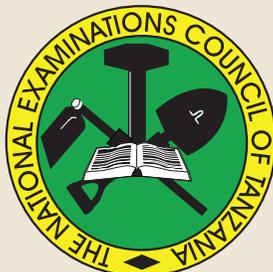


THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA



**STUDENTS' ITEM RESPONSE ANALYSIS REPORT
FOR THE FORM TWO NATIONAL
ASSESSMENT (FTNA) 2019**

070 TECHNICAL DRAWING

THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA



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070 TECHNICAL DRAWING

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FOREWORD

The Students Items Response Analysis report for the Form Two National Assessment (FTNA) 2019 in Technical Drawing subject was prepared in order to provide feedback to students, parents, policy makers and the public in general on the students' performance.

The Form Two National Assessment is a two-year formative evaluation which, among other things, shows the effectiveness of education system in general and education delivery system in particular. Essentially, students responses to the assessment questions is a strong indicator of what the education system was able or unable to offer to students in their two years of secondary education.

This booklet presents the analysis intended to contribute towards understanding some of the reasons affecting good performance of students in the Technical Drawing subject. The report highlights some of the factors that led some students to score high or low marks in the respective questions. The factors which led the students to perform well include their ability to answer the questions according to the demands of the questions as well as their knowledge in the subject matter. However, there are factors which effect some of the students to score high marks. Such factors include lack of skills in relation to a particular concept, failure to interpret the demands of the questions, poor English Language command and inability to answer questions which demand the application of knowledge and skill in performing design, sketching and drawing various machine components .

The feedback provided will enable the educational administrators, school managers, teachers and students to identify proper measures to be taken to improve students' performance in future.

Finally, the Council would like to thank the assessors and all those who participated in preparing and analysing the data used in this report as well as in typesetting the document.



Dr Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This is an analysis of the performance for the students in Technical Drawing examination who sat for the Form Two National Assessment (FTNA) in the year 2019. The Technical drawing paper assessed the students', competences according to the Form I and II Technical Drawing Syllabi. The report shows students' performance question wise by identifying the students' strengths and weakness when attempting the questions. It analyses the questions which were well performed, moderately and poorly performed.

Technical drawing paper had seven (7) questions divided in sections A and B. Section A had four (04) questions each carrying 10 marks each. Students were required to answer all questions. Section B consisted of three (3) questions each carrying (30) marks. Students were required to answer two (2) questions.

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

The number of students who sat for 2019 assessment in this subject was 1489, out of which 513 (34%) passed and 979 (66 %) failed. In 2018, a total of 1485 students sat for the assessment in out of which 238 (16.03%) students passed while the remaining 1247 (83.97%) students failed. These results indicate that there is an increase of 17.97 percent of students who passed the examination in 2019 compared to 2018.

The performance of the students in this report is regarded as unsatisfactory if the students scored from 0 to 29 percent; average if the students scored from 30 to 64 percent and good if the student scored from 65 to 100 percent. This performance is represented in Figures using colour where red, yellow and green colour are used for poor, average and good performance respectively. Figure 1 show overall performance of 1,489 students who sat for Technical Drawing Examination in 2019 FTNA.

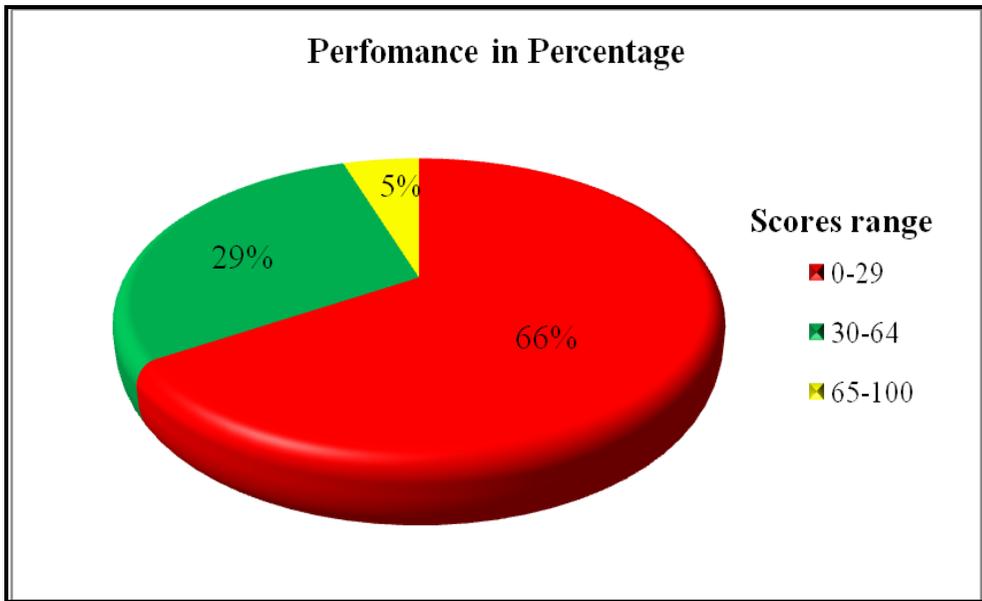


Figure 1: The general students' performance in Technical Drawing

Figure 6 indicates that, the general students' performance in this subject was average since 34 percent scored from 30 percent and above.

2.0 ANALYSIS OF INDIVIDUAL QUESTIONS

2.1 SECTION A: COMPULSORY PART

Section A had four (4) questions and had a total of forty (40) marks. Students were required to answer all questions in this section.

2.1.1 Question1. Multiple Choice Items

The question comprised of ten (10) multiple choice items, with 1 mark each making a total of 10 marks. The items were composed from different topics. Students were required to choose the correct answer from the four given alternatives for each item.

The question was attempted by 1489 (100%) students. The statistics show that 39.6 percent of students scored from 0 to 2.5 marks, 59.8 percent scored from 3 to 6.0 marks and 0.7 percent scored from 6.5 to 10 marks. Hence, performance of this question was good considering that 61 percent of the students scored 30 percent and above (3 to 10 marks). The reason behind of

good performance to this question was that students understood the demand of items. This performance is summarized in Figure 2.

On the other hand those who could not make correct choices of alternatives in most of the items lacked common understanding on the question matters. The performance of students are as illustrated in Figure 2.

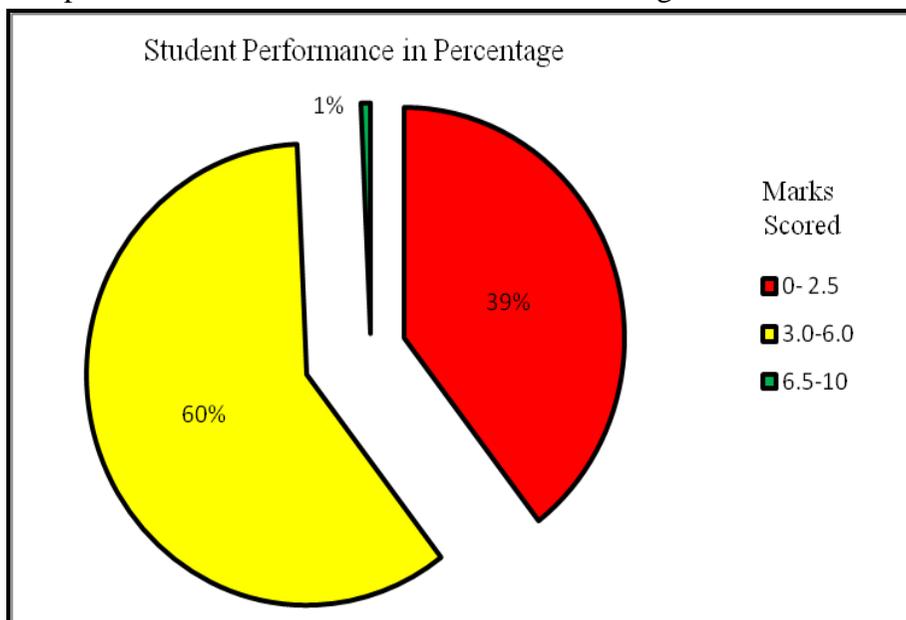


Figure 2: Students' performance in percentage for Question 1

The analysis in Figure 2 indicates that, the student performance in this question was good since 61 percent scored from 3 marks and above.

ANALYSIS OF THE ITEM

In item (i), the students were required to identify the uses of different types of line. Students were required to apply the knowledge of convention used in technical drawing to answer the question. The question was:

- (i) *What is the name given to a section if the cutting plane passes through base and one slant side of a cone is also parallel to the axis of the cone?*
- A *Parabola*
 - B *Hyperbola*
 - C *Ellipse*
 - D *Conical*

The correct response was *B. Hyperbola*; this was opted by students who had knowledge of conic section and true shape. Those who choose alternative A could not differentiate between the methods of drawing hyperbola and parabola. Moreover the alternatives C and D are formed when the section is not parallel to the axis but they make a greater angle with the axis of the cone than does the generator of the elements.

Item (ii) demanded the student to point out a point which it situated inside the generating circle but also rolling the base of circle. This item tested the students' ability to understand the processes of constructing various bending lines and curves. The question was:

- (ii) *The points of locus which is lying inside the generating circle but also rolling the base of circle is called*
- A Inferior trochoid*
 - B Superior trochoid*
 - C Inferior epitrochoid*
 - D Superior epitrochoid*

The correct response was C: Inferior epitrochoid. Those who opted for A, B and D lacked the knowledge on the topic of Loci. They failed to understand cycloidal and spiral curves that the locus of the point is formed when circumference of a circle rolls without slipping along a straight line.

Item (iii) tested the students' ability to demonstrate different types of lettering in technical drawing. In this item, students were supposed to identify the relation between the height of the letter and the horizontal guidelines. The question was:

- (iii) *How are the smaller letters used in drawing?*
- A To give details*
 - B To show hidden portions*
 - C To show the parts to be removed*
 - D To indicate notification to remember*

The correct response was A. Most of the students confused between the uses of lettering in technical drawing and the application of lines in technical drawing. They didn't understand that lettering in technical drawing is divided into two main categories which are Capital and small lettering and all these types are used to indicate the details of the one who make the drawing. Also they had misconception between lettering and types of lines. They confused between the uses of symbols to show the machine parts and lettering which is used to indicate the detailed drawing. This indicates that most of them did not understand deeply the topics of lettering and machine symbols.

Item (iv) intended to measure the students' knowledge about the types of triangle having different sides and angles. The question was:

(iv) *Which of the following is the type of triangle with all unequal sides and angles?*

- A *Scalene triangle*
- B *Equilateral triangle*
- C *Right angled triangle*
- D *Isosceles triangle*

The students who had knowledge on types of triangles were able to opt for the correct answer which is A *Scalene triangle*. This is a correct answer because a scalene triangle is the only type of triangle which all sides have unequal dimensions. The students who opted for this answer had the knowledge of plain geometry and types of triangles. They understood that scalene triangle is the one which has three unequal sides and unequal angles. However, those who opted for other alternatives; B, C or D lacked knowledge on the sides of triangles. The students who opted for B misunderstood the nature of the equilateral triangle which has the same side and equal angle. These students' confused between the scalene and isosceles triangle. A triangle with the two similar sides and equal angles. Those who opted for C: *Right angled triangle* confused the characteristics of this type of triangle whereby it may have two or three sides with differences in dimensions. However, they failed to understand that even the three equal sides will be able to make right-angled triangle. Moreover, those who opted for D: *Isosceles triangle* lacked knowledge differentiating between the types

of triangle in rectilinear geometric figures.

Item (v) was composed from the topic Scale and it was meant to measure students' understanding on various types of scale and factors to consider while selecting the scale. The question required students to identify appropriate factor of drawing scale. The question was:

- (v) *Which of the following is the suitable factor for selection of drawing scale?*
- A Type of scale material*
 - B Space available in the drawing sheet*
 - C Availability of drawing equipment*
 - D Type of drawing table*

The correct alternative is B: *Space available in the drawing sheet*. Those who opted for B understood the importance of selecting appropriate scale of drawing sheet before starting drawing. Also they understood that, all drawings should be drawn to scale and scale used should be stated on the drawing. The students who opted for A *Type of scale material*; C *Availability of drawing equipment* and D *Type of drawing table* didn't understand the what the question required. They lacked knowledge about scaling the drawing in the drawing sheet.

Item (vi) was composed from the topic, Line, and it aimed to measure students' understanding on various types of line used in technical drawing. The question was:

- (vi) *Which of the following line is used to join two or more circles by curves through their circumference?*
- A Centre line*
 - B Tangential line*
 - C Blending line*
 - D Spiral line*

The correct response was C. This option was selected by students who had knowledge on types of lines. Those who failed to choose the correct answer could not distinguish between the tangential, centre and spiral line. For

example, the students who opted for A *Centre line* failed to realise that the function of Centre line is to indicate the axes of cylindrical, conical or spherical objects and also to show centres of circles and arcs. Moreover, distracters B *tangential line* and D *spiral line* are used in Technical drawing to show the point at the circumference of a circle and the spiral curve respectively. The aim of these types of line is to show the size of the part while the direction lines has arrowheads at only one side and they are used to indicate the component or part of the component.

Item (vii) tested the ability of the students' to identify the function of leader line as used in Technical drawing. Knowledge on the rules and the types of dimensioning style for different figures is required. The question was:

(vii) *What is function of a leader line in engineering drawing?*

- A *Indicating the length of blind hole, radius and arc*
- B *Indicating the diameter of a hole and radius of an arc*
- C *Indicating radius of a hole, curves and an arc*
- D *Indicating the extension line of the hole, curve and arc.*

The correct response was B. This was opted by students who had knowledge on types of lines. Those who failed to choose the correct answer could not distinguish between the leader lines and other types of lines. The leader lines are used for descriptive remarks to some features such as dimension, object outline etc., of a drawing.

Question (viii) was extracted from topic, 'Fit and Limit'. It tested the students' ability to demonstrate the application of mating systems of shaft and holes. Students were supposed to identify the application of mating dimension as used in inserting on shaft when fitted with holes. Mating dimensions are types of dimensions which describe the tolerance of the holes when the shaft is fitted on the holes. The question was:

(viii) *What are the uses of mating dimensions in drawing processes?*

- A *To show the parts shaft that fit together*
- B *To locate the various features of a component relative to each other*
- C *To describe diameter, radii and the shape of component*

D To show parts on the pictorial drawing only

The correct responses was A. This was opted by students with the about knowledge types of Limit and Fits dimensions. Those who failed to choose the correct answer could not distinguish between the dimension lines and drawing lines. The mating dimension lines are used to show the parts of the shaft that fit together. The aim of these types of line is to show the size of the part while the direction lines have arrowheads at only one side and used to indicate the component or part of the component. Moreover, alternatives B and D are directional lines which are used in Technical Drawing to show the specific item.

Question (ix) was from the topic, Free Hand Sketches. It demanded the students to identify the tool used to draw a circle in free hand sketches. The aim of this question was to measure students ability in application of various drawing tools.

(ix) Which tools are used to draw a circle in free hand sketch?

- A Square and 45 degree center*
- B Square and fingers*
- C Wrist and 45 degree center*
- D Square and shoulder*

The correct answer was A, *Square and 45 degree center*. Those who opted for B *Square and fingers* lacked knowledge on method of constructing a circle by using a square and angle. In constructing of a circle, the first procedure required is to draw a square and bisect their sides in order to get the centre. Then followed by drawing diagonal of the circle in order to get the path point where the circle can path. Most of the students didn't understand this method. However, those who opted for B *Square and fingers* C *Wrist and 45 degree center* and D *Square and shoulder*, lacked skill of constructing circle in free hand sketch method.

Question (x) was composed from topic Auxiliary. The students were required to identify the method used to find the true shape of the object at the inclined

position. The question tested the students' understanding on common types of pictorial views drawn in Auxiliary. The question was:

- (x) *Which methods are used to obtain size and shape of an inclined surface of the block?*
- A Orthographic projection or auxiliary view*
 - B Auxiliary view or revolution*
 - C Isometric or orthographic projection*
 - D Oblique or Isometric projection*

The correct answer was B *Auxiliary view or revolution*. The question required the students to identify different types of orthographic projection which includes Auxiliary projection, first angle projection and third angle projection. Those who opted the correct answer had enough knowledge of subject matter, auxiliary projection. Auxiliary or revolution view is a type of drawing where the views are drawn on planes at or inclined angle where the true size and shape are obtained.

Those who opted for C and D failed to differentiate between the pictorial drawings which are three dimensions views (Isometric and Oblique) drawn at perpendicular with auxiliary views which are drawn at an angle. Also in nature Auxiliary view should use true length or shape in drawing while it is not necessarily so in pictorial drawing.

2.1.2 Question 2. True or False

This question consisted of ten (10), extracted from various topics. The students were required to write **TRUE** for correct statement and **FALSE** for an incorrect statement. The question was compulsory and was attempted by 1488 Students. The students performance show that 2.28 percent scored from 0 to 2.5 marks which is unsatisfactory, 66.94 percent scored from 3 to 6.0 marks which is an average performance and 30.78 percent scored from 6.5 to 10 marks which is good. Generally, the performance of this question was good considering that 97.72 percent of the students scored 30 percent and above(3 to 10 marks). Figure 3 represent such performance of the students who attempted this question.

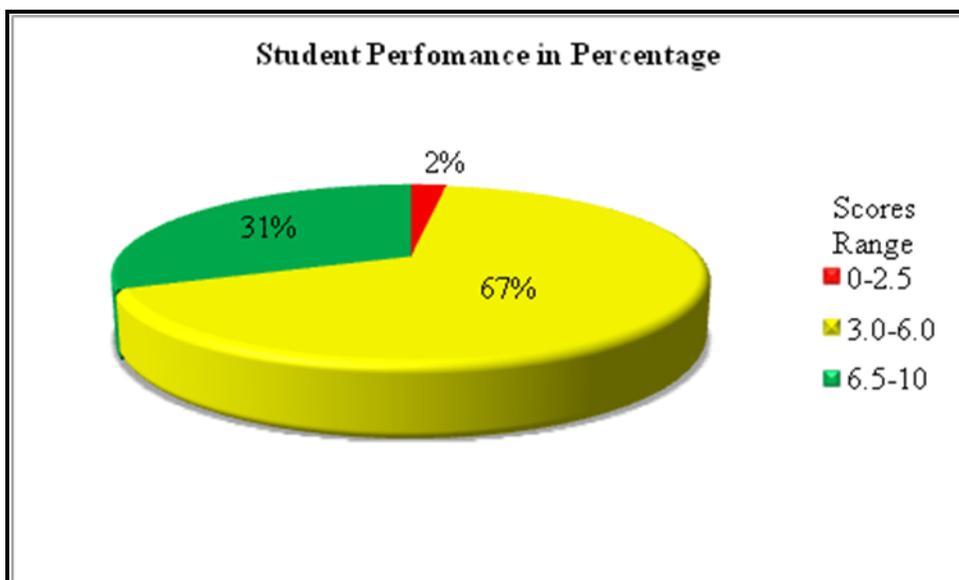


Figure 3: Students' performance in Question 2

The performance trend in figure 3 shows that, students' performance was good since 98 percent of the students scored above 3 marks. This shows that the students had adequate knowledge of the topics tested therefore they managed to correctly match the items given.

Item (i) was composed from the topic Loci. It tested the students' ability to identify types of views obtained after imaginary cutting at inclined plane figure parallel to the axis of the object. The question was:

(i) The shape of the section cut by an inclined plane parallel to one side of the cone is called a parabola.....

The correct answer was TRUE. The students who wrote correct answers had knowledge on the topic, Loci. If the objects are cut by a section plane parallel to a generator, the shape obtained is called parabola. On other hand, those who wrote FALSE confused between the hyperbola and parabola. They couldn't differentiate that hyperbola is obtained when section plane cuts the double cone on one side of the axis.

Item (ii) was extracted from the topic Dimension. The question intended to test the students' ability in analyzing Standard Unit used to portray a linear measurements applied in Technical Drawing. The question was:

(ii) The SI unit of dimension used to describe linear measurement in drawing is meter.....

The correct answer was FALSE. The student with adequate knowledge of SI unit used in engineering were able to answer the question correctly. This shows that these student had clear understanding about Standard Units. Meanwhile, those who wrote TRUE, confused Standard Units used in measurement to identify linear distances and the common linear measurements used to describe various objects.

Item (iii) was composed from the topic Lines. The question required the students' to verify the uses of chain thin double dashed line. The question intended to test the students' ability to analyse application of different types of lines used in Technical Drawing. The question was:

(iii)The chain thin double dashed line is the type of line used to show the limits of partial or interrupted view and sections.....

The correct response was FALSE. Students who wrote correct answer were aware on the difference types of lines used in Technical drawing. They had adequate knowledge on types of lines and their applications. Those who wrote incorrect answer TRUE, failed to recall the types of lines especially when used to show the partial sectioned machine part.

Item (iv) tested the students' ability to apply the knowledge on construction of figures which are similar and equal but unequal its corresponding sides. The question was:

(iv) Two or more figures are similar if the ratio of their corresponding sides is not proportional.....

The correct answer was FALSE. The aim of this item was to test the students' skill in constructing various rectilinear and similar polygon figures by taking into consideration area and their proportionality sides. The students who responded correctly had knowledge and skill on the construction of figures

which are similar and related to their area. Those who wrote TRUE lacked skills on construction of similar figures according to the corresponding sides and area.

Item (v) was composed from topic Equal Area. The was was intended to test the students skills on the methods of obtaining equal triangles from other objects. For example Pentagon, Hexagon, Rhombus, Square and other polygon can be used to obtain equal triangle. The item was:

(v) Irregular polygon can be the source to construct a triangle equal in area

The correct answer was TRUE. The students who wrote correct answer had knowledge on drawing various polygon when given plane geometry. However, those who failed to provide the correct answer had inadequate knowledge of drawing triangles from the given irregular objects.

Item (vi) was composed from topic Orthographic Projection. It intended to test students' understanding of different views obtained in Orthographic drawing. The question was:

(vi) Two methods of representing orthographic views are first angle projection and third angle projection.

The correct answer was TRUE. The students who provided correct answers had knowledge on the orthographic projection. On other hand, those who wrote FALSE confused the Orthographic drawing with Pictorial drawing. They failed to recall that Pictorial drawing is a three-dimension drawing, whereby objects are represented in Isometric, Oblique or Cabinet projection.

Item (vii) was extracted from the topic Pictorial Drawing. It intended to test the students' ability of understanding the views drawn in pictorial after convection from orthographic projection. The question was:

(vii) Pictorial drawing is the technical process which converts the views from three dimensions to two dimensions.....

The correct response was FALSE. Pictorial drawing is a three-dimension drawing, whereby two dimensions projection (Orthographic) are converted to three dimensions projection (Isometric, Oblique etc). The students who wrote correct answer had enough knowledge on Pictorial drawing, whereby both height, length and width are indicated in one object. Orthographic projection is named as two views projection because only two dimensions are shown, that is Front view (length and height), Plan view (Length and Width) and End view (Width and Height). However, those who wrote TRUE which is an incorrect response, didn't understand that pictorial drawing is not a technical way of getting a two dimensional analysis from the given drawing. It is a three-dimension view convert Orthographic views (Third angle or First angle views) to isometric or oblique drawing which are three dimensional figures.

Item (viii) was composed from the topic, Geometrical construction in plane figure. It tested the students' ability to use different line when drawing the difference types of geometrical plane figure. The question was:

(viii) Tangent is a straight line which touches the chord of circle at once

The correct answer was FALSE. Students who responded as FALSE to the assertion knew that tangent line should touch just one point of the circle not the chord. Those who didn't write the correct answer lacked knowledge on tangent line as applied in technical drawing.

Item (ix) was composed from the topic called Freehand sketching. The question intended to test the students' understanding on importance of accurate dimensioning in freehand sketch drawings. The question was:

(ix) The dimensions of the objects produced when making Freehand sketching should be accurate

The correct response was TRUE. Students who wrote correct answer had enough knowledge on principles of freehand sketching and application of dimensions. Those who didn't write the correct answer lacked knowledge on the subject matter. These students answered FALSE which was a wrong assertion. They failed to understand that sketching other by freehand or using special tool the application of correct dimensions and scale is an important

criteria. The analysis of responses on this question revealed that they did not understand the demands of the question.

Item (x) measured students' ability in identifying the types of angles used to draw an oblique projection in pictorial drawing. The question was intended to test the students' understanding on importance of accurate dimensions on freehand sketching. The item was:

(x) *In oblique projection the inclined edges may be drawn at angle of 30° , 45° or 60° to the horizontal*

The correct answer for this assertion was TRUE. The students who got the question correct had enough knowledge on pictorial drawing. Students who wrote FALSE did not have knowledge on engineering drawing. Extracts 2.1 and 2.2 are a samples of a good and a poor response of Question 2.

2. For each of the following statements, write **TRUE** if the statement is correct or **FALSE** if the statement is not correct.

- (i) The shape of the section cut by an inclined plane parallel to one side of the cone is called a parabola... **TRUE**
- (ii) The SI unit of dimension used to describe linear measurement in drawing is metre... **FALSE**
- (iii) The chain thin double-dashed line is the type of line used to show the limits of partial or interrupted views and sections... **FALSE**
- (iv) Two or more figures are similar if the ratio of their corresponding sides is not proportional... **FALSE**
- (v) Irregular polygon can be the source to construct a triangle equal in area... **TRUE**
- (vi) Two methods of representation on Orthographic views are first angle projection and third angle projection... **TRUE**
- (vii) Pictorial drawing is the technical processes which convert the views from three dimensions to two dimensions... **FALSE**
- (viii) Tangent is a straight line which touches the chord of circle at once... **FALSE**
- (ix) The dimensions of the objects produced when making freehand sketching should be accurate... **TRUE**
- (x) In oblique projection the inclined edges may be drawn at angle of 30° , 45° or 60° to the horizontal... **TRUE**

Extract 2.1: A sample of good responses from one of the students.

Extract 2.1 is a sample of response from the student who matched all the items of the question correctly. These responses signify that the student had sufficient knowledge of the topic tested.

2. For each of the following statements, write **TRUE** if the statement is correct or **FALSE** if the statement is not correct.
- (i) The shape of the section cut by an inclined plane parallel to one side of the cone is called a parabola..... **False**.....
 - (ii) The SI unit of dimension used to describe linear measurement in drawing is metre **TRUE**.....
 - (iii) The chain thin double-dashed line is the type of line used to show the limits of partial or interrupted views and sections..... **FALSE**.....
 - (iv) Two or more figures are similar if the ratio of their corresponding sides is not proportional **TRUE**.....
 - (v) Irregular polygon can be the source to construct a triangle equal in area **False**.....
 - (vi) Two methods of representation on Orthographic views are first angle projection and third angle projection **False**.....
 - (vii) Pictorial drawing is the technical processes which convert the views from three dimensions to two dimensions **TRUE**.....
 - (viii) Tangent is a straight line which touches the chord of circle at once **TRUE**.....
 - (ix) The dimensions of the objects produced when making freehand sketching should be accurate **FALSE**.....
 - (x) In oblique projection, the inclined edges may be drawn at angle of 30° , 45° or 60° to the horizontal **False**.....

Extract 2.2: A sample of poor response by the student.

Extract 2.2 shows sample of response from a student who failed to correctly respond to all items. This implies the student lacked content knowledge about the concepts tested.

2.1.3 Question 3: Geometrical Construction in Plane Geometry

The question comprised of parts (a) and (b). The students were required to (a) complete the given views by adding the missed line and (b) write one application of each of the given lines. The question was:

3. (b) Figure 1 shows uncompleted views drawn in orthographic projection; complete the view by adding the missing lines.

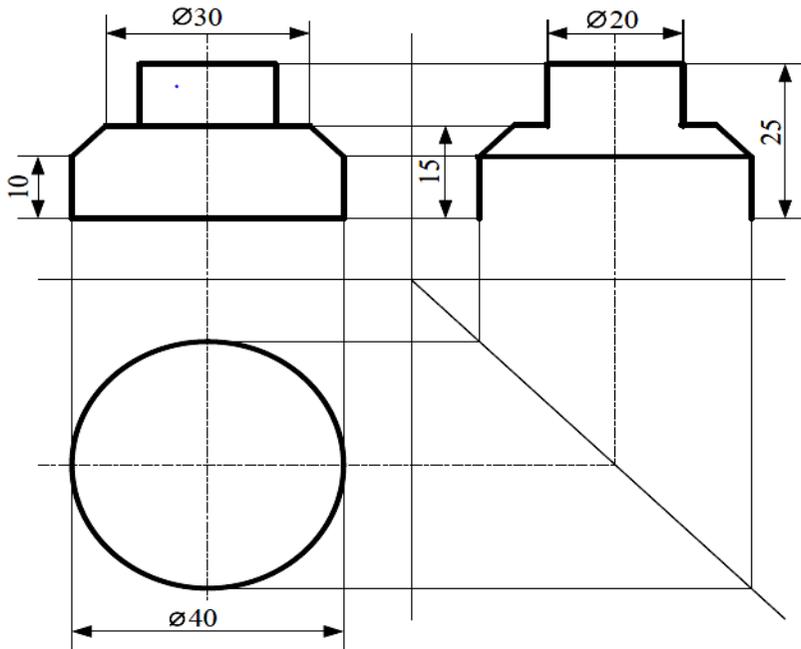


Figure 1

- (b) Write one application of each of the following type of lines:

(i) Chain thin double-dashed line 

.....

(ii) Chain thick line 

.....

(iii) Continuous thin with zigzag line 

.....

(iv) Continuous thick line 

.....

(v) Dashed thin line 

.....

This question was attempted by 1466 (98.5%) of all students who sat for the examination. The statistics show that 72.11 percent of the students scored from 0 to 2.5 marks, 25.78 percent scored from 3 to 6.0 marks and 2.11 percent scored 6.5 to 10 marks. Meanwhile, 1.5 percent of students didn't attempt the question.

The general performance in this question was poor, as 27.88 percent of the students scores from 3 to 10 marks. Figure 4 show scores of students in this question.

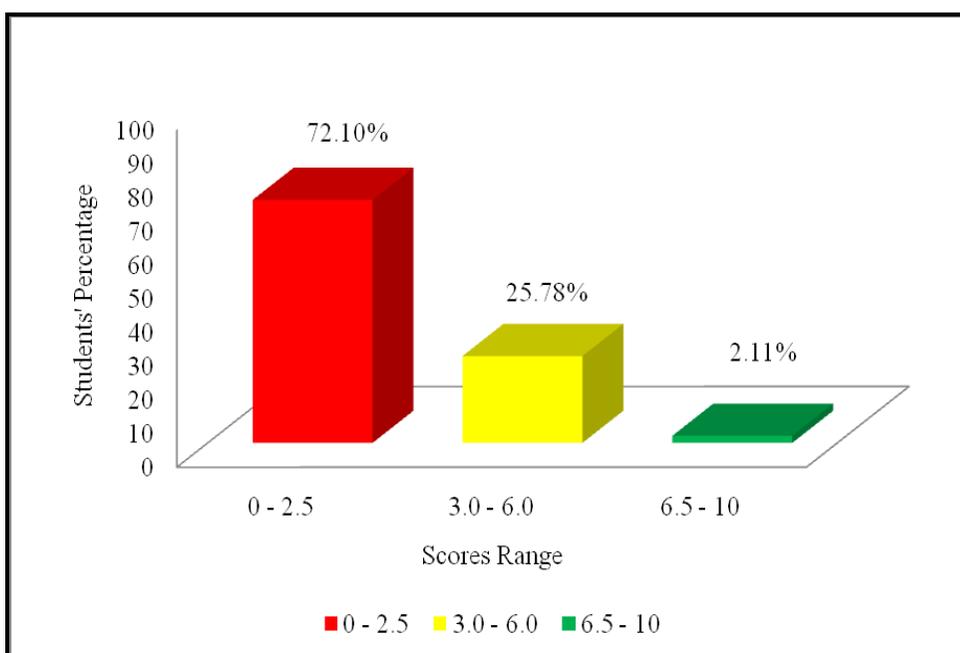
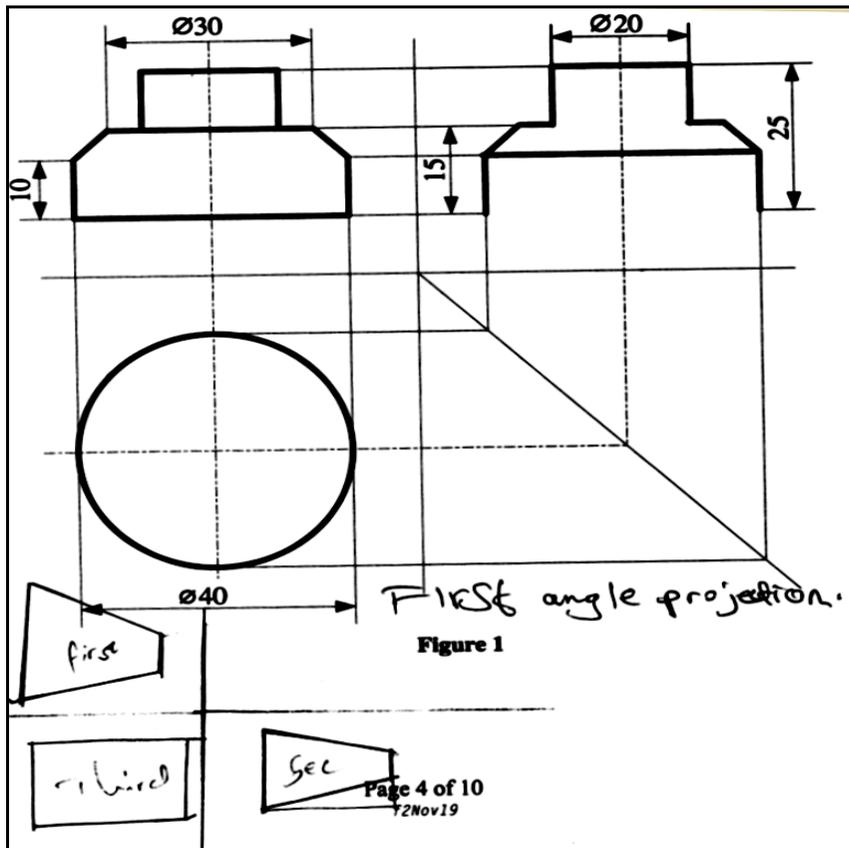


Figure 4: A graph of scores range in terms of percentage of students who did Question 3.

Figure 4 indicates that the students' performance in this question was poor as 72.10 percent scored below 2.5 marks out of 6 allotted marks. These poorly performance was due to unsuccessful of students to identify the correct and incorrect statements.

In part (a), majority of the students who performed poorly failed to draw missed lines. The poor performance in this question was caused by failure of the students to understand the requirements of the question. These

students lacked knowledge and skill on geometrical construction. For example one of the students instead of drawing the missed line, drew symbols of orthographic drawing, as shown in Extract 3.1(a). This indicates that the student didn't to understand the demand of the question. Extract 3.1(a) shows a sample of poor response provided by a student who failed to produce the relevant response in Question 3(a).



Extract 3.1(a) is a sample of poor response provided by student.

In part (b), the students were required to write the application of given types of lines. Most of the students were unable to attempt this correctly question, due to lack of knowledge and skills on the uses and application of various types of line. Extract 3.1 (b) shows a sample of poor response provided by a student who failed to produce the appropriate responses in Question 3(b).

(b) Write one application of each of the following type of lines:

(i) Chain thin double-dashed line 
 Used to show the limit of partial or interrupted views and sections.

(ii) Chain thick line 
 Used to show the limit of partical.

(iii) Continuous thin with zigzag line 
 Used to cutting solid material eg: aluminium.

(iv) Continuous thick line 
 Used to show that is direct to the point.

(v) Dashed thin line 
 Used to control people to over take in the road.

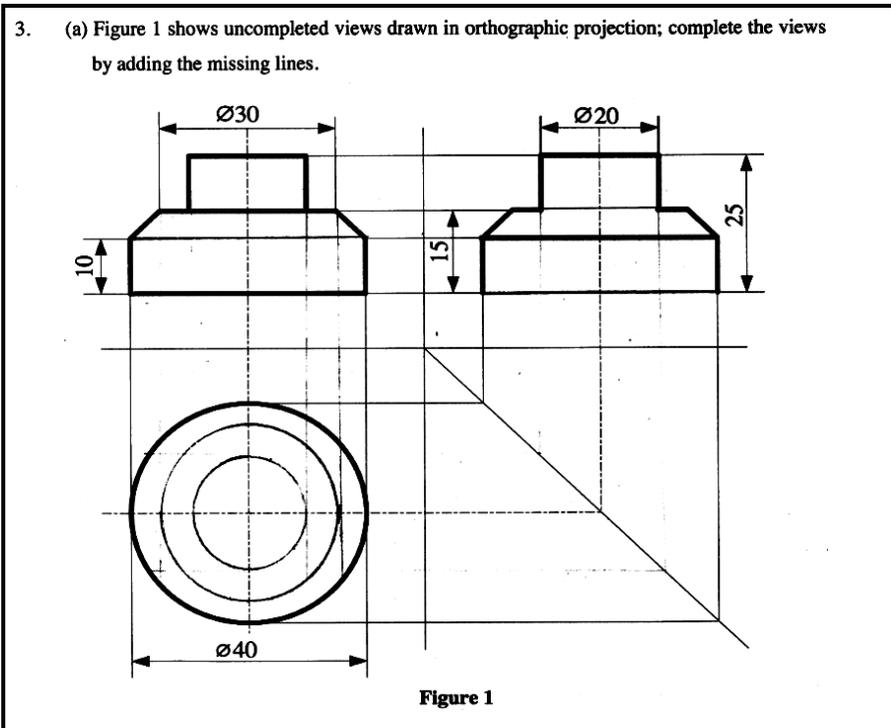
Extract 3.1 (b) is a sample of poor response from a student who failed to produce correct answers.

Extract 3.1 (b) shows sample of response from a student who failed to correctly respond to all items. This implies the student lacked content knowledge about the concepts tested.

The analysis suggests that students with average performance from 3.0 to 6.0 marks had adequate knowledge of the topics and understood a few applications of lines. Further observation reveal that incorrect answer in some of the areas in this question were due to misinterpretation of the views given in part (a). There were five missed lines whereby the students were required to fill; one at Front elevation, two lines at the End elevation and another two at the Plan elevation.

However, there were students who scored from 6.5 to 10 which is a good score range. Some of the students in this category provided correct answers but some of the part of the question were left unanswered. These students

had an adequate knowledge on the subject matter, because they managed to provide correct responses to the question. Others provided correct answers in both parts with one incorrect answer in each part or two incorrect answers in either part. Extract. 3.2 shows a good response provided by a student to the question.



(b) Write one application of each of the following type of lines:

(i) Chain thin double-dashed line 
 The line is used as a centre line.

(ii) Chain thick line 
 The line is used for cutting plane.

(iii) Continuous thin with zigzag line 
 The line is used for cutting of boundaries.

(iv) Continuous thick line 
 The line is used for outline lines.

(v) Dashed thin line 
 The line is used to show the hidden details.

Extract 3.2: A sample of good response from the script of one of the students.

Extract 3.2 shows a sample of response from the student who correctly responded to all items. These responses signify that the student had sufficient knowledge of the concepts tested.

2.1.4 Question 4. Loci and Similar Figure

This question had two (2) parts, (a) and (b) derived from the topic Loci and Similar Figure. Part (a) was from the topic Loci. The question demanded the students to redraw the given square and construct an involute. The question was:

4. (a) Figure 2 show a square ABCD; redraw the given square and construct an involute for that square.

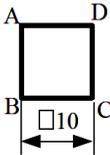


Figure 2

(b) Figure 3 shows an irregular Pentagon ABCDE; reduce it to the ratio of 4:3.

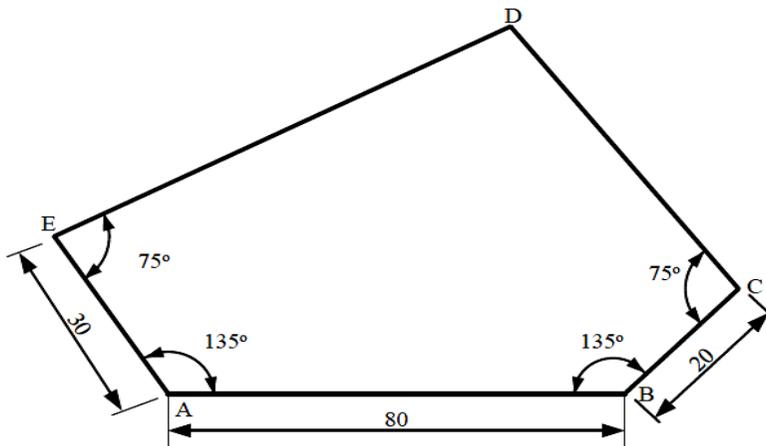


Figure 3

The question intended to measure students' ability to apply knowledge and skills to draw different types of geometrical constructions.

This question was attempted by 1242 (83%) students out of 1489 students. The statistics show that 81.16 percent of students out of those attempted this question scored from 0 to 2.5 marks, 16.18 percent of the students scored from 3.0 to 6.0 marks, and 2.66 percent of the students scored from 6.5 to 10 marks. The students who didn't opt this question is 247, which is equal to 16.6 percent. The general performance was poor because majority (81.16%) of the students scored from 0 to 3.0 marks as illustrated in Figure 5.

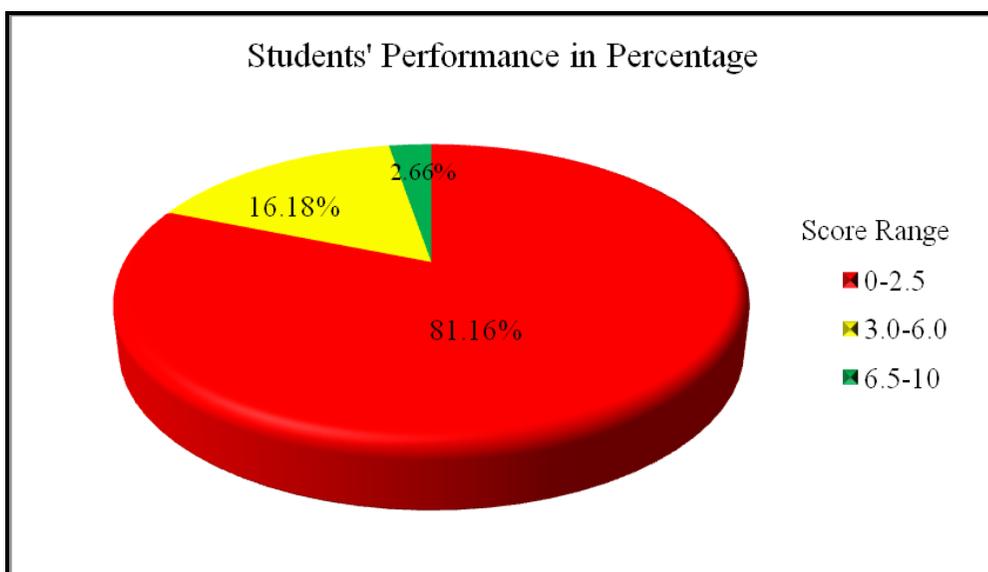


Figure 5: The range of scores in terms of percentage for students who attempted Question 4.

Figure 5 shows that the students' performance in this question was poor since 81.16 percent scored below 2.5 marks. The poor performance in this question was due to failure of the students to understand the requirement of the question. Most of them provided irrelevant answers. For example, part (a) required the students to redraw the given square and use the sides to construct an involute. Some of the students failed to use the side and proper methods to redraw and prolong the side of the given square to get radius. They even failed to redraw the given square. This suggests that the students lacked the skill on how to draw loci.

In part (b), students were required to reduce the irregular Pentagon to the ratio of 4:3. Majority of the students either failed to understand what the question wanted them to do or lacked knowledge on the subject matter.

Further analysis revealed that most of students who attempted this question lacked knowledge on the different methods of constructing Loci and Similar figures. They had no concept on how to apply epicycloid method to construct a locus, also using scale to reduce the figures. Extracts 4.1(a) and 4.1(b) show a sample of poor response by a student who provided a drawing which does not match the demand of the question and the response was taken from the student script.

4. (a) Figure 2 show a square ABCD; redraw the given square and construct an involute for that square.

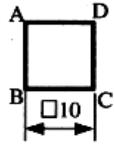
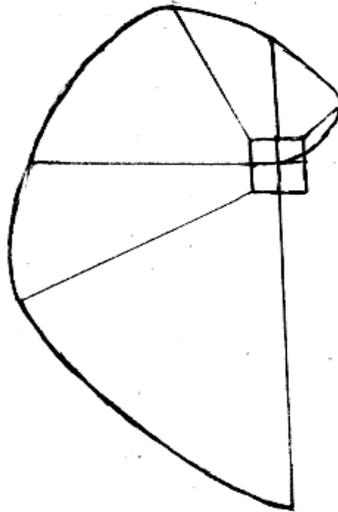
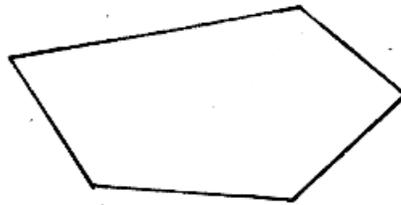
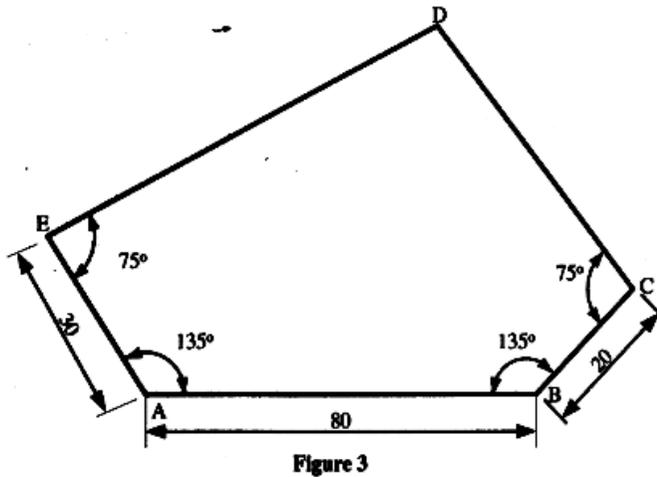


Figure 2



Extract 4:1(a) is a sample of poor response from a student who provided incorrect answer.

(b) Figure 3 shows an irregular Pentagon ABCDE; reduce it to the ratio of 4:3.



Extract 4.1(b) is a poor response by a student who provided a drawing which does not relate to the demand of the question.

The extract 4.1(a & b) shows a sample of students who failed to respond correctly to the Question 4. For example, in part (a) he/she copied the given sketch without showing the methods used. This prohibited that they lacked knowledge and skill for topic of Loci and Similar figure.

Nevertheless, 3.4 percent of students scored from 6.5 to 10 marks. These students drew a completed locus and reduced the polygon to the required ratio. Others attempted partially some parts of the question and followed the principle of Similar area and Loci mechanism. Students in this category were knowledgeable of cycloid locus from other methods of constructing a locus and principle of reducing and enlargement of similar figures. Those who scored higher marks mastered well the topic of Loci and Similar figures as illustrated in Extracts 4.2 (a) and 4.2 (b).

4. (a) Figure 2 show a square ABCD; redraw the given square and construct an involute for that square.

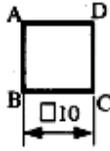
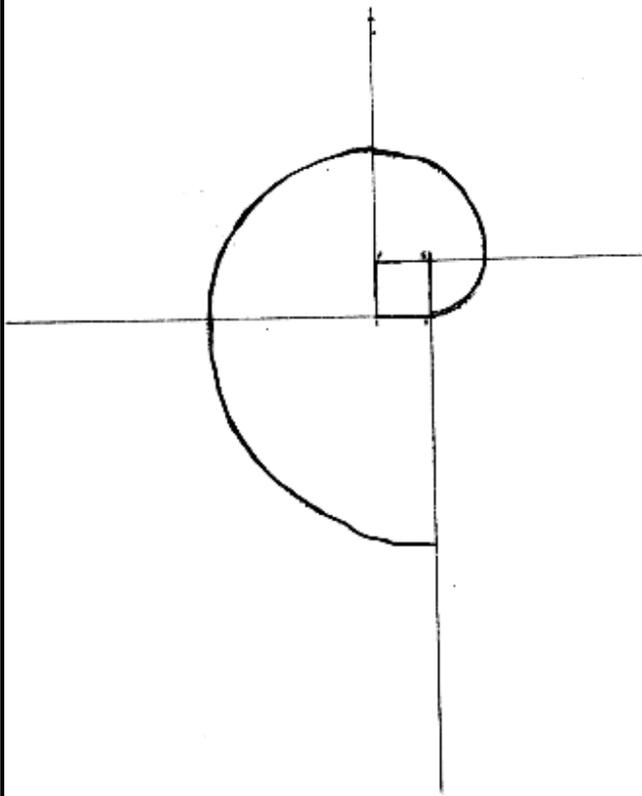
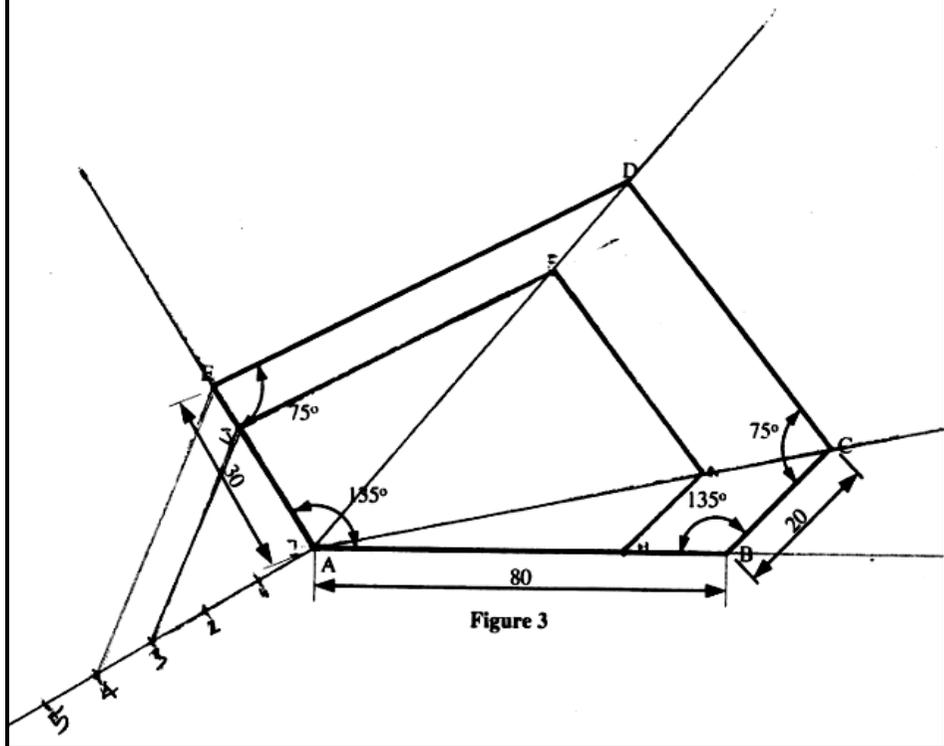


Figure 2



Extract 4.2(a) is a good response from one of the students.

(b) Figure 3 shows an irregular Pentagon ABCDE; reduce it to the ratio of 4:3.



Extract 4.2 (b) is a good response from one of the students.

Extracts 4.2 9 (a&b) shows correct responses from a student who had sufficient knowledge and skill of the concepts tested under the topic of Loci and similar figure.

2.2 SECTION B: OPTION QUESTIONS

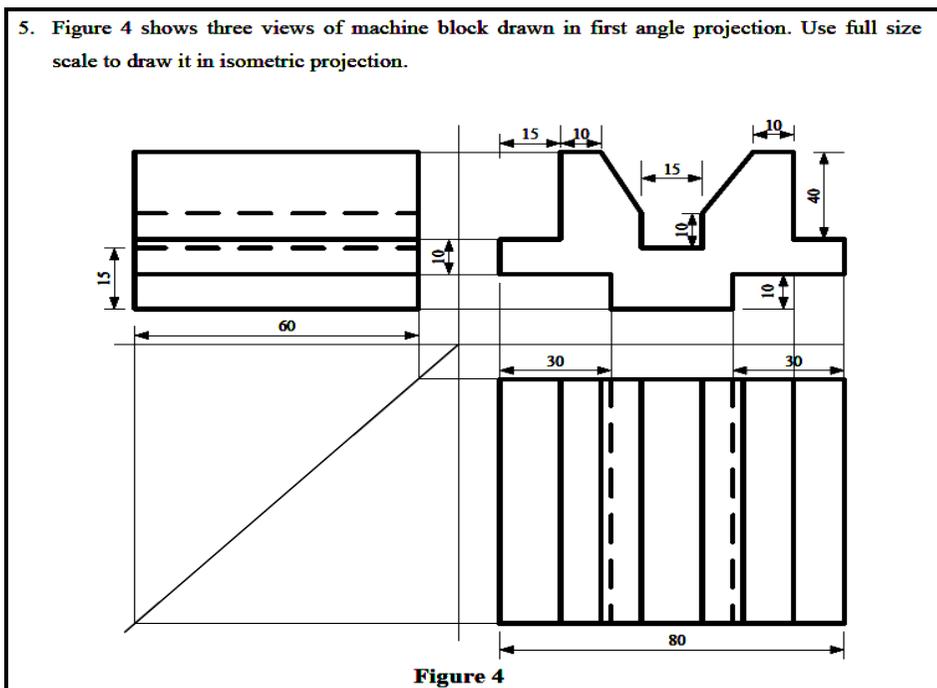
Section B had three (3) questions set from topics of Orthographic drawing, Pictorial drawing, Auxiliary views and Loci mechanisms. Students were instructed to answer only two (2) questions. Each question carried thirty (30) marks, making a total of sixty (60) marks.

ANALYSIS OF THE QUESTIONS

The analysis of performance for students in this section was categorised in the following score ranges from 0 to 29 percent which are 0 to 8.5 marked out of 30 marked as unsatisfactory, 30 to 64 percent which are 9 to 19.0 marks as average and 65 to 100 percent which are 19.5 to 30 marked as good.

2.2.1 Question 5: Auxiliary Views

This question was set from the topic Orthographic projection. The students were required to convert the views drawn in Orthographic projection (first angle projection) to pictorial drawing (Isometric projection). The question was:



This question was opted by 970 (65%) of students out of 1485 sat for examination. The question demanded the students to use full size scale to convert the orthographic views into pictorial drawing (Isometric projection).

The statistics show that 551(56.80%) students out of those attempted this question scored from 0 to 8.5 marks which is unsatisfactory. 217 (22.37%) students scored from 9 to 19.0 marks, which was average score and 202 (19.05%) students scored from 19.5 to 30 marks which was termed as good performance. The general performance of this question was average, where about 43.20% scored from 9 to 30 marks. Figure 6 show scores of students in this question.

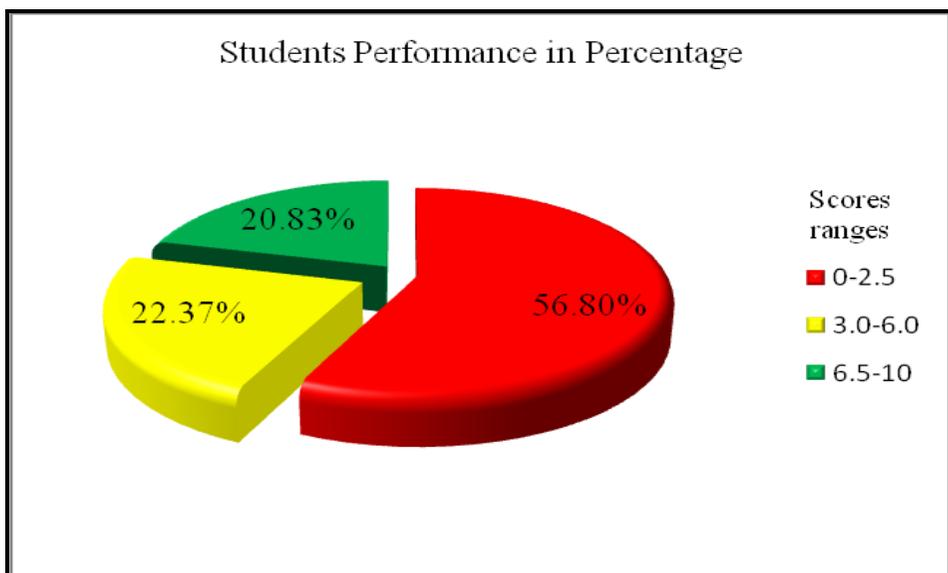
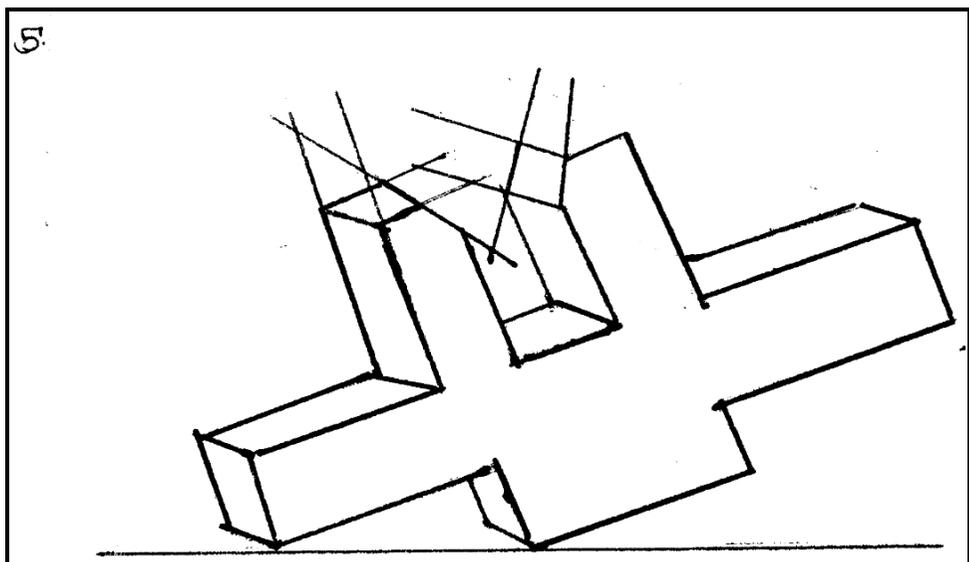


Figure 6: General student's performance in Question 5.

Figure 6 shows that the analysis of students performance in this question was average since 43.2 percent of the students scored 30 percent and above of the 30 marks allocated to this question. According to the analysis, poor performance of the students' in this question was due to the students' inability to understand the demand of the question. For example, one students draw the object in pictorial projection, but failed to consider dimensions, angle of that project as well as the visibility of the objects. This student failed to interpret the of demand the question. The question required to use Isometric projection where drawing angle of their axis is

30° for both direction with datum line, while the students used less than required angle and only in one direction.

Further analysis shows that, 56.80 percent scored from 0 to 9 marks. The majority failure in this question indicates that students lacked knowledge of steps on drawing pictorial views. For example, they didn't identify the angle of projection and differentiate the methods of constructing isometric boxes as the first step. Also most of the students, didn't even construct paper layout. Extract 5.1 illustrates the samples of responses of students who failed to attempt the Question 5.

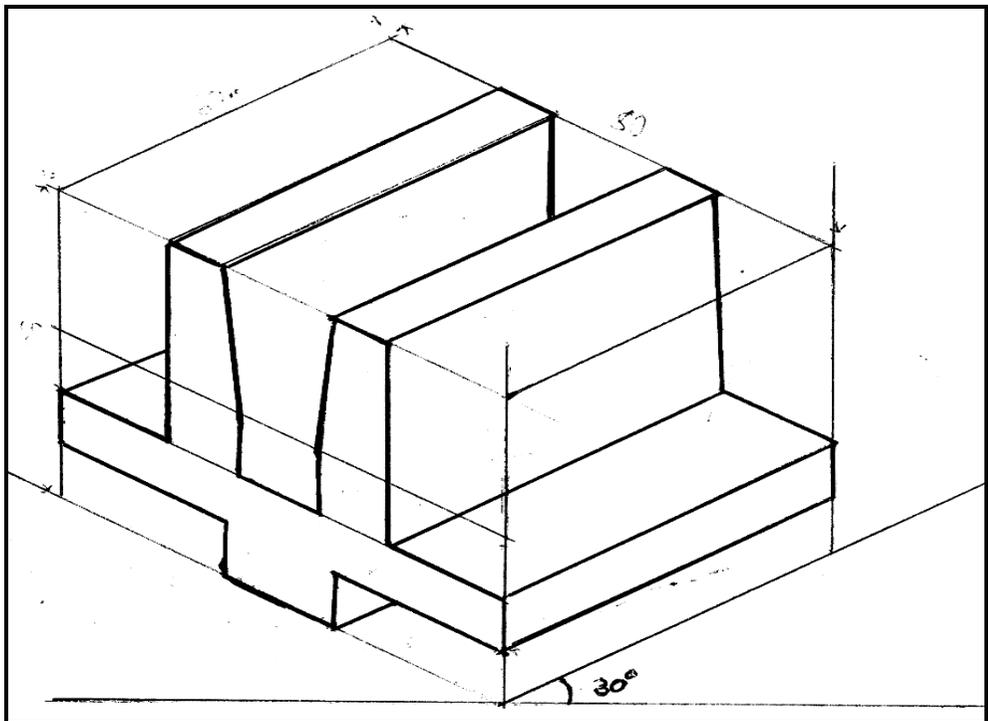


Extract 5.1 is a sample of poor responses from one of the students.

On the other hand, the students who scored from 9 to 19 marks had partly understood the requirements of the question and the subject matter tested. This group of students didn't managed draw exactly all the given views in isometric projection or managed to draw part of the question and paper layout but failed to complete the task.

On top of that, students with a good score marks (20.83%) were those who provided irrelevant responses contrary to the requirements of the questions. These students were managed to apply enough knowledge of the topic and had clear understanding of the demands of the question, thus providing appropriate answer.

The analysis of the students' responses indicates that students who scored high marks (19.5 to 30) understood the demand of the question and had adequate knowledge of the subject matter as they managed to draw relevant responses of question. The good performance of the students in this question was possibly due to the fact that most of the students are familiar with converting Orthographic projections to Isometric views, hence they were able to apply the knowledge and skill in answering the question. Extract 5.2 the samples of responses of students with good performance for Question 5.

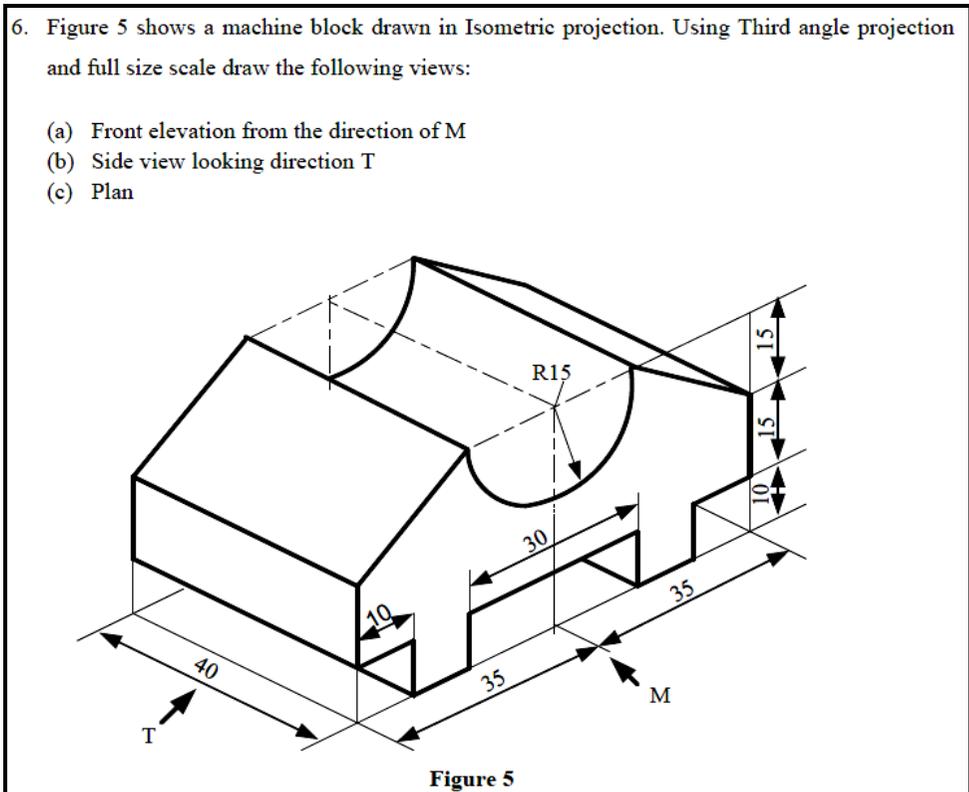


Extract 5.2 is a sample of a response from the students who was able to construct isometric view.

Extract 5.2 exhibits a sample of responses from the student who converted orthographic views to pictorial view. She/he managed to draw correctly the block and hence scored higher marks.

2.2.2 Question 6: Orthographic Projection.

Question 6 was set from the topic called Orthographic Projection. In this question students were required to convert the three views which were given in third angle projection to the isometric projection. The question was:



The question was attempted by 1,113 which is 75 percents of the students who sat for this examination, of whom 557 (50.04%) students scored from 0 to 8.5 marks of whom 168 (11.3%) students scored zero. 344 (30.91%) scored from 9.0 to 19.0 marks, and 212 (19.05%) students scored from 19.5 to 30 marks. The performance in this question was average as 49.96 percent of all the students scored 9.0 and above marks out of the 30 allotted marks in this question. The performance is summarized in Figure 7.

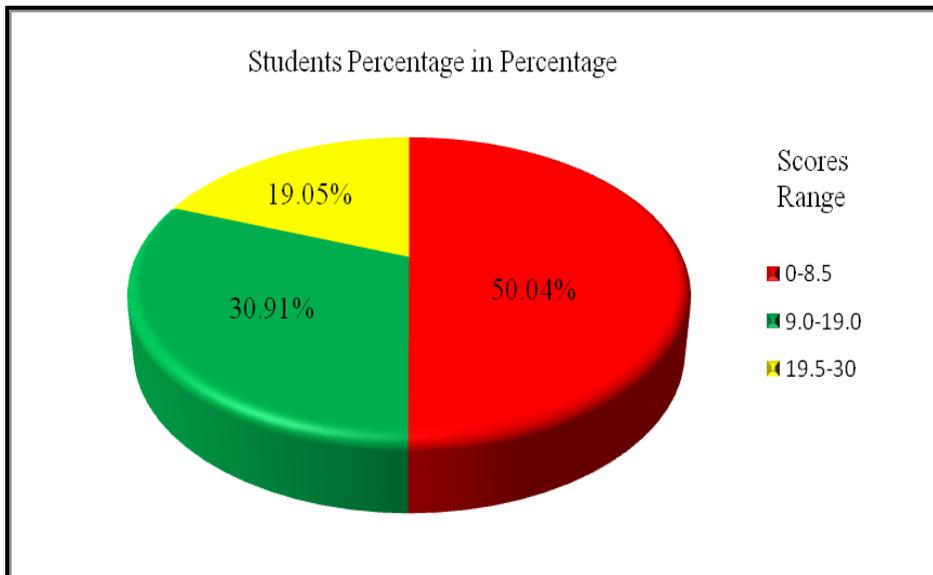
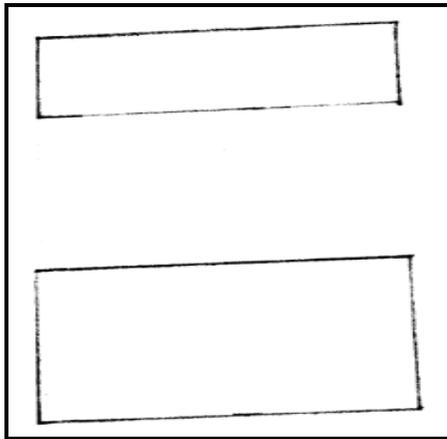


Figure 7: *Percentage of the Students' Performance in Question 6*

Figure 7 shows that the analysis of students performance in this question was good since 49.96 percent of the students scored 30 percent or above of the 30 marks allocated to this question.

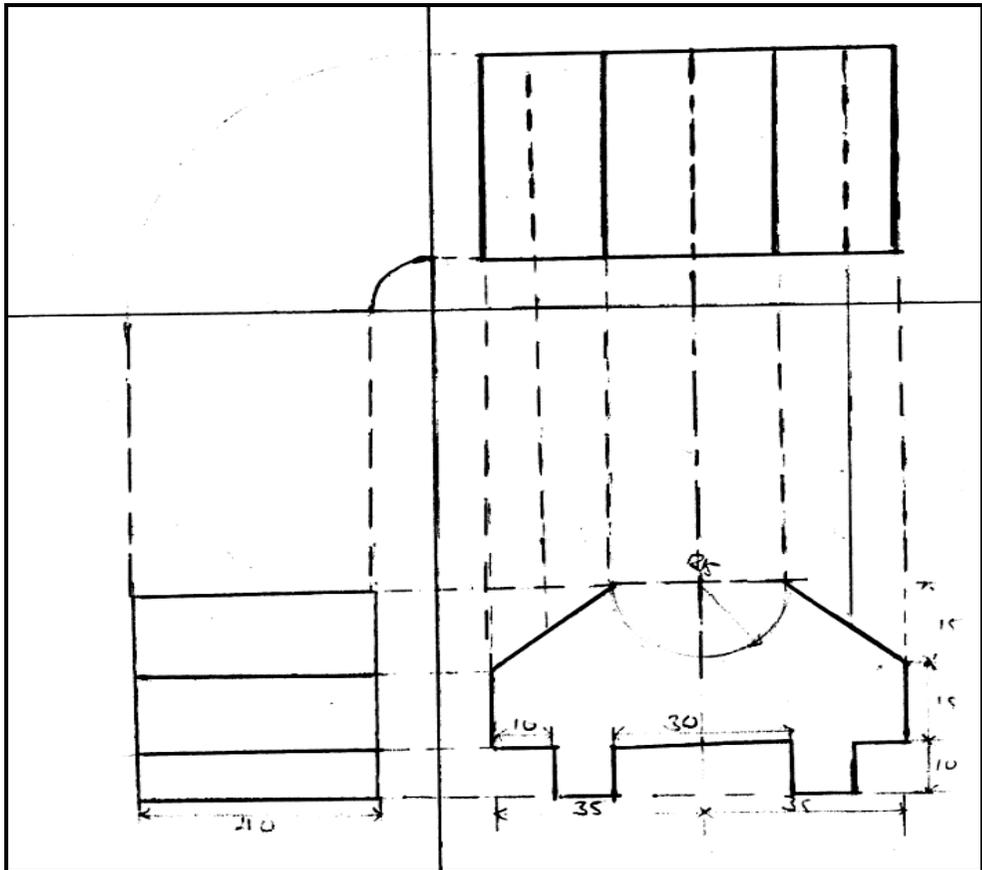
The Students item performance analysis shows that the students (50.04%) who scored poorly in the question either did not cover well the topic or lacked a skills related to the topic. The students who scored 0 mark lacked sufficient skills on drawing and converting orthographic views to pictorial drawing. Moreover, they failed to realise the steps of construct an isometric projection by drawing construction lines or paper layout. For example one student demonstrated poor mastery by drawing only two boxes without consideration of dimensions, construction lines and the paper layout as starting points on drawing as illustrated in extract 6.1.



Extract 6.1 is a sample of poor orthographic projection from one of the students for question 6(a).

Further analysis indicates that, most of the students (30.91%) with average performance in this question attempt few parts of the question, but failed to complete the requirements of the question. These student lacked knowledge of orthographic projection. They failed to draw the third angle projection and drawing views in their relative positions. As a result they scored low marks (9.5 to 19) out of 30 marks allocated in this question. For example one of students misinterpreted the question by mixing the steps of drawing views in third angle with first angle projection, such steps are types of lines; instead of using construction lines which are thin and invisible he/she use dashed lines also she/he indicates dimensions in drawings which are not required.

On the other hand, a few students (19.05%) who had adequate knowledge on the concept of drawing performed well in this question. They were able to provide correct responses of the question by drawing the views in correct side and use the required steps. These students were also able to understand that in first angle projection for the views to be drawn in their relative positions, the plan should come side is drawn to the right or left side of elevation. Extract 6:2 shows a sample of a response from the student who managed draw the views correctly.



Extract 6.2: Good response from one of the students who answered this question.

2.2.3 Question 7. Loci and Auxiliary

The question consisted of two parts. Part (a) was extracted from topic Loci, the students were required to trace the locus of a point when given a link hinged at a point and fixed at the end. The link was moved on guide and required to make a complete revolution. For part (b) the question was composed from topic Auxiliary. The students were required to use full size scale and third angle to convert the views drawn from first angle projection into an auxiliary projections at an angle of 45° . The question was:

7. (a) The link mechanism of machine is given in Figure 6. Construct a locus of point C when point B of crank BD is hinged at point D making one complete revolution while point A is oscillating on the guide. Given that:

$$AB = 192$$

$$BC = 100$$

$$BD = 75$$

$$AD = 80$$

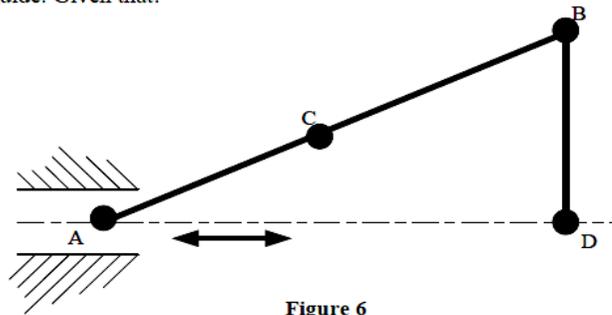


Figure 6

- (b) Figure 7 shows two views of Machine parts in first angle projection. Using full size scale and third angle projection, draw an auxiliary view of the plan to the angle of 45° .

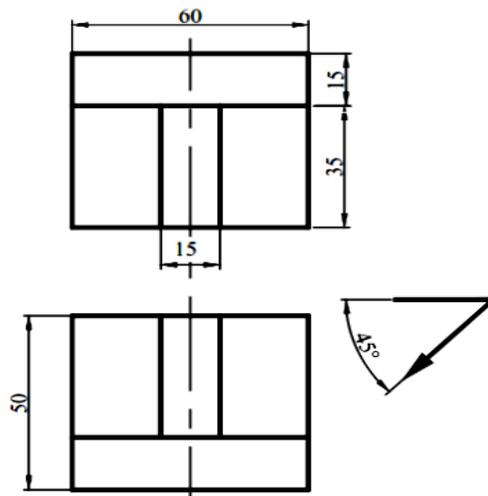


Figure 7

A total of 26.4 percent of the students attempted this question, out of which 84.73 percent scored from 0 to 8.5 marks, 14.50 percent scored from 9.0 to 19.0 marks, and 0.76 percent scored from 19.5 to 30 marks. These scores show that the overall performance in this question was poor as only 84.73 percent performed poorly in the question. These scores imply that the students' performance in this question was poor since 84.73 percent of them scored 0 to 8.5 marks. Figure 8 show the students' performance in this question.

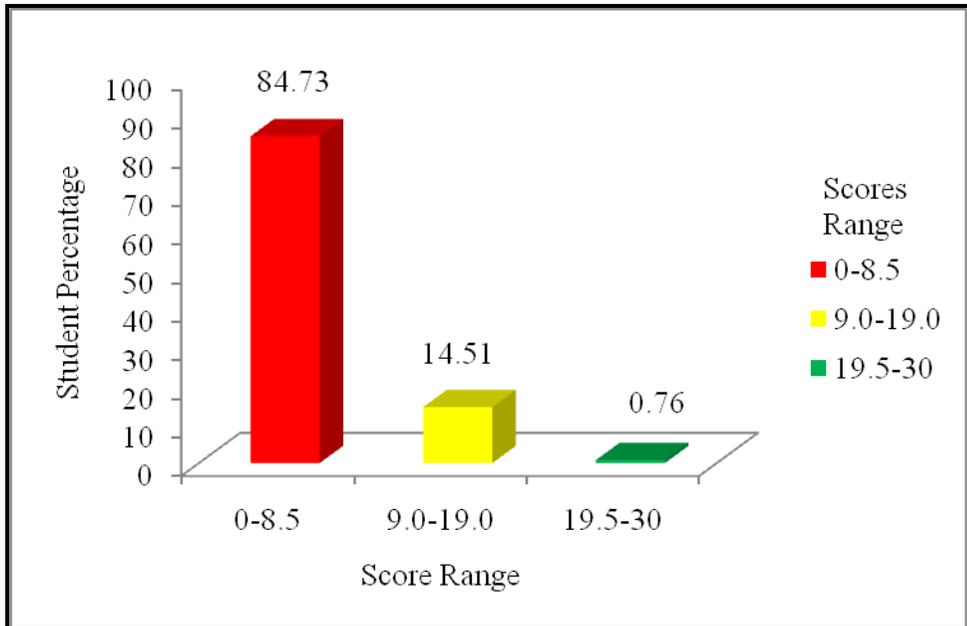
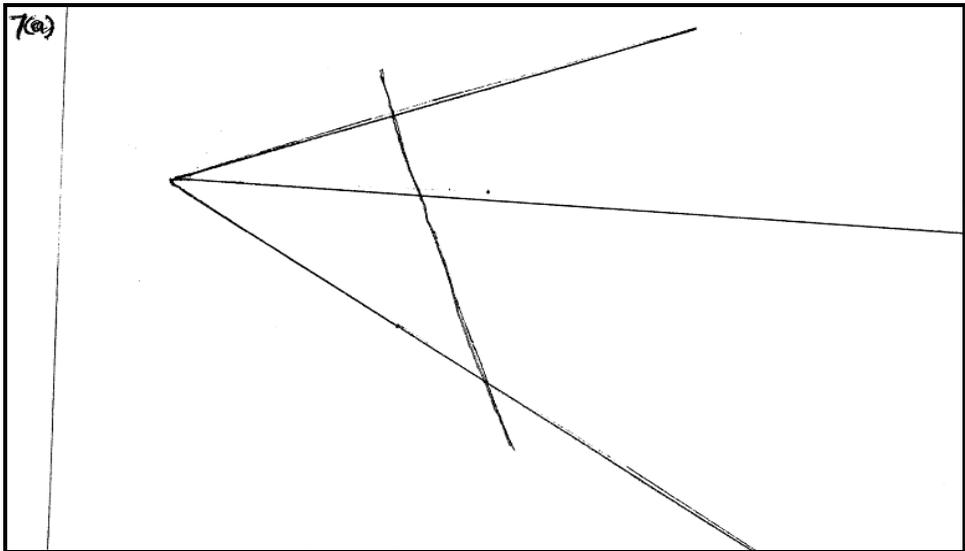


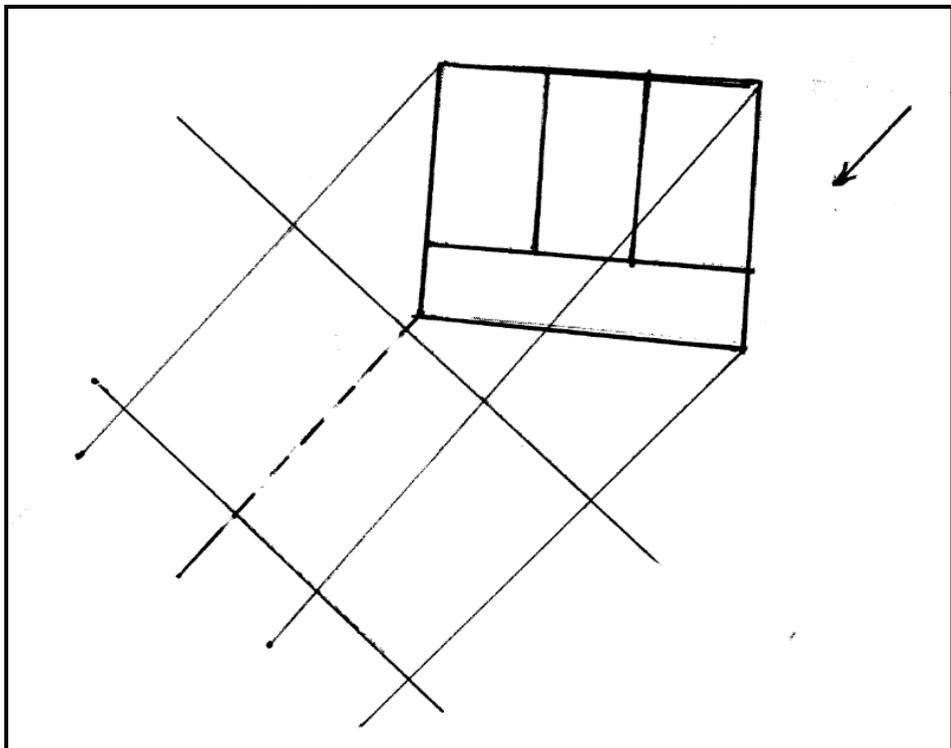
Figure 8: A graph of score range in terms of percentage of students who did Question 7.

Figure 8 shows that the students' performance in this question was weak since 84.73 percent scored below 30 percents of 30 marks allocated to this question.

The analysis show that (84.73%) students scored from 0 to 8.5 marks. These performance suggests that most of them had insufficient knowledge on topics of Loci and auxiliary. For example, in part (a) some students managed to draw lines as drawing triangle but failed to follow the steps on drawing loci by tracing the points. Meanwhile, other student try to attempt part (b) but failed to show other parts of the views. Therefore, likely she/he copied the sketch and adding the projection lines, while the task was to convert from first angle projection to third angle projection and also to add the auxiliary view. This indicate that the students did not understand the steps to be followed in drawing loci mechanisms and auxiliary views. Extract 7.1(a) and 7.1(b) show a sample response from a script of one student who scored poorly in this part.



Extract 7.1a: Poor response from a student who answered question 7(a).

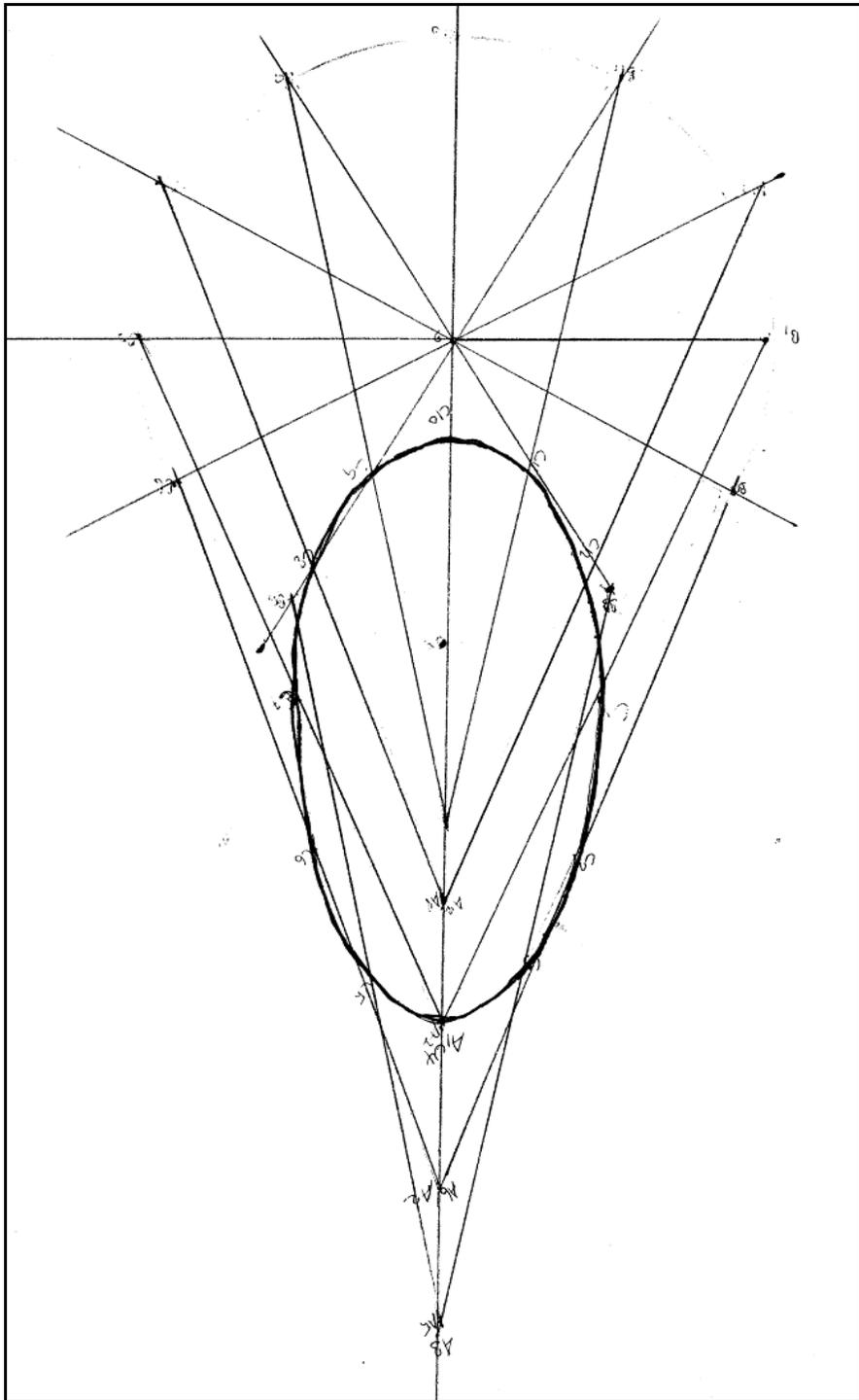


Extract 7.1b: Poor response from a student who answered question 7(b).

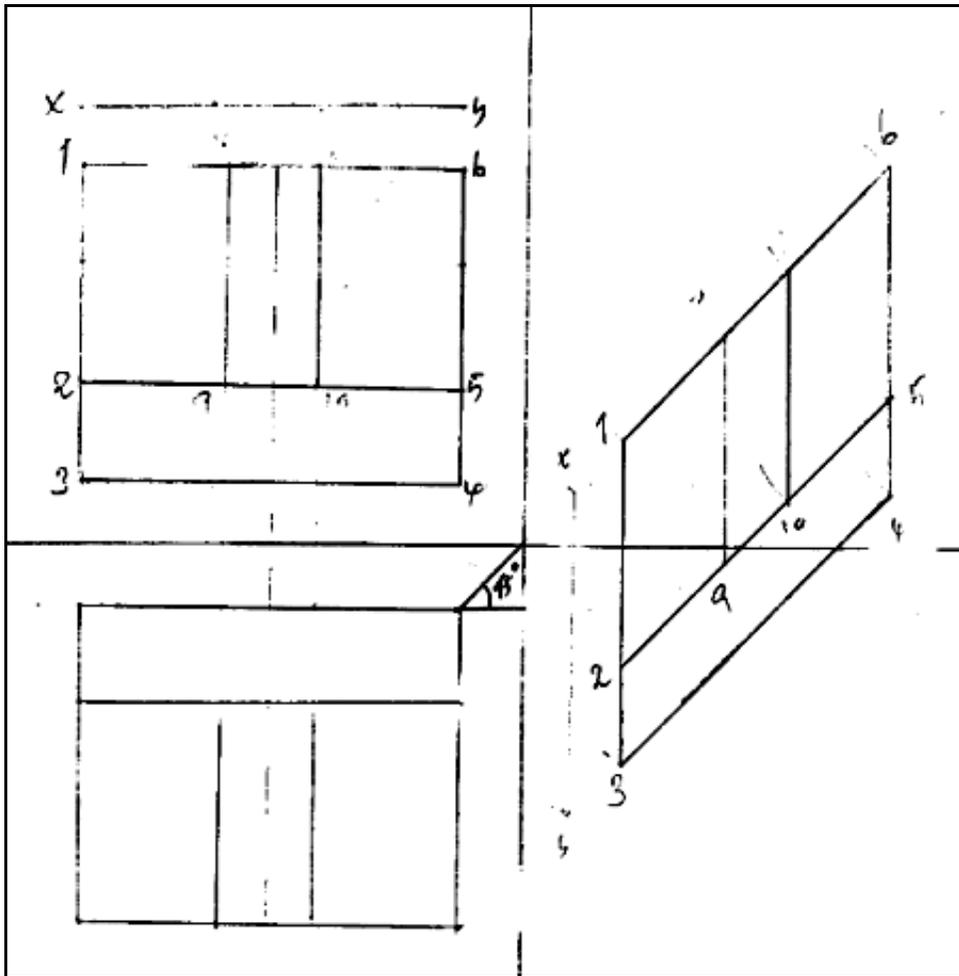
Extract 7.1 (a&b) shows the response of a student who failed to draw Loci movement of crank mechanisms and auxiliary views.

Moreover, 57 students (4%) scored from 9 to 19.0 marks. These students managed to attempt down some parts of the question but failed to complete task. The candidates in this category successfully recalled the importance steps on drawing loci and auxiliary views.

Furthermore, 3 students (0.76%) scored from 19.5 to 30 marks. Most of the students missed marks as they failed to complete some of the parts or skipped some of the steps. For instance, they were able to trace the loci mechanisms of link and convert the orthographic views from the first angle to the third angle, but missed some steps either they erase construction lines or failing to show the visibility of the views. For example, one student provided correct answer for part (a) but failed in part (b) only to transposed the orthographic views to third angle by leaves the plane on top instead of leaving it at the bottom of front view as indicated in extract 7.2 (a&b). These students had knowledge of loci mechanism and orthographic projection. Extract 7.2 (a&b) are a samples of good response from one of students who managed to interpret the task of the question.



Extract 7.2 (a) is a good response from one of the students who attempted Question 7(a)



Extract 7.2 (b) is a good response from one of the students who attempted Question 7(b)

3.0 CONCLUSION

On the basis of the students' response analysis in each question, it can be concluded that the overall performance in Technical Drawing subject for the form Two National Assessment (FTNA) in 2019 was average. That is, 34.88 percent of students passed the easement. This is justified by the fact that performed 84 percent of the students who sat for the examination was below average (*Appendix C*). The majority of the students had good and average performance in four (4) questions and weak performance in three (3) questions. This is justified in *Appendix A*. However, most of students had relatively poor performance in short answered questions (Multiple choice, Filling the blanks and True or False) than drawing questions (Structured question). This show that most of students lacked knowledge and skill in drawing techniques. Therefore, students are encouraged to work hard, think critically and do more practice knowing that Technical Drawing is the language of Engineering.

The analysis of students' performance shows that, the poor performance of students was observed in Questions 3, 4 and 7. Whereby 72.12 percent, 81.16 percent and 84.74 percent respectively attempted these questions scored from 0 to 30 percent of score ranges. These questions were set from Orthographic projection, Lines, Geometrical Construction in Plane figure, Loci and Auxiliary (*Appendix A*). Poor responses of the students was contributed by following factors:

- (a) Students' lack of enough exercises and revisions on the topics tested.
- (b) Inattention of some students in putting important efforts in their studies.
- (c) Follow the instructions and demands of the question matters.
- (d) Lack of skill in attempting drawing questions and applications of drawing tools.
- (e) Low concentration of the students in the subject also teachers un-follow the requirement of the syllabus and examination format also is the another reasons of poor performance.

4.0 RECOMMENDATIONS

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

4.1 Syllabus Covered

- (a) Teachers should guide the students to work hard to master Technical drawing concepts involving drawing skills since it is noted that they failed to associate on attempting structural questions.
- (b) Since Technical Drawing is the Engineering language, students should be guided to acquire this knowledge in order to improve their technical communication and solve technical drawings problems.
- (c) Teachers are advised to provide structural questions and relevant techniques to students in order to make them familiar and adding more skills as an approach on tackling the relevant questions.
- (d) Teachers are advised to adhere to the principles of conducting competence based continuous assessments in teaching and learning process. This will help them to ensure that the objectives are assessed and individual students are continually assessed to get evidences of what they understood and what they do not, hence enabling tutors to take actions.
- (e) Students should work hard in learning drawing skills so that they can be able to solve problems which include draw various structural questions.

4.2 Technical Professional Personnel

To enhance the industrial revolution manpower, the government through responsible ministry should ensure the availability of Technical professional personnel in Technical secondary schools. This will impart technical knowledge and skills to the students. This will help to produce the competent students who at the end of their course will be able to mitigate the industry labour problem.

Appendix A

Table 9: A summary of students performance (Question-wise) in Technical Drawing examination 2019.

S/N	Topics	Question Number	Percentage of Students who Scored 30% or more	Remarks
1	Loci, Dimensions, Lines, Similar figure, Equal area, Orthographic projection, Pictorial drawing, Geometrical construction and Free hand sketch	2	97.72	Good
2	Loci, Lettering, Equal area, Scales , Lines, Dimensions, free hand sketch and Auxiliary	1	60.44	Average
3	Orthographic Projection	6	49.96	Average
4	Pictorial Drawing	5	43.19	Average
5	Orthographic projection and Lines.	3	27.88	Unsatisfactory
6	Geometrical construction in Plane figure	4	18.84	Unsatisfactory
7	Loci and Auxiliary	7	15.27	Unsatisfactory

Table 10: Description of students' performance in each question.

DESCRIPTION	Qn1	Qn2	Qn3	Qn4	Qn 5	Qn6	Qn7
Unsatisfactory	589	34	1057	1008	551	557	333
Average	890	996	378	201	217	344	57
Good	10	458	31	33	202	212	3
TOTAL	1489	1488	1466	1242	1034	1113	393

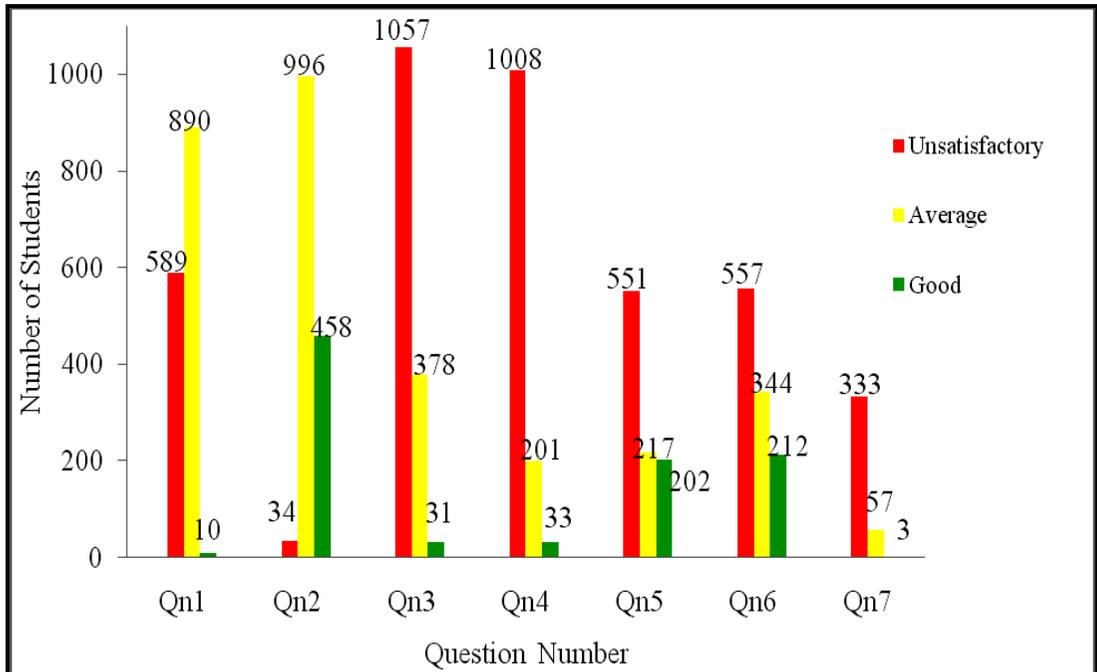


Figure 9: Performance of the students in Technical Drawing per question wise

Table 11: Table shows the overall performance of marks scored by students versus percentage

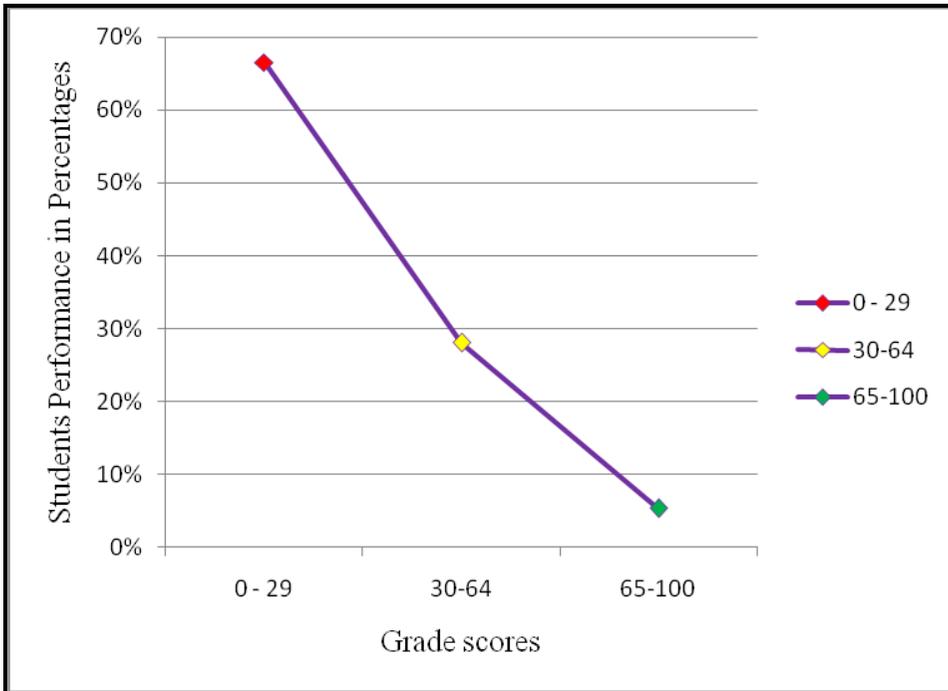


Figure 10: Trends of Grade scored by students versus Performance in percentage

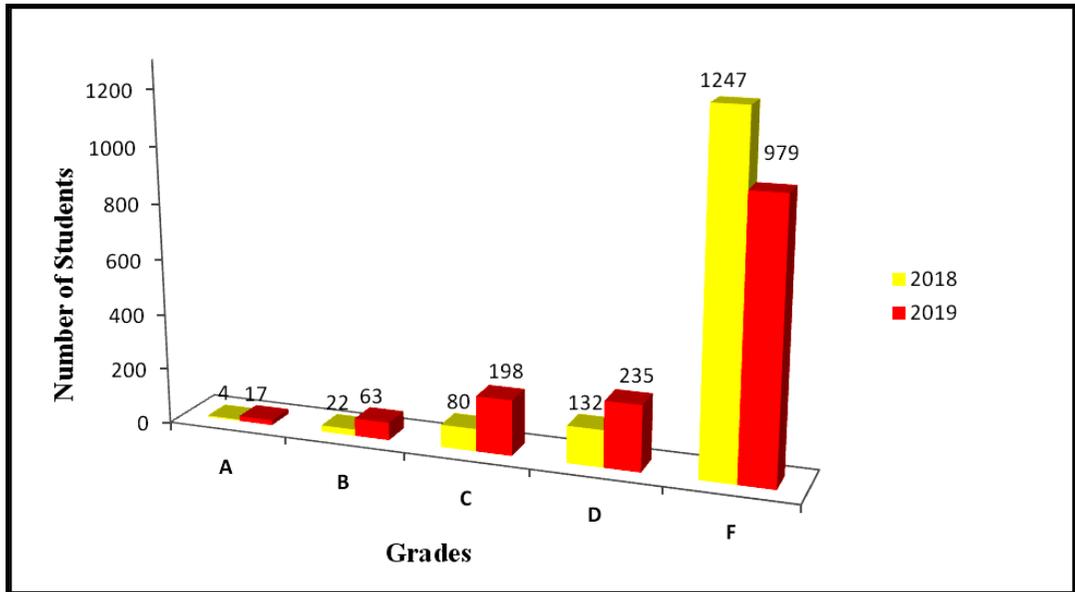


Figure 11: A comparisons of students' performance in grade-wise for the 2018 and 2019

