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) 2022

RADIO AND TV SERVICING

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083 RADIO AND TV SERVICING

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

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FOREWORD

This report presents Candidates Items Response Analysis (CIRA) on Form Four National Examination in Radio and TV Servicing subject which was conducted in November 2022. The report aims to provide feedback to all educational stakeholders on the factors that contributed to the candidates' performance in Radio and TV Servicing subject.

The Form Four National Examination is a formative evaluation which intends to monitor candidates' learning outcome in order to provide feedback that teachers, students and other educational stakeholders can use to improve teaching and learning processes. This analysis justifies the candidates' performance in the Radio and TV Servicing subject. The candidates who attained high scores had adequate knowledge of using formulas in calculating and analyzing some facts as asked in the examination paper. More over these candidates had sufficient basic knowledge in drawing and using different tools, ability to interpret simple diagrams as per questions demand. However, the candidates who scored low marks faced difficulties in responding to the questions due to their insufficient knowledge on the tested concepts.

This report will help to identify candidates' strengths and weaknesses observed in their responses. It will help teachers to identify the challenging areas and take appropriate measures during teaching and learning process.

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

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

Dr. Said A. Mohamed
EXECUTIVE SECRETARY

LIST OF SYMBOLS AND ABBREVIATIONS

RF	Radio Frequency
A.C	Alternating Current
A.M	Amplitude Modulation
D.C	Direct Current
CSEE	Certificate of Secondary Education Examination
Hz	Hertz
TV	Television
UHF	Ultra High Frequency
p.d	Potential Difference
r.m.s	Root mean square
V	Volt
MHz	Mega Hertz
Ω	Ohm
mH	Milli Henry
mA	Milli ampere
%	Percentage
μF	Micro Farad
kΩ	Kilo Ohm
R	Resistance
A	Ampere
E_{in}	Input Electromotive Force Voltage
V_{in}	Input Voltage
pF	Pico Farad
V_{CC}	Voltage Common Collector
β	Beta

1.0 INTRODUCTION

This report presents the analysis of items response of the candidates' performance in Certificate of Secondary Education Examination (CSEE) in Radio and TV Servicing subject conducted in November 2022.

The paper comprised of sections A, B and C. Section A had one (1) multiple choice question with 10 items, (i) to (x). The items were set from the following topics: *Television Receiver, Semiconductor, Oscillators, RF signals, Semiconductor diode, Power supplies, Tools and test equipment, Measurement and Instrumentation, Picture tube, Electronic circuit components* and *Modulation.* The candidates were required to answer all the items from this section. Each item carried 1 mark, to make a total of 10 marks.

Section B consisted of nine (9) short answer questions constructed from the topics of *Safety, Modulation, Television Receivers, Radio Receivers, Transistor Amplifier, Electronic Circuit Components, Tuned circuits* and *Power supplies.* The candidates were required to answer all the questions in this section. Each question carried 5 marks, making a total of 45 marks.

Section C consisted of four (4) structured questions set from the topics of *Tuned Circuit, Television receivers, Antennae* and *Transistor amplifiers*. The candidates were required to answer three (3) questions from this section. Each question carried 15 marks, making a total of 45 marks.

A total of 163 candidates sat for Radio and TV Servicing subject in CSEE 2022. Among them, 114 (69.9%) candidates passed while 49 (30.1%) candidates failed. Generally, the candidates' performance in this paper was good. The analysis of the candidate's performance on each question is categorized into three grade ranges as shown in Table 1.

Table 1: Categories of the Grade Ranges of the candidates' Performance

Range in %	0 - 29	30 - 64	65 – 100
Remark on Performance	Poor	Average	Good

2.0 THE ANALYSIS OF CANDIDATES' RESPONSE TO EACH QUESTION

This part presents strengths and weaknesses of the candidates as they responded to each question.

2.1 SECTION A: OBJECTIVE QUESTIONS

2.1.1 Question 1: Multiple Choice Items

The analysis of the candidates' responses to Question 1 is based on 10 multiple-choice items; (i) to (x). The question instructed the candidates to choose the correct answer from the given alternatives A to E and write its letter beside the item number in the answer booklet provided.

A total of 163 (100%) candidates attempted this question. Among them 49 (30.1%) scored 0 to 3 marks, 84 (51.5%) scored 4 to 6 marks and 30 (18.4%) scored 7 to 10 marks. Generally, the performance was good since 114 (69.9%) candidates scored average marks and above. Most of the candidates proved to have sufficient knowledge on the areas tested. The candidates' performance on this question is summarizes in Figure 1.

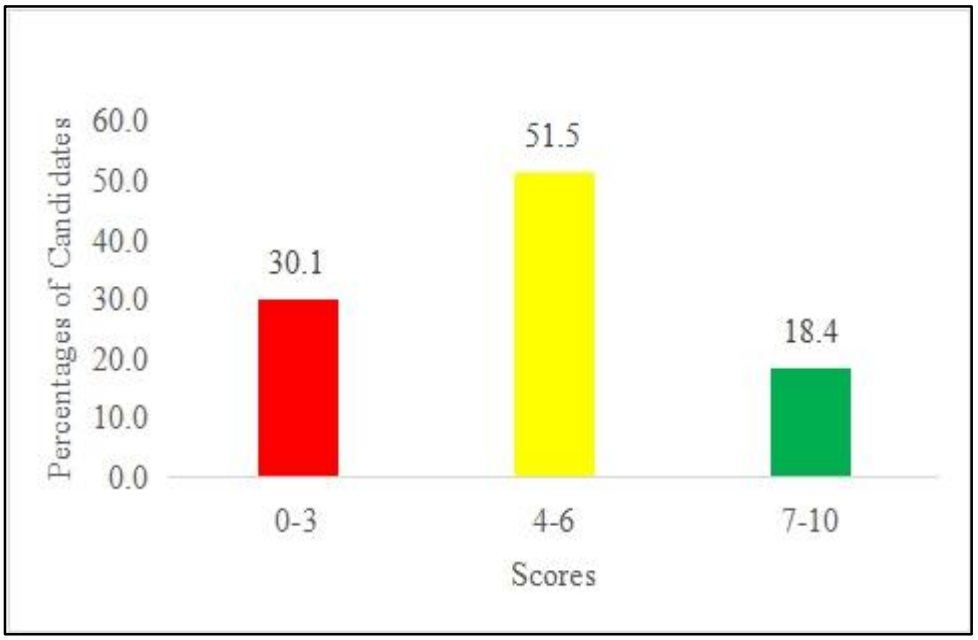


Figure 1: *The Candidates' Performance in Question 1*

The analysis of the candidates' responses in each item on Question 1 is given as follows.

Item (i) was based on the topic of *Television Receiver*. The question required the candidates to select correct meaning of the term "retrace" as used in scanning process of Television Receiver. The question was: *What does the term "retrace" referred to as used in TV technology?*

A Synchronizing pulse *B Field scanning* *C Back porch*
D Interlaced scanning *E Fly back*

The correct alternative was *E, Fly back*. The candidates who selected the correct alternative were conversant enough with the topic of Television Receivers, especially in the principles of operation in Television technology. However, those who selected alternative *B: Field scanning* failed to realize that the field scanning refers to the process of dividing total number of lines into two groups (odd and even field) to reduce flicker problem and not returning back line. Consequently, a few candidates who opted for alternatives A *Synchronizing pulse and C, Back porch,* did not recognize that these terms are used in video waveform and not in scanning process. In addition, the candidates who selected option *D, interlaced scanning,* lacked skills and knowledge on the concept of scanning in Television Receivers. They failed to understand that retrace is concerned with returning back of electron beam while an interlaced scanning is the method used to reduce flicker problem.

Item (ii) was constructed from the topic of *Semiconductors.* The candidates were required to identify the value of barrier potential as used in Germanium diodes. The question was: *What is the value of the potential barrier for Germanium diode?*

A 3V *B 6V* *C 0.3V* *D 0.6V* *E 0.7V*

The candidates who selected the correct alternative *C, 0.3 V* were knowledgeable enough in the topic of semiconductor, specifically about materials used to manufacture diodes. For those who selected alternative *A: 3 V, B: 6 V* and *D: 0.6 V* failed to realize the exact values of operating voltage used in the Germanium diode, as they confused with the values used by silicon. The analysis shows that they had insufficient knowledge and skills on semiconductors. Furthermore, some candidates who opted for E, *0.7 V* were confused with the value of silicon diode.

Item (iii) was derived from the topic of *Oscillator*. It required the candidates to point out the type of oscillator which uses capacitive voltage divider. The

question was: W*hich one is an oscillator which utilizes capacitive voltage divider in providing feedback?*

A	*Hartley*	*B*	*Colpitts*	*C*	*Armstrong*
D	*Multivibrator*	*E*	*Wien*		

The correct alternative was *B, Colpitts*. The candidates who selected the correct answer had sufficient knowledge of the topic of oscillators. A few candidates who selected alternative *A, Hartley* failed to understand that this type of oscillators used as an inductive voltage divider rather than capacitive, while those who opted for distractor *C, Armstrong* lacked skills and knowledge on principles of operation and structure between these two types since Armstrong oscillator does not use two capacitors in series. Others who opted alternative *D, Multivibrator* lacked knowledge on the concept that this oscillator generates frequency by using equal capacitor but not connected in series. They were also supposed to know that a multivibrator circuit oscillates between a "HIGH" state and a "LOW" state producing a continuous output. Those who selected alternative *E, Wien* failed to realize that this oscillator uses resistor and capacitor in series not series capacitors as the question demonds.

Item (iv) intended to measure the candidates' ability to categorize the types of waves according to their frequency propagated. The question read: *In what type of wave is UHF signal range propagated?*

A	*Ground wave*	*B*	*Sinusoidal wave*	*C*	*Sky wave*
D	*Surface wave*	*E*	*Space wave*		

The item was constructed from the topic of R.F signals. The correct response was alternative *C, Sky wave*. Those candidates who selected this alternative had sufficient knowledge on RF signal in electromagnetic spectrum. However, some candidates missed the answer by confusing it with response *A, ground wave.* This shows that they failed to understand the transmission range in ground (2 MHz) and its Medium Frequency (MF). The candidates who selected alternative *B, Sinusoidal wave* confused it with different types of frequency range since all RF signals are sinusoidal. Similarly, some candidates wrongly opted for alternatives *D, surface wave* and *E, space wave* failed to understand that these distractors are among signal range of propagation above ground wave (30-300 MHz) and are in very high

frequency but they are not applied in UHF signal which is in the range of 300 to 3000 MHz.

In item (v) was set from the topic of *Semiconductors*. The question was intended to measure the candidates' ability to identify the diode characteristics. The question was:

W*hich of the following diodes possess negative resistance characteristics?*

A	*Zener diode*	*B*	*Schottky diode*	*C*	*Tunnel diode*
D	*PN junction diode*	*E*	*Varactor diode*		

Those who got correct answer *C, Tunnel diode* had enough knowledge on semiconductor diodes. Most of these candidates had sufficient understanding and knowledge of the function of different diode used in microwave radio frequency. In contrast, some candidates confused this concept by opting distractor *A; Zener diode* which during operation has to be connected in reverse biased. In addition, those who opted for *B, Schottky diode* lacked knowledge of semiconductor devices as this type of diode is used in RF signal application but does not possess negative resistance. In addition, those who selected alternative *D, PN junction diode* were not conversant enough with different types of diode and their properties. They failed to understand that this type of diode is used in the power supply rectifier circuit and detector circuit and it has no negative properties. Those who opted for alternative *E, Varactor diode* failed to understand the application of different types of diode. They were supposed to remember that the varactor diode is used in RF signal and operates in reverse direction.

In item (vi) was set from the topic of *Rectifier*. The item required the candidates to locate the stage in a power supply which uses a zener diode as a main component. The question was:

Which stage of a d.c power supply use a zener diode as a main component?

A	*Rectifier*	*B*	*Voltage divider*	*C*	*Regulator*
D	*Filter*	*E*	*Load*		

The correct response was alternative *C, Regulator*. Those candidates who selected the correct answer had sufficient knowledge and skills in the topic on power supply especially the stages of d.c power supply in the regulator. Those who chose alternative *A, Rectifier* had insufficient knowledge of d.c power supply since the rectifier is used to change a.c voltage to d.c voltage.

Some candidates who opted for alternative *B, Voltage divider* which was wrong lacked knowledge of the d.c power supply and its stages. There were others who opted for alternative *D, Filter.* These candidates confused this with the part of power used for smoothing ripples in d.c power supply. For those who selected alternative *E, Load* assumed that zener diode as it connected to the load of power supply. Also they were not aware of the function of zener diode as it is connected to power supply.

In item (vii) candidates were required to specify the type of instrument used for measuring A.C current. The question asked:

W*hich type of instrument is recommended for measuring A.C current?*

A Induction type ammeter *B Moving iron type ammeter*
C Moving iron voltmeter *D Permanent magnet type ammeter*
E Hot wire type ammeter

This item was set from the topic of tools and test equipment. The correct response was *A, Induction type ammeter.* The candidates who selected this alternative had sufficient knowledge and skills in measuring instruments especially measuring a.c current. Those who opted for alternative *B, moving iron type ammeter* they failed to understand the requirement of the question hence they could not recognize that this type of instrument mostly used to measure both a.c and d.c current. Some candidates opted for alternative C, *Moving iron voltmeter* these candidates had insufficient knowledge as they could not realize that this instrument is used for both a.c and d.c voltages. Those candidates who opted for alternative *D, Permanent magnet type ammeter* had little knowledge on measuring instruments since this type of instrument is used for measuring d.c only. Other candidates who selected alternative *E, Hot wire type ammeter* failed to realize that this type is used to measure a.c and d.c current due to thermal expansion.

Item (viii) was set from the topic of *Television Receiver*. The candidates were required to identify the effect of image produced caused by picture tube to mull functioning. The question was:

What will be the effect to the image produced, if the picture tube operates under poor convergence?

A The image will have chroma *B The image will have random*

phase shift

B The image will have random interference

C The image will have colour fringing

D The image will have unstable sync lock

E The image will have mutual interference

The correct response was alternative *C; The image will have colour fringing.* The candidates who opted for this alternative had knowledge of principles of operation of the picture tube. Others wrongly opted for alternative *A, The image will have Chroma phase shift.* This effect is not related to the picture tube, rather, it is related to the hue which is represented by a phase shift of the chrominance signal relative to the colour burst. Those who opted for alternative *B The image will have random interference* and *E The image will have mutual interference* lacked knowledge on colour mixing process on TV receivers and their effects. For those who opted for alternative *D, The image will have unstable sync lock,* could not recognize that images in TVs and color are two different signals, the unstable sync clock has no effect to the picture/image colour. It deals with picture/video signals and not colour signals.

Item (ix) required the candidates to mention factors which determine the value of current flowing in a capacitor. The question read:

W*hat are the factors that determine the amount of the current flowing in a capacitor?*

A Area, distance between plates and material used.

B Capacitance, area and material used.

C Distance between plates, dielectric and material used.

D Capacitance, distance between plates and area.

E Capacitance, distance between plates and material used

The item was derived from the topic of *Electronics components and circuits.* Those who opted for correct alternative *A, Area distance between plates and the material used* had sufficient knowledge and skills in electronic circuit components. Other candidates selected an alternative *B, Capacitance, area and material used, D, Capacitance, distance between plates and area and E, Capacitance, distance between plates and material used* could not understand the term that appeared in these alternatives, capacitance of a capacitor, the change of capacitance of capacitor are among the factors. It is

a result of the other three mentioned factors "area, material used and distance between plates". On the other hand, those who opted for *C Distance between plates, dielectric* and *material used* failed to recognize that these parameters are used to manufacture capacitors.

Item (x) was constructed from the topic of *Modulation*. The candidates were required to select the characteristics of amplitude modulated wave in radio communication. The question was:

W*hich one is true about an amplitude modulated wave in radio communication systems?*

A *Is the sum of carrier and the modulating signal.*
B *Is the difference between the carrier and the modulating wave.*
C *Is the product of the carrier and the modulating signal.*
D *Is the sum of the carrier and its product with modulating signal.*
E *Is the suppressed carrier signal and modulating wave?*

The correct response was *A, Is the sum of carrier and the modulating signal* had sufficient knowledge on modulation frequencies. Those who selected alternative B*, Is the difference between the carrier and the modulating wave* confused with what happens when modulation and demodulation process take place especially in the demodulation process at the receiver. There were candidates who selected alternative C*, Is the product of the carrier and the modulating signal.* They did not realize that this is a special process which associates an oscillator part combined with R.F amplifier. The product of these two results in a frequency modulation and not amplification. Yet there were candidates who opted for alternative *D, Is the sum of the carrier and its product with modulating signal*. These candidates had insufficient knowledge of modulation process. Some who opted for alternative *E, Is the suppressed carrier signal and modulating wave* confused it with types of A.M modulation.

2.2 SECTION B: SHORT ANSWER QUESTIONS

2.2.1 Question 2: Safety

The question measured the candidates' ability to apply workshop safety rules and regulations related to safety. It consisted of three parts namely (a), (b) and (c), which required the candidates to do a number of things as follows: In part (a) they were required to state the safety factors to be considered in any

electronics and electrical workshop. In part (b), they were required to give four causes of accidents in electronics and electrical workshops. In part (c), they were required to state the importance for having a first aid kit in a work shop.

A total of 163 (100 %) candidates attempted this question. Among them 31 (19.0 %) scored 0 to 1 mark. In addition, 62 (38.0 %) candidates scored 1.5 to 3 marks and 70 (43 %) scored 3.5 to 5 marks. The performance was generally good since 132 (81.0 %) candidates scored above average. Most of them proved to have sufficient knowledge on the areas tested. Figure 2 summarizes the candidates' performance on this question.

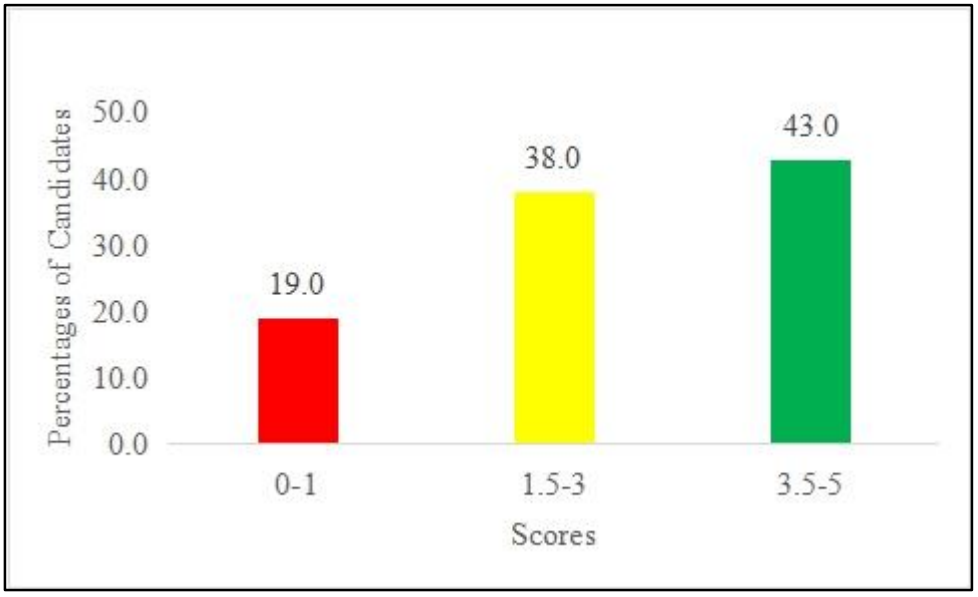
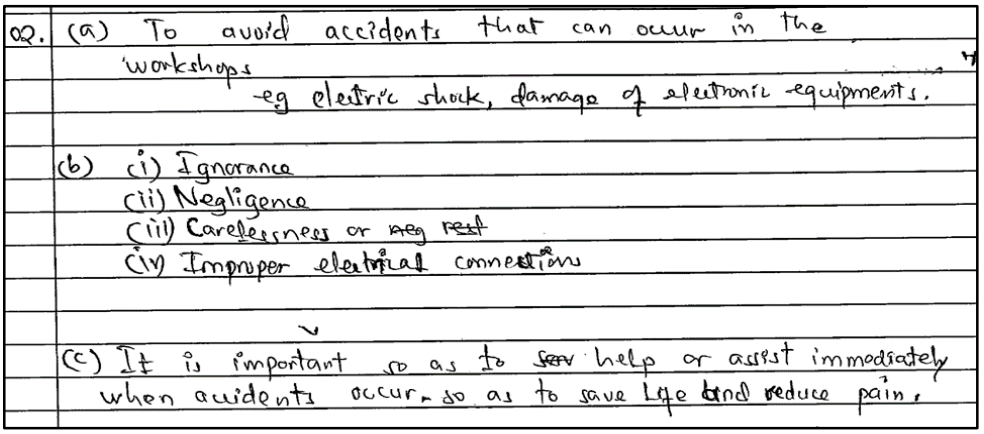


Figure 2: *The Candidates' Performance in Question 2*

The analysis of data indicates that most of the candidates (81.0 %) managed to explain safety factors and causes of accidents in any electronics or electrical workshops. Furthermore, they stated correctly the importance of first aid kit in a workshop. This suggests that they had sufficient knowledge on safety precautions. Extract 3.1 provides a sample of correct responses from one of the candidates.


02. (a) To avoid accidents that can occur in the workshops
-eg electric shock, damage of electronic equipments.

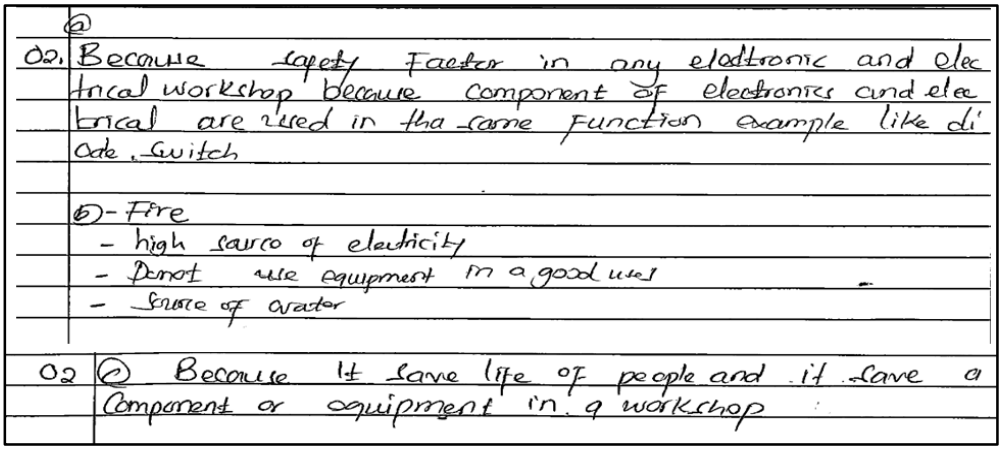
(b) (i) Ignorance
(ii) Negligence
(iii) Carelessness or ~~neg~~ ~~rest~~
(iv) Improper electrical connections

(c) It is important so as to ~~save~~ help or assist immediately when accidents occur, so as to save life and reduce pain.

Extract 2.1: A sample of a correct responses to Question 2

Extract 2.1 shows that the candidate was precise and accurate in responding to all parts of the question.

However, 19 % of the candidates scored low marks (0-1). These candidates had insufficient knowledge and skills in the concept of safety. Some of the candidates in part (b) (i), instead of explaining causes of accidents in a work shop they explained causes of accidents on the main roads. For example, one candidate wrote "*variation of the weather*". Also other candidates wrote the words that are not related to the question like "poor tools ie is not good ventilatal". Another candidate wrote "*electric shock may also cause accident*". These candidates were not able to recognize that electric shock itself is an accident and not the cause of accident. Further analysis on candidates' responses reveals that most of them were not aware of safety precautions, causes of accidents and the essence of first aid kit in the workshop. Extract 2.2 provides a sample of poor responses from a candidate.


(a)
02. Because safety Factor in any elodtronic and electrical workshop because component of electronics and electrical are used in the same function example like diode, Switch

(b) - Fire
- high sauce of electricity
- Donot use equipment in a good used
- Source of ovator

02 (c) Because it save life of people and it save a component or equipment in a workshop

Extract 2.2: A sample of an incorrect responses to Question 2

Extract 2.2 shows the response of the candidate who failed to provide the necessity of safety factors, failed to mention the causes of accident in a workshops and also failed to mentioned the purpose of first aid kit is to save life.

2.2.2 Question 3: Modulation

This question assessed the candidates' ability to (a) explain the main purpose of communication engineering systems and part (b) calculate the wavelength of electromagnetic wave propagated at a frequency of 300 MHz.

A total of 163 (100%) candidates attempted this question and their scores were as follows: 30 (18.4%) scored 0 to 1 mark. The other 62 (38.0 %) scored 1.5 to 3 marks and 71 (43.6 %) candidates scored 3.5 to 5 marks. These scores suggest that candidates' performance was good since 133 (81.6 %) scored average marks and above. Figure 3 is illustrating the candidates' performance on this question.

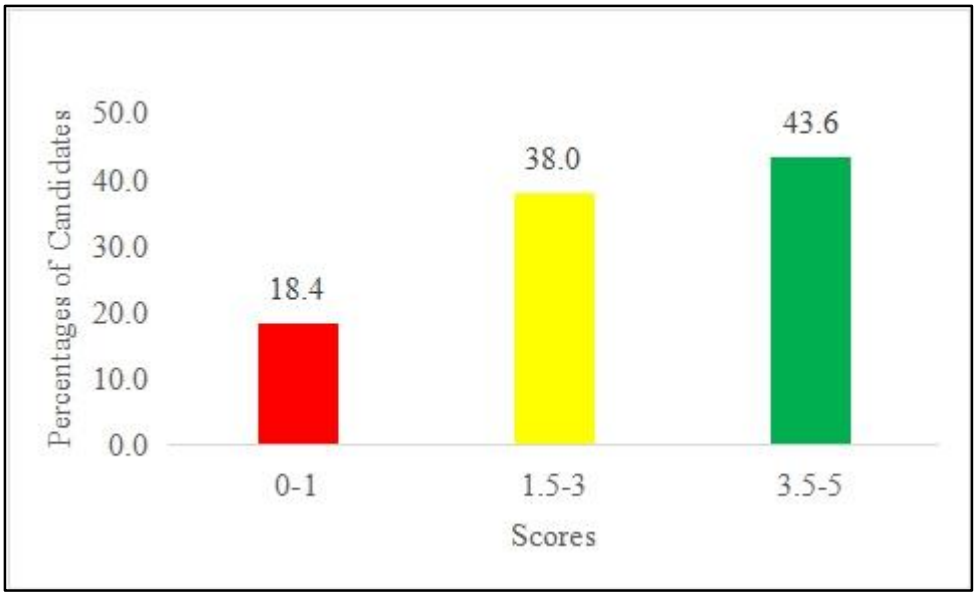
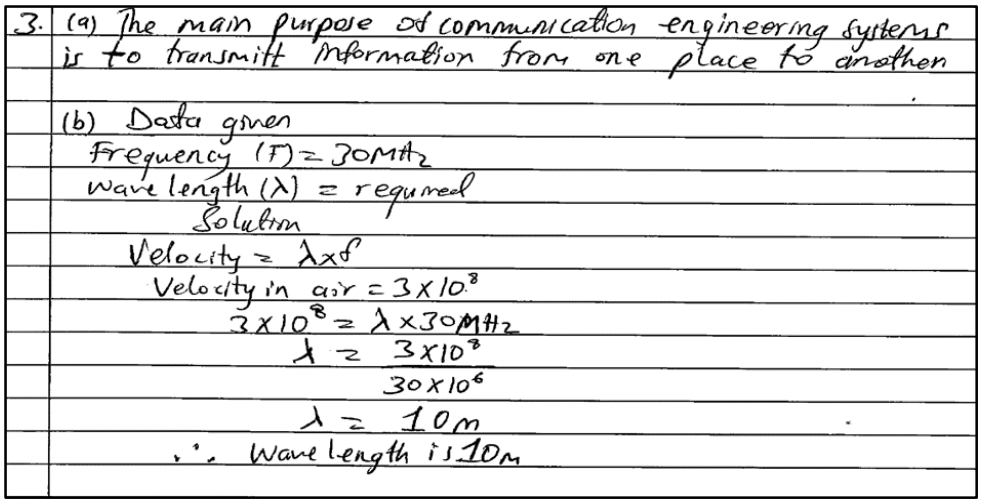


Figure 3: *The Candidates' Performance in Question 3*

The analysis of candidates' performance on this question was good since 133 (81.6%) candidates scored average marks or above. Most of candidates had the ability to explain the main purpose of a communication system and correctly applied the formula to calculate the wavelength for the given frequency. This indicates that they had adequate skills in modulation

technique. Extract 3.1 is a sample of a good response from one of the candidates who scored good marks.

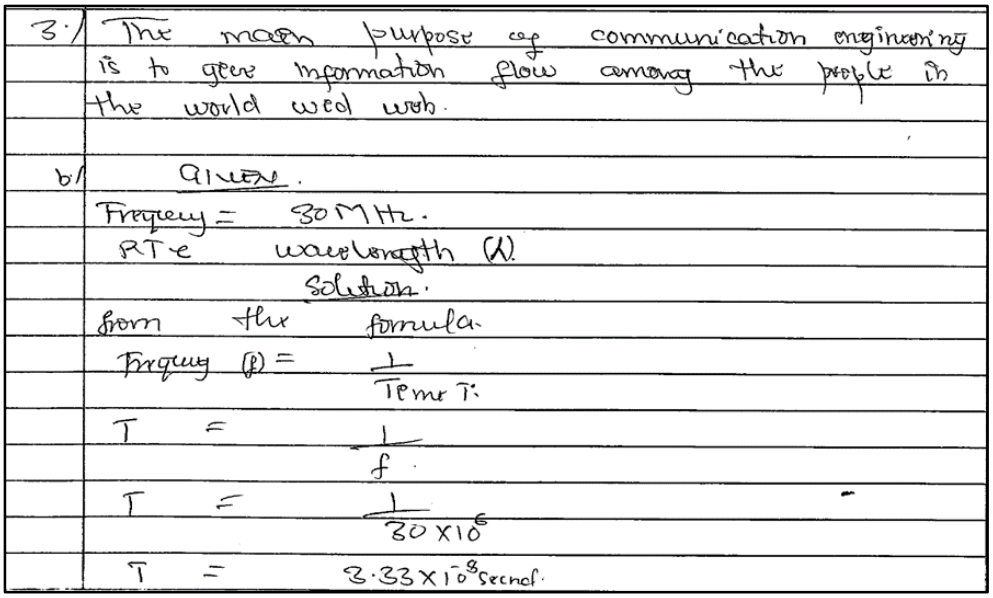

3. (a) The main purpose of communication engineering systems is to transmitt information from one place to another

(b) Data given
Frequency (F) = 30MHz
Wave length (λ) = required
Solution
Velocity = $\lambda \times f$
Velocity in air = 3×10^8
$3 \times 10^8 = \lambda \times 30MHz$
$\lambda = \frac{3 \times 10^8}{30 \times 10^6}$
$\lambda = 10m$
∴ Wave length is 10m

Extract 3.1: A sample of correct responses to Question 3

Extract 3.1, the candidate correctly explained the purpose of communication engineering systems and applied the relevant formula in performing calculation.

On the other hand, 30 (18.4 %) candidates scored low marks (0-1). Some candidates did not understand the demand of the question because instead of explaining the purposes of system in part (a), they explain the purpose of media. For example, one candidate wrote "*main purpose is to help the world in get the news easily and on time*". The correct response is to transfer signals from source to destination. Another candidate responded that "*to simplify works of communication user*", while others responded that *"broadcasting AM and FM signals"* which is not related to the question.
In part (b) some of the candidates failed to change the units from 30 MHz to 30 Hz which made them to get wrong answers. In addition, some of them interchanged the formula of wavelength by writing $\lambda = \frac{f}{C}$ instead of $\lambda = \frac{C}{f}$ where by λ = wavelength, c = speed of the wave and f = frequency which lead to get wrong answer. Some candidates determined the frequency instead of wavelength as required by the question. All these misconceptions justify that most of the candidates lacked knowledge and skills in modulation techniques. Extract 3.2 provides an example of a poor response from a candidate who failed to provide correct answer in all parts of the question.



Extract 3.2: A sample of incorrect responses to Question 3

Extract 3.2 provides a sample of responses from a candidate who poorly explained the purpose of communication engineering and incorrectly used the formula to calculate time instead of wavelength.

2.2.3 Question 4: Television Receivers

The question consisted of two parts, namely (a) and (b). The question tested the candidates' ability to recognize the importance of various types of the scanning process in TV signal transmission. It also assessed the ability of the candidates to perform calculations related to TV signal transmission. The question was:

(a) Why interlacing scanning is used in TV signal transmission?

(b) If the number of lines per field in a TV system is $262\frac{1}{2}$ *and its corresponding number of frames per second is 30;determine the number of lines per second in that system.*

A total of 163 (100%) candidates attempted this question. Out of them, 83 (50.9 %) scored 0 to 1 marks. On the other hand, 63 (38.7 %) scored 1.5 to 3 marks, while 17 (10.4 %) scored 3.5 to 5 marks. The performance was good since 80 (49.1 %) candidates scored marks above average. Most of them proved to have sufficient knowledge of the area tested. The candidates' performance on this question is summarizes in Figure 4.

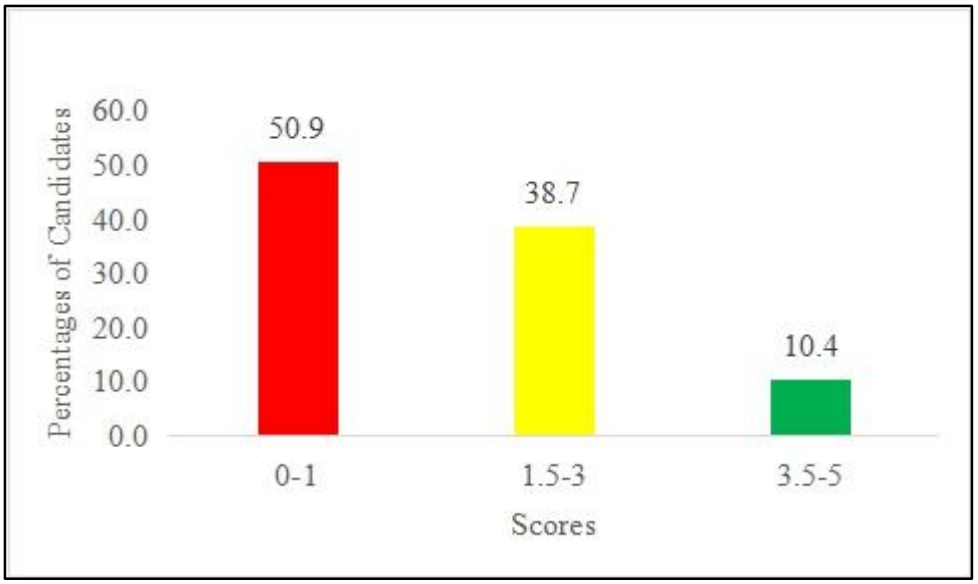
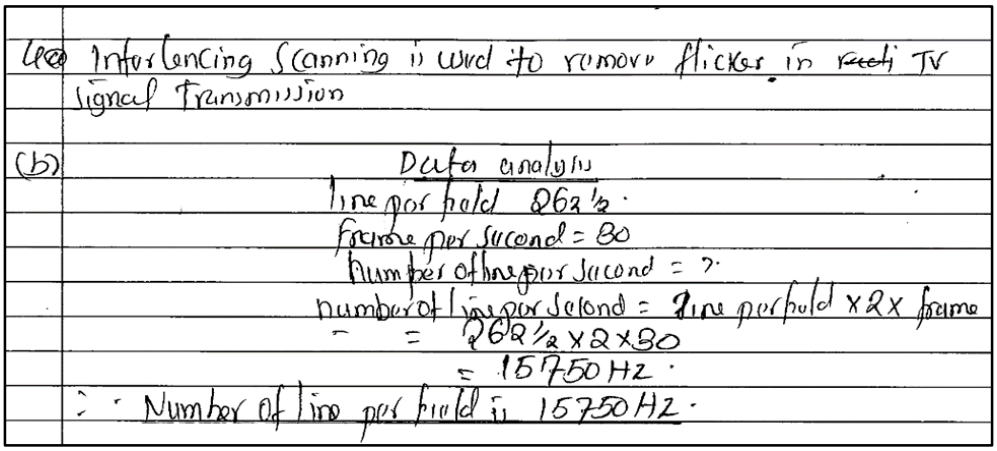


Figure 4: *The Candidates' Performance in Question 4*

The performance on this question was good since 80 (49.1 %) of the candidates scored marks and above. This analysis justifies that the candidates had sufficient knowledge on parameters of television receiver. The candidates correctly explained the purpose of interlaced scanning and also calculated the numbers of lines per second. Extract 4.1 provides a sample of a correct response from the candidate who correctly responded to the question.


(a) Interlencing Scanning is used to remove flicker in ~~reali~~ TV signal Transmission

(b) Data analysis
line per field 262½.
frame per second = 80
Number of line per second = ?
number of line per second = line per field x 2x frame
= 262½ x 2 x 80
= 15750 Hz.
∴ Number of line per field is 15750 Hz.

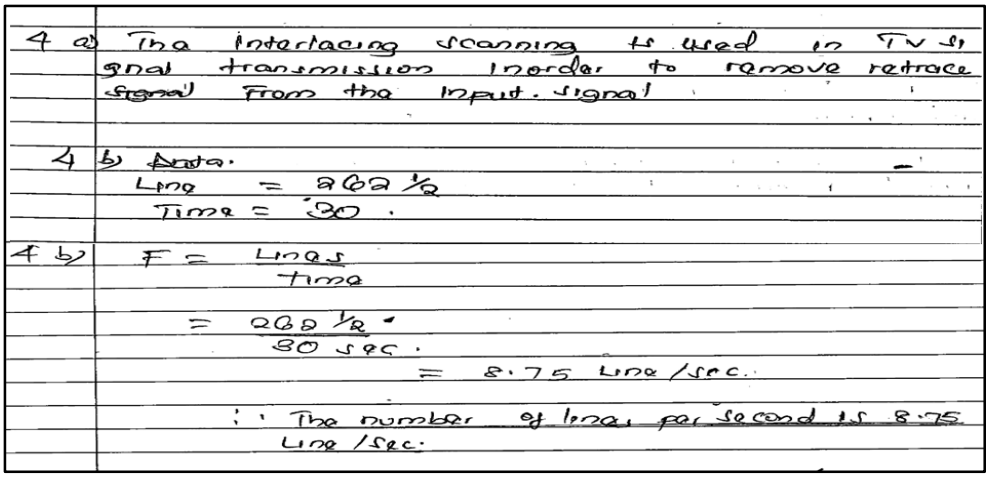
Extract 4.1: A sample of correct responses to Question 4

Extract 4.1 shows a sample of a good responses from a candidate who correctly explained the reasons for interlaced scanning used in TV signal

transmission and applied the correct formula to calculate number of lines per second in interlaced scanning.

However, the analysis on candidates' responses shows that there were 80 (49 %) of the candidates who performed poorly. In part (a) one candidate wrote that "*because it is used to scan picture*", one wrote that "*interlacing scanning is used in TV signal transmission because it scanning by using all horizontal and vertical scanning and image or picture is complete*". These answers are irrelevant to interlaced scanning which is there for the purpose of reducing the flicker problem. Some candidates explained the process of interlacing scanning instead of the purpose of it. For example, one of the candidates wrote "*because it scanning the picture twice*". Another candidate answered that "*interlaced scanning is used because it converts electrical into optical by passing from left to wright of the screen*". These candidates have knowledge on what is happening during the scanning process but they failed to respond to the demand of the question.

In part (b), the candidates used incomplete formula, the number of lines per second $= \frac{L}{F} \times \frac{F}{S}$ without multiplying by 2 which led to an incorrect answer. One candidate used a formula that is used to subtract the number of lines per field (NT) from the number of frames (NC) which led to an incorrect answer. Another candidate stated that interlaced scanning is used to remove retrace which was a wrong answer. In part (b) also candidates used formula which divides the lines with time $F = \frac{lines}{time}$ which was also incorrect. This revealed that candidates lacked knowledge and skills in the scanning process of television receiver. Extract 4.2 shows a sample of poor responses from a candidate who was unable to come up with a correct response.



Extract 4.2: A sample of an incorrect responses to Question 4

Extract 4.2 shows a sample of the candidate who incorrectly stated the use of interlaced scanning, and used an incorrect formula to calculate the number of lines.

2.2.4 Question 5: Radio Receivers

The question consisted of two parts (a) and (b). The question tested candidates' ability to analyse principle operation of superhet receiver. In part (a) the candidates required to state what will happen if a superhet radio receiver operates without a loudspeaker. In part (b), the candidates were required to draw a cross-over network that employs only a tweeter and woofer.

A total of 163 (100 %) candidates attempted this question. Their scores were as follows: 33 (20.2 %) scored 0 to 1 mark. 81 (49.7 %) scored 1.5 to 3 marks and 49 (30.1 %) scored 3.5 to 5 marks. Generally, the candidates' performance was good since 130 (79.8 %) scored the pass mark or above. Figure 5 summarizes these scores.

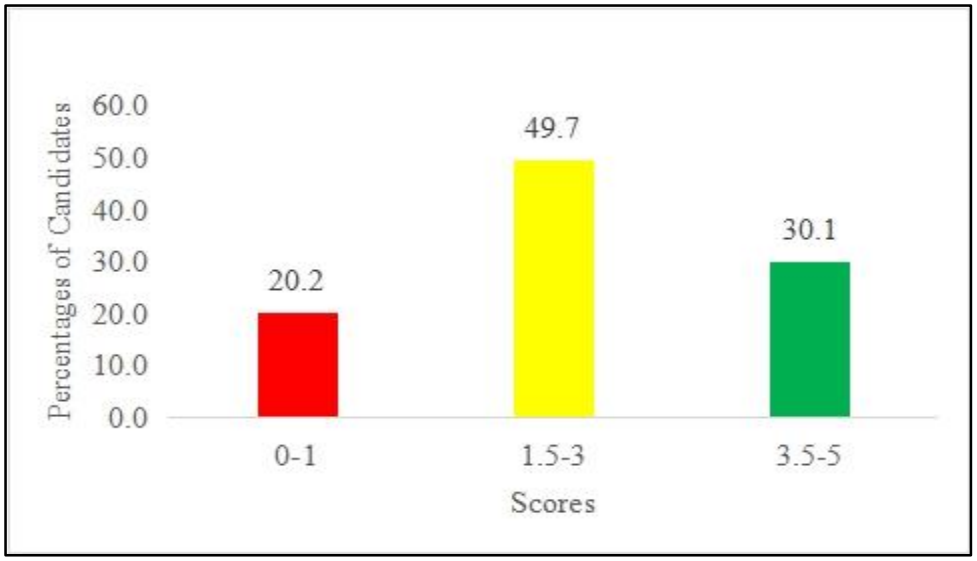
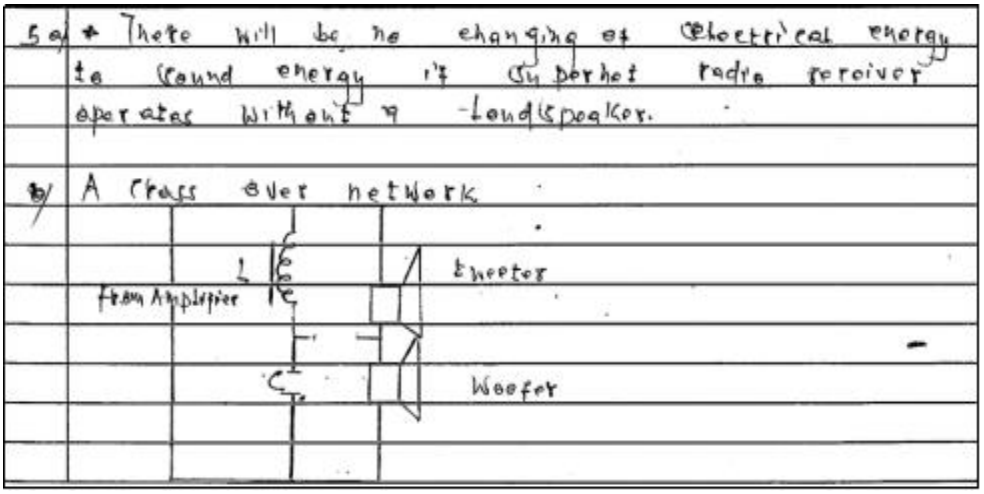


Figure 5: *The Candidates' Performance in Question 5*

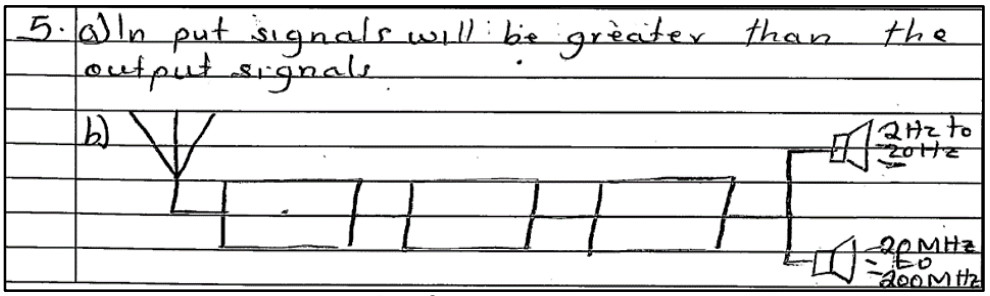
The analysis of candidate's responses shows that those who scored good marks had adequate knowledge and practical skills in radio receivers. Most of them explained properly the consequence of removing a loud speaker while superhet receiver is working. For example, one candidate wrote "*if loud speaker would be removed in the superhet the electrical signal will not be converted into sound*" and drew the cross over network. This suggests that the candidate was familiar with the concept of radio receiver and crossover network and understood the functions of each blocks of a radio receiver. Extract 5.1 shows an example of a correct response from a candidate who correctly responded to the question.



Extract 5.1: A sample of correct responses to Question 5

Extract 5.1 shows that a candidate correctly responded to part (a) of this question. In part (b), he/she correctly drew a crossover network circuit diagram which were relevant to the question demand.

Besides the fact that most candidates (79.8 %) passed the question, some candidates (20.2 %) scored low marks (0-1). These candidates faced difficulties in both parts of the question. Their misconception was based on failure to identify the functions of different electrical appliances. For example, one candidate in part (a) mentioned that *'the function of a microphone is to convert sound wave to electrical signal*' instead of stating that loud speaker converts electrical to sound wave. Another candidate wrote irrelevant responses such as "*it has very high of magnetic wave*" which related the process of converting sound to electrical instead of the outcome of the process. In part (b) a candidate drew a wireless network which comprises houses and towers instead of crossover network. Other candidate drew the tweeter symbols used in tweeter application. While a few of them drew a block diagram of supperhet receiver with all its components instead of tweeter and woofer network. This shows that they had insufficient knowledge and skills on radio receivers. Extract 5.2 is a sample of an incorrect responses from a candidate.



Extract 5.2: A sample of incorrect responses to Question 5

Extract 5,2 the candidate provided an incorrect response to part (a). In part (b), he/she drew untitled block diagram with two speakers at the output instead of a cross-over network.

2.2.5 Question 6: Transistor Amplifiers

The question comprised of two parts (a) and (b). The question tested the candidates' ability to apply knowledge of transistor biasing. In part (a) the candidate required to explain the transistor biasing in order to operate in two regions active region and saturation region and in part (b) to mention the features of good amplifier. The question was:

(a) How are transistor junctions biased in order to operate in the following regions?

(i) Active region

(ii) Saturation region

(b) What are the two features that must be possessed by a good amplifier?

A total of 163 (100%) candidates attempted this question. Among them 118 (72.4 %) candidates scored 0 to 1 mark. 17 (10.4 %) scored 1.5 to 3 marks and 28 (17.2 %) scored 3.5 to 5 marks. Generally, the candidates' performance was poor since 118 (72.4 %) candidates scored lower marks. Figure 6. Presents these scores

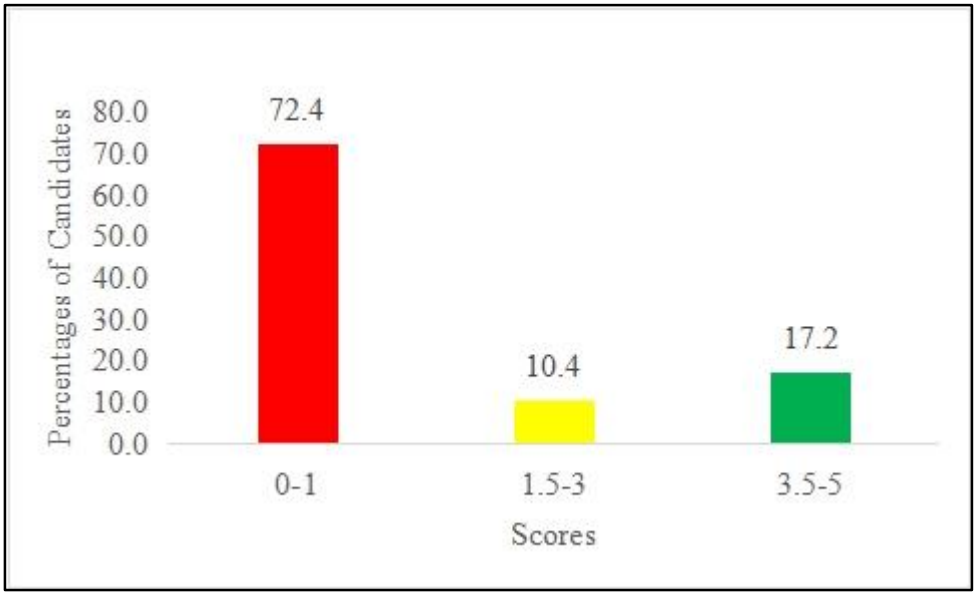
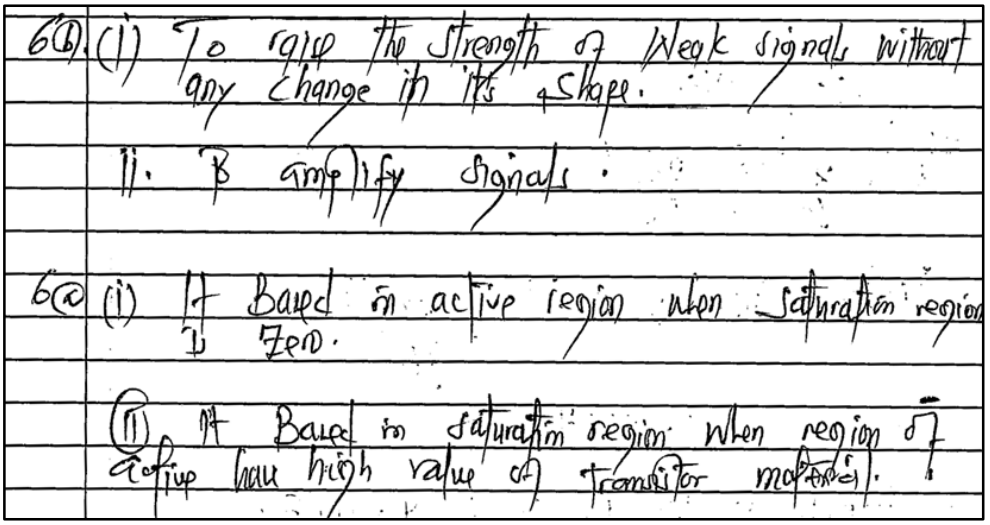


Figure 6: *The Candidates' Performance in Question 6*

The analysis of the data reveals that, the majority (72.4 %) of the candidates who scored low marks (0-1) failed to respond correctly to both parts of in the question. In part (a) (i), some candidate responded that "*active region when the region that are positive side".* They failed to specify which junctions of transistor will be positive and which one will be negative to get active region. In part (a) (ii) a candidate explained the mixture used to fabricate transistors instead of biasing. For example, one candidate wrote *"saturation region when the area are mixed or at the center not for a saturate active region or inactive region but are (neutral)".* This response shows that a candidate lacked skills on how transistor junction can be biased to operate in saturation region. In part (b) some of the candidates related the amplifier features with

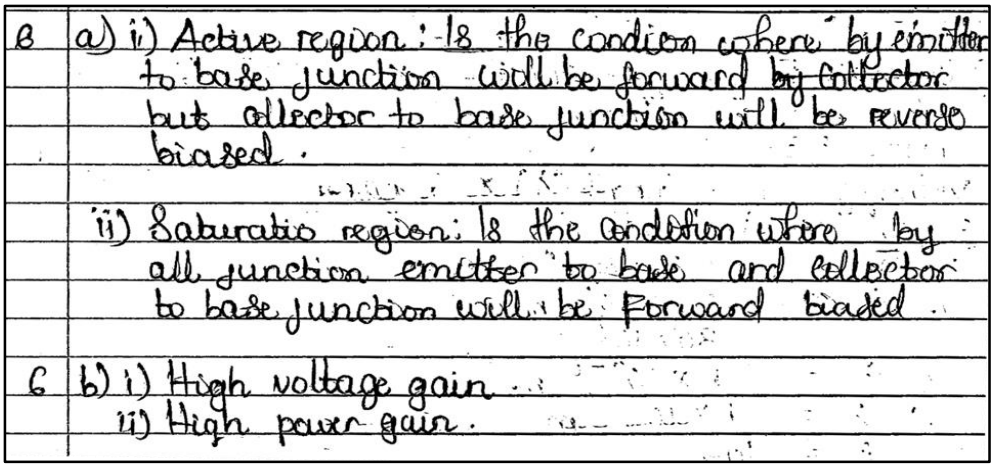
the modulation process. For instance, one candidate wrote, "*must have high modulating ability*". In addition, another candidate recalled the features of a receiver instead of amplifier, by writing "*selectivity good and good sensitivity*". Thus shows that these candidates had inadequate knowledge and skills on transistor amplifier, as they failed to identify and explain the features of a good amplifier and biasing operation of transistor junctions in active and saturation regions. Extract 6.1 provides a sample of incorrect response from one candidate.



Extract 6.1: A sample of incorrect responses to Question 6.

Extract 6.1, the candidate provided incorrect biasing process of active and saturation regions of a transistor and features of a good amplifier.

Despite of all these, there were candidates who scored good marks. Most of them provided a correct response in part (a) by explaining correctly the condition for emitter – base junction and collector - base junction biased in active and saturation regions. Consequently, in part (b), they clearly identified the features possessed by a good amplifier. Extract 6.2 is a sample of the correct responses from one of the candidates.



Extract 6.2: A sample of a correct responses to Question 6

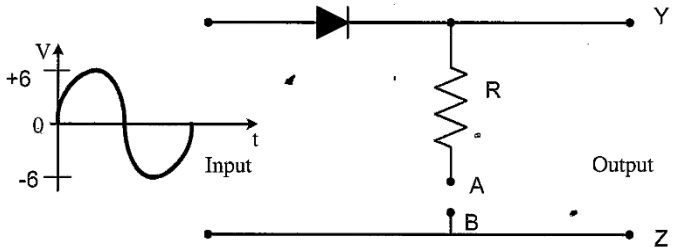
In Extract 6.2, the candidates provided the correct meaning of Active region and saturation region. In part (b) the candidate explained the features of good amplifier.

2.2.6 Question 7: Radio Receivers

The question constructed in two parts namely part (a) and (b). The question tested candidates the ability to understand the function of detector and function of its parts. In part (a) tested candidates' ability to understands the purpose of diode in a detector circuit and in part (b) to draw the input and output wave forms of such circuit. The question was follows:

(a) What is the function of a diode in detector circuit of an AM radio receiver?

(b) Study the figure below and sketch the waveform that would be observed at point Y and Z when point A and B are connected by a conducting wire.



This question was attempted by all candidates. The result indicates that 44 (27.0 %) candidates scored from 0 to 1 mark. Also the result shows that 81

(49.7 %) scored from 1.5 to 3 marks and 38 (23.3 %) scored from 3.5 to 5 marks. The analysis shows that the general performance of the candidates was good since 119 (73.0 %) candidates scored above average. These data are summarized in Figure 7 below.

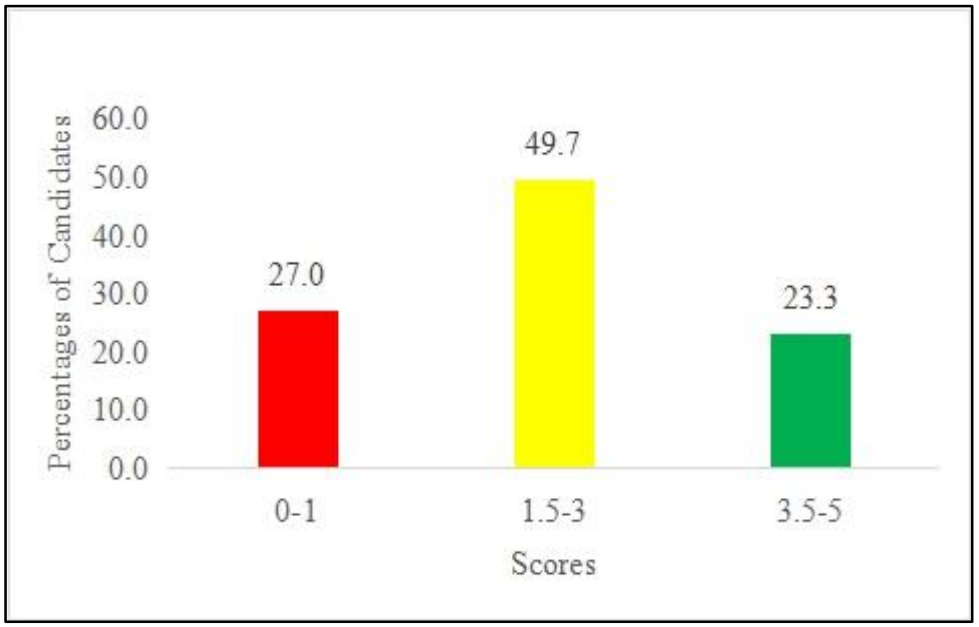
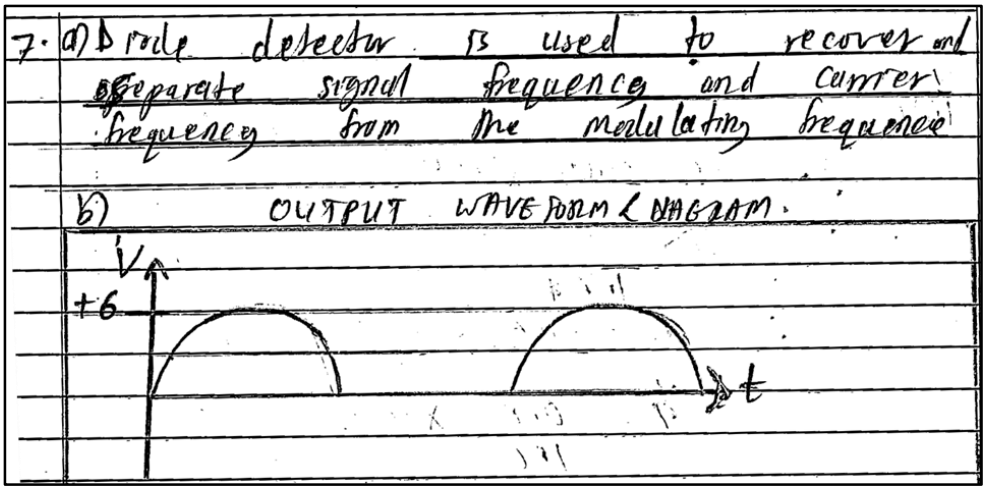


Figure 7: *The Candidates' Performance in Question 7*

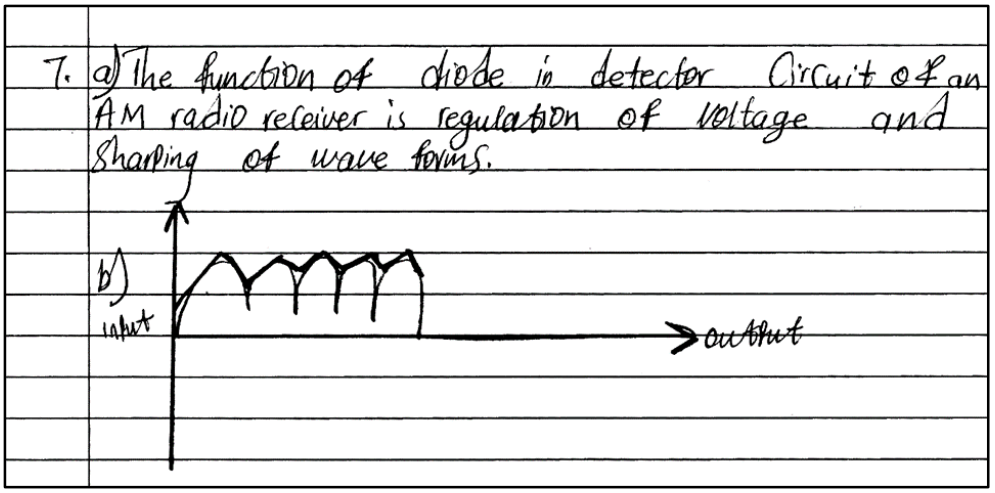
Candidates who performed well in this question were knowledgeable enough to give correct responses. They had ability to discover the function of diode in a detector circuit of an AM radio receiver and also drew the output waveform. This suggests that they had sufficient knowledge and skills on radio receivers. Extract 7.1 is a sample of a correct response from a candidate who correctly provided the function of diode in a detector circuit and correctly drew the output signal wave observed at point Y and Z.



Extract 7.1: A sample of correct responses to Question 7

Extract 7.1 the candidate provided correctly the function of diode in a detector circuit and correctly drew the output signal wave as observed at points Y and Z.

On the other hand, 27.0 per cent of the candidates scored low marks. Most of them failed to mention the function of diode as a detector of an AM radio receiver and drew the output waveform. Further analysis shows that they explained the function of a diode as a rectifier as to convert a.c to d.c in power supply instead of recovering or removing high carrier frequency from low modulating frequency. Another candidate wrote "*to control the current flow in only one direction*". In part (b), he/she drew a.c signal wave form with dashes at the upper and lower peak instead of only positive halves of the signal. Others drew the block diagram of the AM receiver instead of output signal from the detector. This misconception shows that these candidates lacked knowledge and skills to clarify the function of a diode in a detector circuit. Extract 7.2 provides a sample of incorrect responses from one of the candidates.

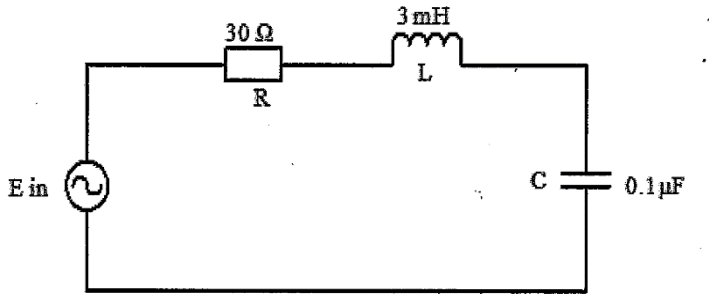


Extract 7.2 A sample of incorrect responses to Question 7

Extract 7.2 shows a sample of incorrect responses from a candidate who correctly stated the function of diode as a detector circuit but also failed to draw the output wave signal at points Y and Z.

2.2.7 Question 8: Electronic Circuit Component

This question intended to test the candidates' ability to use relevant formula to calculate different parameters of electronic circuits components. The question required the candidates to study the given circuit and calculate the impedance of the circuit when its operating frequency (f)= 12 KHz.



The question was attempted by 163 candidates, equivalent to 100 per cent. The distribution of their scores is shown in Figure 8.

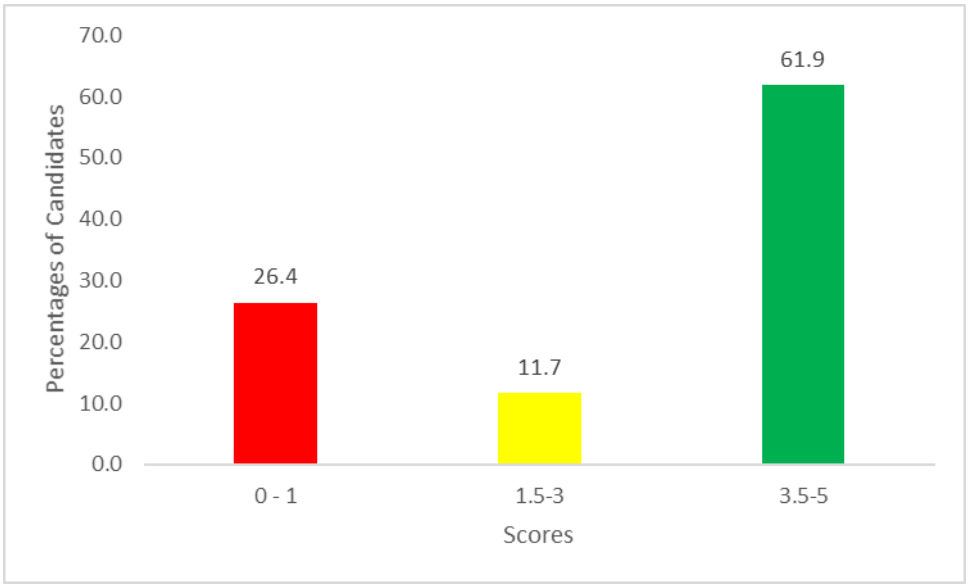
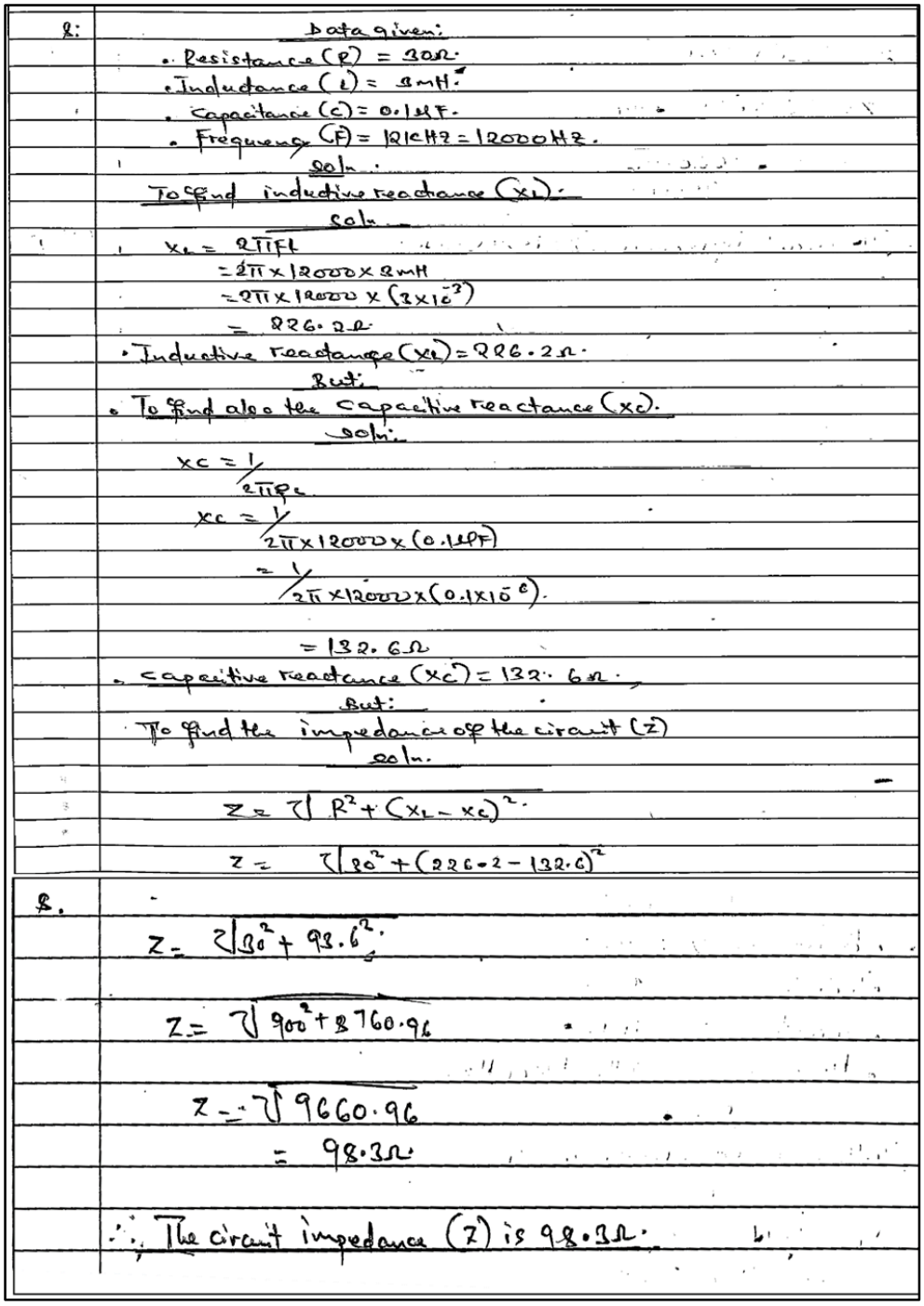


Figure 8: *The Candidates' Performance in Question 8.*

Figure 8 shows that 43 (26.4 %) scored 0 to 1 mark, 19 (11.7%) scored 1.5 to 3 marks and 101 (62.0 %) candidates scored 3.5 to 5 marks

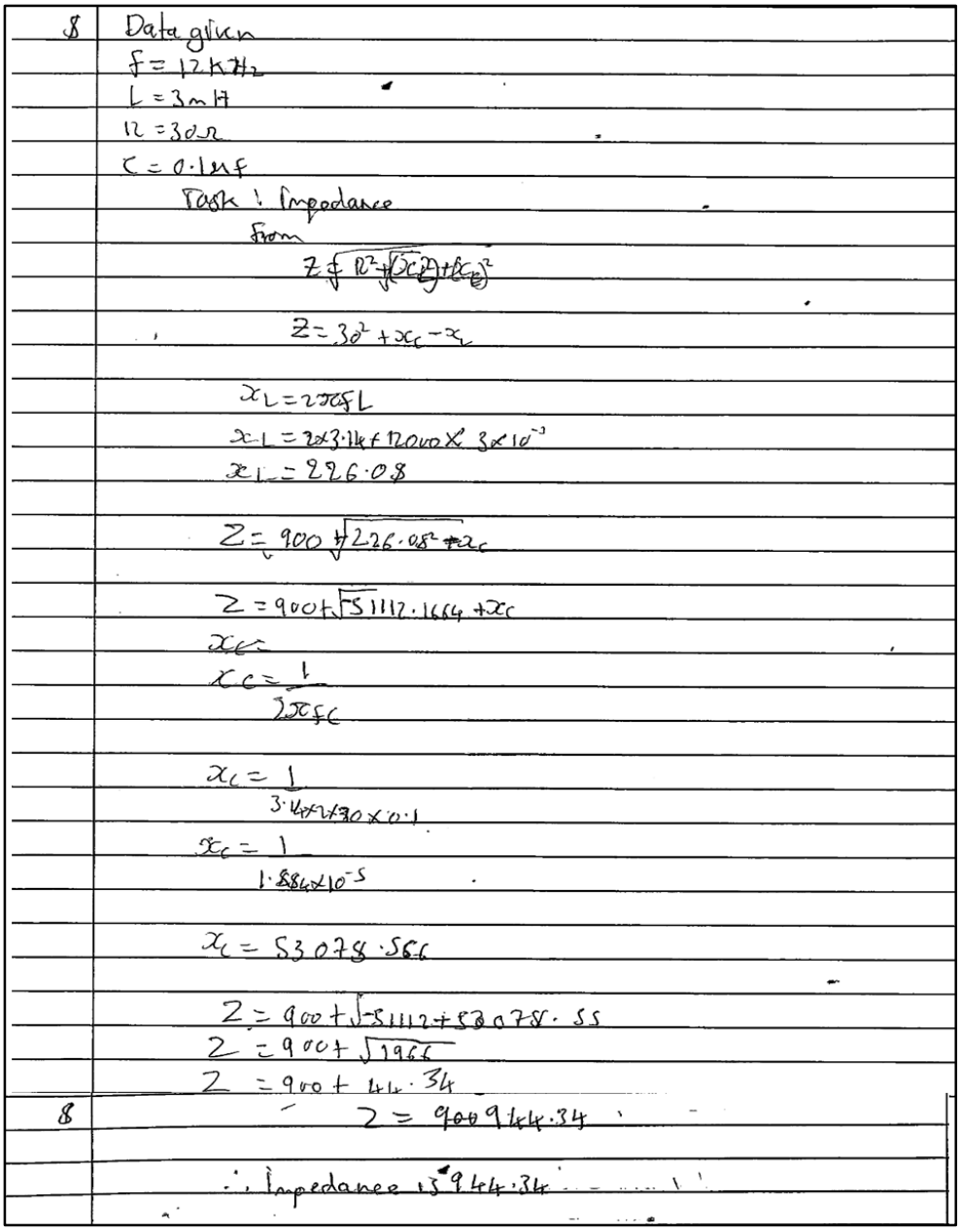
The analysis of data revealed that the general performance on this question was good because more than a half (73.6 %) of candidate's scored the pass mark or above. These candidates had enough knowledge of interpreting the circuit diagram and correctly applied skills in evaluating the impedance. Extract 8.1 provides a sample of the correct responses from one of the candidates.



Extract 8.1: A sample of correct responses to Question 8

Extract 8.1 the candidate analyzed the concept of electronic circuit components to provide the correct response.

Despite, the candidates' performance on this question was good 26.4 percent scored low marks (0-1). These candidates had insufficient knowledge and skills in electronic components. Most of them interchanged the capacitive impedance formula $XC = \frac{1}{2\pi fc}$ to inductive impedance formula $XL = 2\pi fl$ where XC = capacitive reactance, XL = inductive reactance and therefore they got incorrect answers. In addition some candidates used incorrect formula $Z = \sqrt{R^2 - X_L}$ instead of $Z\sqrt{R^2 + (X_L - X_C)^2}$ to calculate impedance where Z = impedance. The candidates also failed to manipulate those formulas to identify and express correctly the arrangement of inductor, capacitor and resistor in the circuit to determine its impedance and to show how the candidates lacked knowledge on the concept tested. Extract 8.2 provides a sample of an incorrect response from a candidate.



Extract 8.2: A sample of incorrect responses to Question 8

In Extract 8.2, the candidate applied incorrect formula and procedures to determine the impedance, capacitive and inductive reactance.

2.2.8 Question 9: Tuned Circuit

The question had two parts (a) and (b). The question required the candidates to analyse radio receiver system operation and its construction of block diagram. The question in part (a) intended to test the candidates' ability to understand the importance of each stage in radio receiver and in part (b) the candidate ability to draw its block diagram. The question was:

(a) Why RF amplifier is a sensitive stage in a radio receiver?

(b) Draw a well labelled block diagram of a tuned-radio frequency receiver.

A total of 163 (100%) candidates attempted this question. Their scores were as follows: 19 (11.7 %) scored 0 to 1 marks; 60 (36.8 %) scored 1.5 to 3 marks and 84 (51.5 %) scored 3.5 to 5 marks. These scores suggest that the candidates' performance in this question was good since 144 (88.3%) candidates passed. Most of the candidates proved to have sufficient knowledge of the areas tested. Figure 9 is illustrative.

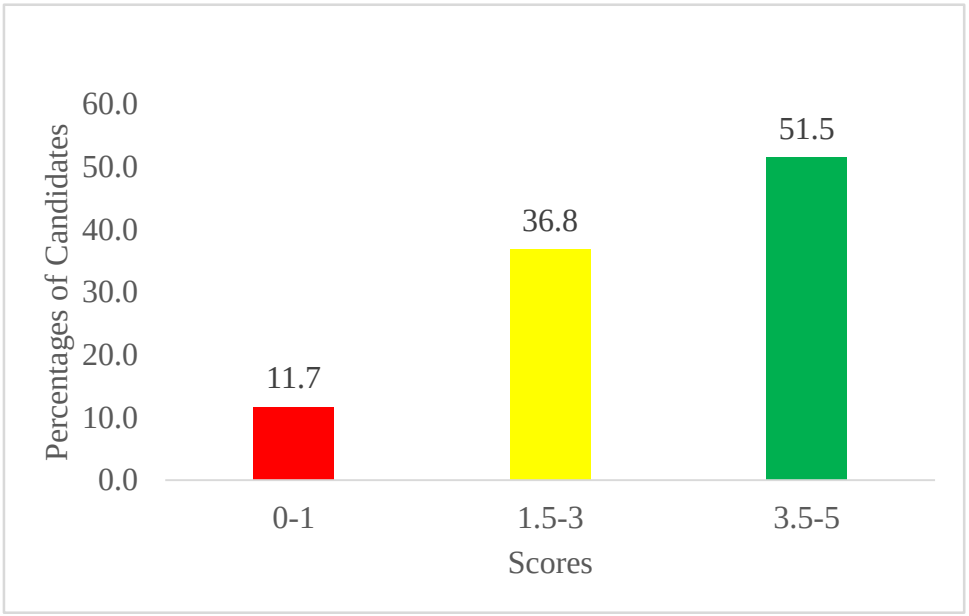
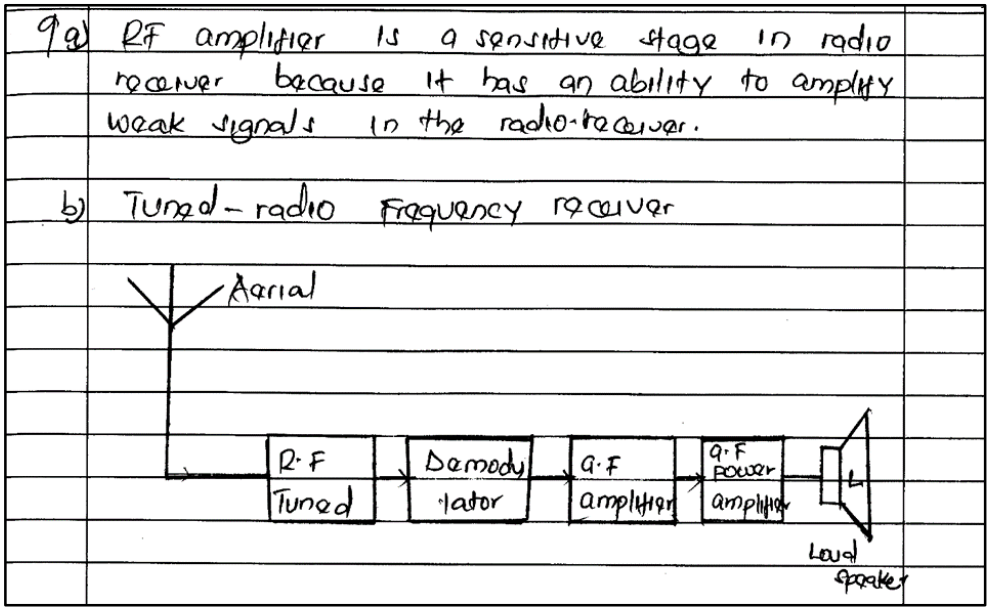


Figure 9: *The Candidates' Performance in Question 9.*

The analysis of candidate's responses shows that the majority (88.3 %) of the candidates who scores average marks or above had adequate knowledge and skills in tuned circuits. They were capable of explaining a sensitive stage in a radio receiver and they correctly drew the block diagram of a tuned radio frequency receiver. However, some of the candidates lost marks in

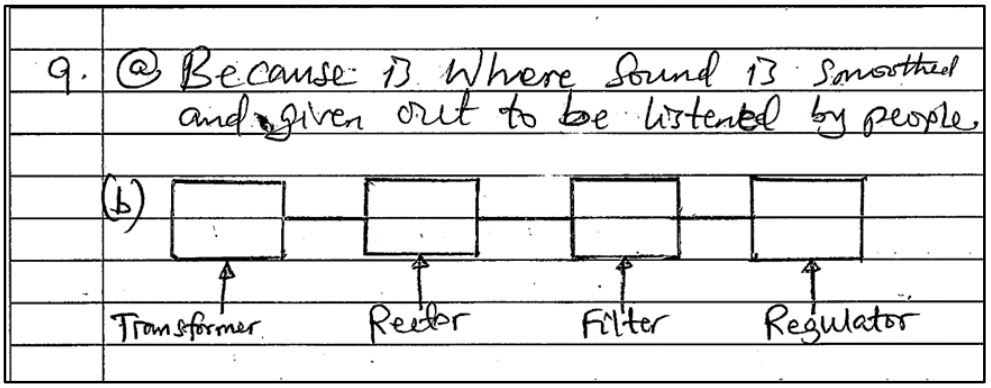
explaining the importance of RF amplifier in radio receiver. Extract 9.1 gives a sample of correct responses from one of the candidates.



Extract 9.1: A sample of correct responses to Question 9

In Extract 9.1, the candidate stated the sensitive stage and correctly drew the block diagram of TRF with their title in each block.

Despite the good performance on this question, a few 19 (11.7 %) candidates had poor performance. In part (a), some of the candidates failed to provide the reason as why RF amplifier is a sensitive stage in a radio receiver. They had to explain that it is called so because it is responsible for amplifying the weak radio frequency (RF) signal from the antenna, instead they provided irrelevant responses like "*because it is the first part in receiving the signals"*. This candidate had an idea on radio receiver block diagram but he/she failed to answer the question correctly. In part (b) some of them wrongly drew the block diagram of a tuned radio frequency (TRF), especially the tuning section of heterodyning receiver. Consequently, some candidates added the mixer stage to the tuned radio frequency TRF which is the part of heterodyning receiver. This misconception shows that the candidates had inadequate knowledge and skills in tuning circuits. Extract 9.2 is a sample of incorrect responses from one of the candidates.

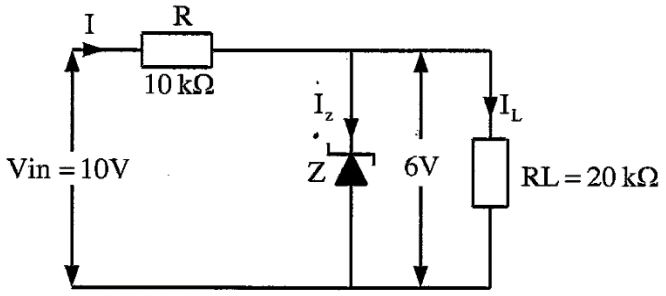


Extract 9.2: A sample of incorrect responses to Question 9

In Extract 9.2, the candidate provided an incorrect response in part (a). In part (b) he/she drew block diagram of power supply instead of a tuned-radio frequency receiver.

2.2.9 Question 10: Power Supplies

The question tested the candidates' ability to examine circuit and associate it with relevant formula to calculate the required parameters of regulator part of the power supply. The candidates required to study the circuit shown in the figure below, and then determine the value of current (I_Z) when a total current (I) of the circuit is $0.4\,\text{mA}$.



A total of 163 (100%) candidates attempted this question. Their scores were as follows: 62 (38.0 %) scored 0 to 1 mark, 16 (9.8 %) scored 1.5 to 3 marks and 85 (52.2 %) scored 3.5 to 5 marks. Generally, the candidates' performance was good since 147 (62.0 %) candidates scored the pass mark or above. Figure 10 summarizes these scores.

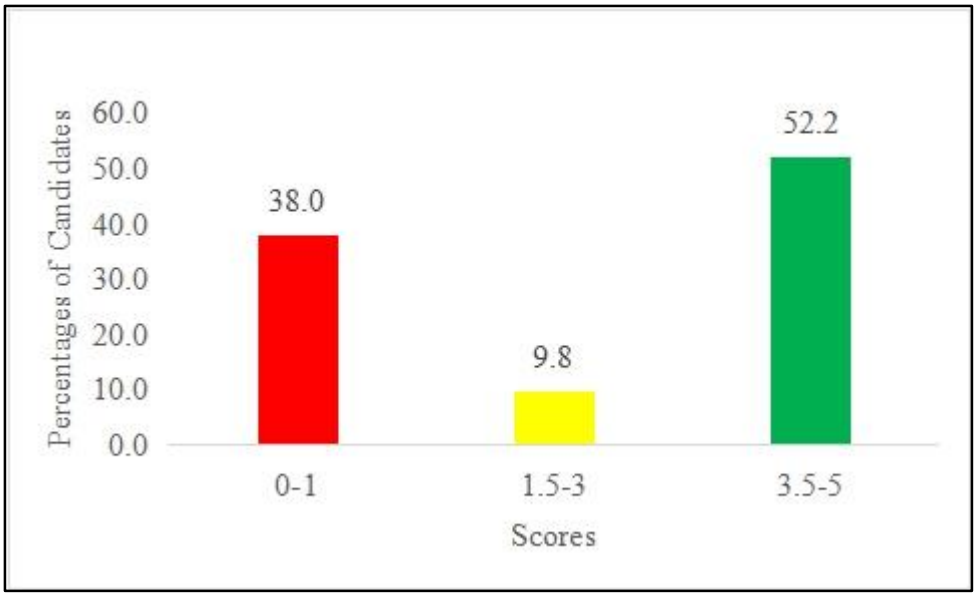
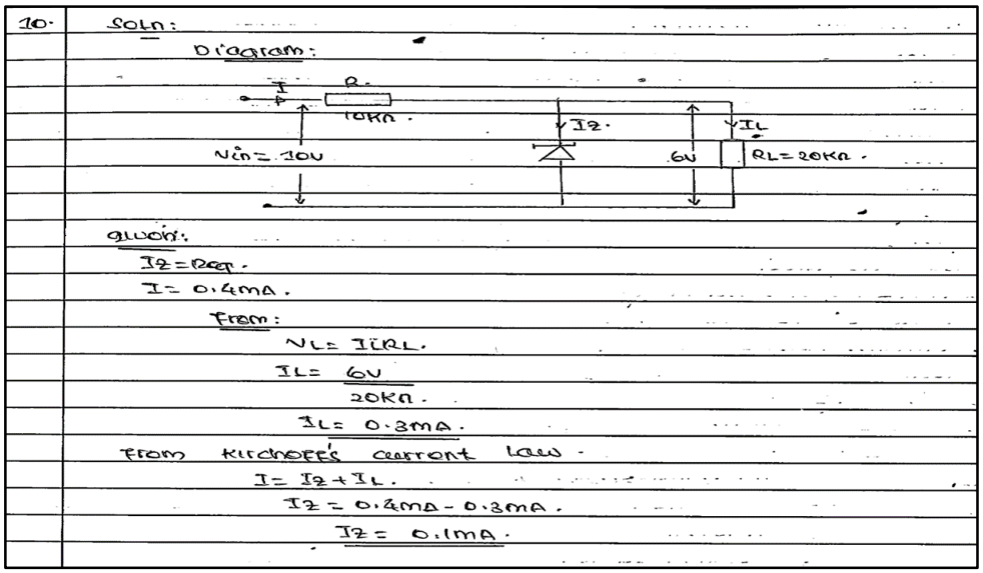


Figure 10: *The Candidates' Performance in Question 10.*

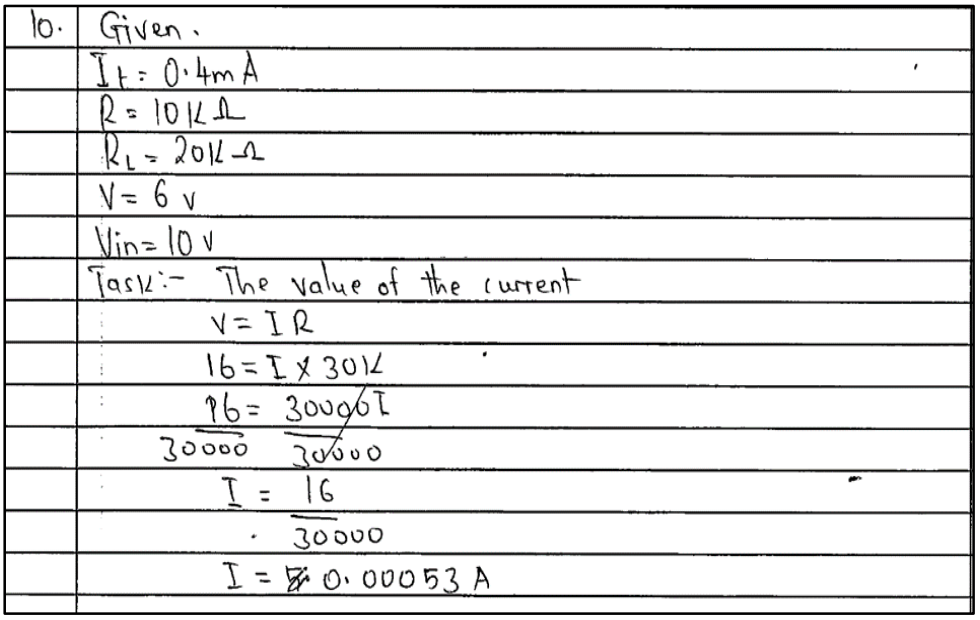
The analysis of the candidates' responses shows that the candidates performed well on this question. These candidates acquired sufficient knowledge of the concepts of power supply especially on the aspect of voltage regulators. Most of the candidates proved their competence in interpreting the circuit diagram by applying the correct formula to determine the zener current. Extract 10.1 shows a sample of correct responses to the question.



Extract 10.1: A sample of correct response to Question 10

Extract 10.1, shows the candidate correctly inserted the formula to calculate the current passed through zener diode (I_Z).

In contrary 38 per cent of the candidates scored low marks (0-1) on this question. These candidates used an irrelevant formula such as $R = \frac{V_{LM} - V_Z}{I_L + I_Z}$ to calculate zener current which led to an incorrect answer. Some candidates used wrong data by replacing resistance with voltages. In addition, in expressing Ohms' law and Kirchhoff's law to find voltages and current passing through zener diode, some of the candidates used incorrect formula $V = \frac{I}{R}$ instead of , where V = voltage, I = current and R = resistance which led to an incorrect answer. This justifies that they had in adequate knowledge of power supply especially on the concept of regulator. Extract 10.2 gives a sample of incorrect responses from one of the candidates.



Extract 10.2: A sample of incorrect responses to Question 10

In Extract 10.2, the candidate incorrectly substituted values in calculating the zener current.

2.3 SECTION C: STRUCTURED QUESTIONS

2.3.1 Question 11: Tuned Circuit

This question had two parts, (a) and (b). The question tested the candidate ability to analyse the importance of LC tuner and how components are connected in different ways to form resonance circuit. The question also shows their competence in determining resonance parameters by using relevant formulas. The question was:

(a) (i) What will happen if one of the components of the LC tuner circuit of a radio receiver is defective?

(ii) Show how an inductor and a variable capacitor are connected to form a parallel resonance circuit.

(iii) From the circuit drawn in, sketch its response curve.

(b) A parallel resonance circuit consists of a 500 pF capacitor and an inductor of 100 mH with resistance of 2 Ω. Determine;

(i) The value of frequency at which circuit will resonate

(ii) The circuit impedance at resonance.

The question was attempted by 161 (98.8 %) candidates and 2 (1.2 %) omitted. Among the candidates 67 (41.6%) candidates scored from 0 to 4 marks; 82 (50.9 %) scored from 4.5 to 9.5 marks and 12 (7.5 %) scored from 10 to 15 marks. The general performance of the candidates on this question was average, since 91 (58.4 %) of the candidates scored the pass mark or above. Figure 11 is illustrative.

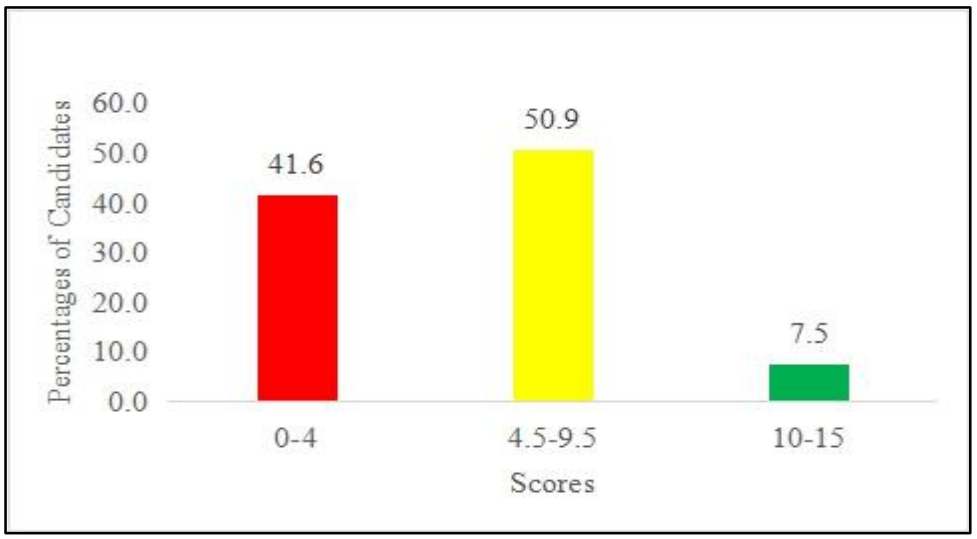
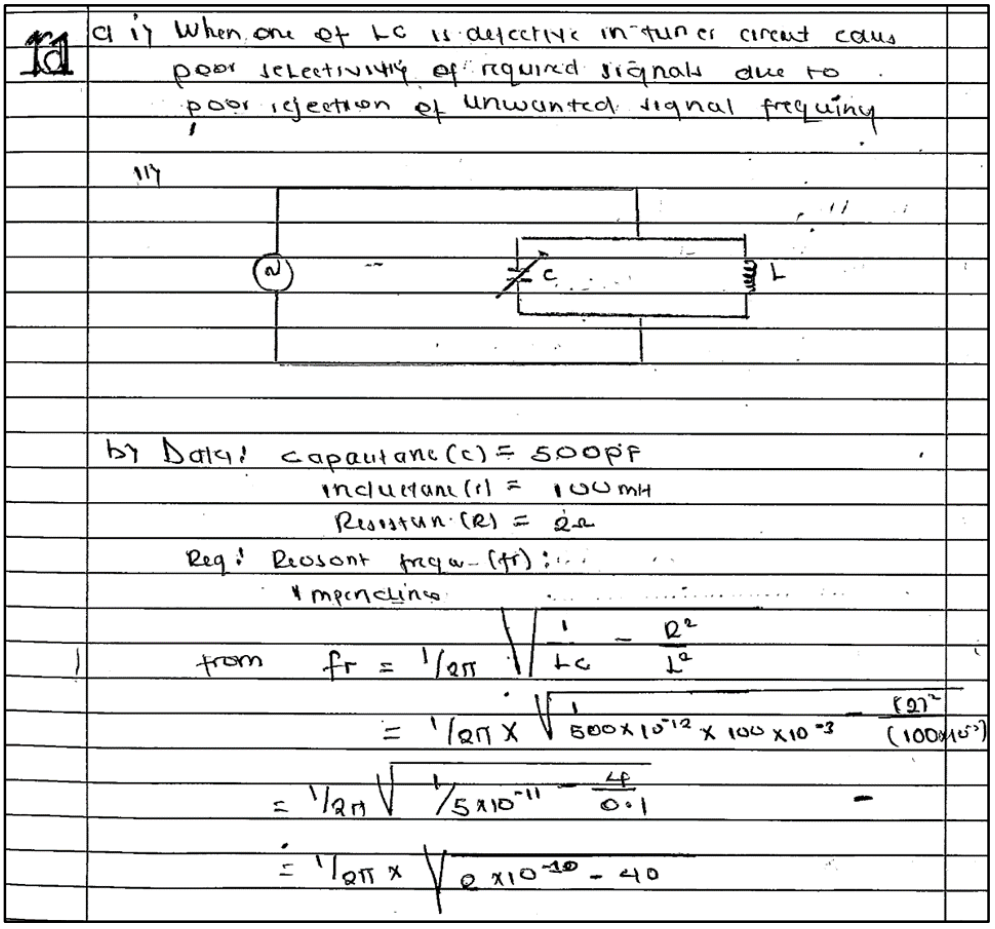
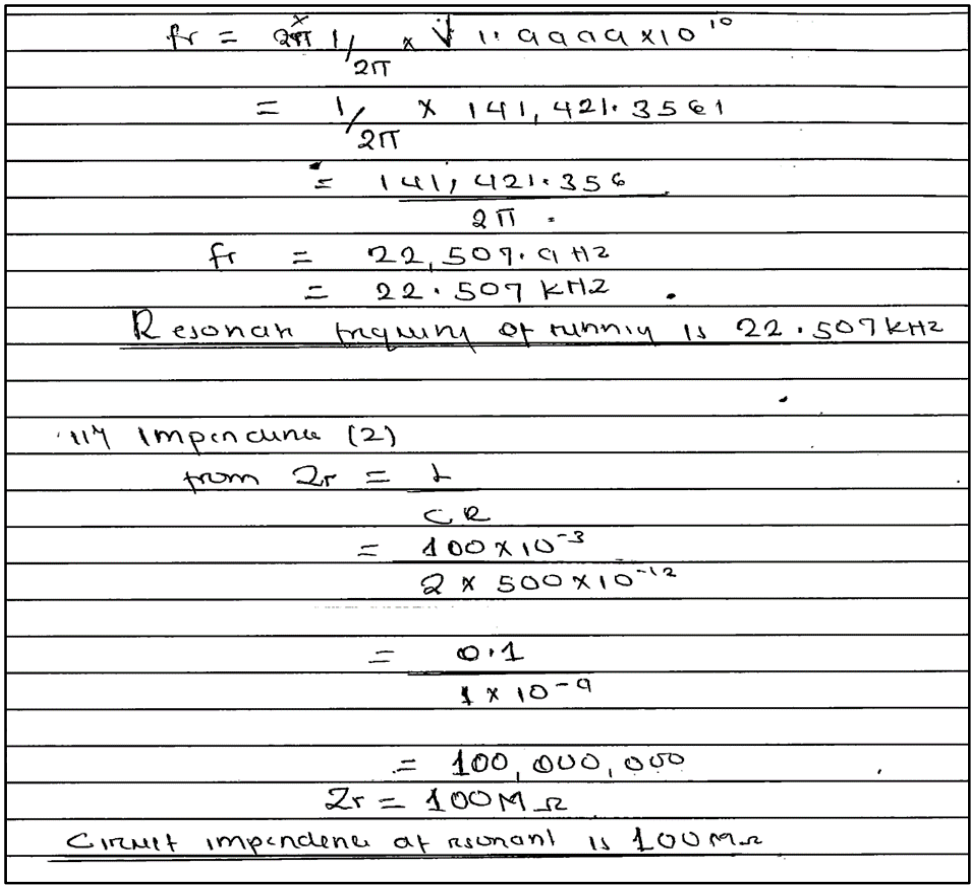


Figure 11: *The Candidates' Performance in Question 11.*

The analysis on candidates' responses reveals that a half (50.9 %) of the candidates who scored average marks (4.5-9.5) responded partially to either part of the questions tested about tuned circuit. In part (a) (i) some of the candidates provided the correct responses but failed to draw the parallel resonance circuit and to sketch its response curve showing the correction of an inductor and a variable capacitor. However, those who scored good marks (10-15) applied their drawing and mathematical skills to evaluate the resonant frequency and impedance at resonance. Extract 11.1 represents an example of correct responses from a candidate.





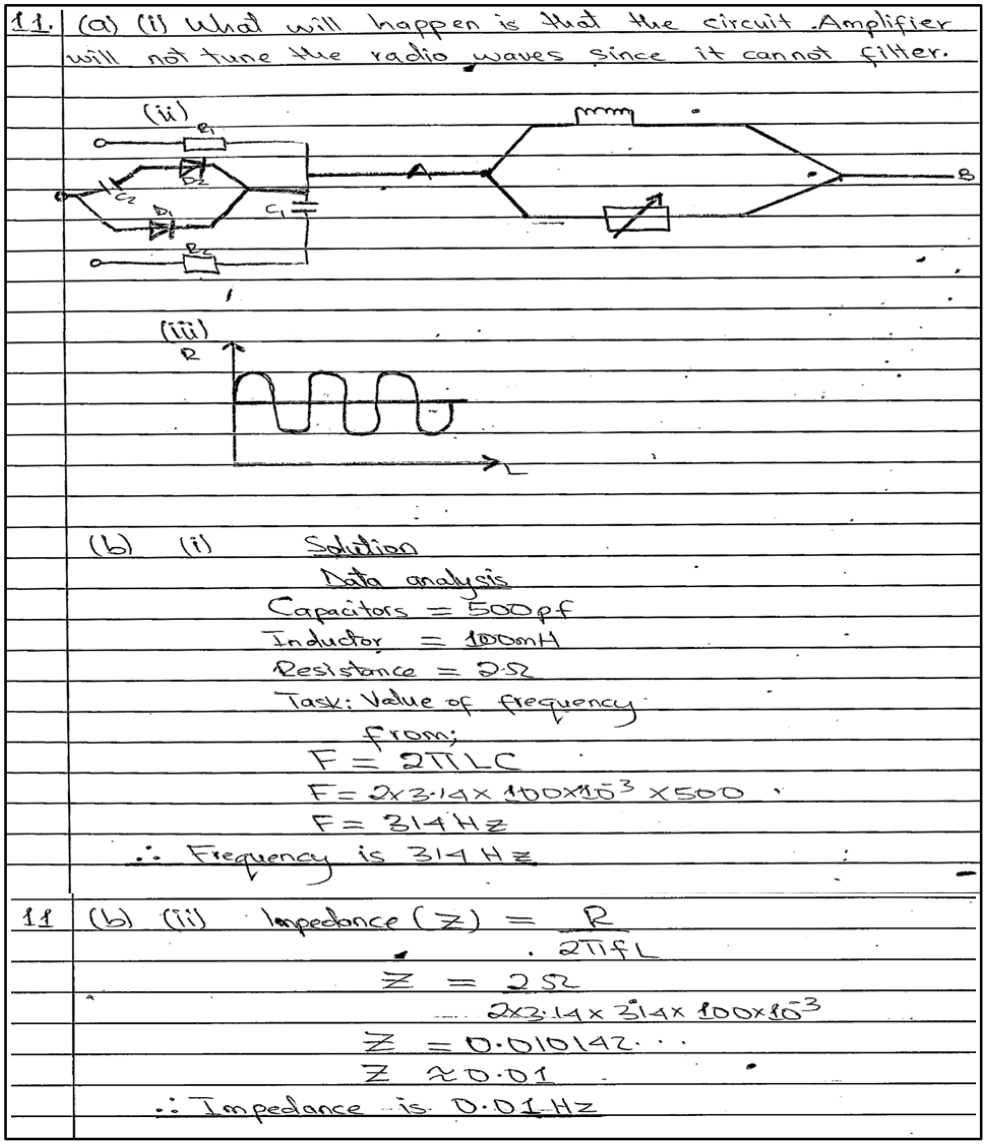
Extract 11.1: A sample of correct responses to Question 11

Extract 11.1, the candidate correctly identified the effect of the LC tuner circuit when one of the components is defective. The candidates sketched the parallel resonance circuit for an inductor and the variable capacitor and calculated impedance and resonant frequency.

On the contrary, 41.6 per cent of the candidates failed to respond correctly to most parts of the question. In part (a) (i), some of the candidates failed to explain the function of tuner that is to select a desired signal. Instead, they wrote *"the signal from antenna will not be recovered"*. Another candidate wrote that "*they will be a bad output formation of signal also the signal/output wave will not be smoothed*". These candidates recalled the concept of filter to smooth the ripples in a power supply. In part (a) (ii), some of the candidates drew a series resonance circuit instead of parallel circuit, and others drew series circuit in parallel with resistor. In part (b) (i), most of the candidates drew the inverse of response curve. Also in part (b) (ii), the

candidate used incorrect series impedance formula $Z = \sqrt{R^2 - (X_L - X_c)^2}$ to calculate the parallel impedance at the resonance instead of the correct formula which is $Z = \frac{L}{CR}$ where Z = impedance, L = inductance, C = capacitance and R = resistance.

This indicates that most of the candidates had inadequate knowledge of the subject matter. Extract 11.2 provides a sample of incorrect responses provided by one of the candidates.



Extract 11.2: A sample of incorrect responses to Question 11

Extract 11.2 shows that the candidate provided an incorrect response to part (a) (i) but also incorrectly drew branches of parallel circuit and sketched a sinusoidal wave instead of a response curve.

2.3.2 Question 12: Television Receivers

The question had two parts, namely (a) and (b). The question intended to measure the ability to analyze different features used in TV signal transmission; it also accessed the candidate ability to use relevant formula to calculate frequencies related to TV receiver. The question was:

(a) What is the importance of the features used in TV signal transmission and reception?
- *(i) Blanking.*
- *(ii) TV receiver compatibility.*
- *(iii) Negative vision modulation.*
- *(iv) Aspect ratio.*

(b) A TV receiver is tuned to one of the TV channels. The radiated vision carrier is at a frequency of 799.25 MHz. If the picture intermediate frequency is maintained at a frequency of 39.5MHz, determine:
- *(i) The frequency of the local oscillator.*
- *(ii) The frequency of the sound carrier when it is placed is 6 MHz above the picture carrier.*
- *(iii) The intermediate frequency of the sound carrier.*

A total of 151 (92.6%) candidates attempted the question. Out of whom, 12 (7.4%) omitted this question. Their scores were as follows: 101 (66.9%) candidates scored 0 to 4 marks; 39 (25.8%) scored 4.5 to 9.5 marks; and 11 (7.3 %) scored from 10 to 15 marks. Generally, the candidates' performance on the question was poor, since 101 (66.9%) of them scored below average. Figure 12 summarizes the candidates scores.

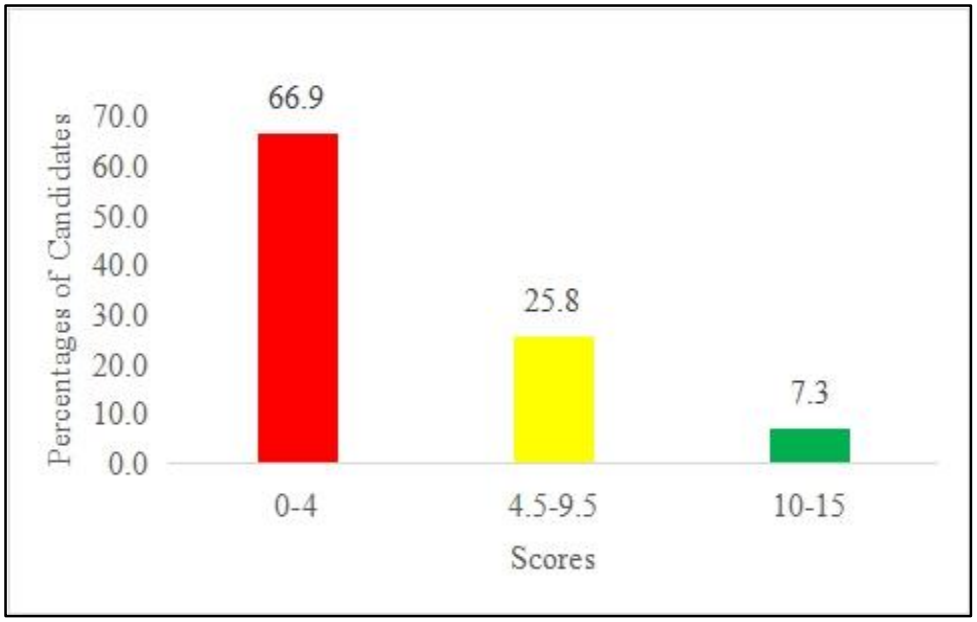


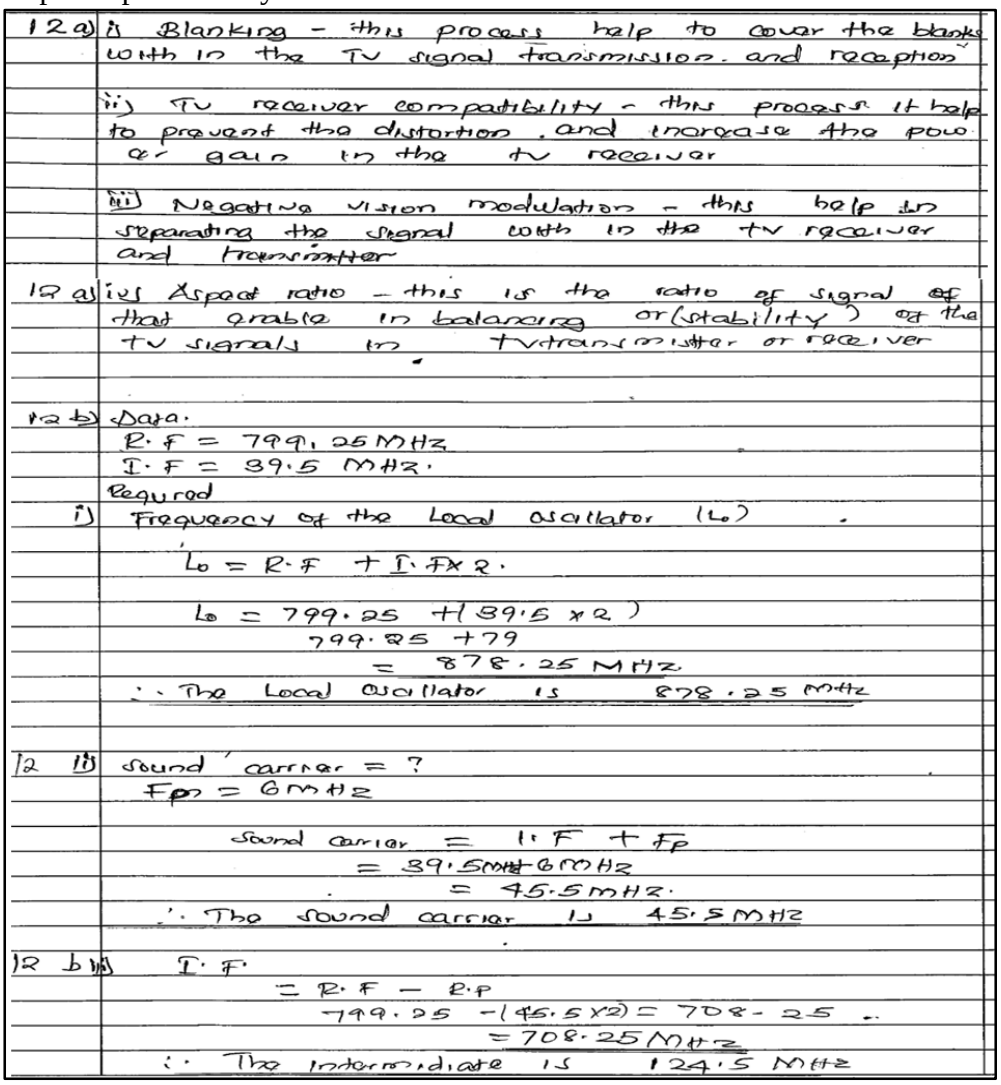
Figure 12: *The Candidates' Performance in Question 12*

The analysis of the data shows that majority (66.9 %) of the candidates scored low marks (0-4). In part (a) (i), some of the candidates explained the details (image resolution) which is not related to blanking that prevent the beam in CRT to be seen during fly back. For instance, one of the candidates represented a wrong perspective by relating blanking with colour signal, the question demand is scanning process and not colour mixing. Another candidate wrote "*Blanking is the process of reterding the arrival of the y-signal in order for a picture to be seen properly*".

In part (a) (ii), the candidate failed to differentiate TV receiver compatibility from distortion. This candidate was supposed to understand that compatibility is the ability of colour TV to show black and white picture and not how the picture is seen on the screen. In part (a) (iii) some candidates missed the concept of negative modulation by writing "*this is a reverse modulation*" instead of stating that it is an inversion of video signal before modulation takes place. In part (a) (iv), most of the candidates failed to understand that the aspect ratio is the ratio of viewable width of the picture tube.

In part (b) some candidates the applied incorrect formulas like $L_O = R.F + I.F \times 2$ and $\text{fs} = \text{tuned frequancy} + 6\,\text{MHz}$ to obtain incorrect values of frequency of the local oscillator and sound carrier respectively. More over in part (b) (iii), some of them interchange the formula

$fsc = flo - fis$ instead of $fis = flo - fsc$, where fis = intermediate frequency, flo = local oscillator frequency and fsc = frequency of sound carrier, which led to an incorrect answer. This shows the candidates lacked knowledge of television receivers. Extract 12.2 is a sample of an incorrect response provided by candidate.


12 a) i) Blanking - this process help to cover the blanks with in the TV signal transmission and reception

ii) TV receiver compatibility - this process it help to prevent the distortion, and increase the power gain in the tv receiver

iii) Negative vision modulation - this help in separating the signal with in the tv receiver and transmitter

12 a) iv) Aspect ratio - this is the ratio of signal of that enable in balancing or (stability) of the tv signals in tv transmitter or receiver

12 b) Data.
R.F = 799.25 MHz
I.F = 39.5 MHz.
Required
i) Frequency of the Local oscillator (L_o).

$L_o = R.F + I.F \times 2.$

$L_o = 799.25 + (39.5 \times 2)$
$799.25 + 79$
$= 878.25$ MHz
∴ The Local oscillator is 878.25 MHz

12 b) Sound carrier = ?
Fp = 6MHz

Sound carrier = I.F + Fp
= 39.5MHz + 6MHz
= 45.5MHz.
∴ The sound carrier is 45.5MHz

12 b) ii) I.F.
= R.F − R.P
$799.25 - (45.5 \times 2) = 708.25$
$= 708.25$ MHz
∴ The intermediate is 124.5 MHz

Extract 12.2: A sample of incorrect responses to Question 12

In Extract 12.1, the candidate failed to explain all four important features used in TV signal transmission and reception. In part (b) the candidate succeeded to use the correct formula for local oscillators but failed to insert the data to calculate local oscillator frequency and sound carrier.

However, 33.1 per cent of the candidates scored the pass mark or above. These candidates had the capability of explaining correctly the features and parameters used in television receiver, TV signal, and transmission and reception. In addition, some of them proved their competence in mathematical skills by applying the correct formula to find the local oscillator frequency, sound carrier frequency and intermediate frequency of the sound carrier. Extract 12.2 is an example of a correct response provided by a candidate who mentioned all four important features used in TV signal transmission and reception.

SECTION C.

Qa i) Blanking - is the dedicated function that prevents a beam in CRT from being seen during flyback

ii) TV receiver compactibility - is the ability of a monochrome receiver to receive a colour transmission and produce a monochrome picture of a reconable quality

iii) Negative vision modulation - is the process of combining carrier frequency and audio frequency without changing the amplitude so that signals to be transferred to a long distance

12 a iv) Aspect ratio - this is the ratio of the viewable height to the viewable width of the picture.

b Solution:

$F_c = 799.25\ MHz$

$IF = 39.5\ MHz$

Required

(i) F_{LO} (Frequency of the local oscillator) = ?

(ii) Frequency of sound carrier when 6MHz picture carrier

(iii) IF of the sound carrier from

(i) $IF = F_{LO} - F_c$

$39.5 = F_{LO} - 799.5$

$F_{LO} = 39.5 + 799.5$

$F_{LO} = 839\ MHz$ ①

(ii) $F_s = ?$

$F_s = F_c + F_{s_c}$

$F_{s_c} = 799.25 + 6$

$= 805.25\ MHz$ ②

(iii) $IF = F_{LO} - F_s$

$= 839 - 805.25$

$= 33.75\ MHz$

(i) ∴ Frequency of the local oscillator is 839 MHz

(ii) = 805.25 MHz

(iii) = 33.75 MHz

Extract 12.2: A sample of a correct responses to Question 12

Extract 12.2, the candidate correctly used the formula to calculate the required parameters as asked in the question.

2.3.3 Question 13: Antennae

The question measured the candidates' ability design, to draw and to apply formula to calculate some parameters related to antennae. The question was as follows:

(a) Three elements of a Yagi-Uda antenna need to be designed to operate at 150 MHz. Calculate:

(i) Length of driven element

(ii) Length of director element.

(iii) Length of reflector element.

(b) Draw a three elements Yagi antenna with the following specifications:

(i) Length of unfolded driven element = 3cm

(ii) Length of director element = 5 cm

(iii) Length of reflector element = 7cm

(iv) Feeder line and the support bar must be clearly shown.

This question was attempted by 42 (21.4 %) candidates and 121 (74.2 %) omitted it. Among them, 33 (78.6 %) candidates scored 0 to 4 marks; 5 (11.9 %) candidates scored 4.5 to 9.5 marks and 4 (9.5 %) scored from 10 to 15 marks. The general performance of the candidates in this question was poor, since (78.6 %) of the candidates scored below the pass mark. Figure 13 shows the candidates' performance in Question 13.

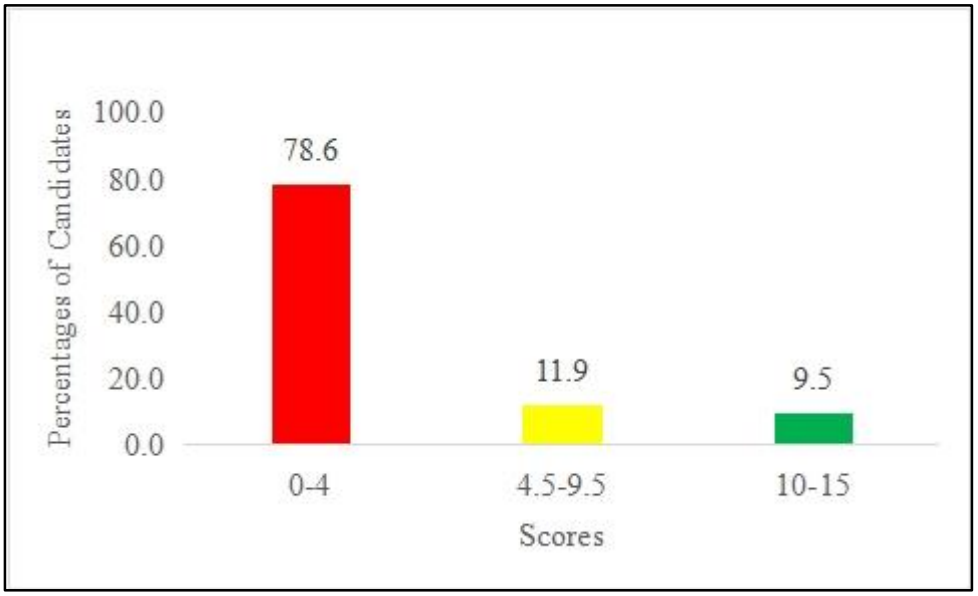
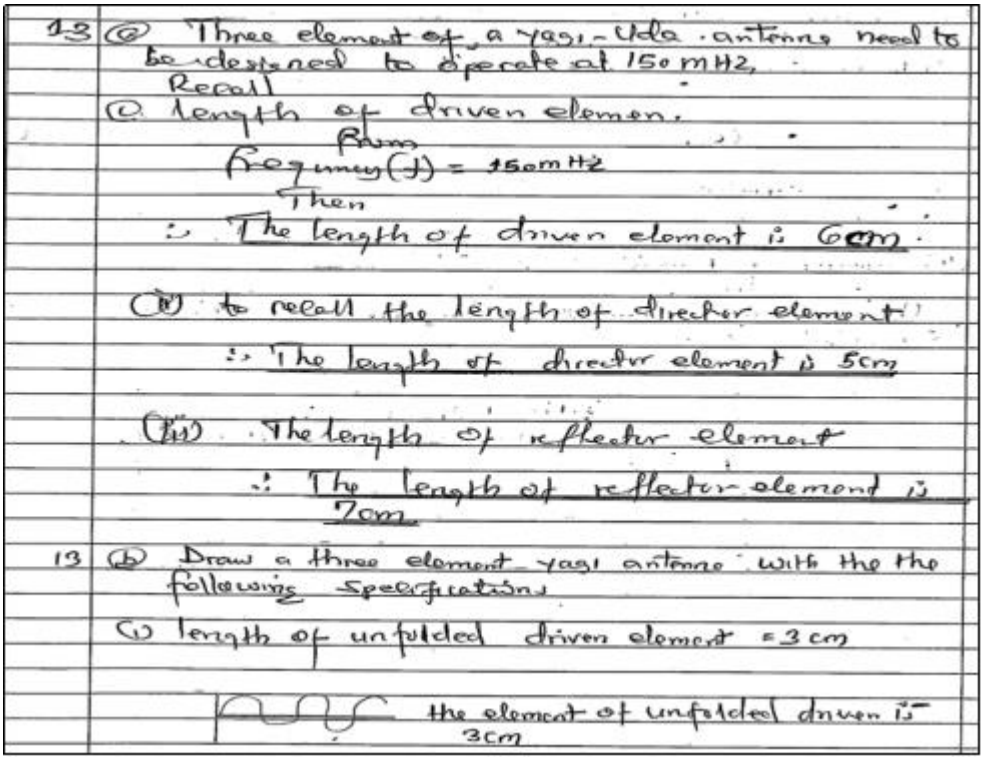
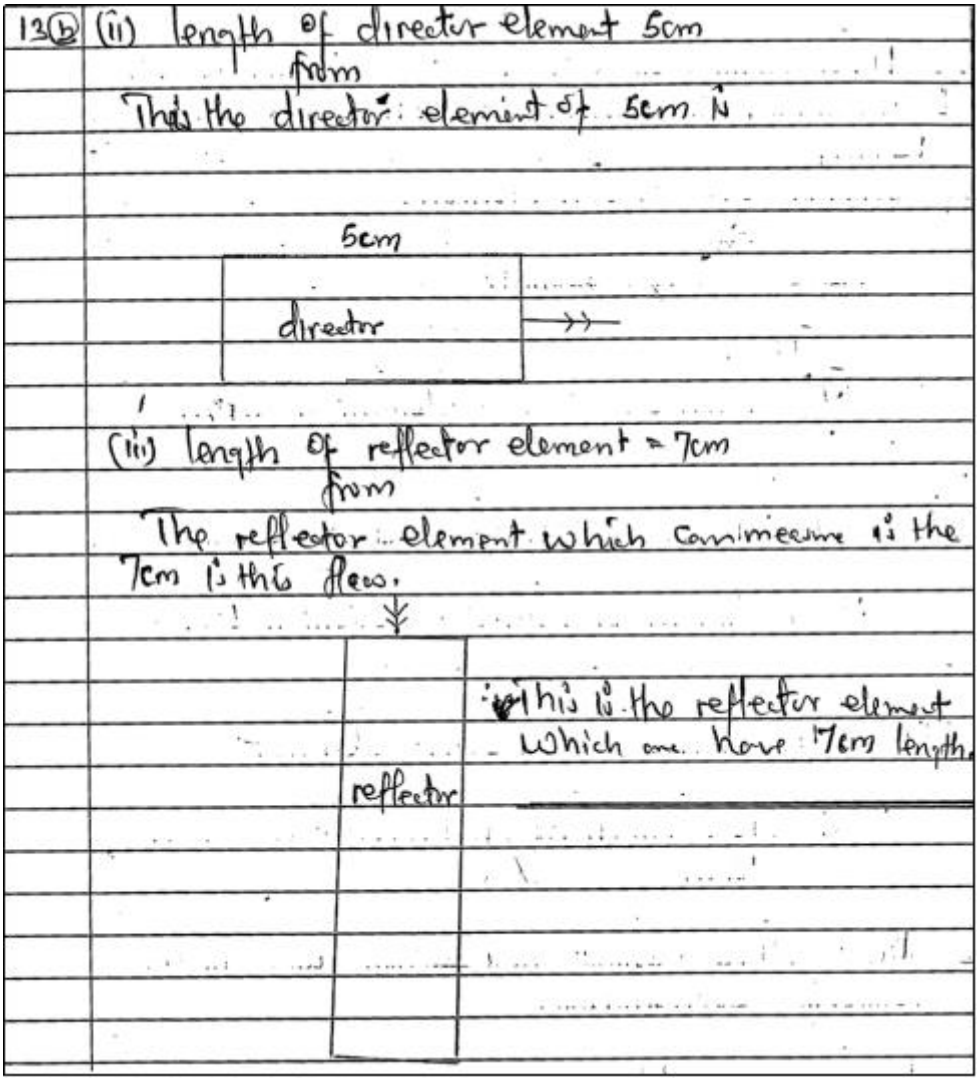


Figure 13: *The Candidates' Performance in Question 13*

The candidates who scored low marks on this question had inadequate knowledge about elements of Yagi-Uda antennae. In part (a) (i), most of the candidates interchanged the formula $f = \frac{C}{\lambda}$ instead of $\lambda = \frac{C}{f}$, λ = wavelength, C = speed of the wave and f = frequency hence they got a wrong answer. Some failed to convert units from MHz to Hz, to find the length of driven element which then led to an incorrect answer. In part (a) (i) and (ii), some candidates applied the formula of length of a reflector $= 0.55\lambda$ and length of a director $= 0.45\lambda$ interchangeably. In part (b), a candidates failed to draw a correct structure of Yagi-Uda antennae instead he/she drew a long supported pole attached with two separate lines left and right. The left line was called a director element and the right line was called it a Reflector element. Some drew antenna with stand support and called the lower part of the support as feeder line and upper part as unfolded driven element. Consequently, there were those who drew a tower and called it an antenna. This shows that most of candidates thought that cellphone towers are antenna but in reality is different. The antennas are attached at the top of the tower. This justifies the fact that argument that the candidates were incompetent in designing the antennae. Extract 13.2 is an example of incorrect responses from one of the candidates.


13 (a) Three element of a yagi-Uda antenna need to be designed to operate at 150 mHz,
Recall
(i) length of driven element.
From
Frequency (f) = 150mHz
Then
∴ The length of driven element is 6cm.
(ii) to recall the length of director element
∴ The length of director element is 5cm
(iii) The length of reflector element
∴ The length of reflector element is 7cm.
13 (b) Draw a three element yagi antenna with the the following specifications
(i) length of unfolded driven element = 3 cm
the element of unfolded driven is 3cm



Extract 13.2: A sample of incorrect responses to question 13

In Extract 13.2, the candidate failed to insert the correct formula in calculating three elements of Yagi antennae. In part (b), the candidate wrongly drew the elements of Yagi antenna as given in the question and candidate copied the specifications given in the question. Also he/she drew unlabeled the sinusoidal wave and a rectangular shape instead of the three elements of Yagi antennae.

On the other hand, the candidates who attempted the question correctly, demonstrated their ability in designing the antennae. Most of the candidates acquired knowledge and skills in the concept as they were able to memorize the correct formula for determining the length of driven, director, and

reflector elements. Some of them showed their competences and skills in drawing the three elements of Yagi-Uda antennae with the given specifications. Extract 13.1 provides a sample of the correct response from a candidate.

13. (a) Soln

Given:

$f = 150\,MHz = 150 \times 10^6\,Hz$

Required (i) Length of ~~driven~~ director element (L_D)

(ii) Length of ~~director~~ driven element (L_d)

(iii) Length of reflector element (L_R)

From, $V = f\lambda$

$\lambda = V/f$

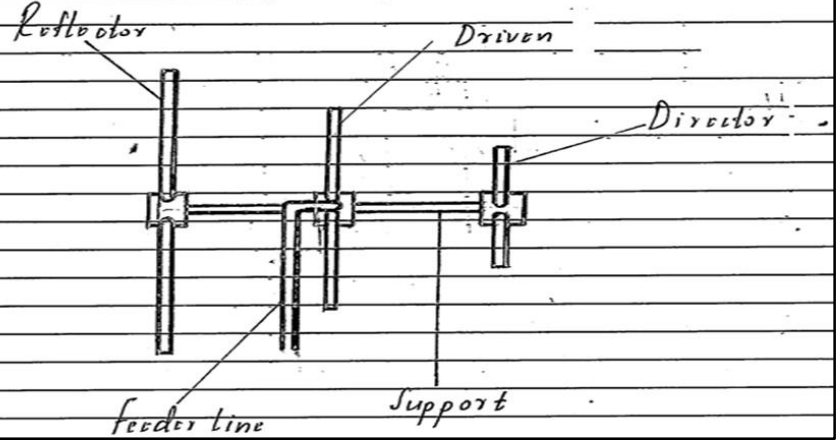
But, Velocity of radio waves $= 3 \times 10^8\,m/s$

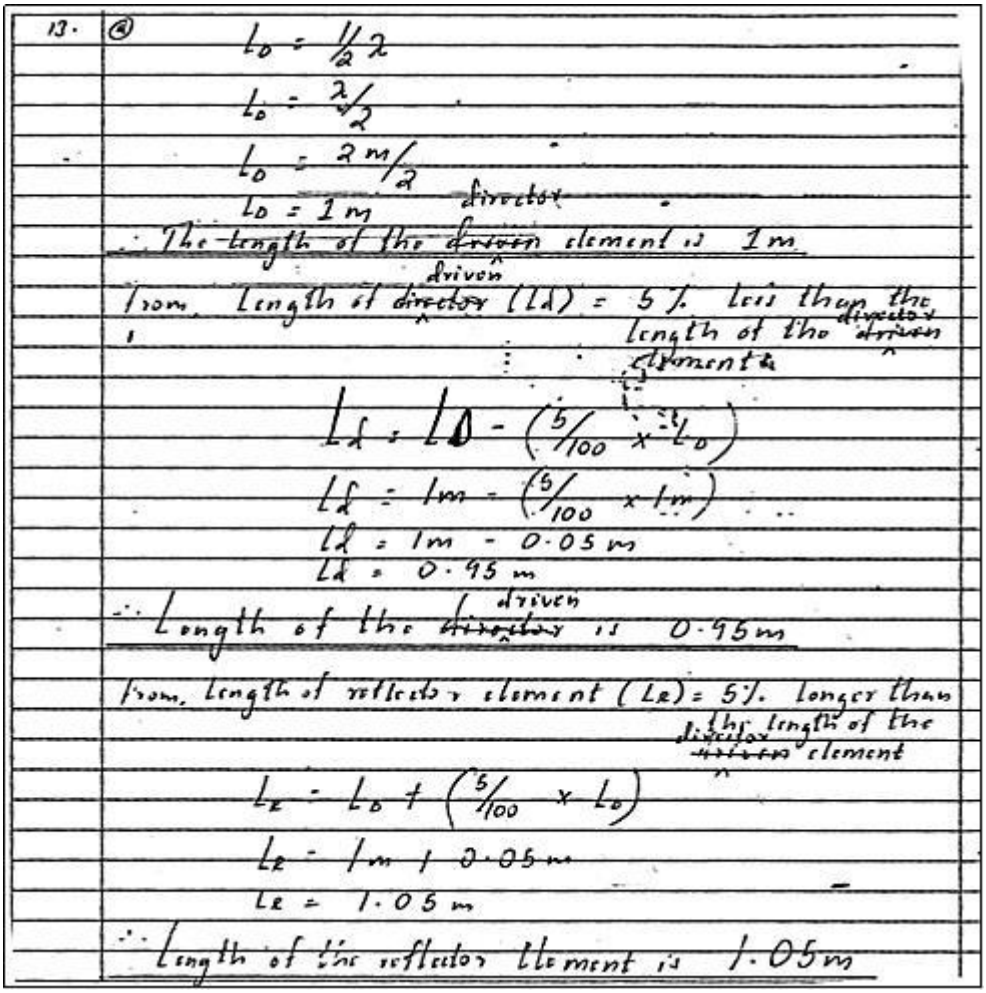
Then, $\lambda = \frac{3 \times 10^8\,m/s}{150 \times 10^6\,Hz}$

$\lambda = 2\,m$

But, Length of a dipole $= 1/2\,\lambda$

YAGI ANTENNA





Extract 13.1: A sample of correct responses to Question 13

In Extract 13.1, the candidate inserted the correct formula to calculate three elements of Yagi antennae in part (a). In part (b), the candidate correctly drew the elements of Yagi antenna as asked in the question

2.3.4 Question 14: Transistor Amplifiers

The question measured the candidates' ability to construct various types of amplifier and to use appropriate formula to calculate different parameters related to transistor amplifiers. The question was as follows:

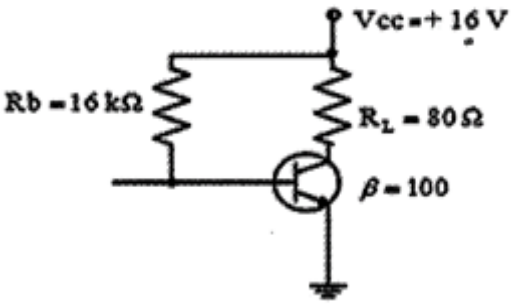
(a) Show how two NPN transistors are connected in Darlington pair with an input resistor R_B and a supply voltage of $+V_{cc}$. Indicate the direction of collector current (I_e), emitter current (I_b).

(b) *The figure below is an amplifier which produce a peak to peak sine wave output of 8V with an average d.c power of 1.6W. Study it carefully and then answer the questions that follow:*

(i) Calculate the r.m.s signal voltage.

(ii) Find the amplifier output power.

(iii) Determine the circuit efficiency.



This question was attempted by 135 (82.8 %) candidates and 28 (17.2 %) omitted the question. Among the candidates who did it, 92 (68.1 %) candidates scored from 0 to 4 marks, 38 (28.1 %) candidates scored from 4.5 to 9.5 marks and 5 (3.8 %) scored from 10 to 15 marks. The general performance of the candidates was average, since 43 (31.9 %) of the candidates scored the pass mark or above. Figure 14 shows the candidates' performance in Question 14.

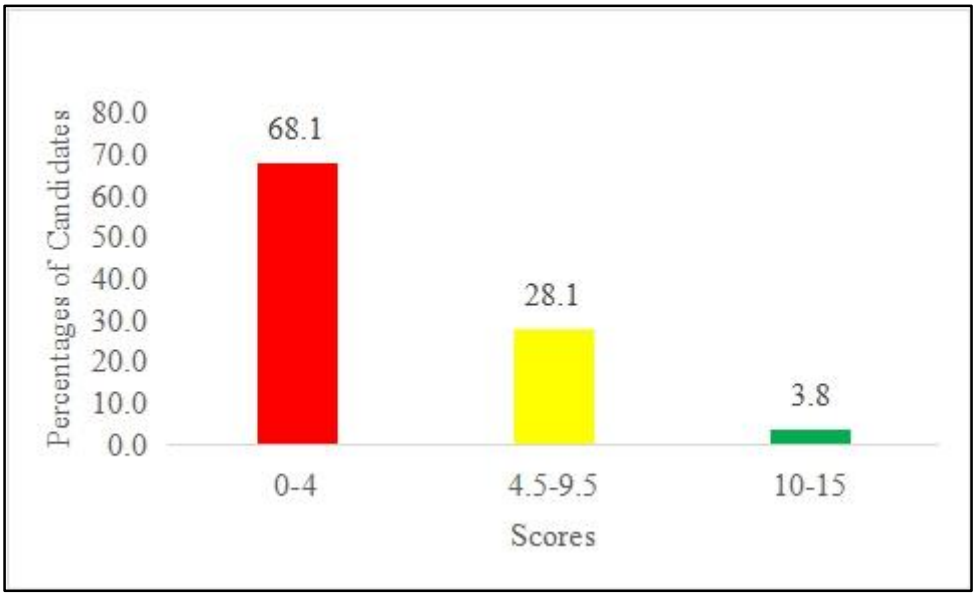
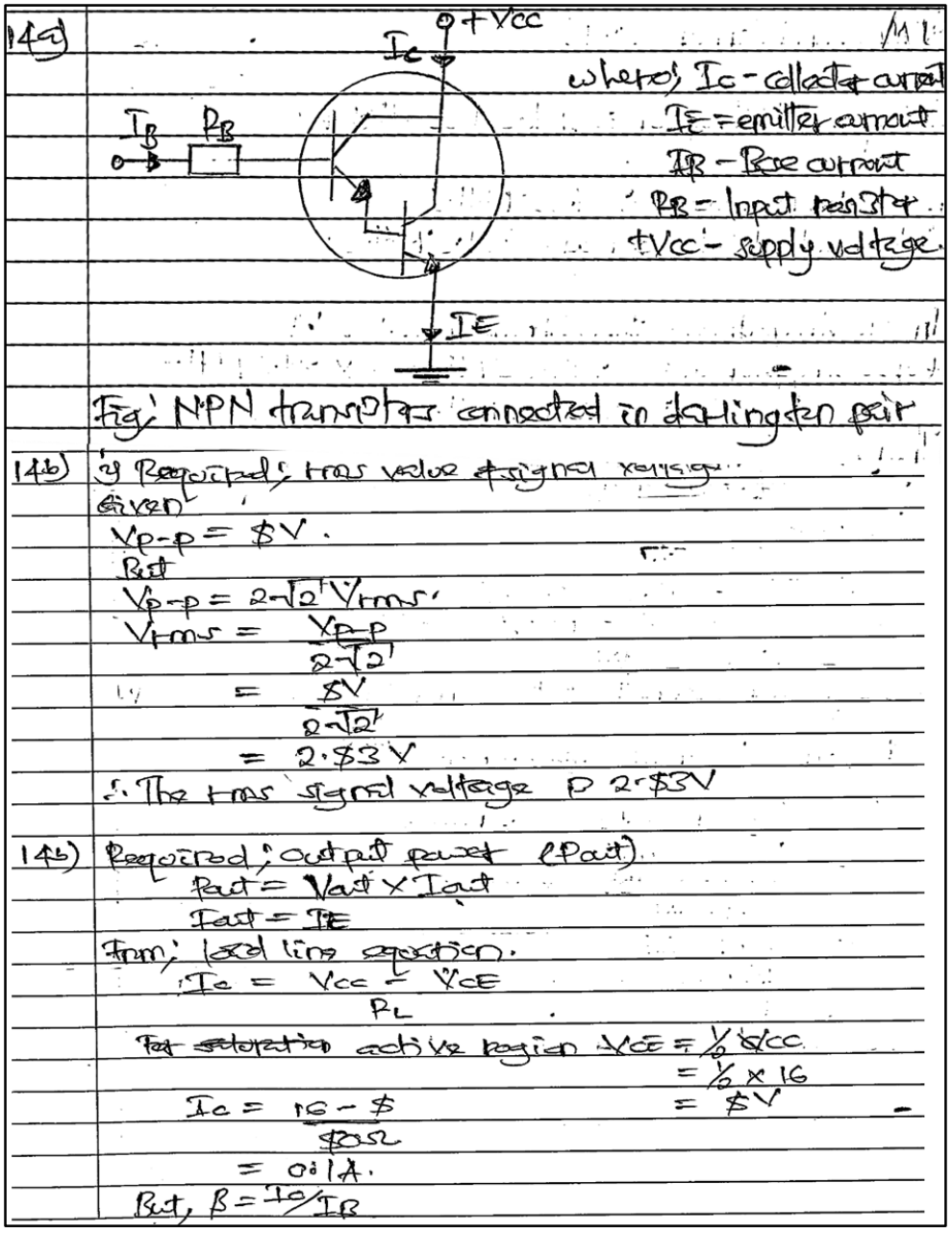


Figure 14: *The Candidates' Performance in Question 14.*

A performance of the candidates in this question was due to the fact that they managed to provide correct responses to either one part of the question or failed the other part. These candidates had partial knowledge of the concepts tested on the topic transistor amplifier. In addition, some of them correctly inserted the formula to calculate the r.m.s signal voltages but they failed to calculate the power and circuit efficiency. Moreover, those who scored good marks (10-15) applied the correct formula and procedures in determining the amplifier output power and circuit efficiency. Extract 14.1 provides a sample of correct responses from a candidate.



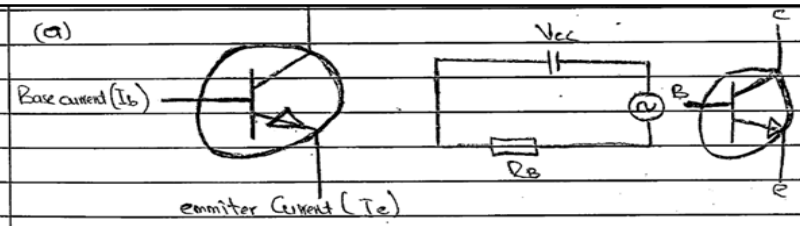
Extract 14.1: A sample of correct responses to Question 14

In Extract 14.1, the candidate correctly drew the Darlington pair of transistors in part (a) and inserted the correctly formula to calculate the r.m.s signal voltage but failed to calculate the output power and circuit efficiency.

Despite the good performance of the candidates, majority (68.1 %) of the candidates got scores that were below the pass mark. They failed to draw the correct darlington pair and to use appropriate formula to calculate the r.m.s signal voltage and circuit efficiency. For instance, in part (a) most of the candidates could not provide the Darlington connection of the transistors, they drew a NPN transistor amplifier with a single transistor and a base resistor, while some drew a PNP transistor amplifier instead of a NPN transistor. Consequently, a few candidates drew two cascading transistor amplifier which is different to darlington pair.

In part (b), candidates failed to provide the correct formula to calculate the required parameters. For example, instead of using formula $\text{Vmax} = \frac{V_{p-p}}{2} \times 0.707$, where Vmax = Maximum voltage, $V_{p\text{-}p}$ = Peak to peak Voltage, they used the transistor d.c circuit formula $\text{Vcc} = \text{Vce} + \text{Vc}$ to find a.c signals. Also some candidates instead of using the correct formula $V_{RMS} = \frac{V_{p-p}}{2\sqrt{2}}$, where V_{RMS} = Root mean square voltage, they used incorrect formula $\text{Vrms} = \frac{V\sqrt{2}}{R_L}$ where $V\sqrt{2}$ is a maximum peak value and not peak to peak value as asked in the question. In part (b) (ii), they wrongly applied the Ohms law formula $P = I^2V$ to get the output power instead of $\text{Power} = \frac{V^2}{R}$ where V = voltage and R = Resistance, while other candidates applied the formula $\text{Ic} = \beta I_B$ to get the current for input power which led them to get wrong efficiency. Extract 14.2 provides a sample of an incorrect response from a candidate.

14 (a)



14 (b) Solution

Data analysis

Output Voltage = 8v

Power Supply = 1.6W

Task: (i) r.m.s Signal Voltage from;

$$P = \frac{V^2}{R}$$

$$V^2 = PR$$

$$V = \sqrt{PR}$$

$$V = \sqrt{1.6 \times 8}$$

$$V = 3.5777\ldots$$

$$V \approx 3.58v.$$

∴ r.m.s Signal Voltage is 3.58v

(ii) Amplifier Output power from;

$$E = \frac{\text{Input power}}{\text{Output power}}$$

$$\frac{E_{input}}{E_{output}} = \frac{P_{input}}{P_{output}}$$

$$\frac{3.58}{8} = \frac{1.6W}{x}$$

$$3.58x = 8 \times 1.6$$

$$x = \frac{8 \times 1.6}{3.58}$$

$$x = 3.57541\ldots$$

$$x \approx 3.6 \text{ watts}$$

∴ Amplifier output power is 3.6 watts

Extract 14.2: A sample of incorrect responses to Question 14

In Extract 14.2, the candidate wrongly drew the Darlington pair of transistors in part (a) and inserted an incorrect formula to calculate r.m.s signal voltage output power and circuit efficiency in part (b).

3.0 CANDIDATES' PERFORMANCE ON EACH TOPIC

The analysis of candidates' performance on the topics which were assessed in the 083 Radio and TV Servicing subject for the year 2022 indicates that the candidates' performance was good on 8 topics, average on 5 topics and poor on 1 topic.

The topics that were performed well included, Modulation (81.6 %) Safety management and rules (81.0%), Radio receiver (76.4 %), Electronic circuit (73.6 %) and Tuned Circuit (73.35 %). The good performance on these topic signifies that the candidates had adequate knowledge, skills and competence on the tested concept. Further, the analysis of the candidates' performance on each topic indicates that the candidates had a good performance of 69.9 % in the topic which were examined in multiple choice items.

The topics on which candidates had averagely performance were Power supply (62.0 %), Television (41.1%) and Transistor amplifier (29.75). The performance shows that the candidates had partial knowledge, skills and competence on those topics.

The candidates performed poorly on the topic of Antennae (21.4 %) because they used wrong formula to calculate antenna elements. They also drew incorrect diagram of antenna which shows that they lacked knowledge on this topic.

The Appendix on the last page presents a summary of the candidates' performance on each topic using green, yellow and red colours to represent good, average and poor performance respectively.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The general performance of the candidates in Radio and TV Servicing for CSEE 2022 was average since out of 163 candidates who sat for the paper, 114 (69.9 %) passed while 49 (30.1 %) failed.

The analysis of the candidates' performance revealed that the candidates faced the same challenges, some candidates failed to calculate some parameters, some failed to draw the diagrams and when attempting the questions. In this paper, it was observed that inadequate content knowledge was one of the major reasons for poor performance of most of the candidates.

Some of the candidates provided incorrect responses while others skipped some of the items. The analysis also shows that lack of mathematical skills was also a challenge on the performance of most candidates particularly in the questions which required application of formulas and followed all stages of calculations through several steps to reach the final answer. For instance, in question numbers 8 and 11 (a) which required the candidates to determine the inductive reactance, capacitive reactance, impedance of the circuit and r.m.s current, majority of candidates failed to apply the correct formulas and mathematical manipulation. Hence they ended up with incorrect answers. Another reason was poor English proficiency. For example, question 6 (a) which required the candidates to explain how transistor is biased to get active region and saturation. Most of them failed to compose their sentences correctly and hence scored low or no marks. Moreover, lack of designing skills contributed to poor performance of some candidates. In question 13, which required the candidates to design antenna, for example, most of the candidates were unable to design and draw the correct antenna while others drew the diagrams of other types of antenna.

4.2 Recommendations

From the shortcomings observed in the analysis of candidates' responses, the following are recommended:

(i) The teaching and learning process for Radio and TV servicing subject should focus more on practical methods to give room for the learners to build their skills and competencies in the subject. That is because some responses given by candidates showed lack of practical skills.

(ii) Candidates should do different computation exercises to support their ability to tackle questions which require applications of formulae and calculations. Some of the candidates lacked skills in attempting application question. This was observed in many tested topics especially *Power supply, antennae, TV receivers and Electronics circuit components.*

(iii) Teachers should put more emphasis on the use of English language by encouraging prospective candidates to practice through writing, reading, listening and speaking. This strategy will improve the candidates' English proficiency.

Appendix:

A Summary of Candidates' Performance on each Topic

S/N	Topic	Question Number	Percentage of Candidates' Performance (%)	Remarks
1	Modulation	2	81.6	Good
2	Safety management and rules	3	81.0	Good
3	Radio Receiver	5 & 7	76.4	Good
4	Electronic circuits	8	73.6	Good
5	Tuned Circuit	9 & 11	73.35	Good
6	Television Receiver, Semiconductor, Oscillator, RF Signals, Semiconductor Diodes, Power Supplies, Tools and Test Equipment's, Picture Tube, Electronic Circuit Components, and Modulation	1	69.9	Good
7	Power Supplies	10	62.0	Average
8	Television	4 &12	41.1	Average
9	Transistor Amplifier	6 &14	29.75	Average
10	Antennae	13	21.4	Poor