THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEMS RESPONSE ANALYSIS REPORTON THE CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (CSEE) 2023

ENGINEERING DRAWING

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091 ENGINEERING DRAWING

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FOREWORD

This report presents Candidates' Items Response Analysis (CIRA) on Certificate of Secondary Examinations in Engineering Drawing subject which was conducted in November, 2023. The report aims to provide feedback to all educational stakeholders on the candidates' performance in Engineering Drawing subject.

The Certificate of Secondary Education Examination (CSEE) is a summative evaluation, which intends to monitor candidates' learning and provide feedback that teacher, candidates, and other educational stakeholders can use to improve teaching and learning processes. The report reveals that, the majority of the candidates had good performance in topics such as Engineering Drawing I, Engineering Drawing II, Engineering Drawing III, and Engineering Drawing IV. The good performance of such topics were observed in questions 1, 3, 4, 5, and 6 specifically in sub-topics like *International Standard Organization (ISO) Layout sheet and size, Construction of Geometric Figures, Pictorial Drawing, Orthographic Projection, Introduction to CAD I and Intersection of Cylinders.* However, the candidates had poor performance in the topic of Engineering Drawing III noted in question 2 particularly in the sub-topic of *Orthographic Projection.* The given performance details are presented in appendices I-III.

The performance analysis shows that, the factors, which contributed to the poor performance of the candidates, are failure to understand the demands of the questions, inadequate knowledge and skills on some of the tested subject matters. Poor English language proficiency also contributed to weak candidates' performance. On the other hand, good performance of the candidates was contributed by the ability to identify the demands of each question, adequate knowledge on the assessed subject matter and proficiency in English language. The justifications of both the poor and good performance are well demonstrated in this report. The extracts of good and weak performed questions are well indicated in the report for reference.

The Council believes that, the report will be used by the education stakeholders to improve the teaching and learning processes in order to achieve the intended instructional objectives. The Council appreciates the efforts of all who contributed to the preparation of this report.

Dr. Said Ally Mohamed

EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents the candidates' performance on Certificate of Secondary Education Examination (CSEE) in Engineering Drawing subject, which was administered in November 2023. The examination assessed the competencies that the form four candidates had gained in accordance with Engineering Drawing Secondary Education Syllabus of 2019.

The Engineering Drawing examination had three sections: A, B, and C. The given examination had six questions. The candidates were required to answer all the questions in section A, three questions in section B, and one compulsory question in section C in the examination. Section A had one objective question. The section had a total of 10 marks. The candidates were required to answer all the questions in this section. Question 1 consisted of ten multiple choice items set from five topics. These topics are Engineering Drawing I, Engineering Drawing II, Engineering Drawing III, Engineering Drawing IV, Introduction to CAD I and CAD II. Each item carried one mark.

Section B had four short-structured questions, 2, 3, 4, and 5. The given questions were set from two topics, which are *Engineering Drawing II* and *Engineering Drawing III*. Each question carried 20 marks. Section C had one compulsory question set from Engineering Drawing IV topic. This question carried 30 marks.

The Certificate of Secondary Education Examination (CSEE) of 2023 in Engineering Drawing subject was sat by 231 (100%) candidates. The performance analysis reveals that, 170 (73.59%) of the candidates passed with a score ranging from 30 to 100 marks. On the other hand, 61 (26.41%) candidates scored from 0 to 29 marks. Generally, the candidates' performance in Engineering Drawing subject was good.

The above general performance was obtained from the performance of each question in the examination. The performance in each question depended on the responses given by the candidates in each question. The responses were awarded marks allocated to the respective response in each question. The allocated marks into responses of each question led to the conclusive performance in terms of good, average and weak. The given performance was illustrated using tables and graphs. The colours such as red, yellow, and green were used to represent weak, average and good performance respectively. In addition, extracts from the candidates' scripts were used to provide vivid and practical examples of candidates who had good and poor response to the asked questions. Additionally, the given performance is presented according to gender of the candidates who sat for the examination as shown in Table 1.

Table 1: The Candidates' Performance According to Gender

Sex	**Grade**					**Passed**	
	A	**B**	**C**	**D**	**F**	**Number**	**Percent**
M	8	29	87	54	22	178	77.06
F	0	2	10	15	4	27	11.69
Total	**8**	**31**	**97**	**69**	**26**	**205**	**88.74**

Table 1 shows that, 2 (6.45%) of the female candidates scored B, 10 (32.26%) scored C, 15 (48.39%) candidates scored D and 4 (12.90%) of the female candidates scored F while none of the females scored A. Thus, majority of female candidates (48.39%) scored D. On the other hand, male performance in Table 1 depicts that, 8 (4.00%) scored A, 29 (14.50%) scored B, 87 (43.50%) scored C, 54 (27.00%) scored D and 22 (11.00%) scored F. This shows that, majority of male candidates had average score of C grade. Therefore, the male candidates performed more than female in CSEE of 2023 on Engineering Drawing subject.

2.0 ANALYSIS OF CANDIDATES' RESPONSES IN EACH QUESTION

This part addresses the performance of the candidates based on the scores obtained in each question. It covers the type of questions, topics and sub-topics from which the questions were constructed, competencies test, the requirements of each question and the percentages of the candidates who had weak, average or good performance based on their responses in each question.

2.1 Section A: Objective Questions

This section is comprised of one question carrying a total of 10 marks. This question consisted of 10 multiple-choice items set from various topics of Engineering Drawing, each item carrying one mark.

2.1.1 Question 1: Multiple Choice Items

This question consisted 10 multiple choice items (i-x) from the following sub- topics: *International Standard Organization (ISO) Sheet Layout Sheet and Sketching, Construction of Geometric Figures, Pictorial Drawing (Oblique, Isometric), Orthographic Projection, Introduction to CAD I* and *Introduction to CAD II*. The candidates were required to answer all the questions in this section.

The question was attempted by 231 (100%) candidates whose scores were as follows: 28 (12.12%) of the candidates scored from 0–2 marks, 181 (78.35%) scored from 3–6 marks and 22 (9.52%) scored from 7–10 marks. Generally, the candidates' performance in this question was good, since 203 (87.88%) of the candidates scored from 3–10 marks. This performance is summarized in Figure 1.

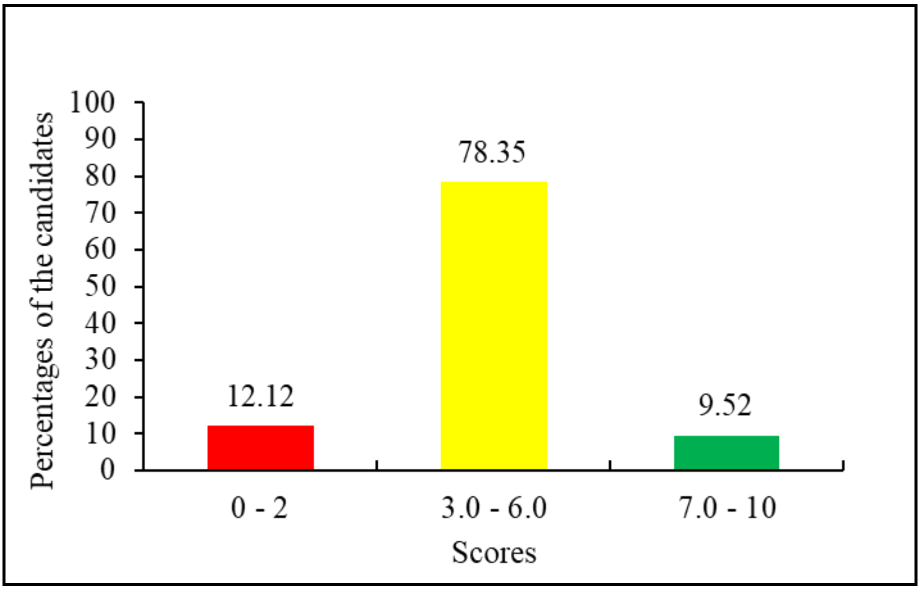


Figure 1: *The Candidates' Performance in Question 1*

Despite of the candidates' good performance in this question, 28 (12.1%) of the candidates performed poor due to the lack of knowledge and skills on International Standard Organization (ISO) layout sheet and size, construction of geometric figures, pictorial drawing, orthographic projection, Introduction to CAD I and CAD II. The following is the analysis of candidates' responses for each item of this question:

Item (i) was set from the sub-topic of *Pictorial Drawing (Oblique and Isometric projection).* Candidates were required to apply their knowledge of *Oblique projection* to identify which type of pictorial projection when drawn shows a true shape front view. The item measured the candidates' ability to identify type of pictorial projection that is used to show the front view in true shape. The question was:

Which type of pictorial projection shows the front view in true shape?

A. Isometric projection *B. Perspective projection*

C. Diametric projection *D. Oblique projection*

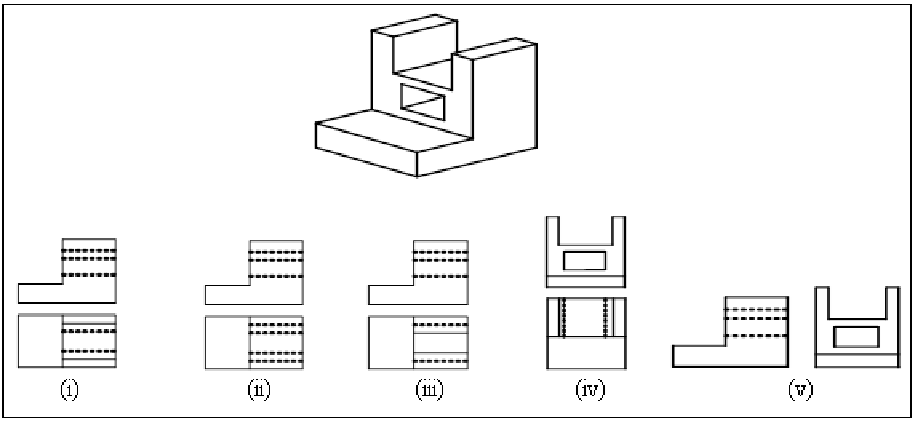
E. Axonometric projection

The correct response was *D, Oblique projection*. The candidates who selected the correct response had enough knowledge and understanding on Pictorial Drawing, especially oblique. The candidates were able to identify that oblique projection shows the true shape in front view. However, those candidates who chose alternative *A*, *Isometric projection* did not know that although both of them, oblique and isometric projections are pictorial projections and that they show the object from an angle, for how to project the dimensions and angles. In oblique projection, the object is shown from a 45-degrees angle to the horizontal plane and the front face of the object is drawn in its true shape and size. On the contrary, in isometric projection, the object is shown from a 30-degree angle to the horizontal plane.

Moreover, the candidates who chose response *B*, *Perspective projection* they were also aware that it was one of the types of pictorial projections but they had no knowledge that perspective projection presents the object as it would look like to the observer. Those candidates who selected response C, *Diametric projection did* not know that in diametric projection two of objects axes make equal angles with the plane of projection and the third angle is larger or smaller than the other two. The candidates who selected *E, Axonometric projection,* had no knowledge that axonometric projection is a technique used to create a pictorial drawing of an object by rotating the object along one or more of its axes relative to the plane of projection while oblique projection renders the true shape of the object in front view.

Item (ii) required the candidates to determine the orthographic projection in two views on first angle projection as represented in Figure 2. The question measured the ability of the candidates to read and interpret the views of orthographic projections in first angle projection. It was sat from *Orthographic Projection (first angle projection)* sub-topic. The question was:

The students were instructed to represent the figure below by drawing two views into orthographic projection in first angle projection. Five students drew the views shown in Figure (i) – (v).



Which views were drawn correctly?

A. (i), (iv) and (v) *B. (i), (ii) and (iii)* *C. (ii), (iii) and (v)*
D. (i), (iii) and (iv) *E. (ii), (iii) and (iv)*

The question demanded the candidates to interpret and determine the orthographic projection into two views in first angle projection as represented in Figure 2. The correct response was alternative *A, (i), (iv) and (v).* Candidates who chose the correct response had adequate knowledge and skills on Orthographic Projection in drawing front and plan views in first angle projection. They were aware that, in order to illustrate the Orthographic Projection in first angle projection, they had to apply the method of first angle projection, that is, for front and side views, what one sees from the left is drawn on the right side and vice versa and for plan or top view, what one sees from above is drawn under the front view. They had knowledge on which type of lines and their uses, such as continuous thick lines and dashed thick lines are used depending on which edges of the object are visible or hidden.

On the other hand, there were few candidates who provided wrong answers by choosing distractor *B, (i), (ii) and (iii).* These candidates were having some knowledge on how to draw orthographic projection in first angle projection but they did not observe that the types of lines used to show the hidden edges and visible edges in views (ii) and (iii) were not correct because continuous thick lines are used to show the visible edges of an object and dashed thick lines are used to show the hidden edges of an object as a result, they misinterpreted the drawing and opted the wrong response.

Moreover, those candidates who selected *C, (ii), (iii) and (v),* did not have sufficient knowledge on how to draw orthographic projection in first angle projection, since they confused the type of lines used to show the hidden and visible edges of the object. Part *(v)* in this alternative was correct, however, parts *(ii)* and *(iii)* were not correct due to the incorrectness of the types of lines used to show hidden and visible edges. The candidates who chose alternative *D, (i), (iii) and (iv)* were also aware of how to draw orthographic projection in first angle projection. However, they did not observe that part *(iii)* in this alternative was not correct since the lines used to show the hidden edges were not correct. And those candidates who selected *E, (ii), (iii) and (iv)* had knowledge on how to draw orthographic projection in first angle projection but they confused the types of lines used to show the hidden edges and visible edges used in the views of parts *(ii)* and *(iii).*

Item (iii) was set from sub-topic of *Introduction to Computer Aided Drafting I*. The question required the candidates to show their skills and experience on what happens when scrolling the mouse on the AutoCAD workplace. It was intended to measure the ability of the candidates in using the AutoCAD application when drawing various objects. The question was:

What will happen if you scroll the mouse on the AutoCAD workspace?
A. Zoom in/Zoom out *B. Pan and scan* *C. Extend/all*
D. Scale Out *E. Explode polyline*

The correct response was *A, Zoom in/ Zoom out*. The candidates who had experience with the *Introduction of AutoCAD I* made the right choice. These candidates possessed sufficient AutoCAD program knowledge and proficiency to scrolling variety of objects on AutoCAD platform. On the other hand, those candidates who chose *B, Pan and scan,* did not adequately remember when using AutoCAD software what happens when scrolling while pressing a wheel mouse. They were supposed to know that when scrolling on AutoCAD the sketches on the screen zooms in or out depending with the mouse scrolled in or out respectively. Also, for those candidates who selected option C, *Extend/all,* did not know that extend/ all is for extending the edges lines from one view to others and this is done after selecting the object, and then the mouse is pressed and dragged to start a freehand selection path. Moreover, those who chose *D*, *Scale Out,* did not understand that *scale out* is done when dragging the mouse after selecting the object. Some candidates selected alternative *E*, *Explode polyline.* These candidates had inadequate skills and experience of employing different applications of AutoCAD in drawing various objects because *Explode polyline* is done by selecting the line and then then pressing the explode button on the ribbon to divide the line into parts.

Item (iv) was extracted from the *Introduction of AutoCAD I* topic. The question required the candidates to identify how many workspaces can be accommodated in AutoCAD when drawing various objects. The item intended to measure the ability of the candidates in AutoCAD application and draw various objects. The question was:

How many workspaces can be accommodated in AutoCAD?
A. 1 *B. 2* *C. 3* *D. 4* *E. 5*

The correct response was alternative *C, 3*. This correct option could only be chosen by candidates who were knowledgeable with *Introduction to AutoCAD I* and had skills on drawing in workplaces using AutoCAD application. Contrarily, those who selected alternatives *A,1* confused the number of workspaces that can be accommodated in AutoCAD with the number of workspaces that appear at a time, that is, one workspace. For the candidates who chose *B, 2*, did not know that by default AutoCAD software has three workspaces, namely, Drafting and Annotation, 3D Basics, and 3D Modelling.

Moreover, the candidates who chose *D, 4,* counted the number the groups of icons appearing on the AutoCAD application window, that is, main menus, Quick access toolbar, and file tabs and the Drawing area to be the number of workspaces, however, these are not workspaces but are things appearing in one workspace. For the candidates who selected *E, 5,* confused AutoCAD workspaces with other icons appearing on AutoCAD software such as modify parametric, window, help, and express. This shows that the candidates' knowledge and proficiency were insufficient.

Item (v) was set from the Orthographic Projection sub-topic. The question asked the candidates on what they knew about the first angle orthographic projection. It intended to measure the ability of candidates to remember the concept of first angle projection. The question was:

Students were asked to say what they know about the first angle orthographic projection. Their responses were as follows:

(a) What you see from the right is drawn on the right.

(b) What you see from the left is drawn on the right.

(c) What you see from the above is drawn below.

(d) What you see from above is drawn above.

Which responses were correct?

A. (a) and (c) *B. (b) and (c)* *C. (c) and (d)*

D. (a) and (d) *E. (a) and (b)*

The candidates were required to recall the concept of first angle projection from Orthographic Projection to identify the correct response. The correct response was *B, (b) and (c).* The candidates who had enough knowledge and skills of first angle Orthographic Projection managed to give correct response on the item. On the other hand, the candidates who chose *A, (a) and (c),* knew that what you see from above is drawn below, however, they did not remember that in first angle orthographic projection what you see from the right is not drawn on the right but drawn on the left. Moreover, the candidates who selected *C, (c) and (d),* did not know that what you see from above can only be drawn below and not above. Alternative *D, (a) and (d)* was selected by the candidates who confused between third angle and first angle projections. The candidates who chose *E, (a) and (b)* were able to recall that in first angle orthographic projection, what you see from the left is drawn on the right, but they forgot that what you see from the right is drawn on the left.

Item (vi) was set from *CAD Application.* The candidates were required to name different zoom commands used in AutoCAD. The question was designed to assess the candidates' knowledge and skills of using AutoCAD application. The question was:

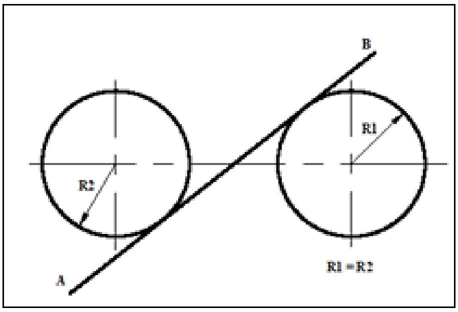
Students were asked to name different zoom command used in AutoCAD, their responses were as follows:
(a) Z Command *(b) Y Command* *(c) Zoom Command*
(d) Rotate mouse wheel *(e) Scroll the mouse*

Which were the correct responses?
A. (a), (b) and (c) *B. (a), (b) and (d)* *C. (b), (c) and (d)*
D. (a), (c) and (d) *E. (c), (d) and (e)*

Option *D, (a), (c), and (d)* and *E, (c), (d), and (e)* was the right response. The candidates that correctly identified the answer possessed sufficient understanding of the various commands employed in AutoCAD applications, particularly the zoom command. Conversely, those who selected alternatives *A, (a), (b) and (c),* were aware that *Z* and *Zoom* Commands are used for zooming objects in AutoCAD platform. However, these candidates did not know that there is no *Y* command in AutoCAD software; however, it can be paired with *Ctrl* (Control key) on the keyboard to perform *Redo last action*. Additionally, the candidates who selected option *B, (a), (b), and (d),* were aware that AutoCAD uses the *Z* and *Rotate mouse wheel* commands for zoom, but they were unaware that AutoCAD does not have a *Y* command. The candidates who chose options *C, (b), (c), and (d),* knew that AutoCAD uses the *Zoom* and *Rotate mouse wheel* commands as zoom commands, but were unaware that AutoCAD does not use the Y command as one of the zooming commands.

Item (vii) was composed from the *Construction of Geometric Figures* sub-topic. The question tested candidates' competence on the knowledge and skills of tangential line. The question was:

Study the figure below and identify the description of the line AB.



A. *Common tangent to two equal circles.*
B. *Common exterior tangent to two equal circles.*
C. *Common tangent to two equal circles.*
D. *Common internal tangent to two unequal circles.*
E. *Common interior tangent to two equal circles.*

The correct response was *E, Common interior tangent to two equal circles*. This option was chosen by the candidates who had knowledge and skills on construction of geometric figures on tangential lines of common interior of two equal circles. On the other hand, the candidates who chose option *A, Common tangent to two equal circles* had knowledge that the two circles are equal and the line is common tangent, but they failed to specify if it was internal or external tangent. Moreover, the candidates who chose *B, Common exterior tangent to two equal circles* were aware that the two circles were equal, however, they confused between internal and external tangent. For the candidates who chose option *C, Common tangent to two circles* shows that they had general knowledge of the line AB since the line is common to two circle, however, it is not specified whether it is internal or external tangent and if the two circles were equal or unequal. Furthermore, those candidates who selected *D, Common internal tangent to two unequal circles* were aware that, the line AB was internal tangent, however, they did not observe from the figure that R1 = R2, so the two circles were equal, hence, the correct answer should be E.
Item (viii) was composed from the *Introduction of AutoCAD II* topic. The question intended to test candidates’ skills on selection of a set of objects in the workplace in AutoCAD. The question was:

If you are asked to select a set of objects in the workplace in AutoCAD, what should you do?

A. *Draw the right to left by crossing window.*

B. *Shift + double clicking the objects.*
C. *Draw from left to right by crossing window.*
D. *Draw from left to right without crossing window.*
E. *Draw from top down without crossing window.*

The correct response was *A, Draw the right to left by crossing window;* and *D, Draw from left to right without crossing window*. Majority of the candidates who had enough knowledge provided the correct response. However, those who selected alternative *B, Shift + double clicking the objects*, confused with steps of deselecting objects in AutoCAD because *Shift + double clicking the objects* deselects the objects instead of selecting them. Furthermore, for the candidates who selected alternative *C, Draw from left to right by crossing window,* they were aware that for selecting a set of objects, one can draw a window from left to right but they did not remember that when selecting a set of objects by drawing from left to right it should not be by crossing window but without the crossing window. For the candidates who chose *E, Draw from top down without crossing window,* they did not have knowledge that drawing from top down without crossing window does not select a set of objects.

Item (ix) was set from the sub-topic of *International Standard Organization (ISO) Layout Sheet and Size*. The item tested the candidates' ability to remember standard size of A3 paper. The question was:

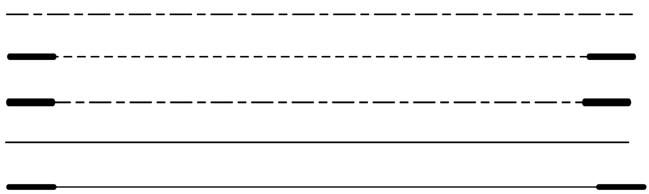
The head master at your school was planning to buy A_3 sheet for office use. Which size of sheet will you advise the head master to purchase?
A. 297 mm x 420 mm *B. 594 mm x 841 mm*
C. 420 mm x 594 mm *D. 841 mm x 1189 mm*
E. 210 mm x 297 mm

The correct option was *A, 297 mm x 420 mm.* The majority of the candidates provided the correct response implying that they were proficient with paper layout and size, particularly on the standard dimensions of paper size. However, the candidates who selected the incorrect response *B, 594 mm x 841 mm,* did not remember that this was for the size of an A1 sheet. Moreover, for those candidates who chose *C, 420 mm x 594 mm,* they confused between A2 and A3 sheet sizes because this was the size of A2 sheet. Furthermore, for the candidates who selected *D, 841 mm x 1189 mm,* did not know that this was the A0 sheet size rather than the A3 sheet size. Additionally, the candidates who chose *E, 210 mm x 297 mm,* were not able to recall that this size was for A4 sheet.

Item (x) was composed from sub-topic of *Sections*. The item measured the competence of candidates in application of lines. The question was:

Identify a line which when an arrow is added at its end becomes a cutting line of sectioning.

A.
B.
C.
D.
E.



The correct response was *C,* . The candidates, who selected option *C*, had sufficient knowledge and understanding to distinguish between the types of lines used in engineering drawing. Conversely, those candidates who selected option *A* were unable to distinguish between cutting plane of sectioning and centre lines. The former are thick dashed lines, while the latter are thin lines composed of both long and short dashes that are used to locate geometric axes. Furthermore, for the candidates who selected *B*, did not know that thin dashed lines are used to indicate hidden edges of an object. Moreover, the candidates who chose response D, were unaware that thin solid lines with arrows at the end are dimension lines used to show the extent of a dimension or a particular size. In addition, those candidates who chose *E*, had no knowledge that thick solid lines are used to indicate visible edges of an object rather than cutting plane of sectioning.

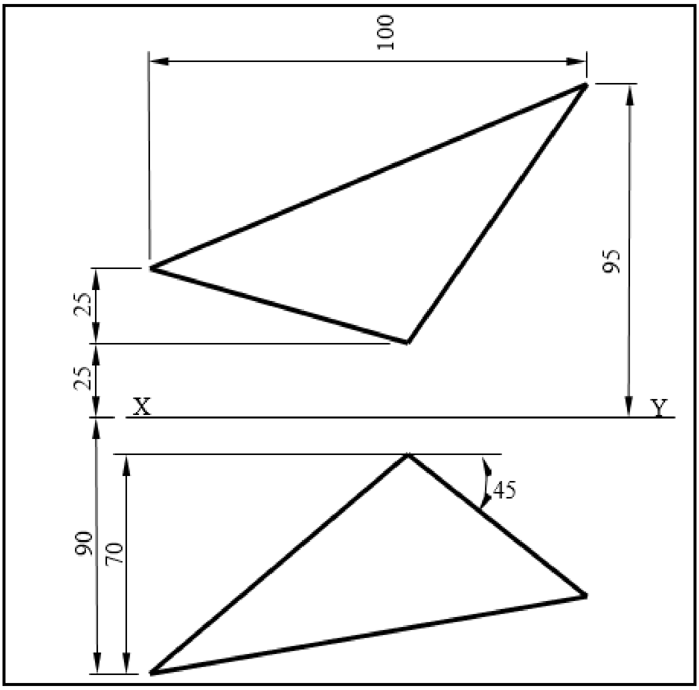
2.2 Section B: Short Answer Questions

This section consisted of four short-structured questions. All the questions were set from topics such as *Engineering Drawing II* and *Engineering Drawing III.* Specifically, the questions were composed from sub-topics like *Orthographic Projection, Intersection of Cylinders, LOCI (Mechanisms),* and *Auxiliary Views.* Each question carried 20 marks. The candidates were required to answer three questions in this section.

2.2.1 Question 2: Orthographic Projection

This was optional question composed from the sub-topic of *Orthographic Projection.* The question intended to measure the ability of candidates to draw the true shape of lamina by using one view of the object. The question was:

Two views of lamina are given in first angle projection as shown in the figure below. Draw the true shape of lamina using front elevation.



The question was attempted by 76 (32.90%) of the candidates out of 231 (100%) who sat for the examination. Analysis shows that, 46 (60.53%) of the candidates scored from 0 to 5.5 marks, 29 (38.16%) of the candidates scored from 6.0 to 12.5 marks and 1 (1.32%) candidate scored from 13.0 to 20 marks. Figure 2 illustrates the candidates' performance in this question 2.

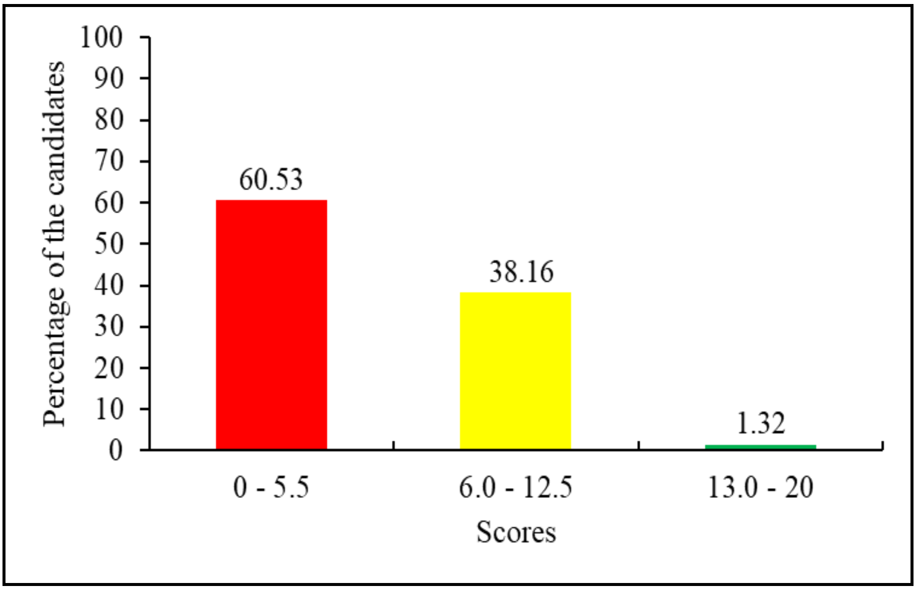
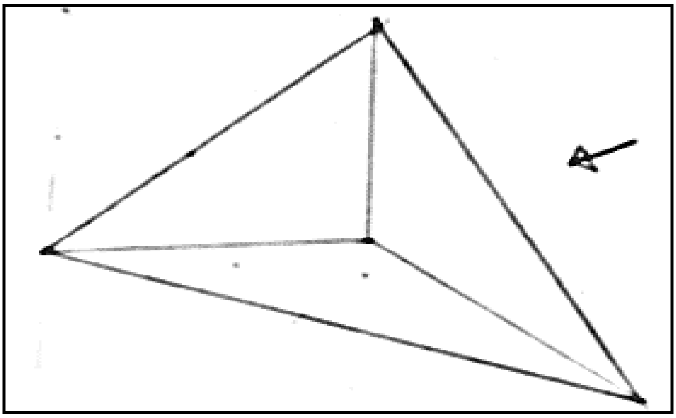


Figure 2: The Candidates’ Performance in Question 2

The analysis shows that, 46 (60.53%) of the candidates scored from 0 to 5.5 marks. These candidates had weak performance in this question. Among them, 22 (28.95%) candidates scored zero mark. These candidates failed to copy the given two views of lamina and could not draw the true shape of lamina in first angle projection. The candidates lacked knowledge and skills on how to use one view to obtain the true shape of lamina. They did not demonstrate the procedures required to draw the required true shape of lamina such as drawing the faint construction lines, employing thick lines to draw the given views, employing correct dimensions, and constructing X’Y’ and X”Y” plans as a result they failed to construct true shape of lamina and naming it accordingly. For example, instead of drawing the true shape of lamina, one candidate drew incorrect triangle and another candidate drew a cube.

However, some candidates managed to score some marks from 1 to 5.5. These candidates were able to follow some few steps such as drawing some of construction lines and the given views lines, but missed many steps in constructing the true shape of lamina, therefore they scored weak marks. For example, one candidate drew some of construction lines, however, did not continue to follow the steps to construct the true shape of lamina. This shows that these candidates had lacked adequate knowledge and skills about the sub-topic of Orthogonal Projection, specifically the part of *true shape of lamina*.

Extract 2.1 shows a sample of poor response provided by one of the candidates.

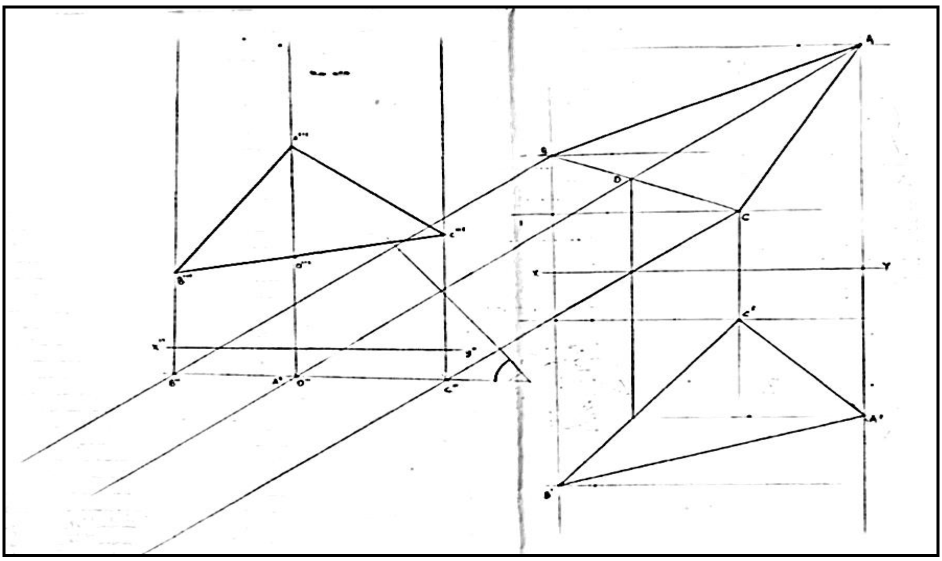


Extract 2.1: A sample of candidates' poor responses to Question 2

Extract 2.1 the candidate drew irrelevant responses to question 2. He/she drew unwanted plan of triangle pyramid instead of the true shape of lamina.

The candidates who scored from 6.0 to 12.5 were 29(38.16%). These candidates had partial knowledge with regard to question demands. These candidates managed to follow some required procedures in drawing the true shape of the lamina but failed to complete the drawing. Moreover, some of them drew the incorrect true shape of lamina. In addition, these candidates managed to draw the construction lines of the given views correctly and ensured their faintness and used correct dimensions to draw visible views. Moreover, some of them drew the auxiliary elevation and construction lines of auxiliary elevation as means to draw visible auxiliary elevation. However, they could not construct X'Y' and X"Y" plans, therefore, they failed to construct the required true shape. The analysis shows that these candidates had partial knowledge with regard to the question demand and missed some steps in drawing the true shape of the lamina thus they scored average marks. For example, one candidate managed to draw the two given view correctly, however, he/she failed to construct the true shape of lamina; instead he/she drew irrelevant rectangles.

On the other hand, only 1(1.32%) candidate scored higher mark, which was 16 marks. This candidate was able to interpret the requirements of the question. The analysis shows that he/she had knowledge and skills to copy front and plan views and correctly managed to name the points of elevation. He/she followed well the steps to construct plans X'Y' and X"Y" was able to follow many steps, which included drawing construction lines of the true shape of lamina and other construction lines. However, this candidate missed some steps when was naming the true shape and therefore, constructed the true shape with some few errors. The analysis of the responses from this candidate show that the candidate was knowledgeable and had skills on preparing the drawing sheet, copying the given view and following the correct steps in constructing the required true shape of the lamina. However, he/she confused some of the steps of naming the true shape of the lamina that is why he/she scored high marks but less than 20 marks. Extract 2.2 shows a sample of good responses provided by one of the candidates.



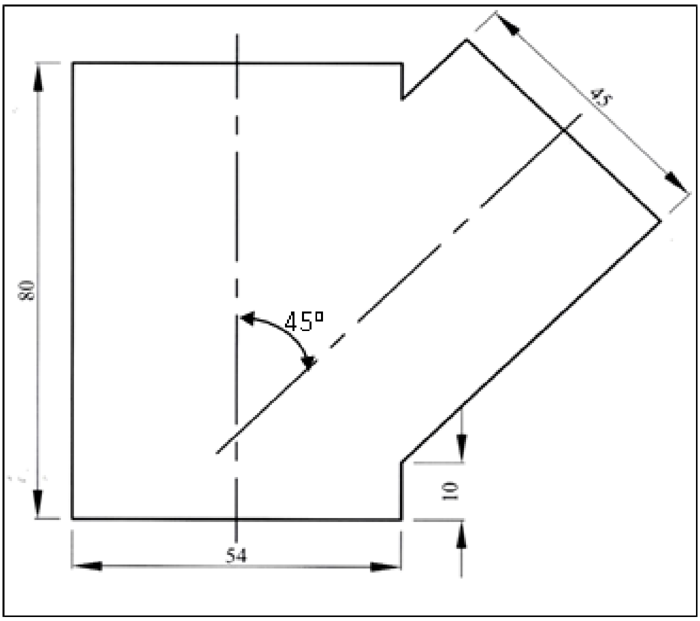
Extract 2.2: A sample of candidates' good responses to Question 2

Extract 2.2 shows the candidate who managed to follow many steps to draw the true shape of lamina. He/she also showed ability of drawing skills by constructing the two given views and of true shape of lamina though it had some few errors.

2.2.2 Question 3: Intersection of Cylinders

The question was composed from the sub-topic of *Intersection of Cylinders*. It was intended to measure the ability of the candidates to apply their knowledge and skills to construct intersection lines which assist to have an appropriate profile on the intersecting parts. The question was:

The figure below shows an elevation of two cylinders meeting obliquely. Trace the line of intersection.



The analysis indicates that, the question was attempted by 194 (83.98%) candidates out of 231(100%) who sat for the examination. The candidates' scores were as follows: 61 (31.44%) scored from 0 to 5 marks, 64 (32.99%) scored from 6.0 to 12.5 marks and 69 (35.57%) of the candidates scored from 13.0 to 20 marks. These data are summarized in Figure 3.

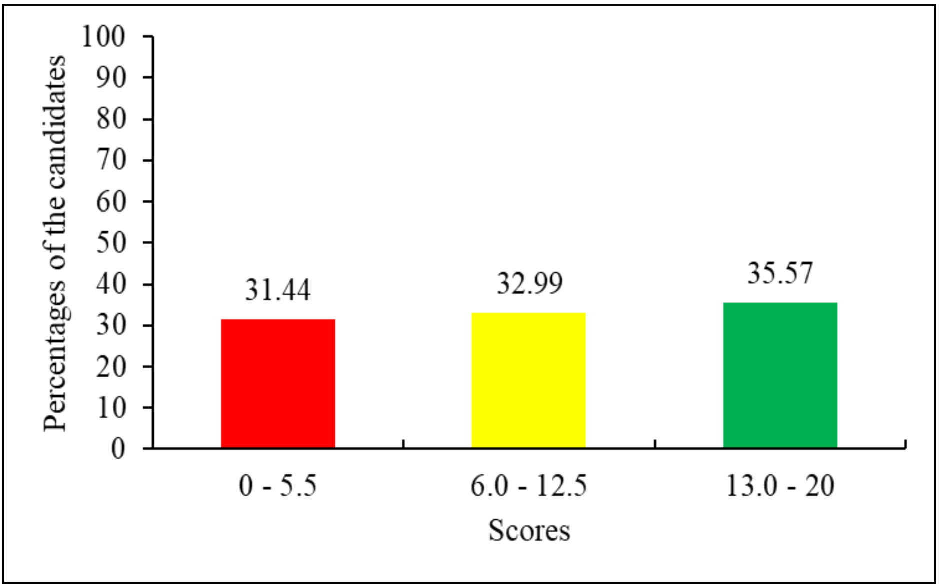
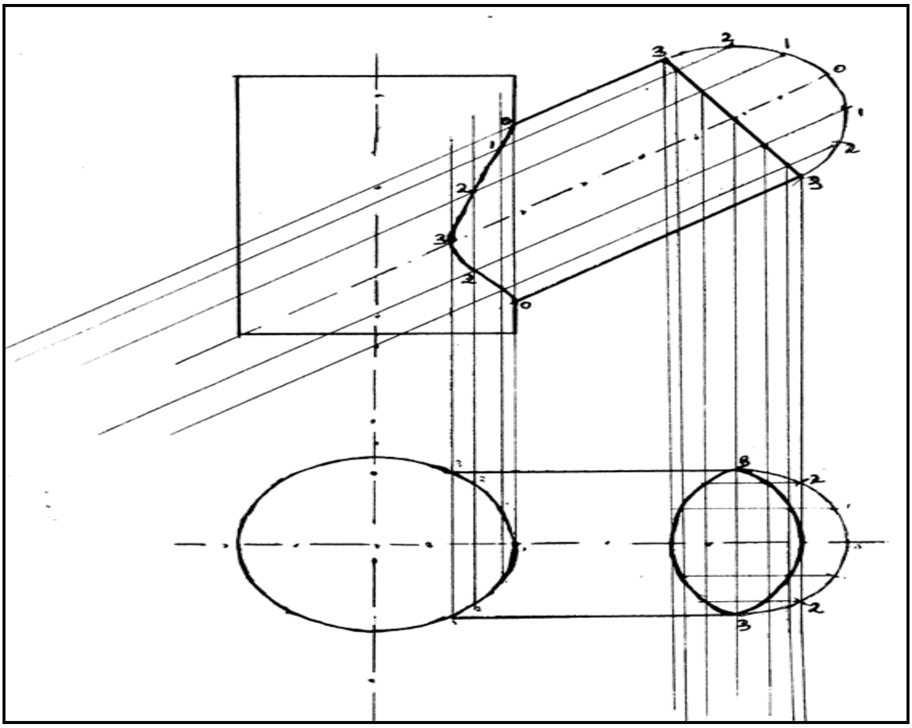


Figure 3: The Candidates' Performance in Question 3

From the analysis it was observed that, the general candidates' performance in this question was good because 133 (68.56%) of the candidates scored from average and above marks. Among them 69 (35.57%) candidates scored higher marks from 13 to 20. The candidates who scored all 20 marks were able to interpret the requirements of the question and employed knowledge and competence to trace the line of intersection and were able to draw a plan view with circle in ellipse shape.

The candidates who got good score but not all 20 marks managed to follow many steps of drawing the required line of intersection of the two cylinders such as drawing of the front view, centre lines, construction lines, auxiliary circles, and plan view with circle in ellipse shape. However, they missed some few steps, for example, one candidate followed most of the required steps but did not draw the centre lines, therefore, he/she did not score full mark while another candidate drew the required front and plan views, construction and centre lines, and correct intersection lines, however, he/she did not draw one auxiliary circle, thus, he/she missed one mark. Extract 3.1 provides a sample of good responses from one of the candidates.

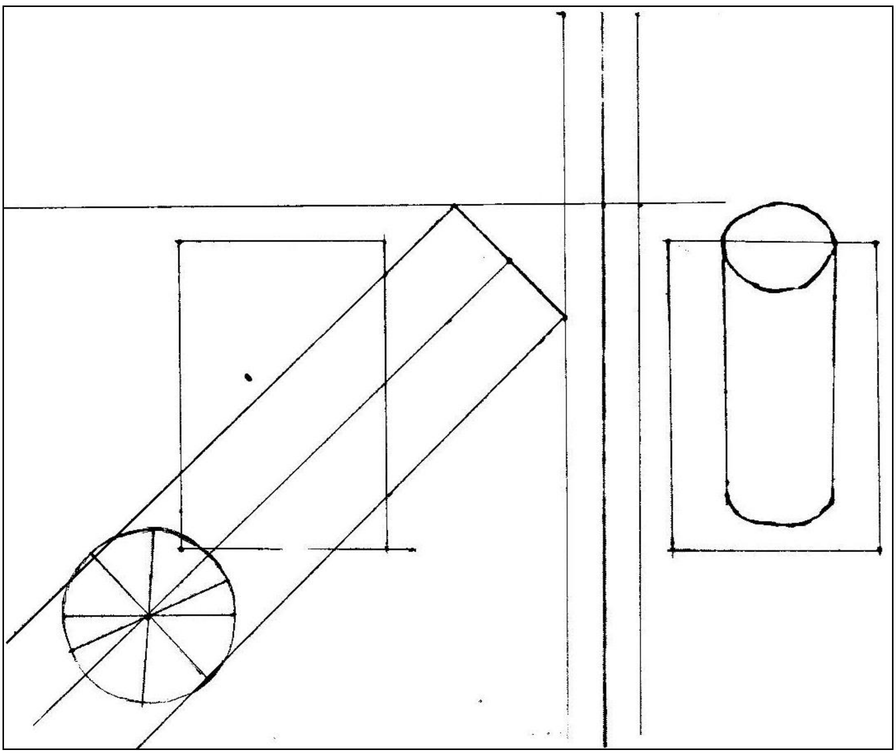


Extract 3.1: A sample of candidates' good responses to Question 3

In Extract 3.1, the candidate managed to draw the given view correctly. He/she was able to follow the steps of tracing the line of intersection by drawing the construction lines, auxiliary semicircles and showed the visibility of the required true shape on plan view and the intersection line.

On the other hand, 64 (32.99%) of the candidates who scored from 6.0 to 12.5 marks managed to draw the required views but failed to complete the figure or missed some steps such as incorrect construction lines, wrong auxiliary circles and plan view with circle in ellipse shape and they drew incorrect intersection lines. These candidates had some knowledge of drawing intersection of objects. The candidates were also able to apply some of the procedures to locate the intersection point where the cylinders of two dissimilar diameters meet at an angle. However, these candidates missed some steps, for example, one candidate managed to draw the construction lines but could not draw the point of intersection of the two cylinders, the centre lines and plan view, therefore, he/she scored average marks.

On the contrary, 61 (31.44%) of the candidates scored from 0 to 5.5 marks. Among them, 12 (6.19%) of the candidates score zero mark. These candidates who score 0 failed to draw the front and views, auxiliary circles, and could not trace the line of intersection. They lacked knowledge and skills of tracing the line of intersection of two cylinders that meet obliquely, thus, they scored zero mark. For example, one student drew only a circle, which was irrelevant response to the question. However, there were some of the candidates who scored from 1 to 5.5 marks. These candidates missed many steps which indicate that they had inadequate knowledge of tracing the line of intersection. They managed to draw only the front view and auxiliary circles, therefore they score weak marks. For instance, one candidate drew only the plan view which was correct, but he/she included the development of cylinder which was irrelevant response. is a sample of a poor response from the script of one of the candidates.



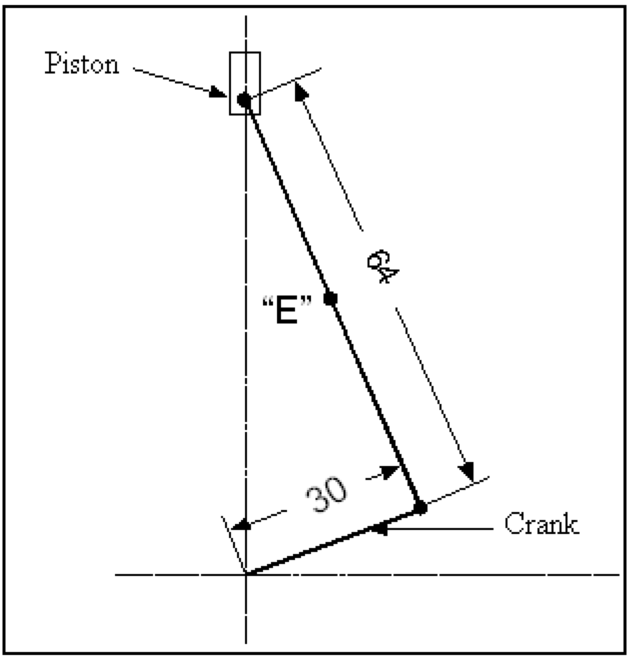
Extract 3.2: A sample of candidates' poor responses to Question 3

From Extract 3.3, the candidate provided irrelevant response in Question 3. The response shows that, the candidate lacked knowledge of the sub-topic of Intersection of Cylinders and lacked the understanding of the procedures and steps of drawing and tracing the required line of intersection and the true shape of a plan view.

2.2.3 Question 4: LOCI and Mechanisms

This was optional question composed from the sub-topic of *LOCI and Mechanisms*. The question intended to test knowledge and skills of candidates of drawing a locus of a point for one complete revolution of a crank. The question was:

*The figure below shows a line diagram representing piston reciprocation through different linkages. Plot a locus of point **'E'** for one complete revolution of crank. Consider that, point **'E'** is at the middle.*



The question was attempted by 219 (94.81%) candidates out of 231 (100%) who sat for the examination. Analysis shows that, 77 (35.16%) of the candidates scored from 0 to 5.5 marks, 19 (8.68%) of the candidates scored 6.0 to 12.5 marks, and 123 (56.16%) of the candidates scored from

13.0 to 20 marks. Figure 4 illustrates the candidates' performance in this question.

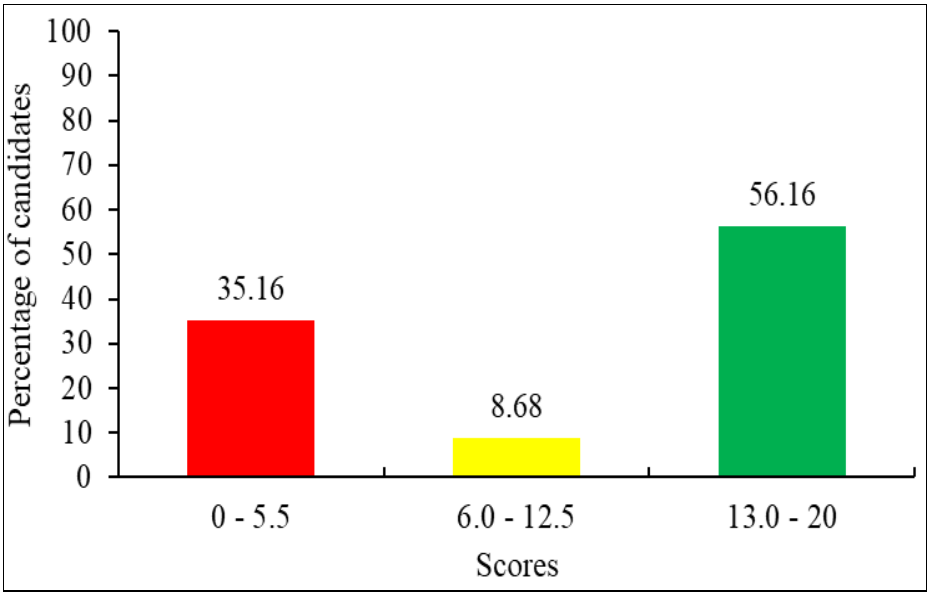
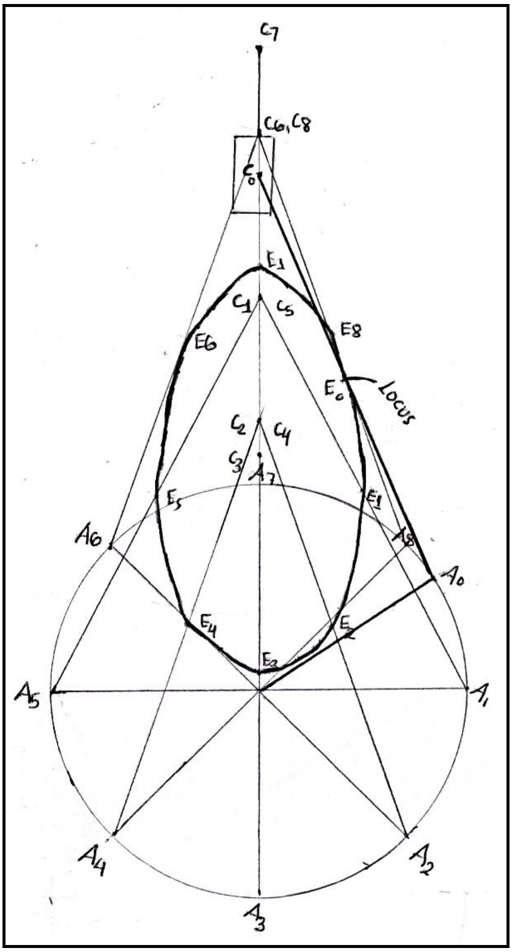


Figure 4: *The Candidates' Performance in Question 4*

Figure 4 shows that, the general performance of candidates in this question was good because 142 (64.84%) of the candidates scored from 6.0 to 20.0 marks while 77 (35.0%) scored of the candidates from 0 to 5.5 marks. Furthermore, 25 (10.82%) of the candidates who scored from 13.0 to 20 marks scored full mark. These candidates who scored 20 marks had knowledge and skills to draw a locus of a point for one complete revolution of a crank. They correctly demonstrated the skills and followed all the procedures of drawing locus of a movement of crank in one complete revolution. However, there were those candidates who managed to score higher marks but not full marks. These candidates followed correctly most of the procedures for drawing the locus of a point for one complete revolution of a crank but they missed some few steps such as incorrect drawing of the locus of the point ‘E’ and the given links. Extract 4.1 a sample of a good extract provided by one of the candidates.

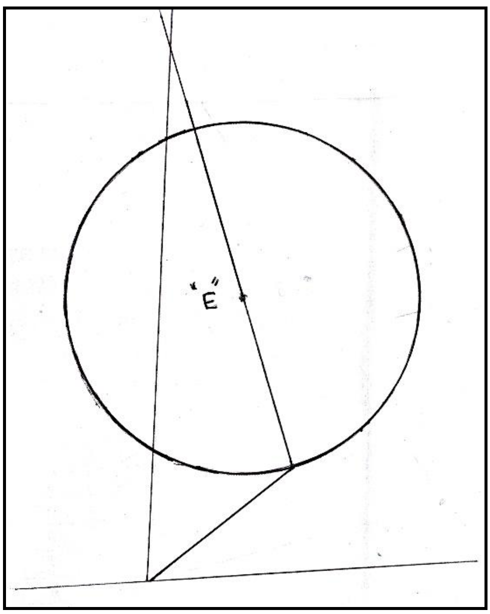


Extract 4.1: A sample of candidates' good responses to Question 4

Extract 4.1 shows the candidate who managed to follow the steps to draw the locus of a point for one complete revolution of a crank. He/she demonstrated his/her drawing skills by equally dividing the circle, correctly drawing the construction lines, the given links, and the locus of the point 'E'.

The candidates who got average score were 19 (8.68%). These candidates understood the requirement of the question and had understanding of some of the procedures and steps for drawing the required locus of a point for one complete revolution of a crank. They managed to demonstrate some drawing steps such as drawing circle and dividing it equally, correctly drawn construction lines. However, they could not draw the given links and locate the locus of the point ‘E’, hence, they scored average marks.

On the contrary, among the candidates who scored from 0 to 5.5 marks, 3 (1.30%) of the candidates scored zero. These candidates who scored 0 mark failed to draw the required locus. They lacked knowledge of procedures and steps to draw a locus of a point for one complete revolution of a crank. They could not draw the construction lines and divided the circles equally. Also, they did not draw the given links and could not demonstrate plotting of the locus of point ‘E’. However, there were candidates who scored from 1 to 5.5 marks. They had inadequate know knowledge and skills of drawing LOCI and Mechanism. These candidates missed many procedures employed in plotting the locus of a point, for example, one candidate drew only the circle and divided it equally but failed to continue with the remaining steps, as a result he/she scored weak marks. Extract 4.2 illustrates a poor response from one of the candidates.



Extract 4.2: A sample of candidates’ poor responses to Question 4

Extract 4.2 shows how poorly one the candidates responded to the question. Instead of taking the length of the crank into consideration as the circle's radius, he/she drew a circle with point "E" at its centre, which was an irrelevant response to the question; therefore, he/she scored poor marks.

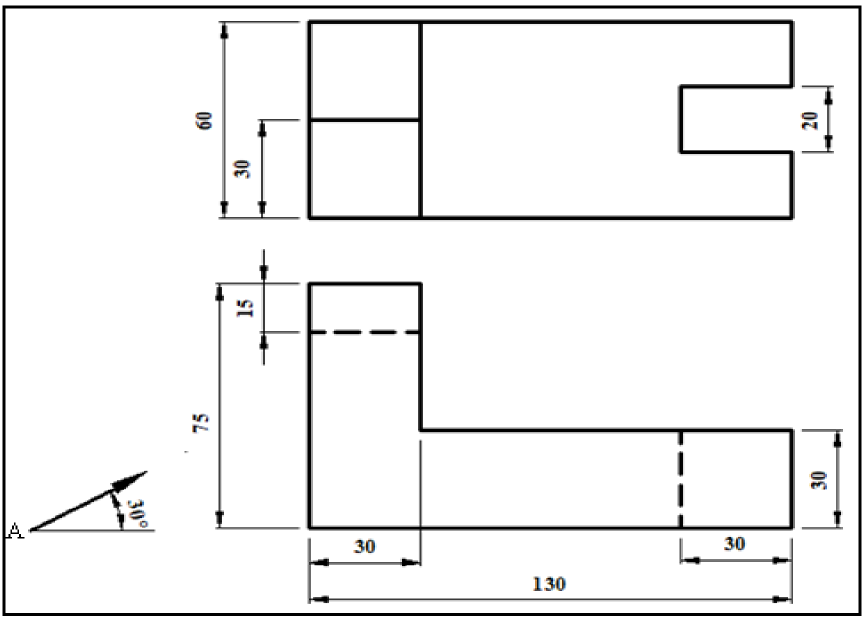
2.2.4 Question 5: Auxiliary Views

This was an optional question from the sub-topic of *Auxiliary Views*. The question required the candidates to use a third angle projection to draw the given views and constructing the auxiliary front elevation. The question was:

Front elevation and the plan of a casting are drawn in third angle projection as shown in the figure below.

(a) Draw the given views.

(b) Construct the auxiliary front elevation looking in the direction of the arrow A.



The data analysis indicates that this question was attempted by 204 (88.31%) candidates. Out of those candidates, 9 (4.41%) candidates scored from 13.0 to 20 marks, 169 (82.84%) of the candidates scored from 6.0 to 12.5 marks, and 26 (12.75%) of the candidates scored from 0 to 5.5 marks. Figure 5 shows the candidates' performance in this question.

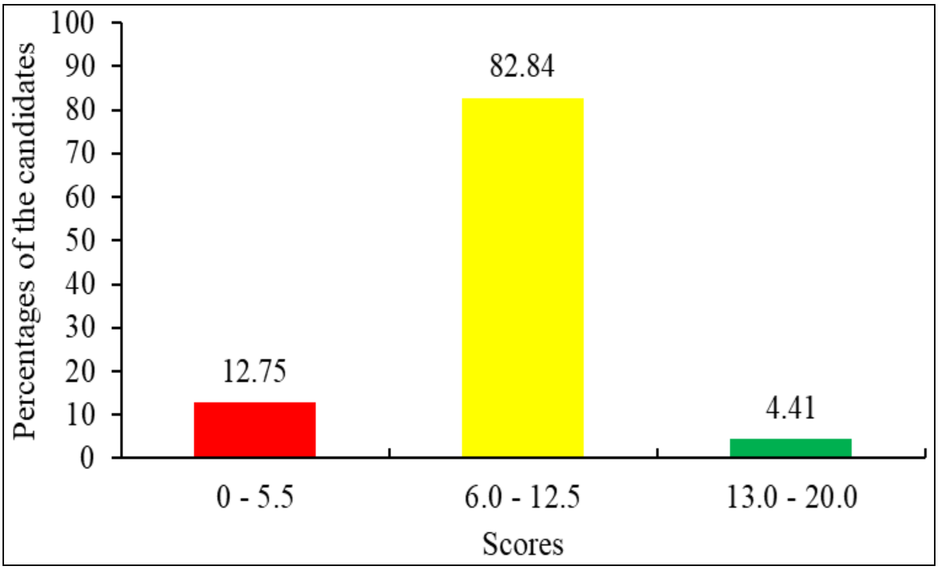
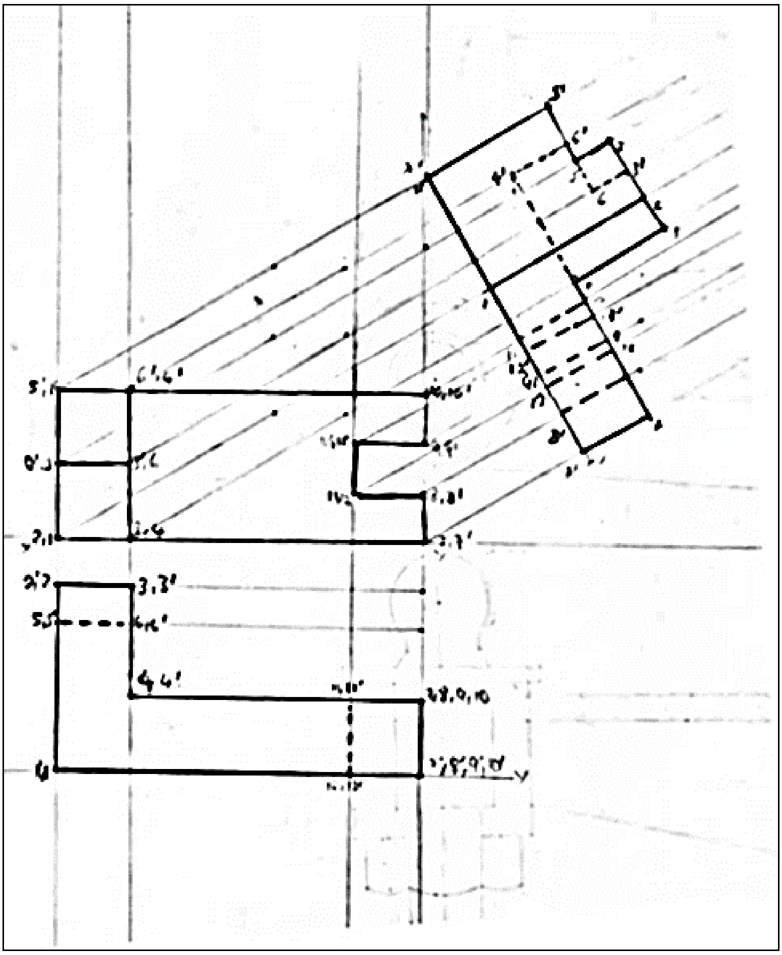


Figure 5: *The Candidates' Performance in Question 5*

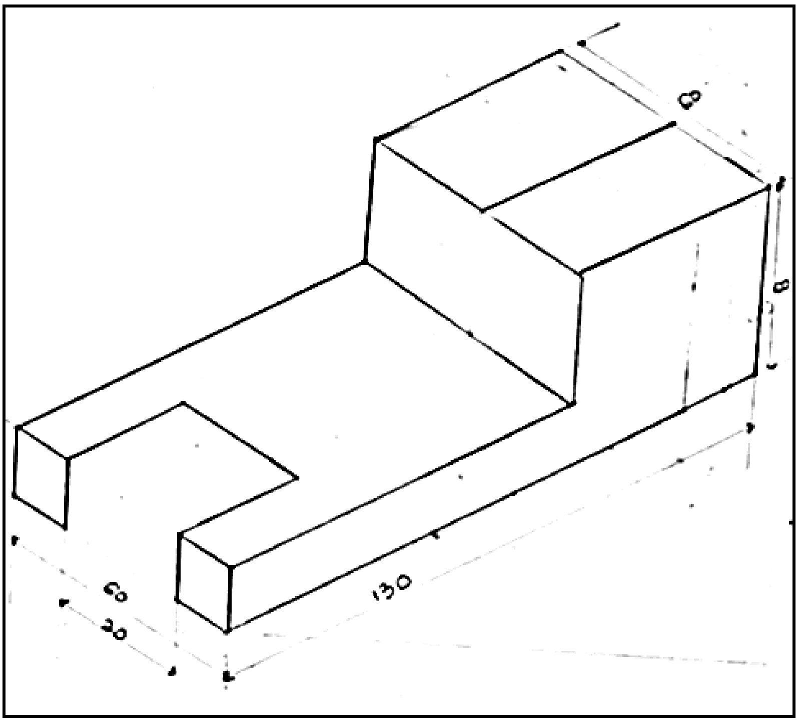
Figure 5 shows that, the performance of the candidates in this question was good since the majority 178 (87.25%) of the candidates scored from 6.0 – 20 marks. This performance was attributed to the fact that; the candidates were familiar with the auxiliary views content. Among the candidates who scored average and above, 9 (4.4%) scored from 13.0 – 20 marks. Moreover, out of the nine students who scored good marks, 4 (1.73%) got full mark. These candidates had adequate knowledge and skills of employing the steps of drawing the given views and constructing the auxiliary front elevation from the third angle projection. However, there were those candidates who scored good marks but not full 20 marks. These candidates managed to correctly draw the front and plan of the given views; however, they missed some steps of drawing the auxiliary view. For example, one candidate drew the front and plan views correctly and managed to project the projection lines at an angle of 30° but could not continue with the remaining steps of constructing the auxiliary view. Extract 5.1 provides a sample of good responses from one of the candidates.



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

Extract 5.1 is a sample of responses from the candidate who managed to draw the given views and the auxiliary front elevation view. He/she demonstrated clearly the procedures by providing proper position and angle of the plan, construction lines, visibility of the required views, neatness as well as good arrangement of the drawing. For the candidates who scored average marks were 169 (82.84%). These candidates had inadequate knowledge and skills of constructing auxiliary front elevation from the third angle projection. Most of the candidates who scored average marks managed to draw only the front and plan views, but forgot to name the corners of the views and could not complete constructing the auxiliary view as a results they scored average marks.

On the contrary, 26 (12.75%) of the candidates scored weak marks. Among them, 10 (4.33%) candidates scored zero mark. These candidates who scored zero mark lacked knowledge and competence in drawing the plan views and constructing auxiliary view. However, for those candidates who scored from 1 to 5.5 marks, the analysis revealed that they had inadequate understanding on the concept of auxiliary views. The majority of these candidates drew wrong auxiliary view with projection lines without following the required angle of direction and position of the view. For example, one of the candidates drew isometric view instead of auxiliary view, front view and plan view as required. He/she could not draw the projection line projected from the front edges looking at the angle of 30^{o} and was not able to correctly draw the visible edges and hidden edges. Most of them received low grades because they failed to complete or follow the correct procedures to draw the given views and auxiliary front elevation which revealed that the candidates were not familiar with the subject matter. Extract 5.2 is a sample of responses from one of the candidates who did not perform well in this question.



Extract 5.2: A sample of candidate's poor responses to Question 5

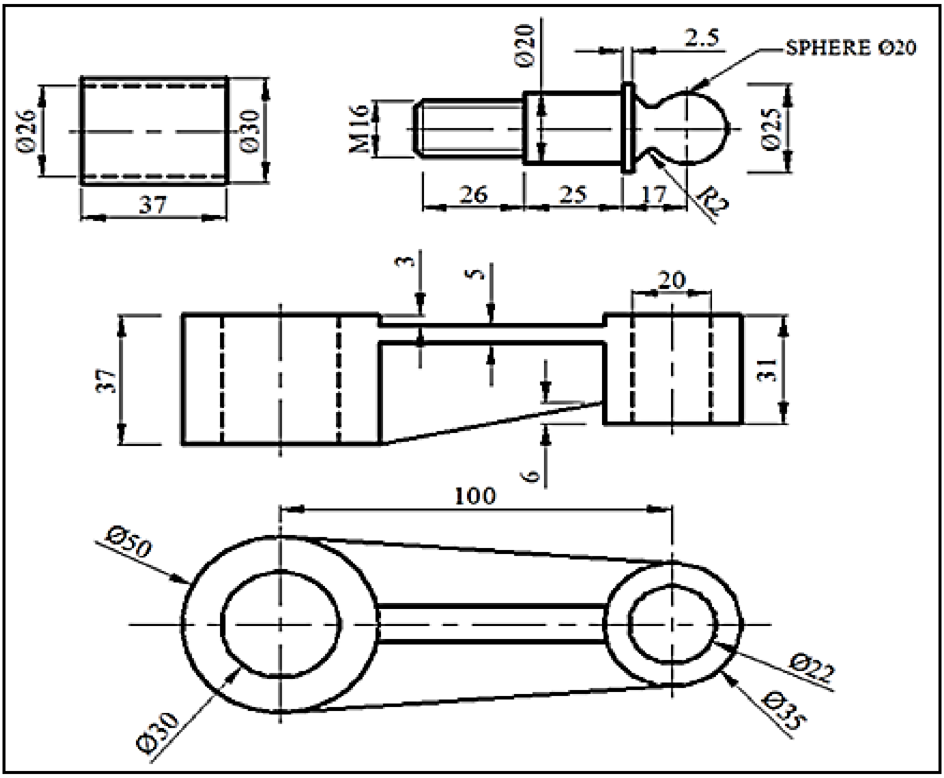
In Extract 5.2, the candidate failed to provide the appropriate auxiliary plan and to draw plan and front views that was required and projected at an angle of 30^{o}, rather he/she drew isometric view.

2.3 Section C: Structured Question

This section consisted of one question which was a compulsory question. The candidates were required to answer this question. The question was set from topic Engineering Drawing IV. Specifically, the question was composed from sub-topic of Assembly Drawing and carried 30 marks.

2.3.1 Question 6: Assembly Drawing

This was a compulsory question sat from the sub-topic of *Assembly Drawing*. The question required the candidates to apply their skills on assembly drawing in third angle projection by projecting plan and sectional front elevation in orthographic projection. The purpose of the question was to measure a candidate's ability to assembly different objects into the orthographic projection. The question was:
A technical teacher dismantled the parts of Gear Changer Liver in Figure the figure below for maintenance. Draw in full size, the assemble drawing in third angle projection by projecting the following views in orthographic projection.
(a) Sectional front elevation.
(b) Plan.
Add suitable washer and nut M16 to hold the assembly.



This question was attempted by 231 (100%) candidates whose scores were as follows: 80 (34.63%) of the candidates scored from 0–8.5 marks, 117 (50.65%) scored from 9.0–19.0 marks and 34 (14.72%) scored from 19.5–30 marks. Generally, candidates' performance in this question was good, since 151 (65.37%) of the candidates scored from 9.0-30 marks. Figure 6 shows the summary of the candidates' performance in this question.

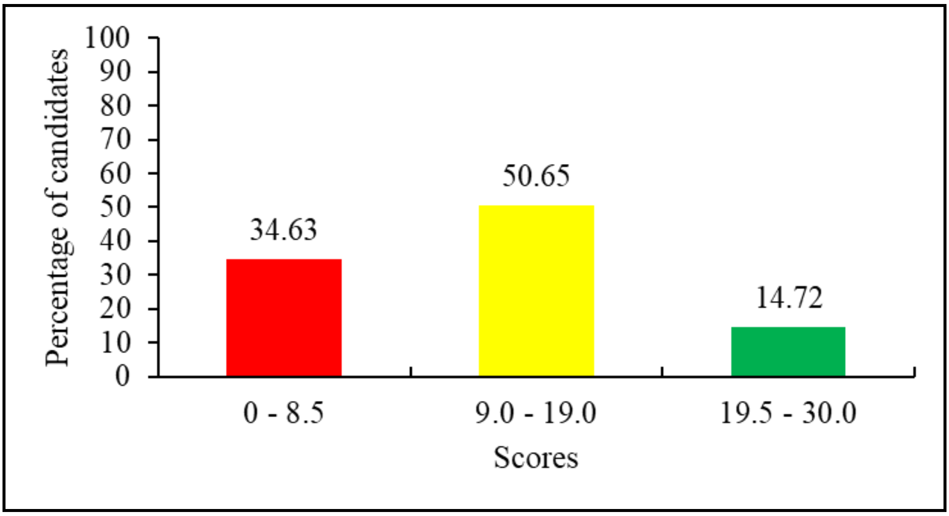
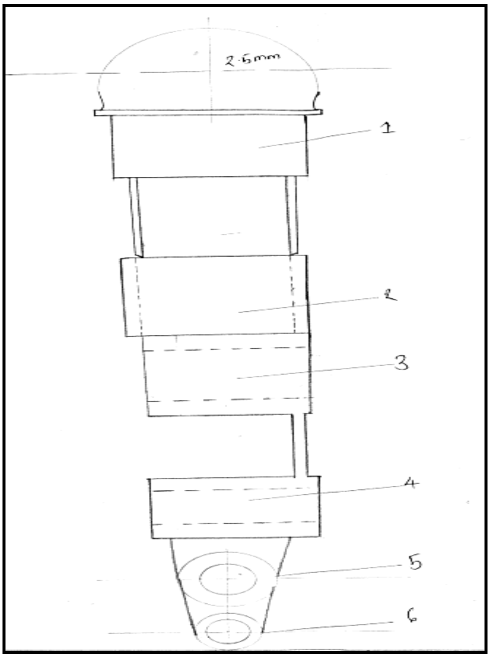


Figure 6: *The Candidates' Performance in Question 6*

The performance trend in Figure 6 shows that, the candidates' performance was good since 151 (65.37%) of the candidates scored from 9.0–30 marks. Moreover, 80 (34.63%) of the candidates got weak marks. Among these candidates who scored weak marks, 21 (9.09%) scored zero marks. These candidates who scored zero marks lacked the knowledge and skills of assembly drawing. These candidates failed to follow procedures of labelling section view and draw assembling parts of gear changer liver in third angle projection which are, to copy correct front and plan views given, section front elevation, to calculate the diameter of washer and nut and assembling it on the plan elevation. In addition, there were those candidates who managed to score from 1 to 8.5 marks. These candidates had inadequate knowledge and skills of assembly drawing. They only managed to draw the title block correctly, however, they failed to draw sectional front elevation and plan view. Some of these candidates managed to draw the border lines correctly and including correct dimensions but the rest of the drawing was wrong. For example, for the sectional front elevation, one candidate he/she managed only to draw correct centre lines, hatching lines and correct dimensions one candidate and he/she failed to continue with the remaining steps to complete the drawing. Another candidate managed to draw correctly only the title block, thus, he/she scored poor marks. Extract 6.1 is a sample of a poor respond taken from the script of one of the candidates.

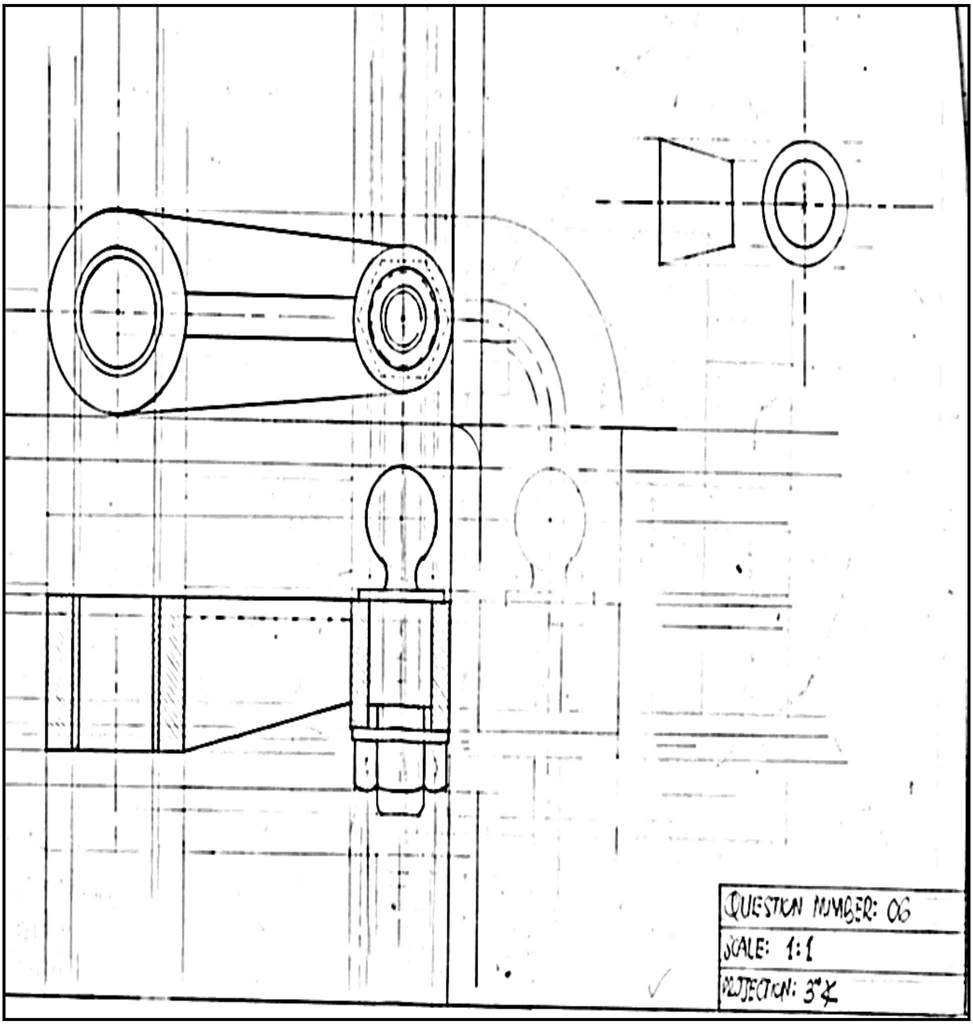


Extract 6.1: A sample of candidates' poor responses to Question 6

In Extract 6.1, the candidate failed to draw the required title block, sectioning the front elevation and assembling the gear changer liver as instructed, instead he/she drew the undefined object.

On the other hand, 151 (65.37%) candidates scored from 9.0 – 30 marks. Among them, 117 (50.65%) scored average marks. These candidates who had average score had partial knowledge and competence in assembly drawing. These candidates managed to draw the plan view and the circles correctly as well as the appropriate title block. However, most of these candidates who scored average marks missed some steps that led them to fail drawing the sectional front elevation view, suitable washer and hexagonal nut and did not show the cutting plane.

On the other hand, 34 (14.72%) of the candidates who scored from 19.5 – 30 marks were able to interpret and study well the drawing of gear changer liver parts on the orthographic projection. These candidates had knowledge and competence on the procedures of drawing the assembly drawing and the title block with correct information. However, they missed few steps needed to complete the drawing of section front elevation view. Moreover, the analysis revealed that most of these candidates who scored good marks but missed some few marks did not draw the suitable washer, hexagonal nut, and the cutting plane, as a results they could not secure full 30 marks. Extract 6.2 is a sample of a good respond taken from the script of one of the candidates.



Extract 6.2: A sample of candidate's good responses to Question 6

In Extract 6.2, the candidate managed to draw the orthographic projection with the assembled Gear Changer Liver. He/she applied the techniques; knowledge and skills of assemble drawing to draw the parts of Gear Changer Liver. Additionally, he/she was able to use a third angle projection to show the different types of lines, and approximate dimensions to show the views, their locations, visibility, and the accuracy of the needed views.

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH TOPIC

The Certificate of Secondary Education Examination (CSEE), 2023 in the Engineering Drawing subject had six questions from topics drawn from the Engineering Drawing Secondary Education Syllabus which was issued in 2019. The topics covered in the examination were Engineering Drawing I, Engineering Drawing II, Engineering Drawing III and Engineering Drawing IV, Introduction to CAD I, and Computer Aided Drafting II. Specifically, the questions were composed from the following sub-topics: *International Standard Organization (ISO) Layout sheet and size, Construction of Geometric Figures, Pictorial Drawing, Orthographic Projection, Introduction to CAD I, CAD II (Pictorial Drawing), Auxiliary Views, Assembly Drawing, LOCI Mechanisms* and *Intersection of Cylinders.*

Analysis of statistical data on candidates' performance reveals that, good performances were in Questions 1, 5, 3, and 6. Question 1 was a multiple choice question composed from the sub-topics of *International Standard Organization (ISO) Sheet Layout Sheet and Sketching, Construction of Geometric Figures, Pictorial Drawing (Oblique and Isometric), Orthographic Projection, and Introduction to CAD I*. Questions 5, 3, and 6 were set from *Auxiliary Views, Intersection of Cylinders,* and *Assembly Drawing* sub-topics respectively. The performance was average for Questions 4 and 2, and there was no weak performance. The two questions, that is, 4 and 2 were extracted from the sub-topics of *Orthographic Projection* and *LOCI Mechanisms* respectively.

The subtopics with the highest degree of attainment for strong performance were *Auxiliary Views*, where 178 (87.25%) of the candidates passed Question 5; 133 (68.56%) and 151 (65.37%) of the candidates passed Questions 3 and 6 respectively. *Intersection of Cylinders* and *Assembly Drawing* were the subtopics from which these questions 3 and 6 were taken. This good performance on these questions resulted from the fact that candidates demonstrated enough knowledge and skills on the tested sub-topics, good English language proficiency, and their ability to understand the requirements of the questions. On the other hand, the performance of candidates on Questions 4 and 2 was marked as average, whereby 142 (64.84%) and 30 (39.47%) of the candidates passed, respectively. These questions 4 and 2 were derived from sub-topic of *LOCI Mechanisms* and *Orthographic Projection (True Shape of Lamina)*, respectively.

Furthermore, the candidates' low performance on Question 2 was caused by their inadequate knowledge and skills about the subject matter, their failure to correctly interpret and identify the requirements of the question, and their limited drawing skills. The candidates' performance per topic is summarized in the appendices whereby green and yellow colours represent good and average performance respectively.

4.0 CONCLUSION AND RECOMMENDATIONS

This section provides conclusion and recommendations following the analysis presented in the previous sections. The given conclusion and recommendations are based on the responses' analysis of each question and each topic in the Engineering Drawing subject of Certificate of Secondary Education Examination (CSEE) 2023.

4.1 Conclusion

The overall performance in Engineering Drawing subject in the Certificate of Secondary Education Examination (CSEE) in November, 2023 was good as 170 (73.59%) of the candidates scored average and above. The weak performances of the candidates were generally contributed by factors such as lack of ability to understand the demand of the questions and inadequate knowledge and skills on Engineering Drawing concepts. These factors led to 46 (60.53%) candidates out of 76 (100%) candidates to have low performance especially in question 2. The good performances in question 1, 5, 3, and 6 were a result of candidates to understand the demand of the questions and having adequate knowledge and skills in

Engineering Drawing. Additionally, the candidates' average performance was caused by either provision of incomplete and irrelevant responses or skipping several steps of the questions.

4.2 Recommendations

From the candidates' weaknesses observed in the analysis of their responses, the following are therefore recommended:

(a) Students should engage in sufficient and regular practice in the drawing studio (Drawing room) to build their ability to draw various shapes, especially those related to *Orthographic Projection* and *loci (Mechanisms)* subtopics found in Engineering Drawing III.

(b) Students should perform more practical activities to connect between the theory and practical in order to enhance drawing skills. This will help the students to identify different Engineering Drawings of machine parts, tools and equipment.

(c) Students should be guided and encouraged to read various and relevant subject materials (books, past papers, journals, and pamphlets) in order to broaden their knowledge and skills.

(d) Students should be aided to improve English language proficiency by embracing the passion of speaking and writing in English. This can be achieved by allowing them to participate in debates, discussions and presentation of various assignments on Engineering Drawing subject.

(e) Students should be guided to participate in Engineering Drawing subject clubs. This will encourage candidate to develop interest on the given subject through their clubs' experience.

4.2.1 Recommendations to Teachers

(a) Teachers should prepare and utilize various teaching aids to instruct students, such as videos and 3D animations. This will help students understand the subject more easily. One of the major challenges faced by candidates is the inability to create a mental image or visualization of a real object, for example, creating a 3-Dimensional object from a 2-Dimensional drawing. Therefore, appropriate examples with demonstrations should be given to students through teaching aids in order to give the students the idea of the subject matter and to create a mental image of the reality of the subject.

(b) Teachers should establish subject clubs, provide regular classroom based exercises, and provide immediate feedback to 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 the Engineering Drawing subject.

(c) Teachers should promote learning by ensuring the availability of learning and teaching facilities. Practice will foster knowledge, skills and competence attained by candidates, thus improving their performance both at the school and national levels.

(d) Teachers should prepare the learning supportive environment to candidates in order to gain and expand their knowledge and understand the requirements of the question and subject matter.

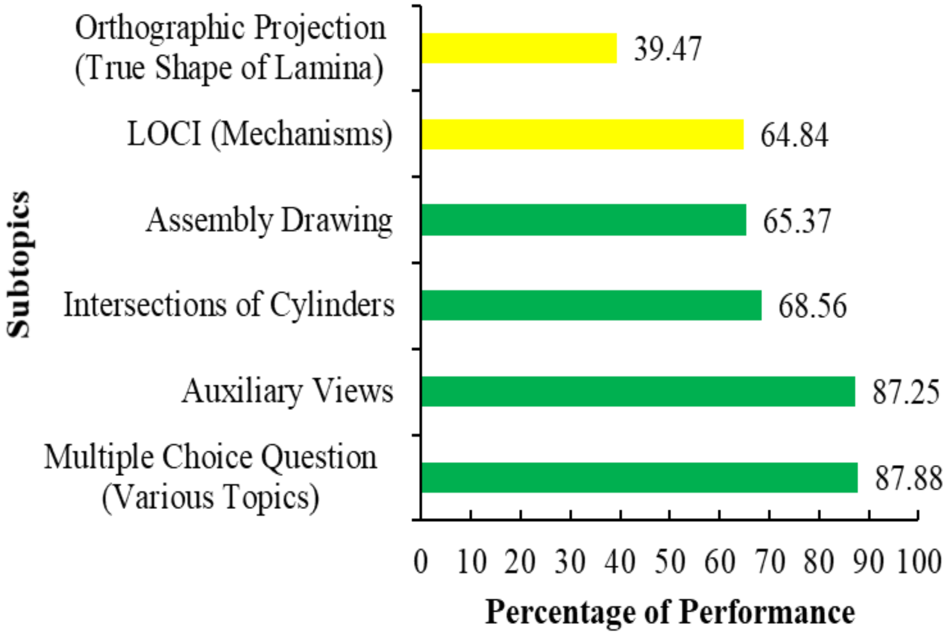
(e) Teachers should guide students in developing the culture of reading questions carefully before attempting them. This will help the candidates to understand the requirements of the questions before attempting.

Appendix I

A Summary of Candidates' Performance (Question-Wise and Topic-wise) in Engineering Drawing

S/N	Topic (Sub-Topic)	Performance for each Topic		Remarks
		Question Number	Percentage of candidates who scored 30% or more	
1.	Engineering Drawing I (International Standard Organization (ISO) Sheet Layout Sheet and Sketching) Engineering Drawing I (Construction of Geometric Figures) Engineering Drawing II (Pictorial Drawing (Oblique and Isometric)) Engineering Drawing III (Orthographic Projection) Introduction to CAD I (Introduction to CAD I) Computer Aided Drafting II (Pictorial Drawing (Oblique, Isometric))	1	87.88	Good
2.	Engineering Drawing III (Auxiliary Views)	5	87.25	Good
3.	Engineering Drawing II (Intersections of Cylinders)	3	68.56	Good
4.	Engineering Drawing IV (Assembly Drawing)	6	65.37	Good
5.	Engineering Drawing III (LOCI Mechanisms)	4	64.84	Average
6.	Engineering Drawing III (Orthographic Projection)	2	39.47	Average

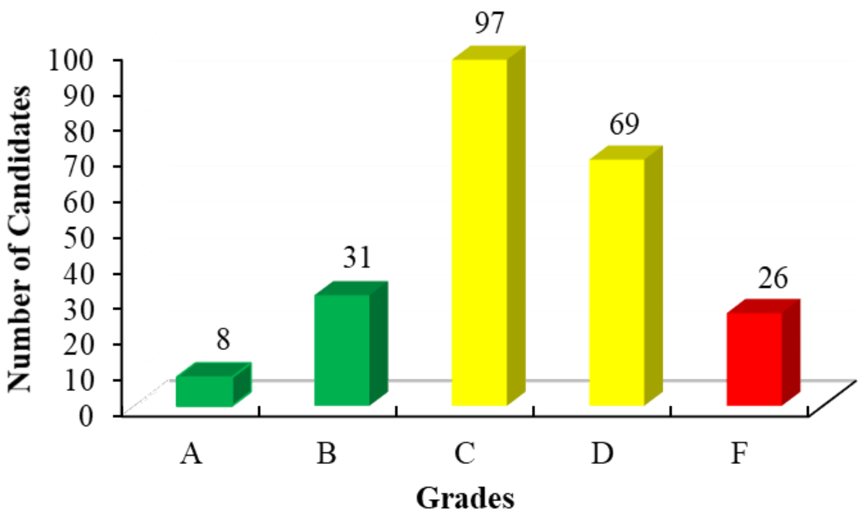
A Summary of Candidates' Performance Topic-wise



Appendix II

Summary of Candidates' Performance Grade-wise in Engineering Drawing Subject

Grade	A	B	C	D	F	Total
Number of Candidates	8	31	97	69	26	**231**



Appendix III

Distribution of Candidates' Performance in Each Question

Questions		Qn. 1	Qn. 2	Qn. 3	Qn. 4	Qn. 5	Qn. 6
Weak		28	46	61	77	26	80
		12.12%	60.53%	31.44%	35.16%	12.75%	34.63%
Average		181	29	64	19	169	117
		78.35%	38.16%	32.99%	8.68%	82.84%	50.65%
Good		22	1	69	123	9	34
		9.52%	1.32%	35.57%	56.16%	4.41%	14.72%
Total		**231**	**76**	**194**	**219**	**204**	**231**