Coimisiún na Scrúduithe Stáit

State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2015

DESIGN & COMMUNICATION GRAPHICS

CHIEF EXAMINER'S REPORT

Contents

1. Introduction

This report should be read in conjunction with the examination papers, the published marking schemes and the syllabus. The examination papers and marking schemes are available on the State Examination Commission's website at www.examinations.ie and the syllabus is available at www.curriculumonline.ie.

1.1 Syllabus Structure

The syllabus in Design and Communication Graphics was introduced in September 2008 and was examined for the first time in June 2009. It replaced the old Technical Drawing syllabus which had been in place since 1984.

The course makes a unique contribution to the development of the students' cognitive and practical skills. These skills include graphic communication, creative problem solving, spatial visualisation, design capabilities, computer graphics and parametric Computer Aided Design (CAD) modelling. The creative and decision-making capabilities of students in the activities associated with design are developed through three principal areas of study: plane and descriptive geometry; communication of design and computer graphics; and applied graphics. The subject is designed and structured to take cognisance of important contemporary developments in the modes of communicating effective design intent and design information. Studying *Design and Communication Graphics* can also be of significant support to students in their study of Leaving Certificate Mathematics. This is particularly so in relation to the *Geometry and Trigonometry* strand of the Mathematics syllabus, as much of the material on the two courses of study is mutually complementary.

The syllabus has a core and options structure. All students must study all of the material in the core. Students must also study two of the five optional modules. This structure is reflected in the structure of the final examination paper.

1.2 Assessment Specification

The examination is offered at two levels – Ordinary and Higher. At each level there are two examination components with a total of 400 marks:

1.	Course Assignment	160 marks	(40%)
2.	A final examination	240 marks	(60%)

Both examination components are externally marked by examiners who are appointed and trained by the State Examinations Commission.

1.2.1 Course Assignment

Candidates at both levels are required to submit a Course Assignment in response to a brief issued by the SEC. The brief issues in early to mid-September and is submitted for assessment by a specified date in early to mid-January. The Course Assignment assesses areas of the syllabus which are not readily assessable by means of the final examination. These areas include freehand sketching, Computer Aided Design (CAD), creativity and decision-making capabilities, design capabilities and communication of design.

Computer Aided Design (CAD), in the form of parametric modelling, forms a significant and compulsory part of the Course Assignment. Candidates are required to generate the CAD models and drawings using *SolidWorks*, which is the software specified by the Department of Education and Skills. CAD models and drawings generated using other software are not accepted for assessment and no difficulties have been encountered in this regard. Students generally have one-to-one access to both computer and manual drafting facilities in schools.

Candidates are required to present a bound A3 hardcopy portfolio of their assignment along with an individual CD (or USB Flash Drive) containing the *SolidWorks* files and the portfolio in electronic format (PDF). At Higher level, a maximum of 14, single sided, A3 pages may be submitted, while at Ordinary level the maximum number of pages is 12. In addition to these pages, candidates also include a cover page and an additional page containing only references to research sources.

The candidates are given nine broad headings under which they are required to respond to the brief. These are referred to as Outputs 1 to 9.

In Part A of the assignment (Outputs 1 to 6), candidates are required to explore existing artefacts and communicate these designs using images, freehand sketches, parametric CAD models, drawings and computer generated photorealistic images. At Higher level, 100 marks out of a total of 160 marks were awarded for this part of the assignment while at Ordinary level it was awarded 110 marks.

In Part B (Outputs 7 to 9), candidates are required to either make a design modification to an existing artefact or to develop a new concept design. Candidates are asked to graphically communicate their design ideas through the use of images, freehand sketches, CAD models

and computer generated drawings. At Higher level this part of the assignment was awarded 60 marks out of the total of 160 marks while at Ordinary level it was awarded 50 marks.

In relation to the electronic aspect of the assignment, candidates are required to adhere to a specified filing structure as set out in the *Instructions to Candidates* document and marks are awarded in relation to this key requirement, which is outlined in the syllabus (File management and organisation). Since 2013 candidates have been given the option of submitting the electronic elements of their assignment on either CD or USB Flash Drive. The latter avoids physical damage to CDs which can occur within the postal system. In 2009, over 60 CDs were damaged in transit. In 2015, only 34 were damaged. Damage can be limited by following the instruction issued, which requires that the CD be *"fixed **close to the bound edge** on the inside cover of the design portfolio"*. This problem can be further reduced by placing an A3 sized rigid board (such as a 3mm plywood board) in the transmission envelope to reduce the risk of the CDs being damaged during transit, or by giving candidates the opportunity to submit the electronic files on a USB key. In 2015, 14% of candidates opted to submit on USB media.

In all cases where CDs were damaged in transit, the schools were contacted by the SEC and a back-up copy of the candidates' work was forwarded for assessment. It was reassuring that the candidates' work was backed up on the schools' IT system, as is required in order to deal with such eventualities.

The Course Assignment is accepted for assessment only where it is the candidates' own individual work, completed in school under the supervision of the class teacher, with the work authenticated by the class teacher and the principal. Examiners further verify the authenticity of the work by checking the logon details for the parts being modified and created in *SolidWorks* in the electronic copy of their work. While a small number of schools have been contacted in previous years with queries over the authenticity of candidate work, leading in some instances to marks being withheld, no such authenticity issues arose in 2015.

The SEC policy and practice for the acceptance of practical coursework for assessment are outlined in circulars S68/04 and S69/04 and in the *Instructions to Candidates* document (M80P/M81P). Copies of these circulars are available on the SEC website (www.examinations.ie).

1.2.2 Final Examination

The examination paper at each level is of three hours' duration and is divided into three sections – A, B and C. **Section A** is worth 60 marks and comprises four short questions, of which candidates are required to answer any three. The style of question, where candidates are required to finish questions where the initial setting up has been completed for them, allows the assessment to focus on higher order analytical and cognitive skills. This section focuses on material from the core, and several topics and learning outcomes can be assessed within a single question.

Section B is worth 90 marks and comprises three longer questions, of which candidates are required to answer any two. Candidates answer the questions from this section on standard drawing paper. This section also focuses on material from the core, and again several topics and learning outcomes can be assessed within a single question.

Section C is worth 90 marks and deals with the five optional areas of study related to Applied Graphics, which are outlined within the syllabus:

- Dynamic Mechanisms
- Structural Forms
- Geologic Geometry
- Surface Geometry
- Assemblies

The syllabus requires that candidate study two of these areas. This section of the examination paper presents candidates with one question from each topic, and candidates are required to answer two questions, again on standard drawing paper. Given that candidates have opted to specialise in these areas of study, the questions in this section are generally more demanding than those in Sections A and B, not only in terms of knowledge, but also in respect of the analytical and problem solving skills that they require.

1.3 Participation Trends

Table 1 gives the overall participation rates of candidates in Leaving Certificate *Design and Communication Graphics* for the last five years. The percentage of the total Leaving Certificate cohort opting to study *Design and Communication Graphics* has remained comparatively stable over that period.

Year	*DCG* candidature	Total Leaving Certificate candidature*	*DCG* as % of total
2011	5680	54341	10.5
2012	5207	52589	9.9
2013	5351	52767	10.1
2014	5354	54025	9.9
2015	5362	55045	9.7

*Total Leaving Certificate candidature excludes Leaving Certificate Applied candidates.

Table 1: Participation in Leaving Certificate *Design and Communication Graphics*, 2011 to 2015

The breakdown in terms of participation at Higher and Ordinary levels over the last five years is given in **Table 2**. It may be noted that the percentage of the subject candidature opting for Higher level has grown steadily over this period.

Year	Total *DCG* candidature	Number at Ordinary level	Number at Higher level	% Ordinary level	% Higher level
2011	5680	1686	3994	29.7	70.3
2012	5207	1403	3804	26.9	73.1
2013	5351	1334	4017	24.9	75.1
2014	5354	1257	4097	23.5	76.5
2015	5362	1170	4192	21.8	78.2

Table 2: Number and percentage of candidates at each level, 2011 to 2015

Candidates are required to take both components at the same level. While the vast majority do so, a small percentage do not. In these cases, the candidates are awarded a grade at Ordinary level. The mark for the component that they took at Higher level is treated as though it had been acquired at Ordinary level for the purpose of generating this grade. Since the standard at Higher level is obviously more demanding, it is clear that these candidates would almost certainly have attained a higher grade if they had opted to take both components at Ordinary level. In 2015, while 4,347 candidates presented coursework at Higher level, only 4,168 sat the final examination at Higher level. Greater initial consideration of level choice would, likely, result in in a better overall performance in the case of those candidates who eventually opt for the Ordinary level examination in June.

The breakdown in terms of gender at Higher level and at Ordinary level over the last five years is given in **Table 3** and **Table 4** respectively.

Year	Total Higher level	Female Candidates	Male Candidates	Female as % of total	Male as % of total
2011	3994	442	3552	11.1	88.9
2012	3804	435	3369	11.4	88.6
2013	4017	480	3537	11.9	88.1
2014	4097	477	3620	11.6	88.4
2015	4192	531	3661	12.7	87.3

Table 3: Gender composition of Higher level cohort, 2011 to 2015

Year	Total Ordinary level	Female Candidates	Male Candidates	Female as % of total	Male as % of total
2011	1686	154	1532	9.1	90.9
2012	1403	115	1288	8.2	91.8
2013	1334	123	1211	9.2	90.8
2014	1257	117	1140	9.3	90.7
2015	1170	118	1052	10.1	89.9

Table 4: Gender composition of Ordinary level cohort, 2011 to 2015

The number of female candidates opting to study *Design and Communication Graphics* has increased slightly over this period. When compared to the last year of the old Technical Drawing course in 2008, the increase is more, having risen by 3.5 percentage points, indicating that *Design and Communication Graphics* as a subject, with its increased design based focus, may be more appealing to female candidates then the previous syllabus. Nevertheless, the candidature remains predominantly male.

It is also noteworthy that, in common with many other subjects, the percentage of females is slightly greater at Higher level than at Ordinary level.

2. Overall Performance of Candidates

2.1 Higher Level statistics

The distribution of grades awarded over the last five years is given in **Table 5** (lettered grades) and **Table 6** (sub-grades).

Year	A	B	C	A, B, C	D	E	F	NG	E, F, NG
2011	14.4	34.7	32.8	81.9	15.5	2.0	0.5	0.1	2.6
2012	14.2	34.3	35.8	84.3	13.6	1.5	0.5	0.1	2.1
2013	14.6	33.1	32.0	79.7	17.0	2.6	0.6	0.1	3.3
2014	14.0	33.2	32.2	79.4	17.2	2.7	0.6	0.1	3.4
2015	14.3	33.9	32.6	80.8	16.4	2.1	0.7	0.1	2.8

Table 5 Percentage of candidates awarded each lettered grade in Higher level *Design and Communication Graphics*, 2011 – 2015

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2011	6.4	8.0	10.1	11.8	12.8	11.2	11.4	10.2	6.9	4.9	3.7	2.0	0.5	0.1
2012	5.4	8.8	9.4	11.9	13.0	13.6	12.7	9.5	6.6	4.2	2.8	1.5	0.5	0.1
2013	6.1	8.5	10.2	11.2	11.7	12.4	10.3	9.3	7.3	5.6	4.1	2.6	0.6	0.1
2014	6.2	7.8	9.7	11.0	12.5	11.5	11.2	9.5	7.2	5.6	4.4	2.7	0.6	0.1
2015	6.4	7.9	8.6	12.1	13.2	11.5	11.0	10.1	6.8	5.2	4.4	2.1	0.7	0.0

Table 6 Percentage of candidates awarded each sub-grade in Higher level *Design and Communication Graphics*, 2011 – 2015

These tables show a high level of consistency in the results in Higher level *Design and Communication Graphics* over the last five years.

The distribution of sub-grades by gender over the last five years is given in **Table 7** (female candidates) and **Table 8** (male candidates).

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2011	7	11.1	12.9	14.3	10.2	9.3	10.9	9.3	5.7	3.2	4.3	1.8	0.2	0
2012	6.2	9.9	10.8	14.3	10.8	14.3	11.7	10.1	4.4	4.4	2.3	0.7	0.2	0
2013	6.3	11.3	11	12.3	10.8	13.5	8.3	8.1	6.3	6.5	3.1	2.1	0.4	0
2014	7.3	9.6	10.3	11.3	15.1	11.5	11.7	7.8	5.2	4.2	4.2	1.5	0.2	0
2015	10.9	8.7	8.9	14.1	13.7	11.5	10.7	8.9	4.7	4	2.8	0.8	0.4	0

Table 7: Percentage of female candidates awarded each sub-grade in Higher level *Design and Communication Graphics*, 2011 – 2015

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2011	6.1	7.8	9.8	11.4	13.1	11.5	11.4	10.3	7	5.2	3.7	2	0.5	0.1
2012	5.3	8.7	9.2	11.6	13.3	13.6	12.8	9.4	6.9	4.1	2.8	1.6	0.5	0.1
2013	6.1	8.1	10.1	11	11.8	12.3	10.5	9.5	7.4	5.5	4.3	2.6	0.7	0.1
2014	6	7.4	9.7	11	12.2	11.5	11.1	9.8	7.5	5.8	4.4	2.9	0.6	0.1
2015	5.8	7.8	8.6	11.8	13.1	11.5	11	10.3	7.2	5.4	4.6	2.2	0.7	0.1

Table 8: Percentage of male candidates awarded each sub-grade in Higher level *Design and Communication Graphics*, 2011 – 2015

The tables show that female candidates perform consistently better than their male counterparts. The A rate and ABC rate for females are both, on average, about 4% higher than for males, while almost twice as many males as females are awarded an E, F, or NG.

2.2 Ordinary Level statistics

The distribution of grades awarded over the last five years is given in **Table 9** (lettered grades) and **Table 10** (sub-grades).

Year	A	B	C	A, B, C	D	E	F	NG	E, F, NG
2011	7.1	33.7	34.3	75.1	17.4	4.6	2.6	0.3	7.5
2012	8.9	31.9	31.6	72.4	18.1	6.0	2.7	0.9	9.6
2013	8.7	30.3	32.9	71.9	18.5	5.6	2.8	0.9	9.3
2014	6.0	34.0	34.6	74.6	17.2	5.0	2.2	0.8	8.0
2015	9.6	30.9	33.2	73.7	18.1	5.4	2.0	0.7	8.1

Table 9: Percentage of candidates awarded each lettered grade in Ordinary level *Design and Communication Graphics*, 2011 – 2015

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2011	1.3	5.8	9.7	11.4	12.6	13.0	11.6	9.7	7.6	5.5	4.3	4.6	2.6	0.3
2012	2.6	6.3	9.3	11.1	11.5	12.0	10.5	9.1	9.1	5.4	3.6	6.0	2.7	0.9
2013	2.5	6.2	8.6	10.9	10.8	13.2	11.5	8.2	7.1	6.2	5.2	5.6	2.8	0.9
2014	1.0	5.0	8.5	12.1	13.4	12.3	13.2	9.1	7.2	6.1	3.9	5.0	2.2	0.8
2015	2.7	6.9	9.4	10.6	10.9	12.8	9.1	11.3	7.4	5.1	5.6	5.4	2.0	0.7

Table 10 Percentage of candidates awarded each sub-grade in Ordinary level *Design and Communication Graphics*, 2011 – 2015

The distribution of sub-grades by gender over the last five years is given in **Table 11** (female candidates) and **Table 12** (male candidates).

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2011	2.6	8.4	13.6	13.0	9.1	13.0	8.4	7.8	2.6	8.4	6.5	3.2	2.6	0.6
2012	2.6	7.0	3.5	9.6	12.2	12.2	11.3	9.6	15.7	7.0	3.5	2.6	3.5	0.0
2013	1.6	6.5	7.3	16.3	11.4	13.0	4.1	10.6	6.5	4.1	9.8	5.7	1.6	1.6
2014	1.7	8.5	7.7	14.5	12.0	12.0	6.8	10.3	6.8	5.1	6.0	6.0	1.7	0.9
2015	4.2	10.2	8.5	12.7	12.7	12.7	6.8	10.2	6.8	3.4	3.4	3.4	2.5	2.5

Table 11 Percentage of female candidates awarded each sub-grade in Ordinary level *Design and Communication Graphics*, 2011 – 2015

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2011	1.2	5.5	9.3	11.2	13.0	13.1	11.9	9.9	8.1	5.2	4.0	4.8	2.6	0.3
2012	2.6	6.3	9.8	11.3	11.4	12.0	10.5	9.1	8.5	5.3	3.6	6.3	2.6	0.9
2013	2.6	6.2	8.8	10.4	10.7	13.2	12.2	8.0	7.2	6.4	4.8	5.6	3.0	0.8
2014	1.0	4.6	8.6	11.8	13.6	12.3	13.9	9.0	7.3	6.2	3.7	4.9	2.3	0.8
2015	2.6	6.6	9.5	10.4	10.7	12.8	9.4	11.4	7.4	5.3	5.9	5.6	1.9	0.5

Table 12 Percentage of male candidates awarded each sub-grade in Ordinary level *Design and Communication Graphics*, 2011 – 2015

Given the small number of candidates involved, it would not be prudent to draw any conclusions from small differences between Table 11 and Table 12.

As was the case at Higher level, these figures show a high level of consistency in the results in Ordinary level *Design and Communication Graphics* over the last five years. While there were minor fluctuations within individual grades and sub-grades over the period, there is no indication of any changes in trends or in overall grade patterns.

The distribution of sub-grades, grades and combined grades by gender over the last five years is given in **Table 10** (female candidates) and **Table 11** (male candidates).

As was the case at Higher level, the statistics indicate that female candidates perform better that male candidates at this level.

3. Analysis of Candidate Performance

3.1 Course Assignment – Higher level

The Higher level Course Assignment brief was as follows:

> From earliest times, torches were used as portable light sources. Modern day, electrically powered torches are ergonomically designed and are available in a wide range of forms, shapes, sizes, materials, colours, etc. Hands-free models have also been developed to meet specific needs.
>
> **(A)** Carry out a design investigation of the physical form and features of a torch light. Your investigation should be informed by the development of the product over time.
>
> ***and***
>
> **(B)** Show graphically how you would physically modify a chosen torch to improve its overall design.
>
> ***or***
>
> Develop and graphically communicate a new concept design for a torch light based on a selected theme or function and aimed at a particular target market.

3.1.1 Analysis of Candidate Engagement and Performance

A detailed analysis of the candidate performance across all nine outputs on the Higher level Course Assignment is presented in Table 13.

Part	Output	Available mark	Mean mark	Mark as %	Rank order
A	1	15	10.6	70.6	6
	2	15	10.7	71.0	5
	3	20	13.9	69.4	7
	4	28	23.4	83.4	1
	5	15	12.2	81.1	3
	6	7	5.8	82.8	2
B	7	25	15.3	61.2	9
	8	10	6.2	62.0	8
	9	25	18.5	74.0	4

Table 13: Statistical analysis of performance on the nine outputs at Higher level 2015.

In general, Part A of the assignment was very well answered with almost all candidates completing and submitting material under each of the six required output headings. Most candidates explored the given design brief and communicated their findings graphically as required. In some instances, however, evidence of primary research was limited and in many cases candidates relied too heavily on the internet as the main source of their information and ideas. Insufficient attention was frequently given to investigating the physical form and features through primary research. Output 2 was reasonably well answered. Many candidates compared and contrasted the main physical design features of two artefacts to good effect. In Outputs 2 and 3 the general standard of freehand sketching was satisfactory with many students using a range of suitable media and various presentation techniques.

The SolidWorks models produced in Output 4 were, in most cases, of a very high standard, with a number of candidates using advanced SolidWorks commands to model difficult surfaces. The file management on the accompanying CD/USB was general very good and in keeping with the required file and folder structure. This was notably better at Higher level than at Ordinary level. Where the file management was poor, problems arose with locating the relevant files and opening the SolidWorks assembly files. This usually resulted in a loss of marks, as file management is a specified learning outcome in the syllabus.

In Part B of the assignment candidates were required to make a design modification to the selected existing artefact or to create a new concept design. Over 86% of candidates opted for a concept design. This percentage has remained relatively stable since 2012, having grown quickly from only 18% in 2009, (the first year of examination of the current syllabus,) to 89% in 2012.

In general, this part (Outputs 7, 8 and 9) was less well answered than Part A. While many candidates produced exemplary work in Part A, some of the modifications in Part B were basic, sometimes very superficial and not developed using a theme, target market or mood board. The graphical presentation of the modified artefact or concept design was generally good but frequently lacked sufficient detail. As a result, candidates fared least well on Output 8. In most cases the candidates produced a CAD model of their modified or concept design and produced hardcopy printouts of a reasonably high standard.

Candidates who opted for the concept design scored a mean mark of 119.9 out of 160 (74.9%). In general, these candidates performed better than those who opted for the design modification, the latter scoring a mean mark of 102.6 out of 160 (64.1%). Candidates who attempted the

concept design usually answered Output 7 more comprehensively than those who opted for a design modification. In many instances, the design modifications were overly simplistic and frequently with inadequate justification and rationale presented. Also, simplistic modifications provided very little opportunity for candidates to demonstrate a range of skills in Outputs 8 and 9.

In some cases it was difficult for examiners to differentiate between Output 5 and Output 9 as candidates did not adequately highlight the modification(s) made to the existing artefact. The progression from initial idea to the final solution should always be clearly communicated. In some instances examiners reported that candidates did not always succeed in "telling the design story" leading to their chosen design solution.

3.2 Course Assignment – Ordinary level

The Ordinary level Course Assignment brief was as follows:

Cufflinks are often considered as important fashion accessories and also as works of art. They can be manufactured from a variety of different materials including metal, precious stones, glass, or a combination of materials. A number of different methods are used to hold cufflinks in place.

(A) Carry out a design investigation of existing cufflinks in graphic format. Your investigation should include an analysis of physical shape, features, colour, materials, etc.

and

(B) Show graphically how you would physically modify your chosen cufflinks to improve the overall design.

or

Develop and graphically communicate a new concept design for cufflinks based on a selected theme or target market.

3.2.1 Analysis of Candidate Engagement and Performance

A detailed analysis of the candidate performance across all nine outputs on the Ordinary level Course Assignment is presented in Table 14.

Part	Output	Available mark	Mean mark	Mark as %	Rank order
A	1	15	11.1	73.8	4
	2	15	10.5	69.6	5
	3	20	13.6	68.1	7
	4	33	27.4	82.9	1
	5	20	15.3	76.4	3
	6	7	5.7	81.8	2
B	7	20	11.4	56.8	9
	8	10	5.8	58.4	8
	9	20	13.8	69.0	6

Table 14: Statistical analysis of performance on the nine outputs at Ordinary level 2015.

Candidates were required to present material for each output and, while the majority of candidates did so, some omitted some of the outputs, and marks were lost as a result. While the outputs in Part B were frequently omitted in previous years, this year it was clearly evident that the majority of Ordinary level candidates made a reasonable attempt to complete outputs 7, 8 and 9. In general, the attempt rates for all of the outputs were higher than in previous years. There was also a significant increase in the marks awarded for Outputs 1 and 2 this year. It is possible that the 2015 brief proved particularly accessible for candidates to investigate and research.

In general, Part A of the assignment was well answered. Candidates scored reasonably well on Output 1 – the graphical exploration of the brief and presentation of existing artefacts. However, there was frequently little evidence of primary research as candidates relied heavily on the internet as the principal source for their ideas. The general standard of freehand sketching was satisfactory in Outputs 2 and 3 with some students using a range of media and various presentation techniques. It was evident that some candidates produced their 'freehand' drawings with the aid of instruments or traced their drawings from the completed CAD drawings. Marks were lost for Output 3 where this occurred. The SolidWorks models produced in Output 4 were generally of a good standard. The file management on the accompanying CD/USB was generally very good and in keeping with the file and folder structure as required and as outlined in the *Instructions to Candidates*.

In part B, the freehand graphical presentation of the modified artefact/concept design in Output 8 was generally fair but often lacked sufficient detail. It was evident that some candidates produced their 'freehand' drawings with the aid of instruments or traced their drawings from the completed CAD drawings. As a result, Ordinary level candidates generally did not perform well on this output. In most cases the candidates produced a CAD model of their modified design/concept design and produced hardcopy outputs of a reasonably high standard. As in previous years, there is more scope for improved performance in Part B rather than in Part A of the assignment, although the increase in the attempt rate for outputs in this section has already resulted in a noted improvement in the overall results and grades achieved.

The presentation of the various aspects of the design portfolio was considered in the marking criteria. In some cases candidates submitted portfolios where the pages were not appropriately sequenced or bound as required. 89 candidates (10.0%) at Ordinary level submitted design portfolios that exceeded the maximum number of twelve A3 pages stated in the *Instructions to Candidates*. Marks were lost as a result.

3.3 Final Examination – Higher level

3.3.1 Analysis of Candidate Engagement and Performance

A detailed analysis of candidate performance across all questions on the examination paper from Higher level candidates in 2015 is presented in Table 15. The statistics are based on data from all 4168 scripts.

Question	Popularity (% attempts)	Rank order in popularity (Section)	Mean mark	Mean mark as %	Rank order in mean mark (Section)	Topic
A-1	68.3%	4	10.2	51.0%	1	Sectioning of a right solid by an oblique plane & true length of line
A-2	78.0%	3	10.1	50.5%	2	Construct a parabola in a rectangle given the principal vertex
A-3	78.9%	2	10.1	50.5%	2	Dihedral angle between intersecting planes & traces of an oblique plane
A-4	80.5%	1	9.8	49.0%	4	Shortest distance between two skew lines
B-1	31.4%	3	26.4	58.6%	3	Intersection of a cone and a sphere
B-2	92.0%	1	35.9	79.7%	1	Axonometric projection & interpenetration
B-3	77.7%	2	33.1	73.5%	2	Perspective projection
C-1	68.5%	1	29	64.0%	4	Geologic Geometry
C-2	39.8%	3	29.6	65.7%	3	Structural Forms
C-3	50.5%	2	29.9	66.4%	2	Surface Geometry
C-4	26.9%	4	34	75.0%	1	Dynamic Mechanisms
C-5	14.4%	5	29	64.0%	4	Assemblies

Table 15: Popularity of and mean mark for each question, Higher level *Design and Communication Graphics*, 2015

Section A

The four questions in this section were among the seven most popular questions in the examination. The majority of candidates (80.1%) attempted at least three out of the four questions in this section, as required. 34.2% of candidates exceeded the minimum answering requirement and attempted all four questions. Only a very small number of candidates (0.1%) did not attempt any question in Section A. Examiners noted that the overall standard of answering had deteriorated slightly on that of 2014. It is, however, encouraging to note that candidates have begun to engage in greater numbers than heretofore with the topic of *Conic Sections*, as evidenced by the answers provided to question A-2.

Section B

The vast majority of candidates attempted two out of the three questions in this section as required. The same choice of questions in Section B often prevailed throughout entire examination centres. This may indicate that particular topics either were not covered in class or were not as comprehensively revised as other topics, thus restricting candidate choice in the examination. The attempt rate and mean mark achieved in question B1 were surprisingly low, as much of the knowledge associated with descriptive geometry of lines and planes is used to answer parts of questions on other topics on the examination paper. This may indicate either that candidates are not engaging with the basic principles relating to the determination of the projections of solids resulting from oblique cutting planes, or that the candidates find the topic abstract and are choosing not to answer examination questions on this topic.

Section C

The vast majority of candidates (95.4%) attempted two or more out of the five questions on the optional areas of the Applied Graphics, as required. 68.5% of the candidates attempted Question C-1 (Geologic Geometry) making it the most popular question in this section. The best answered question was Question C-4 (Dynamic mechanisms) with a mean mark of 34 marks (75%). It is noteworthy that the remaining four questions had almost identical mean marks. This comparatively good and consistent standard of answering could be expected on Section C, as the structure of the syllabus ensures that there will always be a question from each of the five areas on the examination paper. In addition, as the topics in Section C are elective, with the intention of providing opportunity for greater depth of study, this may lead to a greater level of knowledge and understanding.

3.4 Final Examination – Ordinary level

3.4.1 Analysis of Candidate Engagement and Performance

A detailed analysis of candidate performance across all questions on the Ordinary level examination paper in 2015 is presented in Table 16. The statistics are based on data from all 1,149 scripts.

The standard of answering was similar to that of recent years. The performance in Section A showed greater consistency and the attempt rate in the section was also significantly higher than that in preceding years. This contributed to a more balanced distribution of the marks across Sections A, B and C of the paper.

Question	Popularity (% attempts)	Rank order in popularity (Section)	Mean mark	Mean mark as %	Rank order in mean mark (Section)	Topic
A-1	91.6%	1	12.4	62.0%	3	Orthographic Projection
A-2	90.3%	2	16	80.0%	1	Conic Sections
A-3	37.9%	4	11.4	57.0%	4	Perspective Projection
A-4	76.9%	3	13.3	66.5%	2	Tangential Circles
B-1	78.5%	1	31.8	70.7%	2	Interpenetration of Solids
B-2	54.5%	3	35.2	78.2%	1	Axonometric Projection
B-3	60.3%	2	30.3	67.3%	3	Auxiliary Elevations
C-1	52.0%	2	27.9	62.0%	4	Geologic Geometry
C-2	44.6%	3	29.7	66.0%	2	Structural Forms
C-3	65.4%	1	28.1	62.4%	3	Surface Geometry
C-4	16.3%	4	33.9	75.3%	1	Dynamic Mechanisms
C-5	14.2%	5	25.8	57.3%	5	Assemblies

Table 21: Popularity of and mean mark for each question, Ordinary level *Design and Communication Graphics* 2015

Section A

The increased attempt rate in Section A, when compared with previous years, contributed to an improved performance in the section overall. Almost 90% of the cohort attempted at least three questions (as required) and some of the more capable candidates completed all four. A lack of perseverance was evident in many of the weaker attempts, and these candidates frequently did not attempt the second part of the questions.

Two of the questions in Section A (A-1 and A-4) tested candidates' knowledge and understanding of Descriptive Geometry and Projection Systems, while the remaining two focused on Plane Geometry. From the answers presented it is clear that, at Ordinary level, candidates demonstrate a much greater aptitude for the latter. Examiners noted that some candidates displayed a poor understanding of the relationship between the principal planes of reference and the appropriate projections from a given object. The syllabus learning outcome

in relation to the representation of '*three dimensional objects in logically arranged two dimensional views'* was achieved by only 60% of the cohort at this level.

Section B

In Section B, Question B-1 (Interpenetration) was most popular. This was followed by Question B-3 (Auxiliary Elevation). Candidates who attempted the required two questions and their sub-sections scored well. In some of the less successful attempts, questions were abandoned after merely replicating the basic outline as it was presented on the examination paper. Over 90% attempted the requisite number of questions in this section. As was the case at Higher level, the same choice of questions in Section B often prevailed throughout entire examination centres. This, again, may indicate that particular core topics either were not covered in class or were not as comprehensively revised as other topics, thus restricting candidate choice. By way of example, Question B-2, was unpopular yet notably had the highest mean mark (78.2%) in this section.

All of the questions in Section B tested understanding of the principles of Descriptive Geometry and this was frequently lacking in the answers presented. This suggests that more class time needs to be devoted to the basics of projection systems and the interrelationship between the various drawing views (plans, elevations, end views and auxiliaries) and the principal planes of reference.

Section C

Section C focused on the optional areas of study, the ***Applied Graphics*** portion of the syllabus. This is not a discrete area of learning and a fundamental understanding of the principles associated with the core areas of the syllabus is key to success in this section of the examination. Examiners noted that in Section C, the answering of candidates towards the lower end of the achievement spectrum, appeared to be constrained by a limited understanding of the core areas of the syllabus. Questions C-3 and C-1 were the most popular and C-5 was the least attempted question in the section. Combinations of the first three questions dominated candidate choice, mirroring the pattern of previous years.

There was evidence that many of the less successful candidates only scored well on the initial setup parts of the question, where they were required to simply reproduce the drawing as presented on the examination paper. These candidates either didn't attempt to or didn't

demonstrate the analytical skills required to progress successfully through the latter parts of the questions in Section C. This was despite some of these parts being very accessible.

Many of the questions in Section C required the drawing of freehand curves. While many were drawn with care and accuracy, this was not always the case, and this is identified as an area where candidates could improve their performance by exercising more care and attention.

3.5 Meeting of Specific Syllabus Objectives

The *Design and Communication Graphics* syllabus comprises one over one hundred and fifty specific learning outcomes and over one hundred of these pertain to material contained within the 'core' which is studied by all candidates. These learning outcomes emanate from eleven overarching syllabus objectives. These objectives, which define the knowledge and skills that students should have attained on completion of their studies *Design and Communication Graphics,* are outlined below: (Some have been amalgamated to avoid repetition.)

- Be familiar with the principles, concepts, terminology and methodologies associated with the graphics code and be able to produce neat and accurate drawings that comply with internationally recognised standards and conventions

- Be able to model, in two and three dimensions, graphic design problems and solutions, utilising a range of appropriate techniques and media with confidence and discernment and be able to apply the principles of both plane and descriptive geometries to the solution of a variety of concrete and abstract graphic problems

- Be appreciative of the facility which the graphics code provides, in the solution of problems and in the visual communication of data and be able to utilise freehand sketching, both two and three dimensional, as a means of communication and as an aid to spatial reasoning and refinement

- Be able to utilise a variety of rendering and presentation techniques in the solution of graphic design problems, in both two and three dimensions

- Be competent and confident in the application of CAD and other appropriate Information and Communications Technologies (ICT) in the solution, modelling and presentation of graphic design solutions, in two and three dimensions

- Be able to interpret verbal, written and mathematical information, and to represent it graphically
- Be able to evaluate design solutions and solve design problems on the basis of sound aesthetic principles and to appreciate the impact of design on the visual quality of the human environment
- Be appreciative of the broad vocational relevance of Design and Communication Graphics.

The 2015 candidates' engagement with the above *syllabus objectives* were considered in terms of some of their responses to items on the Higher level and Ordinary level examination papers as well as in relation to the content of their Course Assignments. Some observations on excellent responses as well as common errors or types of poor response are included. The comments should be considered in conjunction with the syllabus document, the examination papers and the published marking schemes.

Objectives

Be familiar with the principles, concepts, terminology and methodologies associated with the graphics code and be able to produce neat and accurate drawings that comply with internationally recognised standards and conventions.

Most, if not all, of the questions tested candidates' engagement with the 'graphics code' and graphic conventions, with the vast majority of candidates demonstrating a high level of competence. This was to be expected as the required level of knowledge and skills has already been partially attained by most candidates through the study of Technical Graphics at Junior Cycle and is being built upon for Leaving Certificate DCG.

The degree of familiarity, was naturally greater at Higher level and cognisance of this was taken in the structuring of the various questions at each level. Candidates at both levels were familiar with subject specific terminology and clearly understood references to such technical terms as *Truncation*, *Oblique*, *Dihedral*, *Axonometric*, *Hyperbolic Paraboloid*, *Stratum*, *Acceleration*, *Retardation*, *Dwell*, *Profile*, *Dip*, *Strike*, etc. Drawing conventions were clearly understood by the majority of candidates at both levels. Differentiation in line weight, line colour and line style were used as appropriate throughout the questions and their meaning was almost universally comprehended. Dimensioning was also clearly interpreted by all but a few candidates, with the

different dimensioning styles such as linear, aligned, baseline, radial, angular, etc., being interpreted and understood correctly. All of the candidates used first angle projection to provide their solutions to the problems pertaining to descriptive geometry. While the majority of Higher level candidates demonstrated an appropriate use of recognised standards and conventions such as centrelines, hatching, indexing, etc. in their drawings, this was not always the case at Ordinary level.

The concept of scale was understood and correctly applied by almost all candidates at Higher level. While the majority of questions were presented at either a scale of 1:1 or using a reduced scale, question C-2 on the Higher level examination paper employed an enlarged scale. Again, this did not pose any difficulty for the most candidates. Scaling was not assessed at Ordinary level.

Be able to model, in two and three dimensions, graphic design problems and solutions, utilising a range of appropriate techniques and media with confidence and discernment and be able to apply the principles of both plane and descriptive geometries to the solution of a variety of concrete and abstract graphic problems.

The vast majority of candidates at Higher level demonstrated the desired ability to engage in problem solving in both two dimensions and three dimensions. Candidates displayed the ability to represent three-dimensional space using two-dimensional media effectively and appropriately to solve the questions that were posed on the final examination paper. Key geometric principles were generally understood and applied in an appropriate manner in order to solve the problems presented on the Higher level examination paper. Fundamental concepts pertaining to lines and planes and their projections and traces were examined in questions A-1, A-3 and A-4 in Section A of the examination paper. Question A-1, for the first time since the introduction of the DCG syllabus, tested candidates' ability to solve a geometric problem, pertaining to inclined cutting planes, in a three-dimensional pictorial drawing. The question was the least popular one in Section A, possibly due to the fact that it was novel in its presentation and requirements. Those candidates who did attempt it (68.3%), however, engaged with the requirements of the question positively and, encouragingly, demonstrated a key understanding of the principles being tested. The question had the highest mean mark in the section, at 10.2.

Candidates' knowledge and understanding of alternative projection systems, such as Axonometric and Perspective Projection were tested in questions B-2 and B-3 and the vast majority of candidates obviously had an excellent understanding of the fundamental problem-solving concepts involved. Knowledge and application of two-dimensional geometric

principles were examined throughout the paper and in particular through question A-2, where an excellent knowledge and application of principles pertaining to Conic Sections was evident in many cases. Two-dimensional problem solving was also tested through question C-4. This optional area of study remains traditionally unpopular, although for those candidates who did attempt it, the reward was excellent as it afforded them an opportunity to display key skills in this area. This question had the highest mean mark in Section C on the Higher level examination paper.

At Ordinary level, however, examiners reported that a significant percentage of candidates found the three-dimensional questions much more challenging than those which required the candidates to conceptualise in two dimensions only. The DCG syllabus makes reference to two distinct branches of geometry, i.e. *Plane Geometry* and *Descriptive Geometry*.

At Ordinary level, knowledge and understanding of *Plane Geometry* was tested through questions A-1 and A-4 in Section A and in question C-4 in Section C of the written final examination paper. Question A-4 specifically tested this understanding through the topic of Conic Sections. The question was attempted by over 90% of candidates and was equally popular with candidates of all levels of attainment. The performance in the question exceeded that of all others in Section A. Key plane geometry concepts such as conic section construction, and axial symmetry were understood and demonstrated by most. However, knowledge of a basic concept, that of proportional line division, was displayed by only a minority. Question A-4, which dealt with the plane geometry concept of tangential circles and lines, was also very popular and familiarity with this topic at Junior Certificate level may have contributed to this. Candidates across the achievement spectrum demonstrated differing levels of knowledge and understanding of the key principles of centre location, tangency and location of point of contact. The plane geometry question in Section C (C-4) tested knowledge and understanding relating to cam construction and the depiction of the associated displacement diagram. This question was unpopular but was reasonably well answered. Examiners reported that the majority of candidates demonstrated the skills required to produce the required displacement diagram. Some candidates, however, were unable to transfer those skills and understanding to the drawing of the cam profile.

Most of the other Ordinary level questions on the final examination required candidates to engage in three-dimensional conceptualisation and a significant proportion of candidates struggled here. A basic understanding of projection systems was not demonstrated in many of

the attempts to question A-1, which tested knowledge and understanding of the principal planes of reference and principal orthographic views. In this particular instance, most Ordinary level candidates were able to correctly draw the elevation but most struggled in the visualisation of the end view. The use of indexing as well as other elements of the graphics code would be of assistance in solving problems of this nature. This ability to engage in three-dimensional visualisation was also tested in questions in Sections B and C of the examination paper. In most of these questions, all candidates were able to successfully reproduce the two-dimensional drawing that was presented as part of the question, but many had difficulty thereafter. This was particularly evident in question B-1, where two-dimensional and three-dimensional reasoning were tested through the topic of Interpenetration. Most candidates correctly drew the given outline plan and elevation. However, the higher order skills required by students to visualise the penetration points of the lines and surfaces of the structure in part (a) of the question were not evident in the case of approximately 25% of candidates. Again, approximately 25% of candidates did not demonstrate the knowledge or understanding to engage meaningfully with part (b) which required them to draw an end view.

This level of performance suggests that a much greater emphasis in class should be placed on the rudiments of projection systems. For most students, this involves building on the level of knowledge and understanding acquired from Junior Cycle Technical Graphics, but it may in other cases involve assisting those who may not have mastered that crucial understanding at Junior Cycle to do so. It is evident that this is of particular importance for those candidates opting for Ordinary level.

The Course Assignment also afforded candidates an opportunity to demonstrate their two-dimensional and three-dimensional problem-solving skills, and Ordinary level candidates fared better in this less structured environment than on the final examination paper.

Be appreciative of the facility which the graphics code provides, in the solution of problems and in the visual communication of data and be able to utilise freehand sketching, both two and three dimensional, as a means of communication and as an aid to spatial reasoning and refinement.

While it is difficult to assess appreciation, it can be assumed that those candidates who have developed and demonstrated high levels of skill and ingenuity in the application of the graphics code will have, in the course of their studies, developed an appreciation for the facility which that code provides in the solution of problems and in the visual communication

of data. The Course Assignment was the primary vehicle through which this syllabus objective was tested, albeit in an indirect manner. The final examination paper tends to be somewhat prescriptive in relation to what is being examined in this regard, whereas the Assignment gives students a much greater level of choice of communication media and methodologies. The vast majority of candidates did indeed demonstrate appropriate use of the graphics code and used a wide and varied range of presentation techniques to communicate their ideas graphically.

In most cases, candidates demonstrated a reasonably high level of competence in freehand sketching. The degree of proficiency was, as expected, greater among Higher level candidates and this is an area that has improved significantly since the syllabus was revised to include freehand sketching. However, examiners noted that some candidates produced their 'freehand' drawings with the aid of instruments or traced their drawings from the completed CAD drawings. Marks were lost for Outputs 3 and 8 where this occured. While this was more common at Ordinary level, it was also noted in a significant percentage of Course Assignments at Higher level. It should be noted that only original, non-scanned, sketches should be presented for Outputs 3 and 8. This not only helps to support the authenticity of the work but provides candidates with an opportunity to use a wider variety of drawing media than would be possible with scanned images.

While freehand sketching is not assessed directly through the final examination paper, examiners reported the candidates frequently used sketches, often on a corner of the drawing sheet, in order to assist them in their thought process prior to solving the geometrical problems that were presented. This would suggest that students are also engaging with this highly beneficial activity in class and this is to be commended, as it is one of the specific syllabus objectives.

Be able to utilise a variety of rendering and presentation techniques in the solution of graphic design problems, in both two and three dimensions.

In presenting their Course Assignment, candidates demonstrated competency in a range of graphic communication and presentation techniques. The production of annotated sketches during outputs 1 and 2, where they were required to research, compare and contrast artefacts, afforded them the opportunity to explore such techniques and most did so to very good effect. In the examples which scored higher, and particularly at Higher level, a wider range of communication methods were used, including annotated sketches, calligraphy, scanned

images, internet image clips, watermark images, flowcharts, timelines (where appropriate), etc. In some of the less successful Higher level work and in much of the Ordinary level work, there tended to be an over reliance on only one presentation technique. This generally manifested itself as clips downloaded from the internet with an overreliance on text as the form of communication.

Many candidates, in their Course Assignment, used graphic techniques in representing form, light, shade, tone and texture to good effect and, again, the performance was significantly better at Higher level. Some candidates, particularly at Ordinary level, tended to over-rely on solid colouring techniques and this often did very little to enhance the quality or presentation of the sketches. Greater emphasis needs to be placed on the distinction between the 'colouring' and 'rendering' of freehand sketches, particularly at Ordinary level. The standard of freehand sketching in Output 8 was not as high as in Output 3 and frequently lacked sufficient detail of the design modification or concept design. Again this shortcoming was less prevalent at Higher level.

While most candidates relied on standard white drawing paper as the primary communication medium, many of the candidates who attained higher grades used a wider variety of media and techniques. These included black paper (in a variety of finishes), tracing paper, coloured card, light on dark sketching, black and white only sketching, etc.

Where text was presented candidates generally opted for either a typed (word processed) or a handwritten style. While both are acceptable approaches to communication in a graphic context, examiners noted that those candidates who attained highly appeared to have more courage in the use of handwriting. Many experimented with handwriting styles and used calligraphy to enhance presentation.

Be competent and confident in the application of CAD and other appropriate Information and Communications Technologies (ICT) in the solution, modelling and presentation of graphic design solutions, in two and three dimensions.

The specific skills encompassed by this objective are identified in the syllabus as skills which are not readily assessed through a final examination. They were therefore assessed primarily through the Course Assignment and in particular through outputs 4, 5, 6 and 9. The marks scored on these outputs were consistently higher than the others, indicating that candidates have fully engaged with the Parametric Modelling (CAD) aspect of the syllabus. This

phenomenon was noted at both Higher and Ordinary levels. Ordinary level examiners noted a gradual increase in performance over the years. While almost all candidates produced the required three-dimensional models and hardcopy outputs, the degree of model complexity varied between candidates and centres. When presenting the hardcopies, most candidates printed their orthographic drawings directly from SolidWorks and used PhotoView 360 to produce the required high quality images. A small number of candidates, however, produced their drawings and photorealistic images from SolidWorks by taking a screen grab or saving the CAD file in jpeg format. This resulted in much poorer quality images and candidates lost some marks as a result.

At Higher level, examiners reported that, in general, the standard of modelling was very good, which suggests that a realistic length of time had been spent developing key skills in using the CAD software. Some candidates demonstrated excellent CAD skills and produced exceptionally detailed models. Most candidates produced models that contained a minimum of five parts as required. However, examiners suggested that greater emphasis needs to be placed on design intent and economy of design. The vast majority of candidates produced a number of photorealistic images containing a variety of views of the CAD model and presented these in an attractive manner.

Be able to interpret verbal, written and mathematical information, and to represent it graphically.

All of the questions on the final examination paper are presented in both graphical and written form. Candidates are required to interpret both and to interrelate them in order to initially identify and subsequently solve the given problems. None of the questions can be solved by garnering information from the drawing in isolation. Furthermore, in order to engage with the questions, candidates are generally required to interpret mathematical information, which is often presented in dimension format, but is frequently also provided in the accompanying text. Candidates are generally also required to perform a degree of mathematical computation in order to produce the required solution. The degree of mathematical complexity varies from question to question and also between levels.

Candidates, at both levels, demonstrated the ability to interpret the textual and mathematical information as presented. This resulted in almost all candidates being able to set up the initial drawings before engaging with the problems posed in the various questions. Examiners reported that the candidate responses suggested that the language used in the examination did

not pose a barrier to understanding the tasks. At Ordinary level, the information provided in question C-4 (Cams and Displacements) was presented almost entirely in text format, with just a small accompanying stimulus graphic. Nonetheless, candidates were able to engage with the problem and produce the required drawing. This question, notably, had the highest mean mark on the examination paper.

At Higher level, as expected, candidates were also able to decipher the textual and mathematical information, which was of necessity more complex at this level. The success of candidates in this respect was notable in question B-1, which was novel in its presentation. The textual information, however, was evidently understood by almost all candidates, as shown by the fact that they engaged appropriately with the problem. It was also particularly notable in question C-1, which, of necessity, contained a lot of text-based information. C-1 also introduced the concept of a water feature, which was a new feature in this topic, yet it posed few problems of interpretation for the candidates.

At both levels, in instances where candidates were unable to solve the more challenging question parts, the ability to interpret and apply written and mathematically presented information did not appear to have been an issue.

Be able to evaluate design solutions and solve design problems on the basis of sound aesthetic principles and to appreciate the impact of design on the visual quality of the human environment.

Candidates demonstrated their engagement with this objective, chiefly via the Course Assignment. Candidates at both levels engaged in research, which almost always involved the consideration of aesthetic principles of both their chosen existing artefact(s) and also in the development of their own conceptual design or modification. At Ordinary level, and to a lesser extent at Higher level, much of the research was secondary in nature and candidates relied too heavily on the internet as the main source of their information. Where primary research was carried out it was generally excellent and it afforded candidates the opportunity to consider both aesthetic and anthropometric design principles in a real and engaging context.

Candidates' appreciation of the impact of design on the visual quality of the human environment was most evident in part B of the assignments and more so at Higher level than at Ordinary level. Many candidates, through the effective use of mood boards and mind maps,

identified themes associated with nature and the living environment and bio-mimicry was frequently a feature in the concept designs produced by those candidates.

Be appreciative of the broad vocational relevance of Design and Communication Graphics.

This educational objective emanates, in the main, from the affective domain of learning and is as such difficult, if not impossible, to assess through either the final examination or through the Course Assignment. This is largely addressed through everyday activity and discussion in the classroom. Nonetheless examiners, having had an opportunity to look at candidate work in both components and to appreciate the implied enthusiasm and expertise with which the candidates partook in those activities, would suggest a high level of appreciation amongst candidates for the relevance of Design and Communication Graphics to contemporary society in its widest sense.

4. Conclusions

4.1 Course Assignment

The quality and presentation of the Course Assignments were excellent in the vast majority of cases. Most of the portfolios were appropriately bound and an excellent range of presentation skills were displayed. However, a small number of candidates exceeded the maximum number of permitted pages and lost marks as a result.

The exploration of the design brief (Output 1) was excellent in some cases and satisfactory overall. However, there was evidence of a lack of primary research with an over reliance on the internet as the only source for images and research material.

While many candidates produced excellent freehand presentation drawings, this is an area that could be further emphasised, developed and promoted. The over use of colour in some cases, did very little to enhance the quality or presentation of the sketches. The standard of freehand sketching in Output 8 was not as high as in Output 3 and frequently lacked sufficient detail to adequately communicate the design modification or concept design.

The overall standard of the SolidWorks models was excellent and suggested that a lot of time was spent developing the wide range of CAD/ICT skills evident in the Course Assignments.

However, at Ordinary level there was an over-reliance on the Extrude command to produce complex shapes. Candidates need to carefully consider design intent, particularly at Higher level. In general, however, a very high standard of SolidWorks skills was evident, coupled with a good variety of advanced modelling techniques.

4.2 Ordinary level – Final Examination

The performance at Ordinary level differed greatly depending on the type and nature of question. The syllabus objective that students should be able to apply the principles of both plane and descriptive geometry to their solutions was not realised by a significant percentage of Ordinary level candidates. This was evident in their attempts at completing questions related to orthographic projection.

The syllabus emphasises the importance of producing neat and accurate drawings to recognised standards and convention. It was evident that candidates from some schools did not display this standard.

There were three principal factors which resulted in some candidates underperforming in the examination. Firstly a lack of engagement appeared to be an issue for some. This was particularly evident in relation to Section A of the examination paper, where, in some instances, little was added to the partially completed solutions given on the examination paper. A lack of persistence was also a key factor for some candidates. This was more apparent in Sections B and C of the examination paper, where candidates simply drew what was presented on the paper and little else. This latter point is perhaps related to a third factor that was apparent in some cases – a lack of understanding of key principles. This was of particular note in descriptive geometry questions, which required three-dimensional reasoning and visualisation.

4.3 Higher level – Final Examination

The overall standard of answering was similar to previous years. Candidates demonstrated a good knowledge and understanding of the essential geometric principles and concepts. Those candidates who achieved high grades produced excellent answers and displayed an ability to solve problems in two and three dimensions using appropriate geometries and their underlying principles and theorems, as is required in the educational objectives of the syllabus. The solutions presented by most candidates displayed evidence of a well-structured and integrated analysis of topics as well as a detailed coverage of the whole course.

The DCG examination is hierarchical in nature and, when engaging with the final, more difficult question parts, which tested understanding and visualisation skills, higher ability candidates demonstrated their knowledge and geometric skills clearly, thus showing that the high grades they received were deserved.

In general, candidates followed the instructions on the examination paper correctly and the manner in which candidates presented material was excellent. Nonetheless, candidates who received E, F and NG grades tended to lack the knowledge, understanding and accuracy required at Higher level. It is clear that some of these candidates should have opted for the Ordinary level examination.

The vast majority of candidates completed the required number of questions. This indicates that lack of time is not an issue in the completion of the examination. Very few candidates attempted additional questions in any of the three sections, particularly in Sections B and C.

Analysis of patterns of answering within centres and between centres suggested that the choice of questions was made by some candidates in advance of seeing the examination paper. There was some evidence that essential core parts of the syllabus may not have been studied in detail by candidates in some schools. This restricted the level of choice available to then in the examination.

The main reasons why some candidates underperformed were twofold: not answering the required number of questions and not displaying a clear understanding of the subject matter.

There is an increasing trend by candidates to show little or no construction work for solutions to questions. It is necessary to demonstrate how a problem is solved and this is stated clearly in the rubrics on the examination paper. If the candidate does not use appropriate “indexing” add/or construction lines in the course of displaying their solution, there is a risk that a valid solution will not gain the marks that it otherwise could.

Many candidates underperformed in Section A relative to the competence they displayed in the other sections. In Section A, candidates are not required to “set up” the questions as this has already been done. They are therefore expected to engage from the outset with the less laborious but more intellectually demanding aspects of the topic being tested. This proved challenging for some.

There was evidence that some candidates had not covered the entire syllabus content, judging from the difficulty they had in cases where several different aspects of a topic were tested within a single question.

In general, candidates showed a good level of ability in extracting from the text of the questions the geometrical concepts and principles necessary to solve them.

Candidates at Higher level showed a clear preference for Questions B-2 (Axonometric projection) and B-3 (Perspective projection). This is consistent with candidate choice in previous years' examinations.

5. Recommendations to Teachers and Students

5.1 Course Assignment

The candidates' response to the assignment should conform to the requirements outlined in the brief and should address each of the required outputs. It is important that all candidates carefully read the entire document that is issued with the design brief.

Candidates should be advised not to exceed the maximum number of required pages at each level, Ordinary and Higher.

Primary research methods should be encouraged in the exploration of the design brief, to supplement other secondary sources such as the internet, books and catalogues.

The *Design Feature Comparison* of two selected artefacts (Output 2) should deal with comparing and contrasting the physical design features of two artefacts directly related to the issued brief. The artefacts chosen must have been included in Output 1, the exploration of brief and presentation of existing artefacts.

While the standard of freehand sketching was satisfactory in most cases, this skill should be further developed in the teaching and learning across all areas of the subject.

The practice of producing 'freehand' sketches with the use of instruments, tracing or grid paper should be avoided.

Original, non-scanned sketches must be presented for Outputs 3 and 8. This not only helps to support the authenticity of the work but also provides candidates with an opportunity to use a wider variety of drawing media than would be possible with electronically scanned images.

In producing the parametric models, greater emphasis needs to be placed on design intent and economy of design. Attention should be paid to fully defining sketches and using the most appropriate commands to produce complex shapes, particularly at Higher level. In addition, the main features in the part files should be renamed in keeping with good design practice.

The photorealistic representation should not be produced using images taken directly from "screenshots" in SolidWorks. Candidates should use PhotoView 360, PhotoWorks or other image generation software to create the desired high resolution output.

All of the assignment outputs should be given sufficient time for completion. The tendency to spend an excessive amount time on SolidWorks should be avoided.

In responding to Output 7, candidates should clearly communicate the thought process and rationale for arriving at the chosen modification or concept design. Candidates should carefully consider the following three areas when completing output 7.

- **Inspiration:** Keywords, mood-boards, brainstorming, images and analysis of the original artefact in Part A.
- **Progressions of ideas:** Development of form, physical features and target market.
- **Development and realisation of the final physical form:** At this juncture, the candidate must have clearly communicated their final design.

It is essential that all USB/CDs submitted along with the portfolio be checked by candidates in order to ensure that all necessary files are included. The specified filing structure must be adhered to and no additional files should be submitted on the USB/CD. Prior to submission, the USB/CD should be opened on a computer that is not connected to the school network to ensure that all files are present. Marks are frequently lost by candidates because CDs are not burned and finalised correctly.

All portfolios should be appropriately bound, in accordance with *Instructions to Candidates* and the USB/CDs should be submitted in a protective sleeve, fixed to the bound edge, to avoid damage in transit. It is recommended that teachers include an A3 size piece of 3mm plywood or cardboard in the transmission envelope to prevent any damage due to bending/folding of the assignment in transit or storage.

5.2 Final Examination

The importance of adopting an integrated approach to the study of plane and descriptive geometry is encouraged in the syllabus and it essential that this approach be pursued by teachers preparing students for this examination. In this context, close attention should be paid to the links between related topics, particularly within the "core" areas of study. Teaching a minimal amount of subject matter should be avoided as this will restrict question choice within the examination.

Teachers should encourage pupils to broaden their study of the core areas of the syllabus. Examiners observed that, in many instances, all pupils in particular centres are choosing the same topics, thus limiting their learning and, subsequently, their choices in the examination.

The *Design and Communication Graphics* syllabus was designed to afford students a choice among areas of study within Applied Graphics, which is reflected in part C of the examination. Students should be aware that the choice available within sections A and B of the examination is of a different nature, as the syllabus anticipates coverage of the entirety of the core areas of study. Accordingly, questions in parts A and B of the examination paper can be a conglomeration of all of the subject material in the core, and all of the core topics should therefore be covered by all students. In particular, there a clear need for improved candidate performance in the short answer questions in Section A.

Students should be encouraged to treat the subject of *Design and Communication Graphics* as a discipline of knowledge comprising geometric principles and concepts that need to be understood and applied to a wide variety of problem solving situations. To this end, no one topic should be dealt with in isolation, but rather the inter-relationships between topics should be highlighted and investigated as fully as possible. This will result in an enhanced understanding of the syllabus material. It is essential to focus on developing a deep understanding of the geometric principles rather than focusing on "rote learning" a series of individual methods and constructions.

All candidates should be encouraged to carefully read the examination paper. Every year, examiners report cases where candidates lose marks as a direct result of misinterpretations or other omissions which could have easily been avoided.

Greater emphasis should be placed on the standard of presentation. The uniformity and clarity of line weights need greater attention. A more considered choice of pencil lead would be of

assistance in this regard. There is scope for improvement in the quality of arcs, curves and circles, particularly at Ordinary level.

Teachers should encourage all candidates, but particularly Ordinary level candidates, to attempt the requisite number of questions and not abandon work without attempting all parts of each question. As is the case in all examinations, perseverance is key in maximising performance.

Over one in four of the cohort opting for the Ordinary level final paper completed a Higher level assignment in 2015. These candidates would have gained more marks by sitting both components at the same level. It should be noted that if a candidate sits either of the two *Design and Communication Graphics* components at Ordinary level, this will result in an Ordinary level grade. Greater consideration should therefore be given to choice of level in advance of the submission of the first component.

Conic sections are an important element of the syllabus and the examination, and are part of the core. Examiners noted that some candidates may not have studied the area at all. This will inevitably result in reduced marks and, therefore, all candidates are advised to study this area.

Students should be encouraged to relate their learning of *Design and Communication Graphics* to their learning of other subjects, with particular emphases on mathematics and other technology and science subjects.

Teachers should encourage students to develop an understanding of the key geometric principles of using a variety of techniques. Parametric modelling should be used in interrogating key principles and concepts, linking geometry with real-life applications and using teaching methodologies which encourage the understanding of essential concepts.

Pupils should use the published marking schemes as a resource and a guide when studying *Design and Communication Graphics*. However, they should not rely too heavily on examination papers as a learning tool. It should be noted that the model solutions in the scheme are not exhaustive and that alternative valid answers are acceptable. A much wider variety of material is required in order to build the problem-solving skills required to achieve a high grade.

Drawings should be neat and accurate. Candidates should be careful not to make errors in the setup of questions. A correct and accurate setup is an important step in leading to a solution. If

a trammel is used for a particular construction relating to a question on, for example, Conic Sections or Dynamic Mechanisms, it must be included with the solution.

Candidates should practice the skill of finding dihedral angles between planes, determining true shapes of surfaces, identifying and determining true lengths of lines, true inclinations of lines to the principal planes of reference, locating auxiliary vanishing points, axonometric projection of spheres etc. Further guidance in relation to these core geometrical principles is available on the T4 website.

As the examination draws near, candidates are advised to refine their examination technique. In particular, they should practice answering questions sufficiently quickly to allow them to attempt the required number of questions. In addition, practice of short-answer questions is encouraged.

The relationship between *Design and Communication Graphics* and the other STEM subjects should be emphasized in a holistic sense. The study of *Design and Communication Graphics* has the potential to enhance candidates' understanding of the other technological subjects as well as mathematics.