THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

STUDENTS' ITEMS RESPONSE ANALYSIS REPORT FOR THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2017

031 PHYSICS

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FOREWORD

The Form Two National Assessment (FTNA) is a formative evaluation which intends to diagnose the students' progress towards mastering of various concepts as stipulated in the syllabus of secondary school level for Form I and II. It provides teachers and students with feedback that will direct subsequent teaching and learning process in future.

This report highlights some of the reasons that made the students fail to score high marks in the Physics Assessment questions. The reasons that account for students' poor performance in Physics include failure to follow instructions, inability to identify the requirements of the questions, deficiency in English Language proficiency and inadequate knowledge of the topics as well as a lack of both drawing and mathematical skills. The feedback provided will enable the education administrators, school managers and teachers to identify proper measures to be taken in order to improve the students' performance in future assessments.

The National Examinations Council of Tanzania welcomes comments and suggestions from teachers, students and the public in general, which can be used to improve future analysis reports.

Finally, the Council would like to thank the examiners and all those who participated in preparing this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

Students' items response analysis report for the Form Two National Assessment (FTNA) 2017 for Physics is based on the performance of the students who sat for FTNA Assessment for the year 2017. The paper was intended to assess the competences acquired by the form two students basing on the 2010 reviewed Physics syllabus for secondary education.

The paper comprised of three sections, namely A, B, and C with a total number of 10 questions. Section A had three (3) questions. Question 1 had 20 multiple choice items derived from fifteen (15) topics; Question 2 had five (5) matching items from the topic of *Introduction to Laboratory Practice* while Question 3 also had five (5) filling in the blanks items covering concepts from different topics. (See appendix 1). Section B had five (5) questions derived from the topics of *Work, Power and Energy*, *Pressure*, *Motion in a Straight Line*, *Forces in Equilibrium* and *Light.* Section C had two (2) questions constructed from the topics of *Pressure* and *Current Electricity*. The students were required to answer all questions from all sections. Section A had a total of 30 marks, Section B had 50 marks and Section C had 20 marks.

The statistics show that the students who sat for this paper were 483,693, among them, 177,411 (36.74%) passed the assessment and 305,410 (63.26%) failed. This indicates that the general performance in this paper has increased by 8.61 percent as compared to the year 2016 where only 28.13 percent of the students passed the assessment.

The subsequent section of this report provides the analysis of students' performance in each question. The analysis categorizes the performance as weak, average and good represented by red, yellow and green colour respectively. In each question, weak counts form 0 to 29%, average from 30% to 64% and good from 65% to 100%.

The report further highlights the demands of the question, the weakness observed and the possible reasons for the poor performance. It also gives some recommendations that may help to improve students' performance in future assessments. Some extracts from students' answers have been used to illustrate the poor and good performances. Finally the report has included the appendices which indicate the performance in each question.

2.0 ANALYSIS OF PERFORMANCE IN EACH QUESTION

2.1 Section A: Objective Questions

2.1.1 Question 1: Multiple Choice Items

The students were required to choose the correct answer from the given alternatives and write its letter beside the item number in the box that was provided.

The total percentage of the students who attempted this question was 99.9. The results indicate that 10.6 percent scored from 13.0 to 20 marks, 64.4 percent scored from 6.0 to 12.0 marks, and 25.0 percent scored from 0 to 5 marks. The general performance of this question was good as 75.04 percent of the students passed. Figure 1 is a graphical presentation of this analysis.

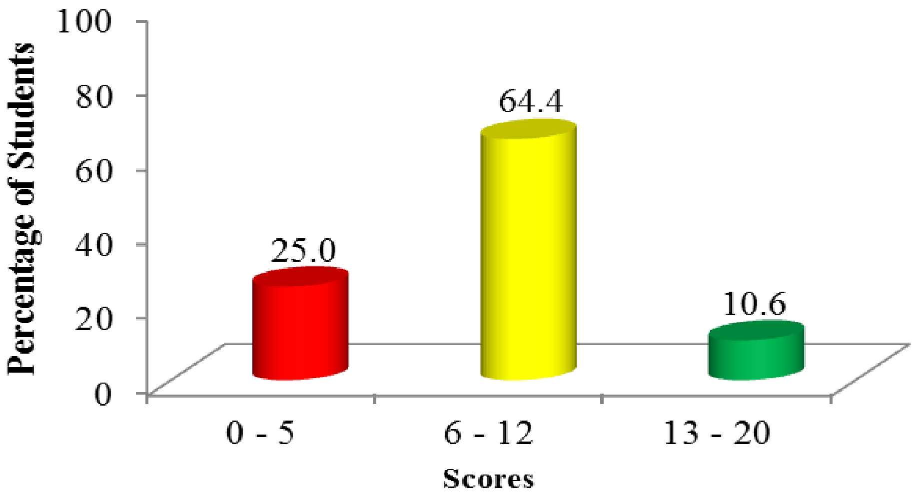


Figure 1: Percentage of Students' Performance per Score in Question 1.

The students who performed well in this question were knowledgeable enough to identify the correct answers. Those students who performed poorly failed to give the correct responses according to the requirements of the question. The analysis of some items' responses is as follows:

In item (ii), the students were required to identify a safety precaution in Physics laboratory. The correct answer was C “use equipment with care in the laboratory”. The students who chose this answer were aware about the laboratory rules and safety. Majority chose B “handling of apparatus in the laboratory”. This statement lacks the essence of care. The reason for such misconception lies in the fact that to use the equipment with care is better than simply handling. Those students who chose other options also had inadequate knowledge of the concept of laboratory rules and safety.

Students in item (vii) were required to determine the number of images formed by the two plane mirrors forming an angle of 60^0 between them. The answer was D “5”. Most of the students chose the wrong options as they failed to understand that the number of images formed in a multiple mirrors relates with the angle θ between two mirrors is given by the relation $n = \frac{360^o}{\theta} - 1$.

The students were required to calculate the potential difference across a resistor of 4Ω when a current of 0.2A flows through it in item (ix). The correct answer was B “0.8V” but most of the students chose A “20V” while others selected C “0.05V” or D “8V”. The students who chose incorrect options failed to apply the relation V = IR to calculate the potential difference across a resistor. Conversely, few students were able to select the correct answer because they understood that the voltage across a conductor was directly proportional to the electric current flowing through it provided that the temperature and other physical conditions of the conductor were kept constant.

In item (xv), the students were required to determine weight X which is placed at a distance of 20cm from fulcrum which will balance with the load of 4N placed at a distance 25cm from the fulcrum. Most of the students chose incorrect answers B “0.5N”, C “100N” and D “200N”. These students failed to apply the rotational balance condition i.e. total clockwise moment is equal to the total anticlockwise moment. On other hand, few students selected the correct answer A “5N” because they had adequate knowledge of the concept of forces in equilibrium.

Item (xix) required the student to determine the temperature in Kelvin scale of a -40^0C body. The correct response was B "233K". Majority of the students lacked the knowledge of temperature scale and numerical skills which could enable them to correctly convert the given temperature from degree Celsius to Kelvin scale. Few students were able to recall that 0^0C is equivalent to 273K hence determined correctly the value of temperature in Kelvin scale using the relation $K = {}^0C + 273$.

2.1.2 Question 2: Matching Items

Students were required to match each item in List A with a correct response in List B by writing its letter below the number of the corresponding item in the table provided. The question was based on measuring instruments and their uses.

This question was attempted by 99.9 percent of the students, and their scores were as follows: 26.2 percent scored from 0 to 1, 38.9 percent scored from 2.0 to 3.0 marks and 34.9 percent scored from 4.0 to 5.0 out of 5 marks allotted to this question.

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

The students were required to find a response which matches the statement "an instrument that measures length, depth, internal and external diameters" in item (i). The correct response C "vernier caliper" was selected by most of the students. Few selected A "measuring cylinder" and B "pipette". These students lacked the knowledge of laboratory apparatus and their uses.

Item (ii) required the students to match the sentence "an instrument that measures volumes of liquid". The correct response was A "measuring cylinder" but most of the students matched this item with the wrong answer B "pipette" as they failed to recognize that pipette is used to transfer specific amount of liquids but small volumes of liquids.

In item (iii), the students were required to write the alternative which matches the statement "an instrument that measures force or pull" The correct answer was E "spring balance". Many students matched it correctly, showing that they had adequate knowledge of measuring instruments. On the other hand, few students matched it incorrectly as they failed to understand that spring balance is used to measure the weight of an object in newton.

Item (iv) required the students to find a response which correctly matches a statement “an instrument that transfer specific amount of liquid from one container to another” The correct answer was B “pipette”. Most of the students matched it wrongly with alternative A “measuring cylinder”. These students failed to understand that the measuring cylinder is used to measure volumes of liquid while the pipette is used to transfer small volumes of liquids. However, few students were able to match it correctly.

In item (v), the students were required to match the statement “an instrument that measures body temperature”. The correct response F “clinical thermometer” was selected by the most of the students. Contrary, few students matched it incorrectly, showing that they had inadequate knowledge of the concept of measuring instruments and their uses.

2.1.3 Question 3: Filling in the Blank Spaces

Students were required to fill in the blanks by writing the correct answer in the space provided.

This question was attempted by 99.9 percent of students, and 85.0 percent performed poorly as they scored from 0 to 1.0, including 66.1 percent who scored a 0 mark. The data show that 12.6 percent scored 2.0 to 3.0 marks and 2.4 percent scored from 4.0 to 5.0 out of 5 marks allotted to this question. The overall performance of this question was poor as only 15 percent of the students scored from 2.0 to 5.0 marks. The graphical presentation of the data is shown in Figure 2.

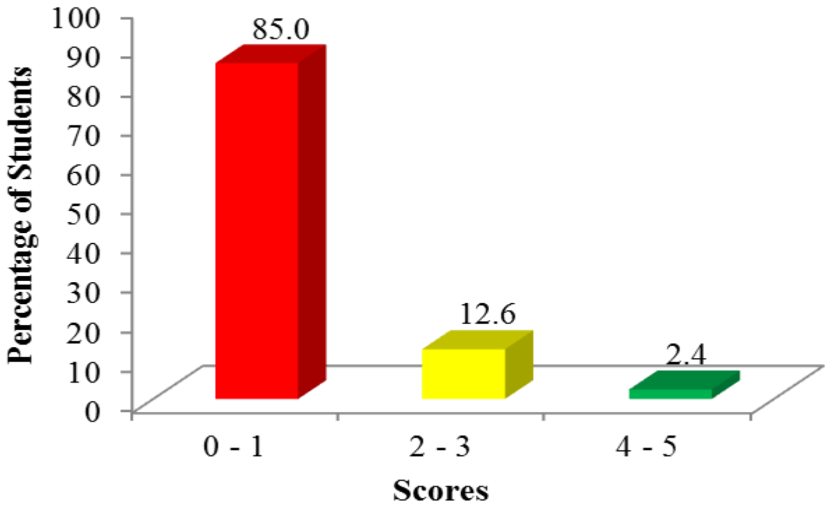


Figure 2: Percentage of Students' Performance per Score in Question 3.

The analysis of students' performance in each item is as follows:

In item (i), the students were required to give a name of basic physical measurement which cannot be obtained from any other measurement. The correct answer was "fundamental quantity". Most of the students wrote derived quantity as they did not understand that derived quantity is a physical quantity whose operation depends on other physical quantities.

Part (ii) required the students to give a collective name given to staircases, winding roads uphill, wedges and a screw. The correct name was "inclined plane". Majority of the students wrote levers. These students were supposed to understand that lever consists of a rigid bar that moves about a fixed point. They were supposed to understand that those were examples of inclined planes which are examples of simple machines.

In item (iii), the students were required to mention the name given to the resistance of a body which changes its state of rest. The correct answer was "inertia of rest" but most of the students wrote inertia of motion as they failed to understand that inertia of motion is the resistance of a body to change its state of motion.

In part (iv), the students were required to give the name of objects which emit light when they are hot. The correct answer was "incandescent objects”. Most of the students got it correct indicating that they had adequate knowledge of the concepts of luminous and non-luminous bodies. However, few students wrote luminous objects as they failed to recognize that luminous objects are objects which emit their own light.

Part (v) required the students to name materials which do not obey Hooke’s law. Most of the students wrote the correct answers “brittle/stiff materials/ inelastic material/plastic materials” but few wrote elastic materials as they failed to recognize that elastic materials are materials which obey Hooke’s law.

2.2 Section B: Short Answer Questions

2.2.1 Question 4: Work, Energy and Power

Part (a) of this question required the students to give the meaning of the terms (i) work (ii) energy and (iii) power while part (b) required them to calculate the power of a pump which can lift 200kg of water through a vertical height of 6m in 10 seconds, given $g = 10m/s^2$. In part (c), they were required to explain the meaning of the terms (i) kilowatt and (ii) kilojoules.

The question was attempted by 99.9 percent of the students whose scores were as follows: 55.5 percent scored from 0 to 2.5; 33.5 percent scored from 3.0 to 6.0 marks and 11.0 percent scored from 6.5 to 10 marks. Generally, students’ performance in this question was average because 44.50 percent of them scored above 2.5 marks. Figure 3 provides the graphical presentation of these data.

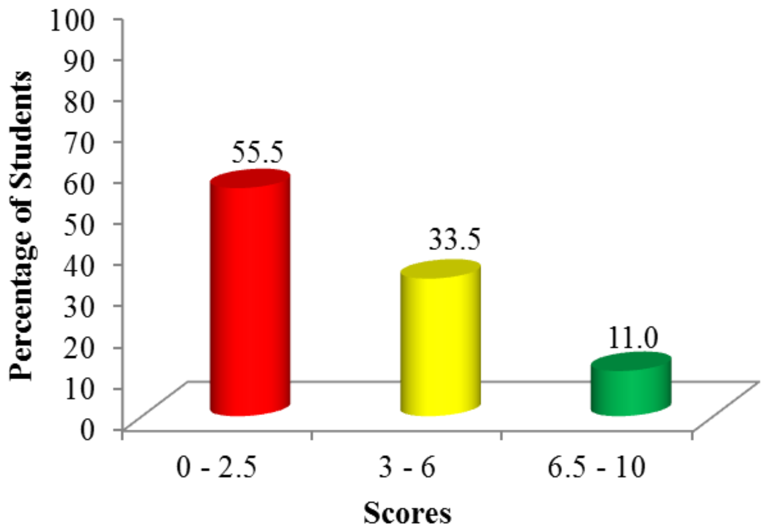


Figure 3: Percentage of Students' Performance per Score in Question 4.

The students who performed well (11.0%) in this question, some were able to provide the correct meaning of the terms work, energy and power. They used the correct formula; work done against gravity = mass $\times$ acceleration due to gravity $\times$ height, to calculate the work done and then they substituted the value obtained in the relation Power = $\frac{\text{Work done}}{\text{Time taken}}$ to calculate the required power. They also explained the meaning of kilowatt and kilojoules correctly. Extract 4.1 is a sample of a good response from one of the students.

Extract 4.1

4. (a) What do you understand by the following terms?

(i) Work. Is the product of force and distance moved in the direction of force.

(ii) Energy. Is the ability to do work.

(iii) Power. Is the rate at which work is done.

(b) Calculate the power of a pump which can lift 200kg of water through a vertical height of 6m in 10 seconds, given $g = 10m/s^2$.

Data given;

Weight $= 200kg \times 10m/s^2 = 2000N$

height $= 6m$

time $= 10$ seconds.

$$\text{Power} = \frac{\text{work done}}{\text{time}}$$

but, Work done $=$ PE

$$PE = mgh$$
$$= 200kg \times 10m/s^2 \times 6m$$
$$= 12000J$$

$$\text{Power} = \frac{\text{work done}}{\text{time}}$$
$$= \frac{12000J}{10s}$$
$$= 1200 \text{ Watts}$$

$\therefore$ Power $= 1200W$

(c) Explain the meaning of the following terms.

(i) Kilowatt. refers to the thousand watts (1000W)

(ii) Kilojoules. Refers to the thousand joules.

Extract 4.1 shows how a student attempted the question and provided the correct responses to all the parts of the question.

On the other hand, the students who performed poorly (55.5%) had inadequate knowledge of the concept of work, power and energy as they failed to give the meaning of the terms work, energy and power. For example, one of the students wrote *work is the ability of do something to get basic need*. He/she failed to understand that *work is the product of a force and its distance or work = force* $\times$*distance moved in the direction of force*. Some students failed to explain the meaning of kilowatt and kilojoules. Moreover, they were not able to calculate power of the pump due to poor mathematical skills as shown in Extract 4.2.

Extract 4.2

4. (a) What do you understand by the following terms?

(i) Work....Is the any activity....which....doing....to the.... people of.... the counby...or society

(ii) Energy. When body is have the energy your will... be good in human activity

(iii) Power...Is....any....legal....activity....doing...to the...people... of power

(b) Calculate the power of a pump which can lift 200kg of water through a vertical height of 6m in 10 seconds, given $g = 10m/s^2$.

Data give
pump = 200kg
height = 6 m
Second = 10
Required
Time
Recally

$\frac{200kg \times 6}{10}$

$= \frac{1200}{10}$

the time vertical is 120 kg/m

(c) Explain the meaning of the following terms.

(i) Kilowatt...this....is....the....kilowatt....of....the.... Mass....and...weight

(ii) Kilojoules.....this.....is...the....joules....of.....the.... mass....and....density

Extract 4.2 indicates that a student failed to understand the question's requirement as he/she provided irrelevant answers and failed to use a correct formula to calculate power.

2.2.2 Question 5: Motion in a Straight Line

This question required the students to (a) (i) give the meaning of acceleration, and (ii) calculate the acceleration of a car with velocity of 60km/h which is uniformly retarded and brought to rest after 10 seconds. In part (b), they were required to (i) distinguish between distance and displacement, and (ii) provide one example of the law of inertia of a body.

Part (c), required them to determine the mass given to a body with an acceleration of $7 m/s^2$ by a force of 3N.

The majority (99.9%) of the students attempted the question, out of them 80.6 percent scored from 0 to 2.5 marks, including 62.5 percent who scored zero; 15.4 percent scored from 3.0 to 6.0 marks; and 4.0 percent scored from 6.5 to 10 marks. These scores indicate that the question was poorly performed.

The students who performed poorly in this question had poor understanding of the concept of linear motion as they were not able to give the correct answers to most parts of the question. They did not understand that acceleration is the rate of change of velocity. Some defined acceleration as *the ratio of displacement and time or acceleration is change in velocity*. These students had ideas on the basic concepts of linear motion but mixed-up the meanings of the terms. Likewise, one of the students defined *acceleration as mass per unit time* indicating that he/she had inadequate knowledge of the concept of linear motion. Moreover, some failed to calculate the acceleration of a car as they used wrong formula while others used the correct formula but interchanged initial velocity and final velocity of the car. The initial velocity was supposed to be 60km/h and final velocity was 0km/h since the car was brought to rest. Additionally, they failed to distinguish between distance and displacement and failed to provide one example of the law of inertia of a body. Furthermore, some students used incorrect formula; *mass* = *force* × *acceleration* instead of *force* = *mass* × *acceleration* to calculate the mass given to a body. Extract 5.1 illustrates the work of one the students who performed poorly in this question.

Extract 5.1

5. (a) (i) What is acceleration?

The resistance of a body to change it state of rest or is the of make of velocity between two ratio

(ii) A car with a velocity of 60km/h is uniformly retarded and brought to rest after 10 seconds. Calculate its acceleration.

Data given
velocity = 60 kmlh
seconds = 10
Required
the acceleration
Recally
Soln.

~~acceleratorati~~
acceleration $= \frac{V}{t}$

$= \frac{\cancel{60}\ 6}{\cancel{10}\ 1}$

the acceleration is 6.

(b) (i) Distinguish between distance and Displacement

destance, between two moving objects will change if both are moving with the same velocity while Dispacment, is the process which place is remain

(ii) Provide one example of the law of inertia of a body

The rest inertia when car to move is Finally Motion the rest after move stop car is pressure.

(c) What mass will be given to a body with an acceleration of $7m/s^2$ by a Force of 3N?

Data given
acceleration $7M/s^2$
Force 3N
What mass

$7 \times 3 = 21$

Mass is $21M/s^2$

In extract 5.1, the student failed to give the meaning of acceleration and to distinguish between the given phrases. He/she also failed to determine the mass given to the body.

On the other hand, the students who performed well had adequate knowledge of the concept of motion. Some students were able to give the meaning of acceleration and used the correct formula; Acceleration = $\frac{\text{Final velocity - Initial velocity}}{\text{time}}$ to calculate acceleration of the car. They also distinguished correctly the terms distance and displacement and provided an example of the law of inertia. Furthermore, they used correct relation; Force = mass $\times$ acceleration to calculate the mass of a body with an acceleration of $7m/s^2$ when a force of 3N was applied. Extract 5.2 shows the responses from a student who attempted well the question.

Extract 5.2

5. (a) (i) What is acceleration?

Acceleration is rate of change of velocity or the change of velocity with time. It's SI unit is m/s².

Demonstrated as $\frac{v_2 - v_1}{t}$

(ii) A car with a velocity of 60km/h is uniformly retarded and brought to rest after 10 seconds. Calculate its acceleration.

Soln.

Data. Velocity (V) = 60km/hr, time (t) = 10 seconds, acceleration = ?

Acceleration (a) = $\frac{\text{Change in velocity}}{\text{time}} = \frac{V - U}{t}$

Whereas V = final velocity and U = initial velocity.

U = 60km/hr = $\frac{60000m}{3600 s}$ = 16.6m/s ≈ 16.7m/s

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

$a = \frac{0m/s - 16.7m/s}{10s} = -1.67m/s^2$

∴ Its acceleration is $-1.67m/s^2$ or its retardation is $1.67m/s^2$

(b) (i) Distinguish between distance and Displacement.

~~Distance is the lenght~~ Distance is the length from one point to the other without considering the direction while Displacement is the length from one point to the other in a specific direction.

(ii) Provide one example of the law of inertia of a body. When the car Starts moving forward the passengers fall backward. This shows that the passengers wanted to remain in their state of rest. This is the first law of motion.

(c) What mass will be given to a body with an acceleration of 7m/s² by a Force of 3N?

~~Data~~ Soln.

Data. acceleration (a) = 7m/s², Force (F) = 3N and Mass (m) = ?

Formula. Force = mass x acceleration.

F = ma

∴ $m = \frac{F}{a}$

∴ $m = \frac{3N}{7m/s^2}$

∴ The mass of a body is 3/7kg or 0.43kg

Extract 5.2 gives a picture of how a student attempted the question and provided the correct responses to all the parts of the question

2.2.3 Question 6: Pressure

The question had three parts: (a), (b) and (c). In part (a), the students were required to state Pascal's Principle of pressure. Part (b) required the students to state three factors affecting the liquid pressure. In part (c), they were required to calculate the area of the object if the pressure exerted is $0.2N/m^2$ and its force is 2N.

This question was attempted by 99.9 percent of the students. The analysis of the data as shown in Figure 4 indicates that, 76.5 percent scored from 0 to 2.5 marks; 13.6 percent scored from 3.0 to 6.0 marks; and 9.9 percent scored from 6.5 to 10 marks. These data indicate that the general performance in this question was poor.

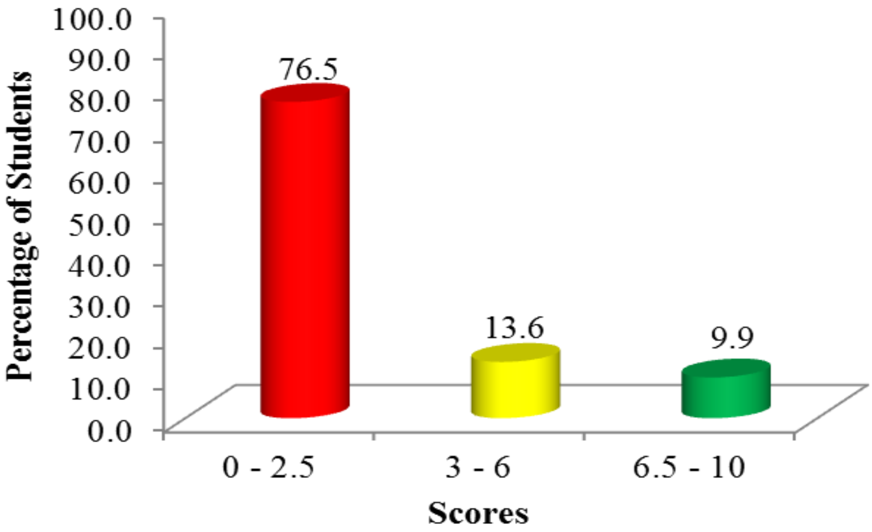


Figure 4: Percentage of Students' Performance per Score in Question 6.

The students who performed poorly (76.48%) in this question had inadequate knowledge of the concept of pressure. Some students failed to state Pascal's Principle of pressure and factors affecting the liquid pressure. Other students defined pressure instead of stating the require principle. For example, one of the students stated Pascal's Principle of pressure as *pressure is direction proportional to the apply force*. Some students mentioned factors affecting the resistance of a conductor instead of factors affecting the liquid pressure. They also failed to recall the simple formula; $Pressure = \frac{Force}{Area}$ to calculate the area of the object. It was also noted that some were able to remember the formula but they substituted the data wrongly. Extract 6.1 is a sample of a student's poor response.

Extract 6.1

6. (a) State the Pascal's principle of pressure ....

It state that when the pressure is down the value increase.

(b) What are the three factors that affect the liquid pressure?

(i) speed

(ii) load

(iii) velocity.

(c) Calculate the area of the object if the pressure exerted is $0.2N/m^2$ and its force is 2N.

soln-

Pressure = 0.2N/m^2

force = 2N

= 0·2 × 2

= 10g/s^2

0·2 × 2

0·2
× 2
0·4 ×10

0·4
10
0·0
14·
14·0

ANS∴ = 14·0

Extract 6.1 displays the incorrect responses given by a student who performed poorly in this question.

On contrary, the students who scored high marks (23.52%) had adequate knowledge of the concepts of pressure. These students were able to state Pascal's Principle of pressure and correctly provided factors affecting the liquid pressure. Furthermore, they used correct formula to calculate the required area of the object as shown in Extract 6.2.

Extract 6.2

6. (a) State the Pascal's principle of pressure An external pressure acting on en closed surface of the liquid is transmitted equally throughout the liquid.

(b) What are the three factors that affect the liquid pressure?

(i) Density of the liquid (P)

(ii) Depth or height (h)

(iii) gravitational acceleration (g)

(c) Calculate the area of the object if the pressure exerted is $0.2N/m^2$ and its force is 2N.

Soln.

Data. Pressure (P) = $0.2N/m^2$, Force (F) = $2N$, Area (A) = ?

Formula. Pressure (P) = $\frac{\text{Force }(F)}{\text{Area}(A)}$

$\therefore$ Area (A) = $\frac{\text{Force }(F)}{\text{press }(p)}$

Area (A) = $\frac{2N}{0.2N/m^2} = 10m^2$

$\therefore$ The area of the object is $10m^2$

Extract 6.2 shows how a student managed to provide proper responses and applied the correct formula in calculations and consequently got the required answers.

2.2.4 Question 7: Light

This question required the students to (a) define the term light. Part (b) required them to state the laws of reflection with the aid of diagram. In part (c), they were required to determine the number of images formed if two plane mirrors are (i) at angle of 60^0 and (ii) parallel to each other.

The percentage of the students who attempted this question was 99.9, and their scores were as follows: 84.1 percent scored from 0 to 2.5, and 69.5 percent of them scored 0 marks. The data displays that 12.5 percent scored from 3.0 to 6.0 marks and 3.4 percent scored from 6.5 to 10.0 out of 10 marks allocated to this question.

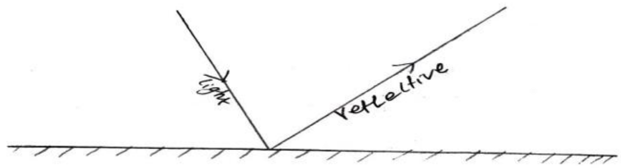
The students who scored low marks provided incorrect answers to most parts of the question. The majority had partial knowledge of the concept of light as they failed to define the term light. Some were able to state the laws of reflection of light but failed to demonstrate them using a diagram while others managed to draw but failed to state the laws. Lack of mathematical skills was another factor that restricted them to manipulate the formula $n = \frac{360^o}{\theta} - 1$ to determine the number of image formed when the mirrors are at an angle of 60^0 in part (c) of the question. They also failed to understand that when the mirrors are placed parallel to each other, the angle between them becomes zero; hence, the number of image is infinite. Extract 7.1 is a sample of a student's poor response.

Extract 7.1

7. (a) Define the term light.

is the an object that form in the source of light to be transparent to see

(b) By aid of a diagram state the laws of reflection.



Stat that when the an object the will be reflected they can charge the positio or direction

(c) How many images can be formed if two mirrors are set?

(i) At angle of 60^0

Solution

$= \frac{180^\circ}{60^\circ}$

$= 3$

A angle of $60^\circ = 3$

(ii) Parallel to each other.

$\frac{180^\circ}{60^\circ \times 2}$

$= \frac{180^\circ}{180^\circ} = 1$

Parallel to each other is 1

In extract 7.1, the student did not comprehend the question. The student lacked knowledge on the concept of light hence provided incorrect answers to all parts of the questions.

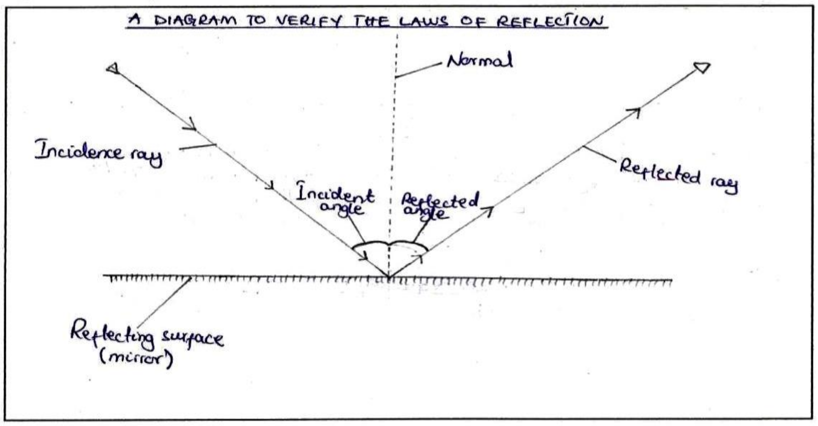
Conversely, some of the students attempted well this question as they were able to correctly define the term light, state the laws of reflection with the aid of diagram, and determine the number of images as required. Extract 7.2 shows the sample answer from a student who attempted well this question.

Extract 7.2

7. (a) **Define the term light.**

Light is an invisible form of energy which enables animals to see or stimulate their vision.

(b) **By aid of a diagram state the laws of reflection.**



(c) **How many images can be formed if two mirrors are set?**

(i) **At angle of 60^0**

Soln.

From the formula

$$\text{No of images} = \frac{360^\circ}{\theta} - 1$$

$$= \frac{360^\circ}{60^\circ} - 1$$

$$= 6 - 1$$

$$= 5$$

$\therefore$ number of images formed is 5

(ii) **Parallel to each other.**

Soln

Parallel means 0° since no angle is formed.

$$\text{No of images} = \frac{360^\circ}{\theta} - 1$$

$$= \frac{360^\circ}{0} - 1$$

$$= \infty$$

$\therefore$ number of images on parallel mirrors is undefined.

In Extract 7.2, the student mastered well the concepts of light. He/she performed well in of all parts of the question.

2.2.5 Question 8: Forces in Equilibrium

This question had three parts, namely (a), (b) and (c). Part (a) required the students to state the principle of moments. In part (b), they were required to distinguish between stable equilibrium and unstable equilibrium. Part (c) required the students to calculate the mass of a metre rule with a load of 0.2N placed at the end, a distance 10cm from pivot.

The question was attempted by 99.9 percent of the students whose scores were as follows: 89.80 percent scored 0 to 2.50 marks including 72.3 who scored zero. 9.2 percent scored from 3.0 to 6.0 marks and 1 percent scored from 6.5 to 10 marks. Generally, students' performance in this question was poor because only 10.2 percent of them scored above 2.5 marks.

The students who scored low marks (89.8%) provided incorrect answers to most parts of the question. Some students lacked knowledge on the basic concept of forces in equilibrium as they failed to state the principle of moments. In distinguishing between stable equilibrium and unstable equilibrium most of the students were able either to state stable equilibrium or unstable equilibrium but failed to compare the two. Other students failed to calculate the mass of the ruler due to poor mathematical skills. These students could not remember that the mass of the ruler acts at its centre. They also could not recognize that the weight of the ruler is obtained by using the principle of moment i.e. Sum of clockwise moments = sum of anticlockwise moments hence, use the relation weight (w) of ruler = mass (m) of ruler $\times$ acceleration due to gravity (g) to calculate the mass of the ruler. Extract 8.1 illustrates the case.

Extract 8.1

8. (a) State the principle of moments.

State that " Moments are product of Force Moved of time which Move that distance In a Moments to change it is state rest .

(b) Distinguish between stable equilibrium and unstable equilibrium.

Stable equilibrium	Unstable equilibrium
The stable equilibrium was flat batom	The unstable equilibrium was shepener
They are stand own	Does not stand own

(c) A metre rule is pivoted about a point O as shown in Figure 2 and it is balanced by a load of 0.2 N.

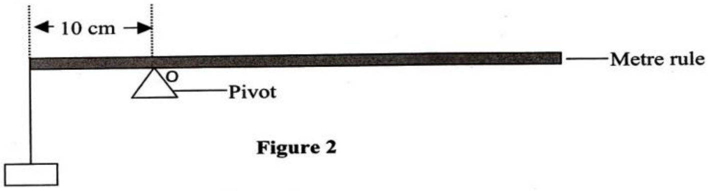


Figure 2

Calculate the mass of the rule.

Soln

Data give.

~~Load~~ Force = 0.2N

length = 10cm

∴ Mass = ?

M = F × L

M = 0.2 × 10

M = 2 kg

∴ The mas of the rule = 2kg.

In Extract 8.1, the student failed to state the principle of moments and to distinguish between stable equilibrium and unstable equilibrium. Similarly, the student failed to use the principle of moments to calculate the mass of the metre rule.

On the contrary, the students who scored full marks (0.2%) in this question demonstrated mastery of the concept of forces in equilibrium as they were able to correctly state the principle of moments and distinguished between stable and unstable equilibrium. These students remembered to use a rotational balance condition to calculate the weight of the ruler at the centre hence they calculated correctly the mass of the ruler. Extract 8.2 shows a good response from one of the students who scored high marks in this question.

Extract 8.2

8. (a) State the principle of moments.

The principle of moments states that "for the body to be in equilibrium level under the action of Parallel forces the clockwise moments must be equal to the anticlockwise moments at any point in a plane."

(b) Distinguish between stable equilibrium and unstable equilibrium.

Stable equilibrium is the type of equilibrium when the object can return to its original position after a small displacement. For the body to exhibit this it should have large area of base and its ~~shote~~ centre of gravity should be lowered. While unstable equilibrium is the one in which the object will not return to its original ~~at~~ position after a small displacement. the body should have small area of base and high centre of gravity.

(c) A metre rule is pivoted about a point O as shown in Figure 2 and it is balanced by a load of 0.2 N.

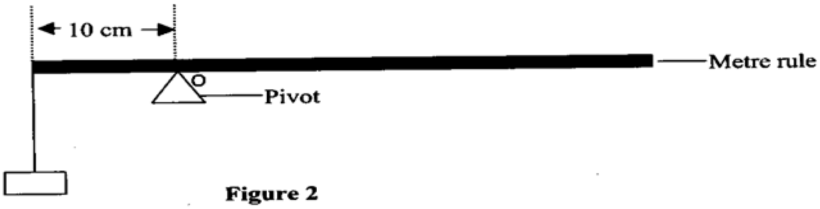
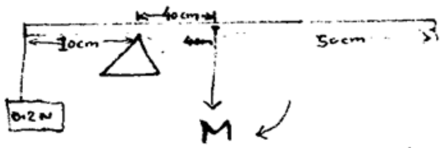


Figure 2

Calculate the mass of the rule.

Solution.



from the principle of moments.

Clockwise moments = anticlockwise moments.

$M \times 40cm = 0.2N \times 10cm$

$M \times 40cm = 2Ncm$

$M = \frac{2N\cancel{cm}}{40\cancel{cm}}$

$M = 0.05N$

but

$\frac{1kg}{x} = \frac{10N}{0.05N}$

$10N x = 1kg \times 0.05N$

$x = \frac{1kg \times 0.05\cancel{N}}{10\cancel{N}}$

$x = 0.005kg$

∴ The mass of the metre rule is 0.005 kg.

Extract 8.2 indicates that the student understood well the concept of moments and hence provided correct answers to all parts of the question.

2.3 Section C: Short Answer Questions

2.3.1 Question 9: Pressure

In this question the students were required to give the uses of (a) (i) manometer, (ii) Hare's apparatus (inverted U-tube), (iii) U-tube and (iv) barometer. In part (b), they were required to explain why a big elephant manages to walk comfortably in mud soil without sinking while human being may sink easily and part (c) required them to draw a well labeled diagram which demonstrates that liquid pressure depends on depth.

About 100 percent of the students attempted this question and out of them, 93.3 percent scored from 0 to 2.5 marks, 6.2 percent scored from 3.0 to 6.0 marks. Only 0.5 percent scored from 6.5 to 10 marks. The students' performance in this question was poor because only 6.7 percent of them scored above 2.5 marks. These data are summarized in Figure 5.

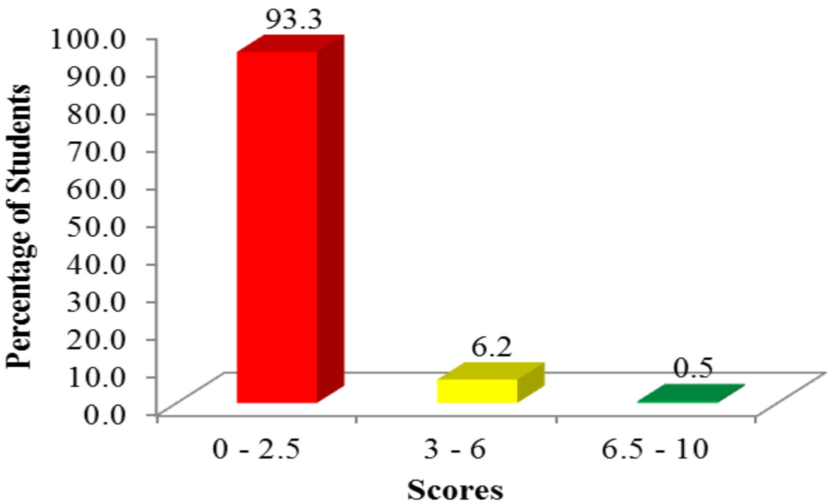


Figure 5: Illustration of Students' Performance in Question 9.

The students who performed poorly in this question had inadequate knowledge of the concept of pressure, as a result they failed to provide the correct uses of the given apparatus. Some were able to provide the use of one of the apparatus and skipped the rest. They also failed to recognize the fact that small area exert a higher pressure while large area exert low pressure hence failed to understand that the wide feet of elephant minimize the pressure of sinking as compared to human beings. Due to inadequate knowledge of pressure they failed to demonstrate that liquid pressure depends on depth. Extract 9.1 shows a poor response from one of the students who scored low marks in this question.

Extract 9.1

9. (a) What are the uses of the following devices?

(i) Manometer It used For Measure volume, Legth

(ii) Hare's apparatus (inverted U-tube) It used For Measure electric current.

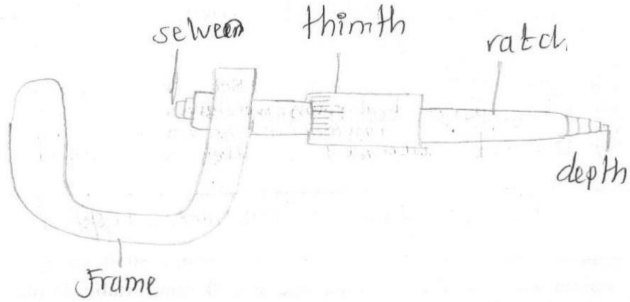
(iii) U-tube It used For Measure distance to ~~liquid~~ electricity.

(iv) Barometer It used For Measure ~~volume~~ Temperature in liquid

(b) Explain why a big Elephant manage to walk comfortably in mad soil without sinking while human being may sink easily?

because Elephant is big to walk comfortably is made soil without sinking while human being is smallest ~~that~~ but ~~to~~ walk is may sink easily.

(c) Draw a well labeled diagram which demonstrates that liquid pressure depends on depth.



In Extract 9.1, the student failed to comprehend the question. The student lacked knowledge on the concept of pressure as he/she failed to provide the correct answers to all parts of the question. For example, instead of drawing a diagram which demonstrates that liquid pressure depends on depth, he/she drew micrometer screw gauge.

On the other hand, the students who did well (6.7%) had adequate knowledge on the basic concepts of pressure as they were able to provide the correct uses of the given apparatus. Some students were able to use the fact that the smaller the area the higher the pressure and the bigger the area the small the pressure to explain why a big elephant manages to walk comfortably in mud soil without sinking while a human being may sink easily. They also demonstrated correctly how liquid pressure depends on depth. Extract 9.2 shows the sample answer from a student who attempted this question well.

Extract 9.2

9. (a) What are the uses of the following devices?

(i) Manometer. Is used to measure gas pressure

(ii) Hare's apparatus (inverted U-tube). Is used to compare density of miscible liquids.

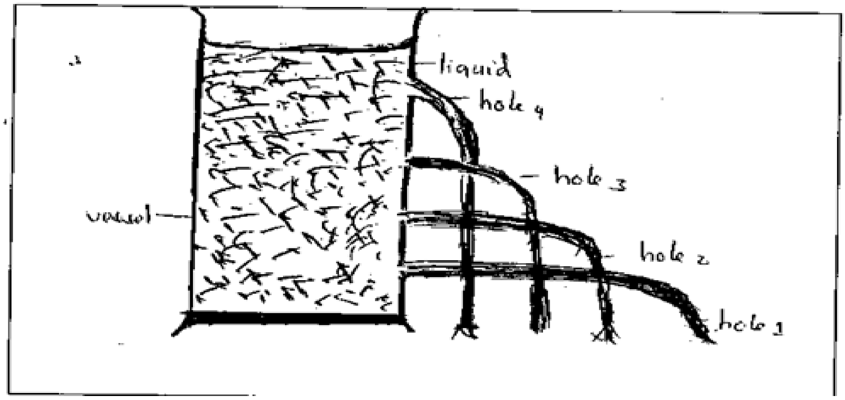
(iii) U-tube. Is used to compare the density of immiscible liquids.

(iv) Barometer ... Is an instrument used to measure the atmospheric pressure.

(b) Explain why a big Elephant manage to walk comfortably in mad soil without sinking while human being may sink easily?

A big elephant manage to walk comfortably in mud soil because the feet of the elephant are very large which increases the surface area and a large surface area decreases the pressure on the soil and it will not sink while a human being sinks this is because the feet of the human are small which decreases the surface area and a (small) minimum area increases the pressure on the soil which causes a human being to sink easily.

(c) Draw a well labeled diagram which demonstrates that liquid pressure depends on depth.



In Extract 9.2, the student was able to give the uses of given apparatus, explain why a big elephant manages to walk comfortably in mud soil without sinking while a human being may sink easily and drew a diagram which demonstrates that liquid pressure depends on depth correctly.

2.3.2 Question 10: Current Electricity

The question had three parts: (a), (b) and (c). Part (a) required the students to mention three uses of current electricity while part (b) required them to explain why it is advised to connect bulb in parallel arrangement during installation of electricity in most buildings. In part (c), they were required to draw a well labeled circuit representing an experiment to verify Ohms' law in the laboratory where by form one students were instructed to *connect in series a resistor R, a battery B of two cells, a switch, an ammeter A and rheostat S* and then were required *to connect a voltmeter V across resistor R.*

The question was attempted by the majority (99.9%) of the students and out of them 86.5 percent scored from 0 to 2.5 marks, 10.8 percent scored from 3.0 to 6.0 marks; and 2.7 percent scored from 6.5 to 10 marks. These scores indicate that the question was poorly performed as only 13.5 percent scored above 2.5 marks.

The students who scored low marks (86.5%) provided incorrect answers to most parts of the question as they lacked knowledge on the basic concepts of current electricity. Some students failed to mention the uses of electric current, instead, they mentioned as *used in hydroelectric power, used in wind power* and *solar panel* as they failed to understand that hydroelectric power and wind power are the sources of electricity while solar panels absorbs radiant energy from the sun. Others wrote that *it used in detection of charge, measure quantity of current* and *measure ammeter* showing that they had inadequate knowledge on current electricity. In the same way, most of the students failed to explain why it is advised to connect bulb in parallel arrangement during installation of electricity in most buildings. For example, one of the students wrote that:

> *we can connect bulb in parallel arrangement because to arrange all bulb in the correct position to involve light or bright light in order to improve dangerous to our houses and then to make houses free to see some wild animals in our house like snake. Because snake is like to across the house during night so, it can cause these dangerous. Building it is better to put electricity for to maintain proper way of use electricity to studing and to make building betters to bright lights so, Electricity is so better to our buildings.* The student could

explain that, when you switch one bulb on or off does not affect the others. Also the full p.d of source is applied across each bulb regardless of the number of bulb hence reducing the resistance of the circuit and increase the brightness of the bulb.

The students had also poor command of English Language. Several students failed to draw a well labeled circuit which represents the experiment to verify Ohm's law. Extract 10.1 shows a sample of poor responses.

Extract 10.1

10. (a) Mention three uses of current electricity.

(i) They are used to mestheture to electricity.

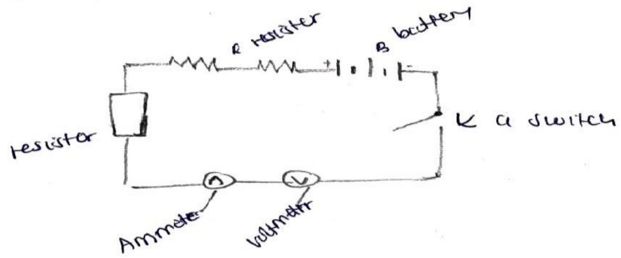
(ii) They are used to conrol the amount of electricity

(b) Explain why it is advised to connect bulb in parallel arrangement during installation of electricity in most building?

It is advised to connect bulb in parallel because the parallel can take the amount of electricity so the bulb can not be transferm electricity in the parralley.

In serries we can conect the bulbu because the serries have the loss amount of electricity so the bulb can be transfermed electricity in serries for light.

(c) The form one students at Saku Secondary School who were conducting an experiment to verify Ohms' law in the laboratory, were given the following instruction: *Connect in series a resistor R, a battery B of two cells, a switch K, an ammeter A and rheostat S. Then connect a voltmeter V across resistor R.* Draw a well labelled circuit representing this experiment.



The responses in Extract 10.1 indicate that the student failed to mention the uses of current electricity and to explain why it is advised to connect bulb in parallel arrangement during installation of electricity in most buildings. He/she also drew incorrect circuit representing the experiment to verify Ohm's law.

On the contrary, the students who performed well in this question were able to give correctly the uses of current electricity. Some of them were able to remember that when bulbs are connected in parallel arrangement the p.d. across each bulb is the same hence the switching on bulbs or off does not affect the others. Furthermore, they drew a well labeled circuit representing an experiment to verify Ohm's law in the laboratory. Extract 10.2 shows a sample answer from a student who attempted this question well.

Extract 10.2

10. (a) **Mention three uses of current electricity.**

(i) Current electricity can be used for lighting bulbs.

(ii) Current electricity can be used to run machines.

(iii) Current electricity can be used also for heating purpose such as iron bar and electric cookers.

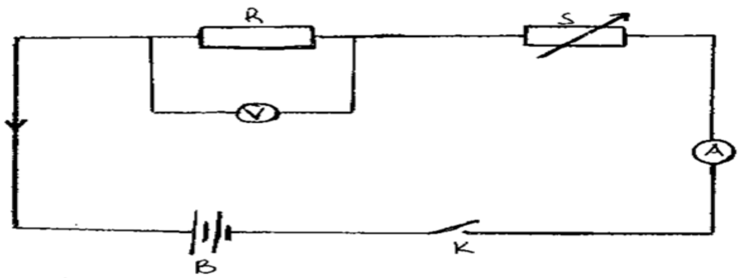
(b) **Explain why it is advised to connect bulb in parallel arrangement during installation of electricity in most building?**

It is advised to connect bulbs in parallel arrangement during installation of electricity in most buildings because the potential difference is transmitted equally in all the bulbs unlike in series arrangement.

Also, it is advantageous because switching on or off of one bulb doesn't affect the other bulbs since each bulb has its own voltage line.

(c) **The form one students at Saku Secondary School who were conducting an experiment to verify Ohms' law in the laboratory, were given the following instruction:** ***Connect in series a resistor R, a battery B of two cells, a switch K, an ammeter A and rheostat S. Then connect a voltmeter V across resistor R.*** **Draw a well labelled circuit representing this experiment.**

A circuit



KEY

R → Resistor
S → Rheostat
V → Voltmeter
A → Ammeter
B → Battery with two cells
K → Switch
—— → Wire

Extract 10.2 indicates a work of a student who understood the concept of current electricity and hence provided the correct answers to all parts of the question.

3.0 ANALYSIS OF PERFORMANCE IN EACH TOPIC

The FTNA 2017 Physics paper had ten (10) questions set from various topics of Form I and Form II. The analysis of the performance shows that two questions 1 and 2 had good performance since the percentages of the students who passed were 75.0 and 73.8 respectively. Question 1 was a multiple choice question that was set from different topics, which are *Introduction to Physics, Introduction to Laboratory Practice, Measurement*, *Archimedes' Principle and Law of Floatation*, *Work, Power and Energy*, *Forces in Equilibrium, Motion in Straight Line*, *Newton's Laws of Motion*, *Simple Machines*, *Light*, *Temperature*, *Magnetism*, *Static Electricity*, *Current Electricity* and *Sustainable Energy Sources*, while question 2 was matching items set from the topic of *Introduction to Laboratory Practice*. Additionally, the topic of *Work, Energy and Power* which was tested in Question 4 had average performance since 44.5 percent scored 30% to 100% of the question.

Furthermore, the analysis shows that, the remaining seven (7) questions had poor performance as most of the students scored below 30% in each question. These questions were constructed from the topics of *Motion in Straight a Line*, *Simple Machines*, *Newton's Laws of Motion*, *Forces in Equilibrium*, *Pressure*, *Light*, *Structure and Properties of Matter* and *Current Electricity*. Appendix 1 summarizes the students' performance in each topic, where a red, yellow and green colour shows weak, average and good performance respectively.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The question-wise analysis of the performance of students in Physics, 2017 clearly highlighted challenges faced by students in understanding the content and requirements of a particular question. Further, it provides the suggestions that can help to overcome the observed problems.

Failure to understand or mixing up of certain concepts necessary to answer most of the questions, coupled with poor conceptualization of the subject matter by students, has led to the generally poor performance. Besides, difficulty in applying mathematical knowledge to solve questions which required the use of mathematical concepts caused some of the students fail to manipulate the data given in order to obtain the required answers. This was observed in questions 4, 5, 6, 7, and 8 which were set from the topics of *Work*, *Energy and Power*, *Motion in Straight Line*, *Pressure*, *Light* and *Forces in Equilibrium*. Additionally, lack of drawing skills led the students to score low marks as they drew poor diagrams. The situation was noted in questions 6 and 10 which were set from the topics of *Pressure* and *Current Electricity*. Moreover, incompetence in using English Language led to students' failure in presenting the answers in the questions which required explanations.

Generally, the students' performance in most questions was poor. The only items which were well performed were the multiple choice items and matching items. The averagely performed question was only Question 4. The rest of the questions had poor performance. See Appendix 1.

The general performance in this year has increased by 8.61 percent as compared to last year where 28.13 percent of the students passed the assessment. The general performance for the year 2017 was average (36.74%). The performance in the year 2016 and 2017 in different grades is shown in Appendix 2.

It is expected that the feedback given in this report will enable the stakeholders, students and teachers, to take necessary measures to improve the students' performance in FTNA Physics assessments. During the preparation period, it is vital for teachers to enable their students understand the subject matter of each topic before attempting any question.

4.2 Recommendations

In order to improve the students' performance in future, it is recommended that:

(a) Students need to be encouraged to concentrate on subject matter of each topic covered under the syllabus and not to rush to solve questions before understanding them.

(b) Students should learn and understand the use of various apparatus in daily life activities as stipulated in the syllabus.

(c) During preparation and assessment periods, students need to be repeatedly advised on the importance to identify the demand/requirements of the question before attempting the question.

(d) Teachers need to promote the spirit of understanding the subject matter and not the habit of working through questions before acquiring the necessary knowledge.

(e) Teachers are supposed to cover the syllabus in time in order to give the students enough time for revisions.

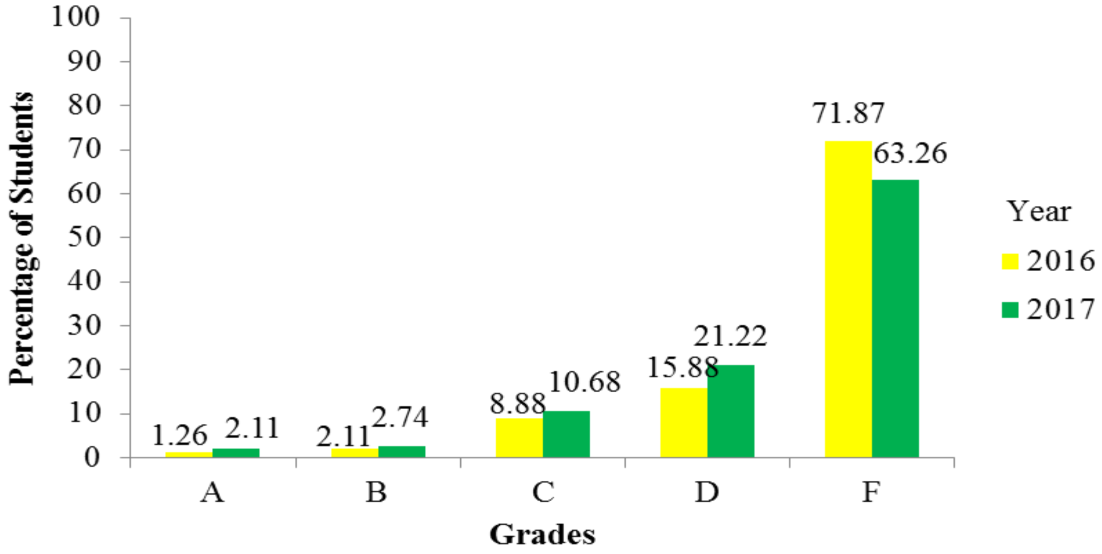
Appendices

Appendix 1

THE STUDENTS' PERFORMANCE IN PHYSICS IN EACH QUESTION IN 2017

S/n	Topic	Question Number	The % of Students who scored an Average of 30% and Above	Remarks
1.	Introduction to Physics, Introduction to Laboratory Practice, Measurement, Archimedes' Principle and Law of Floatation, Work, Energy and Power, Forces in Equilibrium, Motion in a Straight Line, Newton's Laws of Motion, Simple Machines, Light, Temperature, Magnetism, Static Electricity, Current Electricity, and Sustainable Energy Sources	1	75.0	Good
2.	Introduction to Laboratory Practice	2	73. 8	Good
3.	Work, Energy and Power	4	44.5	Average
4.	Motion in a Straight Line	5	19.4	Weak
5.	Light	7	15.9	Weak
6.	Pressure	6 and 9	15.1	Weak
7.	Measurement, Simple Machines, Newton's Laws of Motion, Light and Structure and Properties of Matter	3	15	Weak
8.	Current Electricity	10	13.5	Weak
9.	Forces in Equilibrium	8	10.2	Weak

Appendix 2



The performance in the year 2016 and 2017 in different grades