



LEAVING CERTIFICATE EXAMINATION

2002

TECHNICAL DRAWING

HIGHER AND ORDINARY LEVELS

CHIEF EXAMINER'S REPORT

1. INTRODUCTION

The Leaving Certificate examination in Technical Drawing is offered at two levels – Ordinary Level and Higher Level. At each level the examination comprises three components in the form of terminal examination papers.

1. Paper I Plane and Solid Geometry
2. Paper II (A) Engineering Applications
3. Paper II (B) Building Applications

Each examination is of three hours duration. All candidates must take Paper I. Candidates may opt for either Paper II (A) or Paper II (B).

Each paper is allocated 200 marks. A candidate's final result is determined by combining the results obtained on Paper I and the relevant Paper II. Therefore, the total mark for the overall examination is 400.

Table 1: Allocation of marks to each paper

	Plane & Solid Geometry Paper	Applications Paper	Total
	Paper I	Paper II (A) or Paper II (B)	
Ordinary Level	200 marks	200 marks	400 marks
Higher Level	200 marks	200 marks	400 marks

Marking of the Examination

All six examination papers are marked separately by examiners appointed by the Department of Education and Science.

Candidate Numbers

This year 6039 candidates sat the examination in this subject. This figure represented 10.9% of the total Leaving Certificate cohort of 55,432. This percentage has remained effectively static over the past number of years, essentially confirming that the decline in numbers taking Technical Drawing at Leaving Certificate level is in line with the overall decline in the Leaving Certificate cohort. These figures are outlined in Table 2.

Table 2: Numbers and percentages of candidates taking Technical Drawing in each year

Year	Total cohort	Technical Drawing	
		Number	Percentage
2002	55,432	6039	11%
2001	56,686	6380	11%
2000	60,736	6761	11%
1999	62,826	7517	12%

Overall, 1239 (20.5%) candidates opted for Paper II (A) (Engineering Applications) while 4800 (79.5%) chose Paper II (B) (Building Applications).

Of the total of 6039 candidates, 3112 (51.5%) took the Higher Level paper and 2927 (48.5%) opted to sit the examination at Ordinary Level. This is the second year in succession that the numbers opting for the Higher Level paper have surpassed those opting for the Ordinary Level. This upward trend is to be encouraged

. These figures are outlined in Table 3.

Table 3: Numbers and percentages of candidates taking Technical Drawing at each level in each year

Year	Total	Higher Level		Ordinary Level	
		Numbers	%	Numbers	%
2002	6039	3112	51.5%	2927	48.5%
2001	6380	3199	50.1%	3181	49.9%
2000	6761	3349	49.5%	3412	50.5%
1999	7517	3719	49.5%	3798	50.5%

The number of males sitting the subject continues to exceed significantly the number of females, with females accounting for just 6% of the total who sat this year's examination.

2. PERFORMANCE OF CANDIDATES

HIGHER LEVEL

This year's overall distribution of grades at Higher Level is outlined in Table 4.

Table 4: Numbers and percentages of candidates achieving each grade in Higher Level Technical Drawing in 2002

	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG	TOTAL
Number	259	219	289	309	314	296	287	330	264	181	200	139	23	2	3112
%	8.3%	7.0%	9.3%	9.9%	10.1%	9.5%	9.2%	10.6%	8.5%	5.8%	6.4%	4.5%	0.7%	0.1%	
Number	478		912			913			645			139	23	2	3112
%	15.4%		29.3%			29.3%			20.7%			4.5%	0.7%	0.1%	
Number	2303								645			164			3112
%	74.0%								20.7%			5.3%			

This year's grade distribution is outlined in pictorial format in Chart 1.

Chart 1: Grade Distribution in Higher Level Technical Drawing in 2002

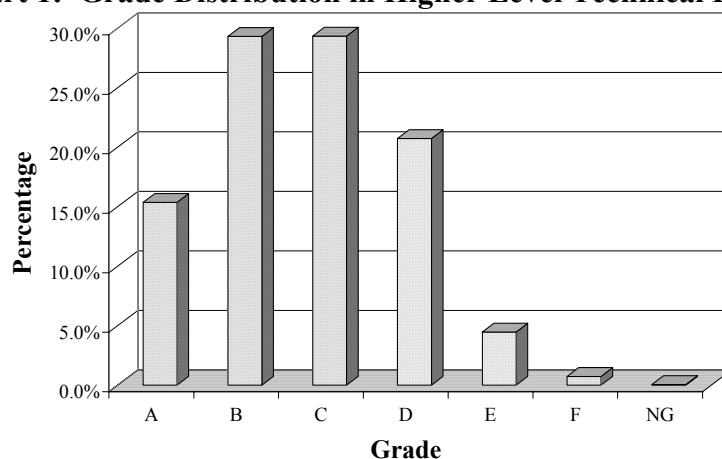


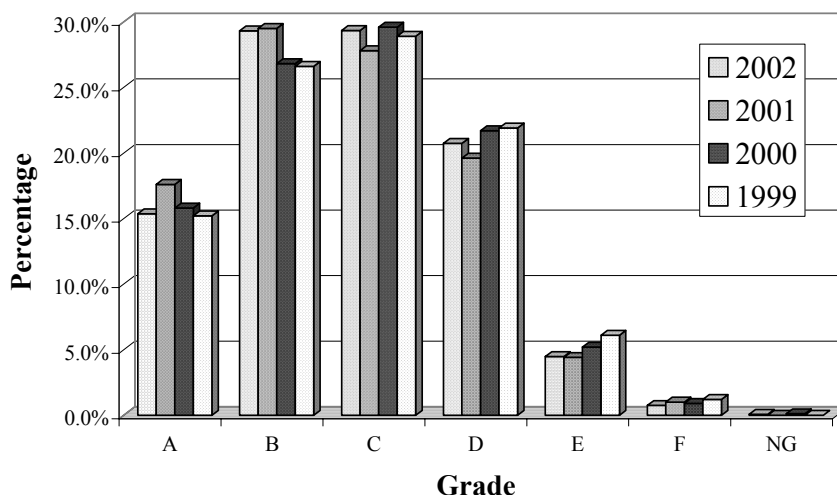
Table 5 compares the grade distribution in 2002 with those of previous years.

Table 5: Numbers and percentages of candidates achieving each grade in Higher Level Technical Drawing in each year

Year	A	B	C	D	E	F	NG
2002	15.4%	29.3%	29.3%	20.7%	4.5%	0.7%	0.1%
	74.0%			20.7%	5.3%		
2001	17.6%	29.5%	27.8%	19.6%	4.4%	1.0%	0.0%
	74.9%			19.6%	5.4%		
2000	15.8%	26.8%	29.6%	21.7%	5.2%	0.9%	0.1%
	72.2%			21.7%	6.2%		
1999	15.2%	26.6%	28.9%	21.9%	6.1%	1.2%	0.0%
	70.7%			21.9%	7.3%		

The percentage of candidates obtaining a grade C or higher increased between 1999 and 2001 and has remained at this improved level this year. Over the same period the percentage of candidates obtaining less than a grade D has fallen significantly, and has remained at the lower level this year. Both of these trends are to be welcomed by all concerned. These figures are outlined in pictorial format in Chart 2.

Chart 2: Grade Distributions in Higher Level Technical Drawing 1999 - 2002

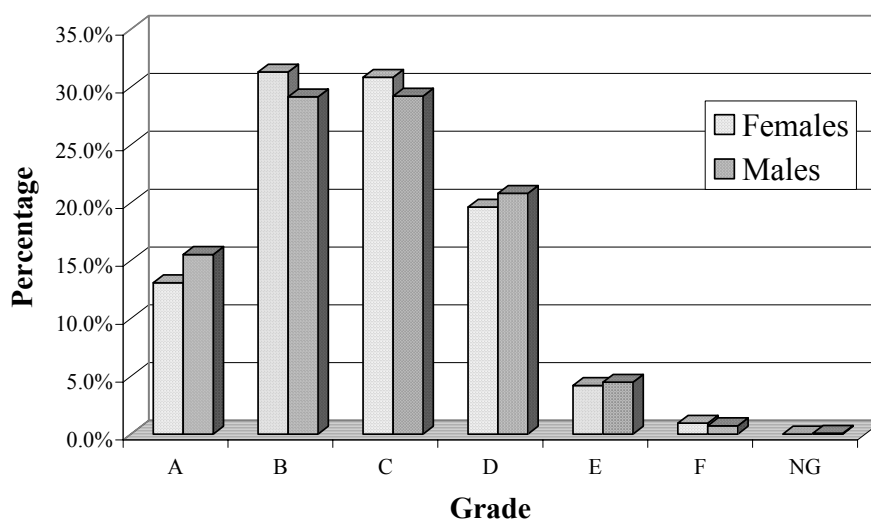


There is no statistical evidence of any significant difference in performance between females and males. The figures to support this are outlined in Table 6 and Chart 3.

Table 6: Percentages of females and males achieving each grade in Higher Level Technical Drawing in 2002

	A	B	C	D	E	F	NG
Females	13.1%	31.3%	30.8%	19.6%	4.2%	0.9%	0.0%
Males	15.5%	29.2%	29.2%	20.8%	4.5%	0.7%	0.1%

Chart 3: Comparison of grades achieved by females and males in Higher Level Technical Drawing in 2002



ORDINARY LEVEL

This year's overall distribution of grades at Ordinary Level is outlined in Table 7.

Table 7: Numbers and percentages of candidates achieving each grade in Ordinary Level Technical Drawing in 2002

	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG	TOTAL
Number	143	213	242	301	314	338	322	263	222	201	188	143	33	4	2927
%	4.9%	7.3%	8.3%	10.3%	10.7%	11.5%	11.0%	9.0%	7.6%	6.9%	6.4%	4.9%	1.1%	0.1%	
Number	356		857			923			611			143	33	4	2927
%	12.2%		29.3%			31.5%			20.9%			4.9%	1.1%	0.1%	
Number	2136								611			180			2927
%	73.0%								20.9%			6.1%			

This year's grade distribution is outlined in pictorial format in Chart 4.

Chart 4: Grade Distribution in Ordinary Level Technical Drawing in 2002

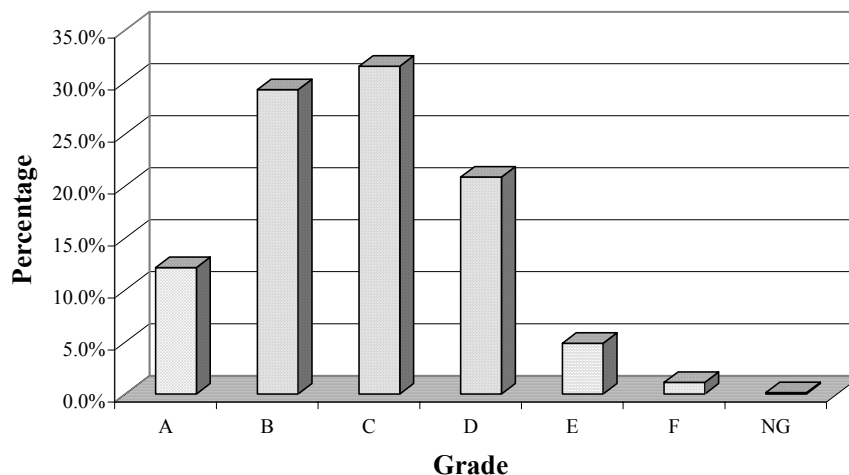


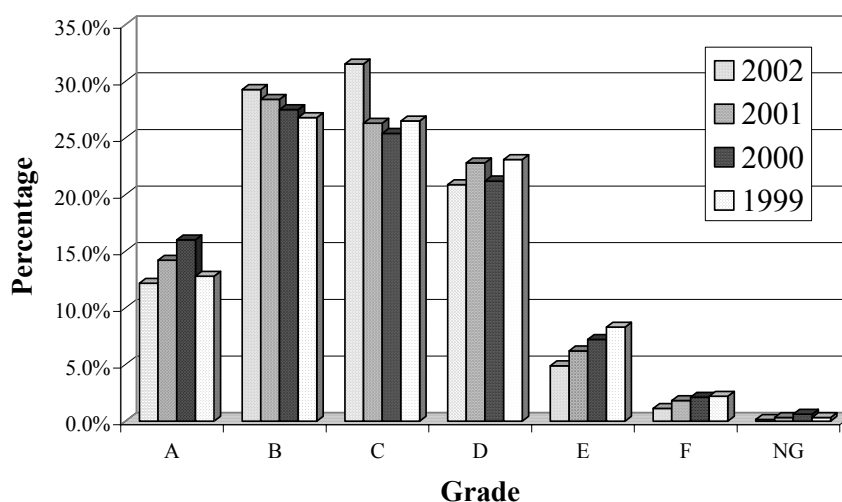
Table 8 compares the grade distribution in 2002 with those of previous years.

Table 8: Numbers and percentages of candidates achieving each grade in Ordinary Level Technical Drawing in each year

Year	A	B	C	D	E	F	NG
2002	12.2%	29.3%	31.5%	20.9%	4.9%	1.1%	0.1%
	73.0%			20.9%	6.1%		
2001	14.2%	28.4%	26.3%	22.8%	6.2%	1.8%	0.3%
	68.9%			22.8%	8.3%		
2000	16.0%	27.5%	25.4%	21.2%	7.2%	2.1%	0.6%
	68.9%			21.2%	9.9%		
1999	12.8%	26.8%	26.5%	23.1%	8.3%	2.2%	0.3%
	66.1%			23.1%	10.8%		

It is noted that the percentage of candidates obtaining an A grade has decreased slightly over the past two years. This can be accounted for by the fact that the percentage opting for Higher Level has increased over the same period. Notwithstanding this decrease, the percentage obtaining a grade C or higher in the past four years has increased to a level of 73%. These figures are illustrated in Chart 5.

Chart 5: Grade Distributions in Ordinary Level Technical Drawing 1999 - 2002



3. ANALYSIS OF CANDIDATE PERFORMANCE

The following section contains a detailed commentary on each of the six examination papers. The comments are intended to aid teachers and candidates in preparing for future examinations. Statistics quoted in this section are based on a random sample of approximately 12% of candidates' scripts.

Higher Level Paper I (Plane and Solid Geometry)

Overview

The candidates were presented with seven questions and were required to answer any four. All questions carried a total of 50 marks each.

Overall, the examination paper contained well-structured questions, with easier elements generally located at the preliminary stages and with the level of difficulty increasing as the questions progressed. This provided an opportunity for candidates of varying abilities to attempt a variety of questions and obtain a wide range of marks.

The examination was fair and allowed candidates sufficient opportunity to demonstrate their knowledge of the subject. The format and content were similar to previous years and provided candidates with ample standard material to achieve a worthy grade. While just under 70% of candidates achieved a grade C or higher on this paper, it is a cause of concern that some 8.6% of candidates achieved less than a D grade. Even though the paper was very fair and predictable, some candidates still found it difficult to achieve the 40% necessary for the award of a D grade. It is the case that some candidates, who opted for the Higher Level paper, would have performed better at Ordinary Level. It should also be noted that, of the candidates who sat the Ordinary Level paper, a significant percentage could have performed admirably at Higher Level. It is therefore recommended that candidates give greater consideration to their choice of levels in order to maximise their true potential.

The overall grade distribution for the paper is outlined in Table 9.

Table 9: Percentages of candidates achieving each grade in Higher Level Paper I

Grade	A	B	C	D	E	F	NG
% of Candidates	16.5%	25.8%	27.4%	21.7%	7.4%	1.1%	0.1%

Popularity of Questions

The pattern of question choice was broadly in line with previous years, with Questions 1, 3, 4 and 5 being the more popular. Table 10 outlines the popularity of questions in terms of the percentage of candidates attempting each question.

Table 10: Percentages of candidates attempting each question in Higher Level Paper I

Question	1	2	3	4	5	6	7
% of Candidates	97.2%	25.3%	86.9%	77.2%	71.9%	32.2%	23.1%

Questions 6 and 7 were broadly perceived as being somewhat easier than in previous years but this did not result in a significant increase in the uptake of these questions.

Standard of Answering

Overall, the standard of answering tended to vary between examination centres. Some excellent answering was presented. This is evident from the fact that 16.5% achieved a grade A. These candidates produced neat and accurate drawings and demonstrated an ability to solve problems in

two- and three-dimensions using the appropriate geometries and their underlying principles and theorems. The solutions presented displayed evidence of a well-structured analysis of the topics combined with careful and thorough revision practices.

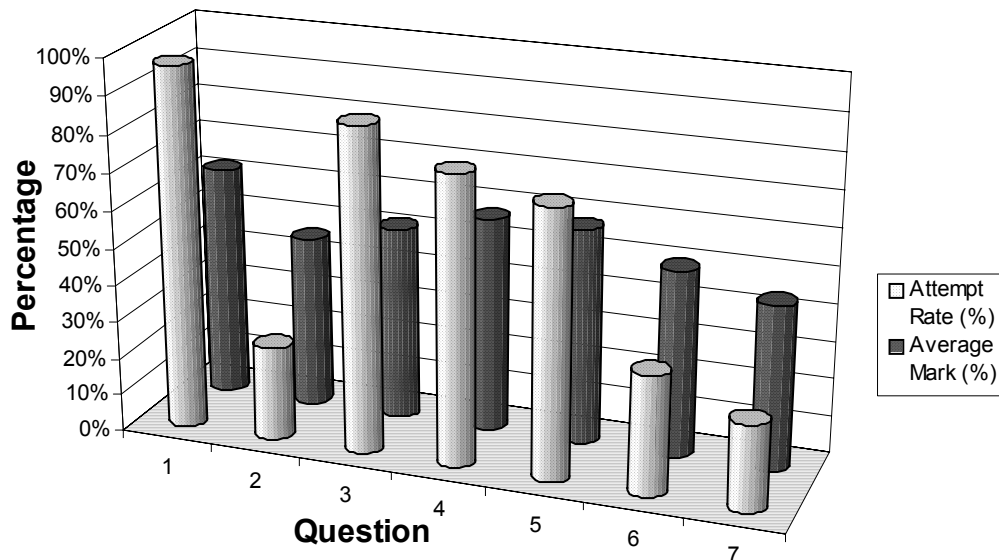
Most candidates appeared to have sufficient time to attempt four, and sometimes more, questions. Some of the attempts at questions were exceptionally good and obtained full marks. Table 11 outlines the average marks obtained by candidates in each of the seven questions.

Table 11: Average marks achieved by candidates in each question in Higher Level Paper I

Question	1	2	3	4	5	6	7
Average Mark	31.2	23.2	26.0	28.8	29.0	25.0	22.1

Chart 6 compares the attempt rate and the average mark for each question. It is of particular note that the average marks for Questions 2, 6 and 7 significantly exceed the attempt rates for the same questions.

**Chart 6: Attempt rate vs average mark for Higher Level Paper I
(average marks are quoted in percentage terms)**



While most candidates did extremely well over the range of questions on the paper, there was a significant percentage who scored well in one, two or three questions but offered little more than token solutions to the remainder. In this case, better time management and more complete revision of the entire syllabus is recommended. The practices of preparing for only the required minimum of four questions is not recommended as it can, evidently, render candidates at a disadvantage during examinations.

Presentation of Work

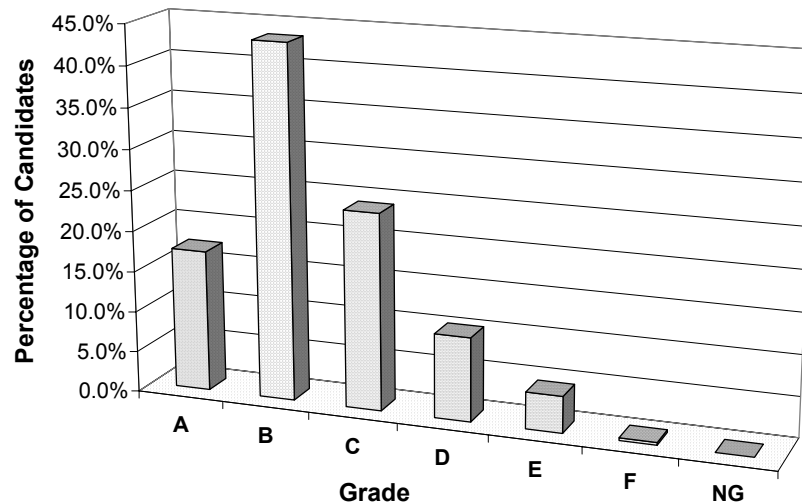
The quality of draughtsmanship and presentation of work was satisfactory. The instructions to candidates state that construction lines must be clearly shown on all solutions. However, while most candidates observe this instruction, some still continue to omit construction and projection lines. Some candidates do not draw these lines clearly. Other candidates do not include any form of indexing; indexing can be very helpful in the solution to most questions, but is particularly beneficial in Questions 1, 4, 5 and 7. Candidates should, therefore, be encouraged to show all construction lines clearly and to use indexing where appropriate.

QUESTION ONE

Co-Ordinate Geometry

This was the most popular question with an attempt rate of 97.2%. It also had the highest average mark of 31.2. Chart 7 outlines how the candidates performed on this individual question.

Chart 7: Percentages of candidates achieving each grade in Question 1, Higher Level Paper I



Very few candidates had any difficulty with the interpretation of the coordinates and almost all drew the projections of the planes correctly. Part (a) was very well answered. Simple mistakes included neglecting to draw the elevation of the line of intersection and projecting back to the wrong line(s) in plan.

Most candidates also correctly located the line of intersection. The most common approach to finding this line was to obtain an edge view of one of the planes. However, each year, the number of candidates using the section plane method is increasing. Those who used the edge view method tended to fare better than those who used the section method, as the latter appeared to confuse some candidates. The fact that two sections were required this year caused difficulty for some and resulted in subsequent errors. Some candidates succeeded in locating one point of intersection between the planes but experienced difficulty in finding a second. Invariably, these candidates drew the line of intersection through the plan of the point A or through the apparent point of intersection of the lines BC and EF.

Part (b), which involved finding the dihedral angle, was exceptionally well answered. Full marks were frequently awarded. Most candidates used two auxiliaries to solve the problem, while a small number used three. The vast majority tended to project all points on the two planes through the auxiliary views but many experienced difficulty in getting all points on both planes to appear collinear in the view showing the dihedral angle. Some candidates, who were unable to find the line of intersection, created a line of intersection and attempted to find the dihedral angle.

Part (c) of the question was less well answered, with only a very small number of candidates managing to draw the correct projections of the required line. Some candidates did not attempt this part at all. Candidates' overall difficulty with visualising the problem and its solution was evident here. Some candidates drew an elevation of the correct cone but were unable to project its plan. A simple but frequent error involved candidates drawing a cone at 50° to the H.P. instead of at 40° . A common attempt was to create a plane through E parallel to ABC in an auxiliary view showing

ABC as an edge, or in a view showing the dihedral angle. While these candidates may not have been able to complete the solution, they were, nonetheless, awarded marks for any correct constructions that could have subsequently led to its completion.

Overall, this was a challenging but fair part of the question. It required a high level of spatial reasoning, and it provided an opportunity for the A and B grade candidates to demonstrate their spatial visualisation and problem-solving skills.

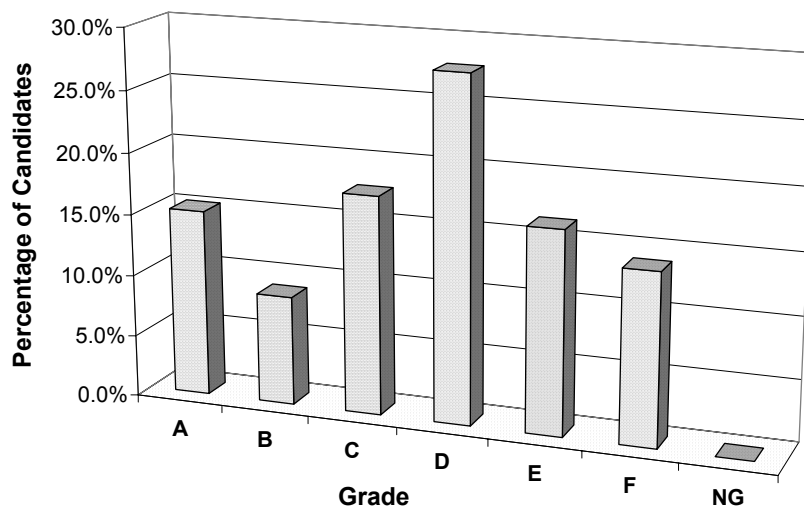
Part (d) was attempted by most and was generally well answered. The parallel plane method was the primary means of solution. Very few attempts to solve the problem using the point view method were encountered. A small number of candidates misread the question and located the shortest distance as opposed to the shortest horizontal distance.

QUESTION TWO

Area of Figures

This question was not a popular option, being attempted by only 25.3% of the total cohort. It had the second lowest average mark of 23.2. Chart 8 illustrates candidate performance in this question.

Chart 8: Percentages of candidates achieving each grade in Question 2, Higher Level Paper I



In general, this question was answered either very well or very poorly. In the case of the latter, the question appeared to be chosen by candidates whose answering in other questions indicated that they were insufficiently prepared for the examination. The candidates who scored well in this question tended to be clustered in centres.

Many candidates made no attempt, or a very poor attempt, at determining the length of the chord BD. Many simply scaled the length from the examination paper, indicating that candidates had little understanding of the related theorem. Those who did determine the correct length tended to opt for a mathematical solution rather than using a graphical method. The calculations were invariably shown on the answer sheet, which is essential in order to avoid losing marks.

The plotting of the locus between B and D was not as well answered. Some candidates were able to determine the combined length of BC and CD, but were unable to draw the required locus. Many candidates completed the quadrilateral by merely copying the figure from the examination paper by scaling. Some candidates positioned point C directly above the centre of the circle.

While some excellent answers were provided to part (b) of the question this was not the norm. Two primary solutions were evident.

- Candidates converted the quadrilateral to a triangle. They then divided the base in the ratio of 2:3 and used triangles between parallels to complete the solution. This was the most frequent method used.
- Candidates divided a diagonal of the quadrilateral in the ratio of 2:3 and proceeded to divide the area.

Many candidates simply divided a side of the quadrilateral in the ratio of 2:3. Some divided the side AB or BC into three or five equal parts. Some candidates demonstrated an ability to draw a triangle equal in area to the quadrilateral. Many of these divided the base in the ratio of 2:3. Only the very high-scoring candidates managed to complete the solution.

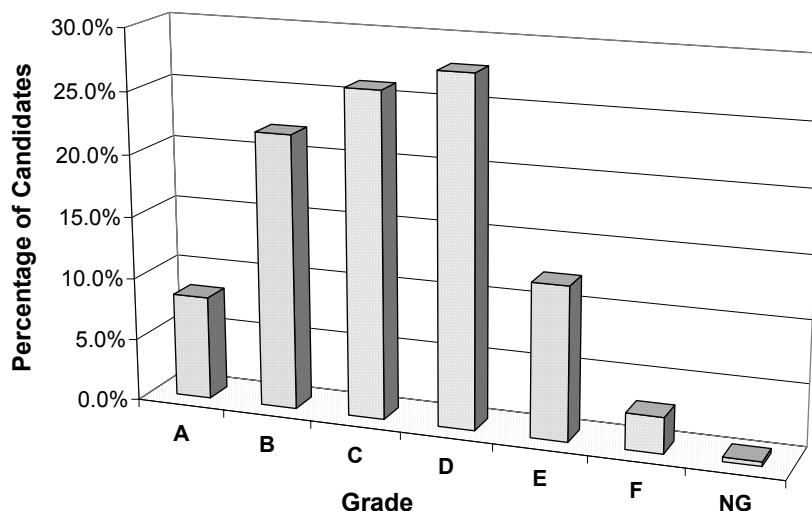
While the average mark would suggest a relatively poor overall performance on this question, it continues to be an excellent choice for those who are properly prepared. Candidates should be encouraged not to take this question simply in a last option scenario.

QUESTION THREE

Solids in Contact

This question was the second most popular. It was attempted by 86.9% of the candidates and the average mark awarded was 26.0. Chart 9 illustrates candidate performance in this question.

Chart 9: Percentages of candidates achieving each grade in Question 3, Higher Level Paper I



Part (a) was well answered, indicating candidates' spatial ability in dealing with two solids when both are resting on the horizontal plane. Most candidates solved the problem using rotation in the elevation, while a small number used an auxiliary elevation. Candidates experienced little difficulty in dealing with the visualisation of the position of the solids with regard to hidden lines. Common mistakes here included projecting the point P directly onto the extreme generator in elevation, and the simple omission of hidden detail. Some candidates drew the normal through the elevation of the point P instead of at the side of the cone.

Part (b) is a standard problem, which is frequently examined. However, candidates' overall difficulties with visualising planes and their traces were evident again this year. While those

candidates who achieved an A or B grade usually solved the problem, others seemed unable to visualise a solution. While some managed to draw the elevation of the cone about the sphere, most were unable to determine the plan of the cone. These candidates usually drew the horizontal trace tangential to the plan of the sphere. The method of finding the vertical trace of the plane was, in contrast, well executed.

Part (c) was well answered by only a small number of candidates. Those who solved the problem did so by means of loci. While most of the better candidates got to the stage where they could draw one set of arcs or lines of the required locus, very few were able to determine the second set. Many candidates drew a locus equidistant between Q (or the centre of the cone) and the XY line in plan. The solutions presented displayed an inability to solve a three-dimensional space problem where the locus moves in three dimensions relative to the planes of reference.

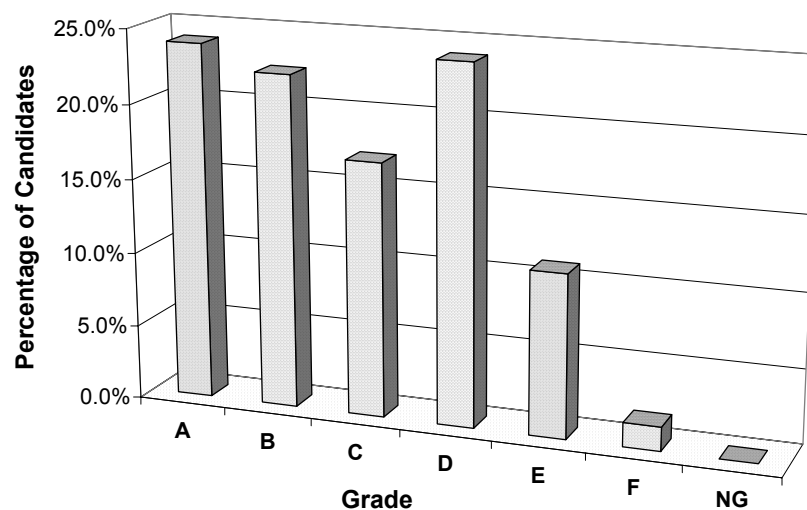
Notwithstanding the problems encountered by some candidates, particularly in relation to part (c), this continues to be a popular and rewarding question choice for candidates, particularly those with better levels of spatial ability.

QUESTION FOUR

Interpenetration of solids

This question was the third most popular option. It was attempted by 77.2% of candidates. The average mark was 28.8. Chart 10 illustrates candidate performance in this question.

Chart 10: Percentages of candidates achieving each grade in Question 4, Higher Level Paper I



The vast majority of candidates used the auxiliary view method to solve the problem, with only a very small percentage opting for the section planes method. The drawing of the outline plan and elevation of the solids proved to be quite straightforward for the vast majority of candidates. The transfer of widths to plan was remarkably well handled this year. There were generally very good attempts at the drawing of the auxiliary plan.

Some candidates did not draw the unbroken edge in plan and elevation. The main difficulty experienced by candidates was an inability to determine the elevation of the points C, D and E. Many drew lines from the apex of the pyramid, which passed 'through' the solid instead of drawing lines on the surface of the solid. This resulted in candidates locating points within the solid or points outside the solid and not on the surface as required. Many candidates managed to determine at least two of the three points P, Q and R. The point P was the one most frequently omitted. The

points S and T were also often omitted. Frequently this was because candidates neglected to draw the horizontal line containing them in the auxiliary plan.

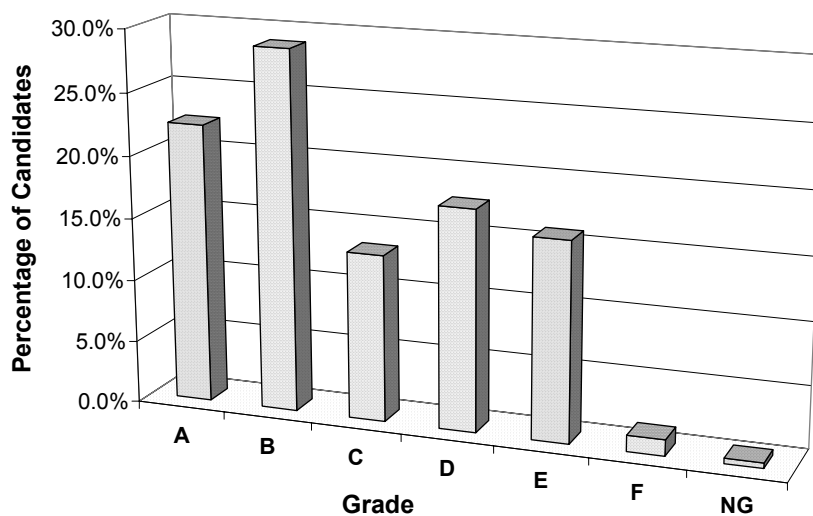
Some candidates experienced difficulty with the visualisation of the intersection when joining up the points, in particular with regard to hidden detail. While it was rare for candidates to be awarded full marks in this question it did, nonetheless, prove to be the best question for most candidates.

QUESTION FIVE

Loci

This question was a popular one and was generally well answered. It was attempted by 71.9% of candidates. The average mark awarded was 29.0. Chart 11 illustrates candidate performance in this question.

Chart 11: Percentages of candidates achieving each grade in Question 5, Higher Level Paper I



Answering in part (a) was good. Dividing both arcs into six equal parts, instead of nine, and hence establishing an inaccurate curve frequently resulted in a loss of marks. Another frequent error was to divide the semi-circle into six equal parts, having divided the arc PCA into nine equal parts. The most common approach to finding points on the locus was to draw two sets of arcs. A mistake that occurred frequently was the incorrect identification of points on the curve, where candidates selected the incorrect points of intersection of the arcs. A small number of candidates found points on the locus by drawing the profile in its rotated position each time.

The exact location of the turning point T was frequently omitted. The majority simply 'guessed' a position for the turning point by drawing the curve to touch the horizontal line from O.

Other errors included:

- drawing the locus of the point P as it travelled along the straight line PA;
- drawing the locus of the point A as it travelled along the semi-circle from A to P;
- drawing the cycloid obtained from plotting the locus of P without consideration of the combined movement.

Part (b) of the question was, in general, not well answered. Errors occurred in the location of points on the involute. A significant percentage of candidates drew the tangents in the wrong direction. A number of candidates misread the question and unwound the involute from A to P. Some candidates extended the division lines and marked distances on these.

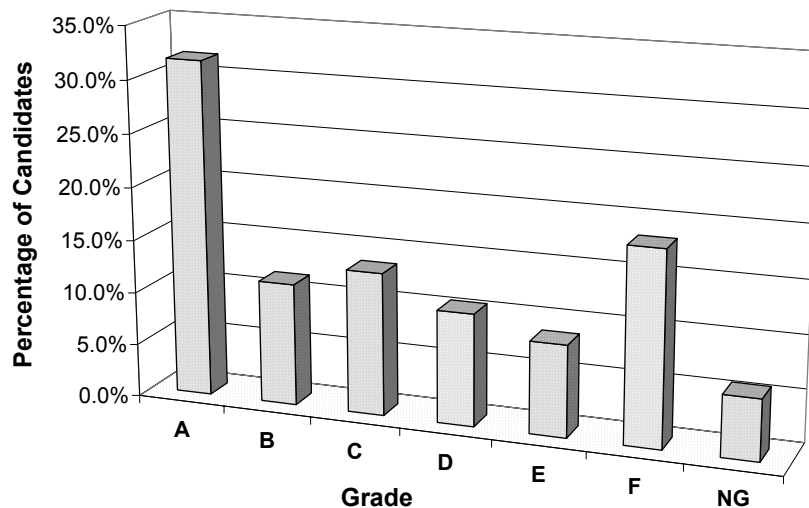
Overall, however, this question had the second highest average mark, the highest being Question 1.

QUESTION SIX

Conic Sections

This was not a popular question, being attempted by only 32.2% of the total cohort. The average mark awarded was 25.0. In general, the answers, and subsequently the marks awarded, tended to be at either end of the spectrum, with very little middle ground. This is evident from Chart 12, which illustrates candidate performance in this question.

Chart 12: Percentages of candidates achieving each grade in Question 6, Higher Level Paper I



Part (a) was well answered. While some candidates were unable to locate the directrix, most displayed a good knowledge of the constructions for locating points on a parabola when given the focus and the directrix. As expected, a reasonable percentage of candidates were able to determine the centre of curvature. The main cause of error was an inability to construct a normal to a parabola. Some candidates simply guessed a position for the tangent and proceeded to draw a normal at right angles.

Part (b) was well answered. Most candidates, who solved the problem, did so by drawing a perpendicular from one of the foci to the tangent and then drawing the major circle. Some candidates found the point of contact first and then determined the length of the major axis and proceeded from there.

In general, candidates either knew how to determine the point of contact between the tangent and the curve or not. This part was well answered by A and B grade candidates. A significant number of candidates treated the tangent as the eccentricity line. Even though these lines were quite close, the two did not coincide. These candidates marked the end of the latus rectum as the point of contact.

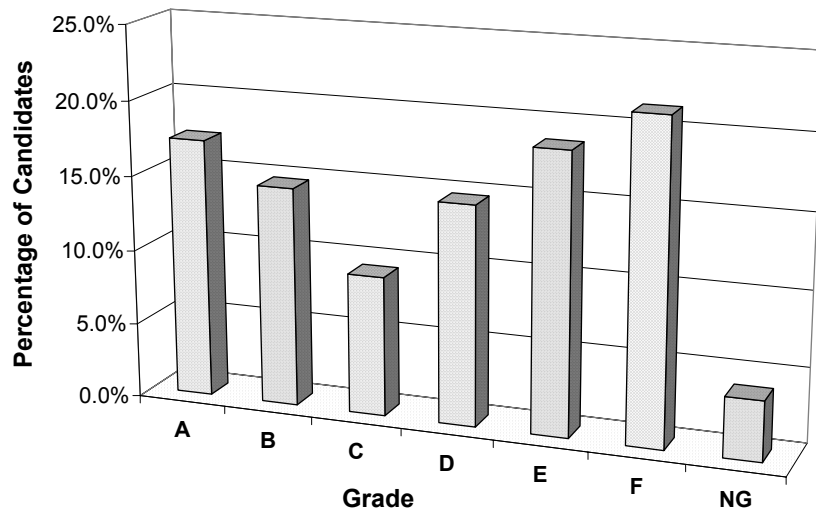
It is widely acknowledged that this question has been quite candidate-friendly in recent years and it is recommended that more candidates should explore the option of taking this question.

QUESTION SEVEN

The Oblique Plane

This question was attempted by only 23.1% of candidates and surprisingly it had the lowest average mark of 22.1. Chart 13 illustrates candidate performance in this question.

Chart 13: Percentages of candidates achieving each grade in Question 7, Higher Level Paper I



It is widely agreed that this question has been one of the most candidate-friendly questions on the paper in recent years. This year was no exception, yet it is surprising that it still remains unpopular.

Even though this question was quite straightforward, it was nonetheless not well answered. In general there was wide variation in the standard of answering. Only a few solutions merited full marks, while much of the work presented indicated a lack of understanding pertaining to the concept of the oblique plane.

The first part of the solution required only a basic understanding of the concept of a three-dimensional rotation of a familiar solid. However, this was not well answered. Many candidates made no attempt at the rotation at all. These candidates drew a square, of side 60 mm, in plan and guessed the heights for the pyramid in elevation. Having done so, candidates then usually proceeded to cut the pyramid successfully with the plane VTH.

The final part, requiring a thorough understanding of the inclination of an oblique plane to the planes of reference, was not well answered, and was frequently omitted. Some candidates attempted to solve the problem by drawing a series of auxiliary views, but without much success. Here, as always, candidates were awarded marks for any work presented that could have led to the correct solution.

It is recommended that more candidates be encouraged to consider this question as an option in future years with a view to gaining improved marks. It is also the case that much of the knowledge associated with oblique planes could assist them in answering a question, or question parts, elsewhere.

Higher Level Paper II (A) (Engineering Applications)

Overview

The examination paper comprised six questions of which candidates were required to answer any four. All questions carried 50 marks.

Performance of Candidates

A total of 554 candidates attempted this level (representing a decrease of 6.6% on last year). Overall the results were in keeping with those in the recent past. When compared with the 2001 results, there was a 1.4% increase in the percentage achieving grade A, an increase of 3.8% in grade B, and a reduction of 5.2% in grade D. A total of 82.5% of candidates were awarded a grade C or higher, while 4.2% of candidates scored a grade E or lower. Table 12 outlines the overall grade distribution and compares it to last year's figures.

Table 12: Percentages of candidates achieving each grade in Higher Level Paper II (A) in each year

Year	A	B	C	D	E	F	NG
2001	13.8%	31.4%	32.4%	18.2%	3.7%	0.5%	0.0%
2002	15.2%	35.2%	32.1%	13.0%	3.8%	0.5%	0.2%

Popularity of Questions

Table 13 shows the ranking of questions in order of decreasing popularity. These figures are derived from an analysis of a random sample of approximately 20% of the total scripts.

Table 13: Percentages of candidates attempting each question in Higher Level Paper II (A)

Attempts (%)	Rank order	Question no.	Topic
93	1	5	Cam/mechanism
92	2	1	Assembly drawing
85	3	4	Dimensioned drawing, etc.
64	4	2	Machine drawing
37	5	3	Gears
31	6	6B	CAD
30	7	6A	Pump sketch

General Comments

The examination paper was perceived as a very fair test, well laid out and in keeping with previous years. Overall the standard of answering was quite good. Most candidates had a good knowledge of the syllabus and had sufficient time to complete the examination. Analysis of the number of questions attempted reveals that 94% of candidates attempted the requisite number of four questions. Almost 6% of candidates had enough time to attempt a fifth question. These statistics are similar to previous years.

The following is an analysis of the individual questions.

QUESTION ONE

Assembly Drawing: Rail-Transport Hanger

This was the second most popular question on the paper, with 92% of candidates attempting it. The overall standard of answering was very good. The average mark was 37.

In part (a) of the question, the assembly drawing was very well answered and only a few were unable to assemble the parts correctly. Some attempted to insert the shaft and pulley wheel from the left-hand side of the hanger, thus removing part of the support web in doing so. Many did not work out the overall height of the assembly and selected the wrong starting position and, consequently, had to stick a patch at the top of the sheet to draw the eyebolt. Some turned the assembly sideways. Many candidates wasted valuable time by drawing out a parts list that was not required.

Some drew a projection symbol (which was not necessary as they had only a single view). The sectioning of the assembly was often poorly attempted and a number sectioned the parts only as they appeared on the examination paper. The majority did not insert correct centrelines.

In part (b), many candidates did not insert the item references as recommended in drawing standards. The printing of the drawing title was often poorly presented.

In part (c), many candidates were unable or unwilling to suggest a suitable method of lubricating the shaft/bush. Some of the methods suggested were not practical and many sketches were of a poor standard. The following deficiencies in the responses presented for examination were noted:

- Incorrect sectioning of the web, eyebolt, shaft, nut, and washer
- Incorrect angle used for hatching
- Omitting to draw fillets, undercuts, chamfers, and threads
- Incorrect construction for establishing the centre of the tangential arc on the hanger and for the three arcs on the faces of the hex. nut
- Omitting, or poor attempt at printing, the drawing title
- Item references not inserted as recommended in drawing standards
- Centre lines incorrectly drawn.

QUESTION TWO

Machine drawing

Part (a)

This was the fourth most popular question. It was attempted by 64% of candidates. The average mark awarded was 31. Overall, the answers were very good in what was a time-consuming, and challenging, question. In many cases candidates had trouble in reading, interpreting/ visualising the drawing supplied. However, there were many good attempts at the section A-A and the section B-B. The more challenged candidates re-produced the drawing as given on the question paper and did not attempt the sectioning. A large number did not show the cutting planes and did not sub-title the views. Other common omissions were the projection symbol and centre lines in all views.

Part (b)

The isometric sketch was attempted by half the number who attempted the previous part and was only well answered by the more focussed candidates. Most candidates seemed to have a reasonable idea of the general shape to be produced but were not able to put it neatly on the drawing sheet. A

few took the view from the wrong corner and did not have X as the lowest point as directed in the question. Some did not hatch the cut surfaces, as was specified in the question. A sizable number used instruments in what was meant to be a freehand isometric sketch.

QUESTION THREE

Gear train, Meshing Spur/ Rack Gear, Bevel Gear

This question was attempted by 37% of candidates and the average mark was 32. It was the fifth most popular question.

Part (a) Gear train

This was very well attempted and answered. A number of candidates used different modules for each gear, resulting in incorrect PCD values. In most answers the direction of rotation was correctly specified but in many attempts the final rotational speed was incorrect. Many lost marks in presentation of the data.

Part (b) Meshing Spur/Rack Gear

Answers to this varied, with some candidates producing well-presented, accurate solutions while others produced inappropriate gear tooth shapes, usually because an incorrect dimension was calculated or guessed. Any recognised approximation was acceptable for the construction of the spur gear teeth but the method used should be clearly shown. Some incorrect responses had teeth with an involute form on the rack gear. Many candidates failed to show any gear formulae or calculations on the sheet and others did not provide the requested data in the spur gear table. Some calculated the PCD correctly but then used the wrong radius and drew the PCD either twice full size or half full size.

Part (c) Bevel Gear

Many candidates did not attempt this part of the question and few correct answers were encountered. A number of those who attempted the question failed to present a drawing of a bevel gear. Efforts to identify the specified gear features were disappointing.

QUESTION FOUR

Development and Sheet-metal Joints

This was the third most popular question on the paper and was attempted by 85% of candidates. The average mark awarded was 33. In general, the development was well answered, showing that the candidates understood the principles of triangulation. It is critical that candidates accurately obtain true lengths (a variety of methods are acceptable). True lengths lines should be drawn, indexed and identified as true lengths so as to distinguish them from generator/ triangulation lines. Where the true length already appears on the drawing then this must be identified on the answer.

In the development, some candidates did not have the seam at the specified position. Many incorrectly used twelve straight lines instead of a curve for the circular portion of the development. A large number incorrectly used 100 mm as the length of the base in the development, the actual true length appeared in the elevation as a sloped line.

The sheet-metal joints, part (b), were well attempted. The wired edge and grooved seam were well answered but a substantial number of candidates did not make an attempt at the S-type slip joint.

The following deficiencies were apparent in the responses presented for examination:

- True length construction not clearly shown or indexed
- No centre lines
- No generator/triangulation lines drawn on the elevation
- No generator lines/fold lines/symmetry line drawn on the development
- Development not indexed
- Development running off the sheet
- Shortest seam not supplied
- Sketches of sheet metal joints poorly presented, poor labelling.

QUESTION FIVE

Cam and Mechanism

There was a good standard of answering in the responses to this question. The question was both the most popular and the highest scoring on the paper. It was attempted by 93% of candidates and the average mark awarded was 41. Many answers merited full marks.

Part (a) Cam Design

The displacement diagram was well answered. However, some candidates confused the construction for uniform acceleration and retardation with that for simple harmonic motion. In the cam, many had the direction of rotation and the nearest approach incorrect. The majority of candidates drew a cam profile suitable for a knife-edge follower and did not allow for the specified roller follower. The following deficiencies in the responses presented for examination were noted:

- No indexing or indexing scribbled on the sheet
- No centre lines or camshaft drawn on the cam profile
- Wrong nearest approach and direction of cam rotation used
- No roller followers drawn
- Poor curves on cam profile
- Construction lines too dense
- Answers not tidied up.

Part (b) Mechanism

This part of the question was well attempted and many plotted the locus correctly. However, a sizeable number did not realise that the slotted links remained vertical and horizontal and swung arcs, resulting in an incorrect locus. The following deficiencies in the responses presented for examination were noted:

- Incorrect starting points resulting in an incorrect locus
- Poor drawing of locus curve
- No indexing or poor printing
- No centre lines
- Construction lines too dense.

QUESTION SIX

Section A

This question was attempted by 30% of candidates and was the third highest scoring question on the paper at 35 marks. It ranked last in the order of popularity.

Part (a) Freehand Drawing of Diaphragm Pump

This part was well answered. In the majority of cases very good quality freehand sketches were presented. However, many other sketches appeared rushed, with little attention paid to detail and some important pump parts omitted or poorly drawn. Identification of the flow direction, pump parts and typical application were well answered.

Part (b) Fastening Devices

This was generally poorly answered, indicating that it was not well covered in the classroom. Only a few candidates were able to answer all three parts of the question. Sketches were poor, usually incomplete and not labelled.

Section B

This question was attempted by 31% of candidates. It was the lowest scoring question, with an average mark of 30. Overall the standard of answering was good. The layout and presentation of many answers was less than impressive.

- (a) This part required the identifying of ten parts of the CAD interface. The majority of answers gained full marks. When marks were lost it was usually for mixing up the 'object snap toolbar' with the 'status bar'.
- (b) In this part, many candidates did not get the storage devices in the correct order, which indicated that they did not know the capacity of each. Only a small number selected the RAM as having the shortest access time and gave the correct reason.
- (c) This part was well answered by most, but only a small number got the co-ordinates correct when the plate was revolved about the Z-axis. Most made a reasonable attempt to explain the scaling operation.
- (d) The CAD commands 'Offset', 'Mirror' and 'Trim' were well answered, but 'Linetype Scale' was correctly answered by only a small number of candidates. Many suggested a line thickness change.
- (e) This part on solid modelling was not well answered; those who attempted it answered the extrusion part quite well. However, 'Revolution' and 'Union' were answered correctly by only a small minority; most sketched only what was given on the question paper.

Higher Level Paper II (B) (Building Applications)

Overview

The candidates were presented with seven questions and were required to answer any four. All questions carried a total of fifty marks.

The paper was identical in format and of a comparable standard to previous years. The overall performance of candidates followed a pattern similar to that observed in previous years. From the scripts of those candidates who obtained the higher grades there was evidence of a real interest in the subject being aroused and developed by conscientious and devoted teachers. Those scripts indicated thorough coverage of the syllabus, depth of thinking and highly developed spatial reasoning.

While the general standard of answering was very satisfactory there were some indications that discrepancies in performance tended to be more marked between examination centres rather than within them. It was particularly encouraging to observe that there were no misinterpretations of questions and that most candidates showed a commendable ability to use the time allotted to answer the four questions required. It was evident that the higher-achieving candidates had prepared well and had spent adequate time at constructive revision. Table 14 shows the distribution of grades for the examination paper.

Table 14: Percentages of candidates achieving each grade in Higher Level Paper II (B)

Grade	A	B	C	D	E	F	NG
% of Candidates	21.2%	28.3%	25.5%	18.8%	5.0%	1.1%	0.0%

The pattern of question choice was broadly in line with previous years, with the notable exception of Questions 1 and 6, which proved more popular than previously. Table 15 outlines the popularity of questions in terms of the percentage of candidates attempting each question.

Table 15: Percentages of candidates attempting each question in Higher Level Paper II (B)

Question	1	2	3	4	5	6	7
% of Candidates	73.9%	68.6%	27.9%	28.2%	88.6%	72.1%	74.6%

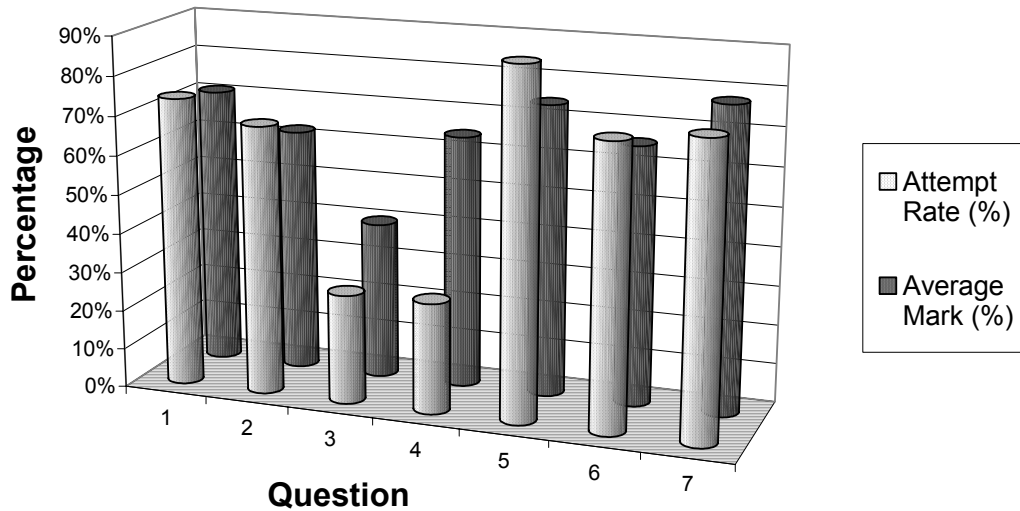
Most candidates appeared to have had sufficient time to attempt four, and sometimes more, questions. Some of the attempts to questions were exceptionally good and obtained full marks. Table 16 outlines the average marks obtained by candidates in each of the seven questions.

Table 16: Average marks achieved by candidates in each question in Higher Level Paper II (B)

Question	1	2	3	4	5	6	7
Average Mark	35.6	31.2	20.1	32.3	37.2	33	38.9

Chart 14 compares the attempt rate and the average mark for each question. It is of note that the average marks for Question 3 and, particularly, Question 4, significantly exceed the attempt rates for the same questions.

Chart 14: Attempt rate vs average mark for Higher Level Paper II (B)
(average marks are quoted in percentage terms)

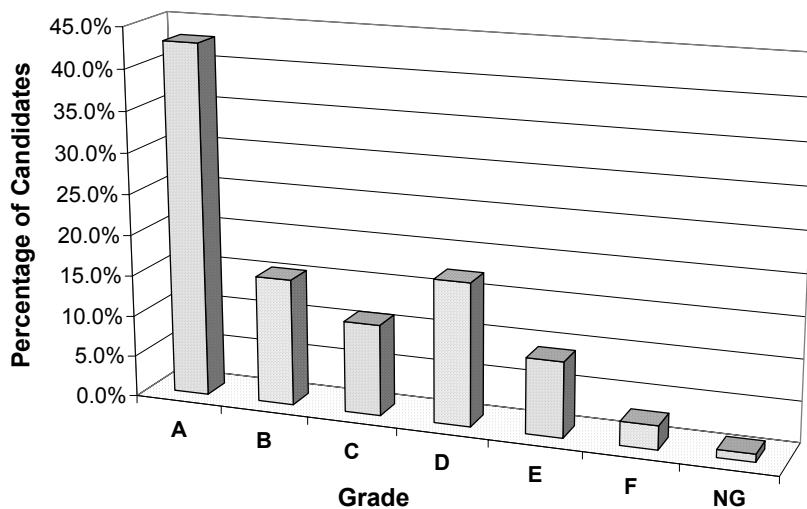


QUESTION ONE

Perspective Projection

This question on perspective projection was more popular than similar questions on the topic in recent years. It was attempted by 73.9% of candidates. The average candidate mark was 35.6. Chart 15 illustrates candidate performance in this question.

Chart 15: Percentages of candidates achieving each grade in Question 1, Higher Level Paper II (B)



As can be deduced from the chart, most answers were complete or almost complete. A number of solutions were completely correct, but the degree of accuracy varied considerably. The level of understanding of the basic setting up of the perspective drawing was particularly good. However,

many candidates incorrectly positioned the picture plane touching the lower left hand corner of the plan rather than through the internal point A as specified in the question.

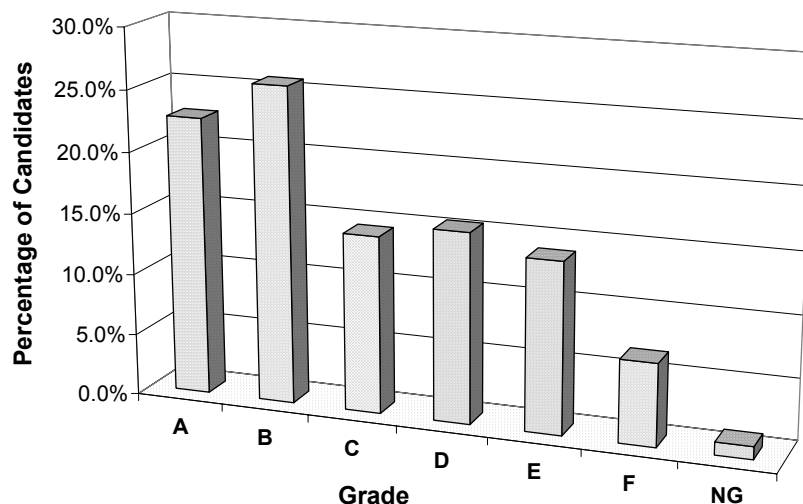
The most obvious weakness in otherwise excellent solutions was an inability to establish vertical heights in the perspective drawing. Auxiliary vanishing points for the inclined 30° lines were almost universally used but a reoccurring error was to locate both auxiliary vanishing points above the horizon line, one to the left and one to the right. A further simple error was not completing the underneath surface of the lowest inclined block in the perspective drawing.

QUESTION TWO

Roof Geometry

Some 68.6% of the candidates attempted this question on roof geometry. The average mark was 31.2. Chart 16 illustrates candidate performance in this question.

Chart 16: Percentages of candidates achieving each grade in Question 2, Higher Level Paper II (B)



The question was of an established style and was generally well answered. It did, however, contain enough material to challenge all candidates. While most solutions outlined clear geometrical constructions for each of the roof surfaces, a significant percentage appeared to use guesswork to find the orientation of the surface A in plan.

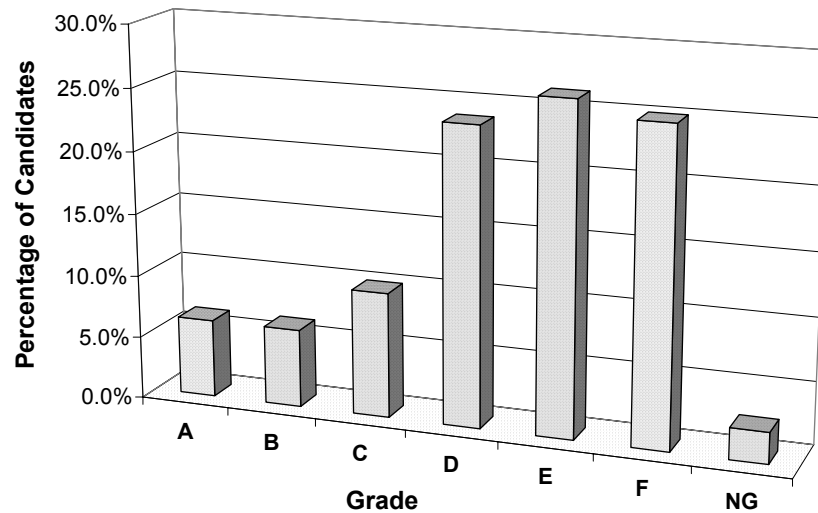
The approaches to locating roof surfaces D, E and F were, in general, logical and systematic. It was noted that many candidates found it necessary to draw an auxiliary elevation to determine the true length of the line of intersection between surfaces D and E, even though the true length was already shown in plan. This more lengthy and time-consuming approach was nevertheless equally correct. Many attempts at completing surface C were excellent. Predictably, part (b) of the question was answered very well and most attempts gained maximum credit.

QUESTION THREE

Shadow Projection

This question on shadow projection proved to be unpopular, as has been the case in previous years. It was attempted by 27.9% of candidates and, on the whole, was poorly answered, as is evident from Chart 17, which outlines candidate performance.

Chart 17: Percentages of candidates achieving each grade in Question 3, Higher Level Paper II (B)



The average mark attained by candidates for this question was only 20.1, i.e., just over 40%. As is the case on the Plane and Solid Geometry paper, many candidates would appear to prepare for only the minimum of four questions. This is a risky strategy and as a result candidates are frequently forced to attempt a question that they have not fully prepared for. It would appear that for many candidates this was such a last resort question and responses generally lacked conviction and authority.

A good measure of success was achieved however in efforts to determine the shadows cast by both the cylindrical surfaces and the conical surface of the structure on the ground. On the other hand, the area of shade on the conical surface in plan was rarely determined.

The lack of awareness of the need to determine the true direction of light to find the shadow cast by the spherical surfaces on the ground was very obvious. Candidates coped even less well with efforts to determine the area of shade on the sphere in plan even though most were aware that an area of shade existed.

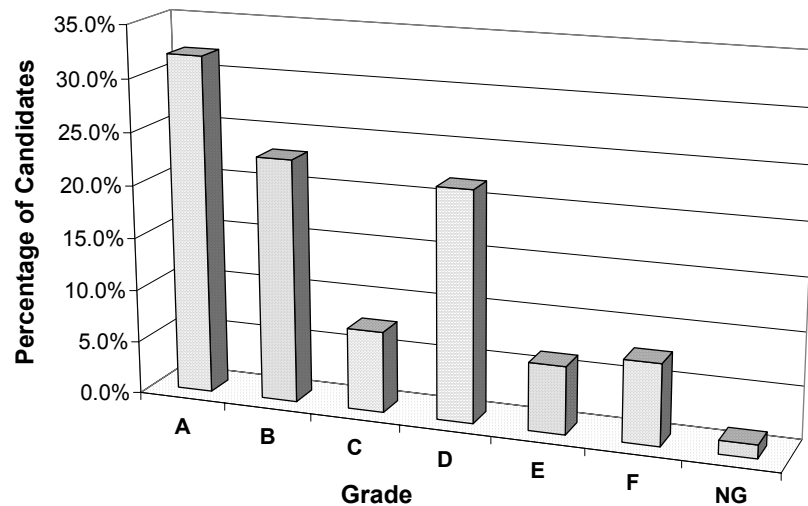
It is recommended that, if candidates are to opt for the shadow projection question in future examinations, the topic be given the classroom attention and subsequent revision that it warrants.

QUESTION FOUR

Hyperboloid of Revolution

As with Question 3 this question also proved to be unpopular. It was attempted by 28.2% of the candidates. However, the average mark for this question – 32.3 – was much higher than that for Question 3. Chart 18 illustrates candidate performance in this question.

Chart 18: Percentages of candidates achieving each grade in Question 4, Higher Level Paper II (B)



Generally, answers fell into two distinct categories: those which were completely correct and where constructions were clearly shown and those where an understanding of the relevant geometrical properties was evidently lacking.

In some cases candidates failed to show how they determined the length of the structure but proceeded well thereafter and gained marks accordingly. Candidates, in general, displayed the knowledge and understanding necessary to determine the hyperbolic curves in plan and elevation. A small but significant percentage of candidates successfully utilised the transverse axis and a point on the curve to generate the hyperbolic curves.

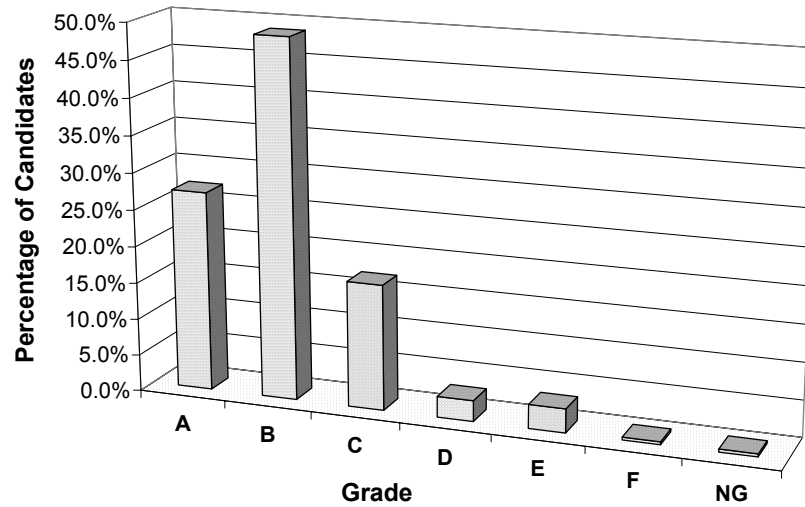
Genuine attempts at finding the curved line of interpenetration in elevation were a positive feature in some of the weaker answers.

QUESTION FIVE

Mining Geometry

The response to this question followed the predictable pattern of many previous years. Some 88.6% of candidates attempted the question and it was very well answered. For most candidates this question rewarded them with their second highest mark. The average mark for this question was an admirable 37.2. Chart 19 outlines the overall candidate performance on this popular question.

Chart 19: Percentages of candidates achieving each grade in Question 5, Higher Level Paper II (B)



Most candidates found the first part of this question quite straightforward, while even the most able were appropriately challenged by the second part.

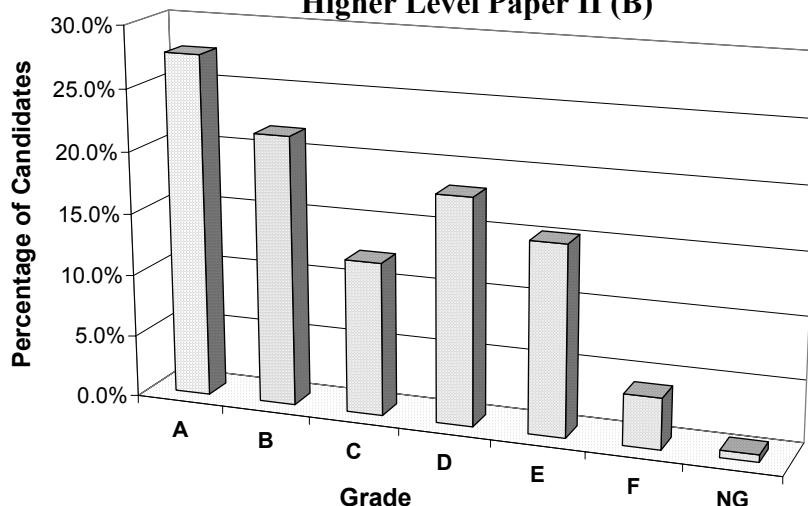
A simple and very avoidable error occurred in the setting up of the question, where candidates treated measurements associated with bore-holes A and B as altitudes rather than as distances measured along the bore-holes. These errors, however, did not impede further progress and most candidates proceeded to amass excellent marks.

Most candidates, having correctly determined the Dip, Strike and Thickness proceeded to attempt the more taxing second part. Responses, in general, were better than in previous years. The need to draw a relevant vertical section through the stratum was increasingly recognised as a basis for an acceptable solution to determine the required distance from A. On the other hand, fewer candidates than expected made an attempt to determine the inclination of the bore-hole or, unsuccessfully, tried to determine the inclination on the sectional view of the stratum.

QUESTION SIX

Hyperbolic Paraboloid

Chart 20: Percentages of candidates achieving each grade in Question 6, Higher Level Paper II (B)



Mostly good responses were produced in answering this question and it was more popular than questions on the same topic in recent years. It was attempted by 72.1% of candidates. The average mark for the question was 33. Chart 20 outlines the candidate performance.

Approximately two thirds of candidates successfully answered part (a) of the question. In most cases elements were drawn on the hyperbolic paraboloid surface ABCD in plan and elevation and extended to the circular perimeter in plan, thus facilitating the finding of points on the perimeter curve in elevation. A smaller percentage of candidates appeared to guess the curve in elevation, showing no systematic method of construction.

Many candidates needlessly drew an end elevation as they rarely used it to complete the elevation.

Most candidates, who located elements on the curve, demonstrated an excellent understanding of the correct procedure for determining the true shape of the section in the second part of the question.

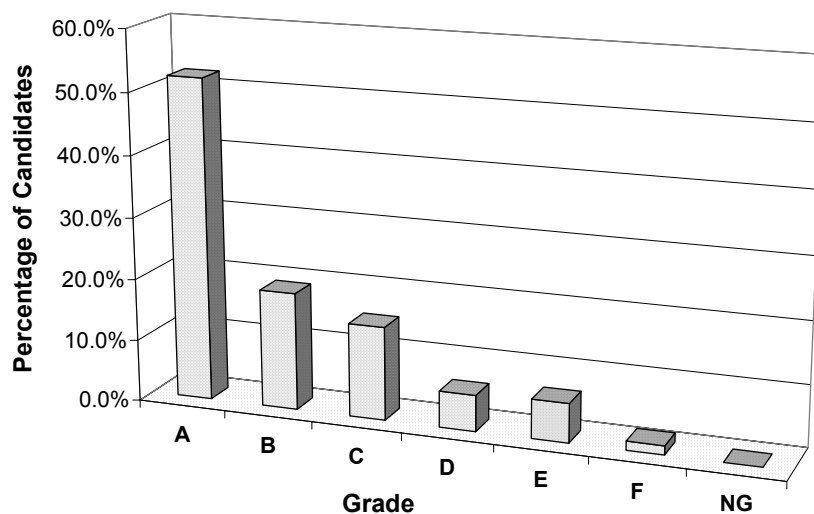
A higher proportion of candidates than in previous years successfully determined the traces of the plane director even though some found the horizontal trace only. Candidates occasionally determined the traces for the wrong set of elements and were marked accordingly.

QUESTION SEVEN

Contouring and Earthworks

The high level of understanding displayed in answering this topic in recent years was even surpassed this year. It was attempted by 74.6% of candidates and yielded more completely correct solutions than any other question on the paper. The average mark was 38.9 (almost 78%). Chart 21 outlines a very admirable candidate performance in this question.

**Chart 21: Percentages of candidates achieving each grade in Question 47
Higher Level Paper II (B)**



Generally marks tended to be lost for incomplete, as opposed to incorrect, answers. Surprisingly, candidates commonly failed to complete the area of cutting near C for the roadway BC and the area of embankment near D for the roadway BD.

Few efforts to determine the earthworks for the level part of the roadway were incorrect. Various but few shortcomings were apparent in a number of answers in dealing with the inclined roadways. These primarily included using an incorrect radius to determine an initial level section line, or subsequently using wrong intervals between section lines. It was not uncommon for candidates to draw section lines in the wrong direction. Another less common error was the failure to extend the cutting and embankment curves to determine their precise intersections and extremities.

Ordinary Level Paper I (Plane and Solid Geometry)

Overview

The candidates were presented with seven questions and were required to answer any four. All questions carried a total of fifty marks.

The examination paper, which followed the familiar format of previous years, tested a wide range of topics from the syllabus. Five questions related to solid geometry while the others focussed on plane geometry. Each question was structured to cater for candidates with differing abilities. All questions featured easier elements to the fore, to build confidence and to help the candidates engage with the examination paper. Each question also examined more difficult concepts, to challenge the more able candidates. The paper assessed what the full cohort might reasonably be expected to comprehend at this level.

The number of candidates achieving the higher grades this year was consistent with that of previous years. While the number of A grades showed a very slight decrease, the number of candidates achieving B or C grades increased. Almost 78% of candidates were awarded a C grade or higher.

There was a notable improvement in the lower grades. This year just 3.7% of the candidates failed to achieve at least a D grade. This is half the figure recorded last year. Table 17 shows the distribution of grades for the examination paper.

Table 17: Percentages of candidates achieving each grade in Ordinary Level Paper I

Grade	A	B	C	D	E	F	NG
% of Candidates	16.0%	32.2%	29.6%	18.5%	2.9%	0.7%	0.1%

Popularity of Questions

The pattern of question choice on this year's examination paper had just one minor variation from that of recent years. Question 4 required candidates to wrap a label about a cylinder. This topic has not appeared on the paper for a number of years. It was, generally, poorly answered and quite unpopular. Questions 1, 3, 5 and 7 proved most popular this year. There were indications from the pattern of question choice in some examination centres that candidates had focused exclusively on four or five topics to the exclusion of other areas from the syllabus. This practice is not recommended as such candidates are deprived of the enrichment of a fuller exploration of the syllabus. These candidates also frequently falter in an examination, having little or no choice available to them.

Plane geometry questions in the past have proved less popular than solid geometry questions. That trend was again noted this year. The answering to the plane geometry questions was also less enlightened. In many instances it appeared that these topics were selected as an extra question and as a result were sometimes left unfinished.

Most candidates answered the required minimum of four questions. Over 20% of candidates attempted at least one extra question. While most of these attempts were knowledge based, some of the weaker candidates attempted six or even seven questions. These candidates did little more than draw the bare outlines of the questions. Approximately 5% of the cohort attempted less than four questions. Table 18 outlines the popularity of questions in terms of the percentage of candidates attempting each question.

Table 18: Percentages of candidates attempting each question in Ordinary Level Paper I

Question	1	2	3	4	5	6	7
% of Candidates	95.3%	30.3%	70.9%	59.1%	57.8%	30.3%	82.5%

Standard of Answering

The standard of answering was comparable with that of recent years. The majority of candidates performed admirably and the standard of presentation was excellent in most cases.

There was a pattern of mistakes which limited the achievement of a minority of candidates. Some errors related more to approach than to any specific lack of knowledge. The aim of this analysis is to highlight the areas of greatest weakness, so that it may serve to improve standards in the future.

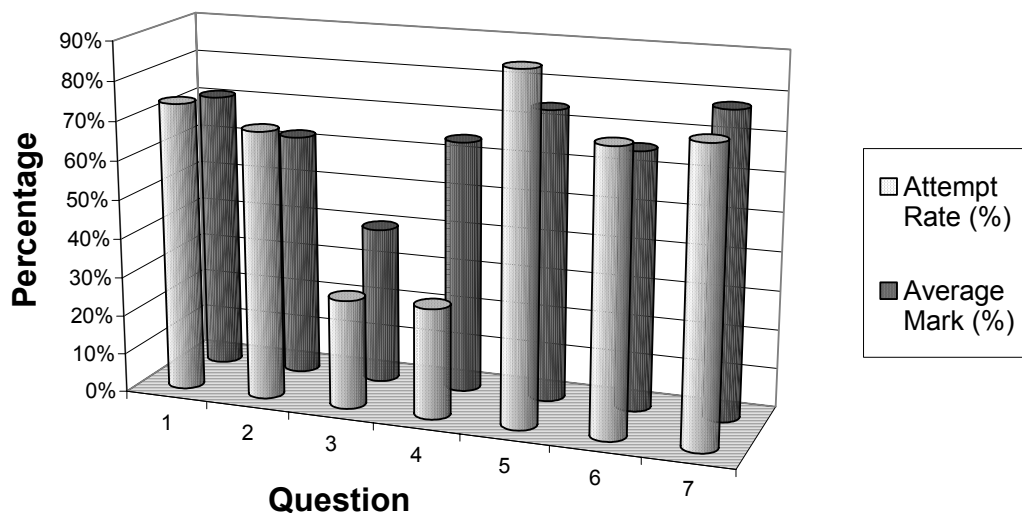
Where candidates lost marks it was usually for a variety of reasons. While a lack of understanding of concepts was often a primary reason another was a failure to read the instructions and the questions properly. Candidates are encouraged to index drawings systematically, as poor presentation and lack of such indexing frequently resulted in apparent confusion and a subsequent, unnecessary, loss of marks. Many of the candidates who performed least well did not persevere with individual questions and instead proceeded to attempt all seven. Other candidates appeared to adopt a very mechanical method of answering some questions. While this was often successful in completing the easier elements, it resulted in poor attempts at the more challenging parts.

Table 19 outlines the average marks gained by the candidates over the range of questions. Chart 22 compares the attempt rate with the average marks. It is noted that there is little correlation between the two. In particular it is noted that Questions 2 and 6 are very unpopular, yet return some of the highest average marks.

Table 19: Average marks achieved by candidates in each question in Ordinary Level Paper I

Question	1	2	3	4	5	6	7
Average Mark	38.9	34.1	29.0	26.4	31.1	31.4	36.0

**Chart 22: Attempt rate vs average mark for Ordinary Level Paper I
(average marks are quoted in percentage terms)**

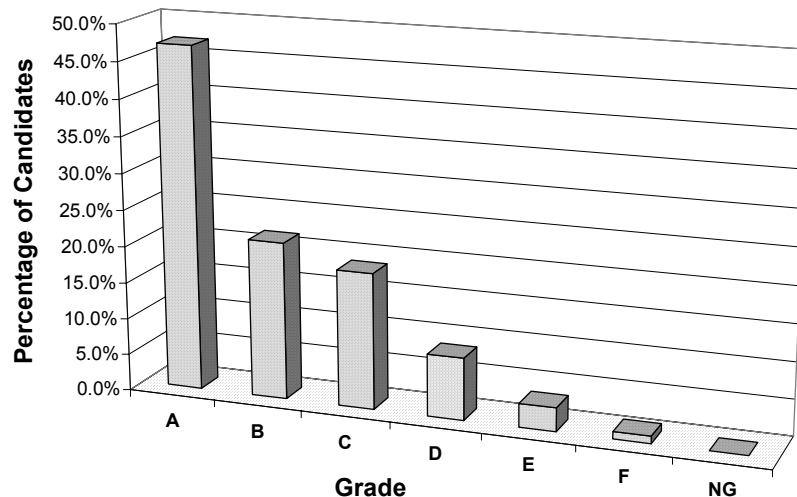


QUESTION ONE

Orthographic Projection

This was the most frequently attempted question on this year's examination paper. Candidates across a full spectrum of abilities selected it. The average mark was 38.9, rendering it the best-answered question. Chart 23 outlines how the candidates performed exceptionally well on this individual question.

Chart 23: Percentages of candidates achieving each grade in Question 1, Ordinary Level Paper I



The requirements in this question have shown just minor changes over the last four years. Candidates were presented with a three-dimensional view on the examination paper. This allowed them to proceed more confidently in setting up and evolving a solution to the question.

Part (a) Elevation

Most candidates correctly drew the outline of the elevation. A small number of candidates drew an elevation viewed from the wrong direction. This resulted in the question being over-simplified and candidates subsequently lost marks.

While mistakes were few, the following were the most common.

- The required construction to locate the line of intersection was omitted.
- Some candidates mistakenly drew an elevation viewed from the right hand side.
- The short horizontal line in the middle of the elevation, was replaced by an intersection line extended fully across the width.

Part (b) Plan

The plan of the solid presented very little difficulty for the candidates. Errors were very infrequent and were generally elementary in nature. Such mistakes often had implications for the projections to the elevation and may be summarised as follows.

- The short horizontal was occasionally omitted.
- The view was reversed and as a result the sloping line in the middle was drawn in the wrong direction.

Part (c) Auxiliary Elevation

It was noted that attempts at this part of the question were generally of a higher standard than those of recent years. Over 75% of candidates had a clear grasp of the principles inherent in the question, though some faltered in the detail. There were fewer attempts this year at mistakenly drawing an auxiliary plan. More than half the candidates, gained very close to full marks in part (c).

Infrequent but typical errors were as follows.

- Some candidates did not draw the X_1Y_1 line parallel to surface A in plan.
- Projection lines from the plan were not perpendicular to the X_1Y_1 line.
- Approximately 20% of candidates drew only surface A on the auxiliary view. This resulted in cases where candidates did not properly read the question.
- Hidden detail was omitted.
- A small number of candidates projected from the elevation instead of from the plan.
- Less than 5% of candidates attempted to transfer widths from the plan to the auxiliary view.

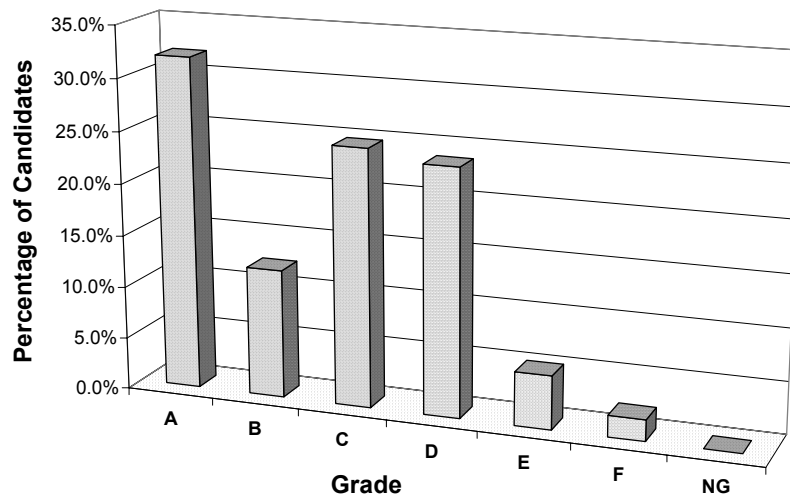
In general, it was clear from the attempts that most candidates understood the principles of this extremely popular topic.

QUESTION TWO

Area of Figures

This topic was one of the less popular questions on the examination paper. It was attempted by less than one third of the candidates. Many candidates appeared to have selected it as an extra question. This sometimes resulted in it being left unfinished. Though not popular, the average mark was quite high at 34.1. Chart 24 gives an indication of overall candidate performance.

Chart 24: Percentages of candidates achieving each grade in Question 2, Ordinary Level Paper I



Approximately 30% of the attempts were based on mathematical rather than graphical methods. Those employing mathematical solutions often fared worst. Many appeared to have got lost in a sea of figures, omitting several stages in the process. The use of calculators may explain some of the missing segments. Almost 10% of candidates completed the question with no evidence of any method being shown on the sheet as is required in the instructions.

Part (a) Drawing the Quadrilateral

This part of the question presented little or no difficulty to any of the candidates. The shape was in most cases accurately reproduced.

Two mistakes frequently occurred:

- using the correct method but applying the ratios to the incorrect lines;
- completing the question accurately but with no method shown.

Completing part (a)

This part of the question was, in general, not well answered by all but a minority of candidates. The solution required an area conversion of the quadrilateral and this was frequently omitted.

The following errors occurred frequently.

- The required area conversion was missing or set up incorrectly.
- The triangle did not have the required area.
- The semicircle required to fix the 90° angle was omitted.

Part (b) Area Conversion

In contrast to the previous part of the question this section was well answered. Over a quarter of the attempts were mathematical. Those applying graphical methods again did so more successfully. Almost 75% of the attempts were fully correct. The area conversion from the rectangle to the square was well answered.

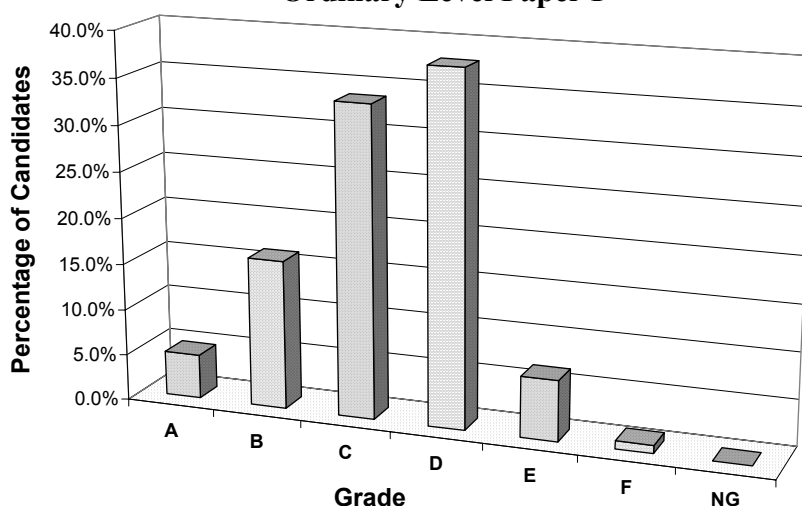
Generally in this question candidates were more successful using graphical constructions. Where mathematical solutions are presented, it is imperative that all calculations are clearly shown on the drawing sheet to avoid a loss of marks.

QUESTION THREE

Topic Description

This was the third most popular question on this year's examination. It was attempted by 70.9% of the cohort. The average mark for the question was 29.0. Chart 25 outlines how the candidates performed on this individual question.

Chart 25: Percentages of candidates achieving each grade in Question 3, Ordinary Level Paper I



The rolling sphere method was far more popular than the auxiliary view method though, those using the latter method were generally more successful.

Part (a)

Setting up the question as given proved very straightforward. Those who drew the plan of the cone before attempting to draw the plan of the sphere were more successful.

The following mistakes were noted:

- Drawing the two circles tangential to each other in plan
- Placing the sphere in front of rather than behind the cone
- Incorrectly locating point P on the sphere in plan
- The omission of hidden detail.

Part (b)

There were many almost perfect solutions to this part of the question. Some of the less successful candidates misunderstood the requirements of the question. Those who failed to position point P correctly in part (a) had their difficulties compounded at this juncture as a result.

The difficulties encountered by the candidates who fared least well in this question may be summarised as follows:

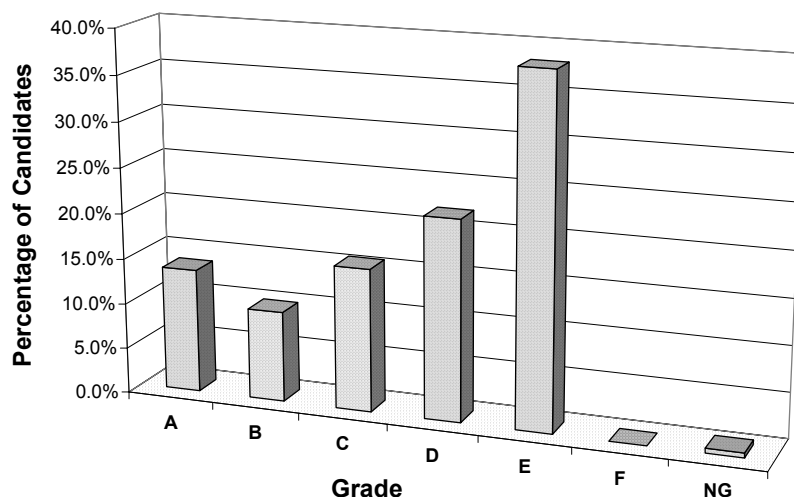
- Attempting to position the new sphere resting on the horizontal plane
- Representing the new sphere as a plane figure tangential to the given sphere in plan and elevation
- The omission of hidden detail.

The spatial concepts inherent in the question challenged those aspiring to the higher grades. Some of the other candidates who successfully drew part (a) of the question experienced difficulties in its completion.

QUESTION FOUR

Envelopment

Chart 26: Percentages of candidates achieving each grade in Question 4, Ordinary Level Paper I



This was a surprisingly popular question, as this topic has not appeared on the paper for some years. It was attempted by 59.1% of the candidates. The standard of answering, however, varied greatly. The average mark was quite low – 26.4. Chart 26 outlines how the candidates performed on this individual question.

While some excellent solutions were presented, many efforts displayed evidence of confusion with the curves. These curves have featured regularly on the examination paper in recent years.

All those attempting the question correctly drew the given plan. The given elevation presented difficulty to only a minority of candidates.

The following errors were frequently noted:

- The surface development was not drawn
- Attempts were made to roll the circle in plan, to form a cycloid
- Some candidates located the five corners of the label correctly in the wrapped position, but joined them with straight lines rather than freehand curves
- Some candidates did not initially transfer the true distances from the surface development to the plan; this resulted in the required points in elevation being inaccurately located.

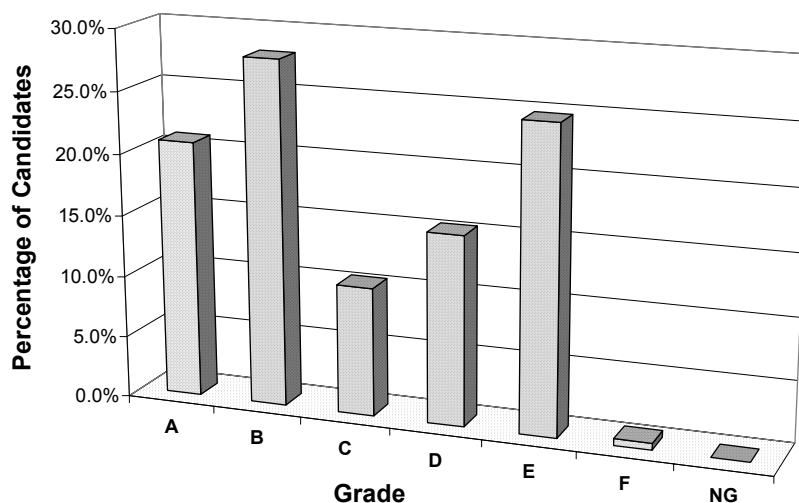
It was felt that the absence of this topic from the examination paper in recent years, rather than its intrinsic difficulty, resulted in the relatively low average mark. It serves to highlight the importance of exploring all aspects of the syllabus in full.

QUESTION FIVE

The Oblique Plane

This question proved popular with candidates of all ability levels. However, it was not attempted at all by candidates in approximately 15% of examination centres. Overall, 57.8% of candidates attempted the question. The average mark awarded for the question was 31.1. The topic is a good indicator of spatial ability. It is encouraging therefore to see candidates performing relatively well in the question as is indicated in Chart 27.

Chart 27: Percentages of candidates achieving each grade in Question 5, Ordinary Level Paper I



Part (a) Truncation

The given plan and elevation of the solid and the traces of the oblique plane VTH were drawn correctly by almost all of the candidates who attempted it. A small minority of candidates abandoned the question at this stage. Most candidates proceeded to set up the required auxiliary elevation and the edge view of the plane. Projections back to plan and subsequently to the elevation presented little difficulty to the candidates.

Many minor mistakes could have been avoided if the points had been indexed in advance.

The more salient errors may be summarised as follows.

- The oblique plane was not viewed along the horizontal trace to set up the auxiliary elevation.
- The solid was sectioned inaccurately due to mistakes in the determination of the edge view of the plane.
- Some of the points of intersection between the solid and the plane were overlooked. The lowest point in elevation was a regular omission.
- A small percentage of candidates joined the points incorrectly.

Part (b) True Shape

While the success rate in part (a) was commendable, the attempts at the true shape were less consistent. Some candidates appeared to run out of time and abandoned the true shape mid-way. Candidates who erred in the earlier parts of the question but who followed correct procedures in this part of the question were justly rewarded for their efforts.

The two most frequently used methods to draw the true shape were:

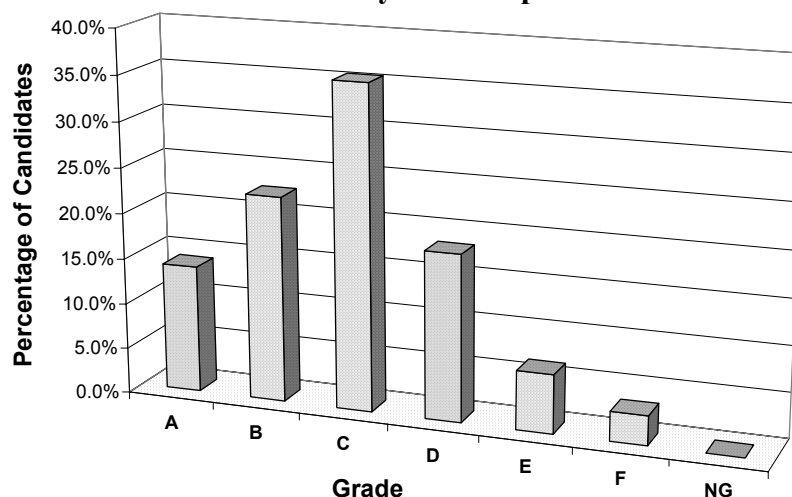
- rebatment of the oblique plane onto the horizontal plane (the more popular);
- auxiliary plan (used by less than 10% of candidates).

Some candidates did not determine the correct widths for the true shape. This resulted in distorted solutions.

QUESTION SIX

Conic Sections

Chart 28: Percentages of candidates achieving each grade in Question 6, Ordinary Level Paper I



Conic sections continue to be one of the less popular topics on the examination paper. This year 30.3% of the cohort attempted the question. It is frequently selected as a fifth or extra question. As a result it is sometimes left unfinished due to time constraints. The quality of some of the freehand curves fell well below what could reasonably be expected at this level. However, Chart 28 illustrates that candidates, overall, performed quite well on this unpopular question.

The question requires an ability to recall and apply numerous properties and constructions. As a result, many of the high achievers scored very well in the topic. The average mark for the question this year was 31.4. It should be pointed out however that this mark was rarely achieved, as the question was more subject to extremes than any other topic on the paper.

Part (a) The Parabola

There were many fully correct solutions to this part of the question. The absence of any reference to eccentricity and its regular appearance on the Junior Certificate Technical Graphics examination may have encouraged some candidates to attempt it.

The simplicity of this question was not recognised by some candidates. They investigated far more complex concepts in search of a solution, frequently getting lost along the way.

The following mistakes were most frequently noted.

- The vertex was located on the wrong side.
- The sides of the rectangle were divided incorrectly.
- Many candidates did not radiate the required points to the vertex.
- Attempts to over-complicate the question by introducing the concept of eccentricity led many candidates away from the correct solution.

Part (b) Ellipse

There were also many excellent attempts at this part of the question. More than half the candidates gained close to full marks. It was notable that some, who performed poorly in part (a), excelled in this section.

The concept of eccentricity continues to be an impediment to greater success in this topic. Confusion with the other conical curves was evident in some solutions. Almost 25% of candidates attempted to draw a hyperbola as a result of inverting the given eccentricity ratio.

The following mistakes were most frequently encountered.

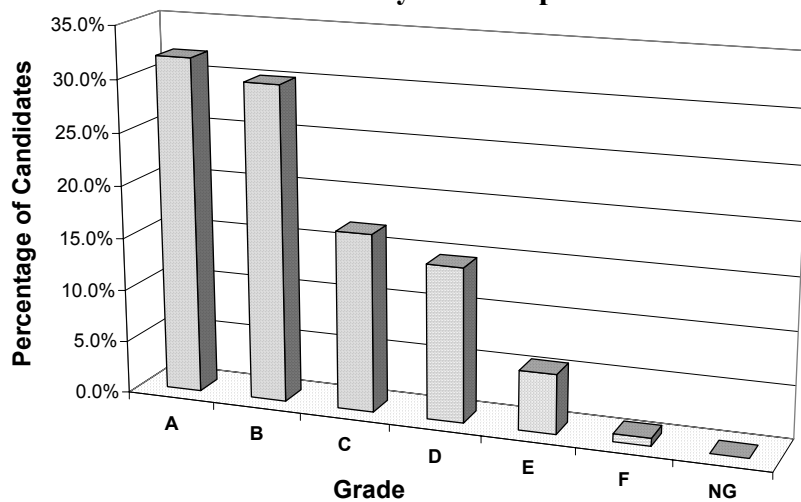
- Many freehand curves were poorly drawn.
- Confusion in relation to the concept of eccentricity was evident.
- Some candidates selected an arbitrary focus point.
- The vertex was incorrectly located.
- Points on the curve were determined by erroneous methods.

QUESTION SEVEN

Interpenetration of Solids

This was the second most popular question on this year's examination paper. It was attempted by 82.5% of the cohort, across the full spectrum of candidate achievement. Chart 29 illustrates how the candidates performed on this question.

**Chart 29: Percentages of candidates achieving each grade in Question 7,
Ordinary Level Paper I**



The predictability of this topic makes it an attractive question for candidates to rely on. Its popularity was matched with enlightened answering from most candidates. The average mark for the question was 36.0.

The tiered structure of the question offered all candidates an opportunity to secure marks on the easier sections while, at the same time, there was sufficient detail to test those aspiring to higher grades. Many candidates could have avoided some elementary mistakes by simply indexing the points on the solid.

While the standard of answering was generally commendable, a number of errors recurred frequently.

- Some candidates did not proceed beyond the relatively easy triangular hole on the front surface of the solid.
- The two points of the interpenetration on the back edge of the prism were frequently omitted.
- While the interpenetration points on the surface of the solid were correctly identified by over 90% of candidates, some failed to join them in the correct configuration.
- Some candidates omitted the horizontal lines on the end view.
- Hidden and visible lines were frequently interchanged.

Ordinary Level Paper II (A) (Engineering Applications)

The examination paper comprised five questions. Candidates were required to answer Question 1, which carried 100 marks and any two other questions at 50 marks each.

Performance of candidates

A total of 663 candidates presented at this level, which represented a decrease of approximately 14% on 2001. There was an increase of 1.3 percentage points in the percentage of candidates achieving a grade A and an increase of 1.5 percentage points in the corresponding figure for grade B. The percentage of candidates who achieved a grade C or higher increased by 1.3 percentage points, while the percentage of candidates who scored E or lower showed an increase of 1.6 percentage points.

Table 20 shows the distribution of grades for 2001 and 2002.

Table 20: Percentages of candidates achieving each grade in Ordinary Level Paper II (A) in 2001 and 2002

Year	A	B	C	D	E	F	NG
2001	10.5%	24.0%	28.2%	22.5%	10.3%	4.0%	0.5%
2002	11.8%	25.5%	27.7%	18.6%	11.5%	3.2%	1.7%

Question Popularity

The order of popularity in answering questions as indicated by an analysis of the total number of scripts is shown in table 21.

Table 21: Percentages of candidates attempting each question in Ordinary Level Paper II (A) in 2002

Attempts (%)	Rank order	Question no.	Topic
99	1	1	Assembly drawing
79	2	3	Cam and locus
45	3	4	Dimensioned drawing, etc.
43	4	2	Developments
27	5	5B	CAD
25	6	5A	Isometric view

General comments

There was a favourable response to the range and standard of the questions set. It was a very acceptable paper that allowed the candidates to demonstrate a range of knowledge and ability to communicate engineering concepts graphically. However, the standard of answering varied considerably and, significantly, only a small number of candidates showed a high level of competence. A large number of the candidates displayed little knowledge of basic drawing concepts and demonstrated little understanding of drawing standards and conventions. In many instances marks were lost through careless reading of the questions in the first instance and through

not adhering to basic drawing conventions, such as centre lines, ISO symbols, indexing, neat printing and correct dimensioning.

The following is an analysis of the individual questions.

QUESTION ONE

Assembly Drawing

This question was attempted by 99% of the candidates and was reasonably well answered overall. The question required the assembly of parts and the production of a sectional elevation and plan of the assembly. The majority of candidates scored in excess of 65% of the marks for this question. The question covered all of the basic principles and elements appropriate to this level of study. While the assembly provided least difficulty for candidates, the following deficiencies in the responses presented for examination were noted:

- Lack of sectioning
- Lack of detail on nut, bolt and washer
- Bolt shown sectioned
- Screw thread convention incorrect
- Only one bush drawn
- No centre lines
- Poor or no dimensions
- Incorrect or no projection symbol
- Nut incorrectly projected
- Neglecting to print title.

QUESTION TWO

Development

This question was attempted by 43% of candidates. Few made a reasonable attempt at completing the question. The majority produced the given view only and made no attempt to complete the other views or the development. The greatest challenge to candidates was to advance to the development or to the true shape because of an apparent lack of knowledge of the basics of interpenetration. Few candidates answered the complete question correctly. There was a complete lack of indexing, which is necessary in successfully attempting to answer this type of question. The most common deficiencies were in:

- transference of generators from elevation for development;
- transference of measurements from plan for true shape of hole;
- projecting points of ellipse in plan;
- projecting points from plan for intersection in elevation.

QUESTION THREE

Cam and Locus

This was by far the most popular of the optional questions; it was attempted by 79% of candidates. The vast majority answered both Sections A and B, with very satisfactory responses given.

3 (a) Cam

Most candidates had a very detailed understanding of plotting the displacement diagram and the cam profile. The problem was solved by the vast majority of candidates and the drawing of the different types of displacement presented little difficulty. In many attempts the cam displacement diagram was well drawn but, when drawing the plate cam, a number of candidates had the incorrect direction of rotation or the minimum and maximum diameters incorrect. Others had difficulty indexing the cam profile. Overall this was a well-answered question.

3 (b) - Locus

Very few candidates experienced difficulty with this question. It was generally very well answered. In a number of cases candidates showed Link AB rotating through 360° instead of 90° . Others neglected to restrict the movement of Rod BC through the trunnion T.

The drawing of a machine guard profile was well answered by the majority of candidates who attempted it.

QUESTION FOUR

Dimensioned Drawing

A total of 45% of candidates attempted this, the third most popular question. Despite its popularity, the question was poorly answered overall. Of those who attempted Question 4 most completed Section A only. A large number of candidates produced the given drawing excellently but failed to dimension it at all. Some of those who dimensioned the drawing did not do so using drawing conventions. Very few others could dimension the key-way or the screw thread correctly.

(b) Mechanism

Very few candidates identified the mechanism correctly and many strange suggestions were made for the parts. There is a need for students to be taught to read drawings and identify parts.

(c) Keys – Freehand Sketches

Most attempts at section C were poor. Candidates appeared not to be familiar with the engineering terms and displayed very poor ability to draw freehand.

QUESTION FIVE

Section A

(a) Isometric View

This was the least popular question on the paper. It was attempted by 25% of candidates. It was also the most poorly answered question. No candidate got this question completely correct. Some produced close to what was required and others just produced an orthographic projection of the views given on the question paper.

(b) Circlips

Of the few who attempted this question only some could distinguish between the external and internal circlip.

Section B – CAD

There was a small increase in the number of candidates who attempted this question this year. The question was attempted by 27% of the candidates and the quality of their answering was quite good for the following reasons.

- Most had no problem in listing the commands necessary.
- The majority named the input devices.
- Most answered the ‘Snap Resolution’ correctly.
- Most displayed an excellent knowledge of the commands asked, but the sketches and short notes of the answer were poorly presented.

Ordinary Level Paper II (B) (Building Applications)

Overview

The candidates were presented with seven questions and were required to answer any four. All questions carried a total of fifty marks each.

The examination paper was similar in format to previous years and tested a wide range of topics from the syllabus. The standard of questioning was also comparable to previous examinations. It allowed candidates of a varying ability range to demonstrate the extent of their knowledge and understanding, both within questions and across the paper as a whole.

Though the standard of answering was broadly similar to previous years, it was felt that the level of performance in Questions 2 and 4 in particular showed a slight ??disimprovement. This was indicative of lower levels of analytical thinking and problem solving. Many solutions did not show the essential geometrical construction lines and little credit could be given for incorrect answers where there was no indication of the solution methods employed.

Overall, however, the candidates performed quite admirably, with 15.6% attaining an A grade and almost 70% obtaining a grade C or higher. Table 22 shows the distribution of grades for the examination paper.

Table 22: Percentages of candidates achieving each grade in Ordinary Level Paper II (B) in 2002

Grade	A	B	C	D	E	F	NG
% of Candidates	15.6%	25.8%	28.5%	21.1%	6.9%	2.1%	0.1%

Few, if any, candidates displayed difficulty in completing four questions within the allotted time. A significant percentage attempted five and even six questions. The pattern of question choice was, by and large, similar to previous years, with the possible exception of Question 3, which proved more popular than before. The answers to this question also displayed a noted improvement. Table 23 outlines the frequency with which candidates attempted the various questions.

Table 23: Percentages of candidates attempting each question in Ordinary Level Paper II (B)

Question	1	2	3	4	5	6	7
% of Candidates	72.5%	57.8%	49.7%	57.8%	68.1%	40.0%	85.9%

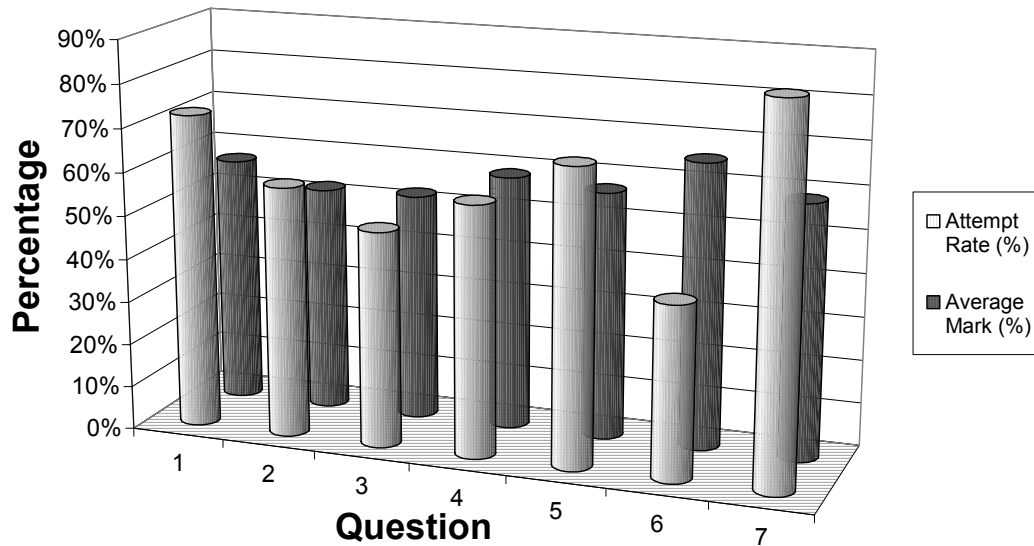
Table 24 outlines the average marks obtained by candidates in each of the seven questions.

Table 24: Average marks achieved by candidates in each question in Ordinary Level Paper II (B) in 2002

Question	1	2	3	4	5	6	7
Average Mark	28.5	26.1	26.2	29.4	28.6	32.9	29.3

Chart 30 compares the attempt rate with the average mark for each question. It is of note that Question 6, which returned the highest average mark of 32.9, was the least popular question on the examination paper. This phenomenon was observed with the corresponding question on the Higher Level paper some years ago but the question has significantly improved in popularity since then.

Chart 30: Attempt rate vs average mark for Ordinary Level Paper II (B)
(average marks are quoted in percentage terms)

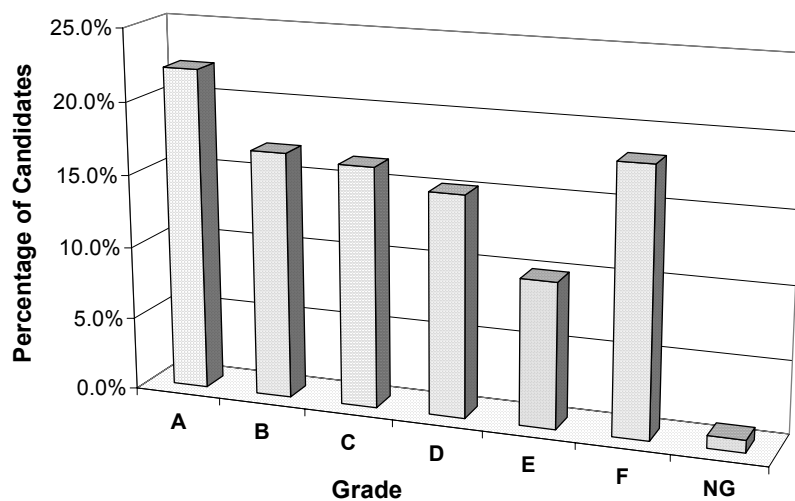


QUESTION ONE

Perspective Projection

This question on perspective projection, yet again, proved very popular with candidates. Some 72.5% of candidates attempted it and the average mark was 28.5. Chart 31 outlines how the candidates performed on this individual question.

Chart 31: Percentages of candidates achieving each grade in Question 1, Ordinary Level Paper II (B)



There were many excellent solutions presented to the question and very few poor solutions. Even candidates whose performance on their other questions was mediocre produced quite acceptable perspective views in response to this question. Fewer errors than usual were evident in the preliminary setting up of the drawing, indicating a high degree of familiarity with the topic.

Some minor, and very avoidable, errors in determining the vanishing points were evident in a number of solutions. The principal error here were extending the edges of the object, rather than drawing parallels, to locate the vanishing points.

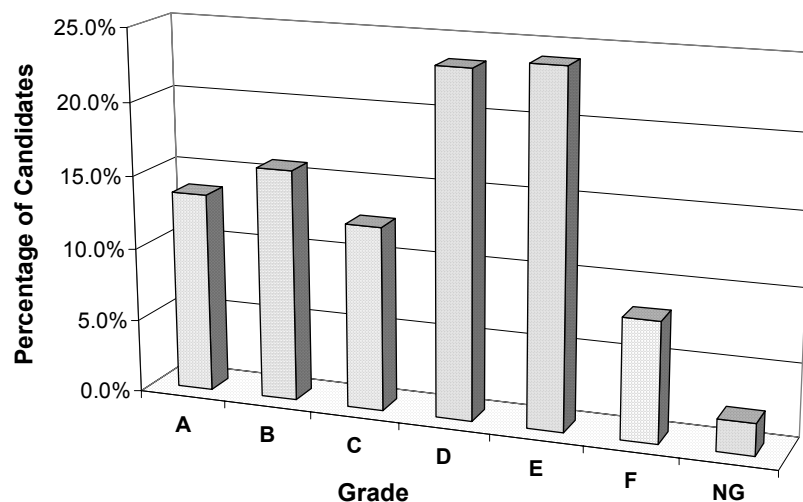
In the main, the greatest shortcoming noted in this otherwise well-answered question, was an obvious lack of appreciation of the concept of measuring and applying heights on the perspective drawing. In a very limited number of cases lines on the perspective drawing were joined to the wrong vanishing point.

QUESTION TWO

Roof Geometry

While this question proved quite popular, with over 57.8% of candidates attempting it, the average candidate mark of 26.1 was the lowest of the seven questions on the examination paper. Chart 32 outlines the overall candidate performance on this question. The relatively large grouping in the D and E grades indicate the large percentage of candidates who managed to respond successfully to only the set-up and preliminary parts of the question.

Chart 32: Percentages of candidates achieving each grade in Question 2, Ordinary Level Paper II (B)



Though quite a number of candidates succeeded in gaining full marks for the question, they were in the minority. The general standard of answering would best be described as fair. It is clear that responses to questions on roof geometry have disimproved somewhat in recent years and this year was no exception. Candidates appear to be resorting to guesswork rather than showing any systematic method of arriving at a correct solution.

In the vast majority of instances candidates did not show how the line of intersection between roof surfaces A and B was determined, even though the procedure should have been quite familiar to them. However, most determined the ridge height of surface A and proceeded to complete the plan and elevation.

The tendency to redraw the plan of roof surface D as a development was a recurring error. It was evident that there was an inherent misunderstanding of what a development was or else a lack of appreciation of the need to determine true widths from the elevation.

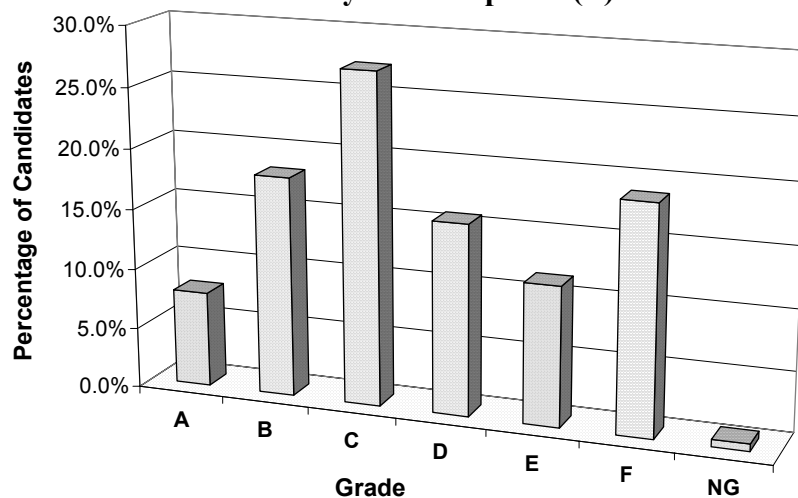
On the whole, candidates dealt more competently with the last part of the question, that of finding the dihedral angle, and many correct solutions were observed. Those candidates who used the point view method of solution generally had a greater degree of success than those who employed the rebatment method.

QUESTION THREE

Shadow Projection

This question showed a marked improvement, both in terms of attempt rate and candidate performance, in this year's examination. It was attempted by 49.7% of candidates and the average mark was 26.2. The candidate performance is outlined in Chart 33.

Chart 33: Percentages of candidates achieving each grade in Question 3, Ordinary Level Paper II (B)



Over the past number of years questions on shadow projection on this paper have been extremely unpopular and the answering has been somewhat less than satisfactory. The topic has generally attracted the candidates who displayed lesser levels of achievement and who usually made only token attempts. This year brought about a change in that trend. There was an exceptional improvement in the standard of answering, even though the question was still only attempted by less than 50% of candidates. It was noted that, in contrast to previous years, there were very few extremely weak attempts.

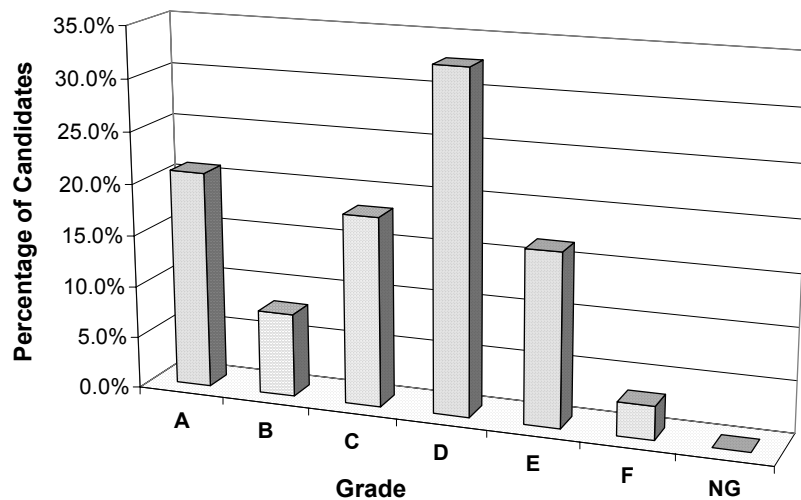
A great degree of success was achieved in determining the shadow cast by the building on the ground. Candidates coped equally well with attempts to find the shadow cast by the chimney on the roof. Determining the shadow cast by the main building on the 'lean-to' portion of the building proved to be the most challenging.

QUESTION FOUR

Shell Structures

In recent years questions on this topic elicited the best response of any on the paper. This year, even though the question was still popular, being attempted by 57.8% of candidates, the amount of completely correct solutions was lower, resulting in an average mark of 29.4. This lower average mark resulted in a more equitable mark distribution over the seven questions. The candidate performance in this question is outlined in Chart 34.

Chart 34: Percentages of candidates achieving each grade in Question 4, Ordinary Level Paper II (B)



For the vast majority of candidates the initial setting up of the plan and elevation posed little or no difficulty. Most also successfully placed the required number of elements in the plan view. Candidates drew the corresponding elements in the elevation with varying degrees of success. The elements, which were horizontal in plan, presented the greatest difficulty. A frequently observed error was to treat the entire elevation as one hyperbolic paraboloid surface.

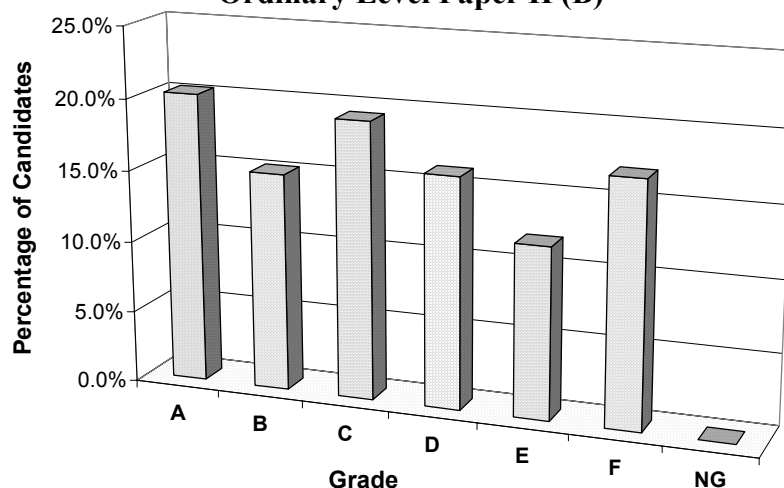
Most candidates displayed the ability to answer the second part of the question correctly although some did not demonstrate how heights from the elevation were determined in order to draw the true shape of the section. While candidates who did not set up the elevation correctly in the previous part were not re-penalised in the second part, many encountered inherent difficulties. Notwithstanding these difficulties there were many instances of completely correct solutions for this question.

QUESTION FIVE

Isometric Drawing

Some 68.1% of candidates attempted this question and the average mark was 28.6. Chart 35 outlines candidate performance.

Chart 35: Percentages of candidates achieving each grade in Question 5, Ordinary Level Paper II (B)



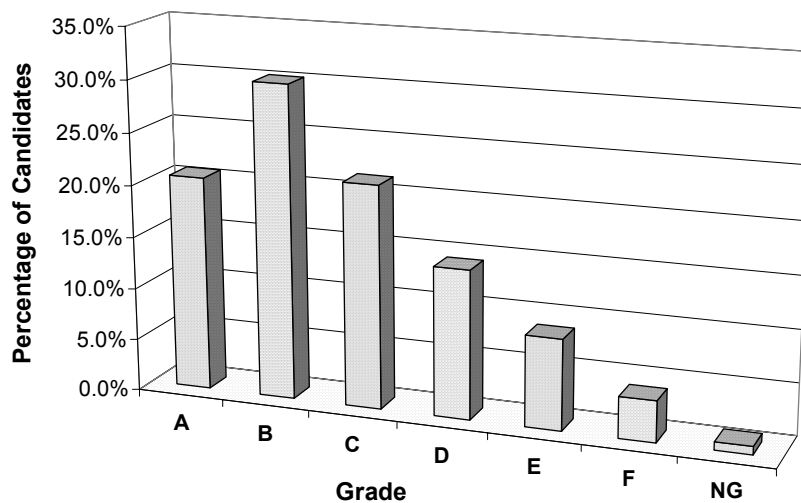
There were many instances of fully correct solutions showing very high standards of draughtsmanship. However, there were also many cases where the standard of answering varied considerably. As expected, few difficulties were experienced by candidates in drawing the isometric view of the base of the structure. Many, however, experienced difficulties in establishing the intersection lines between the base and the upright section of the structure. Some did not measure the appropriate distances from the orthographic view to subsequently transfer to the isometric. Similarly candidates experienced mixed degrees of success in establishing the curved lines of the structure in isometric. Some, who drew a grid in the elevation, did not correctly transfer this grid on to the sloping surfaces. The principal point of note in this question, however, was the surprisingly high number of candidates who inexplicably drew an auxiliary elevation or auxiliary plan as opposed to an isometric view as required.

QUESTION SIX

Conic Sections

Some 40% of candidates attempted this question; it had the highest average mark of 32.9. Chart 36 outlines how the candidates performed in the context of this question.

Chart 36: Percentages of candidates achieving each grade in Question 6, Ordinary Level Paper II (B)



As stated, this was the best question on the paper in terms of the average mark but nonetheless there was significant variation in the standard of answering.

The task of drawing the plan proved simple to all candidates and very few errors were made at this point. The drawing of the elevation, however, presented difficulties to some. The most notable aspect of the responses was the significant percentage of candidates who did not display the ability to construct the parabola in a rectangle in elevation. This would be regarded as a simple and standard construction and should be known by candidates who had undertaken even basic preparation for this question. Frequently candidates failed to show any form of construction for the parabola and simply drew the curve. In a number of cases candidates placed the vertex at the incorrect location and hence constructed 'pointed parabolas'.

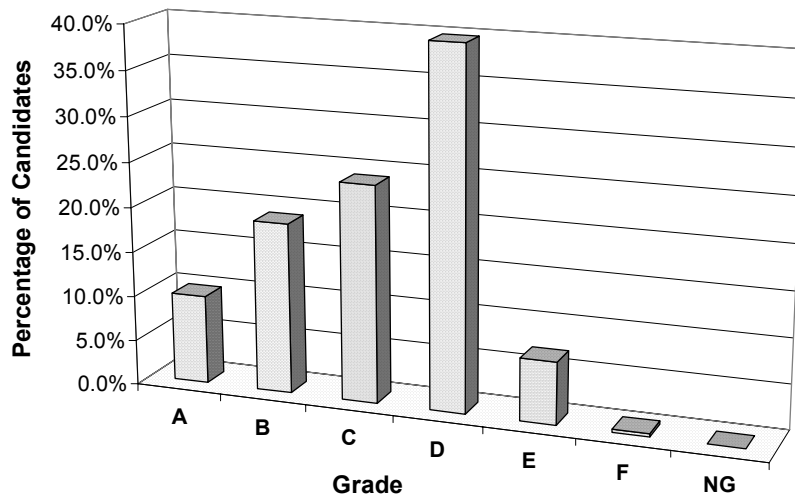
In the second part of the question marks tended to be lost for either omitting the part in its entirety or for not fully completing the end elevation rather than for errors in the execution of the drawing.

QUESTION SEVEN

Geological Geometry

This was a very popular question again this year, being attempted by 85.9dd% of the candidates. The standard of answering, while perhaps not as high as in previous years, was still very good. The average mark was 29.3. Chart 37 outlines how the candidates performed.

Chart 37: Percentages of candidates achieving each grade in Question 7, Ordinary Level Paper II (B)



Predictably the cross-section (profile) was answered competently by all who attempted it.

In the second part of the question, most candidates obtained the strike of the stratum with little difficulty. However, the extent of the difficulty in finding the dip was especially surprising. A frequent error was to project an auxiliary view of plane ABC perpendicular to the strike line, rather than in its direction. A significant percentage of candidates determined the outcrop of the stratum even though not asked to do so in the question.

Though there were some very good responses to the final part of the question, many omitted it. Other candidates' solutions clearly indicated that they were not prepared for a question of this type. Some candidates assumed that the strike could be found by merely joining points F and G on the map. The greatest degree of success was achieved where the elevation of the curve FG was drawn as the basis for proceeding to a solution.

4. GENERAL COMMENT

Overall the examination papers were perceived by all concerned as being very fair both in terms of format and content. Candidates were thoroughly assessed on their knowledge of the subject matter. Technical Drawing is essentially a problem-solving subject and as such each individual question contained ample material which required the candidate to apply previously learned knowledge in a given situation. This approach presented candidates, across the entire ability spectrum, with sufficient opportunity to convey the knowledge and skills acquired over their course of study. The papers were constructed in a manner that gave all candidates ample opportunity to achieve at least a grade D and nonetheless contained sufficient material to test the very high-achieving candidates and thus produce an accurate stratification as required.

Over the past number of years there has been a reduction in the standard of answering required from candidates across all of the examination papers within the subject. This reduction has taken place across the entire marking range and not just at the higher end of the marking range. The standard is felt at this juncture to be a fair reflection of candidates' abilities and is returning a very realistic grade profile as outlined earlier. It is envisaged that future examination papers in the subject will be of a standard similar to that established this year.

In light of the above it is encouraging to note that for the last two years the percentage of candidates opting for Higher Level has surpassed those opting for Ordinary Level. It is essential for the benefit of the subject that this trend be encouraged and further progressed. It is of paramount importance that greater numbers of candidates be encouraged to take the Higher Level Junior Certificate Technical Graphics examination paper in order to increase the Leaving Certificate cohort. Recent changes to that examination paper, both in terms of structure and content, should now provide an opportunity for this to happen.

5. RECOMMENDATIONS FOR TEACHERS AND STUDENTS

From a general observation of the examination scripts the professionalism of teachers who prepared the candidates for the examination was evident and commendable. Their ongoing dedication was clearly manifest from the work of their pupils.

There were, however, indications that some candidates under performed relative to their apparent ability. This was not necessarily as a result of a knowledge deficit, but rather in their approach to answering some of the questions. The following recommendations are made in order to assist candidates and teachers in preparation for future examinations.

- As a preparation for the exigencies of the examination students should be given formal instruction in the requirements of the examination and in the techniques necessary for the efficient answering of the questions posed. This includes compliance with the instruction to include all constructions on the answer sheets.
- It is vital that candidates carefully read the examination paper at the start. This could help avoid many simple mistakes which result in frequent misinterpretations.
- Candidates should utilise the full allocation of time to sit the examination.
- Some candidates work on both sides of the drawing paper, contrary to instructions. While candidates are, of course, not penalised for this they should be encouraged to work on one side of the paper only in order to minimise the risk of error.
- All candidates should attempt the required number of questions and, in the case of those opting for Paper II (A), support answers with diagrams where appropriate, and number and label these correctly.
- Candidates opting for Paper II (A) should be familiar with the requirements of BS308.
- All concerned are encouraged to familiarise themselves with marking schemes and sample solutions to previous examination papers; these are available on the Department of Education and Science website.
- Inconsistent line quality, leading to poor presentation, was a common thread amongst candidates achieving the lower grades on the Ordinary Level papers. Time spent improving the drawings would have been well rewarded.

- There were indications, particularly at Ordinary Level, of less perseverance, with some candidates abandoning questions at an early stage. This often resulted in all seven questions being attempted. Greater success could have been achieved if all the allocated time had been concentrated on just four questions.
- Scripts from some examination centres show clear signs of deviation from standard drawing conventions.
- It is important that all areas of the syllabus receive equal attention and that candidates do not sit any examination component having been prepared for only the required minimum number of questions.
- Greater attention should be focused on the individual candidate's choice of examination level. There are, consistently, between 5% and 10% of candidates who opt for Ordinary Level and yet would appear to have been capable of sitting the examination at Higher Level.