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

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT ON THE CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (CSEE) 2021

PHYSICS

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031 PHYSICS

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FOREWORD

The Certificate of Secondary Education Examination (CSEE) is a summative evaluation done after four years of secondary education. The Examination intends to examine the candidates' performance and provide an overview of the efficiency of the education system. The responses given by candidates to examination questions is the key indicator of what the education system was able or unable to offer to the candidates in their four years of study.

The candidates' item response analysis report in the Physics subject for the 2021 CSEE, has been prepared in order to give feedback to candidates, teachers, parents, policy makers and the public in general on how the candidates responded to the examination questions.

The report points out some of the factors which made the candidates fail or score high marks in the examination questions for the year 2021. The analysis shows that most of the candidates who scored high marks had the following attributes: adequate knowledge on the examined subject matter, ability to identify the task of each question, proficiency in the English Language, and sufficient mathematical and drawing skills. On the contrary, the candidates who scored low marks lacked such qualities.

The recommendations provided in this report will help educational administrators, school managers, teachers and candidates to identify appropriate methods to be followed in order to improve the candidates' performance in future examinations administered by the Council.

The Council appreciates the effort of the examination officers and all others who participated in the preparation of this report. The Council is also thankful to staff members who were involved 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 Form Four National Examination (CSEE) 2021 in the Physics subject. The examination consisted of two papers namely, 031/1 Physics 1 (Theory paper) and 031/2 Physics 2 (Actual Practical paper). The examination was set according to the 2010 revised Physics Syllabus for secondary education and it measure of the competences attained by the candidates after completing four years of study in ordinary level secondary school.

The Physics theory paper consisted of three (3) sections, namely A, B and C. Section A comprised of two (2) objective questions. The first question had ten (10) multiple choice items constructed from ten (10) different topics. The second question contained five (5) homogeneous matching items. Section B comprised six of (6) short answer questions. Section C consisted of three (3) questions. The candidates were required to answer all questions from section A and B and two questions from section C.

The practical examination had three alternative papers: 031/2A Physics 2A, 031/2B Physics 2B and 031/2C Physics 2C. Each alternative paper consisted of two questions, each carrying 25 marks, to make a total of 50 marks.

This report provides a comprehensive analysis of the candidates' performance in each question. It commences by indicating the requirement of the question and then provides the analysis of candidates' performance. It also highlights some misconceptions observed and outlines some reasons behind the candidates' performance in a particular question. The performance of the candidates is expressed in percentage. The performance of the candidates in each question is divided into three categories, which are weak performance, ranging from 0 - 29 per cent, average performance, ranging from 30-64 per cent; and good performance, ranging from 65 - 100 per cent. Different colours are used to distinguish the performance of candidates; red, yellow and green colours represent weak, average and good performance respectively.

The samples of candidate's responses are inserted in extracts to represent good and weak cases. Graphs and charts are used to summarize the candidates' performance in a particular question. Clarifications on specific questions and extracts of candidates' answers have been exhaustively explained to illustrate a particular case.

This report provides some recommendations that may help to improve the candidates' performance in future examinations. In addition, the report has the appendices which indicate the performance of candidates in each topic.

The number of candidates who sat for the Physics subject in CSEE 2021 was 116,610 out of which 64,096 (55.33%) candidates passed and 52,514 (44.67%) failed. In the year 2020 the candidates who sat for this subject were 120,856 out of which 58,808 (48.87%) passed and 62,048 (51.13%) candidates failed. This indicates that the candidates' performance in Physics for the year 2021 has increased by 6.46 per cent. The analysis reveals the strengths and weaknesses of the performance of the candidates.

2.0 ANALYSIS OF THE CANDIDATES' PERFOMANCE IN EACH QUESTION

This part describes the performance of the candidates in each question. The analysis part covers the sections, type of questions, topics from which the questions were set, requirements of the questions and the performance of candidates in each question. The candidates' scores have been analysed as weak, average and good according to the performance.

2.1 Section A: Objective Questions

This section comprises of two (2) questions; (1 and 2) which covered different concepts from 11 topics. Question 1 had 10 multiple choice items which weighed 10 marks and question 2 was a matching item constructed from the topic of Waves which weighed 5 marks. The section had a total of 15 marks.

2.1.1 Question 1: Multiple Choice Items

This question consisted of ten (10) multiple choice items numbered (i) to (x). The candidates were required to choose the correct answer from the five (5) given alternatives and write its letter (A, B, C, D or E) against the item number in the answer book provided. The question items were constructed from the topics of: *Measurement, Light, Magnetism, Motion in a straight line, Temperature, Sustainable energy sources, Transfer of thermal energy, Vapour and Humidity, Thermionic emission and Elementary Astronomy.*

The question was attempted by 116,591 (100%) candidates out of which 39,362 (33.76%) scored from 0 to 2 marks, 74,704 (64.07%) scored from 3 to 6 marks, and 2,525 (2.17%) scored from 7 to 10 marks. These scores indicate that the general performance of the question was good as 77,229

(66.24%) scored from 3.0 marks and above. The performance of candidates in this question is summarized in Figure 1.

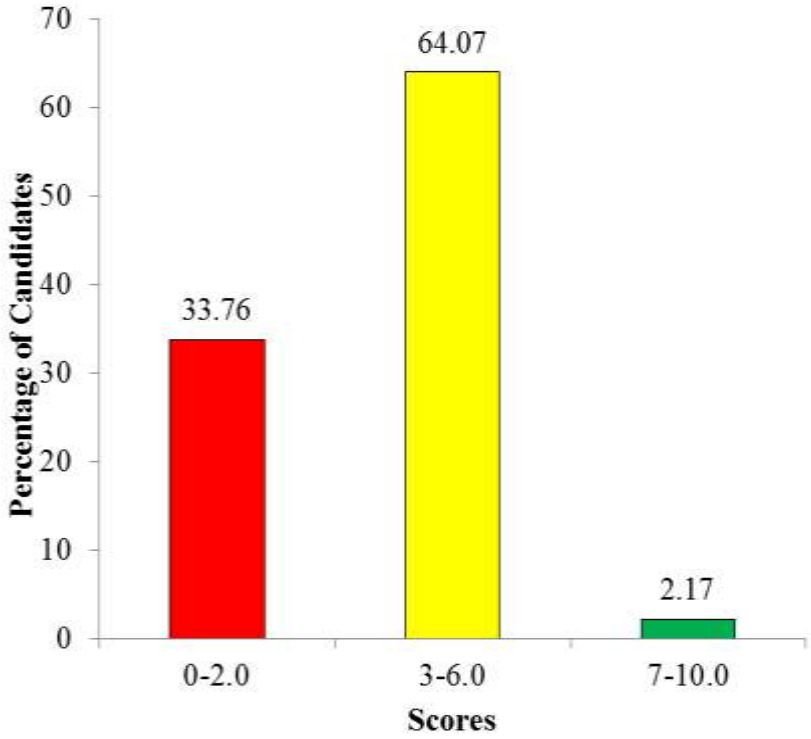


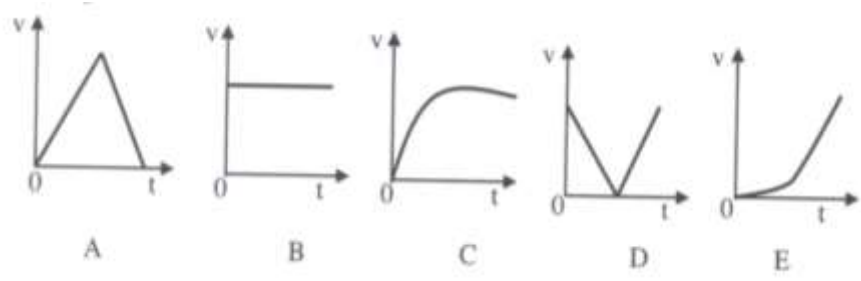
Figure 1: *The candidates' performance in question 1*

Item (i) was from the topic of *Measurement*. The candidates were asked to choose an alternative which explains how the density of a stone with mass X when in air and volume Y when fully immersed in water can be found. The alternatives were; A. *"By dividing the reduced mass of stone to the volume of the water displaced"*; B. *"By dividing the mass of stone in the air to the volume of the water displaced"*; C. *"By dividing the apparent mass of the stone in the water to the volume of the water displaced";* D. *"By dividing the mass of the stone in air to the upthrust"*; and E. *"By dividing the apparent mass of the stone to the upthrust"*. The correct alternative was B. *"By dividing the mass of stone in the air to the volume of the water displaced"*. Most of the candidates got the correct response showing that they had knowledge on the concept of density. Those who opted for distractors A, C, D or E, lacked the knowledge of how the density of irregular and insoluble substances can be found.

Item (ii) was set from the topic of *Light*. Candidates were required to identify the property of concave mirrors which is suitable for a dentist to consider when selecting concave mirrors for repairing dentals. The alternatives were; A. *"The one which produce diminished image"*; B. *"The one with wider field of view"*; C. *"The one which produce virtual and erect image"*; D. *"The one which produce large magnification"*; E. "*The one in which objects and images are seen easily"*. The correct alternative was D, "*The one that produce larger magnification"*. In order to get the correct response, the candidates were required to know the properties and characteristics of images formed by concave mirrors when the object is situated in different positions. This could help them know the location or position which an object should be placed so as to give a magnified image. The candidates who opted for the distractors A, B, C and E lacked proper knowledge about the property of concave mirrors used for repairing dentals.

Item (iii) was from the topic of *Magnetism*. The candidates were required to identify one statement which is not a property of magnetic lines of force from the following alternatives: A. *"Are continuous and always form closed loops"*; B. *"Start at the North Pole and end at the South Pole*"; C. *"Never cross one another"*; D. *"Enter or leave a magnetic material at right angles to the surface"* and E. *"Pass through magnetic materials only"*. The correct alternative was E. "*Pass through magnetic materials only*". In order to select the correct response, the candidates were supposed to understand the concept of magnetism specifically, the properties of magnetic lines of force. Some of the properties include: each line is a closed and continuous curve; they originate from the North Pole and terminate at the South Pole; they will never intersect each other; and they are crowded near the poles where the magnetic field is strong, hence the property "They pass through magnetic materials only" was considered as the correct response.

Item (iv) was from the topic of *Motion in a straight line*. The candidates were required to identify the velocity-time graph which represents the motion of the ball thrown vertically upwards and returning to the ground from the following alternatives:



The correct alternative was D. The candidates were supposed to know the relationship between velocity and time for the body which is thrown vertically upward and return to the ground. Most of the candidates chose response 'A' because they had little knowledge on the concept of motion of the body thrown upwards. The candidates were supposed to consider that: Velocity will decrease according to equation v = u-gt where u is the initial velocity (at t = 0) so the graph cannot start from the origin because u is not zero as thrown with some velocity and v is the final velocity. Then $t = \frac{u}{g}$, the v will become zero and will start increasing in the opposite direction and hence making option 'D' correct.

Item (v) was from the topic of *Temperature.* The candidates were required to choose an option that describes the difference between maximum thermometer and minimum thermometer. The alternatives were; A. *"Maximum thermometer uses mercury while minimum thermometer uses alcohol"; B. "Maximum thermometer measures temperature of the solid object while minimum thermometer measures temperature of the liquid"*; C. *"Maximum thermometer measures temperature in Kelvin while minimum thermometer measures temperature in degrees centigrade"*; D. *"Maximum thermometer has concave meniscus while minimum thermometer has convex meniscus"* and E. *"Maximum thermometer has index below the meniscus while minimum thermometer has index above the meniscus"*. The correct alternative was A. *"Maximum thermometer uses mercury while minimum thermometer uses alcohol*". The candidates who opted for C. "*Maximum thermometer measures the temperature in Kelvin while minimum thermometer measures the temperature in degrees centigrade*" were confused by the unit Kelvin and degrees centigrade while the question required the differences. The candidates who opted for other distractors B, D and E, had no knowledge on the differences between maximum and minimum thermometers. The candidates were supposed to know that maximum thermometer uses mercury as a thermometric liquid so

that it can measure the highest temperature because mercury has a high boiling point while the minimum thermometer uses alcohol because it has high melting point than mercury so it can easily register the minimum temperature of the body.

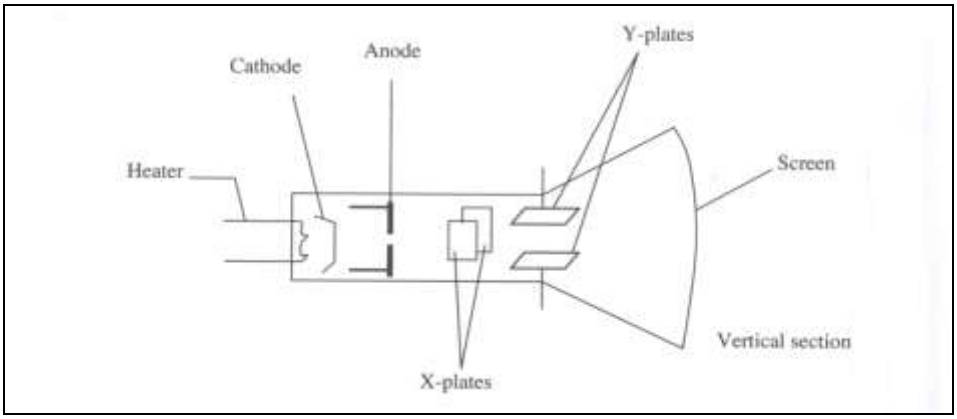
Item (vi) was from the topic of *Sustainable energy sources*. The candidates were given four different properties (1) Energy is virtual available (2) Not reliable (3) Environmental friendly (4) Turn turbine to drive generators; and asked to identify the properties which correctly describe hydroelectric energy. The alternatives were A. *"(1), (2), (3) and (4)";* B. *"(1), (2) and (4)"*; C. *"(1), (3) and (4)"*; D. *"(2), (3) and (4)"*; E. *"(1), (2) and (3)"*. The correct alternative was C. *"(1), (3) and (4)"*. The candidates who scored correctly this item had a clear understanding of the properties of renewable and non-renewable sources of energy. They knew that hydroelectric energy is renewable energy and hence it is environmental friendly, reliable and naturally available and turns turbine to drive generators.

Item (vii) was from the topic of *Transfer of thermal energy*. The candidates were required to choose the letter with the statement that explains why people prefer a white shawl to wrap around a baby to keep the baby warm. The given alternatives were: A. *"White shawl is a poor conductor"*; B. *"White shawl indicates cleanliness"*; C. *"White shawl is the poor radiator";* D. *"White shawl has pockets of air trapped in it"*; E. *"White shawl is a good reflector of heat"*. The correct alternative was C *"White shawl is the poor radiator"*. The item measured candidates' understanding of the application of the methods of transfer of thermal energy (conduction, convection and radiation) which could help them understand the concepts of absorbers, emitters and reflectors on dark/black bodies and white/shiny/polished bodies. The candidates who got it correct had this knowledge.

Item (viii) was on the topic of *Vapour and Humidity*. The candidates were required to choose a letter with a correct statement about a wet-and-dry bulb hygrometer. The given alternatives were; A. *"Wet bulb thermometers measure the temperature of the surrounding air"*; B. *"The temperature recorded by a wet-bulb thermometer is always larger than that recorded by a dry-bulb thermometer"*; C. *"When the difference in temperature recorded by wet and dry bulb is larger no water evaporates"*; D. *"The value of relative humidity is low when the temperature of wet and dry bulbs is the same"*; E. *"Wet-bulb is cooled by the process of evaporation of water"*. The correct alternative was E "*Wet-bulb is cooled by the process of*

evaporation of water". Majority of the candidates opted for D. *The value of relative humidity is low when the temperature of wet and dry bulbs is the same"*and ended missing the marks. This may be partly due to lack of knowledge on the concept of hygrometer and partly due to the presence of the term humidity in that statement which made them relate to the term hygrometer. From the correct response they did not known that evaporation results into a cooling effect.

Item (ix) was from the topic of *Thermionic emission*. The candidates were required to study the given diagram of a cathode ray oscilloscope and then choose a letter with the correct statement that describes the conditional change which can lead into producing a brighter trace on the screen.



The alternatives were; A. *"Using time-based and connect alternating voltage to Y-plates";* B. *"Increasing the anode voltage"*; C. *"Switching off time-based and connect battery to Y-plates"*; D. *"Switching off time-based and connect alternating voltage to Y-plates"* and E. *"Using time base only"*. The correct alternative was B. "*Increasing the anode voltage"*. The candidates who got the right answer showed good understanding of the concept of cathode ray oscilloscope as they knew functions of each part. The cathode plate is heated to eject beam of electrons, the anode then accelerates (speeds up) that beam of electrons and the X and Y plates deflect the beams horizontally and vertically respectively.

Item (x) was from the topic of *Elementary astronomy*. The candidates were required to choose a statement which distinguishes gravity from gravitational force. The alternative statements were; A. *"Gravity is the force that pulls objects towards the earth while gravitational force is the attractive force existing between any two objects"*; B. *"Gravity is the force of attraction between objects while gravitational force is the force acting to*

pull objects towards the earth"; C. *"Gravity is sometimes called universal gravitation while gravitational force is also called centripetal force"*; D. *"Gravity is applicable from the largest stars to the smallest atoms while gravitational force does not"* and E. *"Gravity holds planets to revolve around the sun while gravitational force does not hold planets"*. The correct alternative was A. *"Gravity is the force that pulls objects towards the earth while gravitational force is the attractive force existing between any two objects"* This majority of the candidates got the item wrong as they were unable to precisely differentiate between gravity and gravitational force. The two terms gravitational force and gravity are used often to explain the same thing (*interchangeably one to mean the other as seen in option B*) but they are different. Gravitational force is the attractive force between any two bodies with masses while gravity is the gravitational force that occurs specifically between the earth and other bodies (it pulls objects towards the earth).

2.1.2 Question 2: Matching Items

This question was constructed from the topic of *Waves*. The candidates were asked to match five functions of instruments in List A (*premises*) with their corresponding instruments in List B (*responses*) by writing the letter of the correct response beside the corresponding item number in the answer book provided. Each item carried one (1) mark making a total of five (5) marks.

List A	List B
(i) Helps to observe the behaviours of waves.	A. Resonance tube
(ii) Discriminates sound waves based on frequency, amplitude and direction.	B. Guitar
(iii) Produces heat energy used to heat the food.	C. Turning folk
(iv) It is used to determine the resonance in an air column.	D. Microwave oven
(v) Helps to study the properties of stationary waves.	E. The human ear
	F. Sonometer
	G. Ripple tank
	H. Radar

A total of 116,592 (100%) candidates attempted the question and their scores were as follows: 28,996 (24.87%) scored from 0 to 1.0 mark, 52,863 (45.34%) scored from 2 to 3 marks and 34,733 (29.79%) scored from 4 to 5 marks. These scores indicate that candidates' performance was good as

87,596 (75.13%) scored from 2 to 5 marks out of 5 marks allocated to this question. Figure 2 summarizes the candidates' performance in this question.

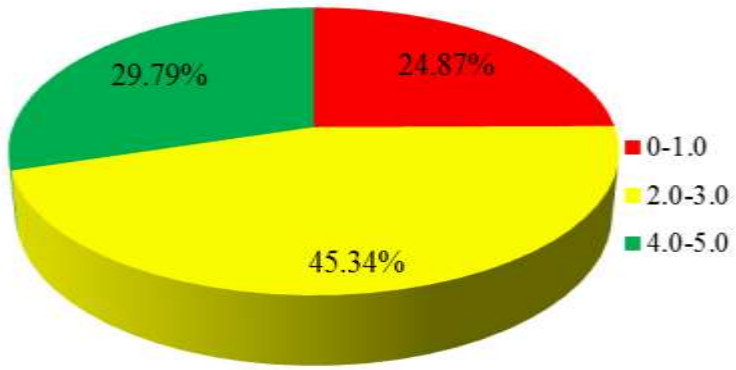


Figure 2: *The candidates' performance in question 2*

The analysis of the performance of the candidates in each of the items in this question is as follows:

In item (i), the candidates were required to provide a suitable response that matched correctly with the phrase *"Help to observe the behaviors of waves"*. The correct response was G. "*Ripple tank*". The item was well performed by most of the candidates, showing that they had good knowledge on how the ripple tank works in-relation to waves. Most of the candidates, who failed to select the correct response, chose resonance tube. These candidates did not understand that a ripple tank is a transparent shallow tray of water with a light shining down through it onto a white card below used to measure and calculate frequency, wavelength and the speed of waves on the water's surface. It is also used to observe the behaviours of waves such as reflection, refraction, diffraction and interference. Whereas a resonance tube is a musical instrument (a hollow cylindrical tube) partially filled with water and forced into vibration by a tuning fork.

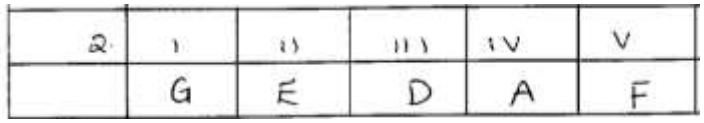
Item (ii) required the candidates to identify a response that matched correctly with the statement "*Discriminates sound waves based on the frequency, amplitude and direction",* the correct response was E. "*The human ear*". Most of the candidates matched it correctly. However, a few candidates failed to identify the functions of the human ear. These candidates were supposed to realize that the function of the ear is to

transmit and transduce sound to the brain through the parts of the ear based on frequency, amplitude and direction.

In item (iii), the candidates were required to match precisely the statement *"Produces heat energy that heat the food"*. The correct response was D. "*Microwave oven*". In order for the candidates to match this item correctly they were supposed to understand the applications and properties of electromagnetic waves. The microwave causes water molecules in food to vibrate, producing heat that cooks the food.

Item (iv) required the candidates to identify a suitable instrument which matched correctly with statement "*It is used to determine the resonance in an air column"*, the correct response was "A", "*Resonance tube"*. This item was matched correctly by most of the candidates showing that they had adequate knowledge on the concept of sound waves especially when finding the velocity of sound in air at ordinary temperatures.

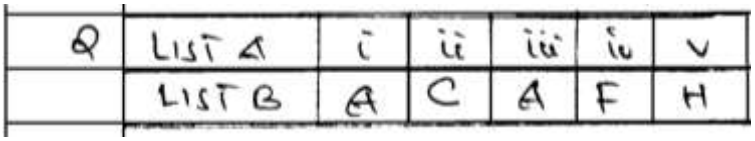
In item (v) the candidates were supposed to match the phrase *"Helps to study the properties of stationary waves"*. The correct response was F. "*Sonometer*". This item required candidates to have a good understanding of the properties of stationary waves. Some of the candidates confused the concept of sonometer and that of turning fork and hence selected the wrong response. These candidates were supposed to know that a sonometer is a device used to demonstrate the relationship between the frequency of the sound produced by a plucked string, and the tension, length and mass per unit length of the string. Whereas a turning fork vibrates at a set frequency after being struck on the heel of the hand and is used to assess vibratory sensation and hearing. Extract 2.1 shows a sample of responses from a candidate who correctly matched all items of the question.



Q.	i	ii	iii	iv	v
	G	E	D	A	F

Extract 2.1: A sample of a candidates' good response to question 2

Extract 2.2 shows a sample of responses from a candidate who incorrectly matched all items of the question.



Extract 2.2: A sample of a candidates' weak response to question 2

Extract 2.2 shows that the candidate had inadequate knowledge of the functions of various instruments used in the concept of waves.

2.2 Section B: Short Answer Questions

This section comprised of six (6) short answer questions. The questions required brief explanations and /or computations or drawings using well labelled diagrams. They were set from eleven topics namely: *Pressure*, *Forces in Equilibrium*, *Light*, *Optical Instruments*, *Measurement of Thermal Energy*, *Radioactivity*, *Newton's Laws of Motion*, *Simple Machines*, *Thermal Expansion*, *Geophysics*, *Waves*, *Current Electricity*, *Electronics* and *Electromagnetism*. Each question carries ten (10) marks, making a total of 60 marks.

2.2.1 Question 3: Pressure and Forces in Equilibrium

In this question, candidates were required to (a) use a diagram to describe how manometer can be used to measure the pressure of a gas at a gas-tap and (b) calculate the tension in each wire of a uniform metal cube of length 5 m and mass 9 kg which is suspended horizontally by two wires attached at 50 cm from the left end of the cube and 150 cm from the right end of the cube.

This question was attempted by 116,486 (99.9%) candidates out of which 105,768 (90.80%) scored from 0 to 2.5 marks, 9,901 (8.50%) scored from 3.0 to 6.0 marks and 817 (0.70%) scored from 6.5 to 10 marks. The general performance of candidates in this question was weak since 105,768 (90.8%) scored marks in the lowest range of marks (0 - 2.5 marks). Figure 3 summarizes the performance of candidates in this question.

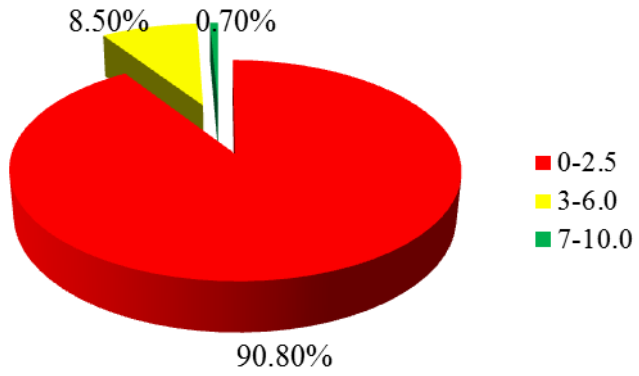
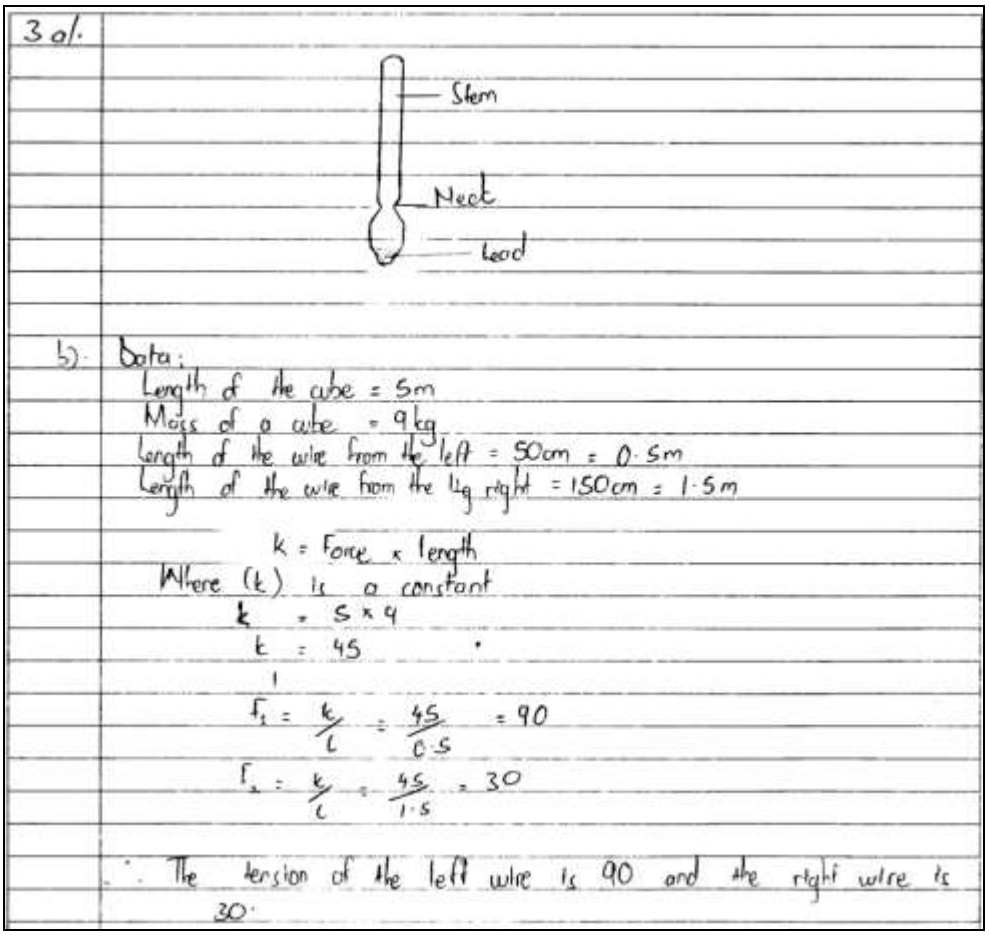


Figure 3: *The performance of candidates in question 3*

The candidates who scored low marks in part (a) lacked knowledge of the instrument used to measure the pressure of gas (*manometer*) and had poor drawing skills. Majority of the candidates not only failed to draw a diagram of a manometer but also failed to describe how it is used to measure the pressure of the gas at the gas-tap. It was also observed that some of the candidates confused the use of manometer with that of a barometer. These candidates were supposed to recognize that a barometer is a scientific instrument used to measure atmospheric pressure whereas a manometer is a device that we use to measure the pressure of the pipelines such as gas, water or liquids. It is also usually referred to as a U-shaped tube that is filled with a liquid.

In part (b), some of the candidates could not apply the principle of moments which made them fail to calculate the tension of each supporting wire. They did not know that for a system to rotate one has to assume that a moment is about one supporting wire which then shifts the moment to another supporting wire. That could assist them apply the correct method to obtain the required answers. Extract 3.1 shows a sample of candidates' weak response.



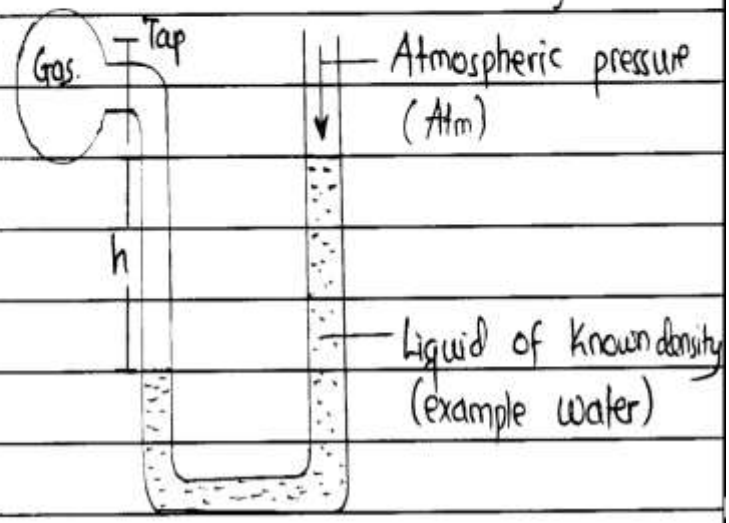
Extract 3.1: A candidate's weak responses to question 3

In extract 3.1, the candidate drew and labelled the diagram of a hydrometer which is a concept of Archimedes principle and the law of flotation instead of a diagram of a manometer and how it is used to measure the pressure of the gas. Consequently, he/she incorrectly employed the concept of Hooke's law instead of the concept of Forces in equilibrium, particularly, the principle of moments.

The candidates who performed well in part (a) of this question had adequate knowledge on the concept of pressure in a gas and drawing skills as they were able to draw a correct labeled diagram of the manometer and explain its mode of action. In part (b), few candidates managed to apply the knowledge of the principle of moments and mathematical skills to calculate the tension in each wire from the given data. Extract 3.2 is a sample of candidate's good response to question 3.

3. a) Manometer is a u-shaped divice connected with a gas filled chamber used to determine gas pressure. The gas pressure can be high or Low.

first case: Gas pressure being higher



3. Explanations ·

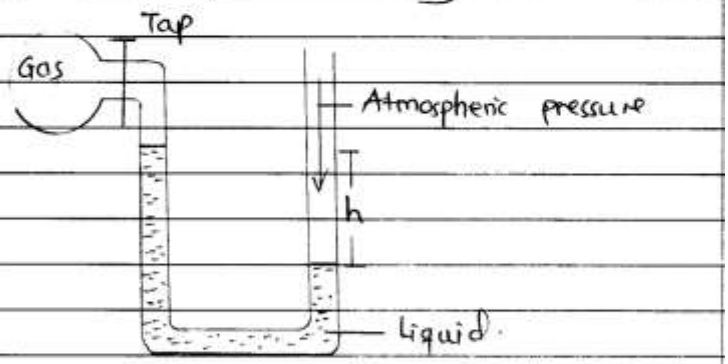
A fluid with a known density example water is filled in a U-shaped tube. The pressure of the gas being greater the fluid is pushed further at the left and rises more to the right to create a difference in height, h. At the open end is atmospheric pressure, Atm acting on the liquid

Gas pressure is determined by;

Gas pressure = Pressure due to fluid (liquid) + Atmospheric pressure

$$\text{Gas pressure} = \rho_{liquid} \times h \times g + \text{Atmospheric pressure}$$

Second case: Gas pressure being Low.



Explanations ·

When the gas pressure is low, then the liquid column in the left raises higher than in the right to create a difference in height at the right · for this case the atmospheric pressure is higher than the gas pressure;

$$Atm = \rho_L \times h_L \times g + \text{Pressure due to gas}$$

Then;

$$\text{Pressure of the gas} = \text{Atmospheric pressure} - \rho_L \times h_L \times g.$$

3. b) Data

Length = 5m = 500cm

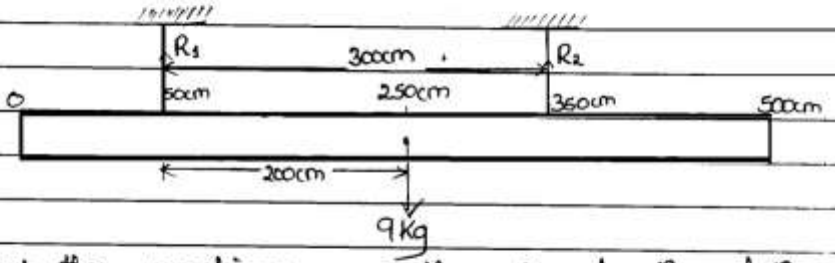
m = 9kg

L_1 = 50cm from left.

L_2 = 150cm from right

Required: Tension on each wire.

Illustration.



Let the reactions on the wires be R_1 and R_2 respectively.

Using R_1 as the pivot;

From the principle of moments;

Total clockwise moments = Total anticlockwise moments

(F x d) clockwise = (F x d) anticlockwise.

$9kg \times 200cm = R_2 \times 300cm$

$R_2 = \frac{9kg \times 200cm}{300cm}$

$R_2 = \frac{18\ kg}{3}$

$R_2 = 6kg$

$F = mg$

$F = 6 \times 10$

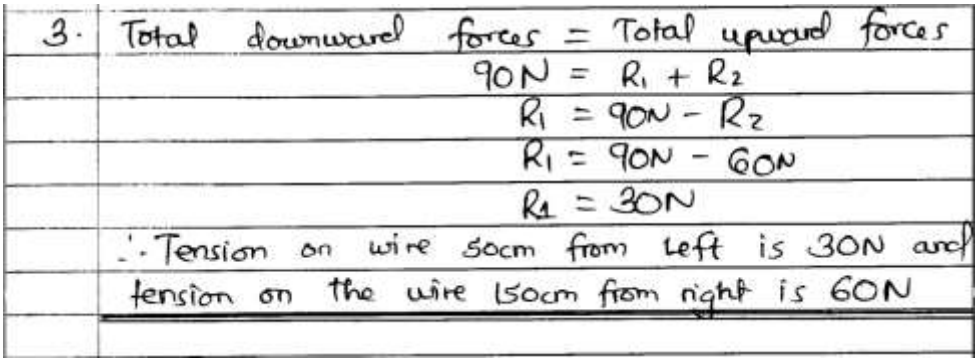
$F = 60N$

$R_2 = 60N$

Also,

$F = 9 \times 10$

$= 90N$



Extract 3.2: A candidate's good response to question 3

In extract 3.2 the candidate managed to answer all parts of the question correctly showing a good understanding of the concept of pressure particularly, the use of a manometer and the principle of moments in calculations involving tension and reaction forces.

2.2.2 Question 4: Light and Optical Instruments

This question comprised of two parts, namely (a) and (b). In part (a) the candidates were required to use a diagram to show that, when a plane mirror is rotated through an angle θ about an axis normal to the plane containing incident ray and normal, the reflected ray rotates through an angle 2θ. In part (b) the candidates were required to use a graphical method to determine the position of the first image formed by a compound consisting of two lenses of focal length 12 cm and 6 cm for the objective lens and eyepiece lens respectively. The two lenses being separated by a distance of 30 cm and the microscope focused to a point where the image is formed at infinity.

The question was attempted by 116,500 (99.9%) candidates out of which 113,607 (97.51%) scored from 0 to 2.5 marks, 2,747 (2.36%) scored from 3.0 to 6.0 marks and 146 (0.13%) scored from 6.5 to 10 marks. These data indicate that the general performance was weak as 113,607 (97.52%) candidates scored from 0 to 2.5 marks. Figure 4 depicts a graphical representation of the performance of the candidates in this question.

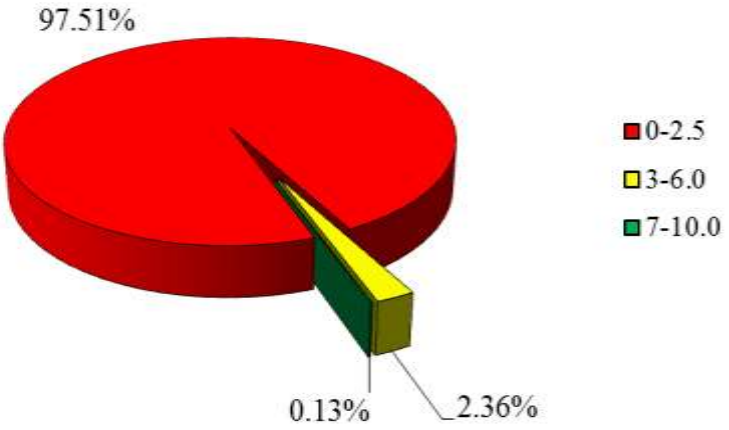


Figure 4: *Performance of candidates in question 4*

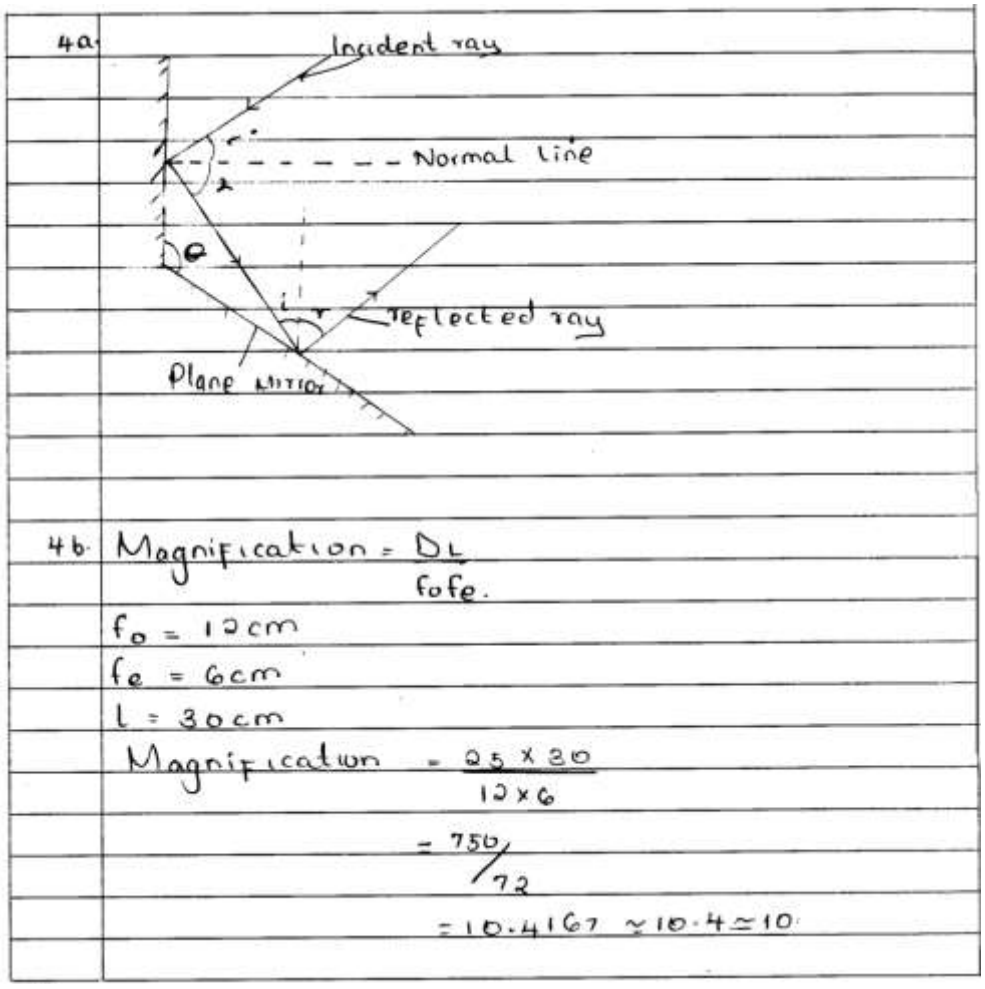
The weak performance in part (a) of the question was contributed by poor knowledge on the concept of light especially the laws of reflection of light and rotating mirrors. The principle that the candidates had to understand was, when the light rays fall on the smooth surface, the incident ray, the reflected ray, and the normal on the surface all lie in the same plane.

Some candidates confused the sketches of plane mirrors and ended with the wrong answer. They were supposed to know that, when the mirror is rotated through angle θ, the incidence angle is reduced while the angle of reflection increases twice to incident angle (2θ). Lack of practice could be the cause of the failure of the majority.

Majority of the candidates also failed to score marks in part (b) of the question. This was contributed by insufficient knowledge and lack of drawing skills. These candidates were not competent on the concept of optical instruments especially, the compound microscope. One of the candidates drew a concave mirror and then placed an object at the centre of a curvature along the principal axis and obtained the image at the principal focus contrary to the need of the question.

The candidates were supposed to understand that a compound microscope generally works using the following steps: first with an objective lens, that produces an enlarged image of the object in a 'real' image plane. This 'real' image is then magnified by the ocular lens or eyepiece to produce the virtual image. Hence, the final image produced is virtual and enlarged. Therefore, the candidates were supposed to use the graphical method to

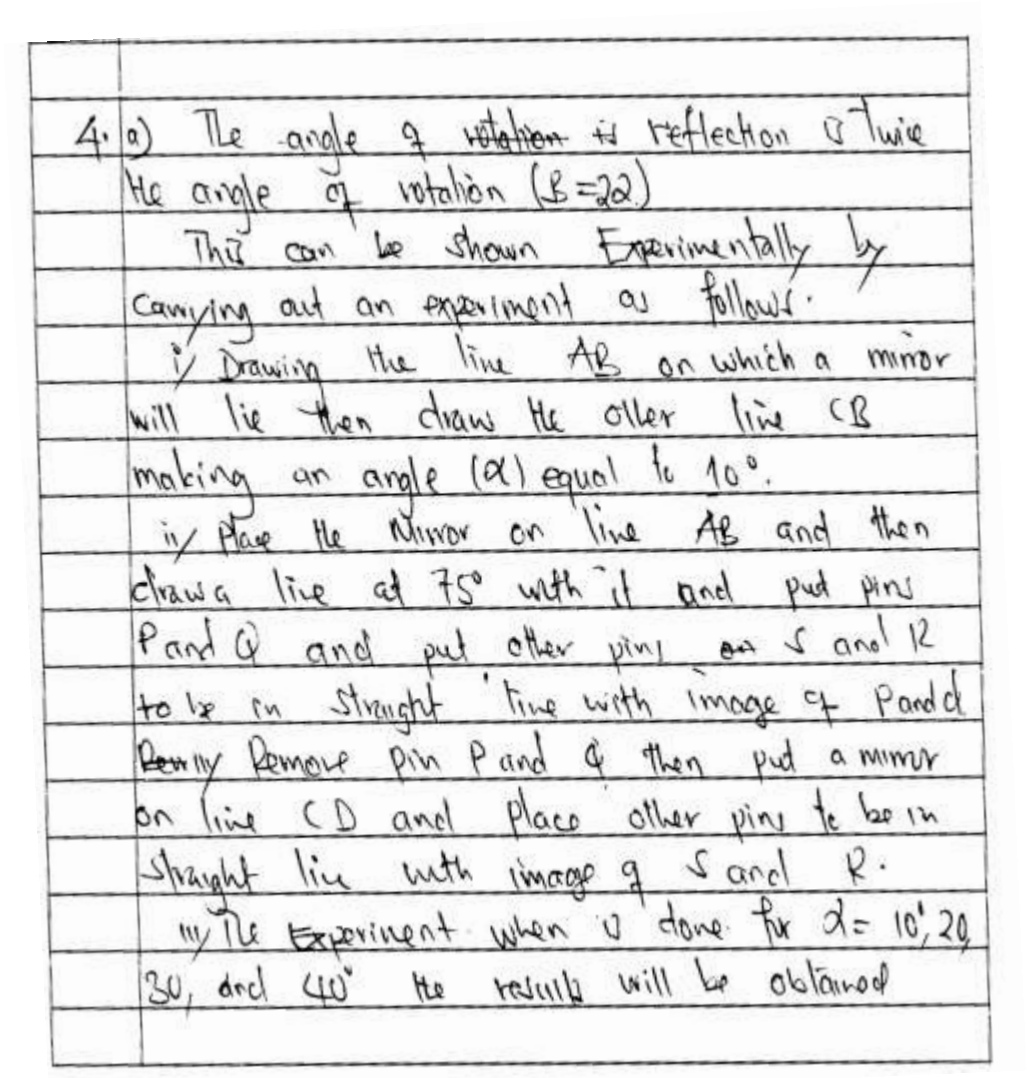
determine the position of the first image when the microscope is focused to a point where the image is at infinity. Extract 4.1 shows a sample of candidates' weak response in question 4.



Extract 4.1: A candidate's weak response to question 4

In extract 4.1 the candidate drew a diagram which is irrelevant to the demands of the question. He/she drew two plane mirrors with no rotated angle and hence missed the concept. Similarly, the candidate used an incorrect magnification formula to determine the position of the first image instead of using graph method.

The candidates who scored high marks in this question were able to draw and use the incident ray, reflected ray and the normal to show the angle of rotation of 2θ. Furthermore, using good drawing skills a few were able to illustrate using graphical method of a compound microscope with two lenses to determine the position of the first image. The candidates managed to use properly the formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ to calculate the position of the first image. Extract 4.2 is a sample of a candidate's good responses in this question.



4. a) The angle of ~~rotation~~ reflection is twice the angle of rotation ($\beta = 2\alpha$)

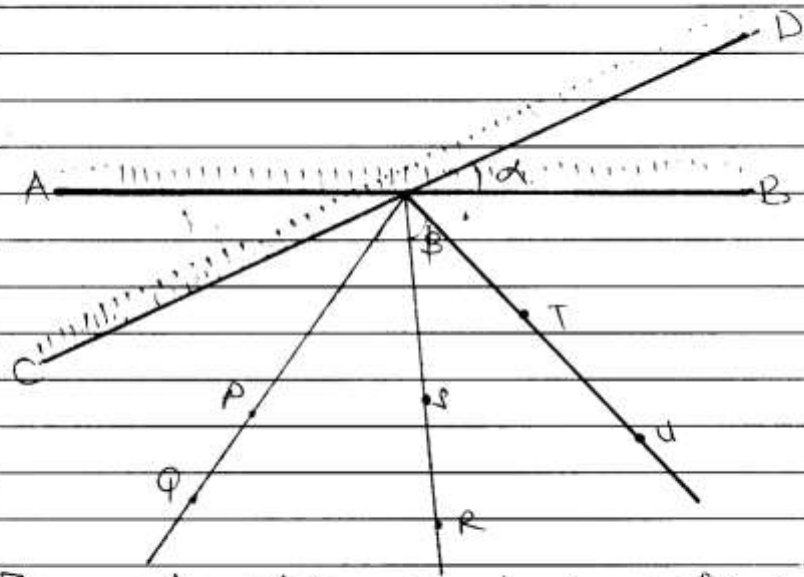
This can be shown ~~Experimentally~~ by carrying out an experiment as follows.

i/ Drawing the line AB on which a mirror will lie then draw the other line CB making an angle (α) equal to 10°.

ii/ Place the mirror on line AB and then draw a line at 75° with it and put pins P and Q and put other pins ~~on~~ S and R to be in straight line with image of P and Q ~~Remove~~ Remove pin P and Q then put a mirror on line CD and place other pins to be in straight line with image of S and R.

iii/ The Experiment when is done for $\alpha = 10°, 20°, 30°$, and 40° the results will be obtained

4. a) Consider the diagram.



The results obtained appear to be as follows

α°	10	20	30	40
β°	10	40	60	80

(ii) Plotting the graph of β° against α° follows and then the slope (m) obtained = 2.

Since, Slope (m) = 2

But $\text{Slope} = \frac{\Delta\beta}{\Delta\alpha}$

$2 = \frac{\beta}{\alpha}$

$\beta = 2\alpha$

β represent angle of reflection

α represent angle of rotation

Thus

$\Phi = 2\phi$

4. (b) Data given

Focal length of objective lens (f_o) = 12cm

Focal length of eyepiece lens (f_e) = 6cm

Separation distance = 20cm

Position of first image = ?

Refers the diagram on graph paper

For image to be formed at infinity

The object at the principle focus

Thus,

Object of eye piece lens = Focal length of eye piece

f = 6cm

u = 6cm

But, The object for eyepiece lens = Image formed by objective lens

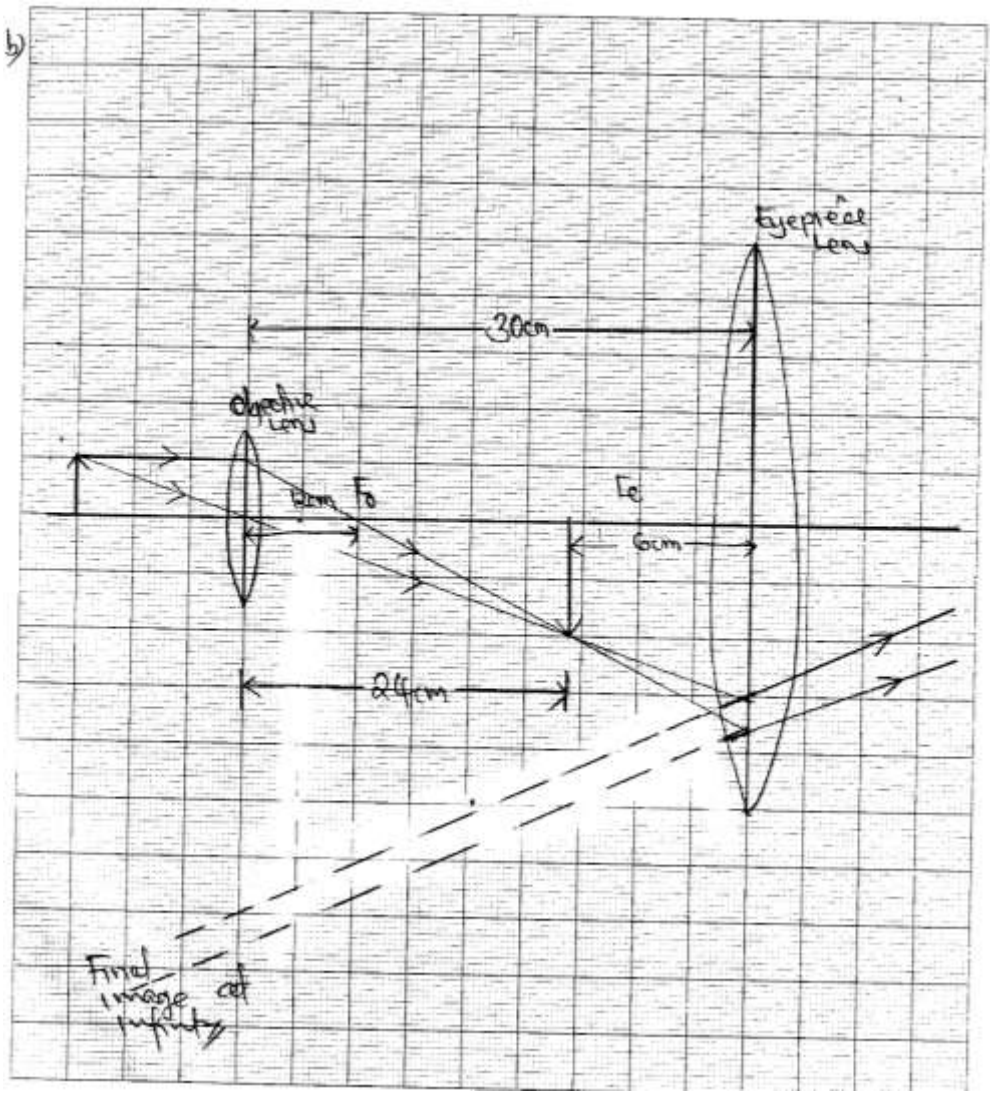
∴ The position of the first image = Focal length of eyepiece lens

Hence,

Position of first image = 6cm from eye piece lens

OR

= 24cm from the objective lens.



Extract 4.2: A candidate's good response to question 4

In extract 4.2 the candidate responded correctly to almost all parts of the question.

2.2.3 Question 5: Measurement of Thermal Energy and Radioactivity

Part (a) of this question was set from the topic of Measurement of thermal energy. The question required the candidates to determine electrical energy consumed in Kilowatt-hour when a water boiler containing 150 kg of water at a temperature of 20 ^{o}C is connected to the 240 V power supply. The resistance of the heating coil in the boiler is 25 Ω if the water in the boiler is heated to a temperature of 40 ^{o}C. Part (b) of this question was constructed from the topic of Radioactivity and required the candidates to use appropriate diagram to describe the nature, effect on electric field and penetrating power of alpha particles, beta particles and gamma rays.

This question was attempted by 116,556 (100%) candidates out of which 82,775 (71.02%) scored from 0 to 2.5 marks, 28,835 (24.74%) scored from 3.0 to 6.0 marks and 4946 (4.24%) scored from 6.5 to 10 marks. These data indicate that general performance was weak since majority 82,775(71.02%) of the candidates, scored from 0 to 2.5 marks. Figure 5 shows the candidates' performance in this question.

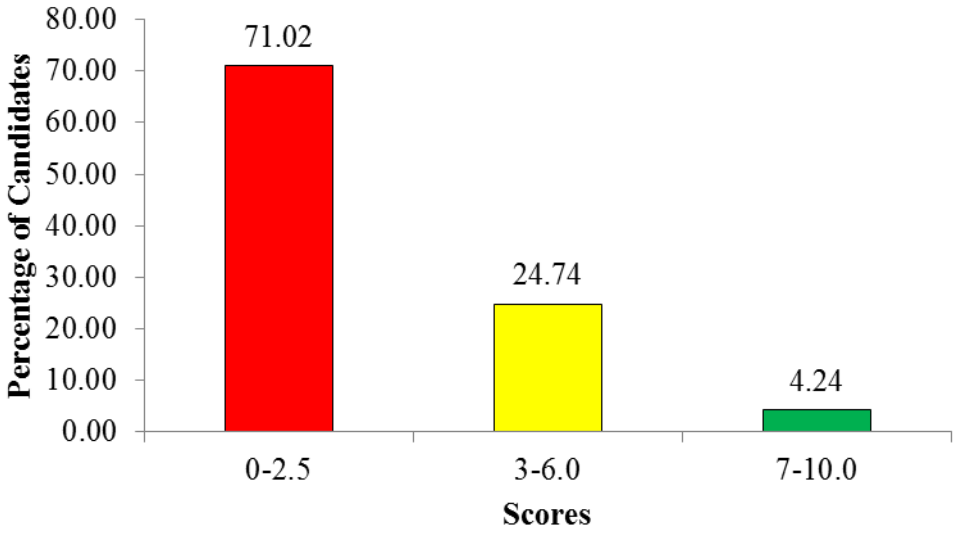
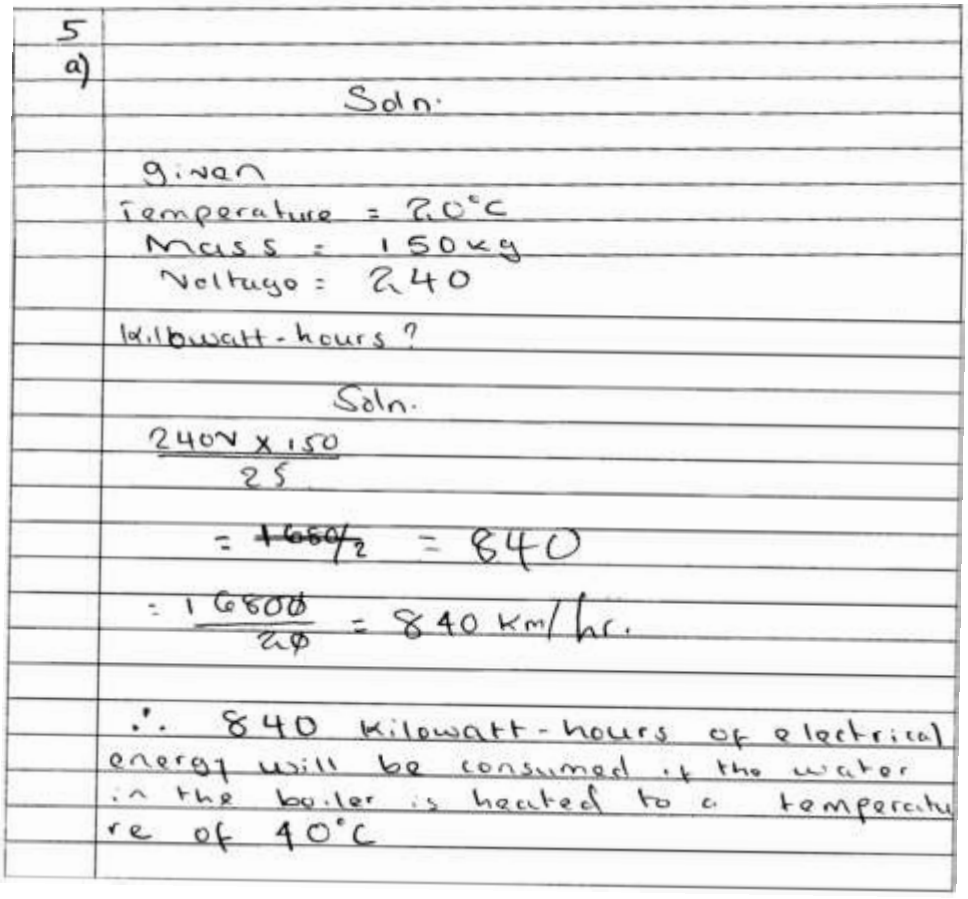


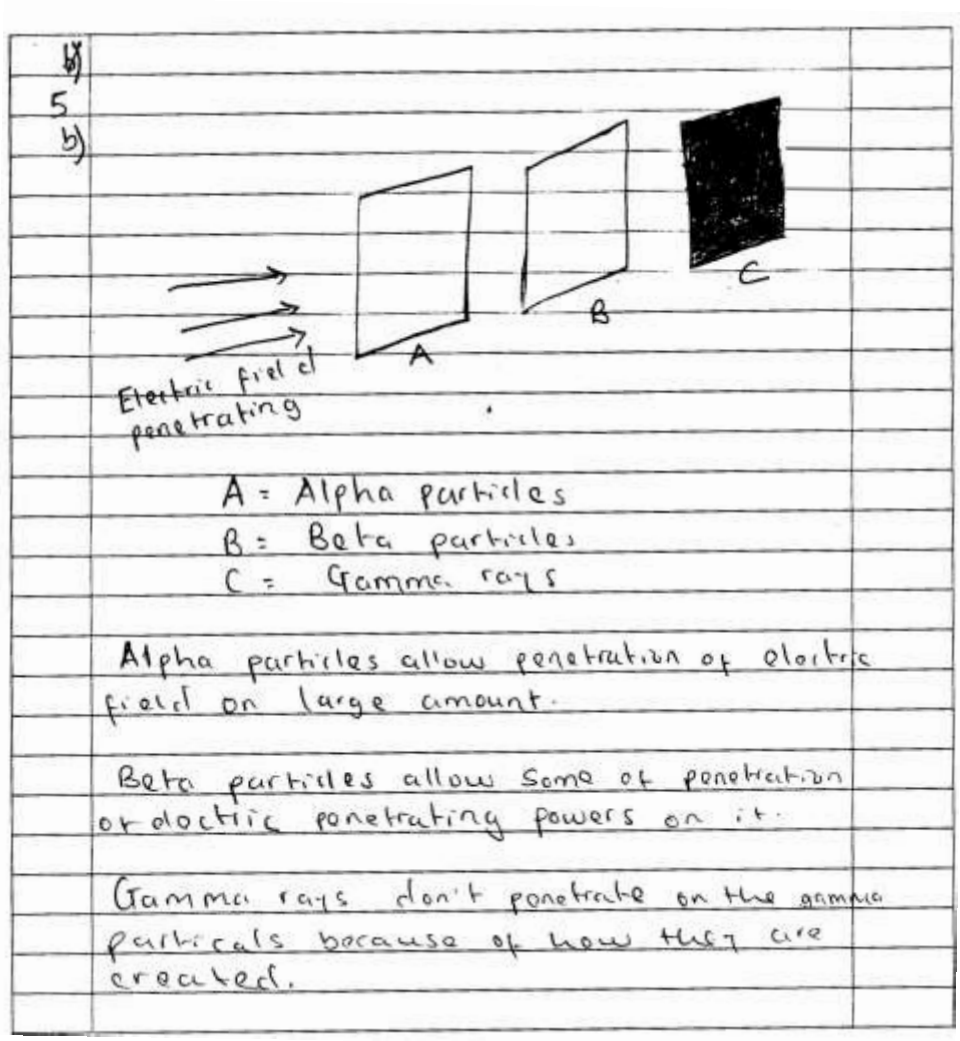
Figure 5: *Performance of candidates in question 5*

The candidates (71.02%) who got low marks (0 - 2.5) in this question lacked mastery of the concept of current electricity especially, *the heating effect of electric current*. In this question, the candidates were asked to calculate the kilowatt–hour consumed by the water boiler using the data provided. The candidates were supposed to apply the principle of conservation of energy which states *"the electrical energy dissipated by the*

coil is equal to heat energy gained by water in the boiler", using appropriate formula $\frac{V^2\,t}{R} = mc\Delta\theta$, then, kilowatt hours of electrical energy consumed = number of kilowatts × number of hours.

In part (b) of the question, the candidates were to use an appropriate diagram to describe the nature, effect on electric field and penetrating powers of alpha particles, beta particles and gamma rays. This part was correctly answered by some of the candidates and they were able to use diagrams to demonstrate the effect and penetrating powers of the particles and hence indicated that the concept of radioactivity was well understood. Generally, alpha particles are helium in nature, have low penetrating power and are deflected towards a negative plate in an electric field; beta particles are electrons in nature, have moderate penetrating power and are deflected towards a positive plate in an electric field and gamma rays are electromagnetic waves in nature, have high penetrating power and pass un-deflected through an electric field. Extract 5.1 shows a sample of a candidates' weak response to question 5.


5
a)
Soln.
given
temperature = 20°C
Mass = 150kg
Voltage = 240
kilowatt-hours?
Soln.
$\frac{240V \times 150}{25}$
$= \frac{1650}{2} = 840$
$= \frac{16800}{20} = 840$ km/hr.
∴ 840 kilowatt-hours of electrical energy will be consumed if the water in the boiler is heated to a temperature of 40°C



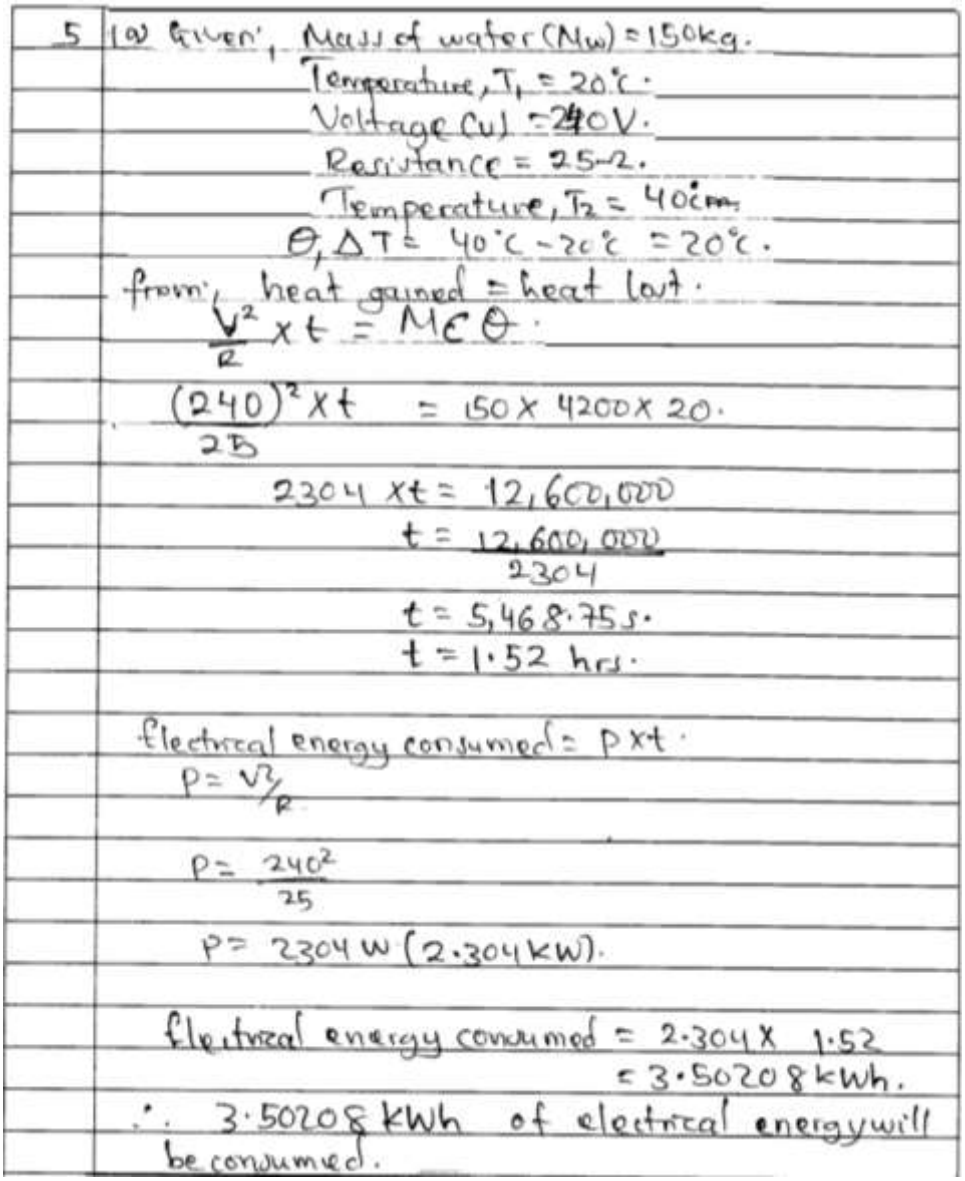
Extract 5.1: A sample of candidate's weak response to question 5

In extract 5.1, the candidate did not understand the concept of heating effect of electric current and hence failed to establish the relationship between electrical energy dissipated by the coil and the energy gained by water. In part (b) of the question, he/she introduced the concept that light travels in straight line by arranging three cardboards and call them A (Alpha particles), B (Beta particles) and C (Gamma rays) instead of describing the nature, effect on electric field and their penetrating powers.

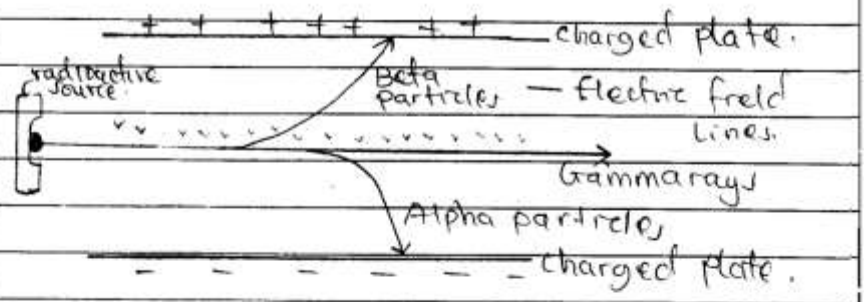
The candidates (4.24%) who got high (7.0-10.0) marks in the question managed to calculate the kilowatt–hours consumed by the water boiler by using appropriate formula and comparing the electrical energy dissipated

by the coil and the heat energy gained by water in the boiler, i.e. Heat dissipated = Heat gain by water, $\frac{V^2 t}{R} = mc\Delta\theta$.

In part (b) of the question, some of them were able to use an appropriate diagram to describe the nature, effect on an electric field and describe the penetrating powers of alpha particles, beta particles and gamma rays correctly. Extract 5.2 is a sample of a candidate's good response to question 5.


5 (a) Given, Mass of water (Mw) = 150kg.
Temperature, T_1 = 20°C.
Voltage (V) = 240V.
Resistance = 25Ω.
Temperature, T_2 = 40°C.
$\theta, \Delta T$ = 40°C − 20°C = 20°C.
from, heat gained = heat lost.
$\frac{V^2}{R} \times t = MC\theta$.
$\frac{(240)^2}{25} \times t = 150 \times 4200 \times 20$.
$2304\ t = 12,600,000$
$t = \frac{12,600,000}{2304}$
$t = 5,468.75$ s.
$t = 1.52$ hrs.
Electrical energy consumed = P x t.
$P = V^2/R$
$P = \frac{240^2}{25}$
$P = 2304$ W (2.304 kW).
Electrical energy consumed = 2.304 x 1.52
= 3.50208 kWh.
∴ 3.50208 kWh of electrical energy will be consumed.

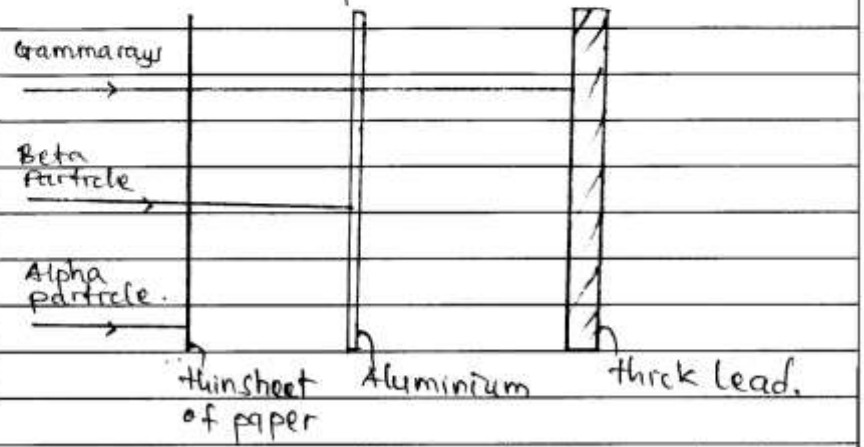
(b) Effect on electric field:



Alpha particles are deflected to the negative charged plate since they are positively charged, Gamma rays are not deflected since they have no charge and, beta particles are deflected to the positively charged

5 (b) plate since they are negatively charged.

Penetration power



Gamma rays have high penetrating power, Beta particles have low penetrating power and Alpha particles have the lowest penetrating power.

Extract 5.2: A sample of candidate's good response to question 5

In extract 5.2 the candidate managed to answer correctly all parts of the question.

2.2.4 Question 6: Newton's Laws of Motion and Simple Machines

In part (a) of this question, the candidates were required to apply Newton's second law of motion to define a unit of force of one Newton when a force F acts on a body of mass m for time t causing its velocity to change from initial velocity 'u' to final velocity 'v'. In part (b), the candidates were asked to calculate the force applied at the end of the handle to lift a load of 2300 N when the handle of the screw-jack is 35 cm and the pitch of the screw is 0.5 cm when the efficiency of the jack is 55%.

This question was attempted by 116,515 (99.9%) candidates out of which 74,670 (64.09%) scored from 0 to 2.5 marks, 27,941 (23.98%) scored from 3.0 to 6.0 marks and 13,904 (11.93%) scored from 6.5 to 10 marks. These data indicate that the general performance was average as 41,845 (35.91%) scored from 3.0 to 10 marks. Figure 6 shows the candidates' performance in this question.

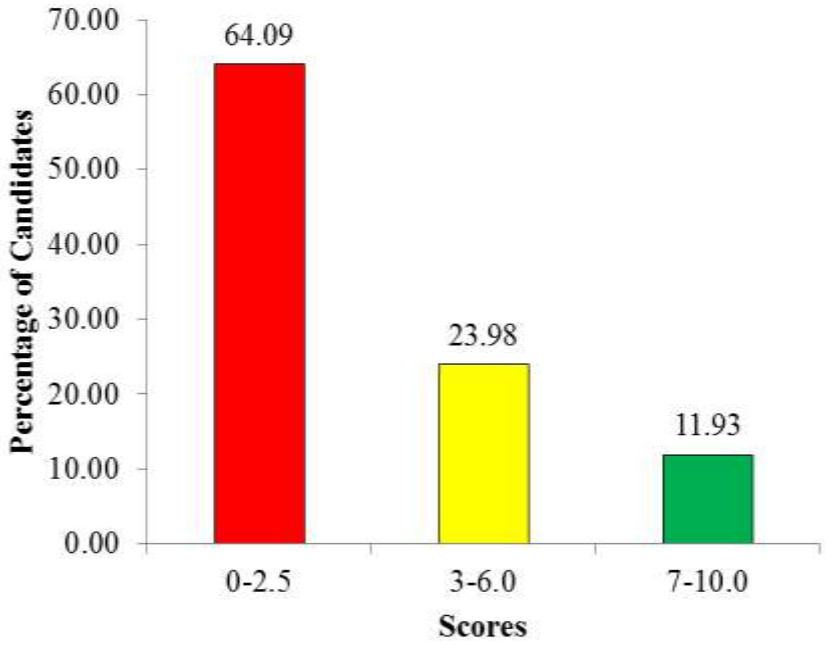
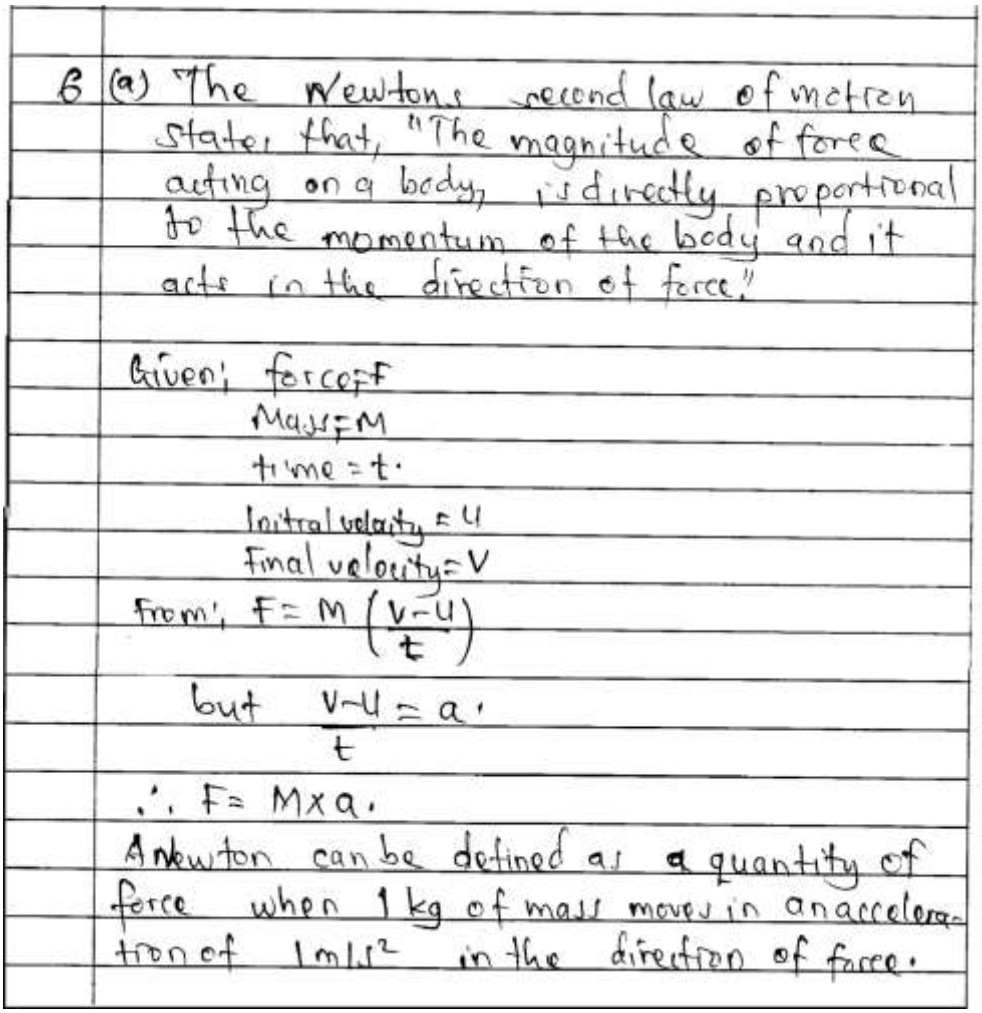


Figure 6: *The performance of candidates in question 6*

Although a number of candidates (64.09%) performed poorly, some (11.93%) of them scored high marks. These candidates applied Newton's second law of motion to explain how a unit of force of one Newton can be

defined. They also correctly related force, mass, velocity and time during motion of an object by writing $F \propto m\left(\frac{v-u}{t}\right)$ and used it to define a unit of force of one Newton. In part (b), majority of the candidates failed to appropriately use the formula $V.R = \frac{2\pi R}{P}$ in finding the velocity ratio and used it as input to compute the force required.

Extract 6.1 is the sample of a candidate's good response to question 6.


6 (a) The Newtons second law of motion state, that, "The magnitude of force acting on a body, is directly proportional to the momentum of the body and it acts in the direction of force."

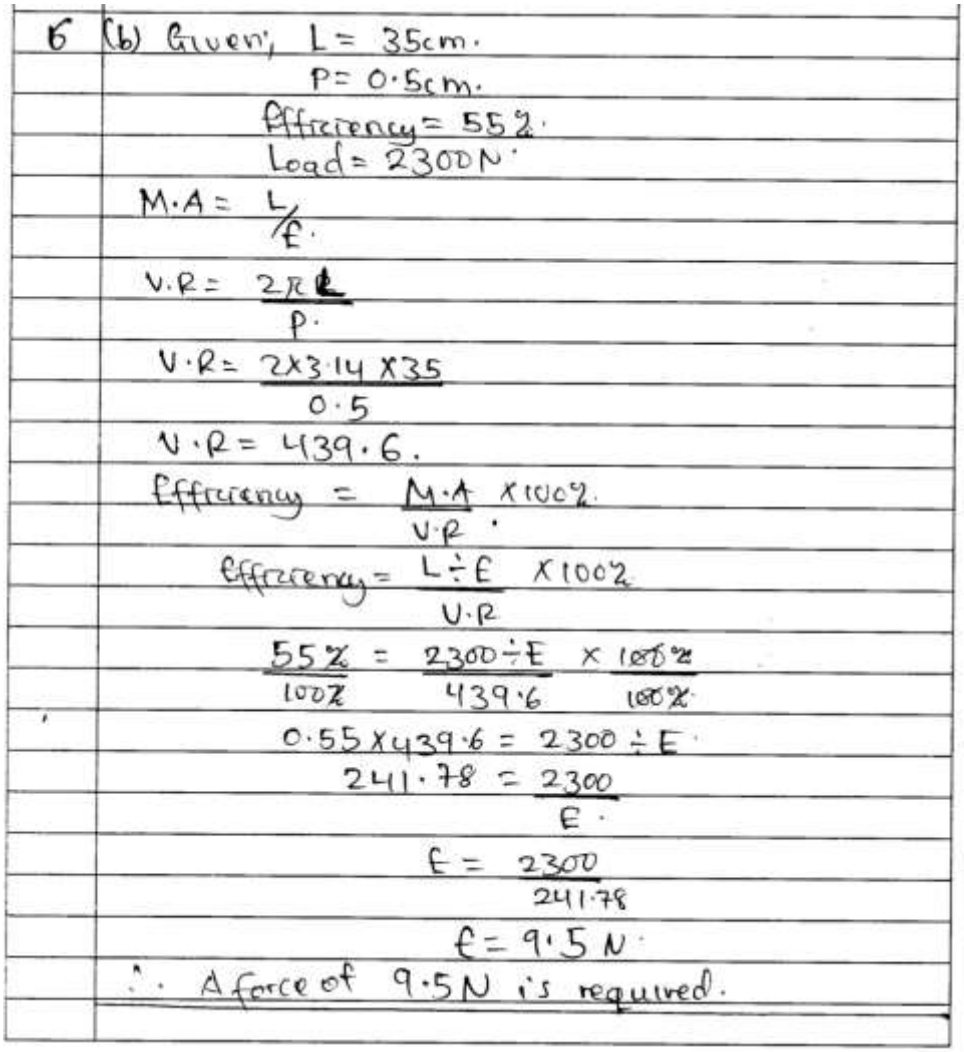
Given; force=F
Mass=M
time=t.
Initial velocity=U
Final velocity=V

From; $F = M\left(\frac{V-U}{t}\right)$

but $\frac{V-U}{t} = a.$

$\therefore F = M \times a.$

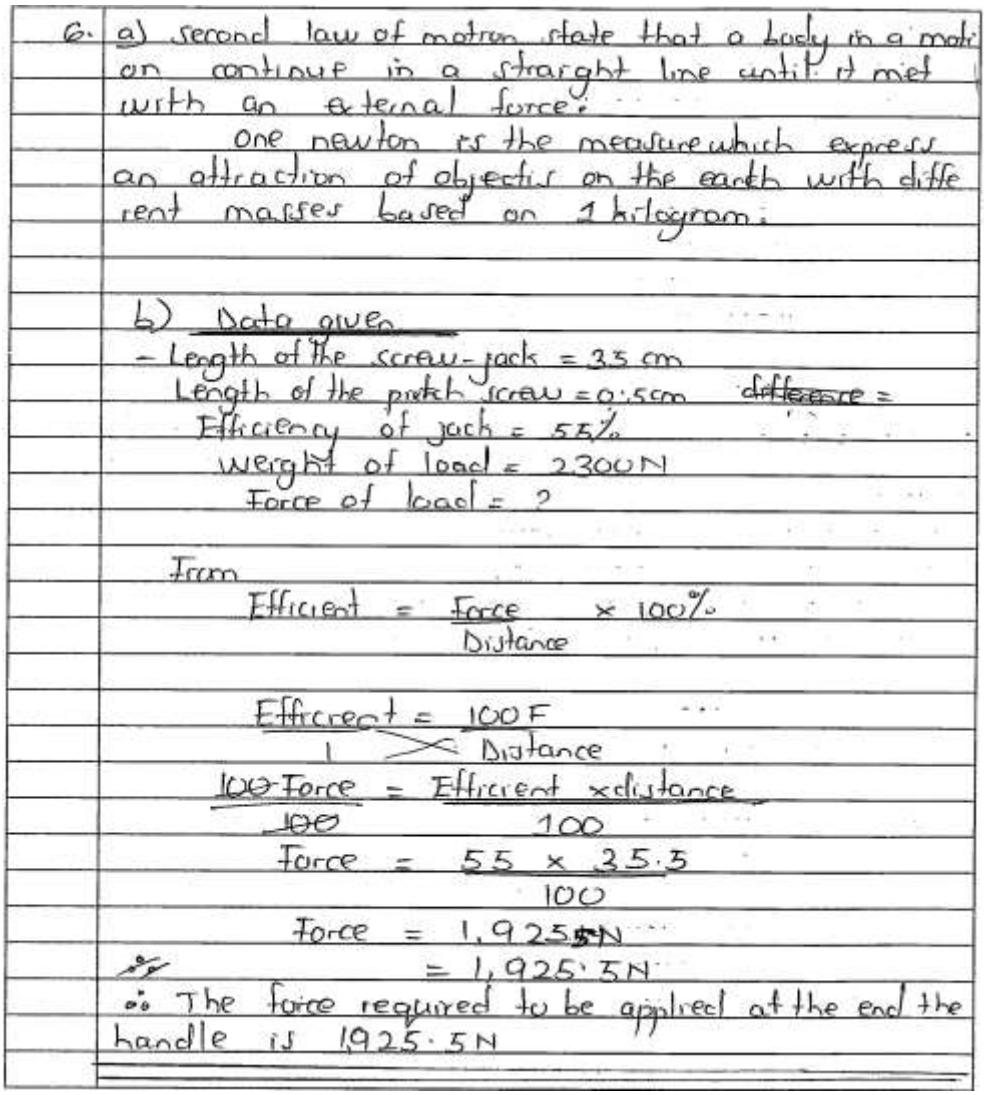
A Newton can be defined as a quantity of force when 1 kg of mass moves in an acceleration of $1 m/s^2$ in the direction of force.



Extract 6.1: A candidate's good response to question 6

However, poor performance by majority of the candidates was due to the following factors: In part (a) of the question, some of the candidates confused the requirement of the question and ended up stating Newton's second law of motion instead of using it to define the unit of force as required. Other candidates wrote anything on Newton's laws although it was irrelevant to the demand of the question while others wrote irrelevant formulae. This shows that these candidates had inadequate knowledge of Newton's laws of motion. They had to recall the relation between force and the rate of change of momentum that could lead them to know that Newton is the force that produces an acceleration of $1m/s^2$ to a mass of 1kg.

In part (b) some of the candidates failed to calculate the force required to be applied at the end of the handle to lift a load of 2300 N. The candidates were supposed to know that to obtain the required effort one should first calculate the velocity ratio of the screw jack by using $= \frac{2\pi R}{P}$; then mechanical advantage by e $= \frac{M.A}{V.R}$ x 100%; and lastly $Effort = \frac{Load}{M.A}$. Most of the candidates failed to apply the formula. Extract 6.2 shows a sample of a candidates' weak response to this question.


6. a) second law of motion state that a body in a moti on continue in a straight line until it met with an external force.
one newton is the measure which expres an attraction of objects on the earth with diffe rent masses based on 1 kilogram.

b) Data given
- Length of the screw-jack = 35 cm
Length of the pitch screw = 0.5cm difference =
Efficiency of jack = 55%
weight of load = 2300N
Force of load = ?

From
Efficient = $\frac{\text{Force}}{\text{Distance}}$ x 100%

$\frac{\text{Efficient}}{1} = \frac{100F}{\text{Distance}}$

$\frac{100 \text{ Force}}{100} = \frac{\text{Efficient} \times \text{distance}}{100}$

Force = $\frac{55 \times 35.3}{100}$

Force = 1,925.5N

= 1,925.5N

∴ The force required to be applied at the end the handle is 1925.5N

Extract 6.2: A candidate's weak response to question 6

In extract 6.2 the candidate incorrectly stated Newton's first law of motion instead of applying Newton's second law of motion to define a unit of force

of one Newton in part (a) of the question. Furthermore, he/she calculated the force to be applied at the end of handle of a screw-jack in part (b) by taking, $\text{Efficient} = \frac{\text{Force}}{\text{Distance}}$, which has no logical meaning in Physics instead of using $\text{Effort (Force)} = \frac{\text{Load}}{\text{M.A}}$.

2.2.5 Question 7: Thermal Expansion and Measurement of Thermal Energy

In part (a) of the question, the candidates were given part of a steel tape used by a surveyor which is 9 m at 25 ^{0}C and asked to determine the overall length measured using the tape sixty seven times on a warm day corresponding to 38 ^{o}C. In part (b), the candidates were required to calculate the specific heat capacity of water on a waterfall of 100 m high when a difference in temperature between water at the top and that at the bottom is 0.24 K.

This question was attempted by 116,526 (99.9%) candidates out of which 86,338(74.09%) scored from 0 to 2.5 marks, 27,035 (23.20%) scored from 3.0 to 6.0 marks and 3153 (2.71%) scored from 6.5 to 10 marks. The data indicate that the general performance was weak as 86,338 (74.09%) scored from 0 to 2.5 marks. Figure 7 portrays the performance of candidates in this question.

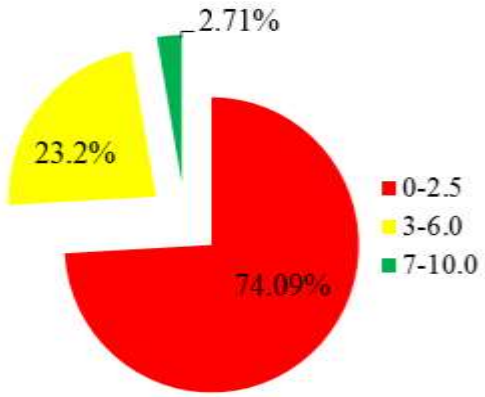
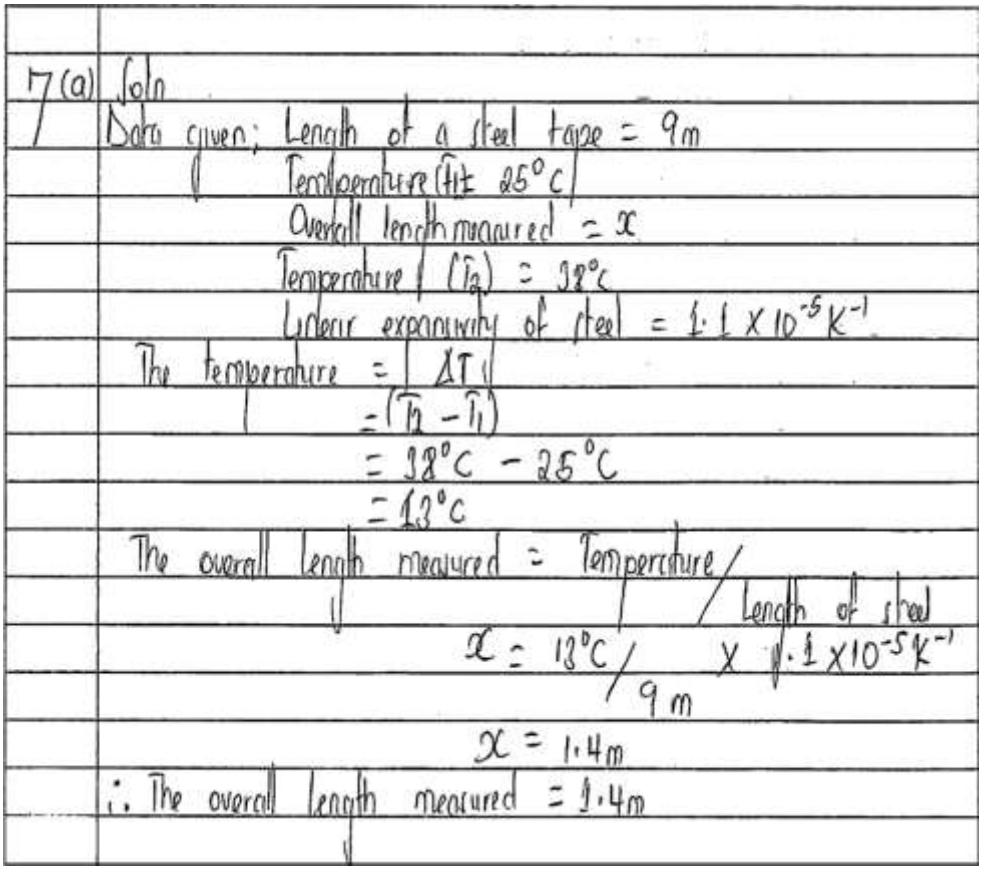
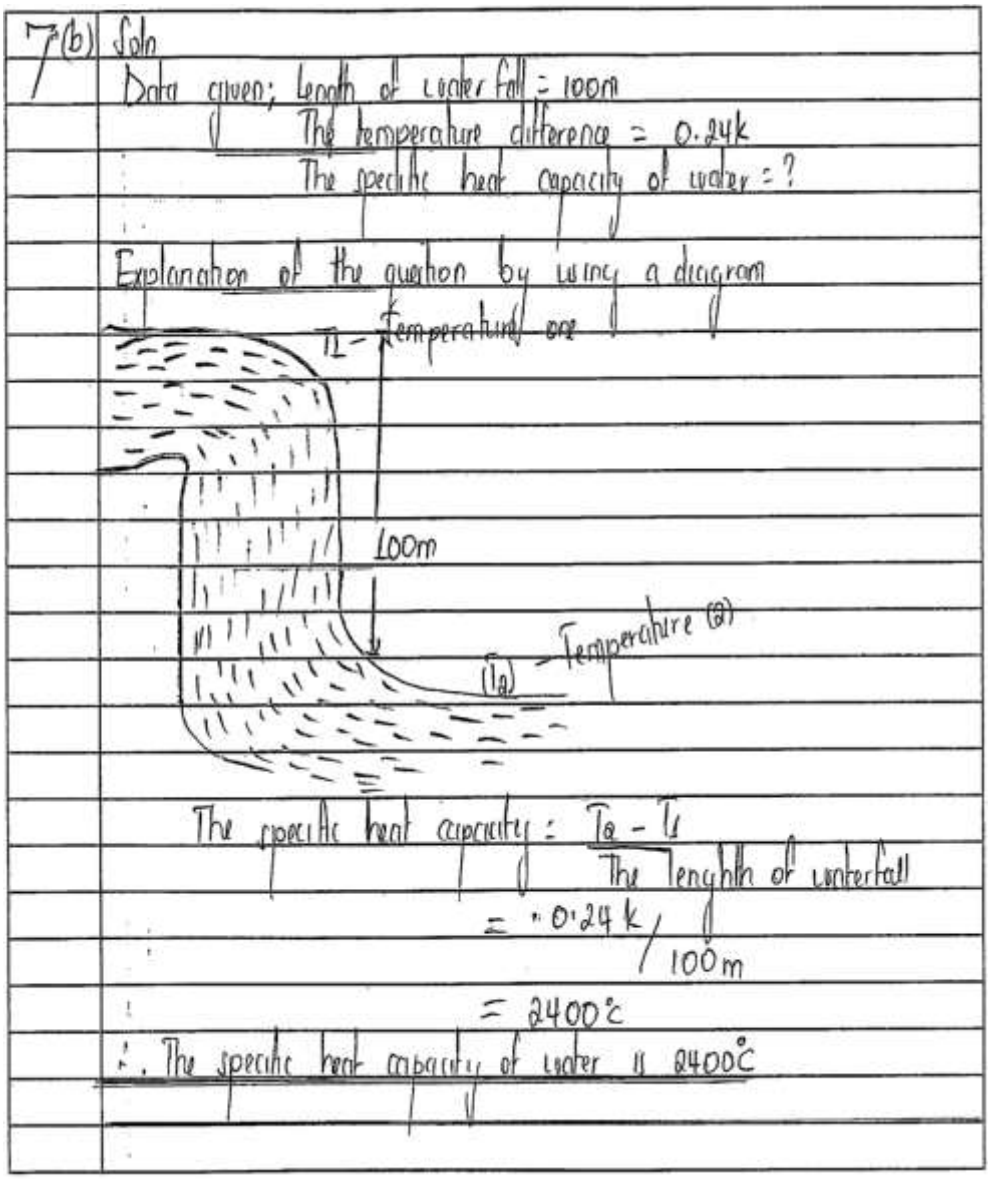


Figure 7: T*he performance of candidates in question 7*

The candidates who scored low marks in this question failed to apply the concept of coefficient of linear expansivity. These candidates had inadequate knowledge on how the change in length is influenced by the change in temperature when a material is subjected to thermal energy (heat

energy). Some of the candidates explained linear expansivity as the ratio of increase in the volume of the body per degree rise in temperature to its unit volume which is a concept of a coefficient of cubical expansion. Others stated it as the ratio of increase in the area of the body per degree rise in temperature to its unit area which is a concept of a coefficient of superficial expansion. They were supposed to realize that linear expansivity is the fractional increase in length of a specimen of a solid, per unit rise in temperature. If a specimen increases in length from l_1 to l_2 when its temperature is raised by $\theta°$, then the expansivity (α) is given by: $l_2 = l_1(1 + \alpha\theta)$. This relationship assumes that α is independent of temperature. Extract 7.1 shows a sample of candidates' weak responses in question 7.

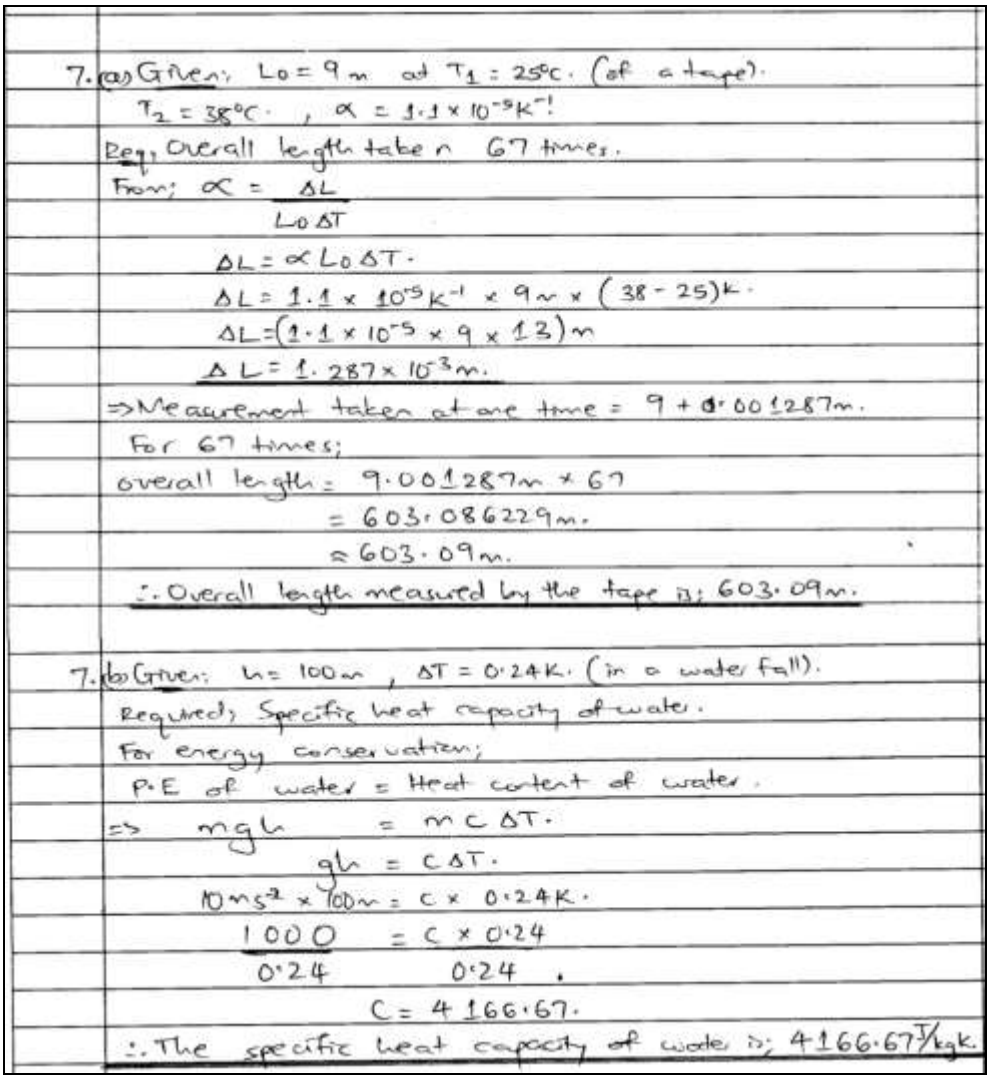

7(a) Soln
Data given; Length of a steel tape = 9m
Temperature (T_1) = 25°C
Overall length measured = x
Temperature (T_2) = 38°C
Linear expansivity of steel = $1.1 \times 10^{-5} K^{-1}$
The temperature = ΔT
$= (T_2 - T_1)$
$= 38°C - 25°C$
$= 13°C$
The overall length measured = Temperature / Length of steel
$x = 13°C / 9m \times 1.1 \times 10^{-5} K^{-1}$
$x = 1.4m$
∴ The overall length measured = 1.4m



Extract 7.1: A sample of a candidate's incorrect response to question 7

In extract 7.1 the candidate determined the specific heat capacity of water, by taking the ratio of the change in temperature per unit length of the waterfall, instead of first relating the transformation of energy from potential energy to heat energy ($mgh = mc\Delta T$) and then taking $c = \frac{gh}{\Delta T}$ to get the correct value of c.

The candidates (2.71%) who managed to score high (7.0-10.0) marks had good knowledge and computational skills on the concept of thermal expansion. They were able to use the correct formula for calculating the length of the tape in part (a). In part (b), the candidates were able to calculate the specific heat capacity of water on a waterfall from the given data. These candidates understood that from the principle of conservation of energy, energy is always converted from one form to another. In this case, potential energy is transferred to thermal energy. That is; $mgh = mc\Delta\theta$, hence the candidates managed to determine the specific heat capacity of water. Extract 7.2 is a sample of a correct response from a candidate who scored high marks in this question.


7. (a) Given: $L_o = 9\,m$ at $T_1 = 25°C$. (of a tape).
$T_2 = 38°C$. , $\alpha = 1.1 \times 10^{-5} K^{-1}$
Req, Overall length taken 67 times.
From; $\alpha = \frac{\Delta L}{L_o \Delta T}$
$\Delta L = \alpha L_o \Delta T$.
$\Delta L = 1.1 \times 10^{-5} K^{-1} \times 9m \times (38 - 25)K$.
$\Delta L = (1.1 \times 10^{-5} \times 9 \times 13)m$
$\Delta L = 1.287 \times 10^{-3} m$.
⇒ Measurement taken at one time = $9 + 0.001287m$.
For 67 times;
overall length = $9.001287m \times 67$
$= 603.086229m$.
$\approx 603.09m$.
∴ Overall length measured by the tape is; $603.09m$.

7. (b) Given: $h = 100m$, $\Delta T = 0.24K$. (in a water fall).
Required; Specific heat capacity of water.
For energy conservation;
P.E of water = Heat content of water.
⇒ $mgh = mc\Delta T$.
$gh = c\Delta T$.
$10ms^{-2} \times 100m = c \times 0.24K$.
$\frac{1000}{0.24} = \frac{c \times 0.24}{0.24}$.
$c = 4166.67$.
∴ The specific heat capacity of wate is; $4166.67 J/kgK$.

Extract 7.2: A sample of candidate's good response to question 7

2.2.6 Question 8: Geophysics and Waves

In this question, the candidates were required to (a) explain four effects of global warming and (b) explain why it is not advisable for solders to march across a bridge having the same beat.

This question was attempted by 116,553 (100%) candidates out of which 15,418 (13.23%) scored from 0 to 2.5 marks, 88,682 (76.09%) scored from 3.0 to 6.0 marks and 12,453 (10.68%) scored from 6.5 to 10 marks. These data indicate that the general performance of candidates was good as 101,136 (86.77%) candidates scored from 3.0 to 10 marks. Figure 8 shows the performance of the candidates in this question.

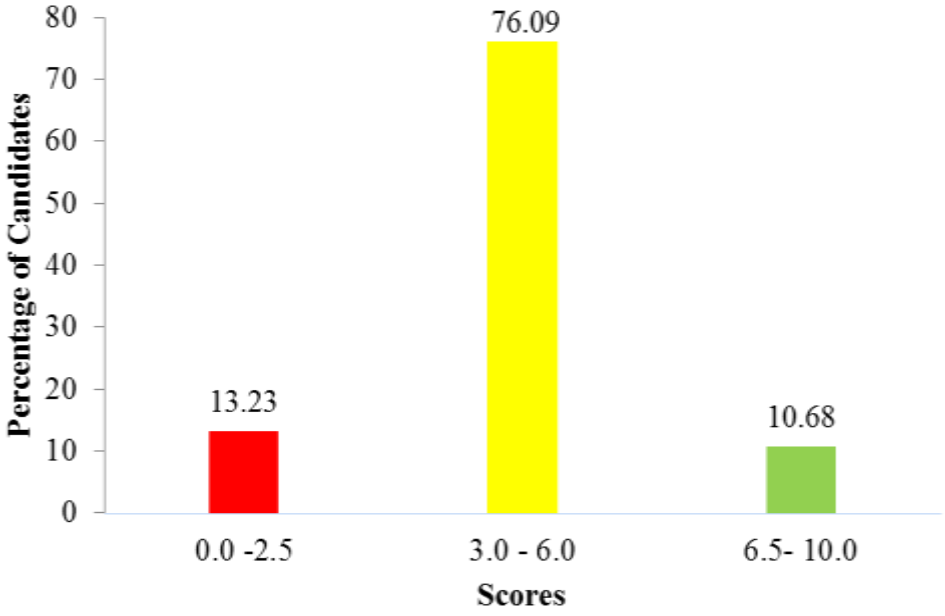


Figure 8: *The performance of candidates in question 8*

Part (a) was correctly answered by majority of the candidates due to easy transfer of knowledge as the effect of global warming is also taught in other subjects such as Geography, Chemistry and Biology. The effects include; increase in temperature of the oceans, rise in sea level and change in world's climatic patterns. In part (b) of the question the candidates who answered it correctly were able to give the reasons by applying the concept of resonance that "*Resonance is said to occur whenever a particular body or system is 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*". When the soldiers march having the same natural frequency as

the bridge it is possible for a large amplitude of vibration to be set up which will damage the bridge. Extract 8.1 is a sample of a correct response from one of the candidates who did this question.

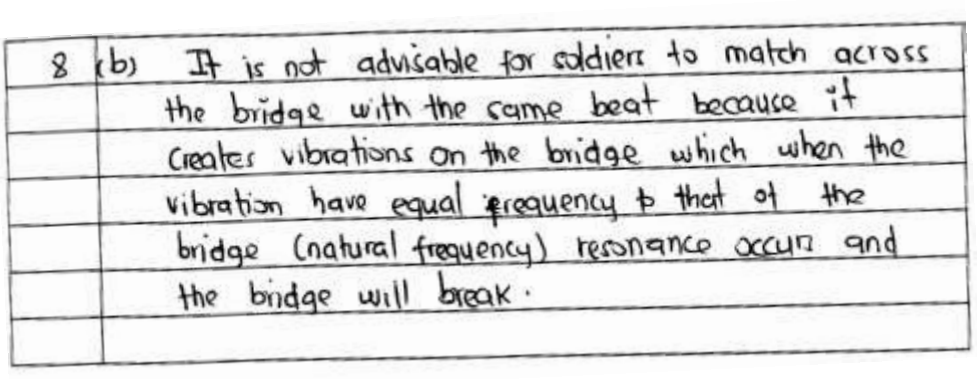
8. a) The following are the effects of global warming.

(i) Change in global's climatic patterns.
Global warming refers to the increase in earth's average temperature as a result there is an interference in the climatic pattern of the world for example areas that were initially very cold have become hot therefore global warming causes change in the globales climatic patterns.

(ii) Occurrence of extreme weather events
Global warming also causes the occurrent of extreme weather events like tornadoes, elnino, tsunamis and hish raintall, this is due to the change in the earth's climatic patterns.

(iii) Rise in sea level.
Due to the increase in temperature, global warming causes rise in sea level as areas that were initially cold like arctic have become hotter thus ice melts leading to rise in the sea level.

(iv) Rise in earth's average temperature.
Global warming is associated with events that add the amount of carbon dioxide in the atmosphere and as a result trap most of sunlight rays in the atmosphere and hence cause an in earth's average temperature.

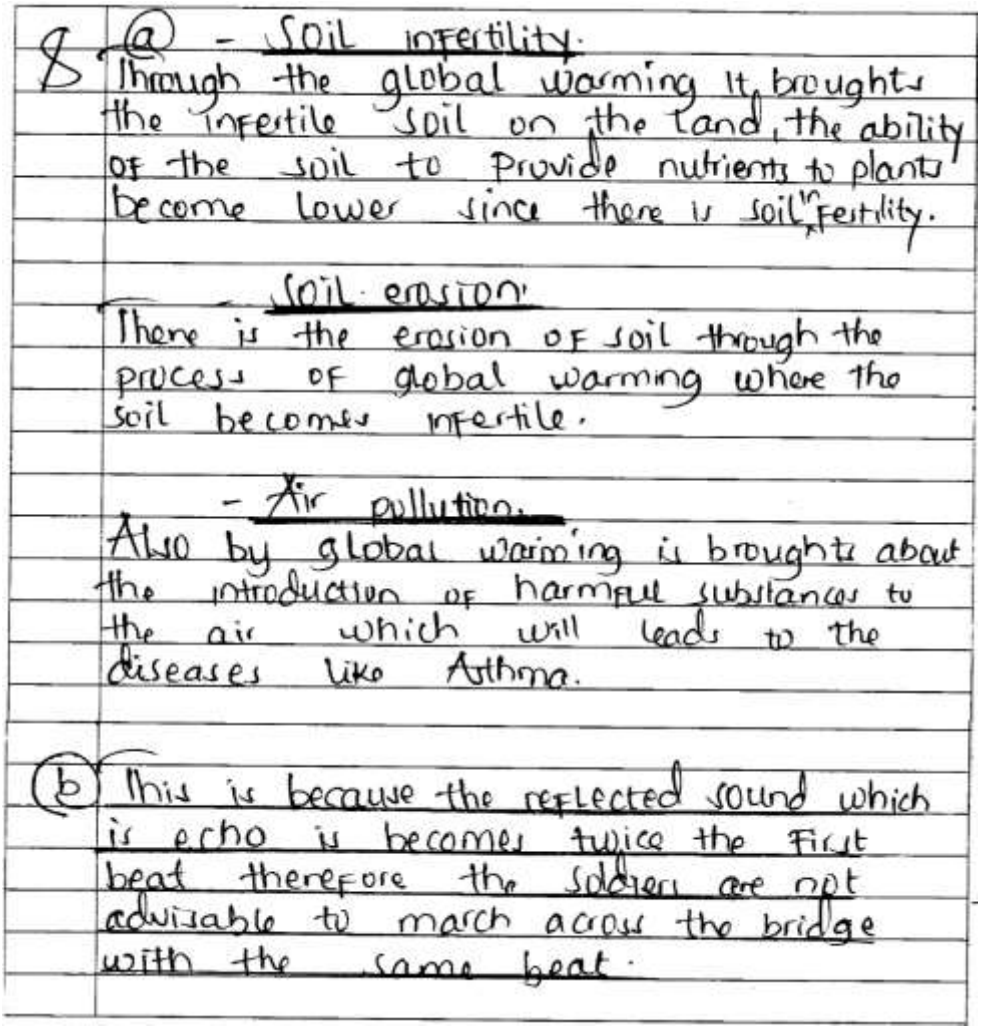


Extract 8.1: A sample of candidate's good response to question 8

A few candidates (13.23%) who scored low marks (0.0-2.5) in this question lacked knowledge of the concept of global warming as applied in Geophysics. One of the candidates for instance, wrote: *"When global warming occurs it leads to greenhouse effects which cause difficulty in breathing due to bad smell"*. Another one wrote: *"Because of sun burning rays"*. These candidates did not know that global warming refers to the increase in the average temperature of the world's atmosphere and oceans caused by the greenhouse effect. Carbon dioxide and other greenhouse gases trap the Sun's heat radiation and reflect it back to the earth. They had to realize that global warming has major effects in four main areas namely; extreme weather, health risks, sea-level rise and food inflation. One of the candidates stated that global warming destroys the ozone layer. In reality, the ozone's ultraviolet radiation-absorbing capacity is reduced by chlorofluorocarbons (CFCs) and halons which cause chemical reactions to break down ozone molecules and not by global warming as stated by the candidate.

In part (b) of the question, candidates were required to explain why it is not advisable for soldiers to march across the bridge with the same beat. The candidates who scored low marks in this part failed to apply the concept of resonance as applied in sound waves due to inadequate knowledge. One of the candidates for example wrote that: *"Because, since beat is the rise or fall of frequency, when the soldiers march across the bridge it leads to different injuries and accident"*. This candidate did not understand the demand of the question as he/she thought that it was all about the effect of beats and the congestion of bunch of the soldiers stepping across the bridge. Another candidate stated that *"Because of no air pressure in the bridge with the same beat"*. Such candidate were supposed to know that if

soldiers march across the bridge with the same beat they generate rhythmic oscillation of waves on the bridge and at a certain point, it will start oscillating at the same rhythm as that of the marching steps. This oscillation would reach a maximum peak when the bridge can no longer sustain its own strength and hence it collapses. Extract 8.2 shows a sample of candidates' weak response to this question.


8 (a) - Soil infertility.
Through the global warming it brought the infertile soil on the land, the ability of the soil to provide nutrients to plants become lower since there is soil infertility.

- Soil erosion.
There is the erasion of soil through the process of global warming where the soil becomes infertile.

- Air pollution.
Also by global warming is brought about the introduction of harmful substances to the air which will leads to the diseases like Asthma.

(b) This is because the reflected sound which is echo is becomes twice the first beat therefore the soldiers are not advisable to march across the bridge with the same beat.

Extract 8.2: A sample of a candidate's weak responses to question 8

In extract 8.2 the candidate failed to give the real effects of global warming by considering things like soil infertility and soil erosion instead of extreme weather, ice melts, rise of sea levels and ocean acidification. In part (b) the candidate introduced an echo as a reason why soldiers should not march

across the bridge with the same beat instead of applying the concept of resonance.

2.3 Section C: Short Answer Questions

This section consisted of three (3) questions from the topics: *Current Electricity*, *Electronics*, *Electromagnetism* and *Waves*. The candidates were required to answer two (2) questions, each carrying 12.5 marks, making a total of 25 marks.

2.3.1 Question 9: Current Electricity and Electronics

The question had two parts (a) and (b). In part (a), the candidates were required to (i) draw a well labelled diagram of a dry cell and (ii) show how the components of a dry cell differ from those of the Leclanche cell. In part (b), the candidates were required to draw a well labelled single-stage common-emitter (CE) amplifier circuit showing directions of currents from the components and power supplies of: Base power supply V_{BB}; Collector power supply V_{CC}; n-p-n transistor; Base resistor R_B; Load resistor R_L and coupling capacitors C_1 and C_2 in the input and output circuits respectively.

This question was attempted by 68,302 (58.6%) candidates out of which 63,236 (92.58%) scored from 0 to 3.5 marks, 4,495 (6.58%) scored from 4.0 to 8.0 marks and 571 (0.84%) scored from 8.5 to 12.5 marks. These data indicate that the general performance of candidates in this question was weak as 63,236 (92.58%) scored from 0 to 3.5 marks. Figure 9 shows the performance of candidates in this question.

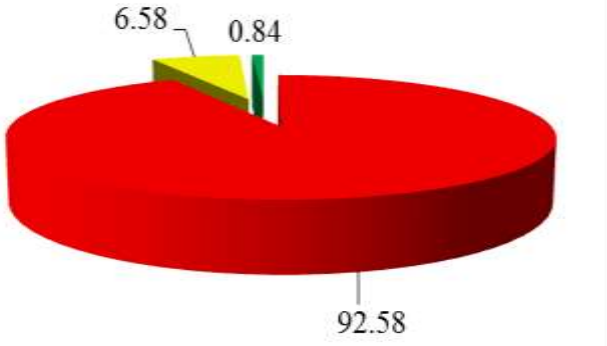
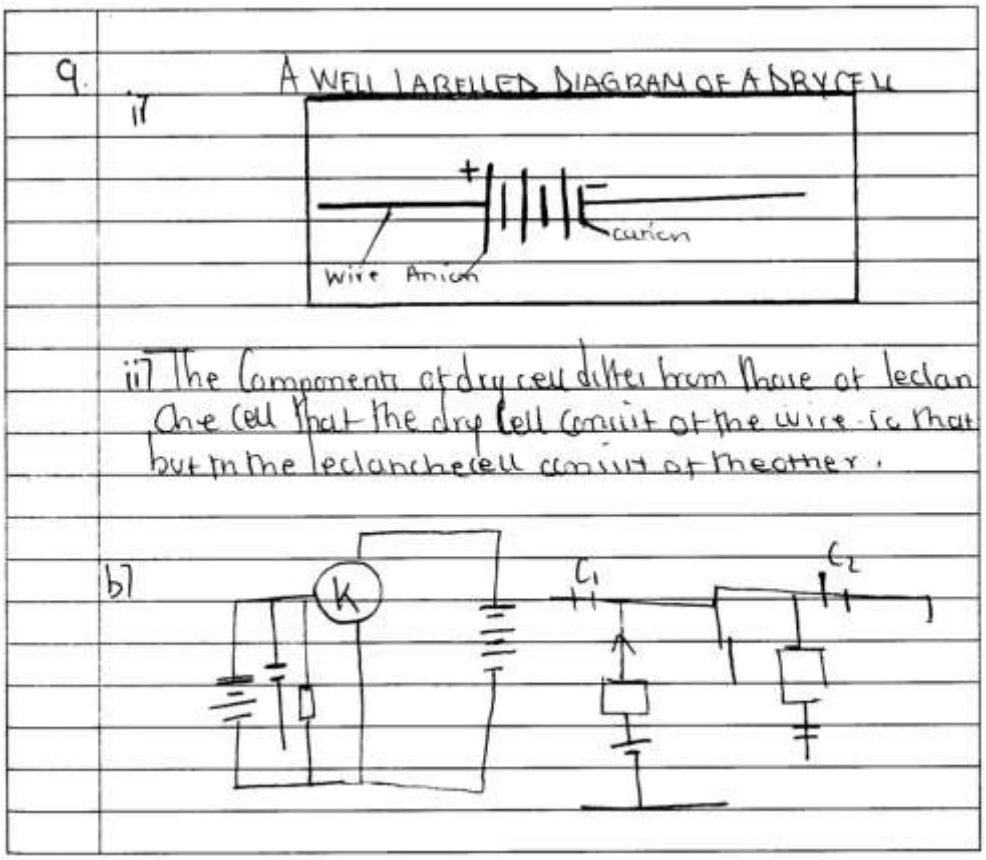


Figure 9: *The performance of candidates in question 9*

Most of the candidates (92.58%) scored from 0 to 3.5 out 12.5 marks, showing that they lacked knowledge on concepts of cells specifically, the

Dry and Leclanche cells. Part (a) of the question was missed by most of the candidates as they drew inappropriate diagrams and failed to differentiate the components of a dry cell from those of the Leclanche cell. Some of the candidates drew a dry cell but failed in labelling while others labelled the components interchangeably. For example, in the place of the brass cap (positive contact), they labelled it as zinc cap (negative contact), zinc case as insulating outer case and carbon disc as carbon rod. They were supposed to know that the dry cell is made of an outer zinc container, which acts as the anode, the central carbon rod as the cathode surrounded by a mixture of carbon and manganese (IV) dioxide (MnO_2). The electrolyte is a paste of ammonium chloride (NH_4Cl). The candidates were also supposed to know that the components of the dry cell are the same as those of the Leclanche cell except that instead of ammonium chloride solution, the battery is filled with a paste of manganese dioxide, ammonium chloride and zinc chloride.

In part (b) of the question, the candidates failed to draw and label correctly a single-stage Common-Emitter (CE) amplifier due to lack of sufficient knowledge and poor drawing skills. This shows that the concept of electronics particularly, designing a single stage amplifier circuit was not well understood by most of the candidates as a result, majority of the candidates performed poorly in this part. The candidates were supposed to understand that when only one transistor associated with the circuit is used for amplification of a weak signal, the circuit is known as a single-stage amplifier. When a common emitter base is used to collect the amplified signal it is known as the single stage Common-Emitter (CE) amplifier. Extract 9.1 shows a sample of candidates' weak responses to question 9.

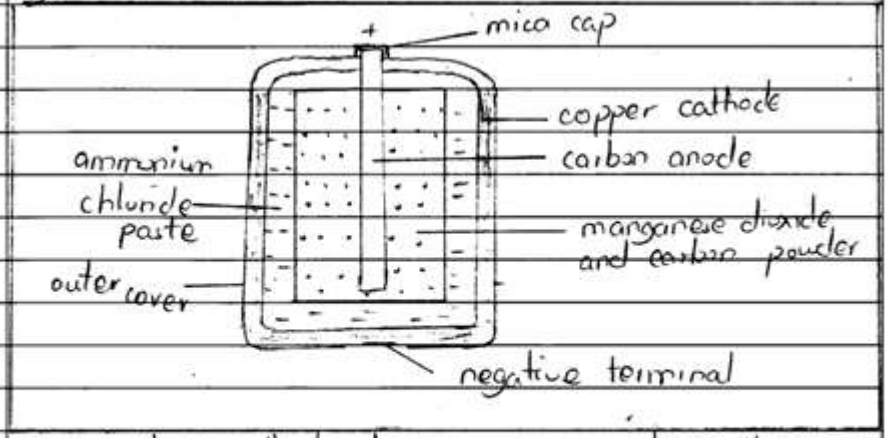


Extract 9.1: A sample of candidate's weak responses to question 9

In extract 9.1 the candidate drew a normal battery symbol instead of drawing a well labelled diagram of a dry cell. Similarly, he/she failed to provide the difference of the components of a dry cell from those of a Leclanche cell. The candidate also drew an incorrect and incomplete single stage amplifier circuit.

A few (0.84%) candidates who performed well in part (a) of this question demonstrated competence on the concept of Current electricity specifically, electric cells. They were able to draw a diagram of a dry cell and give the differences between it and a Leclanche cell. These candidates were also able to draw and label correctly a single-stage Common Emitter (CE) amplifier circuit. Extract 9.2 is a sample of a candidate's good responses to question 9.

9. a)

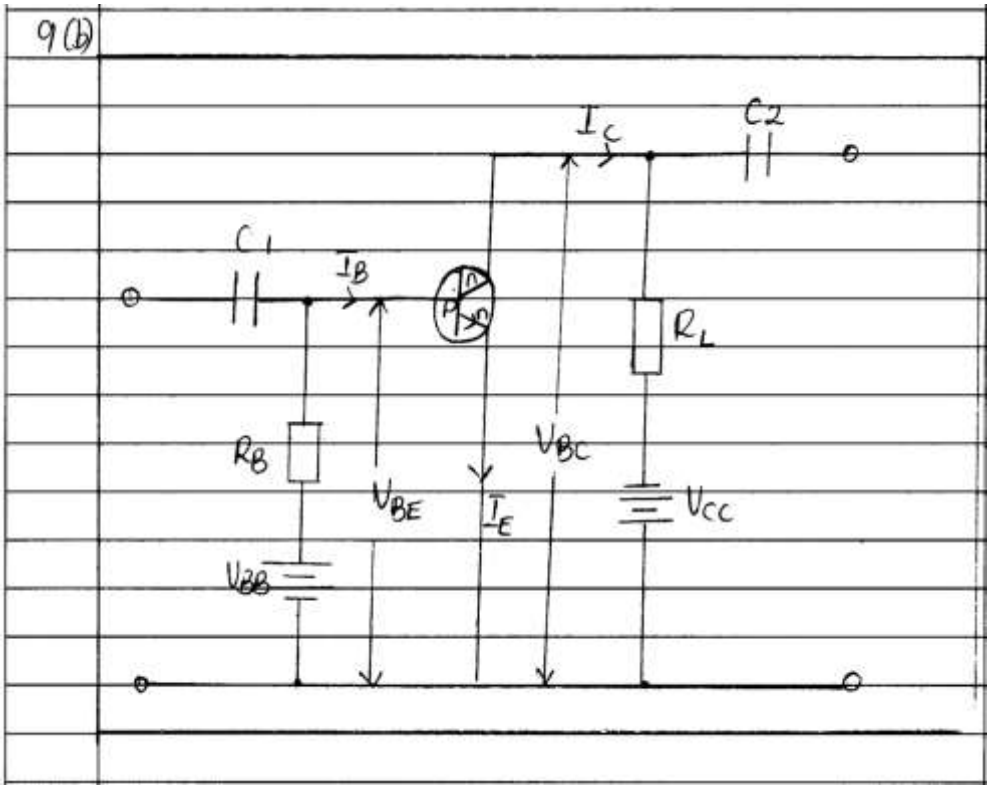


A well labelled diagram of a dry cell

ii) Leclance cell has components in liquid form in which all the chemicals and components are the same as dry cell. This is why it is called a dry cell because it is a leclanche cell in powder form with no liquid only paste

b.)

A common - emitter amplifier circuit has an emitter lead as a common connection point. The input terminal is the base and the collector is the output terminal. It works in such a way that the input signal in the base lead is amplified on the output of the collector.



Extract 9.2: A sample of candidate's good response to question 9

2.3.2 Question 10: Electromagnetism and Waves

This question comprised of two parts which were (a) and (b). The candidates were required to (a) Explain the working principle of a transformer (b) Describe how diffraction of water waves takes place in narrow and wide gaps.

The question was attempted by 91,892 (78.8%) candidates out of which 77,877 (84.75%) scored from 0 to 3.5 marks, 12,335 (13.42%) scored from 4.0 to 8.0 marks and 1,680 (1.83%) scored from 8.5 to 12.5 marks. These data reveal that the performance of the candidates was weak as 77,877 (84.75%) scored from 0 to 3.5 marks out of the 12.5 marks. Figure 10 represents the candidates' performance in this question.

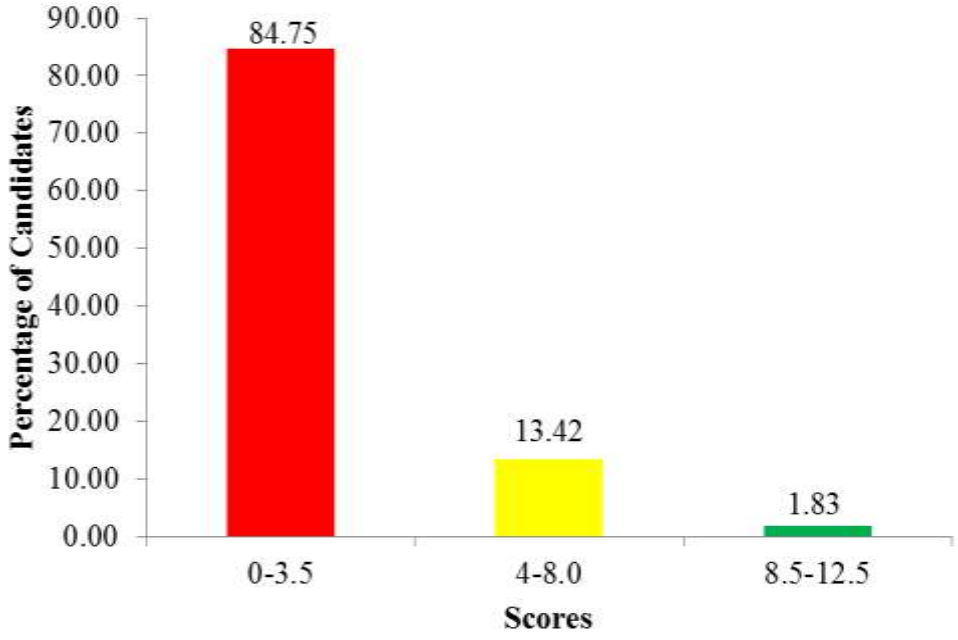


Figure 10: *The performance of candidates in question 10*

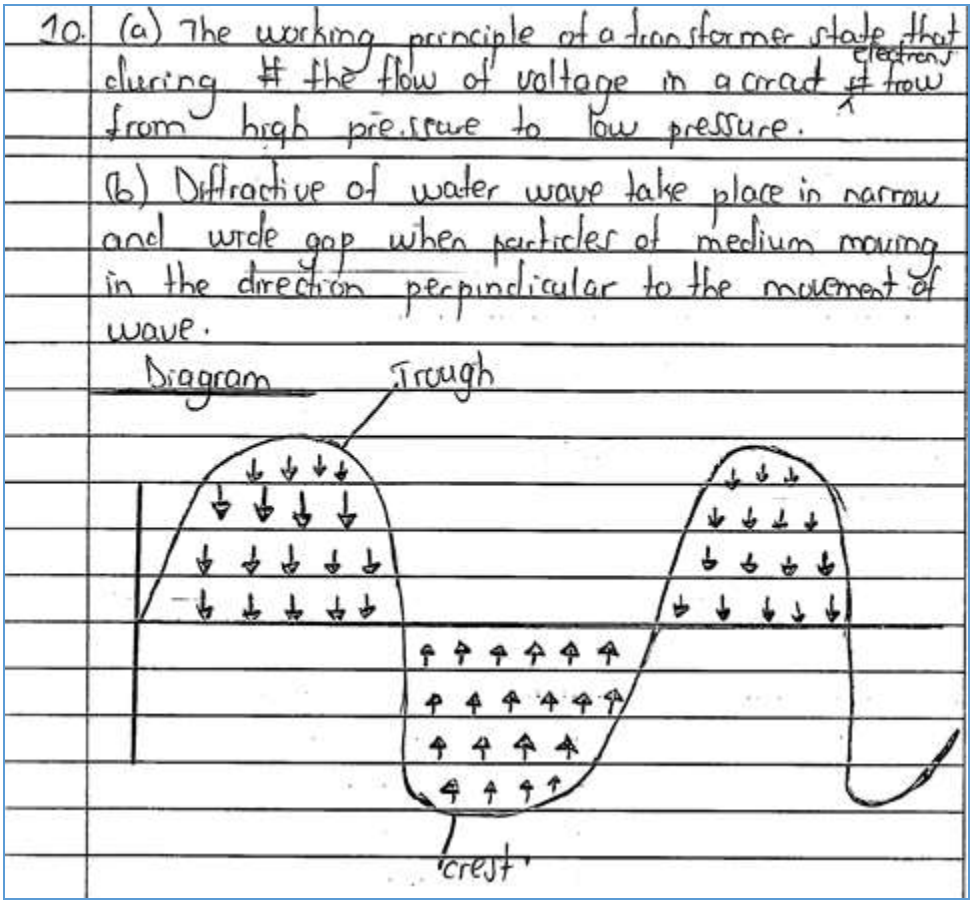
The candidates who scored low marks in this question provided incorrect answers to almost all parts of the question. These candidates failed to explain the working principle of a transformer. Some of the candidates wrote the functions or characteristics of the step up and step down types of transformers contrary to the requirement of the question. One of the candidates for example wrote:

> *"When the transformer wants emits the high current they undergoes step up which cause the high voltage of current to flow and when wants to emit low current they decrease number of secondary coil and increase number of primary coil and make current to flow under low quantity".*

Despite the fact that the sentence is grammatically incorrect, it expresses entirely the turn's ratio relations instead of the working principle of the transformer. In order to explain correctly, the candidates were supposed to understand that a transformer operates on the principle of mutual inductance. It consists of two windings in proximity being coupled by magnetic induction; there is no conductive connection between the windings. One of the windings referred to as primary is energized by sinusoidal voltage while the second winding, referred to as secondary feeds the load. The alternating current in the primary winding steps up an

alternating flux in the core and the secondary winding is linked by most of this flux and EMFs. Energy is transformed from the primary circuit to the secondary circuit through the medium of the magnetic field.

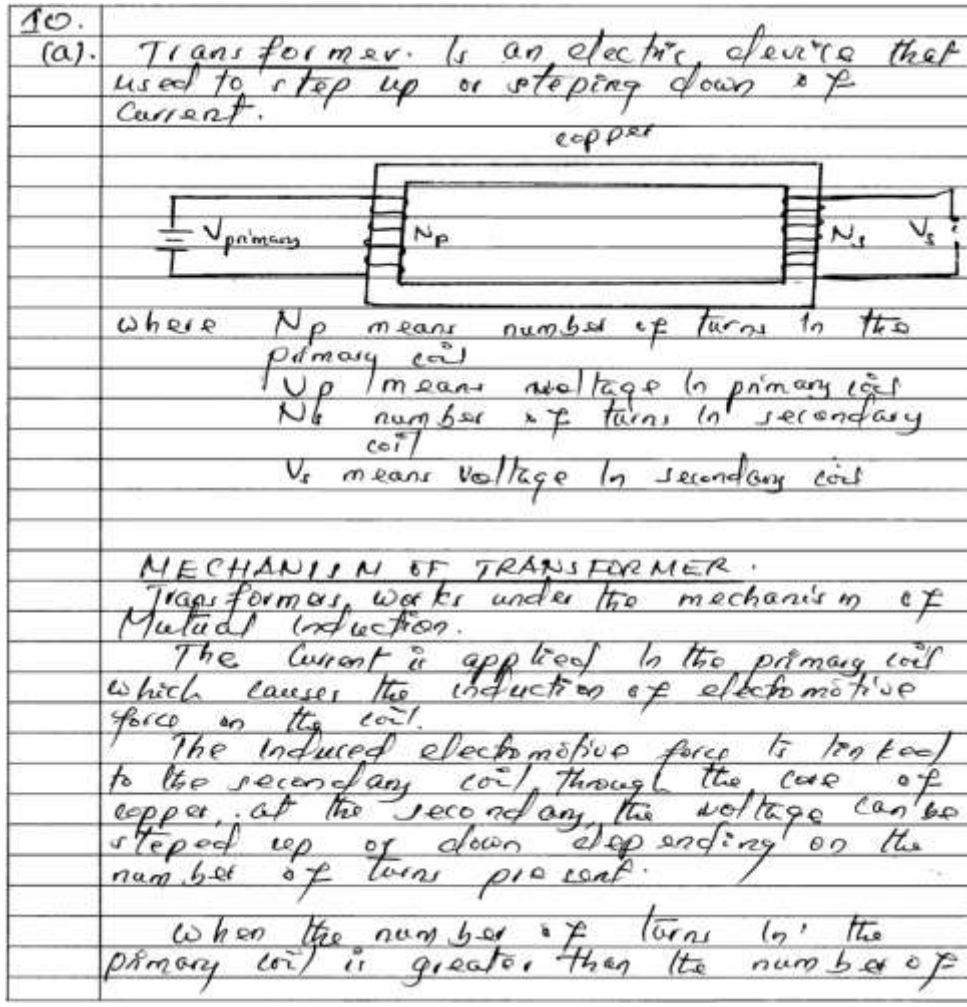
In part (b), some candidates failed to draw diagrams and explained incorrectly the diffraction of water waves as they pass through narrow and wide gaps. Some candidates confused the concepts of longitudinal and transverse waves with that of diffraction of waves. Others explained about the interference of waves using narrow slits to mean diffraction of waves contrary to the requirement of the question. These candidates were supposed to recognize that an obstacle placed in front of incoming incident waves will cause a shadow behind the obstacle. The effect of diffraction is greater when the width of the gap or obstacle is smaller. Therefore, waves passing through a narrow gap spread out wider than waves passing through a wide gap. Extract 10.1 shows a sample of a candidates' weak response to question 10.



Extract 10.1: A candidate's weak response to question 10

In extract 10.1 the candidate introduced the concept of voltage in connection to pressure instead of stating the working principle of a transformer. Consequently, he/she explained about the mode of transmission of waves due to alterations of wave profiles resulting into formation of crests and troughs instead of describing how diffraction of water waves takes place in narrow and wide gaps.

The candidates who scored high marks in this question seemed to have much knowledge on electromagnetic induction especially, the use of mutual induction in explaining the working principle of a transformer. The candidates were also able to draw the diagrams which helped them to describe the diffraction of water waves in both narrow and wide gaps correctly. Extract 10.2 is a sample of candidate's good response to this question.



10(a) of turns in secondary coil) the transformer is said to be step up transformer.

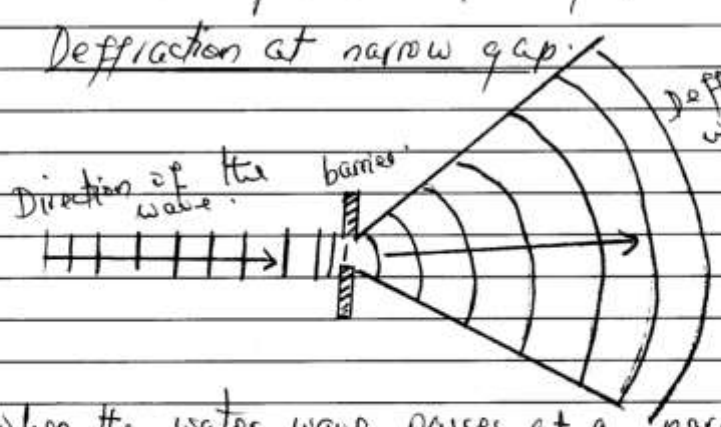
But when the number of turns in the primary coil is less than the number of turns in the secondary coil the transformer is said to be step down transformer.

Transformer equations

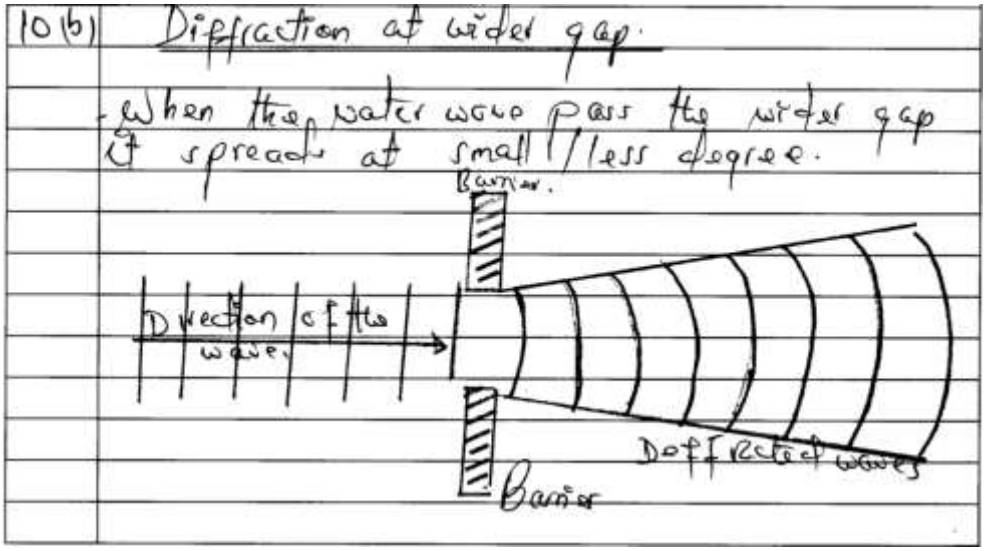
$$\frac{N_p}{N_s} = \frac{V_p}{V_s}$$

10(b) Diffraction is the spreading out of water wave as it passes through a gap.

Deffraction at narrow gap:



when the water wave passes at a narrow gap it spread at high degree, this is due change of frequency of the wave, - is as show above.



Extract 10.2: A candidate's good response to question 10

2.3.3 Question 11: Current Electricity and Electromagnetism

This question comprised of three parts which were; (a), (b) and (c). In part (a), the candidates were required to calculate and show whether the fuse can support the operation of two heaters switched on at the same time in a small house with a mains supply of 240 V, if each heater is rated at 2.5 Kw and the supply has a main fuse rated 15 A. In part (b), the candidates were required to explain three design alterations that would convert a simple a.c. generator which produces a low e.m.f into one of higher e.m.f and part (c) required the candidates to suggest one electronic device to buy that can be used to convert the generator in part 11 (b) into one of higher e.m.f

This question was attempted by 64,912 (55.7%) candidates out of which 50,829 (78.31%) scored from 0 to 3.5 marks, 12,698 (19.56%) scored from 4.0 to 8.0 marks and 1,385 (2.13%) scored from 8.5 to 12.5 marks. From these data the performance of the candidates was weak since 50,829 (78.31%) scored from 0 to 3.5 marks. Figure 11 illustrates the performance of candidates in this question.

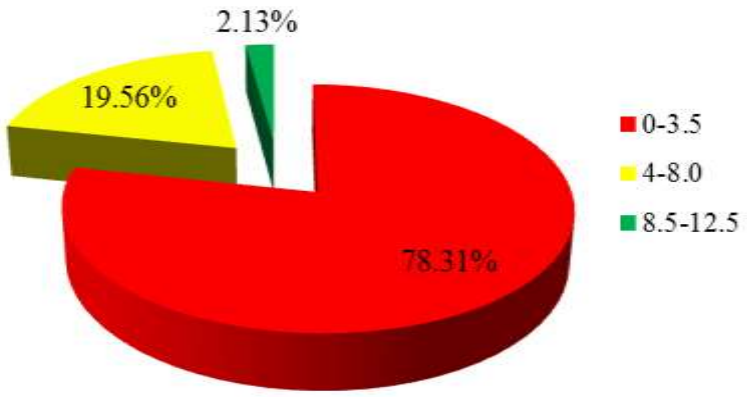
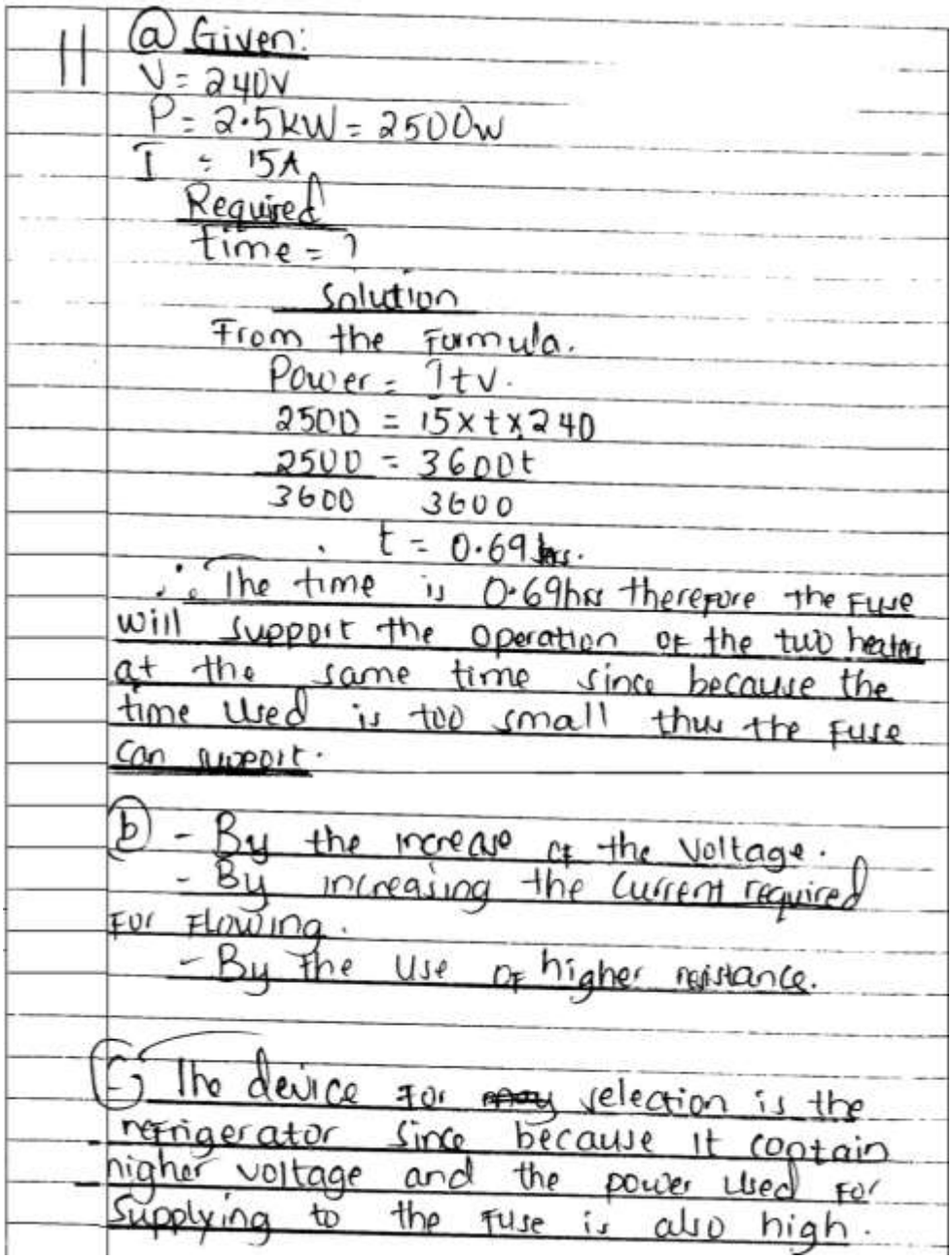


Figure 11: *The performance of candidates in question 11*

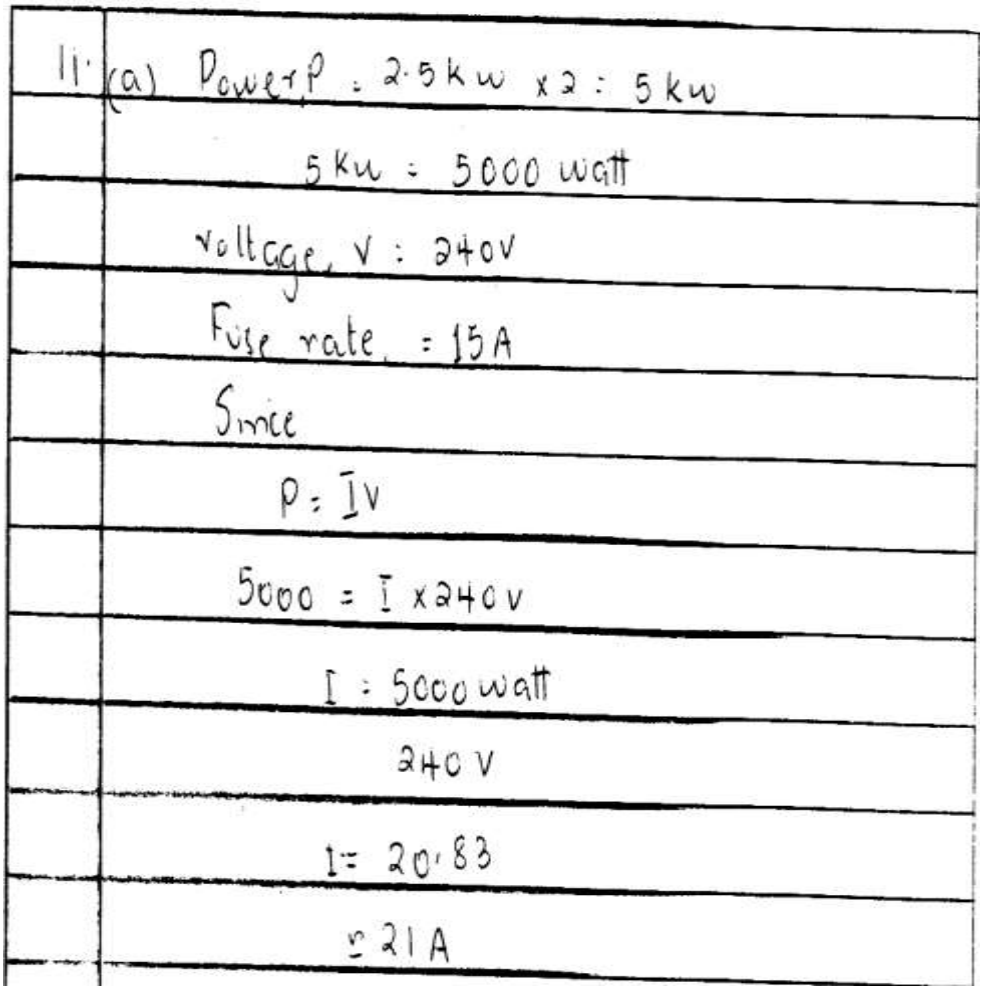
Poor performance in this question was contributed by some factors including; inadequate knowledge of electrical appliance power rating and commercial unit of electrical energy consumption in everyday life as applied in effects of electric current. Failure to apply the correct formula or relationship of variables was another drawback that some of the candidates encountered as they failed to relate electrical power with current and voltage. They also failed to investigate that a simple a.c generator producing a low e.m.f can be designed to convert it into a generator of higher e.m.f by applying Faraday's law of electromagnetic induction. In this area, candidates were supposed to know the factors which increase the magnitude of the e.m.f induced in the conductor. These candidates also failed to identify the device which can be used to increase the e.m.f produced in the generator. One of the candidates for example wrote the device to be used as the "*NPN transistor"*. This candidate had mixed concepts as he/she did not understand that, the NPN transistor is applied in the concepts of electronics and not electromagnetism. It is also an electronic component that is used in circuits for either amplifying or switching electrical signals or power and allowing them to be used in a large array of electronic devices. The NPN transistor does not increase the e.m.f of a.c generator. The candidate was supposed to know that it is the step up transformer which increases the e.m.f produced by a simple a.c generator. Extract 11.1 shows a sample of a candidate's weak response to question 11.


11 @ Given:
V = 240V
P = 2·5kW = 2500w
I = 15A
Required
time = ?
Solution
From the formula.
Power = ItV.
2500 = 15 x t x 240
2500 = 3600t
3600 3600
t = 0·69hrs.
∴ The time is 0·69hrs therefore the fuse will support the operation of the two heaters at the same time since because the time used is too small thus the fuse can support.
(b) - By the increase of the voltage.
- By increasing the current required for flowing.
- By the use of higher resistance.
(c) The device for selection is the refrigerator since because it contain higher voltage and the power used for supplying to the fuse is also high.

Extract 11.1: A sample of a candidate's weak response to question 11

In extract 11.1 the candidate calculated electrical power by using the formula Power = VIt instead of Power = VI. Furthermore, he/she wrote a refrigerator as a device used to convert the generator into one of higher e.m.f instead of it being used as a step up transformer.

The candidates who scored high marks in this question managed to employ the concept of the power rating of electrical appliances and commercial units of electrical energy consumption. Hence, some of them were able to calculate the current of the fuse to show whether it can support the operation of the two heaters at the same time or not by using appropriate formula $= \frac{P}{V}$. In part (b), the candidates were able to properly explain the factors which increase the induced e.m.f in a simple a.c generator and in part (c) they managed to suggest a proper device required to increase the e.m.f. Extract 11.2 is the sample of a candidate's good response to question 11.



11. (a) Since the required rate is 21A and the available one is 15A, the fuse can not support the operation of two heaters at the same time.

(b) i) Increasing the strength of the magnet.
Since magnitude of the e.m.f depends on strength of the magnet. Higher the strength higher the emf.

ii) Increasing the rate of change of magnetic flux.
This can be by increasing speed, the change of magnetic flux is directly proportional to e.m.f.

iii) Using a soft iron core
Since it is easily magnetised it therefore increases a low emf to a higher e.m.f

(c) A step up transformer can be used to convert a lower emf into a higher emf.

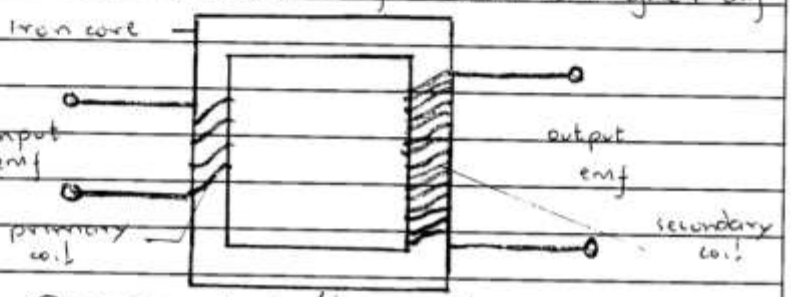
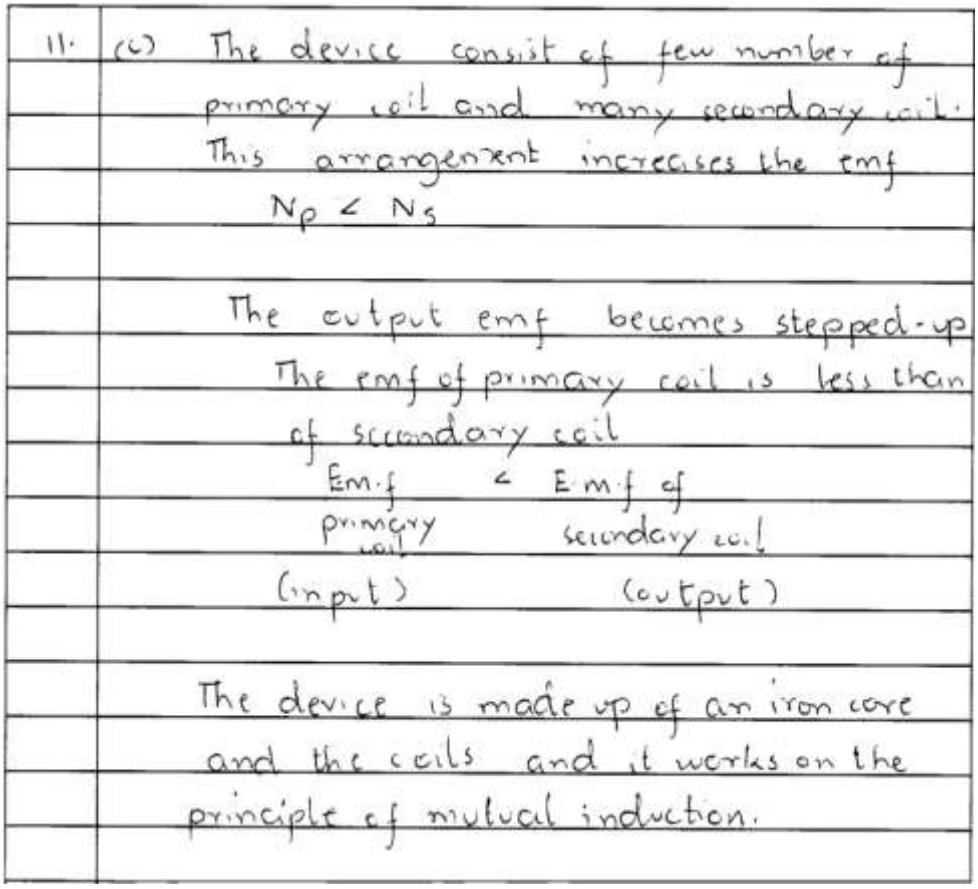


Diagram of a step up transformer



Extract 11.2: A sample of a candidate's good response to question 11

3.0 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH TOPIC

3.1 Analysis of Candidates' Performance in Paper 1 (031/1 Physics 1)

In this part, the candidates' performance was analyzed on the basis of the topics examined. The analysis aims at evaluating the performance and how candidates answered questions so as to look for a better approach and technique to improve the candidates' performance in future examinations.

In Physics paper 1, a total of twenty three (23) topics were tested. The topics examined were; *Measurement; Light; Magnetism; Motion in a Straight Line; Temperature; Sustainable Energy Source; Transfer of hermal Energy; Vapour and Humidity; Thermionic Emission; Elementary Astronomy; Waves; Pressure; Forces in Equilibrium; Optical Instruments; Measurement of Thermal Energy; Radioactivity; Newton's Law of Motion;*

Simple Machines; Thermal Expansion; Geophysics; Current Electricity; Electronics and *Electromagnetism.*

The analysis of candidates' performance revealed that good performance was observed in question 8 set from the topics of *Geophysics* and *Waves* where a total of 101,135 (86.77%) candidates scored above 3 marks out of 10 marks. Good performance was also observed in the topic of *Waves* in question 2 where 87,596 (75.13%) candidates scored 3 marks or above. This question was a homogeneous matching item. Question 1 was set from various topics also was performed well as a total of 77,229 (66.24%) candidates scored high marks in this question.

Average performance (35.91%) was observed in the topics of Newton's Laws of Motion and Simple Machines examined in question 6.

The candidates with good performance had sufficient knowledge and competence on some of the topics tested, had ability to perform questions demanding detailed information or explanations, had capacity to do computations and drawing skills and they were competent in English language.

Further analysis of the candidates' performance showed that some topics had weak performance. These include *Measurement of Thermal Energy* and *Radioactivity* (29.00%) examined in question 5, *Thermal Expansion* and *Measurement of Thermal Energy* (25.91%) examined in question 7, *Electromagnetism* and *waves* (15,25%) examined in question 10, *Current Electricity* and *Electromagnetism (*21.70%) examined in question 11, *Pressure* and *Forces in Equilibrium* (9.2%) examined in question 3, *Current Electricity* and *Electronics* (7.42%) examined in question 9 and *Light* and *Optical Instruments* (2.49%) examined in question 4. Detailed information on the candidates' performance is shown in the Appendix I. Weak performance in these topics was contributed by inadequate knowledge possessed by the candidates, poor English Language proficiency, lack of drawing skills, computational skills and failure to understand the requirement of the question.

3.2 Analysis of the Candidates' Performance in Paper 2 (031 Physics 2)

The practical paper comprised of three alternative papers namely, 031/2A Physics 2A; 031/2B Physics 2B and 031/2C Physics 2C. Each alternative paper consisted of two questions each carrying 25 marks. Question 1 in all alternatives was set from the topic of *Mechanics* specifically, the subtopic

of motion under gravity and question 2 from the topic of Current electricity. The candidates were required to answer all the questions. In this paper, the candidates performed averagely where in the topic of mechanics they had an average performance of 54.90 per cent while in the topic of Current Electricity had a performance of 34.49 per cent as indicated in appendix II.

3.3 Question 1: Mechanics

3.3.1 031/2A Physics 2A

This question was attempted by 116,365 (99.8%) candidates out of which 52,485 (45.10%) scored from 0 to 7.0 marks, 34,519 (29.66%) scored from 7.5 to 16.0 marks and 29,361 (25.24%) scored from 16.5 to 25.0 marks. The performance of candidates was average as 63,880 (54.90%) scored from 7.5 to 25 marks. Figure 12 shows the candidates' performance in this question.

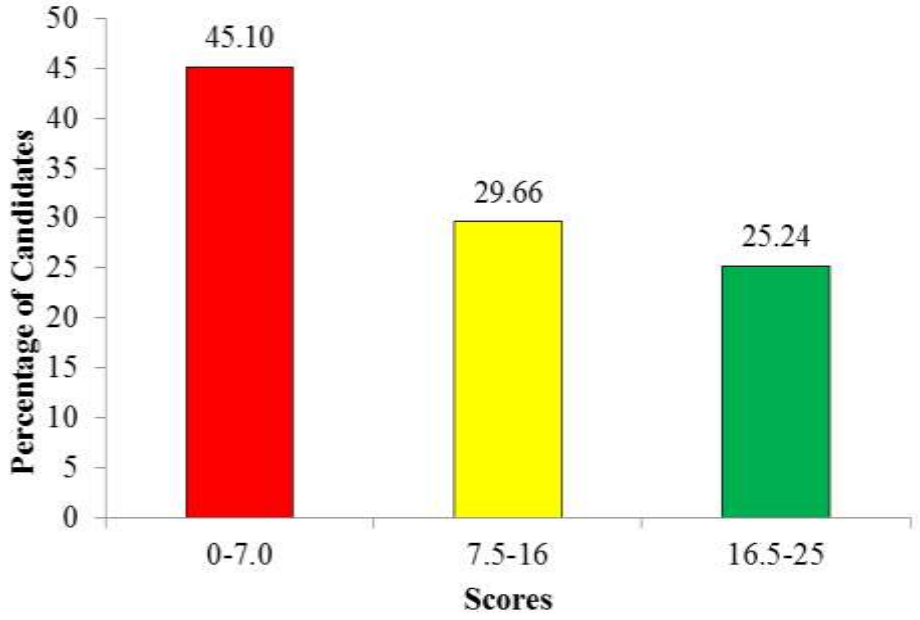


Figure 12: *The performance of candidates in question 1*

In this question the candidates were provided with a retort stand, stopwatch, a thread 110 cm, pendulum bob, cork pads, 20 cm wooden rod, a metre rule and a half metre rule. The candidates were required to:

(a) Tie a thread to a given pendulum bob, fix a wooden rod, mark its reach point N and then remove the rod as shown in Figure 1.

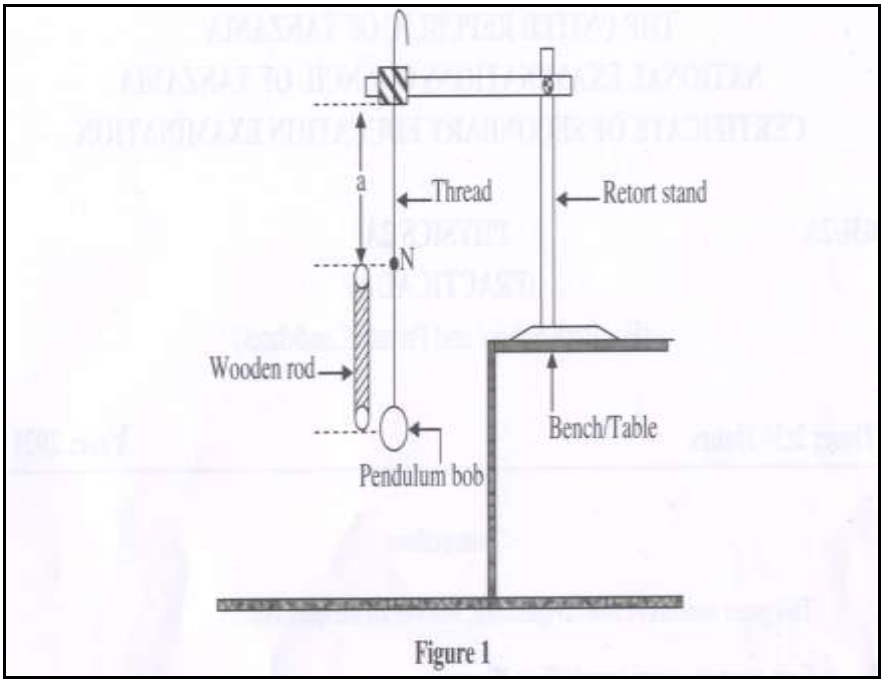


Figure 1

(b) Measure distance a = 20 cm from point N to the point of suspension of the pendulum. Displace the bob to a small distance and release it so that it performs to and fro motion. Determine the time, t for twenty complete oscillations and hence determine the periodic time, T.

(c) Repeat the procedures in 1 (b) for the values of a = 40 cm, 60 cm, 80 cm and 100 cm and then;

(i) tabulate the values of a, t, T and T^2

(ii) plot a graph of T^2 (s^2) against a (cm)

(iii) find the slope, S of the graph

(iv) determine the value of 'b' from the equation: $T^2 = S (a + b)$

(v) explain the meaning of 'b'

The candidates who scored high marks in this question were competent in analyzing, evaluating and applying mathematical skills systematically to obtain the correct answer. The candidates managed to set the apparatuses, prepare a table of results and correctly record the data. The candidates collected the data at a reasonable range and used a table of values to plot the graph of *T^2 (s^2) against 'a' (cm)* correctly.

In the graph, the candidates correctly indicated the following important parameters which are commonly considered when plotting the graph; the *title* of the graph, including their units; the *scale* (vertical and horizontal axes) with their respective SI units; *transfer of points*; *best line* and *slope* indication. Moreover, the candidates used the points at the slope to find the slope of the graph by relation: $slope, S = \frac{\Delta T^2(s^2)}{\Delta a}$ they also employed the equation of the line $y = mx + c$ to relate; $T^2 = S\ (a + b)$ to determine the value of 'b' and finally they correctly explained the meaning of 'b'.

Extract 12.1: is a sample of responses from a candidate who scored high marks in this question.

1. (i) Table of results

a (cm)	t (s)	T (s)	T^2 (s^2)
20	25.37	1.27	1.61
40	81.32	1.57	2.46
60	34.78	1.74	3.03
80	39.85	1.98	3.92
100	42.97	2.15	4.62

(iii) From,

$$\text{Slope} = \frac{\text{Vertical change}}{\text{Horizontal change}}$$

$$S = \frac{\Delta T^2(sec^2)}{\Delta a\ (cm)}$$

$$S = \frac{(3.96 - 1.36)\ sec^2}{(80 - 13)\ cm}$$

$$= 0.04\ sec^2/cm$$

∴ The slope, S of the graph is 0.04 sec^2/cm

(iv) From,

$T^2 = S(a+b)$

$T^2 = Sa + Sb$

$T^2 = S(a) + Sb$

$y = mx + c$

$Sb = c$

But $c = 0.82$

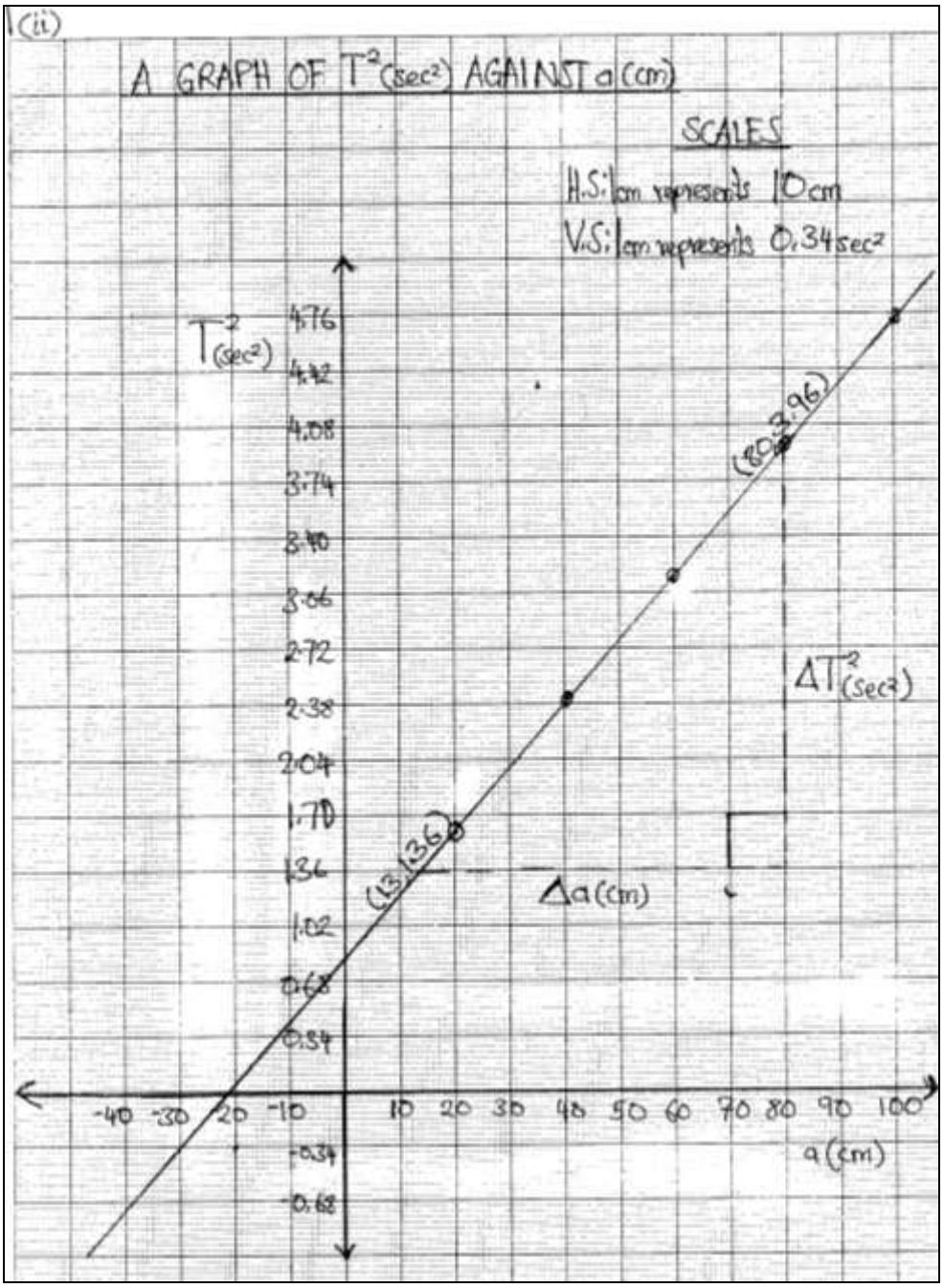
$b = \frac{c}{S}$

$b = \frac{0.82\ sec^2}{0.04\ sec^2/cm}$

$b = 20.4\ cm \sim 20\ cm$

∴ From the equation the value of 'b' is 20cm

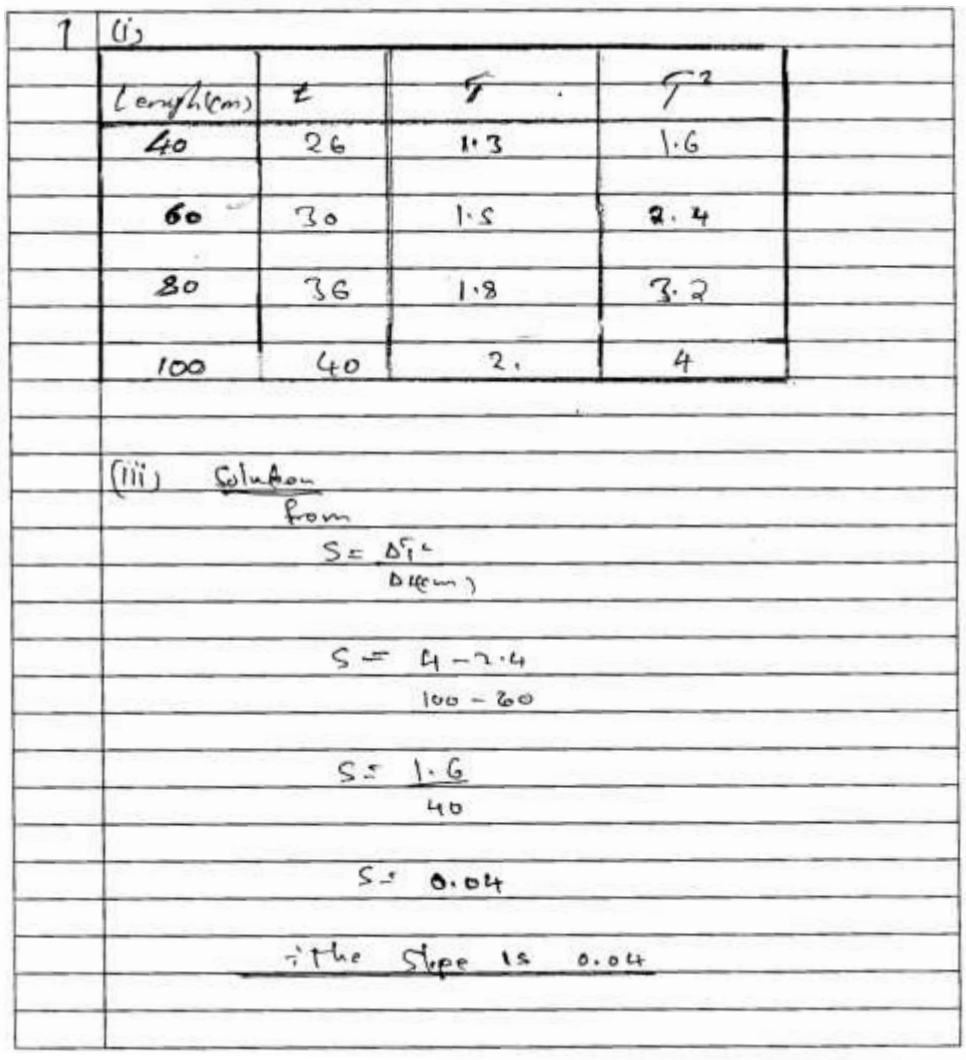
1.(v) The value of 'b' represents the length of the wooden rod. (from the pendulum bob to point N)



Extract 12.1: A candidate's good response to question 1 in Physics 2A

In extract 12.1 the candidate followed appropriate procedures correctly, recorded the data, plotted the graph and used it to perform the calculations accordingly and finally explained the meaning of b.

The candidates who scored low marks in this question lacked knowledge of the concept of mechanics especially the simple pendulum. These candidates failed to set up the experiment correctly which led them to end up with wrong data in the table of results. Some of the candidates drew the graphs without indicating the axis, title of the graph, the scale used, best line and slope indication. This signifies that the candidates lacked knowledge of the choice of the points for slope calculations and thus failed to determine the rest of the items that depend on the preceding variables. Extract 12.2 is a sample of a candidate's weak responses to this question.



7 (ii)

Length(cm)	t	T	T^2
40	26	1.3	1.6
60	30	1.5	2.4
80	36	1.8	3.2
100	40	2.	4

(iii) Solution

from

$$S = \frac{\Delta T^2}{\Delta l(cm)}$$

$$S = \frac{4 - 2.4}{100 - 60}$$

$$S = \frac{1.6}{40}$$

$$S = 0.04$$

∴ the Slope is 0.04

1. (iv) Solution

from

$T^2 = S(a+b)$

$T^2 \rightarrow 2.4$

$S \rightarrow 0.04$

$a \rightarrow 20$

$b \rightarrow ?$

then

$T^2 = S(a+b)$

$2.4 = 0.04(20+b)$

$2.4 = 0.8 + 0.04b$

$2.4 - 0.8 = 0.04b$

$1.6 = 0.04b$

then

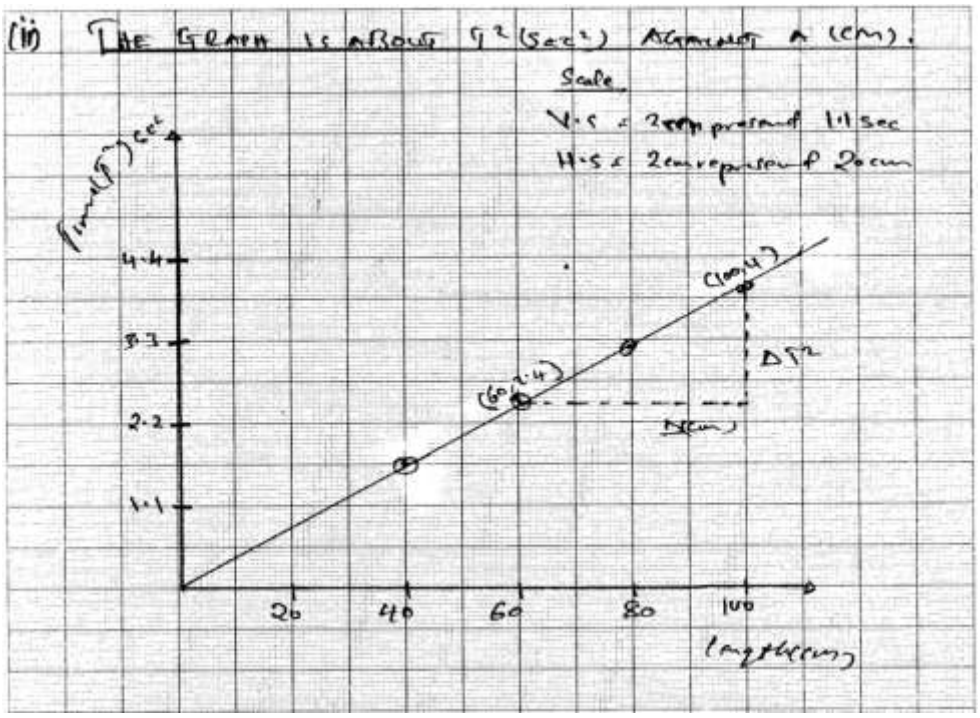
$\frac{1.6}{0.04} = \frac{0.04b}{0.04}$

$b = \frac{1.6}{0.04}$

$b = 40$

∴ The value of "b" is 40cm.

(v) The letter "b" represent the length which present in the experiment.



Extract 12.2: A sample of candidate's weak response to question 1 in Physics 2A

In extract 12.2, the candidate failed to prepare the anticipated table of results where he/she inserted the variables with no SI units. Due to incorrect data values collected, the candidate calculated the wrong slope of the graph. Consequently, he/she failed to interpret the given formula with the linear equation of the graph and the variables which correspond with the slope and T^2 - intercept.

3.3.2 031/2B Physics 2B

In this question the candidates were provided with: retort stand, stopwatch, a thread of 100 cm, pendulum bob, cork pads and a metre rule.

The candidates were required to:

(a) Set up the apparatus such that the pendulum bob is just above the top of the bench as shown in Figure 1.

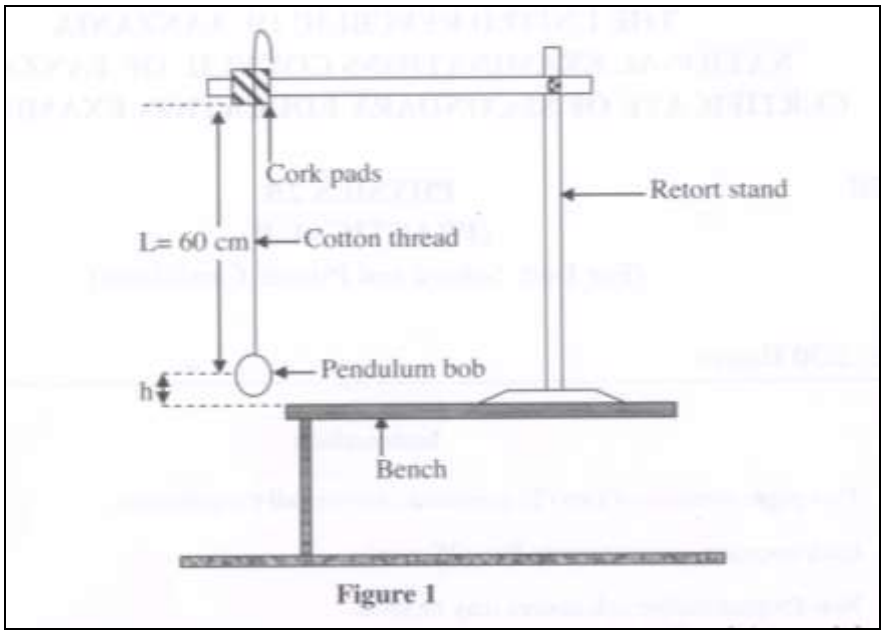


Figure 1

(b) Measure the height, h = 10 cm from the table top to the middle of the pendulum bob and displace the bob through a small distance. Release the bob then determine the time, t for 20 complete oscillations and its periodic time, T.

(c) Repeat the procedures in 1 (b) above for the values of h = 20 cm, 30 cm, 40 cm and 50 cm; and then;

(i) tabulate the results including the values of T^2

(ii) plot a graph of T^2 (s^2) against h (cm)

(iii) find the slope, S of the graph

(iv) record the value of T^2 for which h = 0

(v) determine the value of k from the equation: $T^2 = -(Sh + Sk)$

(vi) explain the physical meaning of the value obtained in 1 (v)

The candidates who scored high marks in this question were competent in analyzing data systematically and applying mathematical skills to obtain the correct answer. The candidates managed to set the experiment, prepare a table of results, record the data correctly and plott the graph of *T^2 (s^2) against h (cm)* correctly.

In the graph, the candidates correctly indicated the following important aspects. The title of the graph, including their units; the scale (vertical and horizontal axes) with their respective SI units; transfer of points; best line or curve and slope indication. Moreover, the candidates used the points at

the slope to find the slope of the graph by relation: $= \frac{\Delta T^2(s^2)}{\Delta h}$, record the values of T^2 for which h = 0, they also employed the equation of the line $y = mx + c$ to relate; T^2 = -(Sh + Sk) to determine the value of k. Finally, they correctly explained the physical meaning of k obtained. Extract 13.1 is a sample of a response of a candidate who scored high marks in question 1 in Physics 2B.

1 (i)

Length L (cm)	Height h (cm)	Time for 20 oscillation (t)	Period (sec) $T = \frac{t}{20}$	T^2 (sec)^2
50	10	28·28	1·414	2·0
40	20	25·28	1·264	1·6
30	30	21·90	1·095	1·2
20	40	17·88	0·894	0·8
10	50	12·64	0·632	0·4

(iii) Slope S of the graph

$$\text{slope } (S) = \frac{\text{Change in } T^2}{\text{Change in } h}$$

$$\text{slope } (S) = \frac{(2{\cdot}0 - 0{\cdot}80)\ \text{sec}^2}{(10 - 40)\ \text{cm}}$$

$$\text{slope } (S) = \frac{1{\cdot}2\ \text{sec}^2}{-30\ \text{cm}}$$

∴ slope (S) = $-0.04\ sec^2/cm$

(iv) From the graph, the value of T^2 for which $h = 0$, is $2.4\ sec^2$

(v) The value of k is required from

$$T^2 = -(Sh + Sk)$$

$$T^2 = -Sh - Sk \text{ (open brackets)}$$

Substitute the value of T^2 when the $h = 0$,

$T^2 = 2.4\ sec^2$ - intercept

1 (v) Also, the value of S is the slope of the graph

$S = -0.04\ sec^2/cm$

Therefore from, $T^2 = -Sh - Sk$

~~$2.4\ sec^2 = -0.04\ sec^2/$~~

$2.4\ sec^2 = (-0.04\ sec^2/cm \times 0) - (-0.04\ sec^2/cm\ k)$

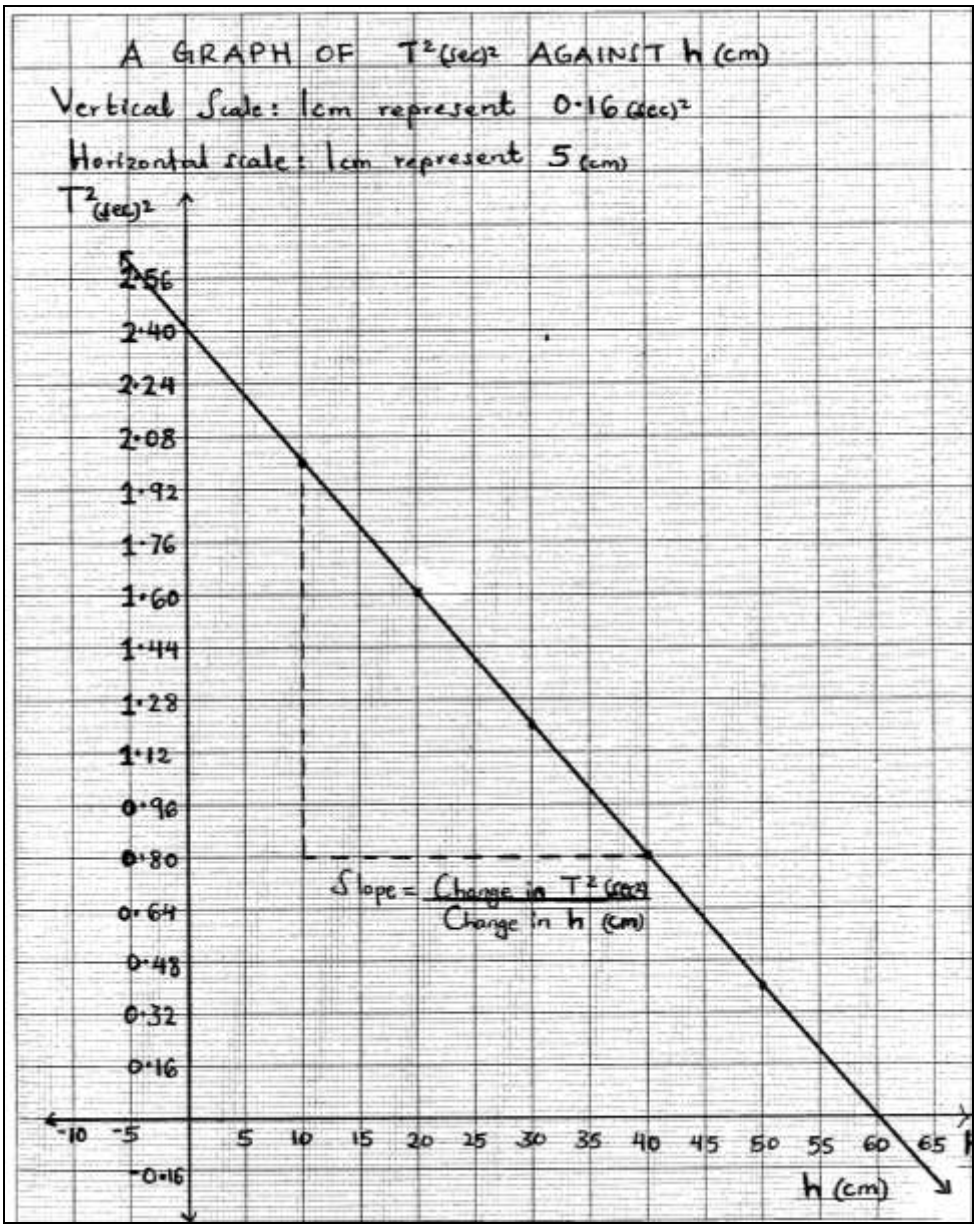
$2.4\ sec^2 = 0.04\ sec^2/cm\ k$

Divide by $0.04\ sec^2/cm$ both side to obtain k

$$\frac{2.4\ sec^2}{0.04\ sec^2/cm} = \frac{0.04\ sec^2/cm\ k}{0.04\ sec^2/cm}$$

Therefore, $k = 60\ cm$

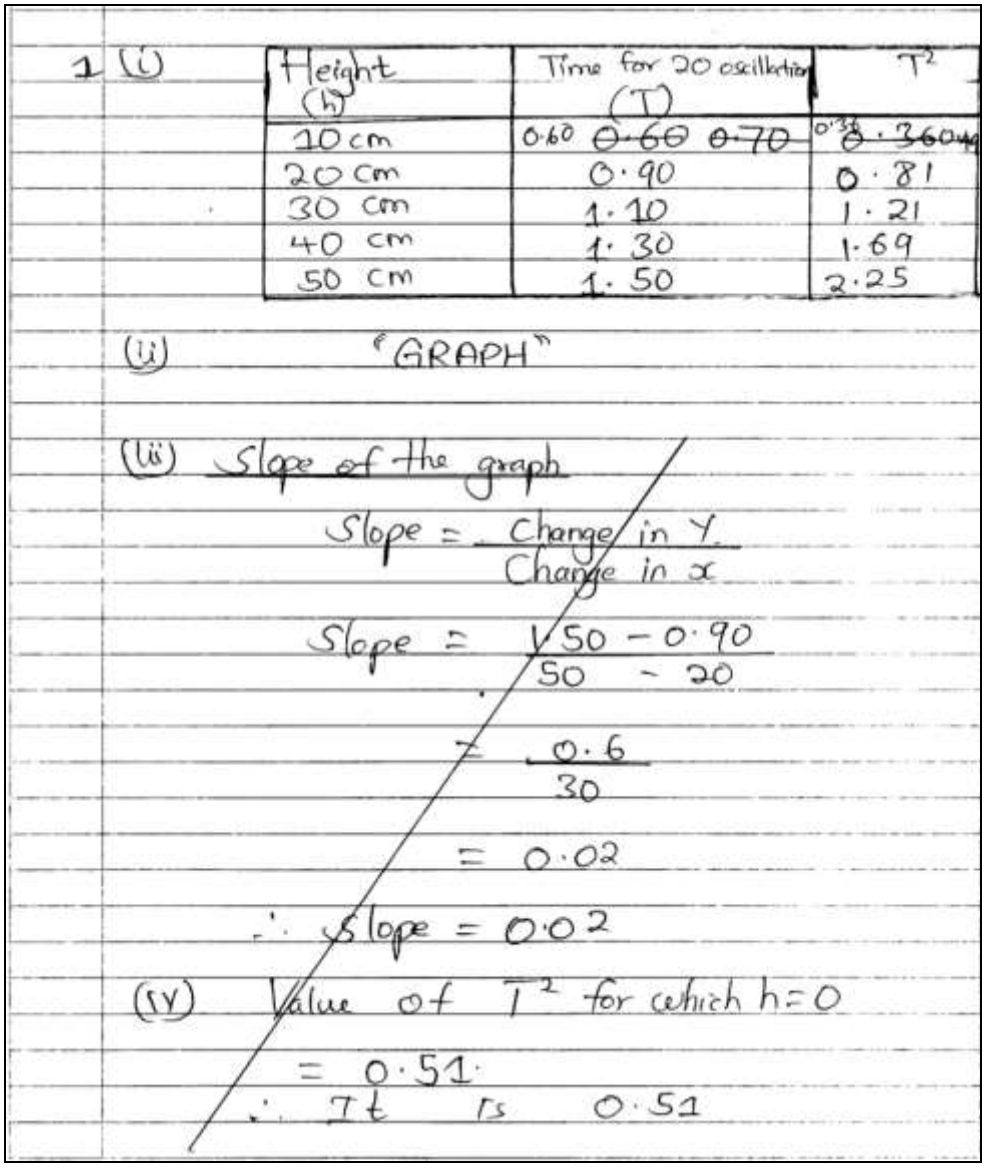
(vi) The physical meaning of k is the length of the cotton threads measured (60 cm)



Extract 13.1: A sample of a candidate's good response to question 1 in Physics 2B

The candidates who scored low marks in this question lacked knowledge of the concept of mechanics especially on the subtopic of motion under gravity (simple pendulum). Another skill that candidates lacked was drawing. Some of the candidates failed to draw a graph of T^2 (s^2) against h (cm) correctly. Some drew the graphs without indicating the axes, title of the graph, the scale used, best line and slope indication. This shows that

candidates had inadequate knowledge of the choice of the points for slope calculations thus failed to determine the rest of the items that depended on the graph. Extract 13.2 is a sample of the candidate's weak responses from question 1 in Physics 2B.



1 (i)

Height (h)	Time for 20 oscillation (T)	T^2
10 cm	0.60 ~~0.60~~ ~~0.70~~	~~0.36~~ ~~0.360~~
20 cm	0.90	0.81
30 cm	1.10	1.21
40 cm	1.30	1.69
50 cm	1.50	2.25

(ii) "GRAPH"

(iii) Slope of the graph

$$\text{Slope} = \frac{\text{Change in } Y}{\text{Change in } x}$$

$$\text{Slope} = \frac{1.50 - 0.90}{50 - 20}$$

$$= \frac{0.6}{30}$$

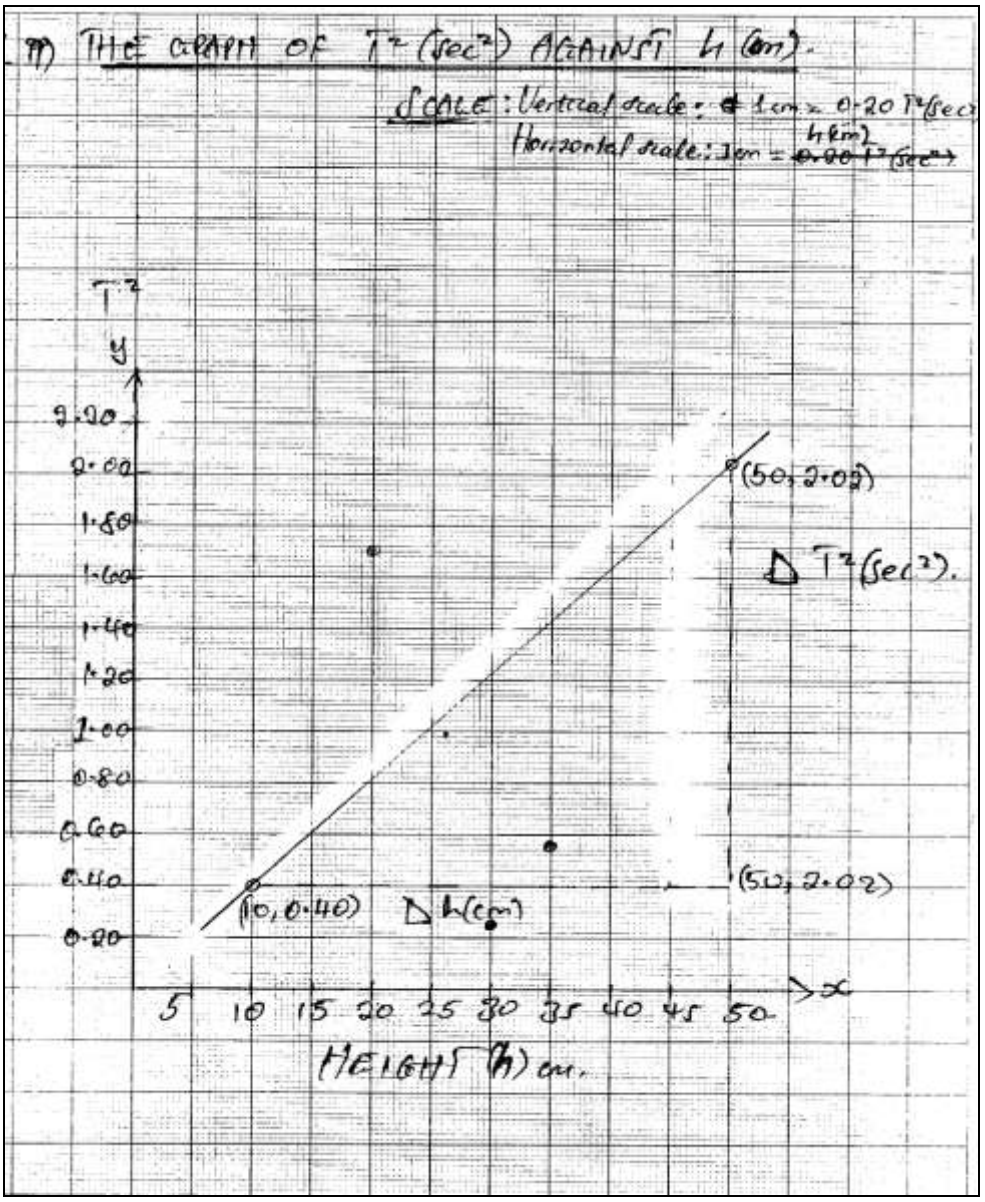
$$= 0.02$$

$\therefore$ Slope = 0.02

(iv) Value of T^2 for which h = 0

= 0.51

$\therefore$ It is 0.51



Extract 13.2: A sample of a candidate's weak responses to question 1 in Physics 2B.

In extract 13.2, the candidate incorrectly tabulated the periodic time and its square without showing the time taken to complete one oscillation hence, ended up with a wrong table of data and items that followed.

3.3.3 031/2C Physics 2C

In this question the candidates were provided with: retort stand, stopwatch, a string of 100 cm, pendulum bob, cork pads and a metre rule.

The candidates were required to:

(a) Set the length of the given string and its pendulum bob to have 50 cm from the point of suspension. The pendulum bob was to be just above the surface of the table to allow swinging of the bob for h = 1cm as shown in Figure 1.

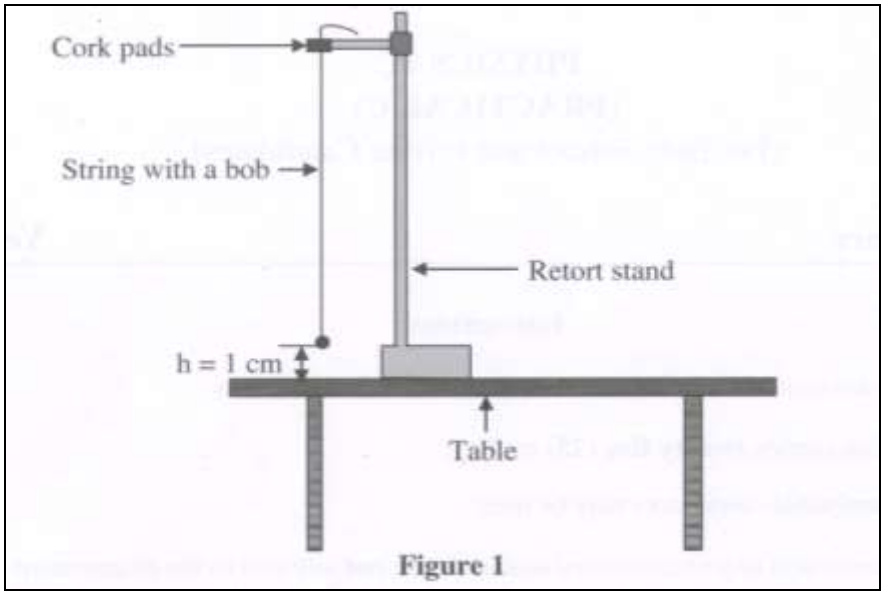


Figure 1

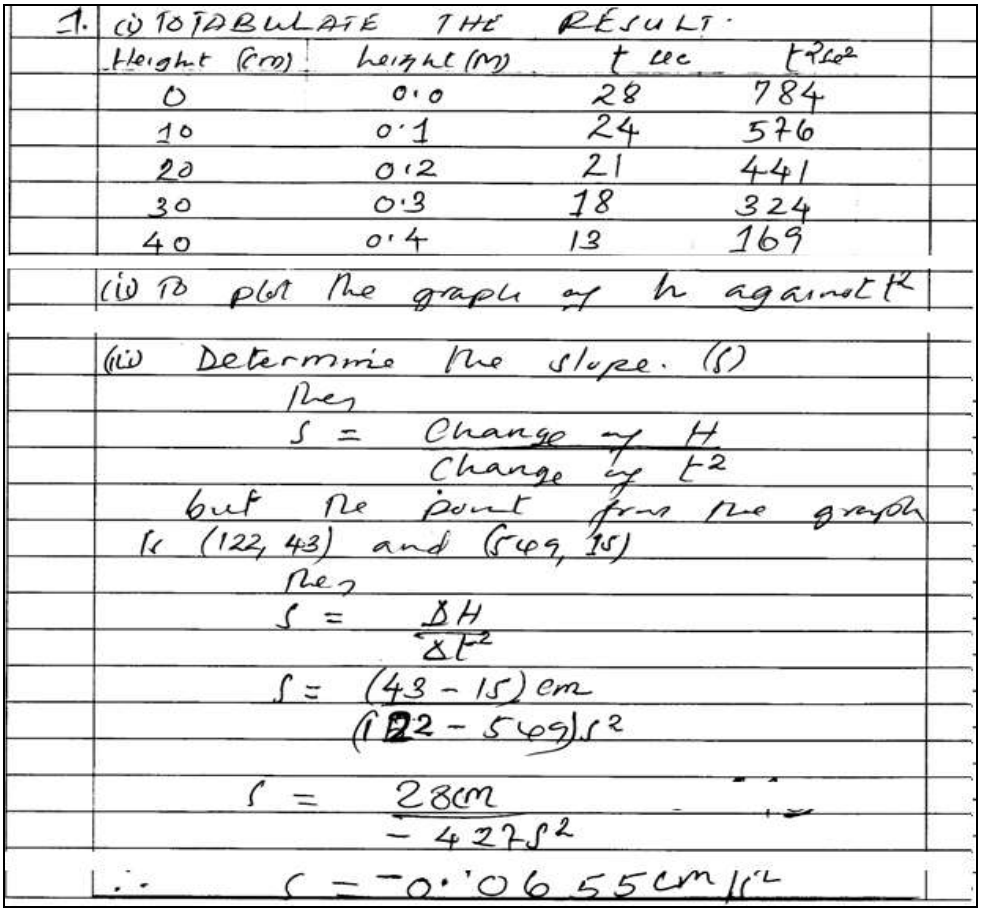
(b) Displace a bob in a small angle and then release it to initiate free oscillations. Using the stop watch provided, measure and record the time, t for 20 oscillations.

(c) Repeat the procedures in 1 (b) above using h = 10 cm, 20 cm, 30 cm and 40 cm. Record the corresponding time, t taken for 20 oscillations for each value of h; and then

(i) tabulate the results including the values of t^2
(ii) plot a graph of h against t^2
(iii) determine the slope, S of the graph
(iv) record the vertical intercept of the graph
(v) state the physical meaning of the answer obtained in 1 (iv)
(vi) calculate the value of $P = -4\pi^2 n^2 S$
(vii) state the aim of the experiment.

The candidates who scored high marks in this question managed to set the apparatus, prepare a table of results and recorded the data correctly. The candidates collected the data at a reasonable range and used a table of values to plot the graph of h against $t^2(s^2)$ correctly.

In the graph, the candidates correctly indicated the following important features: The title of the graph, including their units; the scale (vertical and horizontal axes) with their respective SI units; transfer of points; best line or curve and slope indication. Moreover, the candidates used the points indicated to find the slope of the graph. They were able to calculate the value of $P = -4\pi^2 n^2 S$ and finally were able to state the aim of the experiment. Extract 14.1 is a sample of responses of one of the candidates who scored high marks in question 1 in Physics 2C.



1. (i) TO TABULATE THE RESULT.

Height (cm)	height (m)	t sec	t^2 sec^2
0	0.0	28	784
10	0.1	24	576
20	0.2	21	441
30	0.3	18	324
40	0.4	13	169

(ii) To plot the graph of h against t^2

(iii) Determine the slope. (S)

Then

$S = \frac{\text{Change of } H}{\text{Change of } t^2}$

but the point from the graph is (122, 43) and (569, 15)

Then

$S = \frac{\Delta H}{\Delta t^2}$

$S = \frac{(43 - 15)\text{ cm}}{(122 - 569)\text{ s}^2}$

$S = \frac{28\text{cm}}{-427\text{s}^2}$

$\therefore S = -0.0655\text{ cm/s}^2$

1 (iv) The vertical intercept is 50cm

(v) The meaning of the Answer obtained in 1 (iv).

If is the meaning of the y-intercept which is 50cm.

(vi) Calculate the value of P

Solution:

$P = -4\pi^2 n^2 s$

but

n = number of osillation

s = 0.06555 cm/s²

π = 3.14

Then

$P = -4 \times (3.14)^2 \times (20)^2 \times 0.06555 \text{ cm/s}^2$

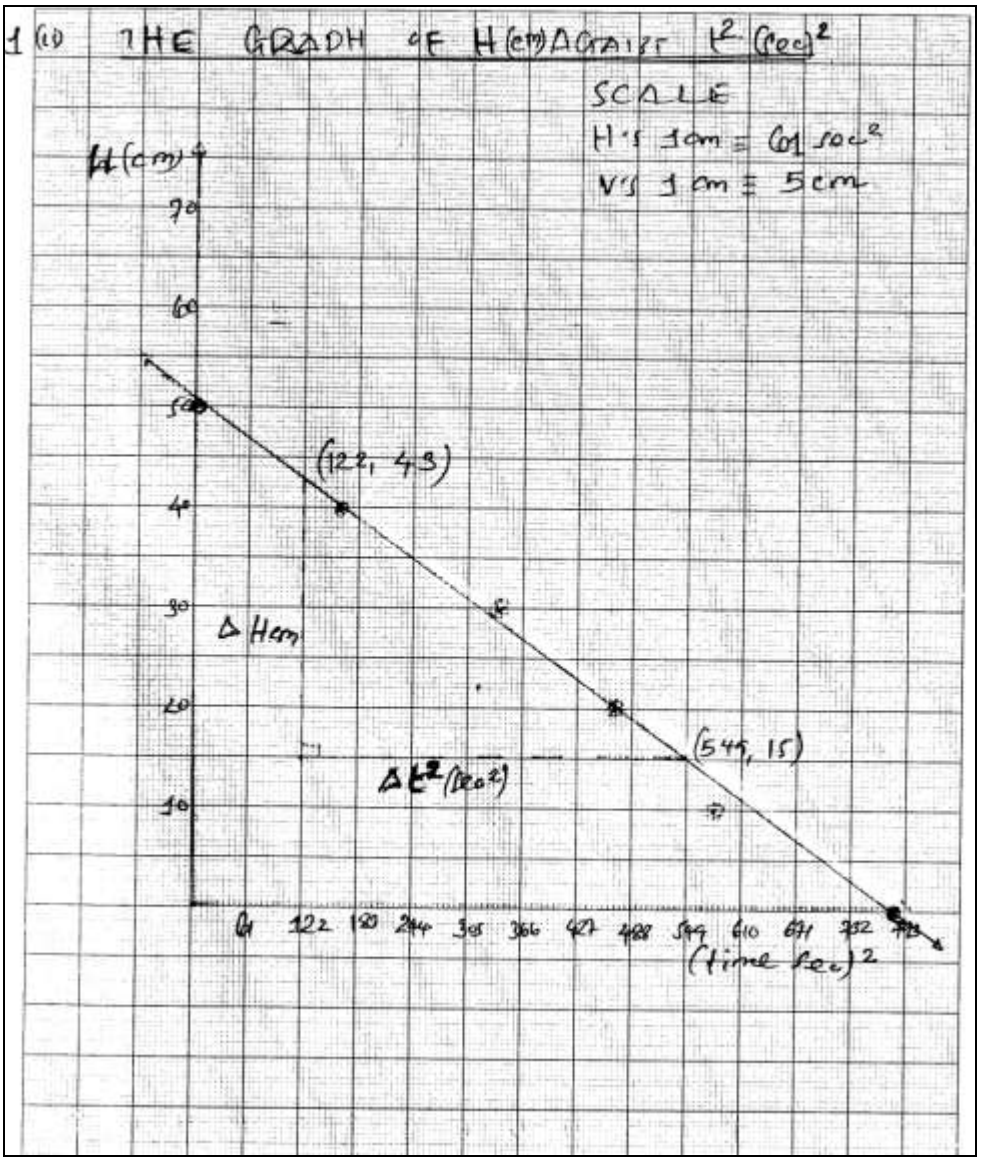
$P = (3.14)^2 \times 0.06555 \times 20^2 \times -4.$

$\therefore P = 1033.28 \text{ cm/s}^2$

or $P = 10.3328 \text{ M/s}^2$

∴ The value of P is 10.3328 M/s^2

(vii) The aim of this experiment is to determine the acceleration due to gravity.



Extract 14.1: A sample of a candidate's good response to question 1 in Physics 2C

The candidates who scored low marks in this question lacked knowledge of the concept of mechanics (motion under gravity) especially, on a simple pendulum. Another skill which the candidates lacked was drawing of graphs. Some drew the graphs without labelling the axes, title of the graph, the scale used, best line and slope indication. This shows that some of the candidates had insufficient knowledge of the choice of the points for slope calculations. They thus failed to determine the rest of the items that

depended on the variables from the graph. Extract 14.2 shows a sample of a candidate's weak response to question 1in Physics 2C.

1 i

20 oscillation

h	t	t^2	t_1/t_2
10	12.6	0.6	0.4
20	17.8	0.8	0.8
30	21.9	1.0	1.2
40	25.2	1.2	1.6

1 ii The table of graph h against t^2

h	10	20	30	40
t^2	0.6	0.8	1.0	1.2

1 iii The slope S of the graph.

$$\frac{\text{Vertical component}}{\text{Horizontal component}} = \frac{1.2 + 35}{0.6 + 5}$$

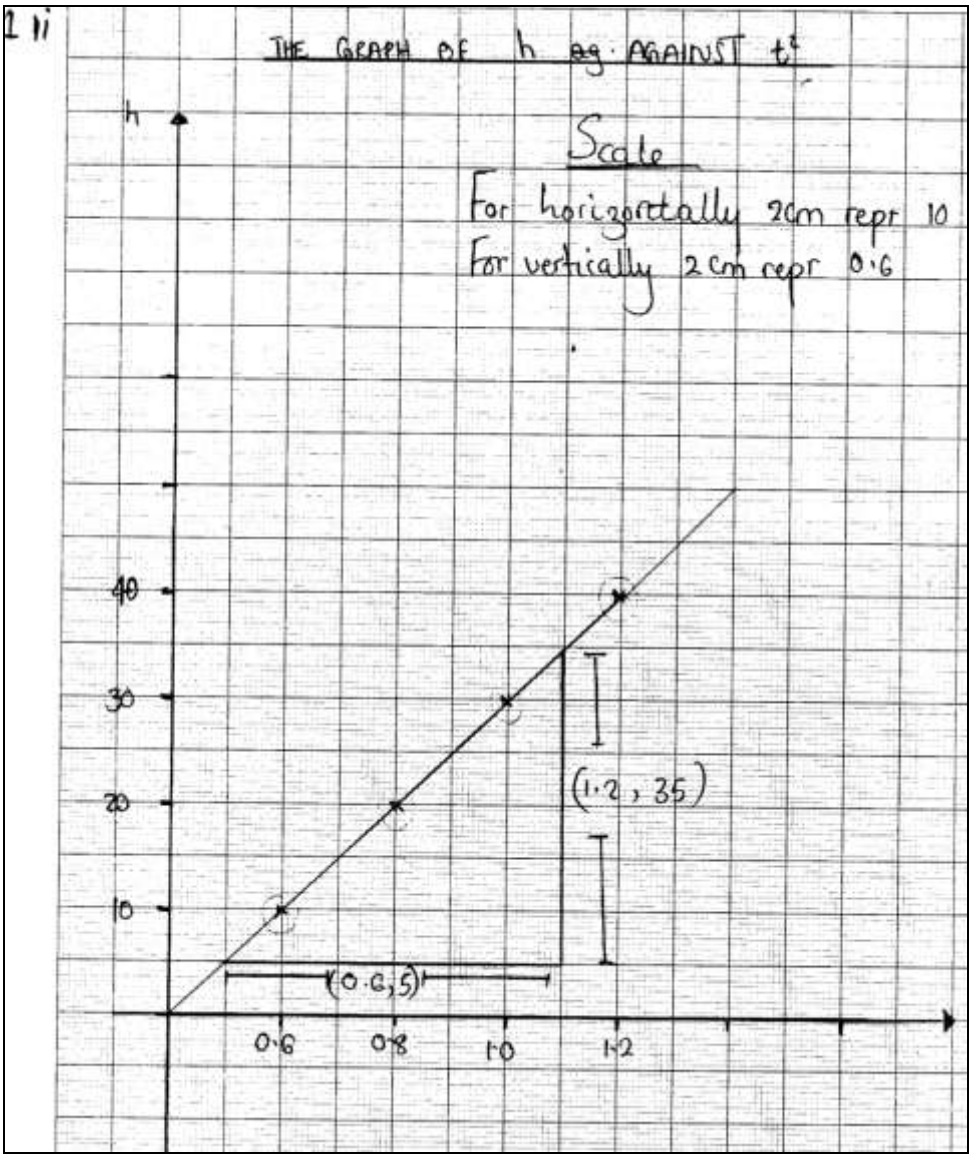
$$= \frac{36.2}{5.6}$$

$$= 6.4$$

∴ The slope S of the graph is 6.4

1 vii The aim of the experiment is to find the pendulum time.

1 iv



Extract 14.2: A sample of a candidate's weak response to question 1 in Physics 2C

3.4 Question 2: Current Electricity

This question was attempted by 116,356 (99.8%) candidates out of which 76,227 (65.51%) scored from 0 to 7.0 marks, 26,380 (22.67%) scored from 7.5 to 16.0 marks and 13,749 (11.82%) scored from 16.5 to 25 marks. These data indicate that the performance of the candidates was average as 40,129 (34.49%) scored from 7.5 to 25 marks. Figure 13 shows the candidates' performance in this question

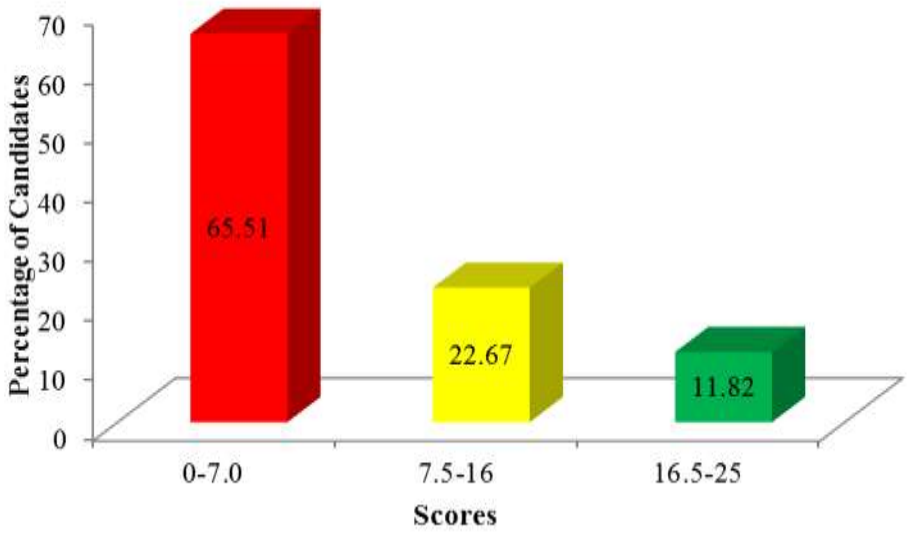


Figure 13: *The candidates' performance in question 2*

3.4.1 031/2A Physics 2A

In this question the candidates were provided with two dry cells of e.m.f, E; a key, K; an ammeter, A; a voltmeter, V; connecting wires, a rheostat, Rh; unknown resistor, R and a 4 Ω resistor.

The candidates were required to:

(a) Set up a circuit as shown in Figure 2.

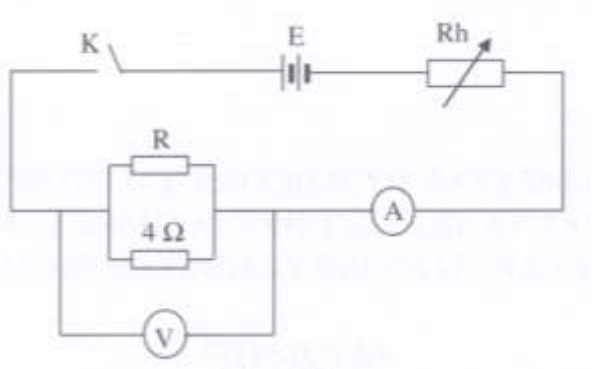


Figure 2

(b) Close the key, adjust the rheostat so that the ammeter reading is 0.1A and then record the voltmeter reading, V in volts.

(c) Repeat the procedures in 2 (b) above for the values of ammeter readings of 0.3 A, 0.5 A, 0.7 A and 0.9 A; and then

(i) tabulate the results including the values of $\frac{1}{I}$ and $\frac{1}{V}$

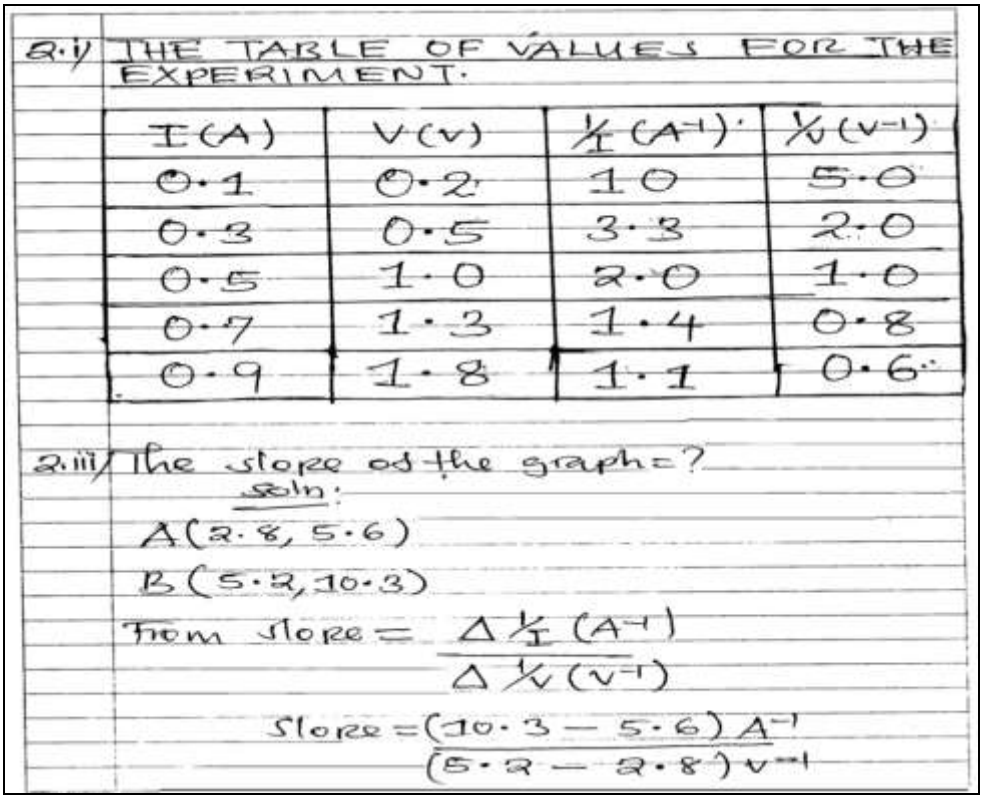
(ii) plot a graph of $\frac{1}{I}$ and $\frac{1}{V}$

(iii) find the slope of the graph

(iv) determine the value of the unknown resistance, R

(v) explain the effect of connecting resistor, R as shown in Figure 2.

The candidates who managed to score high marks in this question were knowledgeable on the concept of current electricity. They were able to connect the circuit correctly and hence collected and tabulated the results correctly. Moreover, these candidates managed to draw properly the graph of $\frac{1}{I}$ against $\frac{1}{V}$ and then find the slope. Generally, they demonstrated good skills in mathematics. Extract 15.1 shows a candidate's good responses to question 2 in Physics 2A.



2.i) THE TABLE OF VALUES FOR THE EXPERIMENT.

I(A)	V(v)	1/I (A⁻¹)	1/V (v⁻¹)
0·1	0·2	10	5·0
0·3	0·5	3·3	2·0
0·5	1·0	2·0	1·0
0·7	1·3	1·4	0·8
0·9	1·8	1·1	0·6

2.iii) The slope of the graph = ?

soln:

A(2·8, 5·6)

B(5·2, 10·3)

From slope = $\frac{\Delta \frac{1}{I}\,(A^{-1})}{\Delta \frac{1}{V}\,(V^{-1})}$

Slope = $\frac{(10·3 - 5·6)\,A^{-1}}{(5·2 - 2·8)\,V^{-1}}$

2.iii) slope = $\frac{4.7\ A^{-1}}{2.4\ V^{-1}}$

slope = 1.9583 ..... A^{-1}/V^{-1}

slope = $2\ A^{-1}/V^{-1}$

∴ The slope of the graph is $2\ A^{-1}/V^{-1}$

OR

$2\ V/A$.

2.iv) The value of unknown resistance, R

Soln:

From ohm's law:

$V = IR$

$I = V/R$

$1/I = R/V$

$1/I = 1/V \times R$

$1/I = 1/V\ R$

2.iv) $\frac{1}{I} = R \times \frac{1}{V}$

$y = M \times x$

R = slope

$R = 2\,V/A$

$R = 2\,\Omega$

The total resistance through the circuit is $2\,\Omega$

Then:

From parallel connections formula:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

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

but $R_1 = 4\,\Omega$ (given)

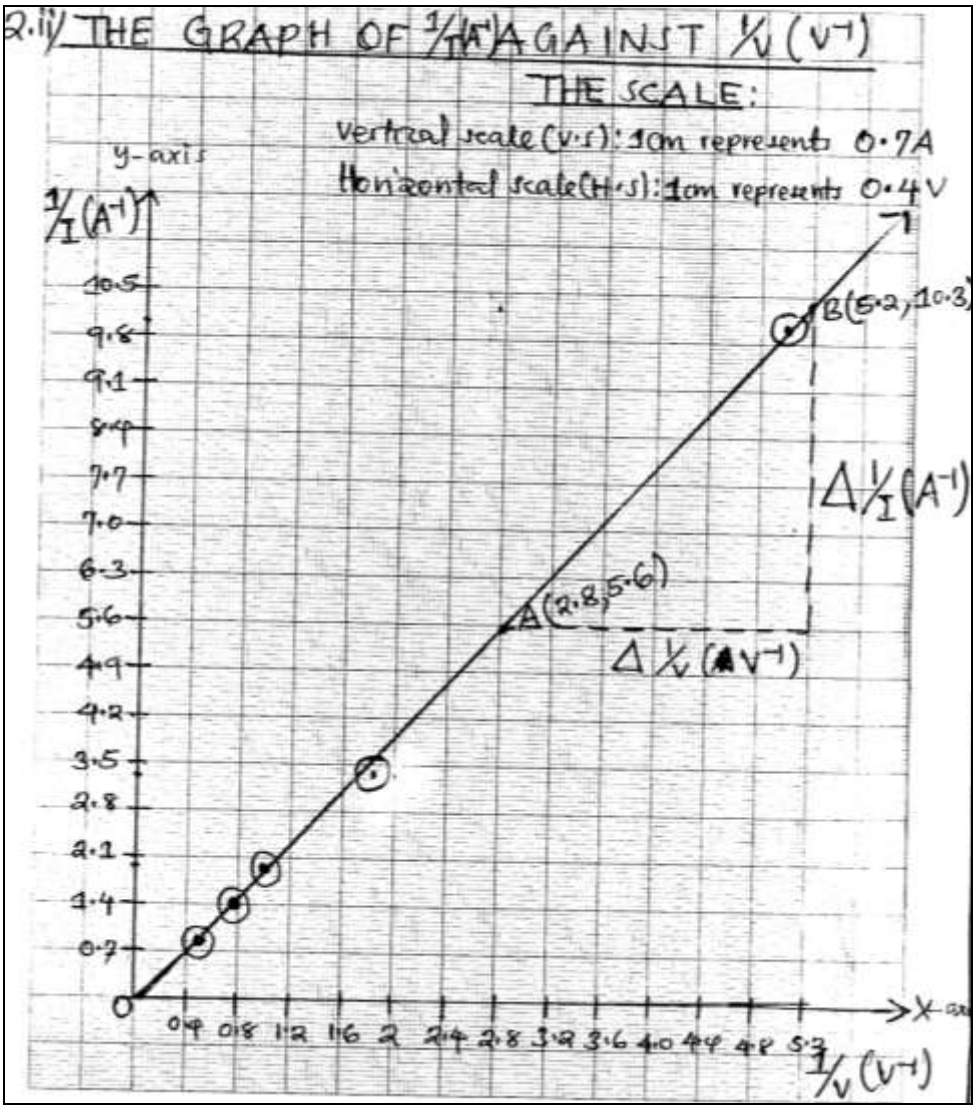
$$\frac{2\,\Omega}{1} = \frac{4\,\Omega \times R_2}{4\,\Omega + R_2}$$

$$4R_2 = 2(4 + R_2)$$

$$4R_2 = 8 + 2R_2$$

$$4R_2 - 2R_2 = 8\,\Omega$$

$$\frac{2R_2}{2} = \frac{8\,\Omega}{2} \Rightarrow R_2 = 4\,\Omega$$



Extract 15.1: A sample of candidate's good response to question 2 in Physics 2A

Inadequate knowledge and misunderstanding of the concepts of current electricity in conjunction with poor computational skills, led some candidates to score low marks in this question. Some of the candidates gathered and recorded incorrect data which resulted in incorrect calculations. It was also observed that some of the candidates had weaknesses on the writing of scales, transfer of points, labelling of the axes, slope indication and they also failed to explain the effect of an unknown resistor, R. Extract 15.2 shows a sample of candidate's weak responses.

2. 

$\frac{1}{I}$	0.1A	0.3A	0.5A	0.7	0.9
$\frac{1}{V}$	2.5	0.89	0.5	0.36	0.28

ii) The graph of $\frac{1}{I}$ against $\frac{1}{V}$

iii) The slop =

$$m = \frac{\Delta xy}{\Delta x}$$

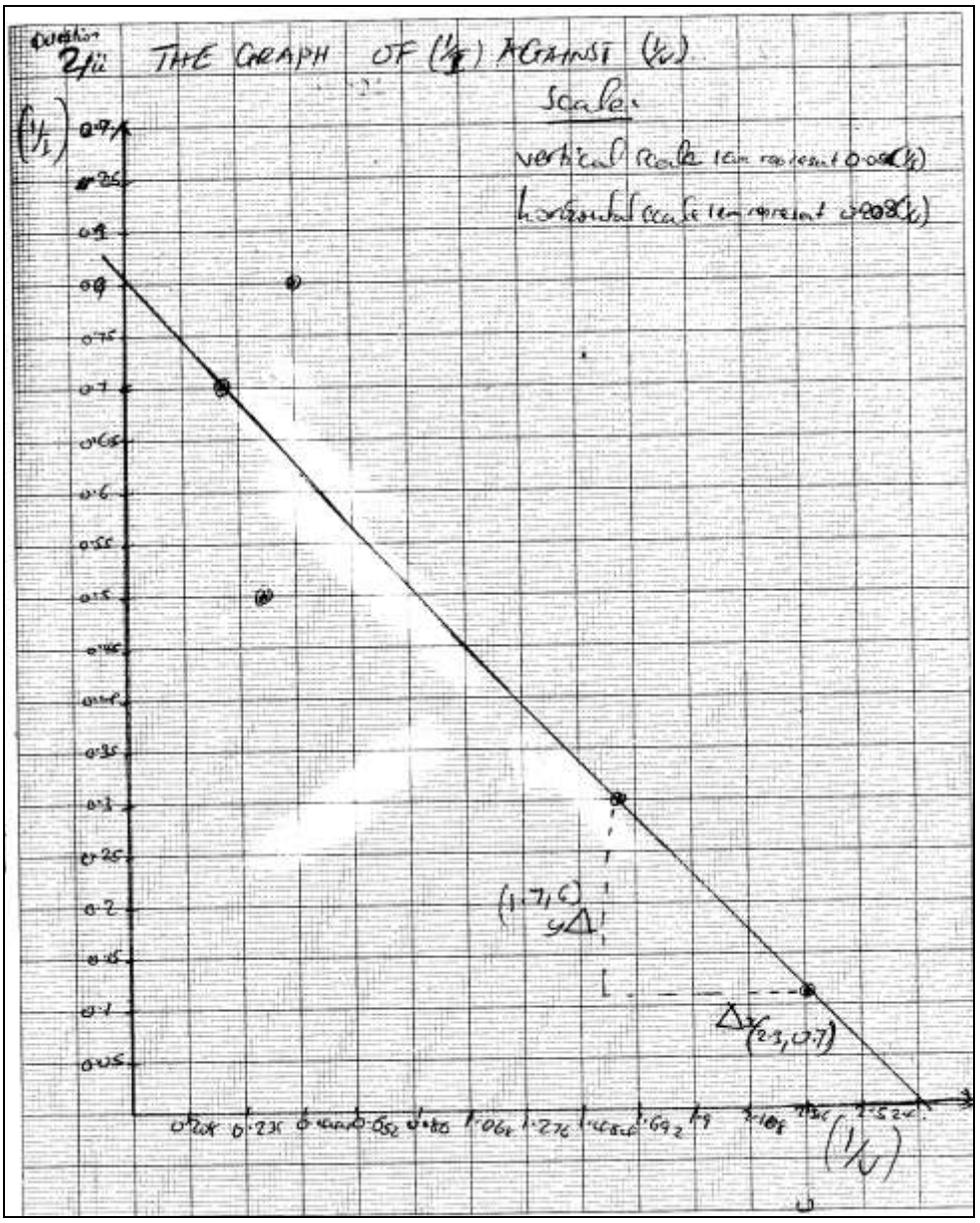
$$S = \frac{y_2 - y_1}{x_2 - x_1}$$

$$S = \frac{6 - 0.7}{1.7 - 2.3}$$

$$S = 3.7.$$

iv, The value of the unknown resistance is 3.7.

v. The effect of connecting resistor is to determine the unknown resistance



Extract 15.2: A sample of candidate's weak response to question 2

In extract 15.2, the candidate failed to construct a table of values and therefore, plotted a wrong graph. He/she failed to determine the slope of the graph due to incorrect data used to draw the graph.

3.4.2 031/2B Physics 2B

In this question the candidates were provided with: a dry cell of e.m.f, E; a switch, S; an ammeter, A; a voltmeter, V; connecting wires, a constantan wire, Q and a jockey J.

The candidates were then required to:

(a) Set up a circuit as shown in Figure 2.

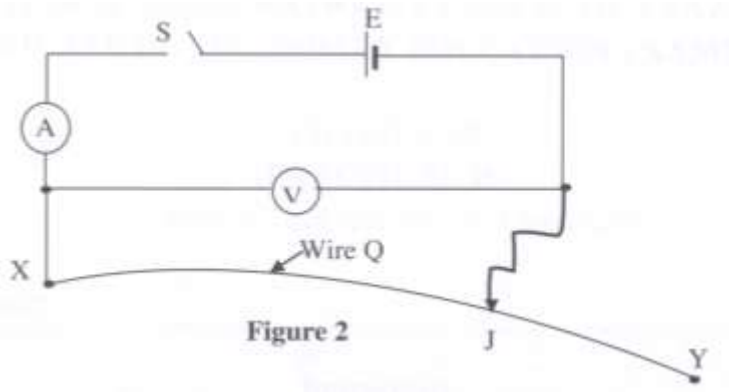


Figure 2

(b) Connect one end of the wire, Q to the ammeter, A at point X.

(c) Start at 15 cm length of a wire Q from end Y, move the jockey, J towards X until the ammeter registers 0.3 A. Record the voltmeter reading, V in volts.

(d) Move again the jockey, J towards X until the ammeter reads 0.4 A. Record the corresponding new voltmeter reading, V in volts.

(e) Repeat the procedures in 1 (d) when ammeter readings are 0.5 A, 0.6 A and 0.7 A; and then

(i) tabulate the results

(ii) plot a graph of current, I against voltage, V

(iii) find the slope, S of the graph

(iv) determine the internal resistance, r of a cell given that:

$$S=\frac{-1}{r}.$$

(v) use the graph in 2(ii) to find the value of e.m.f, E of a dry cell.

The candidates who managed to score high marks in this question understood on the concept of current electricity. They were able to connect the circuit correctly, they collected and tabulated the results correctly, drew a correct graph of current I against voltage V and determined the value of

the slope S correctly. These candidates performed appropriately the required calculations to determine the value of the e.m.f, E of the dry cell by using the slope and graph plotted. Extract 16.1 is a sample response from a candidate who scored high marks in question 2 in Physics 2B.

2(i) TABLE OF RESULTS

Current I (A)	Voltage (V)
0·3	1·35
0·4	1·30
0·5	1·26
0·6	1·20
0·7	1·16

2(iii) Slope S of the graph

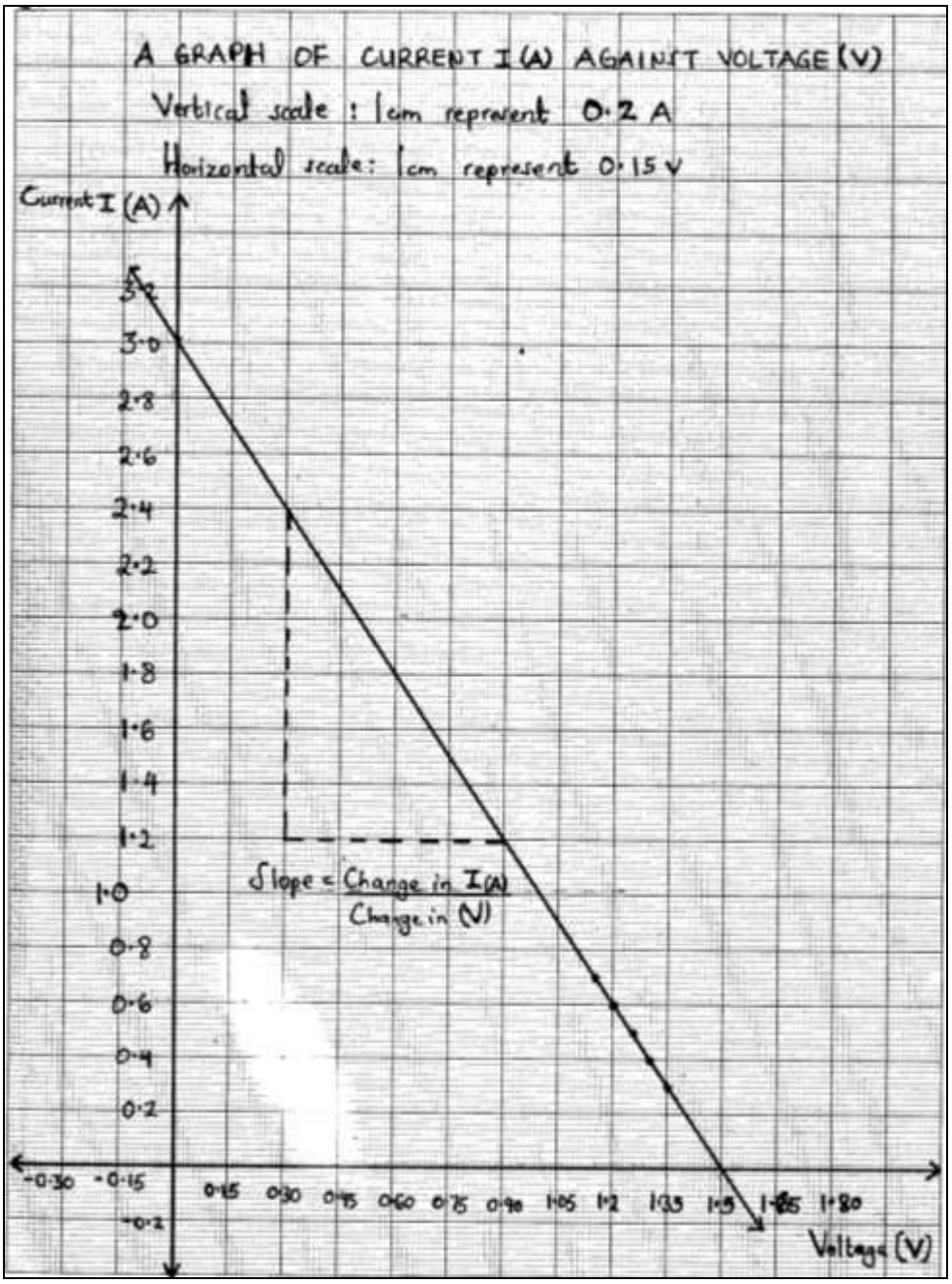
$$\text{Slope } (S) = \frac{\text{Change in Current I (A)}}{\text{Change in voltage (V)}}$$

$$\text{Slope } (S) = \frac{(2{\cdot}4 - 1{\cdot}2)\,A}{(0{\cdot}30 - 0{\cdot}90)\,V}$$

$$\text{Slope } (S) = \frac{1{\cdot}2\,A}{-0{\cdot}6\,V}$$

$$\therefore \text{Slope } (S) = -2\,\Omega^{-1}$$

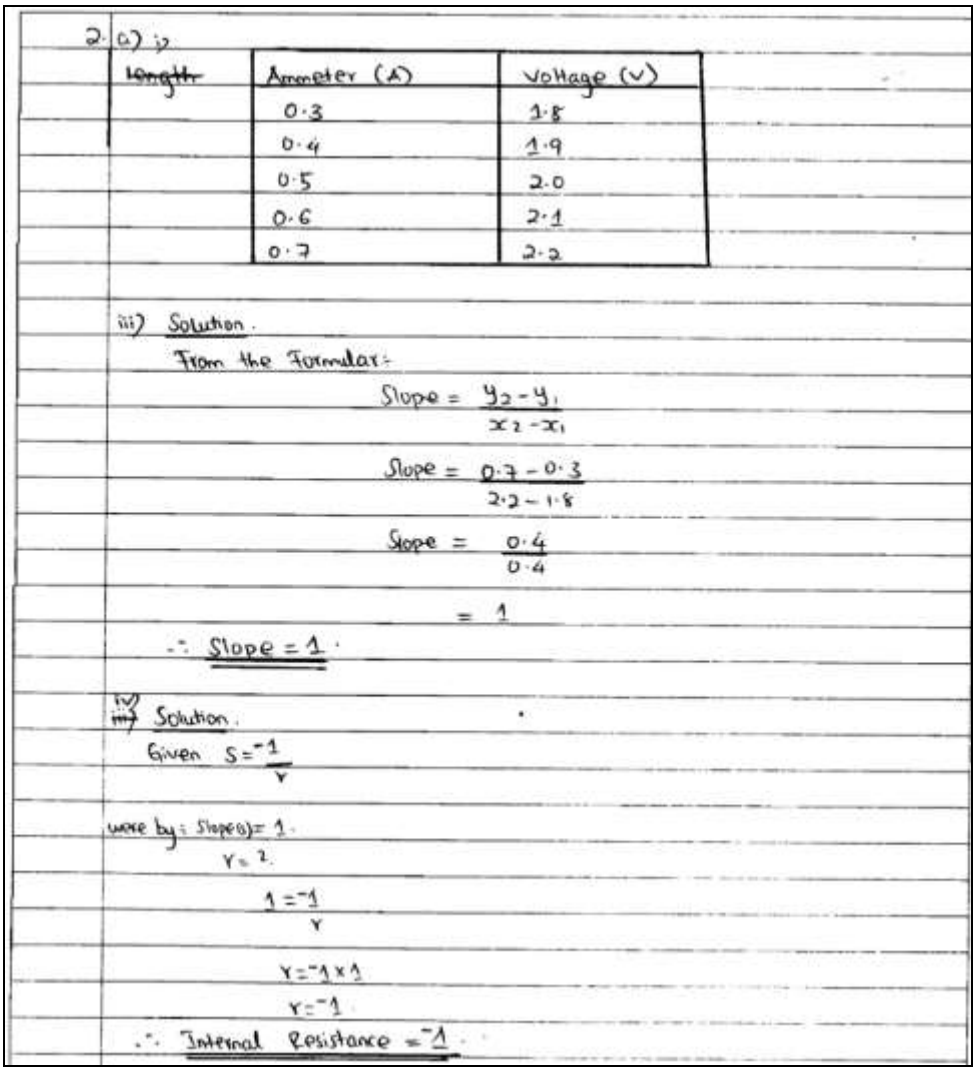
2(iv)	Internal resistance r of the cell from $S = \frac{-1}{r}$
	Since, $S = -2\,\Omega^{-1}$ then,
	$-2\,\Omega^{-1} = \frac{-1}{r}$
	Multiply by -1 both side,
	$2\,\Omega^{-1} = \frac{1}{r}$
	$\frac{1}{2\,\Omega} = r$ (Take reciprocal)
	$\therefore r = 0.5\,\Omega$
	Therefore internal resistance r of a battery is $0.5\,\Omega$
2(v)	From the graph the value of E.m.f E of a dry cell is the Value of Voltage (V) when the value of Current I (A) is 0 (zero)
	Therefore the intercept of Voltage (V) is 1.5 V
	Therefore, the E.m.f of a dry cell is 1.5 V



Extract 16.1: A sample of a candidate's good response to question 2 in Physics 2B

Inadequate knowledge and understanding of the concepts of current electricity made most of the candidates to score low marks in this question. They incorrectly gathered and recorded data which resulted into an unsuitable table of results. Most of them failed to use mathematical skills,

prepare scales, transfer the points, label the axes, indicating slope while drawing the graph and failed to determine the internal resistance, r of a cell from $S = \frac{-1}{r}$ or use the graph to calculate the e.m.f, E of a dry cell. Extract 16.2 is a sample from a candidate's weak response to question 2 in Physics 2B.



2. a) ii)

~~Length~~	Ammeter (A)	Voltage (V)
	0·3	1·8
	0·4	1·9
	0·5	2·0
	0·6	2·1
	0·7	2·2

iii) Solution.

From the Formular:

$$\text{Slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{Slope} = \frac{0.7 - 0.3}{2.2 - 1.8}$$

$$\text{Slope} = \frac{0.4}{0.4}$$

$$= 1$$

$\therefore$ Slope = 1.

iv) Solution.

Given $S = \frac{-1}{r}$

were by; Slope(s) = 1.

$r = ?$

$1 = \frac{-1}{r}$

$r = -1 \times 1$

$r = -1$

$\therefore$ Internal Resistance = -1.

iv) Soln.

From the formular :

~~Electromotive force (e.m.f) = V+Ir~~ $V = E + Ir$

were by : Voltage (V) =

v) Solution.

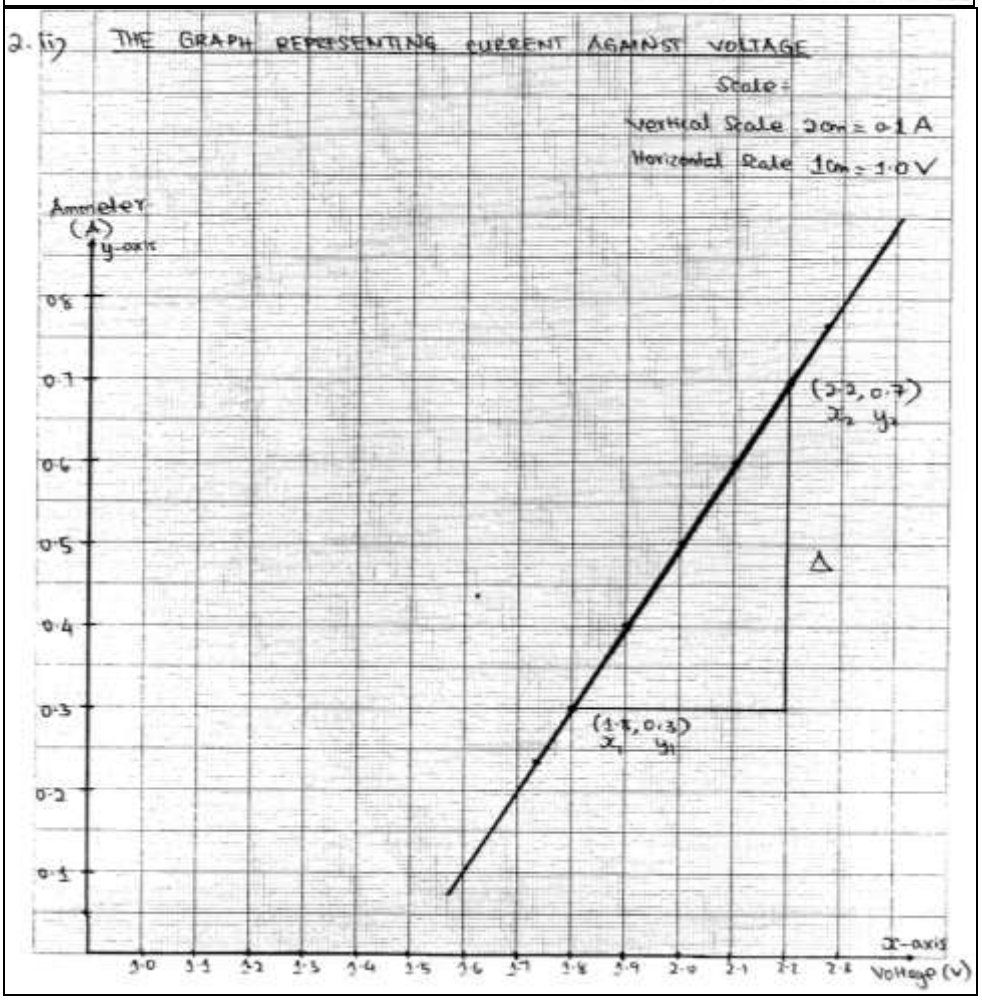
Electromotive force (E.m.f) = Total of Ammeter - Total of Voltmeter

$= 2.5 - 1.0$

$= 1.5$

∴ Electromotive force (E.m.f) of a dry cell is 1.5

2. ii) THE GRAPH REPRESENTING CURRENT AGAINST VOLTAGE



Extract 16.2: A sample of a candidate's weak response to question 2 in Physics 2B.

In extract 16.2, the candidate collected incorrect data values and hence plotted and calculated an incorrect graph and slope respectively. He/she failed to deduce the value of the electromotive force (e.m.f) of the cell.

3.4.3 031/2C Physics 2C

In this question the candidates were provided with: a cell of e.m.f, E; a key, K; an ammeter, A; a voltmeter, V; connecting wires, a resistance box, R; a wire, W and a micrometer screw gauge.

The candidates were required to:

(a) Set up an electric circuit as shown in figure 2 below

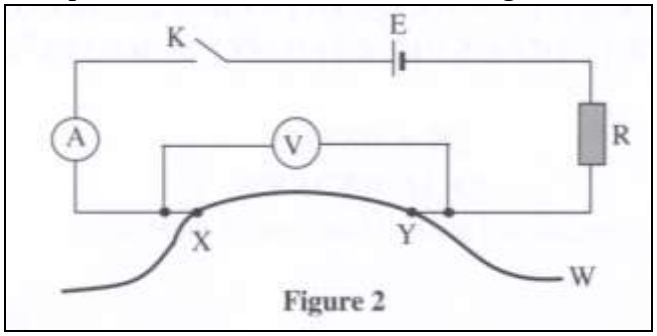


Figure 2

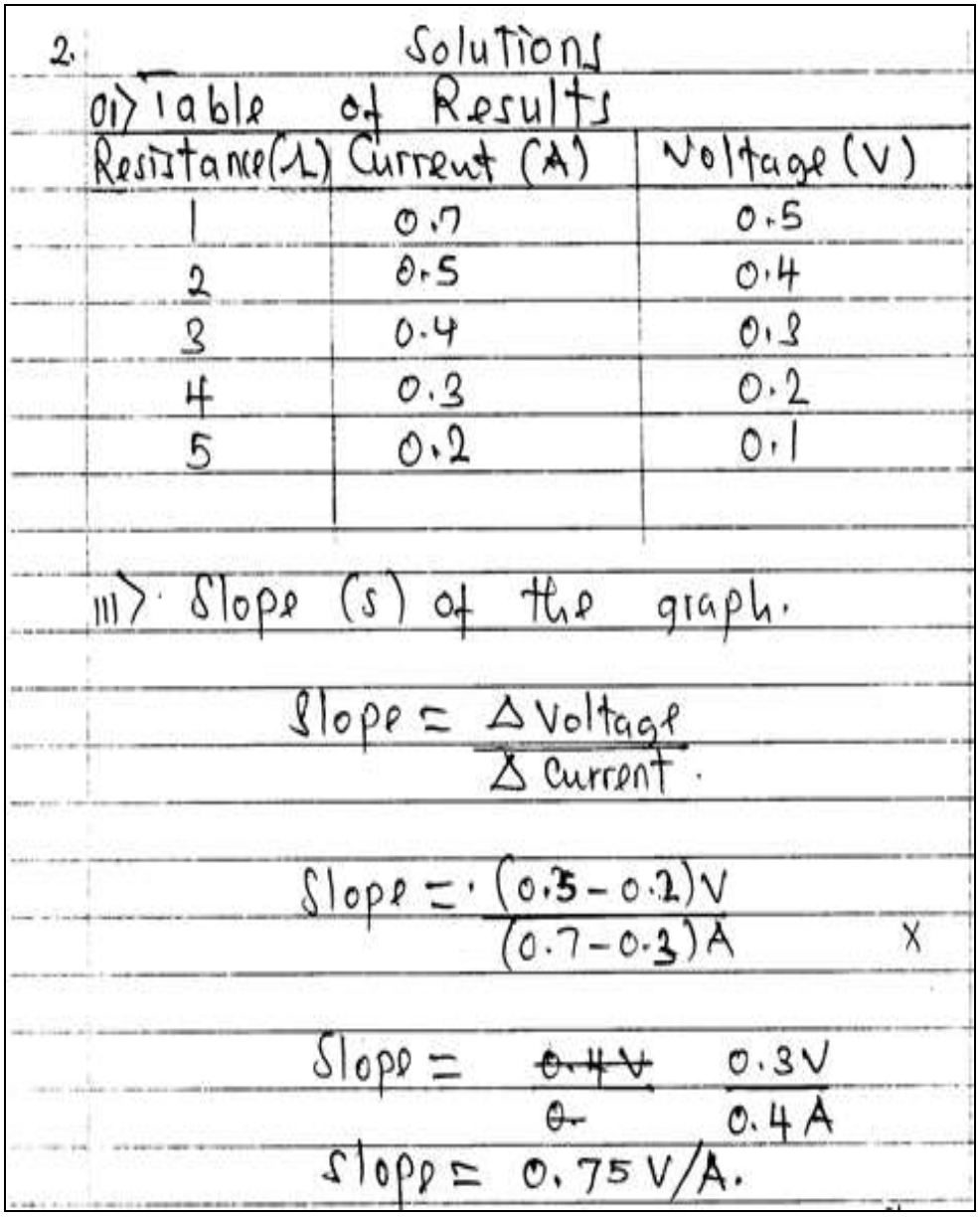
(b) Measure the length XY of the wire, W equal to 17 cm and set R to one 1 Ω then close the key. Read and record ammeter reading, I in Amperes and voltmeter reading, V in Volt. Open the key after taking the readings.

(c) Repeat the procedures in 1 (b) above for the values of R = 2 Ω, 3 Ω, 4 Ω and 5 Ω, keeping the length XY of the wire constant. Read and record the corresponding value of current, I and voltage, V in each case; and then

(i) tabulate the results
(ii) plot a graph of voltage, V against current, I
(iii) compute the slope, S of the graph
(iv) state the physical meaning of the slope
(v) use the information obtained from the graph to determine the resistivity of the material of wire, W

The candidates who managed to score high marks in this question were knowledgeable of the concept of current electricity. They were able to connect the circuit correctly which enabled them to tabulate the results of the data gathered correctly, draw the graph of V and I and find the slope and inter. They also demonstrated good skills in mathematics. Extract 17.1

shows the response of a candidate who scored high mark in question 2 in Physics 2C.



2. Solutions

ii) Table of Results

Resistance(Ω)	Current (A)	Voltage (V)
1	0.7	0.5
2	0.5	0.4
3	0.4	0.3
4	0.3	0.2
5	0.2	0.1

iii) Slope (s) of the graph.

$$\text{Slope} = \frac{\Delta \text{Voltage}}{\Delta \text{Current}}.$$

$$\text{Slope} = \frac{(0.3-0.2)\text{V}}{(0.7-0.3)\text{A}}$$ X

$$\text{Slope} = \frac{\cancel{0.4\text{V}}\ 0.3\text{V}}{\cancel{0}\ \ 0.4\text{A}}$$

Slope = 0.75 V/A.

2. iv) Physical mean of slope

$$S = \frac{\text{Voltage}}{\text{Current}}.$$

But, $\text{Resistance} = \frac{\text{Voltage}}{\text{Current}}$.

$\therefore$ Slope = Resistance

Hence physical mean of slope is Resistance of the wire.

v) Resistivity of the wire.

$$\rho = \frac{RA}{L}.$$

Length (L) = 17cm $\rightarrow$ 0.17m.

Area (A) = $\frac{\pi d^2}{4}$ where $d = 0.36\text{mm}$

$R = 0.75\Omega$.

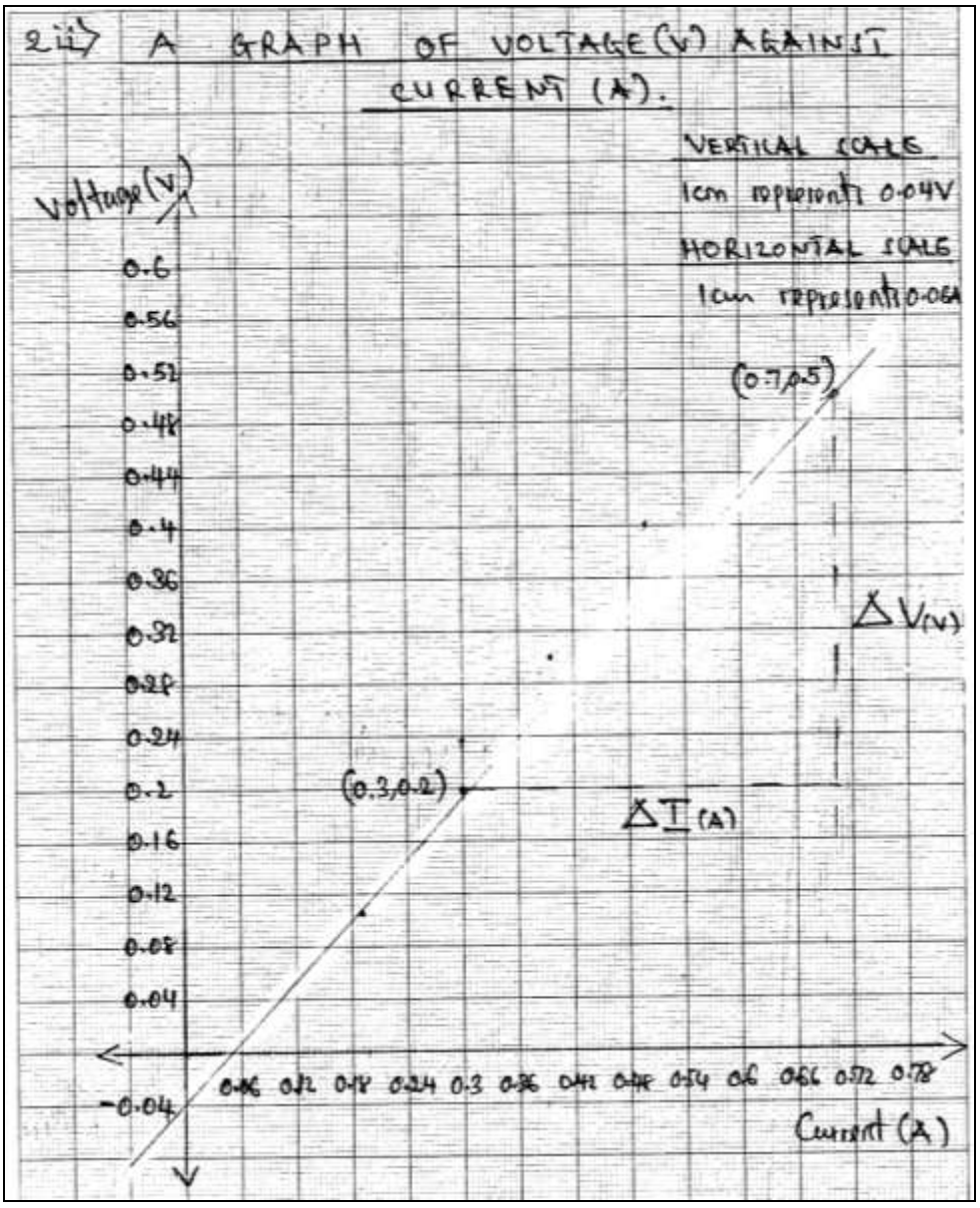
$$\rho = \frac{0.75\Omega \times 3.14 \times (0.00036\text{m})^2 \times}{4 \times 0.17\text{m}}$$

$$\rho = \frac{2.355\Omega \times 1.444 \times 10^{-7}\text{m}^2}{0.68\text{m}}$$

$$\rho = \frac{3.4006 \times 10^{-7}\Omega\text{m}^2}{0.68\text{m}} \times$$

$$\rho = 4.912 \times 10^{-7}\Omega\text{m}.$$

$\therefore$ Resistivity of the wire $4.912 \times 10^{-7}\Omega\text{m}$ x



Extract 17.1: A sample of a candidate's good response to question 2 in Physics 2C.

Inadequate knowledge and understanding of the concepts of current electricity led the candidates to fail and score low marks in this question. They gathered and recorded incorrect data which resulted into a wrong table of results into. Most of them failed to apply the prepared scales, transfer the points, label the axes, indicate the slope while drawing the graph and failed to explain the effect of resistor, R. Extract 17.2 represents one of candidates' weak response to question 2 in Physics 2C.

2 i The table of results

R	I	V	I/V
2	41·3	-58·7	-0·70
3	67·8	-32·2	-2·10
4	73·8	-26·2	-2·8
5	77·8	-22·2	-3·50

2 ii The table of grap V against I

~~X~~ I	41·3	67·8	73·8	77·8
Y V	-58·7	-32·2	-26·2	-22·2

2 iii To compute the slope, S of the graph

$$\frac{\text{Verticatical component}}{\text{Horizontal component}} = \frac{63}{-18}$$

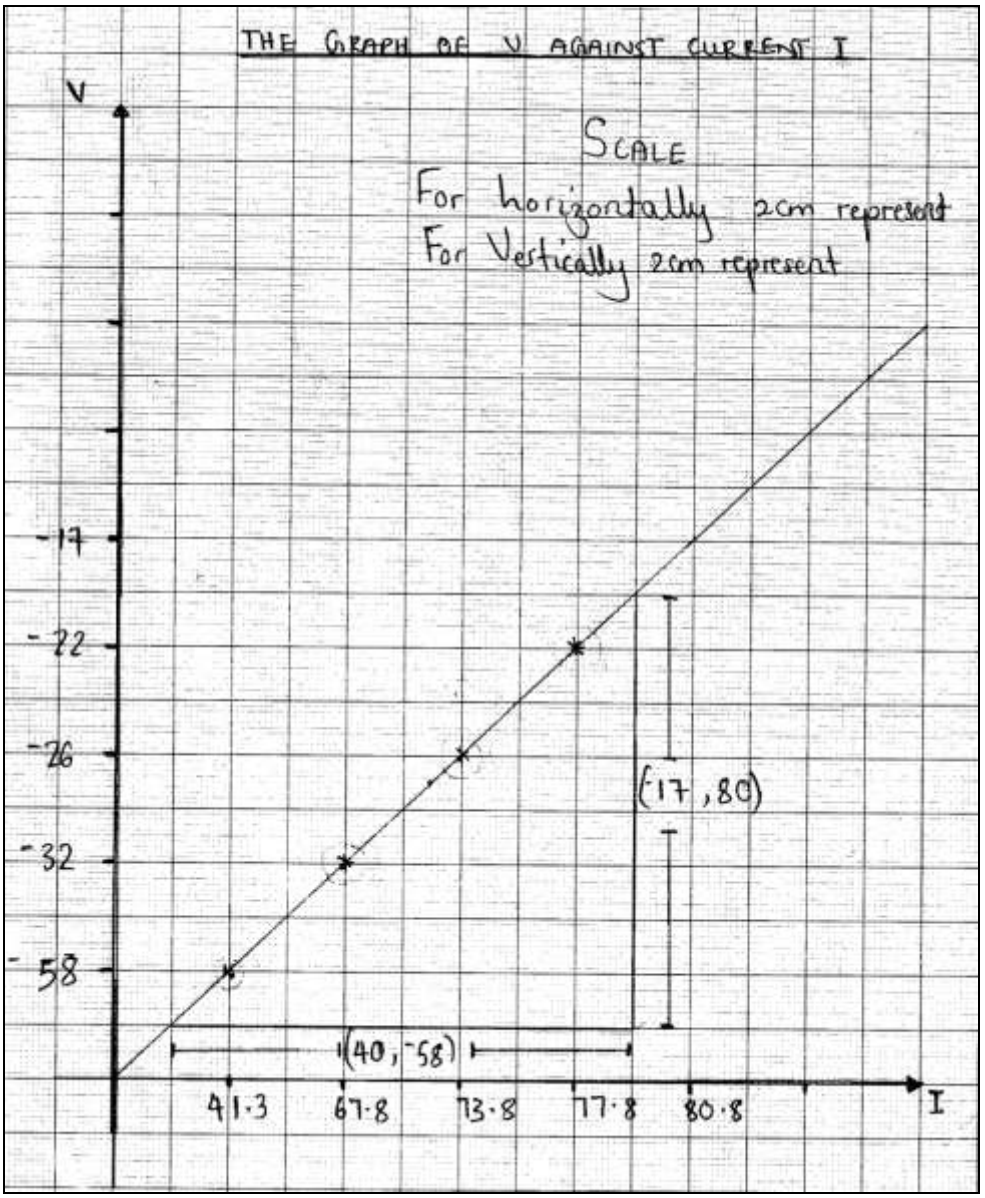
$$\therefore \frac{63}{-18}$$

$$= \frac{45}{}$$

∴ The slope is 45

2 iv The physical meaning of slope is x-exis and y-exis in ~~}~~ current.

2 v 5 ~~resistiti~~ resistivity of material of wire.



Extract 17.2: A sample of a candidate's weak response to question 2 in Physics 2C.

In extract 17.2, the candidate failed to record the expected data and plotted an incorrect graph which led him or her to get an incorrect slope and an incorrect value of resistivity of the wire.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The overall performance in Physics paper was average (55.33%). The analysis of the candidates' performance revealed that, the candidates faced considerable challenges when attempting the questions.

In paper 1, it was observed that inadequate content knowledge was one of the major reasons for weak performance of most of the candidates. Some of the candidates provided incorrect responses while others skipped some of the items without writing the answers.

The analysis also shows that lack of mathematical skills was also a challenge on the performance of most of the candidates particularly in the questions which required application of formula and calculations which go through several steps to reach the final answer. For instance, in question number 5 (a) which required the candidates to determine the number of kilowatt-hours of electrical energy that will be consumed if the water in the boiler is heated to a temperature of 40^{o} C. Majority of the candidates failed to apply the correct formula and mathematical manipulation, hence ended up with an incorrect answer.

Another reason was poor English Language proficiency, where some of the candidates provided responses with grammatical errors while others failed to give satisfactory explanations of the necessary concept. For example, question 10 which required the candidates to describe how diffraction of water waves takes place in narrow and wide gaps, the candidates failed to explain in details. They failed to compose their sentences correctly and hence scored low or no marks.

Likewise, lack of drawing skills contributed to poor performance of some candidates. In question 9 for example which required the candidates to draw a well labelled diagram of a dry cell, most of the candidates were unable to draw while others drew the diagram correctly but failed to indicate its parts or components.

In Paper 2, some of the candidates failed to prepare the anticipated table of results due to inadequate knowledge pertaining to the topic asked. For example, in question 2 of each practical alternative, most of the candidates failed to apply the ammeter-voltmeter method to find the unknown resistance, internal resistance and the e.m.f of the cell. They also lacked drawing skills of graphs which required transfer of data from the table of

results. Others failed to indicate appropriate axes, scales and hence transferred incorrect data points to the graph.

4.2 Recommendations

For future improvement of candidates' performance, it is recommended that teachers should:

(a) lead students to demonstrate how the specific heat capacity of a substance can be obtained by using a Thermometer, Calorimeter, Wooden base, Stirrer, Lid and Beam balance. They should also, brainstorm the properties of alpha (α) and beta (β) particles, and gamma (γ) radiations in the topics of *Measurement of Thermal Energy and Radioactivity*.

(b) lead students to derive the formula for determining linear expansivity of solids by using ball and ring, bar break, source of heat, brass and iron strips, nails and shoe tacks and lead them to discuss *electrical power rating* by using heating element, electric iron, electric kettle and Electric bulb in the topics of *Thermal Expansion* and *Measurement of Thermal Energy*.

(c) lead students to explain the working principle of A.C and D.C generators and how A.C can be converted to D.C generator by using a chart of A.C and D.C generators in the topics of *Current Electricity* and *Electromagnetism*.

(d) guide students to draw a manometer and show how it works in the measurement of the pressure of the gas and perform an experiment to verify the principle of moments by using a *knife edge*, *wooden bar* and a *variety of masses* in the topics of *Pressure* and *Forces in Equilibrium*.

(e) Assist students to draw a dry cell and show how its components differ from those of the Leclanche cell by using dry cells. Guide students to brainstorm on how to design a single stage amplifier by using transistors, capacitors, resistors, microphones, oscilloscope, source of power and connecting wires on the topic of *Current Electricity* and *Electronics*.

(f) lead students to explain parts of a compound microscope and how it works by using a chart of a microscope. Likewise, guide them to perform an experiment to investigate the image formed on a plane

mirror by using a plane mirror, protractor, optical pins, ruler, soft board, plain paper and source of light in the topics of *Light* and *Optical Instruments*.

(g) encourage students to use English language in their day to day communication in order to build both speaking and writing skills in English.

(h) put more emphasis in developing students' mathematical skills in order to improve their computation skills.

(i) give more exercises on drawing and labelling in order to develop candidates drawing skills.

Appendix I

SUMMARY OF PERFORMANCE OF THE CANDIDATES IN EACH TOPIC FOR 031 PHYSICS 1

S/N	Topic	Question Number	The % of Candidates who Scored an Average of 30% or Above	Remarks
1	Geophysics and Waves	8	86.77	Good
2	Waves	2	75.13	Good
3	Multiple Choice Items	1	66.24	Good
4	Newton's Laws of Motion and Simple Machines	6	35.91	Average
5	Measurement of Thermal Energy and Radioactivity	5	29.00	Weak
6	Thermal Expansion and Measurement of Thermal Energy	7	25.91	Weak
7	Current Electricity and Electromagnetism	11	21.70	Weak
8	Electromagnetism and Waves	10	15.25	Weak
9	Pressure and Forces in Equilibrium	3	9.2	Weak
10	Current Electricity and Electronics	9	7.42	Weak
11	Light and Optical Instruments	4	2.49	Weak

Appendix II

SUMMARY OF PERFORMANCE OF THE CANDIDATES IN EACH TOPIC FOR 031 PHYSICS 2

S/N	Topic	Question Number	The % of Candidates who Scored an Average of 30% or Above	Remarks
1	Mechanics	1	54.90	Average
2	Current Electricity	2	34.49	Average