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

STUDENTS' ITEMS RESPONSE ANALYSIS REPORT ON THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2022

ENGINEERING DRAWING

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TABLE OF CONTENTS

FOREWORD

This report presents Students' Items Response Analysis (SIRA) on Form Two National Assessment in Engineering Drawing subject which was conducted in November 2022. The report aims to provide feedback to all educational stakeholders on the factors that contributed to the students' performance in Engineering Drawing.

The Form Two National Assessment (FTNA) is a formative evaluation which intends to monitor students' learning and to provide feedback that teachers, students and other educational stakeholders can use to improve teaching and learning processes. This analysis shows justification for the students' performance in the Engineering Drawing subject. It reveals that students had good performance in the topic of Engineering Drawing I and II (Drawing Office Tools and Similar Figures and Pictorial Drawings) while on the topic of Intersection of Cylinders and Free Hand Sketching had an average performance. However, when it comes to Engineering Drawing I (Construction of Geometric Figures and Similar Figures), their performance is poor. Factors that affected the students' responses include the students' failure to understand the demands of the questions, insufficient knowledge on some tested subject matters and a lack of drawing skills.

This report will help to identify students' strengths and weaknesses so as to improve learning before sitting for their Certificate of Secondary Education Examination (CSEE). It will help teachers to identify the challenging areas and take appropriate measures during teaching and learning process.

The National Examinations Council of Tanzania (NECTA) expects that the feedback provided in this report will enable the education stakeholders to take proper measures to improve teaching and learning of Engineering Drawing subject. Consequently, students will acquire knowledge, skills and competence indicated in the syllabus for better performance in future assessments and examinations.

The Council appreciates the contribution of all those who participated to prepare this report.

Dr. Said Ally Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report analyses students' performance on Form Two National Assessment (FTNA) for year 2022 in Engineering Drawing subject. The Assessment focused on the students' competences as per the current Form I and II Engineering Drawing Syllabuses. The report shows students' performance question-wise by identifying the students' strengths and weaknesses in each question attempted.

The Engineering Drawing subject was done by 479 students. It is noted that, 311 (64.9%) students passed while 168 (35.1%) failed the assessment. In comparison, of the 444 students who sat for the assessment in 2021, 123 (27.70%) passed while 321(72.30%) failed. Therefore, there is an increase of pass rate by 31.20 percent in 2022 compared to 2021.

The Engineering Drawing paper had seven (7) questions which were divided into two sections A and B. Section A comprised of four short answer questions, where each item carried 10 marks. Section B consisted of three questions, each carried twenty (20) marks. The students were required to answer all questions in all sections. The analysis of responses to each question has been done in view of what students were required to do, the general performance and reasons for such performance. Samples of extract of good and poor students' responses are included in the analysis as illustrations.

The performance of students in this report is grouped into three category of poor, average, and good based on the percentage of students' who scored above average in range 0 – 29, 30 – 64, and 65 to 100 percent respectively. This performance is presented in Figures and Tables using colours whereby red, yellow, and green colours are used for poor, average and good performance respectively. Figure 1 shows overall performance of 479 students who sat for Engineering Drawing assessment in November 2022.

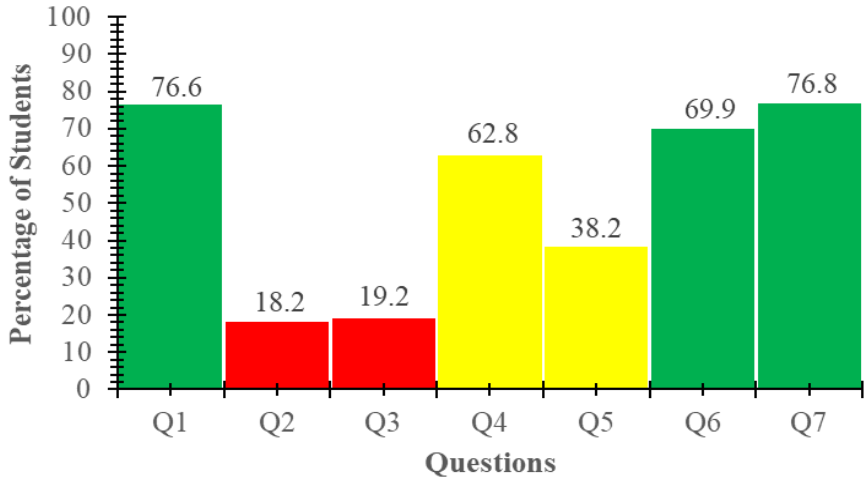


Figure 1*: The percentage of students who performed average and above on each question in Engineering Drawing Subject.*

2.0 ITEM RESPONSE ANALYSIS IN EACH QUESTION

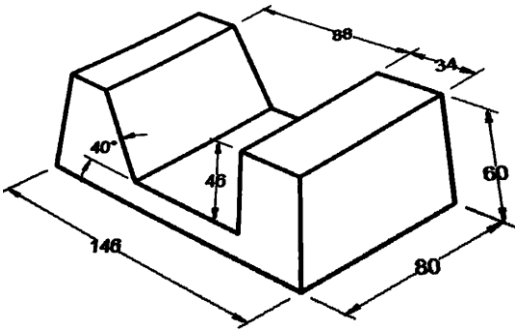
2.1 Section A: Short Answer Questions

Sections A had four questions, each weight 10 marks, making a total of 40 marks. The questions were extracted from the sub-topics of *Pictorial Drawing, Similar Figures, Construction of Geometric Figures, Intersection of cylinders, Free Hand Sketching and Drawing Office Tools.* Students were required to answer all the questions in this section.

2.1.1 Question 1: Pictorial Drawings

The item was composed from the sub-topic of Pictorial Drawings. Students were required to convert the given object drawn in isometric projection to oblique projection. The question was intended to assess the ability of the student to use oblique construction principles in Engineering Drawing. The question was as follows:

Suppose you visited your uncle and found out he is struggling to convert an object below which is drawn in isometric to an oblique projection; draw the expected object after your uncle has completed a task.



The question was attempted by 479 (100%) students. The statistics show that 112 (23.4%) students scored from 0 to 2.5 marks, 142 (29.6%) students scored from 3 to 6 marks and 225 (47.0%) scored from 6.5 to 10 marks. The performance of students in this question was good because, 367 (76.6%) students scored from 3 to 10 marks. The students' performance is summarized in Figure 1.

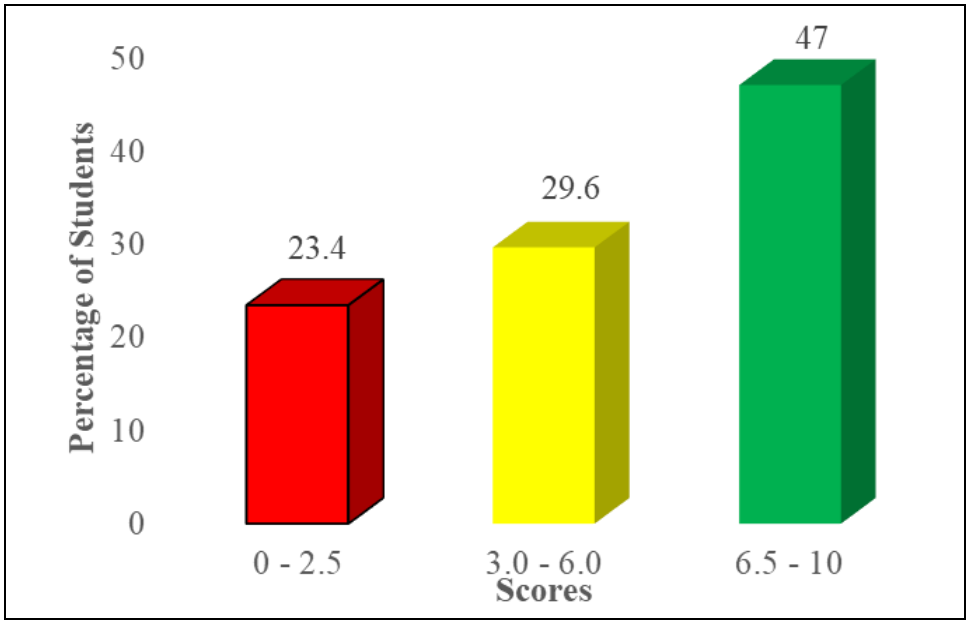
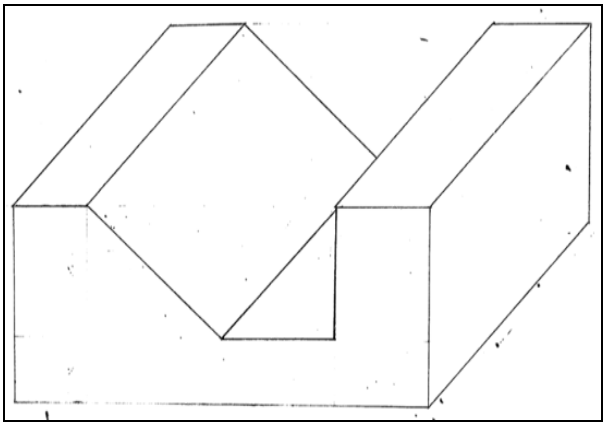


Figure 1: *Students' Performance in Question 1*

Question 1 was performed well, since 76.6 percent scored average and above. Among them, 225 (47.0%) had good performance. Few of them, 43 (9%) applied the skills of converting all the horizontal lines produced at 30 degree angles to oblique by making emphasis on the face or the front side

of an object. Such students drew at 45° angle to represent the third dimension, thus, they managed to score all 10 marks allotted to this question. The majority of the students in this group scored high marks but less than ten. Students in this category made few mistakes, such as, few lines had different line weight. For example, one student converted correctly the given figure from isometric to oblique projection, but incorrectly drew the adjacent lines at 45^{o}, making it too heavy compared to other lines of the oblique drawing. Extract 1.1 is a sample of good responses from the scripts of one of the students.



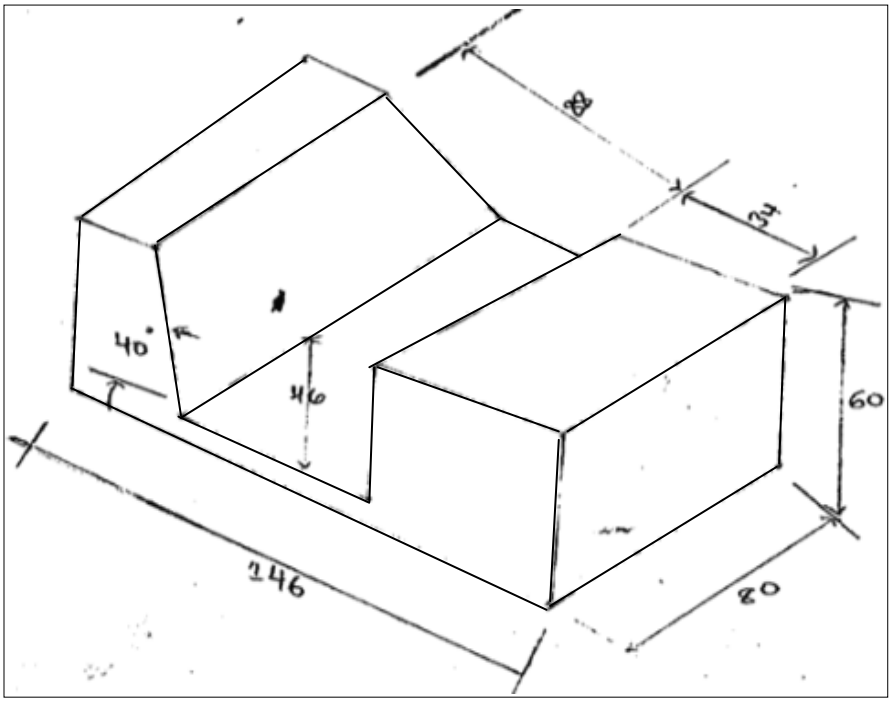
Extract 1.1: A sample of students' good response to Question 1

The response in Extract 1.1 shows that, the student applied the skills of converting all the horizontal lines produced at 30-degree angles to oblique and successfully drew the oblique block.

Further analysis shows that, the responses of the 29.65 percent of the students with average performance reveals they had partial knowledge and skills on converting an isometric drawing to oblique. For instance, some of them, drew wrong dimensions and missed to produce some extension lines. Due to these few errors, their performance was therefore average.

The 112 (23.38%) students who scored below 3 marks were not able to understand that in isometric drawing, all of the horizontal lines of the drawing are produced at 30-degree angles from the predefined vertical line while in oblique the emphasis is made on the face or the front side of an object. Therefore, the oblique drawings are produced by depicting the third dimension by typically drawing at a 45° angle. Lacking this knowledge and

skill led them to incorrect solution. They failed to apply the skills for drawing an oblique projection from the presented isometric projection. For example, one student drew similar figure as it was provided in the question, therefore failed to demonstrate the skills for converting an isometric figure to oblique one. This failure indicates that the student lacked sufficient expertise in the specialty of pictorial drawing. Extract 1.2 is an example of poor responses from a student who answered this question incorrectly.



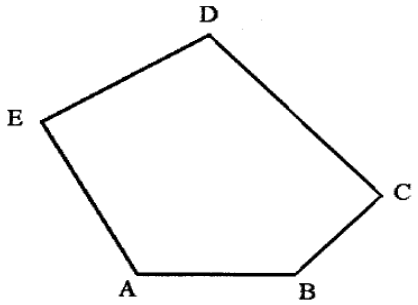
Extract 1.2: A sample of students' poor response to Question 1

The response in Extract 1.2 shows the student who was not able to convert the isometric block to oblique one. He/she only copied the given isometric block from the question paper.

2.1.2 Question 2: Similar Figures

The question required students to construct the enlarged irregular polygon from the given shape. The question was intended to assess the ability of the students to construct similar figures by enlarging or reducing sizes of different objects in Engineering Drawing. The question was as follows*:*

The given figure is a sketch of an irregular polygon shape of a housing cover for a machine submitted in drawing office by a welding technician. You are require to fabricate a similar cover but enlarged in length of each side by a ratio of 8:5. Construct the required new cover.



The question was attempted by 479 (100%) students. The results in Figure 2 shows that 392 (81.8%) students scored from 0 to 2.5 marks, 36 (7.5%) students scored from 3 to 6 marks and 51(10.7%) scored from 7 to 10 marks. The majority of students 392 (81.8%) scored below average, which implies that the performance of students in this question was poor.

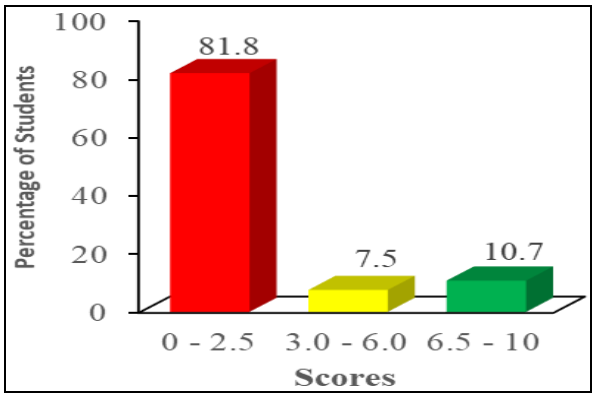
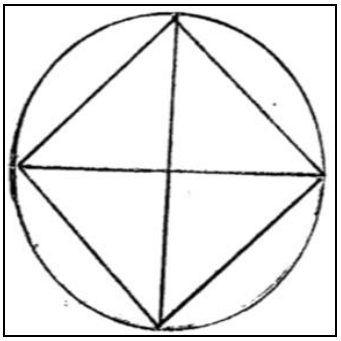


Figure 2: *Students' Performance in Question 2*

The 81.8 percent of students who performed poorly lacked the knowledge of how to develop the plane figure using 8:5 ratios. They lacked the skills required to enlarge a polygon when all of the dimensions of the figure are changed in the given ratio. They were unable to enlarge by increasing the size of a shape by a multiplier known as the scale factor $\frac{8}{5}$. Therefore, they failed to draw the extended lines. Other students from this group, drew

incorrect diagrams as a responded to the question. Extract 2.1 is an example of poor responses from a student whose answer was incorrect.

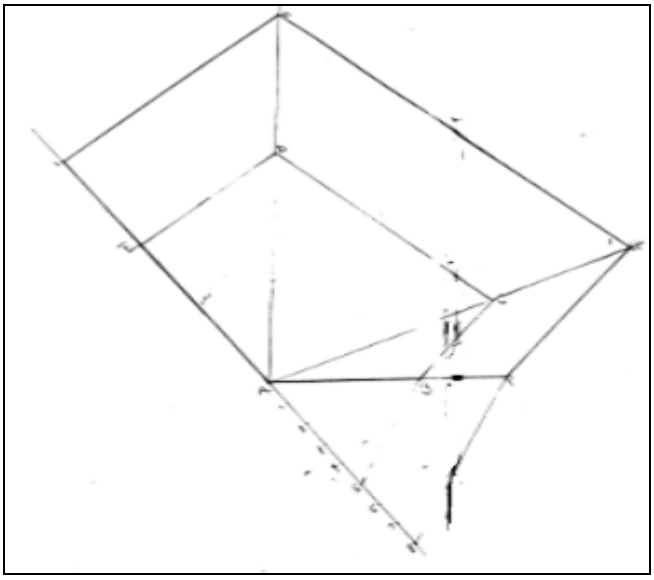


Extract 2.1: A sample of student's poor response to Question 2

Extract 2.1 indicates the misconceptions presented by one of the student who attempted the question. Instead of drawing enlarged irregular polygon by the ratio of 8:5, the students drew irrelevant diagram contrary to the demand of the question.

In addition, 7.5 percent of the students with average performance partially attempted the question and scored average marks. The students in this group managed to redraw the figure, extended the parts and prepared division of one side to five equal parts but provided a figure with very poor visibility and construction lines were not distinguishable. Some others constructed poor parallel sides as a result constructed partially the required diagram.

Besides the students who did this question on average and poor bases, there were 51 (10.7%) who had good performance. These students were knowledgeable about the sub-topic of similar figures because they managed to use their knowledge and drawing skills to develop the presented figure. More than half of these students 27 (5.6%), were able to redraw the figure, divide side into five equal parts, extend three more parts, construct parallel sides and marked correctly the visible line of the required enlarged figure. Students in this category scored all 10 marks. Extract 2.2 is a sample of good response from the script of one of the students who attempted this question.



Extract 2.2: A sample of student's good responses to Question 2

Extract 2.2 shows the work presented by one of the student who attempted the question correctly. He/she drew the enlarged irregular polygon by the ratio of 8:5. He/she followed the procedures and all steps to draw the required diagram.

2.1.3 Question 3: Construction of Geometric Figures

The question required students to change the ellipsoidal shape to an auxiliary circle shape. The question was intended to assess the ability of students to construct loci of different shapes. The question was as follows*:*

A petro station owner wants to change her fuels tank which is in ellipsoidal shape. Using an auxiliary circle method and 120 mm as major diameter and 80 mm minor diameter, construct the required shape.

A total of 479 (100%) students attempted this question whereby majority of students 387 (80.8%) scored from 0 to 2.5 marks, 29 (6.1%) students scored from 3.0 to 6.0 marks and 63 (13.1%) scored from 6.5 to 10 marks. Figure 3 summarises this performance.

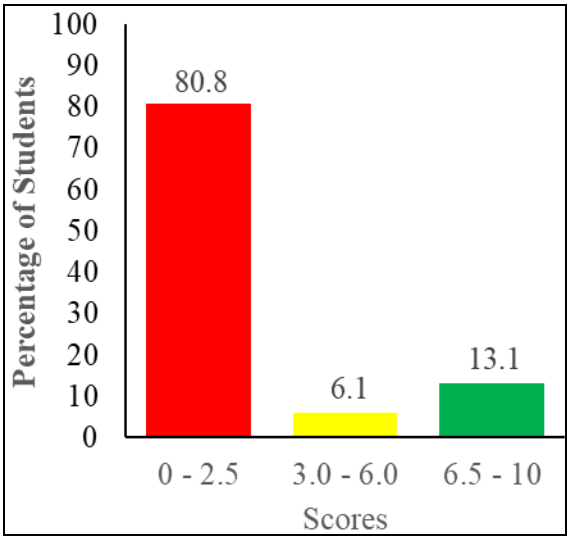
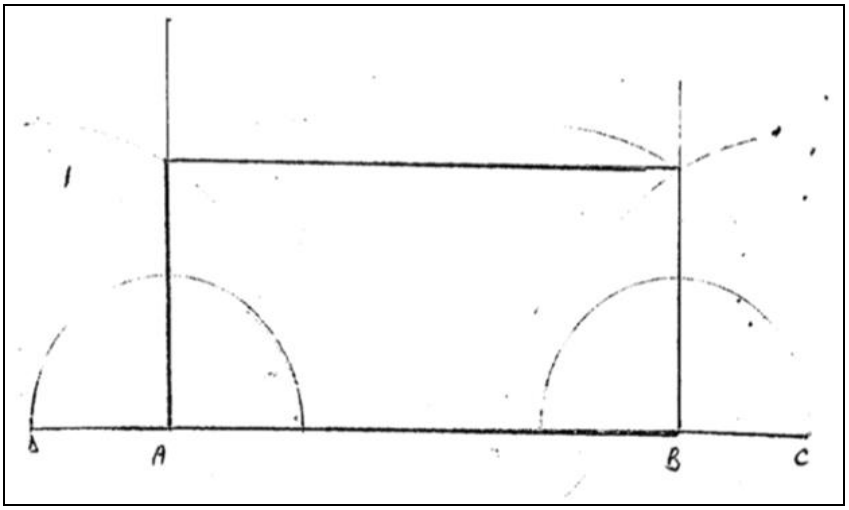


Figure 3: *Students' Performance in Question 3*

In this question, students were required to apply the knowledge of Loci to meet the requirements of the question. They were supposed to remember the procedures of constructing ellipse by employing the concentric circle method. The majority 387 (80.8%) students scored below average as they lacked the knowledge and skills for constructing an ellipse. They were supposed to understand that an ellipsoidal is solid in shape with ellipse surfaces from front and circle from side view. Some of these students, mistook rectangular method for concentric circle method of constructing an ellipse. Instead of employing concentric circles they employed rectangular method. Among other things the analysis of the students' responses shows that, these students were not familiar with the term ellipsoidal as a result, they were not able to construct the relevant shape as per the requirement of the question. Extract 3.1 is a sample of poor response from one of the students.

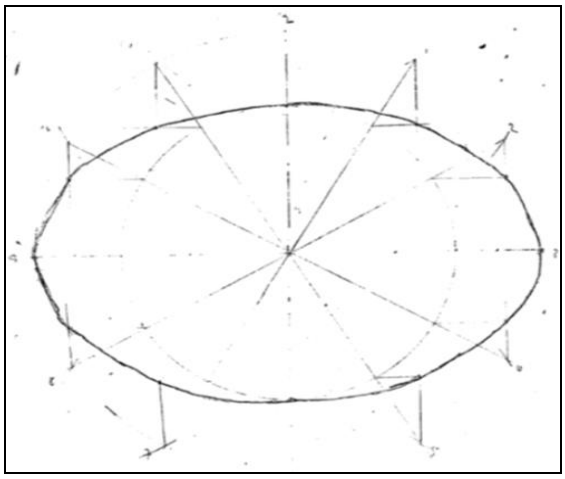


Extract 3.1: A sample of student's poor response to Question 3

Extract 3.1 shows the response of the student who drew a rectangle instead of sketching an ellipsoidal shape. This failure reveals that, the student was at initial stage of drawing the ellipsoidal shape by the method of rectangle instead of employing concentric circles as was instructed in the question.

Almost 6.1 percent of the students with average performance partially attempted the question with respect to subject matter. Some students in this group drew the two circles by considering the dimension provided on the question, numbering parts, constructing lines but failed to show the correct completion of the ellipse. Such students also failed to divide both circle into a number of equal parts and show visible outline. These students had knowledge and skill of constructing ellipsoidal shape, but lacked neatness, drawing speed and some procedures, which made them score average marks.

On the other hand, 63 (13.1%) students had good performance. These students were familiar with construction of ellipsoidal shapes. They drew two circles of diameter 120 mm and 80 mm, divided both circles into a number of equal parts. Next they drew major and minor diameter intersection lines, constructed the extension lines, connected the points for the ellipse and they provided thick visible outline to the required shape. Extract 3.2 is a sample of good response from one of the students who attempted this question.



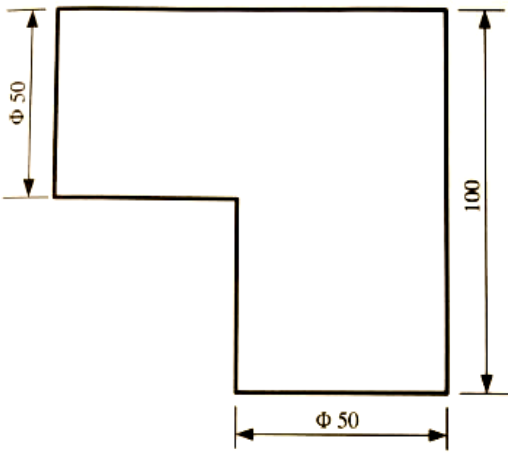
Extract 3.2: A sample of student's good response to Question 3

Extract 3.2 is the work of a student who drew an ellipsoidal shape. This reveals that, the student had knowledge and skills of drawing the ellipsoidal shape by using the concentric circles method as was instructed in the question.

2.1.4 Question 4: Intersection of Cylinders

The question required students to construct the line of intersection which helps the welder to join two equal diameter cylinders connected at right angle. The question intended to assess the ability of the students to construct intersection lines which assists to have an appropriate profile on the mating parts. The question was as follows:

The figure provided shows two cylinders joined at a right angle. Construct the lines of intersections. (Don't omit construction lines).



The question was attempted by 479 (100%) students from whom 178 (37.2%) scored from 0 to 2.5 marks. Moreover, 186 (38.8%) scored from 3.0 to 6.0 marks and 115 (24.0%) scored from 6.5 to 10 marks. The majority of the students (63.05%) scored from 3 and 10 marks. The general performance of students in this question was average. Figure 4 summaries students' performance in this question.

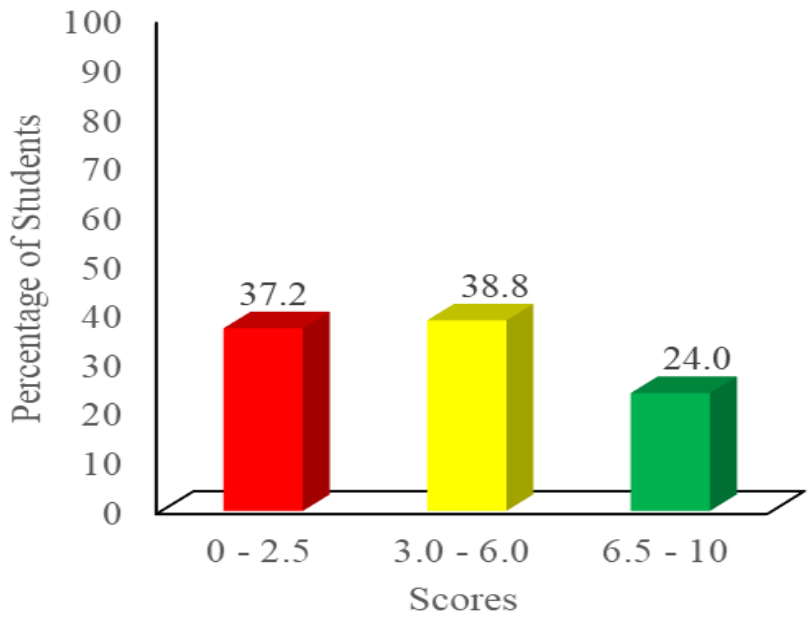
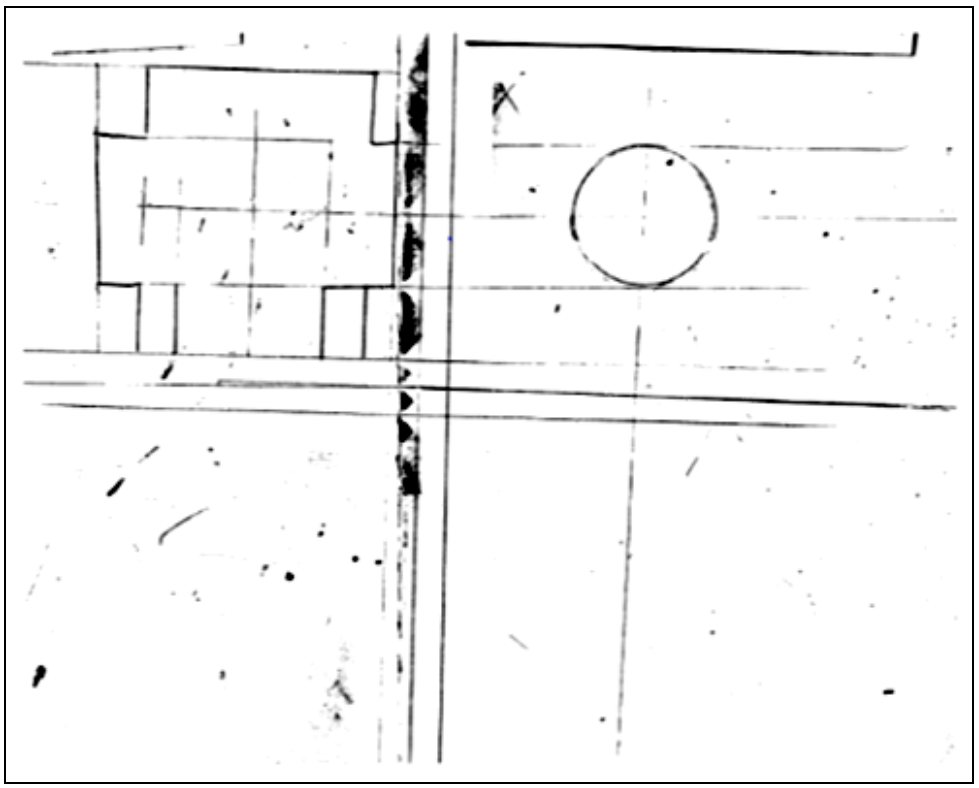


Figure 4: *Students' Performance in Question 4*

The analysis carried out on the students' responses in this question shows that, 36.95 percent of the students scored below average. These students lacked the knowledge that, the three dimension objects are made of a variety of geometrical shapes, such as cubes, cones, spheres, cylinders, prisms and pyramids. Therefore, wherever any two of these shapes meet, some sort of curve of intersection or interpenetration develops. It was necessary for students to draw these curves to complete drawing in orthographic projection. Moreover, the students did not recognize that when cylinders of equal diameter intersect the line at the intersection is straight and at 45^{o}.

The responses provided by students to this question show that they had insufficient knowledge and skills on the sub-topic intersection of cylinders. Others could not differentiate the intersection line from the projection of orthographic views. Instead of constructing intersection line, they

constructed lines as a process of constructing orthographic views. Thus they ended up scoring low marks. For example, one of the students drew the unknown figure that carries the orthographic concept instead of constructing the two cylinder joined at right angle. This indicates that, the students' poor performance was associated with misunderstanding on the requirement of the question. Extract 4.1 is a sample of poor response taken from the script of one of the students.



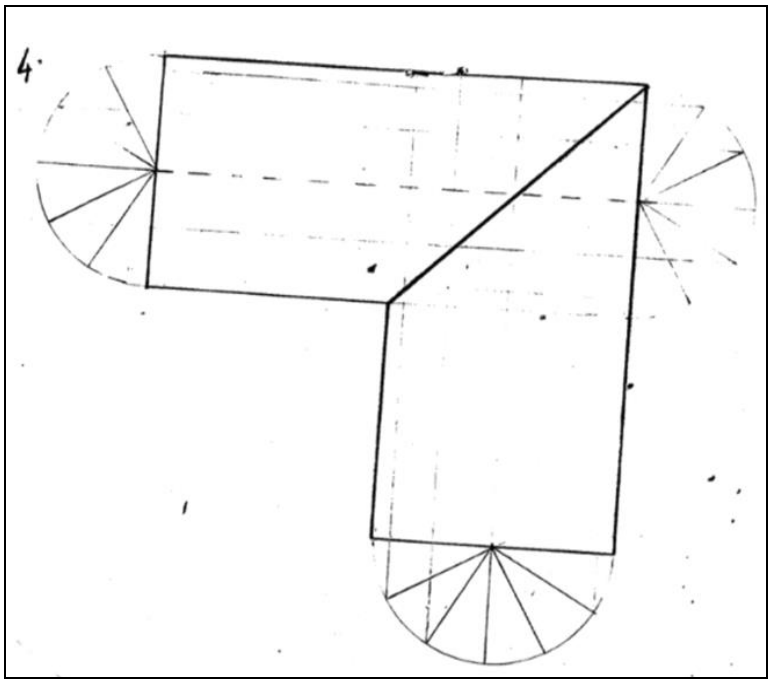
Extract 4.1: A sample of student's poor response to Question 4

Extract 4.1 shows the work of the student who incorrectly initiated to draw the given view and its side and plan views. This student was not able to copy the given view and draw its auxiliary circles which could help to draw the line of intersection, but also to draw the line of intersection.

Some of the students (38.83%) attained average performance as they had limited understanding of the procedures and skills of constructing intersection line of interpenetrating cylinders. Some of these students constructed the intersection of cylinders and showed the construction lines, division of circle, centrelines but ended up not identifying that, the line of

intersection for cylinders meeting at right angle and is the straight line drawn at 45^{o}. Therefore, their performance ended up being average. These students had a partial knowledge on the sub-topic intersection of cylinders.

Despite of low and average scores, few (4.22%) students performed well on this question. Their responses were evidence that the students were familiar with projection of intersection of cylinders. Some of these students scored all ten allotted marks. These students drew two cylinders at 90^{o}, constructed lines, correctly divided the circle into equal parts and drew centreline as well as constructed the correct required line of intersection as a result they scored all 10 marks. Other students scored high marks but less than ten. Such students followed all the procedures but made few errors on constructing either line on line parallelism or the line of intersection. Regardless of the few errors made by these students, they demonstrated their understanding and ability to draw the line of intersection as they adhered to all the guidelines for this particular sub-topic. Extract 4.2 is a sample of good response provided by one of the students.



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

Extract 4.2 shows the drawing provided by a student who attempted correctly this question by drawing the given view and followed correctly

the procedures of finding the line of intersection as he/she drew it inclined at 45 degrees. This student had the knowledge and skills of drawing a line of intersection especially when cylinders interpenetrate at 90 degrees.

2.2 Section B: Short Answer Questions

Section B had three questions which were set from the topics of *Free Hand Sketching, Isometric Projection, Drawing office Tools* and *Similar Figures.* Students were instructed to answer all questions. Each question carried 20 marks, making a total of 60 marks.

2.2.1 Question 5: Free Hand Sketching

This question had two parts, (a) and (b), from the topic of *"Free Hand Sketching"*. In part (a), the students were required to provide sketches which will assist them to sharpen the 2H pencil to a chisel point and the HB pencil to round point. This part intended to assess the students' ability to sharpen pencil into different points and use them in different sketching applications. In part (b), the students were required to draw a free hand sketch in isometric projection of plumb bob. This part intended to measure the students' ability to use free hand in constructing different engineering objects. The question was as follows;

(a) Form one students were assigned a tutorial of paper layout. They were provided with tools like drawing sheet, ruler, 2H and 2B pencils. On conducting the task, you observe that the students suffered on how to sharpen their pencils. Provide sketches which will assist them to sharpen their 2H pencil to a chisel point and their HB pencil to a round point.

(b) A construction company ordered a manufacturing company to make a plumb bob with the specification of 30 mm diameter and 70 mm height. Draw a freehand sketch in isometric projection of a require plumb bob which will help a manufacturer during production of the required component.

The question was attempted by 479 (100%) students, from which 296 (61.8%) students scored from 0 to 5.5 marks. 154 (32.2%) students scored from 6.0 to 12.5 marks and only 29 (6.1%) scored from 13 to 20 marks. Figure 5 summarizes this performance. The general performance of this

question was therefore poor as most of the students scored marks below average.

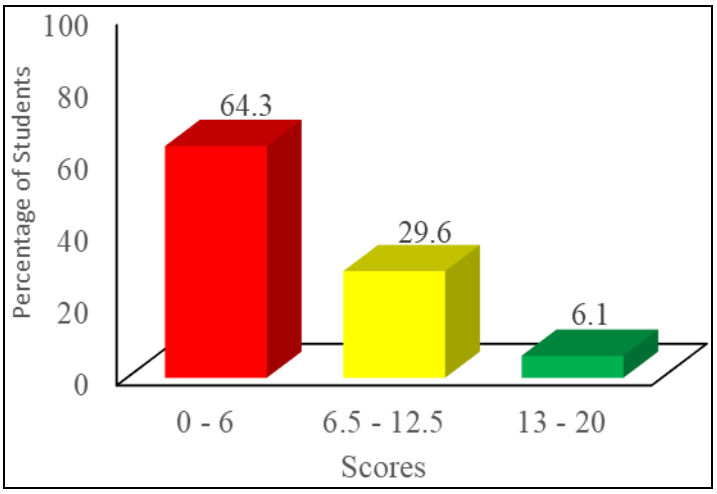
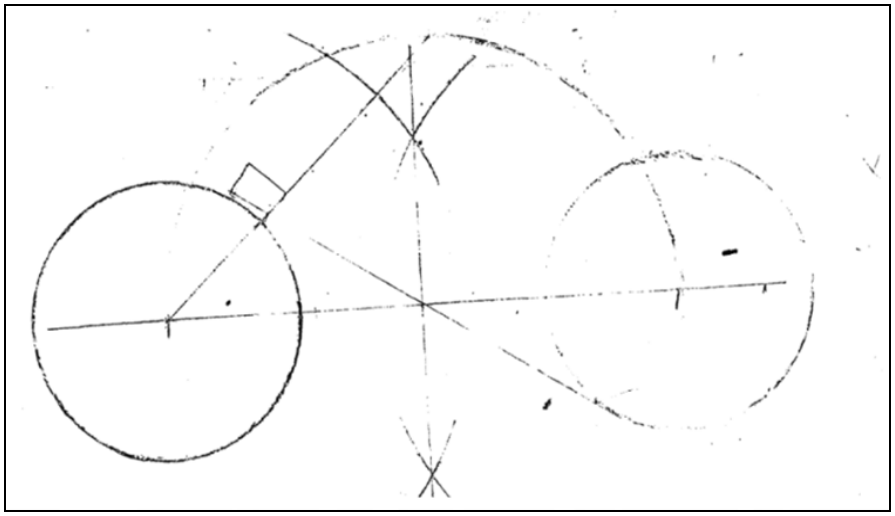


Figure 5: *Students' Performance in Question 5*

The analysis shows that, 296 (61.8%) of the students with weak performance either they did not understand the requirements of the question and lacked knowledge on the sub-topic Freehand Sketching. They failed to construct sketches of a sharpened 2H pencil to a chisel point and HB pencil to a round point in part (a). In part (b) they were not able to draw a freehand sketch in isometric projection of a plumb bob which could help a manufacturer during production of the required component. The students failed to understand that, plumb bob is roundish or cone like vertical equipment usually with a pointed tip on the bottom. It seems, they had no prior knowledge of the shape of plumb bob. For example, one of the students constructed two circles and joined them with lines in part (a) and constructed two arcs facing each other in part (b). This shows that the student lacked adequate skills on the sub-topic Free Hand Sketching. Extract 5.1 is a sample response from a student who had poor performance.



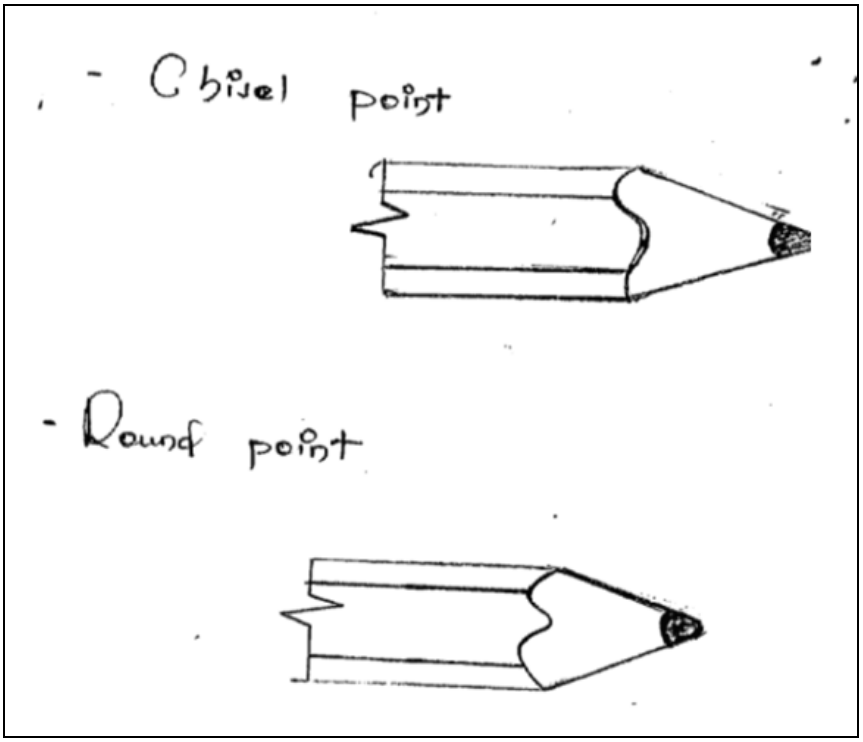
Extract 5.1: A sample of student's poor response to Question 5

The response in Extract 5.1 shows the incorrect diagram drawn by the student. The student was not able to provide freehand sketch which could help to sharpen 2H pencil to a chisel point and their HB pencil to a round point in part (a). In part (b) he/she failed to draw a free hand sketch in isometric projection of a required plumb bob.

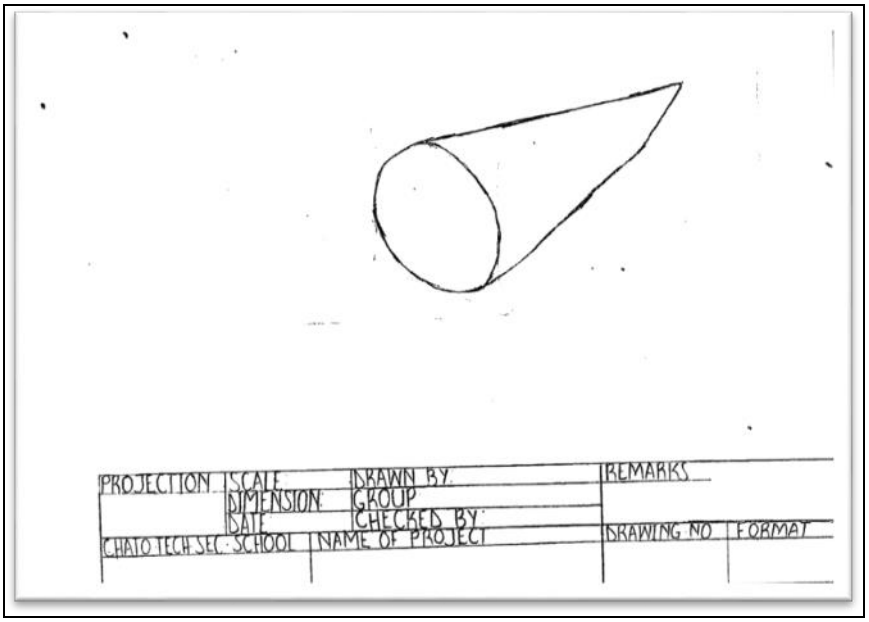
Almost 32.2 percent of the students with average performance scored from 6.0 to 12.5 marks. These students provided correct sketch in part (a) by drawing a round point tip which is a standard round point shape when the pencil has been sharpened by a pencil sharpener and chisel point which allows the user to draw both fine and thick lines depending on the angle which the pencil is used. In part (b) due to the partial knowledge on the plumb bob, students were not able to sketch it by means of freehand and following the procedures for isometric projection, instead some of them sketched incorrect diagram as a result they ended up with average scores. Most of the students in this group answered correct part (a) but in part (b) either they had insufficient skills on free hand sketching or they did not recognise the plumb bob because they skipped or did not finish answering the question as a result they didn't score high marks.

Nevertheless, quite few students 29 (6.1%) who scored marks from 13 to 20, constructed a clear sketch in either both parts or large area of the two parties (a) and (b). Some of these students managed to give the correct responses because they sketched correct chisel point and round points in

part (a) and followed the procedures to construct the plumb bob in part (b). Thus, they scored all 20 mark allotted to this question. These students possessed adequate knowledge, skills and techniques on the procedures and processes of employing freehand to sketch different diagrams. Others only attempted correctly some portions of the question and missed few portions such as decorating the chisel and round point for clarification in part (a) and assumed a plumb bob has flat end instead of roundish and sharp one, thus, they scored high marks but less than 20. Extract 5.2 (a) and (b) are the sample responses from a student who had good performance.



Extract 5.2 (a): A sample of student's good response to Question 5(a)



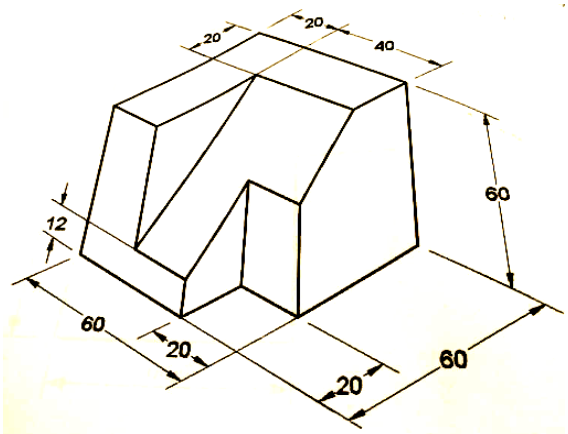
Extract 5.2 (b): A sample of student's good response to Question 5(b)

The responses in Extract 5.2 shows the correct diagram of the drawn chisel point of a 2H pencil and a round point of HB pencil in part (a) and an isometric projection of plumb bob in part (b) drawn by the student who performed well the question.

2.2.2 Question 6: Isometric Projection

This question was derived from the sub-topic isometric drawing. The students were required to redraw the given stopping machine block using a scale of 1:1 into isometric projection. This question intended to measure students' ability to use the same scale in constructing isometric drawing by employing isometric projection principle of engineering drawing. The question was as follows:

The figure shows a pictorial drawing of a stopping machine block. Using a scale of 1:1, draw a block into isometric projection.



The question was attempted by 479 (100%) students whereby 147 (30.1%) of them scored from 0 to 5.0 marks, 81 (16.9%) students scored from 6 to 12 marks and 254 (53.0%) students scored from 13 to 20 marks. In general, the performance in this question was good as the majority of the students (69.3%) scored average and above. Figure 6 summarizes the performance of the students in this question.

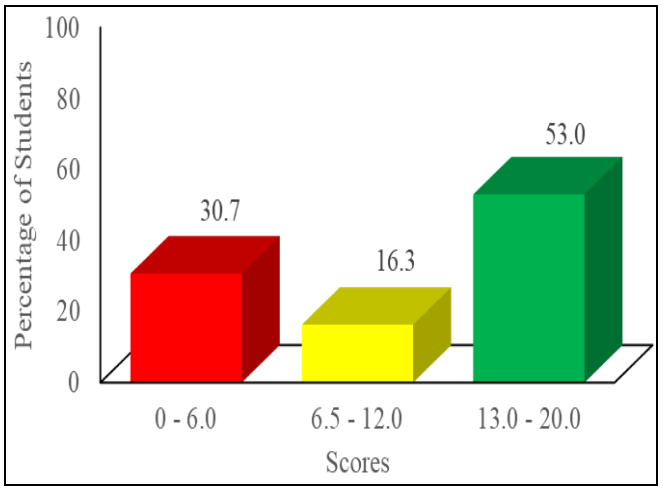
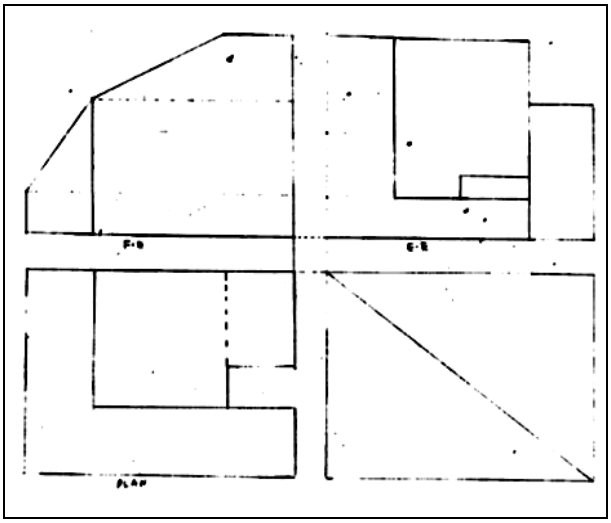


Figure 6: *Students' Performance in Question 6*

Approximately 30 percent of the students who scored from 0 to 5.0 marks either did not understand the demand of the question or lacked the knowledge on the sub-topic Pictorial Drawing as well as drawing skills to redraw the machine block. These students drew orthographic views instead of pictorial drawing in isometric projection. The students could not convert

the given view into other projections such as drawing orthographic projection from isometric projection. For example, one student responded by converting the given figure in first angle projection, instead of redrawing the pictorial drawing in isometric projection using the scale of 1:1. These students did not understand that, in engineering drawings, the scales describe the relationship between the linear dimension of an object as shown in the original design and the actual linear dimension of the same object as it is increased, decreased or the same size with specific ratio provided. With the ratio of 1:1 the task that students were required to respond was only to redraw the machine block as depicted from the question. This indicates that, most of them did not understand the demand of the question. Extract 6.1 is a sample response from a student who had poor performance.



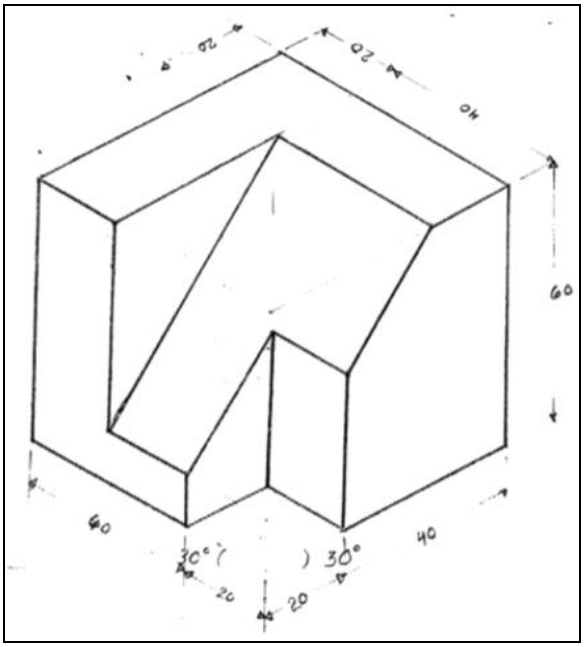
Extract 6.1: A sample of student's poor response to Question 6

The response in Extract 6.1 shows the incorrect work done by the student who did not understand the requirement of the question. Instead of copying an isometric block projection, the student transformed the isometric block into orthographic projection by drawing the three views of an isometric block.

On the other hand, the 16.9 percent of the students who scored from 6 to 12 marks understood the requirements of the question and responded correctly by following some of the procedures when attempting it, but they made few

mistakes that hindered them from earning outstanding marks. Some of the mistakes made include not being keen enough to draw vertical line at exactly 90 degree with horizontal line and base line at 30 degree with horizontal line as well. For instance, some students were unable to draw a base line at a 30-degree angle, thus, they were not able to produce an isometric or recopy from the given figure into isometric projection, which resulted in scoring an average marks.

On the other hand, 254 (53.0%) students performed well and gave correct answers with regard to the question's requirements. They scored from 13 and 20 marks. Among them, 120 (25%) scored all 20 marks. Their responses indicate that, they had enough knowledge and skill of constructing the isometric object and managed to follow correctly the procedures. They were able to construct one vertical line along which defined two points. Furthermore, they set out lines from these points which were constructed at an angle of 30 degrees. From these lines, others were constructed parallel to the first and were then connected to provide the required isometric geometry, thus, they scored all 20 marks. This indicates that, most of the students in this group understood the requirement of the question and had sufficient skills on this sub-topic. Extract 6.2 is a sample response from a student who had good performance.



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

Extract 6.2 shows the correct work done by the student who correctly reproduced an Isometric object as was required. The student followed all the procedure by drawing an isometric box of base line at a 30-degree angle and then projected different lines to obtain the isometric object.

2.2.3 Question 7: Drawing office Tools and Similar Figures

This question had two parts, (a) and (b) from the sub-topics Drawing Office Tools and Similar Figures respectively. In part (a) the students were required to briefly explain the functions of the given drawing tools. This part intended to assess students' ability to explain the use of various drawing instruments. The item (a) was as follows;

(a) A certain technical school wish to conduct a seminar to students on the use of drawing tools. If you are invited as an expert in engineering drawing, briefly explain the function of the following drawing tools as part of your presentation.

(i) Drawing board

(ii) Drawing sheet (paper)

(iii) T-square

(iv) Set square

(v) Protractor

(vi) Compass

(vii) Divider

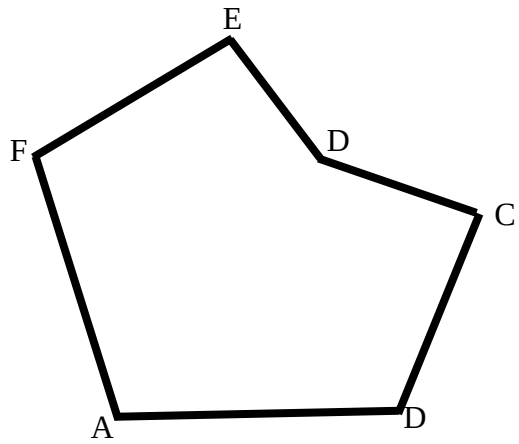
(viii) Eraser

(ix) Pencil

(x) Pencil sharpener

In part (b), students were required to enlarge the given irregular polygon to the scale of 3:5. This part intended to measure students' ability to use scale by following engineering drawing principles. The item (b) was;

(b) Given figure shows an irregular polygon ABCDEF. If AB = 85 mm, AF = EF = 75 mm, ED = 35 mm, BC = 60 mm; and angles FAB = AFE = FED = 105^o and BCD = 90^o; enlarge the figure to the scale of 3:5.



The question was attempted by 479 (100%) students, in which 111(23.2%) students scored marks from 0 to 5, 321 (67.0%) students scored from 6 to 12.0 marks and 47 (9.8%) scored marks from 13 to 20. Figure 7 summarizes this performance.

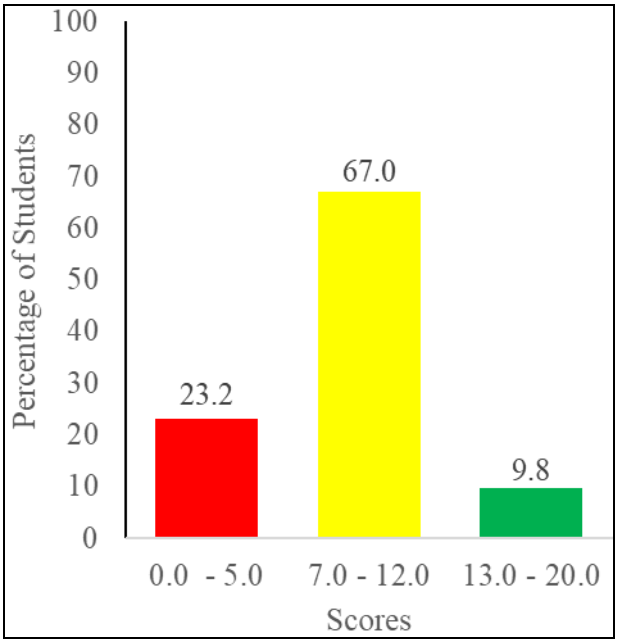
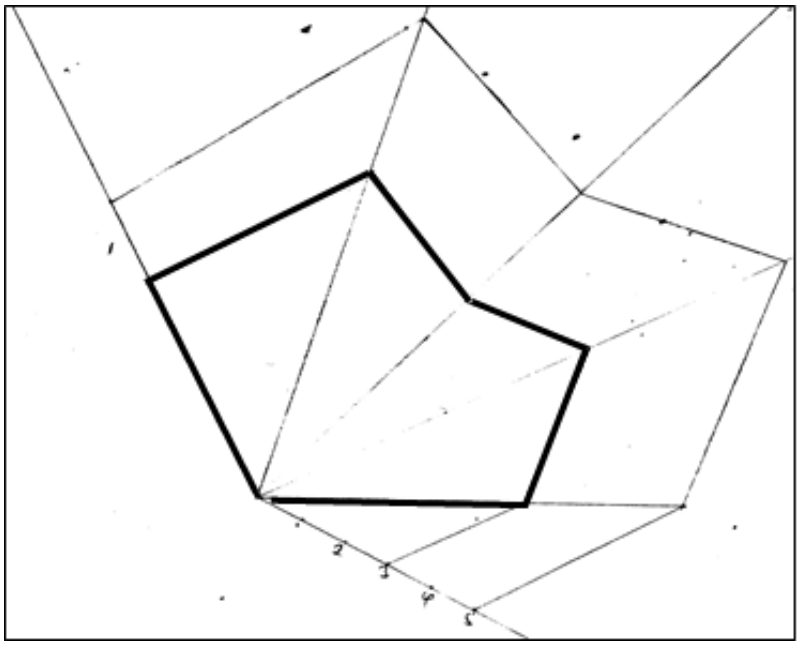


Figure 7: *Students' Performance in Question 7*

The majority of students answered this question correctly as 76.8 percent of the students scored average and above, making it one of the best performed questions. Among them, 9.8 percent of the students scored from 13 to 20 marks.

Some of them answered accurately in most parts of the question, with the exception of a few errors, thus, scoring from 13 and less than 20 marks. Nevertheless there were 13 (2.7%) students who scored all 20 marks. These students explained the function of office tools in part (a) and they constructed the figure and enlarged it to the scale of 3:5 in part (b). They followed correctly the procedures by copying the given figure, showing construction lines and drew the lines AC, AD and AE. Also, they drew an auxiliary line AB and divided it into equal five parts and reduced the figure as the dimension of 3 to read 5 units. They also outlined the visible line. Therefore, they applied their knowledge and skills correctly in attempting the question. Extract 7.1 is a sample of good response provided by a student with good performance.

(ii) Drawing board.
It is the flat board/surface that helps to the paper during drawing.
(iii) Drawing sheet (paper).
It is the flat surface that the object drawn on it.
(iii) T- square.
It is used to draw a vertical lines.
(iv) Set square.
It is used to draw a parallel and vertical lines
(v) Protractor.
It is used to draw angle.
(vi) Compass.
It is used to draw a circle.
(vii) Dividers
It is used to transfor Measurement.
(viii) Eraser
It is used to clear the unwanted lines to rule the construction line
(ix) Pencil
It is used for drawing an object
(x) Pencil sharpener.
It is used to sharper the pencil-For the drawing purpose.



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

Extract 7.1 shows the correct response provided by a student who explained the function of the drawing office tools in part (a). In part (b) the student enlarged the plane figure with regard to the given ratio of 3:5 whereby he/she drew an auxiliary line AB and divided it into equal five parts and was reduced the figure as was instructed in the question.

The analysis on the students' responses shows that, 67.0 percent of the students who scored average (6 to 12.5 marks) provided correct response in part (a) and failed to provide correct response in part (b) or vice versa. Most of them answered part (a) by explaining correctly the functions of drawing office tools as per requirement of the question. Few among them, sketched the figure in part (b) according to the requirements of the question. These students understood the question demand in part (b), but they lacked proficiency in the sub-topics function of drawing office tools.

Despite of the good performance on this question, the analysis shows that, 23.2 percent of the students with weak performance lacked knowledge on either drawing office tools or similar figures. They provided irrelevant responses in part (a) as was revealed in their responses by explaining wrong functions of the drawing office tools and constructed incorrect sketch on part (b). Their responses to this question reveal lack of understanding and competence in the sub-topic "Drawing Office Tools" and "Similar Figures. For example, one student wrote incorrect functions of drawing office in part (a) and in part (b) only he/she copied the question without applying drawing procedural. Extract 7.2 is a sample response from a student who had poor performance.

7. i Drawing board- It used for dust free of eraser

ii. Drawing sheet - It used for sheet paper

iii. T- square - It used for ~~inside~~ side of all angle

iv. set-square - It used for Drawing of angle and triangle area

v. protector - It used for around on the ~~circle~~ circle

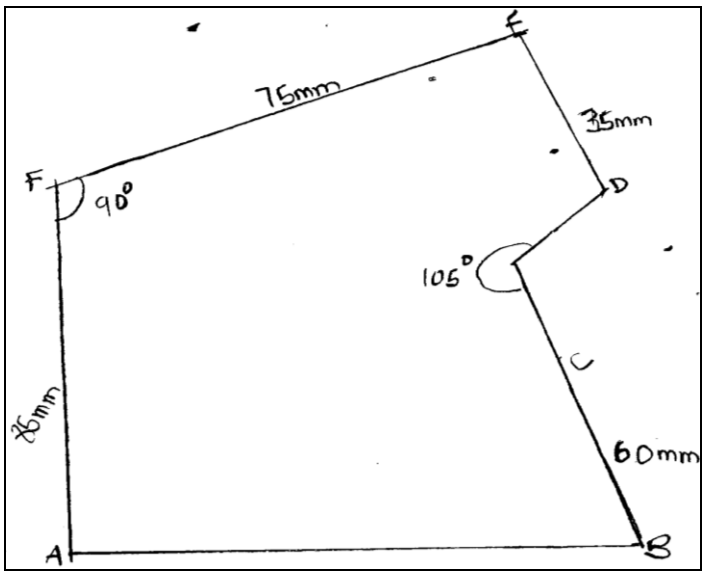
vi. Compass - It used for Drawing Instrument box

vii. Divider - It used for Drawing to kilogram of drawing picture

viii. Eraser - It used for give of pencil and other drawing

ix. pencil - It used for drawing area, angle, triangle and etc

x - pencil sharpener - It used for cleaning drawing area



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

Extract 7.2 shows the incorrect response provided by a student who was not able to give the function of the drawing office tool in part (a). In part (b) the

student was not able to enlarge the plane figure with regard to the give ratio of 3:5.

3.0 ANALYSIS OF THE STUDENTS PERFORMANCE IN EACH TOPIC

The assessment of Engineering Drawing comprised of seven (07) questions from various topics of Form I and II. The analysis on the students' performance indicate that questions 1, 6 and 7 from the topic of Pictorial Drawing, Drawing Office Tools and Similar Figures had good performance since the percentages of the students who passed were 76.6, 69.9 and 76.8 respectively. The questions which were performed averagely (question 4 and 5) were from the topics of Intersection of Cylinders (62.8%) and Free Hand Sketching (38.2%) respectively.

Furthermore, the analysis shows that, two questions had weak performance as most of the students scored below 30 percent. These questions were set from the topics of Construction of Geometric Figures (19.2%) and Similar Figures (18.2%). Appendix 1 summarises the students' performance in each topic.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Based on the student's responses analysis of each question, it can be concluded that the overall performance in Engineering Drawing subject on the Form Two National Assessment (FTNA) in 2022 was average. That is, 64.9 percent of the students passed the assessment.

The majority of the students had good performance in Question 1 and 6 from the topics of *Pictorial Drawings*, *Drawing Office Tools* and *Similar Figures*. They had an average performance in Questions 4 from the topic of *Intersection of Cylinders* and 5 from the topic Free *Hand Sketching*. In addition, the students' weak performance was observed in Question 3 from the topic of *Construction of Geometric Figures* and Question 2 from the topic of *Similar Figures*. The reason of failure in some of these topics is lack of knowledge and skills, failure to follow drawing procedures, and inability to use drawing instruments properly. It is therefore expected that, this report will help students, teachers and the adminstrators to address the

weaknesses identified in the report to ensured good performance in future assessments.

4.2 Recommendations

From the students' weakness observed in the analysis of their responses, the following are therefore recommended:

(a) **Recommendations to Students**

(i) Students should practise on how to use each drawing office tools. Practices would help them become competent in explaining the uses of the tools.

(ii) Students should practise to construct accurately different types of geometric plane figures (triangles, quadrilaterals, polygons, circles, tangents).

(iii) Students should be guided and exposed to many practises on applying the rules and procedures in constructing enlargement of plane figures using the given ratios.

(b) **Recommendations to Teachers**

(i) Teachers should give students more exercise on construction of plane similar figures so as to enable them to apply the rules and procedures in constructing plane similar figures.

(ii) Teachers should give students more practise on converting diagrams from isometric to oblique and vice-versa while teaching the topic of pictorial drawing so that students are able to practise the conversion of one projection to another.

(iii) Teachers should encourage students to practise how to draw ellipse by employing both methods of concentric and rectangular so that they become competent to draw ellipse by employing the stated methods.

(iv) Teachers should build the capacity of the students to draw something by hand without the use of tools or another object. This should be done by controlling the drawing process solely with their hand, and it should be dependent upon their powers of observation.

Appendix I: A Summary of Students' Performance (Question-Wise) in Engineering Drawing 2022

S/N	Topic	Sub-Topic	Performance For Each Topic		Remarks
			Question Number	Percentage of students who scored 30% or more	
1.	Engineering Drawing I	Drawing Office Tools and Similar Figures	7	76.8	Good
2.	Engineering Drawing II	Pictorial Drawings	1 and 6	73.3	Good
3.	Engineering Drawing II	Intersection of Cylinders	4	62.8	Average
4.	Engineering Drawing I	Free Hand Sketching	5	38.2	Average
5.	Engineering Drawing I	Construction of Geometric Figures	3	19.2	Weak
6.	Engineering Drawing I	Similar Figures	2	18.2	Weak

Appendix II: Students' performance grade-wise for year 2022 in comparison to the year 2021

YEAR	A	B	C	D	F	TOTAL
2022	27	46	162	114	130	**479**
2021	1	7	44	71	321	**444**