Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2016

TECHNOLOGY

CHIEF EXAMINER'S REPORT

Contents

1. Introduction

The development of technological capability, a central goal of technology education, can enable students to take advantage of present and emergent educational and vocational opportunities and to become informed citizens in a rapidly changing world. In a modern society, the broad range of skills learnt through a design based approach contributes to a broad, balanced and general education of students, and prepares them for entry into further education and training on completion of the Leaving Certificate.

The current Leaving Certificate Technology syllabus was introduced in September 2007 and first examined in June 2009. Prior to 2007, Technology was offered at Junior Cycle only. The Leaving Certificate Technology syllabus has a mandatory core which must be studied by all candidates and five optional modules from which a candidate may choose to study any two. This structure is reflected in the structure of the final examination paper.

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

1.1 Syllabus Structure

The syllabus aims to cater for a wide range of pupil ability. Assessment is at two levels: Ordinary and Higher. Differentiation between the levels is achieved in three ways:

- Depth and style of treatment: Ordinary level provides an overview of technology and its applications. Higher level involves a deeper and more analytical treatment.
- Skills development: All students will be required to attain a wide range of skills. A more refined expression of these skills will be required at Higher level.
- Range of syllabus material: In addition to the syllabus content required at Ordinary level, Higher level students will be required to study a broader range of subject matter. (Elements designated for Higher level only are printed in black text throughout the syllabus document).

1.2 Assessment Specification

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

1.	Coursework Task	200 marks	(50%)
2.	A final examination	200 marks	(50%)

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

The assessment objectives reflect four primary areas of technological engagement and attainment. These may be summarised as:

- knowledge of technological principles and facts and the terminology associated with technology including relevant symbols and units associated with physical quantities
- understand the role of, and be able to apply, design principles in the solution of specific problems, using mathematical and scientific concepts where appropriate
- competence in the selection, processing and use of a broad range of materials, mechanisms and components
- skills in the safe use of tools and equipment for the production of an artefact or system.

1.2.1 Coursework Task

The student Coursework Task is intended to assess intellectual activities such as analysis, research, planning, design and evaluation as well as practical activities such as materials processing, circuit design and production, mechanism selection, production and integration, CAD, CAM and ICT use.

The student Coursework consists of an artefact and a design folio. Each candidate, at both Ordinary and Higher Level, is required to submit an individual artefact and design folio in response to a coursework brief issued by the State Examinations Commission (SEC). The coursework briefs (one at Ordinary Level and one at Higher Level) are issued by the SEC in October of year two of the Leaving Certificate programme with a completion date at the end of the following April. The Student Coursework must be completed in school under the supervision of the class teacher. The class teacher and school principal are required to verify that the coursework submitted for assessment is the candidate's own individual work, completed in school under teacher supervision. On completion, the coursework is securely stored by the relevant school authority until June when it is laid out in the school and marked by a team of visiting examiners appointed and trained by the SEC.

The SEC policy and practice for the acceptance of practical coursework for assessment are outlined in circulars S68/04 and S69/08 and in the *Instructions to Candidates* document (M103P/ M104P). Copies of these circulars are available on the SEC website (www.examinations.ie).

1.2.2 Final Examination

The examination paper at Higher level is of 2.5 hours' duration while the examination at Ordinary level if of 2 hours' duration. The examination paper at both levels is divided into three sections – A, B and C. Section A and Section B assess the mandatory Core elements of the syllabus while Section C assesses the five Optional elements available to candidates.

Section A is worth 72 marks and comprises short questions relating to material from the core.

Section B is worth 48 marks and comprises two longer questions, each worth 24 marks. Candidates are required to attempt both questions. This section also relates to material from the core, and several topics and learning outcomes can be assessed within a single question.

Section C is worth 80 marks and deals with the five optional areas of study, which are outlined within the syllabus:

- Applied Control Systems
- Electronics and Control
- Information and Communications Technology
- Manufacturing Systems
- Materials Technology

The syllabus requires that pupils study two of these topics. This section of the examination paper presents candidates with one question from each topic, and candidates are required to answer any two questions. All questions are worth 40 marks. As candidates have opted to specialise in these areas of study, the questions in this section are 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.

A summary of mark allocations is given in Table 1.

<table>
<tr><th>Level</th><th>Component</th><th>Marks</th></tr>
<tr><td rowspan="3">Higher Level</td><td>Written examination
Section A
Section B
Section C</td><td>200
72 (12 questions at 6 marks)
48 (2 questions at 24 marks)
80 (2 questions at 40 marks)</td></tr>
<tr><td>Student Coursework
Artefact
Design Folio</td><td>200
100
100</td></tr>
<tr><td>Total</td><td>400</td></tr>
<tr><td rowspan="3">Ordinary Level</td><td>Written examination
Section A
Section B
Section C</td><td>200
72 (9 questions at 8 marks)
48 (2 questions at 24 marks)
80 (2 questions at 40 marks)</td></tr>
<tr><td>Student Coursework
Artefact
Design Folio</td><td>200
120
80</td></tr>
<tr><td>Total</td><td>400</td></tr>
</table>

Table 1: mark weightings by level for all assessment components

1.3 Participation Trends

Table 2 gives the overall participation rates of candidates in Leaving Certificate Technology for the past five years. The percentage of the total Leaving Certificate cohort opting to study *Technology* while small, has grown over this period and this growth is expected to continue as more schools opt to offer the subject. It is worth noting the numbers taking the subject at Junior Certificate have grown by 34% in the same period which further underpins the future growth of the candidature at Leaving Certificate level.

Year	Technology candidature	Total Leaving Certificate candidature*	Technology as % of total
2012	924	52,589	1.8
2013	1,074	52,767	2.0
2014	1,102	54,025	2.0
2015	1,328	55,045	2.4
2016	1,415	55,708	2.5

*Total Leaving Certificate candidature excludes Leaving Certificate Applied candidates.

Table 2: participation in Leaving Certificate *Technology* 2012 to 2016

The breakdown in terms of participation at Higher and Ordinary levels over the last five years is given in **Table 3**. The breakdown in terms of gender at Higher level and at Ordinary level over the last five years is given in **Table 4** and **Table 5** respectively.

It may be noted that the percentage of the subject candidature opting for Higher level, having grown initially, has plateaued over the past three years.

Year	Total Technology candidature	Number at Ordinary level	Number at Higher level	% Ordinary level	% Higher level
2012	925	155	770	16.7	83.3
2013	1,074	130	944	12.1	87.9
2014	1,102	119	983	10.7	89.3
2015	1,328	160	1168	12.0	88.0
2016	1,415	171	1244	12.0	88.0

Table 3: number and percentage of candidates at each level, 2012 to 2016

Candidates are required to take both components at the same level. While the vast majority do so, a small percentage do not. If either component has been taken at Ordinary level the candidate is awarded a grade at Ordinary level. The mark for the component which 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 more demanding, it is clear that these candidates would almost certainly have attained a higher overall grade if they had opted to take both components at Ordinary level. In 2016, the statistics record that 21 candidates who presented coursework at Higher level sat the written examination at Ordinary level and so received an Ordinary level overall grade. Greater consideration of level choice when selecting the Coursework Task to be attempted would be likely to result in in a better overall performance in the case of those candidates who eventually opt for the Ordinary level written examination in June.

Tables 4 and 5 show the numbers and percentage of female candidates and of male candidates taking Technology at each level. While the percentage of female candidate's is low relative to the full Leaving Certificate cohort it does however represent the highest participation rate for females in any of the technological suite of subjects.

Year	Total Higher level	Female Candidates	Male Candidates	Female as % of total	Male as % of total
2012	770	142	628	18.4	81.6
2013	944	158	786	16.7	83.3
2014	983	187	796	19.0	81.0
2015	1168	197	971	16.9	83.1
2016	1244	210	1034	16.9	83.1

Table 4: gender composition of Higher level cohort, 2012 to 2016

Year	Total Ordinary level	Female Candidates	Male Candidates	Female as % of total	Male as % of total
2012	155	32	123	20.6	79.4
2013	130	24	106	18.5	81.5
2014	119	21	98	17.6	82.4
2015	160	36	124	22.5	77.5
2016	171	21	150	12.3	87.7

Table 5: gender composition of Ordinary level cohort, 2012 to 2016

2. Overall Performance of candidates

2.1 Higher Level Statistics

The distribution of grades awarded over the last five years is given in **Table 6** (lettered grades) and **Table 7** (sub-grades).

Year	A	B	C	A, B, C	D	E	F	NG	E, F, NG
2012	15.5	37.1	31.1	83.7	12.0	3.2	0.8	0.1	4.1
2013	15.4	34.2	29.8	79.4	16.8	2.9	1.0	0.1	4.0
2014	12.2	34.6	31.0	77.9	17.1	3.4	1.3	0.4	5.1
2015	12.9	36.2	32.5	81.6	15.0	2.7	0.6	0.1	3.4
2016	11.7	37.6	30.0	79.3	15.7	3.9	0.8	0.2	4.9

Table 6: Percentage of candidates awarded each lettered grade in Higher Level *Technology*, 2012 – 2016

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2012	6.4	9.1	9.1	14.4	13.6	12.7	10.1	8.3	5.3	3.5	3.2	3.2	0.8	0.1
2013	5.4	10.0	9.4	12.9	11.9	11.3	10.2	8.3	6.8	4.7	5.3	2.9	1.0	0.1
2014	4.6	7.6	9.5	12.7	12.4	10.7	11.0	9.3	6.7	6.2	4.3	3.4	1.3	0.4
2015	4.9	8.0	11.1	11.0	14.1	12.1	12.1	8.3	7.0	4.4	3.6	2.7	0.6	0.1
2016	3.9	7.8	11.8	12.5	13.3	11.6	9.6	8.8	6.7	4.3	4.7	3.9	0.8	0.2

Table 7: Percentage of candidates awarded each sub-grade in Higher Level *Technology*, 2012 – 2016

These data show a broadly stable grade distribution at Higher level Technology from 2012 to 2016.

The distribution of sub-grades by gender over the last five years is given in **Table 8** (female candidates) and **Table 9** (male candidates).

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2012	2.8	7.0	11.3	17.6	9.9	13.4	14.1	9.9	4.2	3.5	2.8	2.8	0.7	0.0
2013	7.6	9.5	10.8	14.6	13.9	10.8	11.4	9.5	4.4	2.5	2.5	2.5	0.0	0.0
2014	3.7	9.6	8.6	16.0	15.0	8.6	11.2	9.6	7.0	6.4	1.6	1.6	1.1	0.0
2015	5.6	9.6	14.2	11.7	12.7	15.7	11.7	9.1	6.1	1.5	1.0	1.0	0.0	0.0
2016	3.8	12.4	9.0	13.3	19.5	10.5	7.1	8.6	6.7	4.8	1.0	1.9	1.0	0.5

Table 8: Percentage of female candidates awarded each sub-grade in Higher Level *Technology*, 2012 – 2016

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2012	7.2	9.6	8.6	13.7	14.5	12.6	9.2	8.0	5.6	3.5	3.3	3.3	0.8	0.2
2013	5.0	10.1	9.2	12.6	11.5	11.5	9.9	8.0	7.3	5.1	5.9	2.9	1.1	0.1
2014	4.8	7.2	9.7	11.9	11.8	11.2	10.9	9.2	6.7	6.2	4.9	3.8	1.4	0.5
2015	4.7	7.7	10.5	10.8	14.4	11.3	12.2	8.1	7.2	4.9	4.1	3.1	0.7	0.1
2016	4.0	6.9	12.4	12.4	12	11.8	10.2	8.9	6.7	4.3	5.4	4.4	0.8	0.1

Table 9: Percentage of male candidates awarded each sub-grade in Higher Level *Technology*, 2012 – 2016

It is evident from these data that, over the five years reported upon, female candidates generally outperformed their male counterparts with a greater percentage of the female candidature achieving a higher overall grade at most of the sub-grades reported.

2.2 Ordinary Level Statistics

The distribution of grades awarded over the last five years is given in **Table 10** (lettered grades) and **Table 11** (sub-grades).

Year	A	B	C	A, B, C	D	E	F	NG	E, F, NG
2012	8.4	28.4	28.4	65.2	21.3	7.7	3.9	1.9	13.5
2013	2.3	22.3	33.0	57.6	23.8	14.6	3.1	0.8	18.5
2014	5.0	29.5	30.3	64.8	24.4	7.6	2.5	0.8	10.9
2015	1.3	28.2	36.9	66.4	23.8	6.9	3.1	0.0	10.0
2016	9.4	28.6	36.8	74.8	14.6	6.4	3.5	0.6	10.5

Table 10: Percentage of candidates awarded each lettered grade in Ordinary Level *Technology*, 2012 – 2016

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2012	2.6	5.8	8.4	10.3	9.7	10.3	9.7	8.4	4.5	10.3	6.5	7.7	3.9	1.9
2013	0.0	2.3	5.4	5.4	11.5	13.8	7.7	11.5	5.4	6.9	11.5	14.6	3.1	0.8
2014	0.0	5.0	7.6	10.1	11.8	7.6	11.8	10.9	12.6	4.2	7.6	7.6	2.5	0.8
2015	1.3	0.0	11.9	8.8	7.5	15.6	11.3	10.0	10.0	9.4	4.4	6.9	3.1	0.0
2016	4.7	4.7	7.0	11.1	10.5	11.7	14.0	11.1	2.9	7.6	4.1	6.4	3.5	0.6

Table 11: Percentage of candidates awarded each sub-grade in Ordinary Level *Technology*, 2012 – 2016

These data show a broadly stable grade distribution at Ordinary level Technology from 2012 to 2016 while recognising that greater statistical variations are likely due to the small cohort.

The distribution of sub-grades by gender over the last five years is given in **Table 12** (female candidates) and **Table 13** (male candidates).

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2012	0.0	6.3	18.8	12.5	3.1	6.3	6.3	6.3	9.4	9.4	3.1	9.4	6.3	3.1
2013	0.0	4.2	4.2	12.5	16.7	12.5	12.5	4.2	0.0	8.3	16.7	8.3	0.0	0.0
2014	0.0	4.8	14.3	19	23.8	0.0	9.5	4.8	4.8	4.8	0.0	14.3	0.0	0.0
2015	0.0	0.0	19.4	16.7	11.1	11.1	11.1	2.8	5.6	8.3	0.0	11.1	2.8	0.0
2016	0.0	4.8	9.5	14.3	14.3	9.5	9.5	33.3	4.8	0.0	0.0	0.0	0.0	0.0

Table 12: Percentage of female candidates awarded each sub-grade in Ordinary Level *Technology*, 2012 – 2016

Year	A1	A2	B1	B2	B3	C1	C2	C3	D1	D2	D3	E	F	NG
2012	3.3	5.7	5.7	9.8	11.4	11.4	10.6	8.9	3.3	10.6	7.3	7.3	3.3	1.6
2013	0.0	1.9	5.7	3.8	10.4	14.2	6.6	13.2	6.6	6.6	10.4	16	3.8	0.9
2014	0.0	5.1	6.1	8.2	9.2	9.2	12.2	12.2	14.3	4.1	9.2	6.1	3.1	1.0
2015	1.6	0.0	9.7	6.5	6.5	16.9	11.3	12.1	11.3	9.7	5.6	5.6	3.2	0.0
2016	5.3	4.7	6.7	10.7	10.0	12.0	14.7	8.0	2.7	8.7	4.7	7.3	4.0	0.7

Table 13: Percentage of male candidates awarded each sub-grade in Ordinary Level *Technology*, 2012 – 2016

3. Analysis of Candidate Performance

Statistical information on engagement with and performance on the various questions in the coursework component and the written examination follows. Although the two examination components are not graded separately, the marks for the student Coursework Task are captured and recorded. The overall standard of the work presented for the Coursework Task remains high, and the vast majority of candidates at both levels achieve a higher mark in the Coursework Task than in the written component.

3.1 Coursework Task – Higher Level

The 2016 Higher level Thematic Brief was:

> Animatronics refers to the use of technologies and materials to emulate human or animal characteristics or bring lifelike movement to an otherwise inanimate object. Animatronic creations have included animals, plants and even mythical creatures. They have, since their inception, been used as a spectacle of amusement.
>
> Modern animatronics have found widespread application in the entertainment industry, movie special effects, concert staging and in theme parks. They have been used in advertising, marketing and product promotion while other creative uses have included automated devices which deter pests and predators to protect crops and livestock.
>
> *In a context of your choice, design and make a model of an animatronic system or artefact which emulates lifelike characteristics and includes electro-mechanical movement in operation.*
>
> *Your solution should focus on modern materials, processes and technologies and should also be well presented.*

3.1.1 Analysis of Candidate Engagement and Performance

The average marks awarded for each section of the Coursework Task at Higher level in 2016 is given in **Table 14**.

Design Folder – 100 marks			
No.	Heading	Total Mark	Average Mark
1	Analysis of thematic brief	**50**	**32.3**
2	Overall management of the project		
3	Environmental impact		
4	Research, investigation and specifications of brief		
5	Design ideas and selection of solution		
6	Sketches and drawings for manufacture	**35**	**22.1**
7	Production planning		
8	Product realisation		
9	Testing, evaluation and critical reflection	**15**	**11.0**
10	Presentation and ICT		
Artefact - 100 marks			
1	Artefact meets theme and specification	**30**	**25.1**
2	Originality and creativity		
3	Production skills	**45**	**35.6**
4	Functionality		
5	Quality and finish	**25**	**19.5**
6	Presentation		

Table 14: Average marks awarded, Coursework Task Higher level 2016.

3.2 Coursework Task – Ordinary Level

The 2016 Ordinary level Thematic Brief was:

Pets form a valued part of many households in Ireland. These pets are often dogs or cats but can include birds, fish or reptiles. Pet owners spend large sums of money on devices such as automatic feeders, exercise machines, accommodation requirements, toys and more to care for and to enrich the life of their pets.

In this context, design and make a working model of a device that could enhance the living conditions of a pet animal in a context of your choice.

Using modern materials and technologies, your model should incorporate an electronic and/or mechanical system and should be well presented.

3.2.1 Analysis of Candidate Engagement - Ordinary Level

The average marks awarded for each section of the Coursework Task at Ordinary level in 2016 is given in **Table 15**.

Design Folder – 80 marks			
No.	Heading	Total Mark	Average Mark
1	Analysis, research and investigation	**30**	**21.2**
2	Overall management of the project		
3	Environmental impact		
4	Design ideas and selection of solution		
5	Sketches and drawings for manufacture	**40**	**19.3**
6	Production planning		
7	Product realisation		
8	Evaluation and testing	**10**	**7.3**
9	Presentation and ICT		
Artefact - 120 marks			
1	Artefact fulfills theme and specification	**30**	**25.8**
2	Creativity		
3	Production skills	**60**	**48.2**
4	Functionality		
5	Quality and finish	**30**	**24.2**
6	Presentation		

Table 15: Average marks awarded, Coursework Task Ordinary level 2016.

3.3 Written Examination – Higher Level

3.3.1 Analysis of Candidate Engagement and Performance

Table 16 is a summary based on an analysis of candidate performance in the written component of the 2016 examination. The statistics are based on data from all 1244 scripts.

Question	Popularity (% attempts)	Rank order in popularity	Average mark (and as %)	Rank order in average mark	Topic
A1	100	1	4.9 (81.7%)	4	Market research, product lifecycle
A2	96.7	4	3.6 (60.0%)	10	Infra-Red technologies
A3	89.2	7	3.6 (60.0%)	10	Food miles/transport
A4	97.5	3	4.0 (66.6%)	7	Sensors/material properties
A5	98.3	2	5.4 (90.0%)	3	Newson chair materials
A6	81.7	10	3.6 (60.0%)	10	Resistor tolerance/total resistance
A7	95.8	4	3.9 (65.0%)	8	Energy use/environmental impact
A8	85.0	9	4.7 (78.3%)	5	Product reliability/Bathtub curve
A9	67.5	11	3.5 (58.3%)	11	Cam profiles/names
A10	87.5	8	3.8 (63.3%)	9	Lever class/moments calculation
A11	97.5	3	3.8 (63.3%)	9	CNC/3D printing
A12	98.3	2	4.9 (81.7%)	4	Byte units/file size
A13	93.3	5	4.3 (71.7%)	6	Ortho. views of exploded hairdryer
A14	92.5	6	5.5 (91.7%)	2	Ergonomics/design considerations
A15	96.7	4	5.6 (93.3%)	1	Graphic techniques
B2	98.7	Compulsory	16.4 (66.8%)	n/a	Communications applications, linkages and motion, factor of safety, 3D scanning and printing, affordable tech.
B3	98.7	Compulsory	15.7 (65.4%)	n/a	Material applications/properties, motor types and efficiency, design comparison, Gantt charts
C1	31.3	3	21.8 (54.5%)	2	Applied Control Systems
C2	20.7	4	21.1 (52.8%)	3	Electronics and Control
C3	54.0	2	20.6 (51.5%)	5	Information and Communications Technology
C4	14.9	5	20.7 (51.7%)	4	Manufacturing Systems
C5	83.4	1	23.5 (58.8%)	1	Materials Technology

Table 16: popularity of and average mark for each question, Higher Level *Technology*

Section A was attempted by 100% of the cohort and the average mark for Section A was 50.9 out of the available 72 marks (70.7%). 96% of candidates attempted at least one question in excess of the required number. While candidates demonstrated a good level of achievement in the core topics addressed it is notable that those questions which required a calculation attracted a lower average mark while those dealing with materials, processes and graphics attracted the highest average marks. As Table 16 shows, both of the compulsory core questions in **Section B** had identical attempt rates at 98.7%. While candidates on average achieved a slightly higher mark on B2 at 16.4/24 (66.8%) than on B3 at 15.7/24 (65.4%) it is however reassuring both from a teaching and learning and from an assessment viewpoint that the differential is very small. The overall average mark for **Section C** was 44.4 out of 80 (55.5%). In 2016, 96.4% of candidates attempted the required two or more optional questions. It is particularly noteworthy that a range of only 7.3% exists between the option with the highest average mark (Materials Technology) and the option with the lowest (Information and Communications Technology). It is also noteworthy that the second most popular topic (ICT) returned the lowest average mark, albeit by a very small margin.

The figures in Table 16 are indicative of good coverage of the syllabus in schools.

3.4 Written Examination – Ordinary Level

3.4.1 Analysis of Candidate Engagement and Performance

Table 17 is a summary based on an analysis of candidate performance in the written component of the 2016 examination. The statistics are based on data from all 167 scripts.

Question	Popularity (% attempts)	Rank order in popularity	Average mark (and as %)	Rank order in average mark	Topic
A1	100	1	5.1 (64.7%)	7	Wearable technology/GPS
A2	95	2	6.7 (84%)	4	Materials/finishes
A3	100	1	7.2 (90%)	2	Solar power/renewables
A4	100	1	4.1 (51.2%)	10	Electricity/fuses
A5	85	4	5.5 (68.7%)	6	Gantt charts
A6	100	1	7.3 (91.2%)	1	Design prototyping
A7	95	2	6.9 (86.2%)	3	Orthographic views/sketching
A8	55	6	4.6 (57.5%)	9	PCBs/Ohms Law calculation
A9	95	2	5.7 (71.2%)	5	Chain and sprocket mechanisms
A10	95	2	5.0 (62.5%)	8	Health and safety/machines
A11	80	5	3.5 (43.7%)	11	Joint types/beam cross-section
A12	90	3	5.7 (71.2%)	5	Graphic techniques
B2	97.6	Compulsory	16.6 (69.1%)	n/a	Material properties, sensor circuits, quality assurance/product recall, design modelling, environmental impact
B3	95.8	Compulsory	16.1 (67.0%)	n/a	Technological applications, energy conversions, data storage, computer simulation
C1	15.6	4	17.5 (43.7%)	4	Applied Control Systems
C2	15.0	5	14.1 (35.3%)	5	Electronics and Control
C3	79.6	1	26.0 (65.0%)	1	Information and Communications Technology
C4	21.0	3	22.9 (57.2%)	3	Manufacturing Systems
C5	62.9	2	25.1 (62.7%)	2	Materials Technology

Table 17: popularity of and average mark for each question, Ordinary Level *Technology*

Section A was attempted by 99.4% of the cohort and the average mark for Section A was 55.3 out of the available 72 marks (76.7%). 91% of candidates attempted at least one question in excess of the required number. While candidates demonstrated a good level of achievement in questions which addressed the recall of facts or the naming of materials, components, mechanisms etc., it is notable that those questions which required a calculation attracted a lower average mark. As Table 17 shows, both of the compulsory core questions in Section B had very similar attempt rates at 97.6% and 95.8%. While candidates on average achieved a slightly higher mark on B2 at 16.6/24 (69.1%) than on B3 at 16.1/24 (67.0%) it is however reassuring both from a teaching and learning and from an assessment viewpoint that the differential is very small. The overall average mark for Section C was 47.1 out of 80 (58.8%). In 2016, 90.0% of candidates at this level attempted the required two or more optional questions. It is particularly noteworthy that there is a direct correlation between the popularity of the Options and the average marks achieved. It remains the case that the Options dealing with electronics and their applications remain relatively unpopular and poorly answered by candidates at this level.

3.5 Attainment of Key Syllabus Objectives

The *Technology* syllabus comprises over two hundred and fifteen specific learning outcomes with over one hundred of these pertaining to material contained within the 'core' which is studied by all candidates. These learning outcomes emanate from thirteen overarching syllabus objectives. These objectives which define the knowledge and skills that students should have attained on completion of their studies of Technology, are summarised below: (Some have been amalgamated to avoid repetition.)

- knowledge of technological principles and facts and the terminology associated with technology including relevant symbols and units associated with physical quantities
- understand the role of, and be able to apply, design principles in analysis and solution of specific problems, using mathematical and scientific concepts where appropriate
- competence in the evaluation, selection, processing, use and justification of a broad range of materials, mechanisms and components
- be able to prepare and communicate technological information in written, verbal, graphic and mathematical forms and prepare and present a report in a concise manner

- develop and execute a plan for the realisation of an artefact or system as a solution to a technological problem or challenge, working accurately and safely with materials and equipment

- recognise that technological developments have resource implications, that resources need to be carefully managed and that developed societies have moral responsibilities in their appropriation of world resources

- be able to work both independently and co-operatively to evaluate a completed artefact or system against its original specification and propose alterations and modifications at the design, implementation or completion stages to enhance its appearance or function

While assessment of the subject comprises two distinct components (Coursework and Written), it is essential to recognise that an integrated approach to the theoretical and practical elements of the Technology syllabus is central to the successful attainment of the learning outcomes. The approach to teaching and learning in the subject is centred on a design-led and project-based methodology, and any given syllabus objective may find expression in both theoretical and practical aspects of the course and the assessment.

The 2016 candidates' engagement with and achievement of the syllabus objectives are considered below in relation to some of their responses to items on the Higher level and Ordinary level examination papers and in terms of the work presented in their Coursework Tasks. While the syllabus objectives as a whole relate to all levels in the cognitive domain, some will find expression more explicitly in particular aspects of the coursework or written assessments. 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

Knowledge of technological principles and facts and the terminology associated with technology including relevant symbols and units associated with physical quantities.

This objective relates to core material and as such is tested in Sections A and B of the written examinations as well as being demonstrated through candidate responses to the Coursework Task. Candidates at both levels were required to show knowledge of the basic principles and facts in their answers to a number of questions: examples include, at Ordinary level, Section A, Questions (4), (8), (9) – principles and facts, Question (8) – units, Section B, Questions 2 b (iii) and 3 b (iii) – symbols and units, and, at Higher level, Section A, Questions (4), (8), (9), (11) – principles, facts and terminology, Question (12) – units, Section B, Questions 2 b (i) – types of motion and Section C 3(ii) "Explain *interference, absorption* and *reflection* as influences on the performance of a wireless network."

Candidates' awareness that the applications of technology are fundamental to many aspects of daily life was explored throughout Section B Question 2 at Ordinary level , and Section B Question 2 at Higher level. Candidates at both levels demonstrated good awareness of the appropriate units for physical quantities though the correct placement of the decimal point when dealing with units in terms of standard prefixes (milli, micro, kilo, mega, etc) remains problematic for some, particularly at Ordinary Level. Most candidates demonstrated good overall levels of achievement in both knowledge and in understanding though marks were occasionally lost due to insufficient clarity or detail in responses or through giving a general example when a specific application was required – for example, in question A2 (ii) at Higher level (*Outline how infrared technology can be used in communication applications*). Here a common mistake was providing a general application rather than a communications application as required. In other questions at Higher level the candidate was expected to demonstrate a knowledge of the application of technological processes, principles or procedures, for example, question A11 (ii) (*Describe a specific use of **each** of the following computerised technologies: CNC Lathe, 3D Printing*). While generally well answered, some candidates failed to identify a specific use for a CNC lathe or 3D Printing – giving instead descriptions of the CNC lathe and the 3D printing process. In other questions also, some candidates gave definitions that were lacking the accuracy and detail required for full marks or failed to answer the question which was posed.

Understand the role of, and be able to apply, design principles in analysis and solution of specific problems, using mathematical and scientific concepts where appropriate.

Candidates demonstrated their attainment of skills and learning relevant to this objective, through the Coursework Task and in responses to the core questions at both levels. Candidates responded well to questions such as Higher level question 2B (i) (*These devices can have a Factor of Safety (FoS) of 5. Explain the term 'Factor of Safety of 5' and outline why it is critical in the design of prosthetic devices*.) and Ordinary level question 3B(b) (*The* *images show a drone with a 14 megapixel camera attached. (ii) Using notes and annotated sketches, suggest a suitable method of rotating the camera while in use*). While responses generally showed satisfactory levels of understanding, marks were frequently lost at both levels through a failure to fully annotate sketches and reference such sketches in the accompanying written explanation or outline.

Candidates at both levels showed a good understanding of a design process and its use as a tool to facilitate problem solving. Candidates also made good use of technologies such as circuit simulation software and CAD software to assist in modelling and prototyping possible solutions as evidenced by the design folios presented, however it was noted that the lack of final circuit diagrams and flowcharts for PIC control applications prevented some candidates from attaining full marks. It was also evident that much of the research carried out in relation to the Coursework Task was secondary in nature, with candidates relying too heavily on the internet as their main source of information. The need for iterative research was lost on some candidates as they presented only one level of investigation. Candidates are expected to carry out an analysis of the research data, with an outcome of deriving from the thematic brief a final design proposal. Where primary research was carried out it was generally excellent and led to high marks being achieved.

Competence in the evaluation, selection, processing, use and justification of a broad range of materials, mechanisms and components.

The theoretical aspects of this objective were assessed through several questions at both levels, for example: Ordinary level 2A(i) (*Outline two reasons why plastics are popular in the manufacture of products like the water and food dispenser shown*). Ordinary level 3B(ii) (*Give **two** reasons why products with a similar function are sometimes manufactured from different materials*) and at Higher level 2B(iii) (*Suggest a suitable material for the linkages in the prosthetic hand. Justify your answer making reference to material properties*.) and 3C(ii) (*Outline the advantages of both: • a chain and sprocket drive and • a toothed belt drive as drive systems for the car*). At both levels, candidates demonstrated a good familiarity with the most commonly used materials and mechanisms and showed understanding of their appropriate uses. However, some candidates failed to demonstrate understanding of the concept that a material property (e.g. Malleability) is possessed by many materials but at differing levels. Justifications given for material selection were often insufficiently detailed to achieve full marks. It is noteworthy that Option 5 (Materials Technology) was the most popular option and had the highest average mark at Higher Level and was, by a very small margin, the second most popular and second highest mark at Ordinary Level.

Candidates demonstrated their attainment of the practical elements of this objective via the Coursework Task in both the planning as evidenced in the Design Folio and in the finished Artefact. It is reassuring to note that no cases of identical/copied coursework were identified and that the work presented was designed and created by the individual candidates. A good range of solutions was presented with some very effective and innovative designs attempted and generally well executed. As might be expected, there was a reliance on the usual workshop materials, especially wood and acrylic. In many centres, there was effective experimentation with the genie board and programmable chip solutions to control servos and stepper motors. A good number of schools have purchased CNC routers or laser cutters, and there is now an increased use of this equipment in the design and manufacturing process. However, some products were entirely and excellently crafted using traditional skills and equipment with an emphasis on acrylic and wood and also achieved top marks.

Most candidates successfully produced an artefact that worked well. However, inappropriate selection of materials and processes did prevent some from functioning properly and caused them to lose marks. Recurring issues of concern surrounded poor quality soldering and inadequate integration of circuits into the artefact. The coursework was generally well presented and the more innovative candidates took the opportunity to show creativity in presenting their artefact by including video clips of the working artefact or PowerPoint slides/photos and CAD animations. Good practice seen in many centres was the provision of detailed instructions for the examiner on the power/switch locations and on the setup and use of any particularly novel or unusual designs.

Be able to prepare and communicate technological information in written, verbal, graphic and mathematical forms and prepare and present a report in a concise manner.

Candidates demonstrated their attainment of skills and learning relevant to this objective, through the Coursework Task and in responses to the several questions at both levels. For example: Ordinary level A(7) (*In the box provided, make a well-proportioned 2D sketch of the chair shown when viewed in the direction of the arrow A.)* and Ordinary level A(12) (*Use two graphic techniques to enhance the graphic representation of the claw hammer shown.),* Higher level A(10) (*Calculate the effort required for the lever shown below.)* and C4 (ii) (*Using the graph or other means calculate the break-even quantity and recommend a method* *of packaging the USB sticks*.) Most candidates demonstrated various sketching techniques; shading was most popular as a technique to enhance the graphics presented and the use of other more advanced techniques was limited. It can be observed that those candidates who had evidently practiced the skills of sketching and rendering through their class and project work did very well here. Also, candidates who brought appropriate equipment such as sketching and polychromos pencils or promarkers to the examination also tended to achieve higher marks. The 'verbal' element of this objective is not assessed through either of the terminal components, though it can be assumed that candidates have engaged in such communication as part of the ongoing engagement with their peers and teacher. To the extent that such verbal communication assists candidates in the effective development and execution of the Coursework Task, such skills can be considered to contribute indirectly to the marks achieved in this component.

The Coursework Task is also an opportunity for the demonstration of attainment in many other elements of this learning objective and here most candidates provided working drawings in their folio but with a significant variety in quality. The use of 'SolidWorks' was evident in an increasing number of centres and usually in the work which achieved the best outcomes. The candidate should aim to provide a set of drawings and specifications which would allow a third party to produce their design, but some candidates delivered incomplete and poorly detailed drawings that lacked dimensions. Circuit diagrams and mechanism details were frequently omitted in poorer responses. Parts manufactured using CNC or laser should have production CAD drawings presented in the folio. A materials list should be included and is most effectively presented as a table showing quantity, material, size and cost. The process of scheduling using a work breakdown structure, Gantt charts or critical path diagrams should be integrated into design reports. The use of freehand sketches with effective labels and the inclusion of a small amount of colour would improve the quality of much work presented. In meeting this objective, the most successful coursework responses provided a sequence of manufacturing including a contemporaneous photographic record of the production processes involved in the making of the artefact. This section, in itself, provides an excellent verification of the steps taken to complete the coursework.

The number of candidates who fail to submit a folio continues to decrease. In 2016, 89.6% of candidates submitted a folio for assessment, up from the 2015 rate of 79.7%.

Develop and execute a plan for the realisation of an artefact or system as a solution to a technological problem or challenge, working accurately and safely with materials and equipment.

Candidates demonstrated their engagement with this objective chiefly via the Coursework Task, though theoretical aspects were also included in the written examinations at both levels. Examples are Ordinary level 5C (i) (*Using notes and annotated sketches, suggest a suitable method of joining the leg to the main body of the metal magazine rack in 5(b) above.)* and Higher level 5C(iii) (*The chassis of the hoverboard is made of two separate metal parts which pivot independently of each other, as shown. Outline, using annotated sketches, a method of joining these parts together while accommodating the pivot/swivel motion*). Candidates at both levels were conversant with a sequential planning process and work breakdown structures and also demonstrated a good ability to apply these approaches to the questions posed. However many responses tended to be more of a generic nature than specifically applied to the situation posited, and few candidates managed to provide sufficient levels of detail in their responses to attain full marks.

Candidates demonstrated their attainment of the applied elements of this objective via the Coursework Task in both the planning, as evidenced in the Design Folio, and in the Artefact presented. The best responses integrated research taken from the internet with other primary sources of investigation. Weaker responses persisted in pasting whole sections of material from the internet or other sources into their report. The requirement to acknowledge sources of research information needs to be better addressed by many candidates. The majority of candidates researched key words (e.g. animatronics, mechanisms, applications, etc.) with the presentation of higher order mind maps and other graphical techniques commonly and effectively used. The focus of this initial research should be narrowed and then detailed in a specification of chosen parameters. Lower order lists of generic specifications (safe, look well, etc.) need to be well supported with specific points. It is expected that the optimum solution be clearly identified and justified with a strong argument. It is not sufficient to give simplistic reasons for choosing one solution over another, there is a requirement for significant analysis to choose and justify the solution.

The inclusion of mechanical/electronic sub-systems in sketches is to be commended, as is the use of circuit diagrams. In instances where there was little reference to the required circuitry and electronic components candidates lost marks.

Recognise that technological developments have resource implications, that resources need to be carefully managed and that developed societies have moral responsibilities in their appropriation of world resources.

The theoretical aspects of this objective were assessed through questions at both levels, for example: Ordinary level 2B (*Give **one** example of how the environmental impact of producing a technology task can be reduced.*) and Higher level A3 (*Analyse the impact of the food miles concept under the following headings: (i) Packaging and transport (ii) Seasonal production of food*). Candidates' responses generally showed a lower level of analysis and often gave insufficient detail to achieve full marks.

Candidates, particularly at Ordinary level, tended to answer most confidently in those areas where they had direct experience – either in the classroom or in the home. Questions which required the candidate to infer a cause or evaluate an unfamiliar situation proved more challenging. A central aim of technology education is "to contribute to a balanced education, giving students a broad and challenging experience that will enable them to acquire a body of knowledge, understanding, cognitive and manipulative skills and competencies and so prepare them to be creative participants in a technological world". With this in mind, candidates are expected to develop an awareness of the impacts of technology on society as a whole and to be broadly aware of emerging trends and usages.

Candidates also demonstrated their attainment of this objective via the Coursework Task, in both the planning as evidenced in the Design Folio and in the finished Artefact. Candidates did well when detailing available resources, time constraints and a proposed timeframe specific to their design proposal. The use of Gantt charts here was widespread but it could be expected that students would reflect and personalise this chart to a greater extent. Few candidates mentioned budget considerations as a constraint, even though this is specified in the learning objective. The need for iterative research was lost on some candidates as they presented only one level of investigation. Candidates are expected to carry out an analysis of the research data, with an outcome of deriving from the thematic brief a final design proposal.

Many candidates demonstrated a basic knowledge of energy use in tools and equipment. Better responses showed an understanding of concepts like embodied energy of materials and design for disassembly or suitability for recycling. Many candidates referred only to the impact of the primary materials used in their coursework and should have made reference to soldering, batteries, circuit building and the embodied energy of these processes. This section needs to be individualised to the candidates own work and the best responses demonstrated a justification for choosing particular materials, components and processes.

Be able to work both independently and co-operatively to evaluate a completed artefact or system against its original specification and propose alterations and modifications at the design, implementation or completion stages to enhance its appearance or function.

The theoretical aspects of this objective were assessed through questions at both levels, for example: Ordinary level 2A (ii) (*Describe using notes and annotated sketches how the height of the water container B could be adjusted on the column C.*), Higher level 5C (i) (*Select a suitable material for the anti-slip surface on the pedal pads. Justify your answer*) and Higher level 1C (iii) (*Suggest a modification to your flowchart sequence to check for an excessive build-up of heat in the car*). All candidates were able to provide responses, though the quality of thought and insight evident varied widely. The best responses detailed criteria for the selection of the modifications proposed and also outlined the sequential steps needed to implement such changes, while poorer responses to this type of question lacked justification and tended to be overly simplistic in describing how a modification should be made.

Candidates demonstrated their attainment of the applied elements of this objective, via the Coursework Task. Lower order responses generally focused on testing the artefact for functionality while better responses evaluated the artefact through comparison with the stated brief and objectives, schedules of manufacture and also identified modifications made to develop the design throughout the manufacturing process. Achievement in the cognitive domain at the level of synthesizing and analysing is evident in this section and varies considerably in quality, particularly between Ordinary and Higher Levels. Examples of good practice included the inclusion of a detailed reflection, by the candidate, on their own learning and skills acquisition through the design and production of the student coursework.

Recurring issues identified by examiners which caused the candidate to lose marks were: edge finishing of parts, excessive or inappropriate use of adhesives, no polishing of metals, poorly integrated switches, loose wiring and inadequate assembly. These are issues which should be identified and addressed by the candidate as part of the evaluation process.

4. Conclusions

4.1 Coursework Task

- The overall standard of the work presented for the Coursework Task remains high, and the vast majority of candidates at both levels achieve a higher mark in the Coursework Task than in the written component.
- The quality of the folios submitted was very high in many instances and it was evident that many candidates devoted much time and energy to the development of the folio. However, some candidates who presented very good practical work paid less attention to the folio and thus lost a significant number of marks.
- In many instances, candidates and teachers are to be commended for the display and diversity of design skills, creativity, innovation and problem solving presented.
- Many candidates also demonstrated excellent practical skills in producing coursework artefacts which were manufactured to very high standards.
- Some candidates managed their time poorly and thus spent an excessive amount of time on some areas leaving others incomplete.
- Some candidates failed to pay adequate attention to safe and neat wiring in the construction of electronic circuits. This resulted in poor placement or housing of the electronic circuit/components, battery, loose wiring and poor soldering.
- At both levels the folio sections, *'Analysis of thematic brief'* and *'Testing, evaluation and critical reflection'* generally proved the most problematic, and resulted in some marks being lost.
- It was evident from the coursework presented that some school workshops are excellently equipped while others would benefit from upgrading.
- ICT was widely and effectively used.
- Areas such as the production of Gantt charts, work breakdown structures (WBS), critical path diagrams, analysis of environmental impact and the need for critical reflection on the entire process were generally embraced and worked well for most candidates.
- Some excellent design concepts on the higher level theme of animatronics were presented.

- The standard of artefact can be improved by greater utilisation of the CNC and laser cutting equipment that is already in schools. The standard can also be improved by avoiding an overreliance on adhesive assembly and exploring more mechanical assembly techniques. Appropriate use of PIC is to be commended and gives potential for adding functionality to solutions. However, there were some instances where boards were used to activate simple circuits when a switch would have achieved the same outcome
- No areas of concern regarding the authenticity of coursework presented were reported, with all centres having the required signoff sheet completed and coursework presented correctly. Issues of outside assistance, plagiarism and inappropriate collaboration need constant vigilance and a continued awareness of the consequences of such actions. The Commission appreciates the ongoing co-operation of candidates, teachers, and school authorities in this regard.

4.2 Higher level Written Examination

- The vast majority of candidates presented their work in an organised fashion
- Some candidates whose work was of a reasonable standard in most respects nonetheless displayed a lack of appreciation of the precision of language expected in answering.
- Many candidates demonstrated a good knowledge of the syllabus and excellent levels of preparedness for the examination.
- The more successful candidates gave structure to their answering by tabulating their answers, using bullet points to highlight and give emphasis, presenting neat and accurate graphs and using sketches and diagrams to illustrate their answers where appropriate.
- The majority of students attempted the required number of questions.
- 96.4% of candidates attempted the required two or more option questions.
- Candidates did well in questions which had a strong emphasis on the properties and applications of materials and also on questions relating to health and safety.
- The majority of candidates scored very well in Section A.

- Candidates did not score as highly in questions which required calculations, application and use of formulae and, particularly, in questions which were related to calculations on mechanisms.

4.3 Ordinary level Written Examination

- The vast majority of candidates demonstrated a clear understanding of the structure of the examination paper.
- Candidates selected a wide range of option questions. ‘Information and Communications Technology’ was the most popular option question. The average attempt rate for this question was 79.6%.
- ‘Electronics and Control’ was the least popular option question. The average attempt rate for this question was 15.0%.
- Candidates did very well in questions which related to their practical experiences in school, e.g. properties & applications of materials, the design process, workshop processes, safety, etc.
- Mechanisms and electronics are areas which continue to be cause difficulty for many candidates at this level.
- Many candidates also had difficulty in demonstrating the production of annotated sketches as a developed skill in various questions throughout the paper.

5. Recommendations to Teachers and Students

5.1 Coursework Task

Teachers should:

- display in the Technology room the posters and Directions to Candidates relevant to project work, which are issued each year by the SEC
- ensure that all examination candidates have a copy of the issued Coursework Briefs and that they fully understand the General Directions to Candidates, criteria for assessment and the outline Marking Scheme

- provide candidates with frequent opportunities to engage with the design process over the two years of study leading to the examination
- guide candidates in planning their work in advance and in devising a project management log or Gantt chart to help them set targets and thus help optimise the use of time spend on coursework
- advise candidates to develop the folio in tandem with the development of the artefact
- encourage candidates to compile the folio by following the relevant headings in the design brief pertaining to the level at which they are submitting coursework
- encourage candidates to develop their range of investigative and research skills
- practice freehand sketching and line diagrams with their students and advise students to use diagrams / sketches, tables and bullet points to clarify and support their design folio as appropriate
- guide students in the process of finishing of the artefact to the highest standard they can achieve
- ensure that all candidates complete and sign the necessary documentation prior to leaving the school
- securely store all coursework on completion and arrange layout in ascending numerical order for the visiting examiner
- complete and sign the relevant documentation.

Students should:

- read the General Directions to Candidates issued by the Commission with the Coursework Briefs, and follow these in the development and execution of their project work
- ensure that they are familiar with the outline Marking Scheme and the criteria for assessment
- manage their time carefully so that an excessive amount of time is not spent on project work, at the expense of the theory component

- keep a project management log, or Gantt chart, detailing target dates set for coursework and recording the work completed by each target date
- develop their folio in tandem with the artefact, ensure that the folio contains a complete contemporaneous record of the work-in-progress, and keep a photographic record of the manufacture of the coursework and all important processes
- ensure that a design folio is submitted for assessment, as the report accounts for 50% of the overall mark at higher level and 40% at ordinary level, and ensure that the folio follows the format given with the thematic brief and is as complete as possible.
- avoid the inclusion of superfluous material in the folio
- show evidence of analysis or reflective thought if including material downloaded from the internet and credit the source of such material in the folio.
- integrate the use of ICT in the development of the folio to enhance its content and presentation
- practice freehand sketching and line diagrams and use these skills to clarify and support their design folio as appropriate
- ensure that all parts are accessible, especially electronic circuits and mechanisms, as the examiner will need to see them
- pay particular attention to the finishing and the overall presentation of the artefact
- display the completed coursework – artefact and folio – in a neat and attractive manner clearly identified with the relevant examination number.

5.2 Written Examination

Teachers should:

- familiarise students with the requirements and structure of the written examination, prior to the examination
- encourage students to read the examination paper in full at the start of the examination, before they attempt any question
- keep up to date with technological advancements and applications in everyday life

- encourage students to learn general concepts and then relate those concepts to specific everyday applications
- ensure that a good understanding of the breadth of the curriculum is achieved, to allow each candidate to attempt all questions in Section A
- encourage students to use a pen for writing and a pencil for sketching, and to use graph paper where appropriate
- through classwork and homework, encourage students to practice freehand sketching and to render their sketches – the allocation of marks for sketches should also be discussed with students and reinforced using the marking scheme
- highlight the importance of using clear annotations to support sketches
- practice common calculations, urge students to create a study sheet dedicated to calculations containing common examples and the formulae needed, and alert students to the need to take great care when doing unit conversions
- ensure that students know the correct shape and meaning of each flowchart command used in the Applied Control Option question
- advise students to formulate a time management strategy for sitting the examination, noting that the use of past papers would benefit students in this regard
- dedicate time to ensuring that students spend time reading questions and underlining the key words, so that they are encouraged to only proceed to answer the question when they have a clear understanding of what is being asked
- encourage students to familiarise themselves with past examination papers, marking schemes and Chief Examiner's reports, which are all available on the SEC website www.examinations.ie.

Candidates should:

- attempt the required number of questions and the required sub-sections within these questions
- highlight the key words and phrases of the question to help ensure that they answer all parts of multipart questions
- use a pen for writing and a pencil for sketching, and use graph paper where appropriate

- use clear annotations to support sketches
- build up a bank of key technological terms used in previous papers and through class work
- take great care when doing unit conversions.

Marking schemes may be used to inform teachers and learners of solutions to problems and the main points of answers to previous examination questions. However, the notes to teachers and students included at the front of the published marking schemes about their use should be carefully read and taken into consideration.