



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

LEAVING CERTIFICATE EXAMINATION 2005

TECHNICAL DRAWING

HIGHER AND ORDINARY LEVELS

CHIEF EXAMINER'S REPORT

CONTENTS

1.	Introduction	2
	1.1. Candidate Numbers	2
	1.2. Choice of Applications paper	3
	1.3. Gender Balance	3
2.	Performance of Candidates	4
	2.1. Higher Level	4
	2.2. Ordinary Level	6
3.	Analysis of Candidate Performance	7
	3.1. Higher Level	
	Paper 1 (Plane and Solid Geometry).....	8
	Overview, Frequency of questions attempted, Standard of answering and Presentation of work	
	Paper 2A (Engineering Applications).....	18
	Overview, Frequency of questions attempted, Standard of answering and Presentation of work	
	Paper 2B (Building Applications)	27
	Overview, Frequency of questions attempted, Standard of answering and Presentation of work	
	3.2. Ordinary Level	
	Paper 1 (Plane and Solid Geometry).....	35
	Overview, Frequency of questions attempted, Standard of answering and Presentation of work	
	Paper 2A (Engineering Applications).....	46
	Overview, Frequency of questions attempted, Standard of answering and Presentation of work	
	Paper 2B (Building Applications)	54
	Overview, Frequency of questions attempted, Standard of answering and Presentation of work	
4.	Conclusions	60
5.	Recommendations	62

1. INTRODUCTION

The present Leaving Certificate syllabus in Technical Drawing was introduced twenty-two years ago in 1983. It was examined for the first time in 1985. A new syllabus has been developed by the NCCA and it has recently been indicated by the Department of Education and Science that the new course will be introduced in schools in September 2007 and will be examined for the first time in 2009.

The current examination 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 1 Plane and Solid Geometry
2. Paper 2A Engineering Applications
3. Paper 2B Building Applications

Each examination is of three hours duration. All candidates must sit Paper 1 and either Paper 2A or Paper 2B.

Each paper is allocated 200 marks. A candidate's final result is determined by combining the results obtained on Paper 1 and the relevant Paper 2 with equal weightings. Therefore, the total mark for the overall examination is 400. The mark allocation is outlined in Table 1.

Table 1: Allocation of marks.

	Plane & Solid Geometry Paper	Applications Paper	Total
	Paper 1	Paper 2A or Paper 2B	
Ordinary Level	200 marks	200 marks	400 marks
Higher Level	200 marks	200 marks	400 marks

All six examination components are marked separately by different examining teams who are appointed by the State Examinations Commission.

This report should be read in conjunction with the examination papers and marking schemes, which are available on the State Examinations Commission website www.examinations.ie.

1.1 Candidate Numbers

This year 5775 candidates sat the examination in this subject. This figure represented 10.7% of the total Leaving Certificate cohort of 54,069. This percentage has remained relatively static over the past number of years essentially confirming that the decline in numbers taking Technical Drawing at Leaving Certificate level is broadly in line with the overall decline in the Leaving Certificate candidature. These figures are outlined in Table 2.

Table 2: Percentage of Cohort 2003 – 2005 (L.C.E. and LCVP Candidates).

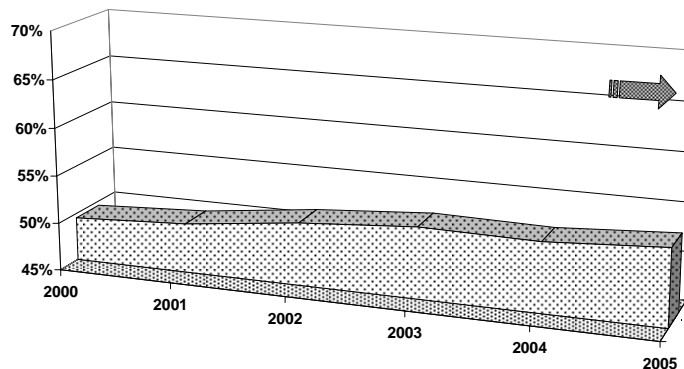
Examination Year	Overall Candidature	Technical Drawing	Percentage of Cohort
2005	54069	5775	10.7%
2004	55222	6036	10.9%
2003	56237	6471	11.5%

Of the overall 5,775 candidates, 3060 (53%) took the Higher Level paper and 2715 (47%) opted to sit the examination at Ordinary Level. This upward trend in relation the numbers opting to sit the subject at the Higher Level is welcomed and is to be encouraged. In this context, it is noted that the average Higher Level/Ordinary Level breakdown¹ for all Leaving Certificate subjects is 66% in favour of the Higher Level. This indicates that even greater numbers of candidates should be encouraged to sit the examination at Higher Level. These figures are outlined in Table 4 and in pictorial format in chart 1.

Table3: Overall Candidates and Choice of Levels.

Year	Total	Higher Level		Ordinary Level	
		Numbers	%	Numbers	%
2005	5775	3060	53.0%	2715	47.0%
2004	6036	3153	52.2%	2883	47.8%
2003	6471	3392	52.4%	3079	47.6%
2002	6039	3112	51.5%	2927	48.5%
2001	6380	3199	50.1%	3181	49.9%
2000	6761	3349	49.5%	3412	50.5%

Chart 1: Upward Higher Level Trend, 2003 – 2005 (Arrow indicates Overall Leaving Certificate Average).



1.2 Choice of Applications Paper

In recent years there has been a noticeable swing from Paper 2A to Paper 2B. The percentage of candidates opting for paper 2B (Building Applications) has increased in recent years from 78% of the cohort in 2003 to 82% of the cohort in 2005. During the same period there has, naturally, been a corresponding, marked, decrease in the numbers opting for paper 2A (Engineering Applications), which has dropped from 22% to 18%. One of the reasons for this decrease is likely to be related to changing demographics within the second level school system. The figures relating to option choice are outlined in Table 3.

Table 4: Options Breakdown – Paper 2A and Paper 2B (2003 – 2005).

	Year		
	2003	2004	2005
Paper 2A	22%	18%	18%
Paper 2B	78%	82%	82%

1.3 Gender Balance

The number of males sitting the subject continues to significantly outweigh the number of females, with the latter accounting for 7% of the total who sat this year’s examination. However there is an indication that female participation is increasing, particularly at Higher Level. In 2002, when the last Chief Examiner’s report was published, females accounted for 7% of the Higher Level cohort. This has increased to 9% in 2005.

¹ In those subjects that are examined at Higher and Ordinary Levels.

2. PERFORMANCE OF CANDIDATES

2.1 Higher Level

This year's overall distribution of grades at Higher Level is outlined in Table 5.

Table 5: Higher Level – Grade Distribution 2005.

	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG	TOTAL
Number	200	242	245	293	359	357	307	306	284	188	159	107	13	0	3060
%	6.5%	7.9%	8.0%	9.6%	11.7%	11.7%	10.0%	10.0%	9.3%	6.1%	5.2%	3.5%	0.4%	0.0%	
Number	442		897			970			631			120		3060	
%	14.4%		29.3%			31.7%			20.6%			3.9%			
Number	2309									631			120		3060
%	75.5%									20.6%			3.9%		

This year's grade distribution is outlined in pictorial format in Chart 2.

Chart 2: Higher Level – Grade Distribution 2005.

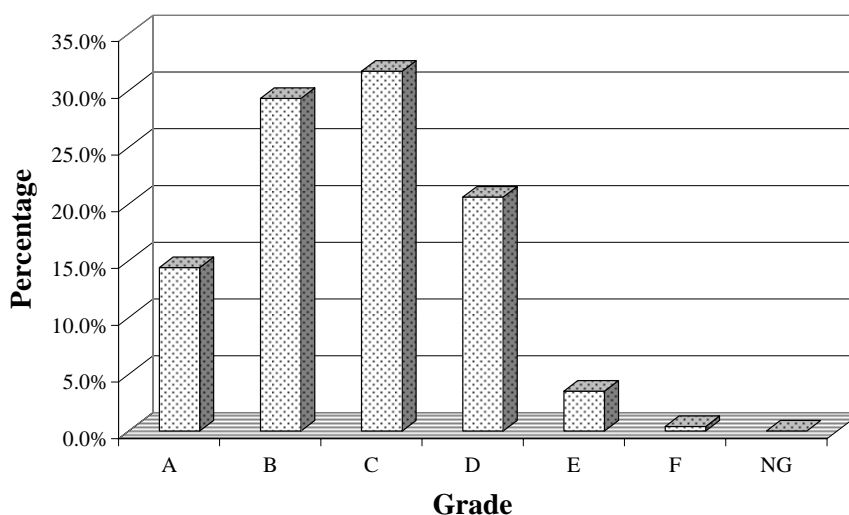


Table 6 compares the grade distribution with that of previous years.

Table 6: Higher Level – Grade Comparisons 2003 - 2005.

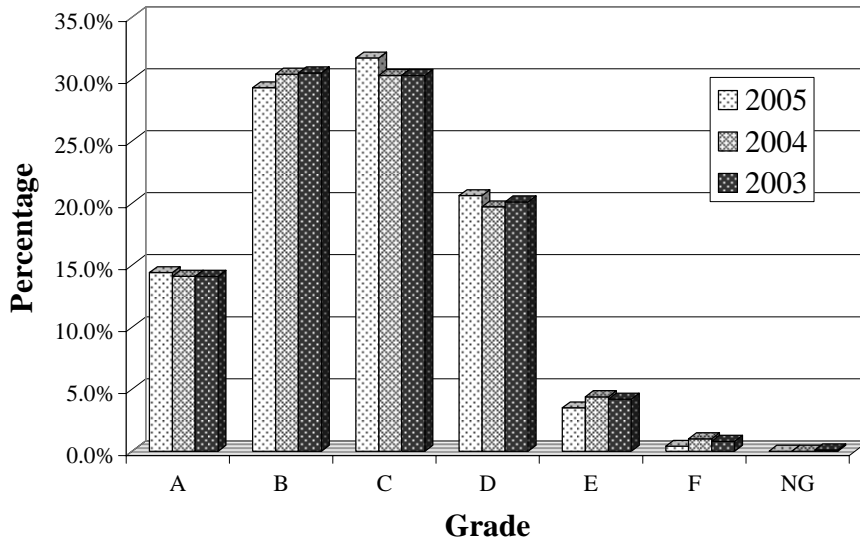
Year	A	B	C	D	E	F	NG
2005	14.4%	29.3%	31.7%	20.6%	3.5%	0.4%	0.0%
	75.4%			20.6%	3.9%		
2004	14.1%	30.4%	30.3%	19.7%	4.4%	1.0%	0.0%
	74.8%			19.7%	5.4%		
2003	14.1%	30.5%	30.3%	20.1%	4.2%	0.8%	0.1%
	74.9%			20.1%	5.1%		

The percentage of candidates obtaining a grade C or higher in the past three years has remained static at approximately 75%, or 3 out of every 4 candidates. It is worth noting that this figure was just over 70% in 1999. This maintained improvement in candidate performance at Higher Level is to be welcomed.

The failure rate this year fell to a level of just under 4%. It is, again, worth noting that in 1999 the failure rate was at 7.3%. Thus it the case that candidate performance has improved right across the grade spectrum and this is also to be welcomed.

These figures are outlined in pictorial format in Chart 3.

Chart 3: Higher Level – Grade Comparisons 2003 – 2005.

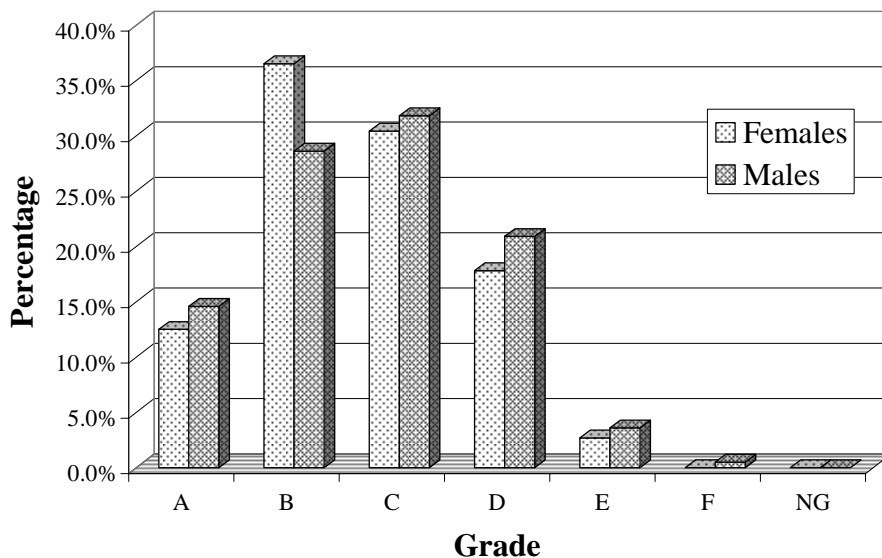


The 9% of females who sat the Higher Level examination tended to perform better than males in terms of combined ABC grades. However the statistics reveal that males perform better than females in terms of Grade A results. It is also noteworthy that the failure rate is lower amongst the female cohort. These figures are outlined in Table 7 and Chart 4.

Table 7: Higher Level – Comparison of Male and Female Grade Distribution 2005.

	A	B	C	D	E	F	NG
Females	12.5%	36.5%	30.4%	17.8%	2.7%	0.0%	0.0%
	79.4%				2.7%		
Males	14.6%	28.6%	31.8%	20.9%	3.6%	0.5%	0.0%
	75.0%				4.1%		

Chart 4: Higher Level – Comparison of Male and Female Grade Distribution 2005.



2.2 Ordinary Level

This year's overall distribution of grades at Ordinary level is outlined in Table 8.

Table 8: Ordinary Level – Grade Distribution 2005.

	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG	TOTAL
Number	178	219	216	249	249	253	253	241	222	201	205	162	56	11	2715
%	6.6%	8.1%	8.0%	9.2%	9.2%	9.3%	9.3%	8.9%	8.2%	7.4%	7.6%	6.0%	2.1%	0.4%	
Number	397		714			747			628			229		2715	
%	14.6%		26.3%			27.5%			23.1%			8.4%			
Number	1858						628			229		2715			
%	68.4%						23.1%			8.4%					

This year's grade distribution is outlined in pictorial format in Chart 5.

Chart 5: Ordinary Level – Grade Distribution 2005.

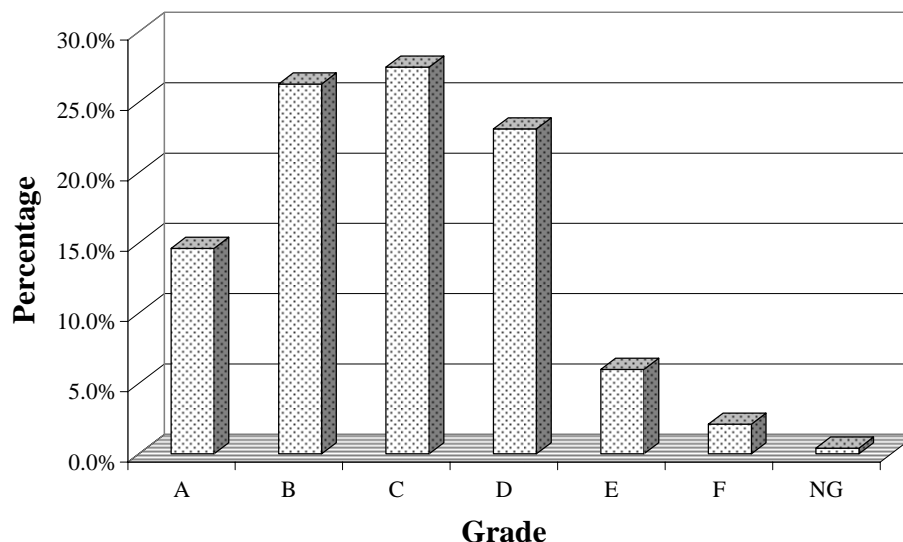


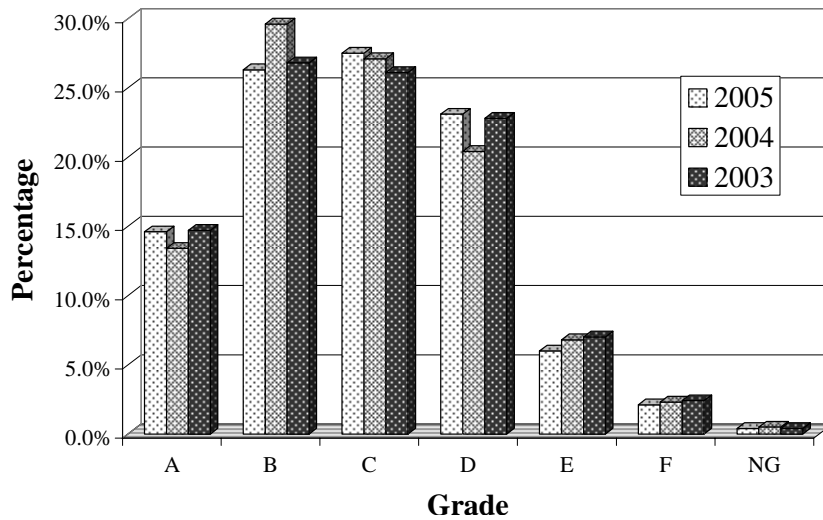
Table 9 compares the grade distribution with that of previous years.

Table 9: Ordinary Level – Grade Comparisons 2003 - 2005.

Year	A	B	C	D	E	F	NG
2005	14.6%	26.3%	27.5%	23.1%	6.0%	2.1%	0.4%
	68.4%			23.1%	8.4%		
2004	13.4%	29.6%	27.1%	20.4%	6.8%	2.3%	0.5%
	70.1%			20.4%	9.6%		
2003	14.7%	26.8%	26.1%	22.8%	7.0%	2.4%	0.4%
	67.6%			22.8%	9.8%		

The grade breakdown at Ordinary Level has remained relatively steady over the past three years, with similar figures being returned in each of the grade and combined grade categories. The only trend of note is a slow but steady decrease in the failure rate. This decrease has resulted in a corresponding slight increase in the numbers obtaining a grade D and this is to be welcomed. These figures are illustrated in Chart 6.

Chart 6: Ordinary Level – Grade Comparisons 2003 - 2005.

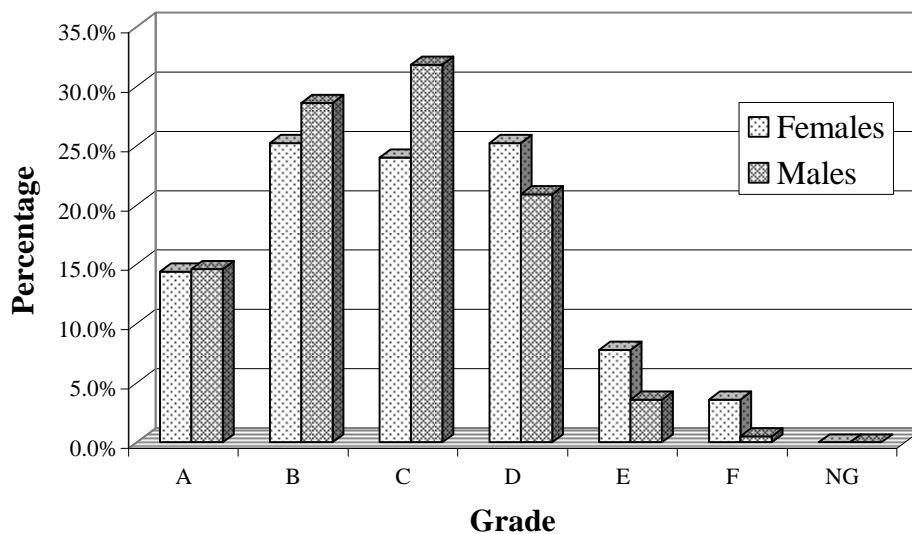


The 94% of males who sat the Ordinary Level examination tended to perform significantly better than females right across the grade spectrum. It is of particular note that the failure rate was in the order of 3% higher for females than males. This phenomenon is the direct opposite of the situation that pertains at Higher Level. The figures are outlined in Table 10 and Chart 7.

Table 10: Higher Level – Comparison of Male and Female Grade Distribution 2005.

	A	B	C	D	E	F	NG
Females	14.4%	25.2%	24.0%	25.2%	7.8%	3.6%	0.0%
	63.6%				11.4%		
Males	14.6%	26.3%	27.8%	23.0%	5.8%	2.0%	0.4%
	68.7%				8.2%		

Chart 7: Higher Level – Comparison of Male and Female Grade Distribution 2005.



3. ANALYSIS OF CANDIDATE PERFORMANCE

The following section contains a detailed commentary on each of the six examination papers. The comments reflect those expressed by the team of examiners who were involved in marking the examinations. The comments are intended to aid teachers and candidates in preparation for future examinations. Statistics quoted in the following section are based on a random sample of approximately 12% of candidates.

Higher Level Paper 1 (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 contained well structured questions, with straightforward elements generally placed at the initial stages of each question and with the level of difficulty increasing as the question progressed. This presented an opportunity for candidates across the attainment range, to attempt their chosen questions and demonstrate what they had achieved.

The examination was fair and allowed candidates to demonstrate their knowledge of the syllabus within the given time allocation. There was an adequate amount of standard material to allow a candidate to achieve an honours grade, while considerable analytical work was required to attain an grade A or a high B grade.

By and large, the results were excellent with 71% obtaining a grade C or higher and with 16.6% receiving a grade A. Only 6.8% of candidates did not achieve a minimum D grade in this year's paper. This figure has decreased steadily from 11.5% just five years ago.

The overall grade distribution for the paper is outlined in Table 11.

Table 11: Paper 1- Higher Level – Grade Distribution.

Grade	A	B	C	D	E	F	NG
No. of Candidates	507	772	895	678	193	14	1
% of Candidates	16.6%	25.2%	29.2%	22.2%	6.3%	0.5%	0.0%

Frequency of Questions Attempted

The pattern of question choice was broadly similar to other years, with Questions 1, 3, 4 and 5 being the most popular. Although each question on the paper was similar in demand some questions proved more popular than others. This would suggest that many candidates pre-select their questions beforehand and thus restrict their opportunities in the examination. Table 12 outlines the frequency with which candidates attempted the various questions.

Table 12: Paper 1- Higher Level – Question Popularity

Question	1	2	3	4	5	6	7
% of Candidates	96.9%	21.1%	85.8%	75.8%	80.0%	28.9%	24.4%

Standard of Answering

Overall, the standard of answering varied between examination centres. Some excellent work was presented as is evidenced by the fact that 16.6% earned a grade A. These candidates produced excellent drawings and displayed an ability to solve problems in two and three-dimensions using the appropriate geometries and their underlying principles and theorems. The solutions presented carried evidence of a well structured analysis of the topics, combined with careful and thorough revision practices.

Most candidates appeared to have adequate time to attempt four, and sometimes more questions. Some of the attempts to questions were exceptional and obtained full marks. There was no evidence to suggest that candidates had insufficient time as less than 2% attempted fewer than the required four questions. There were many candidates who scored well in one or two questions but offered little more than token solutions to the remainder. In these cases, better time management and more complete revision is required by the candidates. The practice of only preparing for the required minimum of four questions is not recommended as it can, evidently, render candidates at a disadvantage during examinations.

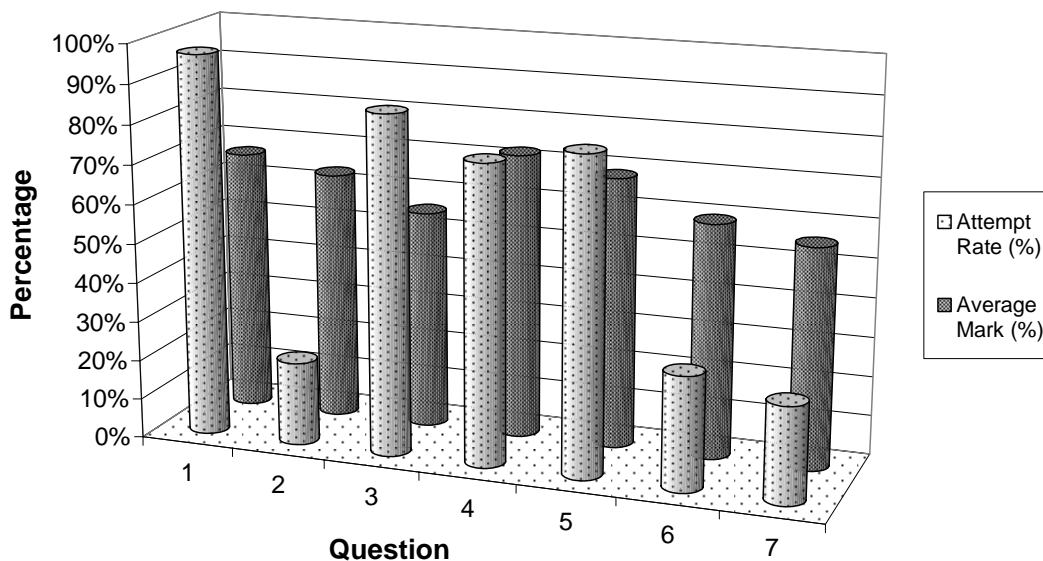
Table 13 outlines the average marks obtained by candidates in each of the seven questions.

Table 13: Paper 1- Higher Level – Average Marks.

Question	1	2	3	4	5	6	7
Average Mark	66.7%	63.3%	55.5%	72.3%	68.6%	59.4%	55.9%

Chart 8 compares the attempt rate and that average mark for each question. It is of particular note that, as in previous years, the average mark for Questions 2, 6 and 7 significantly outweighs the attempt rate.

Chart 8: Paper 1 - Higher Level – Question Popularity Vs Average Marks (Average marks are quoted in percentage terms).



Presentation of Work

The quality of draughtsmanship and presentation of work was, in general, satisfactory. While the instructions to candidates state that construction lines must be clearly shown on all solutions it is noted that some candidates still continue to omit construction and projection lines. Others do not draw these lines clearly. An increasing number of candidates are favouring the marking of points as opposed to drawing construction lines. This practice makes examining more difficult and may result in candidates losing out if an examiner, irrespective of their meticulousness, does not notice a very light dot on a sheet. A significant number do not include any form of indexing which can prove very beneficial in the solution to most questions, but is of particular assistance in Questions 1, 4, 5 and 7.

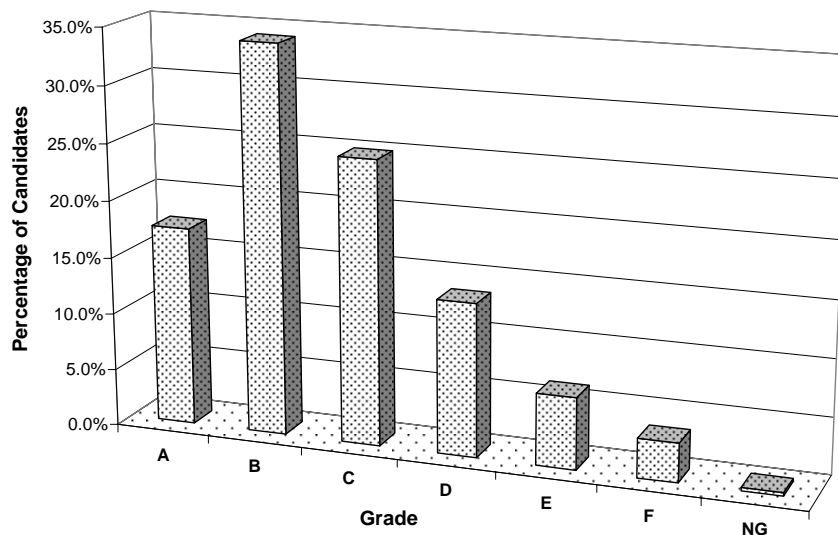
The following is an analysis of the individual questions as reported by examiners.

QUESTION ONE:

Co-Ordinate Geometry

This was the most popular question with an uptake of 96.9%. The average mark was 66.7%. Chart 9 outlines how the candidates performed on this individual question.

Chart 9: Paper 1 - Higher Level – Question 1 – Candidate Performance.



Very few candidates had difficulty with the interpretation of the coordinates and almost all candidates correctly drew the projections of the planes. Part (a) was well answered. Mistakes included neglecting to draw the elevation of the line of intersection, drawing incorrect projections of the line of intersection resulting from projection to invalid lines in plan and/or elevation and not identifying point A as a point on the line of intersection.

In the past the almost universal approach to finding the line of intersection was to obtain an edge view of one of the planes. This, however, is changing. Each year, an increasing number of candidates are using the section method. The fact that only one section was required this year made the question more conducive to the latter solution than was the case in some previous years. However some difficulties were encountered, with quite a number of candidates taking two sections to locate points on the line of intersection. In a few cases, candidates found the dihedral angle and then projected the line of intersection back to the plan and elevation. Most horizontal sections were taken through points B or D. A small number of candidates either guessed the line of intersection or did not locate it at all.

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 every point on the two planes through the auxiliary views but many had difficulty in getting all points on both planes to appear collinear in the view showing the dihedral angle. Common mistakes included drawing the first auxiliary view perpendicular to one of the edges and measuring incorrect distances in the second auxiliary view. Some candidates, who were unable to find the line of intersection, guessed a line of intersection and attempted to find the dihedral angle.

Part (c) of the question was not well answered, with only a very small number of candidates managing to draw the projections of the required line. As was the case in previous years, many candidates did not attempt this part at all. Candidates' overall difficulty with visualising the problem and its solution was evident here. Candidates were credited for drawing a line on the plane ABC 50mm above the H.P. in elevation and in plan, even though a significant number of these did so only because they had used this as part of their construction for finding the line of intersection in the first place. There appeared to be some understanding that the 40° line should be drawn in a view showing the plane ABC as an edge, but only a minority established that this information could be used to solve the problem in the plan and elevation. An arc of the correct radius from D in plan was rarely swung. The vast majority of candidates were unable to draw the plan of the required line.

Some candidates recognised the value of using a cone to solve the problem. Some of these drew an ellipse in plan, while others drew a second auxiliary plan looking along the axis of the cone to determine the plan of the required line.

Common mistakes included drawing an incorrect line in a view showing the plane ABC as edge and projecting this line back to one of the edges of the planes in plan and elevation.

Overall, this was a challenging but fair part to a question. It could not have been answered by candidates who had engaged in "rote" style learning. 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, as appropriate.

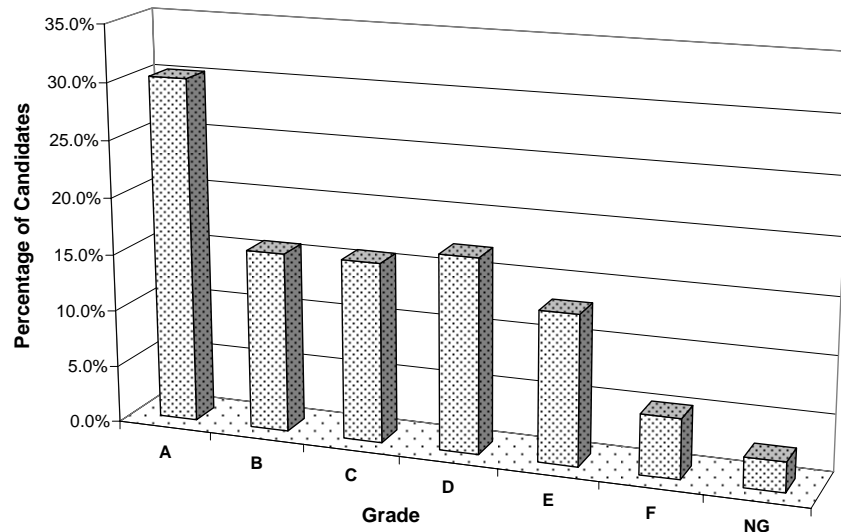
Part (d) was attempted by most and was, generally, very well answered. The parallel plane method was the favoured method of solution. A small number of candidates misread the question and located the shortest distance. The inclusion of an extra part here managed to test the A and B grade candidates and again was included in an effort to discourage "rote" learning. However, most candidates omitted this element altogether. Those candidates who displayed a thorough understanding of the principles of lines and planes solved this part easily.

QUESTION TWO:

Area of Figures

This question was not a popular option, being attempted by 21.1% of the total cohort. The average mark awarded was 63.3%. Chart 10 illustrates candidate performance in this question.

Chart 10: Paper 1 - Higher Level – Question 2 – Candidate Performance.



By and large, this question was answered either very well or very poorly. The question rewarded those candidates who displayed an understanding of the fundamentals of plane geometry and area division. The candidates who scored well in the question tended to be clustered in centres, indicating that, with appropriate preparation, candidates are quite capable of solving two-dimensional space problems graphically using appropriate geometries and their underlying principles and theorems. The omission of construction lines made the marking of this question difficult in some cases.

Many candidates made no attempt, or a very poor attempt, at determining the length of the mean proportional CF. 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 the graphical method. While this year's question and marking scheme were devised in such a manner that allowed for a mathematical solution, this need not necessarily always be the case. It is possible that, in future examinations, candidates may be required to use graphical means only to solve such problems.

Where mathematical solutions were employed the calculations were invariably shown on the answer sheet as is required. Some candidates showed both methods. A small number of candidates recognised that the mean proportional was not required to locate point C. These candidates drew a circle of diameter 155mm about O passing through the points A and B and proceeded to locate the points C and D.

The location of the points C and D, in general, proved to be relatively easy, while the location of point E proved to be more problematic for candidates. Many did not recognise the need for a locus. Only the candidates who scored highly on the paper overall, managed to locate point E correctly. Many candidates completed the pentagon by merely copying the figure from the examination paper by scaling. In this case no marks were awarded. A common mistake involved not bisecting the line AB with a compass.

In general, part (b) of the question was not well answered. A significant number of candidates managed to convert the area of the pentagon into the correct triangle of equal area, but did not succeed in dealing with the 4:5 ratio. Many candidates simply demonstrated an ability to draw a triangle equal in area to the pentagon, but did not progress any further. Only the very good candidates managed to complete the solution fully.

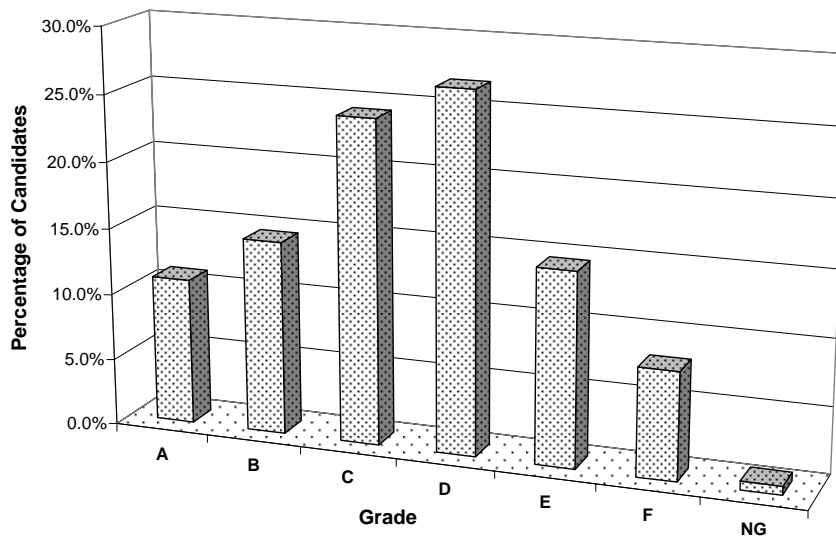
Part (c) of the question was well answered. Most candidates recognised that a spiral similarity was not required and used a locus to solve the problem. The preferred locus was one that constrained one point on the line CD and one on the circle. This locus proved difficult to construct and, occasionally, resulted in a degree of inaccuracy.

QUESTION THREE:

Solids in Contact

This question was the second most popular question with an 85.8% uptake. The average mark awarded was 55.5%. Chart 11 illustrates candidate performance in this question.

Chart 11: Paper 1 - Higher Level – Question 3 – Candidate Performance.



Part (a) was well answered, demonstrating candidates’ aptitude to spatially visualise two familiar solids. Most candidates solved the problem using the elevation view. Candidates encountered little difficulty in dealing with the visualisation of the position of the solids in terms of hidden lines. Common errors here included not locating the centre of the sphere in elevation and the omission of hidden detail in the plan.

Part (b) of this question was handled well by only a small number of candidates. Many candidates who did complete the part displayed great endeavour in doing so. This part was solved, in general, by those candidates who achieved an A or a high B grade overall. Other candidates encountered difficulties in visualising a solution to this type of problem.

Most candidates correctly identified a point 33mm above the H.P. and managed to construct a tangent and normal at this point. Those who solved the problem did so by means of one of a few loci. While most candidates got to the stage where they could draw one set of arcs or lines of the required locus, few were able to determine the second set. In the main, candidates did not recognise that a section of the inverted cone was required. A second set of arcs was invariably measured out from the edge of the cone in plan. The line OP was extended in most cases but the fact that the second set of arcs did not correspond with the first meant that a valid solution could not be reached.

Part (c) of the question, despite being a frequently asked type of problem, was surprisingly not as well answered as was anticipated. Only a minority of candidates placed a cone at the apex of cone C in elevation. The vast majority simply drew the horizontal trace tangential to the plan of cone A and then constructed a vertical trace based on that horizontal trace. The true angle between the

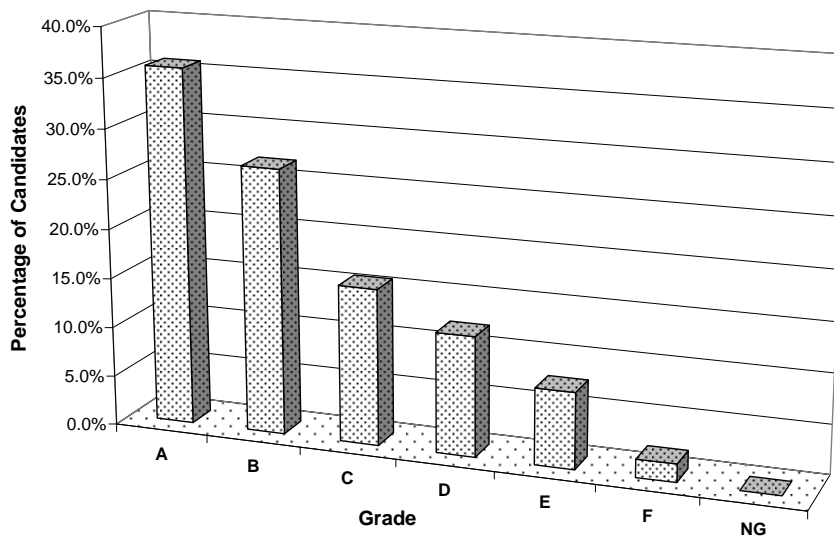
traces was rarely attempted. A common error here involved determining the true angle between the tangent plane and the H.P. or the V.P.

QUESTION FOUR:

Interpenetration of solids

This question was the fourth most popular preference. It was attempted by 75.8% of candidates and was well answered. The average mark awarded was 72.3%. Chart 12 illustrates candidate performance in this question.

Chart 12: Paper 1 - Higher Level – Question 4 – Candidate Performance.



The question contained sufficient intersection points to differentiate effectively between the grades, while allowing the better candidates to demonstrate their visualisation and draughting skills. The vast majority of candidates employed 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 also well managed. There was generally a very good effort at drawing the auxiliary plan. Common mistakes included omitting the plan of the cut surface and misplacing edge 3 in elevation.

For the most part, candidates managed to determine the points A, B and C. A large number of candidates did not establish the points D and E in plan and elevation. When these points were located, they were often located inaccurately.

Many candidates managed to determine most of the ten points F, G, H, I, J, K, L, M, N and O. Point H was the one most frequently omitted. Sometimes, candidates located some or all of these points erroneously by drawing lines on a wrong surface in the auxiliary plan. The points P and Q were rarely located. Where candidates did manage to locate these two points in elevation, only a small minority succeeded in establishing their projections in plan.

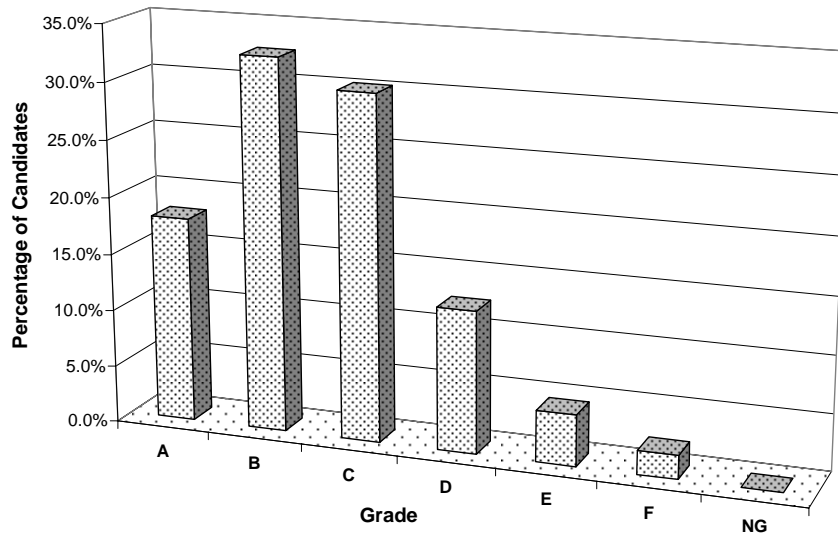
Candidates who managed to obtain the majority of the intersection points experienced little difficulty with the visualisation aspect of the intersection, i.e. the joining of the points. The determination of hidden detail proved to be the most difficult part of this question.

QUESTION FIVE:

Loci

This question proved very popular was also, generally, well answered. It was attempted by 80.0% of candidates. The average mark was 68.6%. Chart 13 illustrates candidate performance in this question.

Chart 13: Paper 1 - Higher Level – Question 5 – Candidate Performance.



The drawing of the cycloid along the horizontal line AB was handled well by the vast majority of candidates. Almost all candidates used 30⁰ divisions when dividing the circle. The curve corresponding to the movement along the line AB was also located correctly by the vast majority of candidates. The final point on this curve proved to be the only difficulty here. The most common approach to finding points on the locus was to draw two sets of arcs. Many candidates (a smaller number than last year) used tracing paper to determine the locus and these solutions yielded very good answers. It should be noted that if candidates opt to use tracing paper all relevant constructions must be shown on the tracing paper and it must be submitted for assessment. A small number of candidates found points on the locus by drawing the profile in its rotated position each time.

The cycloid on the curve BC was not very well answered. Many candidates, including those who used tracing paper, did not deal with the transition in any meaningful manner.

Common mistakes included not locating the point of contact between the rolling circle and the arc BC, stepping distances along the centre line of the rolling circle instead of along BC, taking the point of contact on the line BC as one of the original division points on the circle and swinging the second set of arcs in the incorrect direction. Only a small number of candidates managed to locate all four points.

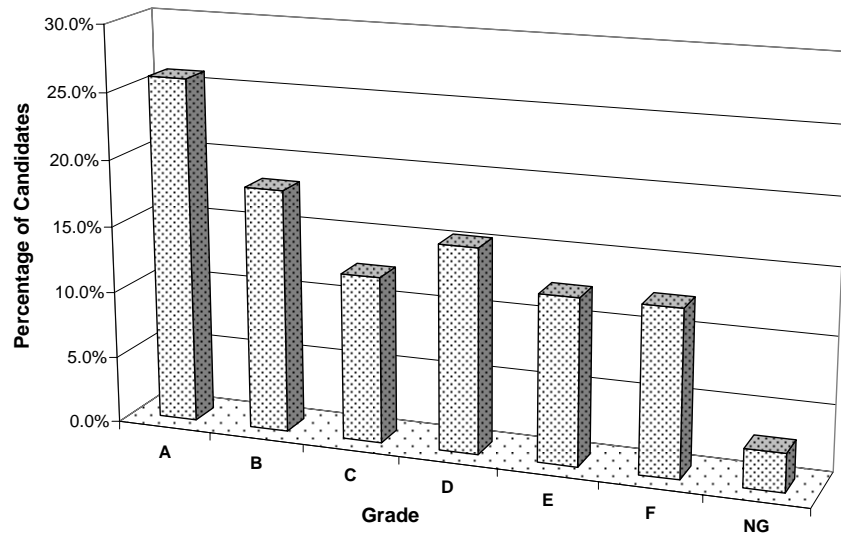
The drawing of the curve along the line CD was located correctly by many, but answers varied based on the accuracy of the curve associated with BC. While many candidates located the point OD before rotation, and a smaller number located OD after rotation, the location of the point PD, before and after rotation, was frequently omitted. Only a handful of candidates drew the compass arc joining PD (before rotation) to PD (after rotation). The majority simply drew a freehand curve in its place.

QUESTION SIX:

Conic Sections

As was the case in previous years, this was not a popular question, being attempted by 28.9% of the total cohort. The average mark awarded was 59.4%. Chart 14 illustrates candidate performance in this question.

Chart 14: Paper 1 - Higher Level – Question 6 – Candidate Performance.



Part (a) was well answered. Many candidates were able to locate the directrix and the axis. Most displayed a good knowledge of the constructions for locating points on a parabola when given the directrix and axis of the curve. The principal cause of error here was an inability to determine the position for the directrix. Some candidates simply guessed a position for the directrix and axis and drew the resulting parabola.

The drawing of the tangent is a standard problem, which is frequently examined. However, many candidates seemed unaware of the methods of solution to such a problem and simply guessed a position for the required tangent; these candidates gave no indication of the point of contact. The preferred method of solution was to draw parallel chords to find the point of contact. A minority of candidates drew a line from the focus at 90° to the line DF to meet the tangent at the vertex as a correct solution.

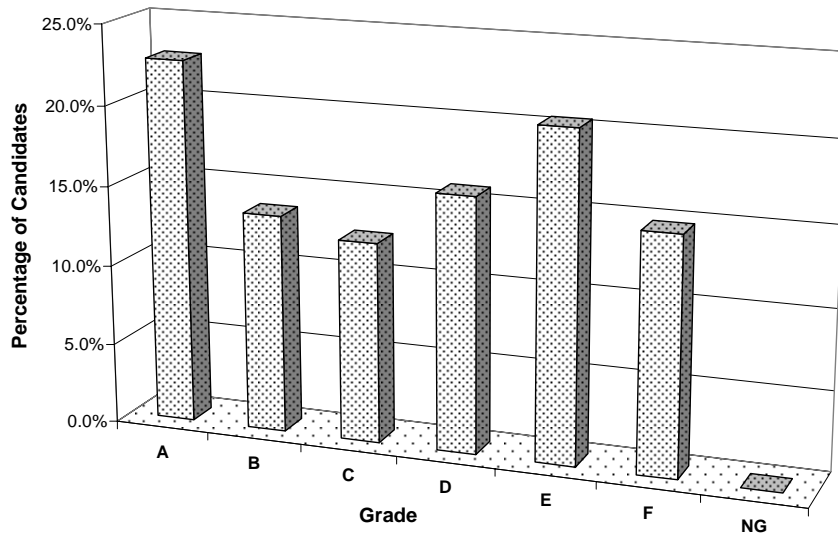
Part (b) was not as well answered as part A. On the whole, candidates either knew how to determine the position for the focal point or they did not. Doubling the angle was the most common source of error. However, a significant number demonstrated their knowledge that the second focal point was located 135mm from F. The candidates who achieved an A or a high B grade overall, completed this part satisfactorily. A high percentage of candidates located their own position for the second focal point and constructed their curve accurately using this information. While these candidates displayed difficulty in obtaining the focal point, they were awarded marks for any correct constructions that could have led to its determination. The centre of curvature was handled well by the vast majority of candidates.

QUESTION SEVEN:

The Oblique Plane

This question was not as popular as in previous years, being attempted by 24.4% of candidates. The average mark awarded was 55.9%. Chart 15 illustrates candidate performance in this question.

Chart 15: Paper 1 - Higher Level – Question 7 – Candidate Performance.



It is surprising that more candidates do not opt for this question as much of the knowledge associated with oblique planes may be used to answer a question, or part of a question, on other topics in any of the three papers. In general, there was wide variation in the standard of answering. Many solutions merited full marks, while other responses indicated a deficiency in knowledge and understanding relating to 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 onto an oblique plane. However, a significant percentage of candidates seemed to have difficulty in understanding what was required in the question. A number of candidates drew the pyramid with the square base, instead of the triangular face, resting on the oblique plane. Visualisation of the problem seemed to be a significant problem for the candidates. The auxiliary view method was the preferred method of solution as opposed to the rabatment method.

Part (b) was handled well, with candidates displaying a good knowledge in relation to the projection of the cut surface from the elevation to the plan.

Part (c) was poorly attempted with the vast majority of candidates only managing to locate the line AB correctly in plan and elevation. Common mistakes here included taking the plan of the line AB as the true length of the same line and drawing an equilateral triangle with the plan length of AB as one side.

Higher Level Paper 2A (Engineering Applications)

Overview

The examination paper comprised six questions of which candidates were required to answer any four. In answering Question 6, candidates had an additional exclusive option of part 6A or part 6B. This essentially presents candidates with seven questions from which they are required to answer four. All questions carried an equal 50 marks.

Performance of Candidates

A total of 542 candidates opted for this component (an increase of 9.4% on last year's candidature). It is of note that while the percentage opting for Higher Level has increased there was a decrease of approximately 15% in those opting for the Ordinary Level paper. Overall the results are broadly similar to those of recent years. When compared with the 2004 results, there was a 2.6% and a 2.1% decrease in the percentage achieving a grade A and a grade B respectively. However the overall combined ABC rate was only marginally down by 1.8%. A total of 78.4% of candidates were awarded a grade C or higher (almost 4 out of every 5 candidates).

The drop in A and B grades is likely to be related to the shift in candidature from Ordinary Level to Higher Level. Examiners noted that a significant number of candidates, who took the Higher Level paper, would have been more suited to sitting the examination at Ordinary Level examination. It is recommended that candidates give more consideration to the level at which they wish to present for examination. Teachers should continue to encourage more candidates to take Higher Level but only where that is deemed appropriate. The failure rate, at 2.6%, was extremely low and this is to be welcomed. Table 14 shows the distribution of grades for the examination paper.

Table 14: Paper 2A - Higher Level – Grade Distribution.

Grade	A	B	C	D	E	F	NG
No. of Candidates	68	177	180	103	12	2	0
% of Candidates	12.5%	32.7%	33.2%	19.0%	2.2%	0.4%	0.0%

Frequency of Questions Attempted

The pattern of question choice was broadly in line with previous years, with Questions 1, 2, 3 and 4 being the most popular. Table 15 outlines the frequency with which candidates attempted the various questions.

Table 15: Paper 2A- Higher Level – Question Popularity

Question	1	2	3	4	5	6A	6B
% of Candidates	83.8%	98.8%	78.8%	53.8%	32.5%	27.5%	22.5%

General Comments

As evidenced by the number of grades A and B awarded, many of the candidates who presented for the examination produced excellent quality work and demonstrated outstanding skills and a comprehensive knowledge of the subject. The exceptional performance of these high scoring candidates confirms that standards are being maintained. One in eight candidates achieved a grade A, and it was usual for clusters of grade A's to come from the same centre indicating a very high standard of class preparation. Regrettably, it is still evident that a number of candidates do not

appear to have prepared properly for the examination in terms of comprehensive coverage of the syllabus.

The examination paper was generally regarded as a very fair test and in keeping with previous years, in terms of standard and format. The question paper was student friendly with no evidence of any ambiguities or misunderstandings. The examination was sufficiently accessible to allow all candidates to attempt all questions. All candidates were able to score marks throughout the paper. This obviously helped to sustain motivation and confidence during the three hour examination.

Evidence indicates that the time allowed for the paper was appropriate. There was very little evidence of questions being unanswered due to a lack of time. Very few (6.5%) answered additional questions and most candidates appeared to have managed their time effectively and may have used any available spare time for enhancing answers to the required four questions.

The quality of draughtsmanship and presentation of work was very satisfactory and the standard of freehand sketching was good, where attempted in Questions 1(b) and 6(b).

While, in general, a good spread of questions was answered, some examiners expressed a concern that, in the case of a small number of examination centres, candidates appeared to lack preparation in examination technique and syllabus coverage. In these cases candidates scored very well in one or two areas only and it would appear that a number of syllabus topics were not well covered. These included: CAD, developments, sectioning, isometric drawing, and freehand sketching.

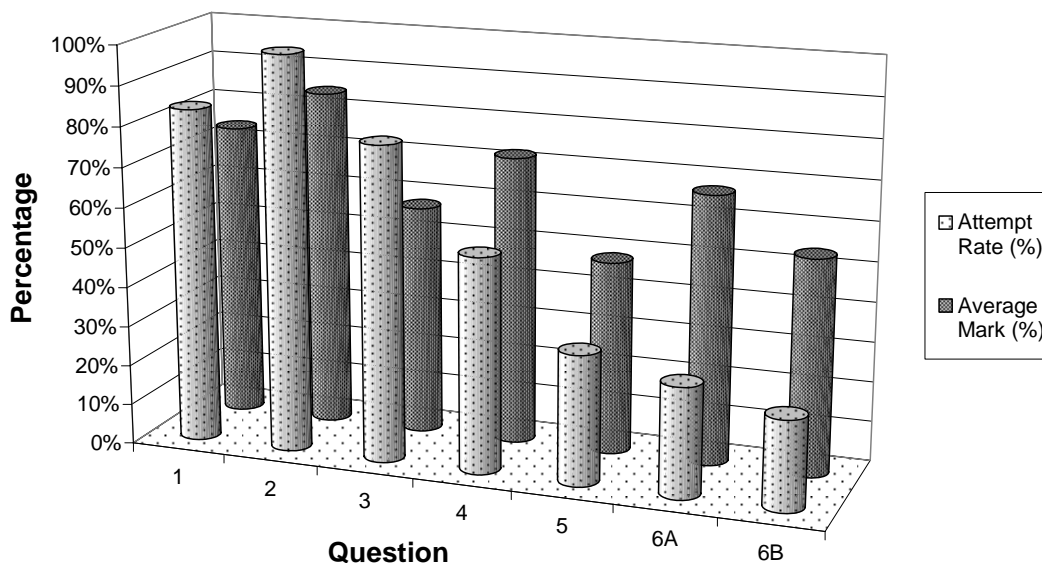
Table 16 outlines the average marks gained by the candidates over the range of questions.

Table 16: Paper 1- Higher Level – Average Marks.

Question	1	2	3	4	5	6A	6B
Average Mark	75.0%	84.5%	57.6%	72.2%	48.3%	67.2%	54.0%

Chart 16 compares the attempt rate and that average mark for each question. It is of particular note that the average marks for the least popular questions (4, 5, 6A and 6B) significantly outweigh the attempt rates.

Chart 16: Paper 1 - Higher Level – Question Popularity Vs Average Marks (Average marks are quoted in percentage terms).



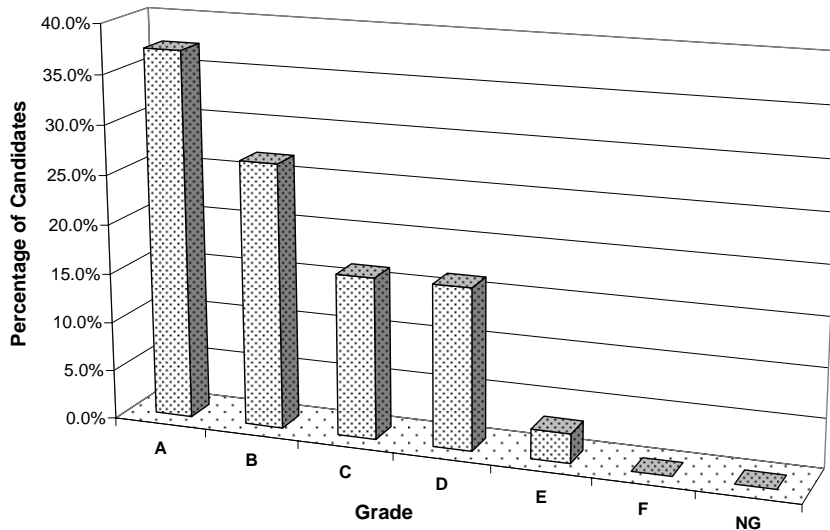
The following is an analysis of the individual questions as reported by examiners.

QUESTION ONE:

Assembly Drawing: Support Roller

This was the second most popular question with 83.8% of candidates attempting it, with varying degrees of success. The average mark was 75%. Chart 17 illustrates candidate performance in this question.

Chart 17: Paper 2A - Higher Level – Question 1 – Candidate Performance.



In part (a) of the question, the assembly drawing was well answered and all but a few candidates were able to assemble the parts correctly. Some did not insert the second tommy bar and others did not draw the roller bracket in the lowest position as required.

The sectioning of the assembly was well executed. However, a number of candidates incorrectly sectioned the standard components i.e. M12 nut and washer, tommy bars, and the screwed spindle. In addition, many incorrectly sectioned the webs on the support roller bracket. The vast majority did not insert the correct centrelines.

In part (b), the part item references were well presented but in many instances they did not conform to the relevant drawing standards. A few candidates wasted valuable time by drawing out a parts list that was not required in the question. In some instances the printing of the drawing title was poorly presented and this was mainly because guidelines were not used.

Part (c) was well answered and sketching was of an acceptable standard. However, many candidates did not suggest a practical method of preventing the screwed spindle from being screwed out of the base. Some stated a method but did not provide a sketch which was specifically required in the question. It should be noted that candidates must outline their proposed modification with an annotated sketch in order to be awarded marks.

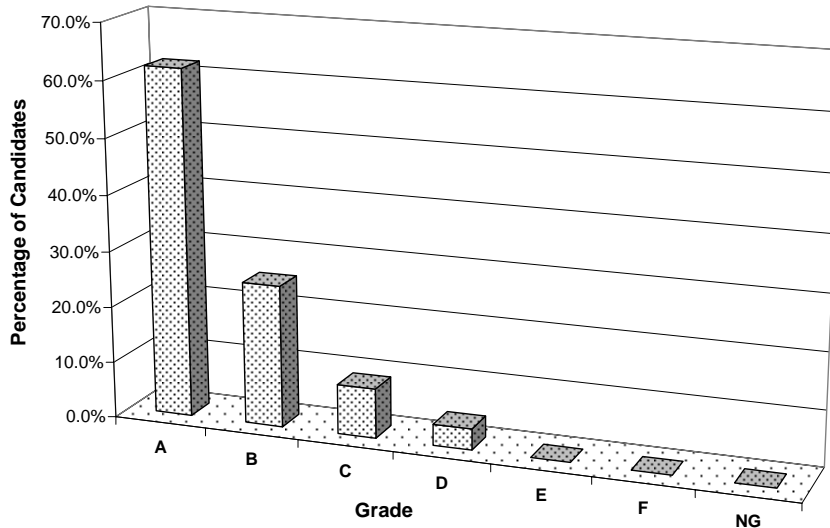
While most candidates correctly inserted the fillets, chamfers and threads, some did not and this resulted in a loss of marks. The non inclusion of the correct centre lines was also identified as a shortcoming in many, otherwise excellent solutions.

QUESTION TWO:

Cam and Linkage

This was the most popular question on the examination paper and also had the highest average mark. It was attempted by 98.8% and the average mark awarded was 84.5%. Chart 18 illustrates candidate performance in this question.

Chart 18: Paper 2A - Higher Level – Question 2 – Candidate Performance.



(a) Cam Design

The displacement diagram was very well answered. In the cam profile some candidates had the direction of rotation and the nearest approach incorrect. For reasons of accuracy, intermediate points needed to be plotted on the cam profile during the uniform velocity movement. Several candidates drew a cam profile suitable for a knife-edge follower and did not allow for the specified roller follower. Some omitted to draw the camshaft.

(b) Linkage

The linkage was well attempted and most plotted the locus correctly and obtained full marks. Only a very small percentage of candidates found maximum and minimum points in relation to the stroke length and angle of travel. In addition to the twelve points plotted, intermediate points should be tested to correctly identify the extremes in order to achieve maximum marks. A small number of candidates did not indicate the required dimensions.

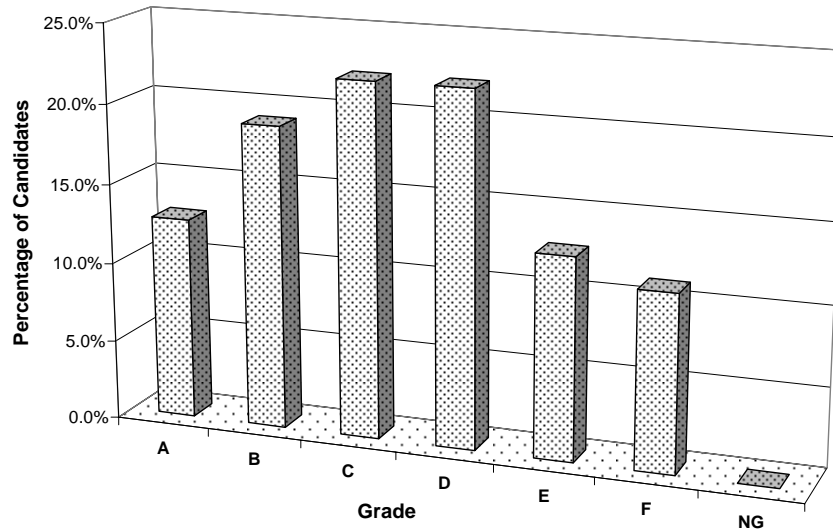
While the standard of draughtsmanship was, in general, very good, areas were identified where scope for improvement exists. These include construction line weights, indexing and freehand curve drawing.

QUESTION THREE:

Development of sheet metal hopper

This was the third most popular question on the paper and the average mark awarded was 57.6%. Although attempted by 78% of candidates, the candidate performance varied as is illustrated in Chart 19.

Chart 19: Paper 2A - Higher Level – Question 3 – Candidate Performance.



(a) Curve of intersection

The task of obtaining the curve of intersection proved difficult for some candidates. Many simply guessed it and continued on with the rest of the question. Only a small proportion correctly constructed the curve.

(b) Development

The square to round portion of the development was skilfully answered showing that the majority of candidates understood the important principles of triangulation. However, in the cylindrical portion of the development, a common mistake was the assumption that the cut out for the branch pipe would appear as a circle of 40 mm diameter. Some candidates did not have the seam at the specified position. A few incorrectly used straight lines instead of curved lines for the circular portions of the development.

(c) True shape of top opening

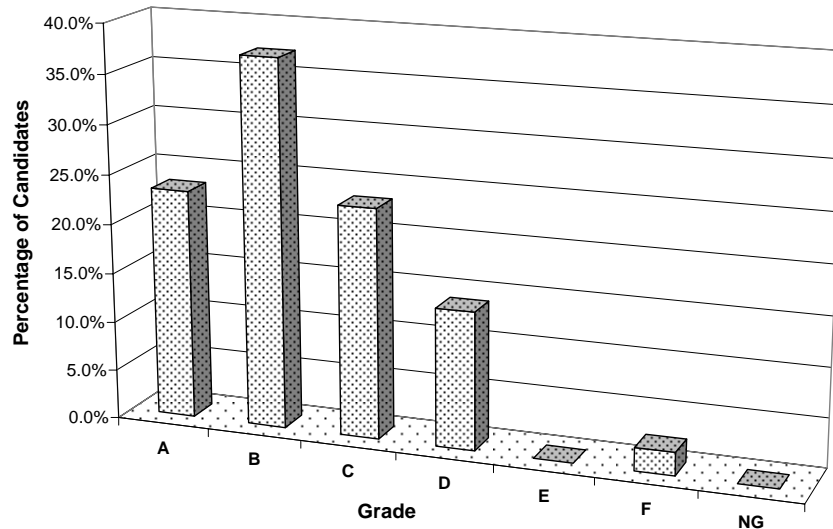
A significant number of candidates did not make any attempt at this part of the question. Most of those who did, correctly projected the auxiliary plan to obtain the true shape of the hopper opening.

QUESTION FOUR:

Valve Housing

This was the fourth most popular question on the examination paper. It was attempted by 53.8% of candidates. The average mark awarded was 72.2%. Chart 20 illustrates candidate performance in this question.

Chart 20: Paper 2A - Higher Level – Question 4 – Candidate Performance.



In order to aid candidates in their visualisation of the housing, a thumbnail pictorial view was provided on the examination paper in addition to the customary orthographic views. This proved most helpful and facilitated candidates across the attainment range to attempt the question. Overall, many excellent solutions were presented in what was a well answered question.

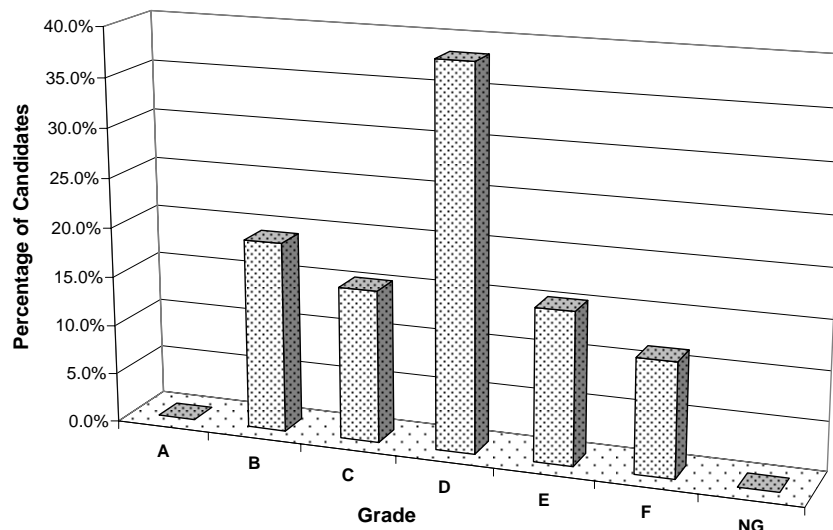
Some candidates did not section the two views correctly as there seemed to be some uncertainty as to which parts were hollow and solid. The end elevation presented very little difficulty for the candidates but a significant number projected the view to the wrong side, confusing 1st and 3rd angle projection. In most answers, correct centre lines were not drawn and in many cases the dimensions were not inserted in accordance with the drawing standards. The projection symbols, which were generally correct, were incorrect in a number of cases. A significant number did not show the cutting planes and did not sub-title the views or insert fillets as was required to achieve maximum marks.

QUESTION FIVE:

Engine part list, Piston sketch and Isometric

This question was attempted by 32.5% of candidates and despite being similar in nature to previous years' questions on this topic the average mark was just 48.3%. Chart 21 illustrates candidate performance in this question.

Chart 21: Paper 2A - Higher Level – Question 5 – Candidate Performance.



(a) Engine Parts list

The majority of candidates had little or no difficulty in naming the engine parts and the parts list was, generally, presented in an excellent fashion.

(b) Piston Sketch

This was well answered and most candidates displayed a good knowledge of the piston parts and scored well. Sketches were of a reasonable standard.

(c) Isometric

In contrast to the previous parts of the question this section was not well answered and sometimes the question was left unfinished. The isometric required a considerable amount of accurate construction work and therefore proved time consuming. The overall standard of answering indicated that it was an area with scope for improvement in terms of candidate performance. The low average mark coupled with the poor attempt rate illustrates the need for greater focus on this topic in order to improve the overall standard. Many attempts at the isometric circles and sphere were just freehand with no method of construction shown.

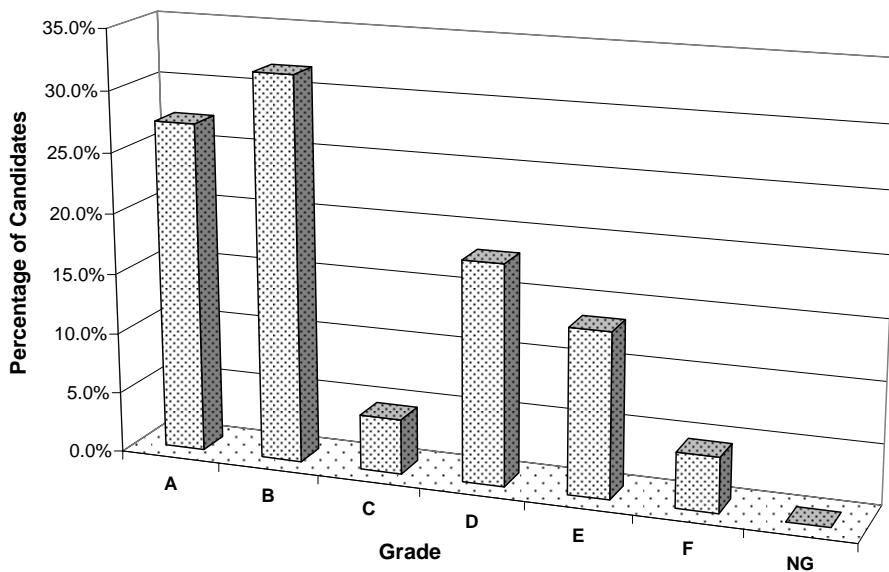
Most candidates ignored the question requirement to use the isometric scale and thus incurred a penalty, albeit small, in terms of marks. Candidates should be familiar with the use of the isometric scale from their experience in Junior Certificate Technical Graphics and its inclusion on this examination paper should not have been unexpected. This stresses the importance of covering the entire syllabus in class and not just the content of previous examination papers.

QUESTION SIX:

Section A - Spur Gear, Feed Screw

This question was attempted by 37% of candidates and the average mark was 67.2%. Chart 22 illustrates candidate performance in this question. As is common in questions with two sub-parts, performance in the grade C range is low as a significant percentage of candidates attempted only one of the two parts.

Chart 22: Paper 2A - Higher Level – Question 6A – Candidate Performance.



(a) Spur Gear

Answering here was excellent in both the calculations and gear drawing. Full marks were frequently awarded. Gear teeth profiles were successfully constructed with most candidates adopting the circular arc method. Any recognised approximate method was acceptable for the construction of the gear teeth. Frequent omissions were the root radii and centre lines. Some candidates mixed up radius with diameter and produced gear teeth half full size.

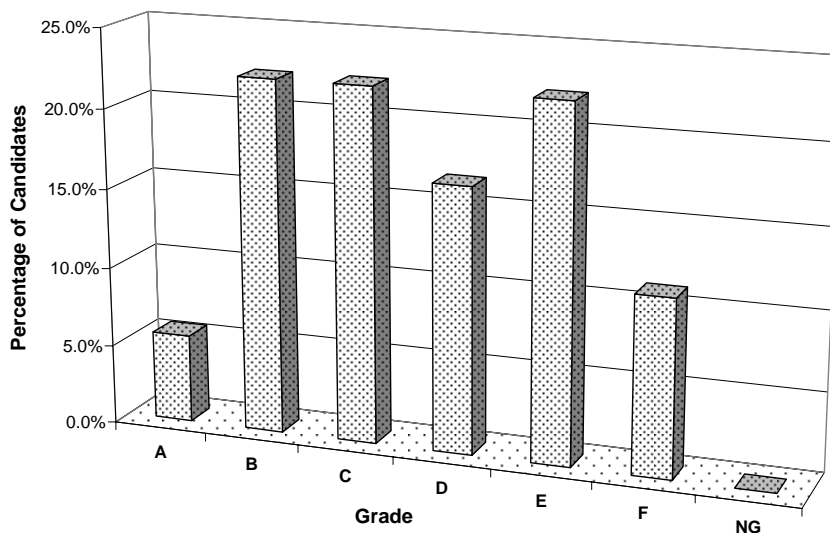
(b) Feed Screw

The feed screw was a difficult construction and only candidates achieving high overall scores did a good job in this part of the question. Most candidates were capable of doing the construction work necessary for both helices but experienced difficulties in finalising the view of two full revolutions.

Section B - Computer Aided Design

This question was attempted by 22.5% of candidates and the average mark was 54%. Chart 23 illustrates candidate performance in this question.

Chart 23: Paper 2A - Higher Level – Question 6B – Candidate Performance.



As in previous years, a high standard of work was noticeable from candidates at certain examination centres where CAD appears to be comprehensively taught in the classroom. However, many scripts displayed a disappointing lack of depth and breadth of knowledge and understanding of the subject matter, and candidates were unable to address questions with any substance or authority. Candidates who used sketches and diagrams were awarded marks for them where they were relevant and clearly labelled.

- (a) The short CAD questions were well attempted and the standard of answers were good with some scope for improvement in terms of presentation and clarity. Very few correctly explained the term ‘vector graphics’.
- (b) This was quite a popular question and generally well answered, although many answers were of a general nature based on typical 2D drawing commands and referred little to the 3D commands needed to produce the model. The correct sequence of 3D commands and concepts, with clear support sketches, featured only in the better responses.

- (c) Most candidates did not score well in this part of the question as many sub-parts of the question were not attempted. The main factor that prevented candidates accessing the full marks was a lack of specific CAD knowledge, particularly, Spline/Fit and Associative / Non associative hatching.

- (d) This part was poorly attempted with few fully correct answers. Many attempts consisted of sheet size, circle and the three lines. The more able candidates were capable of interpreting all the CAD instructions and correctly applied the absolute, relative and polar coordinates to draw the required profile.

Higher Level Paper 2B (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 broadly comparable standard to previous years. The overall performance of candidates also followed a pattern similar to that observed in previous years.

While the general standard of answering was very satisfactory there were some indications that, as in the past, discrepancies in performance tended to be more marked between examination centres rather than within them. It was evident that the candidates who achieved higher grades had prepared well and that the syllabus had been thoroughly covered. Table 17 shows the distribution of grades for the examination paper.

Table 17: Paper 2B - Higher Level – Grade Distribution.

Grade	A	B	C	D	E	F	NG
No. of Candidates	470	791	740	397	95	23	1
% of Candidates	18.7%	31.4%	29.4%	15.8%	3.8%	0.9%	0.0%

The number of candidates achieving each grade this year was broadly in line with that of previous years. Though the number of A grades showed a slight decrease, this was offset by an increase in the numbers achieving combined ABC to grades to 79.5%, and by the reduction in the numbers failing to achieve a grade D to 4.7%. Both of these changes are to be welcomed.

The pattern of question choice was broadly similar to previous years. Questions 1, 5, 6 and 7 continue to be very popular, while Question 3 was more unpopular than usual. Table 18 outlines the frequency with which candidates attempted the various questions.

Table 18: Paper 2B- Higher Level – Question Popularity

Question	1	2	3	4	5	6	7
% of Candidates	78.4%	49.1%	20.6%	32.2%	88.1%	68.4%	71.6%

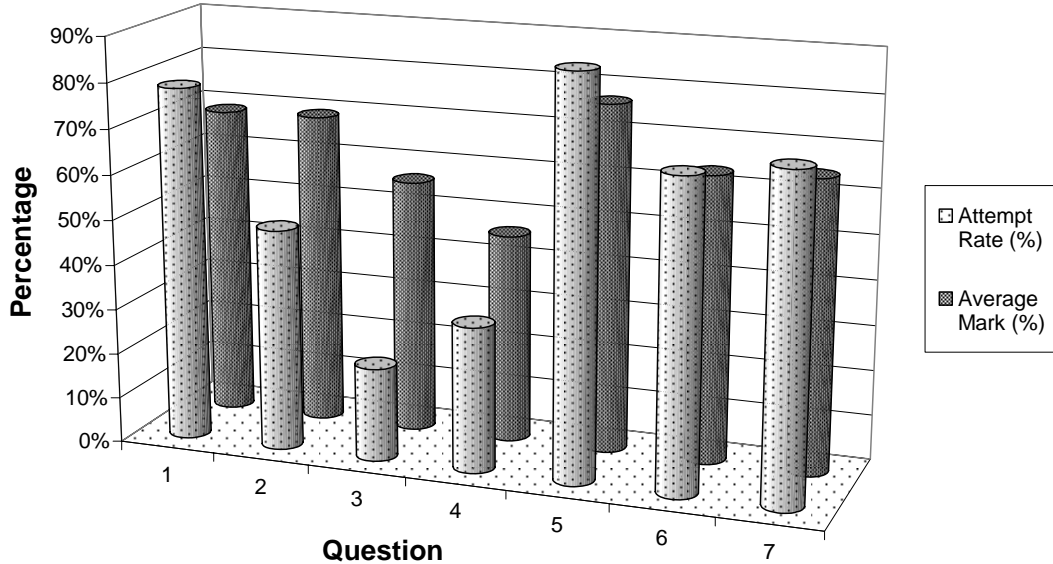
Most candidates appeared to have sufficient time to attempt four, and sometimes more, questions. Some of the attempts to questions were exceptionally good and obtained full marks. Table 19 outlines the average marks obtained by candidates in each of the seven questions.

Table 19: Paper 2B - Higher Level – Average Marks.

Question	1	2	3	4	5	6	7
Average Mark	68.8%	69.2%	56.4%	46.3%	77.0%	63.5%	64.6%

Chart 24 compares the attempt rate and the average mark for each question. It is significant that the average mark for Questions 2, 3 and 4 significantly exceeds the attempt rate. This indicates that candidates would benefit from studying a wider range of topics.

Chart 24: Paper 2B - Higher Level – Question Popularity Vs Average Marks (Average marks are quoted in percentage terms).



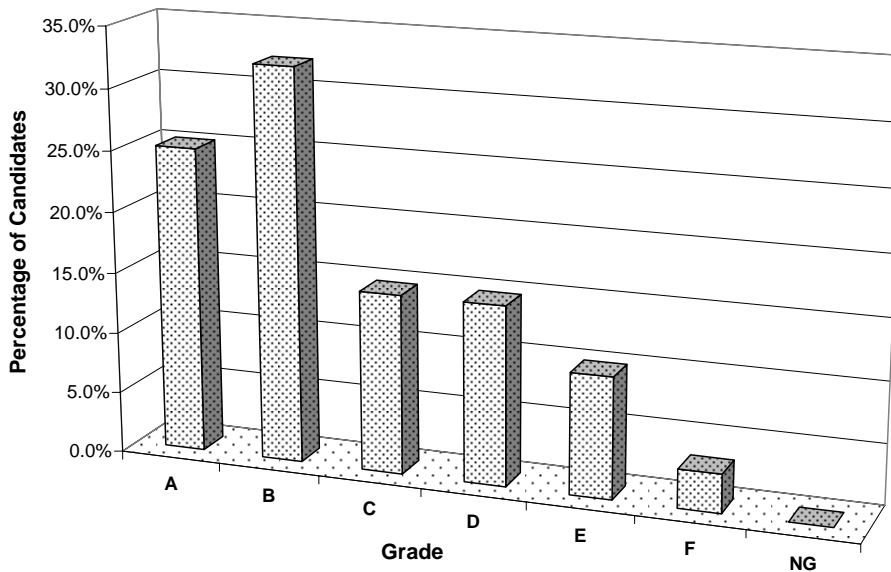
The following is an analysis of the individual questions as reported by examiners.

QUESTION ONE:

Perspective Projection

This question, on perspective projection, was the second most popular question on the paper. It was attempted by 78.8% of candidates. By and large most answers were complete, quite a number were completely correct, but the degree of accuracy of many varied considerably. The average mark was 68.7%. Chart 25 illustrates candidate performance in the question.

Chart 25: Paper 2B - Higher Level – Question 1 – Candidate Performance.



The aspect of answering which most surprised examiners was the extent of candidate unfamiliarity with the positioning of the picture plane through an internal corner in plan. This is despite the fact that this genre of question has frequently been asked in the past. Consequently many candidates had difficulty drawing the base lines of the structure. In other instances candidates incorrectly positioned the picture plane touching the lower right hand corner in plan rather than where indicated. Further progress was not hindered, however, by these shortcomings and marks were awarded accordingly.

A more positive aspect of solutions this year was an increased level of understanding of the application of heights to the perspective drawing. There was a high incidence of candidates drawing the elevation to facilitate the construction of the curve and the inclined 25° lines. In general, the curves were very well drawn in perspective and candidates coped equally well with the application of auxiliary vanishing points. In some solutions, however, the height of the auxiliary vanishing point above the horizon line was incorrect.

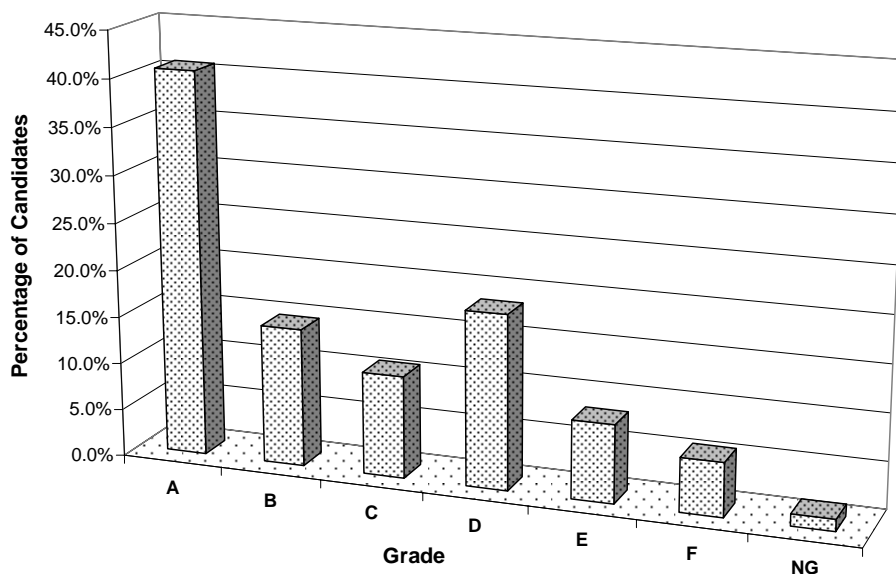
It was apparent that candidates experienced no difficulty interpreting the given orthographic views which ensured that candidates, of varying ability, made a valid attempt at a solution. Candidates who lined in their drawings and who made a clear differentiation between the intensity of construction lines and the finished perspective drawing were rewarded for their extra effort.

QUESTION TWO:

Roof Geometry

This question was attempted by 48.8% of the candidature. The question was presented in a new, more candidate friendly format this year, where details were given separately for each part of the question. Examiners were, generally, pleased with the standard of answering and the incidence of guesswork often seen in questions on roof geometry was almost non-existent this year. The question yielded the highest number of fully correct solutions and the average mark was 69.3%. Chart 26 illustrates candidate performance in this question.

Chart 26: Paper 2B - Higher Level – Question 2 – Candidate Performance.



Part (a)

Most candidates showed a thorough understanding of the geometrical constructions to complete this part of the question.

Part (b)

A high level of competence was evident in answers to this part of the question also. Some solutions were notable for the absence of a construction to determine the line of intersection between the surfaces C and E. Many candidates determined the line of intersection in the development first, thus enabling them devise a valid construction. Occasionally, difficulty was experienced in determining surface D even though this is a well established style of question.

Part (c)

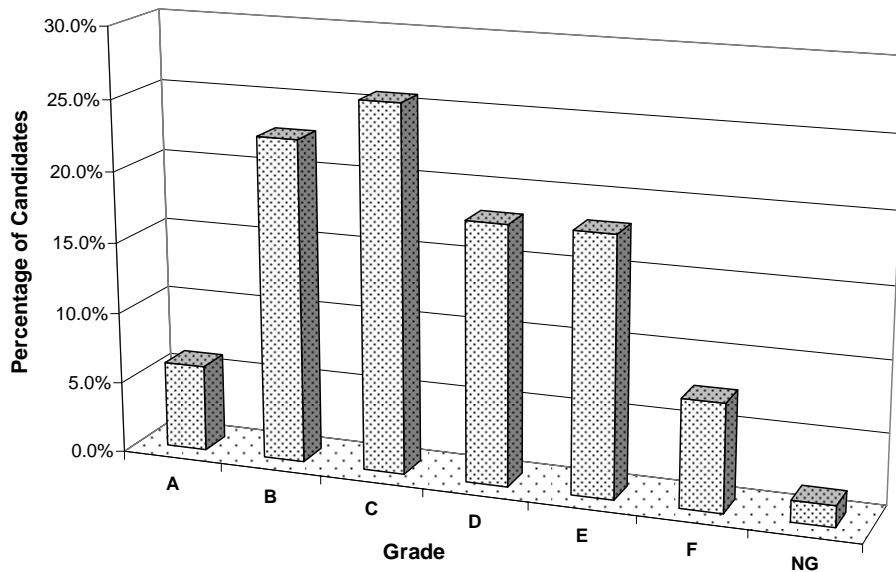
A surprisingly high number of candidates made no attempt to develop surface C. Most of those however, who did attempt it, developed it competently. A recurring error in some solutions was the omission of the triangular section of the roof surface removed by the intersection of surface C with surfaces E and F.

QUESTION THREE:

Shadow Projection

Questions on shadow projection on this paper are unpopular each year and often poorly answered. Although the question on this paper was considered, by examiners, to be somewhat easier than in the past, it proved even more unpopular. It was attempted by only 20.9% of candidates. Nonetheless the average mark achieved was 56%. Therefore, an increased focus on this topic in the classroom is recommended. Chart 27 outlines candidate performance for this question.

Chart 27: Paper 2B - Higher Level – Question 3 – Candidate Performance.



Those attempting the question fell into two distinct categories. The first group, representing approximately 50% of candidates, treated it as a last resort question. They gave no indication that they had ever studied shadow projection as a topic. They picked up a small amount of marks as a result of drawing the given plan and elevation and made a token attempt at determining the cast shadows in plan. Further constructional progress was rarely made, with some merely estimating the shadows without any appreciation of the constructional geometry required.

The second group of candidates produced noteworthy responses to the question. Determining the shadows projected by both buildings on the ground did not prove to be overly challenging, though some omitted to find the area of shade in plan. Candidates who drew a constructional end view were most successful at this concept. Few identified that the curved portions of the shadows

projected by the rectangular building on the curved roof could have been draw with the aid of a compass, but many good solutions were presented nevertheless.

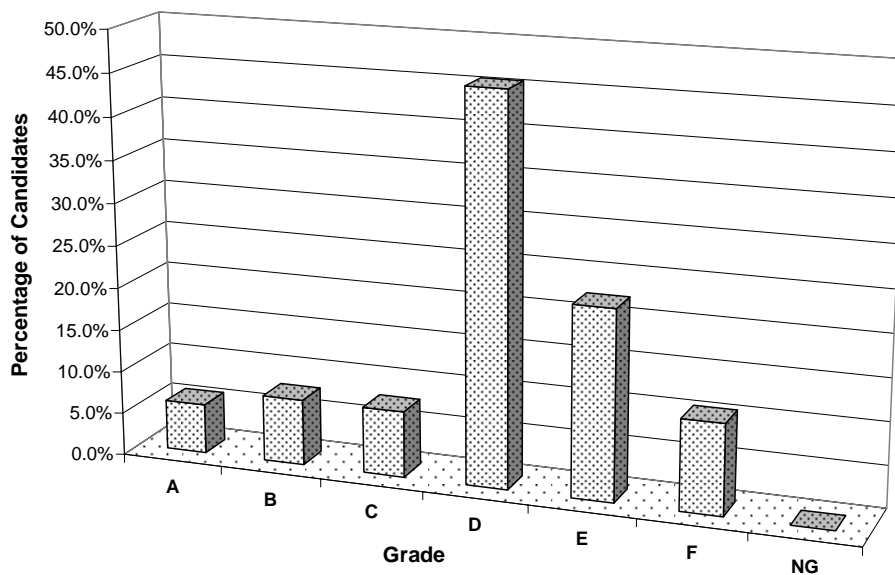
The study of shadow projection would enhance candidate’s knowledge of Technical Drawing and would give them more choice in the examination. It is regrettable that it is not taught in more schools.

QUESTION FOUR:

Hyperboloid of Revolution

This question was attempted by only 32.5% of the candidature and the average candidate mark was just 46.9%. Chart 28 illustrates candidate performance in this question.

Chart 28: Paper 2B - Higher Level – Question 4 – Candidate Performance.



This question proved to be the most challenging on the paper. Constructions of the parabolic curves ABC in plan, and BD in elevation were accomplished very competently by all who attempted the question. Thereafter the majority of candidates displayed an insufficient level of understanding and a lack of familiarity with the generation of the structure. The absence of constructional projection lines made it difficult for examiners to determine the logical thought sequence of candidates in efforts to complete the plan. Very few valid attempts were made to draw the outline of the hole in elevation. Candidates who drew a series of horizontal parabolic sections achieved best results here. It was not uncommon for some to attempt to draw vertical generating parabolas as a possible method at arriving at a solution. Other candidates attempted to draw an end elevation but this approach rarely yielded results. However, candidates from a small number of centres, who had clearly studied the topic in detail, succeeded in producing excellent solutions to the question.

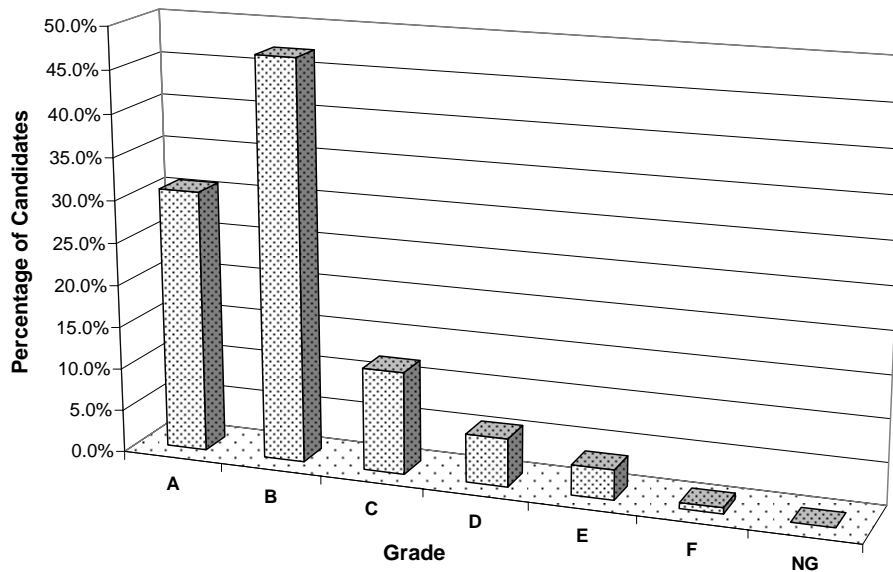
QUESTION FIVE:

Geological Geometry

As in previous years this question proved extremely popular. 88.1% of candidates attempted it and there were many excellent solutions. Some candidates, who produced only mediocre performances in their other questions, demonstrated a good understanding of the relevant geometrical concepts

required here. It was clearly the best answered question on the examination paper and the one which yielded the highest average mark of 76.9%. Chart 29 outlines the overall performance of candidates in the question.

Chart 29: Paper 2B - Higher Level – Question 5 – Candidate Performance.



Part (a)

In the vast majority of instances, candidates experienced little difficulty completing part (a). Where errors occurred they were chiefly as a result of the question not being read carefully enough. The most frequent error was to treat the given measurements associated with the bore-holes as altitudes rather as distances measured along the bore-holes.

Part (b)

Although some candidates did not proceed beyond part (a), examiners observed an increase this year in the level of understanding of the relevant spatial concepts required to arrive at a solution to this part of the question. The necessity of drawing a vertical section through the stratum as the basis for an acceptable solution to determine the required altitude was commonly appreciated. Some candidates unsuccessfully arrived at a solution on the auxiliary view showing the dip and thickness of the stratum in part (a).

Part (c)

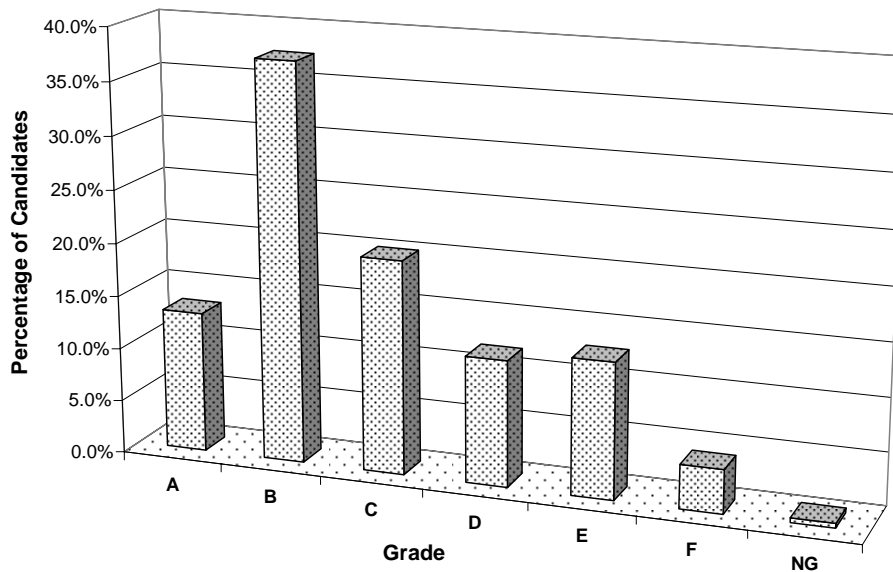
More than 50% of candidates omitted this part of the question and some candidates mistakenly assumed that the angle between the bore-holes at B could be determined by merely measuring the angles between the bore-holes in the elevation. The remaining candidates, who arrived at correct solution, did so by a wide variety of different but equally successful methods.

QUESTION SIX:

Hyperbolic Paraboloid

This question was attempted by 68.4% of candidates and it was, generally, well answered. The average mark was 63.5%. A candidate's overall mark depended a lot on how many parts of the question they attempted. Chart 30 illustrates candidate performance in this question.

Chart 30: Paper 2B - Higher Level – Question 6 – Candidate Performance.



Part (a)

The majority of candidates answered this part of the question without error. In most instances elements were correctly drawn on surface ABCD. The concept of extending the elements thus facilitating the finding of points on the upper curve in elevation was well understood.

Part (b)

Candidates dealt equally well with attempts at drawing the end elevation. Most solutions gained maximum credit and construction lines were generally clearly shown. On some solutions one or more curves were omitted in end elevation while in some cases only a rectangle was drawn.

Part (c)

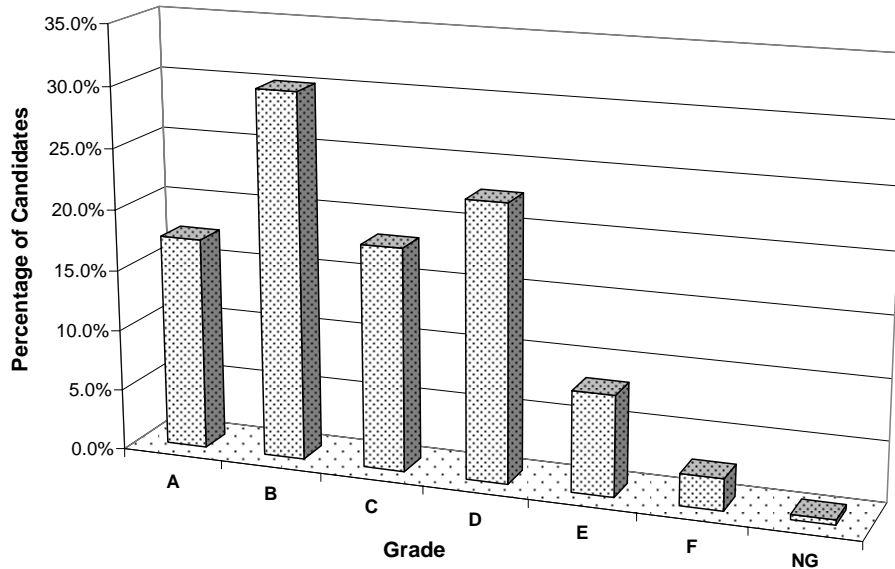
Not all candidates proceeded with this part of the question but the majority of those who attempted it successfully determined the traces of the plane director and gained a high proportion of the marks. This is a concept which candidates struggled with in the past but which is now more clearly and widely understood. Frequently, candidates lost some marks as they drew the horizontal trace through point D in plan rather than positioning the plane to contain point D. This difference between the two positions is a relatively easy concept, however, it is clear from the responses that it required greater focus in the classroom.

QUESTION SEVEN:

Contouring and Earthworks

This question was attempted by 70.9% of candidates and the average mark was 64.6%. The question was, generally, not answered to the same high standard as previous questions on the topic in recent years. The incidence of completely correct solutions was fewer as a result. Chart 31 illustrates candidate’s performance in this question.

Chart 31: Paper 2B - Higher Level – Question 7 – Candidate Performance.



As anticipated, the level part of the roadway was invariably completed without error. Similarly the majority of solutions for inclined roadway BE were correct. There were, however, quite a number of the usual errors such as finding the incorrect radius to determine initial section lines and the tendency to measure wrong intervals between parallel section lines. Less frequently, section lines were drawn in the wrong direction.

Predictably, the earthworks for the parking area (widened part of roadway) proved to be the most challenging part of this question and many candidates completely omitted it. A similar type of question in the 2004 examination was very confidently answered.

In cases where the parking area was attempted, the edge of the parking area that was parallel to the main roadway proved to be least problematic and most efforts were correct. Far less successful were attempts to determine the earthworks for the remaining two edges. In otherwise reasonable solutions the small area of embankment on the edge adjacent to C, and the small area of cutting on the other edge adjacent to D were omitted. A further recurring error was the treatment of the three edges of the parking area as level lines.

In most instances, however, marks were lost because attempts were incomplete rather than incorrect.

3.1.2 Ordinary Level

Paper 1 (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 layout and structure of the examination paper was broadly similar to that of previous years. It featured topics based on both plane and solid geometry, with the former being examined in three questions and the latter in four. The questions ranged across the full syllabus and had an incremental internal structure in order to cater for candidates of differing levels of achievement. The question pattern on this years paper enabled candidates who were familiar with recent past examination papers to confidently approach the challenges posed.

Overall the grade distribution this year was consistent with the previous three years. The average A, B and C grade total for the period 2002-2004 was 71.9%. The average for those awarded less than a D grade in the same period was 6.8%.

The percentage of A grades was marginally up on last year. A significant percentage of these were very close to achieving maximum marks and appeared to be well capable of sitting the Higher Level examination. In this respect greater consideration is required in relation to choice of level if each candidate is to achieve their full potential.

The overall grade distribution for the paper is outlined in Table 20.

Table 20: Paper 1 - Ordinary Level – Grade Distribution.

Grade	A	B	C	D	E	F	NG
No. of Candidates	477	731	671	606	142	64	18
% of Candidates	17.6%	27.0%	24.8%	22.4%	5.2%	2.4%	0.7%

Frequency of Questions Attempted

Question one, which was presented in a three dimensional format, has always been amongst the most popular questions and proved so again this year. Candidates excelled in the plane geometry aspect of the examination, particularly so in questions two and four. Solid geometry, however, proved more popular overall. This pattern is consistent with previous years.

There were clear signs that candidates in some centres focussed on four or five topics, to the exclusion of other areas of the syllabus and often to their detriment. This practice also denied the candidates the enrichment of a broader exploration of the syllabus.

Most candidates succeeded in completing the required four questions and it was not uncommon to see some candidates successfully complete a fifth question. Examiners noted that some of the candidates attempted six or even seven questions, only to abandon the questions with little more than the bare outline completed. These candidates did not perform well overall. Table 21 outlines how the various questions compared in terms of popularity.

Table 21: Paper 1- Ordinary Level – Question Popularity

Question	1	2	3	4	5	6	7
% of Candidates	93.6%	30.0%	67.8%	50.8%	65.6%	22.2%	81.4%

Standard of Answering

The standard of answering closely mirrored that of recent years and reflected the wide spectrum of candidate achievement. Candidates who produced high quality work were duly rewarded with appropriate grades. They displayed obvious commitment to the subject and excellent preparation for the examination.

Many of the candidates who achieved a grade C or less were more successful in procedural rather than conceptual type questions. For example, the average mark for question 4 was 10% higher than that awarded for question 5. Candidates who took some time to carefully read the paper avoided some of the simple unnecessary misunderstandings. Others made simple avoidable errors.

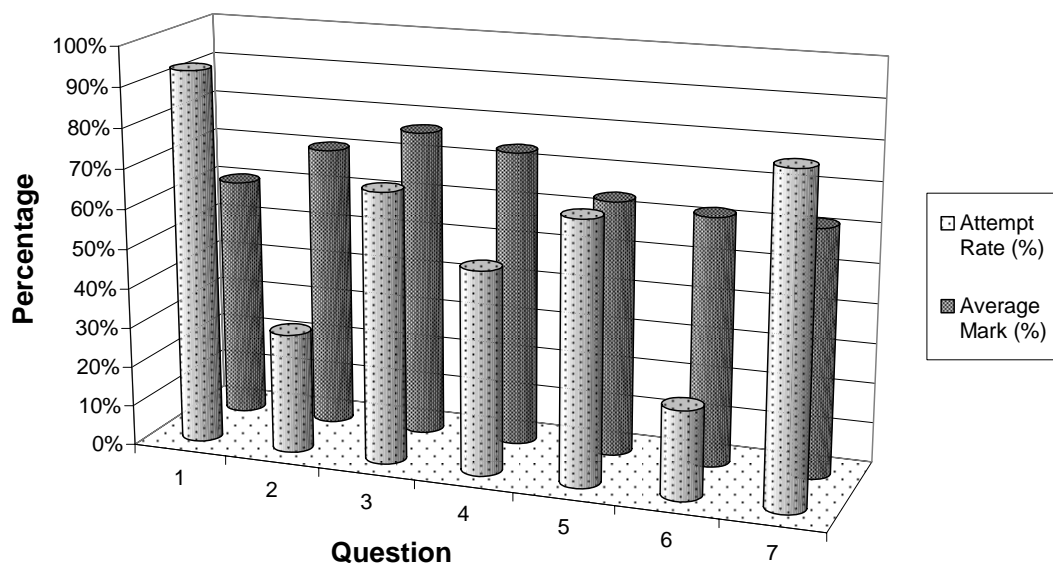
Examiners noted a wide variation in the standard of presentation. There has been a measurable improvement in this area in recent years. Presentation appeared to relate more closely to examination centre than to the overall achievement of individual candidates, indicating an emphasis on this aspect of the subject by particular teachers. It was noted, however, that some of the less successful candidates failed to adhere to recognised drawing standards and conventions. Indexation can be a great aid to successful completion of a drawing and candidates who spent time adding this feature were well rewarded for their efforts, in that it made the solution of the problems easier.

Table 22 outlines the average marks gained by the candidates over the range of questions. Chart 32 compares the attempt rate with the average mark. It is noted that there is little correlation between the two. In particular, it is noted that, over the past number of years, Questions 2 and 6 are very unpopular, yet return some of the highest average marks.

Table 22: Paper 1 - Ordinary Level – Average Marks.

Question	1	2	3	4	5	6	7
Average Mark	60.5%	70.7%	77.0%	73.9%	63.9%	62.2%	61.7%

Chart 32: Paper 1 - Ordinary Level – Question Popularity Vs Average Marks (Average marks are quoted in percentage terms).

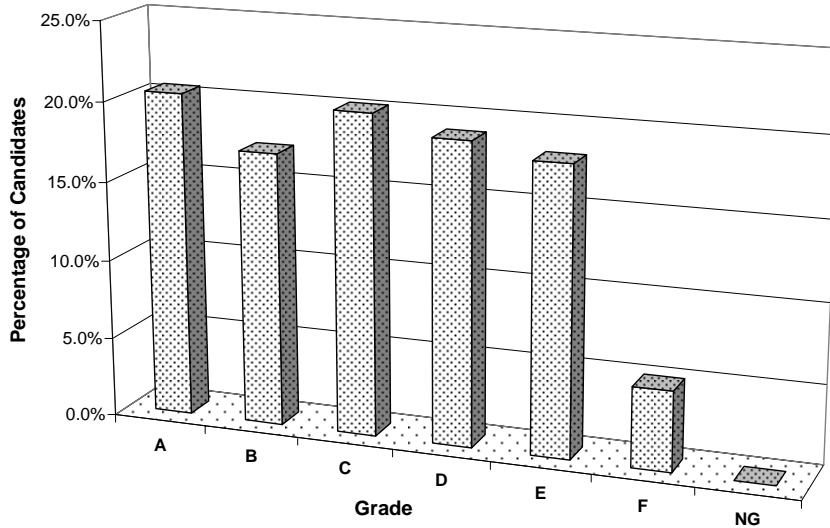


QUESTION ONE:

Orthographic Projection

This was the most frequently attempted question on this year’s examination paper at 93.6%. Candidates across a full spectrum of achievement selected it and the average mark was 60.5%. Chart 33 outlines how the candidates performed on this individual question.

Chart 33: Paper 1 - Ordinary Level – Question 1 – Candidate Performance.



The popularity of the question was not matched by the performance of the candidates. The combined ABC grades for the question was relatively low. The requirement to draw a freehand curve both in the elevation and in the auxiliary view appeared to create problems for many candidates. The grade distribution in the question was unusually consistent and did not adhere to a normal distribution curve.

Part (a) Elevation

The outline elevation, correctly orientated, was successfully drawn by most candidates. A small number of candidates viewed the solid from the right hand side thus greatly simplifying the question. A sound grasp of the basic principles of orthographic projection was evident in all but a few of the attempts. Some candidates omitted the necessary constructions to accurately locate points on the freehand curve. While most candidates successfully completed the elevation, the few mistakes highlighted by the examiners may be briefly summarised as follows:

- The required constructional view was omitted;
- No method was shown to accurately complete the freehand curve;
- The inset at the top of the curve was omitted by some candidates who failed to project from the plan as required;
- The selection of an arbitrary point on the vertical surface on the right hand side was a common feature of the weaker attempts.

Part (b) Plan

Attempts at drawing the plan were excellent in all but a few cases. The few mistakes that existed generally related to orientation and had inevitable consequences for the successful completion of the front elevation.

Part (c) Auxiliary Elevation

This section was attempted by over 85% of the cohort. It was clear from the standard of answering that candidates were generally well informed. The general principles governing the production of auxiliary elevations were understood, though a minority encountered difficulties in terms of detail. The failure by a few to read the question correctly, led to some candidates drawing surface A only in this view. In this context it should be noted that where a question asks candidates to draw a new elevation containing the true shape of a surface, marks are awarded for the drawing of the full view. The surface alone will not suffice. Mistakes relating to the correct transfer of points to the freehand curve resulted in some distorted solutions. The common errors may be summarised as follows:

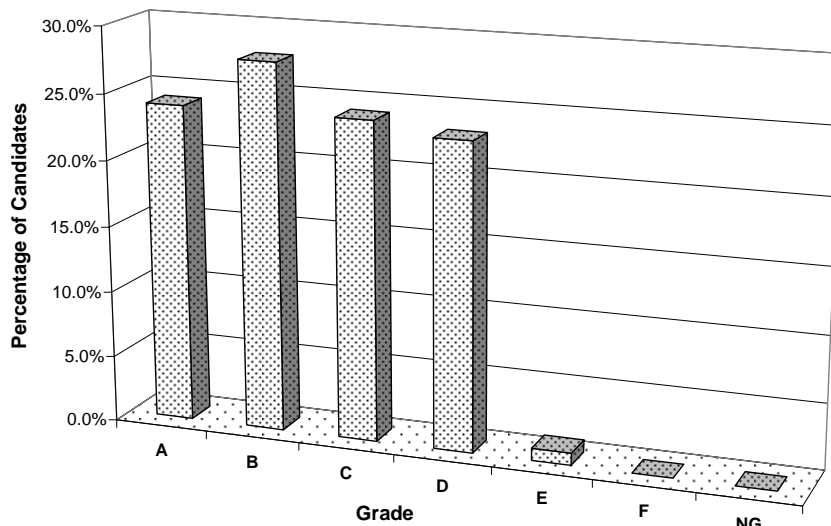
- Drawing surface A only;
- The use of an arbitrary XY line not parallel to the plan of surface A, was a regular feature of the weaker attempts. Setting the XY line up perpendicular to the plan of the surface A was the most common variation;
- Confusing an auxiliary elevation with an auxiliary in terms of heights and distances;
- Representing freehand curve as a line, a compass drawn curve or a freehand curve with no construction lines or projections featured in about 40% of the attempts;
- Hidden and visible lines were occasionally misrepresented.

QUESTION TWO:

Area of Figures

This question was ranked third this year in terms of performance. Its lack of appeal, noted in previous years, was also evident. It was attempted by less than one third of the candidates though the average mark was quite high at 70.7%. Chart 34 gives an indication of overall candidate performance.

Chart 34: Paper 1 - Ordinary Level – Question 2 – Candidate Performance.



While this may not have been a popular question, the efforts of those who did attempt it were well rewarded and the standard of answering was well above average. A clear grasp of the principles was evident from the quality of the answering. A graphical approach was adopted by most candidates to solve the question. About 30% of the cohort used a combination of graphical and mathematical methods. In approximately one in ten attempts, the solutions were completed using

exclusively mathematical calculations. As was the case with the corresponding question on the Higher Level examination, this years' question and marking scheme were devised in such a manner that allowed for a mathematical solution. This need not always be the case. It is possible that, in future examinations, questions could require candidates to use graphical means only to solve such problems.

The mathematical solutions were generally less successful and often scribbled on a corner of the sheet, lacking any discernable sequence. The use of a calculator may account for some of the omitted calculation stages. Some candidates drew part (a) very accurately but made very little progress thereafter.

Part (a) Drawing the parallelogram and the triangle

The given parallelogram was accurately drawn by over 90% of the candidates, generally using a simple geometrical construction. The altitude of the triangle was erroneously established by over one third of the candidates. In many instances an arbitrary altitude appeared to have been chosen with no obvious link to the altitude of given parallelogram. A semi-circle was successfully employed by over 75% of the candidates to establish the 90 degree angle. A few candidates appear to have used the set-square to set up the required angle without showing the necessary construction. The few errors or omissions which occurred in part (a) of the question generally fell into the following categories:

- No geometrical constructions were shown to establish the correct lengths for the sides of the parallelogram;
- The altitude of the triangle was fixed without reference to the altitude of the parallelogram;
- The construction to set up the 90 degree angle was omitted by some candidates.

Part (b) Area Conversion

Candidates tended not to perform as well in this part of the question as in part (a). Standard graphical methods were favoured though some near perfect mathematical solutions were also tendered. Approximately one in four candidates did not attempt this part of the question. The first stage in part (b) required the candidates to convert the given figure to a triangle. This generated the greatest range of solutions, some of which deviated significantly from normal methods. Candidates were far more successful in the conversion to the rectangle and, subsequently, to the square. Some of the more successful candidates cleverly combined the first two stages of the conversion. In about 10% of the attempts, a square was drawn with no visible method of construction.

Examiners highlighted the following recurring errors:

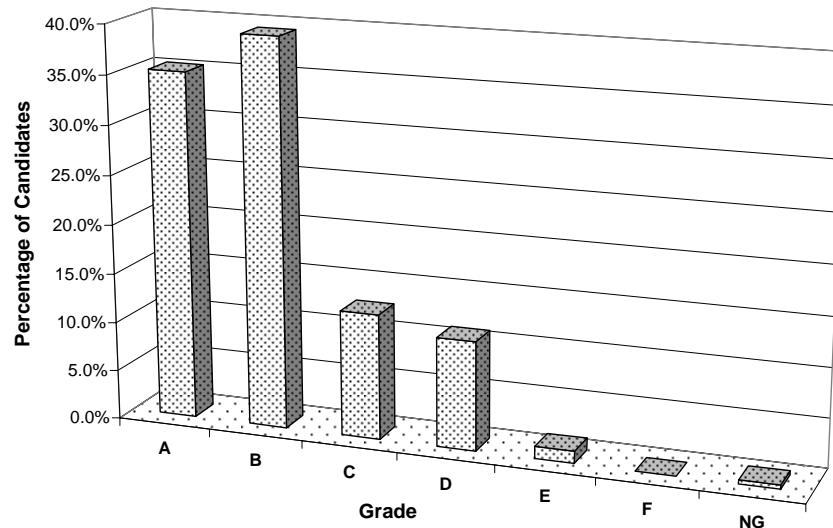
- The absence of any method, graphical or mathematical;
- Problems associated with the conversion of the given figure to a triangle;
- Omission of some of the stages by those adopting a mathematical approach.

QUESTION THREE:

Solids in Contact

This question had the highest average mark at 77% and was also amongst the more popular questions on the examination paper with an attempt rate of 67.8%. Chart 35 outlines how the candidates performed on this question.

Chart 35: Paper 1 - Ordinary Level – Question 3 – Candidate Performance.



This topic has evolved from a position of being both unpopular and poorly answered to its present position at the other end of the spectrum. It has proved particularly popular with high achieving candidates and this contributed to its ranking. It had the highest combined ABC grade total.

Part (a) Cone and Cylinder

Almost all candidates succeeded in drawing the given plan and elevation of both solids. An occasional small inaccuracy was noted in the answers. While the plan of the given point P was invariably located as required, a few candidates either omitted or failed to correctly align it in elevation.

Part (b) Sphere C

More than two thirds of the candidates gained maximum marks here. In doing so, they displayed a clear grasp of the principles inherent in the question. The rolling sphere method was employed almost exclusively, to locate the plan of the sphere. Those who successfully completed the plan had little difficulty in completing the elevation. Though exceptionally well answered, a few errors were noted. These were usually one or a combination of the following:

- Erroneous constructions in the elevation leading to an inaccurate solution;
- The plan of the sphere being represented as circle tangential to the other two circles. This also had consequences for the accurate completion of the elevation;
- Confusion regarding hidden detail in plan.

Part (c) Sphere touching point P

In excess of 75% of the attempts at this part of the question were fully correct. Some of the less successful candidates, however, struggled to establish the correct centre for this sphere in plan. This also had consequences for accurate completion of the elevation. Though very straightforward, some misunderstandings arose. Most of these appeared to emanate from misreading or misinterpreting the question. Other mistakes included:

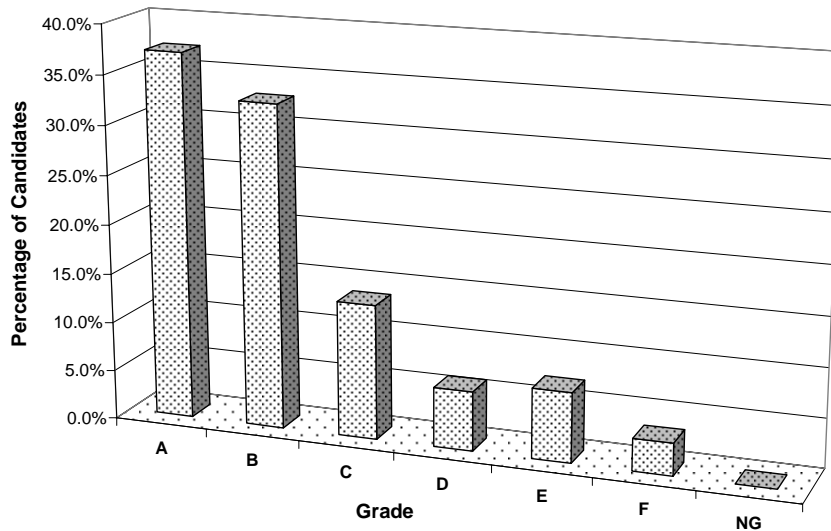
- Not drawing the sphere tangential to the circle in plan. This resulted in the circles, in some instances, intersecting each other;
- Fixing the centre of the new sphere above or below the level of point P in elevation;
- Attempting to represent the elevation of the sphere as a circle passing through the given point P, resulting in the projections of the centres of the spheres in plan and elevation being misaligned.

QUESTION FOUR:

Loci

This was the most popular of the three plane geometry questions with an attempt rate of 50.8%. The standard of answering was exceptionally high. With an average mark of just under 74%, it ranked second in terms of performance. Chart 36 outlines how the candidates performed on this individual question.

Chart 36: Paper 1 - Ordinary Level – Question 4 – Candidate Performance.



Candidates generally used standard geometrical constructions to complete this question. Some examiners noted an increased number of alternative methods being employed this year. These included the following

- In about 10% of the attempts, candidates set up a system of triangulation which involved swinging arcs from the centre line and base line of the question to locate points on the locus;
- A number of candidates used a combination of arcs and radial lines emanating from the centre of the arc to fix points on the locus;
- Tracing paper was popular with candidates in about 5% of the centres this year although the solutions from this method were generally quite inaccurate and were marked accordingly.

Locus of P on circle R

This section of the question was drawn correctly by all but the candidates with the lowest level of overall achievement. Some inaccuracies in the location of the points for the centres on the required line were noted. A few candidates did not match the arcs with the correct projection from the circle in its initial position. This resulted in some distorted solutions.

Locus of P on circle S

Most candidates were very successful in this part of the question also. The few mistakes which occurred were invariably a combination of the following:

- Some candidates used an incorrect starting point;

- A small number of candidates either misinterpreted or failed to read the question properly. They erroneously rolled the circle along the horizontal line thus greatly simplifying the question.

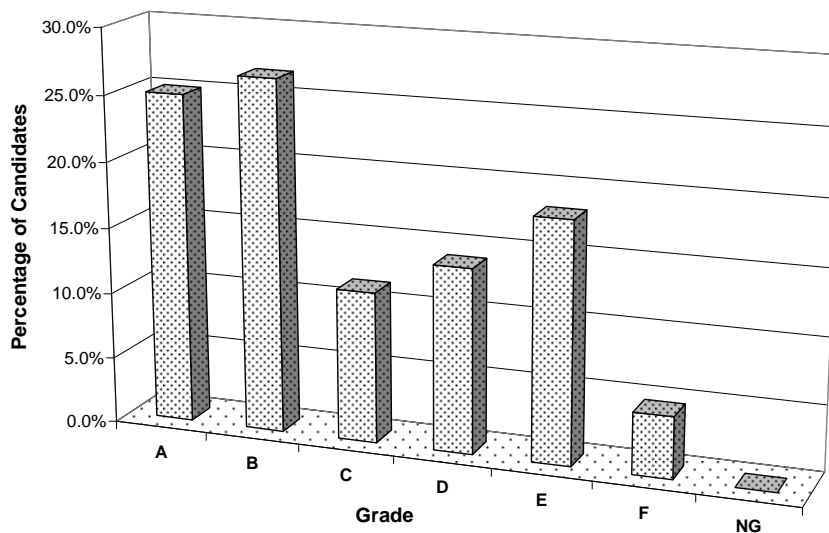
More mistakes overall were identified in the location of the points on this curve compared to that highlighted in the case of circle R.

QUESTION FIVE:

The Oblique Plane

In this question the performance matched the popularity. In each case it fell in the mid-range. The average mark, at 63.9%, was quite close to that of last year. There was, however, a notable increase in the popularity of the topic with an attempt rate of 65.6%. Popularity tended to vary between examination centres as opposed to between candidates. The question was not attempted at all in approximately 20% of the examination centres. Chart 37 outlines how the candidates performed on this question.

Chart 37: Paper 1 - Ordinary Level – Question 5 – Candidate Performance.



The grade distribution this year was more favourable than in previous years, with a substantial increase in the number of combined ABC grades, allied to an improved performance at the lower grades. This topic is an excellent barometer of spatial ability and it was, therefore, encouraging to see so many candidates perform strongly in the question. Some of the more successful candidates, who fully engaged with the question, were rewarded with close to maximum marks. Others appeared to pursue an over mechanical approach in search of a solution. This served them well in the earlier parts of the question but frequently led to considerable confusion in the latter stages.

Part (a) Truncation

The given views were replicated with little difficulty by almost all of the candidates. The only recurring error related to the drawing of the given plan. The required auxiliary elevation was, generally, drawn correctly, though a couple of attempts resulted in the view being inverted relative to the front elevation. The required edge view of the oblique plane was incorrect in approximately 20% of the attempts. This resulted in distorted solutions in elevation and plan. Many of the simple mistakes relating to projecting back to plan and elevation could have been avoided, had the views

been indexed in advance. The mistakes in the plan were invariably transferred to the elevation. The following errors were most frequently referred to by the examiners:

- The X_1Y_1 line was drawn parallel to the vertical trace;
- An arbitrary edge view of the oblique plane was taken;
- The projections to the plan occasionally intercepted the wrong lines;
- The top line on the truncation of the solid was the most frequent omission;
- Joining points in the incorrect configuration was a common feature of some of the weaker attempts.

Part (b) True Shape

The majority of the candidates who completed part (a), were awarded close to full marks here also. Rabattment of the truncated surface onto the horizontal plane proved the most popular and reliable method of completing this section. Approximately 10% of the candidates used an auxiliary plan. These were less successful overall, frequently getting mixed up in the transfer of the required widths or lengths. The time factor may explain why some candidates, who were apparently on the correct path, appeared to abandon the question. The following mistakes were frequently recorded:

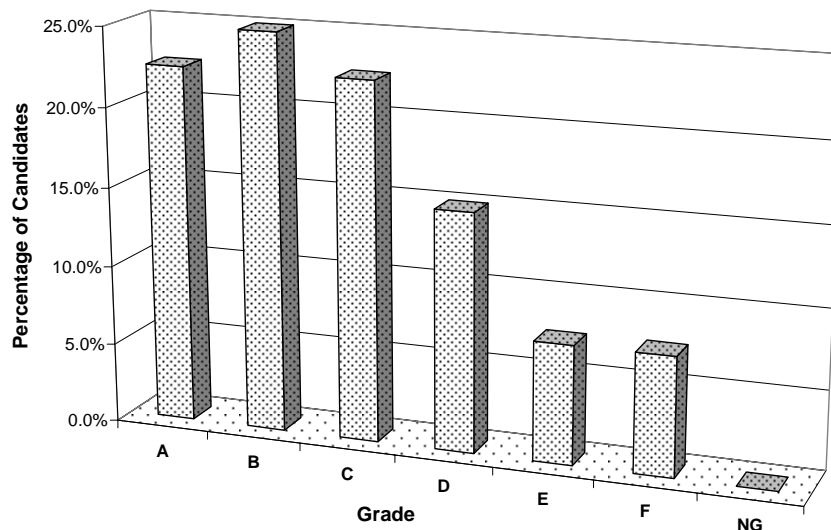
- Some did not to establish the correct lengths or widths;
- The points were not joined in the correct configuration.

QUESTION SIX:

Conic Sections

This was the least popular question on this years’ paper and, at 22.2%, the attempt rate fell well below that recorded in recent years. Those who attempted the question, however, did quite well. The average mark was 62.2% and, consistent with previous years, the results were weighted heavily in the A, B and C grade band. Chart 38 outlines how the candidates performed on this question.

Chart 38: Paper 1 - Ordinary Level – Question 6 – Candidate Performance.



Part (a) The Parabola

Candidates performed very well in this part of the question. Many achieved close to maximum marks. Many would have been familiar with the curve at Junior Certificate level. This invariably builds confidence and may have accounted for many of the excellent solutions. Some candidates tried to over complicate the question and explored properties relating to eccentricity. The few mistakes that were recorded by the examiners generally fell into the following categories:

- Candidates used a rectangular grid instead of radiating lines back to the vertex to locate points on the curve;
- Confusion between the ellipse, hyperbola and parabola was evident in some solutions;
- Attempts to apply properties relating to eccentricity were generally unsuccessful.

Part (b) The Ellipse

The solutions to this part of the question were less consistent overall. A lack of understanding of the concept of eccentricity was evident in some of the weaker responses. This creates inevitable difficulties in setting up the key points as well as in the accurate location of points on the curve. The more salient errors may be summarised as follows:

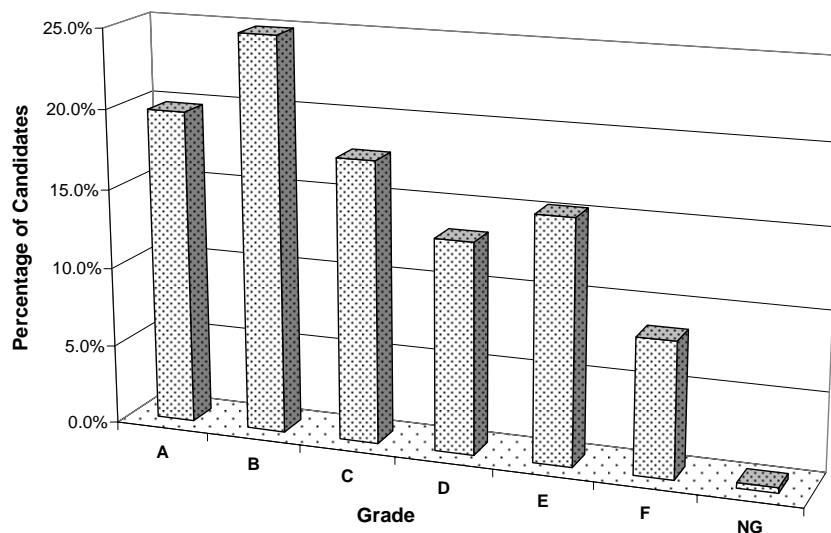
- An arbitrary focus point was fixed without reference to the given eccentricity;
- The vertex was incorrectly fixed midway between the focus and the directrix;
- Inverting the eccentricity was a common feature of many of the weaker attempts. It had consequences both in the set up of the question as well as in terms of the accurate establishment of points on the curve;
- The quality of some of the freehand curves was poor.

QUESTION SEVEN:

Interpenetration of Solids

This was the second most popular question on this year's examination paper with an attempt rate of 81.4%. The question proved particularly popular with the less able candidates resulting in a relatively low average mark of 61.7%. The incremental structure of the question encouraged weaker candidates to engage and gain valuable marks on the easier parts. Chart 39 illustrates how the candidates performed on this question.

Chart 39: Paper 1 - Ordinary Level – Question 7 – Candidate Performance.



There was little difficulty in the setting up of the question, though a few candidates erred in the construction of the triangle in plan. Approximately 5% of the candidates did not proceed beyond the initial stage. The square hole appeared as a parallelogram on the back surface of the prism on the end elevation. As all the points fell on the same surface, most attempts justified a reasonable reward. Three of the four points were usually located and joined up correctly. In the weaker attempts, at least one point was invariably misplaced. This was usually as a result of an errant projection from the plan view.

The hole through the front of the prism resulted in points falling on two surfaces. Most of the points were generally found by projections from the elevation and plan. The mistakes highlighted by examiners frequently arose as a result of candidates failing to join up the points in the correct configuration. The two points falling on the vertical edge were the most common omissions.

Approximately one in five candidates omitted the four horizontal lines linking the openings on the front and back surfaces of the prism. Hidden and visible lines were frequently misrepresented. Most of the attempts, however, were commendable. A pattern of small errors were noted by examiners and are summarised as follows:

- Omission of the end elevation;
- Misrepresenting the prism in the end elevation;
- Confusion in the projections from the plan and elevation which often resulted in points being defined at the wrong level on the end elevation;
- Hidden and visible lines were sometimes interchanged;

It was noted that many of the errors mentioned could have been avoided by simply indexing the drawing.

Ordinary Level Paper 2A (Engineering Applications)

Overview

The examination paper comprised five questions of which candidates were required to answer Question 1 and any two others. In answering Question 5, candidates have an additional exclusive option of part 5A or part 5B. This essentially presented candidates with five optional questions from which they were required to answer two. Question 1 was worth 100 marks and all of the other questions were equally weighted at 50 marks each.

Performance of Candidates

The answering on this examination paper was of a high standard again this year with 63.8% of candidates achieving a grade C or higher. The number of candidates achieving these high grades is very encouraging. The most noticeable change in the grade distribution this year was a sharp decrease in percentage of candidates achieving an A grade. This may be accounted for by the fact that there was an increase (in the region of 9%) in the number of candidates opting to sit this examination component at the Higher Level.

On the opposite end of the scale there was a marked improvement. The failure rate dropped from an average of 16%, over the past five years, to a level of just 12.3% this year. This improvement in candidate performance is to be welcomed. It is hoped that this failure will drop even further in future years.

The overall grade distribution for the paper is outlined in Table 23.

Table 23: Paper 2A - Ordinary Level – Grade Distribution.

Grade	A	B	C	D	E	F	NG
No. of Candidates	45	119	167	124	41	19	4
% of Candidates	8.7%	22.9%	32.2%	23.9%	7.9%	3.7%	0.8%

Frequency of Questions Attempted

As in previous years, most candidates fulfilled the requirement of answering question 1 and two others. Only a small number of candidates attempted less than three questions. All, with the exception of three candidates, attempted the compulsory Question 1. Very few candidates attempted more than three questions although, in a few cases, multiple attempts were made at the same question.

As in previous years, some questions were more popular than others. The same question options regularly prevailed throughout whole centres. Likewise, certain questions were completely avoided by entire centres. This practice would appear to be much more prevalent with paper 2A than is the case with paper 2B.

The most popular of optional questions were Questions 3 and 4. While Question 3 was, generally, quite well answered, Question 4 was frequently poorly answered. Candidates who attempted Question 2 often failed to complete the question. The least popular question of all was 5A, which is quite surprising considering that it is very similar to the requirements at Junior Certificate where an

isometric view is requested, albeit without the section. Table 24 outlines the frequency with which candidates attempted the various questions.

Table 24: Paper 2A- Ordinary Level – Question Popularity

Question	1	2	3	4	5
% of Candidates	96.3%	36.3%	81.3%	50.0%	25.0%

Standard of Answering

The standard of responses to this examination paper varied quite considerably. While many of the candidates excelled in answering, a significant percentage displayed deficiencies in the fundamental concepts associated with engineering drawing. Drawing conventions including centre lines, indexing, dimensioning and hatching etc. were in many instances ignored or incorrectly applied, resulting in candidates losing valuable marks. The range and scope of the paper was such that the average Ordinary Level candidate should have been able to achieve a good grade. Likewise, a D grade should not have been beyond the reach of any candidate who made a reasonable attempt with due regard for basic drawing skills and conventions.

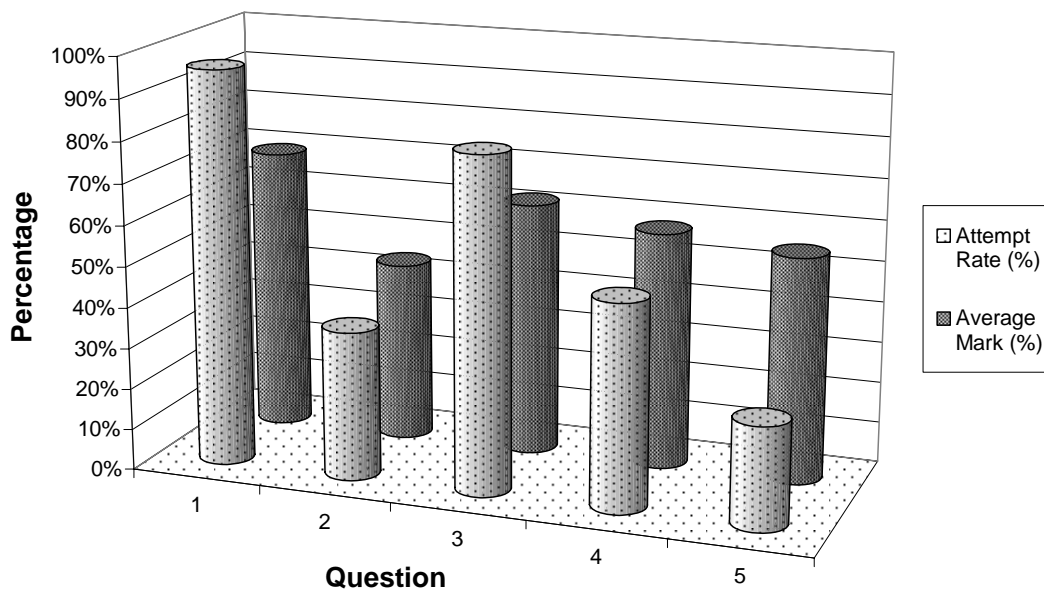
Table 25 outlines the average marks obtained by candidates in each of the seven questions.

Table 25: Paper 2A - Ordinary Level – Average Marks.

Question	1	2	3	4	5
Average Mark	69.2%	44.0%	61.9%	57.8%	55.0%

Chart 40 compares the attempt rate and the average mark for each question. It is of particular note that, as in previous years, the average mark for Questions 2, 4 and 5 outweighs the attempt rate.

Chart 40: Paper 2A - Ordinary Level – Question Popularity Vs Average Marks (Average marks are quoted in percentage terms).

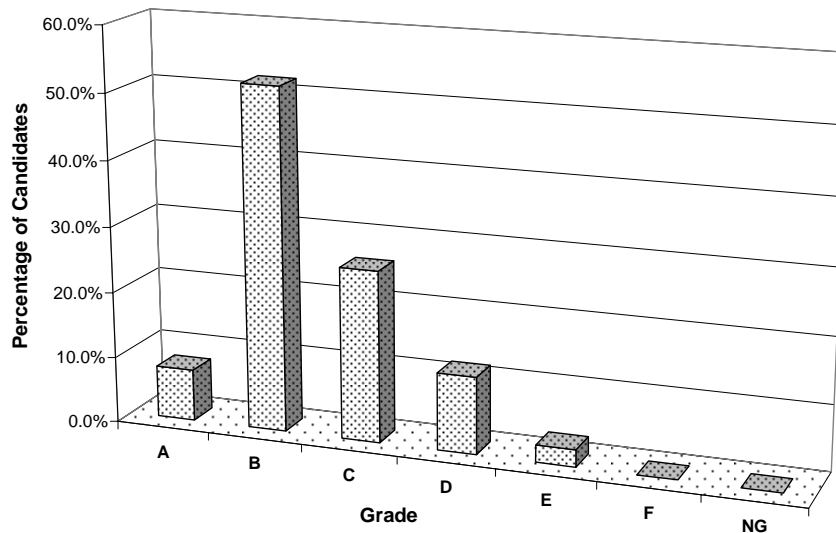


QUESTION ONE:

Assembly Drawing

This question was compulsory and was attempted by all but three candidates (Attempt rate 99.4%). The average mark for this question was 69.2%. Chart 41 outlines how the candidates performed on this question.

Chart 41: Paper 2A - Ordinary Level – Question 1 – Candidate Performance.



As in previous years, this question was generally answered quite well in an overall sense. Being a compulsory element of the examination, candidates are, generally, well practiced at this type of assembly and fulfil the standard requirements as requested each year.

Candidates were presented with an assortment of inter-related components and were required to produce a sectional elevation and plan of the correctly assembled parts. The assembly when completed consisted of a pipe vice with a $\text{Ø}30\text{mm}$ bar clamped within the jaws. The sectional elevation was, generally, very well attempted, with the majority of candidates correctly positioning the respective components. However, a significant percentage of candidates omitted the plan view or made a less than satisfactory attempt at this view.

Assembly

As stated the assembly presented little problem as the pieces could only be logically assembled in one way. A significant percentage of candidates omitted the $\text{Ø}30\text{mm}$ bar, which was specified in the written portion of the question. Occasionally, the grub screw was also omitted.

Sectional Elevation

This portion of the question was answered very well with candidates scoring very well. Some of the common errors were:

- Centrelines omitted or not drawn correctly;
- Lack of sectioning or incorrect sectioning;
- Screw thread convention on bar and grub screw omitted or incorrect.;
- Poor hatching;
- $\text{Ø}30\text{mm}$ bar omitted;
- Absence of grub screw;
- Omission of curves on clamping screw head.

Plan

Attempts at the plan view were often less perfect than the elevation. Most candidates drew the base outline correctly with a small number only drawing half of the plan as intended. In their answers candidates often:

- Omitted centrelines;
- Did not include the Ø30mm bar even when drawn in elevation;
- Did not show fillets on left web;
- Omitted the clamping screw;
- Only showed one circle on clamping screw head.

Additional Requirements

While generally well answered some candidates made common errors which included:

- Dimensioning conventions not fully adhered to;
- Poor quality printing;
- Omitting title;
- ISO symbol omitted or incorrect;
- Poor overall presentation.

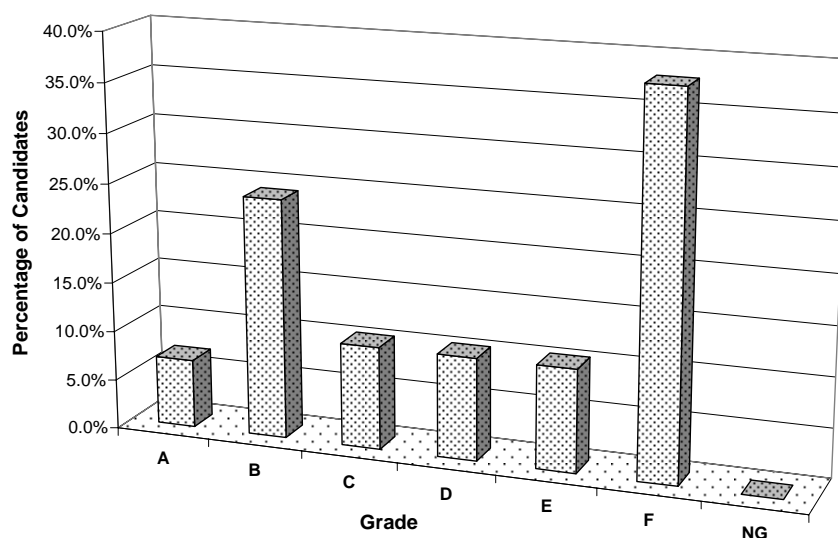
This section should be extremely well attempted as each year candidates are asked to fulfil the same requirements. However, many candidates lose valuable marks through failing to respond correctly to even the most predictable aspects of the question.

QUESTION TWO:

Development

The average mark for this question was 44%. The attempt rate was 36.3%. Chart 42 outlines how the candidates performed on this question.

Chart 42: Paper 2A - Ordinary Level – Question 2 – Candidate Performance.



The standard of answering on this particular question was described by examiners as quite poor. Most candidates drew the incomplete elevation and end elevation as given, though some had major difficulty drawing the elliptical portion in the end elevation. Candidates displayed a very limited

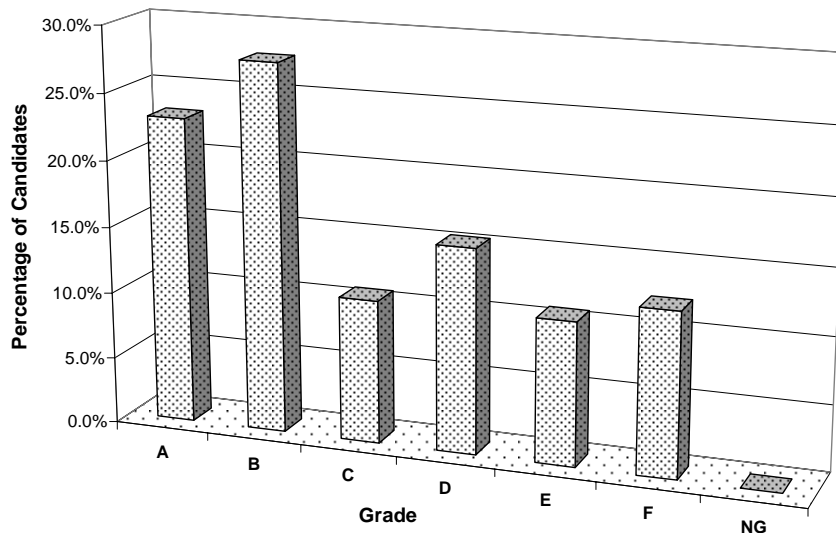
knowledge of the procedures necessary to complete this question. A failure to correctly transfer generators from view to view meant that many candidates could not locate the line of intersection in the elevation. Without this line, neither the surface development of pipe S nor the true shape of the hole in pipe R could be properly executed. In many cases the given views were just reproduced and little further attention given to the remaining sections of the question. Very few candidates answered the complete question correctly. Perhaps the most significant feature of the answering was a frequently encountered lack of indexing which is so essential in this type of question.

QUESTION THREE:

Cam and Linkage

As in previous years, this was the most popular of the optional questions with an attempt rate of 81.3%. The average mark for this question was 61.9%. Chart 43 outlines how the candidates performed on this question.

Chart 43: Paper 2A - Ordinary Level – Question 3 – Candidate Performance.



Candidates usually answered both parts of this question and scored equally well on each part. Many candidates achieved very high marks and displayed an excellent knowledge of the topics being examined.

(a) Cam

This required the drawing of a displacement diagram and cam profile. Candidates attempting this question always had a displacement diagram drawn but at times encountered problems with the respective movements. Occasionally UAR was confused with SHM. The dwell and uniform velocity parts were, generally, correct.

When drawing the cam profile the most obvious error was the incorrect direction of rotation. Indexing of the cam was often omitted and a significant number failed to show the camshaft diameter. Point transference from the displacement diagram was well executed by the majority of candidates and a curve profile was always drawn.

(b) Linkage/Locus:

Almost all candidates successfully represented the given movement as a line diagram. Most problems experienced with this question were encountered when plotting the locus of point E. The

most common error was where candidates treated either point D or point C as a fixed point and plotted the locus of point E with the link BD passing through these fixed points. In cases when point D was regarded as a fixed point, no further points were plotted along line LM for the movement of the linkage.

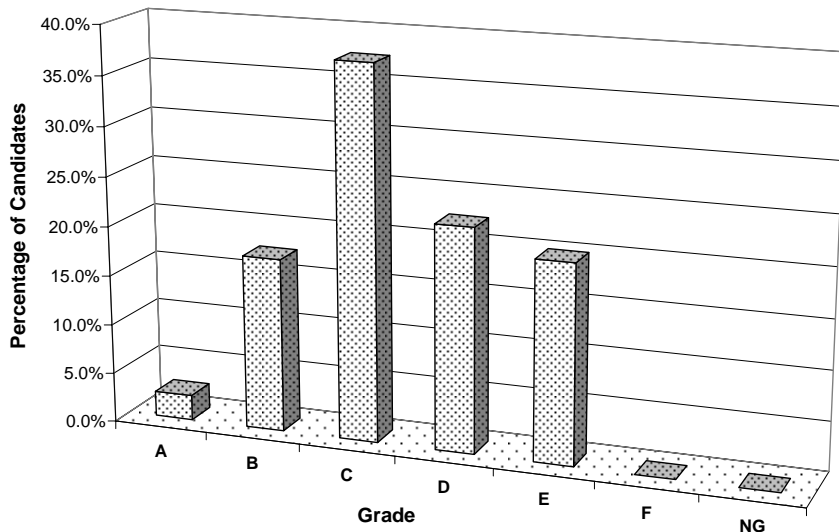
Candidates were then required to draw a machine guard. Almost all attempts showed some guard profile. A minimum clearance of 15mm was usually applied although some of the finished profiles were not streamlined and were frequently uneconomical in the use of material.

QUESTION FOUR:

Dimensioned Drawing

This was the second most popular of the optional questions with an attempt rate of 50.0%. The average mark for this question was 57.8%. Chart 44 outlines how the candidates performed on this question.

Chart 44: Paper 2A - Ordinary Level – Question 4 – Candidate Performance.



Examiners reported that the answering to this particular question was, in general, poor. Apart from the drawing content in this question, candidates, in addition, needed to offer a descriptive element regarding engineering components and this proved quite difficult for many. A large number of candidates only attempted the drawing portion and ignored the remainder of the question.

(a) Dimensioned Drawing

Many candidates only drew the outline drawing as given. Although this is largely a test of dimensioning skills, it is remarkable to note how many candidates did not insert any dimensions on their drawing outline. The following observations were noted in the scripts:

- Undercut frequently drawn too deep;
- Thread convention omitted;
- Conventional representation for flat on component end not shown;
- Datum line SS not shown or used;
- Centre line missing;
- Many had no dimensions shown;
- Dome on thread end missing;
- All three components of thread specification not shown;
- Chamfer poorly dimensioned.

- Poorly formed digits and printing when dimensioning.

(b) Machine Part - Ram and Cam Pump

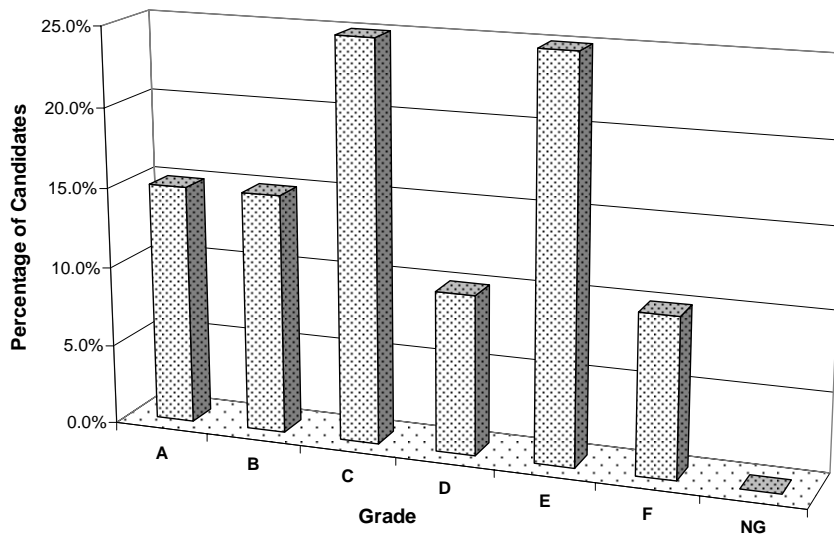
This section of the question was often completely omitted by candidates. Many had difficulty correctly identifying the four parts indicated in the question although a table was often drawn and the part names were inserted. Suggestions for the function of part P were varied, yet often correct. A common incorrect suggestion was that it represented a sensor enabling the counting of the rotational speed of the rotating shaft. Freehand sketches were very poorly attempted and it highlighted an inability to express engineering concepts graphically.

The final section of this question was, again, poorly answered if at all. Surprisingly, a significant percentage of candidates correctly identified the inlet and outlet ports on the pump. Written descriptions explaining the operation of the pump were poorly compiled and it was evident that candidates had extreme difficulty expressing themselves graphically as evidenced by the quality of the freehand drawings in the solutions tendered.

QUESTION FIVE:

Those candidates who chose to answer this question were given the option of opting for section 5A, which required a sectioned isometric drawing, or section 5B, which related to Computer Aided Design. The overall attempt rate for this question was 25% and the attempts were divided equally across both options. The average mark for this question was 55%. Chart 45 outlines how the candidates performed on this question.

Chart 45: Paper 2A - Ordinary Level – Question 5 – Candidate Performance.



Section A

(a) Sectional Isometric View

This was the least popular of all the questions and also, perhaps, the most poorly answered question. Many candidates simply copied the orthographic drawings as given on the question paper. In a few cases the answer was presented as an oblique drawing. Only a small number of candidates managed to complete this question correctly. Visualising the solution seemed to prove difficult for many candidates. This is extraordinary as the individual elements comprising this question are essentially very similar to those learned and practised at Junior Certificate level.

(b) Engineering Terms

Attempts at illustrating the split pin, tee slot and curved slot were very varied. An inability to describe engineering concepts, in freehand graphic format, was evident in the answers. The split pin was best illustrated and the curved slot was least well shown. Many candidates totally ignored this part of the question.

Section B – CAD

This question was slightly more popular than 5A and produced better quality answers. For the first time at this level, candidates were presented with an actual drawing element in the question. The first three parts of this question, which basically test a knowledge and understanding of C.A.D. commands, were reasonably well answered, but again, the inability to accurately and competently express concepts in both graphical and verbal format was strongly evidenced. Sketches were often of poor quality and the written content was frequently lacking.

In contrast, attempts at the drawing element in part (d) were quite good. Many candidates presented excellent and accurate graphical solutions to the listed C.A.D. commands as given in the question. Being a somewhat new element, some candidates steered shy of this section. A few candidates spent time drawing a grid to answer this question where perhaps graph paper could have been used to greater advantage.

Ordinary Level Paper 2B (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 examination paper was similar in format to previous years and tested a wide range of topics from the syllabus. The incremental style of questioning, which has become standard, allowed candidates from across the attainment range to demonstrate the extent of their knowledge and understanding both within questions and across the paper as a whole. A high standard of answering was generally displayed by candidates.

The performance of the candidates, when measured in terms of grades achieved, was almost identical to previous years with one notable exception. The failure rate which averaged 9.4% over the previous five years dropped to 6.9% this year. This improvement in candidate performance is to be welcomed. Table 26 shows the distribution of grades for the examination paper.

Table 26: Paper 2B - Ordinary Level – Grade Distribution.

Grade	A	B	C	D	E	F	NG
No. of Candidates	400	596	552	480	114	33	4
% of Candidates	18.4%	27.4%	25.3%	22.0%	5.2%	1.5%	0.2%

The vast majority of candidates completed the required number of questions within the allocated time. Many candidates attempted five and sometimes even six questions. The pattern of question choice was, by and large, similar to previous years. Table 27 outlines the frequency with which candidates attempted the various questions.

Table 27: Paper 2B- Ordinary Level – Question Popularity

Question	1	2	3	4	5	6	7
% of Candidates	84.2%	50.0%	48.7%	54.6%	62.5%	26.3%	84.6%

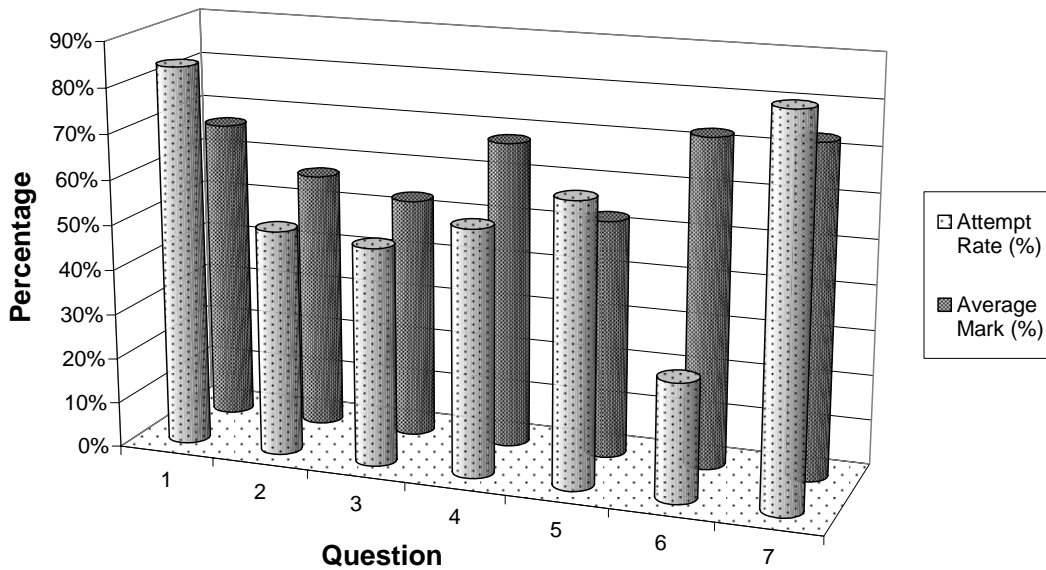
Table 28 outlines the average marks obtained by candidates in each of the seven questions.

Table 28: Paper 2B - Ordinary Level – Average Marks.

Question	1	2	3	4	5	6	7
Average Mark	66.9%	57.1%	53.3%	67.9%	52.8%	72.7%	73.3%

Chart 46 compares the attempt rate with the average mark for each question. As in previous years it should be noted that Question 6, which was the least popular question on the paper, returned the second highest average mark of 72.7%.

Chart 46: Paper 2B - Ordinary Level – Question Popularity Vs Average Marks (Average marks are quoted in percentage terms).

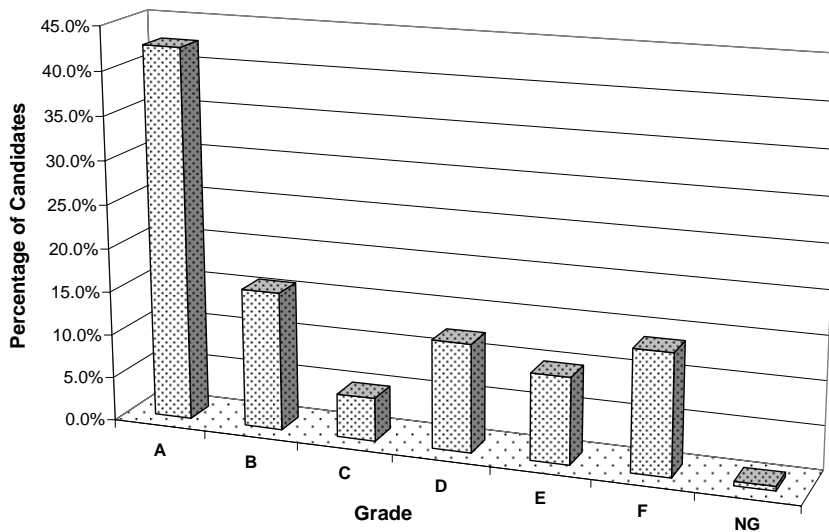


QUESTION ONE:

Perspective Projection

Perspective projection continues to be very popular with 84.2% of candidates attempting it. The average mark was 66.9%. Chart 47 outlines candidate performance on this question.

Chart 47: Paper 2B - Ordinary Level – Question 1 – Candidate Performance.



The majority of solutions presented were excellent. The fact that the majority of candidates correctly interpreted the given information indicates a high degree of familiarity with the topic. A small number of candidates incorrectly extended the outer edges of the plan when attempting to establish the plan of the vanishing points.

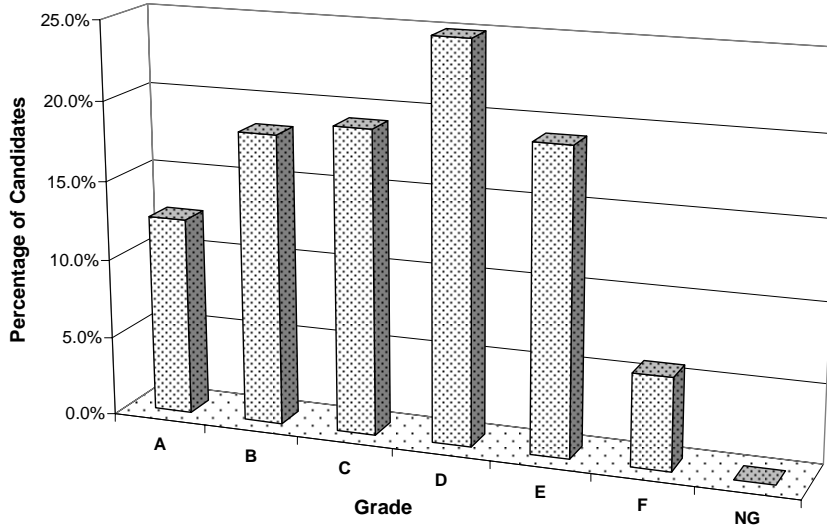
In the main, the greatest shortcoming noted in this otherwise well answered question, was a lack of appreciation of the concept of measuring and applying heights on the perspective drawing. In a very limited number of cases, lines on the perspective drawing were joined to the wrong vanishing points.

QUESTION TWO:

Roof Geometry

This question was attempted by 84.2% of candidates and the average mark was 66.9%. Chart 48 outlines candidate performance on this question.

Chart 48: Paper 2B - Ordinary Level – Question 2 – Candidate Performance.



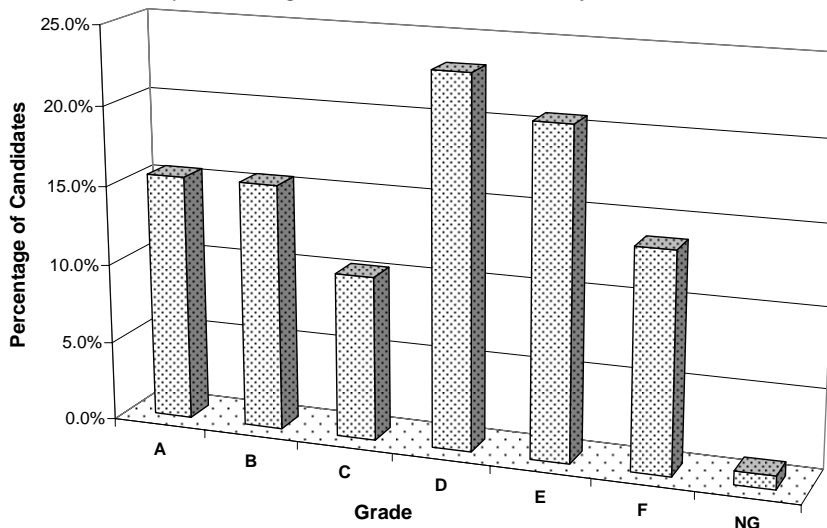
The large number of candidates in the D and E range continues to be an issue with this question. Though there were some excellent solutions produced, very many candidates resorted to guesswork rather than showing any of the repeatedly tested methods necessary to arrive at a correct solution. Many solutions did not demonstrate that candidates were aware of the need to establish true widths in order to correctly develop the surface B. The declining number of candidates attempting to establish the dihedral angle demonstrated a lack of knowledge of the necessary constructions. Candidates employing the point view method were generally more successful than those using the rabatment method.

QUESTION THREE:

Shadow Projection

The inclusion of a pictorial sketch appeared to attract more candidates to the shadow question which was attempted by 48.3% of the candidates. The average mark was 53.3%. Chart 49 outlines candidate performance on this question.

Chart 49: Paper 2B - Ordinary Level – Question 3 – Candidate Performance.



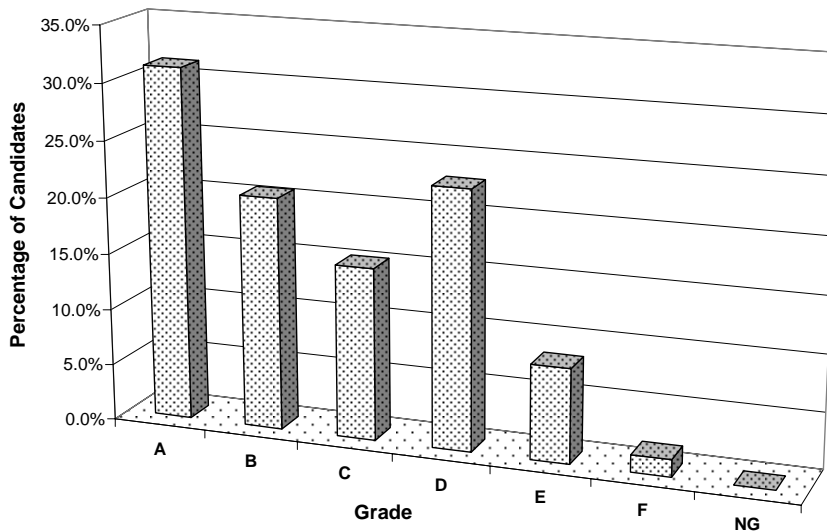
While the number of candidates in the A and B range continues to improve, very many solutions would suggest that candidates rely exclusively on practical experience when attempting to produce a solution. The fact that the question attracts candidates because of its practical relevance has obvious implications for classroom methodologies in teaching this interesting topic.

QUESTION FOUR:

Shell Structures

This continues to be a very popular question. 54.6% of candidates attempted it and candidates achieved an impressive average mark of 67.9%. The candidate performance in this question is outlined in Chart 50.

Chart 50: Paper 2B - Ordinary Level – Question 4 – Candidate Performance.



The majority of candidates had little difficulty in interpreting the given information and hence they correctly set up the plan and elevation. While many candidates demonstrated knowledge of the procedure required to determine the true shape of section, correct labelling of the elements would have reduced the tendency to use the incorrect heights.

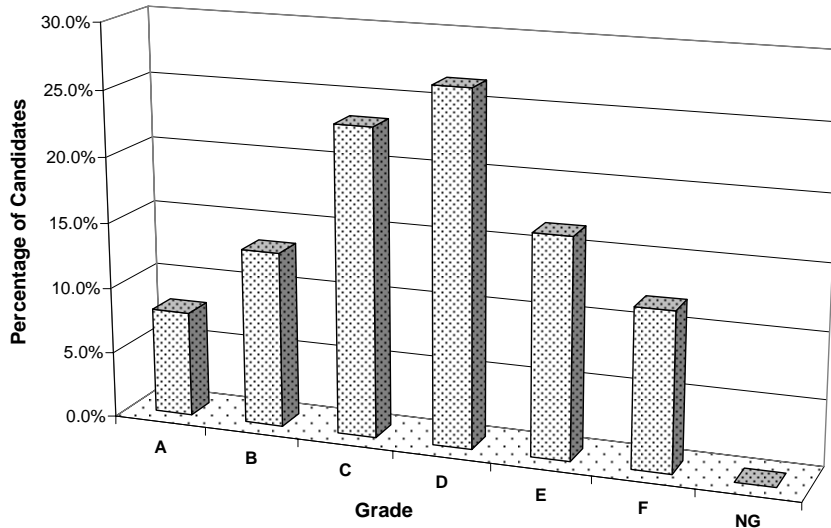
A frequently observed error was that many candidates established the true length of AB but failed to complete the new elevation.

QUESTION FIVE:

Isometric Drawing

This question attracted 62.5% of candidates. The average mark of 52.8 was marginally the lowest on this year’s paper. Candidate performance in this question is outlined in chart 51

Chart 51: Paper 2B - Ordinary Level – Question 5 – Candidate Performance.



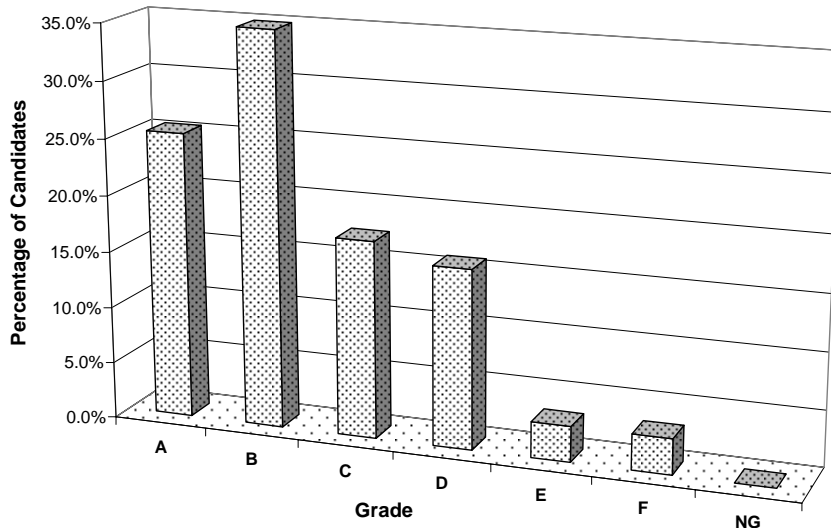
While this question was a very popular choice among candidates the number of correct solutions was somewhat disappointing. Quite a number of candidates had difficulty in relation to the construction of the ellipse in plan. Attempts at the isometric drawing varied considerably, with many failing to complete it. The most notable aspect of the responses was the significant number of candidates who did not demonstrate the ability to even visualize the complete isometric. Many candidates were unable to establish the line of intersection between the semi-cylindrical parts in isometric. Similarly, candidates experienced mixed degrees of success in establishing the sloped surface of the canopy in isometric. When compared with the corresponding question at Junior Certificate level in relation to the level of difficulty, the responses would, perhaps, suggest inadequate preparation of the topic.

QUESTION SIX:

Conic Sections

While being the least popular choice of question on the paper, candidates achieved the second highest average mark. Only 26.3% of candidates attempted the question but obtained an average mark of 72.7%. Chart 52 outlines how the candidates performed in the context of this question.

Chart 52: Paper 2B - Ordinary Level – Question 6 – Candidate Performance.



Candidates had little difficulty reproducing the given plan. The fact that many candidates experienced difficulty with the construction for a parabola in a rectangle - a construction required at Junior Certificate level - is disappointing.

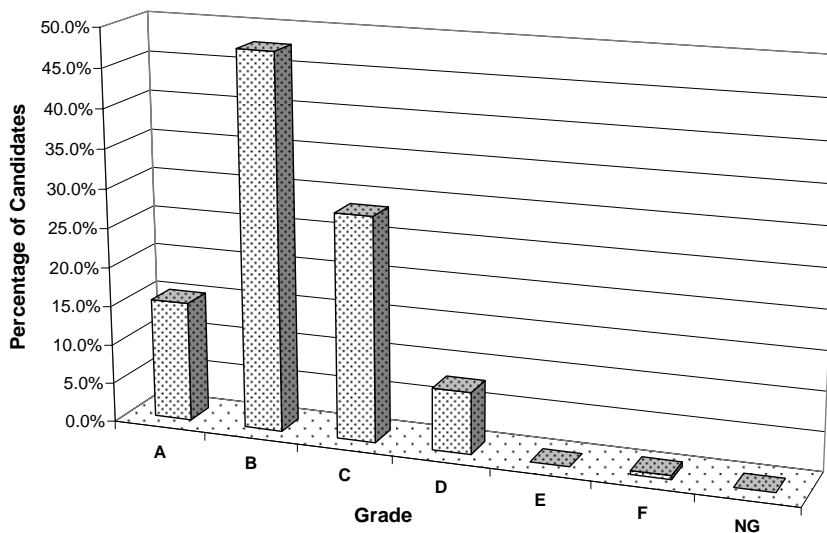
However, there were many excellent solutions produced and hence the high average mark. Candidates progressing to the true shape of section dealt admirably with it.

QUESTION SEVEN:

Geological Geometry

This was, again, the most popular choice of question on the paper this year, being attempted by 84.6% of the candidates. The standard of answering was excellent. The average mark at 73.3% was the highest of all questions on the examination paper. Chart 53 outlines how the candidates performed.

Chart 53: Paper 2B - Ordinary Level – Question 7 – Candidate Performance.



The vertical section posed no problem for candidates attempting this question. Most candidates had little difficulty in determining the strike. However, the number of candidates who did not proceed beyond this point was surprising.

While there were some very good responses to the final part of the question, a significant number of candidates did not attempt it and thus did not achieve an A grade. Despite the fact that the question clearly stated that the tower must not project above the hill in the background many candidates attempted to solve the problem with a profile that did not extend beyond FG. As with other questions, candidates are advised to read the question carefully prior to answering each part.

4. CONCLUSIONS

This year's examination papers were generally well received by all concerned. The papers at each level were perceived by candidates, teachers and examiners as being very fair both in terms of format and content. The format of the examination papers adhered closely to that of previous examinations and there was little by way of surprise in terms of content. Candidates were, however, thoroughly assessed on their knowledge and their application 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 their knowledge and skills to a given situation. This approach presented candidates, across the attainment range, with sufficient opportunity to demonstrate their achievement in the subject. The examination questions on all of the papers were constructed, in so far as possible, in a hierarchical manner. Basic knowledge and concepts were tested at the beginning of each question, with the factor of difficulty increasing with the question progression.

The excellent results that were achieved are to be greatly welcomed. Of particular note is the marked reduction in the failure rate at both levels. In 1999 the failure rate at Higher and Ordinary Level stood at 7.3% and 10.8% respectively. Since then the rates have dropped steadily to 3.9% and 8.4% respectively in 2005. The reduction in the Higher Level failure rate has led to an increase in the number of candidates opting for Higher Level and this is to be encouraged.

The inclusion, on recent examination papers, of pictorial sketches has been widely welcomed. These prove a useful aid to candidates in relation to conceptualisation and visualisation. As a result, candidate performance has increased and this is one of the key factors which has led to a decrease in the overall failure rate.

Notwithstanding the overall excellent performance, examiners have expressed concern that some candidates are not achieving their true potential and cite two principal reasons for this.

- Firstly, examiners have noted an over reliance on "rote" style learning. Technical Drawing is a subject in which candidates are required to solve problems of a spatial or geometrical nature through the application of previously acquired knowledge and skills. Technical Drawing as a subject, therefore, does not readily lend itself to "rote" style learning. The examination papers have been structured to reward candidates who learn in a more meaningful manner and who display the intrinsic subject skills of "*comprehension, analysis, and problem solving*", as stipulated in the syllabus. Consequently, candidates who learn solely or primarily by "rote" will not achieve the higher grades.
- Examiners have also noted that in some examination centres candidates appeared to have focused their learning on only a very narrow portion of the syllabus. While a certain degree of streamlining is necessary in relation to examination preparation, the focus must remain sufficiently wide so as not to be an impediment to overall performance. Examiners frequently referred to candidates who performed excellently on three out of the required four questions. However, those candidates were only capable of producing what could best be described as mediocre answers on the fourth question. This feature was regularly noted throughout entire examination centres, indicating inadequate syllabus coverage. In order to maximise performance, it is essential that candidates be familiar with as many examination topics as is possible.

The overall standard of draughtsmanship in the work presented was, by and large, commendable. However, there were instances where the standard fell short of what was required. It was noted that in some cases the standard of draughtsmanship varied more between centres than between candidates. It is essential that all candidates produce neat accurate drawings with due regard for draughtsmanship. In addition, those opting for Paper 2A in particular, should be familiar with the requirements of BS308.

The candidates' choice of level is probably the area where the greatest degree of focus is required. Each year approximately 5% of candidates achieve almost 200 marks out of a possible 200 on the Ordinary Level examination. From an examiner's perspective it would appear that these candidates are eminently capable of sitting the examination at Higher Level and would benefit greatly from doing so. There has been a marked reduction in the failure rate at Higher Level over the past number of years. The failure rate, now at just 3.9%, should encourage more candidates to opt for what has become a very candidate friendly examination.

5. RECOMENDATIONS

Notwithstanding the overall excellent examination performance it is felt that there are still some areas which, if improved upon, could lead to even better results for both individual candidates and for schools as a whole. Therefore, the following recommendations are made in order to assist candidates and teachers in preparation for future examinations.

- “Rote” style learning should be discouraged. It is not appropriate for a subject where the syllabus refers to comprehension, analysis and problem solving as key skills.
- While candidates should be familiar with the content of previous examination papers they should not be over relied upon as a teaching aid. Each year novel parts to questions will be presented throughout the examination paper. In order to answer these, it is essential that candidates be familiar with the subject matter as defined by the syllabus, as opposed to what has been previously examined.
- Candidates should be given as wide an exposure to the entirety of the syllabus as possible and should not present for examination with only the minimum number of topics studied. Candidates should, in so far as possible, be taught all topics throughout their course of study and should at, a minimum, have thoroughly revised at least one topic in excess of the examination requirements.
- As a preparation for the rigour of the examination, candidates 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 of the examination. This could help avoid many simple mistakes, which result in frequent misinterpretations and a loss of marks.
- Each chosen question should be read carefully. The information given in a question is generally structured in a sequential manner that, if adhered to, should assist in the answering of that question.
- Candidates should be encouraged to answer all parts of the attempted questions. No marks can be awarded if a particular part is not attempted.
- 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 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 2A, answers should be supported with diagrams, where appropriate, and these should be numbered and labelled correctly.
- Candidates opting for Paper 2A, in particular, should be familiar with the requirements of BS308.
- Teachers and candidates are encouraged to familiarise themselves with marking schemes and sample solutions to previous examination papers. These are available on the State Examinations Commission website: www.examinations.ie.
- While the amount of marks allotted to presentation varies between levels and components, all candidates should present answers with due regard to draughtsmanship. Poor draughtsmanship can often militate against a candidate's efforts to solve a problem under examination conditions. In this context the use of indexing is recommended on all appropriate solutions.
- Greater consideration should be given to choice of level by the candidates. Teachers should encourage candidates to prepare and present for the level of examination most appropriate to their level of ability.