THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

EXAMINERS' REPORT ON THE PERFORMANCE OF CANDIDATES CSEE, 2014

031 PHYSICS
(For School Candidates)

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FOREWORD

The Certificate of Secondary Education Examination 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 general and the education delivery 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 examiners' Report on the Performance of Candidates in Physics subject in the Certificate of Secondary Education Examination (CSEE) 2014 has been prepared to provide feedback to students, teachers, parents, policy makers and the public in general, on the performance of the candidates in this subject.

The analysis presented in this report is intended to contribute toward 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 clearly in English language, lack of the basic knowledge on Physics concepts and poor writing skills. Furthermore, some of the candidates failed to identify the demand of the questions. The feedback provided will enable the education administrators, school managers, teachers and students to identify proper measures to be taken in order to improve the candidates' performance in future examinations administered by the Council.

The Council would like to thank all the Examination Officers, Subject Teachers and all who participated in the preparation of this report. We would like also to express sincere appreciation to all staff members who participated in processing the data used in this report.

The National Examinations Council of Tanzania will highly appreciate comments and suggestions from teachers, students and the public in general, that can be used for improving future Examiners' Reports.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report is based on an analysis of the performance of the candidates who sat for the Certificate of Secondary Education Examination (CSEE) in 2014 in Physics paper 1.The paper was set according to the examination format which was derived from the 2008 Certificate of Secondary Education (CSE) Physics syllabus and was intended to measure the competences acquired by candidates after covering the syllabus.

The paper consisted of three (3) sections, namely, A, B and C. Section A consisted of three (3) objective questions (10 multiple choice items, 10 matching items and 10 fill in the blanks items) which were drawn from different topics of the syllabus. Section B comprised of six (6) short answer questions while Section C consisted of two (2) short answer questions. The candidates were required to answer ten (10) questions, including all the questions from sections A and B, and any one from section C.

The number of candidates who sat for this paper was 108,718 and analysis of the results shows that 50,775 (46.71%) passed the examination whilst 57,943 (53.29%) failed. In 2013, the number of the candidates who sat for Physics subject was 104,558 of which 46,096 (44.12%) passed the examination and 58462 (55.88%) failed. This means that the candidates' performance in Physics subject in the year 2014 has increased by 2.59 percent.

The report has analysed performance of candidates for each individual question, whereby a brief overview of what the candidates were required to do, how they performed and the reasons for their performance has been addressed. Some extracts from the candidates' answers are inserted to illustrate the cases presented.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN INDIVIDUAL QUESTIONS

2.1 Section A: Objective Questions

2.1.1 Question 1: Multiple Choice Items

This question consisted of ten multiple choice items derived from different topics in the ordinary level syllabus. For each of the items (i)-(x) the candidates were required to choose correct answer from among the given five alternatives and write its letter beside the item number.

The question was attempted by 97.9 percent of the candidates, of which 0.2 percent scored 0 marks, 82.7 percent scored from 1 to 4 marks and 17.1 percent scored from 5 to 10 marks. These statistics indicate that the question was well performed.

Although this question was well performed, there were some items which were performed poorly by the majority of the candidates which include the item number (i), (ii) (iv), (v), (vii) and (viii).

In item (i), the candidates were required to identify the physical phenomenon which is observed when a tea bag is dipped into a cup containing hot water. The correct alternative was C, which reads *"diffusion"*. Most of the candidates selected option D which reads *"Osmosis then diffusion"*. Option D attracted many candidates because osmosis and diffusion involve movement of the particles. They failed to realize that in osmosis particles of the solvent diffuse through a semi-permeable membrane in an attempt to equalize the concentration on either side as they move from a region of low to that of high concentration while diffusion does not need the presence of semi-permeable membrane and molecules of the particles move from a region of high concentration to those of low concentration.

Item (ii) required the candidates to select the alternative that explains what happens to the molecules of a gas when the gas is compressed at a constant temperature. Most of the candidates selected option A which reads *"move faster than air outside and the pressure is increased"* instead of the correct option E which reads *"make more impacts on the walls of the container"*. Option A attracted many candidates probably because they related the term

compression with speed and pressure to some daily life experiences such as bursting of a compressed air balloon, which results into air molecules to come out with high speed. Also they thought that, since during compression more force is applied therefore pressure is increased. They failed to realise that during compression the air molecules are brought closer therefore more collisions occur resulting into the decrease of speed of the molecules.

In item (iv) the candidates were required to give the reason for the uniformly dark shadow of a table-tennis ball on a white screen when it is illuminated by a certain lamp. The correct alternative was C which reads *"*Very small". Most of the candidates selected option A which reads *"very bright"* Option A attracted most of the candidates because of the relationship between lamp and brightness. The candidates failed to recognize that the type of the shadow formed depends on the size of source of light, the decrease in the size of the source of light decreases the brightness of shadow and hence it becomes darker till disappears.

Item (v) required the candidates to choose the alternative which explains how a black and white television forms an image in a screen. The correct alternative was A which reads *"varying the intensity or brightness of the electron beam".* A few candidates selected the correct option A. The majority of the candidates opted for alternative E which reads *"adjusting the antenna to capture waves of short wavelength"*. Option E attracted many candidates because it contains the term *"Antenna"* which most of the candidates know that it is usually connected to the TV for better viewing of image on the screen. Probably they thought that the function of the antenna is to capture the signals and send them to the TV screen for the image to be formed.

Item (vii) required the candidates to observe the given figure 1 which showed the pattern of waves in a ripple tank travelling from part X to Y across a plane section Z, and then identify the alternative which gives the observation that can be made from that figure. The correct answer was C which reads *"the wave speed V_1 in part X is less than V_2 in part Y"*. Most of the candidates selected option D which reads *"diffraction occurs across Z"*. Option D attracted most of the candidates because of the different orientation of the wave patterns across the plane section Z as shown by the given figure in the question item. Possibly they thought that the slanting or tilted like wave patterns in the medium Y, shows the bending of waves

across Z which means diffraction. They didn't know that diffraction occurs when waves pass through a narrow opening or an aperture.

In item (viii), the candidates were required to choose an alternative which gives the ratio of the resistivity of new cube to resistivity of old cube if a solid metal cube (old) has each side doubled to make a solid cube of the same metal (new cube) eight times bigger in volume. The correct answer was *"*1:1*"*denoted by option C. Most of the candidates who failed this question selected option A which reads *"8:1"* or E which reads *"1:8"*. Options A and E attracted many candidates who selected the answer just because the word eight times was mentioned. They lacked the concept of resistivity that two or more materials of the same nature have the same resistivity regardless of their sizes.

2.1.2 Question 2 : Matching Items

The question consisted of ten matching items set from the topic of Thermal Expansion. In this question, the candidates were required to match the items in List A with responses in List B by writing the letter of correct response beside the item number.

A total of 108,682 (97.9%) candidates attempted this question and analysis shows that 14.7 percent scored zero marks, 73.6 percent scored from 1 to 4 marks and 11.7 percent scored from 5 to 10 marks which indicates that the question had an average performance. Average performance of this question might have been contributed by various factors encompassing lack of knowledge on the topic of thermal expansion.

In item (i), the candidates were required to identify a suitable response which matched correctly with the statement "*mass of water vapour which is actually present in a unit volume of air at constant temperature*". The appropriate response was option E which *reads "relative humidity*". Most of the candidates who failed this part failed to differentiate between relative humidity and absolute humidity; therefore, they selected option M which reads *"Absolute humidity"*.

Item (ii) required the candidates to find the correct response which matched correctly with the term *"Rate at which a material transfer heat energy"*. The correct response was J which reads *"Thermal conductivity"*. Most of the candidates who failed this item selected option G, which reads "*specific*

heat capacity". They failed to distinguish between heat and transfer of heat and heat preserved by a body.

In item (iii), the candidates were required to identify the correct term which matched correctly with the term *"Measurement of amount of moisture present in the atmosphere*". The correct response was A which reads "*Hygrometry"*. In this item most of the candidates matched the correct answer showing that the concept was well understood.

Item (iv) required the candidates to find the term which matched correctly with the term *"Mass of water vapour present in a unit volume of air"*. The correct response was M which reads *"absolute humidity"*. Most of the candidates selected response I which reads *"Humidity"*. They failed to relate the measure of the extent to which the atmosphere contains water vapour as humidity and the mass of water vapour present in a unit volume of it as absolute humidity.

In item (v) the candidates were required to choose the best response which matched correctly with *"Difference between readings of two thermometers"*. The correct response was H which reads *"Wet bulb depression"*. Most of the candidates selected option D which reads *"Liquid in glass thermometer"*. Probably the candidates made comparison between temperature and instrument used to measure it, but they failed to realize that the question needs to identify what causes difference in readings between two thermometers. They also lacked the knowledge on the concept that the rate of evaporation depends on the amount of water vapour present in the air, the less moisture the air has, the greater the difference between the two thermometer readings. Similarly, the word depression implies the difference between two readings whilst liquid in glass thermometer refers to the type of thermometer which utilizes the volume or length of the liquid column as its thermometric property.

Item (vi) required the candidates to choose the correct response which matched correctly with *"A measure of extent to which the atmosphere contains water vapour"*. In this item the correct response was I which reads *"Humidity*". The candidates who failed this question were mostly attracted by response M, which reads *"Absolute humidity*". The candidates failed to distinguish between humidity and absolute humidity". This portrays that

they had mixed concepts on humidity, absolute humidity and relative humidity.

In item (vii), the candidates were required to match correctly the statement *"*it *can be found by the method of mixture or electrical heating*". The appropriate response was option G which reads *"Specific heat capacity*". Most of the candidates who failed this question selected response C, which reads "*Latent heat*". The candidates seemed to lack the knowledge on the methods which are used to determine specific heat capacities, thus they associated the term method of mixture (a term in the stem of the question) and latent heat because it deals with two states.

Item (viii) required the candidates to identify the correct response which matched correctly with the term *"Amount of heat energy required to change the state of a substance*". The correct response was option C which reads *"Latent heat*". Most of the candidates who failed to select the right response were attracted with the option K, which reads "*Latent heat of fusion*". These candidates did not recognize that the stem of the question required them to provide the general term used to name the quantity of heat required to change any state of material whether solid, liquid, or gas.

In item (ix), the candidates were required to select the response which matches correctly with the term *"Measures temperature of inaccessible structures*". The correct answer was option B, which reads *"Bimetallic thermometer"*. Most of the candidates who failed this item selected option L which reads "*Thermistor Thermometer"*. These candidates seemed not to be familiar with the phrase *"inaccessible structures"* therefore, they were guessing the response. They did not understand that bimetallic involves two metals placed together side by side by welding them and that show different properties when subjected to heat. Conversely, thermistor has a decrease in electrical resistance as temperature rises and does not involve two metals or inaccessible structures.

Item (x) required the candidates to find the term which match correctly with the term "*Depends on the electrical properties of materials varying with temperatur*e". In this item the correct response was L, which reads *"Thermistor thermometer"*. Most of the candidates selected response N, which reads *"Bimetallic strip"*. They associated the term *"varying*

temperature" with the tendency of bimetallic strip to respond with temperature changes.

2.1.3 Question 3 : Fill in Blanks Items

The question consisted of ten items, each with blank spaces and candidates were required to fill in the blank spaces, by writing the suitable answer for each of the items (i)-(x).

The question was attempted by 97.9 percent of the candidates, of which 49.4 percent scored 0 marks, 49.1 percent scored from 1 to 4 marks and 1.5 percent scored from 4.5 to 8 marks. No candidate who scored 9 or 10 marks indicating a poor performance. Most of the candidates who did the question poorly failed to supply the correct responses for items number (ii), (iii), (v), (vii) and (ix).

In item (ii) the candidates were required to write the working principle of the automatic flushing tank. The correct answer was *Siphon/atmospheric pressure*. Most of the candidates did not fill in the space in this item of the question showing that they lacked knowledge on the concept of the applications of atmospheric pressure. The candidates were supposed to know that, a siphon is a continuous tube that allows liquid to drain from a reservoir through an intermediate point that is higher than the reservoir where the liquid flow without pumping because of pressure difference. The automatic flushing tank uses the same principle because it does not require a handle to trigger the flushing.

Item (iii) required the candidates to give the converse principle on which the simple a.c generator works. The correct answer was *electromagnetic induction*. Most of the candidates wrote *induction* and some *electromagnetic*, which were incomplete responses. Those two different responses were regarded as incomplete because for those who wrote induction could be electrostatic induction or induction coils which both of them are not correct answers. Those who wrote electromagnetic, it could be electromagnetic spectrum or whatever which do not provide the correct response. A simple a.c generator produces an e.m.f at its terminals when a coil rotates at a steady speed about a fixed axis only by the principle of electromagnetic induction. So the candidates had some ideas pertaining to the question but failed to present it perfectly.

Item (v) required the candidates to write the name given to the defects of the image formed by the single lens. The correct answer was *aberration*s. Most of the candidates failed to give the correct term which indicates that, they lacked enough knowledge on lenses particularly, the defects of the image formed by a single lens. They failed to comprehend that the defects of the image called aberrations occur when the lens used is not thin and that the rays are not close to the principle axis such that when a beam of light rays are incident on a lens, the rays are not all brought to the same focus.

Item (vii) required the candidates to write the name of the part of the earth's mantle and crust containing crystals and dissolved gases. The correct answer was *magma*. Most of the candidates failed to write anything in this item implying that the topic of geophysics is enormously not understood to the majority. The candidates lacked knowledge on volcanic materials where due to tremendous increase of pressure and temperature in the interior part of the earth the molten rocks called magma discharge through the vents (weak points or fault lines) to the earth's surface where they flow as lava and when it cools solidifies and become tuff. Hence they emanate from the mantle and come out to earth's surface or the crust.

Item (ix) required the candidates to give the physical quantity which enables electric current to pass through an electric component. The correct answer was *"Potential difference" (p.d)/Voltage*. Most of the candidates didn't understand the question item as they wrote the answer as a *cell* or a *battery*. Cell and battery are sources of the potential difference *(Voltage)* but they cannot drive the current in any electrical component. It is the potential difference that drives the current when the cell or battery is connected to an electric circuit and that the voltage is normally marked by the cell or battery. This narrates that some candidates had not sufficient knowledge of the terminologies used in current electricity.

2.2 Section B: Short Answer Questions

2.2.1 Question 4: Newton's Laws of Motion

This question had three parts, namely (a), (b) and (c). Part (a) required the candidates to give two practical examples where impulse and momentum play an important role. Part (b) required the candidates to (i) distinguish between elastic collision and inelastic collision and (ii) calculate the uniform acceleration "a" of a box of mass 50kg raised vertically with a uniform acceleration "a". Part (c) required the candidates to (i) state

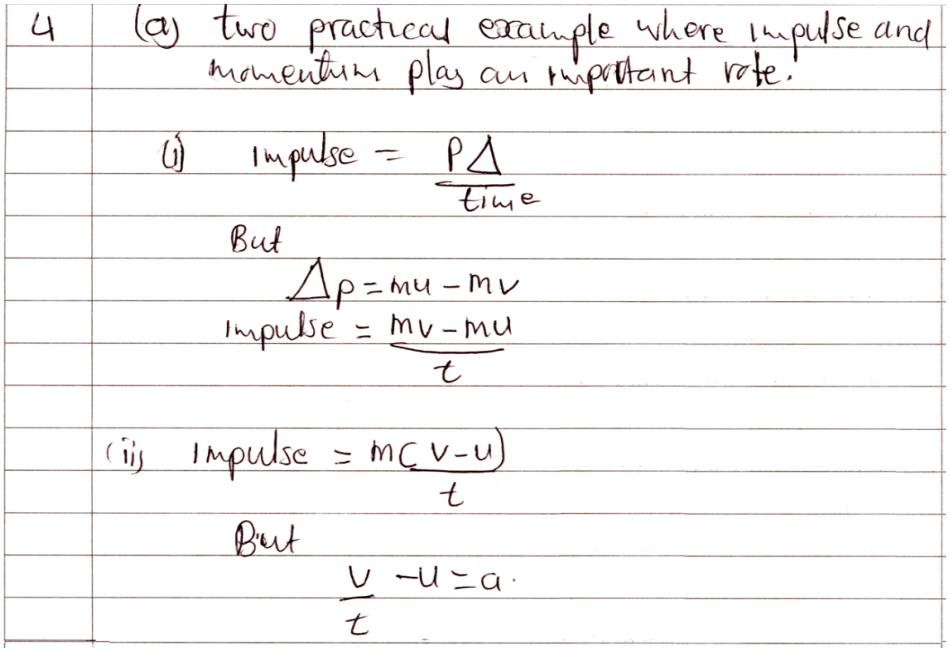
Newton's second law of motion and (ii) find the force in Newton exerted by the sand on the belt when sand falls gently at a constant rate of 50g/s onto a horizontal belt moving steadily at 40cm/s and state any assumption made during calculations.

The question was attempted by 97.9 percent of the candidates, of which 44.3 percent scored 0 marks, 53.9 percent scored from 0.5 to 4 marks and 1.8 percent scored 4.5 to 9.5 marks.This trend indicates that the question was poorly performed.

The candidates who scored low marks failed to give practical examples where impulse and momentum plays an important role. In addition to that, they failed to distinguish between elastic and inelastic collisions and applied poor mathematical approach to calculate the uniform acceleration of the box. They also failed to state the second Newton's law of motion and again failed to use the law to manipulate the formula accordingly so as to find the force exerted by the sand on the belt. In the same way, they failed to state the assumption made to make the calculation.

Extract 4.1 is a typical example of a response from the script of one of the candidates who performed poorly in this question.

Extract 4.1


4 (a) two practical example where impulse and momentum play an important role.

(i) Impulse = $\frac{P\Delta}{time}$

But

$\Delta p = mu - mv$

Impulse = $\frac{mv - mu}{t}$

(ii) Impulse = $\frac{m(v-u)}{t}$

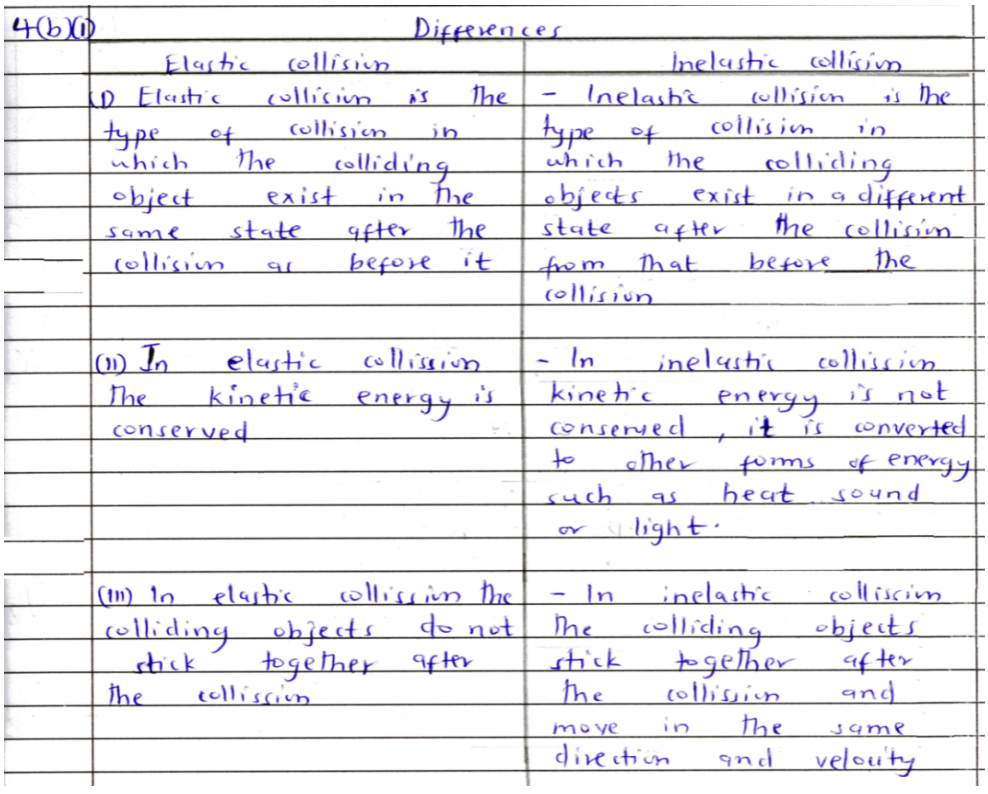
But

$\frac{v}{t} - u = a$

In extract 4.1 the candidate tried to attempt the question but deemed to lack knowledge in both conceptual and mathematical manipulations and hence failed to provide the required responses. For example, she/he tried to write the formula for the acceleration "a" but presented a wrong formula. The correct formula was supposed to be $a = \frac{(v-u)}{t}$ but not $\frac{v}{t} - u = a$ as shown by the candidate in the above extract.

A few candidates who performed the question well were able to answer almost all parts of the question by giving correct practical examples where impulse and momentum play an important role in part (a). In part (b) (i), the candidates were able to distinguish between elastic and inelastic collisions. They also managed to calculate the uniform acceleration 'a' for part (b) (ii). In part (c) (i) the candidates stated the Newton's second law of motion correctly and made proper mathematical manipulations for part (c) (ii) of the question. Extract 4.2 is an example of a response from the script of the candidate who managed to answer the question well.

Extract 4.2



4(b)(i) Differences

Elastic collision	Inelastic collision
(i) Elastic collision is the type of collision in which the colliding object exist in the same state after the collision as before it	- Inelastic collision is the type of collision in which the colliding objects exist in a different state after the collision from that before the collision
(ii) In elastic collision the kinetic energy is conserved	- In inelastic collision kinetic energy is not conserved, it is converted to other forms of energy such as heat sound or light.
(iii) In elastic collision the colliding objects do not stick together after the collision	- In inelastic collision the colliding objects stick together after the collision and move in the same direction and velocity

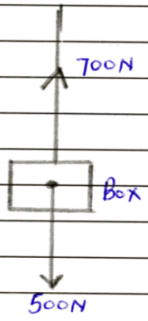
4.(b)(ii) Data given

Mass of the object = 50 kg

Force applied = 700N

Acceleration (a) = ?

4.(b)(ii)



Weight of the box = Mass x gravity

= 50kg x 10N/kg

= 500N

The weight of the box opposes the force applied in the rope. Therefore the net force (F_{net}) causing acceleration will be

F_{net} = Force applied − Weight of box

= 700 N − 500N

= 200 N

F_{net} = 200 N

Then

from newton's second law

$F_{net} = m a$

$\frac{F_{net}}{m} = a$

Then

$$\frac{200N}{50kg} = a$$

$$a = 4N/kg \quad \text{or} \quad 4m/s^2$$

$\therefore$ Uniform acceleration (a) = $4\ m/s^2$

4 (c)(i) Newton's second law of motion states that "The rate of change of momentum is directly proportional to the net external force (F_{net}) acting on a body and takes place in the direction of the force"

$$F_{net} \propto \frac{mv - mu}{t}$$

$$F_{net} \propto m\left(\frac{v-u}{t}\right) \quad \text{but} \quad a = \frac{v-u}{t}$$

$$F_{net} = ma$$

4.(c) (ii) Data given

Rate = $50\ g/s$

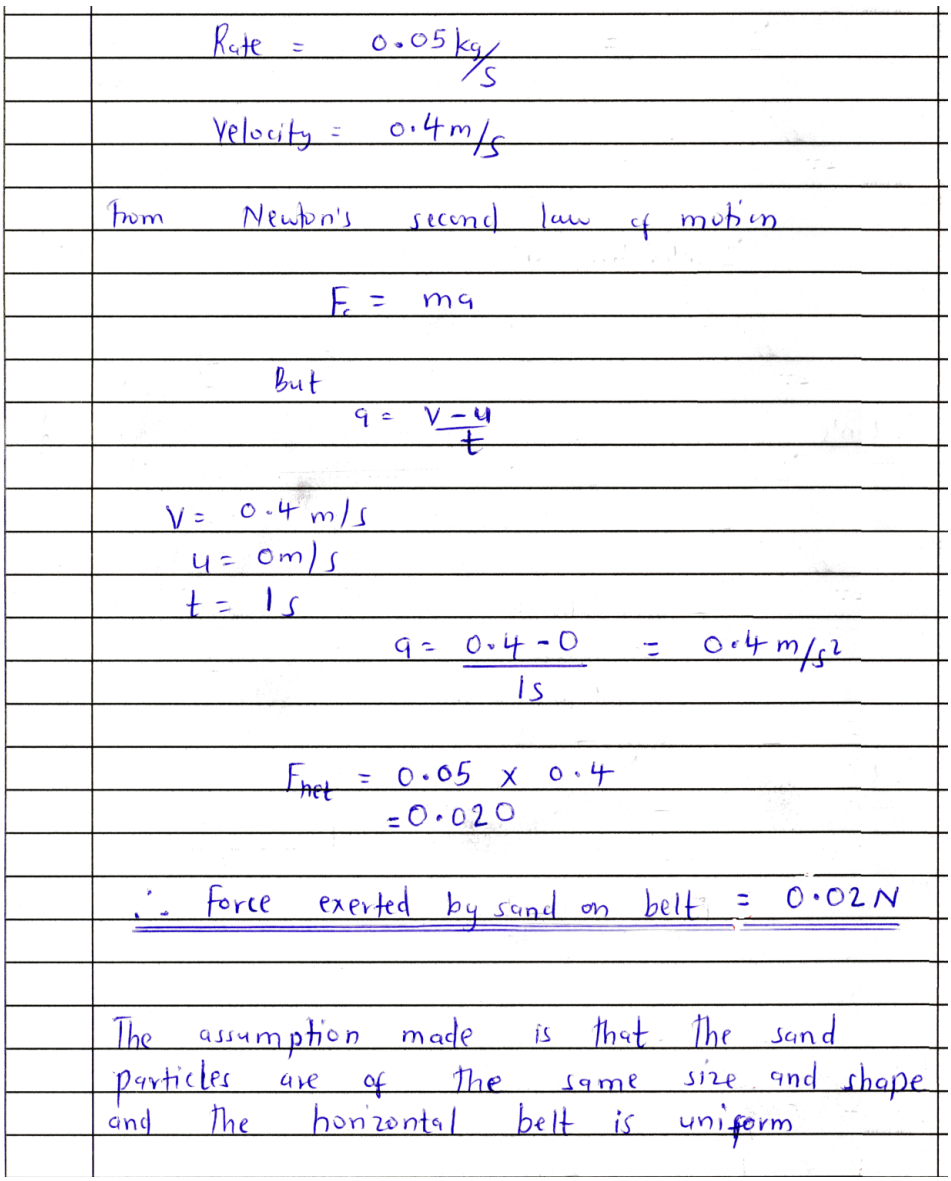
Velocity of belt = $40\ cm/s$

Force on the belt = ?

$50g = 0.05\ kg$

$40cm = 0.4\ m$

Therefore



Extract 4.2 shows the work of the candidate who managed to distinguish elastic and inelastic collision correctly and was able to calculate the uniform acceleration 'a' of the box. The candidate also managed to state the second law of motion and applied an appropriate formula to find the force exerted in Newton by the sand on the belt. However, she/he failed to state the assumption made in the calculation.

2.2.2 Question 5: Waves

The question required the candidates to (a) define terms Resonance and Overtones, (b) give reasons briefly for the following: (i) the fundamental frequency may alter during the day and (ii) notes of the same pitch played on a violin and a flute sound different. In part (c) the candidates were required to calculate (i) the frequency when the tension is increased to 8N if the frequency obtained from a plucked string is 400Hz when the tension is 2N, and (ii) the tension needed to produce a note of frequency 600Hz.

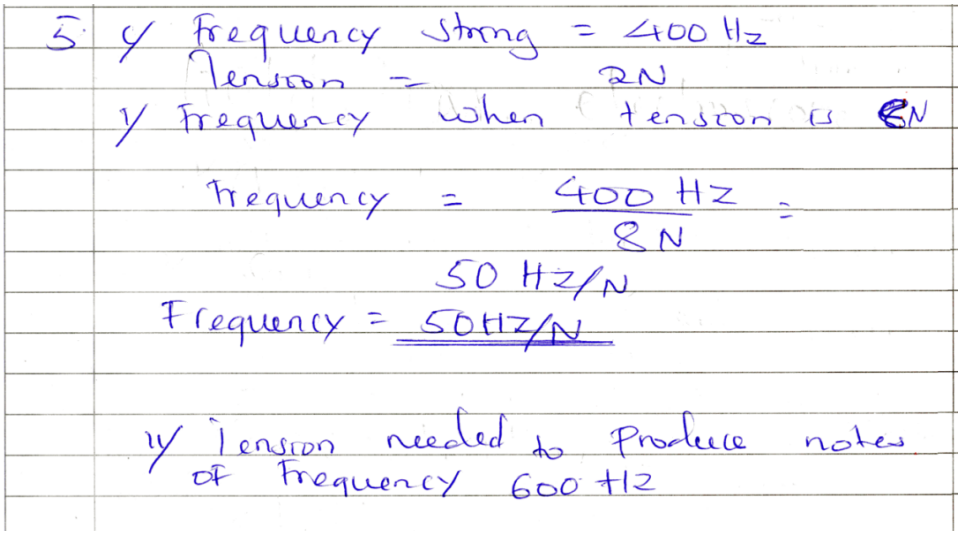
The question was attempted by 97.9 percent of the candidates, of which 80.9 percent scored 0 marks, 13.6 percent scored from 0.5 to 3.5 marks and 5.5 percent scored from 4 to 10 marks. This depicts that, the question and hence the topic of wave was extremely feebly performed by majority of the candidates.

From the above analysis it is obvious that most of the candidates who attempted this question scored low marks. The majority scored zero marks indicating that the topic is not well understood to most of the candidates from different schools. The candidates did not understand that, for a resonance to occur, a particular body or system should be set in oscillation at its own natural frequency as a result of impulses received from some other system which is vibrating with the same frequency, and that the overtones are regarded as higher frequencies multiple of fundamental frequency or vibrations produced in the pipe having different frequencies.

They were also supposed to know that, the velocity of sound waves is a function of temperature, if the temperature changes during the day the velocity of sound waves also changes causing the change in frequency of the wave. On the other hand, notes on the violin and flute have different timbre because each fundamental note should be accompanied by overtones and the overtones of the string instrument is different from those of wind instrument giving different waveforms which determines the timbre of the note.

In general, the candidates lacked knowledge and skills on the basic principles of sound waves and the concept of stationary waves in organ pipes and stretched strings. Extract 5.1 is a sample answer from the script of the candidate who performed the question poorly.

Extract 5.1



In extract 5.1, the candidate escaped parts 5(a) and (b) which consisted explanations and tried to solve part 5(c) which involved calculations. However, the candidate failed to apply appropriate formula to calculate the frequency and tension. This indicates that the candidate lacked knowledge and skills on the basic principles of sound waves and stationary waves on stretched strings and had problems in mathematics.

Despite the poor performance of the majority of the candidates in this question, a few candidates managed to perform well almost all parts of the question whereas 22 candidates scored full marks. These candidates gave the meaning of the resonance and overtones correctly and managed to give the reasons on the observations that the fundamental frequency may alter during the day and that notes of the same pitch played on a violin and a flute sound differently. Similarly, they applied appropriate formulas to calculate the frequency and tension from the given data, performed proper manipulation of the data and finally, obtained correct answers of 800Hz and 4.5N respectively.

Extract 5.2 is a sample response from one of the candidates who attempted the question well.

Extract 5.2

5 a i) Resonance is the phenomenon of producing vibration in a body at its natural frequency due to the impulse received from another vibration body with the same frequency

(ii) Overtones are the harmonics which have higher frequency than the fundamental ~~note~~ frequency.

b)(i) Fundamental frequency may alter during the day due to the heat supplied by the sun causing expansion which leads to altering of fundamental ~~frequency~~ frequency.

(ii) Notes vary due to objects producing them so they sound different on a violin and a flute because a violin

5 b(ii)
is a string instrument and a flute is a wind instrument hence different sources

5 ~~c(ii)~~
(c)

Solution

data given
initial frequency(f_1) = 400 Hz
initial Tension (T_1) = 2N

(c)(i)

when tension (T_2) = 8N

from

$$f \propto \sqrt{T}$$

$$\frac{f}{\sqrt{T}} = \frac{k\sqrt{T}}{\sqrt{T}}$$

$$\frac{f}{\sqrt{T}} = k$$

$\therefore \quad \frac{f_1}{\sqrt{T_1}} = \frac{f_2}{\sqrt{T_2}}$

$\frac{400\,Hz}{\sqrt{2N}} = \frac{f_2}{\sqrt{8N}}$

$\frac{f_2\sqrt{2N}}{\sqrt{2N}} = \frac{400\,Hz\sqrt{8N}}{\sqrt{2N}}$

$f_2 = 400\,Hz\sqrt{\frac{8N}{2N}}$

$f_2 = 400\,Hz\sqrt{4}$

$f_2 = 400\,Hz \times 2$

$f_2 = 800\,Hz$

∴ The frequency when tension is 8 N is 800 Hz

ii) Tension when frequency (f_2) = 600 Hz

from $\frac{f_1}{\sqrt{T_1}} = \frac{f_2}{\sqrt{T_2}}$

Then

5 c) ii) $\frac{f_1}{\sqrt{T_1}} = \frac{f_2}{\sqrt{T_2}}$

$\frac{400\,Hz}{\sqrt{2N}} = \frac{600\,Hz}{\sqrt{T_2}}$

Crossing

$(400\,Hz\sqrt{T_2})^2 = (600\,Hz\sqrt{2N})^2$

$\frac{160000\,Hz^2 T_2}{160000\,Hz^2} = \frac{360000\,Hz^2 \times 2N}{160000\,Hz^2}$

$T_2 = \frac{36 \times 2N}{16}$

$T_2 = \frac{18N}{4}$

$T_2 = 4.5\,N$

∴ Tension when frequency is 600 Hz is 4.5 N.

In extract 5.2, the candidate was able to define resonance and overtone. Also the candidate managed to provide clear explanation on the altering of

fundamental frequency during the day and why notes of the same pitch played in violin and flute sound different. The candidate showed higher understanding on the concept of waves in a stretched strings and great ability in questions involving calculations as he/she deduced the correct formula and finally obtained correct answers.

2.2.3 Question 6: Application of Vectors and Friction

This question required the candidates to: (a) State the parallelogram law of forces. Part (b) required the candidates to (i) distinguish between absolute velocity and relative velocity, (ii) calculate the velocity and direction of the bird given that, wind is blowing 30^{o} west of north at 20km/hour and that the bird is flying in the wind with velocity relative to ground 90km/hour at 75^{o} west of north. Part (c) required them to (i) define coefficient of dynamic friction and (ii) calculate the normal reaction and the force of friction when a body of mass 40kg is placed in a straight track sloping at an angle of 45^{o} to the horizontal given that the body is held from slipping by friction.

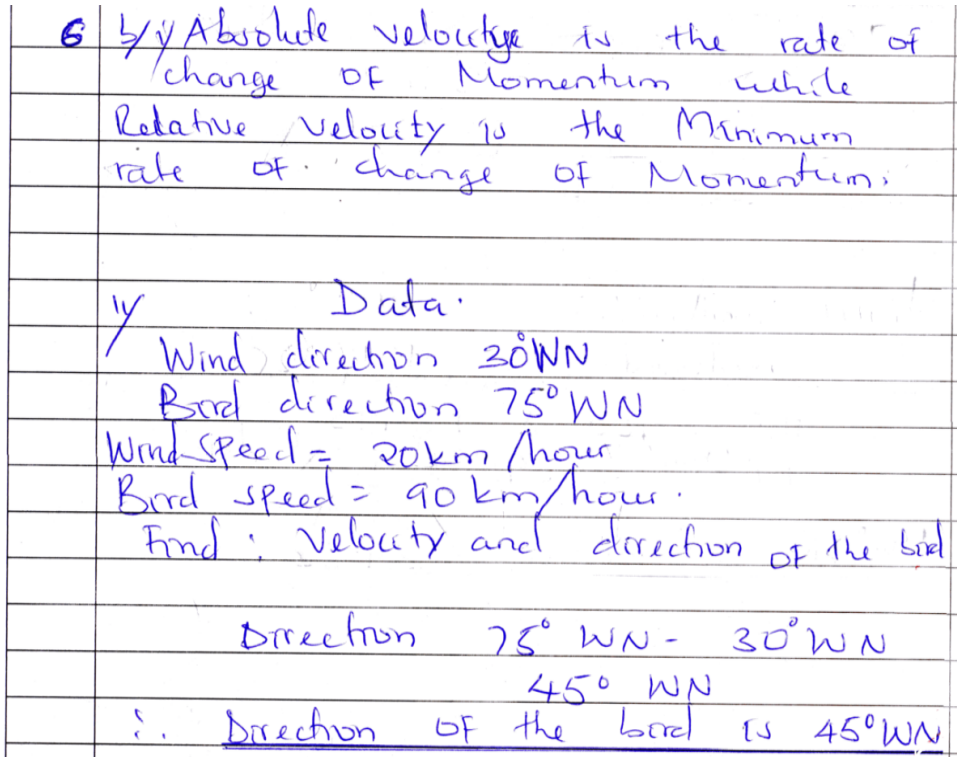
The question was attempted by 97.9 percent of the candidates, of which 59.8 percent scored a 0 mark, 32.4 percent scored from 0.5 to 3 marks and 7.8 percent marks, scored from 3.5 to 10 marks. The analysis shows that, the question was poorly performed.

The candidates who scored zero marks failed to state the parallelogram law of forces and were not able to distinguish between absolute velocity and relative velocity. Most of the candidates stated absolute velocity as the rate of change of momentum which is the definition of force. They didn't know that the absolute velocity is the velocity of the body noted by the stationary observer whereas the relative velocity is the velocity of the body relative to the moving observer where force is the rate of change of momentum. These candidates lacked knowledge and skills in the topic of application of vectors. They ought to remember that if two vectors are represented by the two sides and the angle between them, then the resultant of the two vectors will be represented by the diagonal from their common point of a parallelogram by the two forces and hence the parallelogram law of forces.
The candidates were supposed to apply the concept of resolution of forces to compute part (b) (ii) and (c) (ii) of the question. They even failed to define the coefficient of dynamic friction, something which depicts their weakness in this topic.

On the other hand, most of the candidates who scored moderately failed to attempt 6(b) (ii) which involved application of parallelogram law to calculate velocity and direction of the bird. This might have been contributed by inability of the candidates in designing, drawing and measuring the angles using a rule and protractor. Because of this, most of them opted to apply the cosine and sine rules but failed to obtain the required answer due to poor calculations and approximations.

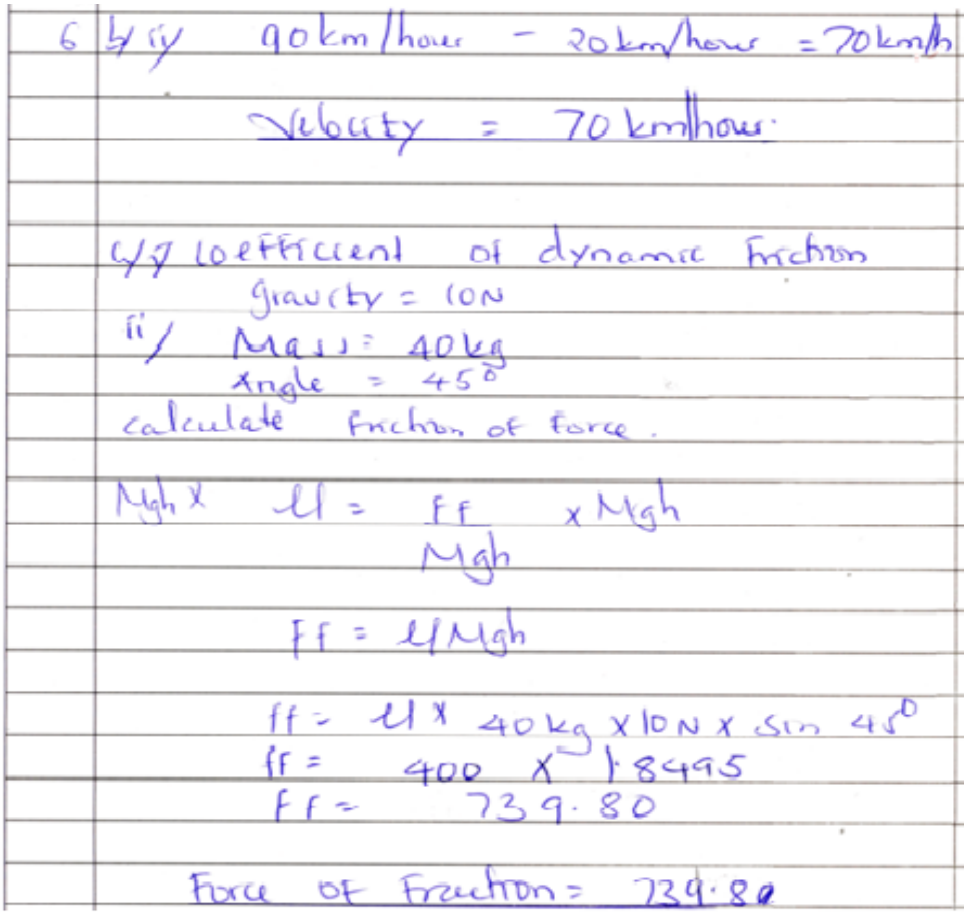
Extract 6.1 shows a sample answer from a script of one of the candidates who attempted this question poorly.

Extract 6.1


6 b/ii Absolute velocity is the rate of change of Momentum while Relative velocity is the Minimum rate of change of Momentum.

iv/ Data.
Wind direction 30°WN
Bird direction 75°WN
Wind speed = 20km/hour
Bird speed = 90 km/hour.
Find: Velocity and direction of the bird

Direction 75° WN - 30° WN
45° WN
∴ Direction of the bird is 45°WN



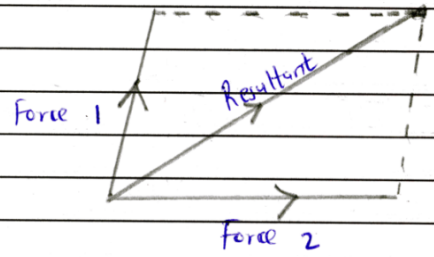
In extract 6.1 the candidate failed to provide the required definitions of absolute and relative velocity. Similarly, the candidate defined the absolute velocity as the rate of change of momentum which refers to the definition of force and not the absolute velocity. He/she also subtracted the angles as if the given velocities are scalar quantities. Likewise, the candidate failed to resolve the forces to calculate the normal reaction and the force of friction.

Although the majority of the candidates scored poorly in this question, few candidates managed to perform well. Those who did it correctly were able to state the parallelogram law of forces, distinguished between absolute and relative velocities and applied the resolution of forces diagrammatically to calculate the velocity and direction of the bird. Finally, the candidates defined the coefficient of friction precisely and computed the normal reaction and the force of friction when a body of mass 40kg is placed in a straight track slopping at an angle of 45^0 to the horizontal provided that the body is held from slipping by friction.

Extract 6.2 is a sample of responses from the candidate who provided correct answers for many parts of this question.

Extract 6.2

6.(a) Parallelogram law states that, "if two vectors (forces) are represented by the two adjacent sides of a parallelogram then the diagonal drawn from their common starting point represents the resultant of the two forces in magnitude and direction."



6 (b)(i)

Differences

Absolute velocity	Relative velocity
- Absolute velocity is the velocity of one body with respect to another stationary body	- Relative velocity is the velocity of one body with respect to another moving body

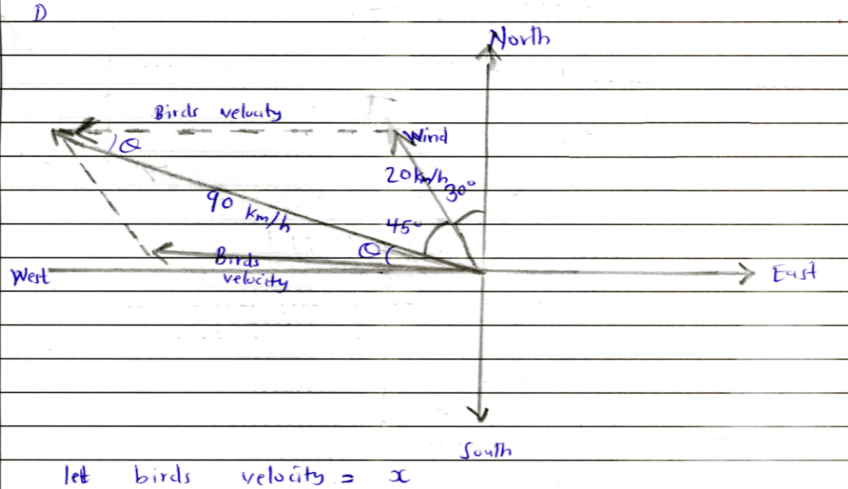
6 (b)(ii) Data given

Wind velocity = 20 km/hr

Wind direction = 30° West of North

Relative velocity of bird = 90km/h at 75° W of North

D



let birds velocity = x

Using cosine rule

$$x^2 = (90)^2 + (20)^2 - (2 \times 90 \times 20 \times \cos 45)$$

$$= 8100 + 400 - (3600 \times 0.7071)$$

$$= 8500 - 2545.56$$

$$= 5954.44$$

$$\sqrt{x^2} = \sqrt{5954.44}$$

∴ Velocity of the bird = 7.717 km/hr

Direction of the bird will be ↑

Using sine rule

$$\frac{\sin 45}{7.717} = \frac{\sin \theta}{20}$$

$$\sin \theta \times 7.717 = \sin 45 \times 20$$

$$\sin\theta = \frac{\sin 45 \times 20}{7.717}$$

$$\theta = \sin^{-1}\left(\frac{\sin 45 \times 20}{7.717}\right)$$

$$= \sin^{-1}\left(\frac{0.7071 \times 20}{7.717}\right)$$

$$\theta = \frac{14.142}{7.717}$$

$$\theta = 1.83^\circ$$

Direction of bird = $75^\circ + 1.83$

$= 76.83^\circ$

∴ Direction of bird = 76.83° West of North

6.(c)(i) Coefficient of dynamic friction is the ratio of the dynamic / kinetic friction (F_K) to the normal reaction (R)

Coefficient of dynamic friction (μ_k) = $\frac{\text{Dynamic friction } (F_K)}{\text{Normal reaction } (R)}$

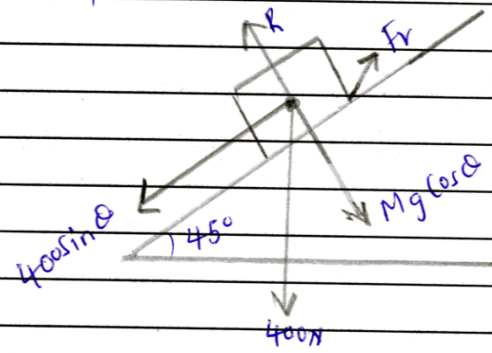
(ii) Data given

Mass = 40 kg

$\theta = 45°$

Normal reaction (R) = ?

Force of friction = ?



From the figure

Normal reaction (R) = $mg \cos\theta$

$= 40 \times 10 \times \cos 45$

$= 400 \times 0.7071$

$= 282.84$

∴ Normal reaction = 282.84 N

Friction force = $mg \sin\theta$

$= 40 \times 10 \times \sin 45°$

$= 400 \times 0.7071$

$= 282.84$

∴ Friction force = 282.84 N

In extract 6.2, the candidate was able to state and illustrate clearly the parallelogram law of forces and gave correct distinction between absolute and relative velocities. Then, he/she used the resolution of vectors and cosine rule to determine the resultant velocity represented by the diagonal of the parallelogram. However, the candidate failed to find the square root of 5954.44. Finally, the candidate calculated the normal reaction and the force of friction correctly explicating that he/she was competent to the concepts tested in the question.

2.2.4 Question 7: Light

In this question, candidates were required to: (a) (i) explain the meaning of refraction of light, (ii) mention three points to be considered when drawing a ray diagram to show the formation of images on a concave mirror.

Part (b) of the question required the candidates to (i) explain briefly why part of the road ahead of a person apparently looks as if it has a pool of water on a sunny day (ii) find the height to which the pin appears to rise when it is at the bottom of the vessel 16cm deep filled with water and viewed from above. In part (c) they were required to explain about (i) the relative velocity of light in paraffin and in water and (ii) path of ray of light when passing from the water into a layer of paraffin given that paraffin has a greater refractive index than water.

The analysis shows that 97.9 percent of the candidates attempted this question whereby 46.9 percent scored 0 marks, 43.2 percent scored from 0.5 to 4 marks and 9.9 percent scored from 4.5 to 10 marks. The analysis elucidates that the question was poorly performed.

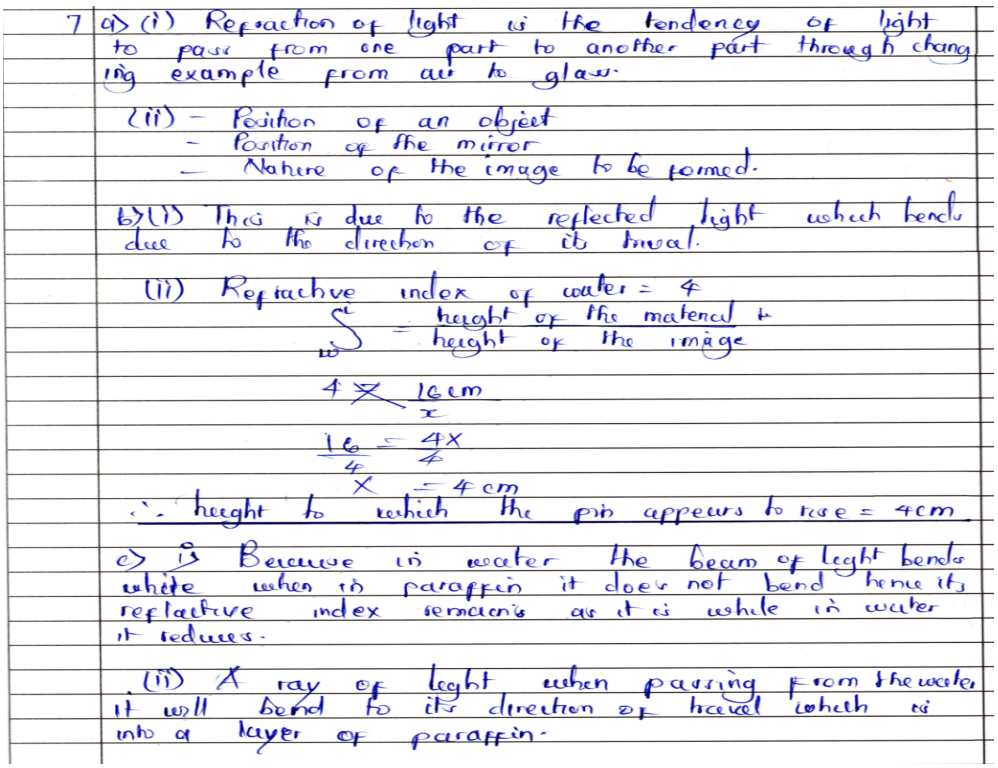
Majority of the candidates with poor performance were not able to provide correct definition of refraction of light and failed to mention the points to be considered when drawing a ray diagram to show formation of images on concave mirror in part (a). Furthermore, they failed to give relevant responses in parts (b) and (c). For example, one candidate gave explanation on why part of the road ahead of a person appears apparently as if it has a pool of water on sunny day by writing "*because of devil"*. This candidate seemed to use concepts which are not in Physics to answer the question and relates the concept with beliefs.

On the other hand, the candidates who scored moderately in this question were able to attempt parts of the question which involved calculations rather than those which required explanation. This might be due to lack of communication skills where some of the candidates failed to use English Language to answer the question correctly.

A few candidates who scored high marks managed to answer most parts of the question correctly. They managed to give the meaning of refraction of light with high degree of accuracy and also managed to mention points to be considered when drawing a ray diagram to show the formation of images on a concave mirror. These candidates also gave a brief correct explanation on why part of the road ahead of a person apparently looks as if it has a pool of water on a sunny day. Likewise, they were able to find the height to which the pin dipped into the vessel filled with water appears to rise when situated at the bottom of the vessel as viewed from above.

Extracts 7.1 and 7.2 are the sample answers from the candidates who did poorly and well respectively.

Extract 7.1


7 a) (i) Refraction of light is the tendency of light to pass from one part to another part through changing example from air to glass.

(ii) - Position of an object
- Position of the mirror
- Nature of the image to be formed.

b) (i) This is due to the reflected light which bends due to the direction of its travel.

(ii) Refractive index of water = 4

$$\frac{\text{height of the material}}{\text{height of the image}} = \frac{16\text{cm}}{x}$$

$$4 \times x = 16\text{cm}$$

$$\frac{4x}{4} = \frac{16}{4}$$

$$x = 4\text{cm}$$

∴ height to which the pin appears to rise = 4cm

c) (i) Because in water the beam of light bends while when in paraffin it does not bend hence its refractive index remains as it is while in water it reduces.

(ii) A ray of light when passing from the water it will bend to its direction of travel which is into a layer of paraffin.

Extract 7.1 shows that, the candidate lacked both content knowledge and communication skills to answer the question. It also shows that the candidate had poor mathematics capability in solving questions involving calculations.

Extract 7.2

7: (a)(i) Refraction of light is the bending in direction of light wh
n it crosses from one medium into another medi
um.

(ii)(a) Rays of light travels parallel to the principal axis reflected through the principal focus

(b) Rays of light travel through the principal focus are reflected parallel to the principal axis

(c) Rays of light travel through the centre of curvature are reflected back in their own path. same

(b)(i) A part of the road ahead of a person apparently looks as if it has a pool of water on a sunny day because of the following. during sunny day air which is close to the road surface is very hot compared to the air above the road or out atmosphere which are cold so when the rays of light travel from the sky will undergo tototed Internal reflection when pass between the cold air into the hot air on the surface because hot air has low refractive index compared to cold air and so why an individual observe the sky as the pool of water on the road surface.

(ii) Soln.

Data given.

actual height = 16cm

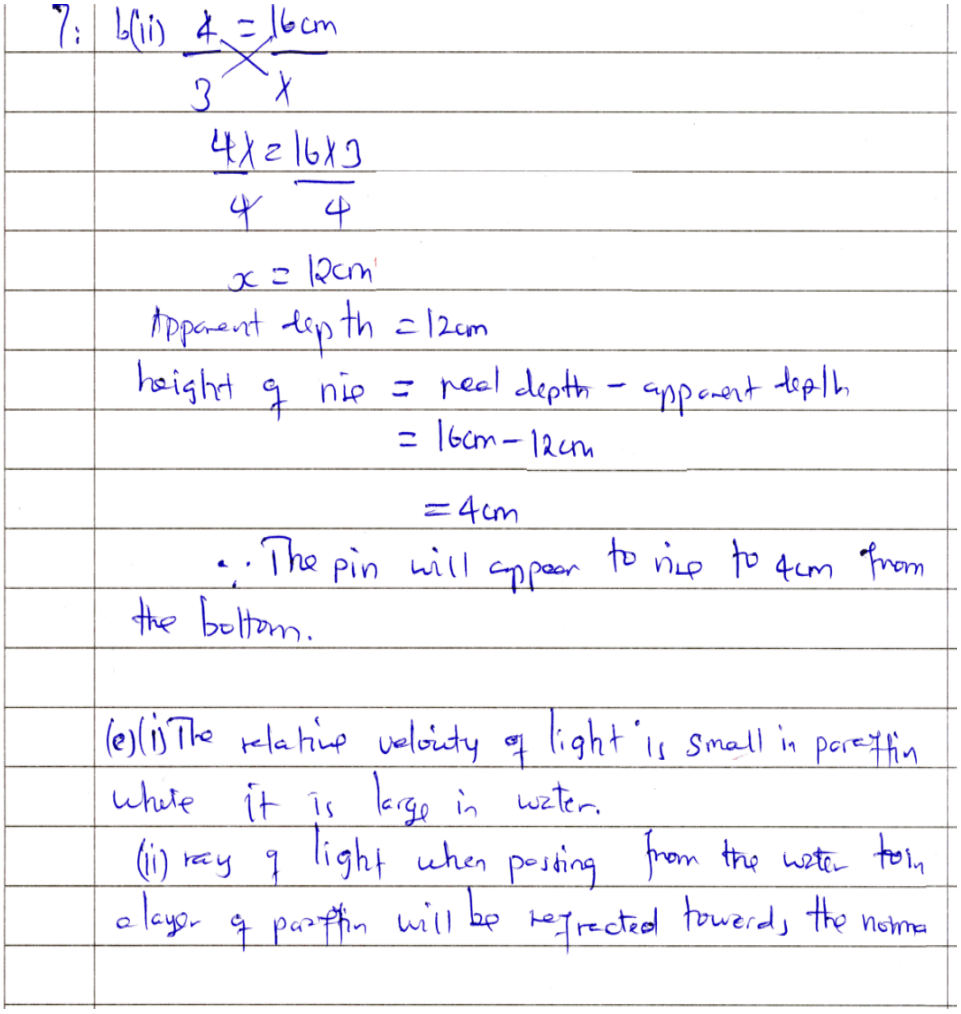
real depth = 16cm

Refractive index (η) = 4/3 of water

Apparent depth = ?

from

$\eta_w = \frac{\text{Real depth}}{\text{apparent depth}}$



In extract 7.2 the candidate managed to give the meaning of the refraction of light and mentioned the points to be considered when drawing a ray diagram to show the formation of images on a concave mirror. The candidate managed to provide correct answers for 7(b) (ii) and 7(c) as per the need of the question.

2.2.5 Question 8: Radioactivity and Current Electricity

The question required the candidates to: (a) (i) explain the meaning of radioactive decay, (ii) give two effects of beta (β) particle on the nucleus of an atom and (b) (i) define the term isotope of an element, (ii) calculate the charge in Coulombs of the nucleus of carbon isotope which has the symbol $^{14}C_{6,}$ and in part (c) the candidates were required to (i) explain by giving three points how they could test whether the car battery needs recharging and (ii) calculate the storage capacity of the battery of e.m.f 5V and

negligible internal resistance when two resistors each of 5Ω are connected in parallel across the same battery given that the battery is fully charged and then discharged within 20 hours.

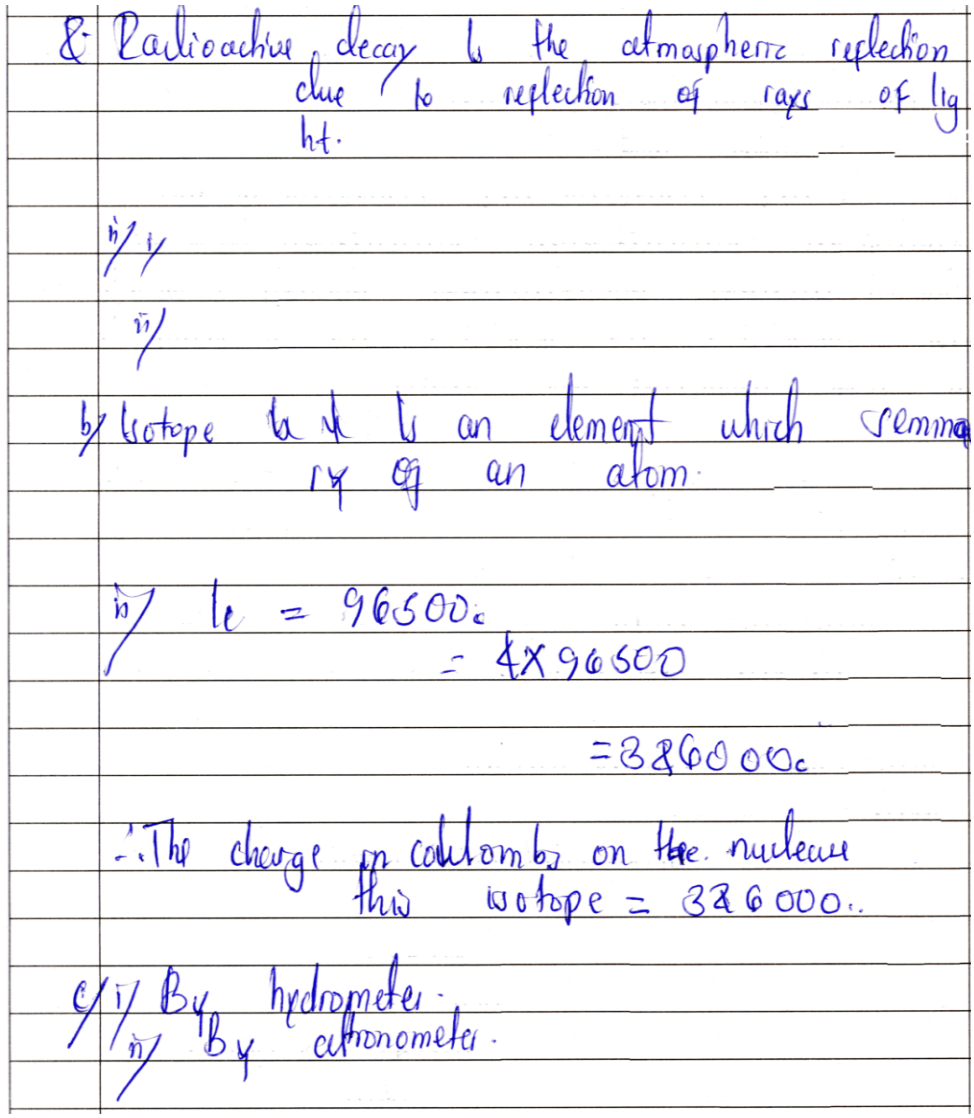
The question was attempted by 97.9 percent of the candidates, of which 37.2 percent scored 0 marks, 56.5 percent scored from 0.5 to 3.5 marks and 6.3 percent from 4 to 10 marks indicating a general poor performance in this question. The analysis shows that, the question and thus the topic of radioactivity and current electricity was poorly done.

The candidates were anticipated to use an integrated approach of learning to perform part (a) and (b) of the question since the concepts tested in these parts are also taught in Physics and Chemistry, but most of them failed. The candidates who scored a zero mark failed to give the definition of radioactive decay and isotope. They also failed to mention two effects of beta particles on the nucleus of an atom and made inappropriate calculations in finding the number of coulombs on the nucleus of carbon-14. Furthermore, they could not perform correctly part (c) of this question.

The candidates who scored relatively good marks performed well most of the parts of the question. They were able to give the correct meaning of the term radioactive decay and gave the effects of beta (β) particle on the nucleus of an atom. They also managed to define the isotope of an element and calculated the charge in Coulombs on the nucleus of the isotope of ${}^{14}_{6}C$ correctly. Similarly, they attempted correctly item (i) of part (c) but failed to do well in item (ii) which required calculations.

Extract 8.1 shows a sample of a response of the candidate who performed poorly and extract 8.2 shows the sample of the response of the candidate who almost attempted this question well.

Extract 8.1



In extract 8.1, the candidate defined radioactive decay as *"the atmospheric reflection due to reflection of rays of light*". The candidate also defined isotope as *"an element which seminary of an atom"*. This is an indication that the candidate had no content knowledge with regard to the topic of radioactivity.

Extract 8.2

8 a) i) Radioactive decay is the disintergration of a radioactive material by emitting some rays.

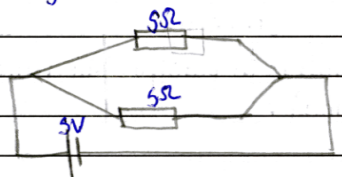
ii) - It makes the atom to have properties ~~to~~ similar to the ~~next~~ atom of next element.
- It causes stable atom.

b) i) Isotope are the atoms of an element with the same atomic number but different mass number.

ii) Data given
The carbon symbol = $^{14}_{6}C$
The charge (Q) = ?
From
Q = electronic charge x ~~Atomic~~ number.
$= 1.602 \times 10^{-19} C \times 6.$
$= 9.612 \times 10^{-19} C.$
The charge in coulumbs on the nucleus is $9.612 \times 10^{-19} C$

c) i) - By measuring the density of sulphuric acid if it is low then the battery needs to be ~~rec~~ recharged.
- By observing the electromotive force given out if it is low then the battery needs to be recharged.
- By measuring the workout put of the battery if it is ~~at~~ at high or low level.

ii) Data given



8 ~~Time~~ c) ii) Time (t) = 20hrs. = (60x60)x20seconds.

From the circuit

$E = I(R + r)$.

$E = IR_T$

$I = \frac{E}{R_T}$

$I = \frac{5V}{\Omega}$

$I = \frac{E}{R_T}$ $R_T = \frac{R_1 R_2}{R_1 + R_2}$

$R_T = \frac{5 \times 5}{5+5}$

$= 2.5\Omega$

$I = \frac{5V}{2.5\Omega}$

$I = 2A$

From Quantity of charge (Q) = It.

$Q = 2A \times 36000$ seconds

= 144000 Coloumbs.

∴ The storage capacity of was 144000 coloumbs

Extract 8.2 portrays how the candidate managed to give the meaning of the term radioactive decay correctly and gave the effects of beta particle on the nucleus of an atom. The candidate also managed to define the isotope of an element and calculated the charge in Coulombs on the nucleus of the isotope of ${}^{14}_{6}C$ correctly. Nevertheless, the candidate failed to manipulate the storage capacity of the battery.

2.2.6 Question 9 : Geophysics and Sustainable Energy Sources

The candidates were asked to: (a) explain the meaning of the terms (i) Volcanoes (ii) Non-renewable sources of energy; (b) (i) Mention two merits and two demerits of volcanoes (ii) Briefly explain two hazards associated with earthquake and (c) (i) List down two disadvantages of non-sustainable energy sources and (ii) State two applications of energy generated from water.

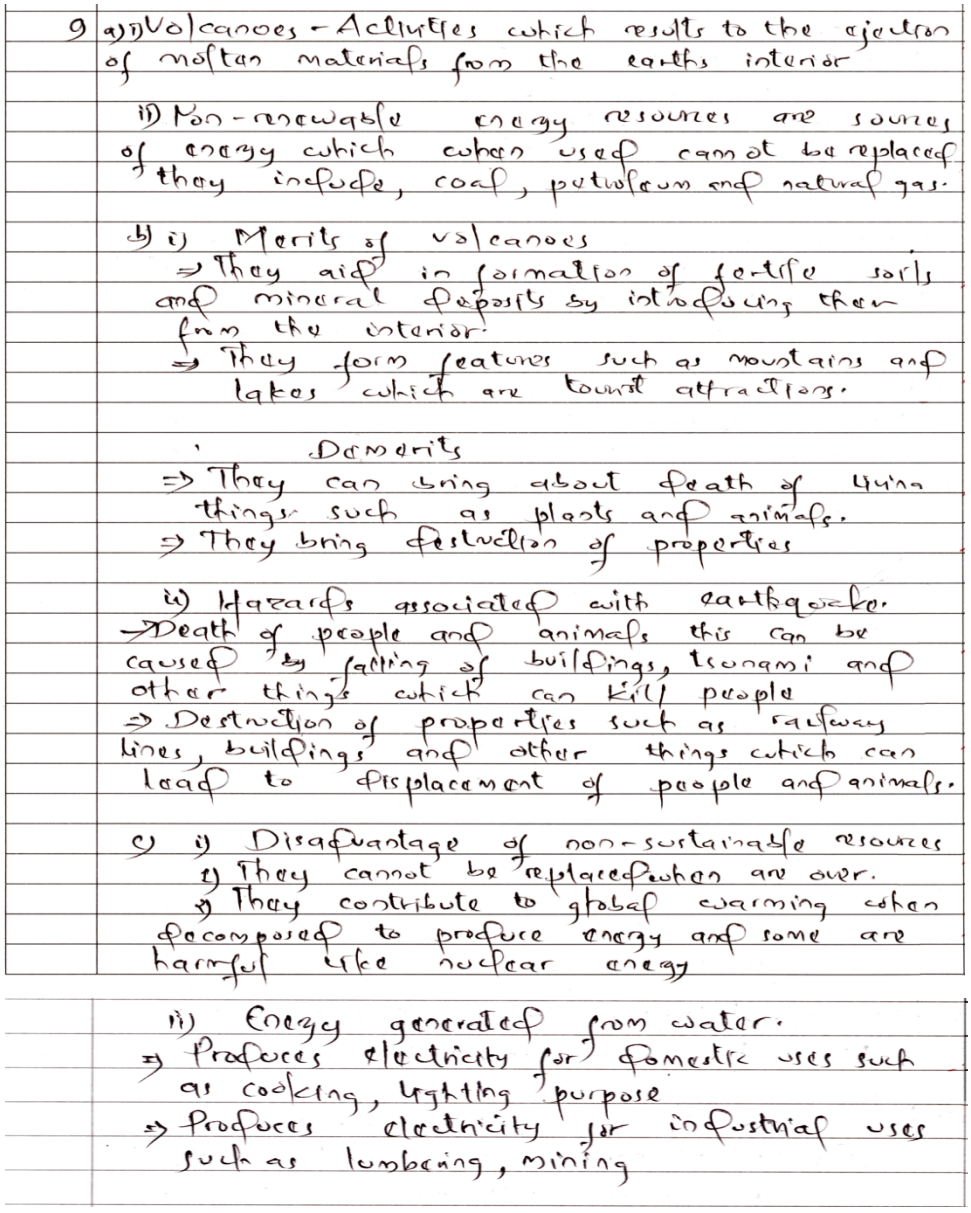
The question was attempted by 97.9 percent of the candidates, of which 11.6 percent scored 0 marks, 35.1 percent scored 0.5 to 4 marks and 53.3 percent scored from 4.5 to 10 marks. This is among the two questions which most of the candidates performed well as revealed by the analysis. A total of 1503 (1.4%) of the candidates who attempted this question scored full (10) marks.

The candidates who did well this question managed to give the meaning of volcanoes and non-renewable sources of energy. They also mentioned merits and demerits and briefly explained hazards associated with earthquakes correctly. The candidates also managed to list down disadvantages of non-sustainable energy sources and stated correctly the applications of energy generated from water.

On the contrary, a few candidates who scored zero in this question wrote incorrect answers or left blanks in some parts of the question. For example, one of the candidates defined non-renewable sources of energy as, *"the source of energy used in short period of time",* instead of *"are natural sources of energy which once used can't be replaced"* which signifies lack of knowledge in the concepts tested in this question.

Extract 9.1 shows a sample of a response of the candidate who performed correctly this question and extract 9.2 shows sample of the response of the candidate who performed poorly.

Extract 9.1


9 a) i) Volcanoes - Activities which results to the ejection of molten materials from the earths interior

ii) Non-renewable energy resources are sources of energy which when used cannot be replaced they include, coal, petroleum and natural gas.

b) i) Merits of volcanoes
⇒ They aid in formation of fertile soils and mineral deposits by introducing them from the interior.
⇒ They form features such as mountains and lakes which are tourist attractions.

Demerits
⇒ They can bring about death of living things such as plants and animals.
⇒ They bring destruction of properties

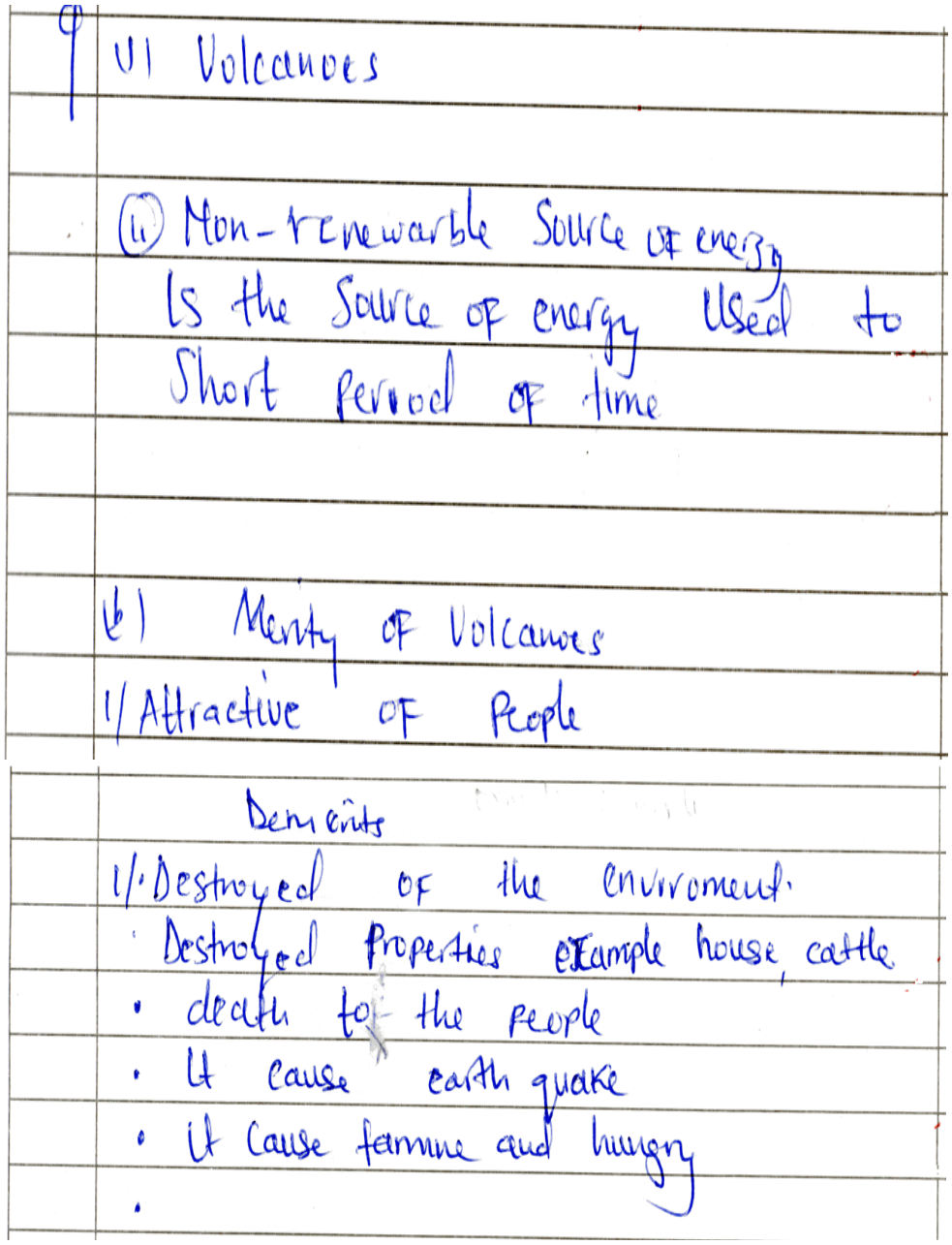
ii) Hazards associated with earthquake.
⇒ Death of people and animals this can be caused by falling of buildings, tsunami and other things which can kill people
⇒ Destruction of properties such as railway lines, buildings and other things which can lead to displacement of people and animals.

c) i) Disadvantage of non-sustainable resources
i) They cannot be replaced when are over.
ii) They contribute to global warming when decomposed to produce energy and some are harmful like nuclear energy

ii) Energy generated from water.
⇒ Produces electricity for domestic uses such as cooking, lighting purpose
⇒ Produces electricity for industrial uses such as lumbering, mining

In extract 9.1 the candidate managed to provide correct answers as per the demand of the question.

Extract 9.2

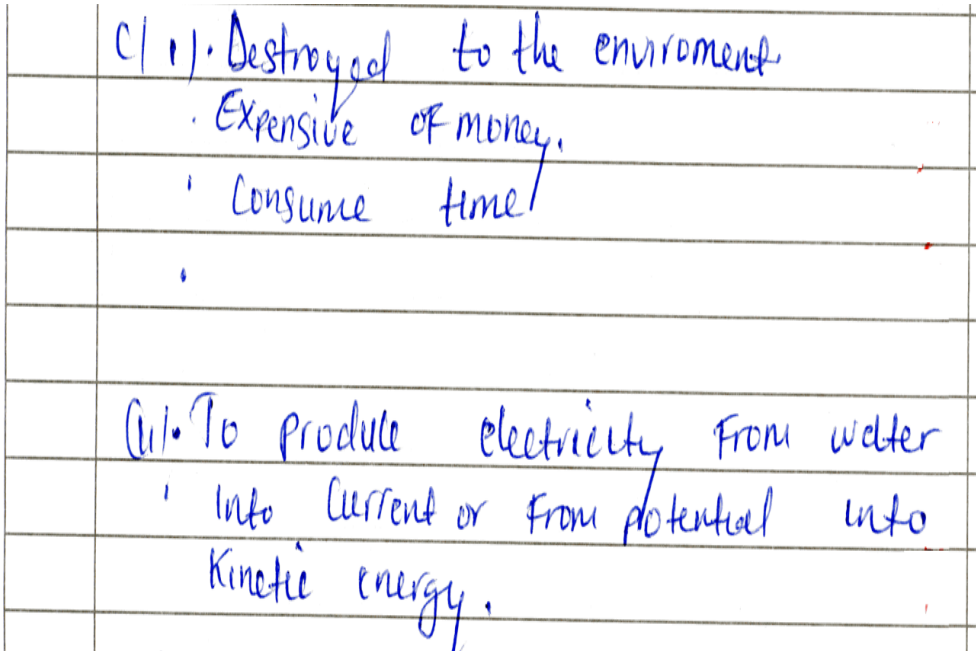


7 (i) Volcanoes

(ii) Non-renewable source of energy
is the source of energy used to
short period of time

(b) Merits of Volcanoes
1/ Attractive of people

Demerits
1/ Destroyed of the environment.
- Destroyed properties example house, cattle
- death to the people
- It cause earth quake
- it cause famine and hungry
-



In extract 9.2, the candidate failed to provide correct responses. She/he failed to give the meaning of volcanoes and non-renewable sources of energy. She/he also failed to mention the merits and demerits of volcanoes and was unable to explain the hazards associated with earthquake. Moreover, her/his work is characterized by grammatical errors and mistakes.

2.3. Section C: Short Answer Questions

2.3.1 Question 10: Electronics and Thermionic Emission

This was an optional question with parts (a), (b) and (c). In part (a) the candidates were required to (i) define saturation current and (ii) give one peculiar property of diode as a rectifier. Part (b) required the candidates to explain the function of (i) Geiger-Muller (G-M) tube and (ii) Diffusion cloud chamber. In part (c), the candidates were required to study the diagram in Figure 2 which showed parts of a cathode ray oscilloscope and explained the changes which should be done in order to produce (i) a brighter trace (ii) a vertical line (iii) a wave pattern and (iv) a horizontal line.

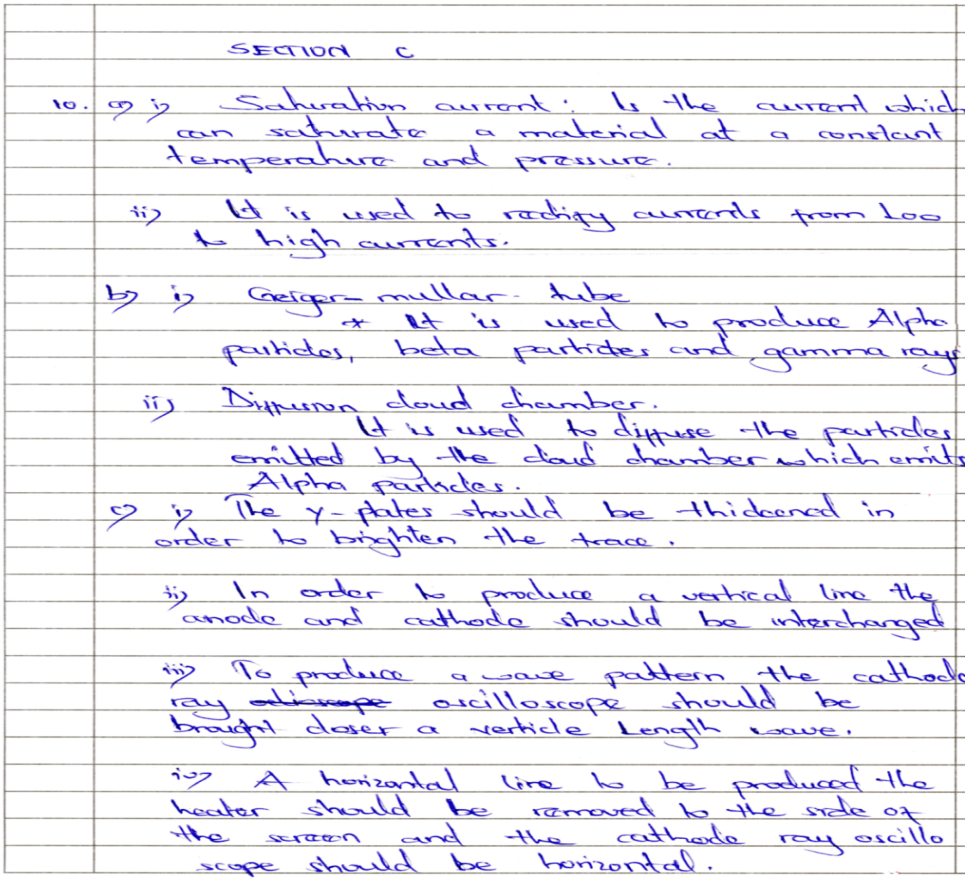
The question was opted by 42.2 percent of the candidates, of which 67.4 percent scored a 0 mark, 21.6 percent scored from 0.5 to 3.5 marks and 11 percent scored from 4 marks to 10 marks. Only 5 (0.01%) candidates

scored full (10) marks which is an indication that the question was poorly done.

The candidates who scored zero marks failed to provide definition of saturation current, also failed to give a peculiar property of a diode as rectifier. They were unable to explain the functions of Geiger-Muller tube and diffusion cloud chamber. They also failed to brainstorm the functions of the different parts of the cathode ray oscilloscope when a beam of electron is emitted by the cathode and then focused on the anode which is then being accelerated through the deflecting system to the screen. Hence, they failed to state the changes which should be done in the cathode ray oscilloscope in order to produce a brighter trace, vertical line, wave pattern and horizontal line on the screen.

Extract 10.1 shows an example of an answer of a candidate who provided incorrect responses for this question.

Extract 10.1


SECTION C

10. a) i) Saturation current: Is the current which can saturate a material at a constant temperature and pressure.

ii) It is used to radiate currents from Low to high currents.

b) i) Geiger-muller tube
* It is used to produce Alpha particles, beta particles and gamma rays

ii) Diffusion cloud chamber.
It is used to diffuse the particles emitted by the cloud chamber which emits Alpha particles.

c) i) The y-plates should be thickened in order to brighten the trace.

ii) In order to produce a vertical line the anode and cathode should be interchanged

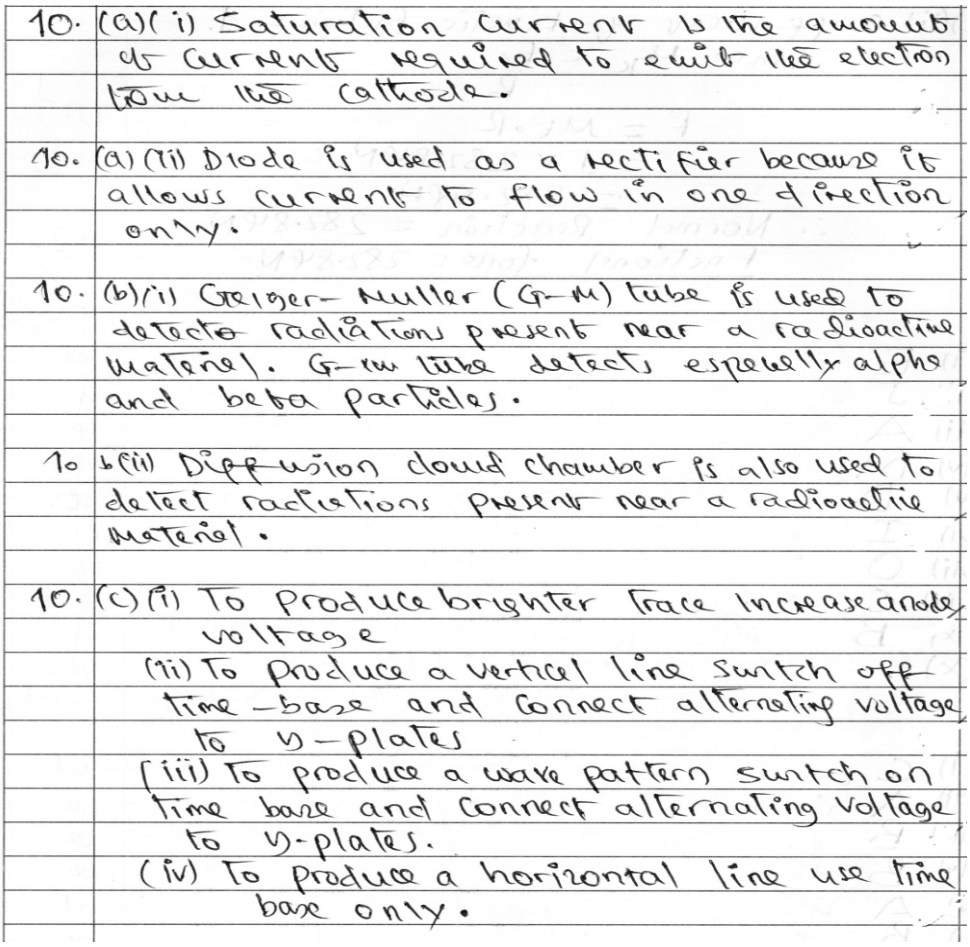
iii) To produce a wave pattern the cathode ray ~~oscilloscope~~ oscilloscope should be brought closer a vertical Length wave.

iv) A horizontal line to be produced the heater should be removed to the side of the screen and the cathode ray oscillo scope should be horizontal.

Extract 10.1 shows how the candidate failed to provide correct answers for all parts of the question. For example, in each part where the candidate was required to give definition, he/she provided the definition which included part of the terms to be defined. For instance, in 10 (a) the candidate defined saturation current as:*"the current which can 'saturate' a material at a constant temperature and pressure "*.Since the word saturation is in the stem of what has to be defined, the candidate was expected to use other words to define it.

In contrary, the candidates who performed well this question provided correct answers and their work was well presented. They managed to give correct meaning of saturation current and peculiar property of a diode as a rectifier. They also managed to give a precise brief explanation on the functions of the Geiger–Muller (G-M) tube and of the diffusion cloud chamber. Similarly, they did well part (c) of the question. See extract 10.2.

Extract 10.2


10. (a)(i) Saturation current is the amount of current required to emit the electron from the cathode.

10. (a)(ii) Diode is used as a rectifier because it allows current to flow in one direction only.

10. (b)(i) Geiger– Muller (G–M) tube is used to detecte radiations present near a radioactive material. G–M tube detects especially alpha and beta particles.

10 b(ii) Diffusion cloud chamber is also used to detect radiations present near a radioactive material.

10. (c)(i) To produce brighter trace increase anode voltage
(ii) To produce a vertical line switch off time–base and connect alternating voltage to y–plates
(iii) To produce a wave pattern switch on time base and connect alternating voltage to y-plates.
(iv) To produce a horizontal line use time base only.

Extract 10.2 shows that the candidate managed to give peculiar property of a diode as a rectifier but failed to give the meaning of saturation current. The candidate also explained briefly the functions of the apparatus of the Geiger-Muller tube and that of the diffusion cloud chamber. Likewise, she/he gave the changes to be done in the oscilloscope so as to produce a brighter trace, a vertical line, a wave pattern and a horizontal line on the screen correctly.

2.3.2 Question 11: Thermal Expansion and Electromagnetism

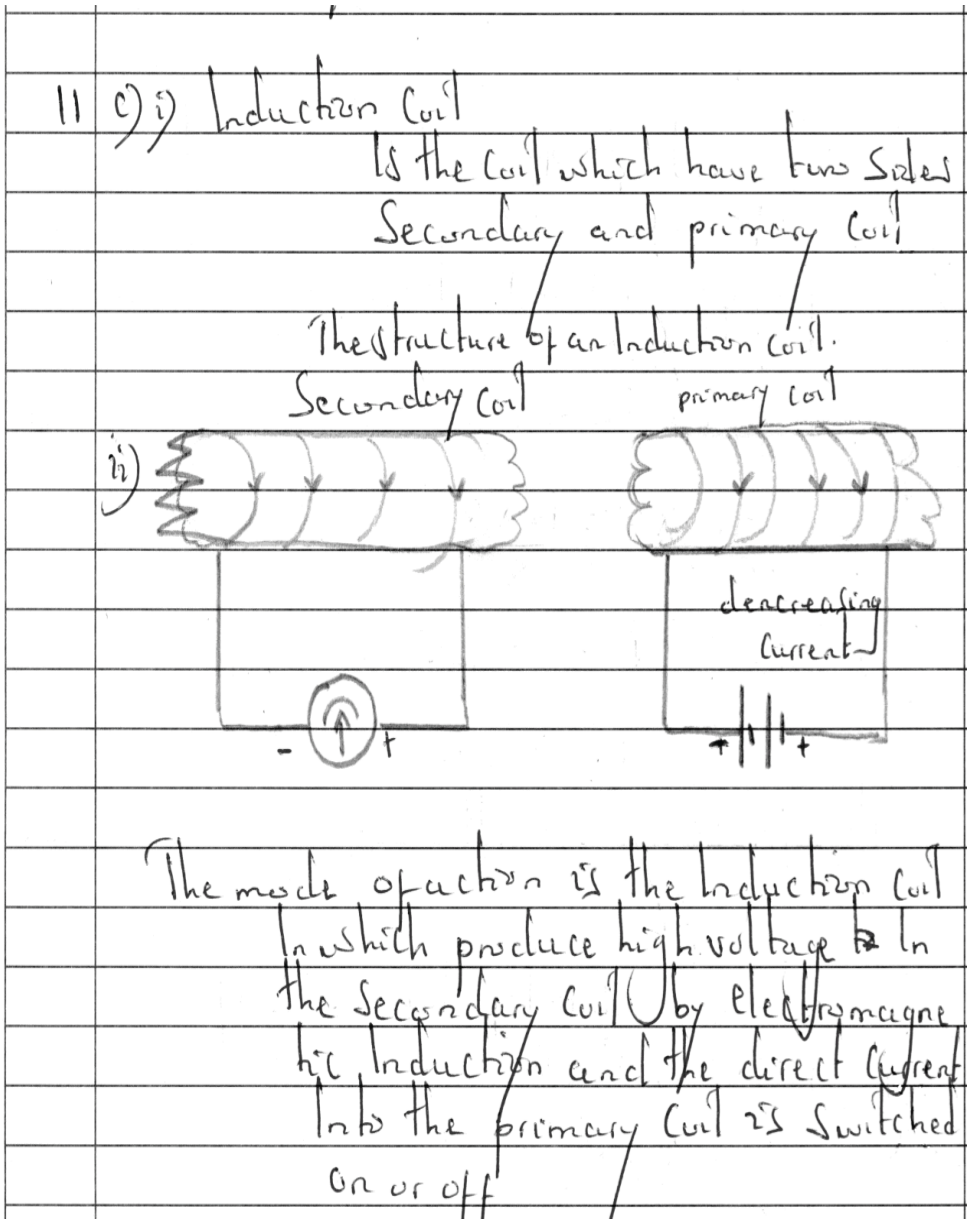
The question demanded the candidates to (a) (i) use the kinetic theory to explain why solids expand when heated and (ii) mention two experiments which can be done in the laboratory to verify thermal expansion of solids. In part (b) they were asked to explain how each of the following works; (i) a bimetallic thermostat and (ii) a bimetallic thermometer. In part (c) the candidates were required to (i) define induction coil and (ii) describe the structure of an induction coil and briefly explain its mode of action.

The question was attempted by 61,860 (55.7%) of the candidates, of which 49.0 percent scored a 0 mark, 46.6 percent scored from 0.5 to 4 marks and 4.4 percent scored from 4.5 to 10 marks. This question was badly performed.

Majority of the candidates who scored low marks specifically those who scored zero marks provided incorrect responses to all parts of the question while others left some parts unanswered. Most of them attempted part (c) of the question and skipped parts (a) and (b). These two unanswered parts were from the topic of Thermal Expansion. In part (a) (i) of the question, the candidates were just supposed to use the kinetic theory of matter to explain the expansion of solids when subjected to heat. In part (b) of the question, the candidates lacked content knowledge on the contextual use of bimetallic thermostat and bimetallic thermometer. This is an indicator that, the concept of thermal expansion was not well known to most of them.

Extract 11.1 shows a sample response from a script of a candidate who opted for question 11 and provided incorrect answers.

Extract 11.1



In extract 11.1 the candidate did not do parts (a) and (b), only attempted part (c) but supplied incorrect responses and hence scored a 0 mark.

However, the few candidates who performed well this question were able to explain why a solid expands when heated with reference to the kinetic theory of matter and they mentioned clearly the two experiments which can be done in laboratory to verify thermal expansion of solids. These candidates explained correctly how a bimetallic thermostat and a bimetallic thermometer work. Finally, the candidates provided correct definition of induction coil and described the structure and its mode of action.

These candidates showed great understanding on the concept of kinetic theory of matter, the part which most of the candidates showed an enormous weakness. For example one candidate explained why solids expand when heated by using kinetic theory as follows:

> *"Temperature changes affect metals and other solids. Every day experience shows that most metals expand when warmed and contract when cooled. Solids are made up of very minute particles which are at constant haphazard motion. When a solid is heated, thermal energy or kinetic energy is acquired by the molecules of the solid and then starts to vibrate about their equilibrium position with increased displacement. The increase in displacement of the molecules of the particles results into an increase in the size of the solid and thus the solid is said to expand".*

The above quotation is an indicator that some of the candidates had the content knowledge and also writing skills to express themselves in English Language.

Extract 11.2 shows a sample answer from another candidate who performed this question correctly.

Extract 11.2

11: (a)(i) According to kinetic theory of matter solids are made up with molecules which are in constant vibration or is all the time. When heat energy is supplied to the solid its particles will gain kinetic energy and increased their vibration and velocity, continues supplying heat energy to the solid lead to increasing move the velocity of particles which can result into increasing in its dimensions, such as length, area and volume that is what we call it expansion.

(ii) Experiment, to verify thermal expansion in solids are
(i) a Ball and a ring experiment
(ii) ~~A Bar and gap experiment.~~
(ii) Bar and a gap experiment:

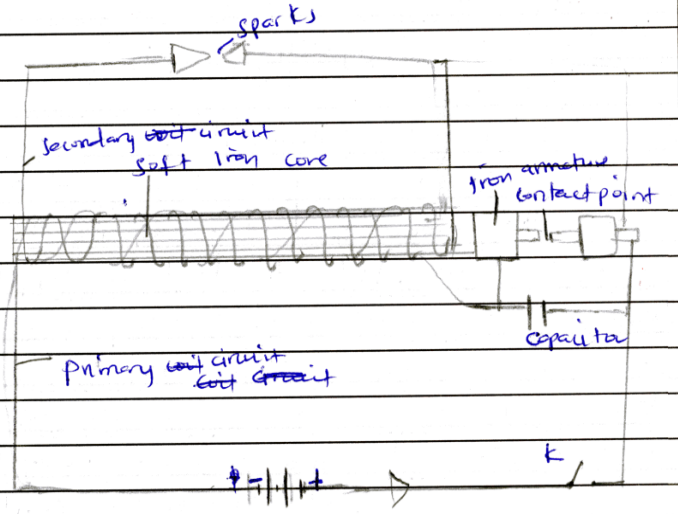
(b)(i) a bi bimetallic thermostat is made up with two different metals such as iron and brass. It is used to control the amount of heat energy in the devices such as electrical iron. When the heat is supplied to a thermostat it will reach the temperature where by ~~on the~~ metals will expand differently to form a curve which will complete the circuit and where the current will start flowing through a circuit but then when the temperature decrease, ~~also~~ the metal, contract to break the circuit ~~the~~ action occurs continously which enable to control amount of heat in a device.

(ii) A bimetallic thermometer used to measure the temperature. It is made up of two different metals such as iron and brass which is connected to the pointer and a scale. when heat is supplied to the thermometer then metals will tend to expand and complete the circuit of

to deflect on the scale, through clockwise motion and measure the temperature of a body.

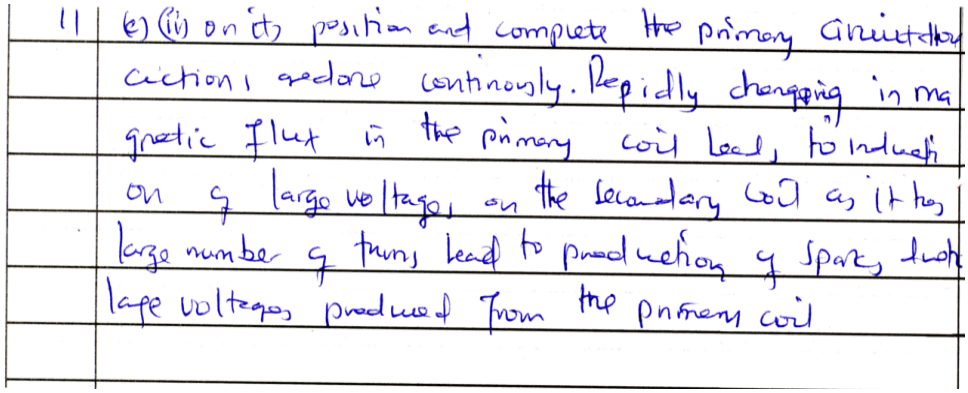
(c)(i) Induction coil is the electrical system which can produce large voltages from small alternating voltage through two electrical circuits connected on the same iron core.

(ii) Structure of an induction coil.



Mode of action

The induction coil is made up of primary coil which has small number of turns and secondary coil which has large number of turns. When the switch K is closed then the current will flow in the primary coil and cause magnetization of the soft iron core which will attract the iron armature and break the primary circuit. After then it demagnetized and iron armature retainer



In extract 11.2, the candidate managed to apply the kinetic theory of matter to explain the expansion of solids. She/he mentioned the experiments used in the laboratory to verify the expansion of solids correctly. Similarly, the candidate managed to explain how the bimetallic thermostat and bimetallic thermometer work. Finally, he/she stated the meaning of the induction coil and comparatively described the structure and its mode of action.

3.0 CONCLUSION AND RECOMENDATIONS

3.1 Conclusion

The analysis of the candidates' performance question-wise in CSEE 2014 in Physics paper 1 portrays that, two questions were well performed, one was averagely performed and eight were poorly performed. This is connected with analysis of performance in each topic as summarized in the appendix. According to the appendix, the question/topic was graded as poorly, averagely or well performed if the percent of the candidates who scored 30 percent or above of marks allocated to a particular question was from 0-29, 30-49 and 50-100 respectively.

The only topic which had good performance was Geophysics and Sustainable sources of energy and the topics which were poorly performed by the candidates were waves, Newton's laws of motion, Thermal Expansion and Electromagnetism, Radioactivity, Application of vectors and Friction, Electronics and Thermionic Emission and Light as shown in the appendix.

Question-wise analysis has shown that the candidates encountered problems in stating the laws and manipulating the formulas to solve the questions which involve mathematics. For example, question 4, 6 and 8.

The candidates also lacked knowledge on how different terms and quantities can be defined and distinguished from other quantities.

Poor English Language communication skills deemed to be a great obstacle to good performance of most of the candidates as they failed to integrate and organize their work in proper words. This was observed in questions which needed explanation of facts or concepts as per the requirement of the question, for example, questions 5, 7, 8, 9, 10 and 11.

The candidates' poor performance could have been contributed among other factors by inadequate preparation of students for mastering the subject, such as insufficient classroom exercises and poor self-learning techniques. Other attribute could be lack of resources; both human and material to facilitate teaching and learning processes. These trends need to be curbed and if possible eradicated in order to alleviate performance for the present and the future generation in Physics and other science subjects.

3.2 Recommendations

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

(a) Candidates have to prepare themselves for the examinations and carefully read and understand the requirements of the questions while doing examinations.
(b) Candidates have to concentrate on theories and the content of each topic in the syllabus, in order to acquire deep understanding of the concepts there in.
(c) Candidates have to put more emphasis on acquiring mathematical skills to enhance their learning and therefore, eliminate the problem of doing questions which involve computations.
(d) Candidates have to be allotted with adequate tasks to accomplish in the process of learning so as to make them eager to learn.
(e) Candidates should be encouraged to use English Language which is a medium of instruction, in their day to day communication that is, in the school and out of the school so as to improve their language proficiency.
(f) Teachers should promote the spirit of understanding the subject matter of every topic in receiving the required knowledge in order to develop candidates' enthusiasm and their talents.

(g) Teachers should take deliberate measures to undergo an effective teaching on the topics which the candidates seem to perform poorly as shown in the appendix.

Appendix

Summary of performance of candidates-Topic-wise

S/N	Topic	Question Number	Percentage of candidates who scored 30 percent or above	Comments
1	Structure and Properties of Matter, Friction, Light, Waves, Current Electricity, Radioactivity, Motion in a Straight Line (Motion under gravity)	1	81.4	Good
2	Geophysics and Sustainable Sources of Energy	9	70.4	Good
3	Thermal Expansion	2	39.3	Average
4	Light	7	20.4	Weak
5	Electronics and Thermionic Emission	10	15	Weak
6	Application of Vectors and Friction	6	11.3	Weak
7	Radioactivity	8	10.5	Weak
8	Thermal expansion and Electromagnetism	11	10	Weak

9	Static electricity, Pressure, Electromagnetism, Radioactivity, Light, Astronomy, Geophysics, Electronics, Current Electricity, Thermal Energy	3	9.5	Weak
10	Newton's Law of Motion	4	9.3	Weak
11	Waves	5	7.7	Weak