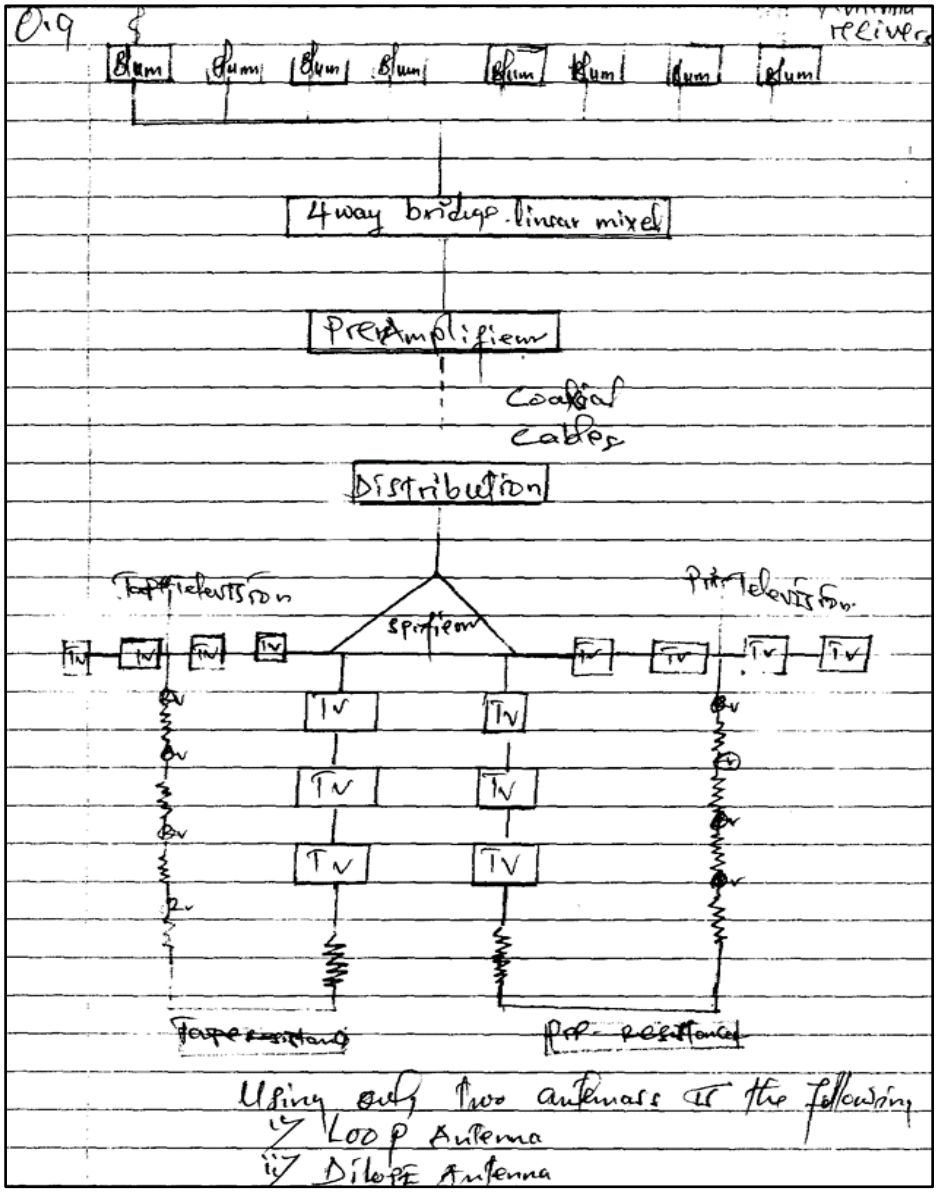
Extract 9.1 illustrates the incorrect response from one of the candidates who poorly performed on question 9.



Extract 9.1: A sample of incorrect responses to Question 9

In Extract 9.1, the candidate drew two towers and named them MATV instead of block diagram of a Master Antenna Television (MATV) as per demand of the question. Additionally, the candidate drew two screen like blocks and named them Television Receiver. This implies that the candidate had insufficient knowledge on the requirement of the question.

Although the general performance of this question was poor, one of the candidates scored above average marks. Extract 9.2 presents a good response from the candidate's script.



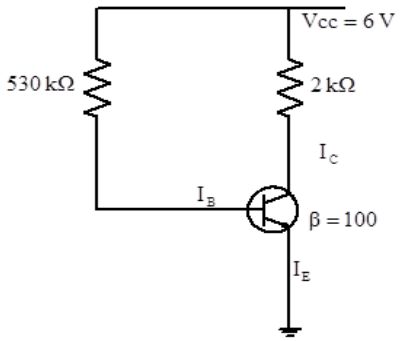
Extract 9.2: A sample of good responses to Question 9

In Extract 9.2, the candidate managed to locate sequentially linear amplifier, pre-amplifier and distribution amplifier in block diagrams. This shows that the candidate had sufficient knowledge and skills in the topic of cable television.

2.2.9 Question 10: Transistor

The question comprised of two parts (a) and (b), which required the candidates to determine the operating point of the output characteristics, and, state the biasing method used in a given part of an amplifier circuit, explain the configuration used in the amplifier circuit, and draw a diagram for both NPN and PNP transistor. The question was intended to test the candidates' ability to analyze the parts of an amplifier circuit. The question was as follows;

A candidate designed a part of an amplifier circuit using a silicon transistor with a 6 V d.c supply as shown in the figure below.



(a) Determine operating point for the output and state the biasing method used.

(b) (i) Briefly explain the configuration used in the amplifier circuit.

(ii) Draw a diagram for both NPN and PNP transistor.

The question was attempted by 214 (99.53%) candidates while 1 (0.47%) did not attempt this question. The data analysis shows that, among those who attempted the question, 117 (54.67%) candidates scored from 0 to 4.5 marks, 43 (20.10%) scored from 5 to 9.5 marks and 54 (25.23%) scored from 10 to 15 marks. The analysis depicts that the performance on this question was poor, since 117 (54.67%) candidates failed. The candidates' performance in this question is summarized in Figure 9.

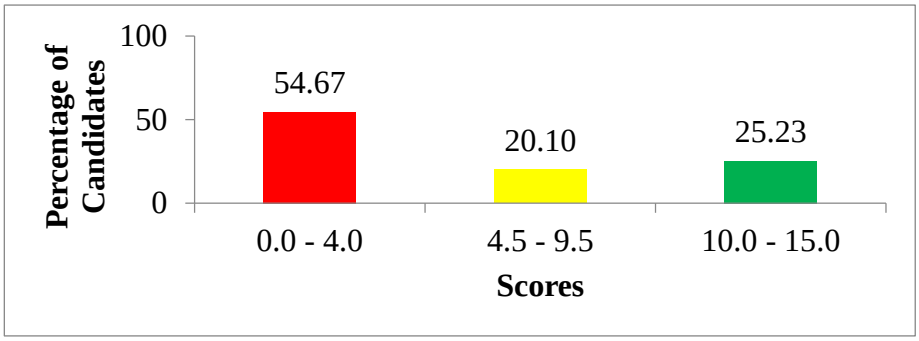
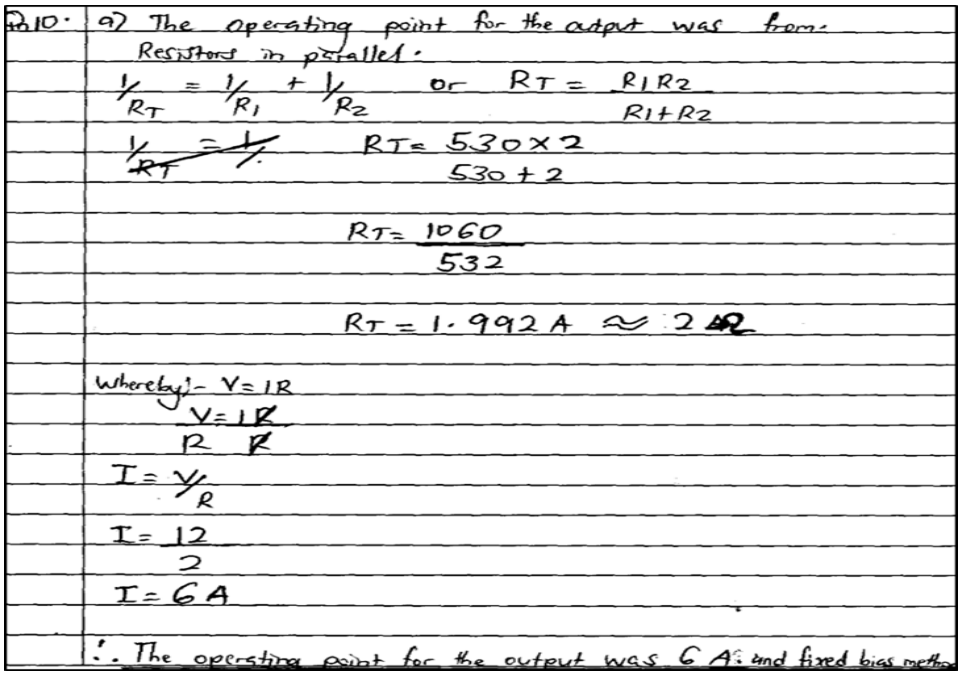
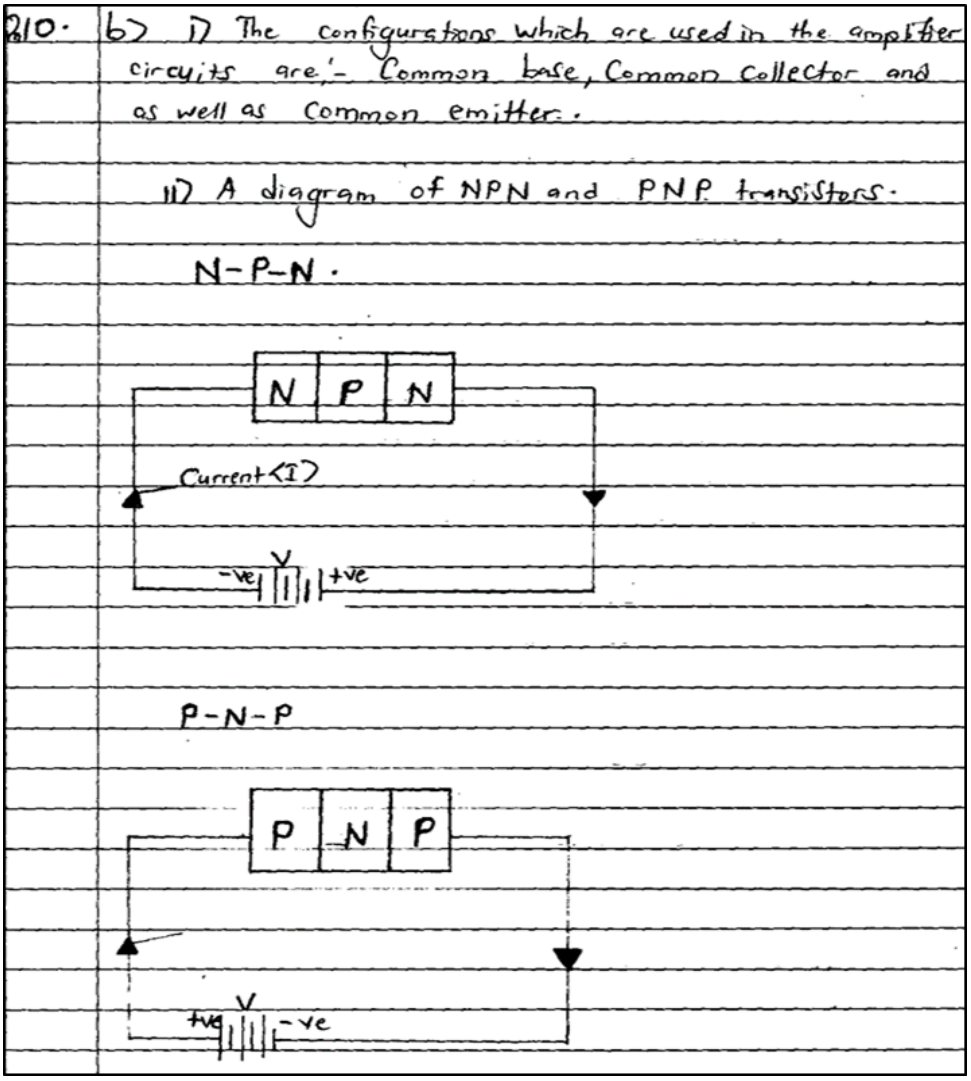


Figure 9: *The Candidates' Performance in Question 10*

The analysis shows that 117 (54.67%) of the candidates who attempted this question had weak performance. Majority of the candidates failed to determine the operating point for the output and state the biasing method used on a given transistor circuit, as well as to identify the configuration used in the amplifier circuit. Furthermore, some of them failed to draw a diagram for both NPN and PNP transistor. For instance, one of the candidates used wrong formula in determining the operating point of the transistor circuit, incorrectly stated that the configuration used in the transistor circuit was Common Collector, instead of Common Emitter and interchangeably sketched the symbols for the two Transistors, NPN and PNP. Extract 10.1 shows a sample of incorrect responses by one of the candidates.


10. a) The operating point for the output was from:
Resistors in parallel.
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$ or $R_T = \frac{R_1 R_2}{R_1 + R_2}$
$\frac{1}{R_T} = \frac{1}{}$ $R_T = \frac{530 \times 2}{530 + 2}$
$R_T = \frac{1060}{532}$
$R_T = 1.992\,A \approx 2\,A\Omega$
Whereby:- $V = IR$
$\frac{V}{R} = \frac{IR}{R}$
$I = V/R$
$I = \frac{12}{2}$
$I = 6\,A$
∴ The operating point for the output was 6 A: and fixed bias metho



Extract 10.1: A sample of incorrect responses to Question 10

In Extract 10.1, the candidate used the formula for calculating total resistance in parallel combination, instead of considering base biasing method as demanded by the question. The candidate interpreted the two resistors in the transistor circuit as connected in parallel to each other, hence, started by determining the equivalent resistance. The candidate also failed to mention the configuration specifically used in the given amplifier circuit, instead, the candidate mentioned three transistor biasing configurations. Moreover, student sketched incomplete diagram of the formation of BJT, with only two pins, instead of drawing the correct diagram for both NPN and PNP transistor.

Although, the general performance of the candidates on this question was poor, 97 (45.33%) candidates scored average and above. Extract 10.2 presents good responses from one of the candidates.

10 (a) Data given;

$V_{CC} = 6V$

$R_C = 2k\Omega$

$I_C = ?$

$R_B = 530k\Omega$

$\beta = 100$?

Operating point (V_{CE}, I_C) = required.

from $I_C = \beta I_B$

but

$V_{CC} - V_B - V_{BE} = 0$

$V_{CC} - I_B R_B - V_{BE} = 0$

$I_B R_B = V_{CC} - V_{BE}$

$\frac{R_B}{R_B} \quad \frac{}{R_B}$

$I_B = \frac{V_{CC} - V_{BE}}{R_B}$

$= \frac{6V - 0.7V}{530k\Omega}$

$= \frac{5.3V}{530k\Omega}$

$I_B = 10\mu A$

$\therefore I_B = 10\mu A$

but $I_C = \beta I_B$

$= 100 \times 10\mu A$

$= 1mA$

$\therefore I_C = 1mA$

for V_{CE}

from, $V_{CC} - V_C - V_{CE} = 0$

$V_{CC} - I_C R_C - V_{CE} = 0$

10(a) $V_{CE} = V_{CC} - I_C R_C$

$= 6v - (1mA \times 2k\Omega)$

$= 6v - 2v$

$= 4v$

$\therefore V_{CE} = 4v$

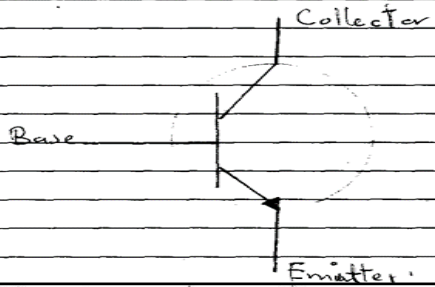
∴ The operating point is $V_{CE} = 4v$ and $I_C = 1mA$

The biasing method used is FIXED BASE BIAS

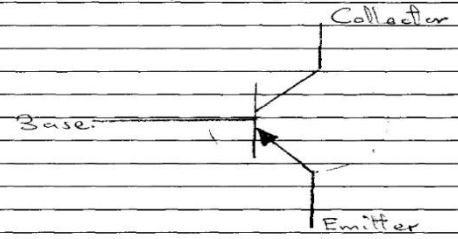
(b)

(i) The configuration used in the amplifier circuit is common emitter (CE) configuration, in this type of configuration the emitter terminal of the transistor is made common to both input and output of the transistor as seen in the given amplifier.

(ii) NPN transistor.



10(b) (ii) PNP transistor.



Extract 10.2: A sample of correct responses to Question 10

In Extract 10.2 the candidate applied the correct formula to determine operating point for the output of the amplifier circuit, and correctly stated the biasing method used. Also, the candidate managed to explain the configuration used in the amplifier circuit, and correctly drew a diagram for both NPN and NPN transistors. It signifies that the candidate had enough knowledge and skills in the topic of *Transistor*.

2.2.10 Question 11: Radio Communication

The question comprised of three parts (a), (b) and (c). It required candidates to explain the uses of fixed inductors in radio frequency, audio frequency and high frequency. Also, it required candidates to calculate inductance of the choke of radio receiver, inductive reactance of the choke and the inductance of the coil from the given data. The question was aimed at testing the candidates' knowledge on a fixed inductor's as used in different frequency ranges as well as ability to analyze the parts of a radio receiver, based on inductors. The question was:

(a) A media company ordered equipment for the media production. The equipment is built in with different fixed inductors which will operate in radio frequency, audio frequency and high frequency. Why is it important to have fixed inductors in each operation?

(b) A candidate diagnosed radio receiver circuit and realized that a choke of 5cm long and cross section area of 5 x 10^{-4} m^2 is damaged. A choke has core material of relative permeability of 3540 and permeability of 4π x 10^{-7} H/m. If the choke will operate correctly at 250 Hz, determine:

(i) The inductance of the choke of radio receiver.

(ii) Inductive reactance of the choke.

(c) A coil wound on an iron core of permeability 400 has 150 turns and a cross sectional area of 5cm^2. Given that a steady current of 3 mA produces a magnetic field of 10 lines/cm^2 when air is present as a medium. Calculate the inductance of the coil

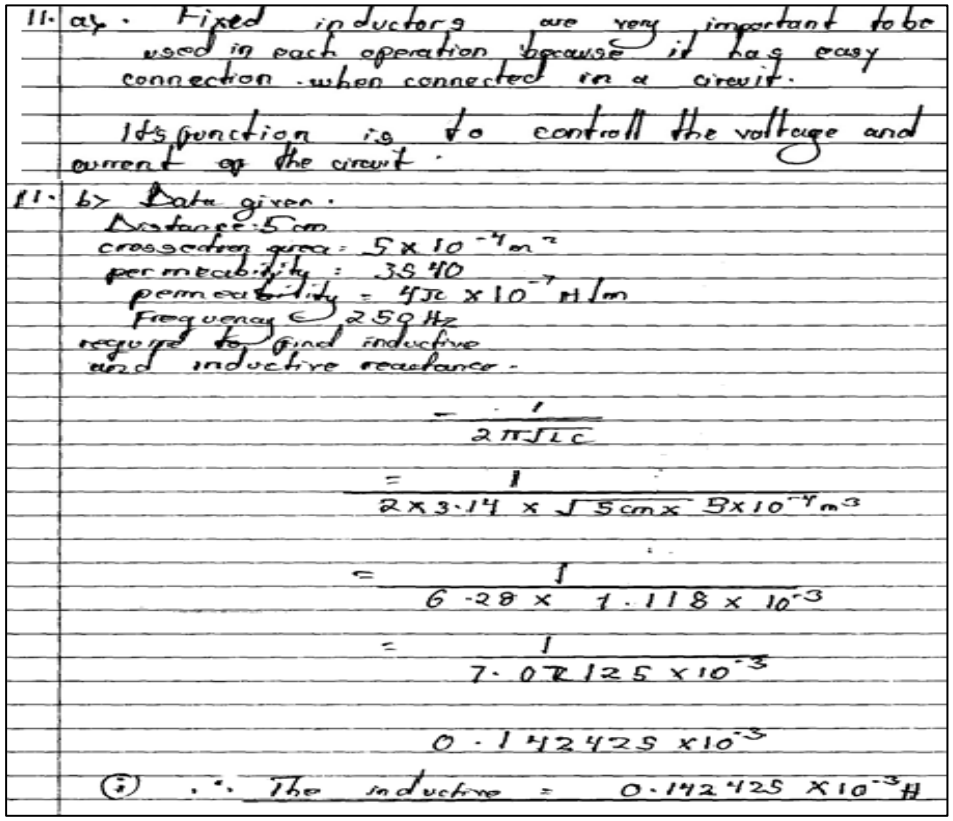
The question was attempted by 79 (36.74%) candidates while 136 (63.26%) did not attempt this question. The data analysis shows that 77 (97.47%) candidates scored from 0 to 4.5 marks, 2 (2.53%) scored from 5 to 9.5 marks; no candidate scored from 10 to 15 marks. The candidates' performance in this question is summarized in Table 4.

Table 4: The Candidates' Performance in Question 11

Range	Performance		
	Number of Candidates	Percentage (%)	Remark
0 – 4.5	77	97.47	Weak
5 – 9.5	2	2.53	Average
10 - 15	0	0	Good

The analysis predicts that the performance of all candidates to this question was poor, since 77(97.47%) candidates out of 79 who attempted this question failed. This indicates that the candidate had insufficient knowledge on the tested concepts on the topic of Radio Communication.

Most of the candidates, 77(97.47%) out of those who attempted the question failed to remember the correct formula for solving for the required parameters. Majority of them also failed to state the importance of the fixed inductor in radio frequency, audio frequency and high frequency. Extract 11.1 illustrates the incorrect responses from one of the candidates.


11. a) · Fixed inductors are very important to be used in each operation because it has easy connection when connected in a circuit.

Its function is to controll the voltage and current of the circuit.

11. b) Data given.
Distance: 5cm
cross section area: $5 \times 10^{-4} m^2$
permeability: 3S40
permeability = $4\pi \times 10^{-7}$ H/m
Frequency = 250 Hz
required to find inductive and inductive reactance.

$$= \frac{1}{2\pi\sqrt{LC}}$$

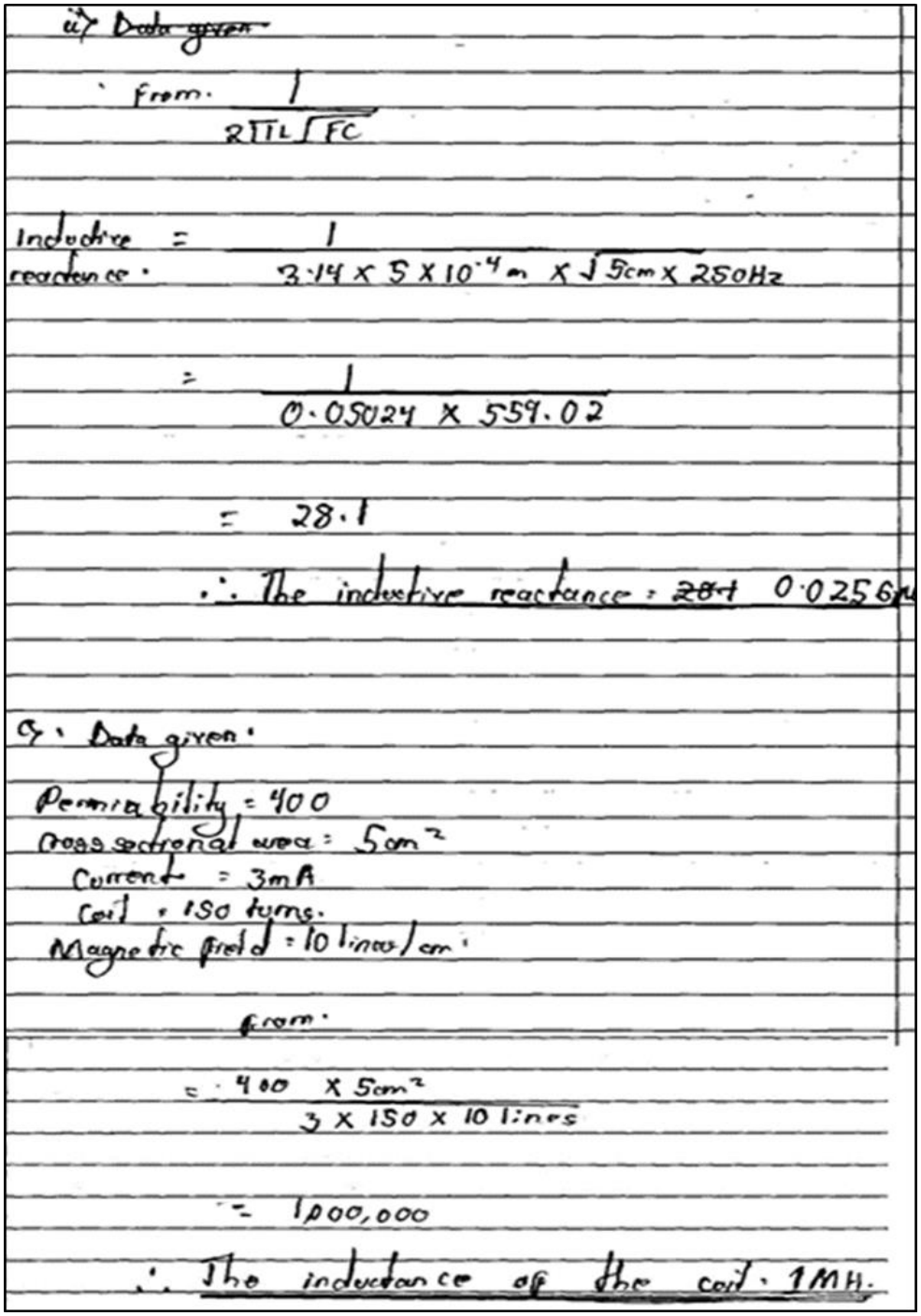
$$= \frac{1}{2 \times 3.14 \times \sqrt{5cm \times 5 \times 10^{-4} m^3}}$$

$$= \frac{1}{6.28 \times 1.118 \times 10^{-3}}$$

$$= \frac{1}{7.02125 \times 10^{-3}}$$

$$0.142425 \times 10^{-3}$$

(i) ∴ The inductive = 0.142425×10^{-3} H

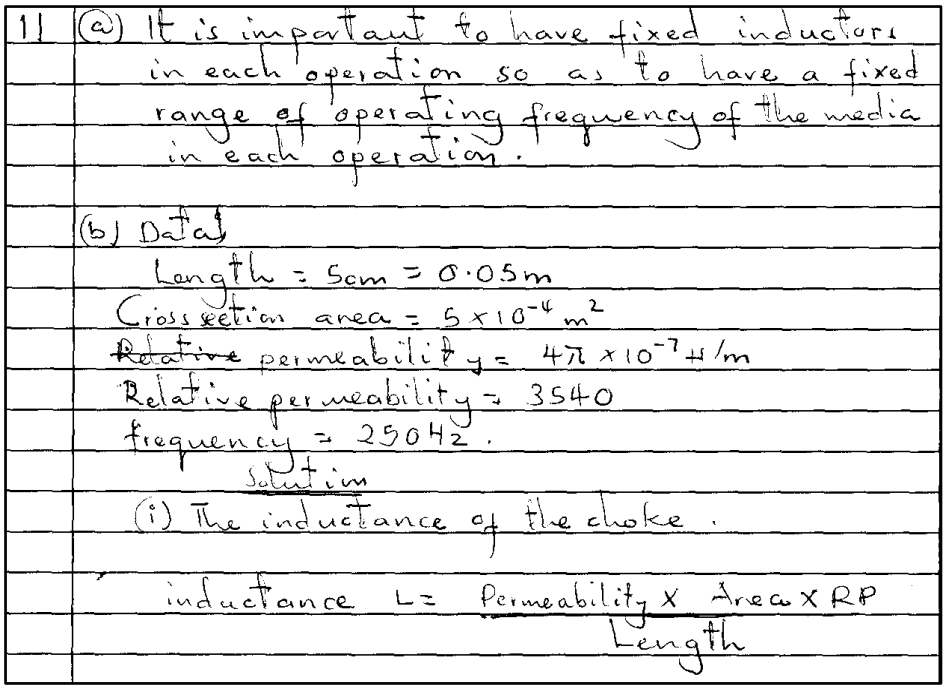


Extract 11.1: A sample of incorrect responses to Question 11

In Extract 11.1, the candidate incorrectly stated that "*the function of the fixed inductor is to control voltage and current*" which is not correct. The

candidate recalled the function of a fixed resistor instead the importance of a fixed inductor in radio frequency, audio frequency, and high frequency. The candidate also failed to apply right formula to calculate inductance of the choke of radio receiver, inductive reactance part (b) and inductance of the coil in part (c) of the question. The candidate recalled and applied the formula for resonant frequency in part b (i and ii), which does not correlate with the given data. This implies that the candidate had some ideas concerning the radio communication topic, but was not competent with the tested concepts.

On the other hand, only 2(2.53%) candidates out of those who attempted the question scored average marks. Extract 11.2 presents satisfactory responses from one of the candidates.


11 (a) It is important to have fixed inductors in each operation so as to have a fixed range of operating frequency of the media in each operation.

(b) Data

Length = 5cm = 0.05m

Cross section area = $5 \times 10^{-4}\ m^2$

~~Relative~~ permeability = $4\pi \times 10^{-7}\ H/m$

Relative permeability = 3540

frequency = 250Hz.

Solution

(i) The inductance of the choke.

inductance $L = \frac{\text{Permeability} \times \text{Area} \times RP}{\text{Length}}$

10(b) (i)

$L = 4\pi \times 10^{-7} H/m \times 5 \times 10^{-4} m^2 \times 3540$
$0.05 m$

$= \frac{2.223 \times 10^{-6}}{0.05} H$

$= 4.45 \times 10^{-5} H$

$\approx 44.5 \mu H$

∴ The inductance of the choke is $44.5 \mu H$

(ii) Inductive reactance of the choke

from,

Inductive reactance, $X_L = 2\pi FL$

$X_L = 2\pi FL$

$= 2 \times 3.14 \times 250 \times 44.5 \mu H$

$= 6.28 \times 250 \times 44.5 \mu H$

$= 6.28 \times 0.011125 \Omega$

$= 0.069865$

$\approx 0.07 \Omega$

∴ The inductive reactance is 0.07Ω.

(c) Data;

permeability = 400

turns = 150 turns

Cross sectional area = $5 cm^2$

Current = 3mA

Magnetic ~~flux~~ field = 10 lines/cm^2

Inductance = ?

Solution.

11(c) from, Inductance = $\frac{\text{Permeability} \times \text{~~Area~~} \times \text{field} \times I}{\text{turns}}$

$= \frac{P \times A \times f \times I}{\pi}$

$= \frac{400 \times 5 cm^2 \times 10 \text{ lines/cm} \times 3mA}{150 \text{ turns}}$

$= \frac{20,000 \times 3m}{150}$

$= \frac{60}{150}$

$= 0.4 H$

$= 400 mH$

∴ The inductance of the coil is 400mH.

Extract 11.2: A sample of satisfactory responses to Question 11

In Extract 11.2, the candidate correctly responded to part (a) of the question by explaining the importance of a fixed inductor in radio frequency, audio frequency and high frequency. Also, in part (b) the candidate applied the right formula, hence, correctly calculated the inductance of the choke of the radio receiver as well as the inductive reactance of the choke. This depicts that the candidate had sufficient knowledge in the topic of radio communication, although, the candidate failed to apply the correct formula to compute inductance of the coil in part (c) of the question.

3.0 THE CANDIDATES' PERFORMANCE IN EACH TOPIC

The analysis of the candidates' performance in the topics which were examined in the Electronics and Communication Engineering subject for the year 2023 indicates that the candidates performed well in the topics of *Introduction to Electricity, Repair and Maintenance of TV Receiver, Electronics Drawing, Communication System, Television Receiver, Consumer Electronics, Electronics Components and Communication System* (question 1), and *Digital Electronic (question 8).* The good performance on these topics was contributed by the candidates' sufficient knowledge, skills and competence on the tested concepts and understanding of the requirements of the questions.

The analysis indicates that the candidates' performance was average in the topics of *Cellphone Repair (question 6), Communication System (question 3, 4 and 7), Transistor (question 10) and Radio Communication (question 5).* The performance was due to sufficient knowledge that the candidates had about the tested topics. However, in few items, some of the candidates provided fewer or incorrect points and failed to use appropriate formula to perform calculations.

The candidates had weak performance in the topic of *Cable Television*. The major challenges were the failure of the candidates to match the functions with their corresponding devices in Cable Television as it was asked in question 2, also due to inadequate knowledge of Master Antenna in question number 9. A summary of the candidates' performance in each topic is presented in the Appendix.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The general performance of the candidates in Electronics and Communication Engineering on Form Four National Examinations (CSEE) in the year 2023 was good. Out of 215 candidates who sat for the paper, 151 (70.23%) passed, while 64 (29.77%) failed. The good performance of the candidates resulted from their ability to understand requirements of the questions, their knowledge, skills and competence in the subject matter, and their mastery of calculation skills.

However, few shortcomings have been revealed. These include the candidates' insufficient knowledge in responding to some of the questions, failure to understand the questions, and inability to apply appropriate mathematical formulae in computations as it was highly observed in the topics of *Cable Television* which was poorly done.

4.2 Recommendations

Based on the observations made in the Candidates' Item Response Analysis (CIRA), the following recommendations are put forward in order to improve the performance in this subject.

(a) Candidates are advised to be very keen in studying in order to gain sufficient knowledge, skills and competences of the learned concepts in various topics within the prescribed syllabus.

(b) The competence-based mode of material delivery should be put into practice in various topics. This will ensure sufficient knowledge, skills, and competences are acquired and mastered by the prospective candidates.

(c) Candidates should be guided to carryout different computation exercises to strengthen their ability to tackle questions which require application of formulae and calculations.

(d) English language should be emphasized more in primary and secondary school level as it seems that an average number of candidates failed to interpret the questions given correctly, and

expressed poor communication skills which affected their overall performance.

Appendix

A Summary of the Candidates' Performance in each Topic in Electronic and Communication Subject for the Year 2023

S/n	Topic	Question Number	Percentage of Candidates who Scored 30 Per cent and above	Remarks
1	Introduction to Electricity, Repair and Maintenance of TV Receiver, Electronics Drawing, Communication System, Television Receiver, Consumer Electronics, Electronics Components and Communication System	1	88.84	Good
2	Digital Electronics	8	82.33	Good
3	Cellphone Repair and Service	6	63.26	Average
4	Communication System	3, 4 & 7	56.75	Average
5	Transistor	10	45.33	Average
6	Radio Communication	5 & 11	38.94	Average
7	Cable Television	2 & 9	20.00	Weak