THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

# STUDENTS' ITEM RESPONSE ANALYSIS REPORT FOR THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2015

## 031 PHYSICS

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## FOREWORD

The Form Two National Assessment (FTNA) is a formative evaluation after two years of study in secondary school level. The assessment intended to diagnose the student's progress towards mastering of various concepts as stipulated in the syllabus. It provides teachers with feedback that will direct subsequent teaching in future. It also serves as a continuous assessment when the students register to sit for Certificate of Secondary Education Examination (CSEE).

This report briefly highlights some of the reasons that made the students fail to score high marks in the questions. Factors that account for students' poor performance in Physics include: inability of the students to express themselves in English Language, failure to interpret the requirements of the questions, misconceptions on the subject matter, inadequate knowledge on various concepts as well as lack of both drawing and mathematical skills. These factors have been elaborated by using students' responses figures and extracts drawn from students' scripts which provide substantial examples of what was actually written.

The report provides comments which will enable the education administrators, school managers, teachers, students and other education stakeholders to take measures that will help to improve students' performance in future assessments.

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

Finally, the Council would like to thank the Examiners and all those who participated in preparing and analyzing the data used in this report.

Dr. Charles E. Msonde

**EXECUTIVE SECRETARY**

# 1.0 INTRODUCTION

This report is based on the analysis of the students' performance in Physics subject for Form Two National Assessment (FTNA) in 2015. The paper was based on the revised Physics syllabus for secondary education of 2007 and was intended to measure the competences acquired by the students after completing two years of study in ordinary level.

The paper consisted of three sections, namely A, B and C. Section A had 20 multiple choice items derived from almost all topics in two years of study. Section B had five (5) questions constructed from the topics of: Measurement, Properties of Matter, Motion in a Straight Line, Forces in Equilibrium, Temperature, Current Electricity, Light, Force, Introduction to Laboratory Practice and Magnetism. Section C comprised four (4) short answer questions derived from the topics of Newton's Laws of Motion, Simple Machines, Work, Energy and Power and Light. The students were required to answer all questions from all sections. Section A had a total of 20 marks, while sections B and C had 40 marks each.

The number of students who sat for this paper was 360,579, of which, 93,237 (25.86%) passed the assessment and 267,342 (74.14%) failed. This implies that the general performance in this paper was poor as compared to the year 2014 when the general average performance was 38.7 percent. This indicates that there was a drop in performance in the year 2015 by 12.9 percent.

Subsequently, the report provides the analysis of students' performance in each question. The question is graded as poorly, averagely or well performed (good) if the percent of students who scored 30 percent or above the marks allocated to the question is from 0 – 29, 30 – 49 and 50 – 100 respectively. This report expressively highlights the demands of the questions, the misconceptions observed and the possible reasons for poor and good performance. Comments on individual questions and extracts of students' answers have been thoroughly explained to illustrate the respective cases.

## 2.0 ANALYSIS OF THE STUDENTS' PERFORMANCE IN EACH QUESTION

### 2.1 Section A: Objective Questions

### 2.1.1 Question 1: Multiple Choice Items

This question required the students to choose the correct answer from the given alternatives and write its letter in the box provided.

The question was attempted by all (100%) students. The analysis of the data as shown in Figure 1 indicates that, 20.2 percent of the students scored from 0 to 5 marks, 43.3 percent scored from 6 to 9 marks and 36.5 percent scored from 10 to 20 marks. The overall performance of this question was good as 79.8 percent of the students passed the question.

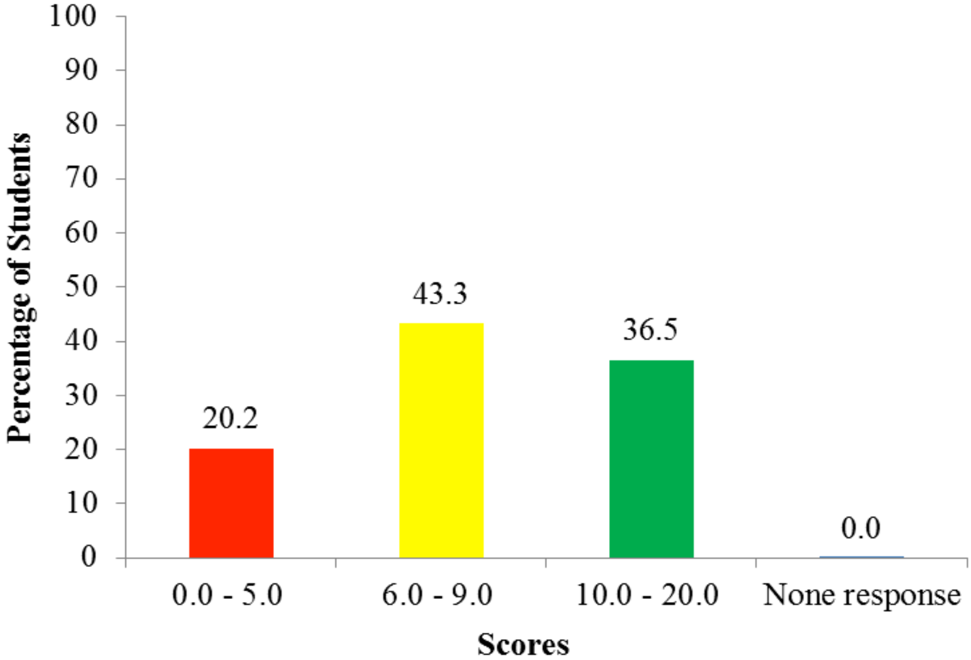



**Figure 1:** Percentage of students' performance per score.

The general performance in this question was good because of all the students who attempted this question, 79.8 percent scored from 6 to 20 marks. This indicates that students had adequate knowledge on the items tested in this question as they were able to identify the correct answers. On the other hand, students who scored below 6 marks (20.2%) had inadequate knowledge of the subject matter. Some of them lacked mathematical skills as they failed to recall the formula and manipulate the mathematical related items like items number (iii), (v), (viii), (xi) and (xv). The arguments on these items are as follows:

In item (iii), the students were required to convert the speed of $72kmhr^{-1}$ into $ms^{-1}$. The correct answer was C “20m/s” but some of the students selected D “200m/s” while others selected B “1200m/s” or C “20m/s”. These students had inadequate knowledge on the concept of unit conversion as they failed to recognize that 1 Kilometre and 1 hour is equivalent to 1000 metres and 3600 seconds respectively.

Item (v) required the students to name the region around a magnet. The correct answer was C “Magnetic field”. Most of the students selected A “Magnetization” and others selected B “Demagnetization”. These students failed to recognize that, magnetization and demagnetization are processes of making magnet and destroying magnetism in a magnet respectively. Some of the students opted for D “Magnetic domains” as they did not understand that a magnetic domain is a group of dipoles. These students had inadequate knowledge of the concept of magnetism as they were supposed to understand that magnetic field is the region around magnet where magnetic force occurs.

In item (viii), the students were required to identify the energy associated with areas of frequent earthquakes. The correct answer was C “Geothermal energy”. However most of the students chose A “Tidal energy” while others chose B “Solar energy” or D “Wind energy”. The students who opted for the wrong answers failed to differentiate geothermal energy from other types of energy such as tidal energy, solar energy and wind energy. Geothermal energy is the energy generated by the flow of heat from the earth’s surface while tidal energy is produced due to gravitational pull of the moon and to some extent, the sun. Solar energy is the energy from the sun and wind energy is the energy from wind.

The students were required to mention the name of a huge discharge of static electric charges between two clouds in item (xi). The correct answer was C “lightning” but most of the students chose A “radar”. These students failed to differentiate radar from lightning. They were supposed to understand that lightning is a huge discharge of static electric charges between two clouds or a cloud and the ground while radar is a zigzag path taken by electrons when the negative clouds moves across air towards the positive clouds. There were those who selected B “thunder”. These failed to recognize that thunder is a resulting sound heard after lighting. On the other hand, there were students who chose D “lightning conductor”. These students were not aware that lightning conductor is used to prevent lightning. It is a metal rod attached to a building and connected to a thick copper strip that leads into the ground and its tip has sharp spikes.

In item (xv), the students were required to identify molecular forces that are exerted between molecules of the same kind. The correct answer was B “cohesive” but many students opted for A “adhesive” as they failed to distinguish adhesive from cohesive: adhesive are molecular forces which are exerted between the molecules of different substances e.g. a water molecule and a glass molecule. Other students selected C “upthrust” or D “surface tension” because they had inadequate knowledge of the concepts of Structure and Properties of Matter. These students were supposed to understand that upthrust is an upward force exerted by liquid, and surface tension is an ability of the surface of liquid to behave like a fully stretched elastic skin.

## 2.2 Section B: Matching Items, Filling in the Blanks and Short Answer Questions

### 2.2.1 Question 2: Matching Items

This question had eight (8) items in List A and eleven (11) corresponding responses in List B. 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 Current Electricity.

The question was attempted by almost 100 percent of the students, of which 56.2 percent scored from 0 to 2 marks, 14.8 percent scored 3 marks and 28.9 percent scored from 4 to 8 marks, as shown in Figure 2.

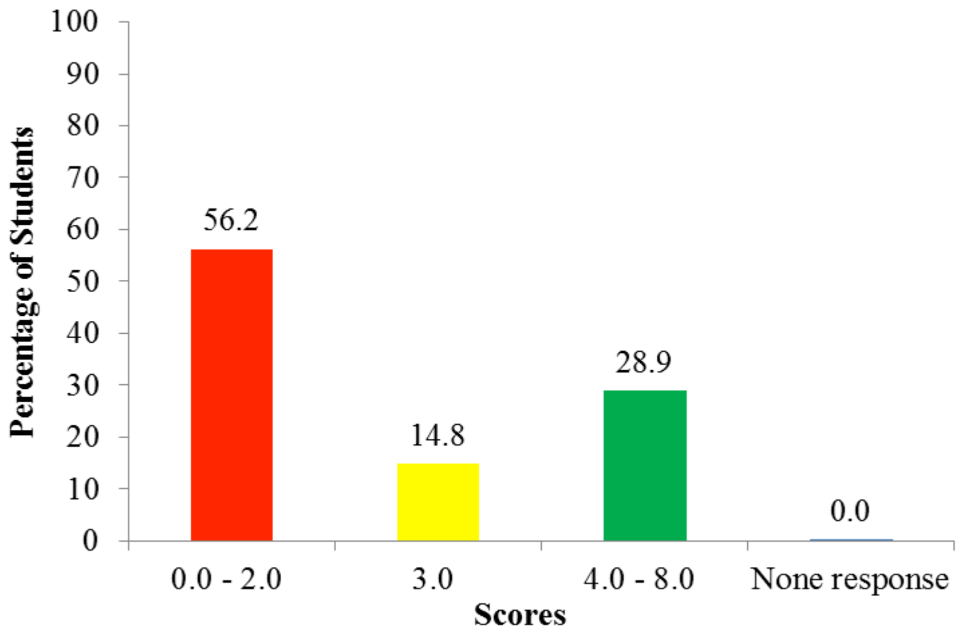



**Figure 2:** Percentage of students' performance per score.

Generally, the performance in this question was average. Most of the students in this category were able to interpret some of the given information and match with the appropriate electric symbol derived from current electricity. The discussion on students' performance in each item is as follows:

In item (i), the students were required to identify a suitable electric symbol which supplies electrical energy. The correct response was E "the electric symbol of the battery", but most students selected I "the electric symbol of the capacitor". Students who failed to select the correct symbol had misconception between the two electric symbols. They did not comprehend that electrical symbol for a battery is represented by vertical plates of different sizes while that of capacitor is illustrated by two vertical metal plates of the same size.

Item (ii) required the students to identify the symbol of a quantity which converts electrical energy to heat and light. The correct response was G "the electric symbol of the lamp". Majority of the students matched this item with a wrong answer C 'the electric symbol of the galvanometer' which is sometimes indicated by using a pointer or an arrow inside the oval. The students confused it with the symbol of lamp with X or a curve like structure inside it. In order to recognize the appropriate electrical symbol, students were required to recall that a galvanometer detects the presence of current while a lamp converts electrical energy to heat and light.

In item (iii), the students were asked to choose the response which match with the sentence “impedes the flow of current”. The correct answer was K “the electric symbol of the resistor”. Many students matched it correctly, showing that they had an insight on the electric symbol for an instrument which hinders the flow of electric current in circuit components. However, some students matched it with D “the electric symbol of the variable resistor”. These students failed to recall that the electric symbol of a resistor has an arrow, unlike to that of variable resistor. The students who were attracted by electric symbol of the resistor with an arrow across did not understand that this kind of resistor is used to adjust the flow of current in the circuit but not to prevent the current to flow through it.

The students were required to identify the electric symbol which represents an instrument that detects the presence of current in item (iv). The correct answer was C “the electric symbol of Galvanometer”. The majority of the students got it wrong as they confused with the electric symbol of the lamp (G). However, few students were able to match it correctly.

In item (v), the students were asked to match a symbol that measures current. The correct answer was F “the electric symbol of ammeter”. Most of the students matched it correctly indicating that the concept was well understood.

Item (vi) required the students to identify the electric symbol which matched correctly with the expression “stores charge”. The correct response was I “the electric symbol of the capacitor”. The students were required to understand that it is only the capacitor which is used to store charge. They were also supposed to understand that the capacitor has two vertical metal plates of the same length separated by a dielectric material (insulator). The majority of the students confused it with the electric symbol of a battery, indicating that the concept was not well understood.

In item (vii), the students were required to select the electric symbol which represents an instrument which measures potential difference. The correct electric symbol was H “voltmeter”. The majority of the students got the correct answer H as they were able to associate the electric symbol of the voltmeter and its main function when used in various electrical components or circuits.

Item (viii) required the students to give the proper matching on the statement “opens and closes a circuit”. The correct answer was A “the electric symbol of the key or switch” and many students attempted well this item.

### 2.2.2 Question 3: Filling in the Blank spaces

The question consisted of five (5) items each with a blank space. Students were required to fill in the blank by writing the correct answer on the space provided for each of the item.

The question was attempted by 99.3 percent of the students, of which 82.8 percent scored below 2 marks, and out of these, 49 percent scored 0. The percentage of students who scored 2 marks was 11.6 while 4.9 percent scored from 3 to 5 marks. Hence, the general performance of this question was poor. The students who performed poorly had inadequate knowledge of the subject matter and some of them had some problems in the use of English. The items that were poorly performed were (ii), (iv) and (v).

In item (ii), the students were required to mention a quantity which occurs when a body’s rate of displacement is constant. The correct answer was “Uniform velocity”, but most of the students wrote velocity as they failed to understand that velocity is just the rate of change of displacement.

Item (iv) required the students to name force which causes an object to turn about a fixed point. The correct answer was “Turning force”.  Some of the students wrote fulcrum. They did not know that fulcrum is not force but is the point where the body turns about and what causes that body to turn is turning force.

In part (v), the students were required to name the angle between the geographic north and the magnetic north. The correct answer was “angle of declination”. Some of the students wrote angle of inclination as they failed to differentiate between the angle of declination and angle of inclination. The angle of inclination is the angle between magnetic field and the earth's surface.

### 2.2.3 Question 4: Measurements in Physics

This question had two parts; (a) and (b). In part (a), the students were required to state the meaning of capillary action while in part (b), they were required to differentiate: (i) Magnetization from demagnetization, (ii) Luminous from non-luminous bodies, (iii) Regular from irregular reflection of light, and (iv) Conductor from insulator.

The question was attempted by 99.0 percent of the students and out of these, 85.0 percent scored from 0 to 2 marks, 6.4 percent scored from 3 to 4 marks, and 7.7 percent scored from 5 to 9 out of 9 marks as shown in Figure 3.

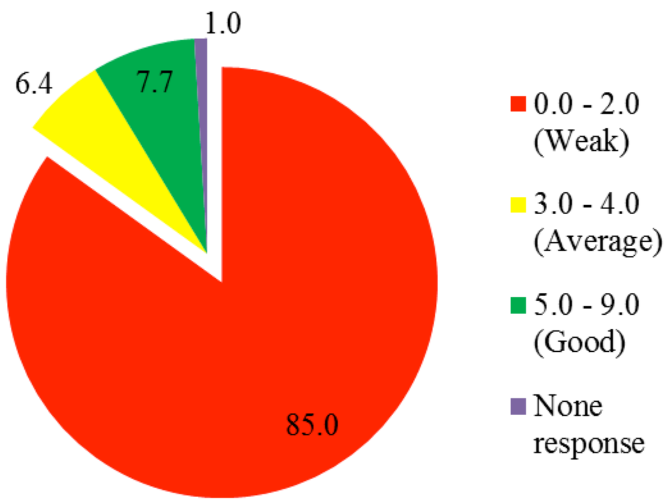



**Figure 3:** Percentage of students' performance per score.

The general performance of this question was poor. The majority of the students who performed poorly had inadequate knowledge of the concept of Structure and Properties of Matter specifically on Capillarity, Magnetism, Light and Static Electricity. Some of them failed to give the meaning of capillary action. For example, one of the students wrote; *"Capillary action is the action of capillary"*. Another student wrote; "*Capillary action is the action which shows the passage of charges in a conductor material"*. These students failed to associate the concept of structure and properties of matter with static electricity as they gave the definition of conductor found in static electricity instead of capillary action. This indicates that the students had inadequate knowledge of the subject matter. They failed to understand that *"Capillary action is the ability of liquid to rise or fall in narrow tube"*. In part (b) many students failed to differentiate the given terms. For example, some of the students confused luminous and non-luminous flames as applied in Chemistry with the luminous and non-luminous bodies applied in Physics. These students failed to differentiate luminous and non-luminous flames from luminous non-luminous bodies. Extract 4.1 is a sample of poor responses from one of the students.

**Extract 4.1**

4. (a) What is meant by capillary action... Is the movement of the molecules.

(b) Differentiate between the following terms:

(i) Magnetization and demagnetization. Is the way in which magnet can attract to each other and demagnetization is the magnet which can not atract to each other.

(ii) Luminous and non-luminous bodies. Is the source of light which works when the hole is closed while non luminous is when the hole is opened.

(iii) Regular and irregular reflection of light. Regular is the way of light pass into a straigh line which irregular the lights bends.

(iv) Conductor and insulator. Is a material ~~with~~ which allow light to pass through while the insulator do not allow light to pass through

In extract 4.1 a student failed to explain the meaning of capillary action. He/she also failed to differentiate between the given phrases.

On the other hand, few (6%) students who performed well in this question had adequate knowledge of the subject matter. They were able to give the meaning of capillary action and differentiate correctly the given phrases. Extract 4.2 shows a sample of good responses from one of the students.

**Extract 4.2**

4. (a) What is meant by capillary action...is the raise or fall of liquid ...in a narrow tube...

(b) Differentiate between the following terms:

(i) Magnetization and demagnetization.

Magnetization is the process of adding magnetism to the substance while demagnetization is the process of removing magnetism to the substance

(ii) Luminous and non-luminous bodies.

Luminous bodies are bodies which produce light while non luminous bodies are those which do not produce light

(iii) Regular and irregular reflection of light.

Regular reflection of light is the reflection which occur the smooth surface while irregular reflection occur on the rough surface

(iv) Conductor and insulator.

conductor are those material which allow the flow of electric current while insulator are the material which do not allow flow of current

In extract 4.2 the student was able to explain the meaning of capillary action. He/she also differentiated the given phrases correctly.

### 2.2.4 Question 5: Forces and Measurements

The question had two parts; (a) and (b). In part (a) (i), the students were required to define friction and in (ii), to identify three effects of force. In part (b) (i) the students were required to define density and give its SI unit and in (ii) to list three applications of density in real life.

The question was attempted by 99.3 percent of the students, of which, 84.1 percent scored below 3 marks and among these, 48.6 percent scored zero. Few students (15.2%) were able to score 3 marks and above.

The students who performed poorly failed to define the term friction and to identify the effects of force. They had no idea that friction is a force encountered by an object when resting or moving over another object. For example one of the students wrote; "*Friction is the type of force that a person can do work without use the mind*." Another student explained one of effects of force as; *"To force to do something which you don't want"*. These students should have written the effects of force as to *stretch, compress, bend, rotate and turn materials*. Furthermore, the students failed to define density, give the SI unit of density and to list applications of density in real life due to inadequate knowledge of measurements especially on density. For example, one of the students defined density as; "*Density is the force product of weight at which work is done. SI unity is $m/s^2$"*. This student should have written *"density is the mass per unit volume. Its SI unit is $Kg/m^3$"*. Extract 5.1 is a sample of poor responses from one of the students.

**Extract 5.1**

5. (a) (i) Define friction Is the System of force in which to one product an one product to forces.

(ii) Identify three effects of force.

friction force

Inaquate force

(b) (i) Define density and give its SI unit.

(ii) List three applications of density in real life.

Voltage

Capacitor

Ampia

In extract 5.1, the student failed to comprehend the requirement of question. The student lacked knowledge on the concept of forces and measurements.

These students who scored from 3 marks and above were able to define the term friction, identify the effects of force and list the application of density in real life situation. This implies that they had adequate knowledge of the concepts of forces and measurements. Extract 5.2 is a sample of one of the good responses.

**Extract 5.2**

5. (a) (i) Define friction. Is the force which prevents the body from sliding or Is the resistance force of motion of an object on the surfaces.

(ii) Identify three effects of force.

(I) Force can change the shape of the body.

(II) Force can cause the body at rest to move.

(III) Force can cause the body in motion to stop or increase its velocity or speed.

(b) (i) Define density and give its SI unit.

Density is the mass per unit volume of substance.

SI unit is kg/m³ or kgm⁻³.

(ii) List three applications of density in real life.

(I) It helps in making various structures Example Aeroplanes

(II) It helps in identification of gemstones and rocks

(III) It helps to recognize the pure substances by considering their densities Example. Pure milk.

In extract 5.2, the student mastered well the concepts of forces and measurements. The student performed well in of all parts of the question.

### 2.2.5 Question 6: Introduction to Laboratory Practice

The question aimed to determine student's knowledge of laboratory practices. In part (a), the students were required to give the meaning of First Aid. In part (b), they were required to draw the symbols or warning signs for: (i) Irritant, (ii) Danger of an electric shock, (iii) Toxic and (iv) Flammable.

The data analysis shows that, 99.9 percent of the students attempted this question and out of those, 45.3 percent scored from 0 to 2 marks, 23.2 percent scored from 3 to 4 marks and 31.5 percent scored from 5 to 9 marks as shown in Figure 4.

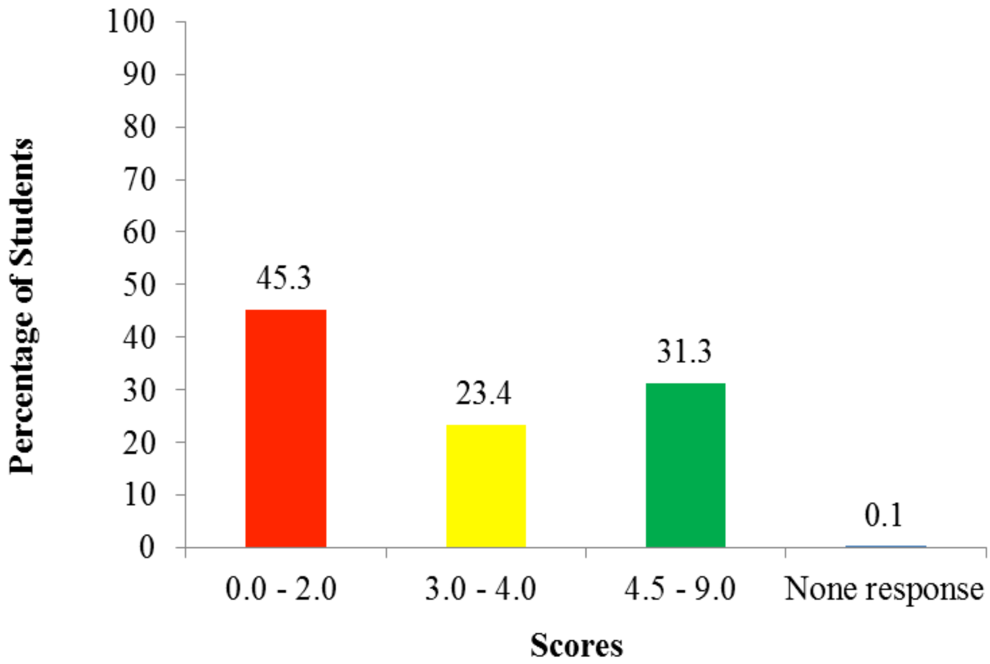



**Figure 4:** Percentage of students' performance per score.

The general performance in this question was good as majority (54.7%) of the students performed well. Good performance was attributed to adequate knowledge of the concepts of Laboratory practice since students were able to give correctly the meaning of First Aid and draw the correct warning signs. Extract 6.1 illustrates one of the good answers given by a student.

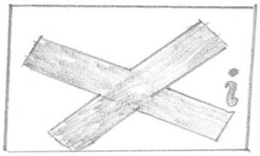
**Extract 6.1**

6. (a) What is meant by First Aid?

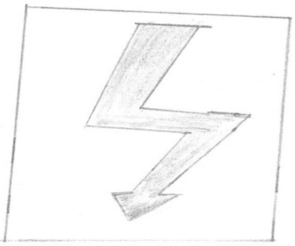
IS the help or assistance given to a sick or an injured person before getting professinal treatment.

(b) Draw the symbols or warning signs for each of the following:

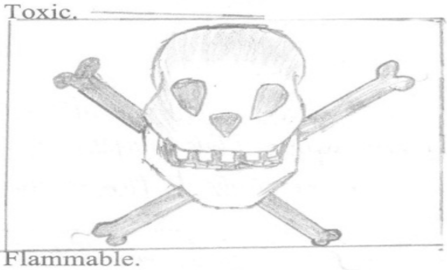
(i) Irritant.



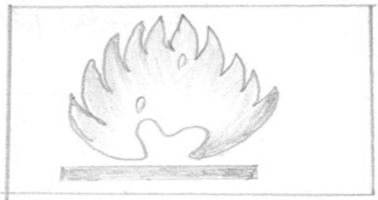
(ii) Danger of an electric shock.



(iii) Toxic.



(iv) Flammable.



In extract 6.1, a student was able to define and draw the warning signs correctly.

Students who performed poorly failed to give the meaning of First Aid and drew wrong symbols or warning signs. Some failed to distinguish between the symbol of irritant and harmful substances hence drew the symbol of harmful substances while others drew poor symbols. Extract 6.2 was taken from the script of one of the students who performed poorly in this question.

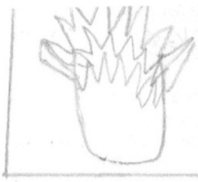
**Extract 6.2**

6. (a) What is meant by First Aid?

Is the immediate tempaary given injure person before take profersi-nal madical at the hospital.

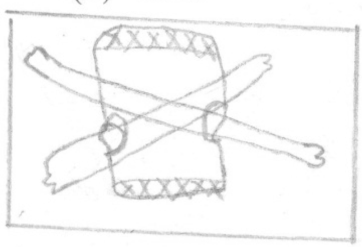
(b) Draw the symbols or warning signs for each of the following:

(i) Irritant.

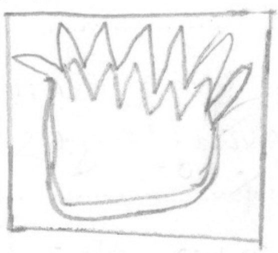


(ii) Danger of an electric shock.

(iii) Toxic.



(iv) Flammable.



In extract 6.2, the student failed to give the meaning of the word First Aid. Similarly, the student failed to draw correctly the diagrams for warning signs.

## 2.3 Section C: Short Answer Questions

### 2.3.1 Question 7: Newton's Laws of motion

This question had two parts, (a) and (b). In part (a) the students were required to write equations of motion and to distinguish between elastic and inelastic collision. In part (b), they were required to state the principle of conservation of linear momentum. They were further required to calculate the common velocity of a 4kg object moving to the right at 2m/s when it makes a head-on collision with a 5kg object moving with a velocity of 1m/s in the opposite direction, provided that, the objects stuck together after collision.

The question was attempted by 98.7 percent of the students, and 83.0 percent scored below 3 marks of which, 69.7 percent scored 0. However, 9.8 percent of the students scored from 3 to 4 marks while 5.9% scored 5 to 10 marks.

The majority of the students who performed poorly lacked knowledge of the concept of Newton's laws of motion, particularly the equations of motion. They also failed to distinguish between elastic and inelastic collision. These students failed to recall that in elastic collision both momentum and kinetic energy are conserved and that the individual objects move separately after collision.

On the other hand, for inelastic collision only the momentum is conserved while the kinetic energy is lost and the two objects may stick together after collision. Consequently, the students failed to state and apply the principle of conservation of linear momentum and to calculate the common velocity of an object. This further indicates that they lacked knowledge and skills on the concept of collision. For example one of the students stated the principle of conservation of liner momentum as; "*the momentum on its object of a body is constant to be equal*" instead of stating that *"If there is no external force acting on a colliding system, total momentum before collision equals to the total momentum after collision"*. Extract 7.1 shows a sample of poor responses.

**Extract 7.1**

7. (a) (i) Write three equations of motion.

① Electric current

② To minimize zero

③ A beam balance

(ii) Distinguish between elastic and inelastic collision.

The quant of space that an object occupies

(b) (i) State the principle of conservation of linear momentum.

The conduction of an forcest of force to an SI unit area.

(ii) A 4kg object is moving to the right at 2m/s when it makes a head-on collision with a 5kg object moving with a velocity of 1m/s in the opposite direction. If both objects stick together after collision, calculate their common velocity.

Soln

Data given

A = 4Kg

g = 2m/s

h = 5kg

v = 1m/s

r = ?

From

$\frac{4kg \times 2m/s \times 5kg}{1m/s \times ?}$

$= \frac{40\,kgm/s}{1\,m/s}$

$= 40kg$

∴ The common velocity = 40Kg

In extract 7.1, the student failed to comprehend Newton's laws of motion, particularly the questions of motion and principle of conservation of linear momentum. The student had also poor command of English Language.

However, the students who performed well in this question had adequate knowledge of the concept of Newton's laws of motion because they were able to write correctly the three equations of motion. They were also able to distinguish between elastic collision and inelastic collision. Furthermore, they understood the principle of conservation of linear momentum since they applied it to calculate the common velocity of the two objects and noted that the body which was moving in the opposite direction is given a negative sign and that when they move together after collision their final velocity is the same. Extract 7.2 is a sample of one of the students who attempted well this in question.

**Extract 7.2**

7. (a) (i) Write three equations of motion.

i/ $v = u + at$

ii/ $s = ut + \frac{1}{2}at^2$

iii/ $v^2 = u^2 + 2as$

(ii) Distinguish between elastic and inelastic collision.

Elastic collision is the type of collision where by both kinetic energy (K.E) and momentum are conserved while inelastic collision is the type of collision in which only momentum is conserved.

(b) (i) State the principle of conservation of linear momentum.

When two or more bodies are collide together their total momentum remain constant if there is noany external force act upon them"

(ii) A 4kg object is moving to the right at 2m/s when it makes a head-on collision with a 5kg object moving with a velocity of 1m/s in the opposite direction. If both objects stick together after collision, calculate their common velocity.

Solution

$M_1V_1 + M_2V_2 = (M_1 + M_2)V_c$

$(4 \times 2) + (5 \times -1) = (4 + 5)V_c$

$8 - 5 = 9V_c$

$\frac{3}{9} = \frac{9V_c}{9} = 0.3\,m/s$

Common velocity is $0.3\,m/s$.

Extract 7.2 indicates that the student mastered well the concept of equations of motion and principles of conservation of linear momentum.

### 2.3.2 Question 8: Simple Machines

This question had two parts, (a) and (b). In part (a) the students were required to give the meanings of pitch of the screw and velocity ratio. In part (b), they were required to calculate the: Velocity ratio of a screw jack with a pitch of 0.1cm when a handle of length 21cm is used to lift a car of weight 528N, given that the efficiency of the screw is 20%. They were also required to calculate the effort required to raise the same car from the given parameters.

This question was attempted by 98.5 percent of students and was poorly performed as majority of the students (91.6%) scored below 3 marks of which, 70.6 percent scored 0 marks. However, 2.5 percent scored 3-4 marks while 4.4 percent scored from 5 to 10 marks.

The students who performed poorly failed to utilize the knowledge acquired in the concept of simple machines especially screw jack to give the meaning of the pitch of the screw and the velocity ratio. Consequently, they failed to calculate the velocity ratio and the effort required to raise the car by using a screw jack. The students were expected to give the meaning of the pitch of the screw as the distance between two successive threads and velocity ratio of a simple machine as the ratio of distance moved by the effort to the distance moved by the load. Instead of giving these answers they provided incorrect answers as shown in Extract 8.1.

**Extract 8.1**

8. (a) What is meant by the following terms as used in simple machines:

(i) Pitch of the screw.

This is where by the screw is released to simplify work to the parts of a machine.

(ii) Velocity ratio.

Is the ratio of the load to effort which is overcamed by the effiency of 100%.

(b) A screw jack with a pitch of 0.1cm and a handle of length 21cm is used to lift a car of weight 528N. If the efficiency of the screw is 20%, Calculate the

(i) Velocity ratio.

Soln

$V.R = \frac{L}{E} \times 100\%$

(ii) Effort required to raise the car.

Soln

$L \times LA = E \times EA$

$0.1cm \times 21cm = 58N \times x$

$\frac{10000N \times 21cm}{58} = \frac{58N \times x}{58} = 105000$

$29 \overline{)105000}$

The responses in extract 8.1 indicate that the student failed to give the meaning of the terms pitch of the screw and the velocity ratio as applied in simple machines. He/she also failed to calculate the velocity ratio and the effort required to raise the car by using a screw jack.

The students who scored from 3 marks and above were able to state correctly the meaning of the terms pitch of the screw and the velocity ratio in simple machines. Some of them were also able to apply the correct formulas to calculate the velocity ratio and the effort of the screw jack required to raise the car. This depicted that, they had adequate content knowledge and good mathematical skills that enabled them to obtain the required answers. Extract 8.2 is a sample of responses taken from the script of one of the students who attempted well in this question.

**Extract 8.2**

8. (a) What is meant by the following terms as used in simple machines:

(i) Pitch of the screw.

Is the distance between two successive threads.

(ii) Velocity ratio

Is the ratio of the distance moved by effort to the distance moved by load.

(b) A screw jack with a pitch of 0.1cm and a handle of length 21cm is used to lift a car of weight 528N. If the efficiency of the screw is 20%, Calculate the

(i) Velocity ratio.

Soln

Data,

Pitch = 0.1cm

Length (r) = 21cm

Load = 528N

Efficiency = 20%

$V.R = \frac{2\pi r}{Pitch} = \frac{2 \times \frac{22}{7} \times 21}{0.1}$

$= \frac{132 \times 10}{0.1 \times 10} = \frac{1320}{1}$

$\therefore$ Velocity ratio = 1320 answer.

(ii) Effort required to raise the car.

$Efficiency = \frac{M.A}{V.R} \times 100\%$

$20\% = \frac{M.A}{1320} \times 100\%$

$\frac{20\% \times 1320}{100\%} = M.A$

$\therefore M.A = 264$

$M.A = \frac{Load}{Effort}$

$264 = \frac{528N}{E}$

$\frac{264E}{264} = \frac{528N}{264}$

$\therefore$ Effort = 2N answer

The responses in extract 8.2 indicate that the student understood the concept of screw jack in simple machines and hence provided the correct answers to all parts of the question.

### 2.3.3 Question 9: Work, Energy and Power

In part (a), the students were required to (i) define potential energy and in (ii), they were required to calculate the height reached on rebound for a ball of mass 0.5kg when dropped from a height of 10cm and on impact with the ground loses 30J of energy. In part (b), the students were required to (i) state the principle of conservation of energy and in (ii), they were required to describe the energy changes when the bob of a simple pendulum swings from one side to another.

The question was attempted by 99.1 percent of the students, of which 92.9 percent scored from 0 to 2 marks, 3.2 percent scored from 3 to 4 marks and 3 percent scored from 5 to 10 marks, these scores which indicate a poor performance in this question as shown in Figure 5.

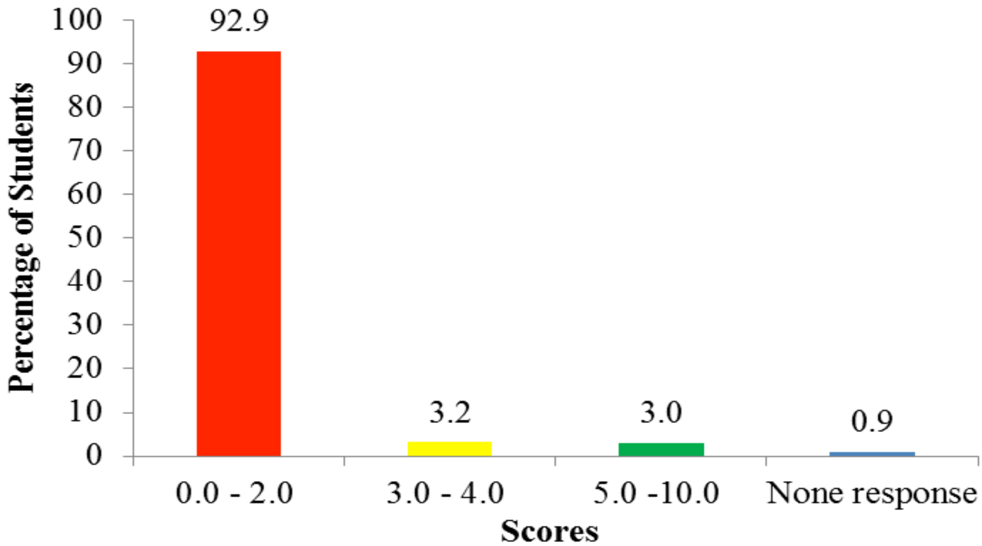



**Figure 5:** Percentage of students' performance per score.

The students who performed poorly had inadequate knowledge of the concepts of work, power and energy since they failed to provide the correct answers to most parts of the question. Some were able to give the correct answers to parts (a) (i) and (b) (i) but failed to give the correct answers to other parts of the question, while others failed completely to provide the answers to all parts.

On responding to part (a) (ii) students were supposed to use the formula *mgh* to find the initial energy of the ball and energy after impact, and then find the difference between the two energies which will give energy at the top of rebound. The energy at the top of rebound was supposed to be used to find the height on rebound. In part (b) (ii) students were supposed to recognize that when a pendulum bob swings, the potential energy is maximum at the maximum height and the kinetic energy at that point is minimum while the kinetic energy is maximum at minimum height and potential energy is minimum at that point. Extract 9.1 was sampled to illustrate the case.

**Extract 9.1**

9. (a) (i) Define potential energy.

Is the forste and dagrace and hotanss and Kotens of a body

(ii) A ball of mass 0.5kg is dropped from a height of 10m and on impact with the ground it loses 30J of energy. Calculate the height it reaches on the rebound.

Data given

Mass 0-5Kg
haight 10m
loses 30j

= 45 Kg

0-5 Kg
1 - 0
3 - 0 J
4 ·5 Kg

(b) (i) State the principle of conservation of energy.

Don't run in the laboratory
Don't taste in the laboratory
Don't Smoking in the laboratory
Don't substance the tast laboratory
Don't substance in the tast rom experiment

(ii) Briefly describe the energy changes when the bob of a simple pendulum swings from one side to another.

In Extract 9.1, the student failed to meet the demand of the question. He/she mentioned laboratory rules instead of stating the principle of conservation of energy.

On the contrary, few students who performed well had adequate knowledge of the subject matter as they were able to provide the correct answers to all parts of the question. Extract 9.2 was taken to illustrate the case.

**Extract 9.2**

9. (a) (i) Define potential energy.

Is the energy possesed by the body due to it's state of rest.

(ii) A ball of mass 0.5kg is dropped from a height of 10m and on impact with the ground it loses 30J of energy. Calculate the height it reaches on the rebound.

**Data Given**

Mass = 0.5kg

Height = 10m

Energy lost = 30J

Height reached = ?

P.E = mgh

= 0.5kg x 10N/kg x 10m

= 50Nm, 50J → before it loses

50J - 30J = 20J → After loosing

From P.E = mgh

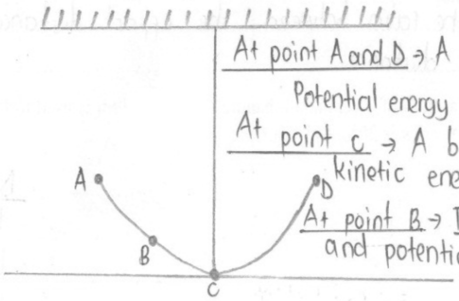
20J = 0.5kg x 10N/kg x h

$\frac{\cancel{20}^{4}\cancel{N}m}{\cancel{5}\cancel{N}} = \frac{\cancel{50}\cancel{N}h}{5\cancel{N}}$ h = 4m ∴ The height reached is 4m

(b) (i) State the principle of conservation of energy.

It states that "Energy can neither be created nor destroyed but it can be transformed for one form to another".

(ii) Briefly describe the energy changes when the bob of a simple pendulum swings from one side to another.




At point A and D → A bob posseses maximum Potential energy due to it's height.

At point C → A bob posseses maximum kinetic energy.

At point B → It posseses both kinetic and potential energies.

Extract 9.2 shows the work of a student who understood the concepts of work, energy and power and provided the correct answers to all parts of the question.

### 2.3.4 Question 10: Light

This question consisted of two parts, (a) and (b). In part (a) the students were required to (i) distinguish between a real and virtual image, (ii) calculate the number of images formed between two plane mirrors placed at

$60^0$. In part (b) (i), the students were required to list three applications of periscope in everyday life and (b) (ii), they were required to state two properties of the final image formed by a periscope.

About ninety eight percent (97.7%) of the students attempted this question. Out of these, 87.8 percent scored below 3 marks, of which, 77.1 percent scored 0. The data show that 6.8 percent of the students scored from 3 to 4 marks while 3.1 percent scored from 5 to 10 marks.

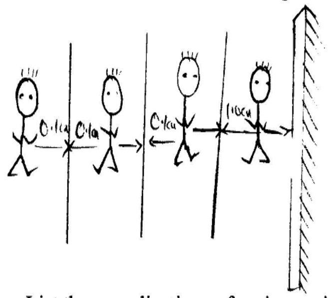
The majority of the students who performed poorly lacked the knowledge of the concept of light. They failed to distinguish between a real and a virtual image. Some of them had poor mathematical computation skills so they failed to interpret the given information to calculate the number of images formed by two plane mirrors placed at $60^0$. In order to get the correct answer, the students were expected to recall the formula $n = \frac{360^0}{\theta} - 1$. Other students failed to recall that a periscope in everyday life can be used in submarines to view targets or threats in the surrounding sea and air, and in the military to observe any potential danger, and it forms part of the modern telescopes used for magnifying distant objects, such as stars. Furthermore, they failed to state properties of the final image formed in a periscope because they failed to recognize that periscope uses plane mirrors in which the image formed is erect, virtual, and not laterally inverted and is of the same size as the object. This further indicates that, students had inadequate laboratory practices on real and virtual images. Extract 10.1 is a sample of poor responses.

**Extract 10.1**

10. (a) (i) Distinguish between a real and a virtual image.

Real image It ~~formed in~~ means that the image is not virtual while virtual image is formed in a plane mirror when an object it seemed to be real but in it is not real

(ii) Calculate the number of images formed between two plane mirrors placed at $60^0$.



The image formed is 4cm with the different virtual left-right virtual and right-left virtuals

(b) (i) List three applications of periscope in everyday life.

It is not up-side down

It is vertically straight

It is convergent bent

It is divergent way.

(ii) State two properties of the final image formed in a periscope.

It is up straight and show full image

In Extract 10.1, the student failed to distinguish between real and virtual image. Also he/she drew four images instead of using a formula $n = \frac{360^0}{\theta} - 1$ to calculate the number of images. Consequently, he/she failed to list applications of periscope in everyday life.

On other hand, few (3.1%) students who performed well had enough competences on the aspect of light, particularly on the images. They also demonstrated good mathematical computation skills. Extract 10.2 is a sample taken from the script of one of the students who performed well in this question.

**Extract 10.2**

10. (a) (i) Distinguish between a real and a virtual image.

Real image is the image formed infront of the screen while the virtual image is formed behind of the mirror

(ii) Calculate the number of images formed between two plane mirrors placed at $60^0$.

Soln.

From (n)number of images $= \frac{360}{\theta} - 1$

$\theta = 60^\circ$

$n = \frac{360}{60} - 1$

$n = 6 - 1$

$n = 5$

$\therefore$ Number of images $= 5$

(b) (i) List three applications of periscope in everyday life.

- It is used in submarines to see things over ahead.
- It is used to see things around the corner
- It is used in see above the heads of people in acrowd

(ii) State two properties of the final image formed in a periscope.

- The image is virtual
- The image size is usually equal to the object's size.

In Extract 10.1, the student was able to distinguish virtual and real images and correctly calculated the number of images. The student was also able to state the properties of final image formed in a periscope but missed some of the applications of periscope in daily life.

## 3.0 PERFORMANCE OF STUDENTS IN EACH TOPIC

The analysis of the students' performance in each topic shows that, the topic of Introduction to Laboratory Practice was good as it was performed well by 54.7 percent of the students. Likewise, the multiple choice question composed from various topics was also performed well by 79.8 percent of the students. On the other hand, 43.8 percent of the students had an average performance in the topic of Current electricity.

It was observed that the majority of the students' performance lied in the category of weak performance as the topics in Newton's laws of motion, (17%), Force and Measurement (15.9%), Structure and properties of matter, Magnetism and Light (15%), Simple machines (8.4%) and Work, Energy and Power (7.1%) were performed poorly. In connection to this, the question in Filling in blank spaces composed from various topics of Measurement, Motion in straight line, Temperature, Forces in equilibrium and Magnetism was also weakly performed by 17.2 percent of the students. See the details in appendix 1.

## 4.0 CONCLUSION AND RECOMMENDATIONS

### 4.1 Conclusion

The question-wise analysis of the students' performance in this report has highlighted the challenges faced by the students in attempting the questions. Besides, it provides the suggestions that can help to surmount the observed problems.

The questions tested in Physics paper were intended to assess the students' competences achieved and how well they were able to integrate them in attempting particular questions.

The analysis has revealed that the majority of the students (74.14%) failed the assessment while 25.86 percent passed. In appendix 1 the students' performance was analyzed into three categories, namely good, average and weak with green, yellow and red colours respectively. The poor performance was attributed to many factors such as: lack of knowledge on the subject matter and incompetence in using English Language hence failure in presenting the required answers. This was observed in questions 4, 5 and 10 which were set from the topics of Structure and Properties of Matter, Magnetism, Force and Measurement and Light.

In addition, some of the students lacked mathematical skills such that they failed to manipulate the data given to obtain the expected answers. Questions number 7, 8 and 9 which were extracted from the topics of Newton's Laws of Motion, Simple Machines and Work, Energy and Power illustrate this case. Question number 9 was poorly performed as compared to other questions. On the other hand, question number 2 derived from the topic of current Electricity was averagely performed while question 1 which covered Form One and Two topics as stipulated in Physics Syllabus and question number 6 were well performed by many students (See appendix 1).

The analysis also shows the average performance in percentage at the expense of grades attained by the students compared to the year 2014. The student's performance in Physics subject for Form Two National Assessment in the year 2015 was poor as only 25.8 percent scored grades from A to D. In the year 2014 the general performance was an average of

38.7 percent which indicates that there was a drop in performance in the year 2015 by 12.9 percent. This trends needs to be alleviated. Appendix 2 shows the difference in performance between the year 2014 and 2015.

It is expected that the feedback given in this Students' Items Response Analysis Report will be useful and valuable to students, teachers and other stakeholders to enhance the students' performance on FTNA Physics assessment in the future.

## 4.2 Recommendations to Students

The analysis has shown that a large number of students performed poorly, Therefore we recommended that the forthcoming students should:

(a) prepare themselves for the assessment so as to be able to answer the questions;

(b) put more efforts on acquiring mathematical skills so as to avoid problem arising due to lack of confidence in manipulating mathematical related questions;

(c) learn and understand the applications of various apparatus in daily life activities as stipulated in the syllabus; and

(d) attempt more practical work that will help to build up their skills and competence on the subject matter.

### 4.2.1 Recommendations to Teachers

In order to enhance the students' knowledge and skills that ultimately improve their performance, teachers are advised to:

(a) Encourage and assist students to make intensive preparations before the assessment;

(b) assign the students more practical work that enables them to attain skills and competence in basic apparatus/equipment used for measurement;

(c) encourage and guide students to solve Physics problems which enable them to achieve substantial skills of solving mathematical related questions;

(d) assign to students adequate tasks that are competence based. This will enable them to incorporate the applications of the acquired knowledge in daily life activities; and

(e) encourage the students to use English Language in their day to day communications so as to improve their language proficiency.

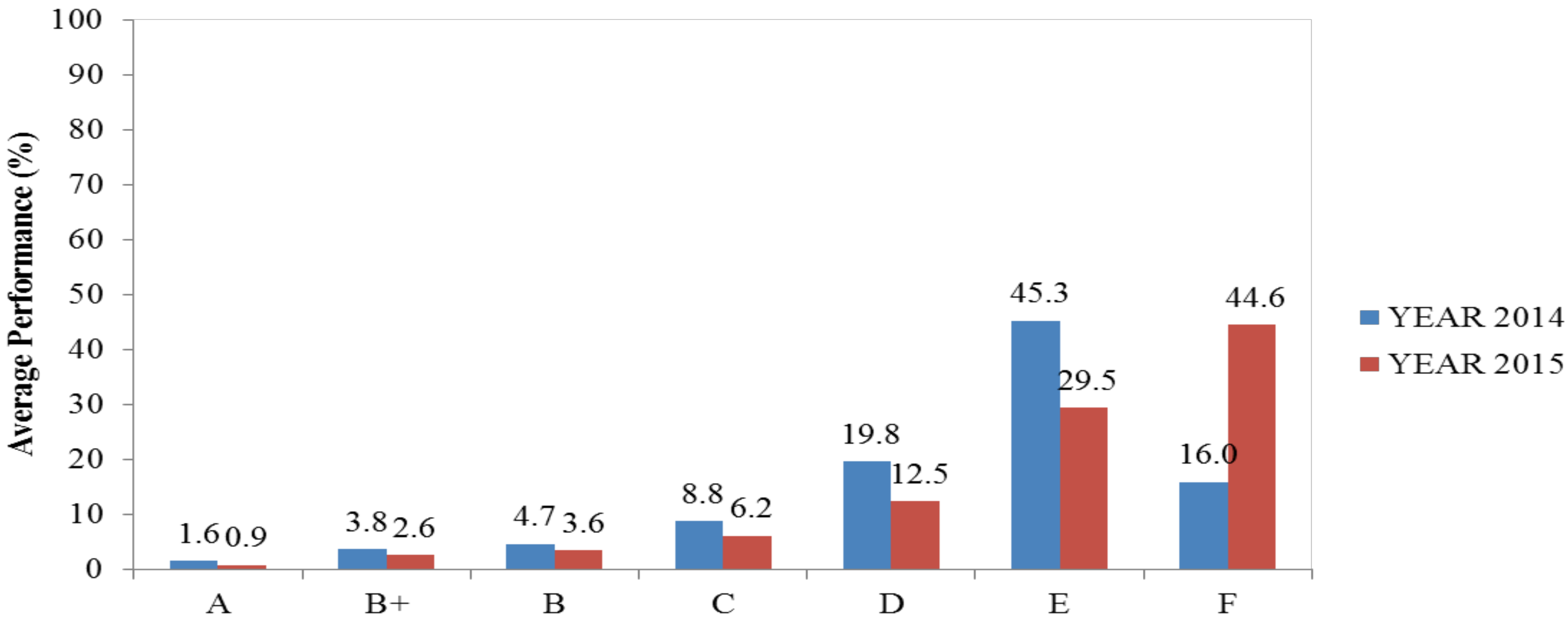
**Appendices**

**Appendix 1**

**THE PERFORMANCE OF STUDENTS IN PHYSICS IN EACH QUESTION IN 2015**

| S/n | Topic | Number of Question | The % of Students who scored an Average of 30% and Above | Remarks |
|---|---|---|---|---|
| 1 | Measurement, Work, Energy and Power, Motion in Straight line, Magnetism, Archimedes Principle Structure and Properties of Matter, Sustainable Energy Sources, Light, Static Electricity, Current Electricity, Pressure, Newton's laws of Motion, Simple Machines, Forces in equilibrium, Temperature and Force | 1 | 79.8 | Good |
| 2 | Introduction to Laboratory Practice | 6 | 54.7 | Good |
| 3 | Current Electricity | 2 | 43.8 | Average |
| 4 | Measurement, Motion in straight line, Temperature, Forces in Equilibrium and Magnetism. | 3 | 17.2 | Weak |
| 5 | Newton's laws of Motion | 7 | 17 | Weak |
| 6 | Force and Measurement | 5 | 15.9 | Weak |
| 7 | Structure and Properties of matter, Magnetism and Light | 4 | 15 | Weak |
| 8 | Light | 10 | 12.2 | Weak |
| 9 | Simple Machines | 8 | 8.4 | Weak |
| 10. | Work, Energy and Power | 9 | 7.1 | Weak |

**Appendix 2**




The difference in performance between 2014 and 2015