Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION 2008

TECHNICAL GRAPHICS

ORDINARY LEVEL CHIEF EXAMINER'S REPORT

HIGHER LEVEL CHIEF EXAMINER'S REPORT

CONTENTS

1. General Introduction

1.1 The Syllabus

The syllabus for Technical Graphics was first examined in 1994 and a revision of this syllabus is currently being conducted under the aegis of the NCCA. It is hoped to align the revised syllabus more closely with the new syllabus in Design and Communication Graphics at Leaving Certificate.

The current syllabus for Technical Graphics is available on the website of the Department of Education and Science (www.education.ie) in the section headed 'Curriculum, Syllabus & Teaching Guides'.

1.2 The Examination

Technical Graphics at Junior Certificate level is examined at two levels – Ordinary and Higher. At both levels, the examination paper comprises two Sections; Section A and Section B.

Section A

At both levels, Section A consists of a returnable booklet with fifteen short-answer questions of which the candidate is required to attempt ten. Section A has a mark allocation of 120 marks out of an overall total of 400 marks.

Section B

Section B consists of six long questions from which candidates are required to answer four. Candidates answer the questions from Section B on standard drawing paper and using standard drawing equipment of drawing board, tee square and set squares etc. In all questions, marks are specifically awarded for the drawing skills of accuracy, neatness and draughting. Section B has a mark allocation of 280 marks out of an overall total of 400 marks.

Duration of examination

The examination at Ordinary Level is 2.5 hours duration while Higher Level is 3 hours duration.

1.3 Candidature

There has been a decline in the uptake of Technical Graphics over the past six years, as shown in the following tables:

Year	Total Junior Certificate Candidature	Technical Graphics Candidature
2003	59,635	13,333
2004	57,074	12,488
2005	56791	12,358
2006	57,946	12,743
2007	57395	12,149
2008	56,073	11,850

Table 1: Total candidature - Technical Graphics 2003-2008

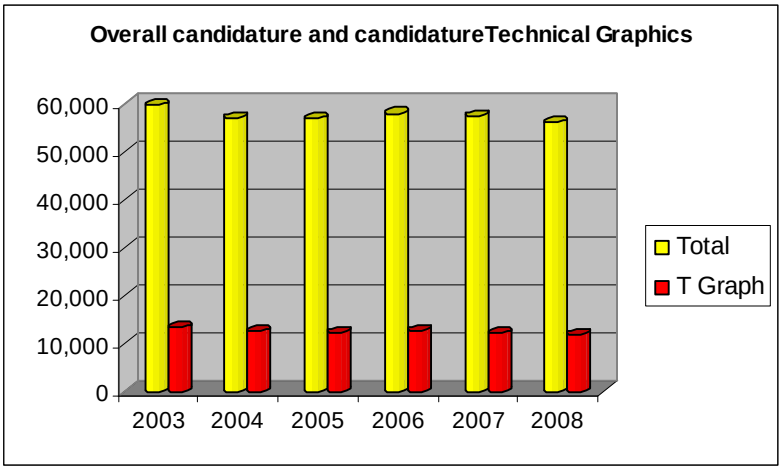


Table 2: Candidature Technical Graphics as percentage of total candidature 2003 – 2008

Candidate choice of level

The following table and graph show the percentage of candidates taking Technical Graphics at each level from 2003 to 2008 inclusive.

	% taking Higher Level	% taking Ordinary Level
2003	56.0	44.0
2004	56.7	43.3
2005	56.3	43.7
2006	58.1	41.9
2007	60.9	39.1
2008	62.0	38.0

Table 3: Percentage of candidates taking Technical Graphics at each level

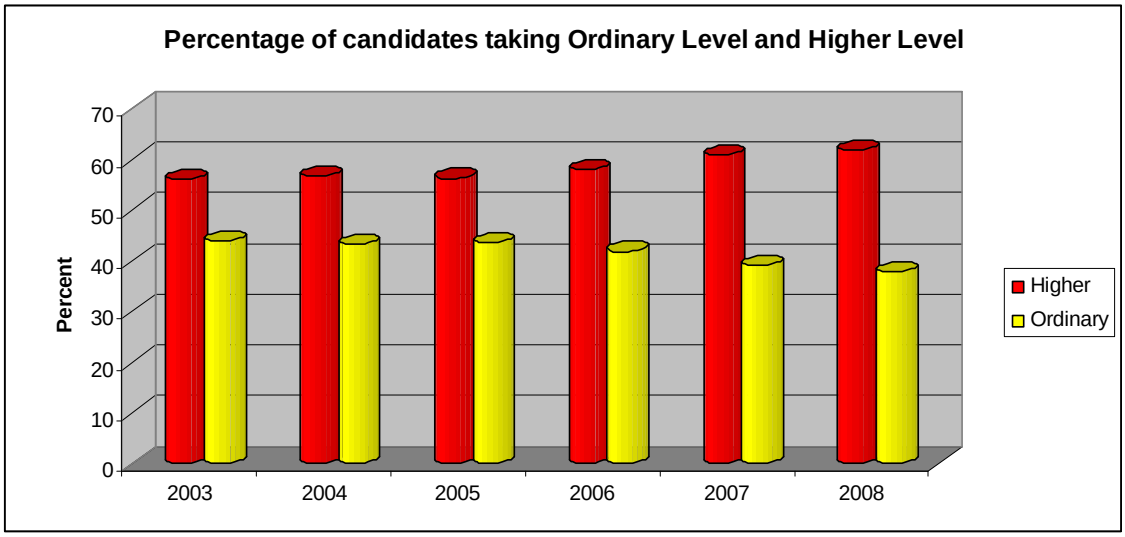


Table 4: Graph showing percentage taking Ordinary and Higher Level Technical Graphics 2003-2008

As can be seen from the graph, there is a steady increase in the percentage of candidates taking Technical Graphics at Higher Level. This increase of 6% from 2003 to 2008 in

the number of candidates taking Higher Level is welcomed as the percentage of candidates taking the Higher Level in Technical Graphics has been traditionally low when compared to other subjects at Junior Certificate level. Examiners also noted that on the evidence of candidate responses, some candidates who sat the examination at Ordinary Level would be capable of taking the examinations at Higher Level. It is recommended that teachers encourage students to prepare and present for the level of examination most appropriate to their underlying level of ability.

Uptake of Technical Graphics by Gender

The following graph shows the uptake of Technical Graphics by gender from 2003 to 2008 inclusive. As can be seen the uptake has remained fairly consistent. As some 13% of the candidature is female, boys outnumber girls by a ratio of about 7:1. To help reduce gender stereotyping, it is recommended that more females be encouraged to study Technical Graphics. An analysis of results shows that females achieve higher grades than males at Higher Level and perform slightly lower than males at Ordinary Level.

	2003	2004	2005	2006	2007	2008
Female	1593	1640	1481	1559	1652	1643
Male	11794	10854	10906	11205	10498	10207

Table 5: Uptake of Technical Graphics by gender 2003-2008

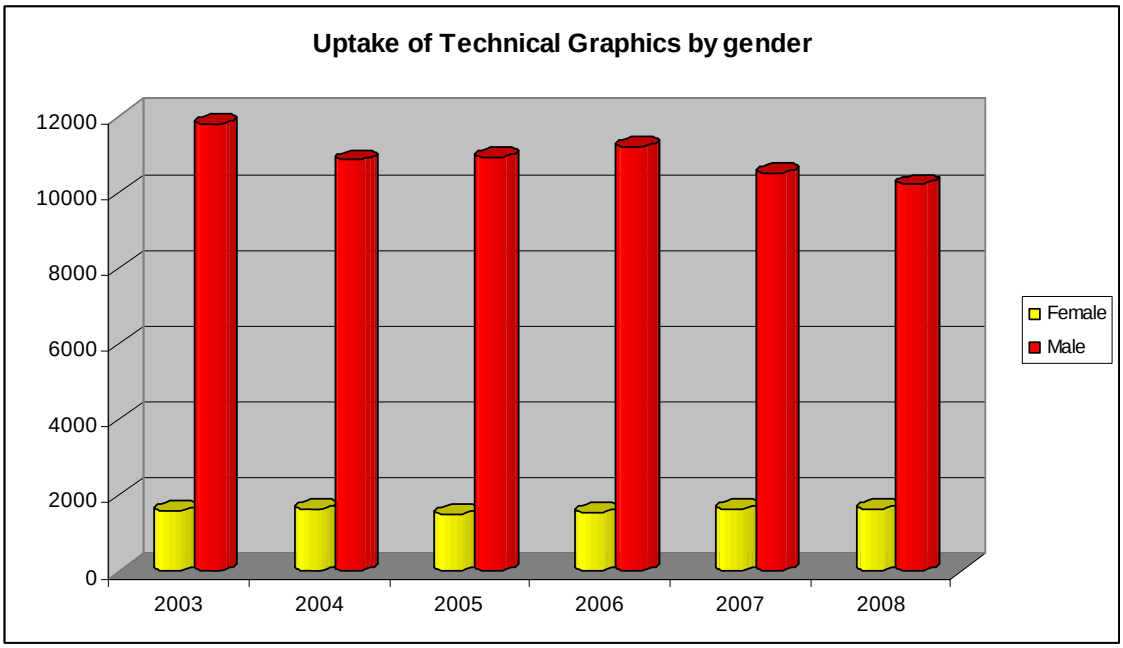


Table 6: Graph showing uptake of Technical Graphics by gender 2003-2008

The following reports for the Ordinary and Higher Level examinations should be read in conjunction with the relevant published marking scheme which can be accessed on the State Examinations Commission website www.examinations.ie

2. Ordinary Level

2.1 Introduction

In Section A candidates are required to attempt ten short-answer questions from a total of fifteen questions. The questions are designed to allow a candidate demonstrate their knowledge across a wide selection of the syllabus content. As well as testing a candidate's knowledge of basic geometric principles, some questions test candidates' abilities in freehand sketching, shading, colouring and rendering of drawings.

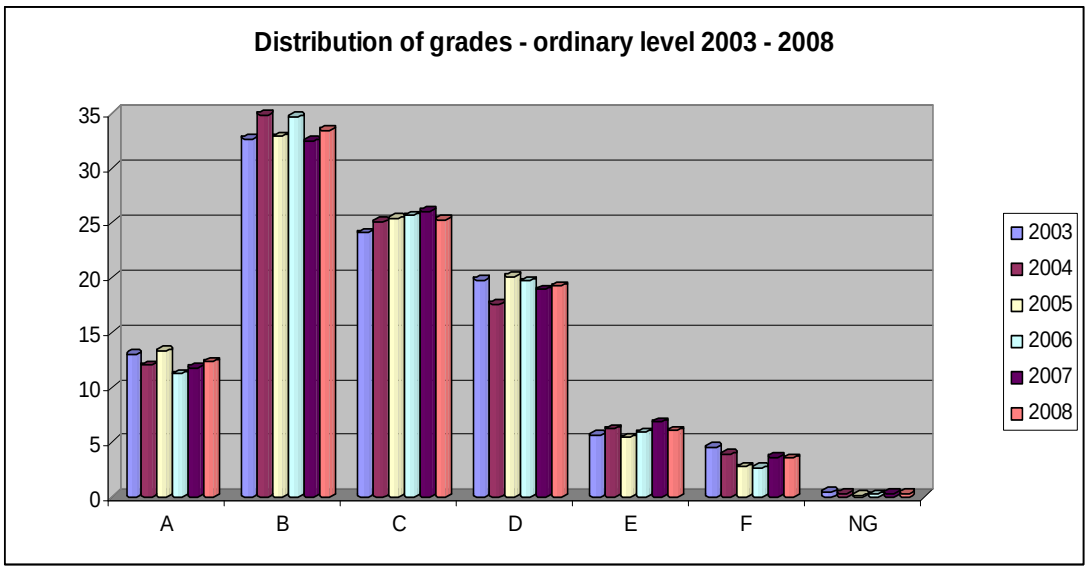
In Section B candidates are required to show a more in-depth understanding of a range of topics. Candidates are required to answer from a total of six questions. These questions are completed on standard drawing paper and specific marks are allocated for the graphic skills of accuracy, neatness and drafting.

2.2. Performance of Candidates

As can be seen from the table and graph below, the performance of candidates at Ordinary Level in 2008 is consistent with the trend established over the last six years. Approximately 70% of all candidates taking the examination at Ordinary Level achieved a C grade or higher at this level. A total of 9.4% of candidates did not achieve a D grade at this level. Examiners noted that all of the candidates who did not succeed in achieving a D grade had not attempted four questions in section B, as required.

Year	Number	A	B	C	ABC	D	E	F	NG	EFNG
2003	5857	13.0	32.7	24.1	69.8	19.8	5.6	4.5	0.4	10.5
2004	5398	12.0	34.9	25.1	72.1	17.6	6.2	3.9	0.3	10.4
2005	5423	13.3	32.9	25.4	71.6	20.1	5.4	2.7	0.1	8.3
2006	5334	11.2	34.7	25.7	71.6	19.7	5.9	2.6	0.2	8.6
2007	4744	11.8	32.5	26.1	70.4	18.9	6.8	3.6	0.3	10.8
2008	4502	11.7	32.3	25.5	69.5	21.1	6.2	2.8	0.4	9.4

Table 7: Table showing grade distribution in Technical Graphics - Ordinary Level 2003-2008



2.2.1 Performance of Candidates by Gender

As can be seen from the accompanying graph, there is a close correlation between the examination performance of both male and female candidates at Ordinary Level.

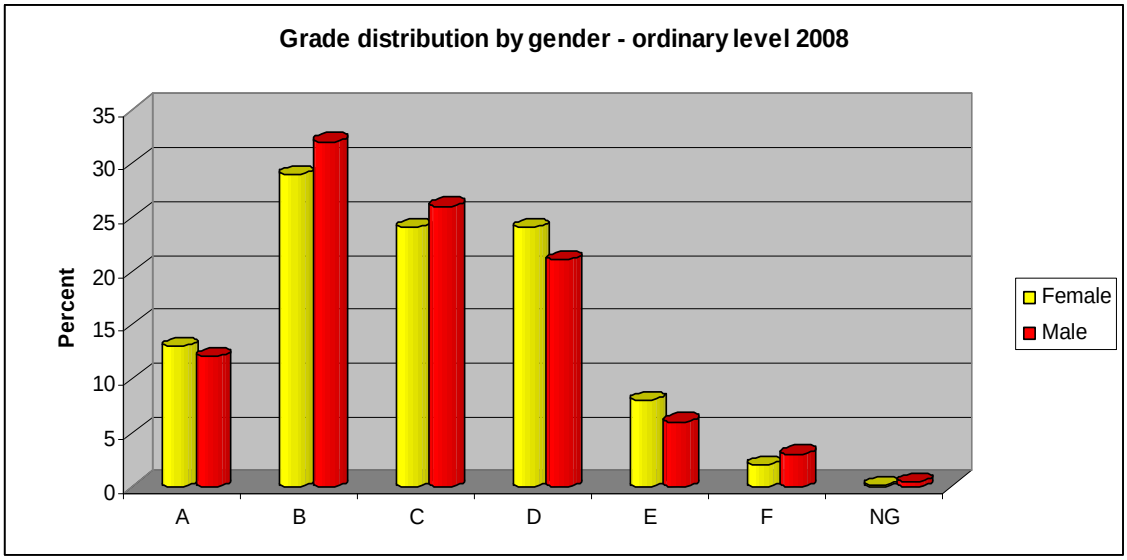


Table 9: Graph showing grade distribution by gender - Technical Graphics - Ordinary Level 2008

Females scored marginally better at A and D grades and males performed marginally better at B and D grades. However, it can be deduced that there is no significant difference in performance by gender in Technical Graphics at Ordinary Level.

2.3 Analysis of Candidate Performance

Candidates are required to answer ten from a total of fifteen short answer questions in Section A. These questions are answered on a returnable answerbook.

SECTION A - SHORT ANSWER QUESTIONS

The following commentary is based on an analysis of the responses of a random sample of 240 candidates - 5.3% of cohort - taking Technical Graphics at Ordinary Level.

Question 1 - Completing an orthographic view of a given figure - a clock case

This question was a popular question and was well answered by almost all candidates. Most candidates demonstrated a good knowledge of orthographic projection and successfully included the missing lines in the various projections. A small number of candidates did not draw vertical lines in the end view and drew lines at an angle instead.

Question 2 - Freehand pictorial drawing – of a given trailer

Most candidates demonstrated a good standard of freehand drawing and lines were generally drawn straight and parallel. Some candidates had difficulty getting the proportions right and consequently lost marks. A small number of candidates had difficulty representing the finer detail and the hitch was at an incorrect angle in a number of solutions.

Question 3 - Identifying and using computer devices

This computer component and its use were correctly identified by virtually all candidates who attempted this question. A small number of candidates incorrectly identified it as an MP3 player.

Question 4 - Converting an area - from a rectangle to a triangle

Candidates who understood the geometry involved had little difficulty in converting the area. However, many candidates did not show the relevant constructions needed to determine the correct height and appeared to guess the height and then constructed a triangle of incorrect height with AB as the base.

Question 5 - Tangents to a given ellipse at a point on the curve

Examiners noted that this was generally not well answered. Most candidates understood the concept of tangency. Many drew a tangential line but showed no method of construction and did not understand the concept of the bisection of the focal angle. Candidates who understood this property produced accurate and correct solutions.

Question 6 - Freehand sketching of an MP3 player

This was the most popular question and was attempted by the majority of candidates. The question was generally well answered. Proportions again proved challenging for many candidates and some candidates had difficulty representing the curved surfaces.

Where candidates had experience in applying colour and shade, this was well done. A number of candidates shaded the sketch rather poorly in black and white.

Question 7 - Converting from pictorial to orthographic projection - drawing the elevation of block series

This was a popular question and it was generally well answered. Most candidates who attempted this question understood the principles of orthographic projection and also drew the blocks in good proportion.

Question 8 - Understanding of scale and reading a scale

This question was generally well answered. Many candidates used the scale correctly, measured accurately and recorded the values of the dimensions. A small number of candidates did not analyse the given scale closely and measured from the beginning of the scale instead of from the point marked 0.

Question 9 - Estimating of area of irregular figure – a segmental head window

Most candidates who attempted this question understood the concept of approximation of area and scored well, with a high proportion of candidates scoring full marks. A small number of candidates did not keep a precise record of the squares counted, were inaccurate in determining the required area and thus lost marks.

Question 10 – Projecting an auxiliary elevation of hexagonal based candle

This was not a popular question and it was generally not well answered. Many candidates showed a poor understanding of auxiliary projection. A large number of candidates did not project perpendicular to the given XY line, while many did not relate the heights on the projected elevation to those of the original figure.

Question 11 - Drawing a regular octagon given a length of side

Candidates who knew the correct angles had little difficulty in completing the octagon and scored well. However, many candidates did not understand the concept of regularity and drew irregular octagons instead. Some candidates who knew the correct angle did not consistently measure the length of sides, particularly at the top of the octagon, and thus scored poorly.

Question 12 - Projecting the shadow of an doorway on to a vertical plane

Many candidates drew the projection lines parallel to the edge of the horizontal plane, completed the shadow correctly and thus scored well. Some candidates were unable to determine the intersection of the projection lines with the vertical plane and thus positioned the shadow incorrectly on the vertical plane. Such candidates then resorted to guesswork to complete the shadow on the vertical plane.

Question 13 - Locating the points of contact in an array of snooker balls

Candidates who understood the concept of tangency had little difficulty in determining the points of contact and scored well. Some candidates who attempted this question were unable to determine all of the points of contact. A small number of candidates guessed the points of contact, drew them without construction and consequently lost marks.

Question 14 - Completing a two-point perspective drawing

This was a very popular question and it was very well answered by the majority of candidates. Most candidates understood the concept of vanishing points and drew the lines correctly to the appropriate vanishing point. The majority of candidates scored well in this question.

Question 15 - Rotating a figure - the minute hand

This was generally a well answered question and most candidates understood the concept of rotating about a fixed point and drew the rotated shape at the correct angle. The length of line was incorrectly drawn by a small number of candidates. However, the majority of candidates scored well in this question.

SECTION B

This Section comprises six long answer questions from which candidates are required to answer four. This section is marked out of 280 marks - 70 marks per question.

Almost one in three candidates at Ordinary Level did not attempt the required 4 questions in Section B.

- 31.5% of candidates did not attempt the required four questions in Section B
- 6.6% of candidates attempted only two questions in Section B
- 7.2% of candidates attempted one question in Section B
- 0.7% of candidates did not attempt any question in Section B

Popularity of Questions in Section B

The following table shows the order of popularity of questions in Section B. Pictorial Projection-Question 4 and Orthographic Projection-Question 1 were the most popular questions and Question 4 was also the best answered question in Section B.

Popularity of Questions in Section B - Ordinary Level			
Order of Popularity	**Question**	**Popularity -%**	**Topic**
1st	Question 4	89.0	Pictorial Drawing
2nd	Question 1	75.2	Orthographic Projection
3rd	Question 3	62.1	Development
4th	Question 6	56.5	Circles and tangency
5th	Question 2	36.5	Logo with Ellipse
6th	Question 5	30.2	Transformation Geometry

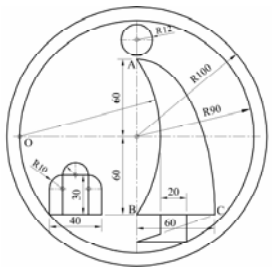
Table 10: Table showing order of popularity of questions in section B - Ordinary Level 2008

The following commentary is based on an analysis of the responses of a random sample of 240 candidates - 5.3% of cohort - taking Technical Graphics at Ordinary Level

Question 1 - Orthographic Projection – a small radio

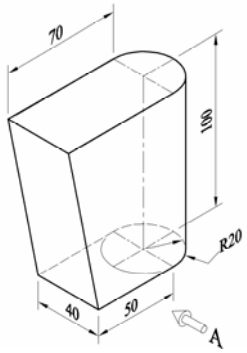
This was the second most popular question in Section B and was attempted by 75.2% of candidates. The question was well answered by most candidates; the average mark awarded was 49 out of a total of 70 marks. Most candidates positioned the main views correctly and demonstrated a sound knowledge of the projection systems. A minority of candidates positioned the clasp incorrectly in plan and a minority omitted the hidden detail. Some candidates experienced difficulty in drawing the small circles. However, most candidates scored very well in this question.

Question 2 - Logo for a waiting room



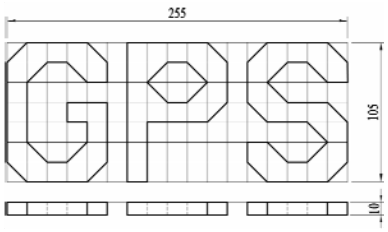
This was not a popular question and was attempted by 36.5% of candidates. Candidates who attempted this question answered the question very well and the average mark obtained was 47.2. Most candidates were able to locate the centres of the circles and arcs and were familiar with constructions for drawing an ellipse. A small number of candidates had difficulty drawing the quarter ellipse, and constructions using the concentric circles method were not always correct. Candidates who used the trammel method generally scored higher. Most candidates completed the remainder of the question with little difficulty and thus scored well.

Question 3 - Development of container



While this question was attempted by 62.1% of candidates, it was not very well answered. The average mark obtained, 31.6 marks, was the lowest for any question in Section B. Most candidates who attempted this question succeeded in completing the plan and elevation correctly and positioned the views in their correct locations. However, the development proved challenging for many candidates – and in particular, the development of the curved surface. Many candidates succeeded in drawing the plane surfaces correctly but had difficulty in determining the lengths of the curved surface. Fold lines were omitted by some candidates. A mall number of candidates scored well in this question.

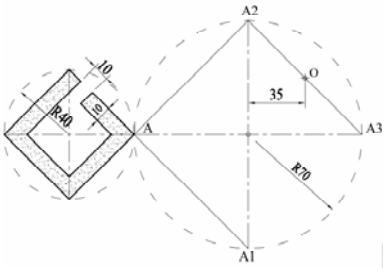
Question 4 - Pictorial drawing using oblique or isometric



This was the most popular question in Section 2 and was attempted by 89% of candidates. It was also the best answered question with many candidates scoring very well, the average mark achieved was 54.2 out of 70 marks. This was the highest average mark for any question in Section B. A small number of candidates had difficulty in visualising the back surfaces when

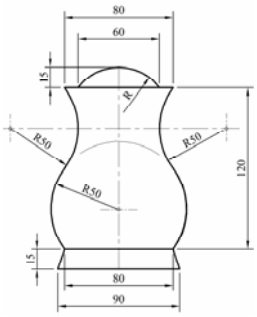
projected and were thus unable to complete the required figures. However, the majority of candidates demonstrated a good knowledge of pictorial projection and scored well in this question

Question 5 - Transformation Geometry



This was the least popular question in Section B and was attempted by only 30.2% of the sample. However, Examiners noted that many of the candidates who attempted this question had a good knowledge of transformation geometry and the average mark awarded, 44.4 marks, was high. Almost all candidates succeeded in doing the first transformation. However, some candidates then experienced difficulty in projecting the other transformations from this projection. Axial Symmetry and Central Symmetry proved to be the most difficult transformations. A small number of candidates drew the original figure to the wrong size. However, many of the candidates who attempted this question had a good understanding of transformation geometry and scored well.

Question 6 - Circles in contact and tangency



This was a popular question and was attempted by 56.5% of the sample. Many candidates answered this question very well and achieved high marks; the average mark achieved was 43.2. Most candidates understood the concept of tangency, had little difficulty in locating the centres of the large circles and in drawing the three tangential circles. Some candidates experienced difficulty in determining the centre of the lid where an understanding of the principle of bisection of chords was required and thus omitted the necessary constructions for finding the centre of the top arc. The shape was completed by almost all candidates. Some candidates omitted the points of contact and thus lost the marks for this section.

2.4 Conclusions

Performance of candidates across the ability range was generally satisfactory and consistent with the trend established over the last six years. Approximately 70% of all candidates taking the examination at Ordinary Level achieved a C grade or higher. A total of 9.4% of candidates did not achieve a D grade.

An analysis of the data revealed that almost 1 in 3 candidates - 31.5% - who sat the examination at Ordinary Level did not attempt the required four questions in Section B. 7.2% of candidates attempted only one question, while 0.7% of candidates did not attempt any question in Section B. A small number of candidates - 2% - attempted one additional question in Section B, while 0.5% attempted all six questions in section B. Candidates who do not attempt the required number of questions have a greatly reduced chance of obtaining a high grade in the examination. Teachers are advised to encourage candidates to use the full time allocation available for the examination and to attempt the required 10 questions in Section A, and the required 4 questions in Section B.

2.5 Recommendations to Teachers and Students

It is recommended that teachers should:

- Encourage students to prepare and present for the level of the examination most appropriate to their underlying level of ability
- Advise students to read the instructions carefully and follow these instructions
- Advise students to use the full time allocation so as to maximise the possibility of attaining high marks
- Advise students to read questions carefully and choose questions judiciously
- Practise freehand sketching on a regular basis with students so that they develop flair and competence in the execution of freehand sketching
- Demonstrate the use of colour and rendering techniques in the classroom to enhance student drawings and sketches
- Encourage students to draw the ellipse with the major axis both vertically and at an angle so that they can manipulate the shape in positions other than when the major axis is horizontal
- Develop in students a sense of proportion through an understanding of scale and through the measured drawing of everyday objects to various scales. Students should also be encouraged to draw objects freehand in order to develop an awareness of scale and proportion
- Set homework on a regular basis so that students can practise drawing on their own and develop accuracy, neatness and draughting skills

It is recommended that students should:

- Read the instructions carefully and follow these instructions
- Use the full time allocation so as to maximise the possibility of attaining high marks
- Attempt the required number of questions in each section
- Practise freehand sketching on a regular basis both in class and for homework
- Use colour to render, shade and enhance drawings
- Practise render and shading techniques using both soft black pencil and colour pencil to enhance drawings
- Measure accurately and take care with presentation, line weight and thickness so as to obtain the marks awarded for draughting, neatness and accuracy in each question
- Show all constructions in the solution of problems so as to gain maximum marks.

3. Higher Level

3.1 Introduction

The examination paper is of 3 hours duration at Higher Level and is divided into two Sections - Section A and Section B. Section A consists of a returnable answerbook with fifteen short answer questions of which candidates are required to attempt ten. In Section B, candidates are required to answer four long-answer questions from a total of six questions. The answers to Section B are presented on standard drawing paper. Section A is marked out of 120 marks (30%) and Section B is marked out of 280 marks (70%).
The following commentary is based on an analysis of the responses of a random sample of 640 candidates. This sample represents 8.7% of the total cohort at this level.

3.2 Performance of Candidates

The performance of candidates at Higher Level has shown a similar shown trend over the last six years, as illustrated in the accompanying table and graph shown below. A total of 78.7% of candidates taking Technical Graphics at Higher Level achieved a C grade or higher. The percentage of candidates who did not achieve a D grade is low at 3.5% and this percentage has been consistently low for the past three years. Examiners noted that candidates appeared to be better prepared for the examination, resulting in a decline in the number of candidates not achieving a D grade. Furthermore there was an increase in the number of candidates attempting all four questions in Section B.

	Number	A	B	C	ABC	D	E	F	NG	EFNG
2003	7522	15.2	31.7	31.6	78.5	17.0	3.6	0.7	0.2	4.5
2004	7090	15.6	31.2	31.0	77.7	18.1	3.6	0.6	0.1	4.2
2005	6960	15.6	30.3	29.8	75.7	18.6	4.9	0.7	0.1	5.7
2006	7404	15.2	32.8	31.0	79.0	17.8	2.8	0.5	0.0	3.3
2007	7403	15.6	32.9	30.9	79.4	17.2	2.9	0.4	0.0	3.3
2008	7348	15.3	32.8	30.7	78.7	17.8	2.9	0.5	0.1	3.5

Table 12: Table showing grade distribution Technical Graphics - Higher Level 2003-2008

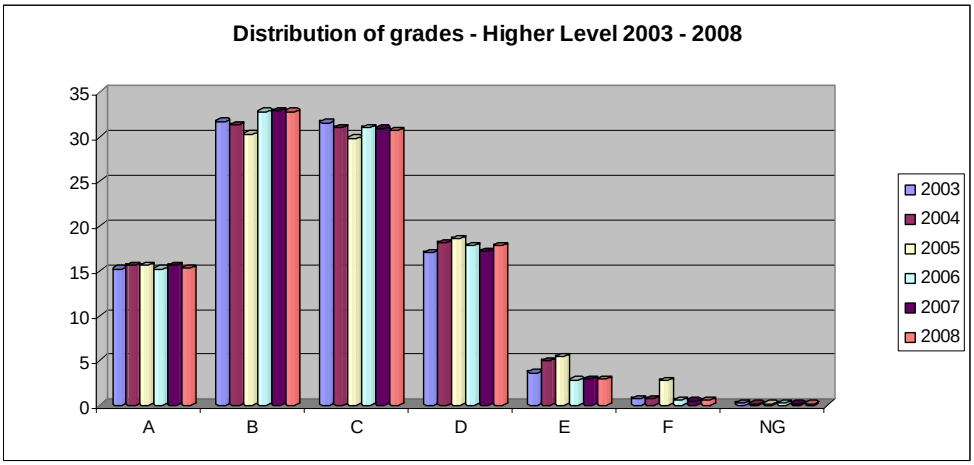


Table 13: Graph showing grade distribution Technical Graphics - Higher Level 2003-2008

3.2.1 Performance of Candidates by Gender

As can be seen from the accompanying graph, females scored better than males at the A, B and C grades.

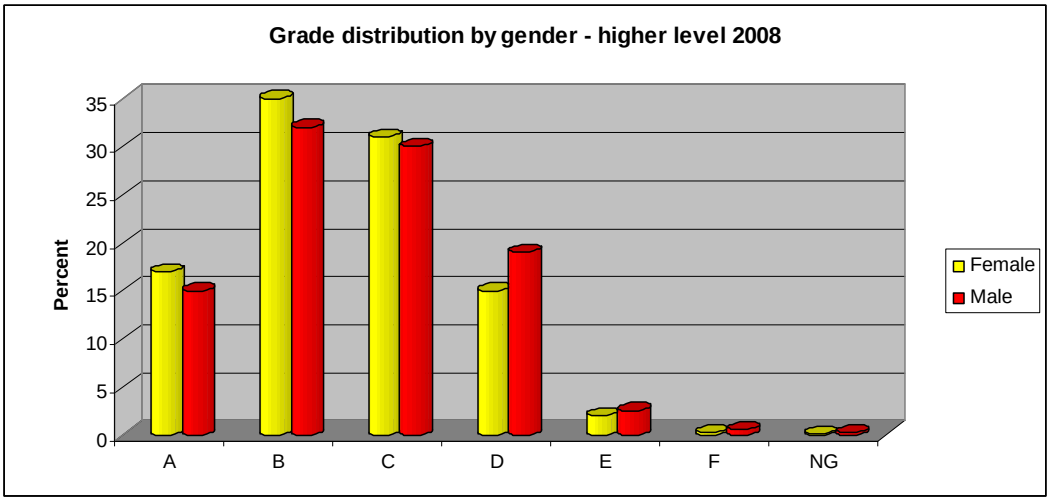


Table 14: Graph showing grade distribution by gender - Technical Graphics - Higher Level 2008

3.3 Analysis of Candidate Performance

Almost 8 out of 10 candidates (78.7%) achieved a C grade or higher in this examination. This reflects a high level of achievement by candidates at this level. As can be seen from Table 13, the grade profile has been very consistent over the past six years. The percentage of candidates who do not achieve a D grade is low and has decreased marginally in the past three years.

SECTION A - SHORT ANSWER QUESTIONS

Candidates are required to answer ten short-answer questions from a total of fifteen. This section is marked out of 120 marks – 12 marks per question.

There was strong correlation between the grade attained by candidates in Section A and the overall grade achieved in the subject.

Question 1 - Identification of solids

This question was the most popular of the short answer questions and was attempted by 99% of the sample. It was also a very well answered question. Most candidates correctly identified the solids and many candidates obtained full marks.

Question 2 - Development of a truncated hexagonal prism.

This was a popular question and was attempted by 78% of candidates. However, while some candidates scored full marks, it was generally not a well answered question as all six sides of the total development were seldom completed.

Question 3 - Completion of the perspective drawing of a laptop computer

This was a very popular question and was attempted by 95% of the sample. It was generally well answered. The left front corner was not always correctly drawn and the keyboard was not always completed.

Question 4 - Freehand sketch of a plug top from a given orthographic drawing.

This was a very popular question and was attempted by 95% of candidates. While the question was popular, locating the position of the second pin created difficulty for some candidates. Some candidates applied shade or colour as was required, but this was not always executed to a high standard.

Question 5 - Completion of the elevation of the rotation of a road

This was not a very popular question and was attempted by only 30% of the sample. The concept of rotation about a point was not fully understood by many candidates. The correct size and completed rotation was obtained only by very good candidates.

Question 6 - Drawing a triangle given the coordinates and the X and Y axes

This was a very popular question with a 97% attempt rate. It was generally well answered and most candidates were able to read the required coordinates. A small number of candidates took the intervals in units of 10 while others had difficulty with minus values.

Question 7 - Determining the points of contact in a portion of the handle of a scissors

This was not a popular question and was attempted by less than half the candidates - 48%. The average mark achieved was also low at 6.4 marks. Many candidates had difficulty in determining the points of contact to the small circle.

Question 8 - Freehand sketch and applying colour or shade to a computer joystick

This was a popular question and was attempted by 86% of the sample. Some candidates completed very good sketches, with the proportions and scale correct. Such candidates showed flair in the application of colour and shade. However, many candidates had difficulty in drawing the various elements in proportion. Shading with pencil was more frequent than the application of colour.

Question 9 - Using CAD commands to edit a figure

This was not a popular question and was attempted by only 39% of the sample. While many candidates understood the *chamfer* and *circle* commands, the *trim* command was seldom understood.

Question 10 - Internal tangent to circles A and B

This was a popular question and was attempted by 79% of the sample. Many candidates drew the tangents and guessed the points of contact. The construction for the internal tangent was seldom correct and was usually drawn freehand.

Question 11 - The angle at the circumference of a circle subtended on a chord

This was a popular question and was attempted by 84% of the sample. It was also a well answered question. Many candidates answered all parts correctly but a minority of candidates had difficulty in determining the external angle.

Question 12 - Determining the elevation of the valve on a spherical object

This was a popular question and was attempted by 72% of the sample. Many candidates did not understand the construction required in determining the correct location of the valve in elevation. Consequently the average mark awarded was low.

Question 13 - Completing the auxiliary elevation of playing blocks on a given X1-Y1

This was not a popular question and was attempted by just 52% of the sample. Some candidates demonstrated a good understanding of auxiliary projection and had little difficulty in completing the auxiliary elevation. Many candidates had difficulty in transferring the three heights correctly to the given auxiliary elevation.

Question 14 - Drawing a rectangular sail of equal area to a triangular sail

This was not a popular question and was attempted by only 38% of the sample. A minority of candidates understood the constructions necessary to convert to a similar area and scored full marks. However, many candidates appeared to guess the required height and did not provide the construction that was required. The average mark achieved was 8 marks.

Question 15 - Readings on a graphic equaliser for a music amplifier

This was the second most popular question in this Section and was attempted by 98% of the sample. Most candidates had little difficulty in completing the graphs to indicate the correct sound levels. The average mark of 11.8 was high.

SECTION B – HIGHER LEVEL

This Section comprises 6 long answer questions from which candidates are required to answer 4. This section is marked out of 280 marks - 70 marks per question - and all questions in this section carry equal marks

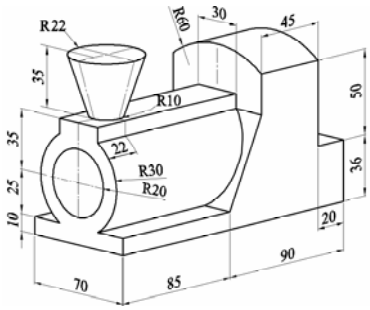
Popularity of Questions - Section B

The following table shows the order of popularity of questions in Section B. Question 1, Orthographic Projection, was the most popular question and was also the best answered question in Section B. Question 4, Solids in Contact/Developments was the least popular and was also the least well answered question in Section B.

Popularity of Questions in Section B – Higher Level			
Order of popularity	**Question**	**Popularity - %**	**Topic**
1st	Question 1	94	Orthographic Projection
2nd	Question 6	76	Ellipse-Parabola
3rd	Question 2	75	Mapping-rotation
4th	Question 5	71	Transformation geometry
5th	Question 3	50	Isometric projection
6th	Question 4	30	Solids in Contact/Development

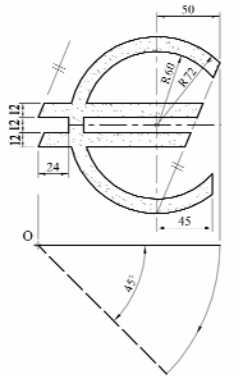
Table 15: Table showing order of popularity of questions in section B - Higher Level 2008

Question 1 - Orthographic Projection



This was the most popular question in Section B and was attempted by 94% of the sample. It was also a well answered question. Most candidates had little difficulty in positioning the plan, elevation and end elevation in their correct positions and in drawing the outline of the three views. There were some excellent responses and many candidates scored full marks in this question. Some candidates experienced difficulty in determining the finer details in each view. Determining the points and drawing the elliptical curve in plan proved challenging for many candidates. Hidden detail was omitted by some candidates in the elevation and end elevation and some candidates omitted hidden detail in all views and thus lost marks. The average mark awarded was 49 marks.

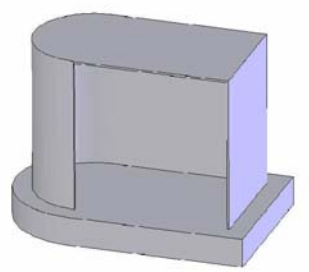
Question 2 - Rotation of figures



This was the third most popular question in Section B and was attempted by 76% of the sample. It was a generally well answered question and the average mark achieved was 48 marks. Most candidates had little difficulty in locating the end elevation in its correct position and in projecting the outline of the shape in the end elevation. Some candidates did not index the points in the various views and thus experienced difficulty when projecting these points from the plan and elevation to the end elevation to

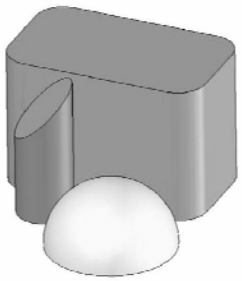
obtain the elliptical curves in the rotation. Some candidates experienced difficulty in joining the points with a well drawn freehand curve.

Question 3 - Isometric Projection / axonometric axes



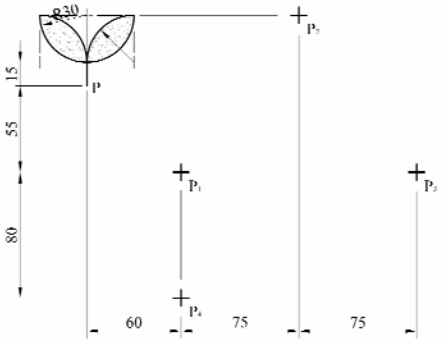
This question was the 5th most popular question and was attempted by 50% of the sample. This question was not as popular as in previous years. The isometric scale was the method most frequently used by candidates to solve this problem. Most candidates established the correct outline of the bus shelter. Some candidates experienced difficulty in establishing the points for the projecting curves on the base and the freehand curve joining the points was not always accurately completed. The average mark awarded in this question was 44.

Question 4 - Solids in contact and surface development



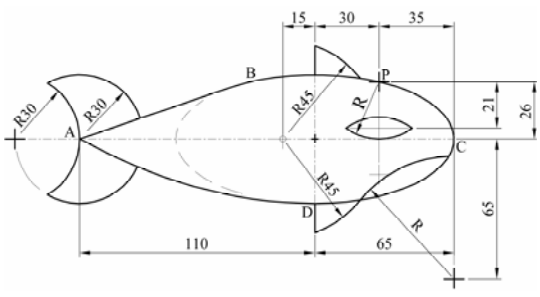
This was the least popular question with an attempt rate of 30%. It was also the least well answered question and the average mark awarded was 37.5. Candidates who understood the principles of solids in contact had little difficulty and some candidates scored very well in this question. However, many candidates had difficulty in locating the position of the centre of the hemisphere in plan. Many candidates either omitted the points and lines of contact or appeared to guess them and thus lost marks. Some candidates had difficulty in determining the circumference of the truncated cylinder and in drawing a graceful freehand curve through the points.

Question 5 - Transformation Geometry



This was the 4th most popular question in Section B and was attempted by 71% of the sample. Even though it was not as popular as in previous years, candidates who answered this question generally scored very well. Most candidates who attempted this question understood the principles of transformation geometry and completed at least three of the transformations. The average mark awarded was 48. Most candidates understood how to determine a translation, a central symmetry and an axial symmetry. Some candidates experienced difficulty in completing the rotation, especially in finding the centre of the rotation and the centre of the rotation was sometimes guessed.

Question 6 - Ellipse and Parabola



This was the 2nd most popular question in Section B and was attempted by 76% of the sample. It was a reasonable well answered question and the average mark awarded was 44. Most candidates had little difficulty in drawing the ellipse and the associated arcs. The external tangent to the ellipse proved challenging for many candidates and only a small number of candidates had the correct constructions. Examiners noted that it appeared that some candidates guessed the

tangent and showed no constructions. A small number of candidates had difficulty in determining the length of the minor axis of the ellipse. Most candidates understood how to construct a parabola and completed this portion successfully. A small number of candidates used the incorrect vertex for the parabola. Some candidates experienced difficulty in drawing a smooth freehand curve through the located points in the parabola and ellipse. As no marks are awarded for guesswork, candidates should show the necessary geometrical constructions in order to obtain the allotted marks.

3.4 Conclusions

The performance of candidates was generally very satisfactory at this level. The grade profile of candidates in 2008 very closely resembles that of the previous years.

The statistics obtained from the sample show that 6.8% of candidates at Higher Level did not attempt the required four questions in Section B. A total of 5.6%, of these attempted only three of the required four questions in Section B and a further 0.6% of candidates attempted only two questions in Section B. Candidates who do not attempt the required number have a significantly reduced chance of obtaining a high grade in the examination. A total of 5.7% of candidates attempted one extra question and 0.6% of candidates attempted all six questions in Section B.

Certain questions were more popular than others. Question 1, Orthographic Projection, was the most popular question and was also the best answered question in Section B. Question 4, Solids in Contact/Developments was the least popular and was also the least well answered question in Section B.

Recommendations to Teachers and Students

It is recommended that teachers should:

- Advise all students to read the instructions carefully and to follow these instructions
- Advise students to use the full time allocation so as to maximise the possibility of attaining high marks
- Advise students to read the questions carefully and to choose questions judiciously
- Encourage all students to attempt at least ten of the short answer questions in Section A and four long answer questions in Section B, as required
- Practise freehand sketching on a regular basis with students so that they develop flair and competence in the execution of freehand sketching
- Encourage students to keep a sketchbook and to practise freehand sketching of everyday objects on a regular basis so as to develop freehand sketching skills
- Demonstrate the use of colour and rendering techniques in the classroom and encourage students to develop these skills
- Encourage students to develop the spatial awareness so as to solve problems relating to Solids in Contact and Developments
- Help students to develop a sense of proportion through an understanding of scale and through the drawing of everyday objects to various scales
- Set challenging homework on a regular basis so that students become independent learners and acquire confidence in solving problems in a setting independent of the classroom, and without the direct assistance of the teacher

It is recommended that students should:

- Read the instructions carefully and follow these instructions
- Use the full time allocation in the examination
- Attempt the required number of questions in each section
- Practise freehand sketching on a regular basis both in class and for homework
- Draw 3D freehand sketches of the problems in solid geometry so as to aid the development of spatial awareness and also to develop proficiency at drawing accurate, well proportioned freehand sketches
- Use a sketchbook to practise and to develop the skill of doing freehand sketches of everyday objects in a confident and competent manner
- Measure and draw everyday objects from the surrounding environment so as to gain a confident sense of size and proportion. Make scaled drawings of such objects so as to develop an awareness of scale and proportion
- Use colour to shade render and enhance drawings

- Practise render and shading techniques using both soft black pencil and colour pencil to enhance drawings
- Show all constructions in the solution of problems so as to gain maximum marks.