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

STUDENTS' ITEM RESPONSE ANALYSIS REPORT ON THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2021

MECHANICAL ENGINEERING

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090 MECHANICAL ENGINEERING

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FOREWORD

The Mechanical Engineering items responses analysis report on the students' performance in the Form Two National Assessment (FTNA) 2021 has been written in order to provide feedback to students, teachers, parents, policy makers and public in general on the performance of the students and challenges they faced in attempting questions.

The Form Two National Assessment marks the end of two years of ordinary level secondary education. It is a formative evaluation of which its effectiveness shows the achievement of education system in general and the education delivery system in particular. Essentially, the students' responses to the assessment question are foremost pointers of what the education system was able or unable to offer to the students in their two years of early stage of ordinary level secondary education.

The report highlights the factors that affected the students' performance in the questions. The feedback provided will help the educational administrators, school managers, teachers, students and other stakeholders to identify proper measures to be taken in order to improve the FTNA students' performance in the future assessment.

The Council would like to thank the examination officers and others who participated in analysing the data used in this report and writing the report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This performance analysis report for the 2021 Form Two National Assessment (FTNA) in Mechanical Engineering subject shows students' performance question-wise by identifying the students' strengths and weakness when attempting the questions. It analyses the items which were well performed, moderately and poorly performed.

Mechanical Engineering paper had ten (10) questions with three sections: A, B and C. Section A had two (2) questions in which question one (1) comprised ten (10) multiple choice items and question two (2) comprised five (5) matching items. Section B consisted of seven (7) short answer questions and section C had one (1) question. The students were required to answer all questions in all sections.

This report provides analysis of each question by giving an overview of what students were required to do, the general performance and possible reasons for their performance. Extract of good and poor students' responses are included in this report.

The number of students who sat for assessment in this subject were 451 of which 142 (31.49%) passed and 309 (68.51%) students failed. In 2020, the total of 272 students sat for the assessments in which 98 (36.03%) passed while the remaining 174 (63.97%) students failed. These results indicate that there is decrease of 4.54 per cent of the students who passed examinations in 2021 compared to 2020. Appendix V summarizes this performance.

The students' performance in this report is regarded as weak if the scores range from 0 to 29 marks, average if the scores range from 30 to 64 marks and good if the scores range from 65 to 100 marks. This performance is represented in Figures and Tables using colours whereby red, yellow and green colours are used for weak, average and good performance, respectively. Appendix II indicates overall performance of the students who sat for Mechanical Engineering assessment in 2021 (FTNA). Finally, the Appendix I indicates the performance in each question.

2.0 ANALYSIS OF THE STUDENTS' PERFOMANCE ON EACH QUESTION

2.1 Section A: Multiple Choice and Matching Items

Sections A had two (2) questions. Question one (1) comprised of ten (10) multiple choice items which carried a total of 10 marks and question two (2) comprised matching items which carried a total of 5 marks.

2.1.1 Question 1: Multiple Choice Items

The question comprised of ten (10) multiple choice items, each weighing one mark, thus making a total of 10 marks. The items were composed from topics of *Metal Work Technology, Mechanical Engineering Jobs and Occupations, Introduction to Science, Engineering and Technology, Workshop Management* and *Safety Rules* and *Engineering Materials*. The students were instructed to choose the correct answer from the four alternatives given for each item by writing its letter in the box provided besides the question.

The question was attempted by 451(100%) students. The statistics show that 5 (1.1%) students scored from 0 to 2 marks, 314 (69.6%) students scored from 3 to 6 marks and 132 (29.3%) scored from 7 to 10 marks. The performance of this question was average due to the fact that 446 (98.9%) students scored from 3 to 10 marks. This performance is summarised in Figure 1.

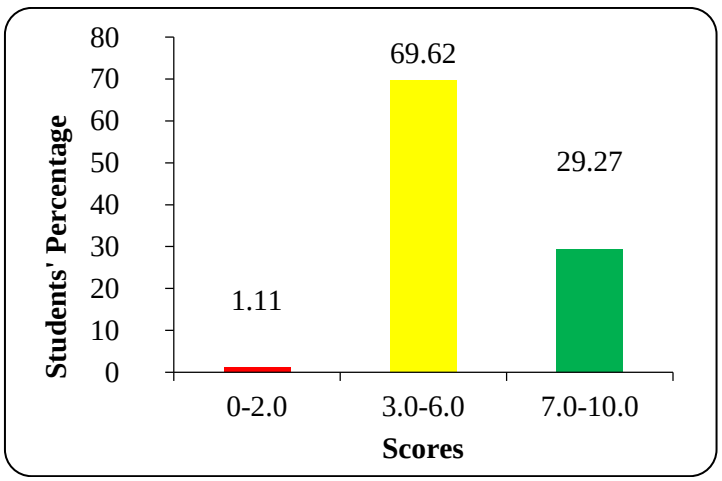


Figure 1: *Students Performance in Question 1*

In item (i), the question required the students to apply the knowledge of workshop tools used in Mechanical Engineering. The question was:

(i) Which type of filling technique should be used for a good surface finish of the metal product?

A Single cut filing and double cut filing.

B Cross filing and draw filing.

C Draw filing and double cut filing.

D Single cut filing and cross filing.

The correct response was *B Cross filing and draw filing.* This opted by the students who had knowledge of workshop tools used in Mechanical Engineering and had clear understanding on file profile, tools used for filling and techniques used for surface finishing. Those who chose alternatives *A, C,* and *D* did not understand that double cut filling and single cut filling are the profiles of a file which are used for filling process and not the technique used for good surface finishing. Therefore, the students overlooked the distracters and mixed up the techniques for good surface finishing and profile of file.

Item (ii) tested students' ability to understand material handling procedures. The question was:

(ii) Which of the following is an unsafe working habit that you should observe during material handling?

A Caring of too heavy load and tuck your chin in

B Gasping of the load firmly to the body and lifting

C Handling with leather sleeves and carrying too heavy load

D Wearing of PPE and lifting improperly the load

The correct response was D *Wearing of PPE and lifting improperly the load*. Most of students managed to match correctly because wearing of PPE is a safe working habit but improper lifting of load is not safe working habit. Hence wearing of PPE and lifting improperly the load leads them to choose D as correct answer. The students who chose B *gasping of the load firmly to the body and lifting* C *Handling with leather sleeves and carrying too heavy load* were wrong because these are the safe working habit during handling of material due to the application of proper tools and clothes in lifting and carrying loads.

Item (iii) tested student's knowledge on mechanical engineering jobs and occupations. The question was:

(iii) How is the trained person having the ability to make technical drawings and write reports called?

A An Engineer
B A Technician
C A craft person
D An artisan

The correct response was A *an Engineer.* The students who had knowledge on Mechanical Engineering Jobs and Occupations were able to choose correct response. The students had an ability to differentiate the duties and responsibilities of mechanical engineering personnel. Students who chose distracters B, C and D had insufficient knowledge on different qualifications of Mechanical Engineering Jobs and Occupations. They did not understand that *a technician* is a worker in a field of technology who is proficient in the relevant skill and technique, with a relatively practical understanding of the theoretical principles; they attained the skills from training technical college within three years after the accomplishment of Ordinary level. They also did not know a *craft person* is a person having a skill learned from trade or industry and an *artisan* is a trained person who learned at school to perform maintenance and repair of machines or equipment depending on the area of specialization; they get skills from vocational training centres. Based on the level of education *a technician, a Craft person* and *an artisan* cannot produce technical drawings and writing reports.

In item (iv), the students were required to use the knowledge of Introduction to Science, Engineering and Technology in determining the relationship between Science, Technology, Engineering and Mechanical Engineering. The question was:

(iv) What is the term used to describe the professional of applying the scientific principles in designing, developing and producing components?

A Science
B Technical
C Engineering
D Mechanical

The correct response was *C Engineering.* The students who had knowledge of Introduction to Science, Engineering and Technology were able to determine the relationship between Science, Technology, Engineering and

Mechanical Engineering, hence they chose the correct response. The students who chose response A *Science* did not understand that science deals with the study of the physical world around us and is mostly theoretical hence science does not handle designing. Those who chose B *Technical* did not understand that Technical education does not involve designing but developing and producing components and those who chose D *Mechanical* failed to understand that Mechanical engineering is a branch of engineering. The students who chose incorrect answers had insufficient knowledge on Introduction to Science, Engineering and Technology, specifically in determining different duties and responsibilities of mechanical engineering personnel with other engineering personnel.

Item (v), was developed from the topic of workshop management and safety rules. The question was:

(v) Everyone working in the workshop is advised to put on PPEs when executing his/her job. What does PPE's stand for?

A Personal Production Equipment
B Personal Preventive Equipment
C Personal Protective Equipment
D Personal Permissible Equipment

The correct response was *C Personal Protective Equipment*. The students who chose the correct answer had an adequate knowledge on workshop rules and safety. On other hand, the students who chose response A, B and D did not understand that PPEs are equipment used to protect the users against health or safety risks at work. This proves that these students were not aware of the workshop rules and safety.

Item (vi) was set from the topic of Engineering Materials. It aimed to measure student's understanding of various properties of engineering materials. The question was:

(vi) Most of machine case and complicated heavy weights machine base are made with cast iron. Which property makes this type of iron materials most preferable to be used?

A Machinability
B Malleability
C Fluidity
D Workability

The correct response was *C Fluidity*. The students who chose incorrect answers did not understand that *Machinability* is the ease in which the metal can be machined and *Malleability* is the ability of the metal to be shaped into something else without breaking. Furthermore, the students did not understand that cast iron is not malleable and it cannot be machined and that C *workability* is the ability of the metal to be changed into a new shape. These students lacked knowledge on engineering materials, specifically on properties of material. Hence, fluidity of cast iron is the most preferable property in most machine case and heavy weight machine base.

In item (vii) the students were tested on their knowledge of Engineering Materials. The question aimed to measure students understanding on production of engineering materials. The question was:

(vii) During working process of selecting a steel material for a certain job, it was observed that the material has higher amount of residue and coercive magnetic force. Which element causes the steel used to have this property?

A Chromium
B Vanadium
C Manganese
D Cobalt

The correct response was *D Cobalt*. The students who chose cobalt were correct since it has unpaired electrons in the valence orbital which act as magnetic dipoles, hence it has a magnetic substance. Those who chose A, B and C did not understand that *Chromium, Vanadium and Manganese* are non-magnetic materials which cannot be magnetized. These students had insufficient knowledge on production of Engineering Materials.

Item (viii) was set from the topic of Workshop Management and Safety Rules. The question intended to measure the knowledge and understanding on Workshop Management and Safety rules. The question was:

(viii) Which type of fire extinguishers would you use to extinguish the fire resulted from electrical fault in the school workshop?

A Dry powder, foam and water
B Carbon dioxide, dry powder and sand
C Carbon dioxide, foam and water
D Carbon dioxide, water and sand

The correct response was *B Carbon dioxide, dry powder and sand*. The students who chose correct answer had a clear understanding of the workshop safety rules which lead them to determine different categories of fire and fire extinguisher. Those who chose *A, C or D* failed to identify the suitable fire extinguisher to be used to extinguish the fire that resulted from electrical fault in school workshop. They did not understand that *foam and water* are good conductors of electricity. Hence using them as fire extinguishers will result to electrocution.

Item (ix) was derived from the topic of Metal Work Technology. The question instructed students to identify the function of oxygen gas in Oxyacetylene flame. The question was:

(ix) Oxy-acetylene flame is obtained after mixing oxygen gas with acetylene gas. What is the function of oxygen gas in that flame?

A To burn the acetylene gas

B To reduce smoke during burning

C To support combustion

D To reduce flame intensity

The correct response was *C to support combustion.* The students who chose the correct response had a clear understanding of gas welding as they were able to recall the functions of oxygen in oxy-acetylene flame. The students who chose A *to burn the acetylene* did not know that mixing acetylene gas and oxygen gas results to oxy-acetylene flame hence oxygen gas cannot burn acetylene gas. The students who chose B *to reduce smoke during burning* did not understand that the cylinders are fixed with a regulator which is used to reduce the smoke during burning by changing the ratio of oxygen and acetylene. Those who chose D *to reduce flame intensity* were not aware that the oxy-acetylene cylinders incorporated with blowpipe are designed to accommodate different sizes of nozzles which allow the correct intensity of flame. This proved that, the students who chose distracters lacked enough knowledge on gas welding.

Item (x) was developed from the topic of Engineering Materials. The students were instructed to identify the behaviour of filing on metals of different properties. The question tested the student's knowledge on the engineering material properties. The question was:

(x) *A mechanist was performing a filing on metal work pieces A and B. The result shows that work piece A causes much pinning to the file than work piece B. What conclusion can you draw from that observation?*

A Work piece A is harder than work piece B

B Work piece A is stronger than work piece B

C Work piece A is soft than work piece B

D Work piece A is tough than work piece B

The correct response was *C Work piece A is soft than work piece B.* The students who chose correct answer had enough knowledge on different properties of engineering material. Those who chose A, B and D failed to identify the behaviour of filing on metals of different properties. They did not understand that *hardness, strength and toughness* of a metal work piece are good properties of material for filling processes in workshop. This implies that the students had insufficient skills and knowledge on determining different properties of engineering materials.

2.1.2 Question 2: Matching Items

The question consisted of five (5) items (i) to (v) which were set from the topic of Engineering Materials. The students were required to match the properties of engineering materials in List A with the type of material in List B by writing a letter of the correct response to the corresponding item number. The question was attempted by 451 (100%) students, of whom 170 (37.7%) students scored from 0 to 1 mark, 205 (45.5%) scored from 2 to 3 marks and 76 (16.9%) scored from 4 to 5 marks. Generally, the performance for this question was average considering that 281 (62.4%) students scored from 2 to 5 marks. Figure 2 represents this performance.

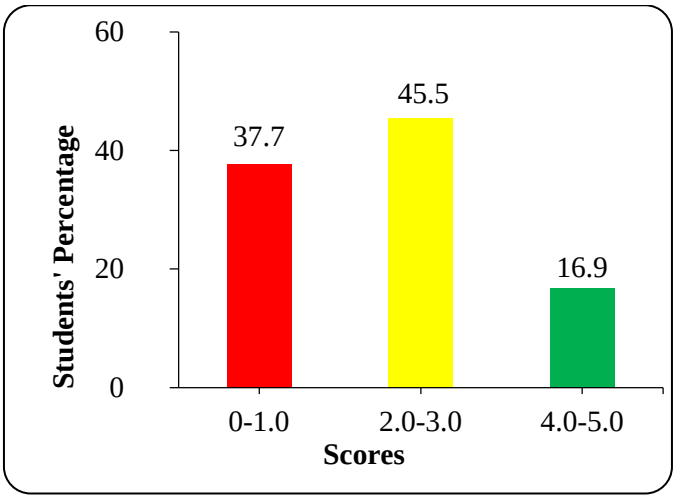


Figure 2: *Students' Performance in Question 2*

The question tested the student's ability to identify the properties of Engineering Materials. The items were:

(i) It is an alloy of copper and zinc which contain small amount of lead, tin or aluminium.

The correct response was D *Brass.* The students who managed to match correctly had clear understanding of engineering material particularly on introduction of metals and non-metals. However, few students matched the item incorrectly with G *Bronze*, these students failed to differentiate bronze from brass whereby bronze is an alloy of copper (88%) which contain small amount of tin (12%) and brass is an alloy of both copper and zinc with small amount of lead, tin or aluminium.

(ii) It is an aluminium alloy. The correct response is H *Duralumin.* Most of students matched correctly this item. On other hand, few students matched it incorrectly with B *Non-ferrous alloy*. These students did not understand that aluminium alloy contain different metals in which aluminium is predominant metal while non-ferrous alloy are the metals which do not contain iron. Hence aluminium alloy cannot match with non-ferrous alloy.

(iii) It has higher ability to resist corrosion. The correct response is E *non-ferrous metal.* Only few students matched correctly this item because they understood that, *non-ferrous metal* are the metals which does not contain iron hence they have higher ability to resist corrosion. The students who matched incorrectly with B *non ferrous alloy*, D *Brass*, G *Bronze* and H *Duralumin* did not understand that, these materials cannot resist

corrosion because they contain iron. Hence these students did not understand the demand of the question to match with the one with highest ability to resist corrosion which was non-ferrous metal. Few students who selected incorrect answers C and D which are *High carbon steel* and *Medium carbon steel* respectively indicates they had insufficient knowledge on the properties of engineering materials because any carbon steel provides poor resistance to corrosion unless it is has a protective coating.

(iv) It is steel with carbon percentage from 0.8 to 1.5. The correct response is C *High carbon steel.*
Most of the students failed to choose the correct response because they confused it with medium carbon steel. This is because the student did not understand the categories of carbon steel and the percentages of carbon present in each category.

(V) It is an alloy of copper and tin. The correct response is G *bronze.*

The students who wrote the correct answer had knowledge on the topic of Engineering Materials. The students who matched incorrectly with D *Brass* failed to differentiate bronze from brass. They did not understand that, brass is an alloy of copper, tin and other elements while bronze is an alloy of copper and tin only.

2.2 Section B: Short Answers Questions

Section B had seven (7) questions which were set from the topics of *Mechanical Engineering Job and Occupations, Workshop Management and Safety Rules, Workshop Tools and Equipment, Engineering Materials* and *Metal Work Technology*. Students were instructed to answer all questions. Each question carried 10 marks, making a total of 70 marks.

2.2.1 Question 3: Workshop Tools and Equipment

This question had two parts, (a) and (b). In part (a), the students were instructed to identify three (3) measuring and checking tools used in daily workshop activities. In part (b), the students were required to identify seven (7) marking out equipment used in the workshop.

A total of 451(100%) students attempted this question, whereby 197 (43.7%) students scored from 0 to 2.5 marks. Moreover, 210 (46.5%) students scored from 3.0 to 6.0 marks and 44 (9.8%) scored from 6.5 to 10 marks. Figure 3 summaries this performance

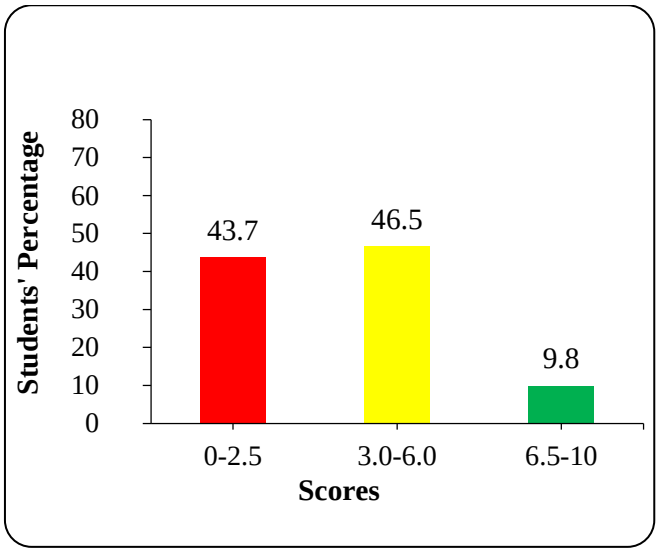
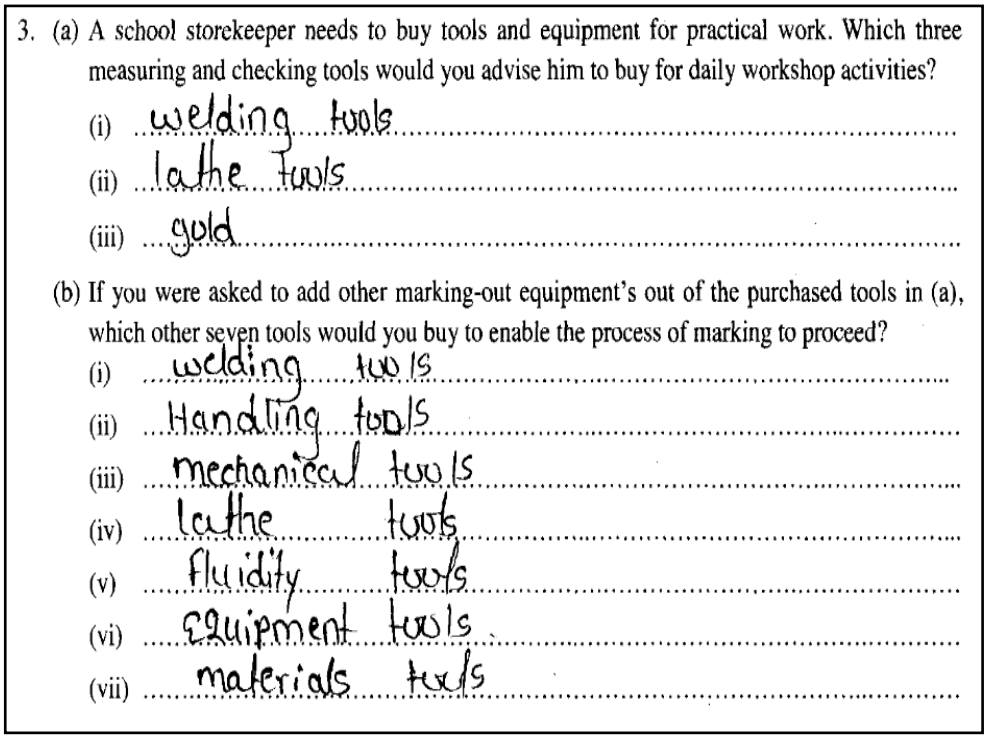


Figure 3: *Students' Performance in Question 3*

General performance in this question was average because 254 (56.4%) students scored from 3.0 to 10 marks.

In this question, the students were required to apply the knowledge on Workshop Tools and Equipment to meet the requirement of the question. The 43.7 per cent of the students who scored low marks managed to provide one to two points out of three required measuring, checking and marking tools. This is due to lack of adequate skills of using workshop tools and equipment. Some of the students who scored zero mark, failed to understand the requirement of the question and others had insufficient knowledge and skills on workshop tools and equipment. For example, in part (a) and part (b) one student wrote incorrect answers such as *cutting tools, machine tools and purchased tools*. This student did not understand that measuring, checking and marking tools are the groups of tools used in different workshop activities. Hence, he/she listed the similar points in answering part (a) and (b). However cutting tools and machine tools are the other groups of tools used in different workshop activities. Extract 3.1 is a sample of poor responses from the student's script.


3. (a) A school storekeeper needs to buy tools and equipment for practical work. Which three measuring and checking tools would you advise him to buy for daily workshop activities?

(i) welding tools

(ii) lathe Tools

(iii) gold

(b) If you were asked to add other marking-out equipment's out of the purchased tools in (a), which other seven tools would you buy to enable the process of marking to proceed?

(i) welding tools

(ii) Handling tools

(iii) mechanical tools

(iv) lathe tools

(v) fluidity tools

(vi) equipment tools

(vii) materials tools

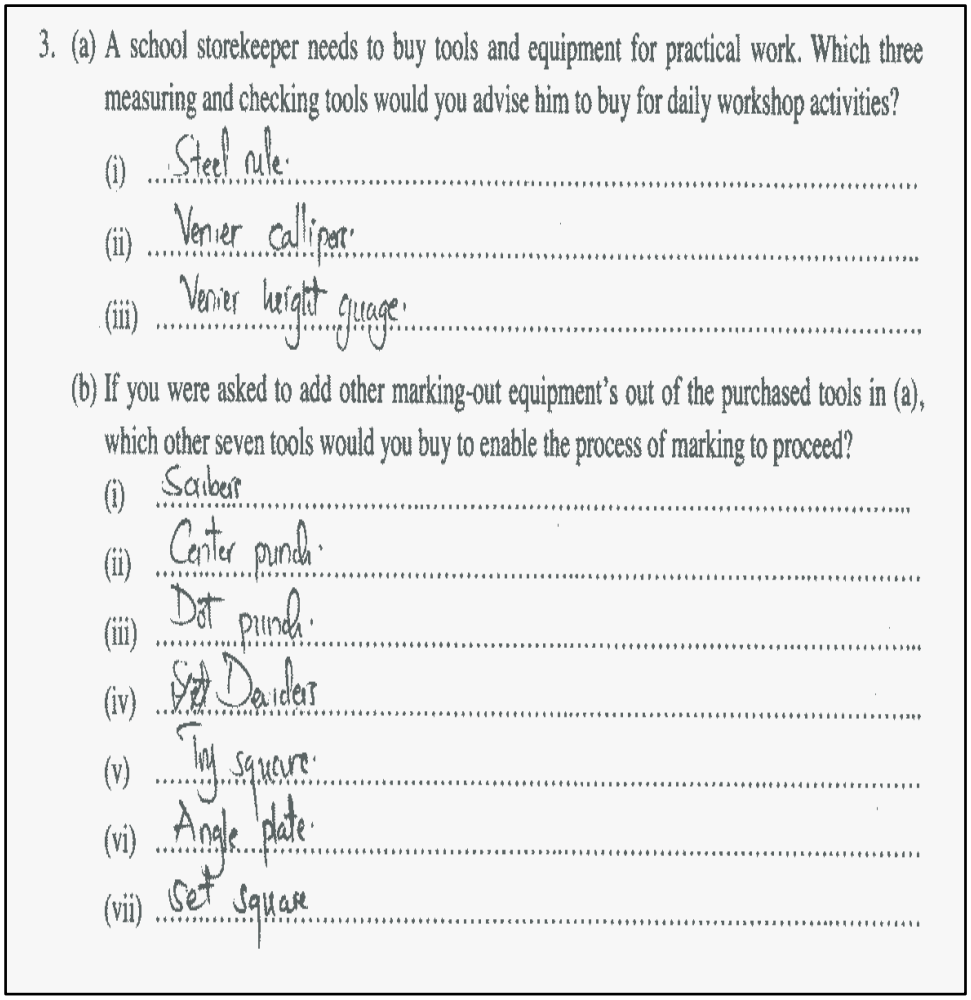
Extract 3.1: *A sample of a student's poor response in Question 3*

In Extract 3.1 the student wrote irrelevant answers. In part (a) he/she listed *welding tools* and *lathe tools*. This student did not understand that *welding tools* are the tools used during welding and *lathe tools* are the tools used in lathe machine to cut the metal and form a final symmetrical part or component. In part (b), the student repeated points listed in part (a) and added other irrelevant answers such as *mechanical tools*, *fluidity tools*, *equipment tools* and *material tools*.

On the other hand, students (46.5%) with average performance partially understood the requirements of the question and the subject matter tested. The students under this group managed to identify three to six points out of seven required in measuring, checking and marking-out tools. For example, one student who scored 3 marks listed one correct response in part (a) *tape measure* but the other points were incorrect such as *pair of divider*. He/she did not understand that pair of divider is the tool used for marking processes and not for measuring or checking out tool. Also in part (b) the student managed to provide two correct points such as punches, set square and but also provided other incorrect tools for measuring and checking, such as *vernier calliper*, *meter rule* and some were the correct answers for

part (a). This student managed to identify workshop tools but lacked the skills on application of these tools in different workshop activities.

However, 9.8% of the students had good performance, most of whom were familiar with workshop tools and equipment. Therefore, they were able to apply the knowledge and skills in answering the question. Extract 3.2 is a sample of good responses from the script of one of the students.


3. (a) A school storekeeper needs to buy tools and equipment for practical work. Which three measuring and checking tools would you advise him to buy for daily workshop activities?

(i) Steel rule.

(ii) Vernier calliper.

(iii) Vernier height guage.

(b) If you were asked to add other marking-out equipment's out of the purchased tools in (a), which other seven tools would you buy to enable the process of marking to proceed?

(i) Scriber

(ii) Center punch.

(iii) Dot punch.

(iv) Set Dividers

(v) Try squere.

(vi) Angle plate.

(vii) Set square

Extract 3.2: *A sample of a student's good response in Question 3*

In Extract 3.2, the student managed to apply the knowledge of workshop tools to identify the measuring, checking and marking tools as per demand of the question.

2.2.2 Question 4: Metal Work Technology

This question had two parts, (a) and (b). In part (a), the students were required to describe and give examples of fusion and non-fusion welding processes used to join metals. In part (b), the students were required to explain briefly five procedures to be followed in order to shut down a gas welding plant. Part (a) and (b) carried a total of 10 marks of which each part was worth 5 marks.

The question was attempted by 451 students of whom 387 (85.8%) scored from 0 to 2.5 marks. Moreover, 62 (13.8%) scored from 3.0 to 6.0 marks and 2 (0.4%) scored from 6.5 to 9.0 marks. Figure 4 summaries this performance

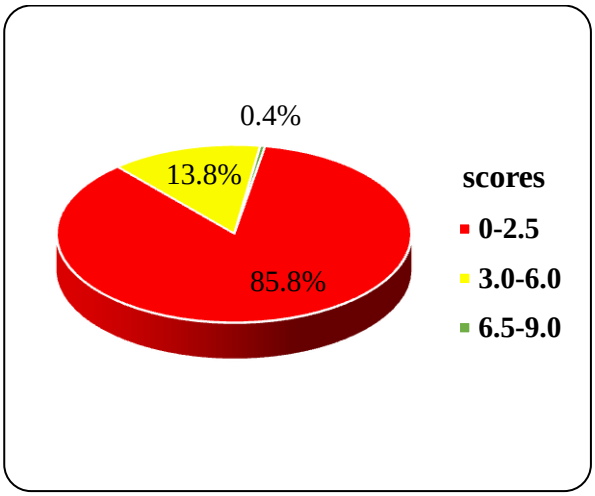
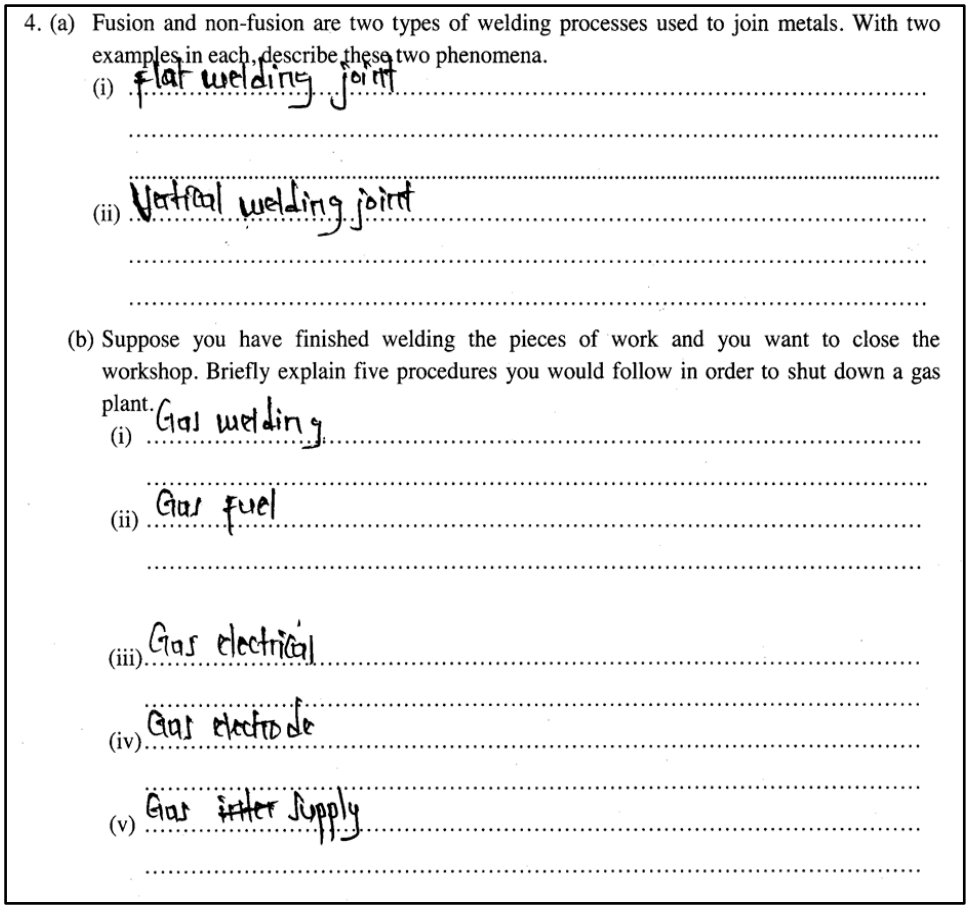


Figure 4: *Students' Performance in Question 4*

General performance in this question was weak because 387 (85.8%) students scored below average.

The analysis indicates that 85.8% of the students who scored low marks in this question failed to describe fusion and non-fusion welding phenomena and gave incorrect examples of the two types of welding processes. Some wrote wrong explanations such as *fusion is the type of welding that adds flux in the process of welding* and *non-fusion is the type of welding that do not flux in process of welding*. Other students failed to explain but managed to give correct examples of fusion welding which were *arc welding and gas welding*. This indicates that the students' poor performance was associated with misunderstanding of the requirement of the question.

Further analysis indicates that, most of the students had insufficient knowledge and skills on metal work technology based on welding. As a result, they provided incorrect answers. Extract 4.1 is a sample of poor responses from the script of one of the students.


4. (a) Fusion and non-fusion are two types of welding processes used to join metals. With two examples in each, describe these two phenomena.

(i) flat welding joint

(ii) Vertical welding joint

(b) Suppose you have finished welding the pieces of work and you want to close the workshop. Briefly explain five procedures you would follow in order to shut down a gas plant.

(i) Gas welding

(ii) Gas fuel

(iii) Gas electrical

(iv) Gas electrode

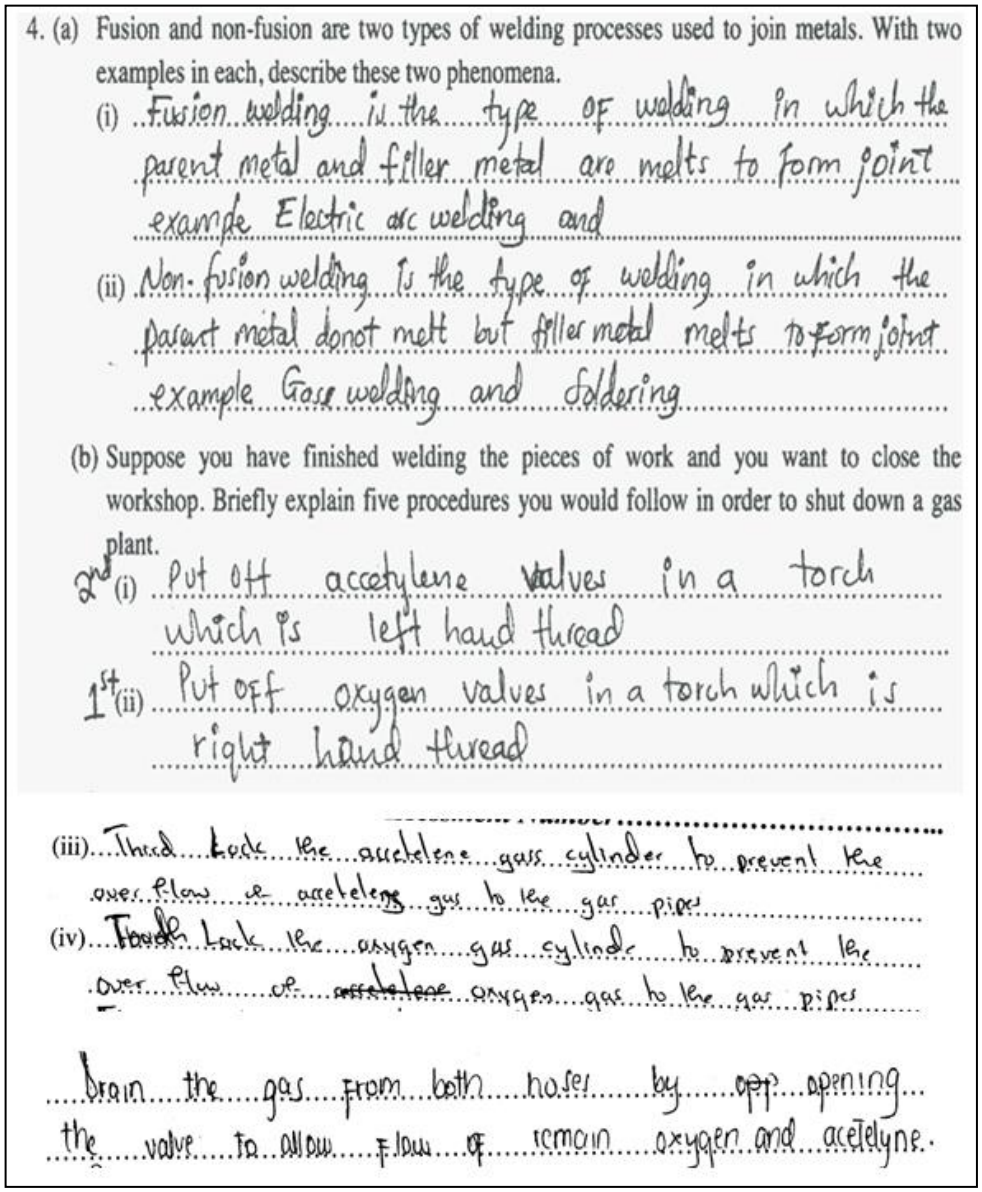
(v) Gas ~~inter~~ supply

Extract 4.1: *A sample of a student's poor response in Question 4*

In Extract 4.1 the student wrote two incorrect welding processes in part (a) such as *flat welding joint* and *vertical welding joint*. In part (b) he/she wrote wrong procedures for shut down welding plant such as *gas welding, gas electrical, gas electrical, gas supply* and *gas fuel*.

On the other hand, 13.8% of the students who had average performance managed to describe correctly fusion and non-fusion welding phenomena. They also, explained one to three procedures to be followed when shutting down a gas welding plant. These students had a partial understanding of the requirements of the question and the subject matter tested but failed to recall all procedures for shutting down gas welding plant.

However, very few students (0.4%) with good performance in part (a) managed to describe clearly the two phenomena and provided one or two examples in each. They also managed to explain five procedures for shutting down gas plant. These students had adequate knowledge on gas welding and clear understanding of the demand of the question. Extract 4.2 is a sample of good responses from the script of one of the students.


4. (a) Fusion and non-fusion are two types of welding processes used to join metals. With two examples in each, describe these two phenomena.

(i) Fusion welding is the type of welding in which the parent metal and filler metal are melts to form joint example Electric arc welding and

(ii) Non-fusion welding is the type of welding in which the parent metal donot melt but filler metal melts to form joint example Gass welding and soldering

(b) Suppose you have finished welding the pieces of work and you want to close the workshop. Briefly explain five procedures you would follow in order to shut down a gas plant.

2nd (i) Put off accetylene valves in a torch which is left hand thread

1st (ii) Put off oxygen valves in a torch which is right hand thread

(iii) Third Lock the acetelene gass cylinder to prevent the over flow of acetelene gas to the gas pipes

(iv) Fourth Lock the oxygen gas cylinde to prevent the over flow of ~~acetelene~~ oxygen gas to the gas pipes

Drain the gas from both hoses by opp opening the valve to allow flow of remain oxygen and acetelyne.

Extract 4.2: *A sample of a student's good response in Question 5*

Extract 4.2 shows that the student managed to provide a precise explanation and examples of two phenomenon and procedures for shutting down a gas

plant. However this student failed to score all the 10 marks because he/she provided one example of fusion welding instead of two required examples.

2.2.3 Question 5: Engineering Materials

This question had two parts, (a) and (b). In part (a), the students were instructed to describe the five main properties of bronze materials that differentiate it from other non-ferrous metals. In part (b), the students were required to outline five main applications of non-ferrous metals and their alloys. Each part carries a total of 5 marks which makes a total of 10 marks.

The question was attempted by 451(100%) students, of whom 329 (72.9%) students scored from 0 to 2.5 marks. Moreover, 99 (22%) students scored from 3.0 to 6.0 marks and 23 (5.1%) scored from 7.0 to 9.0 marks. Figure 5.1 summarizes this performance

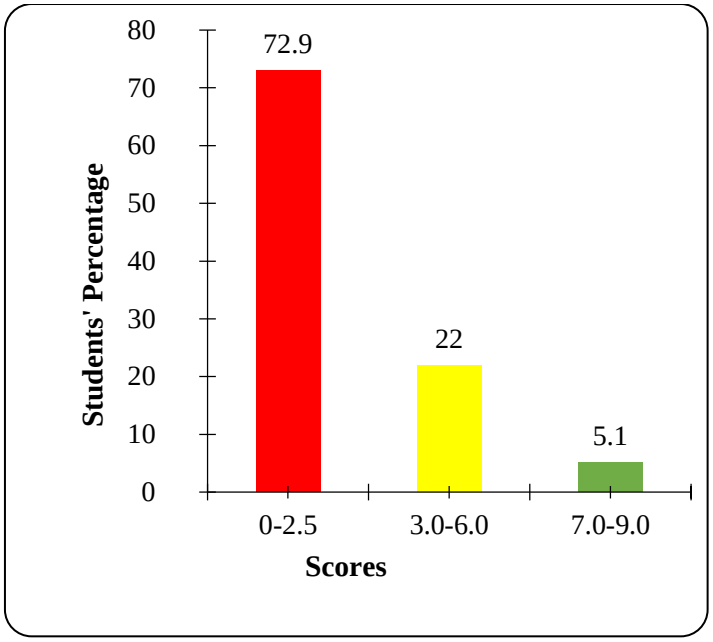
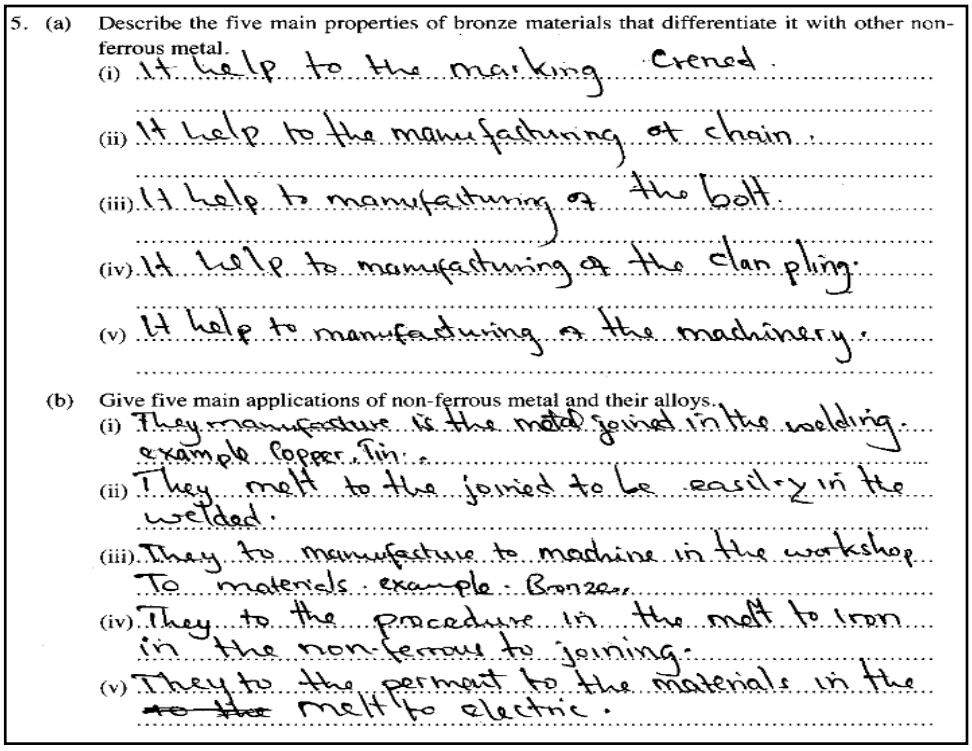


Figure 5: *Students' Performance in Question 5*

In general, the performance in this question was weak because 329 (72.9%) students performed below average.

The analysis shows that the students (72.9%) with weak performance did not understand the demand of the question and also lacked knowledge on engineering materials which leads them to provide irrelevant answers. For example, one of the students, instead of giving main applications of non

ferrous metal and their alloys, he/she copied words from question 1 such as *single cut filing and double cut filing, draw filing and double cut filing and person production equipment.* These were distracters from question 1 (i), (ii) and (v). Some provided properties which were not related with bronze material. This is due to their insufficient knowledge on the properties of different materials in engineering, hence they failed to provide the correct properties of bronze which differentiate it from other non-ferrous metals. Others provided one to two correct answers out of the five required by the question. For example the student wrote *used in conducting electricity* and added the other point which was opposite to the provided answer *bad conductor of electricity*. This proves that the student lacked adequate knowledge on application of ferrous metals which led them in gassing by knowing that one of the two points must be a correct answer. Extract 5.1 is a sample responses from the script of a student who had poor performance.



5. (a) Describe the five main properties of bronze materials that differentiate it with other non-ferrous metal.

(i) It help to the marking crened.

(ii) It help to the manufathuring of chain.

(iii) It help to manufathuring of the bolt.

(iv) It help to manufathuring of the clan pling.

(v) It help to manufathuring of the machinery.

(b) Give five main applications of non-ferrous metal and their alloys.

(i) They manufacture is the metal joined in the welding. example copper. Tin.

(ii) They melt to the joried to be easily in the welded.

(iii) They to manufacture to machine in the workshop To materials example: Bronze.

(iv) They to the procedure in the melt to iron in the non-ferrous to joining.

(v) They to the permant to the materials in the ~~to the~~ melt to electric.

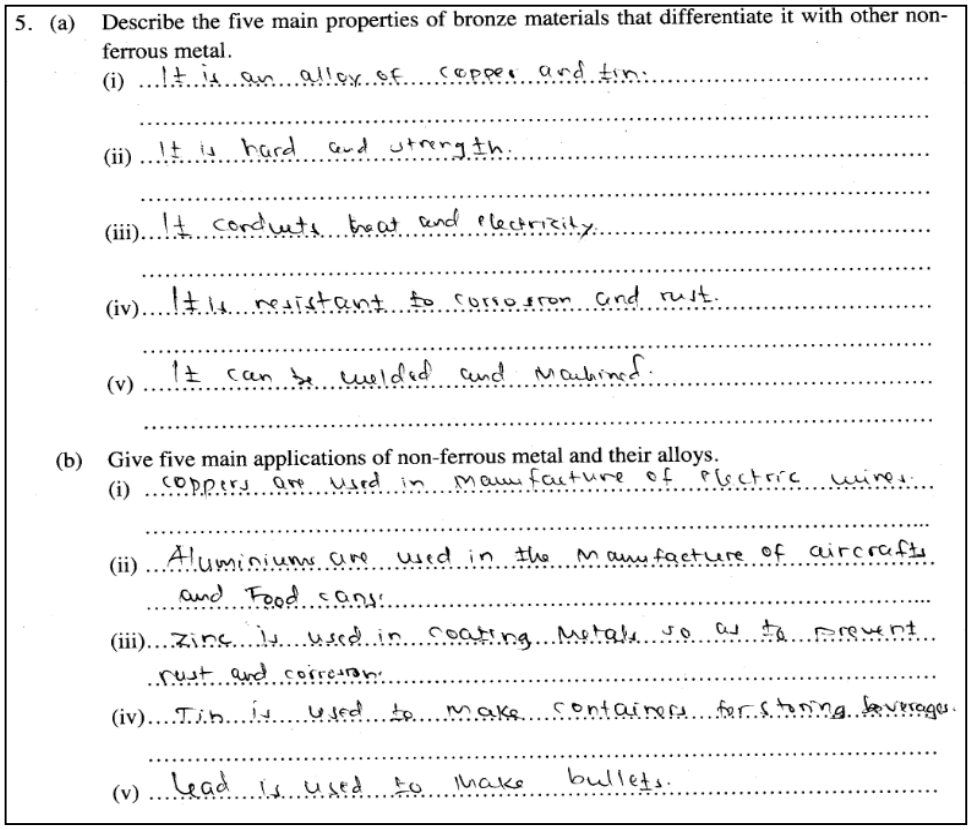
Extract 5.1: *A sample of a student's poor responses in Question 5*

Extract 5.1 in part (a) the student wrote incorrect answers by listing the applications of bronze material such as *it help to the manufacturing of chain* instead of providing main properties of bronze. In part (b) he/she wrote unrecognized answers such as *they melt to the joined to be easily in*

the welded instead of providing main applications of non-ferrous metals and its alloy.

On other hand, 22% of the students with average performance managed to write one to two properties of bronze out of five points and one to two applications of non-ferrous metals and their alloys out of five points. These students understood the demand of the question but had insufficient knowledge on engineering material.

However, quite few students (5.1%) who scored from 7.0 to 9.0 marks explained clearly the properties of bronze and applications of non-ferrous metals and its alloys. These students had an adequate knowledge on engineering materials and clear understanding on the demand of the question. Extract 5.2 is a sample of responses from the script of a student who had good performance.


5. (a) Describe the five main properties of bronze materials that differentiate it with other non-ferrous metal.

(i) It is an alloy of copper and tin.

(ii) It is hard and strength.

(iii) It conduts heat and electricity.

(iv) It is resistant to corrosion and rust.

(v) It can be welded and machined.

(b) Give five main applications of non-ferrous metal and their alloys.

(i) coppers are used in manufacture of electric wires.

(ii) Aluminiums are used in the manufacture of aircrafts and food cans.

(iii) zinc is used in coating metals so as to prevent rust and corrosion.

(iv) Tin is used to make containers for storing beverages.

(v) Lead is used to make bullets.

Extract 5.2: *A sample of a student's good responses in Question 5*

In Extract 5.2 the student wrote four correct properties of bronze and precise five applications of non-ferrous metals and their alloy. Nonetheless this student failed to score all 10 marks because in part (a) he/she wrote

bronze it is an alloy of copper and tin instead giving clarifications on the effects of copper and tin in bronze material.

2.2.4 Question 6: Workshop Tools and Equipment

This question had three parts, (a), (b) and (c). In part (a), the students were instructed to draw a neat sketch of a twist drill bit and label the tang, neck, flute and the angle of cut. In part (b), the students were required to describe the two criteria which makes a drill bit differ to a reamer. In part (c), the students were required to describe three functions of reamer and drill bit flutes. Part (a), (b) and (c) carried a total of 4, 3 and 3 marks respectively, which makes a total of 10 marks.

The question was attempted by 451(100%) students, whereby 368 (81.6%) students scored from 0 to 2.5 marks. Moreover, 68 (15.1%) students scored from 3.0 to 6.0 marks and 15 (3.3%) students scored from 6.5 to 10 marks. Figure 6 summarize this performance.

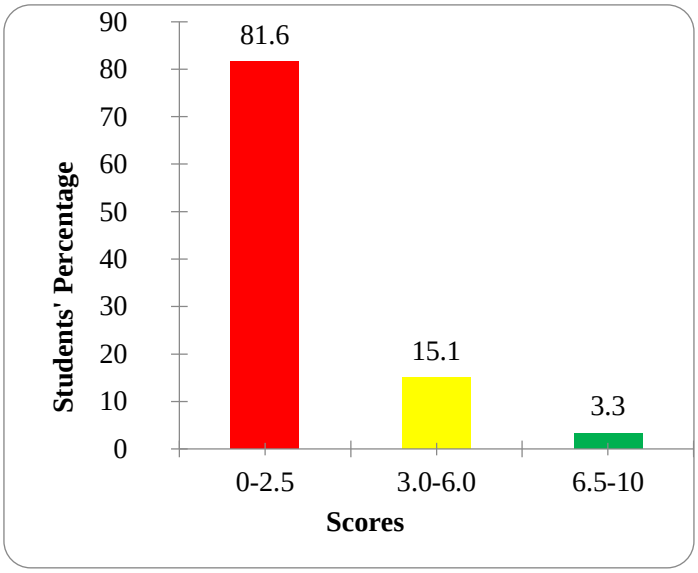
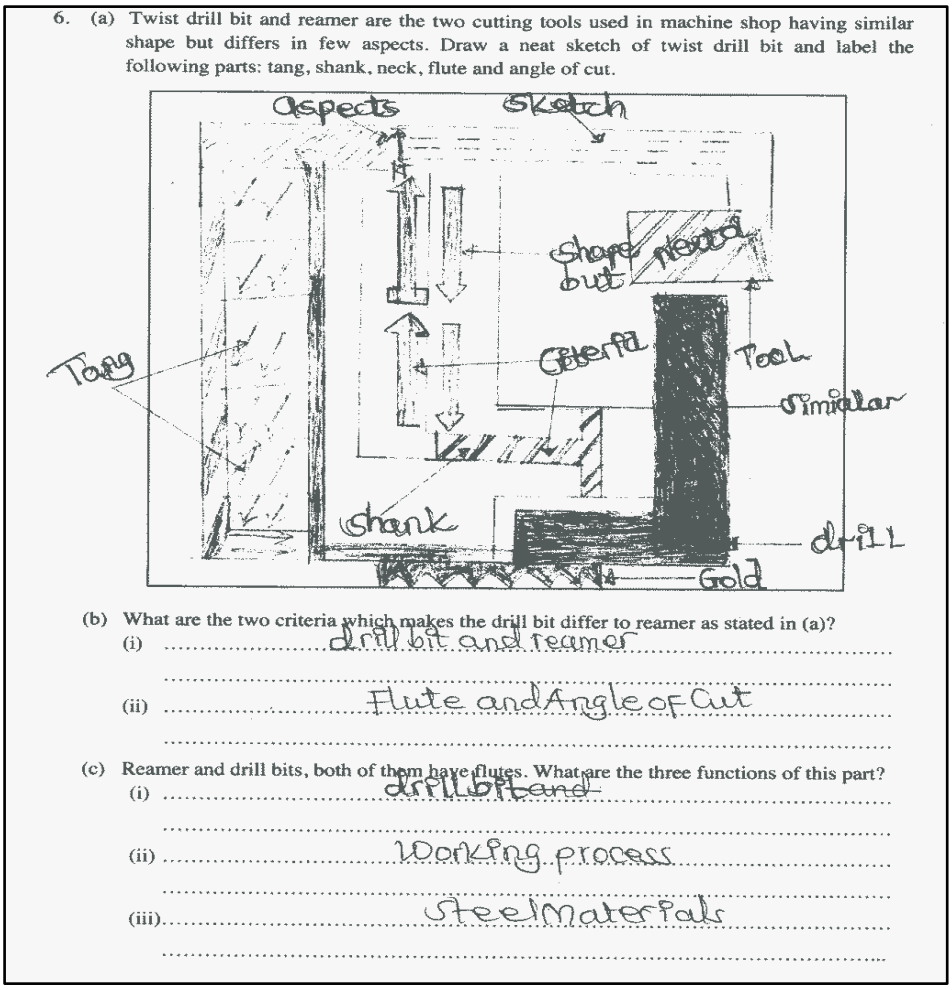


Figure 6: *Students' Performance in Question 6*

In general, the performance in this question was weak because 368 (81.6%) students performed below average.

The 81.6% of the students scored low mark, among them 41.2% of the student scored 0 marks. These students did not understand the demand of the question and lacked the knowledge on workshop tools and equipment as well as drawing skills. For example, one student drew an unknown

sketch instead of drawing a sketch of drill bit. Another student did not draw anything and provided wrong explanation in part (b) and (c) by listing the parts that were supposed to be labelled in the sketch of drill bit in part (a) such as *tang, shank, neck flute* and *angle of cut*. Some tried to draw a sketch of drill bit without labelling the given parts, thus scored low marks. Extract 6.1 is a sample response from a script of a student who had poor performance.



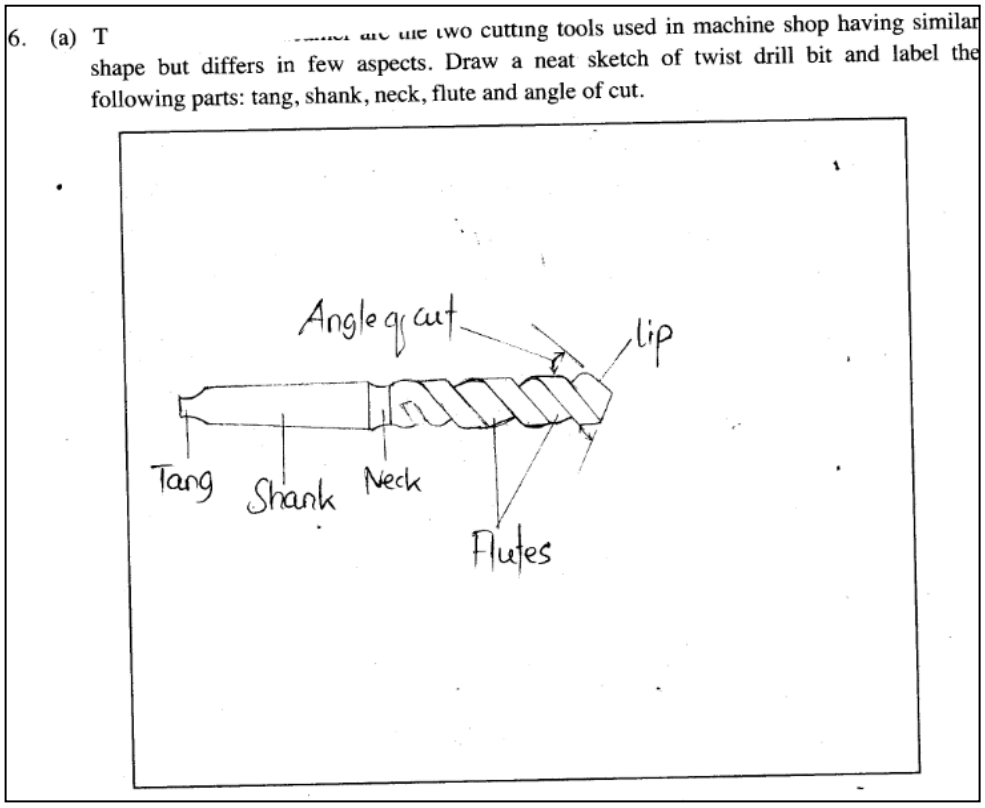
Extract 6.1: *A sample of a student's poor response in question 6*

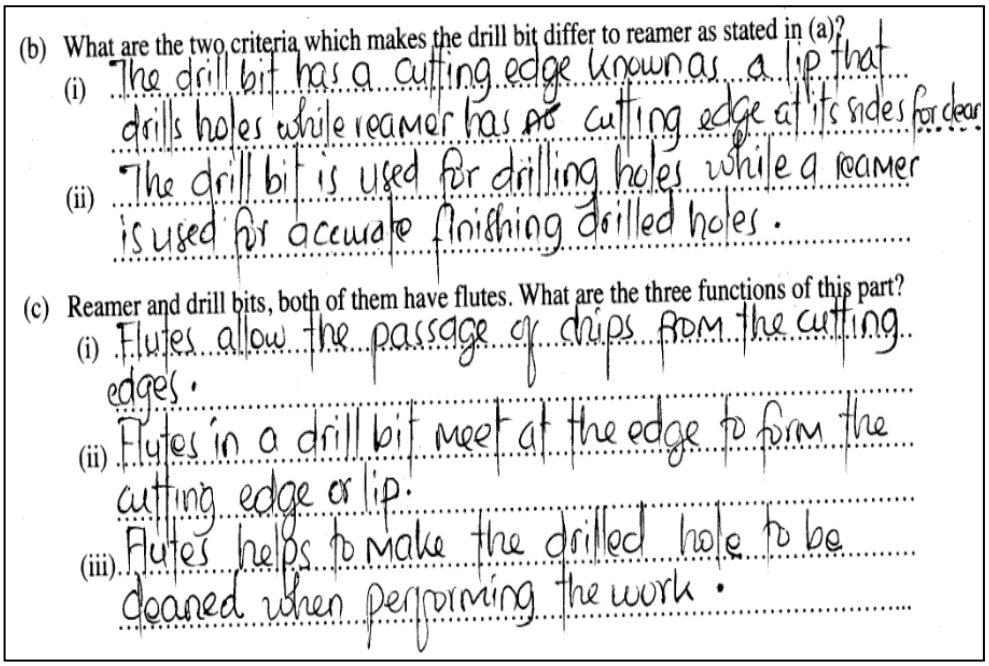
In Extract 6.1, the student in part (a) drew unrecognized sketch and labelling the given parts. In part (b) he/she wrote incorrect criteria such as first point *drill and reamer* and second point *flute and angle of cut.* The student just repeated the words from the question 6 instead of providing correct answer. In part (c) he/she wrote *drill bit, working process and*

steelmaterpals. These were irrelevant answers which were out of the demand of the question.

On the other hand, 15.1% of the students who scored from 3.0 to 6.4 marks partially understood the requirements of the question and the subject matter tested. They provided three to six criteria which makes the drill bit differ from reamer and the functions of flutes in reamer and drill bits.

However, the few students (3.3%) with good performance provided relevant responses as per the requirement of the question. These students managed to extract enough knowledge of the topic and had clear understanding of the demand of the question. Extract 6.2 is a sample of responses from the script of a student who had good performance.




(b) What are the two criteria which makes the drill bit differ to reamer as stated in (a)?

(i) The drill bit has a cutting edge known as a lip that drills holes while reamer has ~~no~~ cutting edge at its sides for clear

(ii) The drill bit is used for drilling holes while a reamer is used for accurate finishing drilled holes.

(c) Reamer and drill bits, both of them have flutes. What are the three functions of this part?

(i) Flutes allow the passage of chips from the cutting edges.

(ii) Flutes in a drill bit meet at the edge to form the cutting edge or lip.

(iii) Flutes helps to make the drilled hole to be cleaned when performing the work.

Extract 6.2: *A sample of a student's good responses in Question 6*

In Extract 6.2 the student managed to draw and label a correct sketch of drill bit. In part (b) he/she managed to explain clearly the two criteria which makes drill bit differ with reamer and stated correctly the functions of reamer and drill bits.

2.2.5 Question 7: Workshop Management and Safety Rules

This question had two parts, (a) and (b). In part (a), the students were instructed to describe five causes of accidents. In part (b), the students were instructed to describe the five prevention measures of accidents. Each part carries 5 marks which makes a total of 10 marks.

The question was attempted by 451(100%) students, of whom 109 (24.2%) scored from 0 to 2.5 marks. Moreover, 129 (28.6%) students scored from 3.0 to 6.0 marks and 213 (47.2%) scored from 6.5 to 10 marks. Figure 7 summarizes this performance.

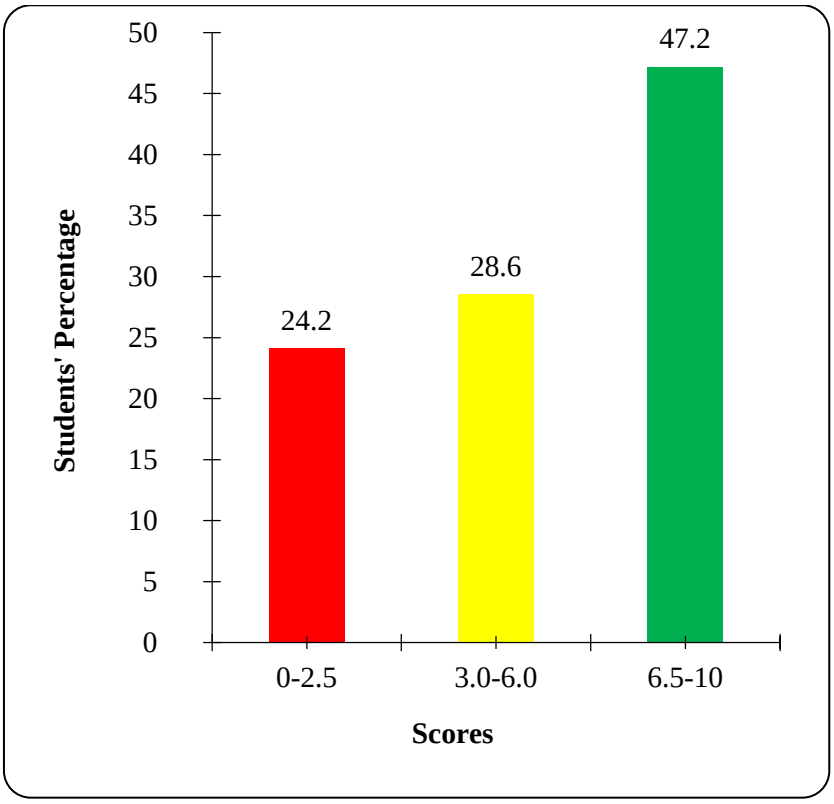


Figure 7: *Students' Performance in Question 7*

On the basis of the Figure 7, the general performance in this question was good because 342 (75.8%) students had average performance and above.

Most of the students who scored from 6.5 to 10 marks managed to provide relevant causes and preventive measures of accidents as per the demand of the question. These students managed to extract enough knowledge on the topic and had clear understanding of the demand of the question. The good performance in this question is an indicative of the fact that most of the students were familiar with workshop management and safety rules. Therefore, they were able to apply the knowledge and skills in answering the question. Extract 7.2 is a sample of good responses from the script of a student with good performance.

ccidents are bad luck events which cause injury to people, damage machines, tools and quipment, resulting into loss of productions. What are the five causes and prevention of :cidents?

a) Causes

(i) Improper wearing or clothing

(ii) Watery or slippery floor with tiles

(iii) Dirty and untidy workshop

(iv) Improper arrangement of things in the workshop.

(v) Failure to observe workshop safety rules

b) Preventive measures

(i) Proper wearing or clothing when in the workshop should be observed.

(ii) Workshop floor should be rough and not covered with tiles and it should be kept away from water or other liquids.

(iii) The workshop should always be clean and tidy.

(iv) Things and materials found ~~sho~~ in the workshop should be arranged properly.

(v) Observing workshop safety rules should be obligatory.

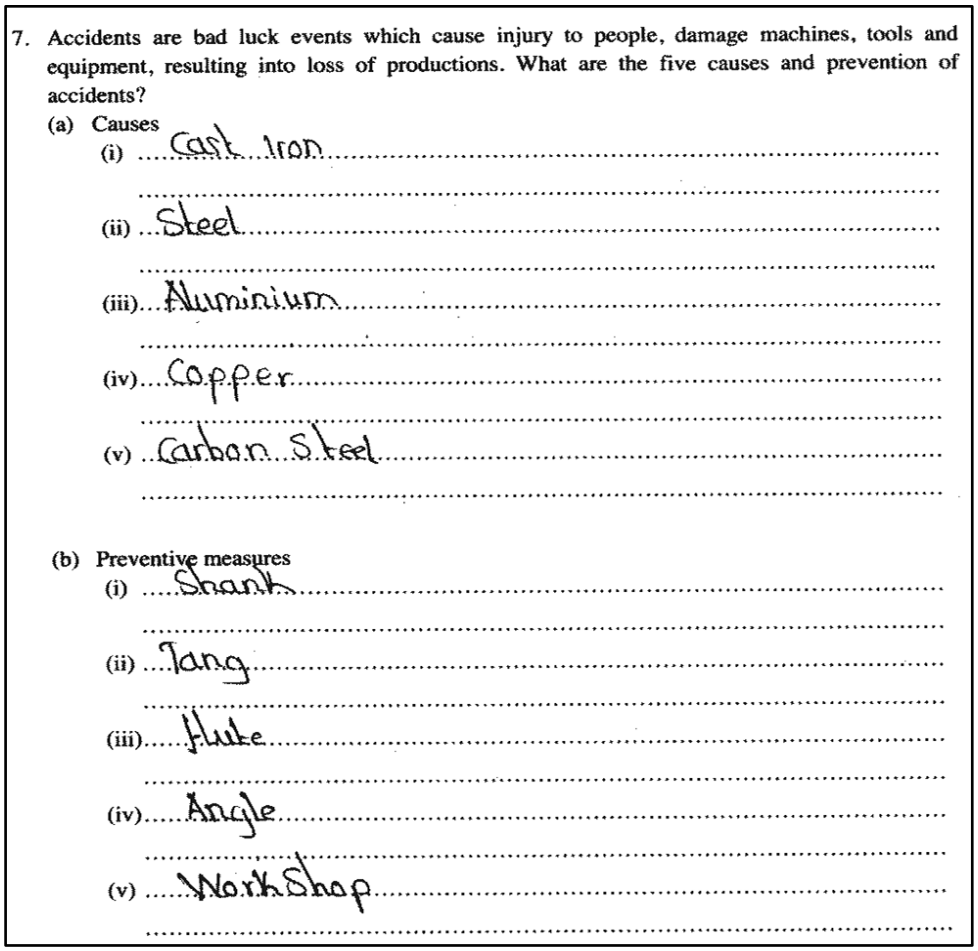
Extract 7.1: *A sample of a student's good responses in Question 7*

In Extract 7.1 the students managed to precisely explain causes and preventive measures of accidents.

On the other hand, the 28.6% of the students who had average performance partially understood the requirements of the question and the subject matter tested. The students under this group managed to describe two to three causes of accidents and two to three preventive measures of accidents. For example one student provided three correct causes and preventive measures of accidents and repeated two points in part (a) and (b). Another one provided incorrect answers in part (a) such as *the accident it can cause the injury to people when the accident it can occur, the accident it can cause*

the damage of tool and equipment in workshop. This student copied the words from question 7. Moreover, he/she managed to write correct preventive measures of accident in part (b).

Few students (24.2%) who had weak performance did not understand the demand of the question and lacked knowledge on workshop safety and rules. For example, in part (a) one student wrote incorrect answers such as *it help to can down and given water,* enables to saves life in the wound, *it helps to reducing pain of a wound and injury to people damage and it helps to sending hospital to professional medical of wound.* In part (b), the student did not write anything. Extract 7.2 is a sample of poor responses from the script of a student with good performance.


7. Accidents are bad luck events which cause injury to people, damage machines, tools and equipment, resulting into loss of productions. What are the five causes and prevention of accidents?

(a) Causes

(i) Cast Iron

(ii) Steel

(iii) Aluminium

(iv) Copper

(v) Carbon Steel

(b) Preventive measures

(i) Shank

(ii) Tang

(iii) Flute

(iv) Angle

(v) WorkShop

Extract 7.2: *A sample of a student's poor responses in Question 7*

Extract 7.2, the student mentioned names of engineering materials such as *cast iron, steel Aluminium, copper and carbon steel* in part (a). In part (b)

he/she listed the parts of drill bit such as *shrank, tang, flute* and *angle.* This student did not understand the demand of the question, hence failed to explain the causes and preventive measures of accidents.

2.2.6 Question 8: Metal Work Technology

This question had three parts, (a), (b) and (c). In part (a), the students were instructed to differentiate metals from non-metals as applied in engineering materials. In part (b), the students were instructed to differentiate steel from cast iron, and in part (c), the students were instructed to explain briefly the effects of the following impurities when added to mild steel: (i) Sulphur, (ii) Manganese and (iii) Phosphorous. Part (a), (b) and (c), carries 2, 2 and 6 marks, respectively, of which make a total of 10 marks.

The question was attempted by 451(100%) students, of whom 436 (96.7%) scored from 0 to 2.5 marks. Moreover, 15 (3.3%) students scored from 3.0 to 6.0 marks and there were no students who scored from 6.5 to 10 marks. Table 1 summarizes this performance.

Table 1: *Students' performance in Question 8*

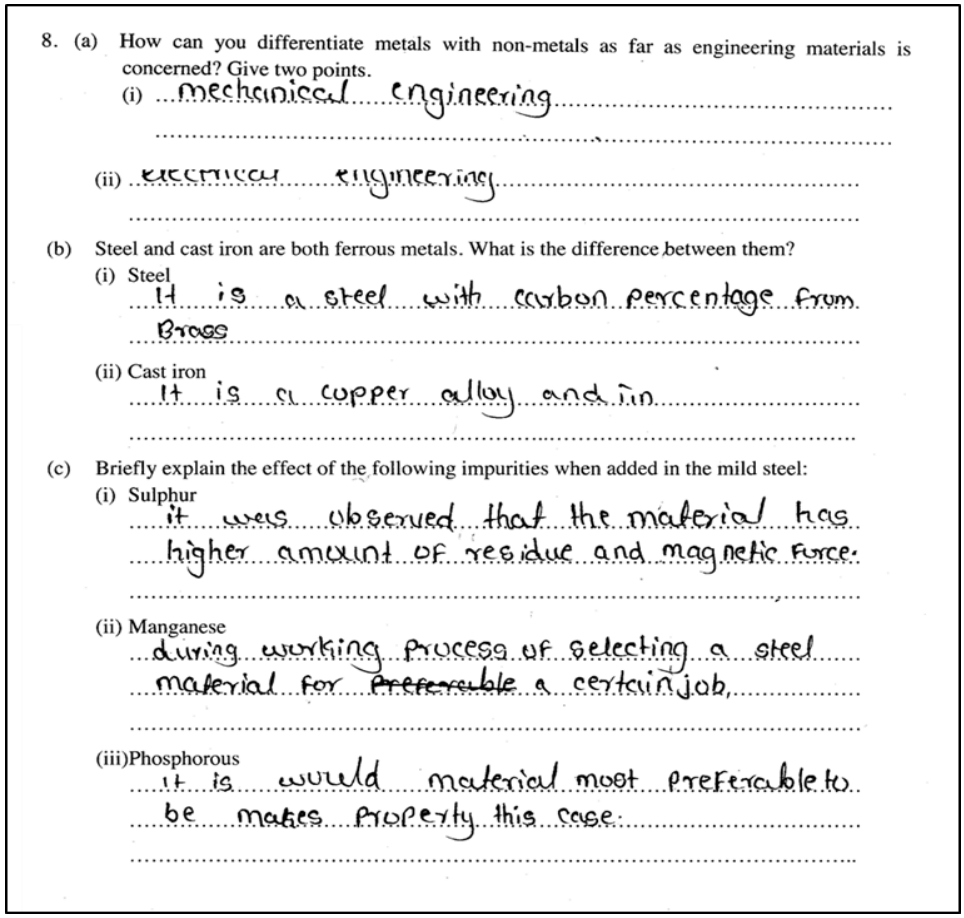
Grade General	Percentage Range	Description	Number of students	Percentage
0-2.5	0 – 29	Unsatisfactory	436	96.7
3.0-6.0	30 – 64	Average	15	3.3
6.5-10.0	65 – 100	Good	0	0.0
TOTAL			**451**	**100**

According to the analysis, the students' performance in this question was weak because 436 (96.7%) of students had performance below average.

The analysis shows that 96.7% of the students had weak performance; among them 57.2% scored zero marks meaning that they did not understand the demand of the question and lacked knowledge and skills on production of engineering materials. For example, one student wrote *metals used to producing material* and *non-metals are not producing others material*. Another student in part (a) wrote incorrect answers such as *metals*

and non-metals it help in classification of engineering materials. In part (b), the student provided incorrect answer such as *steel is the non-metal which is does not produce the large amounts of heat in the welding metal* while *cast iron- this is the iron which contain large amount of steel*. Similarly in part (c) the student wrote incorrect answers such as *in addition of Manganese in mild steel- because manganese it is important for welding process.*

The students who scored low marks managed to write one to two correct answers from the combination of three parts. For example, one student wrote precise difference between metals and non-metals but did not write anything in part (b) and (c). Extract 8.1 is a sample of responses from the script of a student who had poor performance.



8. (a) How can you differentiate metals with non-metals as far as engineering materials is concerned? Give two points.

(i) mechanical engineering

(ii) electrical engineering

(b) Steel and cast iron are both ferrous metals. What is the difference between them?

(i) Steel

It is a steel with carbon percentage from Brass

(ii) Cast iron

It is a copper alloy and tin

(c) Briefly explain the effect of the following impurities when added in the mild steel:

(i) Sulphur

it was observed that the material has higher amount of residue and magnetic force.

(ii) Manganese

during working process of selecting a steel material for ~~Preferable~~ a certain job,

(iii)Phosphorous

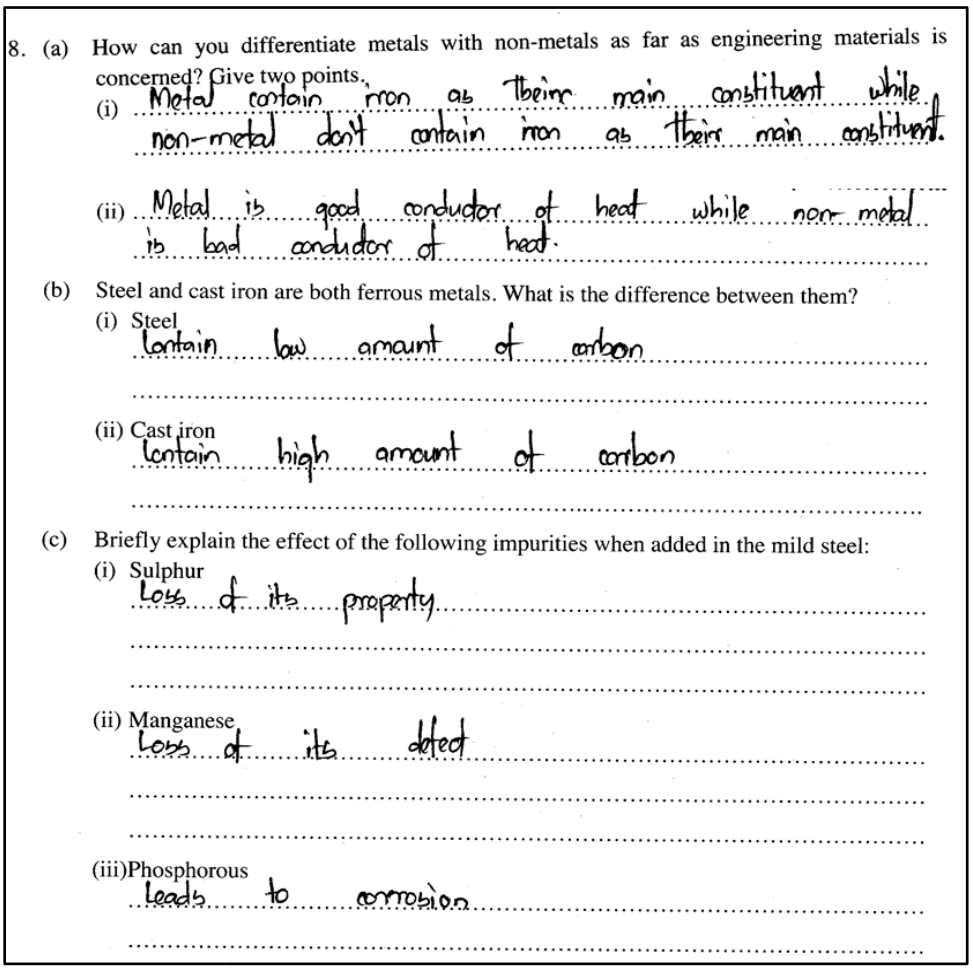
it is would material most preferable to be makes property this case.

Extract 8.1: *A sample of a student's poor responses in Question 8*

Extract 8.1 shows the student who wrote irrelevant answers by listing different engineering fields *mechanical engineering and electrical engineering* instead of providing difference between metals and non-metals in part (a). Likewise, in part (b) the student copied the words from question 1 (vii) such as *sulphur-it was observed that the material has higher amount of residue and magnetic force, manganese-during working process of selecting a steel material for a certain job*, hence scored low marks.

On the other hand, the very few students (3.3%) who had average performance had insufficient knowledge and skills on production of engineering materials. The students in this group managed to provide three to four correct points out of the required points in parts (a), (b) or (c). For example, one student managed to write correct answers in part (a), the difference between metals and non-metals and one correct answer in part (c). However, this student failed to differentiate between cast iron and steel in part (b) and also failed to explain the effect of adding manganese and phosphorus in mild steel.

In this question there were no students who scored good performance, all 451 students scored from 0 to 4 marks. This indicates that students had insufficient knowledge on the production engineering material based on the effect of adding impurities into different metals. The students also failed to differentiate cast iron with steel as some think that iron and steel are similar. The truth is that cast iron has a more compressive strength, and steel is more tensile. If compared with cast iron, steel is superior in tension, and does not rust. The main difference between the two elements is that steel is produced from iron ore and scrap metals, and is called an alloy of iron, with controlled carbon, whereas, around 4% of carbon in iron makes it cast iron and less than 2% of carbon makes it steel. Extract 8.2 is a sample responses from the script of a student who had average performance.


8. (a) How can you differentiate metals with non-metals as far as engineering materials is concerned? Give two points.

(i) Metal contain iron as their main constituent while non-metal don't contain iron as their main constituent.

(ii) Metal is good conductor of heat while non-metal is bad conductor of heat.

(b) Steel and cast iron are both ferrous metals. What is the difference between them?

(i) Steel
contain low amount of carbon

(ii) Cast iron
contain high amount of carbon

(c) Briefly explain the effect of the following impurities when added in the mild steel:

(i) Sulphur
Loss of its property

(ii) Manganese
Loss of its defect

(iii)Phosphorous
Leads to corrosion

Extract 8.2: *A sample of a student's average responses in Question 8*

In Extract 8.2 the student managed to provide correct answers in part (a) and (b) but failed to explain the effect of adding sulphur, manganese and phosphorus in the mild steel. He/she wrote, adding phosphorus in mild steel, *will result to corrosion* instead of *will increase the resistance of corrosion,* in addition of sulphur *it results to loss its property.* This response was incomplete because student was supposed to give more clarification which property will be lost. In part (b) (ii) the student *wrote in addition of manganese into mild steel results to loss of defects.* This also was incomplete response as the student was required to give clarification of what kind of defects will be lost when manganese is added into the mild steel. Therefore this student had insufficient knowledge on engineering materials based on the effect of adding impurities in different metals.

2.2.7 Question 9: Mechanical Engineering Jobs and Occupation

This question had two parts, (a) and (b). In part (a), the students were instructed to give two categories of engineers and five main activities of each. In part (b), the students were instructed to mention other three technical expertise and their roles out of the one mentioned in part (a). Part (a) and (b) carried 7 and 3 marks, respectively, which make a total of 10 marks.

The question was attempted by 451(100%) students, of whom 422 (93.6%) scored from 0 to 2.9 marks. Moreover, 24 (5.3%) students scored from 3.0 to 6.4 marks and 5 (1.1%) scored from 6.5 to 10 marks. Figure 8 summarizes this performance.

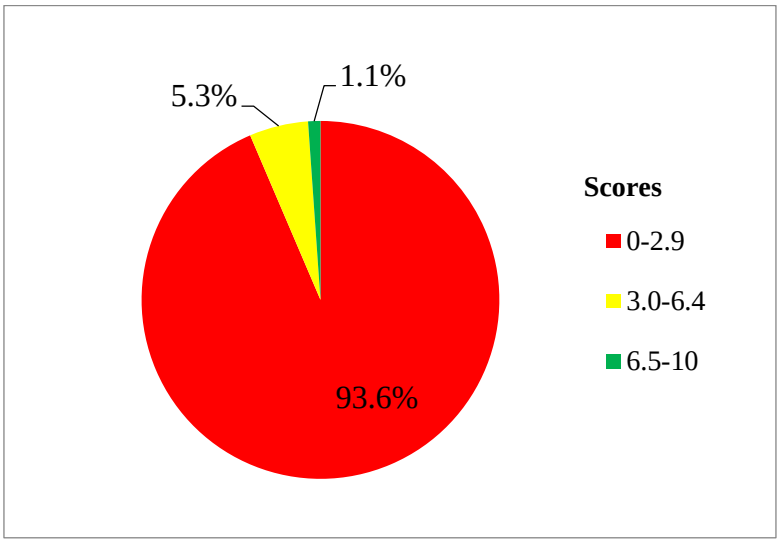


Figure 8: *Students' Performance in Question 9*

Based on the findings, the general performance in this question was weak because 422 (93.6%) students performed below average.

The analysis indicates that 93.6% of the students had weak performance, among them 62.5% scored 0 marks. These students did not understand the demand of the question and lacked the knowledge on different qualifications and roles of engineering occupations. For example, one student wrote incorrect response in part (a) such as *category 1-Automotive* main activities were *help in the production in car industry, used in the electricity in car building category 2-Welding, main activities are it help to used in welding to the melt, it help to manufacture in the machinery*. Also in part (b) the student wrote *expert 1- bench rolling, expert 2- counter bore*

rolling and expert 3-counter futher rolling. Other students (31.1%) who scored from 1.0 to 2.5 marks partially understood the demand of the question and had insufficient knowledge on the roles of different engineering qualifications. For example, in part (a) the student responded by writing *practical engineers* and *theory engineers* which are *Scientist and Technologist Engineers*. Also in part (b) he/she managed to mention clearly all three technical experts but failed to give their roles. Extract 9.1 is a sample of responses from the script of a student who had poor performance.

9. A certain manufacturing company from abroad need to invest in Tanzania. A top manager requested you to make presentation on categories of engineers and other technical experts required for the project and their job descriptions.
   (a) Give two categories of engineers and five main activities of each.
      (i) Category 1

~~Manufacturing workshop~~ MANUFACTURING

Main activities

- Manufacturing of simple tools and instruments
- Manufacturing different types of machines
- Changing of metals to different shapes
- Sharping, Chipping of metals
- Fabrication of steel metals

(ii) Category 2

~~Automotive~~ AUTOMOTIVE

Main activities

- ~~For~~ Repairing some parts in the car
- ~~Servicing~~ of cars
- Manufacturing some parts found in car eg engine etc
- Manufacturing of cars
- Marking of car's components

(b) What other three technical expertise needed and their roles out of the one mentioned in (a)?

Expert 1

AIR CONDITION AND REFRIGERATION

Role function

~~Serving~~ Servicing of parts found in air conditions and fridges.

Expert 2

MAINTENACE PROFESSIONAL

Role function

~~For~~ Repairing some parts in the ~~machi~~ machines and heavy equipments.

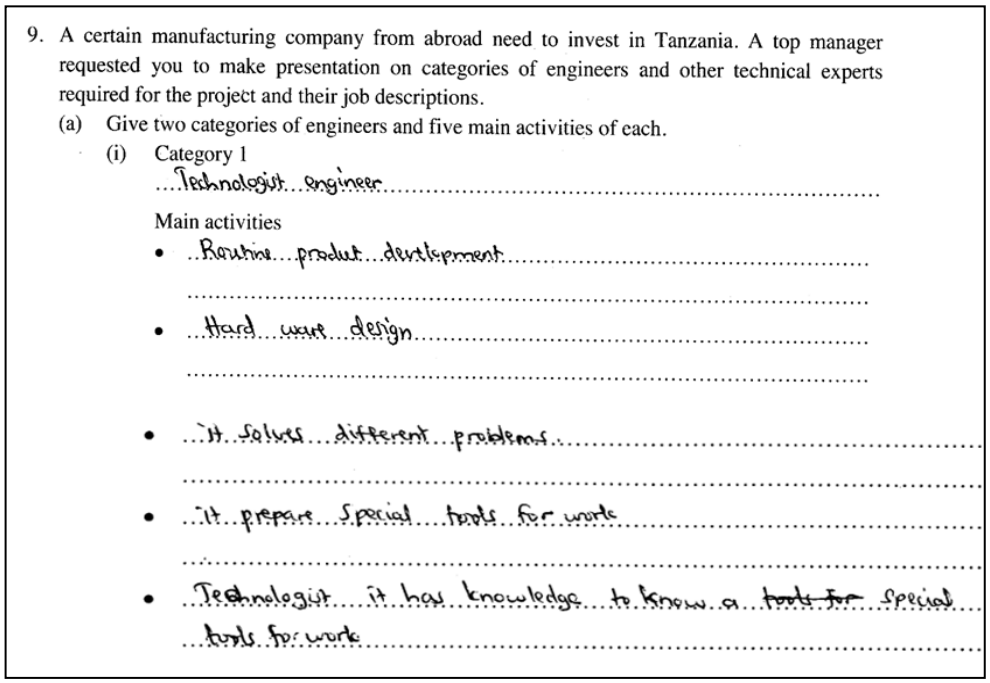
Extract 9.1: *A sample of a student's poor responses in Question 9*

In Extract 9.1 the student provided incorrect response by providing disciplines of mechanical engineering such as *Manufacturing and Automotive* instead of categories of Engineers in part (a). Likewise in part (b) he/she wrote different sections in workshop such as *air condition and*

refrigeration, maintenance and foundry. This student did not understand the demand of the question and subject matter tested.

On the other hand, the few students (5.3%) who had average performance managed to provide one of the categories and few main activities as well as list few correct technical experts. For example one student in part (a) managed to identify one category of engineers and list some of activities. In part (b) he/she managed to identify clearly all technical experts but failed to provide their roles. Students in this group had insufficient knowledge on responsibilities of different engineering qualifications.

However, the very few students (1.1%) with good performance provided relevant response as per requirement of the question. These students extracted enough knowledge of the topic and had clear understanding on the demand of the question. Therefore, they were able to apply the knowledge and skills in writing properly the categories of engineers and their activities as well as groups of technical experts required in manufacturing company. Extract 9.2 is a sample of responses from the script of a student who had good performance.



9. A certain manufacturing company from abroad need to invest in Tanzania. A top manager requested you to make presentation on categories of engineers and other technical experts required for the project and their job descriptions.
   (a) Give two categories of engineers and five main activities of each.
      (i) Category 1
      Technologist engineer
      Main activities
      - Routine product development
      - Hard ware design
      - It solves different problems
      - It prepare special tools for work
      - Technologist it has knowledge to know a ~~tools for~~ special tools for work

(ii) Category 2

Scientist engineer

Main activities

- Computer aided design
- Scientist A descovery new ~~way~~ feeling of how to solve problems.
- Scientist should be to Understand how to natural world ~~work~~ work hard how it came to be that way.
- Scientist it support with a Technologist to come with a new ideas
- Scientist it do practical in order to come with a new way.

(b) What other three technical expertise needed and their roles out of the one mentioned in (a)?

Expert 1

Artisan

Role function

it is selecting and assembling a special tools for work

Expert 2

Craft persons

Role function

it interact and a Artisan to select and assembling tolerics for work.

Expert 3

Technician

Role function

It is a schedule models.

Extract 9.2: *A sample of a student's good responses in Question 9*

In Extract 9.2 the student clearly wrote two categories and the main activities also provided precise all three technical experts and their roles.

2.3 Section C: Structured Question

Section C had one (1) question which was set from *Metal Work Technology* topic. This question was compulsory to be answered by all students. The total marks allotted to this question are 15 whereby part (a) carries 4 marks, part (b) carries 5 marks and part (c) carries 6 marks.

2.3.1 Question 10: Metal Work Technology

This question comprised three parts, (a), (b) and (c). In part (a), the students were instructed to briefly explain two types of electrodes based on melting point and their applications. In part (b), the students were instructed to provide information found on the electrode package (box). In part (c), they were instructed to describe the meaning of the mark on an electrode with code number E6013, according to American Welding Society (AWS).

The question was attempted by 451(100%) students, of whom 365 (80.9%) scored from 0 to 4.0 marks, 81 (18%) students scored from 4.5 to 9.5 marks and 5 (1.1%) scored from 10 to 15 marks. Figure 9 summarizes this performance.

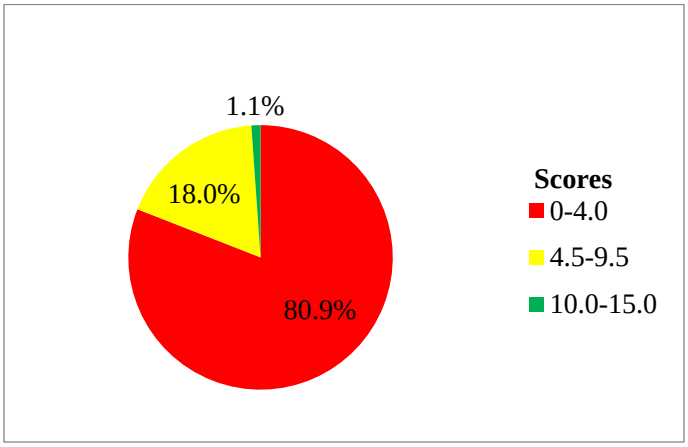


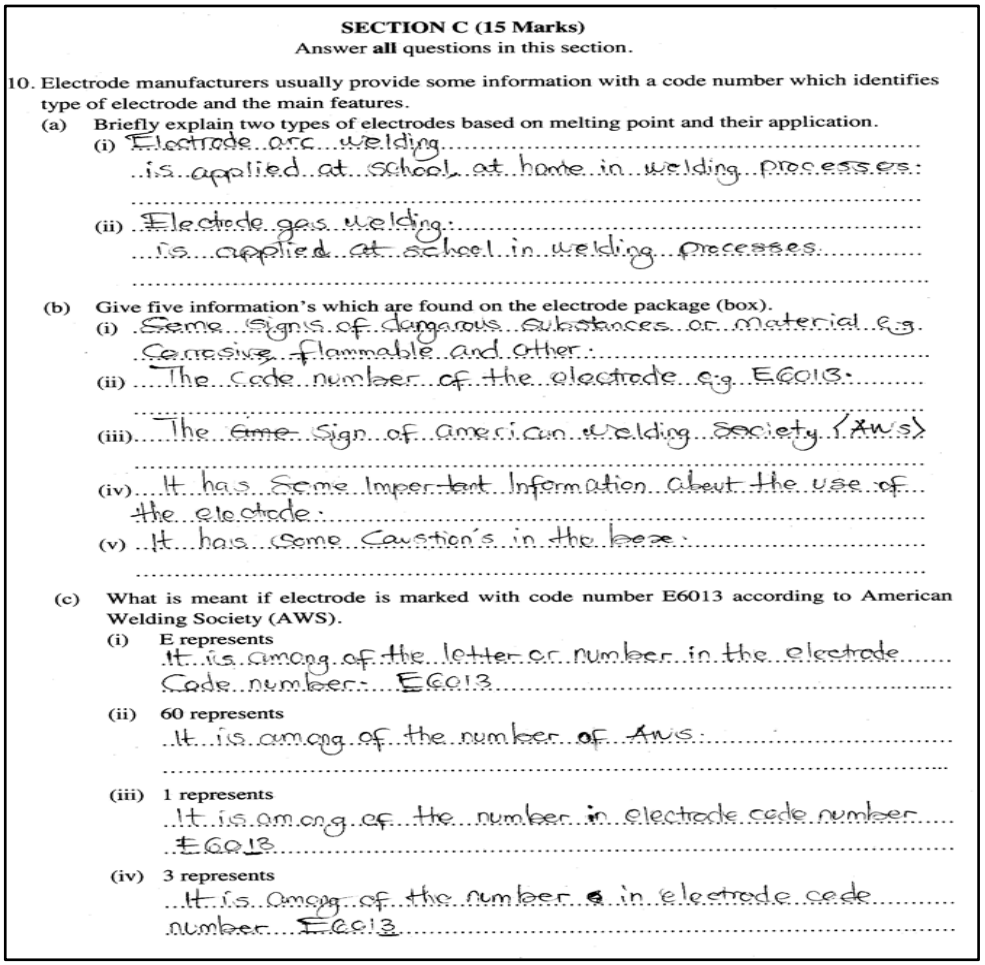
Figure 9: *Students' Performance in Question 10*

The general performance in this question was weak because 365 (80.9%) students performed below average.

The analysis, shows that, 80.9% of the student had weak performance, of whom (33.3%) scored 0 marks. These students did not understand the demand of the question and most of them had insufficient skills and knowledge on welding technology, resulting into irrelevant answers. For example, one student who scored 0 wrote incorrect response such as *coated electrode* and *uncoated electrode* in part (a). This student did not

understand that all electrodes are coated in a metal mixture called flux which gives off gases as it decomposes to prevent weld contamination. In part (b) and (c) he/she did not write anything.

The students who scored from 1 to 4 marks managed to give correct response in one of the three parts (a), (b) and (c). Some wrote correct and incorrect types of electrode in part (a) and (c); others managed to provide one to four correct answers in part (a), (b) and (c). Extract 10.1 is a sample of responses from the script of a student who had poor performance.



SECTION C (15 Marks)
Answer **all** questions in this section.

10. Electrode manufacturers usually provide some information with a code number which identifies type of electrode and the main features.

(a) Briefly explain two types of electrodes based on melting point and their application.

(i) Electrode arc welding
is applied at school at home in welding processes:

(ii) Electrode gas welding:
is applied at school in welding processes

(b) Give five information's which are found on the electrode package (box).

(i) Seme signs of dangerous substances or material e.g. Corrosive flammable and other:

(ii) The code number of the electrode e.g. E6013:

(iii) The seme sign of american welding society (AWS)

(iv) It has seme Imperstant Information about the use of the electrode:

(v) It has seme Caustion's in the boxe:

(c) What is meant if electrode is marked with code number E6013 according to American Welding Society (AWS).

(i) E represents
It is among of the letter or number in the electrode Code number: E6013

(ii) 60 represents
It is among of the number of Aws:

(iii) 1 represents
It is among of the number in electrode code number E6013

(iv) 3 represents
It is among of the number 3 in electrode code number E6013

Extract 10.1: *A sample of a student's poor responses in Question 10*

In Extract 10.1 the student wrote incorrect response in part (a) such as *electrode gas welding* and *electrode arc welding.* He/she did not understand that gas and arc welding are the types of welding and electrode is a tool used in welding processes which is also categorised into two types

which are consumable electrode and non-consumable electrode. In part (b) the student provided incorrect response such as *cable, metals, angles, electrode holder and working piece.* In part (c) he/she repeated the given code number *E6013* and other incorrect answers such as *is the among of the number in electrode code* in mark E, 60, 1 and 3.

On the other hand, few students (18.0%) with average performance understood the requirements of the question and the subject matter tested but had insufficient knowledge and skills on welding technology. Students in this category managed to provide four to six points from part (a), (b) or (c). Most of them provided wrong answers in part (c).Therefore about 400 students did not understand the meaning of the code number marked on the electrode E6013. For example, one student in this category wrote correct answers in part (a) and (b), but in part (c) he/she provided incorrect answers. He/she managed to name E-*Electrode* but wrote incorrect meaning of mark 60, 1 and 3 where 60-*the electrode generation number*, 1-*company number in the country* and 3-*the country* instead of writing correct answers which are 60- Electrode tensile strength of 60,000 psi, 1- welding position and 3- type of flux covering and power source characteristics.

However, very few students (1.1%) with good performance provided relevant response as per demand of the question. These students had sufficient knowledge on welding technology. Therefore, they were able to apply the knowledge and skills in answering the question. Extract 10.2 is a sample response from a script of a student who had good performance.

10. Electrode manufacturers usually provide some information with a code number which identifies type of electrode and the main features.

(a) Briefly explain two types of electrodes based on melting point and their application.

(i) ...Consumable...electrode...which...melts...during...the...arc...
...welding...and...acts...as...a...filler...rod...It...is...used...in...process...
like...submerged...arc...welding...and...metal...gas...arc...welding.....

(ii) ...Non-consumable...electrode...which...is...not...consumed...during
...arc...welding...It...is...used...in...Tungsten...arc...welding...and.....
...plasma...arc...welding...to...weld...stainless...steel.....

(b) Give five information's which are found on the electrode package (box).

(i) The type of electrode ~~and mater~~ either consumable or non-consumable

(ii) Length of the electrode and size

(iii) The material used to make electrode example low carbon steel electrode or aluminium electrode

(iv) The material coated with (flux) on the electrode

(v) The base metal type during welding of the required electrode

(c) What is meant if electrode is marked with code number E6013 according to American Welding Society (AWS).

(i) E represents

Electrode for arc welding

(ii) 60 represents

It represents minimum tensile strength

(iii) 1 represents

The welding position (flat welding position, verticle, horizontal and overhead)

(iv) 3 represents

the mixture of flux coated with on the electrode and power supply

Extract 10.2: *A sample of a student's good response in question 10*

In Extract 10.2 the student explained clearly two types of electrode and gave the correct applications. He/she also managed to provide five information found on electrode box as well as the correct meaning of the mark on electrode E6013. Furthermore, the student correctly applied the skills and knowledge of welding in answering the question.

3.0 ANALYSIS OF THE STUDENTS PERFORMANCE IN EACH TOPIC

In Mechanical engineering paper six (6) topics were assessed: *Metal Work Technology, Mechanical Engineering Jobs and Occupations, Introduction to Science, Engineering and Technology, Workshop Tools and equipment, Workshop Management* and *Safety Rules* and *Engineering Materials.*

Based on the analysis of the students' performance, good performance was observed in Question 1 which was tested from *various topics in which* 98.9% of students scored above average. The other good performance (75.8%) was observed in Question 7 from the topic of *Workshop Management and Safety Rules*. The students who had good performance understood the demand of the questions as well as ability to apply the knowledge and skills in the topics tested in producing drawings, providing precise explanation and identification of different mechanical components and systems.

The average performance was observed in Questions 2, 5 and 8 from the topic of *Engineering Materials.* 30.9% of the students who had average performance partially understood the demand of the question as well as ability to apply the knowledge and skills in the topics tested in producing drawings, providing explanation and identification of some of mechanical components and systems.

Furthermore, the analysis of the students' performance revealed that weak performance was observed in three (3) topics *Workshop Tools and Equipment* (29.6%), *Mechanical Engineering Jobs and Occupations* (6.4%) and *Metal Work Technology* (19.1%) which were tested in question 3, 4, 6, 9 and 10.Weak performance of the students associated with inadequate knowledge and practical skills on tested subject matter as well as failure to understand the demand of the questions. For example, some students failed to identify measuring, checking and marking tools in the topic of workshop tools and equipment. The students' performance in each topic is summarised in Appendix I.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

On the basis of the student's analysis of each question, it can be concluded that, the overall performance in Mechanical Engineering subject for the Form Two National Assessment (FTNA) in 2021 was average because, 31.5% of the students scored 30% and above.

The poor performance of the students is attributed to different factors as explained in the analysis of each question such as failure of students to understand the demand of the questions. This has observed in questions 3, 4, 5, 6, 8, 9 and 10 in which most of the students wrote irrelevant answers. Insufficient knowledge on some tested subject matter was observed in Question 8 in which 96.7% of the students failed and in Question 9 in which 93.6% of the students failed. Lack of mechanical skills was also factor that contributed to weak performance. The students failed to explain practical oriented questions. This was observed in Questions 6 and 10. Another factor was lack of drawing skill, in which most of the students drew irrelevant sketch as analyzed in Question 6 where the students failed to draw a sketch of twist drill bit.

4.2 Recommendations

In order to improve performance on this subject, it is recommended that:-

a) Students are advised to carryout different workshop activities so as to become competent in practical oriented topics such as metal work technology and workshop tools and equipment.

b) Students are advised to read different books in order to expand their knowledge.

c) Students to arrange themselves in groups to present their responses for sharing and discussion in different topics.

d) Students are advised to develop the art and practice of drawing different mechanical tools and simple machinery.

APPENDICES

Appendix I

Table 2: *A summary of students' performance (question-wise)*

S/N	Topics	Question Number	Percentage of students who scored 30% or more	Remarks
1	Metal Work Technology, Mechanical Engineering Jobs and Occupations, Introduction To Science, Engineering and Technology, Workshop Management and Safety Rules and Engineering Materials	1	98.9	Good
2	Workshop management and Safety rules	7	75.8	Good
3	Engineering Materials	2, 5 and 8	30.9	Average
4	Workshop Tools and equipment	3, 4 and 6	29.6	Poor
5	Metal work Technology	10	19.1	Poor
6	Mechanical Engineering Jobs and occupation	9	6.4	Poor

Appendix II

Table 3: *General Students' performance in Mechanical Engineering Subject*

Grade	Percentage Range	Description	Number of students	Percentage
F	0 – 29	Weak	309	68.51
C & D	30 – 64	Average	141	31.27
A & B	65 – 100	Good	1	0.22
TOTAL			**451**	**100**

Appendix III

Table 4: *Description of Performance of students in each question*

Questions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Unsatisfactory	5	170	197	387	368	368	109	436	422	365
Average	314	205	210	62	99	68	129	15	24	81
Good	132	76	44	2	23	15	213	0	5	5
TOTAL	**451**	**451**	**451**	**451**	**451**	**451**	**451**	**451**	**451**	**451**

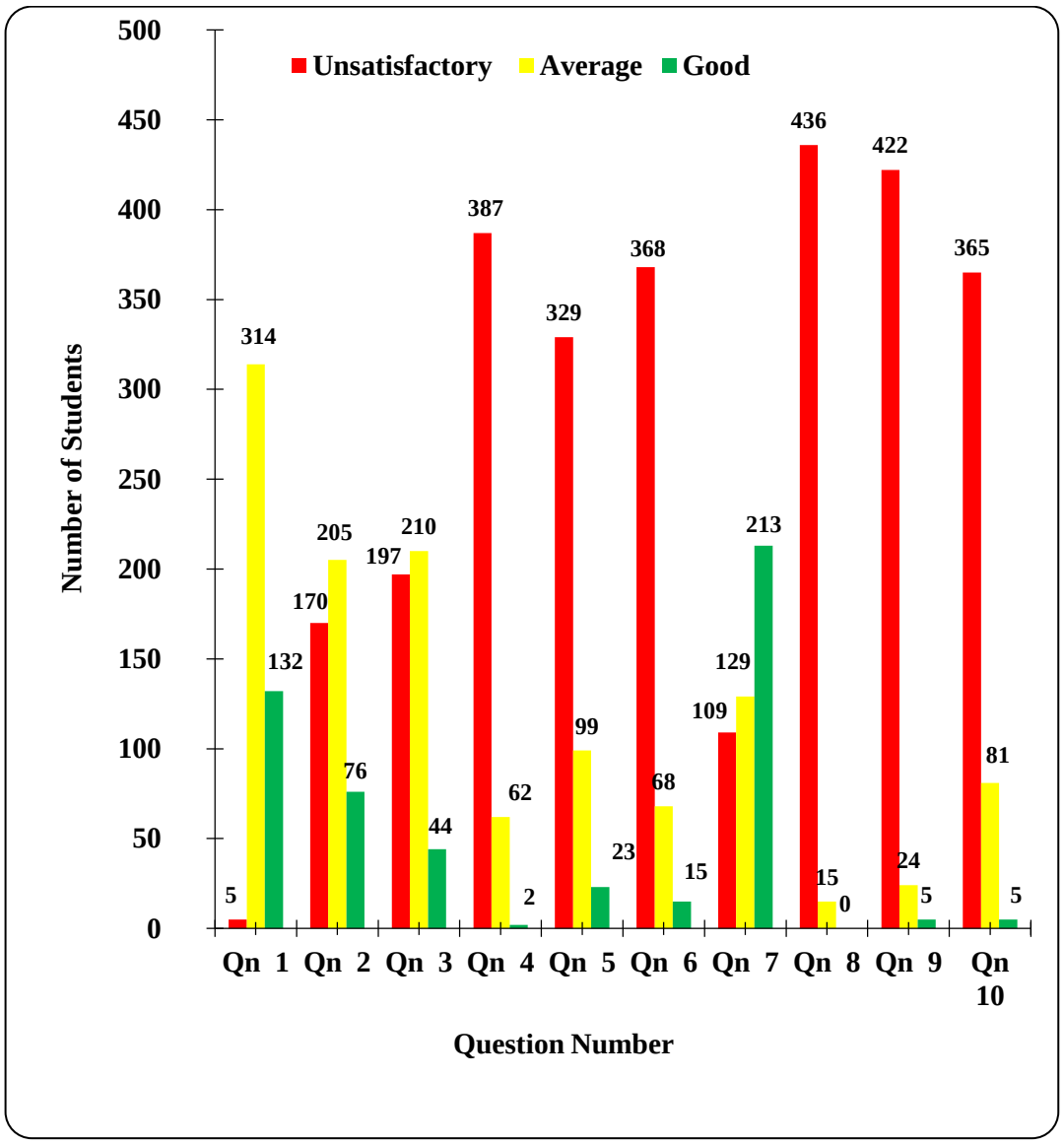


Figure 10: *Overall performance of students question wise for year 2021*

Appendix V

Table 5: *Student's performance (grade-wise) for year 2021 in comparison to the year 2020*

YEAR	A	B	C	D	F	TOTAL
2021	0	1	28	113	309	**451**
2020	2	7	31	58	174	**272**