THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

ANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR THE CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (CSEE) 2015

031 PHYSICS
(For School Candidates)

THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR THE CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (CSEE) 2015

031 PHYSICS

(For School Candidates)

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

©The National Examinations Council of Tanzania, 2016

All rights reserved.

TABLE OF CONTENTS

FOREWORD

The Certificate of Secondary Education Examination (CSEE) marks the end of four years of secondary education. It is a summative evaluation, which among other things shows the effectiveness of the education system in particular. Essentially, the candidates' responses to the examination questions is a strong indicator of what the education system was able or unable to offer to the students in their four years of secondary education.

The candidates' item response analysis in Physics subject for CSEE 2015, has been prepared to provide feedback to students, teachers, parents, policy makers and the public in general on the performance of the candidates in the subject.

The analysis presented in this report is intended to contribute towards the understanding of some of the reasons behind the performance of the candidates in Physics subject. The report highlights some of the factors that made the candidates fail to score high marks in the questions. Such factors include inability to express themselves in English, lack of the basic knowledge on Physics concepts and poor drawing skills. Furthermore, some of the candidates failed to identify the demand of the questions. The feedback provided will enable the education administrators, school managers and teachers to identify proper measures to be taken in order to improve the candidates' performance in future examinations administered by the Council.

The National Examinations Council of Tanzania will highly appreciate comments and suggestions from teachers, students and the public in general. Such comments and suggestions will be used for improving future analysis reports.

The Council would like to thank all the Examiners and stakeholders who participated in preparation of this report. The council is also grateful to all staff members who participated in processing the data used in this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents an analysis of the performance of the candidates who sat for the Certificate of Secondary Education Examination (CSEE) in 2015 in Physics subject. This paper intended to measure the competencies acquired by the candidates as stipulated in 2010 Physics syllabus.

The paper consisted of three (3) sections, namely A, B and C. Section A comprised three (3) objective questions which were drawn from various topics of the syllabus. Section B comprised six (6) short answer questions while Section C consisted of two (2) short answer questions. Each question in section B and C had three parts; (a), (b) and (c). The candidates were required to answer all questions in section A and B and one question from section C.

The number of candidates who sat for Physics in CSEE 2015 was 129,904 of which 44.30 percent passed and 55.7 percent failed. In the year 2014 the candidates who sat for this subject were 108,718 of which 46.71 percent passed and 53.29 percent failed. This indicates that the candidates' performance in Physics for the year 2015 dropped by 2.41 percent.

The following section analyses performance of the candidates for each question. It starts by indicating the question demand and provides the analysis of candidates' performance. It also highlights misconception observed and outlines some reasons behind the candidates' performance in a particular question. The criteria used in the analysis are as follows, the performance is considered to be good, average or poor if the percentage of the candidates who scored from 30 percent or more of the marks allocated in the question laid in the interval of 45 – 100 (green), 30 – 44 (yellow) and 0 – 29 (red) respectively. The samples of candidates' responses are inserted as extracts to represent good and poor cases. Also some graphs and charts are used to summarize the candidates' performance in a particular question. The report also contains appendices which indicate the general performance in each topic. These appendices also make comparison between the 2014 CSEE performance and that of 2015. Finally, the report provides some

recommendations that would help to improve the candidates' performance in the future.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH QUESTION

2.1 Section A: Objective Questions

2.1.1 Question 1: Multiple Choice Items

This question consisted of ten multiple choice items derived from the topics of Properties and Structure of Matter, Waves, Light, Sustainable Energy Sources, Electromagnetism, Modern Physics, Electronics and Current Electricity. The candidates were required to choose the correct answer from the five given alternatives by writing the letter in the answer booklet provided.

The question was attempted by 100 percent of the candidates of those who attempted, 52.0 percent scored from 0 to 2.0 marks, with 7.5 percent scoring zero. The data shows that, 33.2 percent scored from 3 to 4 marks and 14.8 percent scored from 5 to 10 marks. This indicates that the candidates' performance in this question was generally good.

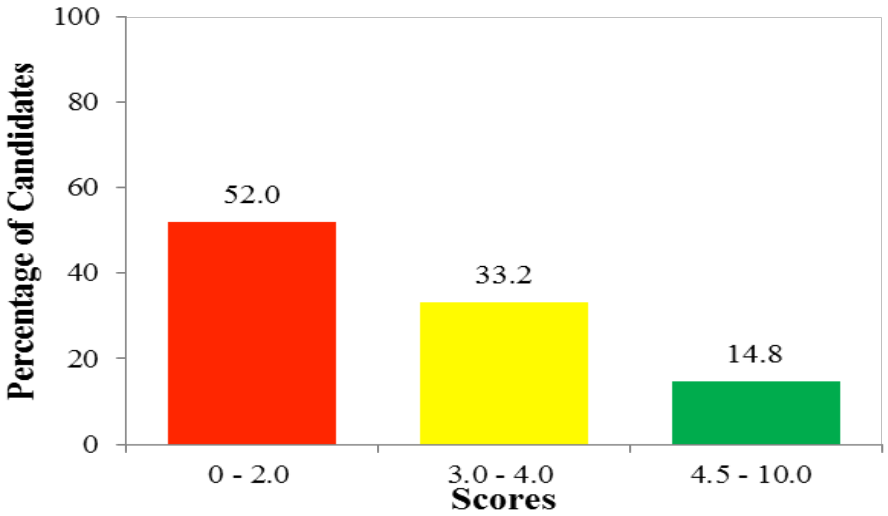


Figure 1: Illustration of candidates' performance in question 1.

The analysis of the items responses is as follows:

In item (i), the candidates were required to choose the alternative which represents the extension of a spiral spring of natural length 1.50 m when it is extended to 1.505 m by a force of 0.80 N. The correct response was "C" (0.020 m). To obtain this answer, the candidates were required to apply the concept of Hooke's law and perform some computations. Most of the candidates who failed this question selected alternative "B" (6.020m); which is obtained by cross multiplication of lengths and forces which gives the physical meaning of work done. The failure to supply the correct answer can be attributed to lack of knowledge and skills in calculations.

Item (ii), required the candidates to choose the alternative that represents the type of electromagnetic wave which is used to detect flaws and defects in steel plates. The correct alternative was "C" (x- rays). However, most of the candidates who failed this item were attracted by alternative "D" (gamma rays). Probably this is due to the fact that x-rays and gamma rays have some similar properties such as high penetrating power. Nonetheless, they failed to realize that the suitable rays for the detection of flaws and defects are those which do not penetrate the material under test but have small wave length to pass through the fractures which are the gamma rays.

In item (iii), the candidates were required to select the alternative which represents the name of the part of human eye that corresponds to the film in a camera. The correct response was "E" (retina). Most of the candidates who failed to write correct answer were attracted by alternative "C" (lens). This might be due to the fact that a lens has a property of forming an image.

Item (iv) required the candidates to choose the response which represents the process by which the sun generates energy. The correct alternative was "E" (geothermal fission). Most of the candidates who wrote incorrect answers were distracted by alternative "D" (geothermal fusion). This might be caused by lack of knowledge to distinguish the terms fusion and fission.

Item (v) required the candidates to select the alternative which represents the size of an image which is formed if an object 4 cm tall is placed 20

cm in front of a concave mirror of focal length 15 cm. The correct answer was “D” (12 cm). Most of the candidates failed to recall the formulae for magnification on curved mirrors in terms of heights of image and object as well as that which is in terms of distance of image and object. As a result, the candidates, who failed to choose the correct response, were attracted by alternative “E” (3 cm) as they multiplied directly the height of the object with the focal length of the mirror then divided by the distance of the object from the mirror. These candidates lacked content knowledge and ability to formulate the relations between magnification in relation to image and object distances and ability to relate heights of objects to images.

In item (vi), the candidates were required to choose an alternative which represents the function of a step up transformer. The correct response was “C” (to increase a.c voltage). Most of the candidates who failed this question were attracted by alternative “E” (to increase a.c current). The reason for this is an inadequate knowledge on the functions of transformer.

Item (vii) required the candidates to select an alternative which represents the name of the radiation which forms a well – defined track when passed in cloud chamber. The correct alternative was “D” (alpha rays). The alternative which attracted most of the candidates was “E” (x-rays). The reason for this might be lack of knowledge about the properties of the rays when passing in a cloud, thus candidates chose x-rays because it is commonly used in hospitals, factories etc.

In item (viii), the candidates were required to choose an alternative which represents the name of a crystal produced when an acceptor impurity is added to silicon. The correct response was “A” (P-type). Most of the candidates who failed this question chose alternative “B” (N-type). This indicates that the candidates lacked an insight on the fact that, acceptor impurity is formed when a trivalent atom such as boron is added to a pure semiconductor like silicon thereby creating a hole to be filled by an electron for complete covalent bonding. The charge carriers produced in this process are the positive charges, hence the name p-type. On the other hand, the candidates who selected “B” (N-type) failed to recognize that N-type is formed when a donor impurity is introduced

into a pure semiconductor such as silicon. In general, the candidates failed to distinguish between the formation and nature of impurities responsible for the two types of extrinsic semiconductors.

Item (ix) required the candidates to choose the alternative which represents the reason for formation of colours when white light passes through a glass prism. The correct response was "C" (in glass different colours travel at different speeds). Most of the candidates who failed to choose the correct response were attracted by alternative "E" (diffraction of light occurs). This shows that the candidates had misconception on the reason for dispersion of light and that for diffraction of light.

In item (x), the candidates were required to select an alternative which is true about measurement of resistance using an ammeter, voltmeter and rheostat. The correct response was "C" (a graph of V against I has a gradient equal to R). Most of the candidates who failed this question were attracted by alternative "B" (voltmeter is in series with R). This might be caused by lack of practical knowledge on measurement of resistance using ammeter-voltmeter method which is a verification of Ohm's law. These candidates were not aware of the properties of graph but they knew theoretically that voltmeter measures p.d across the resistor.

2.1.2 Question 2: Matching Items

This question consisted of ten (10) items in List A with fourteen (14) responses in List B derived from the topic of Geophysics. The candidates were required to match each item in List A with a correct response in List B by writing its letter beside the item number in the answer booklets provided.

A total of 129,858 (100%) candidates attempted this question. The analysis of the data as shown in Figure 2 indicates that, 62.6 percent scored from 0 to 2.0 marks, 21.4 percent scored from 3 to 4 marks and 16 percent scored from 5 to 10 marks. Figure 2 indicates that, the total percentage of the candidates who passed this question was 37.4 indicating that it was averagely performed.

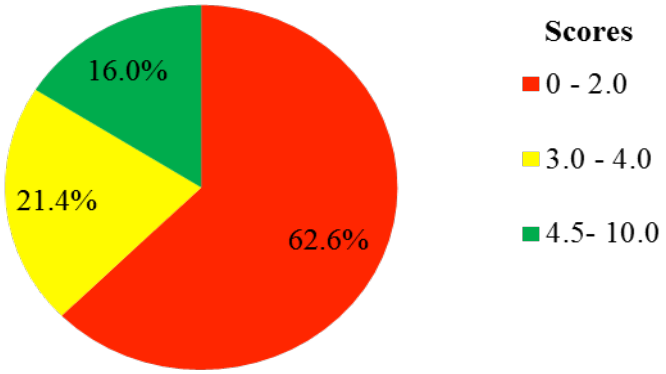


Figure 2: The candidates' performance in question 2

The analysis of the candidates' response to items of this question is as follows:

In item (i), the candidates were required to find a response which matches the region nearest the earth where most weather phenomenon occur. The appropriate response for this item was "F" (troposphere). Most of the candidates who responded wrongly chose option "B" (atmosphere). These candidates did not understand that troposphere is a layer of the atmosphere situated at the height of about 15 km above the Earth's surface. They lacked knowledge on the layers of the atmosphere and its characteristics.

Item (ii) required the candidates to choose the alternative which represents the name of the layer in which ozone layer is found. The correct response was "A" (stratosphere). Most of the candidates who failed this question selected alternative "J" (lithosphere). This might be caused by the candidates' lack of knowledge about characteristics of layers of the atmosphere. The candidates were supposed to know that ozone layer is a region of the stratosphere containing a relatively high concentration of ozone which absorbs most solar ultraviolet radiation while lithosphere is a rigid solid portion of outer layer of the earth.

In item (iii), the candidates were required to choose the name of the boundary which separates stratosphere from other layers. The correct response was "D" (stratopause). Most of the candidates who wrote incorrect answers selected alternative "H" (thermosphere). This might be caused by lack of knowledge about boundaries separating layers of the atmosphere. Stratopause is the boundary between the stratosphere and

the mesosphere whilst thermosphere is the layer of the earth's atmosphere above the mesosphere and below the exosphere. Therefore, the candidates failed to differentiate between layers of the earth's atmosphere and the boundaries separating them.

Item (iv) required the candidates to select the option which matches the statement "boundary which separates troposphere from stratosphere". The correct response was "N" (tropopause). Some of the candidates who failed this item selected alternative "G" (Exosphere). This was again a result of lack of knowledge of the basic concepts about the layers and boundaries of the earth's atmosphere as applied to Geophysics. The candidates failed to recall that the tropopause is the line or boundary separating the troposphere and stratosphere whereas exosphere is the uppermost layer of the atmosphere whose lower boundary is estimated to be at 500 km to 1000 km above the earth's surface.

In item (v), the candidates were required to choose an alternative which represents the name of "the region found in the exosphere where satellites orbit the earth" The correct response was "E" (magnetosphere) and was chosen by most of the candidates.

In item (vi), the candidates were required to choose the option which represents the name of the outermost region of the atmosphere. The correct answer was "G" (exosphere). Most of the candidates who failed this item selected alternative "M" (lower atmosphere). This indicates that they did not understand that the outermost region of the atmosphere is the outer region of the atmosphere but not the lower part of the atmosphere as perceived by the candidates.

Item (vii) required the candidates to write an alternative which represents the name of "the layer which is also known as upper atmosphere". The correct response was "H" (Thermosphere). Most of the candidates who failed this question selected alternative "K" (mesopause). They lacked insight on the vertical arrangement of atmospheric layers contrary to the boundaries separating them.

In item (viii), the candidates were required to give the alternative which represents the collective name given to troposphere and stratosphere.

The appropriate response was “M” (lower atmosphere). Some of the candidates who failed this question selected alternative “N” (tropopause). These candidates did not apprehend that the troposphere is the lowest layer of the atmosphere followed by the stratosphere. Hence, the two make the lower part of the atmosphere.

Item (ix) required the candidates to select the option which represents “the layer just above the stratosphere in which most meteors burn while entering the earth’s atmosphere”. The correct response was “L” (mesosphere). Most of the candidates who provided incorrect responses to this question selected alternative “C” (Ionosphere). This option attracted most candidates due to the fact that, ions are formed when gases around the sun are burnt. They did not consider the proper possible arrangement of the layers of the atmosphere. The candidates were supposed to realize that ionosphere is the region of the earth’s atmosphere extending from 60 to 1000 km above the earth’s surface in which there is a high concentration of free electrons and ions formed as a result of ionizing radiation entering the atmosphere from space. They were also supposed to recall that this is not the layer where the meteors can burn.

In item (x), the candidates were required to match the statement with the name of the layer of gases containing numerous small suspended solid and liquid particles that surrounds the earth. The correct response was “B” (atmosphere). However most of the candidates who failed this item were attracted by alternative “I” (hydrosphere). This might be due to the fact that hydrosphere is the layer of all the waters of the earth which is in liquid form. They failed to distinguish hydrosphere from atmosphere. The atmosphere contains both suspended solid and liquid particles surrounding the earth while hydrosphere includes the waters of the ocean, rivers, lakes, and other bodies of surface water in liquid form on the continents. In the hydrosphere there are no suspended solid particles which are found in the atmosphere.

2.1.3 Question 3: Fill in the Blank Items

This question consisted of ten items from the topics of Motion in Straight Line, Light, Electromagnetism, Current Electricity, Structure

and Properties of Matter, Moment of Forces, Waves, Astronomy and Geophysics. In each of the items the candidates were required to fill in blank spaces by writing the suitable answer for the item in the given answer booklets.

The question was attempted by 100 percent of the candidates, and their scores were as follows: 61.7 percent scored from 0 to 2.0 marks, 26.9 percent scored from 3 to 4 marks and 11.4 percent scored from 4.5 to 10 marks. These scores indicate that the general performance of the question was average. Figure 3 summarizes the candidates' performance in this question.

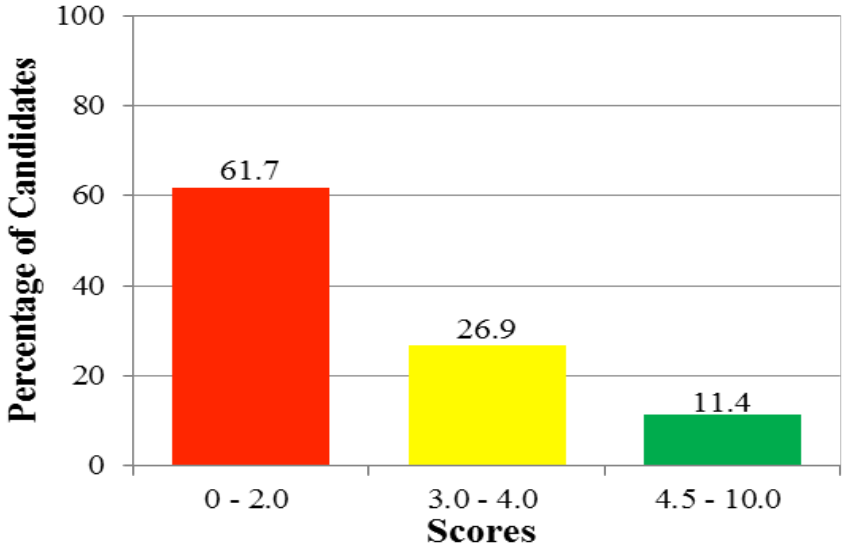


Figure 3: A summary of candidates' performance in percentage.

In item (i), the candidates were required to write the name which is given to the rate of change of displacement. The correct answer was "velocity". Most of the candidates wrote the correct answer though a few of them wrote "speed". These candidates lacked content knowledge on the distinction between speed and velocity. They failed to comprehend that velocity is a vector quantity in which the rate of distance travelled by the body has specified direction. On the other hand, speed is a scalar quantity in which the rate of distance travelled by the body has magnitude only.

Item (ii), required the candidates to complete the statement by writing the process whereby the eye can alter its focal length in order to form

images of objects at different distances. The correct answer was "accommodation of the eye". Most of the candidates who failed this question wrote "long sightedness". They failed to understand that accommodation of the eye embroils the adjustment of the eye to change the distance from an observed object but long sightedness refers to a vision defect in which the lens of the eye is unable to accommodate sufficiently to throw the image of near objects onto the retina. They failed to relate the accommodation power and the defects of the human eye.

In item (iii), the candidates were required to write the rule used to deduce the direction of the magnetic field lines due to a solenoid or circular coil. The correct answer was "cork screw rule/right hand grip rule". Most of the candidates who failed this question wrote "Fleming left hand rule". These candidates referred only to the rule used to give the direction of the magnetic field lines without considering the type of the conductor used to trace magnetic lines of force. Nevertheless, they failed to recall how the current is led in the conductor to allow the magnetic effect to be felt. This shows inadequate knowledge of the candidates pertaining to the determination of the direction of the current carrying conductors.

Item (iv) required the candidates to write the function of an induction coil. The correct response was to produce "high voltage". Most of the candidates wrote to produce "field lines". This might be caused by lack of knowledge on the function of induction coil, which is to produce a high voltage alternating current pulse from low voltage direct current supply.

In item (v), the candidates were required to write the quantity that is measured by using Wheatstone bridge. The correct answer was "resistance of a conductor". Most of the candidates who failed this question wrote "current". These candidates failed to recognize that, a Wheatstone bridge is a modern version of a meter bridge which is used to determine the resistance of the conductor when the current is made to flow through the circuit. They also failed to diagnose that, the current flowing in the Wheatstone bridge helps to obtain the balanced length on

the bridge wire which in turn assists in finding the unknown resistance of the conductor.

Item (vi) required the candidates to identify the positive characteristic of a force which causes anticlockwise rotation. The correct answer was "moment". Most of the candidates who failed this question wrote "charge". These candidates failed to recognize that rotation motion is caused by moment. They lacked knowledge of the concept of equilibrium of forces as they included static electricity where it didn't hold.

In item (vii), the candidates were required to supply the term with which elasticity and surface tension are accounted for by the kinetic theory of matter. The correct answer was "thermal expansion/diffusion". Most of the candidates who failed this question wrote "capillarity". They failed to understand that the kinetic theory of matter explains the physical properties of matter in terms of the motions of its constituent particles while thermal energy facilitates their speed. Obviously, thermal expansion becomes another physical quantity which is accounted for by the kinetic theory of matter.

Item (viii) required the candidates to write another factor on which the quality of a note produced by a musical instrument depends. The correct answer was "overtones/harmonics". The candidates who performed poorly failed to understand that harmonic is an oscillation having a frequency that is a simple multiple of a fundamental sinusoidal oscillation and that the upper harmonics produces overtones. This factor governs the quality of a note produced by a musical instrument.

In item (ix), the candidates were required to write the name which is given to the collection of heavenly bodies that revolve around the sun. The correct answer was "solar system" but most of the candidates who provided incorrect answers wrote "astronomy". Although these candidates had an idea of the topic of astronomy they failed to understand that solar system involves an arrangement of planets and other heavenly bodies revolving around the sun, while Astronomy is the study of the universe beyond the earth's atmosphere or is the science concerned with celestial bodies.

Item (x) required the candidates to write the term which is used to represent the phenomenon of increase in the average temperature of the world's atmosphere. The correct response was "global warming" and was provided by most of the candidates. However, some of them gave incorrect responses such as "greenhouse effect", "carbon dioxide" and "oxygen". These candidates failed to differentiate global warming from greenhouse effect. They were supposed to know that global warming is a sustained increase in the average temperature of the earth's atmosphere brought about by greenhouse effect which is induced by emission of greenhouse gases sufficient to cause climate change. On the other hand, greenhouse effect refers to the warming of the earth's atmosphere caused by the increasing concentration of atmospheric gases such as water vapour and carbon dioxide which absorb radiation emitted by the earth, thus slowing down the loss of radiant energy from the earth back to space. However, a few candidates failed to score good marks because of poor spelling. For example one candidate wrote the term "globoworming" instead of global warming. The misspelt word lost the intended meaning and consequently the candidates lost marks.

2.2 Section B: Short Answer Questions

2.2.1 Question 4: Archimedes Principle and Law of Flotation

In part (a), the candidates were required to explain (i) the effect of increasing temperature on the density of most liquid substances and (ii) the procedure of using methylated spirit, water and a pendulum bob to find the relative density of spirit. In part (b), the candidates were required to (i) state Archimedes' Principle and (ii) explain briefly why a ship sinks deeper in fresh water than in sea water. In part (c), the candidates were presented with the following situation: "when a piece of wood is put in a graduated cylinder containing water, the level of water rise from 17.7cm^3 to 18.5cm^3". Then they were required to calculate (i) the mass of piece of wood and (ii) total volume of the piece of wood if its relative density is 0.60.

The question was attempted by 100 percent of the candidates, out of which 77.9 percent scored from 0 to 2.5 marks, 11.6 percent scored from 3 to 4 marks and 10.6 percent scored from 4.5 to 10 marks. The

summary of candidates' performance indicates that, the question was generally poorly performed.

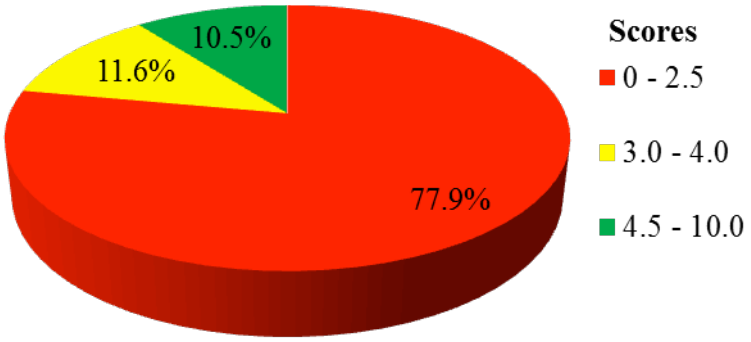
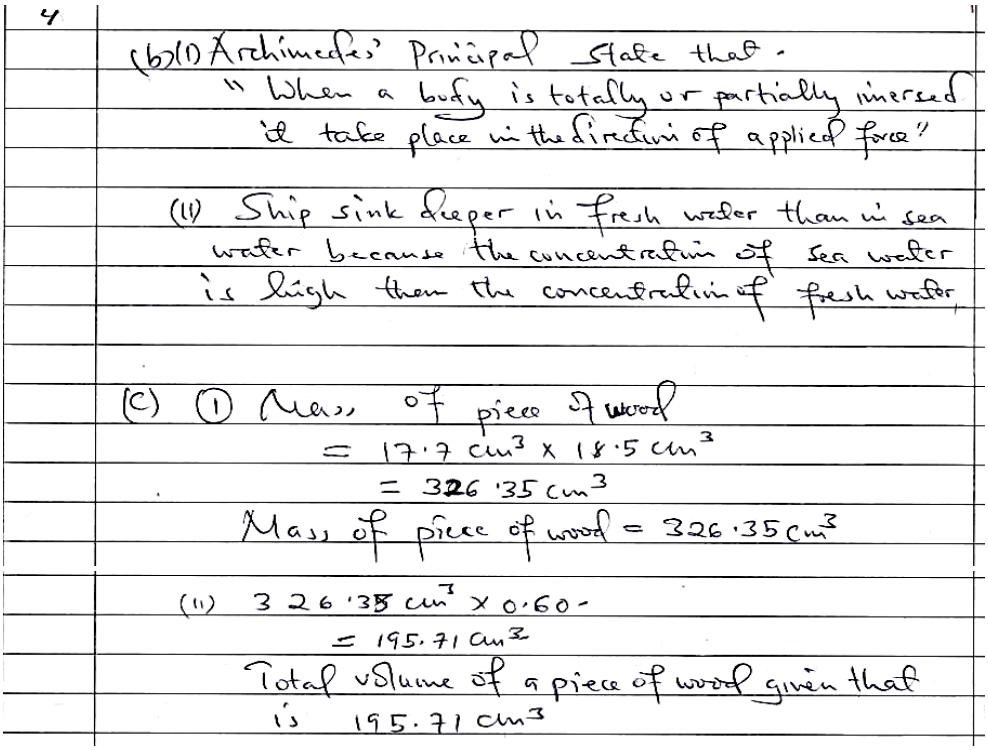


Figure 4: A summary of the general performance in question 4.

The candidates, who performed poorly in this question, either skipped some parts of the question or provided incorrect answers to all or some parts of the question. It was observed that, most of the candidates who scored low marks provided inappropriate responses to part (a) and (b) (ii) which required brief explanation. In these parts, the candidates failed to explain the effect of increasing temperature on the density of most liquid substances and the procedure of using methylated spirit, water and a pendulum bob to find the relative density of spirit. They also failed to state Archimedes' principle and to explain why a ship sinks deeper in fresh water than in sea water. Similarly, they failed to calculate the mass and the total volume of a piece of wood whose relative density is 0.60 when it is put in a graduated cylinder containing water, as the level of water rises from 17.7cm^3 to 18.5cm^3. The poor performance in this question indicates that, most of the candidates lacked content knowledge and mathematical computational skills on the concept of Archimedes' principle and the law of flotation. Extract 4.1 shows a sample of candidates' poor responses.

Extract 4.1


4

(b)(i) Archimedes' Principal State that.
" When a body is totally or partially inersed it take place in the direction of applied force"

(ii) Ship sink deeper in fresh water than in sea water because the concentration of sea water is high than the concentration of fresh water.

(c) (i) Mass of piece of wood
= 17.7 cm^3 x 18.5 cm^3
= 326.35 cm^3
Mass of piece of wood = 326.35 cm^3

(ii) 326.35 cm^3 x 0.60
= 195.71 cm^3
Total volume of a piece of wood given that is 195.71 cm^3

Extract 4.1 shows that the candidate failed to attempt part (a) and provided incorrect answers for part (b) and (c). He/she also failed to recall a formula for finding the mass and the total volume of the piece of wood.

Despite the poor performance by the majority of the candidates in this question, some of them did it well. They presented their work clearly and used suitable Physics formulae to calculate the mass and total volume of the piece of wood, indicating that the concept was well understood by these candidates. Extract 4.2 shows a sample of candidates' good answers in this question.

Extract 4.2

4 (a) (i) When the temperture increases in liquid the density of a liquids will decrease due to increase in volume of liquids.

(ii) - Measure the weight of a bob in air = W_1
- Put the bob in water and measure the apparent weight of a bob in water using a spring balance = W_2
- Remove the bob from the water
- Put the bob in methylated spirit and measure the apperent weight of the bob when it's in methylated spirit W_3
- Then start calculation

upthrust in water = $W_1 - W_2$

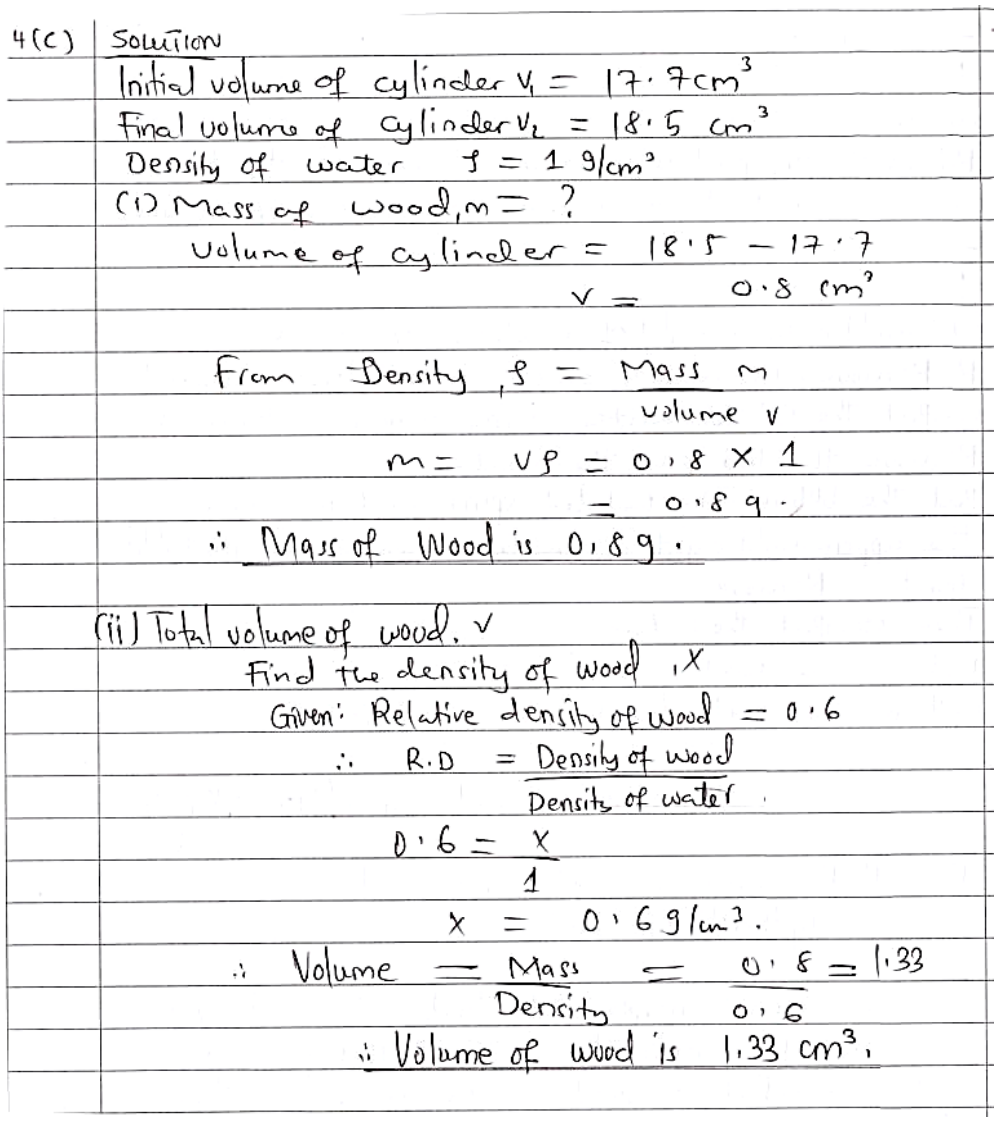
upthrust in methylated spirit = $W_1 - W_3$

Relative density of methylated spirit, $R.D = \frac{W_1 - W_3}{W_1 - W_2}$

$R.D = \frac{\text{upthrust in methylated spirit}}{\text{upthrust in water}}$

(b)(i) Archimede's principle state that when a body is totaly or partially immersed in a fluid it experiences an upthrust which is equal to the weight of the fluid displaced.

(ii) Because density of sea water s greater than the density of fresh water.



Extract 4.2 indicates that the candidate performed well as he/she stated clearly the effect of temperature on the density of liquids. The candidate explained correctly the procedures of finding relative density of liquids using methylated spirit, water and a pendulum bob and used the required formula in his/her calculations.

2.2.2 Question 5: Thermal Expansion

In part (a) the question required the candidates to define; (i) coefficient of superficial expansion and (ii) anomalous expansion of water whereas in part (b) the candidates were asked to (i) calculate heat required to change 340g of ice at 0^oC to water at 0^oC and (ii) state the name of the

heat lost in (b) (i). In part (c) they were given that; an iron rivet of radius 8.95mm at 20^{o}C is to be inserted into a hole of iron plate of radius 8.92mm at 20^{o}C, then, they were required to calculate the temperature the rivet must be heated in order to fit in the hole.

The question was attempted by 100 percent of the candidates and their scores were as follows; 89.1 percent scored from 0 to 2.5 marks, 7.3 percent scored from 3 to 4 marks and 3.6 percent scored from 4.5 to 10 marks. Figure 5 summarizes the candidates' performance in this question.

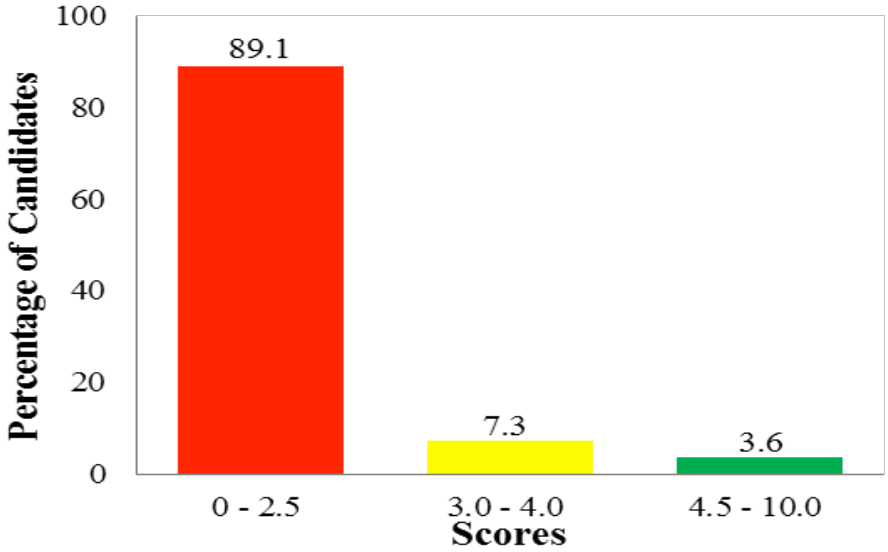
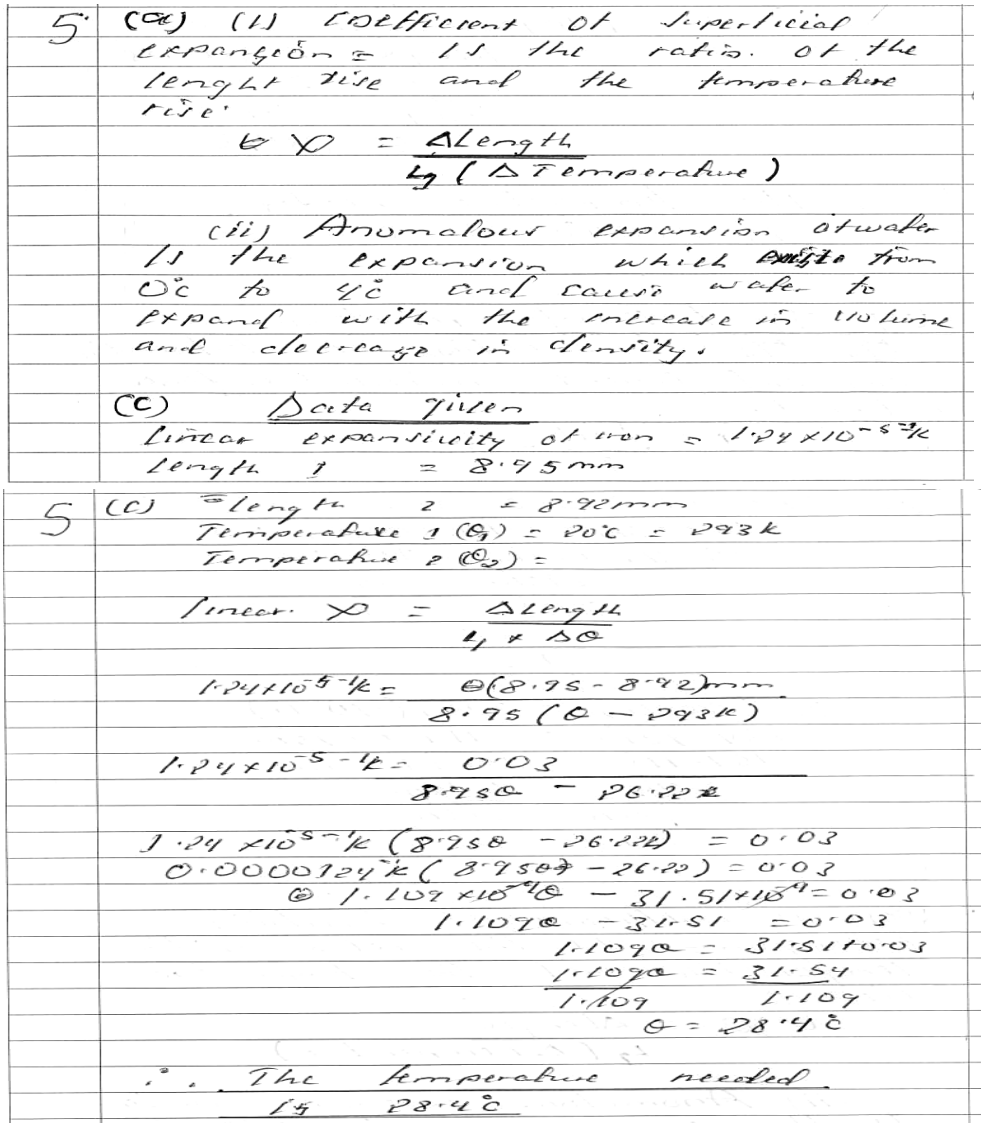


Figure 5: Percentage of candidates' performance in question 5 which indicates that, the performance was poor.

As shown in Figure 5 the candidates performance was poor because the majority of candidates (89.1%) scored low marks. Low performance was revealed particularly in part (a) where many candidates confused the coefficient of superficial expansion and coefficient of linear expansion. They failed to understand that the coefficient of superficial expansion is a fractional increase in area of a solid surface caused by unit rise in temperature while coefficient of linear expansion is a fractional increase in length of a specimen of a solid per unit rise in temperature. These candidates failed to recall that coefficient of superficial expansion involves increase in area but coefficient of linear expansion involves increase in length. In addition to that, the definition of anomalous expansion of water was poorly stated by the majority of the candidates.

Many other candidates failed to do well in part (b) and (c) of the question which required the use of formulae and mathematical computations indicating that they were also poor in mathematics. Extract 5.1 shows a sample of poor responses given by candidates who attempted the question poorly.

Extract 5.1


5. (a) (i) Coefficient of superficial expansion = is the ratio of the length rise and the temperature rise.

$\alpha = \frac{\Delta Length}{L_1(\Delta Temperature)}$

(ii) Anomalous expansion of water is the expansion which occurs from 0°c to 4°c and causes water to expand with the increase in volume and decrease in density.

(c) Data given

Linear expansivity of iron = $1.24 \times 10^{-5} K^{-1}$

length 1 = 8.95 mm

length 2 = 8.92 mm

Temperature 1 (θ_1) = 20°c = 293 k

Temperature 2 (θ_2) =

$Linear\ \alpha = \frac{\Delta Length}{L_1 \times \Delta\theta}$

$1.24 \times 10^{-5} K^{-1} = \frac{\theta(8.95 - 8.92)mm}{8.95(\theta - 293K)}$

$1.24 \times 10^{-5} K^{-1} = \frac{0.03}{8.95\theta - 26.22}$

$1.24 \times 10^{-5} K^{-1}(8.95\theta - 26.22) = 0.03$

$0.0000124 K^{-1}(8.95\theta - 26.22) = 0.03$

$1.109 \times 10^{-4}\theta - 31.51 \times 10^{-4} = 0.03$

$1.109\theta - 31.51 = 0.03$

$1.109\theta = 31.51 + 0.03$

$\frac{1.109\theta}{1.109} = \frac{31.54}{1.109}$

$\theta = 28.4°c$

∴ The temperature needed is 28.4°c

In extract 5.1 a candidate defined superficial expansion as "*the ratio of length rise and temperature rise"* by using the formula $\alpha = \frac{\Delta Length}{\Delta Temperature}$ which was not correct. Also, the candidate was

not able to solve the question in part (b) and (c) due to application of incorrect formulae. This indicates that, he/she lacked knowledge of the concept of thermal expansion.

The candidates who scored high marks in this question were able to correctly define superficial expansion and anomalous expansion of water. They also performed systematic and accurate calculations in the parts which required mathematical computations. Extract 5.2 is a sample of responses given by the candidates who scored high marks in this question.

Extract 5.2

5 (a)(i) Coefficient of superficial expansion is the fractional increase in area of the material per degree rise in temperature. It is also called the aearial expansivity.

(ii) Anamalous expansion of water is the phenomenon that explains the increase in volume of water as it is cooled between 4°C to 0°C. Example, water is denser at 4°C than at 0°C when it is cooled and ~~ent~~ expands.

(b)(i) Data:

Heat = ? = H

Mass of ice (m) = 340g

constant temperature = 0°C

Specific latent heat of fusion of ice (L_f) = 336J/g

solution

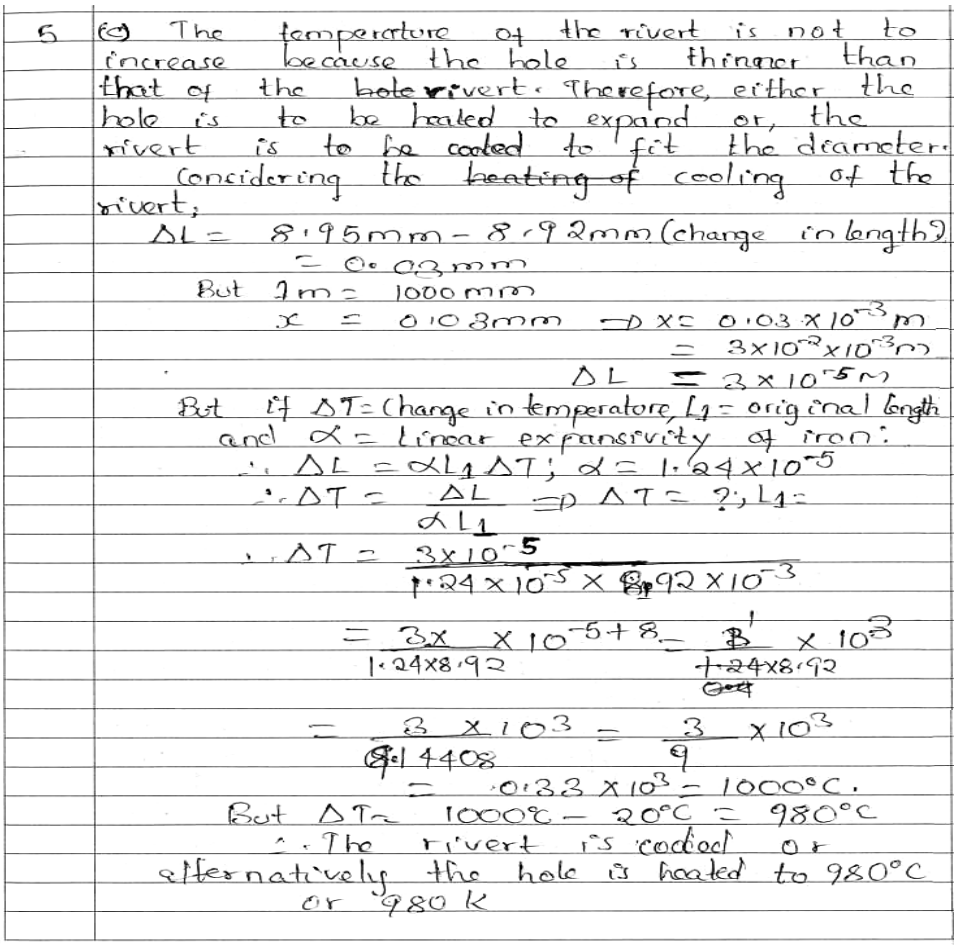
$H = mL_f = (340 \times 336)J = 114240J$

∴ The required heat is 114240 J.

(ii) The heat above in b(i) is not lost; but it is gained to form water by ice. The heat gained is called LATENT HEAT OF FUSION of ice.

(c) Iron rivert = 3.95mm (20°C)

Iron plate = 3.92 mm (20°C), hole


5 (c) The temperature of the rivet is not to increase because the hole is thinner than that of the hole rivet. Therefore, either the hole is to be heated to expand or, the rivet is to be cooled to fit the diameter. Considering the ~~heating of~~ cooling of the rivet;

$\Delta L = 8.95mm - 8.92mm$ (change in length)

$= 0.03mm$

But $1m = 1000mm$

$x = 0.03mm \Rightarrow x = 0.03 \times 10^{-3}m$

$= 3 \times 10^{-2} \times 10^{-3}m$

$\Delta L = 3 \times 10^{-5}m$

But if ΔT = change in temperature, L_1 = original length and α = linear expansivity of iron:

$\therefore \Delta L = \alpha L_1 \Delta T$; $\alpha = 1.24 \times 10^{-5}$

$\therefore \Delta T = \frac{\Delta L}{\alpha L_1} \Rightarrow \Delta T = ?$; $L_1 =$

$\therefore \Delta T = \frac{3 \times 10^{-5}}{1.24 \times 10^{-5} \times 8.92 \times 10^{-3}}$

$= \frac{3 \times 10^{-5+8}}{1.24 \times 8.92} = \frac{3 \times 10^{3}}{1.24 \times 8.92}$

$= \frac{3 \times 10^3}{11.4408} = \frac{3}{9} \times 10^3$

$= 0.33 \times 10^3 = 1000°C.$

But $\Delta T = 1000°C - 20°C = 980°C$

∴ The rivet is cooled or alternatively the hole is heated to 980°C or 980 K

In extract 5.2 the candidate was able to define superficial expansion and anomalous expansion of water. The candidate used the correct formula H = mL to calculate the amount of heat required to change 340g of ice at 0^0C to water at 0^0C. The candidate also used correct formula in part (c) but failed to substitute the data hence failed to calculate the final temperature.

2.2.3 Question 6: Light

In part (a), the candidates were required to (i) state two ways in which the image formed in the plane mirror differs from that formed in pinhole camera and (ii) explain the effect of moving the pinhole camera closer to the object. In part (b), the candidates were required to (i) list three rules used to locate images in curved mirrors and (ii) give two similarities and two differences between the human eye and a lens camera. In part (c),

the candidates were required to (i) draw a sketch diagram to show the formation of mirage and (ii) explain briefly how mirage is formed.
The question was attempted by 100 percent of the candidates and their scores were as follows; 92.1 percent scored from 0 to 2.5 marks, 5.1 percent scored from 3 to 4 marks and 2.8 percent scored from 4.5 to 10 marks. Figure 6 depicts the poor performance of the candidates in this question.

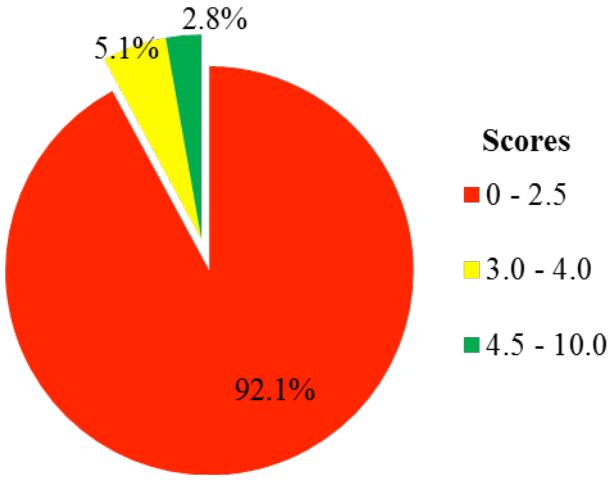
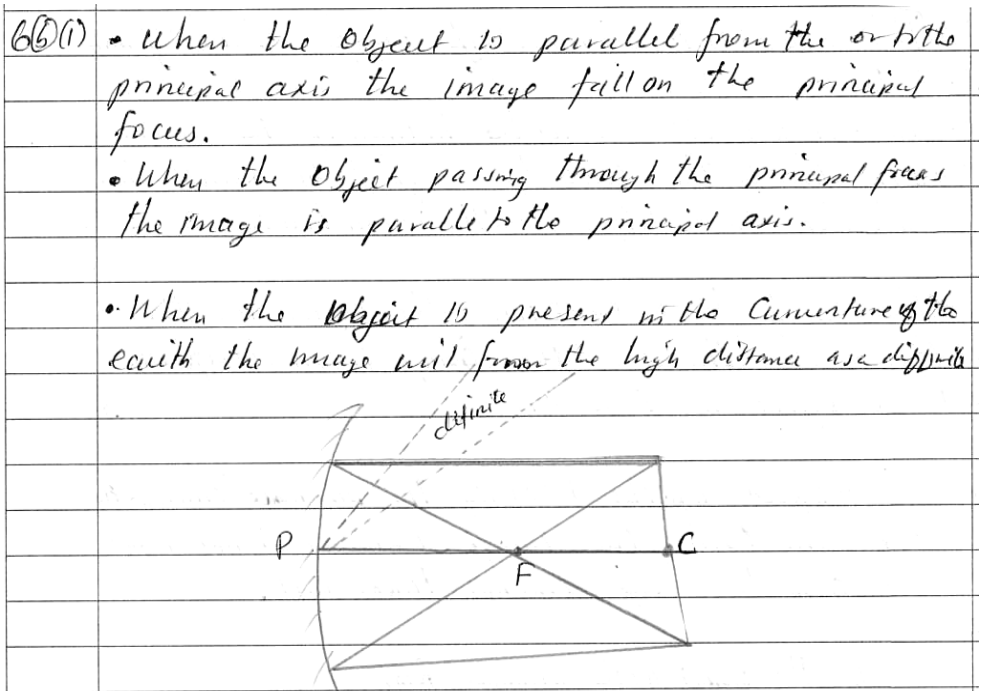


Figure 6: Percentage of candidates' performance in question 6. The figure indicates that the performance was poor.

The candidates who performed poorly, provided irrelevant answers to most parts of the question. In part (a), many candidates were unable to state the ways in which the image formed in plane mirror differs from that in a pin camera. They also failed to give the effect of moving the pinhole camera closer to the object. The candidates' performance in part (b) was also poor due to lack of knowledge of the appropriate rules used to locate images in curved mirrors and on the human eye and lens camera. Likewise, these candidates lacked drawing skills to show and explain the formation of a mirage.

Extract 6.1 shows an example of the responses from one of the candidates who performed the question poorly.

Extract 6.1



The responses in extract 6.1 indicate that the candidate had an idea of the rules used to locate images in curved mirrors but instead of using the term, a "ray of light" the candidate used the word the "object" in his/her explanation. However, this candidate failed to attempt the rest of the parts of the question.

Despite the general poor performance of the candidates in this question, a few candidates performed well. They correctly stated the ways in which the image formed in plane mirror differs from that in a pinhole camera. They also gave correct responses for the effect of moving a pinhole camera closer to the object. These candidates listed the rules used to locate images in curved mirrors and correctly highlighted the differences between the human eye and a lens camera, but they provided incorrect similarities between them. There were few candidates who failed to score full marks because they managed to explain the formation of image precisely but failed to label some important features, like layers of the cooler and hotter air and the position of total internal reflection in the diagram. Extract 6.2 exhibits a sample of good responses of candidates who accurately attempted most parts of the question.

Extract 6.2

6 a) i) → Image in plane mirror is upright and left –right reversed WHILE image in a pinhole camera is upside down ne versed

→ Image in a plane mirror is of the same size as the object WHILE the image in pinhole camera is diminished.

ii) Moving the pinhole camera closer to the object cause the image to increase in size.

b) ii) → The light rays travelling parallel to principal Axis will be reflected through the principal focus.

→ The light rays travelling through the principal focus will be reflected parallel to principal Axis.

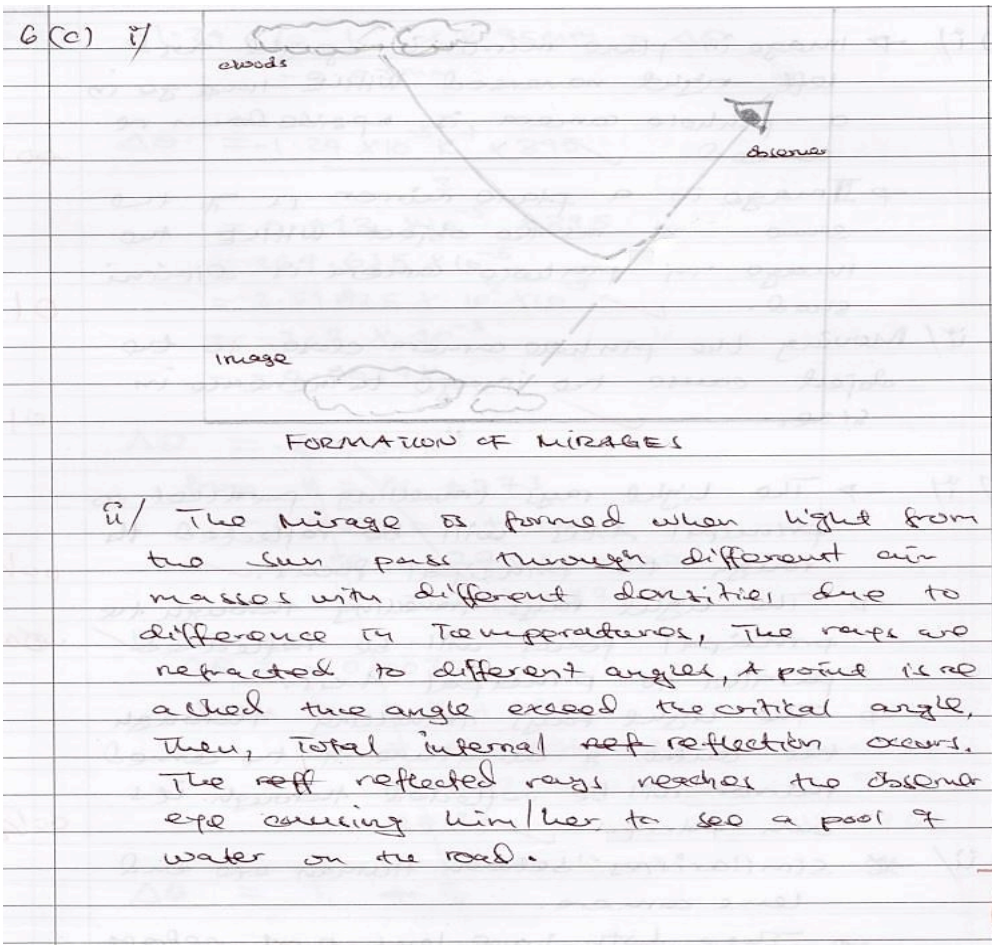
→ The light rays travelling through the centre of curvature of the conved mirror will be reflected through its own path.

ii) → Similarities between Human eye and lens camera.

→ They both have lens that refract light

→ All produce diminished image

Human Eye	Lens camera
Image is formed at Retina	image is formed in film.
produce upside down reversed image	produce upright image



In extract 6.2 the candidate provided correct answers to almost all parts of the question but failed to give correct similarities between a human eye and a lens camera. The candidate also failed to label some important parts such as layers of cooler and hot air as well as the point of total internal reflection.

2.2.4 Question 7: Current Electricity

The candidates were required to (a) (i) explain the meaning of internal resistance of a cell and (ii) distinguish between a cell and a battery. In part (b) they were asked to (i) draw a well labelled diagram of a dry cell (Leclanche) and (ii) identify three disadvantages of a Leclanche cell over Lead-acid accumulators. In part (c) the candidates were given that "The current of 3.0A passes through a coil of resistance 5Ω connected to the terminals of a cell of constant e.m.f E (volts) and internal resistance, r (ohm). If a uniform wire of length L (cm) is joined across the 5Ω coil to

form a parallel arrangement of resistance 4Ω, the current is reduced to 0.25A". The candidates then were required to determine; (i) internal resistance of a cell and (ii) e.m.f of a cell.

The question was attempted by almost all candidates and their scores were as follows; 95.1 percent scored from 0 to 2.5 marks, out of these, 61.5 percent scored 0 marks. The data further show that the candidates who scored from 3 to 4 marks were 3.8 percent and 1.1 percent scored from 4.5 to 10 out of 10 marks. Hence, the general performance of this question was poor as shown in Figure 7.

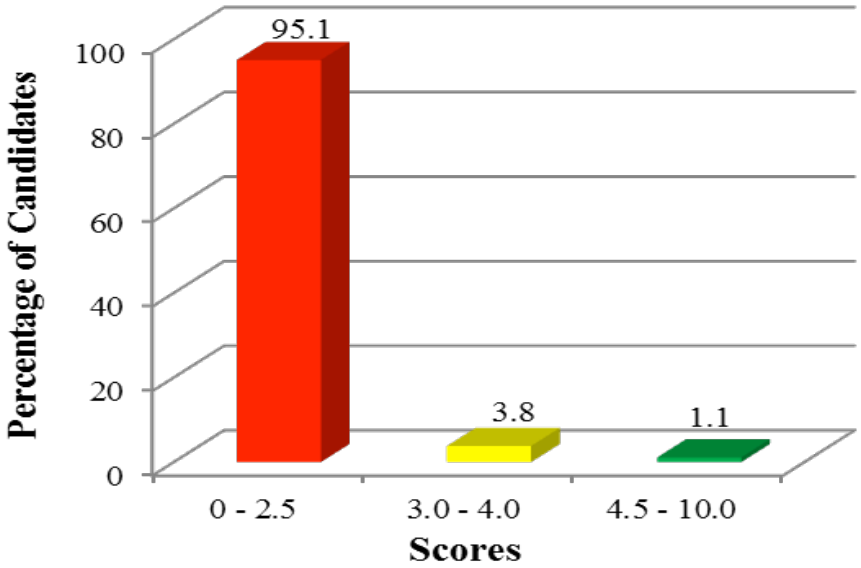


Figure 7: Percentage of candidates' performance per score in question 7.

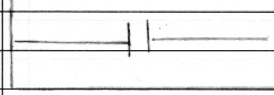
The candidates who performed poorly in this question had inadequate knowledge of the concept of current electricity and therefore, they just guessed the answers. For example one of the candidates defined internal resistance of a cell as *the amount of electric current passing inside of the rheostat OR Is the amount of electric charge which are in the battery before connected in connection*. The definition indicates that the candidate had an idea of electric current but failed to recall the concept of internal resistance hence decided to guess the answers. The candidate was supposed to recognize that, the internal resistance of a cell is the property of chemical in a cell which opposes the flow of current. Some candidates attempted few parts of the question and scored low marks due to provision of wrong answers. A few (4) candidates skipped the

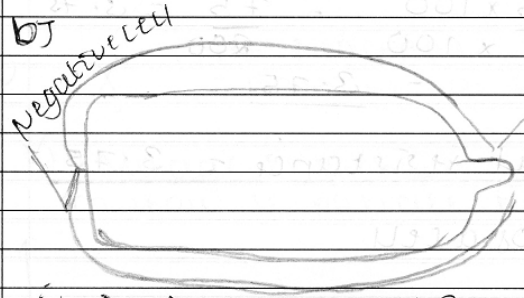
question. In part (b) (i), some of the candidates drew a diagram of a circuit instead of a dry cell. This response indicates that the candidates failed to identify the question demand. Others failed to translate the given information in part (c) into a circuit hence they performed incorrect calculations and using a wrong formulae. Extract 7. 1 is a sample of poor responses given by the candidates.

Extract 7.1

7 i) Internal resistance of a cell is the resistance which connected to the terminal of the current.

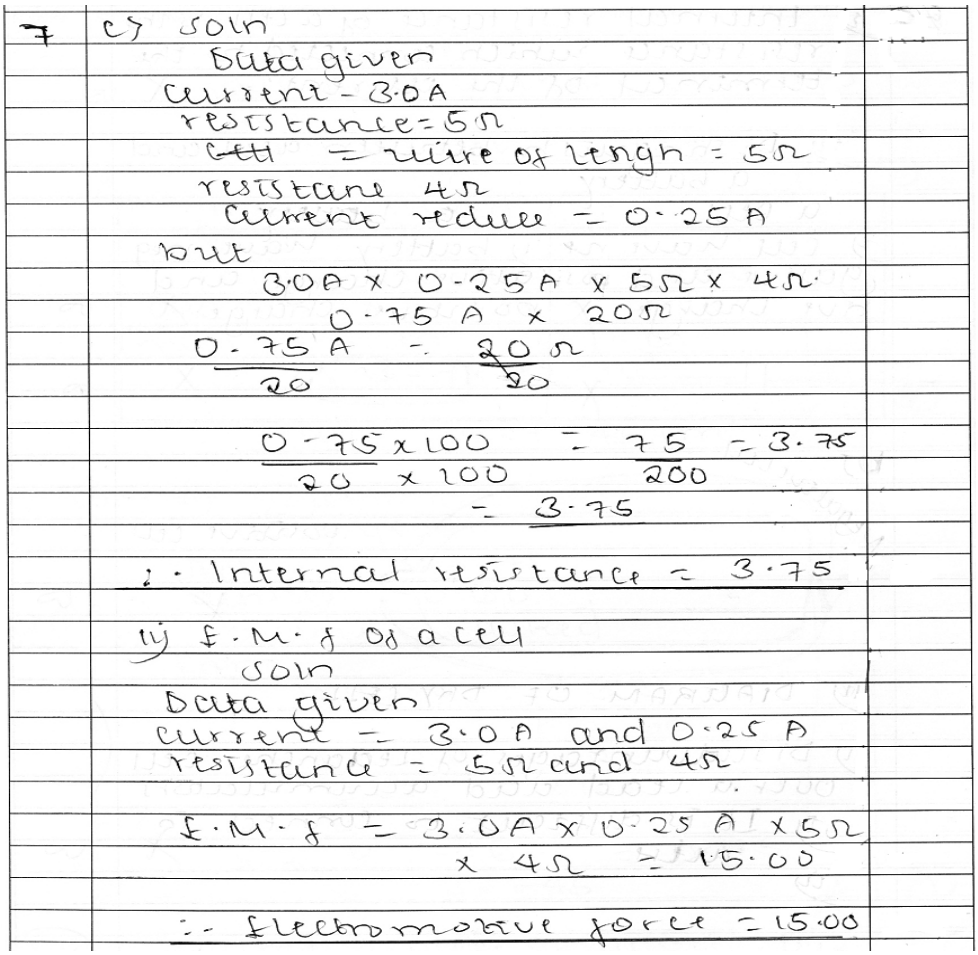
ii) Distinguish between a cell and a battery

a cell	a battery.
i) cell have ne gative and posi tive charge	i) battery have neg ative charge and positive charge.
	

b) 

ii) DIAGRAM OF DRY CELL

iii) Disadvantages of Leclanche cell over a lead acid accumulators
i) It is difficult to connect in ser ies
ii)



In extract 7.1, a candidate failed to explain the meaning of internal resistance of a cell. He/she failed to distinguish between a cell and a battery and drew a poor diagram of a dry cell. He/she also failed to calculate the internal resistance and e.m.f of a cell.

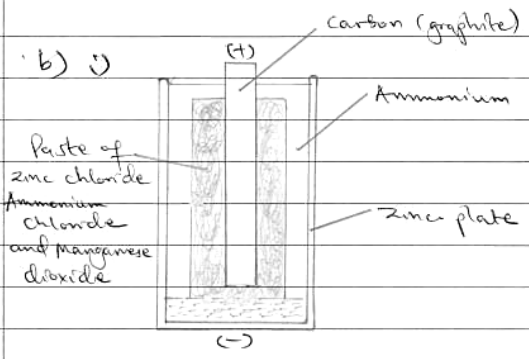
On the other hand, the candidates who attempted this question well were able to provide the correct responses to almost all parts of the question but some failed to organize well the ideas in part (c), hence used incorrect formula to calculate internal resistance and e.m.f of a cell. Other candidates tried to formulate correctly the equations connecting internal resistance and e.m.f but failed to solve them simultaneously to get the required values. Only two (2) candidates were able to provide the correct answers to all parts of the question hence scored 10 out of 10 marks allotted to the question. Extract 7.2 is a sample of responses from the candidates who performed well in this question.

Extract 7.2

7. a) i. Internal resistance of a cell is the resistance or opposition offered by the cell to the current flowing in that cell.

7. a) ii. A cell is a set up which causes the flow of current while a battery is a collection of many cells. A cell is a set up which involve chemical reactions which lead to the flow of current but a battery is a collection of many cells causing the flow of current in a circuit.

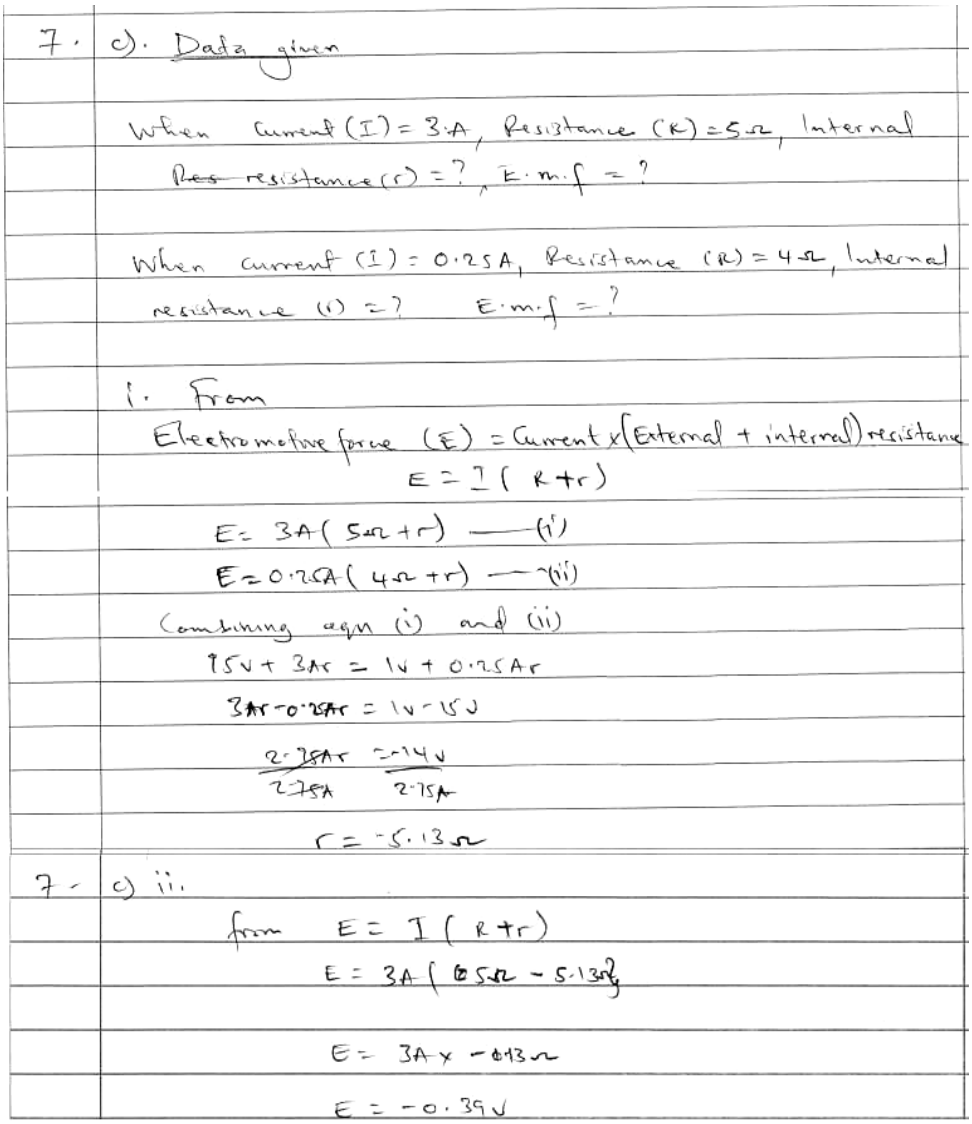
b) i)



A dry cell

ii. Disadvantages of a leclanche cell over lead acid accumulators.

- Cannot be recharged unlike lead acid accumulat
- Affected by local action and polarisation unlike the ~~Provides~~ lead acid accumulators.
- Provides small voltage compared to the lead acid accumulators.



In extract 7.2 a candidate provided short and clear answers. Also the candidate drew a diagram of a dry cell and labelled the zinc plate, ammonium chloride, graphite and indicated well the positive and negative terminals.

2.2.5 Question 8: Radioactivity

In part (a), the candidates were required to (i) define nuclear fission and (ii) mention two products of nuclear fission. In part (b), they were given a figure which shows a comparison of the penetrating powers of three radiations, A, B and C on the paper, aluminium sheet and lead block. The figure showed that radiation A passes through paper and aluminium

sheet but not through lead block, B passes through paper but not aluminium sheet and radiation C passes through none of the materials. The candidates were then required to (i) identify the names of the radiations represented by the letters A, B and C, (ii) write two properties of each type of radiations named in (b) (i) and (iii) explain the effect of radiation B on the nucleus of an atom. Part (c) required the candidates to complete the decay equations and name the type of decay in each equation.

The question was attempted by 100 percent of the candidates who scored as follows: 53.4 percent scored below 3 marks of which, 28.0 percent scored 0 marks. However, 11.7 percent of the candidates scored from 3 to 4 marks while 34.9 percent scored 4.5 to 10 marks. Therefore, the general performance was good. Figure 8 summarizes the candidates' performance.

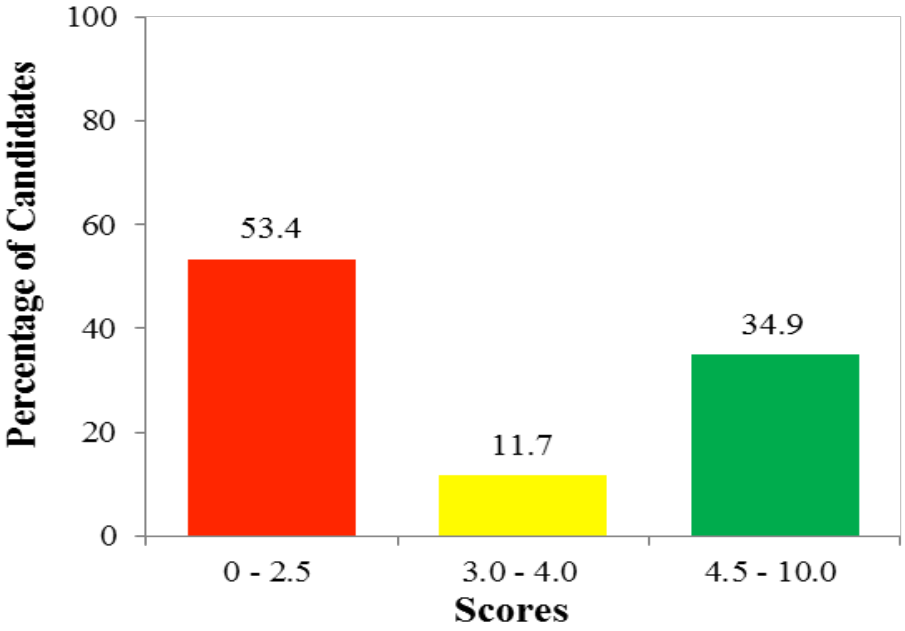


Figure 8: Percentage of candidates' performance per score in question 8. The figure shows that the performance was good as 46.6% scored 3 marks and above.

The candidates who performed well were able to provide correct answers to most parts of the question. Most of these candidates defined correctly the word nuclear fission and mentioned its products. They also correctly identified the radiations given and completed the equations, but failed to write some properties of radiations and types of decay. Other candidates

failed to explain the effect of radiation B on the nuclear of an atom. The candidates were supposed to explain that the effect of radiation B on the nuclear of an atom is an increase by one (1) in the number of protons and a decrease by one (1) in the number of neutrons. They also failed to complete the nucleus reaction equations but provided the correct answers to the remaining parts of the question. Extract 8.1 shows the responses of one of the candidates who attempted well the question.

Extract 8.1

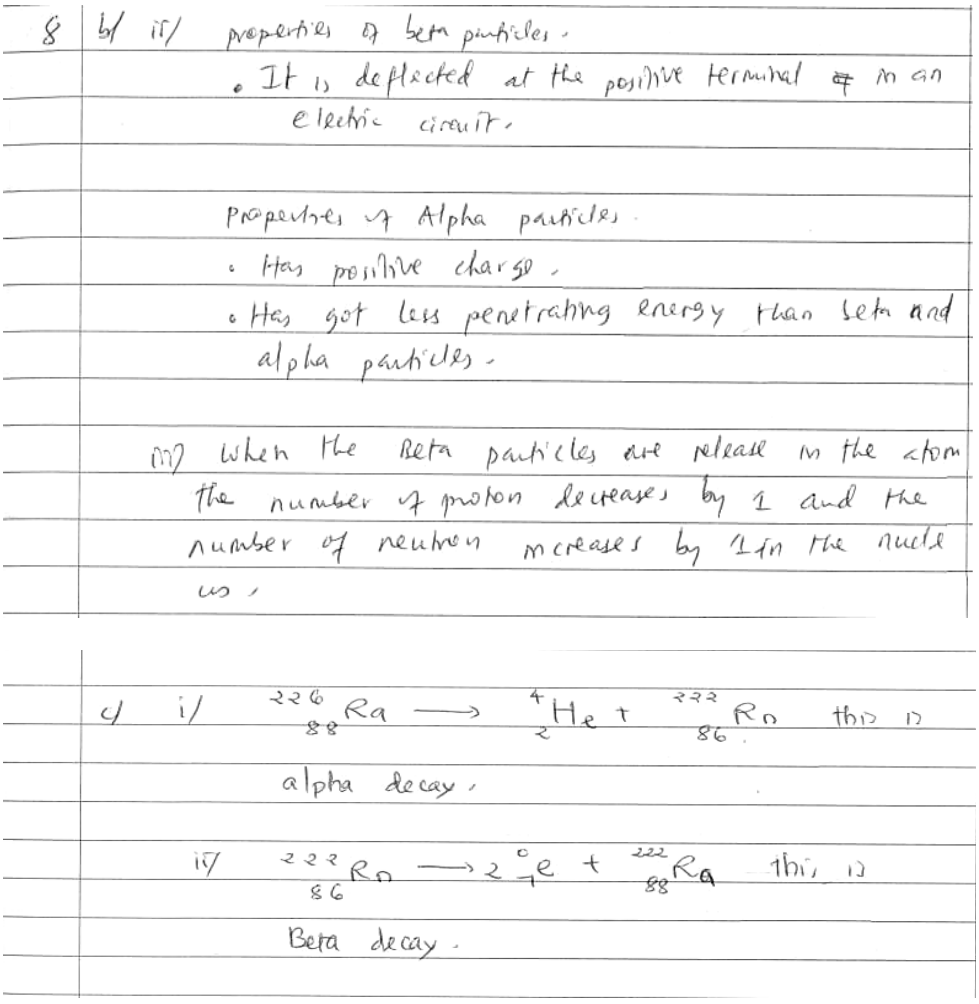
8. a/ i/ Nuclear fission refers to the splitting of a heavier radioactive element into smaller element to release energy.

ii/ The products are smaller elements and Energy.

b/ i/ A - Gamma radiation.
B - Beta particles
C - Alpha particles.

ii/ Properties of Gamma radiation
- Has high penetration power more than the beta and alpha particles.
- Has got no charge.

Properties of Beta particles.
- Has negative charge.

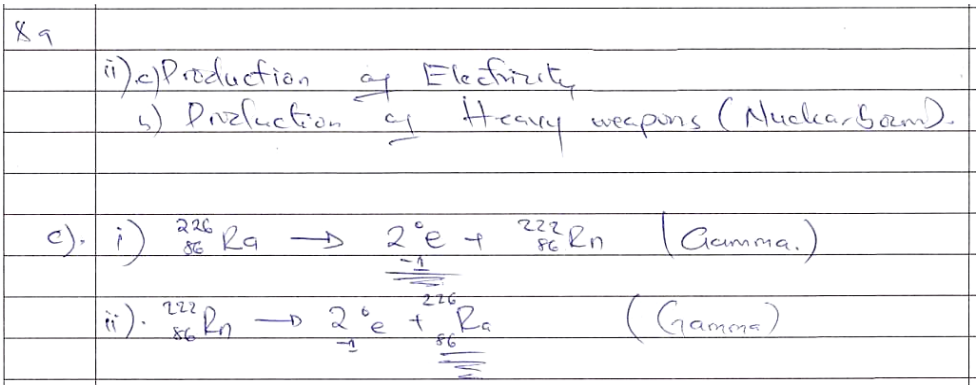


In extract 8.1, the candidate was able to provide the correct answers to all parts of the question except part (b) (iii) as he/she reversed the increase of the number of protons and neutrons.

On the other hand, the candidates who scored low marks lacked knowledge on Radioactivity as most of them skipped many parts of the question. Some of the candidates provided irrelevant answers to all parts and consequently scored zero. Other candidates were able to recall the properties of alpha and gamma radiations but failed to identify them in the figure provided. The candidates were supposed to know that "A" represents gamma or γ- rays because they have strongest penetrating power as they penetrate through paper and aluminium sheet but can be stopped by lead block while B represents beta or β- particles which penetrate through paper but can be stopped by aluminium sheet.

Furthermore, they were supposed to know that alpha particle has low penetrating power as it can be stopped by paper and is represented by a letter C. Extract 8.2 is a sample response from the candidates who performed poorly.

Extract 8.2



In extract 8.2, a candidate failed to comprehend the question demand as he/she wrote the product of nuclear fission as *production of electricity* and *heavy weapons* instead of lighter atoms, two or three neutrons and release energy. He/she also failed to complete the equation and name the type of decay for each equation.

2.2.6 Question 9: Astronomy

In this question the candidates were required to (a) explain the meaning of asteroids and astronomy and (b) distinguish between (i) constellation and a galaxy and (ii) meteor and meteorites. Part (c) required the candidates to (i) mention two types of tides and (ii) describe with the aid of diagram the formation of ocean tides.

This question was attempted by 100 percent of the candidates and was poorly performed as majority of the candidates (77.6%) scored from 0 to 2.5 marks of which, 50.2 percent scored zero. The candidates who scored from 3 to 4 marks were 13.2 percent and those who scored from 4.5 to 10 marks were 9.2 percent as shown in figure 9.

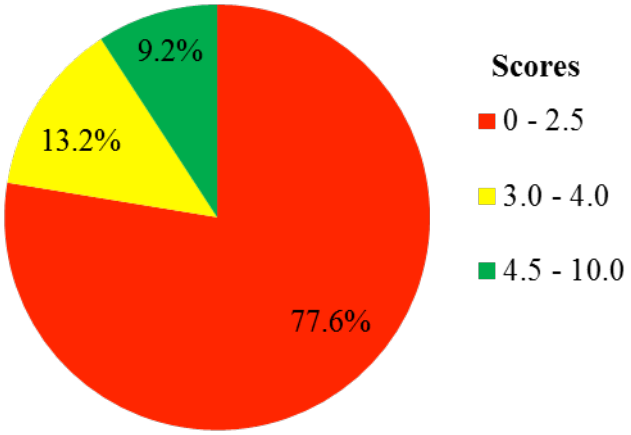


Figure 9: Percentage of candidates' performance per score in question 9 which indicates that the question was performed poorly.

Some of the candidates who performed poorly were not able to give the meaning of asteroids and astronomy. For example one candidate explained the meaning of asteroids as *a branch of Physics that deals with the study of universt* instead of defining astronomy as the study of the universe and heavenly bodies. The candidate was supposed to use the word science instead of branch of Physics and the word universe instead of universt in giving the meaning of astronomy. Another candidate mentioned the types of tides as *rise tides* and *fall tides* instead of spring tides and neap tides. These candidates were not able to distinguish the given terms and to describe the formation of ocean tides but were able to mention types of tides. Other candidates were able to give the meaning of the given terms but failed to provide correct answers to other parts of the question. These candidates had inadequate knowledge of the concept of astronomy. Extract 9.1 is a sample of poor responses from the candidates' scripts.

Extract 9.1

9. a) i) Asteroids.
Are heavenly bodies which are collected and revolve around the sun.

ii) Astronomy
Is a branch of science which deals with study of asteroids that revolve around the sun.

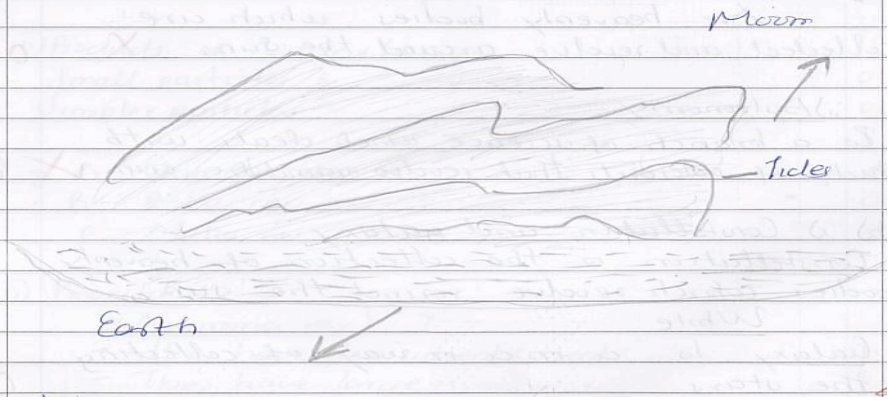
b) i) Constellation and galaxy
Constellation is the collection of heavenly bodies which revolve round the sun
While
Galaxy is a milky way of collecting the stars

ii) Meteor and Meteorites
Meteor Are the heavenly bodies which runs towards the earth surface but burn on the atmosphere before reaching the surface
While

9. b) ii) Meteorites
Is the force which allows the meteor to penetrate and fall towards the surface.

c) i) Types of tides
- Ocean tides
- Current tides

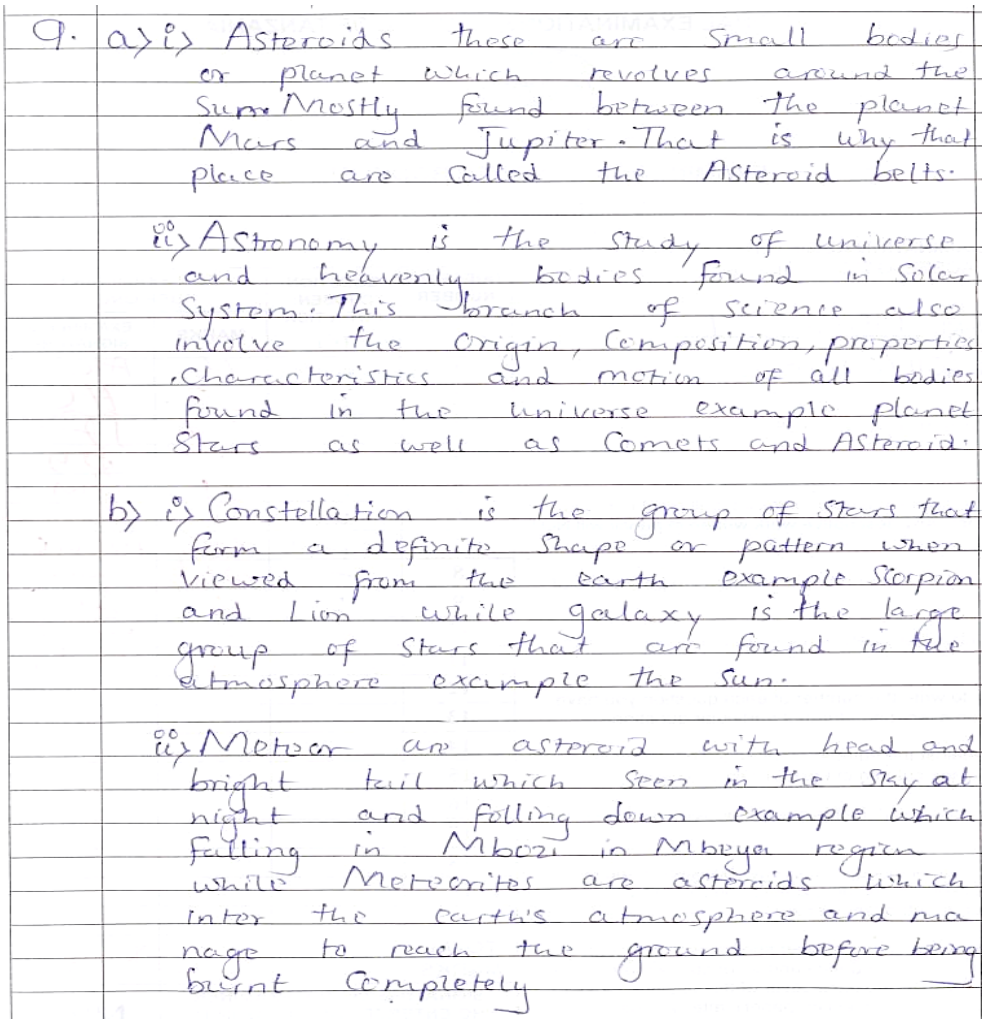
ii) Ocean tides are formed through the force of push and pull which occurs between the earth and the moon.



In extract 9.1, the candidate provided the irrelevant answers to all parts of the question.

On the other hand, the candidates who performed well in this question were able to define asteroids and astronomy. Also they were able to distinguish between constellation and galaxy as well as meteor and meteorites. In addition, the candidates were able to mention the required types of tides and to briefly explain how ocean tides are formed. Extract 9.2 represents the work of the candidate who scored good marks in this question.

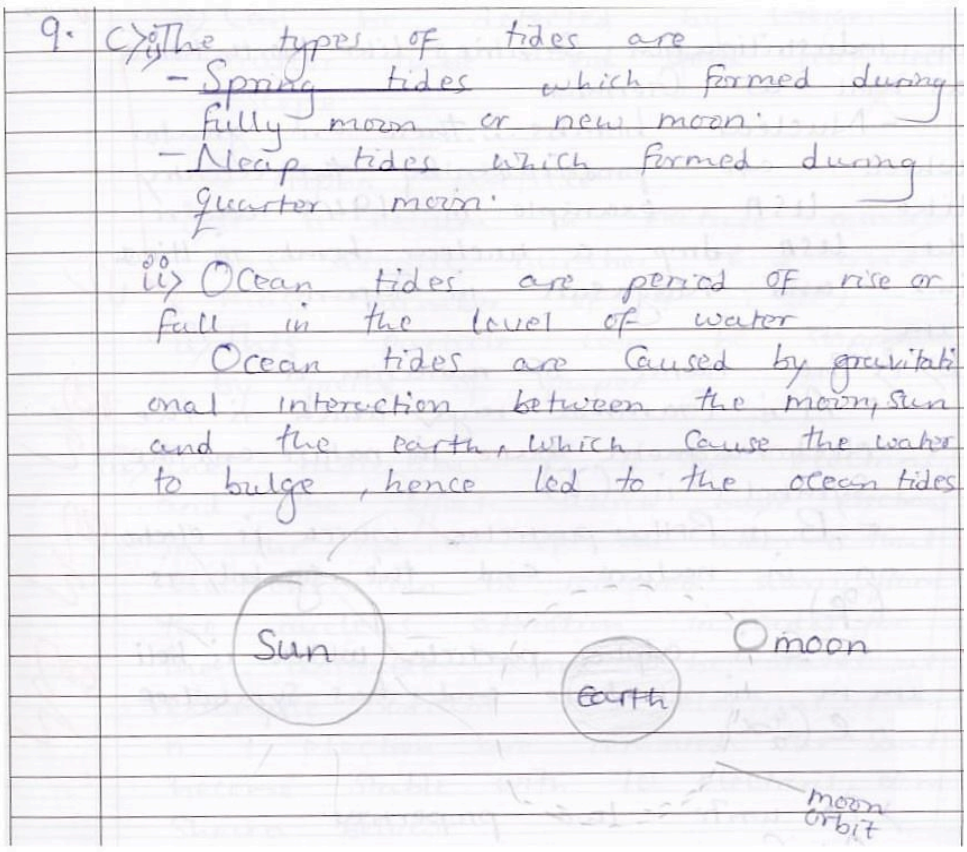
Extract 9.2


9. a) i) Asteroids these are small bodies or planet which revolves around the Sun. Mostly found between the planet Mars and Jupiter. That is why that place are called the Asteroid belts.

ii) Astronomy is the study of universe and heavenly bodies found in Solar System. This branch of science also involve the origin, composition, properties, characteristics and motion of all bodies found in the universe example planet Stars as well as Comets and Asteroid.

b) i) Constellation is the group of stars that form a definite shape or pattern when viewed from the earth example Scorpion and Lion while galaxy is the large group of stars that are found in the atmosphere example the Sun.

ii) Meteor are asteroid with head and bright tail which seen in the sky at night and falling down example which falling in Mbozi in Mbeya region while Meteorites are asteroids which inter the earth's atmosphere and manage to reach the ground before being burnt completely



In extract 9.2 the candidate gave the required answers and supported some of them with clear illustrations.

2.3 Section C: Short Answer Questions

2.3.1 Question 10: Waves

In part (a) the candidates were required to (i) list four main parts of a ripple tank and (ii) explain the role of a stroboscope in a ripple tank experiment whereas in part (b) the candidates were required to explain (i) the reason for a violin to have four strings of different thickness and (ii) what a violinist does to change the note emitted by a particular string. In part (c), the candidates were required to (i) explain briefly how a resonance tube works and (ii) calculate the frequency of vibration in a resonance tube of shortest length of 0.22 m when the next resonance length is 0.47 m.

The question was chosen by a small number of candidates (21.7%) who scored as follows: 93.3 percent scored from 0 to 2.5 marks, 4.4 percent scored from 3 to 4 marks and 2.3 percent scored from 4.5 to 10 marks. These scores indicate that the performance in this question was poor as depicted in Figure 10.

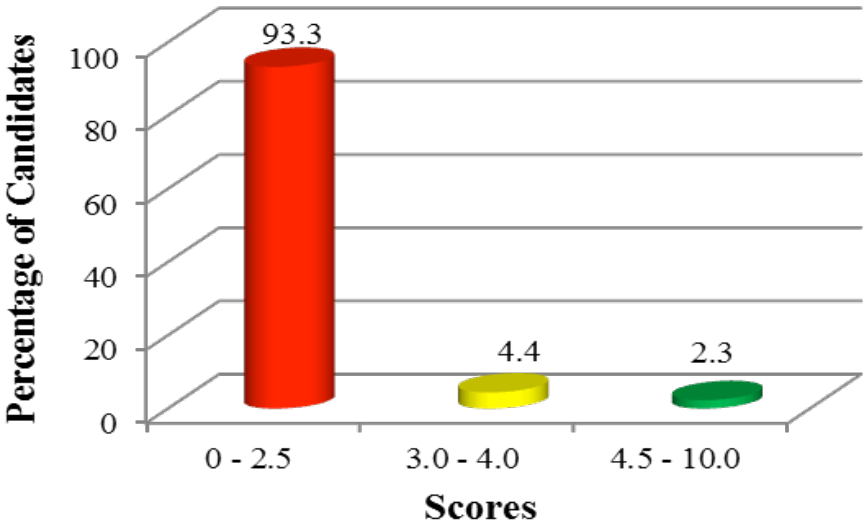
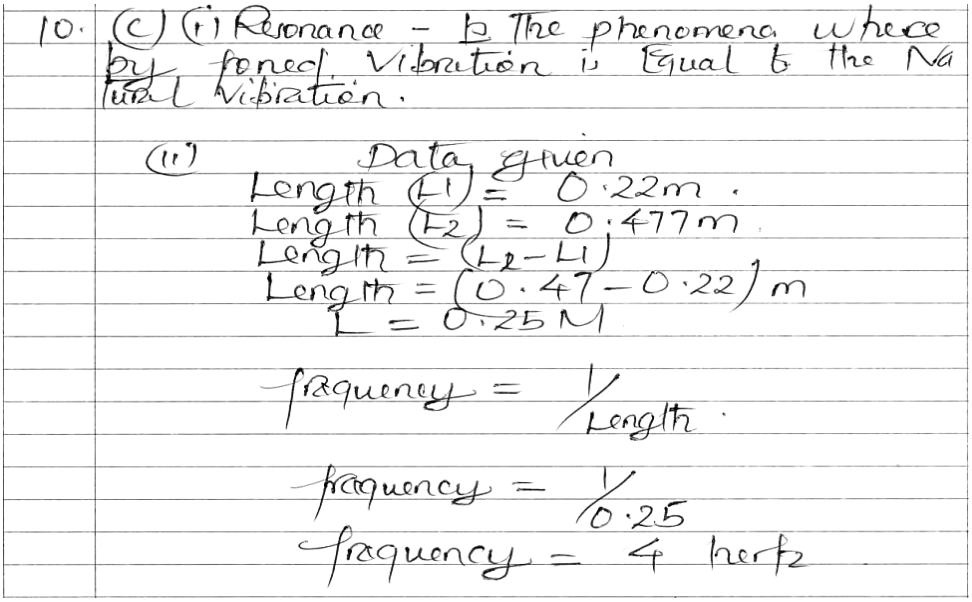


Figure 10: Percentage of candidates' performance per score in question 10. This figure indicates that the question was poorly performed by most of the candidates.

Most of the candidates who scored low marks, failed to provide correct answers to some parts of the question especially, parts (a), (b) and (c) (i). These candidates had inadequate knowledge of the concept of waves, particularly on ripple tanks, violin and resonance. This might be due to the absence of ripple tanks, violins and resonance tubes in most of the school laboratories which would have enabled the learners grasp the required knowledge theoretically as well as practically. Extract 10.1 shows a sample of responses from the candidates who answered the question incorrectly.

Extract 10.1



Extract 10.1 indicates that the candidate attempted only part (c) of the question and defined resonance while the question required him/her to explain how resonance tube works. The candidate also applied incorrect formula to calculate the frequency of vibration in a resonance tube.

On the contrary, few candidates who scored high marks in this question were able to provide correct answers to most parts of the question. Some of them who failed to score full marks, correctly answered parts (a) and (b) but failed to calculate the frequency of vibration in part (c) (ii) as they used incorrect formula. Other candidates provided correct answers to all parts except part (a), as they failed to list main parts of a ripple tank and to explain the role of a stroboscope in a ripple tank experiment. Only one candidate was able to provide the correct answers to all parts of the question. Generally, the candidates attempted well part (c) compared to the other parts of the question due to the fact that this part involved calculations which required the candidates to recall simple formula while part (a) and (b) required explanations.

Extract 10.2

10 (a) (i) ~~Source of~~ lamp
~~Ref~~ Reflector
Water reservior
Wave producer.

(ii) It used to make the water wave to appears stationary when studying the waves.

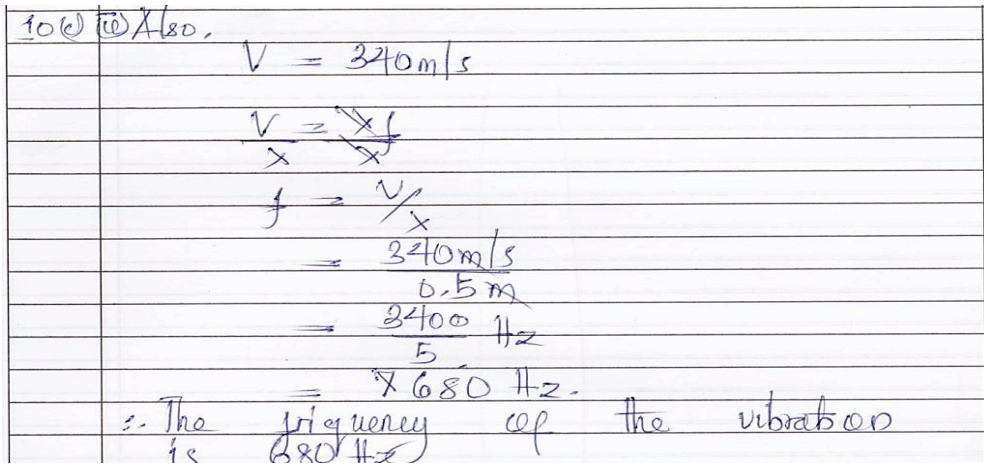
(b) This is because of producing ~~note~~ musical note of different frequencies, thickness of string determine the frequency of a note it produces. This make the

10 (b) (i) violin to produce notes of different frequencies.

(ii) The violinish have to change the following.
a) ~~the tention~~ tension of the string (slackedness/tightedness) the violinist have to ~~slate~~ slack / lighten the string in order to produce different musical note.
b) The length of the strings

(c) (i) Resonance tiebe work by changing the vibration of air in the tube by raising or lowering the height of the tube. This increases the ~~cm~~ compression in the tube which causes forced vibration which produces resonance.

(ii) Soln.
~~Data~~ given.
$l_1 = 0.22m$
$l_2 = 0.47m$
Then.
$x = 2(l_2 - l_1)$.
$= 2(0.47m - 0.22m)$.
$= 2 \times 0.25m$.
$= 0.5m$.
$\lambda = 0.5m$.



In extract 10.2, the candidate scored good marks in this question as he/she managed to show how resonance tube works and used a correct formula to calculate the frequency of vibration.

2.3.2 Question 11: Electromagnetism

The candidates were required to (a) (i) state the functions of the hair spring in a moving coil galvanometer and (ii) explain why moving coil galvanometer is not suitable for measuring alternating current. In part (b) they were required to (i) draw magnetic field lines pattern in horizontal plane due to a current carrying conductor when a d.c flows through it and (ii) explain what would happen on the pattern in (b) (i) if a.c were used instead of d.c. Part (c) required the candidates to (i) explain what should be done in order to increase the speed of rotation in d.c electric motor and (ii) calculate the resistance of the cable, when an electric motor is connected by a cable of to a generator produces a current of 10A at 240V.

The question was opted for by 78.3 percent of the candidates of which, 84.2 percent scored below 3 marks with 43.3 percent scoring zero. The percentage of candidates who scored 3 marks and above was 15.7. Only five (5) candidates were able to score 10 out 10 marks. Figure 11 summarizes the performance of candidates in this question.

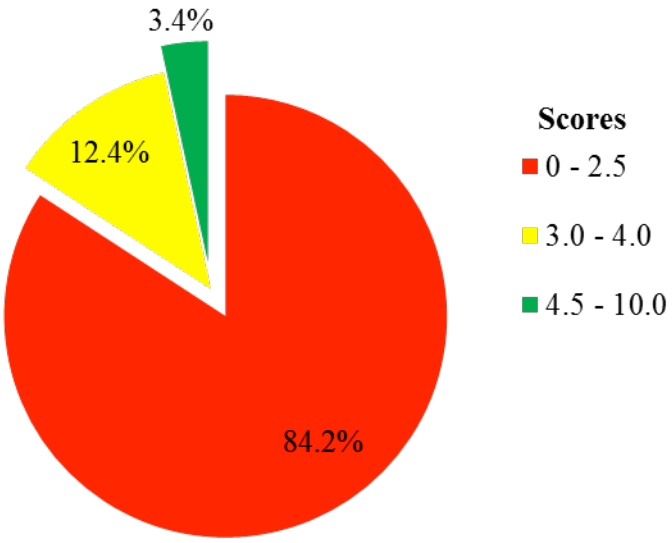
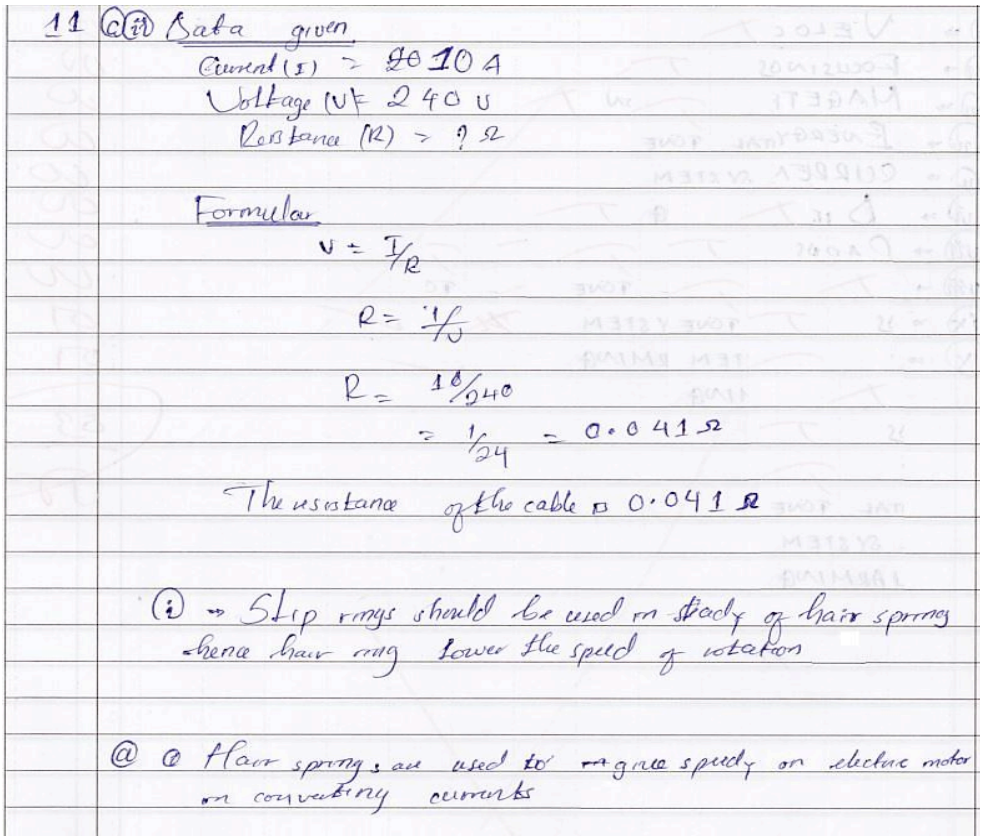


Figure 11: Percentage of candidates' performance per score which indicates that the performance was poor.

Most of the candidates who attempted this question scored low marks due to inadequate knowledge of the concept of electromagnetism. These candidates lacked mastery of the terms used to build the required ideas. For example some of the candidates wrote one of the functions of the hair springs in a moving coil galvanometer as *to increase the amount of current* instead of to carry current or to provide the opposing couple. Another candidate wrote *moving coil galvanometer is unstable for measuring alternating currents because depend on the magnetic flux linking the on the conductor* as one of the function of hair springs. In this category, some of the candidates were able to draw the magnetic field lines patterns in a horizontal plane but failed to label some parts while other candidates were able to recall the Ohm's law hence calculated correctly the resistance of the cable. Extract 11.1 shows a sample of responses from the script of the candidates who poorly attempted this question.

Extract 11.1


11 (a)(i) Data given
Current (I) = 10 A
Voltage (V) = 240 V
Resistance (R) = ? Ω
Formular
V = I/R
R = 1/V
R = 10/240
= 1/24 = 0.041 Ω
The resistance of the cable = 0.041 Ω
(i) → Slip rings should be used instead of hair springs because hair ring lower the speed of rotation
(ii) Hair springs are used to regulate speed of electric motor in converting currents

In extract 11.1 the candidate indicated well the data used for computing resistance R but he/she wrote incorrect formula for calculating resistance. The candidate also failed to state the functions of hair spring in a moving coil galvanometer.

The candidates who scored high marks were able to provide brief and precise explanations for items which required explanations and made systematic calculations. Also the candidates were able to draw appropriate diagrams showing patterns of the magnetic field lines due to a straight conductor. Extract 11.2 shows responses of the candidates who attempted this question well.

Extract 11.2

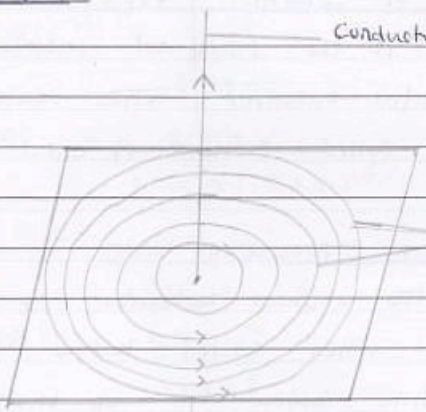
11. a) i) The functions of hair spring in moving coil galvanometer include;

- It conduct an electric current into coil between magnets to produce force which would cause pointer deflection.
- It is attached to the pointer of galvanometer. Hair spring is attached to galvanometer's pointer and return pointer to zero after deflection.

ii) Moving coil galvanometers are unsuitable for measuring alternating currents. (a.c). because;

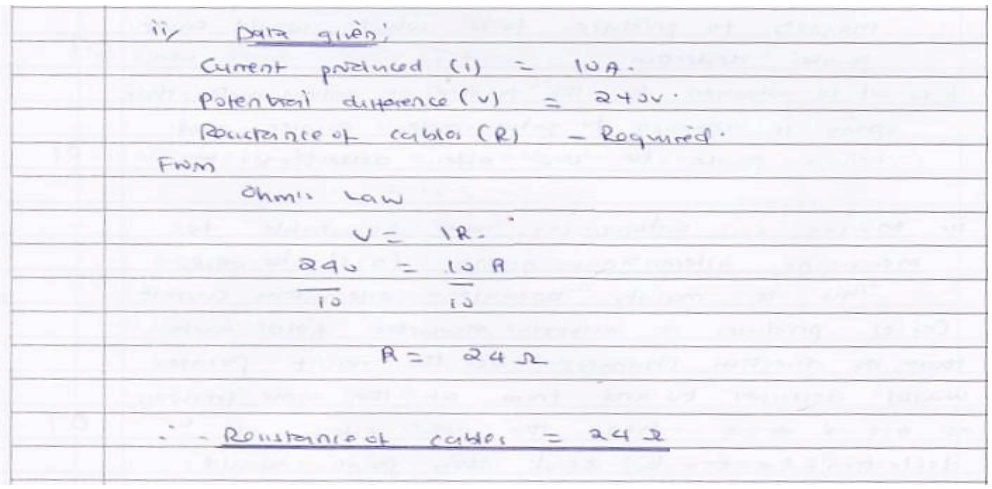
This is mainly because alternating current (a.c) produces a varying magnetic field such that its direction changes, as the result pointer would deflected to and from at the same frequency as a.c varies and hence the net effect of deflection would be zero that point would remain at the same position without being deflected.

11. b/ i/ Magnetic field in a straight conductor when d.c is passed.



ii/ If a.c was used instead of d.c the effect on the pattern would be as explained below;
The pattern of the magnetic field would be continously changing its directions as the a.c current alternates in the conductor hence the magnetic pattern would be distorted.

11. c/ i/ To increase the speed of rotation in a d.c electric motor the following should be done;
- Using of strong magnets: strong magnets produces strong magnetic flux hence increase speed of rotation.
- By increasing the number of turns of coil. The number of turns should be increased to increase area exposed to magnetic field thus increase forced produced and speed of rotation.
- By increasing the applied d.c current. The current applied from outside should be increased to increase the speed of rotation of motor.



In extract 11.2, the candidate scored high marks as he/she provided the correct answers to almost all parts of the question except in part (a) (i) where the second point of the functions given is not correct.

3.0 ANALYSIS OF CANDIDATES' PERFORMANCE PER TOPIC

The analysis of the candidates' performance in each topic shows that the topic of Radioactivity was performed well by 46.6 percent of the candidates. Likewise, the multiple choice questions which were constructed from different topics including Thermal Expansion, Work, Energy and Power, Light, Current Electricity, Magnetism, Electronics, Elementary Astronomy, Geophysics, and Static Electricity were also performed well by 48 percent of the candidates.

The topic of Geophysics was done averagely. Similarly, question 3 which involved filling in the blank spaces contained items from various topics including Geophysics, Electronics, Elementary Astronomy, Static Electricity, Light, Thermionic Emission, Simple Machines, Newton's Laws of Motion and Transfer of Thermal Energy. This question had an average score. It was observed that the majority of the candidates' performance was poor in the topics of Elementary Astronomy, Archimedes' Principle and Law of Flotation, Electromagnetism, Thermal Expansion, Light, Waves and Current Electricity. The summary of how candidates performed in different topics is shown in appendix 1.

When the candidates' performance in the topics tested in CSEE 2014 and 2015 was compared, the analysis indicates a decrease or increase of

performance in some of the topics tested. The analysis depicts a tremendous decrease in performance in the topics of Geophysics, Thermal expansion and Light. The performance in Geophysics has dropped from 70.4 percent in 2014 to 37.4 percent in 2015 while that in Thermal Expansion has dropped from 39.3 percent to 10.9 percent. For the topic of Light, the performance has decreased from 20.4 percent in 2014 to 7.9 percent in 2015. This decrease in performance might have been contributed by lack of content knowledge and English poor Language proficiency as the topic/question required detailed explanations in answering. Despite this decrease in the mentioned topics, there was a rapid increase in performance in the topic of Radioactivity where performance increased from 10.5 percent in 2014 to 46.6 percent in 2015. However, the topics of Electromagnetism, Light and Waves have continued to have poor performance, which indicates that no efforts have been made so far to overcome the observed challenges in the previous year. See appendix 2.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The question-wise analysis of the candidates' performance pinpointed the challenges which faced the candidates in attempting the questions. The analysis also provided the summary of the performance in each topic and the recommendations that will help to overcome the detected challenges.

The analysis of the candidates' performance has revealed that, the major obstacle to candidates who scored low marks was inadequate knowledge of the concepts of different topics. Due to this obstacle, the candidates failed to display their competencies by supplying incorrect responses to some questions. For instance, they depicted insufficient knowledge on Current Electricity, Waves, Light, Thermal Expansion, Electromagnetism, Archimedes' Principle and Law of Flotation and Elementary Astronomy. Also many candidates faced difficulties in dealing with questions which required them to give facts involving the laws and principles of Physics as applied in daily life situations. For example, in question 4, the candidates failed to write the procedures

necessary for finding the relative density of spirit using methylated spirit, water and a pendulum bob.
Another problem observed was lack of mathematical skills due to inability of most of the candidates to remember the expected formulae or applying the correct mathematical approaches or procedures in solving the questions. This was observed in questions 4, 5, 7 and 11.

Lack of drawing skills was another problem as candidates failed in circuit designing and diagrams' drawing as it was observed in question 6. Most of them drew rough diagrams with irrelevant labelling. They also encountered the problem of English Language in answering the questions which demanded detailed explanations, such as questions 4, 10 and 11.

Furthermore, the candidates failed to identify the demand of the questions, which may be attributed to lack of enough exercises. This was observed in questions 8, 9 and 11.

4.2 Recommendations

In order to improve the performance of the candidates in future, it is recommended that:

(a) Students have to put much effort on the topics of Waves, Current Electricity, Electromagnetism, Elementary Astronomy, Archimedes Principle and Law of Flotation, Light and Thermal Expansion as these topics are poorly performed in almost each year.

(b) Students have to concentrate on theories and the content of each topic in the syllabus, so as to gain the necessary knowledge and skills which in turn assists in creating confidence and ability to answer questions correctly.

(c) Students have to put much emphasis on attaining mathematical skills in order to develop their learning and eliminate the difficult of doing questions which involve computations.

(d) Students should be provided with enough tasks and exercises during the learning process in order to develop their learning interests.

(e) Students should be encouraged to use English Language in their day to day communication so as to improve their language proficiency.

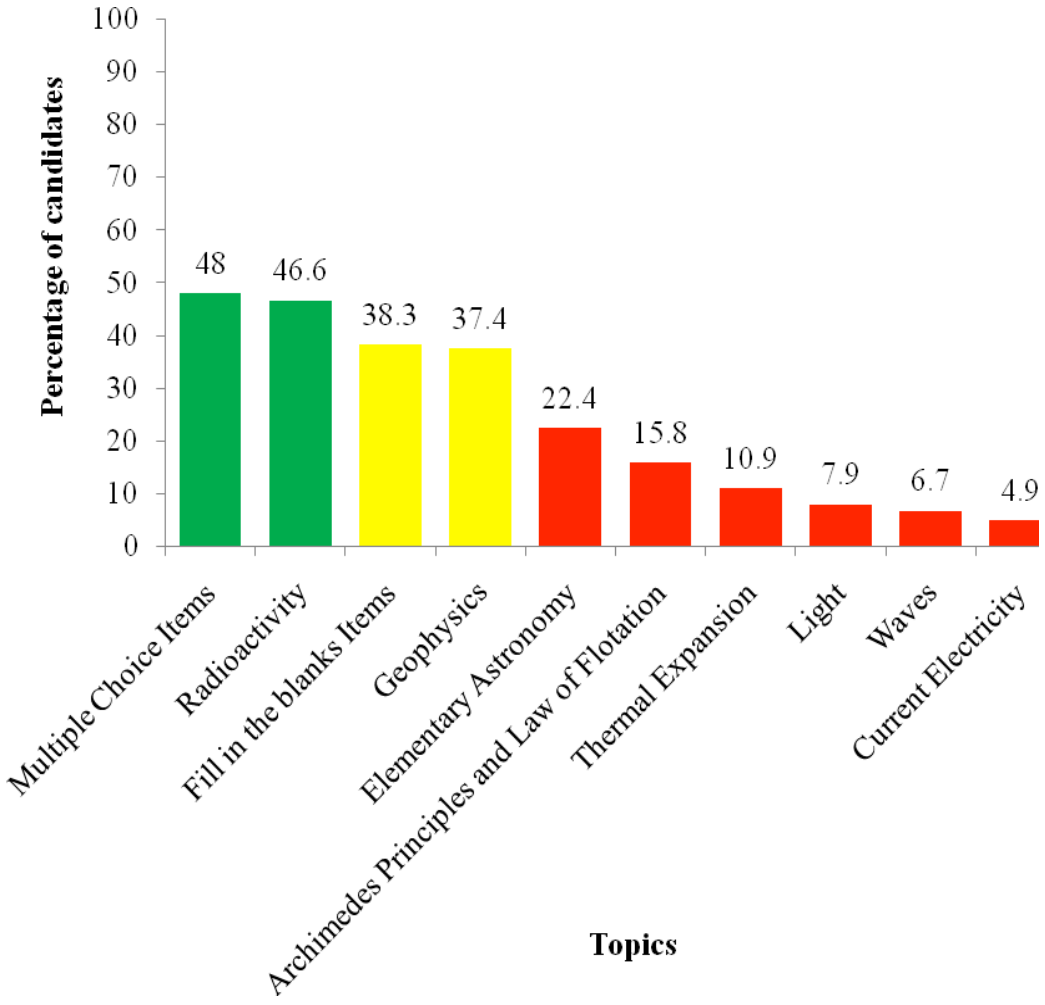
(f) Teachers should encourage the students to make effective revision by providing group assignment, homework, quizzes and tests.

(g) The Ministry of Education, Science, Technology and Vocational Training should ensure that, each school has a Physics Laboratory for students to conduct practicals and experiments.

Appendices

Appendix 1

THE PERFORMANCE OF CANDIDATES IN PHYSICS TOPIC-WISE



Appendix 2

THE COMPARISON OF THE CANDIDATES' PERFORMANCE BETWEEN CSEE 2014 AND 2015 TOPIC-WISE

S/N	TOPIC	EXAMINATION FOR 2014			EXAMINATION FOR 2015		
		Number of questions	Percentage of candidates who scored 30 percent and above	Remarks	Number of questions	Percentage of candidates who scored 30 percent and above	Remarks
1	(Multiple Choice Questions)		81.4	Good		48	Good
2	Radioactivity		10.5	Weak		46.6	Good
3	Filling in the Blanks Questions		9.5	Weak		38.3	Average
4	Geophysics		70.4	Good		37.4	Average
5	Elementary Astronomy	-	-	-		22.4	Weak
6	Archimedes Principle and Law of Flotation.	-	-	-		22.1	Weak
7	Electromagnetism		10	Weak		15.8	Weak

S/N	TOPIC	EXAMINATION FOR 2014			EXAMINATION FOR 2015		
		Number of questions	Percentage of candidates who scored 30 percent and above	Remarks	Number of questions	Percentage of candidates who scored 30 percent and above	Remarks
8	Thermal Expansion		39.3	Average		10.9	Weak
9	Light		20.4	Weak		7.9	Weak
10	Waves		7.7	Weak		6.7	Weak
11	Current Electricity	-	-	-		4.9	Weak