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

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

ENGINEERING DRAWING

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091 ENGINEERING DRAWING

Published by
National Examinations Council of Tanzania,
P.O. Box 2624,
Dar es Salaam, Tanzania

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FOREWORD

This report is written in response to the 2021 Form Two National Assessment (FTNA) results in Engineering Drawing subject. The report provides feedback to students, teachers, parents, policymakers, and other education stakeholders on the students' performance in this subject.

The FTNA is a formative evaluation in secondary education which, among other things, shows the effectiveness of the education system in general and the education delivery system in particular. Essentially, the quality of students' responses in the assessment indicate what the education system offered or did not offer to the students in their two years of study.

The report analyzes students' performance based on the responses provided. Generally, statistics show that most of the students had weak performance in this year's assessment. The report attributes this performance to several reasons including, poor mastery of the topics, inability to meet the requirements of the questions, and failure to respond, per the requirements of the question task. In addition, most of the students who attained weak performance exhibited poor drawing skills.

Nevertheless, a few students had good performances. These students demonstrated a thorough understanding of the topics covered, as well as ability to meet the requirements of the questions. The students also responded correctly to the drawing steps and procedures as per the respective question tasks.

In view of this, the report offers recommendations on how to improve students' performance in future. It is expected that the feedback provided in this report will enable education stakeholders to take proper measures to enhance the teaching and learning process and improve students' performance.

The Council would like to thank all examination officers, examiners, and those who participated in preparing this report.

Dr. Charles E. Msonde

EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report analyses the students’ performance in Engineering Drawing subject for the students who sat for Form Two National Assessment (FTNA) in 2021. The paper assessed the students’ competences according to Form I and II Engineering Drawing topics stipulated in the Mechanical Engineering Syllabus. This is the first national assessment performance after revising the version for Mechanical Engineering syllabus of 2019. The report shows students’ performance question-wise, whereby the students’ identified their strength and weakness when attempting the question. It analyses the questions which were well performed, moderately and weakly performed.

The Engineering Drawing paper comprised seven (7) compulsory questions which were distributed in two (2) sections; A and B. Section A consisted of four (4) questions whereby each question carried 10 marks making a total of 40 marks. Section B consisted of three (3) questions whereby each question carried 20 marks making a total of 60 marks.

This report also presents the analysis of the students’ performance on each question by giving an overview of what students were required to do and the reasons for good performance as well as for weak performance. It also presents the demands of each question, the students’ responses, their strengths and weaknesses in answering the questions. The report uses samples of students’ answers to illustrate the responses, charts and graphs which show the percentages of the students’ scores in each question. Finally, it provides a conclusion, recommendations and the percentage of students’ scores in each question and topic as shown in Appendixes.

The performance in Section A was categorised in the classes of good for a score range of 6.5 to 10 marks; average for a score range of 3.0 to 6.0 marks and unsatisfactory for a score range of 0 to 2.5 marks. In Section B, good performance ranges from 13 to 20 marks, average from 6.0 to 12.5 marks and unsatisfactory from 0 to 5.5 marks. These groups were denoted by using colours where Green, Yellow and Red denote good, average and unsatisfactory performance respectively. The colours were highly used to represent performance in figures and appendix.

A total of 444 students sat for this paper, out of which 123 (27.71%) students passed the assessment with the following grades: A - 1 (0.23%), B - 7 (1.58%), C - 44 (9.92%) and D - 71 (15.99%), however 321 (72.29%) students failed. The students' performance is summarised in Table 1.

Table 1: *General Students' Performance*

Percentage Range	Description	Students	
		Number	Percentage
0-29	Unsatisfactory	321	72.30%
30-64	Average	115	25.90%
65-100	Good	8	1.80%
TOTAL		**444**	**100%**

Table 1 indicates that the general performance on this assessment was weak since only 123 (27.7%) students scored above average. This performance shows that students lacked knowledge on various topics, which led to low scores.

2.0 ITEM RESPONSE ANALYSIS IN EACH QUESTION

2.1 SECTION A: Short Answer Questions

Section A comprised four (4) questions, each worth ten (10) marks, making a total of forty (40) marks. The questions were extracted from the subtopics *Construction of Geometric Figures, Intersections of Cylinders, Free Hand Sketching* and *Pictorial Drawing (Oblique and Isometric).* Students were required to answer all questions in this section.

2.1.1 Question 1: Construction of Geometrical Figures

The item was composed from the topic Geometric construction. Students were required to construct different regular polygons (Pentagon, Heptagon, and Octagon) in one drawing by using the given length of one side. The question stated that: A *certain industry that deals with pavement blocks needs a metal pavement block pattern. The shapes of that pattern are pentagon, heptagon, and octagon, and the size of one side is 20 mm. Construct these polygons into one drawing showing all the construction lines*.

The question was attempted by 444 (100%) students, out of which 74 (16.67%) scored from 6 to 10 marks, 30 (6.76%) scored from 3 to 5.5 marks and 340 (76.58%) scored from 0 to 2.5 marks. Figure 1 presents the students' performance in this question.

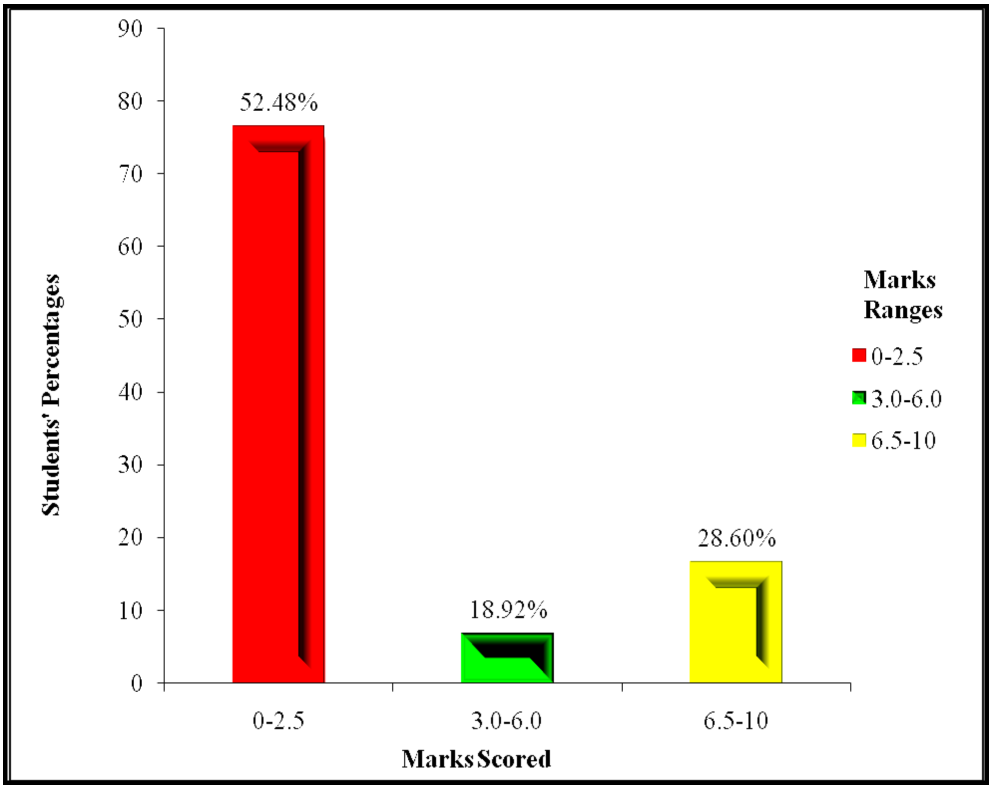
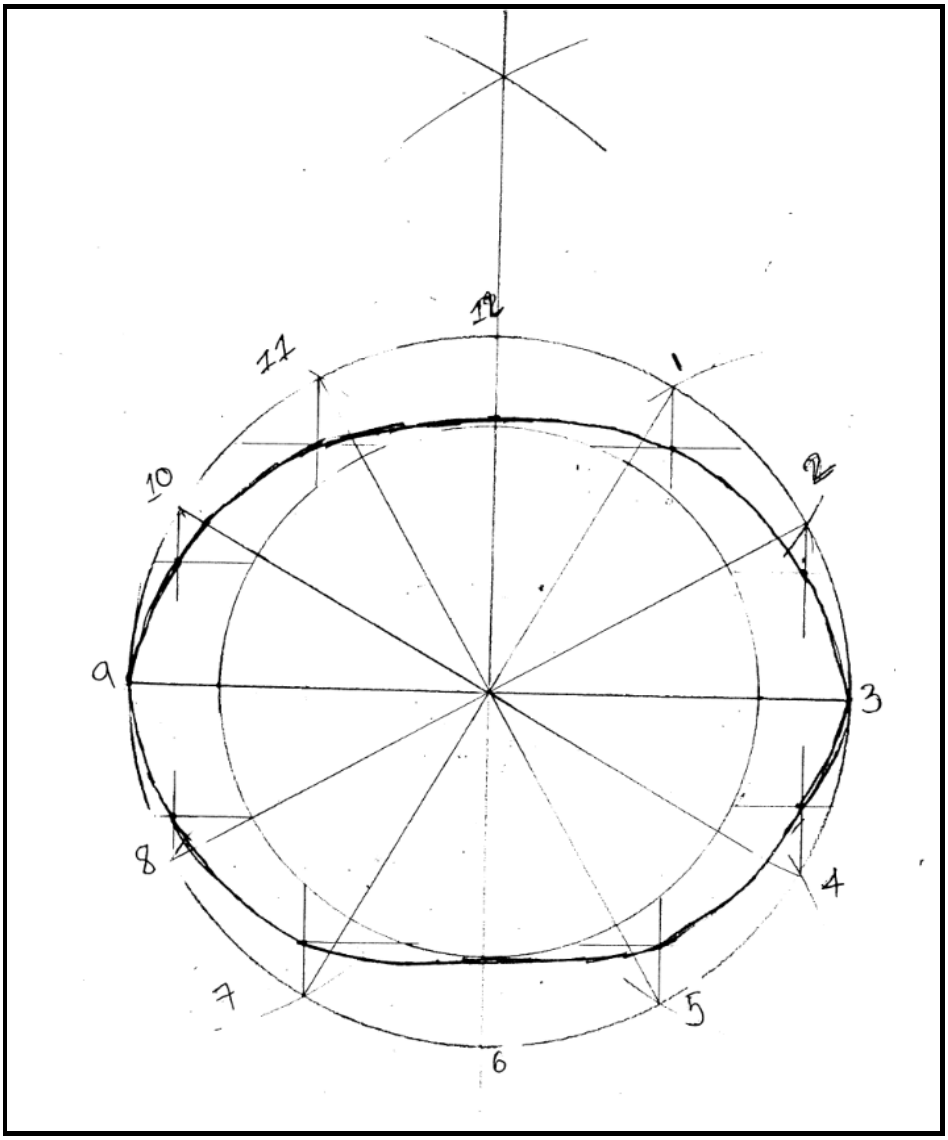


Figure 1: *The Percentage of Students' Scores in Question 1*

As Figure 1 indicates, 403 (90.77%) students scored below 3 marks. Therefore, the performance of the students in this question was generally weak. The students who scored low marks made mistakes that led to incorrect solution. They failed to follow procedures on attempting such kind of question.

The majority of them failed to apply the knowledge of drawing various polygons for a given one side using methods of setsquare and compass. They drew separate polygons, indicating the dimensions for each side. Nevertheless, they drew manually without using set squares, as well as ignoring the requirement of leaving construction lines. These responses show that these students know how to construct various polygons, but they didn't understand the requirements of the question. The weak performance was greatly contributed by the failure of the students to complete the task. They either failed to follow the procedures of drawing polygons or to combine all the polygons into one drawing. Extract 1.1 is an example of a poor responses from a student who answered this question incorrectly.

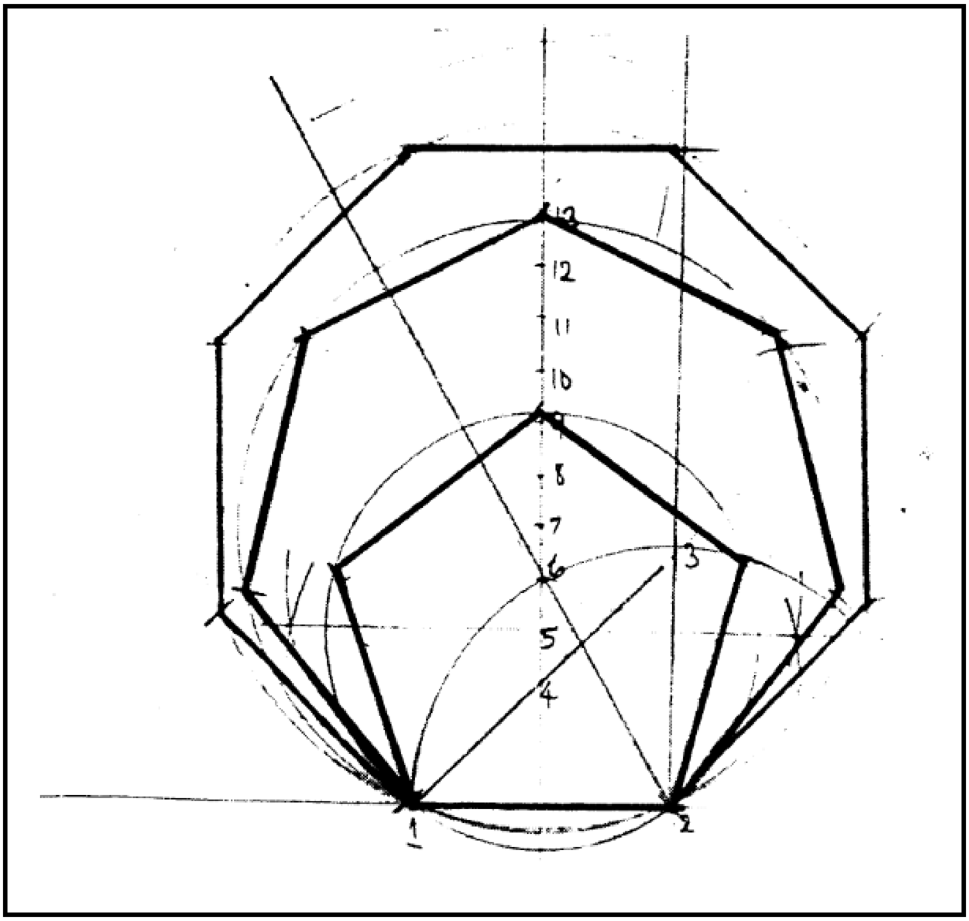


Extract 1.1:.*A sample of poor responses to Question 1.*

In Extract 1.1, the student provided incorrect diagrams of polygons, due to lack of knowledge and skill in construction of geometrical figures. Instead of drawing the required three polygons (pentagon, hexagon and octagon), she/he drew eclipses by using cycles methods. This indicates that, she/he lacked knowledge on the topic matter.

Besides this misconception, 24 (5.41%) students were able to draw partially correct polygons as they scored from 3 to 6 marks. These students were able to follow procedures of drawing polygons by leaving constructions lines and using proper drawing tools. However, they failed to complete the task by showing visibility of the required objects or left other types of polygons, hence they scored average marks.

Furthermore, the analysis depicts that 17 (3.83%) students attempted the question correctly and scored full marks. Those are the ones who managed to draw all three polygons asked and followed the procedures of drawing and showing the steps used to obtain the required polygon. In order to score full marks, the students were required to do the following; *first to draw horizontal line with given dimensions as one side, then with the help of drawing tools to bisect the drawn side at the centre to obtain perpendicular lines with the drawn side. Using 45^0 and 60^0 set squares, students were required to construct a lines with end edge of drawn sides and mark point 4 and 6. With point 4 and 5 the students were needed to bisect the perpendicular line to obtain point 5. With point 5 and 6 step off along the perpendicular bisector line to obtain point 7 and 8. The students were now required to use end point of drawn side and any points 5, 7 and 8 to draw three circles which all of them touch at the ends of the side drawn. Lastly, with dimension of side step-off the drawn circles, join the points and outline to obtains the required polygons.* Extract 1.2 is a sample of responses from a student with good performance.



Extract 1.2: *A sample of good responses to Question 1*

Extract 1.2 exhibits a sample of responses from the student who managed to draw the metal pavement block pattern having the shape of pentagon, heptagon and octagon on the same drawing. He/she correctly outlined the shapes as well as leaving the stepped lines to indicate how he/she got the object. This indicates that the student had knowledge and skills on drawing geometrical figures.

2.1.2 Question 2: Intersections of Cylinders

The question required the students to construct a line of intersection which helps the welder to join two unequal diameter cylinders connected at right-angle. In this question students were expected to start to draw the bisected circles at the side of each cylinders which will help to obtain points of lines which closed each other. At the point at which the vertical and horizontal lines intersected there are points which are required to be connected to get the required arc of joining. The question was:

2. Figure 1 shows two cylinders of unequal diameters which are supposed to be welded at right angle (90^{o}). Construct a line of intersection to lead the welding process.

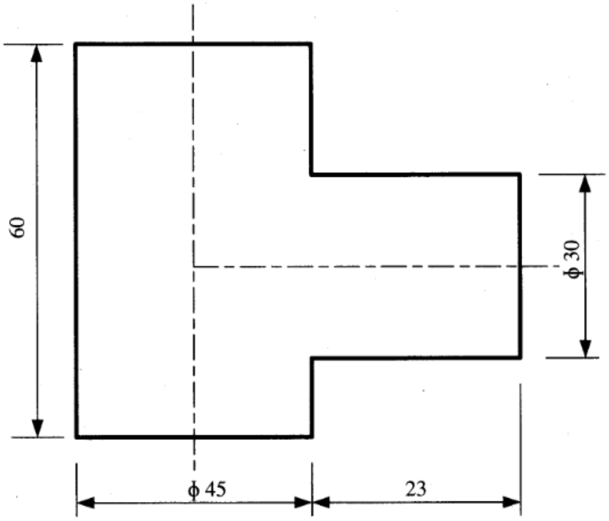


Figure 1

The question was compulsory and was attempted by 444 (100%) students, out of which 403 (90.76%) scored below 3 marks, 24 (5.41%) students scored from 3 to 6 marks and 17 (3.83%) students scored above 6 marks. Based on these data, the question was poorly performed as shown in Figure 2.

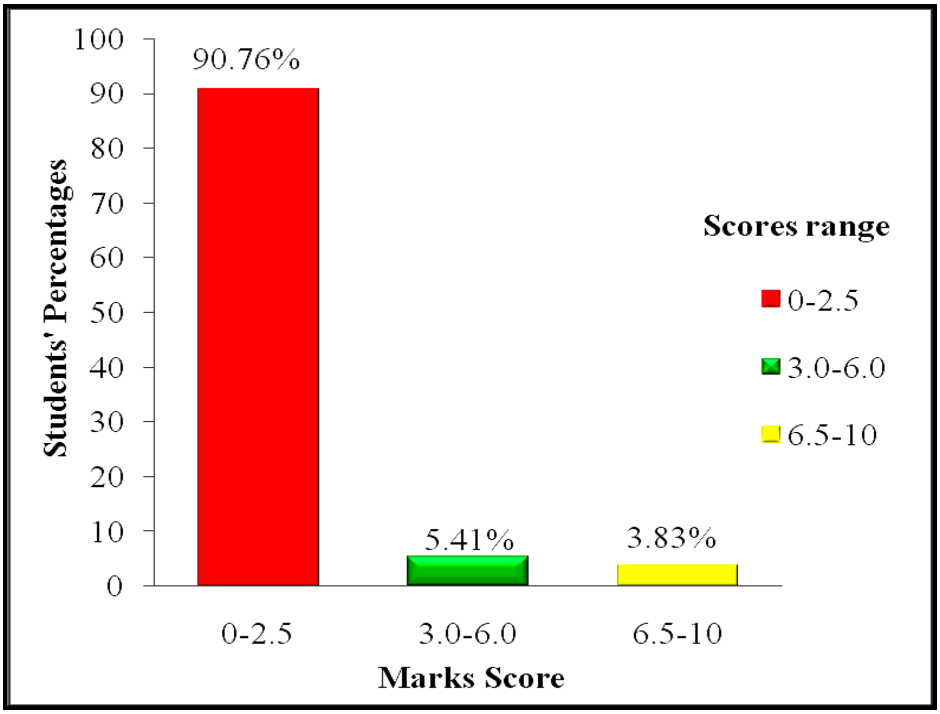
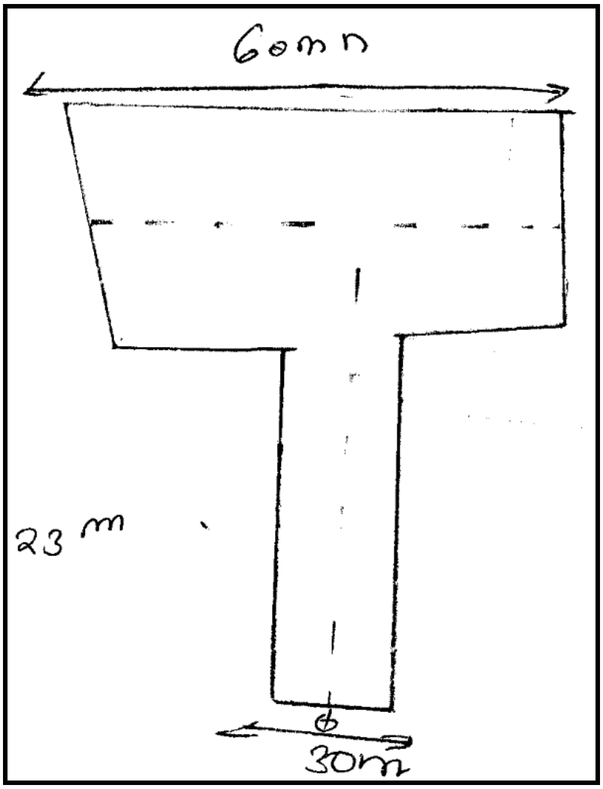


Figure 2: *The Percentage of Students' Scores in Question 2*

Figure 2 shows that the general performance on this question was poor since 90.77 percent of the students scored below average. This performance indicates that the students had inadequate knowledge about the intersections of cylinders.

Further analysis of students' responses show that 403 (90.76%) students who scored below 2.5 marks on this question had inadequate knowledge about the intersections of the circles, especially two circles that intersected at the right angle. Some of them copied the question without constructing the required intersection curves and used the wrong scales. Others used freehand sketches to draw the given task, which is wrong procedure in drawing. Some of them drew given cylinders and added other perpendicular holes to the major cylinder. This proved that the majority of the students lacked enough practice in working on different intersections of circles joined at different angles. Hence, they failed to present the correct responses. Extract 2.1 is a sample of a poor answer from the script of a student.

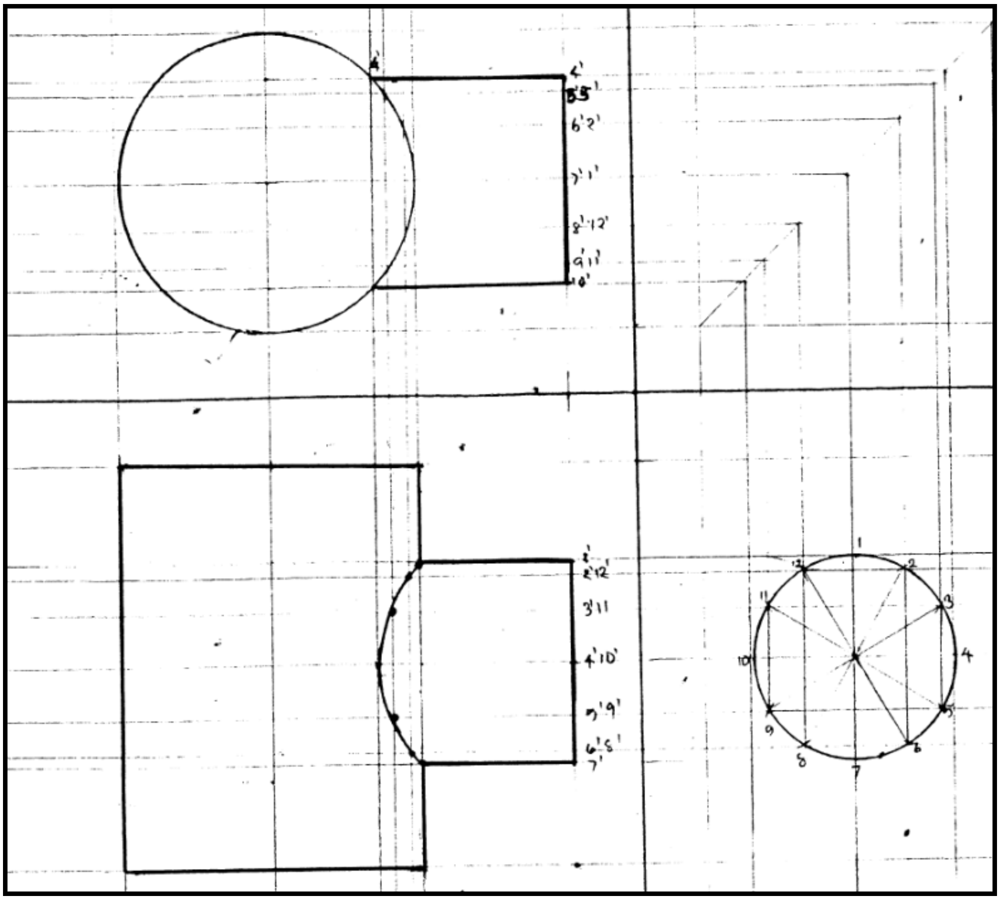


Extract 2.1: *A sample of poor responses to Question 2.*

In Extract 2.1, the student provided incorrect responses for the task given. He/she drew the diagrams with different directions, used wrong scale, failed to indicate the bisected semicircles or arcs, failed to show construction lines and paper layout hence the student scored low marks.

Furthermore, analysis shows that those who performed averagely were able to draw the given cylinders and their arcs or semicircles, bisects, but failed to draw all the lines required to allocate the points of intersection. For example, one student drew the required task but failed to maintain visibility of the drawn curves and erased the construction lines, hence failed to obtain full marks. However, some of the students mixed the correct and incorrect rules and methods of drawing intersected cylinders at the right angle. For example, one student drew only one semicircle and failed to obtain other lines that intersect each other. This kind of attempt shows that the student mixed between developments and interpenetration. Also, most of the students failed to draw the correct intersection curves between the two circles. This proved that they lacked enough knowledge and skills to practice geometrical drawings.

On the other hand, the students who showed good performance on the question had sufficient knowledge of geometrical constructions, especially in the intersection of the cylinders. These students managed to draw the required curves by considering drawing procedures. They were able to construct and bisect the semicircles, which helped them obtain the required points used to draw lines that intersect at the meeting point. Extract 2.2 is a sample answer from the student who scored full marks.



Extract 2.2: *A sample of good responses to Question 2.*

Extract 2.2 shows a sample of responses from the script of the student who managed to draw interpenetration curves and show all the procedures. This indicates that he/she had sufficient knowledge and skills on the interpenetrations of cylinders.

2.1.3 Question 3: Free Hand Sketching

In this question, students were required to apply freehand sketch techniques to draw two plates joined together with a bolt. The question is intended to measure a student's capability of drawing various figures without using drawing tools, such as drawing straight lines and making smooth and clear lines using freehand sketch methods. The question was as follows: two *plates having a thickness size of 12 mm are bolted and held together by using a bolt of the size M12. By applying freehand sketch techniques, show how the two plates are bolted together.*

A total of 444 (100%) students attempted the question, out of which 18 (4.05%) scored from 6.5 to 10 marks, 91 (20.50%) scored from 3 to 6 marks and 335

(75.45%) students scored from 0 to 2.5 marks. The students' performance is rated as weak as portrayed in Figure 3.

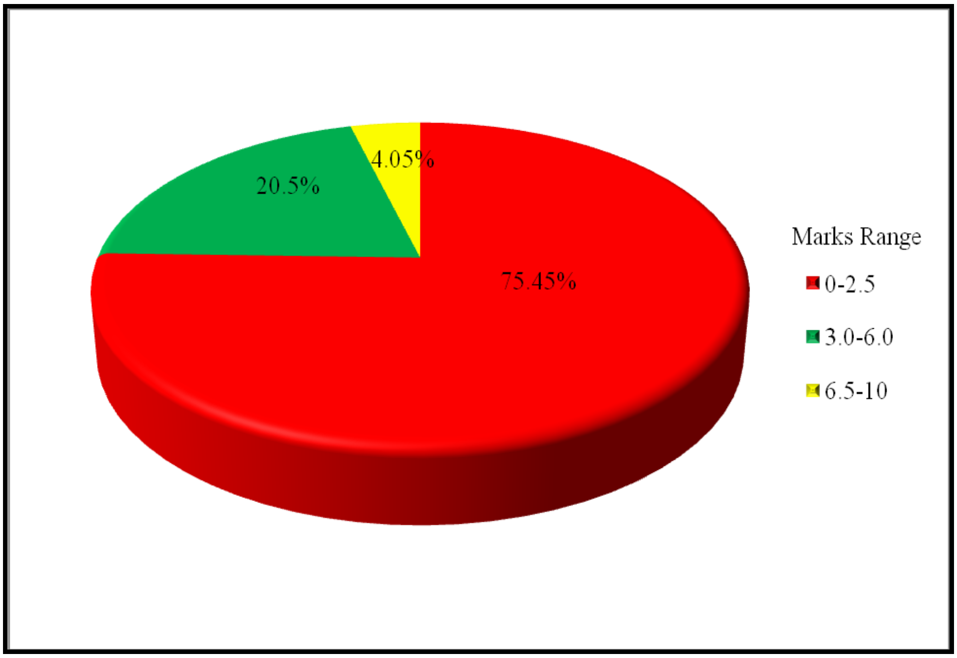
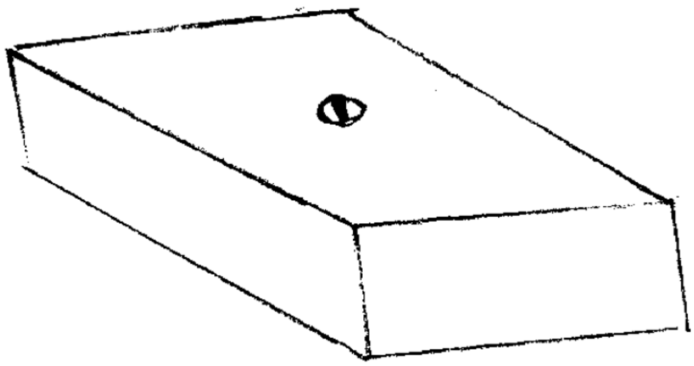


Figure 3: *Percentage of Students' Performance in Question 3.*

As seen in Figure 3, 75.45 percent of students performed poorly, which made the general performance of the students in this question to be weak. The weak performance was due to students' inability to apply knowledge on the drawing of free hand sketches.

The question required the students to sketch pictorial views of two plates joined with a bolt. The sketches were required to contain plates, bolts, and nuts and were drawn in orthographic or isometric views. In order to draw these views, students were required to apply straightness, be accurate in estimations, and understand how to transmit the problems to the drawing work. Therefore, those students who failed to accurately attempt this question lacked knowledge of free hand drawing as well as the ability to interpret the question in light of the working drawing. For example, one student drew a freehand sketch of a drilled hole without inserting a bolt and a nut. This indicates that, she/he understood the question concepts of using a free hand but failed to complete the task.

The majority failure rate on this question shows that students lacked knowledge of free hand drawing. Most of them didn't identify the procedures of drawing freehand sketches and other methods of using drawing tools to construct various objects. Some of the students used drawing tools such as rulers, sets-square and other measuring tools in attempting this question which is wrong. Inability to understand the demand of the question, lack of knowledge, lack of practice in the concepts that needed practical skills and poor command of the English language affected students in clarifying the concepts. Extracts 3.1 shows a sample of poor responses of students who failed to attempt the question correctly.

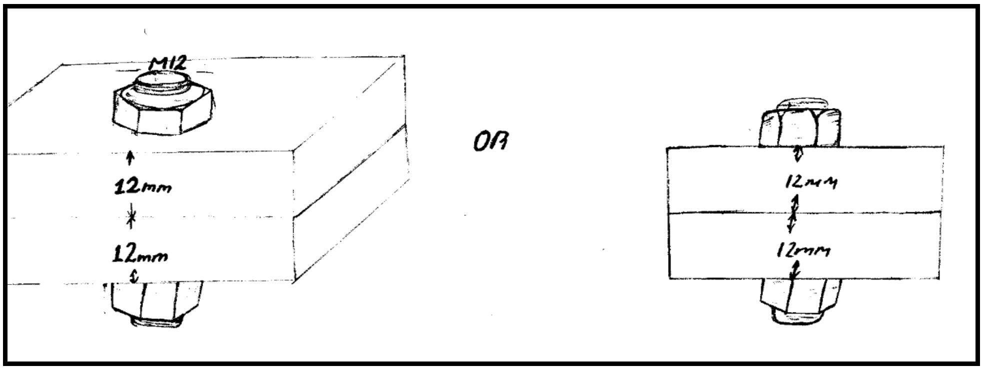


Extract 3.1: *A sample of weak responses to Question 3.*

Extract 3:1 shows a sample of the student who provided irrelevant responses to the question by drawing objects using a drawing tool, incomplete tasks, and only one drilled plate instead of two plates joined with bolt and nut as asked. This indicates that he/she lacked knowledge and skill in freehand drawing.

On the contrary, 20.5 per cent of the students failed to provide the correct drawing. The majority of them drew free-hand sketches but failed to draw estimated dimensions as required. Others drew the sketches in separate parts on the drawing sheets and then drew another joined part on another sheet. It seems the students misunderstood the question task.

Moreover, students who scored 10 marks in this question were able to construct correctly the freehand sketches of the plates held together with 12M bolts and nuts. Extract 3.2 illustrates the correct responses to the question.



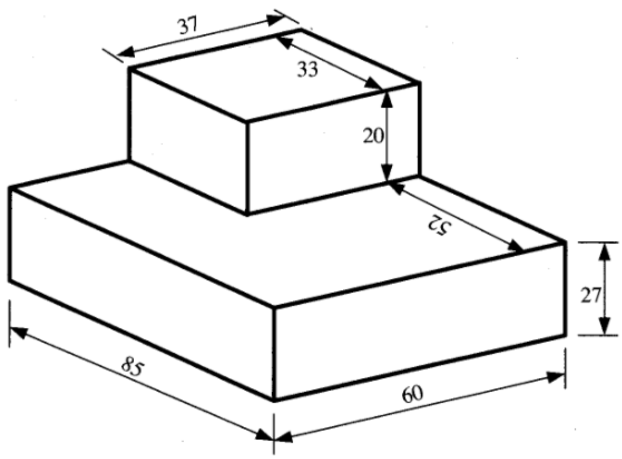
Extract 3.2*: A sample of students' good responses to Question 3*

In Extract 3.2, the student correctly drew the joined plates using bolts and nuts. He/she also appropriately demonstrated the use of free hand sketch in drawing as well as the estimated diameter of the plate. Hence, the student deserved to score higher marks.

2.1.4 Question 4: Pictorial Drawing

The question was derived from the sub-topic of pictorial drawing. Students were required to convert the given machine component into an oblique projection. This question was intended to measure a student's ability to use oblique construction principles in engineering drawing. The question was as follows:

4. A school workshop teacher wants to manufacture a machine component which is similar to the drawing shown in Figure 2. For easier understanding of the diagram he wish to change the view in oblique projection and asked you for assistance. Convert the component in oblique projection as he wish.



The question was attempted by 444 (100%) students, out of which 191 (43.02%) scored from 0 to 2.5 marks, 161 (36.26%) scored from 3 to 6 marks and 92 (20.72%) scored from 6.5 to 10 marks. Figure 4 illustrates this data.

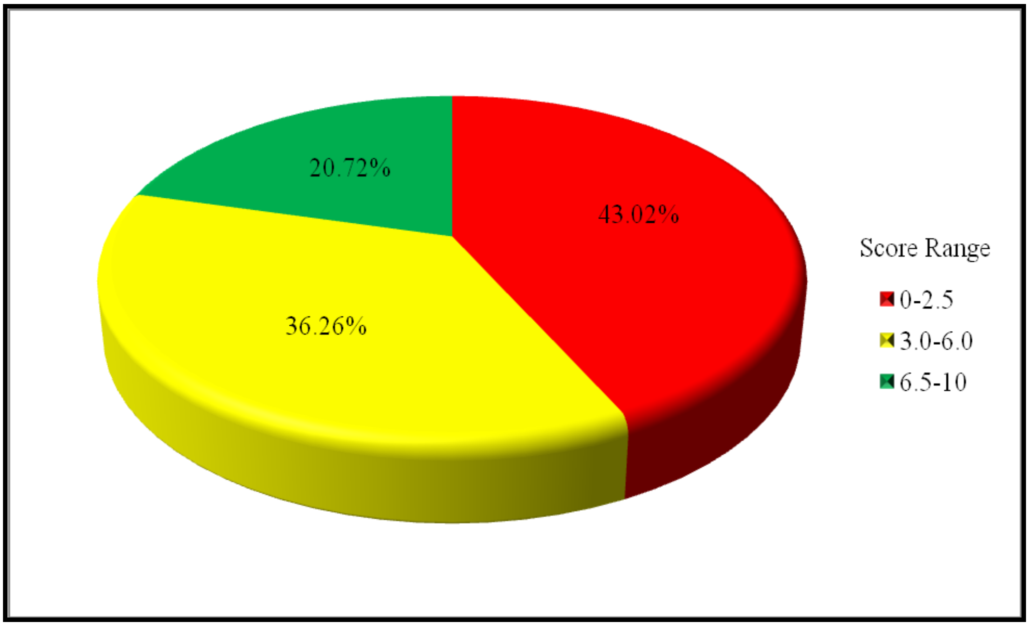
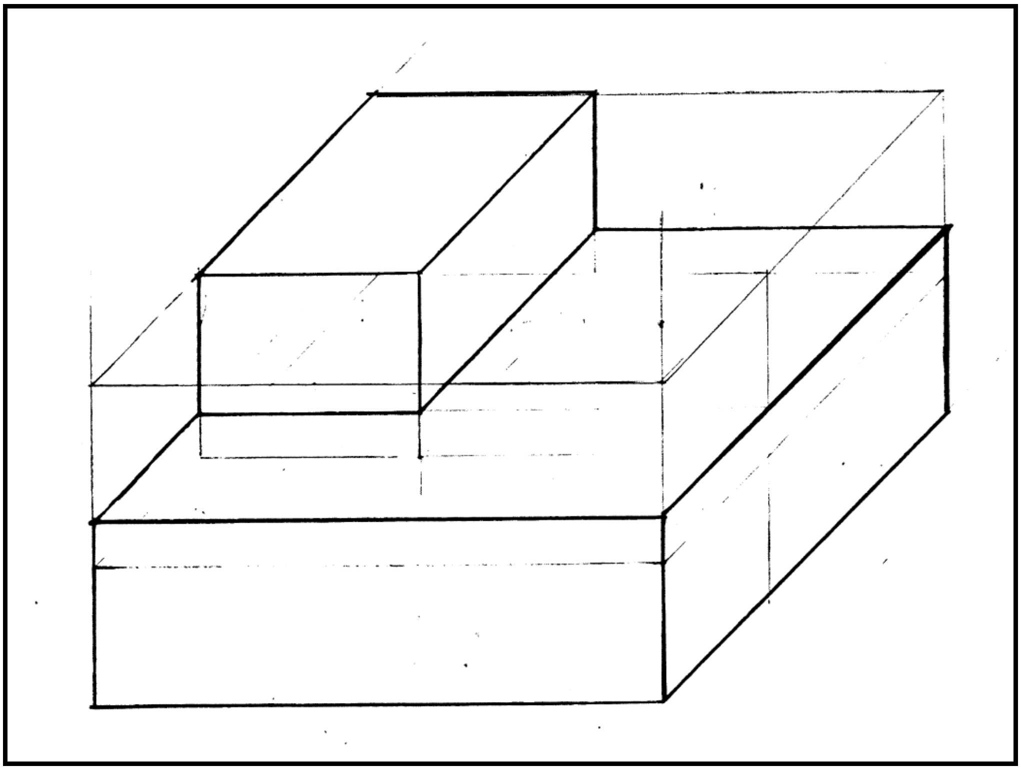


Figure 4: *Students' Performance in Question 4*

Figure 4 shows that students' performance in this question was average since 253 (56.98%) students were able to score 30 percent or above. Most of them were able to provide relevant responses, which were attributed to adequate knowledge and the ability to understand the demand of the question.

The analysis of the students' responses shows that the students who scored good marks in this question had adequate knowledge of converting the given objects to oblique projection. These students managed to draw one side of the views at 45^0 or 30^0, while others remained at 180^0. This was attained with the help of the drawing tools and consideration of the accurate dimensions as well as the neatness and visibility of the drawn object. However, some of them managed to construct the objects but failed to make them visible, so they failed to score full marks. This indicates that the students had enough knowledge and skills for drawing but lacked more practice in pictorial drawing. Extract 4.1 is a sample answer from the script of a student who answered this question well.



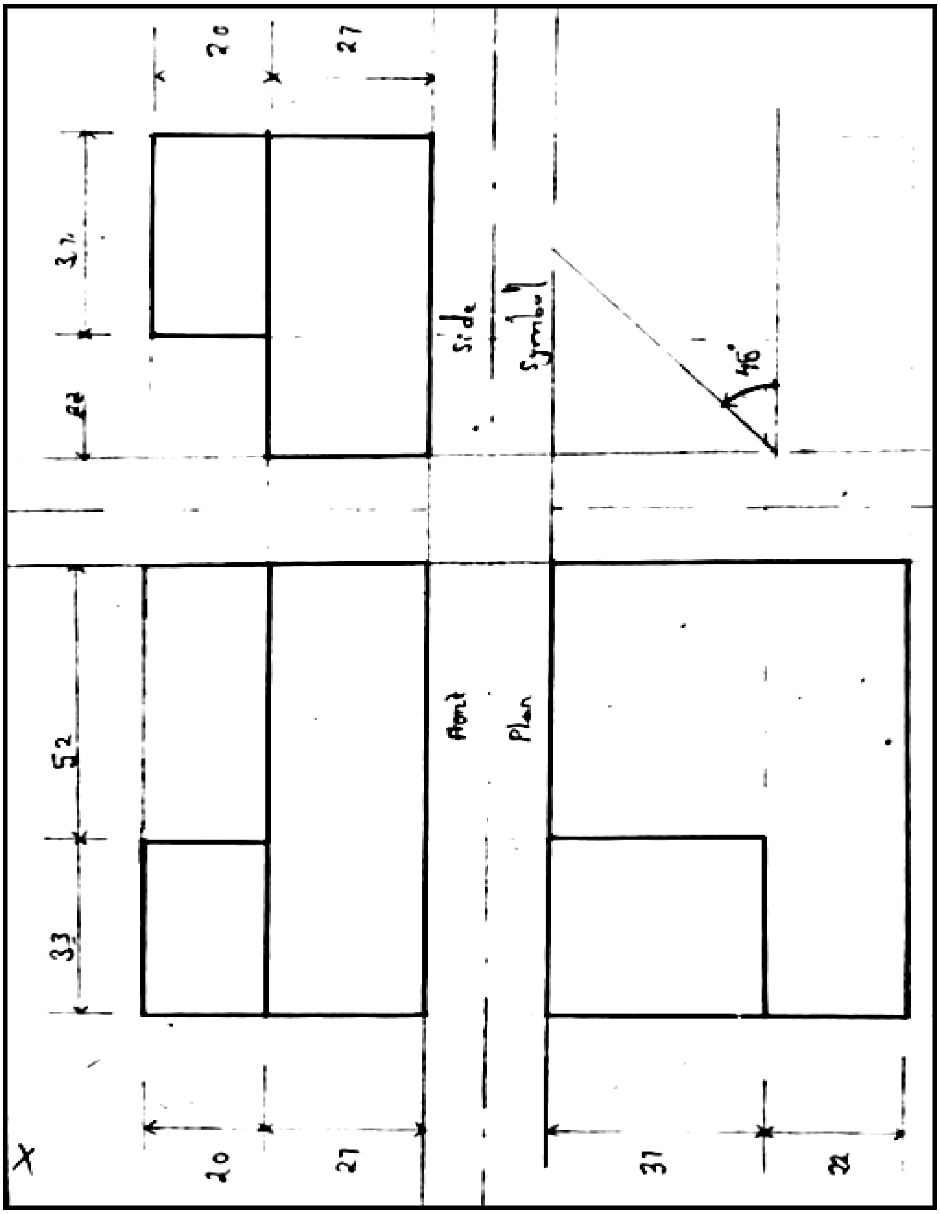
Extract 4.1*: A sample of students' good responses to Question 4.*

In Extract 4.1, the student provided relevant answers to questions 4, indicating that he/she understood the demand of the question and mastered the topic *of pictorial drawing*.

As depicted in the analysis of the students' performance, 22.30 percent of the students scored 0 because they gave wrong answers to all the items. The rest of the students scored from 0.5 to 2.5 marks.

Students who scored low marks on this question had a poor understanding of the concept of oblique projection. They could not use the required angle of projection to draw the needed object. Therefore, they were unable to reveal that on converting the drawn object to the oblique projection, only one side is drawn at an angle of 45^0 or 30^0. The rest are drawn as horizontal lines.

Also, some students sketched diagrams that did not resemble the pictorial views or oblique objects as required. In this case, they drew diagrams such as triangles, squares, and other orthographic objects. For example, one of the students drew an inscribed circle and bisected the drawn objects into eight equal parts. This indicates that such a student had insufficient skills in pictorial drawing. Extract 4.2 is a sample of incorrect answers to this question.



Extract 4.2*: A sample of students' poor responses* to Question 4

In Extract 4.2, the student provided irrelevant responses to all parts of the question. Instead of drawing pictorial drawings, she or he drew objects in orthographic projection. In addition, the object had to be converted into block-shaped objects, but she/he drew a circle and divided it into eight equal parts. This indicates that he/she lacked sufficient knowledge of converting objects to oblique projections.

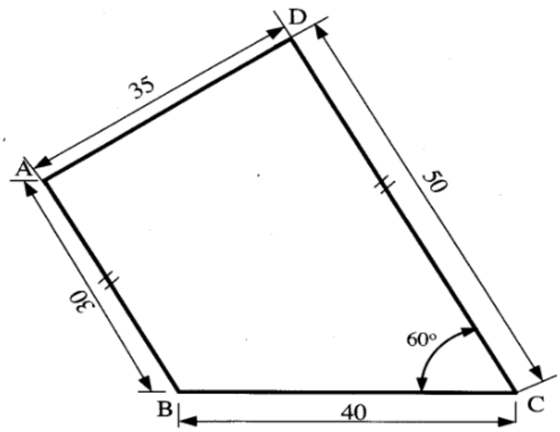
2.2 SECTION B: Structured Questions

Section B had three questions (5, 6 and 7) set from the sub-topics *Similar Figures*, *Geometrical Constructions* and *Pictorial Drawings*. Students were required to answer all three questions. Each question carried 20 marks, making a total of 60 marks.

2.2.1 Question 5: Similar Figures

The question was extracted from the sub-topic Similar Figures. In this question, students were required to change the given shape of the drawing to square in order to facilitate measurement. They were also required to draw a title block on the working drawing and fill in all the necessary information in the title blocks. The question was:

5. John's father had a piece of land shaped like Figure 3. He didn't know the size of the land because of the shape. Change the shape to a square in order for him to be able to measure the land. Consider that all dimensions are in mm.



The question measured the higher level of the cognitive domain. In attempting this question, students were required to first draw the given polygon and then draw the required square. This process requires knowledge on how to construct different types of similar figures.

The analysis shows that 361 (81.31%) students out of those who attempted this question scored from 0 to 5.5 marks, which is weak performance. Likewise, 76 (17.12%) students scored from 6 to 12.5 marks, which is average, and 7 (1.58%) students scored from 13.0 to 20 marks, which is classified as good performance. Figure 5 summarizes students' scores in this question.

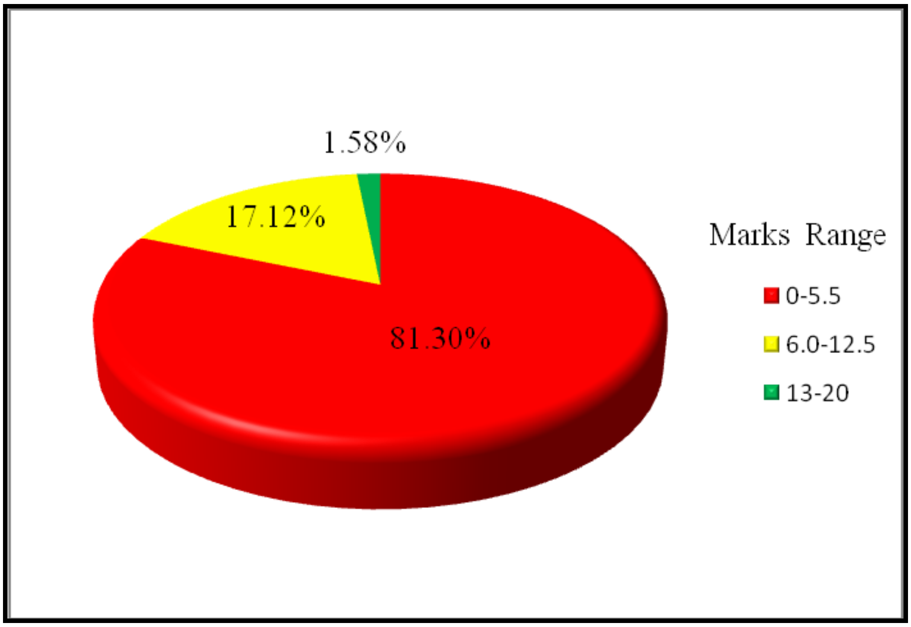
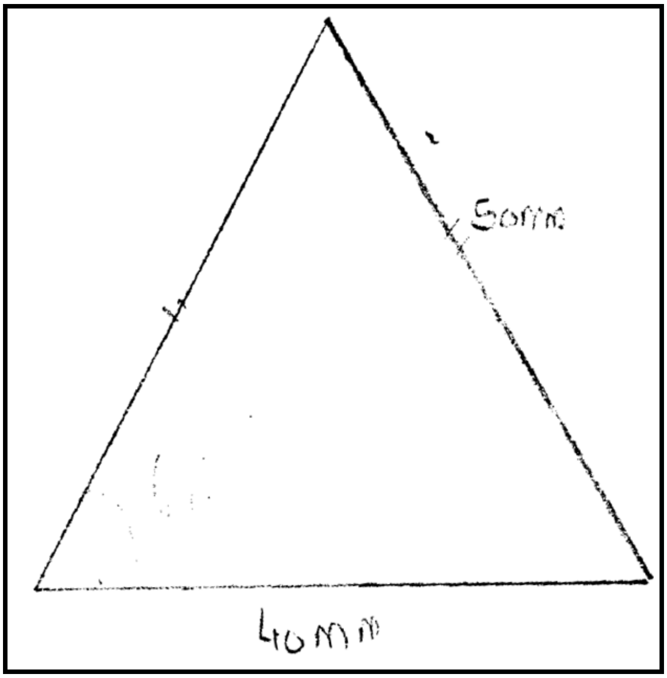


Figure 5: *The Percentage of Students' Performance in Question 5.*

Figure 5 shows that the analysis of students' performance in this question was poor, since 81.3 percent of the students scored below the 30 per cent mark allocated to this question. These students failed to draw correctly a square which is equal to the dimension of a given trapezium.

According to the analysis of the students' responses, 361 (81.31%) of the students who scored between 0 and 5.5 had insufficient knowledge in constructing the required square. Students with weak performance in this question were unable to follow the procedures of obtaining the square. To attempt this question, students were required to first draw the given object at full scale. Then, they had to follow procedures for drawing similar figures to draw rectangular shapes and, lastly, to draw the required figure. Extract 5.1 provides a sample answer from the script of a student with low marks.

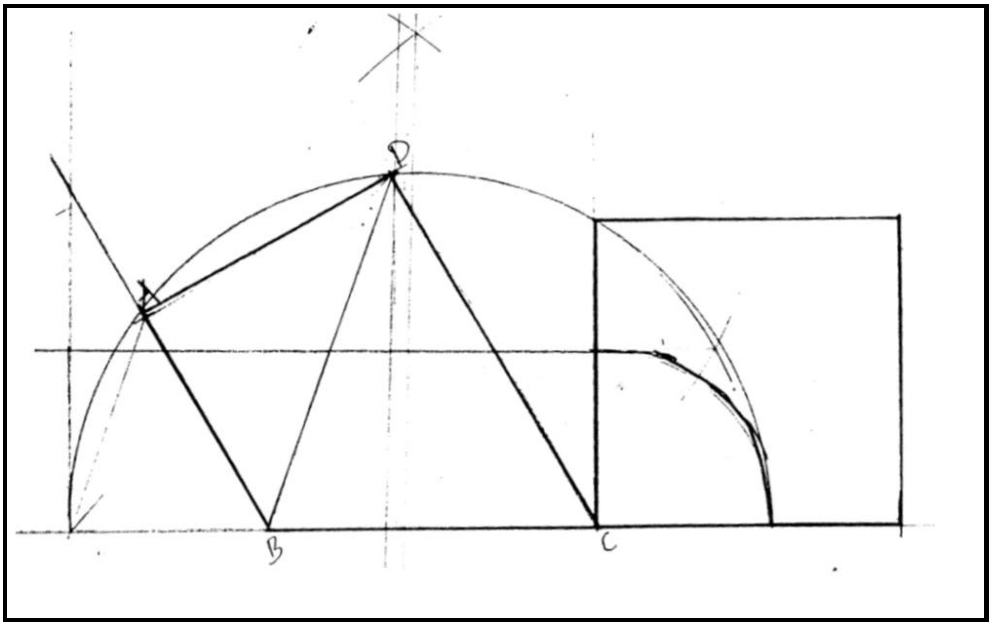


Extract 5.1: *A sample of students' poor responses to Question 5.*

Extract 5.1 shows a sample of responses from a student who drew an improper shape. Instead of drawing the required square from trapezium, she/he drew a triangle. This implies that, she/he lacked drawing skills and misunderstood the requirements of the question.

On the other hand, 76 (17.12%) students who scored from 6 to 12.5 marks had partially understood the requirement of the question and the subject matter in general. Students under this category managed to draw title block, few stages of the diagram and the paper layout but failed to complete the task as they lacked knowledge and skills related to drawing similar figures.

Despite weak performance, 1.58 percent of the students demonstrated good performance as they managed to provide relevant responses as per the requirements of the question. Most of them had a clear understanding of the demand of the question and were familiar with how to change the given shape to square. In attempting this question, the students were required *to drew full-size scales of the given object by first drawing the horizontal line BC, then the line CD at the angle of* 60^0 *provided. After that, they drew and marked point A on the line AB from point B and indicated dimensions. These students noted that the line (AB) is parallel to line CD, so they lastly drew line EA, which is parallel with line BD. The second stage is to construct rectangular objects that will help to obtain the required square. At this* *stage, students were required to draw a perpendicular line from point D to the horizontal line BC and mark point F, then bisect the drawn line DF. With points E and D, perpendicular lines EG and CH are constructed. Also, with bisected points at line FD, parallel line GH is constructed. The last stage was to obtain the required square. At this stage, students were required to use distance CD as the radius to draw an arc to touch point I and bisect line EI to obtain point O. Then, with EO or OI as the radius, they were required to draw a semicircle that touched point J at line CH. The obtained distance from CJ will be equal to the square side distance.* Those who were able to follow the mentioned steps were able to obtain higher marks. Extract 5.2 shows a sample of correct responses provided by one of the students.



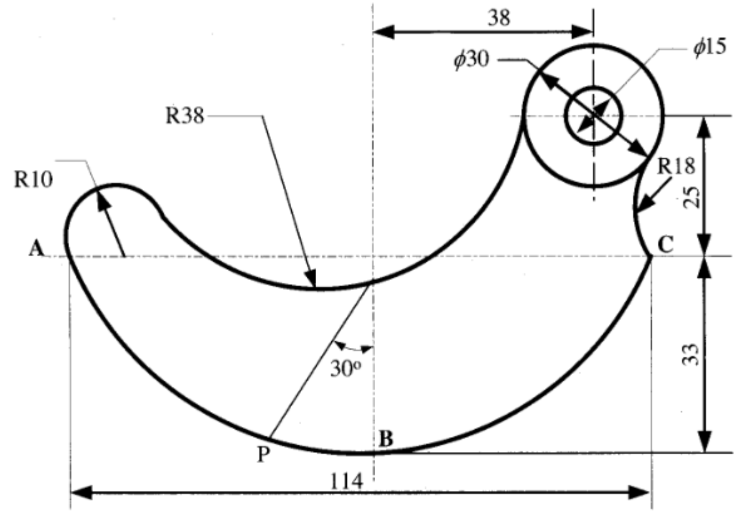
Extract 5.2: *A sample of students' good responses to Question 5.*

Extract 5.2 shows a drawing by a student who managed to draw the required square. This student demonstrated good drawing skills by providing relevant perspectives on how he/she obtained the required views and their visibility.

2.2.2 Question 6: Pictorial Drawing and Orthographic Projection

This was a compulsory question based on the topic of geometric construction. Students were required to redraw the given component, using all necessary procedures. The question was intended to test the creativity of students through the application of drawing instruments in making arcs of various shapes and sizes. The question was:

6. Figure 4 shows the elevation of a catch plate. Redraw the given elevation showing clearly the constructions lines used to determine the centres of the various circular arcs.



The question was attempted by 444 (100%) students who sat for the Engineering Drawing assessment. There were 305 (68.09%) students who scored from 0 to 5.5 marks, 127 (28.60%) students scored from 6 to 12.5 marks, and 12 (2.70%) students scored from 13 to 20 marks. In this question, students were required to apply knowledge of using a compass and set-square to facilitate the task. The question was intended to measure students' ability to join various arcs together to make a drawing template. This skill is most helpful in making different layouts of sheet fabrications as well as cam mechanism parts in the production. This performance is summarized in Figure 6.

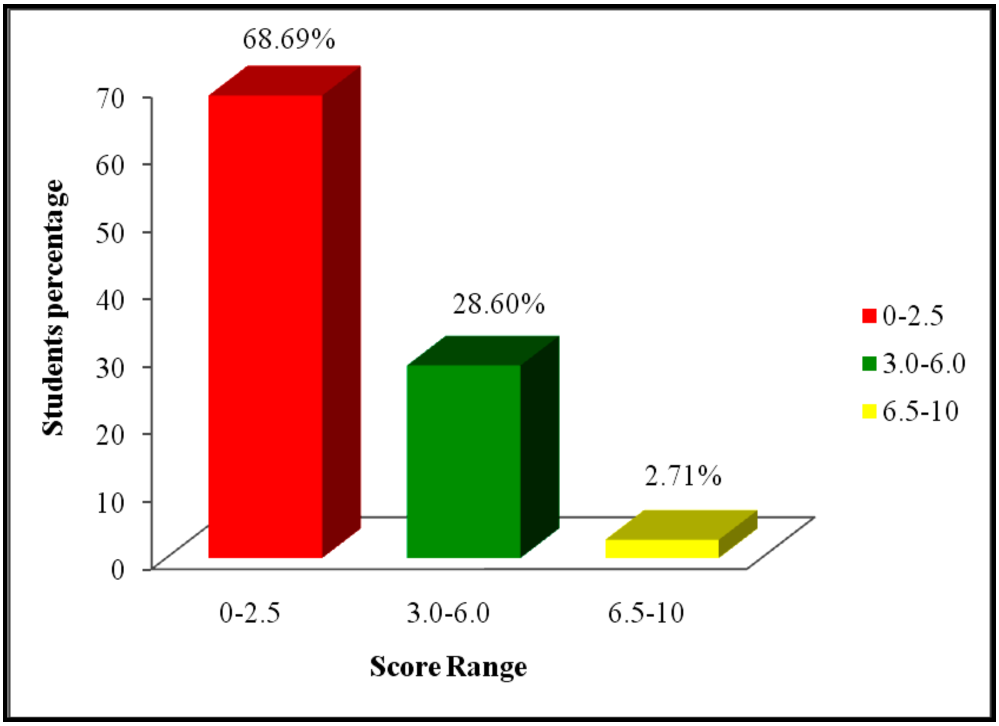
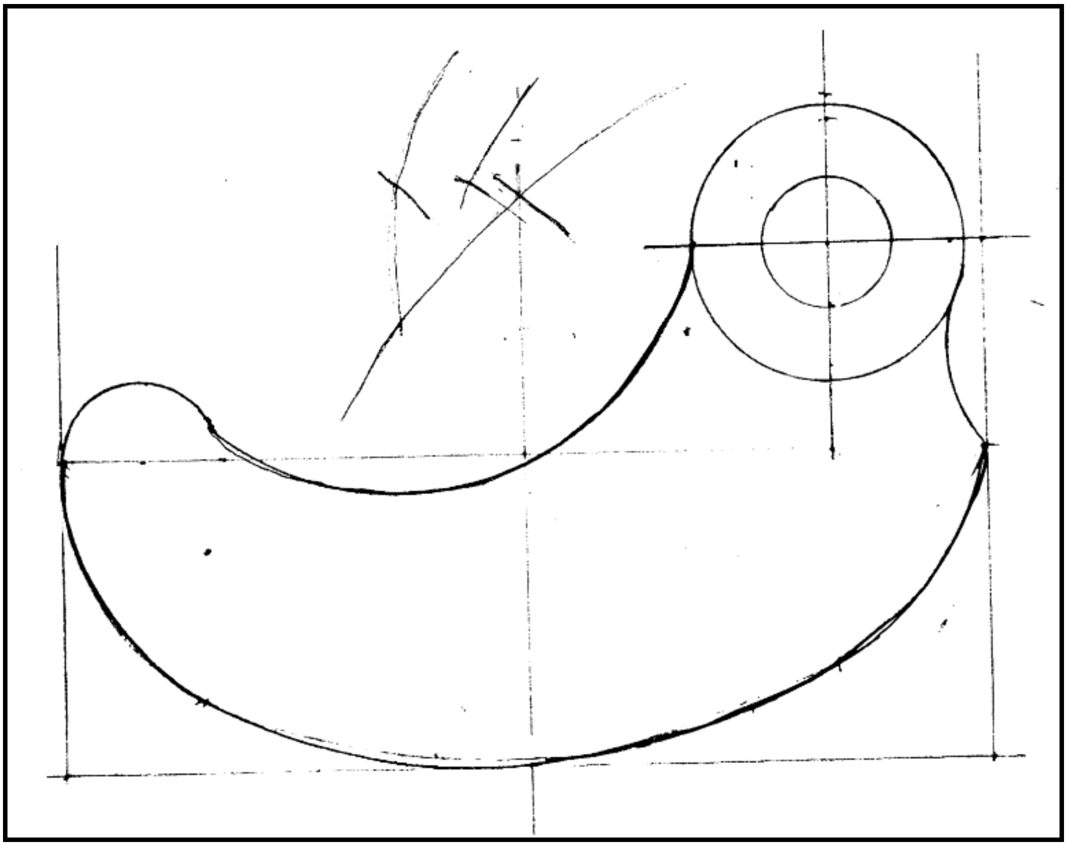


Figure 6: *The Percentage of Students' Performance in Question 6.*

Figure 6 shows that the general performance of students in this question was poor since 305 (68.09%) scored from 0 to 5.5 marks. Majority of the students who scored from 0 to 5.5 marks deviated from the requirements of the question.

Students who scored from 6 to 12.5 marks exhibited little geometrical figures drawing skills because they managed to layout paper and ended up drawing the views but failed to complete the required task. However, others were able either to draw all views but failed to follow the required procedures or missed some steps. This shows that they had sufficient knowledge but they lacked time management due to the fact that they showed the proper starting points of attempting the question but left in the middle way.

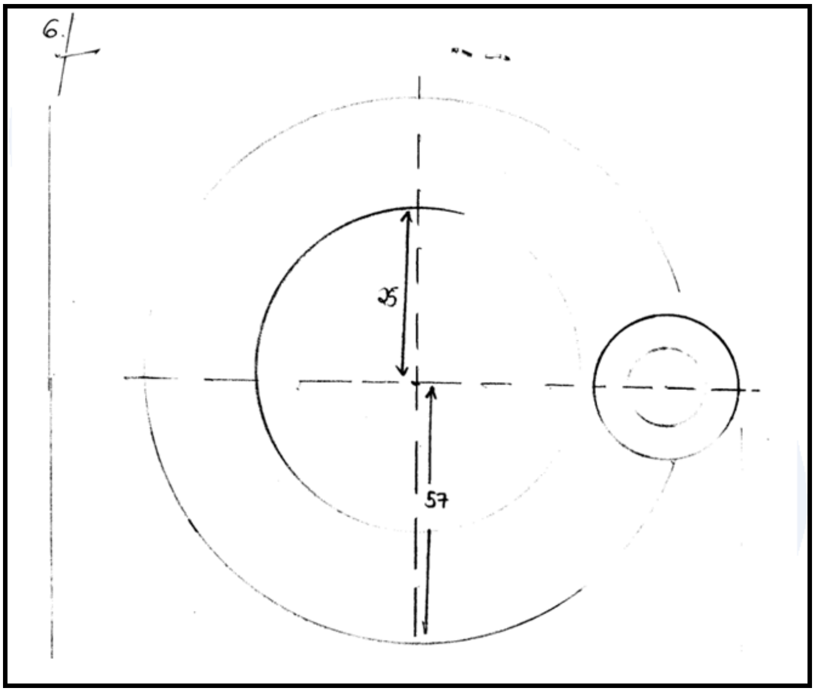
On the other hand, students who scored high marks (13 to 20 marks) managed to draw the given object by following proper procedures. In attempting the question, students were required to find the total dimensions between centers. This would help them to construct parallel and perpendicular center lines, which would help them to get the centers of the circles and arcs. This stage is called "layout," and any student who reaches this stage obtained marks. After the layout, students were required to construct three circles. Lastly, using the relationship between R+r and R-r, students were required to draw the required curves that ended at the tangent points with the drawn circles. After accomplishing this stage, the remaining step was to create visibility for the required object. Therefore, weak performance in this question was greatly contributed by students' failure to recognize the relationship between R+r and R-r, which caused students to fail to draw the curves. Extract 6.1 is a sample of responses from a student with good performance.



Extract 6.1: *A sample of the students' correct responses to Question 6*

In Extract 6.1, the student provided relevant responses to question 6. The responses show that the student was familiar with the topic and understood the requirements of the question.

Moreover, those students who scored less than 5.5 marks demonstrated insufficient skills on stage and in steps of drawing the required object. They failed to use the formula of *R-r* and *R+r*, where the capital R is the outer radius and small r is the inner radius of the curves. Erasing construction lines, object invisibility, and not understanding the principle of tangent when drawing an arc and a circle were also factors for their failure. Extract 6.2 is a sample response illustrating how a student failed to answer the question.



Extract 6.2: *A sample of incorrect answer provided by one of the students*

Extract 6.2 shows incorrect responses from a student who had insufficient knowledge and skills on the concepts tested under the topic geometrical constructions. She/he ended up drawing circles, which are not the correct steps for attempting the question.

2.2.3 Question 7: Pictorial Drawing

The question was set from the subtopic Pictorial Drawing, whereby students were required to convert the given machine jaw from oblique to isometric projection. The aim of this question was to measure the ability of the students to apply knowledge of three-dimensional drawing to convert other types of mechanical drawing.

The analysis of the students' performance shows that 233 (52.48%) students scored 0 to 5.5 marks, 84 (18.92%) scored from 6 to 12.5 marks, and 127 (28.60%) scored from 13.5 to 20 marks. Figure 7 illustrates the performance of the students on this question.

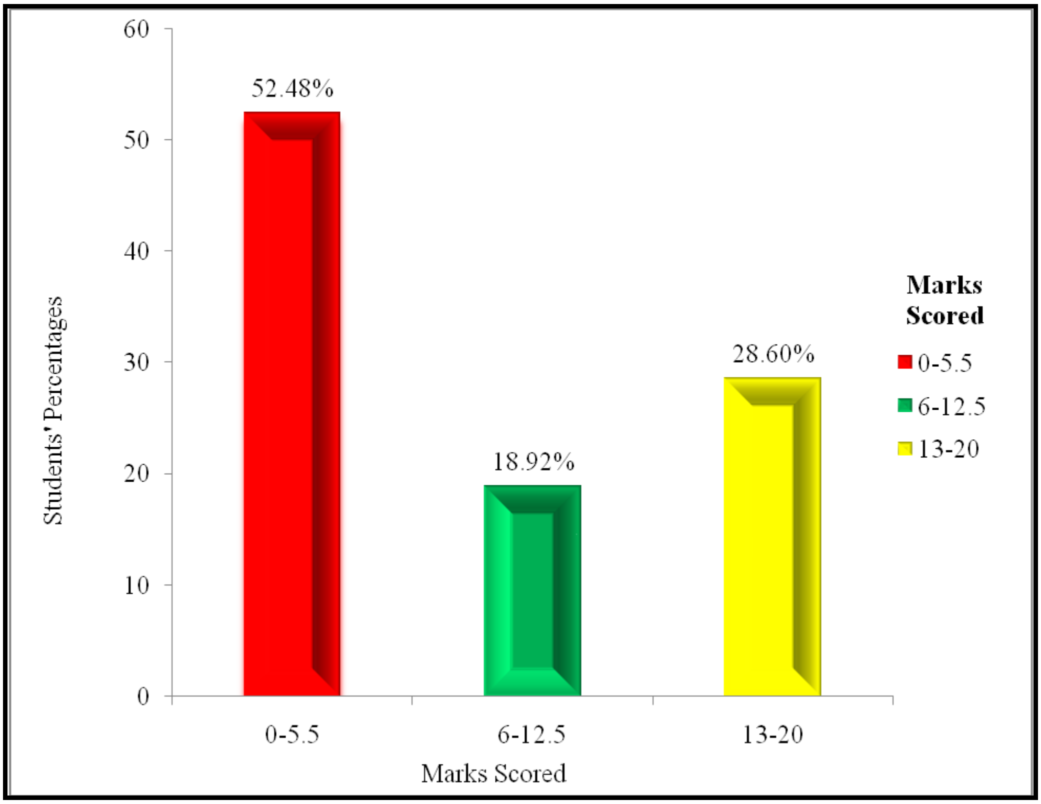
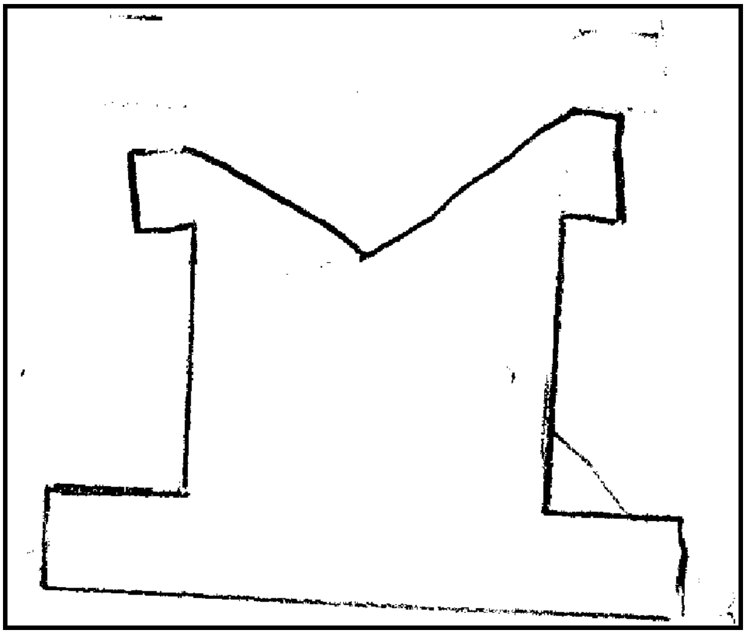


Figure 7: *Students' Performance in Question 7.*

Figure 7 illustrates that the general performance of the students in this question is average. Most of them managed to convert the given oblique object into an isometric projection. This result demonstrates that they were sufficiently knowledgeable on the subject matter.

The analysis of the responses shows that 233 (52.48%) students scored from 0 to 5.5 marks, which is poor performance. Most of them gave incorrect responses. They failed to interpret the demands of the question. A few students drew construction lines but failed to draw visibility of the object as a result, they scored low marks. On the other hand, those who scored zero marks were unable to draw or follow the drawing steps, even to draw title block. For example, one student drew an orthographic shape having two dimensional views instead of drawing a pictorial object with three-dimensional views. The student's incorrect responses indicate that he/she lacked knowledge and skills of drawing. Extract 7.1 is a sample of weak responses from one of the students who attempted this question.

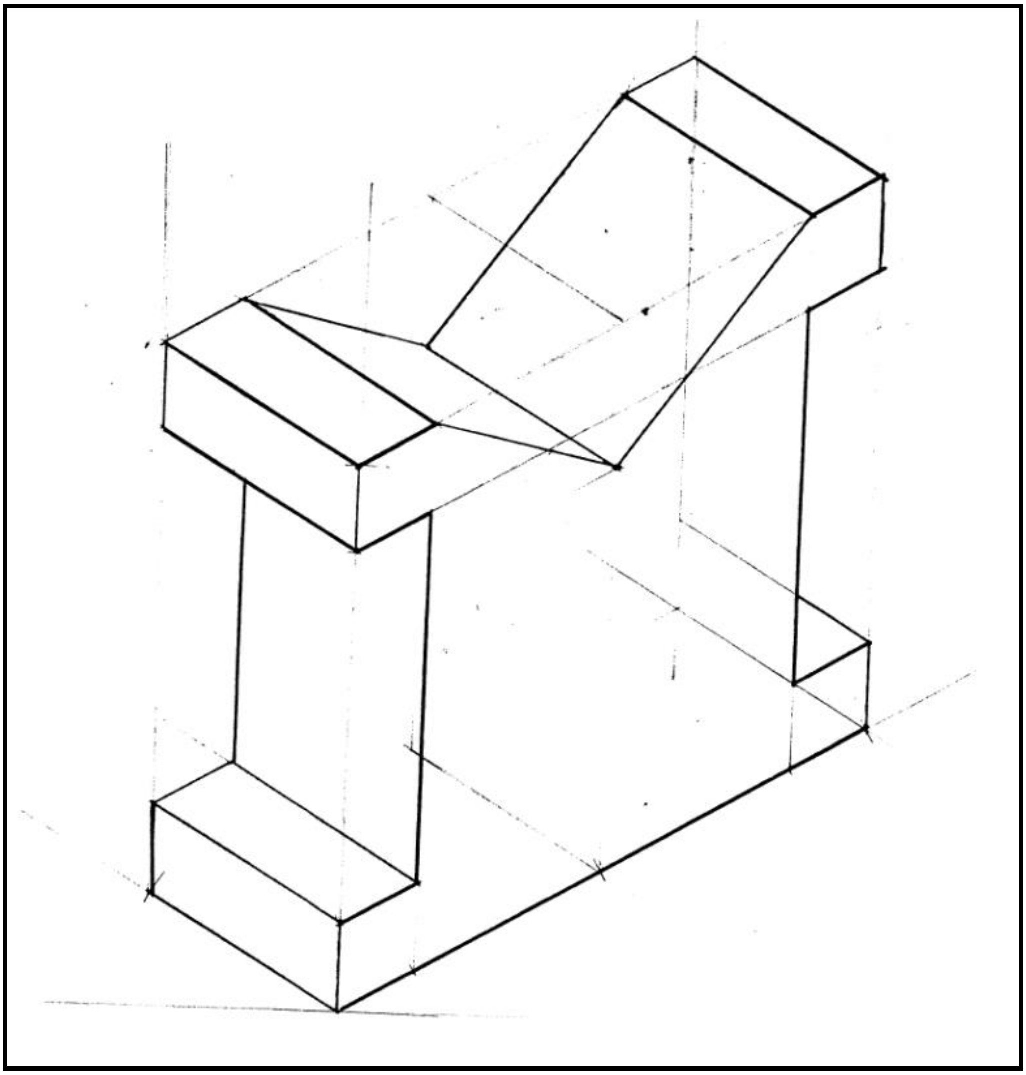


Extract 7.1: *A sample of the students' incorrect responses to Question 7.*

Extract 7.1 is a response from the student who provided the wrong procedures of drawing isometric objects. The student failed to convert the given oblique object to isometric projection. This implies that, students lacked knowledge of interpreting the drawing views.

On the contrary, the students who had average performance provided partial steps of drawing the required projection. Thus, they scored average marks of 6 to 12.5 as they skipped some of the steps. For instance, some of them were able to convert an oblique object to an isometric object, but didn't follow the instruction given to the question by erasing construction lines. Others showed the hidden details inaccurately, but they didn't show the visibility of the drawn objects accurately.

On the other hand, 28.60 percent of the students scored 13 to 20 marks. Students in this category mastered the topic of pictorial drawing well. They were able to convert the object from an oblique projection to an isometric projection. They considered the application of isometric angles, left construction lines, erasing hidden details, the neatness of the drawing, and accurately followed the dimensional procedures as well as the visibility of the objects. This indicates that these students had sufficient knowledge and skills in the subject matter. Extract 7.2 illustrates a good performance by one of the students who attempted this question.



Extract 7.2: *A sample of the students' correct responses to Question 7*

Extract 7.2 shows that the student provided good responses to question 7, by demonstrating relevant answer. She/he managed to use isometric angles, apply the knowledge of pictorial drawing by erasing the hidden details as well as the accuracy and visibility of the object. This implies that the student had knowledge and skills in isometric drawing.

3.0 ANALYSIS OF THE STUDENTS' PERFORMANCE IN EACH TOPIC

The Form Two National Assessment (FTNA), 2021 in the Engineering Drawing subject had seven (7) questions from topics covered in the Form I and II syllabus. The sub-topics covered are Geometrical Constructions and Plane Figure Intersection of Cylinders, Free Hand Sketches, Oblique Projections, Similar Figures, Standard ISO and Drawing Sheet and Lettering, Scale and Isometric Projection.

Statistical analysis of the students’ performance in this paper shows good performance in Question Number 6, set from the combination of scale and geometric construction sub-topics. The performance was average in Questions 4, 7, and 6, whereby 253 students (56.98%) passed in Question 4, followed by Question 7, whose 211 students (47.52%) passed and Question 6, whose 139 (31.31%) students passed. This average performance on these questions resulted from the fact that students demonstrated enough knowledge and skills about the tested topics, good English language proficiency, and their ability to understand the requirements of the questions.

On the other hand, the remaining questions 3, 1, 5, and 2 were marked as poor. The weakest performance was observed in question 2, where only 41 (9.23%) students scored above 30% out of 444 students who attempted this question. The question was derived from the topic, Intersection of the Cylinders.

In a nutshell, the students' weak performance on these questions was caused by their inadequate knowledge and skills about the subject matter, failure to correctly interpret and identify the requirements of the question, and limited drawing skills.

The students’ performance per topic is summarised in the appendices, whereby green represents good performance, yellow represents average performance, and red represents weak performance.

4.0 CONCLUSION

Based on the students' response analysis, the overall performance in Engineering Drawing subject for the Form Two National Assessment FTNA 2021 was weak. Only 123 (27.70%) students who sat for the assessment obtained grades A to D. However, 321 (72.30%) students failed the assessment. The majority of the students had average performance on three (3) questions, and the rest of the questions had weak performance. The performance of students question-wise, topic-wise, and grade-wise with respect to the topics extracted from the Engineering Drawing Syllabus is summarized in Appendices A, B, and C, respectively.

Furthermore, the analysis of the students' performance for each question shows that the average performance observed was the result of the students' ability to understand the demand of the questions, their adequate knowledge of technical drawing concepts, and their adequate drawing skills. Conversely, the weak performance in some of the questions among students was a result of a failure to understand the demands of the questions and having inadequate knowledge and skills in structured questions. Hence, students who provided irrelevant responses and partial responses by skipping some steps of the questions.

5.0 RECOMMENDATIONS

From the shortcomings observed in the analysis, it is therefore recommended that:

(a) School administrators and subject teachers should promote learning by ensuring the availability of learning and teaching facilities. Practice will foster knowledge and competence attained by students thus, improve their performance both in school and national level.

(b) Teachers should establish subject clubs, provide regular exercises and immediate feedback for students to learn how they can identify the requirements of the questions and the best way of presenting their responses whether in drawing or description in relation to Engineering.

(c) Students should be guided and encouraged to read various and relevant subject materials (books, past paper, journals and pamphlets) in order to broaden their knowledge and skills. Teachers should guide them to identify the tasks/requirements of the question(s).

(d) Students are required to practice the applications of drawing tools and other equipment in order to be familiar with Engineering Drawing.

Appendix A: Summary of Students' Performance Question-wise

Table 2. *A summary of students' performance (question-wise) in Technical Drawing 2021*

S/N	Sub-topics	Question Number	Percentage of students who scored 30% or more	Remarks
1	Oblique Projection	4	56.98	Average
2	Isometric projection	7	40.95	Average
3	Scale and Construction of Geometrical Figures	6	31.31	Average
4	Free Hand Sketch	3	24.55	Weak
5	Geometrical Construction in plane Geometry	1	23.42	Weak
6	Similar Figure	5	18.7	Weak
7	Intersection of the Cylinder	2	9.23	Weak

Appendix B: Summary of Students' Performance Topic-wise

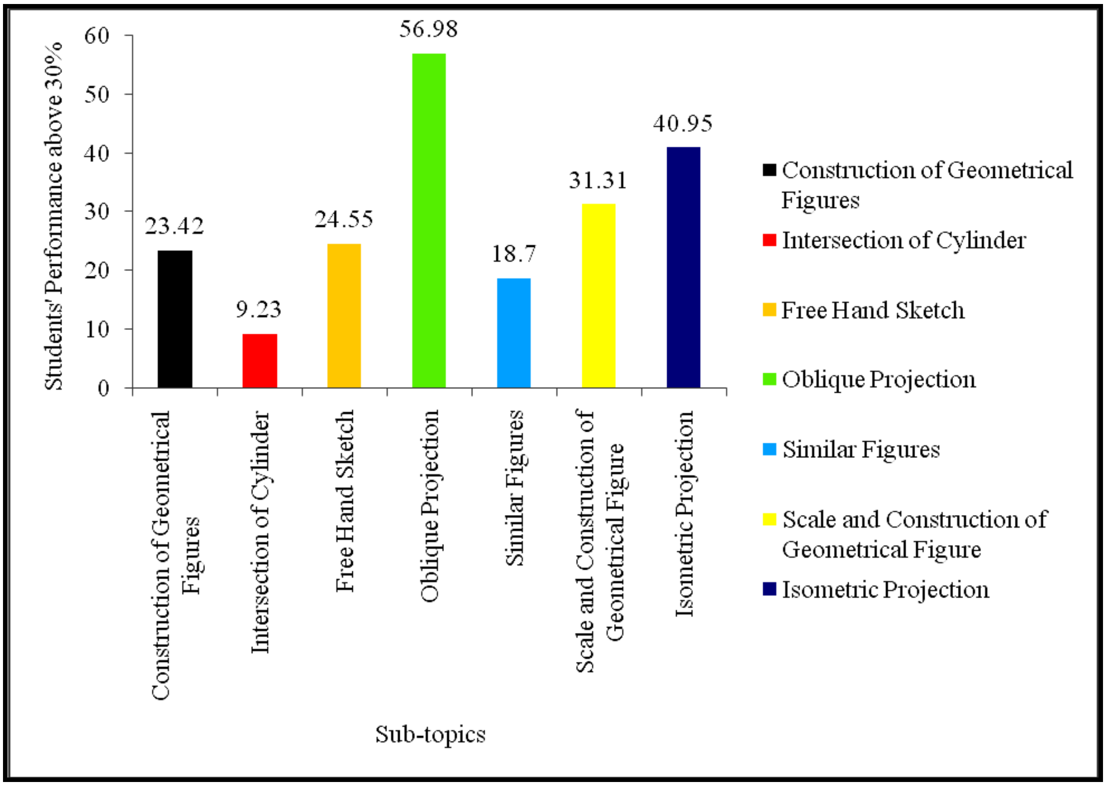


Figure 8: *Students' Performance in topic-wise*

Appendix C: Summary of Students' Performance Grade-wise

***Table 3**: Performance of the students grade-wise*

GRADE	A	B	C	D	F	Total
Number of Students	1	7	44	71	321	**444**

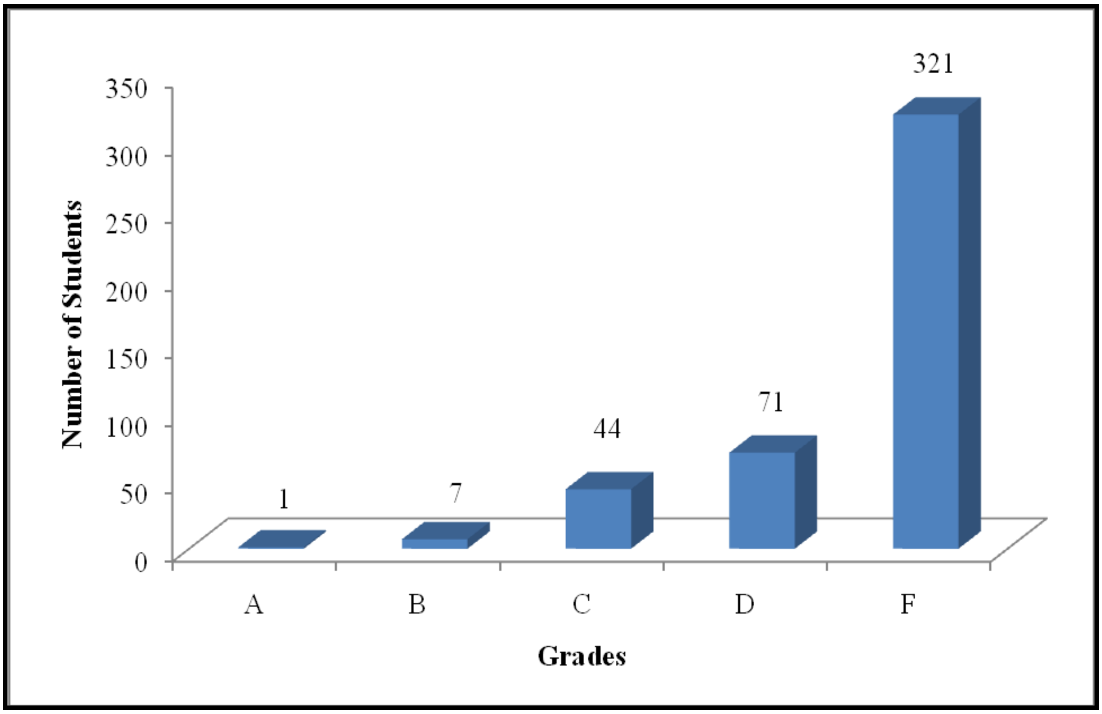


***Figure 9:** Students' Performance Grade-wise*

Appendix D: Performance of Students in Each Question

Table 4: Performance of students question-wise

Questions		Qn 1	Qn 2	Qn 3	Qn 4	Qn 5	Qn 6	Qn 7
Number of Students	Weak	340	403	335	191	361	305	233
	Average	30	24	91	161	76	127	84
	Good	74	17	18	92	7	12	127
	Total	**444**	**444**	**444**	**444**	**444**	**444**	**444**

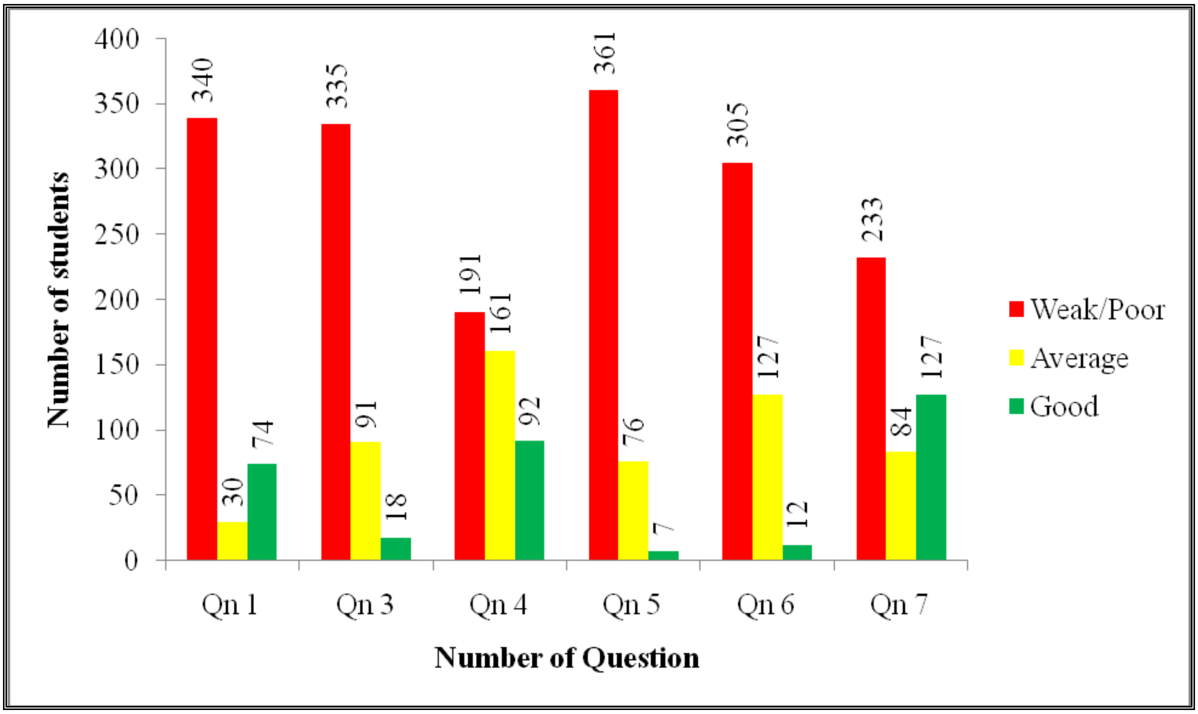


Figure 10: Students' Performance Question-wise