JUNIOR CERTIFICATE EXAMINATION

2002

TECHNICAL GRAPHICS

HIGHER AND ORDINARY LEVELS

CHIEF EXAMINER'S REPORT

1. INTRODUCTION

The examination in Technical Graphics is offered at Higher and Ordinary Levels. The structure of the two examination papers is as follows.

HIGHER LEVEL

Time	3 hours	400 marks
Section A	Fifteen short questions, answer any ten	120 marks
Section B	Six questions, answer any four	280 marks

ORDINARY LEVEL

Time	2½ hours	400 marks
Section A	Fifteen short questions, answer any ten	120 marks
Section B	Six questions, answer any four	280 marks

The following table shows the numbers of candidates taking Technical Graphics in each year since 1996. The percentages of the cohort taking the subject at each level are also shown.

Table 1: Numbers of candidates taking Technical Graphics in each year and the percentages taking the subject at each level

Year	Number	% HL	% OL
1996	18765	47.4	52.6
1997	17393	52.5	47.5
1998	16972	53.0	47.0
1999	16128	51.9	48.1
2000	15017	53.8	46.2
2001	14272	54.0	46.0
2002	14403	51.3	48.7

When the Junior Certificate Technical Graphics syllabus was introduced into schools it was envisaged that the ratio of Higher Level to Ordinary Level candidates would be approximately two-to-one. This year, 51% of the candidates opted for Higher Level, which once again falls considerably short of what was envisaged when the Junior Certificate Technical Graphics syllabus was introduced in September 1991. There still remains considerable work to be done in encouraging more of the Technical Graphics cohort to opt for Higher Level in the Junior Certificate examination. It is clear from the distribution of grades at Ordinary Level that many candidates who could attempt the Higher Level are opting to sit the examination at Ordinary Level.

Table 2: Numbers of schools in each sector providing Technical Graphics in each school year

Year	Secondary	Vocational	Community	Comprehensive
1999/2000	230	213	64	14
2000/2001	220	209	66	14
2001/2002	217	206	69	14

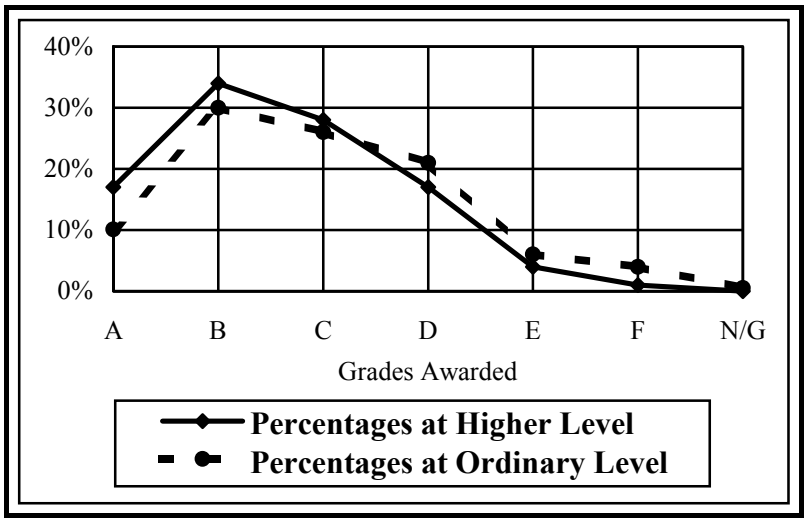
2. PERFORMANCE OF CANDIDATES

Table 3 below sets out the grades awarded at Higher and Ordinary Levels for 2002. These data are illustrated graphically in Figure 1.

Table 3: Numbers and percentages of candidates achieving each grade in Higher and Ordinary Level Technical Graphics in 2002

	Higher		Ordinary	
Grade	**Number**	**Percentage**	**Number**	**Percentage**
A	1250	16.9	708	10.1
B	2506	33.9	2142	30.6
C	2043	27.6	1863	26.6
D	1222	16.5	1536	21.9
E	303	4.1	467	6.7
F	63	0.9	269	3.8
NG	6	0.1	25	0.4
Total	7393		7010	

Figure 1: Distribution of grades in Higher and Ordinary Level Technical Graphics in 2002



The distribution of grades at Higher Level is close to that obtained last year, which once again is reflective of the ratio of Higher Level to Ordinary Level candidates. A total of 78.4% of the Higher Level candidates achieved an A, B or C grade, while a total of 5.0% of candidates achieved less than a grade D at Higher Level.

At Ordinary Level, a total of 10.9% of candidates were awarded an E, F or NG grade. The number of questions attempted by candidates in Section B is a key factor contributing to this statistic:

- 15.9% attempted 3 questions out of the 4 required in Section B (12.8% in 2001)
- 3.8% attempted 2 questions (3.0% in 2001)
- 1.3% attempted 1 question (1.5% in 2001)
- 1.3% attempted 0 questions (0.5% in 2001)
- 22.2% in total did not attempt the required 4 questions in Section B.

A total of 10.1% of candidates were awarded an A grade at Ordinary Level. It would appear that a significant number of candidates who take the examination at Ordinary Level are capable of taking the examination at Higher Level. It is hoped that candidates will give more consideration to the level at which they wish to present for examination and that teachers will encourage candidates to take the Higher Level where appropriate.

It is also worth noting that there was an increase in the number of candidates taking Ordinary Level this year, from 6561 (2001) to 7004 (2002), an increase of 443 or 6.8%.

HIGHER LEVEL

Questions attempted in Section B

The vast majority of candidates attempted the required number (four) of questions in Section B. A significant proportion (7.5%) attempted five questions, while only 0.6% attempted six questions.

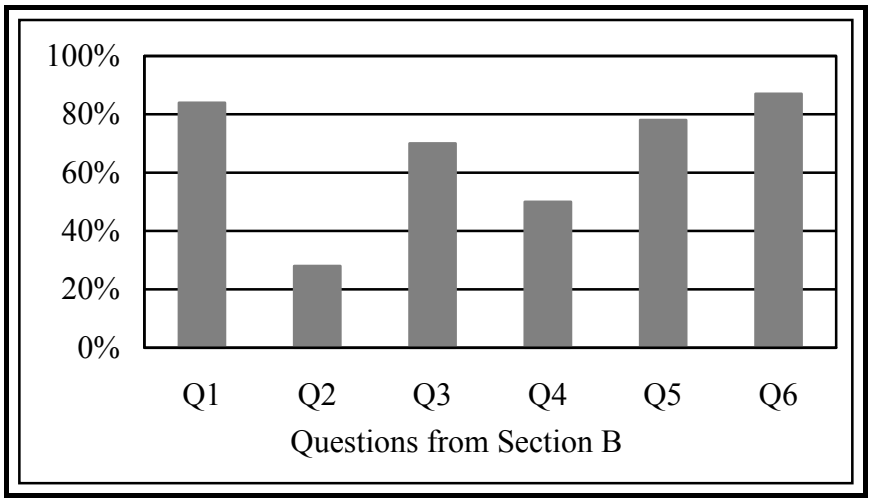
Question 6 (the ellipse / parabola) was the most popular question, followed by Question 1 (orthographic projection), which included an auxiliary elevation. Question 2 (solids in contact) was the least popular.

These finding are presented in Table 4 below and illustrated graphically in Figure 2.

Table 4: Percentages of candidates attempting each question in Section B, Higher Level Technical Graphics in 2002

Question no.	Rank order	Attempts (%)	Topics
6	1	87	Ellipse / parabola
1	2	84	Orthographic projection
5	3	78	Transformation geometry
3	4	70	Isometric projection
4	5	50	Surface development
2	6	28	Solids in contact

Figure 2: Percentages of candidates attempting each question in Section B, Higher Level Technical Graphics in 2002



Average marks awarded

- The average mark awarded for Section A was 89 out of a possible 120 marks, which in percentage terms is equivalent to 74%.
- The average mark awarded for Section B was 186 out of a possible 280 marks, which in percentage terms is equivalent to 66%.
- The average total mark awarded for the paper as a whole (Section A combined with Section B) was 275 out of a possible 400 marks. In percentage terms this is equivalent to 69% - a grade C.

An examination of the average mark awarded for each question in Section B shows how performance varied in this section of the examination. Three of the questions (Questions 3, 5 and 6) received similarly high marks. Questions 1, 2 and 4 received comparatively low marks.

- Question 5 (transformation geometry) received the highest average marks.
- Question 4 (surface development) received the lowest average marks.

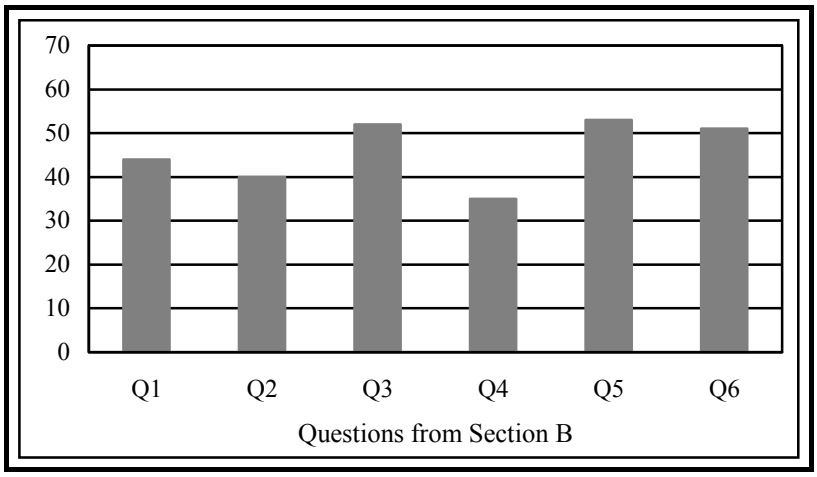
The average marks awarded for each of the questions in Section B are set out in Table 5 below and illustrated graphically in Figure 3.

(Note: Each question in Section B carried a maximum of 70 marks.)

Table 5: Average marks awarded to each question in Section B, Higher Level Technical Graphics in 2002

Rank order	Question no.	Average mark	Topics
1	5	53	Transformation geometry
2	3	52	Isometric projection
3	6	51	Ellipse / parabola
4	1	44	Orthographic projection
5	2	40	Solids in contact
6	4	35	Surface development

Figure 3: Average marks awarded to each question in Section B, Higher Level Technical Graphics in 2002



ORDINARY LEVEL

Questions attempted in Section B

The vast majority of candidates attempted the required number (four) of questions in this section. Quite a small proportion (2.81%) attempted five questions, while 0.31% attempted six questions.

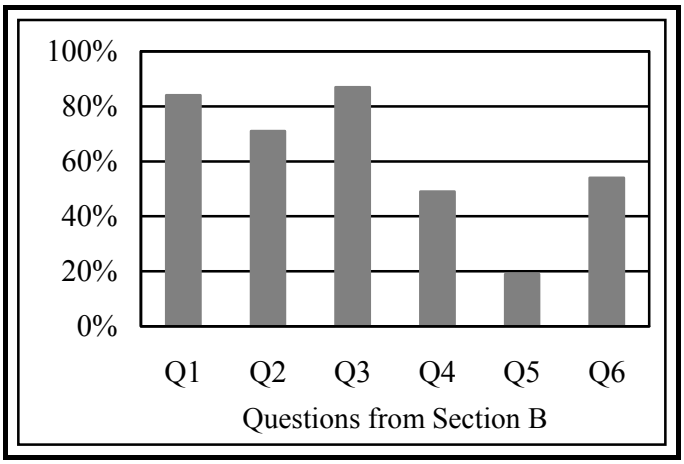
Question 3 (development) was the most popular question, followed by Question 1 (orthographic projection). Question 5 (transformation geometry) was the least popular question.

These finding are presented in Table 6 below and illustrated graphically in Figure 4.

Table 6: Percentages of candidates attempting each question in Section B, Ordinary Level Technical Graphics in 2002

Question no.	Rank order	Attempts (%)	Topics
1	3	87	Developments
2	1	84	Orthographic projection
3	2	71	Ellipse
4	6	54	Plane figures
5	4	49	Pictorial drawing
6	5	19	Transformation geometry

Figure 4: Percentages of candidates attempting each question in Section B, Ordinary Level Technical Graphics in 2002



Average marks awarded

- The average mark awarded for Section A was 88, which in percentage terms is equivalent to 73.3%.
- The average mark awarded for Section B was 155, which in percentage terms is equivalent to 55.4%.
- The average total mark awarded for the paper as a whole (Section A combined with Section B) was 243 out of a possible 400 marks. In percentage terms this is equivalent to 60.75%, a grade C.

An examination of the average mark awarded for each question in Section B further highlights variations in performance by candidates. Interestingly, the questions that attracted the highest average marks did not rank highest on the popularity scale.

- Question 6 (plane figures) together with Question 2 (the ellipse), received the highest average mark.
- Question 3 (developments) together with Question 5 (transformation geometry) received the lowest average mark.

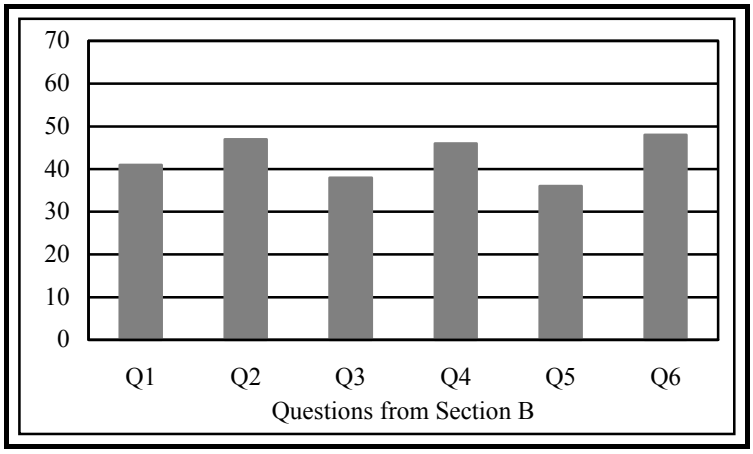
The average marks awarded for each question in Section B are set out in Table 7 below and illustrated graphically in Figure 5.

(Note: Each question in Section B carried a maximum of 70 marks.)

Table 7: Average marks awarded to each question in Section B, Ordinary Level Technical Graphics in 2002

Rank order	Question	Average Mark	Topics
1	6	48	Plane figures
2	2	47	Ellipse
3	4	46	Pictorial drawing
4	3	41	Orthographic projection
5	4	38	Development
6	5	36	Transformation geometry

Figure 5: Average marks awarded to each question in Section B, Ordinary Level Technical Graphics in 2002



3 ANALYSIS OF CANDIDATE PERFORMANCE

HIGHER LEVEL

Section A

Question 1 *(Labelling diagrams relating to various polygons)*

This question was well answered. Most candidates had little difficulty in identifying the polygons.

Question 2 *(Inscription of a circle in a given triangle)*

This question was reasonably well answered. Most candidates bisected the angles and correctly determined the position for the centre of the circle. However the use of a normal in fixing the points of contact was less well attempted.

Question 3 *(CAD commands)*

This question was well answered. Few candidates obtained full marks for this question. The 'chamfer' command was correctly identified in most cases, whereas the 'extend' command was not identified by most of the candidates.

Question 4 *(Orthographic projection on a square grid)*

In a small number of cases the orthographic views were not arranged correctly.

Question 5 *(Inscription of a regular pentagon in a given circle)*

Many of the attempts highlighted a difficulty in applying the appropriate angles, resulting in the construction of an irregular pentagon.

Question 6 *(Completion of a pictorial sketch on an isometric grid)*

This question was well answered in most cases. Some candidates had a certain amount of difficulty with the lines representing both of the sloping surfaces.

Question 7 *(Loci)*

This question was poorly answered by a considerable number of candidates. A lack of appropriate construction was evident in many of the attempts.

Question 8 *(Completion of the end view of a truncated solid)*

This question was poorly answered. Many candidates misplaced the semi-elliptical curve and the sloping lines. Hidden detail was omitted in the majority of cases.

Question 9 *(Division of a line using a given ratio)*

This question was well answered and was a popular choice with candidates.

Question 10 *(Determination of the minor axis of an ellipse)*

Candidates used either the concentric circles method or the trammel method in answering this question. Some of those opting for the concentric circles method had difficulty in correctly applying the construction to the problem posed.

Question 11 *(Freehand pictorial sketching)*

The standard of sketching was notably varied. Only a small number of candidates produced a freehand pictorial sketch deserving of full marks.

Question 12 *(Shading of a given sketch)*

This question proved to be popular with candidates. However, lack of depth and absence of texture were evident in the majority of sketches produced.

Question 13 *(Area conversion)*

Approximately half of the attempts resulted in a correct graphical solution to the problem posed. Many of the mathematical attempts contained errors, especially as regards determining the square root of the calculated area.

Question 14 *(Rotation of a given figure)*

This question was poorly answered. The majority of candidates had difficulty applying the 60º angle(s) in order to fix the image points on the arcs drawn.

Question 15 *(Indexing of orthographic views)*

The majority of candidates correctly identified the points to be indexed in the elevation and end view. However, in most cases the subscript numbers were omitted.

Section B

Question 1 *(Orthographic projection)*

Parts (a), (b) and (c) (elevation, end view and plan) were very well answered. It was in the auxiliary elevation, part (d), that candidates forfeited marks. Difficulties with the auxiliary elevation included an incorrect angle for X1-Y1, projecting from the elevation, and omission of the hidden detail. The sloping lines also posed difficulty for some candidates.

Question 2 *(Solids in contact)*

This question was the least popular question on the paper this year. The plan and elevation were drawn well by the majority of those attempting the question, apart from some cases where the fixing of centres in elevation was not correctly dealt with. The auxiliary elevation proved to be quite testing for a significant number of candidates, especially as regards the projection of the cylinder.

Question 3 *(Isometric projection)*

This question was very well answered and posed little difficulty for candidates. Both methods (axonometric axes method and isometric scale method) proved to be equally popular. The width of the cylinder in isometric projection was not accurately handled in a considerable number of cases.

Question 4 *(Surface development)*

The drawing of the plan and elevation presented little difficulty for candidates. However, determining the length of the curved surface, the true lengths and widths of the sloping surfaces and the application of these measurements to the surface development presented many obstacles, which a majority of the candidates had difficulty in overcoming. The question was not a popular one with candidates and attracted relatively low marks.

Question 5 *(Transformation geometry)*

The answering of this question posed the least difficulty for candidates this year. A small number of candidates made errors relating to the setting up of the given figure, especially in relation to the location of the line QR and the point S. Among the infrequent errors was the use of horizontal lines for the axial symmetry and a translation in the reverse of the specified direction.

Question 6 *(Ellipse and parabola)*

This question proved to be the most popular question on the paper this year and was well answered in most cases. A certain amount of difficulty was evident in two of the key constructions relating to the ellipse, namely, determining the minor axis and constructing the tangent. In most cases the construction of the parabola in a rectangle was handled extremely well. A small number of candidates had inconsistencies in the number of divisions used on the sides of the 60×50 rectangle.

ORDINARY LEVEL

Section A

Question 1 *(Completion of an orthographic)*

This question was answered very well and was a popular question.

Question 2 *(Freehand drawing)*

Candidates made a very good attempt at a freehand pictorial.

Question 3 *(Computer devices)*

This question was well answered. Most of the answers were correct.

Question 4 *(Conversion of a triangle to a rectangle)*

This question was well answered and was attempted by 75% of the candidates.

Question 5 *(Ellipse)*

The construction of the ellipse was well answered using the concentric circle method. Some candidates could not distinguish between major and minor.

Question 6 *(Inscription of a circle in a triangle)*

This question was poorly answered; constructions were seldom shown.

Question 7 *(Isometric)*

This question was very well answered. Dimensional inaccuracies were the main errors in this question.

Question 8 *(Scale)*

The concept of scale in relation to graphics was well understood.

Question 9 *(Area)*

Candidates achieved high scores in this popular question.

Question 10 *(Auxiliary)*

This question was poorly attempted. Candidates exhibited a lack of understanding of auxiliary projection.

Question 11 *(Isometric drawing on grid)*

This question was well answered. The block at the corner was often omitted.

Question 12 *(Shadow)*

Many candidates resorted to guesswork in relation to the positioning of the shadow on the vertical plane. Otherwise, this question was well answered.

Question 13 *(Arc tangential to two circles)*

This was a poorly answered question. Candidate knowledge of tangent constructions is very weak.

Question 14 *(Perspective)*

The concept of perspective is well understood and this is manifest each year. Many candidates are omitting the projection lines to the VPs.

Question 15 *(Rotation)*

This question was popular. Errors that did occur were in the orientation of the rotated figure.

Section B

Question 1 *(Orthographic projection)*

This question was very well answered question. The placing of the end elevation on the incorrect side of the elevation and the omission of the hidden detail and dimension lines were the most common errors.

Question 2 *(Ellipse)*

This question was very well answered. However, many candidates did not show *clearly* a method for obtaining points on an ellipse. Most candidates had little difficulty in completing the outline figure. However, the construction for the location of the centre of the four circles was seldom shown.

Question 3 *(Development)*

This question was very well answered. Locating the end view in the incorrect position, along with the omission of the fold lines in the development and the incorrect length of the curved surface, were the main errors exhibited.

Question 4 *(Pictorial drawing using oblique or isometric)*

This question was very well answered. Candidates had difficulty with the sloping sides, the depth of the openings on top and the position of the button.

Question 5 *(Transformation geometry)*

The small number of candidates who attempted it answered this question very well. Problems with the understanding of axial symmetry and central symmetry were the main difficulties encountered.

Question 6 *(Plane Figures)*

This question was not answered very well. Many candidates omitted the constructions required to locate the points of contact to each of the circles and the centres for each of the arcs. Points of contact were almost always omitted.

3 RECOMMENDATIONS FOR TEACHERS AND STUDENTS

Teachers should advise pupils of the success rate of candidates taking the Higher Level paper over recent years and should encourage pupils to take the Higher Level paper, as the syllabus lays a good foundation for Leaving Certificate Technical Drawing.

Teachers should promote the link between drawing using three axes and computer-aided applications for drawing.

Table 1, page 1, records the decline in the numbers taking this subject over a period of seven years. A number of factors may be contributing to this decline.

(i) There is an on-going decline in the total numbers taking the Junior Cycle Programme.

(ii) The supply of teachers available to teach the subject may be less than adequate.

(iii) There has been an increase in the numbers taking Material Technology (Wood). As Technical Graphics and Material Technology (Wood) are delivered by teachers with the same qualifications there has been a corresponding reduction in the number of teachers available to teach Technical Graphics.

(iv) The challenge of Leaving Certificate Technical Drawing for some teachers and some pupils over many years has not encouraged students or teachers to promote Junior Certificate Technical Graphics.

However, teachers should be aware of the impending changes to Technical Drawing. They will find that the existing syllabus in Technical Graphics is leading the way in relation to the topic of three-dimensional geometry by the inclusion of projection using three axes. Teachers and pupils will find that a good foundation has been laid for the proposed project work in CAD at Leaving Certificate level. The inclusion of an appropriate geometry in Technical Graphics will also greatly assist in the introduction of the revised Leaving Certificate Programme.