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), 2023

MECHANICAL ENGINEERING

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090 MECHANICAL ENGINEERING

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FOREWORD

This report presents Students' Items Response Analysis (SIRA) on Form Two National Assessment in Mechanical Engineering subject which was conducted in November, 2023. The report aims to provide feedback to all educational stakeholders on the students' performance in Mechanical Engineering subject.

The Form Two National Assessment (FTNA) is a formative evaluation which intends to monitor students' learning and provide feedback that teachers, students and other educational stakeholders can use to improve teaching and learning processes. This report reveals that, students had good performance in question 4 and 7 which were prepared from the topic of Workshop Management and Safety Rules. Additionally, the students had average performance in question 3, 5, 6, 8 and 9 drawn from the topic of Metal Work Technology. The average performance was likewise noted in question 10 which was from the topic of Workshop Tools and Equipment. However, the students had weak performance in question 2 from the topic of Engineering Materials. The overall performance is properly found in Appendix I-V**.**

The performance analysis further shows that, the factors which contributed to the weak performance of the students were failure to understand the demands of the questions, inadequate knowledge and skills on some of the tested subject matters. Lack of enough knowledge in English language was also affected the given performance. Alternatively, good performance of the students was contributed by the ability to identify the demands of each question, adequate knowledge on the assessed subject matter and proficiency in English language. The justification of weak or good performance is well demonstrated in this report using extracts for reference.

The Council believes that, the report will be used by concerned education stakeholders to improve the teaching and learning processes for attainment of required instructional objectives.

The Council acknowledges the efforts of all those who contributed in some way to the production of this report.

Dr. Said Ally Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

The performance of the students in the November, 2023 Form Two National Assessment (FTNA) in Mechanical Engineering subject is analyzed in this report. The assessment evaluated the Form Two students' competencies in accordance with the 2019 Mechanical Engineering Secondary Education Syllabus.

The assessment had three sections, A, B, and C with a total of ten questions. The students were required to answer all the questions. Section A had two objective questions, 1 and 2. The questions in section A had the total of 15 marks. Question 1 consisted of ten (10) multiple choice items. Question 1 was drawn from four topics including *Engineering Materials*, *Workshop Management* and *Safety Rules, Tools and Equipment and Engineering Drawing I*. Every item had a single mark on it. On the other hand, question 2 had five (5) homogeneous matching items made from the topic of *Engineering Materials*. Question 2 had one mark for each item. Therefore, question 2 had a total of five marks.

Section B had seven short answer questions. These questions were 3, 4, 5, 6, 7, 8, and 9. The questions were constructed from the topics of Metal Work Technology, Workshop Management and Safety Rules, and Workshop Tools and Equipment. Each question worth 10 marks. Finally, Section C had one question with 15 marks. The given question was constructed from the topic of Workshop Tools and Equipment.

The 2023 FTNA in Mechanical Engineering subject was done by 381(100%) students. The performance analysis shows that, 95 (24.93%) students scored from 0 to 29 marks. Alternatively, 286 (75.07%) students scored from 30 up to 100 marks. Generally, 95 (24.93%) failed while 286 (75.07%) students passed the assessment. Therefore, the overall performance of the Mechanical Engineering subject in the 2023 FTNA was good. In 2022, a total of 424 (100%) students took the assessment from which 297(70.05%) passed while 127(29.95%) failed. Being that the case, there is an increase of 5.02% students who passed the assessment in 2023 compared to 2022. Appendix V provides a summary of this performance.

The above general performance was obtained from the performance of each question in the assessment. The responses that students provided for each question determined performance in that particular question. The given

responses determined the final performance in terms of good, average, and poor. Tables and charts were used to illustrate the final performance. Colors like red, yellow, and green were used to stand for poor, average, and good performance, respectively. Extracts from the students' scripts were used to present poor or good responses on the answered questions.

Furthermore, the analysis depicts performance according to gender of students who participated in the assessment as shown in Table 1. Regarding the female performance, none obtained grade A, 5 (6.02%) obtained grade B, 18 (21.69%) obtained grade C, 22 (26.51%) obtained grade D and 38 (45.78%) obtained grade F. The majority 38 (45.78%) female students scored grade F. On the other hand, Table 1 presents as well male performance. In so doing, 7 (2.35%) students scored grade A, 46 (15.44%) students scored grade B, 140 (46.98%) students scored grade C, 48 (16.11%) students scored grade D and 57 (19.13%) scored grade F. The majority 140 (46.98%) scored grade C. Therefore, the male to female ratio (5.36) in 2023 FTNA for Mechanical Engineering was better than the female to male ratio (0.19) of 2022.

Table1: Students' Performance According to Gender

Sex	Grades					Passed	
	A	B	C	D	F	Number	Percent
M	7	46	140	48	57	241	63.25
F	0	5	18	22	38	45	11.81
Total	7	51	158	70	95	286	75.07

2.0 ANALYSIS OF THE STUDENTS' PERFORMANCE IN EACH QUESTION

This part addresses the performance of the students based on the scores obtained in each question. It covers the types of questions, the topics on which the questions are constructed, competencies tested, and the requirements of each question and the percentages of the students who had weak, average or good performance based on their responses in each question.

2.1. Section A: Objective Questions

This section comprised of two questions carrying a total of 15 marks. Question 1 consisted of 10 multiple choice items and was constructed from the topics such as *Workshop Tools and Equipment, Engineering Materials,*

Engineering Drawing I, Workshop Management and Safety Rules. Each item in question 1 carried one mark. Question 2 included five matching items from the topic of *Engineering Materials*. Each item worth one mark in question 2.

2.1.1 Question 1: Multiple Choice Items

This question consisted of ten multiple choice items (i-x). These items were from the topics of *Workshop Tools and Equipment, Engineering Materials, Engineering Drawing I, Workshop Management and Safety Rules*. The students were instructed to choose the correct answer from among the given alternatives by writing its letter in the box provided. Each item carried one mark.

A total of 381 (100%) students answered this question, the results were as follows: 32 (8.40%) students scored 0 to 2 marks, 269 (70.60%) students scored 3 to 6 and 80 (21.00%) students scored 7 to 10 marks. In general, students' performance on this question was good, with 349 (91.60%) students scoring 3 to 10 marks. This performance is summarized in Figure 1.

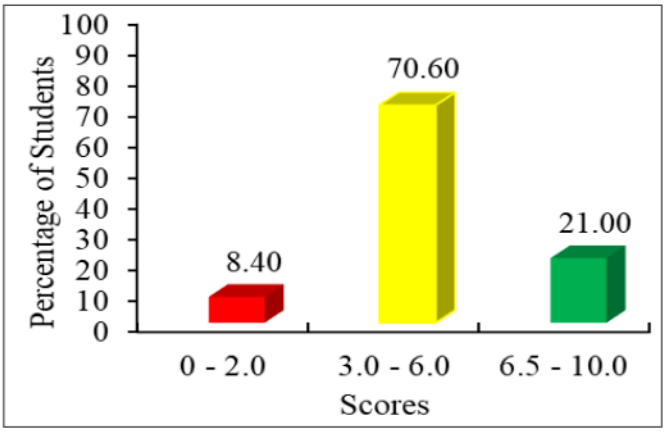


Figure 1: Students Performance in Question 1

The performance analysis generally shows that, 349 (91.60%) students performed well while 32 (8.40%) students performed poorly. The analysis of students' responses for each item is individually presented below:

Item (i) was set from the topic of *Workshop Tools and Equipment*. The students were required to apply their knowledge of Workshop Tools and Equipment to identify types of chisels used for chipping away material

from the workpiece. The question was:

Which types of Chisels are used for chipping away materials from the workpiece?

A Flat, round, square and diamond point
B Flat, cross cut, diamond point and square
C Flat, cross cut half round and diamond point
D Hollow, flat and pin chisel

The correct response was *C: Flat, cross cut, half round and diamond point.* The students knew that, the flat chisel is commonly used for general chiseling tasks and for creating flat and the cross cut chisel is used for making curved or rounded cuts. Likewise the half round chisel has a curved cutting edge, and it is suitable for creating concave shapes or rounding edges. This type of chisel is often used for shaping and smoothing curved surfaces. The diamond point chisel has a sharp, pointed end that resembles a diamond shape. It is versatile and can be used for detailed work, engraving, and for making small, precise cuts in various materials. It is especially useful for intricate designs and fine detailing. They further know that, each type of chisel serves a specific purpose, and their uses can overlap depending on the task at hand.

However, those who opted for alternative A, B and D were confused and mismatched the type of chisels. They failed to relate the grouped type of chisels in alternative A, B and D as explained in the topic of Workshop Tools and Equipment. For example, those who opted for alternative A, *Flat, round, square and diamond point* had inadequate knowledge and skills on chisels types/classification.

Item (ii) was constructed from the topic of *Engineering Materials*. It assessed students' knowledge in identifying material which falls under ferrous metal group. The students were required to select the appropriate answer by applying the knowledge on classification of metals. The question was:

Which metals fall under ferrous metals group?

A Steel, Copper and Tin *B Pig iron, Brass and Cast iron*
C Pig iron, Steel and Cast-iron *D Cast iron, Brass and Steel*

The correct response was *C, Pig iron, steel and cast iron.* Students who chose the correct response had adequate knowledge on Engineering Materials specifically on the classification of metals. They were able to identify the types of metals which fall under the group of ferrous metals. They realised that since steel, cast iron, and pig iron are examples of ferrous metals, they all belong to the same group. They also knew that, iron containing metals are known as ferrous metals, and they commonly have magnetic qualities. For instance, pig iron, which comprises ferrous metal, is an intermediate product utilised in the production of iron rather than a finished good used in manufacturing or building. Steel is an iron and carbon alloy, with a normal carbon concentration of 0.2% to 2.1%. Due to its strength, adaptability, and numerous uses in manufacturing, transportation, and building, steel is one of the ferrous metals that is most frequently utilised. A strong and brittle iron alloy is cast iron. Compared to steel, it has larger carbon content. Cast iron is commonly used in construction, pipes, and automotive parts.

The students who chose alternative A failed to differentiate some of the ferrous metals from non-ferrous metal. Failed to understand that, copper is a non-ferrous and it is a ductile metal with excellent electrical conductivity and is known for its malleability, corrosion resistance, and distinctive reddish-brown color. Also tin is a silvery-white metal known for its malleability, ductility, and low melting point.

Similarly, the students who opted for an alternative B and D didn't know that a brass is a non-ferrous metal and is a metal alloy made primarily of copper and zinc. These incorrect responses from the students suggested that, they lacked knowledge on engineering materials and the intended types of metal and their classifications.

Item (iii) was set from the topic of *Engineering Material* focusing on mechanical properties of materials. It tested the students' knowledge on characteristics of a material subjected to repeated loads. The question was:

The tendency of materials to develop different characteristic behavior when subject to fluctuating or repeated loads is known as;

A Fatigue *B Resilience*
C Creep *D Stiffness*

The correct response was *A*, *Fatigue.* The students who got the right answer were knowledgeable on the topic of engineering material specifically on the properties of materials. They knew that, the term "fatigue" refers to a material's potential to generate varied characteristic behaviour when subjected to fluctuating or repetitive stresses. The process known as fatigue occurs when materials are subjected to cyclic loading, such as repetitive stress or strain, and eventually suffer damage and deterioration. However, those who lacked enough knowledge on the subject matter chose options B, C, or D. These students were unaware that, materials have a tendency to develop different characteristics when subjected to repeated load. The options B, C and D are not the characteristics of engineering materials which can be developed from being subjected to repeated loads. Students were supposed to know that, resilience is a measure of a material's capacity to withstand and recover from deformation, providing an indication of its toughness and elasticity. In engineering materials, resilience encompasses both elastic and plastic aspects, indicating the ability of a material to absorb and recover from deformation, while Creep in engineering materials refers to the time-dependent deformation that occurs under a constant load or stress, typically at elevated temperatures. On the other hand, the term "stiffness" in engineering materials describes a material's resistance to deformation under the influence of an applied force or load. It is an essential mechanical characteristic that measures the degree of deformation a material will undergo when subjected to a specific force or stress. In many engineering applications, stiffness is an important factor to take into account while designing and analysing materials, components, and structures.

Item (iv) tested the students' knowledge on the nomenclature of a twist drill in the topic of *Workshop Tools and Equipment*. The question was:

Drill bit is the cutting tool which facilitates the making of a hole in the workpiece. Which part pass chips during cutting operation?

A Heel *B Shank*
C Flute *D Pitch*

The correct answer was C, *Flute.* The students who chose the correct alternative understood the subject matter. They had enough knowledge on the nomenclature of a twist drill. They knew that, the correct answer was C *Flute* because the flute is the part of a drill bit that is responsible for the

removal of chips during a cutting operation. The flute is a helical groove that runs along the length of the drill bit. As the drill bit rotates and penetrates into the workpiece, the flutes help in evacuating the chips or swarf (material removed during cutting) away from the cutting area. Those who opted for alternatives A *Heel*, they did not know that, the term "heel" in relation to a drill bit describes the rear or trailing edge of the cutting lip and does not facilitate the passage of the chips. Likewise, those who chose option B *Shank* did not know that, regarding a drill bit, the cylindrical body situated opposite the cutting end that is, the point featuring the flutes and cutting edges is referred to as the "shank". The portion of the drill bit that is grabbed and held in place by the drill chuck or another tool-holding mechanism is called the shank. For those who opted D *Pitch* they were unaware that, the term "pitch" refers to the distance between corresponding points on adjacent turns of the helical flutes and does not support the passage of any unwanted materials from the drilled hole. In general, for those who chose wrong options lacked knowledge and skills on describing the nomenclature for a drill bit.

Item (v) was set from the topic of *Workshop Tools and Equipment*. This item tested students' knowledge on selection of a correct hacksaw blade for cutting a revolving or stationary workpiece. The question was:

Which material of hacksaw blade is appropriate for cutting a revolving or stationary workpiece?

A High tungsten steel *B High carbon steel*
C Carbide tool steel *D* High *speed steel*

The correct answer was D, *High speed steel.* The students who chose the correct alternative D understood that, high-speed steel (HSS) is a type of tool steel that is employed because of its remarkable hardness, resistance to wear, and capacity to endure high temperatures. In contrast, those who selected option A *High tungsten steel*, were not aware that, high tungsten steel is not typically used for hacksaw blades, especially in comparison to materials like high-speed steel (HSS) for cutting applications. While tungsten is a hard and dense metal, is often alloyed with other materials, such as carbide, to enhance its properties. However, it's not as common as high-speed steel for hacksaw blades for several reasons, such as cost, brittleness and manufacturability. Compared to high-speed steel, tungsten is not as frequently utilised in hacksaw blades, despite being a valuable

component in several cutting instruments and materials. For many cutting applications, high-speed steel is still a well-liked and dependable option due to its combination of toughness, cost-effectiveness, and hardness. For those who chose B high carbon steel, they lacked knowledge on the concept that, hacksaw blades made of high carbon steel are frequently used, compared to high-speed steel (HSS), although it might not be the best material to cut a rotating or stationary workpiece. Since the specific demands of cutting a rotating or stationary workpiece may benefit from the enhanced qualities of high-speed steel, high carbon steel might not be the ideal choice for this particular application. In applications where heat resistance, durability, and versatility are important considerations, high-speed steel is frequently chosen.

Others who chose C *Carbide tool steel* did not understand that, Carbide tool steel is often referred as tungsten carbide, is a very hard and wear-resistant material commonly used in cutting tools. While carbide is excellent for certain cutting applications, it may not be the ideal choice for a hacksaw blade cutting a revolving or stationary workpiece because carbide tool steel can be quite brittle, especially when compared to materials like high-speed steel.

Carbide tool steel is generally more expensive than materials like high-speed steel. For many general-purpose cutting applications, the cost-effectiveness of high-speed steel makes it a more practical choice. High-speed steel may be sharpened more easily than carbide tools. A carbide tool's sharpening procedure is more involved and needs specific equipment, while hacksaw blades may need to be sharpened on occasion as for the carbide tool steel can be advantageous when cutting hard materials, however because of these qualities, it may not be a good material for hacksaw blades used in more dynamic and adaptable cutting situations, such as cutting a rotating or stationary workpiece. The combination of high-speed steel's hardness, toughness, and ease of use makes it a well-liked and dependable option for a variety of cutting instruments, including hacksaw blades.

Item (vi) was drawn from the topic of Workshop Tools and Equipment which required the students to use knowledge of workshop tools specifically tools for cutting processes in order to choose the correct tool for cutting a given metal material. The question was:

Suppose you are assigned to cut the given metallic components: round bar with Ø20 mm, black pipe Ø25 mm and flat bar having thickness of 6 mm, which appropriate tool will you select for the job?

A Power hacksaw machine *B Hand hacksaw*
C Cold chisel *D Shear machine*

The correct alternative was B, *Hand hacksaw.* Students who chose the correct response understood the subject matter and had enough knowledge on workshop tools for cutting processes. They were able to distinguish between tools and equipment as given in alternatives above. They had enough skills to select the proper tool for cutting the material by considering tool specifications. However, those students who chose alternatives A and D, had inadequate knowledge on the topic of workshop tools and equipment. They failed to remember the differences between tools and equipment/machine and their activities. Moreover, those who chose alternative C, failed to choose the correct response regarding the subject matter. In fact, the cold chisel is used to cut material (sheet metal or wire) with small thickness or diameter and not as material provided on the question.

Item (vii) was set from the topic of *Engineering Materials*. It tested students' ability to identify various types of furnaces. The question was:

What appropriate type of furnace is required to be installed first in order to make mass production of steel for industrial use?

A Bessemer process *B Open-heath process*
C Steel making process *D Manufacturing process*

The correct alternative was *A, Bessemer process*. Students, who chose the correct alternative, had adequate knowledge on engineering material and types of furnaces. They understood that, in mass production of steel bessemer, furnace process has an advantage. Those students who chose the incorrect response B, C and D did not understand the specifications considered during the selection of furnace used in mass production of steel for industrial use.

Item (viii) was extracted from the topic of *Engineering Material.* The pig iron produced from this process contained of 93.62%Fe, 3.5%C, 1.55%Si, 0.87%Mn, 0.05%P, and 0.087%S. It required the students to identify set of elements found in producing pig iron in blast furnace. The question was:

Which set of elements are found in the process of producing pig iron by smelting iron ore in the blast furnace?

A Magnesium, manganese, sulphur, chromium and carbon
B Carbon, silicon, manganese, sulphur and phosphorus
C Sulphur, phosphorus, manganese and magnesium
D Chromium, carbon, sulphur, silicon and phosphorus

The correct answer was alternative *B, Carbon, silicon, manganese, sulphur and phosphorus.* The students who chose the correct response had enough knowledge on engineering materials. They understood that, the group of elements (carbon, silicon, manganese, sulphur, and phosphorus) listed in option B stands for essential elements used in the blast furnace smelting process to produce pig iron. They had concept that, carbon is primarily introduced into the furnace as a coke (a form of carbon derived from coal) and it acts as a reducing agent, reacting with iron ore (iron oxide) to produce molten iron. They also knew that, silicon commonly present in iron ore, and is added during the smelting process in the form of ferrosilicon, it helps to increase fluidity and lower the melting point of iron. Furthermore, they understood that, in the form of ferromanganese, manganese is added to iron ore as a separate alloy to deoxidize the molten iron and improving the quality of the final pig iron. Also they should understand that sulphur is present in iron ore, and its content needs to be controlled during the smelting process, while phosphorus is another impurity found in iron ore. Its content needs to be controlled as high levels can lead to brittleness in the resulting pig iron.

The students who opted for A, C and D had inadequate knowledge on the engineering materials. They failed to understand that, magnesium and chromium are not in the list of elements in the production of pig iron. Magnesium presence is generally not associated with the standard smelting process used in blast furnaces for converting iron ore into pig iron, similarly, chromium is not typically intentionally added during the production of pig iron. While small amounts of chromium may be present as impurities in raw materials, it is not a standard alloying element for pig iron production in a blast furnace.

Item (ix), was set from the topic of *Workshop Tools and Equipment* as well as *Engineering Drawing I*. It tested the students' knowledge in identifying the application of a divider. The question was:

Which one of the following can be the uses of divider?

A Reading the arc, measuring and dividing the line
B Dividing the arc, reading and transferring measurements
C Transferring measurement and dividing the arc
D Marking arcs, dividing a line and transferring dimensions

The correct answer was alternative D, *Marking arcs, dividing a line and transferring dimensions.* Those who chose this option were aware on the uses of divider, and applications like describing circles etc. Option C *Transferring measurement and dividing the arc*, is correct but it is not self-sufficient as option D, due to the fact that option C does not provide as many uses as option D, that is why option D has become the most correct answer than option C. Those who chose option A and B failed to know that reading does not use the divider as shown in option A and B. Reading is not the use of divider and that is the only reason why option A and B are not correct answers of this item.

Item (x), was set from the topic of Workshop Management and Safety Rules. A key element of fire safety is the colour coding of fire extinguishers, which provides a quick and simple method of determining the kind of fire that each extinguisher is intended to put out. It required the students to identify the importance of colour code in fire extinguisher. The purpose of this item was to assess the student's knowledge on firefighting using different types of extinguishers. The question was:

Why is it necessary to colour the coding in fire extinguisher?

A For its quick identification and rust prevention
B For preventing misuse and attractiveness
C For inspection and reflectiveness
D For quick identification and reflection

The correct answer was alternative *D, For quick identification and reflection.* The students who chose the correct response had adequate knowledge on *Workshop Management and Safety Rules*. They understood the primary purpose of color-coding fire extinguishers is to facilitate instantaneous extinguisher type identification. Different types of fire extinguishers are intended to put out different classes of fires (such as Class A, B, C, D Electrical fire and F), and colour coding makes it easier for users to instantly identify which class of fire the extinguisher is meant for.

This is essential to guarantee the proper and efficient use of the fire extinguisher in emergency situations. Moreover, and reflection can contribute to visibility in low-light conditions to identify the type of fire extinguisher required

Those who chose alternatives A, B, and C they did not know that the primary function of colour coding in fire extinguishers is to facilitate rapid identification by identifying the type of extinguisher and the class of fires that it is appropriate for. Although fire extinguishers are designed and manufactured with *rust prevention* and *reflection* in consideration, these are not the main reasons for colour coding. On the other hand, colour coding is not related to *inspection* of the fire extinguishers. Rather, it focuses more on making sure the fire extinguisher is in good operating order and includes checking elements such as pressure, seals, and general operation.

Students who selected the incorrect responses were unaware of the specific functions and fundamental concepts of colour coding in fire extinguishers. Understanding the purpose of color coding involves knowledge of safety standards, emergency response procedures, and the classification of fires. Lack of knowledge about these factors caused the students to choose incorrect options because they failed to recognise the primary purpose of colour coding fire extinguishers.

2.1.2 Question 2: Matching Items

This question consisted of five matching items derived from the topic of *Engineering Materials*. This question required the students to match the descriptions in List A with their corresponding responses in List B by writing the letter of the correct response below the corresponding item number in the table provided. The question was:

Match the properties of engineering material in List A *with the corresponding metallic element in* List B *by writing a letter of the correct response in the table provided.*

List A	List B
(i) It increases the elasticity, strength at high temperature and machinability of steel.	A *Vanadium*
(ii) It resists wear and corrosion, increases toughness and hardness of steel.	B *Manganese*
(iii) It is toughened and strengthen steel, fatigue and wear resistant	C *Phosphorus*
(iv) It promotes hot shortness and weakens steel by marking brittle	D *Molybdenum*
(v) It promotes cold shortness, increases strength and resists corrosion	E *Chromium*
	F *Carbon*
	G *Silicon*
	H *Sulphur*

A total of 381(100%) students attempted this question whereas, 309 (81.10%) students scored from 0 to 1 mark and 72 (18.90%) students scored from 1.5 to 3 marks. None got a score of 3.5 to 5 marks. In general, students performed poorly on this question as only 72 (18.90%) students scored average and above. Figure 2 shows the reported results.

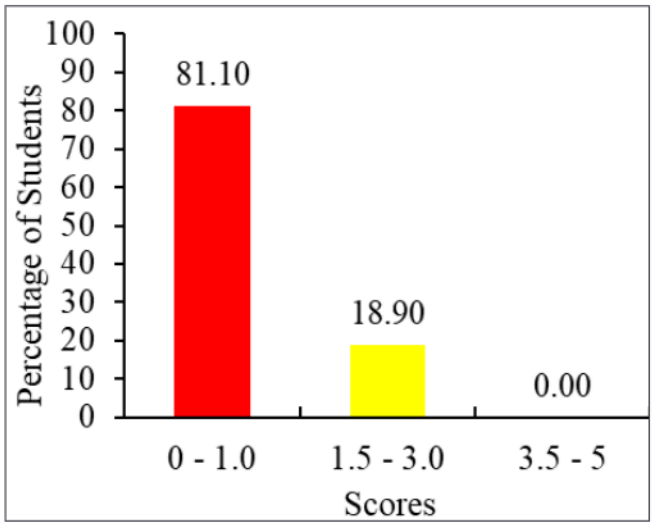


Figure 2: Students' Performance in Question 2

Most of the students failed to match the correct properties of engineering material to corresponding metallic element. The most poorly matched items were (i) and (iii). In item (i) was to match metallic element which increases the elasticity, strength at high temperature and machinability of steel. Most of the students matched this item with 'G' *Silicon* which is wrong. They did not know that, the metallic element which increases the elasticity,

strength at high temperature and machinability of steel is the D, *Molybdenum*. They further did not understand that option 'G' *Silicon* is metallic element which is associated with increasing the elasticity, strength at high temperatures, and machining ability of steel.

Item (iii) was to match the metallic element that *toughens and strengthen the steel and enhance fatigue and wear resistant.* Most of the students responded as *D Molybdenum* which is wrong. The correct respond was 'A' *Vanadium.* With this metallic element steel is strengthened and made tougher and steel resistant to wear and fatigue.

On the other side, Items (ii), (iv) and (v) were moderately responded correctly. There were those who responded correct to item (ii) and (v) while others (iv) and (v). Few managed to respond to all three. The student who managed to respond correctly to these three items were able to understand the metallic elements Chromium, Sulphur and Phosphorus are the elements where Chromium in steel causes steel to resist wear and corrosion hence, increases toughness and hardness. While Sulphur in steel promotes hot shortness and weakens steel by making brittle.

Furthermore, Phosphorus promotes cold shortness, increases strength and resists corrosion on steel. No student responded either to four or five items correctly. This is among of the poorly performed question. Most of the student who attempted this question lacked knowledge on the properties of alloying element of steel. They were supposed to understand that, alloying elements are elements that are added to steel in controlled amounts to enhance or modify its properties. Steel is primarily composed of iron and carbon, but the addition of alloying elements can impart specific characteristics such as increased strength, hardness, corrosion resistance, and other desirable properties.

Despite the few 72 (18.90%) students who managed to score from 2 to 3 marks, others had confusion between the given metallic elements to some items. For example, in item (iii) required students to identify the element that *toughens and strengthen steel improves fatigue and wear resistant*. The correct answer was *A, Vanadium*. The students who matched properly were knowledgeable on the formation of Vanadium in alloy steel. Most of the students failed to match the item with Vanadium, as they opted for *E, Chromium.* The students had a partial understanding on the formation of Vanadium and Chromium, since both elements improves toughness and

wear resistance. Generally, the students had a moderate understanding on the topic of engineering material, especially on the alloying elements of steel.

Item (ii) required the students to identify the metallic element which resists wear and corrosion, increases toughness and hardness of steel when alloyed to it. A few numbers of students were able to select the correct response 'E' *chromium.* These students understood that chromium is flexible alloying element that gives steel resistance to corrosion, hardness, wear, and high temperatures.

Item (iv) required the students to classify and match correct element which promote hot shortness and weakens steel by making it brittle. The correct answer was *H, Sulphur.* The students managed to link the correct element as they had full knowledge on the properties that are improved when steel is alloyed with sulphur. The students who chose 'phosphorous' failed to remember that, *Phosphorous* promotes cold shortness and increases strength of steel. The students who mismatch the item with *C, Phosphorous* had subjective understanding. The students matched this item with other elements did not have the proper knowledge on the effects of alloying steels with sulphur.

Item (v) required the students to relate the element that promotes cold shortness, increases strength and resists corrosion. The correct answer was *C, Phosphorous.* The students who were able to associate a correct element had competent knowledge on alloying elements of steel. Conversely, most of the students who made the incorrect selections matched the item with *H, Sulphur.* The students misunderstood the effects of alloying steels with phosphorous and sulphur. They misunderstood which one causes hot shortness and the other one that causes cold shortness. The students who opted for other element did not have the clear knowledge on engineering material especially the effects of alloying steels with Phosphorous. Generally, the weak performance of the students in this question was highly contributed by failure of understanding the demands of the questions. They also had inadequate knowledge and skills on some tested subject matters.

2.2. Section B: Short Answers Question

This section comprised of seven short answer questions. The questions were constructed from the topics of *Metal Work Technology, Workshop Management and Safety Rules* and *Workshop Tools and Equipment*. The whole section had the total of 70 marks. Each question had 10 marks.

2.2.1 Question 3: Metal Work Technology/Workshop Tools and Equipment

This question had two parts (a) and (b), the question asked:

A 60 mm x 50 mm x 8 mm mild steel bar is to be filed, hacksawed and drilled during workshop practice.

(a) Briefly explain six operational sequences in order to accomplish the work.

(b) What are the four precautions to be taken into account during the work operation?

Among 381(100%) students, 156 (40.95%) students scored 0 to 2.5 marks, 146 (38.32%) students scored 3 to 6 marks and 79 (20.73%) students scored 7 to 10 marks. The given performance is summarized in Figure 3.

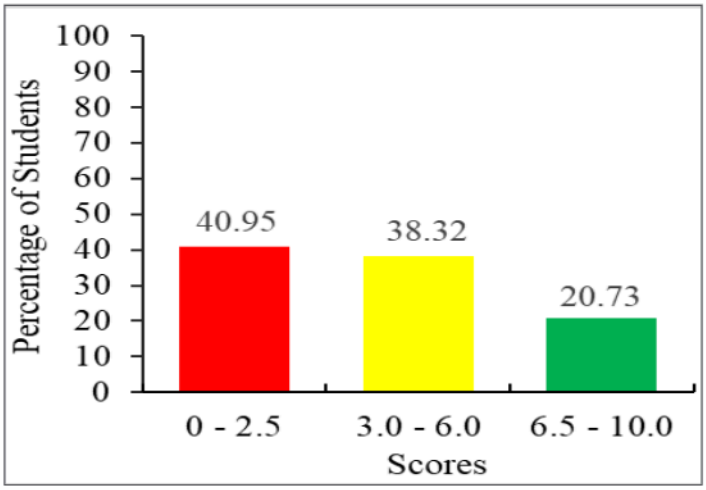
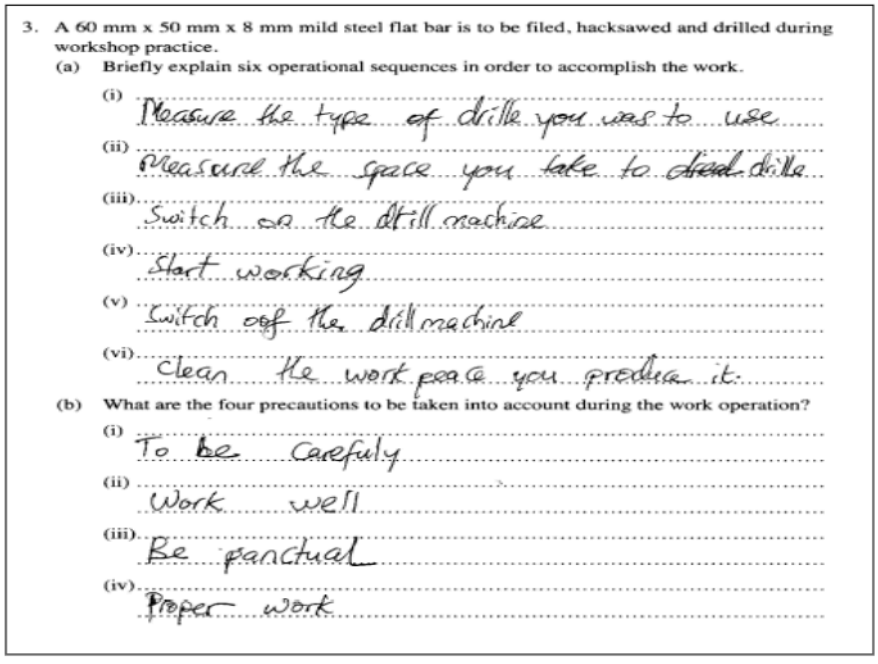


Figure 3: *The Students' Performance in Question 3*

The students who scored low from 0 to 2.5 marks failed to explain the operation sequences for accomplishing filing, cutting and drilling during workshop practice. Most of the students from this group responded incorrectly by giving the procedures of a single operation. Moreover, the students mixed workshop safety rules and the procedures for the operation sequence. Nevertheless, others from this group failed and scored 0 mark,

while others responded partially in part (a) and managed to score less.
In part (b), most of the students did not understand the requirements of the question, similarly, they did not understand the precautions taken during work, hence they gave irrelevant responses. Furthermore, they did not understand the procedures considered during specific operations such as filling, cutting and drilling. Other students gave incomplete, unclear and limited responses. For example, one student responded to this part as; *secure protection your hands from mild steel.* This shows that, the students had inadequate knowledge and skills in Metal Work Technology. Most of the students did not know the four branches of precautions which has to be taken into account during these work operations. They were unaware of Personal Protective Equipment (PPE) which includes wearing of safety glasses, ear protection and gloves. Furthermore, they did not know securing the workpiece on machine which include clamping securely and ensuring the workpiece is properly supported was also precautions during the work. Also they should remember environment of the workshop which include ventilation and cleanness of the workshop including floor, machinery, tool and equipment as should be taken into consideration as precaution during the machining period. Extract 3.1 shows the sample of weak performance from one of the students.


3. A 60 mm x 50 mm x 8 mm mild steel flat bar is to be filed, hacksawed and drilled during workshop practice.

(a) Briefly explain six operational sequences in order to accomplish the work.

(i) Measure the type of drille you was to use

(ii) Measure the space you take to dreal drille

(iii) Switch on the drill machine

(iv) Start working

(v) Switch off the drill machine

(vi) Clean the work place you produce it.

(b) What are the four precautions to be taken into account during the work operation?

(i) To be Carefuly

(ii) Work well

(iii) Be panctual

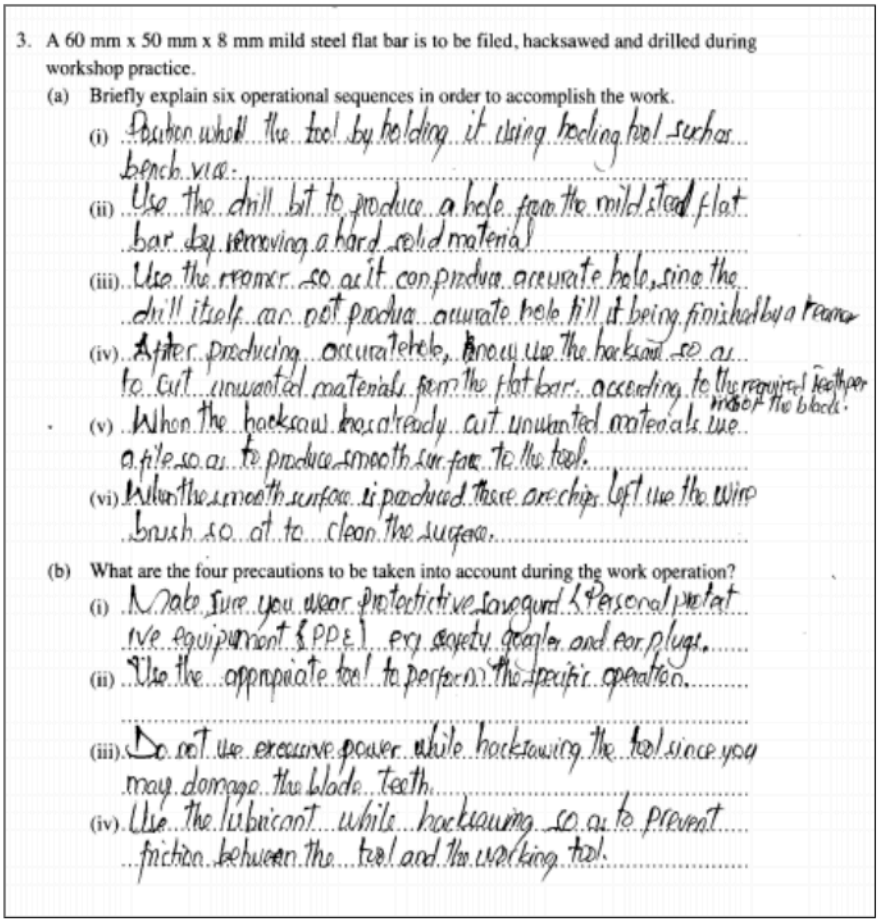
(iv) Proper work

Extract 3.1: A sample of a student's weak responses to Question 3

In Extract 3.1, the student provided irrelevant responses to this question. In part (a) s/he wrote wrong operation sequence as well as in part (b) produced unclear safety precaution with regard to machine and workshop safety.

On the other hand, the students who performed averagely understood the question, but had partial knowledge on Workshop Tools and Equipment as well as Metal Work Technology. The majority of them were able to give a few correct steps for the operation sequence in accomplishing the work during workshop practice. For example, in part (a) one student wrote *(i) measuring and marking the work piece (ii) to use a hammer and dot punch to produce a mark* and *(iii) fix the mild steel bar and drill a hole at the marked location.* In part (b) this student wrote *(i) Wear good gloves to protect your hands* and scored average on this question. Some students managed to respond perfectly in part (a) but failed in part (b) and the vice versa thus scoring average as well.

Though the question was averagely performed, there were those who scored high. Some of these students managed to write correct operation sequence in part (a) and some safety precaution in part (b) thus obtained high scores. Only 5 (1.31%) students got all 10 marks in this question. These were able to answer correctly both parts, (a) and (b). They had knowledge and skills about filing, cutting using a hacksaw and drilling the work of 60 mm x 50 mm x 8 mm mild steel bar thus, they wrote operational sequences to accomplish the entire intended work in part (a). They were also knowledgeable about the safety precaution to take into consideration during the operation of filing, hacksawing and drilling. Their description of operation sequence and safety precaution demonstrated that, the students had adequate knowledge and experience in workshop tools and equipment and workshop safety. Extract 3.2 is a sample of good responses from a script of one of the students.



3. A 60 mm x 50 mm x 8 mm mild steel flat bar is to be filed, hacksawed and drilled during workshop practice.

(a) Briefly explain six operational sequences in order to accomplish the work.

(i) Position whole the tool by holding it using holding tool such as bench vice.

(ii) Use the drill bit to produce a hole from the mild steel flat bar by removing a hard solid material

(iii) Use the reamer so as it can produce accurate hole, since the drill itself can not produce accurate hole till it being finished by a reamer

(iv) After producing accurate hole, know use the hacksaw so as to cut unwanted materials from the flat bar according to the required length or width of the blank.

(v) When the hacksaw has already cut unwanted materials use a file so as to produce smooth surface to the tool.

(vi) When the smooth surface is produced there are chips left use the wire brush so as to clean the surface.

(b) What are the four precautions to be taken into account during the work operation?

(i) Make sure you wear protective safeguard & Personal protative equipment (PPE) eg safety goggles and ear plugs.

(ii) Use the appropriate tool to perform the specific operation.

(iii) Do not use excessive power while hacksawing the tool since you may damage the blade teeth.

(iv) Use the lubricant while hacksawing so as to prevent friction between the tool and the working tool.

Extract 3.2: A sample of student's good responses to Question 3

Extract 3.2 shows a sample of correct responses from a student who managed to answer correctly the question. S/he was able to give the proper steps to complete the workshop practice of drilling, filing and hacksaw cutting in part (a). In part (b), s/he was able to write down the safety measures that were taken into account while doing the work.

2.2.2 Question 4: Workshop Management and Safety Rules

This question was constructed from the topic of Workshop Management and Safety Rules. The question had two parts (a) and (b). In part (a), the students were required to identify any five causes of accidents caused by mechanical Equipment. In part (b), the students were required to identify any five causes of accidents caused by human errors. The question was:

Suppose you were assigned to do safety assessment in school workshop and you observe that there were many accidents caused by mechanical and human errors. Briefly explain five mechanical causes of accident and five human causes.

(a) Mechanical causes

(b) *Human error causes*

The question was attempted by 381(100%) students. The performance analysis shows that, 67 (17.59 %) students scored from 0 to 2.5 marks, 167 (43.83%) students scored from 3.0 to 6.0 marks and 147 (38.58%) students scored from 6.5 to 10 marks. Generally, the performance in this question was good as 314 (82.41%) students scored from 3.0 to 10 marks. Figure 4 portrays the students' performance in this question.

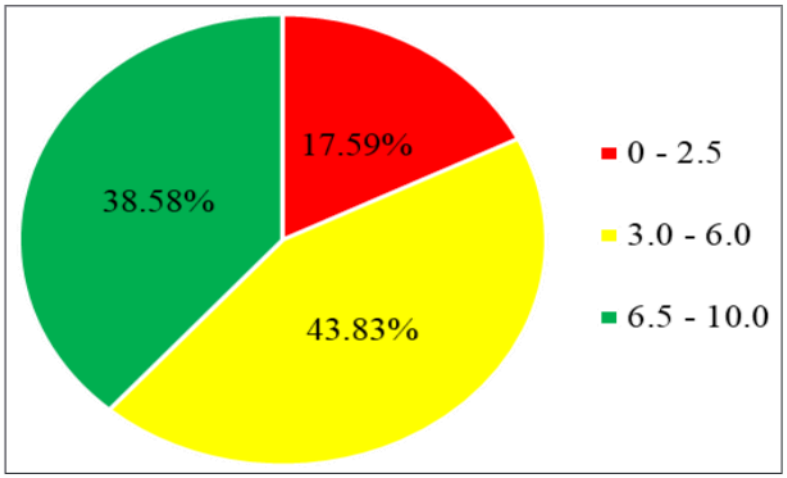
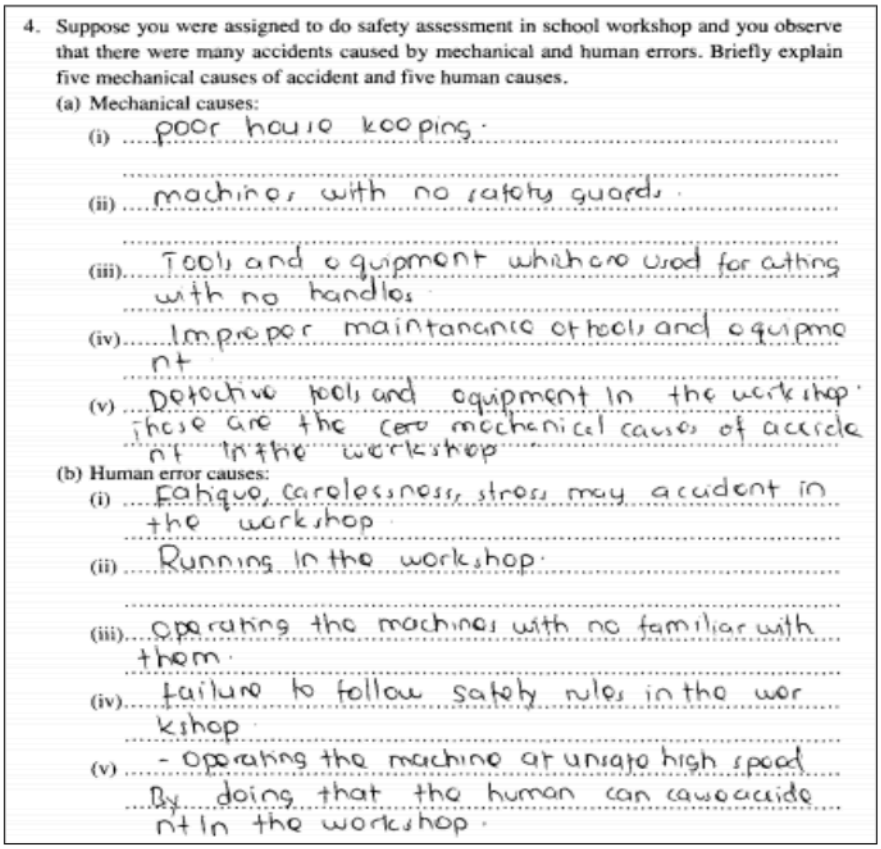


Figure 4: The Students' Performance in Question 4

Students' performed well on this subject matter, according to the statistics in Figure 4. It reveals that, 314 (82.41%) students accurately identified the accidents caused by both human and mechanical error. In part (a) they knew that, the use of old machine, use of unguarded or improper guarded equipment and improper plant layout can cause accident. They also identified that, use of weak maintained equipment, improper material handling system and improper design are mechanical cause of accident. Moreover, the students were able to give the human cause of accident. They perfectly understood that, improper use of tools, failure to apply person protective equipment (PPE's), operating a machine without knowledge and operating or working at unsafe speed can cause accidents. The students from this group knew that, long period of working and

failures to use standard operation procedure are the human causes of accidents. These students had good understanding on the topic of Workshop Management and Safety Rules. Extract 4.1 illustrates the responses given by one of the students who attempted well this question.



4. Suppose you were assigned to do safety assessment in school workshop and you observe that there were many accidents caused by mechanical and human errors. Briefly explain five mechanical causes of accident and five human causes.

(a) Mechanical causes:

(i) poor house keeping.

(ii) machines with no safety guards.

(iii) Tools and equipment which are used for cutting with no handles.

(iv) Improper maintanance of tools and equipment.

(v) Defective tools and equipment in the workshop. These are the zero mechanical causes of accide nt in the workshop.

(b) Human error causes:

(i) Fatigue, carelessness, stress may accident in the workshop.

(ii) Running in the workshop.

(iii) Operating the machines with no familiar with them.

(iv) failure to follow safety rules in the wor kshop.

(v) - operating the machine at unsafe high speed By doing that the human can cause accide nt in the workshop.

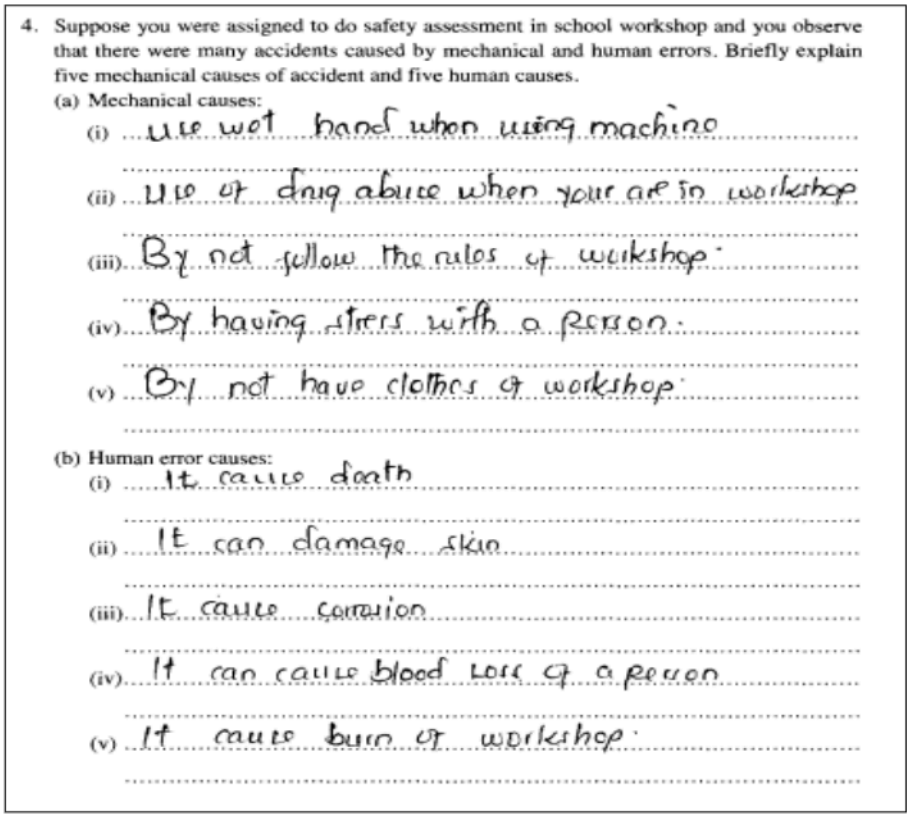
Extract 4.1: A sample of student's good responses to Question 4

Extract 4.1 shows that, the student managed to give the correct response to mechanical causes of accident in part (a). Moreover, he/she managed to mention the human error causes of accidents.

Additionally, 167 (43.83%) students who scored average responded partially to both parts of the question. Some students were able to identify five causes of accidents caused by mechanical equipment in part (a) and did not managed to give few responses in part (b) and the vice versa. Others were capable to give partially correct answers in either part (a) or (b) thus scored average scores. The variations observed in the students' scores depended on the students' ability to give the appropriate responses. It seemed that, some students had insufficient understanding or knowledge

about mechanical and human factors that contribute to accidents in workshop settings. They were not familiar with the machinery, safety protocols, or human error concepts. It was evident from several students' comments that those lacking hands-on experience in a workshop setting could find it difficult to envision or pinpoint potential reasons of accidents. Their inability to experience real-world workshop circumstances limited their capacity to provide appropriate responses. Extract 4.1 shows a sample of an incorrect response from the student who scored low marks.

On the other hand, there are two groups of the students who scored poorly from 0 to 2.5 marks, those who got zero and others between 0.5 and 2.5 marks. Those who got zero were not knowledgeable about causes of accident either by mechanical or human error. They did not understand that accidents can occur due to mechanical failures in workshop machinery and tools. Furthermore, insufficient training of worker in the proper use of tools and machinery can lead to human errors. They did not understand about the mechanical error that can be caused by faulty equipment, lack of machine guard, poor maintenance and tool misuse or failure. On the other hand, they were unaware that lack of training, complacency and lack of awareness, poor communication, fatigue and stress and failure to follow safety procedures can cause accidents due to human error. In general, they did not know that the “mechanical causes of accidents" describes malfunctions or breakdowns in machinery, equipment, or systems that result in accidents or incidents. They also did not know that human error in other way is a significant contributor to many accidents and incidents across various workshops activities. Some students did not respond to the question in both parts. Moreover, students in this group identified few responses and others interchanged the responses of part (a) in (b) and (b) in (a). The analysis implies that, these students had inadequate knowledge on workshop Management and Safety Rules. Some of the students who score 1 to 2 marks were able either to write one correct response in either part or wrote two correct responses in one part of the question.



4. Suppose you were assigned to do safety assessment in school workshop and you observe that there were many accidents caused by mechanical and human errors. Briefly explain five mechanical causes of accident and five human causes.

(a) Mechanical causes:

(i) use wet hand when using machine

(ii) Use of drug abuse when your are in workshop

(iii) By not follow the rules of workshop.

(iv) By having stress with a person.

(v) By not have clothes of workshop.

(b) Human error causes:

(i) It cause death

(ii) It can damage skin

(iii) It cause corrosion

(iv) It can cause blood lose of a person

(v) It cause burn of workshop.

Extract 4.2: A sample of student's weak response to Question 4

Extract 4.2 shows a sample response from a student who failed to respond to both parts of the question. S/he confused between mechanical and human errors. Instead of mechanical error he/she wrote few human errors in part (a). In part (b), the student gave the effects of accidents that are caused by human error instead of writing human error that can result into an accident.

2.2.3 Question 5: Metal Work Technology

This question was derived from the topic of Metal Work Technology. It had two parts, (a) and (b). Part (a) required the students to explain the differences between fusion and non-fusion welding processes. Part (b) required the students to analyze five procedures to be followed in order to shut down the gas plant after finishing welding activity. The question was designed to assess students' knowledge and skills on the welding practices. The question was:

(a) *The process of joining two metals using gas welding can be done either by fusion or non-fusion welding process. What makes these two processes differ from each other?*

(b) *Briefly explain five procedures you will follow in order to shut down a gas plant after finishing welding activity.*

The question was attempted by 381(100%) students; from which 159 (41.73%) scored from 0 to 2 marks, 110 (28.87%) scored from 3 to 6 marks, and 112 (29.40%) scored from 7 to 10 marks. Generally, the students' performance in this question was average since 222 (58.27%) of the students scored from 3 to 10 of the allocated marks. This performance is summarized in Figure 5.

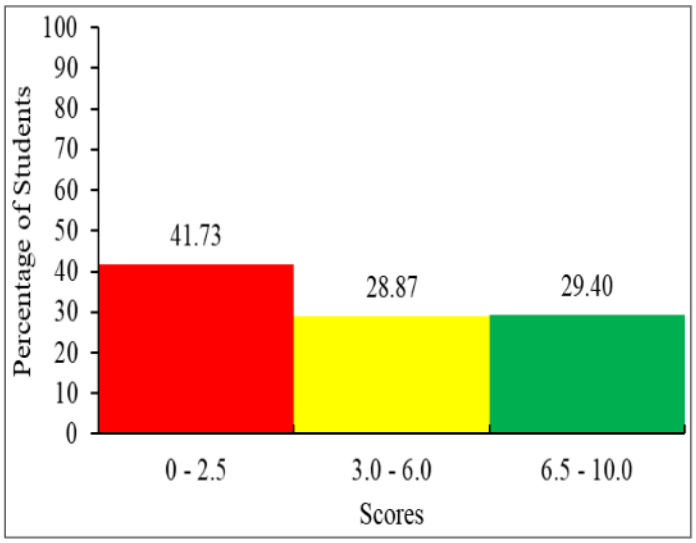


Figure 5: The Students' Performance in Question 5

The performance trend in Figure 5 shows that, the students' performance was average since 222 (58.27%) scored from 3 to10 marks. The students' response analysis reveals that 159 (41.73%) of students performed poorer. From Figure 5 it shows that, 112 (29.40%) students performed well. These students proved to have a clear understood the main distinction between fusion and non-fusion welding in gas welding is the degree to which the base metals are melted in order to create the junction in part (a). They further knew that, in contrast to non-fusion welding, which creates a joint without melting the base metals, but in fusion welding the base metals being joined are melted to create a molten pool, which then solidifies to

form a joint upon cooling. They further knew that, in non-fusion welding, instead of melting the base metals, the joining process occurs at temperatures below the melting point, often through the application of pressure or friction. Further analysis shows that among these students described further this part correctly as welding techniques including gas welding processes such as forge welding, resistance welding, and friction welding. In part (b) these students were able to produce all five procedures to be followed in shutting down. They understood that, the first step in shutting down a gas plant is turning off the acetylene by the blowpipe control valve followed by turning off the oxygen by the blow pipe control valve, then close the cylinder valves or both acetylene and oxygen and opening the blowpipe valves to release pressure in the hoses and finally unscrewing the pressure regulating screws on the regulator. Some of the students from this group were able to answer correctly a large portion of the question and scored high marks but less than 10 marks. They were able to answer a large portion of the question but missed some point in either part (a) or (b). For example, one student answered correctly part (a) and missed two point to explain the procedure in shutting down a gas plant in part (b), thus scored high marks but less than 10 marks. Extract 5.1 is an example of responses from a student who performed well.

5. (a) The process of joining two metals using gas welding can be done either by fusion or non-fusion welding process. What makes these two processes differ from each other?

Fusion welding is a type of welding where the parent metals are melt heated ~~below~~ above their melting points so as the melt and fuse so as to form a joint WHILE

Non fusion welding is when the parent metals are not heated above their melting points

(b) Briefly explain five procedures you will follow in order to shut down a gas plant after finishing welding activity.

(i) Turn off the acetyline valve

The acetyline control valve should be firstly turned off.

(ii) Turn off the oxygen valve

The oxygen control valve should follow to be turned off

(iii) Close the acetyline knobs in the acetyline cylinder

Close the acetyline knob to stop the supply of acetyline.

(iv) Close the oxygen knob in the oxygen cylinder

Close the oxyen knob to stop the oxygen supply

(v) Secure the gas cylinders with a wrench

Secure with a wrench to avoid gas leakage in the cylinders

Extract 5.1: A sample of student's good responses to Question 5

In Extract 5.1, the students were able to explain correctly the differences between fusion and non-fusion welding processes in part (a). He/she wrote correct procedures taken to shut down gas welding plant after finishing welding task.

On the other hand, there were students who were able to give a correct response to some parts of the question. For instance, some students managed to answer correctly in part (a) while failed to respond perfectly part (b) and the vice versa. This analysis proves that, the students had partial knowledge, skills and experience in gas welding and fusion or non-fusion welding process in the topic of Metal Work Technology. Some students provided the standard procedures for shutting down a gas welding plant after finishing welding activity. The students realized that, to close both acetylene and oxygen cylinder blow pipe control valves and close cylinder valve for acetylene and oxygen are among the procedures to shut down a gas welding plant. Furthermore, they were able to understand that, to open the blow pipe valve for releasing pressure in the holes and unscrew the pressure regulator are the next procedures. Students from this group have acceptable skills and experience on metal work technology notably in gas welding process.

Despite of the students who had good and average scores, there were those 159 (41.73%) students who had weak performance. Among them, 86 (22.6%) failed by scoring zero because they lacked knowledge fusion and non-fusion welding in part (a) and on welding procedures and practices in part (b). It seemed they had inadequate training or skills on proper shutdown procedures for a gas plant after welding activity. They were unaware of the necessary steps involved in shutting down the plant. Furthermore, they had inadequate knowledge of gas welding and its terminologies. Some of them mixed the group of gas welding and the technique of arc welding. Some of their responses reveal that, others did not understand the question context on part (b) and wrote the procedures of shut down an arc welding plant instead of gas welding plant. Extract 5.2 is an example of a weak response from one of the students' scripts.

5. (a) The process of joining two metals using gas welding can be done either by fusion or non-fusion welding process. What makes these two processes differ from each other?

~~buting on and conner~~ buting the differed of or welding in the activities in the activity bufting ~~used~~ used to proces the joining the metal

(b) Briefly explain five procedures you will follow in order to shut down a gas plant after finishing welding activity.

(i) It is the arc welding or the absore time plant and weld of its to the study or application or workshop to machine

(ii) The lower method to the welding to proporation to brify the procedures or development of economic

(iii) help to because or between to the activity to the arc welding Dring machine workshop

(iv) help and the workshop to accident to the Dangerous to machine will come nato the flammable and ocean

(v) it snot to the should be the after program to the work shop to current or Dangerous to the following and mining

Extract 5.2: A sample of student's weak responses to Question 5

In Extract 5.2, the student responded both parts incorrectly. The student did not distinguish between fusion and non-fusion welding in part (a). S/he responded without considering the context of the question. Additionally, s/he did not adequately describe the five steps that must be taken in item (b) when shutting down a gas welding facility.

2.2.4 Question 6: Metal Work Technology

This question was composed from the topic of Metal Work Technology. It had two parts, (a) and (b). Part (a) required the students to list the advantages and disadvantages of Direct Current Straight Polarity (DCSP) and Direct Current Reverse Polarity (DCRP). Part (b) required the students to give a short explanation and a well labelled sketch of a Direct Current Straight Polarity (DCSP). The question was designed to assess students' knowledge of connecting workpiece on the arc welding power supply

source forming the DCSP. The question was:

(a) *Give two advantages and two disadvantages of Direct Current Straight Polarity (DCSP) and Direct Current Reverse Polarity (DCRP) welding* processes

(b) With the help of well labelled sketch diagram, explain how you will connect your workpiece from arc welding power supply source to get a Direct Current Straight Polarity *(DCSP).*

The statistics show that 381(100%) students attempted this question, from which 152 (39.90%) scored from 0 to 2 marks, 146 (38.32%) scored from 3 to 6 marks and 83 (21.78%) students scored from 7 to 10 marks. Figure 6 presents the students' performance in this question.

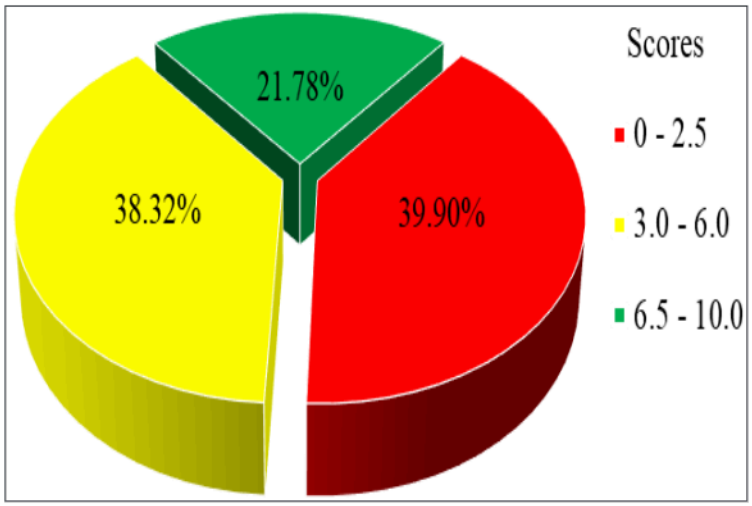
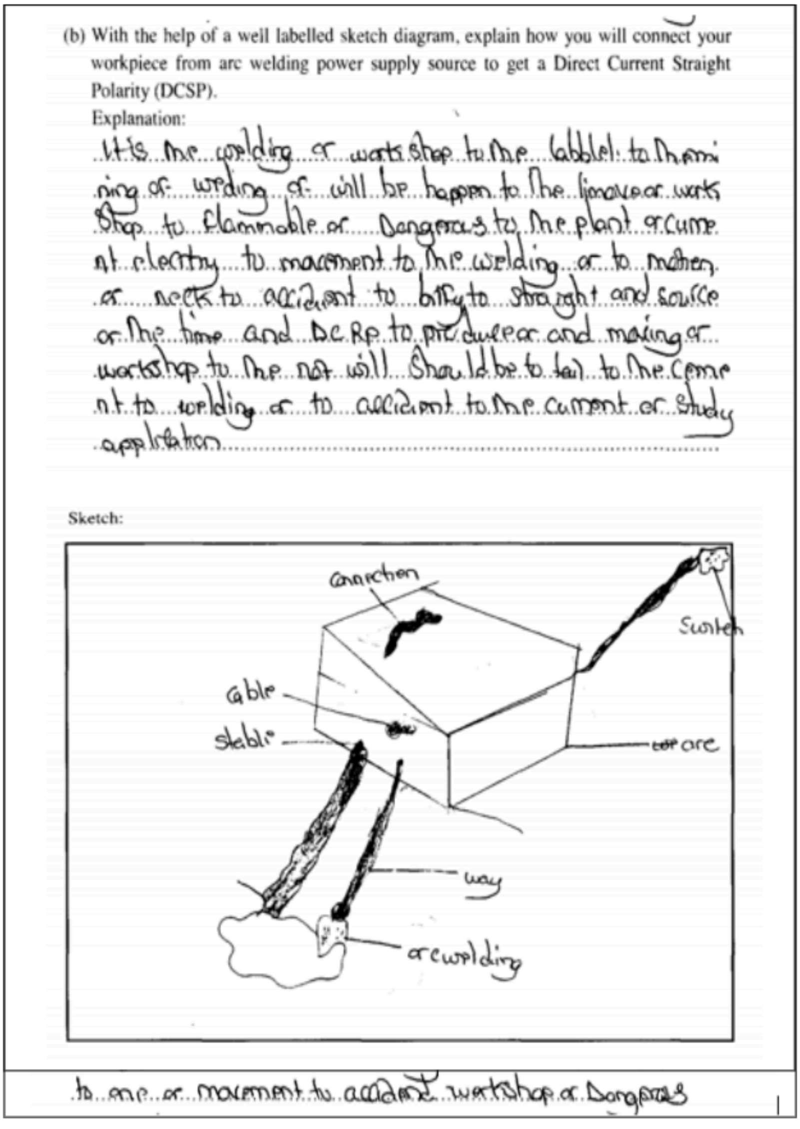


Figure 6: The Students' Performance in Question 6

This is among the question with average performance, where 152 (39.90%) of the students performed poorly. Among them 97 (25.5%) performed poor by scoring zero. These students mixed up the advantages of Direct Current Straight Polarity, (DCSP) to Direct Current Reverse Polarity, (DCRP) and the vice versa. They also failed to provide two disadvantages of each (DCSP) and (DCRP) in part (a). In part (b), some students mismatched the connection of workpiece on the arc welding power supply source to get a DCSP. They also failed to label parts of the connection. Furthermore, they failed as well to illustrate direction of electric current of DCSP circuit correctly. It seemed that, they were incapable to clarify that the cable

which carries an electrode holder and electrode is connected to the positive terminal of the power source while that carrying an earth is connected to the negative terminal of the power source. Generally, these students lacked knowledge, experience and skills on metal work technology especially on arc welding processes. Students did not have a solid knowledge of welding polarity concepts, such as how DCSP and DCRP impact the welding process and the properties of the final weld. Extract 6.1 is a sample of poor responses from one of the students.


(b) With the help of a well labelled sketch diagram, explain how you will connect your workpiece from arc welding power supply source to get a Direct Current Straight Polarity (DCSP).

Explanation:

It's the welding or works shop to the labblel to the mai ning or welding or will be happen to the limover works Shop to flammable or Dangerous to the plant or cume nt electry to movement to the welding or to mother, or necks to accident to bify to straight and source or the time and DCRP to preducer and making or workshop to the not will Should be to fail to the Come nt to welding or to accident to the current or Study application

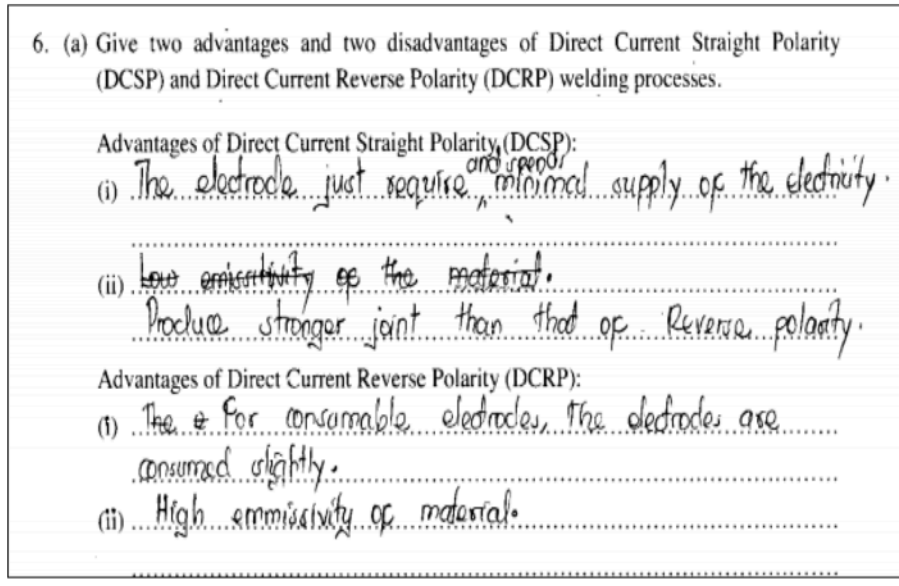
Sketch:

to one or movement to accident workshop or Dangerous

Extract 6.1: A sample of incorrect responses to Question 6

On the other hand, the 146 (38.32%) of students who scored average managed to provide few correct responses in either one or both parts. They also gave perfect answers partially in either part (a) or (b). Most of the students who scored average repeated some advantages and disadvantages in both parts of the question. Others jotted down few advantage and disadvantage in part (a) and they either drew incomplete diagram or did not label it in part (b). The analysis further indicates that, the students understood the question context but had partial knowledge, skills and experience on DCSP and DCRP technique to attempt the question correctly as a result they ended up scoring average scores.

Despite the poor and average performance, there were 83 (21.78%) students who had higher marks. Among these students, there were two groups of those who got all 10 marks and those who got scores from 6.5 to 95 marks. For those who scored all the marks wrote correct advantages and disadvantages of both DCSP and DCRP in part (a). In part (b) they were able to sketch a DCSP connection diagram and allocate each part perfectly and were also able to specify the flow of electric currents. Their responses reveal that they understood that, electrode holder connected to the positive terminal and workpiece or base metal connected to the negative terminal in DCSP. Furthermore, these students had adequate knowledge, skills and experience on metal work technology. Extract 6.2 shows a sample of responses from a student who provided relevant answer to this question.



6. (a) Give two advantages and two disadvantages of Direct Current Straight Polarity (DCSP) and Direct Current Reverse Polarity (DCRP) welding processes.

Advantages of Direct Current Straight Polarity (DCSP):

(i) The electrode just require and speed minimal supply of the electricity.

(ii) ~~Low emissivity of the material.~~ Produce stronger joint than that of Reverse polarity.

Advantages of Direct Current Reverse Polarity (DCRP):

(i) The ~~e~~ For consumable electrodes, the electrodes are consumed slightly.

(ii) High emmissivity of material.

Disadvantages of Direct Current Straight Polarity (DCSP):

(i) High consumability of the electrode.

(ii) Low emmisivity of material.

Disadvantages of Direct Current Reverse Polarity (DCRP):

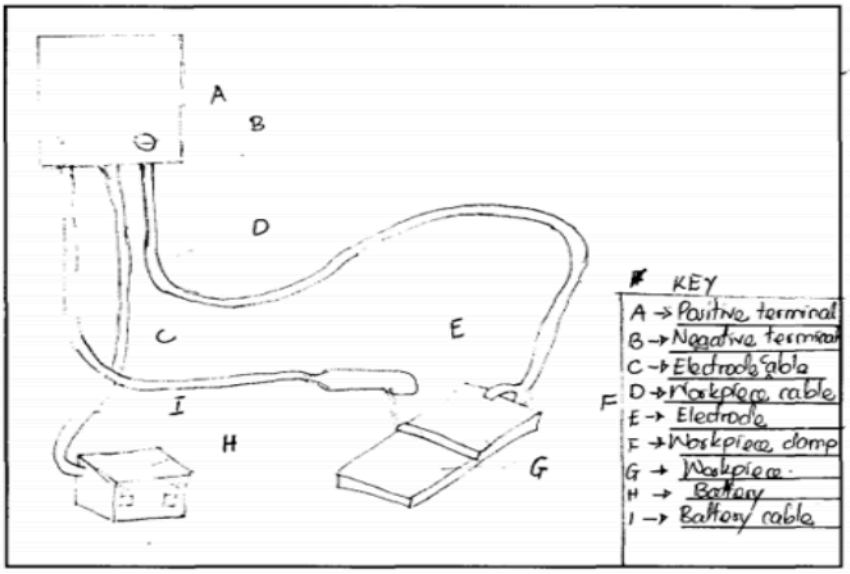
(i) The electrode uses much supply of electricity.

(b) With the help of a well labelled sketch diagram, explain how you will connect your workpiece from arc welding power supply source to get a Direct Current Straight Polarity (DCSP).

Explanation:

From the power source connect the electrode cable to the positive (+) terminal and the workpiece cable to the negative (-) terminal.

Sketch:



Extract 6.2: A sample of a student's good response to Question 6

In Extract 6.2 the student managed to explain the advantages and disadvantages of DCSP and DCRP in part (a). He/she managed to draw a well labeled sketch diagram and show the connection of workpiece from arc welding power supply source to get a DCSP in part (b).

2.2.5 Question 7: Workshop Management and Safety Rules

This question had two parts (a) and (b). The students were required to use their knowledge of Workshop Management and Safety Rules to respond to question part (a) and (b). Part (a) required students to explain four importance of establishing safety and health programmes in industries. Part (b) required the students to analyse any six safety precautions practiced in order to avoid injuries in machine shops. The purpose of the question was to assess how well the students could practice the use of safety precaution in working area. The question was:

(a) *Why is it important to establish safety and health programmes in industries? Give four benefits.*

(b) *What are the six personal safety precautions you should practice in order to avoid injuries in machine shop?*

The question was attempted by 381(100%) students from which, 39(10.24%) students scored from 0 to 2 marks, 45 (11.81%) scored from 3 to 6 marks and 297 (77.95%) scored from 7 to 10 marks.

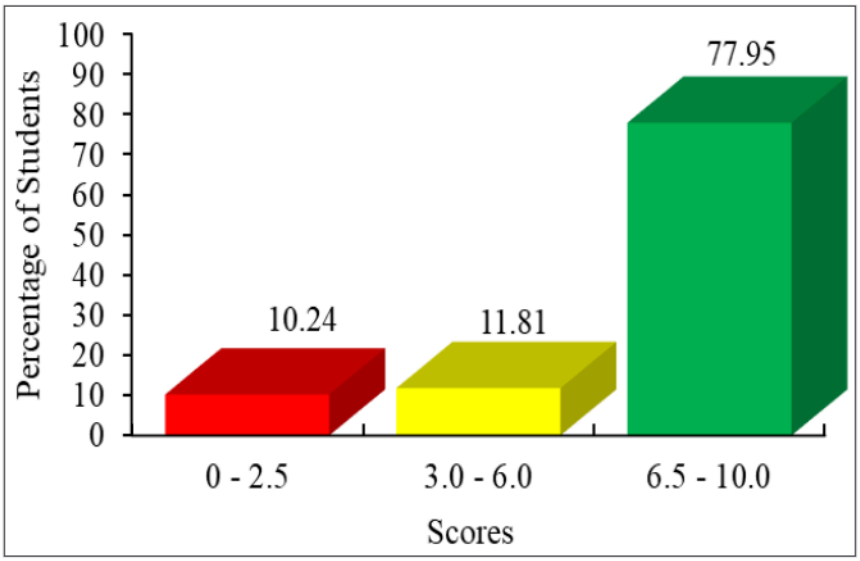
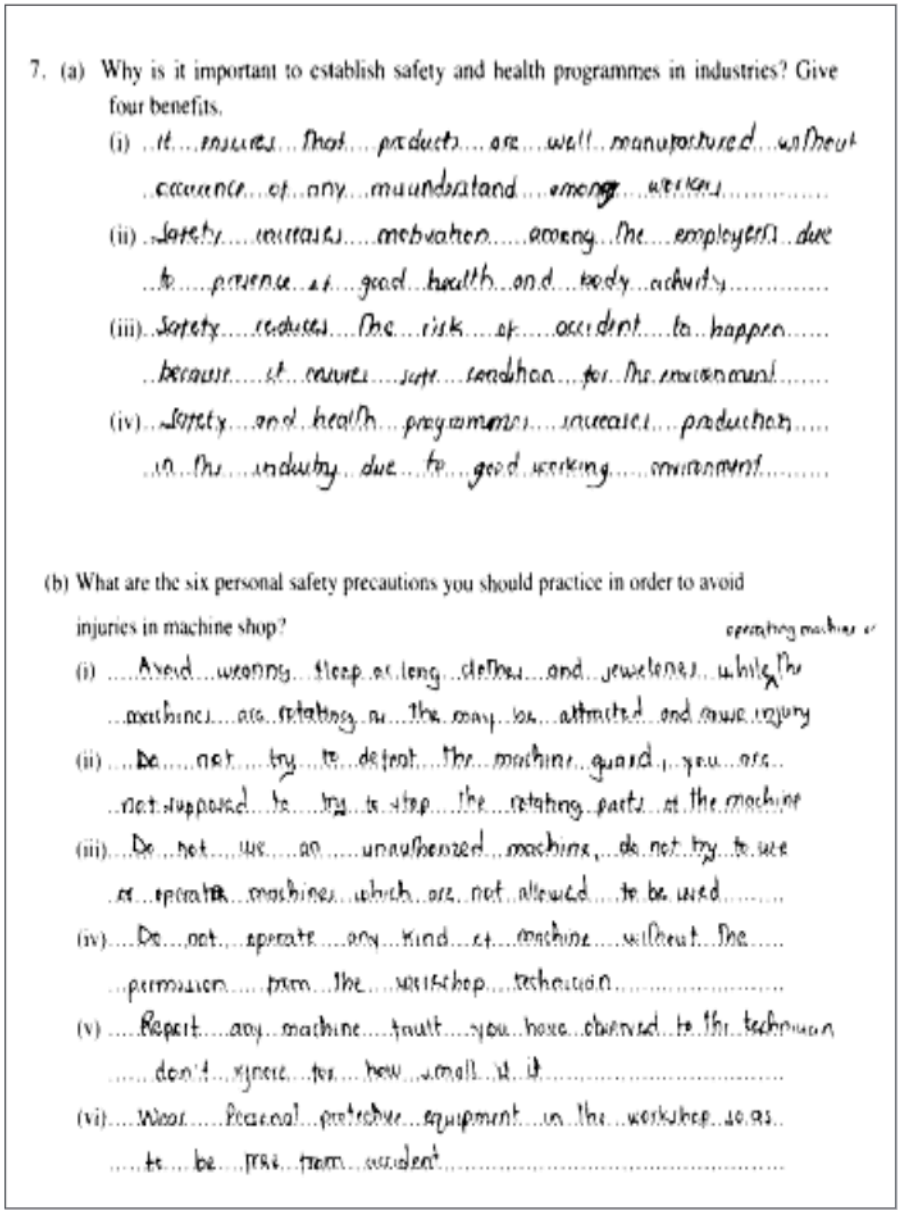


Figure 7: The Students' Performance in Question 7

This is the question which most of the students performed well as 297 (77.9%) scored high marks and among them 183 (48%) scored all 10 marks. Those who scored all marks, in part (a) were able to state that, establishing safety and health programs in industries is crucial for ensuring

the well-being of workers and maintaining a productive and sustainable workplace environment. They further outlined the benefit of establishing safety and health programmes in industries as to increase productivity and efficiency, prevention of accidents and injuries, to increase motivation and morale to workers, ensuring legal compliance and increasing the quality of the products. In part (b) were able to mention the six personal safety precautions which should be practiced in order to avoid injuries in machine shop. In general, in part (a) they managed to state that, establishing safety and health programmes is crucial for industries to ensure regulatory compliance, safeguard employees, foster a positive work environment, and achieve long-term cost savings and profitable outcomes. Apart from part (a), in part (b) they stipulated that, workers could reduce their risk of injury and make the machine shop a safer place to work by continuously implementing the personal safety precautions they enlisted. Despite the student who scored all marks, there were those with high score but less than 10 marks. These students were either able to answer correct part (a) and partially part (b) or the vice versa. Extract 7.1 is an example of responses from a successful student.



7. (a) Why is it important to establish safety and health programmes in industries? Give four benefits.

(i) It ensures that products are well manufactured without occurence of any misunderstand among workers

(ii) Safety increases motivation among the employers due to presence of good health and body activity

(iii) Safety reduces the risk of accident to happen because it ensures safe condition for the environment

(iv) Safety and health programmes increase production in the industry due to good working environment

(b) What are the six personal safety precautions you should practice in order to avoid injuries in machine shop?

(i) Avoid wearing sleep or long clothes and jewelenes while the machines are rotating as the may be attracted and cause injury

(ii) Be not try to defeat the machine guard you are not supposed to try to stop the rotating parts of the machine

(iii) Do not use an unauthorized machine, do not try to use or operate machines which are not allowed to be used

(iv) Do not operate any kind of machine without the permission from the workshop technician

(v) Report any machine fault you have observed to the technician don't ignore for how small it is

(vi) Wear Personal protective equipment in the workshop so as to be free from accident

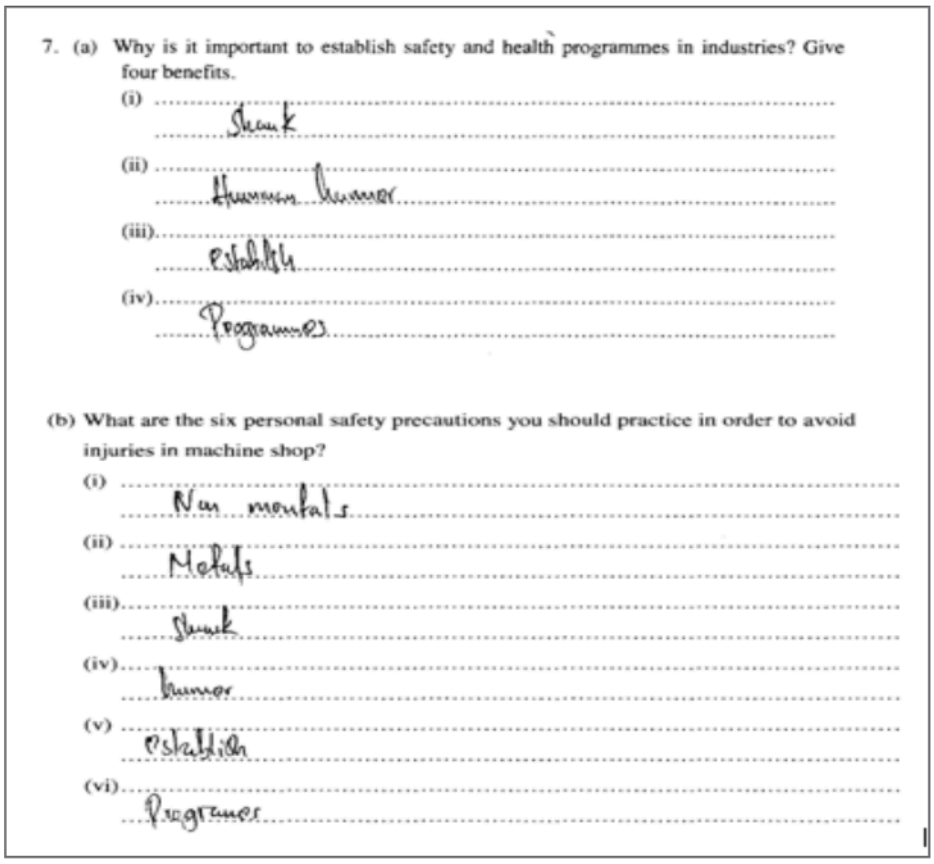
Extract 7.1: A sample of student's good responses to Question 7

Extract 7.1 shows responses of a student who managed to provide benefits of establishing safety and health programs in industries in part (a). In part (b) he/she succeeded to enlist the personal safety precautions practices to avoid injuries in machine shop.

Further analysis shows that, 31 (11.81%) of the students managed to score average by providing partial responses to part (a) and (b). For example, they provided less than required the benefits of establishing safety and

health programs in industries in part (a) and wrote less than six on the list that was required on the need to take personal safety precautions to prevent injuries in machine shops in part (b) thus led them to pursue average scores in this question. Others responded correctly part (a) but incorrectly in part (b) and the vice versa, therefore they ended up with average score as well. This trend of performance indicates that, the students had moderate understanding on the topic of Workshop Management and Safety Rules especially on the benefits of establishing safety and health programs in industries and personal safety precautions in machine shop. They had a limited understanding of the fundamentals and significance of workplace safety. They partially grasped the significance of safety and health programs in preventing workplace injuries and promoting well-being. They also seemed to lack 'awareness of industry standards' as such**,** students were not fully familiar with relevant safety regulations, standards, and best practices applicable to industries and machine shops.

Apart from those with average performance, 33 (10.24%) had weak performance. There were two groups of these students, those who scored a zero and others who achieve to score 1 or 2 marks. The analysis indicates that, the students who scored zero mark lacked knowledge on both; importance to establish safety and health programs in industries in part (a) and on the personal safety precautions which should be practiced in the machine shop in order to avoid injuries in part (b). Besides, some of the students confused between function of safety gears and benefit of safety and health programs. For example, in part (a) they listed safety gears such as helmets, safety goggles, gloves and respirators instead of listing benefits of safety and health programs which focus on comprehensive strategies and initiatives aimed at promoting and maintaining a safe and healthy work. In general, this group of students did not know the fact that, safety gears provide direct physical protection to individuals from workplace hazards, while safety and health programs encompass broader organizational strategies aimed at promoting safety, preventing injuries and illnesses, and fostering a culture of health and well-being in industries. Others from this group were those with 1 or 2 marks whereby, they managed either to write only one response in either part of the question or wrote one correct response in each part of the question thus they scored 1 or 2 marks respectively. Extract 7.2 is an example of incorrect responses to this question.


7. (a) Why is it important to establish safety and health programmes in industries? Give four benefits.

(i) Skeuk

(ii) Human human

(iii) Pshshsh

(iv) Programes

(b) What are the six personal safety precautions you should practice in order to avoid injuries in machine shop?

(i) Non mental s

(ii) Metals

(iii) Skeuk

(iv) humor

(v) Pshshsh

(vi) Programer

Extract 7.2: A sample of student's poor responses to Question 7

Extract 7.2 shows the student's answers to both parts were wrong because they were not relevant to the scenario in question. He/she wrote irrelevant responses showing that s/he was not conversant to the topic tested.

2.2.6 Question 8: Metal Work Technology

This question had two parts (a) and (b). The students were required to use their knowledge of the metal work technology to give a correct response to the subject matter. In part (a) students were required to explain the term marking out as used in bench work. In part (b) the students were required to list eight operation procedures to accomplish a marking out of a steel plate to be drilled. The key objective of the question was to assess students' abilities to mark out the workpieces before operation. Moreover, the question intended to measure the students understanding for preparation of work to be drilled. The question was:

(a) Briefly explain the term 'marking out' as used in bench workshop.

(b) You have been assigned to mark steel plate to be drilled. Give eight operations procedure you will follow to accomplish the task.

The question was attempted by 381 (100%) students from which 97 (25.46%) scored from 0 to 2 marks, 112 (29.40%) scored from 3 to 6 marks and 172 (45.14%) scored from 7 to 10 marks. Figure 8 summarizes this performance.

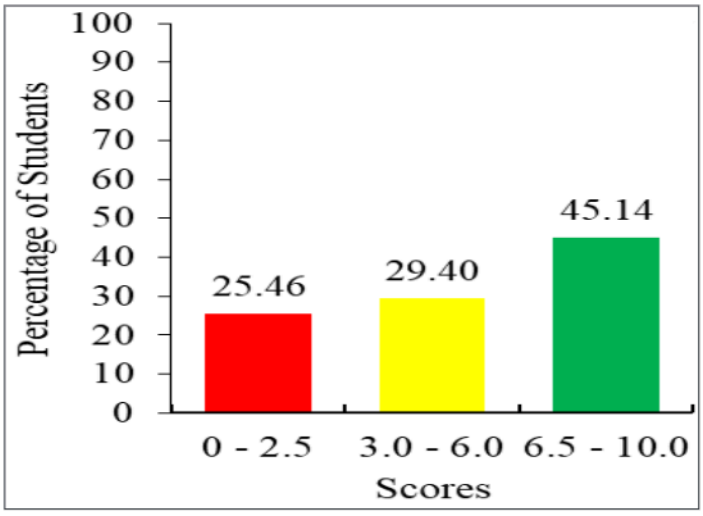


Figure 8: The Students' Performance in Question 8

The general performance in this question was good since 284 (74.54%) students scored from 3 to 10 marks. This signifies that most of the students had adequate knowledge on Metal Work Technology, specifically on the subtopic of marking out and machining processes. From this group there are two groups, namely those who pursued high marks and others who performed average. For 172 (45.14%) students who had good performance some of them, which is 38 (10%) students managed to score all 10 marks because they were able to explain the term 'marking out' as used in bench workshop in part (a) and gave correct eight operations procedure to follow so as to accomplish the task of marking steel plate to be drilled in part (b). They gave the meaning of marking out in part (a) as a setting out of dimensions on a work piece with the help of a working drawing or directly transferring them from a similar part. They further emphasized that, marking out refers to the process of transferring measurements and layout lines from a technical drawing or blueprint onto a work piece. Some of the students went more on explaining that, precision measuring instruments

like rulers, squares, and callipers, as well as marking instruments like scribes or layout pencils, are commonly used for marking out. In part (b), the students managed to list the operations procedure to accomplish drilling task. Moreover, they listed the procedures correctly and other required responses. These students had upright skills and experience on the topic of Metal Work Technology and Workshop Tools and Equipment.

Others from the group who achieved well were able to attempt part (a) correctly but missed some or made mistake on listing the eight operations procedure to follow in order to accomplish the plate to be drilled thus ended up scoring good but less than 10 marks. Extract 8.1 is a sample of the correct responses from a student with good performance.

8. (a) Briefly explain the term 'marking out' as used in bench workshop.

Marking out is the process of marking or dipining a point in a work piece need to be machined or for other process exarm of Machine tool are like scriber, checkline, Punch and V.block.

(b) You have been assigned to mark steel plate to be drilled. Give eight operations procedure you will follow to accomplish the task.

(i) ~~Take~~ At first wear PPE for the desire work to avoid Accident.

(ii) Take the steel plate and Put it on the working area or Bench.

(iii) Choose the appropriate marking out equipment such as scriber, Punch, clamp, Surface plate, and Hammer

(iv) Use the Clamp to hold the work piece on the bench of marking out process

(v) If the making out is tomake line onthe work piece then Use scriber to do or accomplish the marking out

(vi) If is to make a datum place to be drilled Use the punch and hammer to punch the datum Place.

(vii) Then Loosen the clamp and test the steel plate for flatness, Then look for trueness or look if the plate is marked accurately.

(viii) After all steps then remove the tool on workingarea and return for the storage after work.

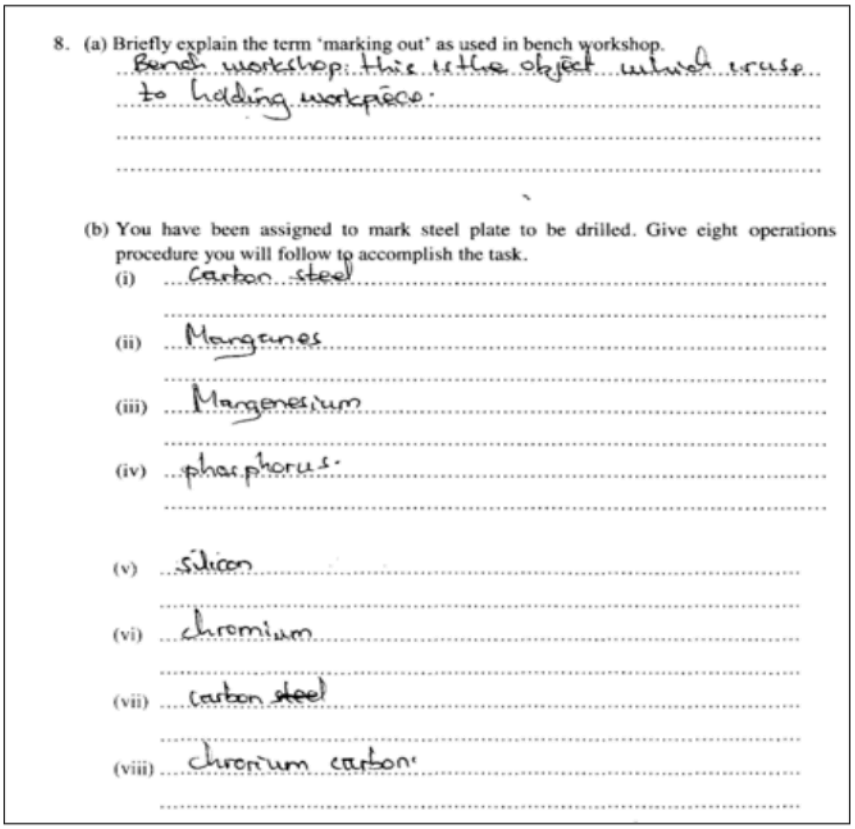
Extract 8.1: A sample of student's good responses to question 8

Extract 8.1 shows a student's responses was able to explain the term marking out as used in bench workshop in part (a). Also, he/she provided the correct operation steps to mark steel plate to be drilled.

The analysis further shows that, 112 (29.40%) of students had partial understanding on the topic of Metal Work Technology and Workshop Tools and Equipment. Most of these students were able to give correct responses in part (a) and provided few correct ideas in part (b) as a result they ended up scoring average marks on this question. The analysis shows that, either these students partially understood the process of marking a steel plate for drilling or were not familiar with the necessary steps involved in marking out the workpiece. Further analysis on mediocre scorer reveals that, these students had limited knowledge or experience in machining or metalworking, which led to uncertainty about the procedural steps required for the marking out of the work piece.

On the other hand, 97 (25.46%) of students had weak performance. Among these, 58 (15.22%) of the students scored a zero mark since were not able to respond correctly in both parts. In part (a), students failed to explain the meaning of marking out as used in bench work activities. Also, these students were unable to describe marking out as a setting out dimension on a blank workpiece with the help of a working drawing or directly transferring them from a similar part.

Besides, some of them failed to respond in part (b) correctly because they confused between marking out procedures and workshop safety rules. They did not understand that marking out refers to the process of transferring measurements and layout lines from technical drawings onto workpieces in preparation for machining, fabrication, or assembly processes. The analysis further reveals that the students lacked knowledge and skills on the procedures for marking a steel plate. They also lacked clear understanding which led them to miscomprehend on procedures of marking out and workshop safety rules. Extract 8.2 is a sample of a weak response from the script of one of the students.


8. (a) Briefly explain the term 'marking out' as used in bench workshop.

Bench workshop: this is the object which is use to holding workpiece.

(b) You have been assigned to mark steel plate to be drilled. Give eight operations procedure you will follow to accomplish the task.

(i) carbon steel

(ii) Manganes

(iii) Margenesium

(iv) phosphorus.

(v) silicon

(vi) chromium

(vii) carbon steel

(viii) chromium carbon.

Extract 8.2: A sample of student's poor responses to Question 8

In Extract 8.2, the student wrote responses that show s/he did not understand the requirements of the question. In part (a) instead of explaining the term marking out, he/she explained bench workshop. Nevertheless, he/she provided unmatched responses compared to the competence tested in this part. This student responded by listing material engineering elements instead of operation procedures to mark a steel plate that is to be drilled.

2.2.7 Question 9: Metal Works Technology

This question was derived from the topic of Metal Work Technology and it had two parts, (a) and (b). In part (a), the students were required to explain the term fusion welding as applied in gas welding processes. On the other hand, in part (b) the students were required to identify both four advantages and four disadvantages of fusion welding. The question was:

(a) *Briefly explain the term 'fusion welding' as applied in gas welding process.*

(b) *What are the four advantages and four disadvantages of fusion welding?*

The performance analysis shows that, among the 381 (100%) students who attempted this question, 102 (27.03%) students scored from 0 to 2 marks, 193 (50.66%) scored from 3 to 6 marks and 86 (22.31%) scored from 7 to 10 marks. Figure 9 represents the performance of the students in question 9.

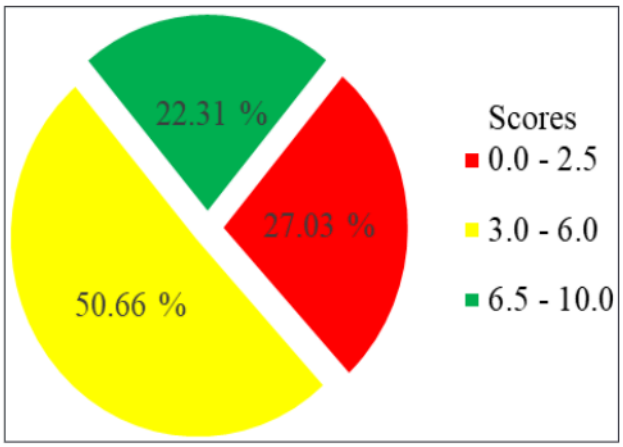
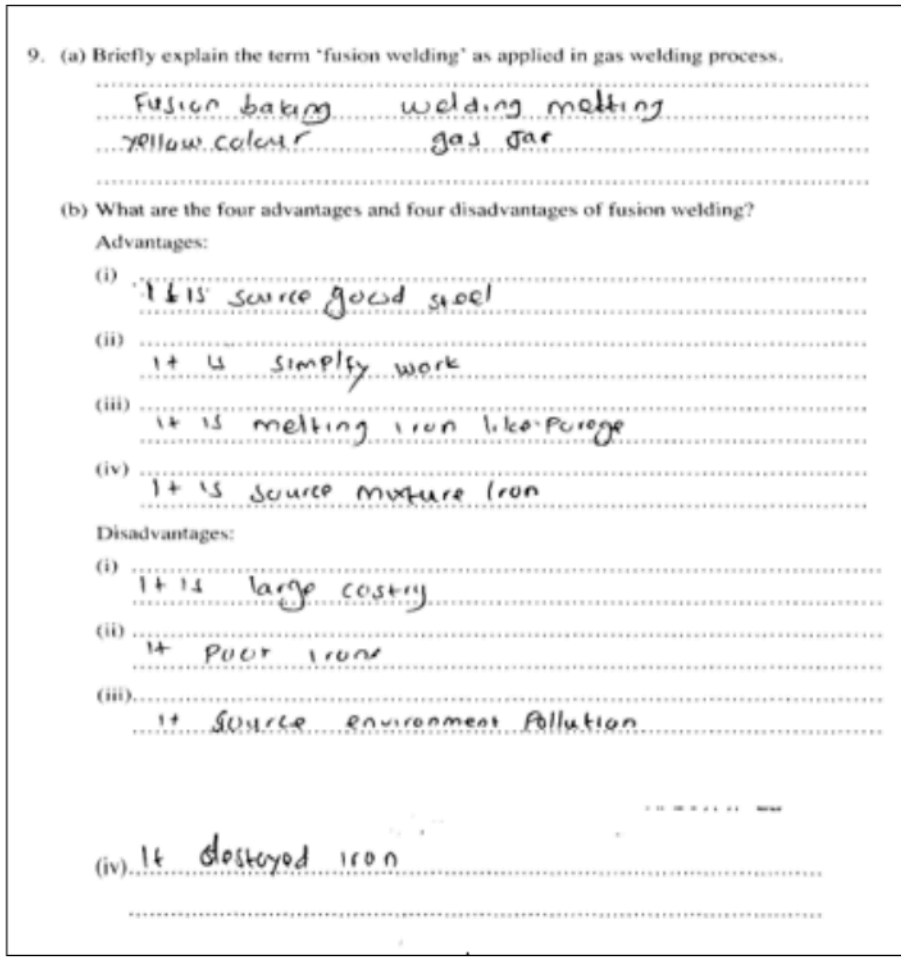


Figure 9: The Students' Performance in Question 9

The student's response analysis reveals that, 103 (27.03%) performed weakly in both part (a) and (b) as they had inadequate knowledge on Metal Work Technology specifically on the concept of gas welding. Some of the students were able to provide correct answer in part (a) while they failed in part (b). Others did not attempt part (a) of this question accordingly. Moreover, most of the students had confusion on the advantages of gas welding and arc welding in part (b). They provided advantages of arc welding instead of advantages of gas welding. Also, the students from this group confused between advantages and disadvantages of gas welding. Extract 9.1 is a sample of weak responses from one of the students.


9. (a) Briefly explain the term 'fusion welding' as applied in gas welding process.

Fusion baking welding melting
yellow colour gas gar

(b) What are the four advantages and four disadvantages of fusion welding?

Advantages:

(i) It is source good steel

(ii) It is simply work

(iii) It is melting iron like porage

(iv) It is source mixture iron

Disadvantages:

(i) It is large costly

(ii) It poor iron

(iii) It source environment pollution

(iv) It destroyed iron

Extract 9.1: A sample of student's weak responses to Question 9

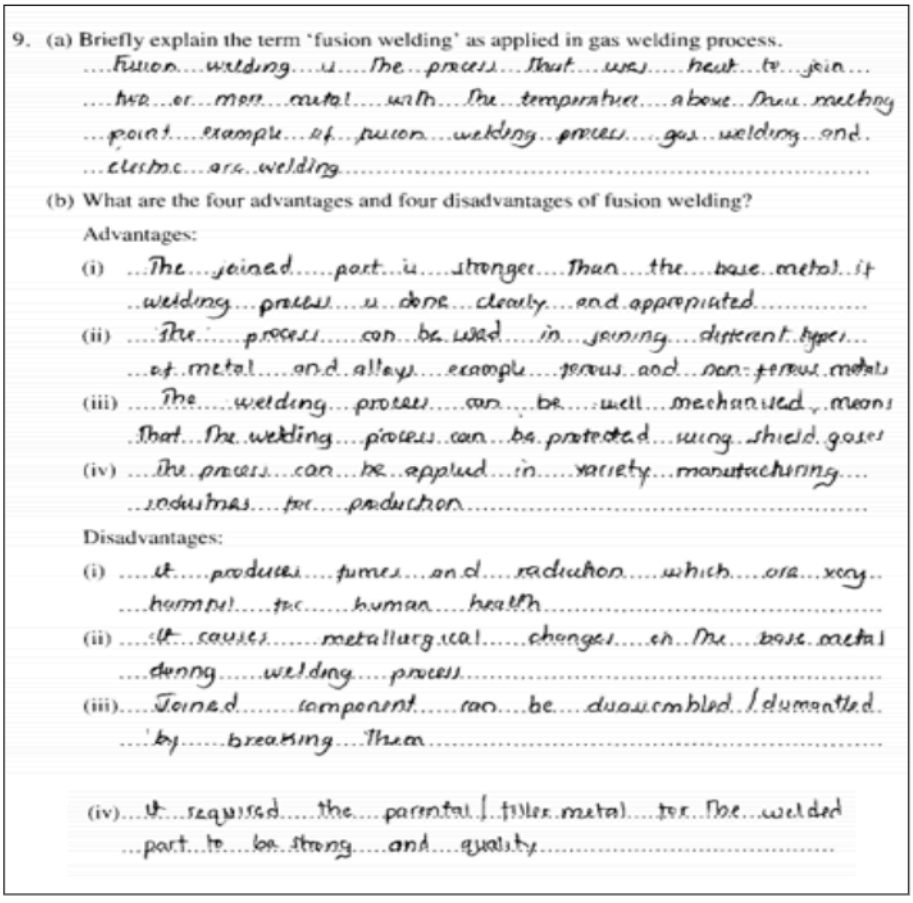
In Extract 9.1, the student wrote responses that indicate poor understanding on the question requirements in part (a). This student provided irrelevant answers and s/he failed to explain the term fusion welding as applied in gas welding process. S/he provided unmatched responses to the subject matters. Also, s/he generated incorrect responses as advantages and disadvantages on fusion welding. This implies that, s/he lacked enough knowledge on the tested competence.

The performance of this question shows that, 193 (50.66%) managed to score average on both parts in this question. Most of these students were capable to define part (a) and provide limited responses in (b). This is due to incomplete understanding on the topic. The same students were able to explain fusion welding as a process that uses heat to join or fuse two or more material by heating them to melting point.

Most of the students had mixed up some of both advantages and disadvantages of gas welding to that of arc welding. This led to the incomplete correct response and scored some marks in part (b). The analysis implies that, the students understood the question requirement but did not respond correctly due to the little knowledge on Metal Work Technology specifically on gas welding.

In addition to the above average performance, 85 (22.57%) of the students had good performance as they were able to respond correctly on both parts of the question. In part (a), the students were competent to explain the meaning of fusion welding as a process that uses heat to join or fuse two or more materials by heating them to melting point and scored the allotted marks.

In part (b), most of the students offered the perfect answers on the advantages and disadvantages of fusion welding. These students answered that, fusion welding can be used to join dissimilar material easily, external filler material can be added easily and more than two components can be welded at a step as the advantages of fusion welding. They also knew that, the disadvantages of fusion welding are excessive heat input causes severe deformation, and excess heat creates a heat-affected zone around the weld bead. This confirms that, these students were capable on Metal Work Technology topic. Extract 9.2 is a sample of the correct responses from a student with good performance.



9. (a) Briefly explain the term 'fusion welding' as applied in gas welding process.

....Fusion...welding...is...the...process...that...uses...heat...to...join...
....two...or...more...metal...with...the...temperature...above...their...melting
...point...example...of...fusion...welding...process...gas...welding...and...
...electric...arc...welding.....

(b) What are the four advantages and four disadvantages of fusion welding?

Advantages:

(i) ...The...joined...part...is...stronger...than...the...base...metal...if
...welding...process...is...done...clearly...and...appropriated.....

(ii) ....The...process...can...be...used...in...joining...different...types...
...of...metal...and...alloys...example...ferrous...and...non-ferrous...metals

(iii) ....The...welding...process...can...be...well...mechanized...means
...that...the...welding...process...can...be...protected...using...shield...gases

(iv) ...the...process...can...be...applied...in...variety...manufacturing....
...industries...for...production.....

Disadvantages:

(i) ....it...produces...fumes...and...radiation...which...are...very...
....harmful...for...human...health.....

(ii) ....it...causes...metallurgical...changes...in...the...base...metal
....during...welding...process.....

(iii)....Joined...component...can...be...disassembled.../dismantled...
....by...breaking...them.....

(iv)...it...required...the...parental/filler...metal...for...the...welded
...part...to...be...strong...and...quality.....

Extract 9.2: A sample of student's good responses to Question 9

In Extract 9.2, the student was able to explain the term fusion welding as applied in gas welding process in part (a). Also, this student established correct advantages and disadvantages of fusion welding in part (b). This denotes that, the student had adequate knowledge, skills and attitude on the tested topic competence.

2.3 Section C: Structured Questions

This section had one compulsory structured question which composed from the topic of *Workshop Tools and Equipment*. The question had 15 marks.

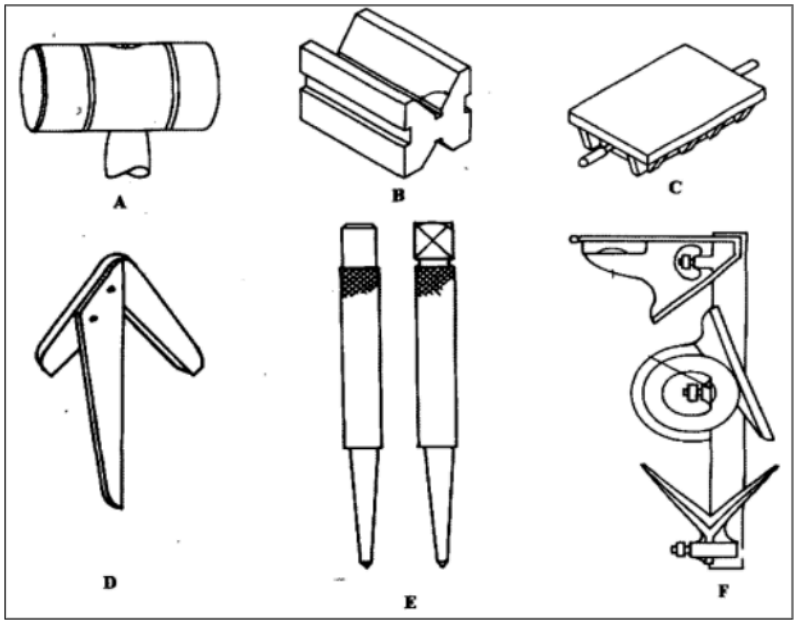
2.3.1 Question 10: Workshop Tools and Equipment

This question had two parts, (a) and (b). In part (a), the students were required to sketch the head of given types of hammers and state one use for each; *straight pein hammer, planishing hammer and blocking hammer*. For part (b), the students were required to identify different types of tools and

equipment, materials used to make them and two applications of each tool in bench workshop labelled with letter A to F. The question was:

(a) *Hammer is one of the common tools used in workshop to facilitate various activities. Sketch the head of the given types of hammer and state one use for each.*
(i) Straight pein hammer (ii) Planishing hammer (iii) Blocking hammer

(b) *The figure below shows different types of tools and equipment used in bench workshop labeled with letters A to F. Identify the tools, material used to make them and two applications of each tool.*



A total of 381 (100%) of the students attempted the question, from which 236 (61.94%) scored from 0 to 4 marks, 133 (34.91%) scored from 4.5 to 9.5 marks and 12 (3.15%) scored from 10 to 15 marks. These scores are presented in Figure 10.

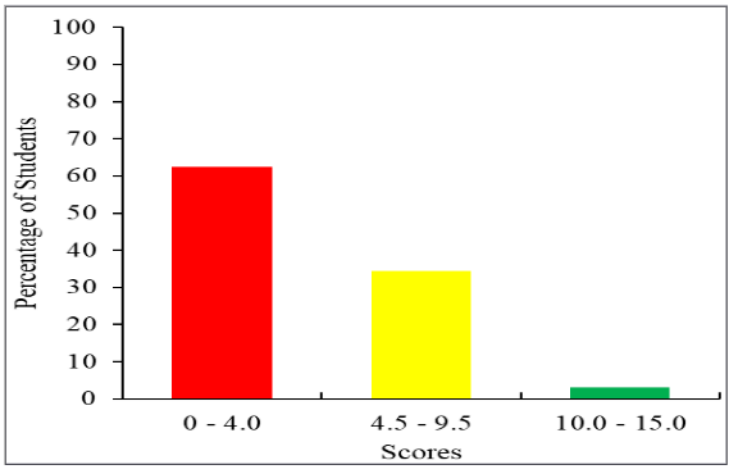
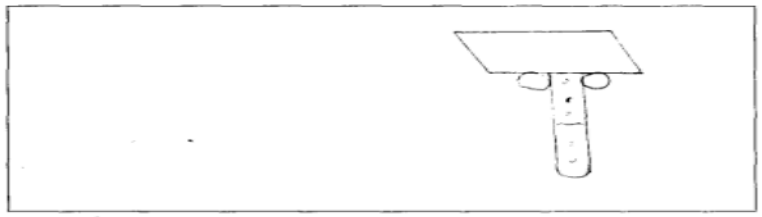


Figure 10: The Students' Performance in Question 10

Figure 10 show that, the students' general performance in this question was weak since 236 (61.94%) students scored from 0 to 4 marks.

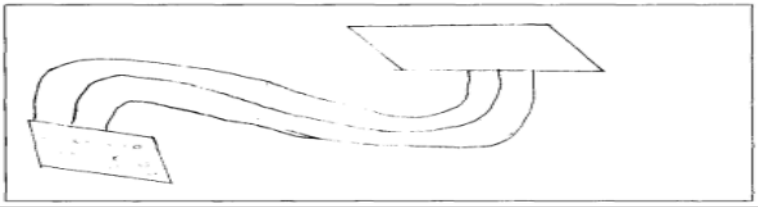
Students who scored low marks (0 - 4) had inadequate knowledge on Mechanical Workshop Hand Tools. Most of them failed to give relevant responses to the question due to lack of knowledge on Workshop Tools and Equipment. Many students scored low marks as they sketched irrelevant drawings of straight pein hammer, planishing hammer and blocking hammer. Some students managed to write one use of each type and score half mark for each in part (a). Extract 10.1 is a sample of weak responses for part (a) from one of the students.

(i) Straight pein hammer
Sketch:



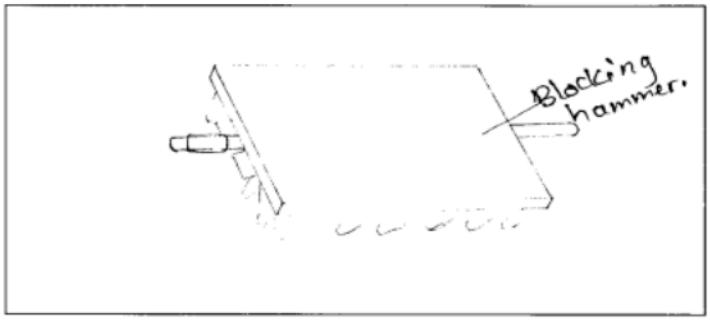
Uses:
The uses to straight pein is the working to work piece of work shape.

(ii) Planishing hammer
Sketch:



Uses:
The uses of planishing hammer to the hamme of the to drow of electric car to work pieces

(iii) Blocking hammer
Sketch:



Uses:
uses of the Blocting hamemer to the hammer to the chetking of bleading of hammes.

Extract 10.1: A sample of student's weak responses to Question 10 (a)

Besides, the students failed to name the different types of hand tools and equipment used in bench workshop labeled with letters A to F in part (b). They lacked knowledge which could help them to identify the tools labeled with letters A, B, C, D, E and F. These tools were mallet hammer/soft hammer, vee block, surface table, center square, center punch and combination set. Also, these students failed to explain the application of the mentioned types of hand tools and equipment. In fact, most of the students

had weak performance in this question as they lacked knowledge and experience on Workshop Tools and Equipment. Extract 10.2 is a sample of weak responses for part (b) from one of the students.

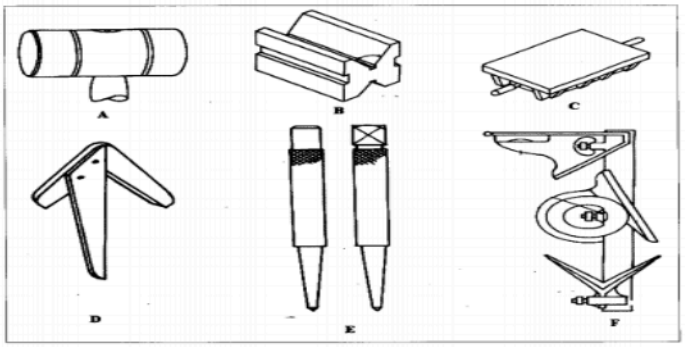


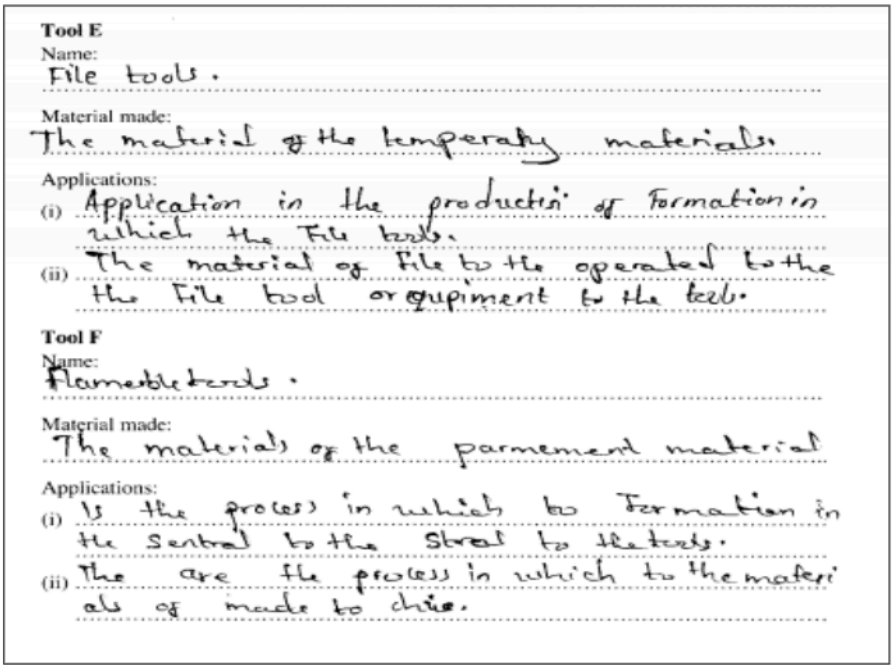
Figure 1

Tool A
Name:
Hammer tools.
Material made:
The materials of temperatry of the materials.
Applications:
(i) Used to the Sources hammer tools.
(ii) Thy Used for making of plain carbon steels to the harmmer tools.

Tool B
Name:
Fite Thir tools.
Material made:
The temperary material -
Applications:
(i) The human activities of dini.
(ii) The to hand tools the dini the human activity of the dini.

Tool C
Name:
Hand tools
Material made:
It is the temperary materials.
Applications:
(i) Are the applied to formation in which the bend.
(ii) They are the hand tools to agere heat to the flame.

Tool D
Name:
Broken tools.
Material made:
It the matrial of the temperatry materials.
Applications:
(i) Are the producted of the broken tools of the material little broken.
(ii) They are metal to the fraction to the broken tools.



Tool E

Name:
File tools.

Material made:
The material of the temperaty materials.

Applications:
(i) Application in the productin of formation in which the File tools.
(ii) The material of file to the operated to the the File tool or equipment to the tools.

Tool F

Name:
Flamestle tools.

Material made:
The materials of the parmement material

Applications:
(i) Is the process in which to formation in the sentral to the stral to the tools.
(ii) The are the process in which to the materi als of made to chise.

Extract 10.2: A sample of student's weak responses to Question 10 (b)

On the other hand, 128 (34.38%) of students scored average marks (4.5-9.5). Most of these students provided mixed relevant and irrelevant responses in both parts (a) and (b). Some were not able to sketch the head of the given type of hammer and stated one use of each in part (a). Also, they managed to name some different types of tools and equipment used in bench workshop labeled with letters A to F. They likewise identified few materials used to make the labeled hand tools. They also failed to explain two applications of each tool in part (b) of this question. Furthermore, other students managed to provide limited correct responses in both parts (a) and (b) due to the mistakes observed from the analysis. Generally, these students had partial understanding on workshop tools and equipment.

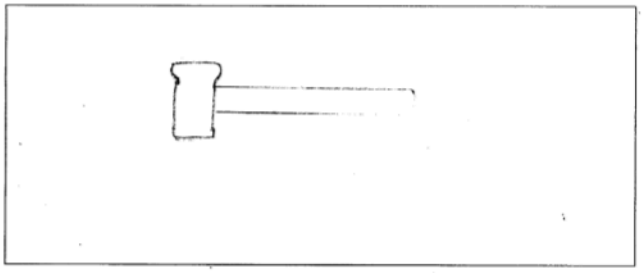
Inspite of the above average performance, 12 (3.15%) of the students had good performance as they managed to score between 10 to 15 marks in this question. The students scored higher marks as they were able to provide some correct responses in this question. In part (a), the students were able to state the uses of each of the given type of hammers and managed to sketch correctly some of the hammers. This denotes that, the students had adequate knowledge on the uses of hand tools specifically hammer. They also expressed lack of skills to sketch the required head hammers tested on

the topic competence. Extract 10.3 presents one of the good responses by one of the student in part (a).

10. (a) Hammer is one of the common tools used in workshop to facilitate various activities. Sketch the head of the given types of hammer and state one use for each.

(i) Straight pein hammer

Sketch:

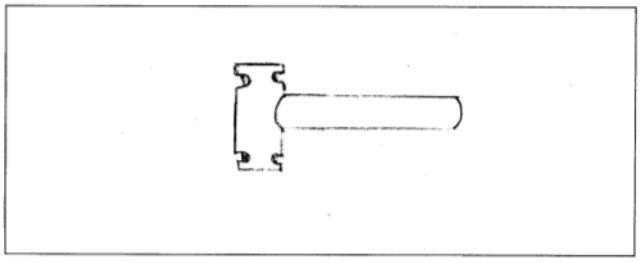


Uses:

This is the type of hammer which is used in riveting process.

(ii) Planishing hammer

Sketch:

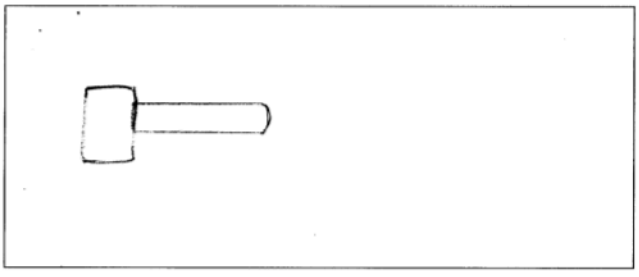


Uses:

This is the type of hammer used to finishing of the work, to put smoothen and levelling.

(iii) Blocking hammer

Sketch:



Uses:

This is the type of hammer used to remove or block material in a plate or sheets

Extract 10.3: A sample of student's good responses to Question 10(a)

In part (b), the students were capable to identify different types of tools and equipment used in bench workshop labeled with letters A to F as well as to identify materials used to make the labeled tools. They had enough knowledge which helped them to identify most of the tools labeled A, B, C, D, E and F. These tools were mallet hammer/soft hammer, vee block, surface table, center square, center punch and combination set. These students also managed to give applications for most of the labeled tools. The performance of the students implies that, they had good knowledge, skills and experience on Workshop Tools and Equipment. Extract 10.4 presents one of the good responses provided by one of the students in part (b).

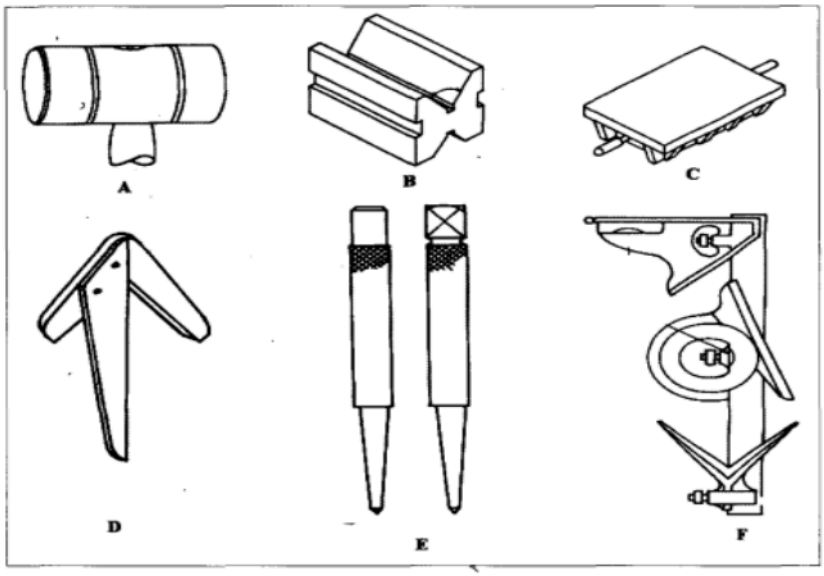


Figure 1

Tool A

Name:

hammer

Material made:

Rubber

Applications:

(i) It applied on con construction of building

(ii) It apply in workshop.

Tool B

Name:

V- block

Material made:

cast steel.

Applications:

(i) It applied in industry

(ii) It applied in workshop.

Tool C

Name:

Surface plate

Material made:

cast steel from steel.

Applications:

(i) It used in workshop

(ii) It used in industry

Tool D

Name:

Try square

Material made:

Steel iron

Applications:

(i) It applied in workshop

(ii) It applied in industry

Material made:

Mild steel

Applications:

(i) It applied in industry

(ii) It applied in workshop.

Tool F

Name:

Fr Try square

Material made:

Steel iron

Applications:

(i) It applied during setting out building

(ii) It applied during prepare the plate to be welding.

Extract 10.4: A sample of student's good responses to Question 10(b)

In Extract 10.4, the student identified some correct different types of tools and equipment used in bench workshop labeled with letters A to F. S/he was able to mention the materials used in the manufacturing of the labeled tools and the two uses of each tool.

3.0 ANALYSIS OF THE STUDENTS PERFORMANCE ON EACH TOPIC

The FTNA in Mechanical Engineering subject had five (5) topics. These topics are *Metal Work Technology, Engineering drawing I, Workshop Tools and Equipment*, *Workshop Management and Safety Rules* and *Engineering Materials*.

Based on the analysis of the students' performance, 349 (91.60%) students were observed to have good performance in question 1. Question 1 was drawn from the topics such as *Engineering Materials, Workshop Tools and Equipment, Engineering Drawing I, and Workshop Management and Safety Rules*. The good performance of 328 (81.89%) students was also observed in questions 4 and 7 being drawn from the topic of *Workshop Management and Safety Rules*. These students with good performances understood the requirements of the questions and had ability to apply their knowledge and skills to the given topics tested.

The average performance on 141 (60.16%) students was observed in question 3, 5, 6, 8 and 9 from the topics of *Metal work Technology* and *Workshop Tools and Equipment*. The students who had average performance identified ability of workflows for performing activities; provided explanations of various techniques of welding; and provided well-labeled drawings of metal joining and usage. They had the ability to apply their knowledge and skills on the competencies assessed.

Finally, the weak performance on 72 (18.90%) students was observed in question 2 which was drawn from the topic of *Engineering Materials*. The weak performance was contributed by inadequate knowledge and practical incapability in the subject matter. The failure to grasp the concept of the questions likewise contributed to students' low performance. A summary of the students' performance in each topic is presented in Appendix I.

4.0 CONCLUSION AND RECOMMENDATIONS

This section summarizes comments and further actions following the performance analysis summarized in the previous sections. Response analysis is presented based on each question and topic. Although multiple stakeholders are involved in this analysis, most of the recommendations are directed to students and teachers for future improvements.

4.1 Conclusion

The overall performance in the Mechanical Engineering subject in the FTNA, 2023 was good. The good performance was observed in question 3, 4, 5, 6, 7, and 8. The good performance was contributed by factors such as students' ability to identify the requirements of each question; adequate knowledge of the subject being assessed; and command of the English language. However, the students had weak performance in question 2. The weak performance was influenced by lack of understanding on the requirements of the questions; inadequate knowledge and skills in some tested subjects; and lack of adequate knowledge in English language. The good or weak responses of the students are well demonstrated using extracts in this report for reference.

4.2 Recommendations

To improve the performance of mechanical engineering students, the following recommends are given:

4.2.1 Recommendations to the Students

(a) Students should acquire practical skills through practical activities that combine theory and practice. This will help students identify hand tools and their uses, as described in workshop tools and equipment topic.

(b) Students should be encouraged to join a mechanical engineering club. This will make students interested in the topics.

(c) Students should be supported to improve their English Language skills by developing a passion for speaking, writing and listening. This can be achieved by allowing students to participate in debates, group discussions, and presentations of various assignments which are conducted using English Language.

(d) Students must combine their drawing skills with knowledge from other subjects (Engineering Drawing I and II) to establish connections with mechanical engineering. As young engineers in training, students must communicate effectively and use drawings as the language of engineering. This will help them acquire the proper skills to draw diagrams neatly and label them correctly.

4.2.2 Recommendations to the Teachers

(a) Teachers should provide students with a learning-supportive environment that allows them to expand their knowledge and skills and gain experience that meets the questions and needs of the subject matter.

(b) Teachers should prepare practical sessions and guide students to conduct practical properly. The practical should base on properties of materials and processing techniques. They should emphasis on applications in various topics of mechanical engineering

(c) Teachers should carefully guide students to develop a culture of reading problems before attempting them. This helps students understand the requirements of a question before attempting it.

Appendix I: Summary of Student Achievements (Topic-Wise)

S/N	Topics	Question Number	Percentage of students who scored 30% or more	Remarks
1	Engineering Materials, Workshop Tools and Equipment, Engineering Drawing I & Workshop Management and Safety Rules	1	91.60	Good
2	Workshop Management and Safety Rules	4 and 7	81.89	Good
3	Metal Work Technology	3, 5, 6, 8 & 9	60.16	Average
4	Workshop Tools and Equipment	10	38.06	Average
5	Engineering Materials	2	18.90	Weak

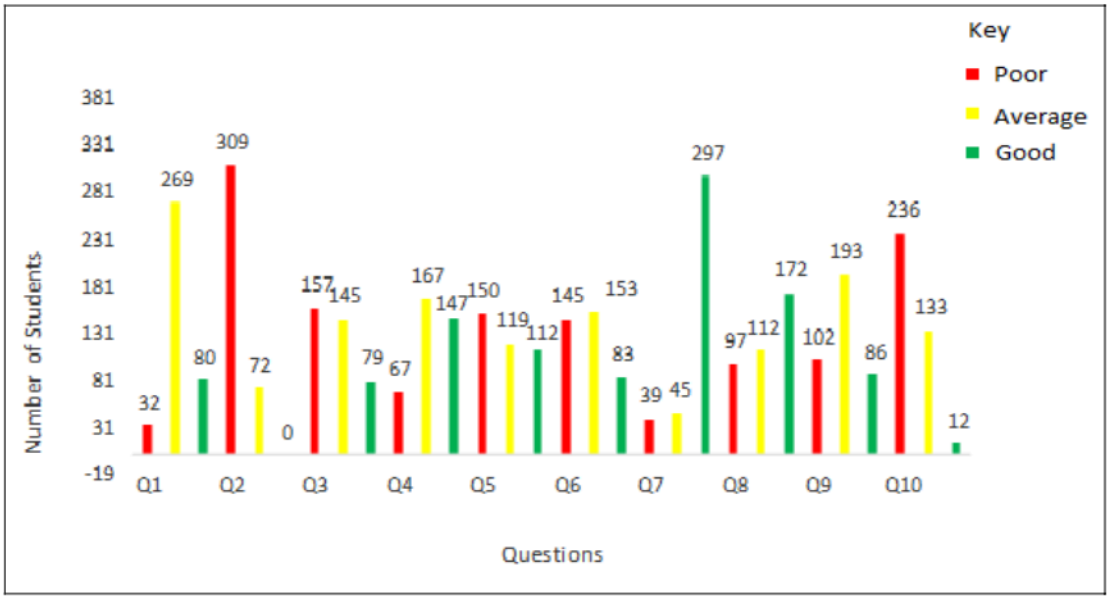
Appendix II: General Students' Performance in Mechanical Engineering Subject

Grade	Percentage Range	Description	Number of Students	Percentage
F	0 – 29	Weak	95	24.93
D & C	30 – 64	Average	228	59.84
B & A	65 – 100	Good	58	15.22
Total			**381**	**100**

Appendix III: Distribution of Student' Performance in Each Question

Questions		Qn 1	Qn 2	Qn 3	Qn 4	Qn 5	Qn 6	Qn 7	Qn 8	Qn 9	Qn 10
Weak	Students	32	309	157	67	150	145	39	97	102	236
	%	8.40	81.10	41.21	17.59	39.37	38.06	10.24	25.46	26.77	61.94
Average	Students	269	72	145	167	119	153	45	112	193	133
	%	70.60	18.90	38.06	43.83	31.23	40.16	11.81	29.40	50.66	34.91
Good	Students	80	00	79	147	112	83	297	172	86	12
	%	21.00	00	20.73	38.58	29.40	21.78	77.95	45.14	22.57	3.15
Total	Students	**381**	**381**	**381**	**381**	**381**	**381**	**381**	**381**	**381**	**381**
	%	100	100	100	100	100	100	100	100	100	100

Appendix IV: Overall Performance of Students Question Wise for Year 2023



Appendix V: Student's performance in 2023 in Comparison to 2022

Year	A	B	C	D	F	Total
2023	7	51	158	70	95	**381**
2022	0	2	79	172	171	**424**