EXPERT GROUP REPORT

FOR

AWARDS SEEKING ADMISSION TO

THE UCAS TARIFF

THE IRISH LEAVING CERTIFICATE

November 2003

CONTENTS **Page**

INTRODUCTION

The UCAS Tariff is a new points score system for entry to HE from September 2002. It replaces the existing A-level points system. The new system was developed to reflect a wider range of qualifications currently offered by applicants to and accepted by Higher Education Institutions. It also embraces substantial reforms to post-16 qualifications implemented from September 2000, popularly known as Curriculum 2000. These reforms completely restructured GCE A/AS levels, replaced the Advanced GNVQ with a suite of VCE awards, and introduced more emphasis on the attainment of Key Skills. For the first time, the points system accommodates Scottish Framework Qualifications.

The Tariff was developed with three specific purposes in mind as follows:

- To report achievement as a points score to Higher Education
- To allow admissions staff to make flexible offers
- To allow broad comparisons to be made between different types of achievement and different volumes of study

The table on the next page shows the points values within the Tariff of the qualifications currently contained within the system:

UCAS Tariff (Revised April 2003)

CACHE Diploma[1]		BTEC Nationals[2]			GCE/VCE Qualifications				Points	Scottish Qualifications			
Theory	Practical	Award	Certificate	Diploma	GCE AS/ AS VCE	GCE A level/ AVCE	AVCE Double Award	Free standing Maths[3]		Adv Higher	Higher	Int 2	Standard Grade
				DDD					360				
				DDM					320				
				DMM					280				
A			DD	MMM			AA		240				
							AB		220				
B			DM	MMP			BB		200				
							BC		180				
C			MM	MPP			CC		160				
							CD		140				
D	A	D	MP	PPP		A	DD		120	A			
	B					B	DE		100	B			
E	C	M	PP			C	EE		80	C			
									72		A		
	D				A	D			60		B		
					B				50				
									48		C		
									42			A	
	E	P			C	E			40				
									38				Band 1
									35			B	
					D				30				
									28			C	Band 2
					E			A	20				
								B	17				
								C	13				
								D	10				
								E	7				

Key. Adv Higher=Advanced Higher, Int 2=Intermediate 2

[1] Covers the CACHE Diploma in Child Care and Education and comes into effect for entry to higher education in 2004 onwards

[2] Covers the newly specified BTEC National Award, Certificate and Diploma and comes into effect for entry to higher education in 2005 onwards

[3] Covers free-standing Mathematics qualifications – Using and Applying Statistics, Working with Algebraic and Graphical Techniques, Modelling with Calculus

Core Skills[4]	Key Skills[5]	Institute of Financial Services		Points	Music Examinations[8]					
					Practical			Theory		
		CFSP[6]	CeFS[7]		Grade 6	Grade 7	Grade 8	Grade 6	Grade 7	Grade 8
				75			D			
				70			M			
		Pass	A	60		D				
				55		M	P			
			B	45	D					
				40	M	P				
	Level 4			30						D
				25	P					M
Higher	Level 3			20					D	P
				17						
				15				D	M	
				13						
Int 2	Level 2			10				M	P	
				7						
				5				P		

[4] The points shown are for each of the five Scottish Core Skills – Communication, Information Technology, Numeracy, Problem Solving & Working with Others

[5] The points shown are for each of the three Key Skill qualifications - Application of Number, Communication and Information Technology

[6] The points shown for the IFS Certificate in Financial Services Practice (CFSP) comes into effect for entry to higher education in 2004 onwards

[7] The points shown for the IFS Certificate in Financial Studies (CeFS) come into effect for entry to higher education in 2005 onwards.

[8] The points shown are for ABRSM, Guildhall, LCMM and Trinity music examinations, grades 6, 7 and 8 and come into effect for entry to HE in 2004 onwards

The Tariff and the National Qualifications Framework

The Tariff gives numerical values to qualifications, and establishes agreed equivalences between the types of qualifications covered. The system allows broad comparisons to be made between applicants with different volumes of study and types of achievement. The equivalences derive from those established within the English, Welsh, and Northern Irish National Framework of Qualifications. Qualifications admitted to the framework are the subject of a rigorous regulation system operated by three sister regulatory authorities, led by the Qualifications and Curriculum Authority. The framework has been developed to give coherence and clarity to the provision of qualifications. It includes three broad categories of qualifications:

- General, e.g. GCE GCE A-level and the new GCE AS
- Vocationally-related, e.g. VCE A level, VCE AS and VCE Double Award
- Occupational, e.g. National Vocational Qualifications.

Details of the accreditation process are contained in the publication *Arrangements for the statutory regulation of external qualifications in England, Wales and Northern Ireland.*

The Tariff – promoting wider access to Higher Education

The Tariff is highly relevant in the context of the UK government's aim to increase participation rates in Higher Education, in that it covers both standard and non-standard entry routes. One of the features of the expansion of HE over the last decade has been an increase in the types of qualification presented by applicants, some of which may be vocational, some general, some taken mainly by adults, and so on. The advantage of the Tariff is that it facilitates comparison across applicants with very different types and sizes of achievement. It also ensures that UCAS communicates information to HE admissions and academic staff about the nature of such achievements, and that entry requirement information is collected.

The Republic of Ireland also seeks to promote wider access to HE and has its own tariff system for admission to Irish HEIs. However, increasing numbers of Irish students are applying to UK HEIs, particularly in Northern Ireland. While the numbers of students presenting the Irish Leaving Certificate may be small in comparison with GCE A Level, it is nevertheless important, in the interests of widening participation in both countries, that the Irish qualification is understood and accepted for entry to HE in the UK. The admission of the Irish Leaving Certificate to the Tariff is designed to support this aim.

THE CONDUCT OF THE COMPARABILITY STUDY

In order to ensure a robust and transparent procedure for allocating UCAS tariff points to qualifications seeking admission to the framework, UCAS approached the University of Oxford, Department of Educational Studies for assistance in developing an appropriate methodology. Acknowledging the problematic nature of comparability studies, the Department proposed a procedure based on the premise that such comparisons can only be achieved through the exercise of collaborative judgement by an expert group. Guidelines were drawn up for the composition of the expert group, the evidence that would need to be collected and examined and the choice of a benchmark qualification. Procedures were developed for the conduct of the work of the expert group, including detailed sets of questions to be addressed at different stages in the process. Section 4 of this report illuminates these procedures and reflects the sets of questions and the decision making process in its structure.

The judgements made by the Expert Group in this report are presented as suggested allocations of UCAS points which take account of the size and demand of the award seeking admission to the Tariff and a candidate's level of attainment within that award. However, the guidelines provide for an automatic review process to be conducted at a later stage in the light of further evidence. This latter point acknowledges the fact that both benchmark qualifications and those seeking admission to the Tariff may still be relatively new. Consequently there may only be a relatively small amount of evidence available at the time of the work of the Expert Group. There is, therefore, a need to review the decisions of the Group when more evidence becomes available and when HE admissions tutors have gained more experience of using the awards as entry qualifications.

The work of the Expert Group is subject to a quality assurance procedure, which includes scrutiny of the Group's report by an independent auditor from Higher Education.

SUMMARY AND RECOMMENDATIONS

This report provides details of the Comparability Study conducted by an Expert Group to consider the admission of an overarching award, the Irish Leaving Certificate (ILC), into the UCAS Tariff. Section 1 sets out the composition of the Expert Group.

Section 2 contains an overview of the ILC, a qualification awarded on completion of a number of examinations in individual subjects each of which can be taken at one of two levels: Higher Level and Ordinary Level. (A Foundation Level is available in Mathematics and Irish, but is not considered in this report.) Candidates for the two levels follow similar, though not necessarily identical, programmes of study and may leave the decision on which level of examination paper they will attempt until the day of the examination. The essential difference between the Higher and the Ordinary Level lies in the level of demand of the respective examination papers. The 'tiered' structure of these examinations means that a broad range of attainment is represented in the outcomes.

Section 3 contains a description of the aims, content and assessment of each of the ILC subjects selected for the Comparability Study. Thirty four subjects are offered within the ILC, of which candidates aiming for university entrance normally take seven. In order to make the Comparability Study feasible, three of these subjects were selected for the current study: Mathematics, Chemistry and English. Mathematics and English were selected because they are taken by the majority of students. Chemistry was selected because preliminary analysis identified that the content of the syllabus was well defined, and that the application of the guidelines in the Protocol would, therefore, be relatively straightforward. The description of each of these subjects is followed by an overview of each of the awards against which the subject is benchmarked, namely Edexcel GCE A Level Mathematics, OCR GCE A Level Chemistry, AQA GCE A Level English and Literature Syllabus A.

Section 4 reports on the proceedings and findings of the Expert Group which, for the majority of the meeting, worked as three Subject Groups. Within the guidelines of the Protocol, each group developed its own methodology for comparing the respective awards in order to take account of differences between the subjects in terms of the sorts of knowledge, skills and understanding they seek to develop in learners.

Section 5 brings together the work of the three subject groups, provides a summary of, and a commentary on, the outcome of their deliberations regarding the relative size and demand of the awards, and sets out a number of modelling approaches for the allocation of UCAS Tariff Points.

Relative size and demand of the awards

While the three subject groups reached broadly similar judgements about the level of demand of the ILC subjects compared with the A Level awards, they could not reach complete agreement about the relative size of the individual subjects. Although the Mathematics and Chemistry Groups reached different conclusions about the relative size of the respective awards, they did agree that the volume of study undertaken by an ILC candidate was less than the volume of study undertaken by an A Level candidate. The English Group, on the other hand, because of the nature of the subject, was not able to distinguish between A Level and ILC candidates in terms of the volume of study undertaken using the procedures set out in the protocol. Rather they agreed that the outcomes for learners in both systems were identical.

It is acknowledged that this Comparability Study revealed a potential difficulty with the application of the Protocol. Current procedures require that the size of the qualification seeking entry to the Tariff be assessed relative to the benchmarking award by comparing the study hours needed to complete the qualification, and by careful matching of the content laid out in the specifications or syllabuses of the two awards. It became clear that this process does not work well for subjects such as English where there is a large 'skills' component. This reflects the natural difference in the nature of subjects and the different types of knowledge, skills and understanding that they seek to develop. Work is under way to find a solution to this issue in the application of the Protocol.

A subsequent meeting was held to resolve the question of the relative sizes of the awards. This meeting, in October 2003, was attended by members of UCAS and representatives from the Irish Department of Education and Science, the National Council for Curriculum and Assessment and the State Examination Commission. For largely pragmatic but justifiable reasons, explained in detail in Section 5, it was agreed that an ILC subject should be taken as being equivalent to four units of an A Level.

The allocation of UCAS Tariff Points

A number of different modelling approaches, as detailed in Section 5, to allocate UCAS Tariff Points to the ILC, based on the comparisons of levels of attainment between the ILC subjects and the A Level awards agreed by the subject groups, had been circulated to all Expert Group members prior to the meeting in October. The proposed allocation of UCAS Tariff Points for the ILC Higher Level, based on modelling the equivalence between the ILC Higher Level and the A Level, was agreed. However, in order to include the spread of attainment represented by the 'tiered' structure of the Higher Level and Ordinary Level examinations, it was agreed to employ the Irish Central Applications Office (CAO) scale for the final allocation of UCAS Tariff Points to both the Higher and Ordinary Levels. A full explanation of the relationship between the CAO scale and UCAS Tariff Points is provided on Pages 57 to 59 of Section 5.

The recommended allocation of UCAS Tariff points to the ILC Higher and Ordinary Level grades is set out on the next page.

Recommended allocation of UCAS Tariff Points to Higher and Ordinary Level Grades in the ILC using the CAO Model.

ILC Higher Grade	CAO Points	UCAS Tariff Points	ILC Ordinary Grade	CAO Points	UCAS Tariff Points
A1	100	90			
A2	90	77			
B1	85	71			
B2	80	64			
B3	75	58			
C1	70	52			
C2	65	45			
C3	60	39	A1	60	39
D1	55	33			
D2	50	26	A2	50	26
D3	45	20	B1	45	20
			B2	40	14
			B3	35	7

SECTION 1: THE COMPOSITION OF THE EXPERT GROUP

The following individuals with expert knowledge and experience of the qualifications under consideration in this study were selected:

GCE A Level Examiners
Mr Gordon Skipworth, Chief Examiner for Mathematics, Edexcel
Dr Helen Eccles, Chair of Examiners for Chemistry, OCR
Mr Andy Archibald, Principal Examiner for English Language & Literature A, AQA

Irish Leaving Certificate Examiners
Mr Hugh McManus, ILC Maths (Higher, Ordinary & Foundation Levels)
Mr Terence White, ILC Chemistry (Ordinary Level), Department of Education and Science
Mr Declan Cahalane, ILC Chemistry (Higher Level), Department of Education and Science
Mr Raymond Frawley, ILC English (Higher Level)
Mr Alec MacAlister, ILC English (Ordinary Level)

Higher Education Representatives
Dr Andy Walker, Admissions Tutor for Mathematical Sciences, University of Nottingham
Dr Gordon McDougall, Senior Lecturer Chemistry, Edinburgh University
Dr Anne McCartney, Course Director English, University of Ulster

The CVs of the eleven Expert Group members are provided in Appendix 1.

The following personnel responsible for the development and examination of the Irish Leaving Certificate also participated in some of the work and/or attended parts of the meeting:

Mr Pat Coffey, Assistant Head of Examinations and Assessment, State Examinations Commission
Mr John Hammond, Deputy Chief Executive, National Council for Curriculum and Assessment (NCCA)
Mrs Doreen McMorris, Assistant Chief Inspector, Department of Education and Science
Mr Hal O'Neill, Education Officer, NCCA
Mrs Margaret Kelly, Principal Officer, Department of Education and Science

Anne Matthews, Jennifer Tuson and Jill Johnson acted as facilitators for the work, ensuring that the Group worked systematically through the procedures laid down in the Protocol.

Helen Wakefield, Fiona Ford and Louise Holder, from the UCAS Outreach Department, acted as Secretaries to the Group.

The whole process was overseen and quality assured by Dr Geoff Hayward, as an independent representative of Higher Education.

SECTION 2: OVERVIEW OF THE AWARD SEEKING ADMISSION TO THE TARIFF

This section contains an overview of the overarching award seeking admission to the Tariff – the Irish Leaving Certificate (ILC). Thirty four subjects are offered within the ILC, of which candidates aiming for university entrance normally take seven. In order to make the Comparability Study feasible, three of these subjects were selected for the current study: Mathematics, Chemistry and English. Section 3 contains a description of the aims, content and assessment of each of these ILC subjects, followed by an overview of each of the awards against which the subject is benchmarked.

GENERAL DESCRIPTION OF THE IRISH LEAVING CERTIFICATE

Aims and purpose of the qualification

The ILC is awarded upon completion of the chosen ILC examinations. These are national public examinations which are taken at the end of the two-year Leaving Certificate course.

The purpose of an ILC course is to prepare students for immediate entry into open society or for proceeding to further education and training. It aims to provide students with a range of subjects suited to their abilities, aptitudes and interests so that each student can develop his or her potential to the full.

History of the qualification

The ILC has been in existence since 1924. The qualification has traditionally commanded a high level of public confidence and no major re-structuring has taken place. Individual subjects undergo revision and new subjects are brought on board as needs arise. Syllabus development and revision are the responsibility of specialist course committees of the National Council for Curriculum and Assessment.

Entry requirements for the qualification

Students are eligible for admission to a Leaving Certificate Examination course if they have followed an approved Junior Certificate Examination course of not less than three years' duration or a course of education of similar standard and duration.

Age of candidates

Candidates are normally 16 – 18 years old.

Hours

The majority of subjects are designed to be delivered within a 180 hour framework. However, some subjects, e.g. Maths and English, may exceed this number of hours.

Content and structure of the qualification

Students following an approved ILC course must study at least five subjects from a list of 34 specified subjects. This ensures that a broad range of knowledge, skills and competencies are acquired. Candidates aiming for university entrance normally take seven subjects.

The 34 subjects are grouped as follows:

Language Group – 13
Science Group – 6
Business Studies Group – 4
Applied Science Group – 8
Social Studies Group – 5

It is recommended that candidates take three subjects from one group and at least two from other groups. The inclusion of Irish is mandatory.

The specific content of the three subjects is provided in Section 3.

All subjects may be studied at two levels – Higher and Ordinary Level. Mathematics and Irish are available at three levels – Higher, Ordinary and Foundation. Candidates for Higher and Ordinary Level may be taught in the same class.

Assessment – procedures, methods and levels

Candidates sit a terminal examination, consisting of one or two papers for each subject at their chosen level. Additional components, practical, oral and/or aural, are taken in a number of subjects. Candidates may leave the decision on which level of examination paper they will attempt until the day of the examination.

The examination was administered by the Examinations Branch of the Department of Education and Science up to and including 2002. In March 2003, the State Examinations Commission was established as a separate statutory body with full responsibility for examinations.

Information on the examination of the three selected subjects is provided Section 3.

Grading

Marks for all ILC examination papers are converted directly to percentages and then graded as follows:

GRADE	PERCENT
A1	90 or over
A2	85 but less than 90
B1	80 but less than 85
B2	75 but less than 80
B3	70 but less than 75
C1	65 but less than 70
C2	60 but less than 65
C3	55 but less than 60
D1	50 but less than 55
D2	45 but less than 50
D3	40 but less than 45
E	25 but less than 40
F	10 but less than 25
N.G	Less than 10

QA systems and code of practice

The entire marking process in each subject is overseen by a Chief Examiner who is usually an Examinations and Assessment Manager in the State Examinations Commission. Assistant examiners carry out the marking and are monitored by advising examiners. The ratio of assistant examiners to advising examiner is 8 to 1.

The marking scheme used in the marking of each subject is finalised by advising examiners at pre-conferences. These are two-day conferences held shortly after the examinations are taken but before the marking process begins. At these pre-conferences the marking scheme is tested against selected samples of candidates' work and modified if necessary. Marking schemes for each subject are subsequently published.

Two-day training conferences for assistant examiners are held prior to the commencement of the marking process. At these conferences assistant examiners are trained in the application of the marking schemes.

The marking of candidates' examination work is monitored by the Chief Examiner and advising examiners who ensure that all examiners mark in accordance with the marking scheme. At set stages throughout the marking process assistant examiners submit scripts that they have marked to their advising examiners for monitoring. They also supply statistics on the grades being awarded. Advising examiners monitor a minimum of 5% of the work of each assistant examiner.

Random sampling is conducted at the beginning of the marking process. In this exercise each assistant examiner selects a number of scripts (usually 20) at random from the bag of scripts assigned and marks them in accordance with the agreed marking scheme. The advising examiner monitors four of these scripts from each assistant examiner. The Chief Examiner aggregates the grade returns from assistant examiners as a predictive exercise on the final examination outcome. The marking scheme may be adjusted as a result of this exercise.

The Appeal Process

Candidates have the right of appeal against the grades awarded. The also have the right to view their scripts prior to appeal and also post appeal.

Examiners involved in the marking of appeals attend appeal conferences for purposes of training. The work of appeal examiners is monitored by appeal advisers. All recommended changes of grade are referred to the appeal advisers. Candidates have recourse to independent appeals commissioners and also to the Ombudsman if they are dissatisfied with the outcome of appeal.

2.5% of the grades awarded in the 2002 Leaving Certificate were appealed by candidates. 0.5% of the grades awarded were changed as a result of the appeal process.

SECTION 3: OVERVIEW OF ILC SUBJECTS AND THE BENCHMARK AWARDS

This section contains a description of the aims, content and assessment of the three ILC subjects selected for the Comparability Study: Mathematics, Chemistry and English. Mathematics and English were selected because they are taken by the majority of students. Chemistry was selected because preliminary analysis identified that the content of the syllabus was well defined, and that the application of the guidelines in the Protocol would, therefore, be relatively straightforward.

Each of the benchmark awards described in this section was chosen because they represented the closest match in aims and content to qualifications which had already been admitted to the UCAS Tariff.

3.1 ILC MATHEMATICS

Aims and Objectives

Although not a compulsory subject, mathematics is treated as a core subject in almost all schools. In order to address the needs of the full range of students, the subject is offered at three levels: Higher, Ordinary and Foundation Level. Separate syllabuses are provided for each level. Foundation Level is not considered in this report.

The Higher Level syllabus has two broad aims:

- To contribute to the personal development of students
- To provide students with the mathematical knowledge, skills and understanding needed for life and work.

These broad aims are translated into general objectives as follows:

A. Students should be able to recall basic facts; that is, they should be able to:
   - Display knowledge of conventions such as terminology and notation
   - Recognise basic geometrical figures and graphical displays
   - State important derived facts resulting from their studies.

B. They should be able to demonstrate instrumental understanding; hence they should know how (and when) to:
   - Carry out routine computational procedures and other such algorithms
   - Perform measurements and constructions to an appropriate degree of accuracy
   - Present information appropriately in tabular, graphical and pictorial form, and read information presented in these forms
   - Use mathematical equipment such as calculators, rulers, set squares, protractors, and compasses, as required for the above.

C. They should have acquired relational understanding, i.e. understanding of concepts and conceptual structures, so that they can:
   - Interpret mathematical statements
   - Interpret information presented in tabular, graphical and pictorial form
   - Recognise patterns, relationships and structures
   - Follow mathematical reasoning.

D. They should be able to apply their knowledge of facts and skills; that is, they should be able when working in familiar types of context to:
   - Translate information presented verbally into mathematical form
   - Select and use appropriate mathematical formulae or techniques in order to process the information
   - Draw relevant conclusions.

E. They should have developed the psychomotor and communicative skills necessary for the above.

F. They should appreciate mathematics as a result of being able to:
   - Use mathematical methods successfully
   - Acknowledge the beauty of form, structure and pattern
   - Recognise mathematics in their environment
   - Apply mathematics successfully to common experience.

G. They should be able to analyse information, including information presented in unfamiliar contexts:
   - Formulate proofs
   - Form suitable mathematical models
   - Hence select appropriate strategies leading to the solution of problems.

H. They should be able to create mathematics for themselves:
   - Explore patterns
   - Formulate conjectures
   - Support, communicate and explain findings.

I. They should be aware of the history of mathematics and hence of its past, present and future role as part of our culture.

The objectives of the Ordinary Level syllabus are the same as A – E above.

Development of the Mathematics Syllabus

The current Higher and Ordinary syllabus was introduced in 1992. The content is broadly similar to the previous syllabus, although there has been some reduction in the breadth and depth of coverage in order to ensure that the syllabus could be fully covered by all students in the time available.

The structure of the examinations was also revised since it was felt that 'middle of the road' candidates were not adequately rewarded. The present graded internal structure of the questions (see Assessment below) was introduced to ensure that students of a wider range of mathematical achievement would have the opportunity to demonstrate their competence.

Content and structure

For both Higher and Ordinary Levels the syllabus consists of a core plus a list of four options. Students are expected to study the entire core and one of the options.

Higher Level	Ordinary Level
Core material – 6 broad categories Algebra Geometry Trigonometry Sequences and series Functions and calculus Discrete mathematics and statistics.	*Core material – 7 broad categories* Arithmetic Algebra Geometry Trigonometry Finite sequences and series Functions and calculus Discrete mathematics and statistics
Options: Further calculus and series Further probability and statistics Groups Further geometry	*Options*: Further geometry Plane vectors Further sequences and series Linear programming

Assessment

Assessment is based on a terminal examination consisting of two written papers, each of 2½ hours. Paper 1 consists of eight questions on the core material, of which the candidate must answer six. Paper 2 consists of two sections: A and B. Section A has seven questions on the core material of which the candidate must answer five. Section B has one question on each of the four options, of which the candidate must answer one.

Typically, examination questions are made up of three parts:

a) testing recall and basic understanding
b) testing application of routine procedures in relatively familiar contexts
c) testing less familiar applications or problem solving

Each question on each paper carries 50 marks, yielding a maximum of 300 marks on each paper.

3.2 EDEXCEL GCE A LEVEL MATHEMATICS

Aims and purposes of the qualification

The specification has been designed to produce Advanced Subsidiary and Advanced GCE examinations which enable schools and colleges to provide courses which will encourage candidates to:

A. Develop their understanding of mathematics and mathematical processes in a way that promotes confidence and fosters enjoyment
B. Develop abilities to reason logically and recognise incorrect reasoning, to generalise and to construct mathematical proofs
C. Extend their range of mathematical skills and techniques and use them in more difficult, unstructured problems
D. Develop an understanding of coherence and progression in mathematics and of how different areas of mathematics can be connected

E. Recognise how a situation may be represented mathematically and understand the relationship between ‘real-world’ problems and standard and other mathematical models and how these can be refined and improved
F. Use mathematics as an effective means of communication
G. Read and comprehend mathematical arguments and articles concerning applications of mathematics
H. Acquire the skills needed to use technology such as calculators and computers effectively, recognise when such use may be inappropriate and be aware of limitations
I. Develop an awareness of the relevance of mathematics to other fields of study, to the world of work and to society in general
J. Take increasing responsibility for their own learning and the evaluation of their own mathematical development.

History of the qualification

This specification came into operation from September 2000 with the first units being examined in January 2001. The first AS award was in June 2001 and the first A Level award was in June 2002.

Entry requirements

Normally, at least Grade C in GCSE Mathematics or equivalent, having covered all the material in the Intermediate Tier.

Age

Normally 16 – 18.

Hours

Approximately 50 hours per unit.

Content and structure of the qualification

In order to provide candidates with a choice of options within mathematics, the content of the specification is presented in 20 Units.

Units P1 – P6	Pure Mathematics
Units M1 – M6	Mechanics
Units S1 – S6	Statistics
Units D1 – D2	Decision Mathematics

P1, M1, S1 and D1 are designated AS units, with P2 being a hybrid unit of approximately half AS material and half A2 material. All other units are designated as A2 units.

All Mathematics Advanced GCE specifications comprise six units, and contain an AS subset of three units. The AS subset of three units may comprise a combination of AS and A2 units. All Advanced GCE Further Mathematics, Pure Mathematics and Statistics specifications comprise at least five A2 units. Advanced Subsidiary awards are available for Mathematics, Pure Mathematics, Further Mathematics, Statistics, Mechanics and Applied Mathematics. Advanced GCE awards are available for Mathematics, Pure Mathematics, Further Mathematics and Statistics.

Assessment – procedures, methods and levels

All units, except S3 and S6, are assessed by written examination only. Both S3 and S6 are assessed by written examination, plus a project of the candidate's own choosing, which contributes 25% of the maximum mark for that unit.

Grading

Grades are awarded in line with the QCA Code of Practice.

The raw mark for each Unit is converted to a Uniform Mark Scale (UMS) and then converted to a grade for each unit. For both the AS and the full A Level qualifications the total marks for all units are converted to the UMS and then to a five-grade scale: A, B, C, D and E. Candidates who fail to reach the minimum standard for Grade E will be recorded as U (unclassified) and will not receive a qualification certificate.

Individual Unit results are reported.

QA systems and code of practice

The qualification works within the terms of the QCA's *'GCSE, GCE, VCE and GNVQ Code of Practice'*.

3.3 ILC CHEMISTRY

Aims

ILC science syllabuses are designed to incorporate the following components:

- Science for the enquiring mind, or pure science, to include the principles, procedures and concepts of the subject as well as its cultural and historical aspects
- Science for action, or the applications of science and its interface with technology
- Science, which is concerned with issues – political, social and economic – of concern to citizens.

The three components are integrated within each science syllabus, with the first component having a 70% weighting. The remaining 30% is allocated to the other two components in the ratio 3 to 1.

The aims of the chemistry syllabus are to:

- Stimulate and sustain students' interest in, and enjoyment of, chemistry
- Provide a relevant course for those students who will complete their study of chemistry at this level
- Provide a foundation course in chemistry for those students who will continue their studies in chemistry or in related subjects

- Encourage an appreciation of the scientific, social, economic, environmental and technological aspects of chemistry and an understanding of the historical development of chemistry
- Illustrate generally how humanity has benefited from the study and practice of chemistry
- Develop an appreciation of scientific method and rational thought
- Develop skills in laboratory procedures and techniques, carried out with due regard for safety, together with the ability to assess the uses and limitations of these procedures
- Develop skills of observation, analysis, evaluation, communication and problem-solving.

Development of the Chemistry Syllabus

The current syllabus was revised during the 1990s and introduced in September 2000. The revision took into account:

- The changes to Junior Certificate Science
- The need to emphasise the vocational value of chemistry
- The fall in uptake of the subject over a number of years (particularly at Ordinary Level)
- The perceived need to shorten the syllabus.

In the drawing up of the revised syllabus, the fact that both Ordinary and Higher Level students are normally taught in the same class was borne in mind.

Content and structure

The syllabus consists of a core plus options. At both Higher and Ordinary Level, the content of the core and options includes:

Core	Options
1. Periodic table and atomic structure 2. Chemical bonding 3. Stochiometry, formulas and equations 4. Volumetric analysis 5. Fuels and heats of reaction 6. Rates of reaction 7. Organic chemistry 8. Chemical equilibrium 9. Environmental chemistry: water	Option 1A: Additional industrial chemistry Option 1B: Atmospheric chemistry Option 2A: Materials Option 2B: Extraction of metals and additional electrochemistry.

Higher Level candidates must study all of the core, plus either Option 1A and 1B or Option 2A and 2B. Ordinary Level candidates must study all of the core, plus two of the four options. Only two of these options are examinable in any given year, and candidates must study one of these. Depending on the year, Ordinary Level candidates must study one of Options 1A and 2A **or** one of Options 1B and 2B.

The syllabus consists of approximately 70% pure chemistry; the remaining 30% deals with the social and applied aspects of chemistry. All material within the syllabus is examinable.

The content of the core and options is presented in four columns, setting out:

1. *The content*: All of the Ordinary Level material, except for one mandatory experiment, is included at the Higher Level which has some additional content.

2. *The depth of treatment*: The Ordinary level syllabus provides an overview of chemistry and its applications to everyday life. At Higher level, a deeper and more quantitative treatment of chemistry is required.

3. *Suitable activities*: The third column includes mandatory experiments (21 for Ordinary Level and 28 for Higher Level).

4. References to relevant social and applied aspects, where appropriate.

Assessment

Assessment is based on a terminal examination consisting of one written paper. While practical work is recognised as an integral part of the study of chemistry, it is currently assessed through the written examination. An element of practical assessment or course work may be included as part of the overall assessment in the future.

Examination papers in chemistry demand a high level of specificity in relation to the knowledge, understanding and skills required. Marks are allocated rigidly on the examination paper and delivery of a paper that is pitched at an appropriate standard is essential. There is little flexibility at the marking stage.

3.4 OCR GCE A LEVEL CHEMISTRY

Aims and purposes of the qualification

The aims of the GCE AS and A Level specifications in chemistry are to:

- develop essential knowledge and understanding of the concepts of chemistry, and skills needed for the use of these new and changing situations
- develop an understanding of the link between theory and experiment
- be aware of how advances in information technology and instrumentation are used in chemistry
- appreciate the contributions of chemistry to society and the responsible use of scientific knowledge and evidence
- sustain and develop enjoyment of, and interest in, chemistry.

In GCE only

- to bring together knowledge of ways in which different areas of chemistry relate to each other.

History of the qualification

The current chemistry syllabus was developed from the modular chemistry syllabus which was introduced in 1991, and was revised in 1993/4.

Entry requirements

Grade CC in GCSE Science: Double Qualification (or equivalent).

Age of candidates

Normally 16 – 18.

Hours

There is no official guidance on the number of hours of guided learning. It varies widely in Centres from about 3.5 to 6 hours per school week.

Content and structure of the qualification

The OCR specification is based on a modular structure with three modules at AS Level and three at A2. At AS level students must study the first two modules and Component 01 of the third module. At A2 Level students must study the first module, Component 01 and one of Components 02 – 06 of the second module, and Component 01 of the third module.

AS Modules		**A2 Modules**	
2811	*Foundation Chemistry* Atoms, Molecules and Stoichiometry Atomic Structure Chemical Bonding and Structure The Periodic Table	2814	*Chains, Rings and Spectroscopy* Further organic chemistry and spectroscopy
2812	*Chains and Rings* Organic chemistry	2815	Component 01: *Trends and Patterns* Component 02: *Biochemistry* Component 03: *Environmental chemistry* Component 04 : *Methods of analysis and detection* Component 05: *Gases, liquids and solids* Component 06: *Transition elements*
2813	Component 01: *How Far, How Fast?* Enthalpy, rates and equilibria Component 02: *Coursework* Component 03: *Practical Examination*	2816	Component 01: *Unifying concepts* Further enthalpy, rates and equilibria Component 02: *Coursework* Component 03: *Practical Examination*

Assessment – procedures, methods and levels

Each of the above modules leads to an Assessment Unit with the same number and title.

AS Assessment Units 2811 and 2812 and Component 01 of 2813 are each assessed by a written examination. In addition, for 2813, students must choose to enter either Component 02 (coursework) or 03 (the practical examination).

At A2, Assessment Unit 2814, Component 01 and the Centre/candidate's choice of 02 to 06 of Assessment Unit 2815, and Component 01 of Assessment Unit 2816 are each assessed by a written examination. In addition, for 2816, students must choose to enter either Component 02 (coursework) or 03 (the practical examination).

Coursework

The skills assessed are:

- Planning
- Implementing
- Analysing evidence and drawing conclusions
- Evaluating evidence and procedures

These skills can be assessed in the context of separate practical exercises, or a single whole investigation. Candidates' work is internally marked and externally moderated. There are four descriptors for each skill, to a maximum of 8 marks, applied hierarchically.

Practical examination

This tests the same skills as the coursework. The planning exercise is done before the practical examination. The candidate develops this plan in 500 – 1000 words.

Grading

Grades are awarded in line with OCR procedures and the QCA Code of Practice

The raw mark for each Assessment Unit is converted to a Uniform Mark Scale (UMS) and then converted to a grade for each unit. For both the AS and the full A Level qualifications the total marks for all units are converted to the UMS and then to a five-grade scale: A, B, C, D and E. Candidates who fail to reach the minimum standard for Grade E will be recorded as U (unclassified) and will not receive a qualification certificate.

Individual Assessment Unit results are reported.

QA systems and code of practice

The qualification works within the terms of the QCA's *'GCSE, GCE, VCE and GNVQ Code of Practice'*.

3.5 ILC ENGLISH

Aims

The syllabus is designed for both Higher Level and Ordinary Level students and aims to:

- Initiate students into enriching experiences with language so that they become more adept and thoughtful users of it and more critically aware of its power and significance in their lives

- Enable students to interpret, compose, discriminate and evaluate a range of material so that they become independent learners who can operate in the world beyond the school in a range of contexts.

The specific aims of the syllabus are to develop in students:

- A mature and critical literacy to prepare them for the responsibilities and challenges of adult life in all contexts;
- A respect and appreciation for language used accurately and appropriately and a competence in a wide range of language skills both oral and written;
- An awareness of the value of literature in its diverse forms for enriching their perceptions, for enhancing their sense of cultural identity, and for creating experiences of aesthetic pleasure.

In addressing these aims this syllabus will foster students' development in the following areas:

- *Concepts and processes*: the ability to think, reason, discriminate and evaluate in a wide variety of linguistic contexts, personal, social, vocational and cultural. In comprehending, the students should be able to analyse, infer, synthesise and evaluate: in composing, students should be able to research, plan, draft, re-draft and edit.

- *Knowledge and content*: knowledge about the nature and the uses of language and the variety of functions and genres in which it operates. In this context genres of literature will be of particular significance.

- *Skills*: interpreting and controlling the textual features (grammar, syntax, spellings, paragraphing) of written and oral language to express and communicate.

- *Attitudes and effects*: the development of interest and enjoyment in using language, a respect for its potential to make meaning and an appreciation of diverse cultural manifestations.

Development of the English Syllabus

The English syllabus was implemented in 1999 to meet the following requirements:

- To give priority to the study and acquisition of the language skills, both oral and written, which are needed for adult life
- To provide opportunities for the development of the higher-order thinking skills of analysis, inference, synthesis and evaluation
- To give particular attention to students' knowledge and level of control of the more formal aspects of language, e.g. register, paragraphs, syntax, punctuation and spelling.

Content and structure

The syllabus is organised around two general domains, comprehending and composing, and is designed to be taught in an integrated manner. It is intended that students should engage with the domains of comprehending and composing in oral, written and, where possible, visual contexts. The subject 'English' as envisaged by this syllabus is not limited to the written word. In the modern world, most students encounter significant language experiences in oral and visual contexts. The experience of language in the media in all forms, visual, aural and print, needs to be recognised as a prime, shaping agency of students' outlook. This wide range of encounters with language will be reflected in the assessment and examination of students.

The integration of language and literature is central to the syllabus. Students are required to study:

- Language in a wide variety of contexts, genres, functions, and styles
- A range of poetry, one literary text for study on its own, and a group of narrative texts to be studied in a comparative manner.

A range of poets, writers and texts is prescribed. The differing requirements for Higher Level and Ordinary Level students are set out below.

Higher Level	**Ordinary Level**
Poetry Students are required to study a representative selection from the work of eight poets: a representative selection would seek to reflect the range of a poet's themes and interests and exhibit his/her characteristic style and viewpoint. Normally the study of at least six poems by each poet would be expected.	*Poetry* Students are required to study a selection of poetry, consisting, normally, of about 40 poems.
Single text One text suitable for Higher Level to be studied on its own.	*Single text* One text suitable for Ordinary Level to be studied on its own.
A comparative study of three texts – emphasis on attitudes, values, structures and styles Modes of comparison: • A theme or issue • A historical or literary period • A literary genre • The cultural context • The general vision and viewpoint. Three comparative modes are prescribed, two of which are examined.	*A comparative study* of three texts – emphasis on attitudes, values, structures and styles Modes of comparison: • Hero/Heroine/Villain • Relationships • Social Setting • Change and Development • Specific Themes e.g. love, race, prejudice, violence etc. • Aspects of story: tension, climax, resolution, ending etc. Three comparative modes are prescribed, two of which are examined.
Shakespeare The study of a Shakespearean drama is compulsory. This may be chosen *either* for study as a single text *or* as an element in the comparative study of a group of texts.	*Shakespeare* The study of a Shakespearean drama is optional.

Assessment

Assessment is by terminal written examination. At both Higher and Ordinary Level there are two papers:

Paper I (Comprehending and Composing), 2 hours 50 minutes
Paper II (Literary Studies), 3 hours 20 minutes

There is an equal allocation of 200 marks to each paper. The marking scheme is constructed on the evidence of exemplar materials. This evidence undergoes detailed scrutiny for the purposes of norm referencing in an assessment college comprised of an Examinations and Assessment Manager, an External Chief Examiner and Advising Examiners. Candidate performance is judged using four interdependent criteria to reflect the centrality of the activities of comprehension and composition in the syllabus. They are

1. The ability to show Clarity of Purpose in answering questions
2. The ability to show Coherence in the Delivery of their answers
3. The ability to show Mastery of Language to communicate clearly
4. The ability to show a Mastery of Mechanics.

Each of the above criteria is weighted as follows: 30%, 30%, 30% and 10% and is applied to all writing across both papers.

3.6 AQA GCE A LEVEL ENLGISH LANGUAGE AND LITERATURE A

Aims and purpose of the qualification

The specification is intended to provide candidates with a progression from the knowledge, understanding and skills established at GCSE. It caters for those who wish to develop their study of English to GCE AS or A Level, providing a foundation for those who wish to study either Language or Literature or related subjects in Higher Education.

The overall aim of the specification is to:

- Encourage candidates to study language and literature as interconnecting disciplines in ways which deepen their understanding and enjoyment of these studies.

At AS, the specification aims to:

1. Encourage candidates to develop their ability to use linguistic and literary critical concepts and analytical frameworks in commenting on a wide range of spoken language and written texts;
2. Encourage candidates to develop as independent, confident and reflective readers;
3. Enable candidates to relate literary and non-literary texts to the contexts in which they were produced;
4. Enable candidates to develop their skills in speaking and writing for different purposes and audiences.

At A Level, the specification aims to:

1. Broaden and deepen candidates' knowledge and understanding, encouraging them to evaluate different analytical approaches to the interpretations of texts;
2. Enable candidates to make comparisons and connections between a range of texts, taking account of the social, cultural and historical factors which influenced them;
3. Enable candidates to be able to select approaches most appropriate for their investigation and research.

History of the qualification

The new specification was introduced in September 2002. It was developed out of the highly successful AEB 0623 specification. There has been a conscious retention of many of the elements which characterised the old specification; the emphasis on the interconnection of language and literature as mutually supportive disciplines; a broad range of classic and contemporary texts; the importance of analytical and comprehension skills; the emphasis on writing for a variety of purposes. There is also the introduction of new components that sit comfortably within the spirit of the old specification, including the opportunity for comparative study, and an emphasis on playing to candidates' linguistic strengths. To this end, the more formalised linguistic element helps to inform the literary components of this specification.

Entry requirements

It is recommended that candidates should have acquired the skills and knowledge associated with a GCSE English course or equivalent before commencing study for this specification.

Age of candidates

Normally 16 – 18 years old.

Hours

There is no official guidance on the number of guided learning hours. Typical class contact time is approximately 4 – 5 hours a week over 30 weeks of the year.

Content and structure of the qualification

The AQA specification is based on a modular structure with three modules at AS Level and three at A2.

AS Modules		**A2 Modules**	
1	*Language Production* Writing for specific audience/evaluation of process	4	*Comparative Literary Studies* Paired texts studied comparatively
2	*Poetic Study* 1 text from 6: 3 pre-1900, 3 post 1900	5	*Text and Audience* Dramatic study, adaptation of texts for audience
3	*Study of Language of Prose and Speech* 1 prose text, 1 speech text	6	*Language in Context* Analytical comparison, evaluation of methods

The A2 modules build on the skills and processes developed at AS Level as candidates' study of Language and Literature widens and deepens.

Assessment – procedures, methods and levels

Each of the above modules leads to an Assessment Unit with the same title. There are six examinations taken over the course of the two year programme: three at AS Level, normally taken in May of the first year and three at A2 Level taken in June of the second year. Modules may also be taken in January of each year and each module may be re-taken once each. Assessment Unit 6 is the synoptic unit for the whole GCE A Level.

Each examination paper contains one or two sections, each section requiring one question to be answered, except for Unit 5 where Section B comprises two questions.

There are six Assessment Objectives (AOs) which are given different weightings in each paper. AOs 1, 4, 5 and 6 are common to both AS and A Level. AOs 2 and 3 also apply to both, but are extended at A Level to reflect the more sophisticated level of response required. For example, candidates at AS Level are required to describe, explain, interpret and evaluate texts; at A Level they are required to demonstrate a more penetrating and evaluative analysis of the texts they study.

All examination questions are marked against the relevant AOs. Each AO is amplified by a series of generic descriptors of performance at each of five mark bands.

The examination requirements and their associated assessment tasks are fully analysed in Section 4.

Grading

Grades are awarded in line with AQA procedures and the QCA Code of Practice

The raw mark for each Assessment Unit is converted to a Uniform Mark Scale (UMS) and then converted to a grade for each unit. For both the AS and the full A Level qualifications the total marks for all units are converted to the UMS and then to a five-grade scale: A, B, C, D and E. Candidates who fail to reach the minimum standard for Grade E will be recorded as U (unclassified) and will not receive a qualification certificate.

Individual Assessment Unit results will be certificated.

QA systems and code of practice

The qualification works within the terms of the QCA's *'GCSE, GCE, VCE and GNVQ Code of Practice'*.

SECTION 4: THE WORK OF THE EXPERT GROUP

The Expert Group met on one occasion for two and a half days to examine and discuss the evidence listed in Appendix 2. This section contains an account of the deliberations of this meeting.

The first afternoon was mainly concerned with the dissemination of information about the comparability study and the qualifications involved. The session included:

- Jill Johnson briefing the Expert Group about the current UCAS Tariff
- Geoff Hayward briefing the Group on the Protocol agreed with UCAS for conducting a comparability study
- Jill Johnson presenting an overview of GCE A Level
- The Chief Examiners from each of the three English Awarding Bodies presenting information about the benchmark awards, GCE A Level English, Chemistry and Mathematics respectively
- Senior representatives of the Irish Department of Education and the State Examinations Commission presenting an overview of the Irish Leaving Certificate
- The senior ILC examiners presenting information about the three Certificates selected for the comparability study, English, Chemistry and Mathematics respectively
- The HE representatives presenting information about the appropriateness of the ILC for entry to British HEIs from the perspective of admissions tutors.

It was agreed that the majority of the next two days should be spent in Subject Groups. Within the guidelines of the Protocol, it was expected that each group would develop its own methodology for comparing the respective awards. Plenary sessions to compare progress would be held at appropriate points. An account of the work of each group and its findings is set out below.

4.1 THE MATHEMATICS GROUP

Comparing aims and objectives

The Mathematics Group began by comparing the aims and objectives of the ILC syllabus and the GCE A Level specification. It was agreed that they were broadly very similar. The full set of aims and objectives is provided in Section 3. A summary of the main elements from the respective sets of aims and objectives is shown below.

Comparison of main elements in ILC Objectives and GCE A Level Aims

ILC Higher Level Objectives	GCE A Level Aims
A. Knowledge B. Instrumental understanding (know how & when) C. Relational understanding (concepts & interpretation) D. Application (in familiar contexts) E. Psycho-motor & communicative skills F. Appreciation of mathematics G. Analysis (proof, modelling, problem-solving) H. Creativity I. Awareness of history of mathematics	A. Understanding → confidence & enjoyment B. Logical reasoning, generalisation & mathematical proof C. Extension of skills to more difficult unstructured problems D. Coherence & progression in mathematics – connections E. Mathematical modelling of real world situations F. Mathematics as effective communication G. Comprehension of mathematical arguments H. Skills to use technology & recognise its limitations I. Relevance of mathematics to other fields J. Responsibility for own learning

It was noted that Objectives E, F, H and I in the ILC were not in the GCE A Level aims and objectives. Objective E was felt to contribute to the wider development of the candidate and was embedded in the GCE A Level but expressed as an aim. Objectives F and H in the ILC were implicit in the GCE A Level and Objective I was not examined in either the ILC Higher or the GCE A Level. It was suggested that the attitudes implicit in the ILC objectives were important (e.g. appreciation of the history of mathematics) and perhaps this aspect should be included in the report.

Later in the work of the Group, when the examination papers had been reviewed, the group members reconfirmed their view that the aims and objectives were very similar having interpreted them in the context of the examination papers.

Structure of the awards

The ILC Higher Level core material is presented in the broad categories: algebra, geometry, trigonometry, sequences and series, functions and calculus, discrete mathematics and statistics. The four options are further calculus and series, further probability and statistics, groups, further geometry. ILC Higher Level candidates are required to study the whole of the core plus one option; over 95% of candidates take Option 1 (Further Calculus and Series). All candidates who take Applied Mathematics Higher would also take Mathematics Higher.

The Edexcel GCE A Level material is organised in 20 Units: six Pure Mathematics units (P1 to P6) and 14 Applications units (Mechanics M1 to M6, Statistics S1 to S6, Decision Mathematics D1, D2). P1, M1, S1 and D1 are designated AS units. All other units are designated as A2 units although P2 is considered a hybrid unit of approximately half AS material and half A2 material.

All GCE A Level Mathematics specifications comprise six units, and contain an AS subset of three units. The AS subset of three units may comprise a combination of AS and A2 units.

GCE AS awards are available for Mathematics, Pure Mathematics, Further Mathematics, Statistics, Mechanics, Discrete Mathematics and Applied Mathematics with variable combinations of AS and A2 units. The GCE AS specification for Applied Mathematics is the only one which may comprise of three AS units; the others include at least one A2 unit.

GCE A Level awards are available for Mathematics, Pure Mathematics, Further Mathematics and Statistics. These specifications comprise at least three A2 units - A Level Mathematics, for example, may comprise three AS units (P1, M1, S1) and three A2 units (P2, P3, M2); A Level Pure Mathematics comprises one AS unit (P1) and five A2 units (P2, P3, P4, P5, P6).

Determining size – comparison of study hours

Neither the ILC syllabus, nor the Edexcel specification, prescribes class contact hours. However, the ILC examiners indicated that the ILC is normally allocated around 200 hours teaching time over two years with about 5-6 class periods a week of 35-40 minutes each. There is sometimes an extra class per week for those studying the ILC Higher Level. Each unit in the Edexcel GCE A Level Mathematics is normally allocated about 50 hours which would amount to 300 hours over two years, including class contact and guided study time. It was noted that this allocation would probably be made for the top end of GCE A Level and not all schools would do this. In terms of hours, therefore, the ILC Higher is about two-thirds the size of a GCE A Level.

It was noted that ILC mathematics is, effectively, compulsory. Students can take the subject at Higher, Ordinary or Foundation level. Typically, ILC mathematics would be one of seven subjects, six of which could be at Higher Level. GCE A Level candidates normally take three subjects. This may have some bearing on the number of study hours available in each system.

Determining size – comparison of content

The content analysis was based on a comparison of the ILC Higher Level Core syllabus, together with the syllabus for Option 1 (the most commonly taken option), and the GCE A Level specification for Pure Mathematics, which comprises one AS unit (P1), one AS/A2 hybrid unit (P2 – see above), and four A2 units (P3 to P6).

An initial mapping of ILC Higher Level Core plus Option 1 (Further Calculus and Series) with GCE A Level Units P1, P2 and P3 suggested that there was a very good match, with the ILC syllabus including much of the content in these three units and some additional content from Units P4 to P6. The revised mapping, based on Units P1 to P3, is attached as Appendix 3.1.

Further detailed scrutiny by the Mathematics Group of the material that was common to the two awards showed that two-thirds of the ILC syllabus corresponded to two and one-third GCE A Level units. This suggested, on the basis of arithmetic only, that the whole of the ILC syllabus would correspond to three and a half GCE A Level units.

Group members then looked in detail at the content of the ILC Higher Level in comparison with Units P4 to P6. They agreed that the one third of the ILC Higher Level Mathematics syllabus content, which was not found in the Units P1 to P3 of the A Level, matched some parts of the content of Units P4 to P6, with a substantial amount falling into the P5 and P6 content.

A very detailed exercise was conducted to estimate the size and demand of the subject material that was in only one or other of the awards – this was done on the basis of teaching time in units of one week. The details of that exercise are shown in

Appendix 3.2., where it may be seen that this material would take similar amounts of teaching time to cover.

On the basis of the above analysis, the group therefore concluded that the ILC Higher Level was about the size of 3.5 A Level units, with a substantial amount of the ILC content being at A2 level.

Comparing examination papers and requirements

The group compared the examination papers and requirements for the ILC Higher Level and the six A Level units P1 to P6. The group was reminded of the structure and depth/level of the respective examination papers.

Typically, questions in the ILC Higher Level examination are made up of three parts:

a) Questions testing recall and basic understanding
b) Questions testing application of routine procedures in relatively familiar contexts
c) Questions testing less familiar applications or problem solving

In the GCE A Level, the examination papers for Unit P1 are at AS Level and those for Units P3 to P6 are at A2 Level. Unit P2 is nominally at A2 level, but in practice is a hybrid because it contains some AS and some A2 standard questions.

The outcome of this exercise was as follows:

- The structure, phrasing, language, content and demand of the questions is very similar
- The ILC papers include questions which relate to the content of Units P1 to P6. Where comparable content is being tested, the demand of the questions is generally comparable
- The ILC papers are more demanding than those for the GCE AS Unit P1 because of the Part c) questions
- Expectations of candidate performance are very similar between the ILC Higher Level papers and those for GCE A Level Units P1 to P3, (although the ILC papers cover additional content from Units P4 to P6)
- The ILC Higher Level paper in Part b) and Part c) questions were of equal demand to questions in the papers for GCE A2 Units P2 and P3
- About half of the questions in GCE A2 Unit P4 papers, and a few of the questions from Units P5 and P6, were similar in demand to those in the ILC Higher Level papers although, in general, these two A2 papers were too demanding for ILC
- There was more signposting used in the GCE A Level Mathematics (P1 at AS Level) than was generally used for the ILC Higher Level.

Hence the level of demand of the ILC examination papers was found to be greater than that of AS level and similar in demand to GCE A Level where the content was comparable.

Comparing levels of attainment – candidate evidence

The ILC representatives looked at GCE A Level Mathematics scripts and the GCE A Level representatives looked at ILC Mathematics scripts. There are no 'grade descriptions' in the ILC Higher and those in the GCE A Level offer only general descriptions of performance. Each group used its experience and knowledge of the marking schemes and expectations of candidates in its 'own' examination to grade the candidate work presented.

Group 1

The Edexcel Chief Examiner and the HE representative reviewed the ILC Higher Level A2 borderline scripts and found that the candidate displayed mastery of approximately two thirds of the more advanced parts of the ILC syllabus. They agreed that such scripts would have been awarded a clear but borderline Grade A at GCE A Level. These are roughly equivalent to the corresponding parts of the GCE A Level syllabus (both AS and A2 i.e. P1, P2, P3).

After looking at ILC Higher Level D3 borderline scripts, they concluded that candidates displayed mastery of some isolated aspects of the ILC syllabus. They agreed that such scripts showed sufficient evidence of understanding to be awarded a Grade E at GCE A Level.

Group 2

The ILC representatives examined a borderline Grade A candidate script from Unit P3 (A2 Level Pure Maths). They agreed that the knowledge of content, skill of application and overall mastery indicated that this student would have performed very well on ILC Higher Level Part c) questions. Hence, this candidate would most likely have achieved a Grade A1 at ILC Higher Level.

They then examined a borderline Grade E script from Unit P3. They agreed that this candidate showed good basic knowledge and routine application in many parts of the paper and was quite accurate in what s/he attempted. S/he would not have made progress in Part c) questions of the ILC Higher Level papers; s/he would have done well on Part a) questions and would have scored quite well on Part b) questions. The best estimate is that this candidate would score a Grade D1 on an ILC Higher Level paper. (S/he would have received a Grade A1 at Ordinary level).

Finally they examined a borderline Grade E script from P1 (AS level Pure Maths). This candidate showed basic knowledge of limited content but had clear difficulties with application. This candidate would have been awarded a Grade E at ILC Higher Level. (S/he would have received a Grade C1 at Ordinary level).

There was a good similarity of ideas in the marking with ILC examiners awarding similar marks to Edexcel scripts and vice versa.

In summary, the results of grading according to the demands of the other examination are:

Edexcel GCE A Level	Equivalent to	ILC Higher	ILC Ordinary
P1 AS Grade E		E	C1
P3 A2 Grade A		A1	
P3 A2 Grade E		D1	A1

ILC Higher	Equivalent to	Edexcel GCE A Level	
A2		A	
D3		E	

ILC Ordinary level

The Group did not have time to review any ILC Ordinary Level scripts; the ILC representatives outlined their judgement of how the Ordinary and Higher levels lined up against each other. They felt that a Grade A candidate at Ordinary Level would struggle to make a Grade C at Higher Level. An A1 candidate at Ordinary Level would probably make C3 at Higher. An A2 candidate at Ordinary Level would probably not make C3 at Higher Level but would be graded D1. This would be due to the difference in demand. Each level can have the same teaching time (depending on the school), but it takes much longer to cover the same area with Ordinary Level students than with Higher Level students. Their competencies and knowledge at entry point are very different.

4.2 THE CHEMISTRY GROUP

Comparison of aims and objectives

The Group considered the aims and objectives of the ILC syllabus and the OCR Chemistry specification, and found them to be virtually identical. (See Section 3 for the full set of aims and objectives.)

Structure of the awards

The OCR specification comprises six discrete modules, three at AS Level and three at A2 Level. The ILC syllabus is not divided into modules, but into a series of sections. Consequently, the content of individual modules within the GCE AS/A Level was mapped against the whole of the ILC syllabus. (A full list of the OCR modules and the sections of the ILC syllabus may be found in Section 3.)

Determining size – comparison of study hours

Consideration was then given to study hours. The ILC syllabus is designed to be delivered in 180 class contact hours over the two years. While OCR does not prescribe a number of study hours, average numbers of class contact hours for chemistry are likely to be in the region of 300 hours over the two years, depending on the school and the timetabling arrangements. Using guided learning hours as a basis of comparison suggests, then, that the volume of learning in an ILC is about 60% of an A Level, suggesting a maximum allocation of 72 Tariff Points to the ILC

Chemistry Higher Level award. However, the Group agreed that while the number of teaching hours devoted to a subject may provide an indication of the volume of study, this information would need to be interpreted with caution.

Determining size – comparison of content/breadth and depth of coverage

The Group then focussed its attention on the content of the ILC Higher Level syllabus and OCR specification, using the mapping exercise prepared prior to the meeting (see Appendix 2), and the full syllabus/specification documentation made available to group members.

AS Modules

The process started with consideration of the AS Module 2811: *Foundation Chemistry*. It was agreed that this mapped closely to the ILC syllabus. The OCR specification was more detailed, but the same topics were nonetheless covered in the ILC in a number of sections (predominantly Sections 1, 2 and 7). The Group agreed, therefore, that there was a 100% match between AS Module 2811 and the content of the ILC Higher Level syllabus.

The AS Module 2812: *Chains and Rings* was also judged by the Group to have a 100% match with the content of the ILC Higher Level syllabus (predominantly in Sections 5 and 7). Any differences between the two were agreed to be very minor.

The content of the AS Module 2813, Component 01: *How far, how fast?* was also found to be fully covered in the ILC Higher Level syllabus (Sections 5, 6 and 8) with only minor differences. The Group therefore agreed that there was a 100% overlap in the content of Module 2813, Component 01 and the ILC Higher Level syllabus.

A2 Modules

Overall there was considerably less overlap between the content of the ILC Higher Level syllabus and the A2 modules, the content of which generally went beyond the scope of the ILC syllabus. Thus, the content of the ILC syllabus was found to have areas of omission when compared to the content of A2 Module 2814: *Chains, Rings and Spectroscopy*. These omissions were most marked in the more challenging areas of the module, such as the chemistry of nitrogen compounds, carboxylic acids and esters. The Group agreed that the degree of overlap between Module 2814 and the ILC syllabus was 50%.

In the case of the other A2 Modules:

- Module 2815: *Trends and Patterns* was found to have few parallels with the ILC syllabus, even when the associated optional areas were taken into consideration. The Group agreed that the degree of overlap between Module 2815 and the ILC syllabus was only 5%.

- Module 2816, Component 01: *Unifying Concepts* (half an A2 module) was found to have some elements in common with the ILC syllabus. These common elements, however, were agreed to be in the less challenging content areas of the

Module. The Group agreed that the degree of overlap between Module 2816, Component 01 and the ILC syllabus was 30%.

- Module 2816, Components 02 and 03: *Unifying Concepts* (half an A2 module) concerns the planning, performance, analysis and evaluation of practical work. Component 02 (coursework) is internally assessed whereas Component 03 (the practical examination) is externally assessed. Candidates take either Component 02 or 03. ILC candidates perform mandatory experiments throughout their coursework, but are not assessed, and instead answer written questions on practical work in their ILC examination. ILC candidates are not expected to be able to plan or fully evaluate their practical work. On this basis, the Group agreed that the degree of overlap between the ILC syllabus and Module 2816/02&03 was 50%.

- Overall, therefore, the Group agreed that the degree of overlap of the ILC syllabus and Module 2816 was 40%.

After completing this second exercise to estimate the relative volume of the two awards, the Group agreed that:

- The content from all three modules of the GCE AS Level Chemistry specification was included in the ILC Higher Level syllabus
- 33% (equivalent in size to one module) of the GCE A2 Level content was included in the ILC Higher Level syllabus

The Group therefore concluded that, in total, the ILC Higher Level award was two-thirds the size of a GCE A Level, i.e. equivalent in size to four modules. This suggested that the maximum number of Tariff Points that the ILC Higher Level Chemistry could attract is 80. This value is within 11% of the value calculated earlier using study hours.

Estimating the relative demand of the qualifications – comparing examination requirements

Having established the maximum size of the awards, the next step was to consider the relative demand of the two qualifications using the available examination papers and candidate scripts.

There are a number of differences in the examination requirements in the OCR AS/A Level and the ILC Higher Level Chemistry:

- GCE A Level has six Assessments Units, three at AS Level, normally taken at the end of the first year of the two year course, three at A2 Level, normally taken at the end of the second year. ILC chemistry has one examination at the end of a two-year programme
- Practical assessments differ markedly between the ILC and GCE, with the GCE requiring timed assessments which include elements of planning and evaluation. The ILC practicals are not timed or assessed.
- Two of the A2 Assessment Units (2815, Component 01, and 2816, Component 01) contain synoptic assessment which:

- Requires candidates to make and use connections between different areas of chemistry, for example, by applying knowledge from different areas of the course to a particular situation or context

- Provides opportunities for candidates to use ideas and skills which permeate chemistry, for example, the analysis and evaluation of empirical data and other information in contexts which may be new to them.

The ILC does not have such a requirement.

- GCE A Level defines performance separately at AS, A2 and A Level using criterion referenced descriptors
- The ILC does not use grade descriptors; grades are based solely on the marks given for the paper (converted to a percentile scale) taking account of the performance of previous years' cohorts.
- The ILC has a total of 13 grades (including the banding within the broad grades of A to E) ranging from A1 to F. Both GCE AS and GCE A Level have five grades, A-E.

The AS Assessment Unit 2811: *Foundation Chemistry* assessment procedures and examination papers were compared with those for the ILC, and it was found that some ILC questions combined assessment associated with standards at both AS and A2 Levels. The Group agreed that the Module 2811 and the ILC examination had many comparable elements at AS standard, but that the ILC examination also asked more demanding types of question which were more akin to A2 standard. This suggested that the level of demand of the ILC paper is greater than the level of demand of the AS paper.

The GCE AS Assessment Unit 2812: *Chains and Rings* examination papers, in common with all the OCR chemistry papers, have no optional questions, unlike the ILC which has a number of optional questions. This could suggest that the GCE AS Level was more demanding. The ILC was, however, more demanding in its style of question because, unlike the AS, it provided no prompts as to the length or structure of the correct answer. On the other hand, the marking procedures for the ILC allowed a larger number of marks for each question, which allowed examiners more flexibility in recognising where a candidate had been partially correct.

The demands of the questions on the examination paper for AS Assessment Unit 2813, Component 01: *How far, how fast?* and the ILC questions assessing the same content were agreed to be very similar.

On the basis of this evidence, the Group therefore agreed that overall the level of demand of the ILC examination was the same as the demand of the three AS Assessment Units.

Comparison of the A2 Assessment Unit examinations with the ILC papers was potentially problematic, given the earlier finding that large areas of the A2 content were not present in the ILC syllabus. However, there was still sufficient overlap to make, in principle, meaningful comparisons of demand based upon the questions being set in the examination papers. So, for A2 Module 2814: *Chains, Rings and*

Spectroscopy, the Group agreed that the examination questions in Assessment Unit 2814 were covered to the same degree of demand in the ILC examination.

However, the subject matter being assessed in the two A2 Assessment Units 2815: *Trends and Patterns*, Component 01and 2816, Component 01: *Unifying Concepts* is synoptic in nature and synoptic assessment relates the content in these modules with knowledge and understanding acquired elsewhere in the course, as discussed earlier.

Thus, questions requiring candidates to demonstrate these abilities are set in Assessment Unit 2815, Component 01, and Assessment Unit 2816, Component 01. Such synoptic questions are not part of the ILC examination. Consequently, where synoptic abilities are being tested in the OCR examination papers, even if the content which is being assessed is the same as in the ILC papers, the demand of the OCR questions was judged to be greater than that of the ILC questions. Where similar content and non-synoptic abilities are being tested in these papers, the Group judged the standard of assessment to be the same.

Therefore, the differences in content and purposes of assessment between the two Assessment Units 2815/01 and 2816/01, and the ILC examination, suggested that, for benchmarking purposes, making a valid comparison between the demand of the overall A Level in Chemistry and the ILC Chemistry was potentially problematic.

Consequently, at this stage, the Group reconfirmed its earlier view that the ILC Higher Level syllabus is equivalent in volume to four units of an A Level, but that the assessment demand of the ILC examination seemed more aligned with the assessment demand of an AS Level.

Comparing levels of attainment – candidate evidence

The Group reviewed a number of GCE A Level and ILC candidate scripts. The differences in the marking procedures between the two awards meant that it was not possible to apply the respective marking schemes in this exercise. Group members therefore used their own experience and knowledge of the marking schemes and expectations of candidate performance in their ‘own’ examination to grade the candidate scripts.

Group members began with a general discussion about expectations of candidate performance in the respective AS/A2 and ILC examinations. They then reviewed pairs of comparable scripts from each examination, (i.e. a Grade A script from an OCR AU and a Grade A script from the ILC, a Grade E script from an OCR AU and a Grade D script from the ILC) and then awarded an ILC grade to the A Level paper.

The following conclusions were reached:

- The AS Assessment Unit 2811 Grade A examination script would be awarded a borderline ILC Grade A2/B1. The candidates on both papers displayed the same knowledge of subject content, and application of this knowledge. Both had good mathematical ability.
- The AS Assessment Unit 2811 Grade E examination script would be awarded an ILC Grade D2/D3 (a narrow pass). Both types of candidate showed similar

variation on specification coverage, and were able to perform very basic calculations only.

- Extrapolating across the three AS units, on the basis of some candidate evidence available for AS Assessment Units 2812 and 2813, Component 01, the GCE A Level Chair of Examiners stated that the Grade D3 ILC Higher Level examination script would be awarded a Grade E at AS Level. Her judgement was based on the demonstration of syllabus coverage and the ability to demonstrate understanding.

The Group then looked at examination scripts from the OCR Assessment Unit 2814, an A2 Assessment Unit. It had already been agreed that the degree of overlap of content of this module with the ILC syllabus was 50%, but that questions on the comparable content were of a similar level of demand. Given this, the Group agreed that:

- The A2 Grade A examination script would be awarded a borderline A1/A2 in the ILC on the comparable questions. Both candidates displayed similar deep subject knowledge, and were able to apply this knowledge competently.
- The Grade E examination script would be awarded a C3 in the ILC on the comparable questions. Both types of candidate were able to apply subject knowledge in a basic way, and showed a similar patchy knowledge of the subject.

Finally the Group considered some exemplar assessment evidence for the A2 Assessment Units 2815, Component 01, and 2816, Component 01 against the ILC scripts. It was recognised that, given the significant amount of synoptic assessment in these examinations, as well as the fact that significant areas of content of these modules is not present in the ILC syllabus, a valid comparison was problematic. However, while there is no requirement for synoptic assessment in the ILC, group members agreed that, on questions of comparable content, there was some evidence of some of the required synoptic skills in the ILC Grade A scripts and, to a lesser extent, some evidence of these skills in the Grade D1 scripts (but not D2 or D3). Therefore, taking the three A2 units together, the group agreed that an ILC candidate would need to be graded D1 or above in order to be awarded a Grade E at GCE A2 Level.

Given the differences in assessment approaches between the two awards, the best judgement of the Group was that the ILC Higher Level award was equivalent in volume to four units of the GCE A Level, but with a level of demand intermediate between AS and A2. This would therefore suggest allocating a maximum of 80 Tariff Points to the ILC Higher Level award.

In summary, the results of the grading according to the demands of the other examinations are:

OCR GCE A Level	**Equivalent to**	**ILC Higher**	**ILC Ordinary**
Module 2811 AS Grade A		A2/B1	
Module 2811 AS Grade E		D2/D3	
Module 2814 A2 Grade A*		A1/A2	
Module 2814 A2 Grade E *		C3	

* On comparable questions

ILC Higher	**Equivalent to**	**OCR GCE A Level**	
D3		AS Grade E	

ILC Ordinary Level

The Group discussed the relationship between the ILC Ordinary and Higher Levels. Preliminary work conducted prior to the meeting confirmed that both Ordinary and Higher levels had relevance for admission to higher education in Ireland. Mapping of content suggested that the ILC Ordinary Level is a subset of the ILC Higher Level and this was confirmed by the ILC examiners. Key differences between Ordinary and Higher levels include: the volume, breadth and depth of material studied; and the amount of assessment of quantitative material, which is at a lower standard for Ordinary Level compared to that for Higher Level.

Consideration was also given to the size relationship of the Ordinary Level within the ILC with the Higher Level. This was based on the mapping undertaken and also on the views of the two ILC examiners. The Group agreed that ILC Ordinary Level award comprises approximately 70% of the volume of ILC Higher Level award.

The content of the ILC Ordinary Level was considered to be mainly equivalent to GCSE, with some elements from GCE A Level, all at AS level. The Group was of the opinion that ILC Ordinary Level standards aligned with high GCSE standards. Differences between the Ordinary and Higher level were particularly marked in the areas of content, assessment, demand, choice, marking schemes and question structure. As a result, the following judgements were made by the Group:

ILC Ordinary	Equivalent to	ILC Higher	GCSE
B1		D3	A
D3		Below Higher	Foundation level

Additional evidence

Dr McDougall indicated that, for entry to University of Edinburgh, ILC Higher Level students are deemed suitable for entry into Year One of a four-year Honours programme (i.e. the same as Scottish Higher students). Advanced Higher and good GCE A Level students are more likely to enter Year Two. Dr McDougall also thought that an ILC Higher Level was equivalent to a Scottish Higher, both in terms of volume and demand.

Dr McDougall's view is supported by further evidence from Queens University, Belfast, where an ILC candidate has tended to be treated as equivalent to a Scottish Higher candidate. Given that ILC candidates normally take seven subjects, it is expected that content coverage in a given subject will be less than for A Level. ILC applicants to a three year Chemistry degree programme would normally be selected on their potential ability to close this knowledge gap.

In conclusion

Given the differences in assessment approaches between the two awards, the best judgement of the Group was that the ILC Higher Level award was equivalent in volume to four units of the GCE A Level, but with a level of demand intermediate between AS and A2. This would therefore suggest allocating a maximum of 80 Tariff Points to the ILC Higher Level award.

However, there are potentially important qualitative differences in the knowledge, skills and understanding of an ILC candidate compared to an A Level candidate, given that:

- Some more difficult material is covered in the A2 units which is not covered in the ILC Higher
- There is the requirement for synoptic assessment in the A Level

Admissions tutors should be made aware of these potential qualitative differences when considering an ILC candidate. This difference is akin to that between a candidate with a Scottish Higher and an A Level. This difference is reflected in the decision of the University of Edinburgh Chemistry Department's admission policy of giving applicants with good A Level grades advanced standing (entry into Year Two of the degree programme), relative to an applicant with a Scottish Higher qualification, who would typically enter Year One of the University of Edinburgh's Chemistry degree programme.

4.3 THE ENGLISH GROUP

A note on the application of the Protocol

As will become clear in the first few pages of this section, the nature and design of the English syllabuses made it difficult to apply some of the guidelines set out in the Protocol. The syllabuses are written in terms of the knowledge, skills and processes candidates are required to demonstrate in the examinations. The English Group therefore approached the comparison of the two syllabuses by focussing on the examination requirements and the tasks candidates are required to do in the examinations and then reviewing candidate evidence.

Introduction

Given the differences in the language in which the two syllabuses are expressed and their different structures, the English Group initially spent some time discussing the general aims, intentions and expectations of candidate performance of the two awards. It was found that this discussion was more usefully informed by referring to the assessment tasks required of candidates in the respective examinations than by other sections of the syllabuses which tended to reflect different philosophical approaches to the examination of English while not affecting the intended outcomes.

Comparison of aims and objectives

Group members agreed that the aims of the two awards were very similar. In both syllabuses the study of language and literature is integrated. Both awards aim to produce mature, reflective, critical and independent readers and thinkers. The overarching aim of both awards was summarised as follows:

'To develop the world of the student in the capacity to engage with language and literature, through a series of interventions using both closed and freely encountered texts.'

To confirm these similarities, the group compared the six Assessment Objectives (AO) in the AQA specification with the aims and assessment requirements of the ILC syllabus, as is shown in the table below.

Table 1: Comparison of aims and objectives

AQA Assessment Objectives The examination will assess a candidate's ability to:	**ILC Aims and Assessment Requirements**
1. Communicate clearly the knowledge, understanding and insights gained from the combined study of literary and linguistic study, using appropriate terminology and accurate written expression. 6. Demonstrate expertise and accuracy in writing for a variety of specific purposes and audiences, drawing on knowledge of literary texts and features of language to explain and comment on the choices made.	This syllabus will foster students' development in the following area: *Concepts and Processes:* The ability to think, reason, discriminate and evaluate in a wide variety of linguistic contexts, personal, social, vocational and cultural. In comprehending, students should be able to analyse, infer, synthesise and evaluate; in composing, students should be able to research, plan, draft, re-draft and edit.
2. Respond with knowledge and understanding to texts of different types and from different periods, exploring and commenting on relationships and comparisons between them.	At Higher Level, as a minimum requirement, students should demonstrate the ability to: • Compare and contrast a range of texts under a variety of abstract categories, e.g. cultural and historical contexts, author's viewpoint, literary form and period, etc.
3. Use and evaluate different literary and linguistic approaches to the study of written and spoken language, showing how these approaches inform their readings. 4. Show understanding of the ways contextual variation and choices of form, style and vocabulary shape the meaning of texts.	The aims of this syllabus are to develop in students: • A respect and appreciation for language used accurately and appropriately and a competence in a wide range of language skills both oral and written. The syllabus will foster students' development in the following area: *Skills*: Interpreting and controlling the textual features (grammar, syntax, spellings, paragraphing) of written and oral language to express and communicate.
5. Identify and consider the ways attitudes and values are created and conveyed in speech and writing.	The syllabus will foster students' development in the following area: *Attitudes and Effects:* The development of interest and enjoyment in using language, a respect for its potential to make meaning and an appreciation of its diverse cultural manifestations.

It was agreed that, while the language in which the AQA Assessment Objectives and the ILC aims and assessment requirements were expressed was different, the underlying concepts and expectations of candidate performance were very similar; for example, AQA AO1: To communicate clearly the knowledge, understanding and insights gained from the combined study of literary and linguistic study, requires the candidates to demonstrate the same skills and knowledge as ILC Aim 3.4.1: The ability to think, reason, discriminate and evaluate in a wide variety of linguistic contexts, personal, social, vocational and cultural.

Structure of the awards

As with all GCE A Levels, the AQA specification comprises six modules, three to be completed for the AS award normally in the first year of the course, with a further three required for the full A Level qualification normally at the end of the second year. In the English specification, the AS modules are designed to begin the development of the skills and processes which candidates will be required to demonstrate at greater depth in the A2 modules.

The ILC syllabus is designed to be delivered over two years and describes the learning outcomes and levels of attainment required at the end of the course for both Higher and Ordinary Level.

Determining size – comparison of study hours

A measure of the size of an award is normally the number of hours of study needed to complete it. However, the English Group did not believe this would be a very productive line to follow. Neither award prescribed the number of study hours required. The ILC examiners noted that, among the ILC subjects, English normally had more contact hours, but that this could vary from school to school, possibly accounting for some 225 hours across the two years. Similarly, the number of contact hours for GCE A Level English depended on individual school's timetabling arrangements, but may account for some 270 hours. It should be borne in mind, however, that candidates normally take seven subjects for the ILC, whereas GCE A Level candidates normally take three subjects. This may have some bearing on the number of study hours available in each system.

Nevertheless, all group members felt strongly that the number of study hours would not be a relevant measure of the relative size of the two awards and that any difference in size of the two awards was unlikely to be dependent on the number of study hours required. The HE representative supported this argument from her perspective as an Admissions Tutor (see below).

Determining size – comparison of content/breadth and depth of coverage

The English Group quickly agreed that, while it could be done, there was no value in comparing the numbers and types of texts to be studied. These would vary from syllabus to syllabus and from year to year. It was agreed that, while students clearly had to have knowledge and understanding of the texts and the relevant literary and linguistic concepts, it was their ability to demonstrate the skills and processes, indicated in the above table, through their knowledge of the texts which was important.

The HE representative, Anne McCartney, confirmed this point from her perspective both as an Admissions Tutor for English and as an English lecturer. In her experience, over many years, she has admitted and taught both Grade A ILC and GCE students. While these students come from a variety of schools and colleges following different syllabuses requiring the study of varying numbers and types of texts, they perform equally well at university since they have developed the skills and processes needed to engage with the material of an English degree. In her view, the development of these skills and processes is quite independent of the numbers and types of texts studied, as well as independent of the length of study. In addition, she noted that many of the relevant analytical and writing skills are also developed through the study of other subjects such as, for example, history, geography and social studies.

Therefore, although there is 'content' in the two English syllabuses in terms of texts to be studied and literary and linguistic concepts to be learned, these are not significant factors to be considered when determining the breadth and depth or volume of an English syllabus. The fact that both syllabuses are written in terms of learning outcomes, or the knowledge, skills and processes candidates are required to demonstrate in the respective examinations, adds weight to this argument.

The group therefore agreed that the only way to determine similarities and differences in the breadth and depth of coverage of the two syllabuses, and thereby to gain a measure of the relative sizes of the two awards, was to:

- Compare examination requirements
- Compare the tasks candidates are required to do to demonstrate their skills and knowledge and then to
- Compare levels of attainment by examining candidate evidence from the respective examinations.

NB: Initial mapping exercises conducted prior to the meeting, and made available to the Group, had indicated that this would be the way forward. They formed the basis of are the more detailed work of the Group which follows, and are therefore not included in Appendix 3.

Comparing examination requirements

Given the modular structure of the AQA English specification, there are six examinations normally taken over the course of the two year programme, three at AS Level in May of the first year and three at A2 Level in June of the second year. While the requirement to demonstrate similar skills and processes therefore occurs at both AS and A2 Levels, the A2 candidate is expected to demonstrate a more sophisticated use of these skills and processes, reflecting their developing maturity of perception.
In both the ILC Higher and Ordinary Levels there are two examination papers taken at the end of the two year course. There is no course work in either syllabus and all examinations are externally marked.

Each AQA examination paper contains one or two sections, each section requiring one question to be answered, except for Unit 5 where Section B comprises two questions. Paper 1 of the ILC Higher Level contains two sections, each with one question and Paper 2 three sections, two with one question and one with two questions.

The length of the respective papers and numbers of questions/assessment tasks required was noted. If the end of course ILC papers are set against the AQA A2 papers, there is a significant similarity between the length of the papers and the numbers of questions/assessment tasks required, as the table below shows. Taken together with the similarity in aims and objectives discussed earlier, it was suggested that this evidence may be an indicator of a similarity in the relative sizes of the two awards.

Table 2: Comparison of length and content of end of course examination papers

AQA	Length of paper	No of tasks	ILC Higher Level	Length of paper	No of tasks
Unit 1	1hr 15mins	2			
Unit 2	1hr 15 mins	1			
Unit 3	1 hr 30 mins	2			
Total	4 hrs	5			
Unit 4	1hr 30 mins	1	Paper 1	2 hrs 50 mins	2
Unit 5	2hrs 15 mins	3			
Unit 6	2hr 30 mins	2	Paper 2	3 hrs 20 mins	4
Total	**6hrs 15 mins**	**6**		**6 hrs 10 mins**	**6**

Comparing assessment tasks

The group then moved on to compare the assessment tasks required of candidates in the respective examinations. The following methodology was agreed, working through the six AQA assessment units. The AQA Principal Examiner discussed the requirements for each section of each assessment unit and provided a brief summary of the task involved. The ILC senior examiners responded with an overview of the requirements for each section of each of the two ILC examination papers, and indicated in which section of which paper a task similar to the AQA assessment task was required. At each stage the HE representative's view/agreement on the similarity of the tasks was sought.

Although all six AQA units were included in the exercise, the AQA Principal Examiner reminded the group that the AS modules and their respective assessment units are designed to develop and assess skills and processes which candidates will be required to demonstrate at greater depth in the A2 examinations. There is therefore a transfer of skills and processes from Units 1-3 to Units 4-6 as follows.

Unit 1: Language Production	Similar skills as in	Unit 5: Text & Audience	Directed writing
Unit 2: Poetic Studies	Similar skills as in	Unit 4: Comparative Literary Studies	Poetry or prose texts
Unit 3: The Study of Language of Prose and Speech	Similar skills as in	Unit 4: Comparative Literary Studies	Prose
		Unit 6: Language in Context	Speech

The ILC Higher Level assessment tasks are therefore mapped in more detail to Units 4-6 since, given the evidence relating to the similarity in aims and objectives and the comparable length of the ILC and AQA Units 4-6 examinations, it was felt that the main thrust of the comparison should be between the two sets of end of course examinations.

The following table provides a record of the above process of comparing assessment tasks. The left hand column indicates the title of the AQA assessment unit and the task required in each section of the examination. The middle column indicates the brief summary of the assessment task identified by the AQA Principal Examiner. The third column shows the titles and sections of the ILC Higher Level examinations, with some brief description of the tasks, set against the summary of each AQA assessment task.

Table 3: Comparing assessment tasks

AQA Assessment Units	AQA Summary of Task	ILC Higher Level Papers
Unit 1: Language Production Section A Directed writing, e.g. a leaflet Section B Evaluation of process of own writing	Directed writing Evaluation – see bullet points on next page	*Paper 1: Comprehending & Composing* Sections 1&2 *Paper 2: Literary Studies* Section 3b:Prescribed Poetry Paper 1: Comprehending & composing Section 1 (evaluation of printed texts) Paper 2: Literary Studies Section 3a: Unseen poem
Unit 2: Poetic Study Write essay on single text- pre-1900 or modern Open book	Write essay	*Paper 2: Literary Studies* Section 3: Prescribed Poetry – pre1900 and modern Closed book
Unit 3: Prose Study Section A Write essay on single text – context given>wider effect – pre-1900 or modern Open book Section B Comment on how spoken language is used	Write essay Different task of equal value – see bullet points on next page	*Paper 2: Literary Studies* Section 1: Single text – pre-1900 and modern Closed book *Paper 1: Comprehending and Composing* Section 1: Visual imagery – descriptive, narrative and affective
NB: Units 4-6 require candidates to demonstrate at a more sophisticated level skills and processes developed in Units 1-3.		
Unit 4: Comparative Literary Studies Essay comparing two texts, from different periods; choice of prose and poetry. Open book	Write essays comparing/commenting on prose/drama/poetry texts from different periods.	*Paper 2: Literary Studies* Section 1: Single Text Essay on choice of prose/drama text, from different periods Section 2: Comparative Studies Essay comparing different types of texts; choice of theme/issue or cultural context. Section 3a: Unseen Poem Commentary Section 3b: Prescribed Poetry Essay All closed book
Unit 5: Text and Audience Section A Write essay on dramatic text Closed book, but passage provided Section B Directed writing – adaptation of material from two linked texts for a specific audience Commentary on methods; evaluation of linguistic/literary techniques used.	Write essay Directed writing See bullet points on next page	*Paper 2: Literary Studies* Section 1: Single text See detail above Section 2: Comparative study See detail above *Paper 1:Comprehending & Composing* Section 1: Comprehending Three questions on non-fiction texts, including visual images, plus a directed writing task. Section 2: Composing Range of tasks for various audiences.
Unit 6: Language in Context (Synoptic) Section A Analytical comparison of 3 unseen texts of differing forms, including spoken language Section B Commentary on/evaluation of techniques used	Write essay Compare texts See bullet points on next page	*Paper 1: Comprehending & Composing* Section 2: Composing *Paper 2: Literary Studies* Section 2: Comparative study

At the end of this process, the group was agreed that assessment tasks similar to those in the AQA papers could be found in the ILC papers. So, although the papers are structured differently, it was agreed that both sets of candidates were being asked to do very similar tasks, particularly in respect of the end of course exams.

A number of differences were, however, noted, all of which stemmed from the different approaches to the examination of English reflected in the two syllabuses:

- Paper 1 of the ILC examination includes the assessment of visual literacy, an area not included in AQA. On the other hand the AQA papers require candidates to comment on the use of spoken language, an aspect that does not feature largely in the ILC papers. It was thought that these different aspects were of equal value, reflecting a difference in approach to the assessment of English, and did not have a significant bearing on the main body of skills and processes under consideration.

- Two of the AQA units are open book papers, whereas there are no open book papers in the ILC.

- AQA places an emphasis on the candidate's ability to evaluate their own writing and their own use of literary concepts when analysing texts. This 'meta awareness' is not explicit in the ILC papers, although candidates are required to evaluate a writer's use of literary and linguistic concepts in the texts studied, and the use of language appropriate to the chosen audience is required in the directed writing tasks. In this sense, ILC candidates' evaluation of the use of language and literary concepts is implicit in their choice of language and terminology to answer the questions. They are not required to explain or justify these choices. It was suggested that the AQA approach could be characterised as being more concerned with technicalities of critical awareness than the ILC where the emphasis is on candidates' ability to express themselves freely in response to a range of texts.

  The HE representative agreed with this difference in emphasis between the two approaches to the examination of English, but noted that the requirement for explicit skills of critical awareness does not necessarily mean that candidates demonstrate the main body of skills and processes at more sophisticated level. In her experience, she had found candidates from both awards to be equally self - analytical.

  The group agreed that there was no value in pursuing this issue further. It was suggested that since the relevant questions on the AQA papers represented a very small percentage of the overall GCE A Level grade, this difference in approach to English examining may not significantly affect the comparison of levels of attainment.

- In order to meet the QCA specification criteria for GCE A Level, all specifications are required to have a synoptic assessment. AQA Unit 6 is designed to draw on all the elements of the previous modules and reflect all the Assessment Objectives. There is no equivalent requirement for the ILC examinations.

Comparing levels of attainment – candidate evidence

Having agreed that broadly similar assessment tasks were required of both AQA and ILC candidates across the two sets of papers, the group then moved on to look at marked candidate scripts to determine whether

- there were any differences between the depth and breadth of the skills and processes the respective candidates demonstrated when carrying out these tasks
- this exercise would indicate any difference in size of the two awards

In selecting the AQA scripts, the group decided to concentrate on the three A2 papers since these would demonstrate the depth and breadth of skills and processes required at the end of the two year course, and could therefore be compared with those required in the terminal ILC examinations.

Differences in the respective marking schemes were noted. AQA questions are marked against the relevant Assessment Objectives. There are five mark bands within each AO, each of which has generic descriptors of performance. The ILC questions are marked against four broad assessment criteria, (Clarity of Purpose, Coherence in Delivery, Mastery of Language to communicate clearly and Mastery of Mechanics) and the marks then converted to a grade. There are no individual grade descriptors. (See Section 3 for more detail.) These differences, together with the lack of direct correspondence between papers, meant that it was not possible to apply the respective marking schemes in this exercise. Group members therefore used their own experience and knowledge of the marking schemes and expectations of candidate performance in their 'own' examination to grade the candidate scripts.

It was also noted that while AQA papers are graded A-E, the ILC has 13 grades, including the banding within the broad grades of A-E, ranging from A1 to F.

The senior ILC examiners reviewed the examination scripts of three candidates at Grades A and E borderlines from AQA Units 4, 5 and 6 taken from the June 2002 examination session. The AQA Principal Examiner reviewed a sample of two ILC Higher and two Ordinary Level Paper 1 and 2 scripts at Grades A and D from the June 2002 examination session, and the HE representative reviewed a sample of scripts from both awards.

ILC grading of AQA candidate scripts

The exercise began with the ILC examiners presenting their views on and allocating an ILC Higher Level grade, and, where appropriate an Ordinary Level grade, to each of the AQA candidate scripts.

AQA Unit 4: Comparative Studies

The ILC examiners thought that the skills of comparison demonstrated by the AQA Grade A candidate would achieve a Grade A1 in the ILC grading system. The AQA Grade E candidate would merit a D1 or C3 in the ILC system.

AQA Unit 5: Text and Audience

The ILC examiners found many skills and processes in both the Grade A and Grade E candidate scripts which are required in the ILC examinations, for example, comparative skills, directed writing, writing for a specified audience. As had been discussed previously, the requirement in the second part of Question 2 for candidates to provide an evaluation of their own use of literary and linguistic concepts is not an explicit feature of the ILC papers, reflecting differences in approaches to examining English. Given that this question represents a very small percentage of the overall A Level grade, it was agreed that it did not significantly affect the grading exercise. The ILC examiners agreed that the Grade A candidate would merit an A2/B1 grade in the ILC system. They did not, however, think that the Grade E candidate came up to the ILC Higher Level standard, relying too much on narrative with little use of comparative skills. This paper would merit a B2 at Ordinary Level.

AQA Unit 6: Language in Context

As discussed previously, there is no equivalent requirement for synoptic assessment in the ILC. However, the ILC examiners were able to find evidence of many similar skills and processes which they would expect to be demonstrated across both Paper 1 and Paper 2 of the ILC examinations. The skills of comparative analysis are to be found in Paper 2 and the skills of manipulating the language and writing for various audiences are addressed in Paper 1. Here again, the requirement in Question 2 for candidates to demonstrate a meta awareness in their use of language and literary concepts arose. Nevertheless, the ILC examiners believed that ILC candidates would, to some extent, demonstrate these skills in Paper 1.

Taking the paper overall, the ILC examiners felt that the candidate would merit a B1/B2 in the ILC system since they would expect the skills and processes to be demonstrated in more depth to be awarded an ILC Grade A. There was, for example, more narrative than analysis in Question 1 and no new skills were demonstrated in Question 2. As in Unit 5, they did not think that the Grade E candidate came up to the ILC Higher Level standard, relying almost exclusively on narrative rather than demonstrating the level of sophistication required at the Higher Level. They thought it would merit a C2/C3 at Ordinary Level.

In subsequent discussion, the AQA Principal Examiner indicated that the structure of the paper was under review, and that, currently, candidates may include information in Question 1 which might be more appropriate in Question 2. AQA examiners, however, take this into account and credit this overlap accordingly. Responses to Question 2, taken in isolation from Question 1, may therefore seem to lack depth. It seemed likely that these circumstances contributed to the ILC examiners giving the paper lower ILC grades than those they had awarded for Units 4 and 5.

AQA grading of ILC candidate scripts

The AQA Principal Examiner then gave his views on the ILC papers. In his view, the Higher Level Grade A candidate on the ILC Paper 2 Comparative Studies question would also have been awarded a Grade A at GCE A Level. The Grade D candidate's work matched the AQA Grade E, both showing a basic range of the required skills of each component. He did not apply GCE A Level grades to individual candidate scripts for Paper 1 or the other sections of Paper 2, but made the following general observations about the standard of work.

ILC Higher Level

The positive qualities in the two candidate scripts across the two papers which would merit the comparable award of a Grade A or D at GCE A Level included:

- Greater technical accuracy and wider vocabulary than shown by many AQA candidates
- Excellent quality of written expression – a natural eloquence
- A consistent focus on the task in hand throughout the question – not always the case with AQA candidates
- Clear evidence of excellent comprehension of texts

The issues which might affect the award of a comparable grade stemmed once again from the differences in approaches to examining English.

- A tendency to provide more narrative than literary criticism and to overuse quotations – both of which arise from the closed book examination
- The absence of explicit self analysis of linguistic and literary concepts

In general, the AQA Principal Examiner thought that the standard of work shown by the ILC Higher Level candidates at Grades A and D was broadly equivalent to that demonstrated by the A Level candidates at Grades A and E.

In summary, the results of the grading according to the demands of the other examination are:

AQA	**Equivalent to**	**ILC Higher**	**ILC Ordinary**
Unit 4 Grade A		Grade A	
Unit 4 Grade E		Grade C3/D1	
Unit 5 Grade A		Grade A2/B1	
Unit 5 Grade E			Grade B2
Unit 6 Grade A		Grade B1/B2 *	
Unit 6 Grade E			Grade C2/B3
ILC Higher		**AQA**	
Grade A		Grade A	
Grade D		Grade E	

* See last paragraph under AQA Unit 6 above

The group acknowledged that there were certain limitations with the candidate evidence available for this exercise. In particular, although the ILC examiners were able to look at six scripts, they would have liked to have had scripts from a single candidate across the three AQA units. On the other hand, while the AQA Principal Examiner was able to examine all the work relating to an individual candidate across both papers, only two sets of scripts were available.

However, on the basis of the evidence from this exercise, the group agreed that there was broad equivalence between the standard of candidate performance required for Grade A in both awards, and that the ILC Grade D was broadly equivalent to the GCE

A Level Grade E. There was, therefore, no significant difference in depth and breadth of skills and processes required at end of two year course.

Determining the size of the awards – conclusions

The evidence from the comparison of aims and objectives (Table 1), the comparison of the length and numbers of questions/assessment tasks in the A2 and Higher Level examination papers (Table 2) and the similarity of assessment tasks (Table 3) had already indicated that the demands and requirements of the ILC Higher Level and AQA A Level awards were very similar. The evidence from the comparison of levels of attainment demonstrated that:

- The standards of assessment are comparable
- Levels of attainment are comparable
- There was no difference in the level of demand across the two sets of papers in the two awards

The group returned to the numbers of study hours required and agreed, as they had argued, that the difference in contact time had no bearing on their findings.

The group therefore concluded that the ILC Higher Level award should be considered to be equivalent in size and demand to the AQA GCE A Level award. The HE representative confirmed that this conclusion accorded with her experience of admitting and teaching candidates from both awards.

ILC Ordinary Level

Higher Level and Ordinary Level candidates follow the same syllabus and are sometimes taught together in the same class. Candidates are technically able to decide on which level of paper they will sit on the day of the examination. The material covered by Higher and Ordinary candidates is more or less the same. Ordinary Level candidates study fewer poetry texts than Higher Level candidates, the study of Shakespearean drama is optional, whereas it is compulsory for Higher Level candidates and they are only examined on the use of two comparative modes instead of three at Higher Level. The two examination papers at Ordinary Level are the same length with the same number of sections and questions, and require candidates to do similar assessment tasks. The essential difference is in the level of sophistication expected of Ordinary Level candidates' answers. For example, questions may be worded to allow candidates to place more reliance on narrative than the critical analysis which would be expected of Higher Level candidates.

The examination papers are marked according to the same four broad assessment criteria as the Higher Level papers, although, as stated above, the expectations of candidate performance are lower. The same grading system is used. There is no formal equivalence between the Higher and Ordinary Level grades. However, in the tariff points system established by the Central Applications Office for entry to HE, a Grade A1 at Ordinary Level is allocated the same number of points as a Grade C3 at Higher Level. The HE representative stated that in her experience a Grade A at Ordinary Level was broadly equivalent to a Grade C at Higher Level.

The final plenary

At the end of the three days, the following similarities and differences among the three ILC awards in comparison with the respective GCE A Levels had become clear.

Aims and objectives

All three subject groups had found very close similarities between the aims and objectives of the respective ILC and GCE A Level awards.

Size of the ILC Higher Level awards in comparison with the relevant GCE A Level award

Subject	**Size**
Mathematics	ILC Higher Level estimated to be equivalent to about 3.5 GCE A Level units, with a substantial amount of the ILC content being at A2 Level.
Chemistry	ILC Higher Level estimated to be two-thirds the size of the GCE A Level, or equivalent to 4 units.
English	ILC Higher Level estimated to be the same size as the GCE A Level.

Comparisons of levels of attainment

The outcomes of the comparison of examination scripts by each of the subject groups is shown in Table 4. Although the awards are of different sizes, there would seem to be a significant degree of agreement across the three groups that the GCE A Level Grades A and E are comparable to the ILC Higher Level Grades A and D. The position regarding the ILC Ordinary Level was, however, less clear.

Table 4: Comparison of levels of attainment

Mathematics

Edexcel GCE A Level	Equivalent to	ILC Higher	ILC Ordinary
P1 AS Grade E		E	C1
P3 A2 Grade A		A1	
P3 A2 Grade E		D1	A1

ILC Higher	Equivalent to	Edexcel GCE A Level	
A2		A	
D3		E	

ILC Ordinary	Equivalent to	ILC Higher	
A		C3	

Chemistry

OCR GCE A Level	Equivalent to	ILC Higher	ILC Ordinary
Module 2811 AS Grade A		A2/B1	
Module 2811 AS Grade E		D2/D3	
Module 2814 A2 Grade A		A1/A2	
Module 2814 A2 Grade E		C3	

ILC Higher	Equivalent to	OCR GCE A Level	
D3		AS Grade E	

ILC Ordinary	Equivalent to	ILC Higher	GCSE
B1		D3	A
D3		Below Higher	Foundation level

English

AQA GCE A Level	Equivalent to	ILC Higher	ILC Ordinary
Unit 4 Grade A		Grade A	
Unit 4 Grade E		Grade C3/D1	
Unit 5 Grade A		Grade A2/B1	
Unit 5 Grade E			Grade B2
Unit 6 Grade A		Grade B1/B2*	
Unit 6 Grade E			Grade C1/B3
ILC Higher		**AQA GCE A Level**	
Grade A		Grade A	
Grade D		Grade E	

*See last para under AQA Unit 6 on P47

SECTION 5: ALLOCATING UCAS TARIFF POINTS TO THE ILC

The ILC is a qualification comprising a number of subjects each of which is awarded at two levels – Higher and Ordinary. (A Foundation Level is available in Mathematics and Irish, but is not considered in this report.) Candidates for the two levels follow similar, though not necessarily identical, programmes of study. The difference between Higher and Ordinary Level lies, therefore, mainly in the level of demand of the final examination papers taken by the candidate. The choice of which examination paper(s) a candidate chooses to sit can be exercised up to the day on which the examination is taken. Thus a candidate can, on the day of the examination, opt, for example, to take the Ordinary rather than the Higher Level paper. The effect of this 'tiering' is to spread the level of attainment that it is possible to achieve in the ILC from below a Grade E at A Level up to a Grade A at A Level. This broad range of attainment needs to be taken into account when allocating UCAS Tariff Points to the ILC.

For Higher Education admissions purposes in Ireland, marks achieved on either the Higher Level or the Ordinary Level examinations are converted to a common scale. This Central Applications Office (CAO) scale indicates the equivalence between the different grades achieved in the Higher and Ordinary papers, in terms of points as shown in Table 5. The CAO scale can, therefore, be used as a common metric to compare attainment at Higher and Ordinary Levels in the ILC, and is used for this purpose to model the final allocation of UCAS Tariff points to the ILC later in this section.

Table 5: The CAO scale and its relation to the grades obtained in Higher and Ordinary Level examinations.

Grade	Higher Level	Ordinary Level
A1	100	60
A2	90	50
B1	85	45
B2	80	40
B3	75	35
C1	70	30
C2	65	25
C3	60	20
D1	55	15
D2	50	10
D3	45	05

Estimating the relative demand of the two qualifications

In terms of the relative demand of the two qualifications there was some agreement among the subject groups, as is shown in Table 4 in the previous section. ILC Higher Level Grades A2/B1 aligned with Grade A at A Level in two out of three comparisons of examination scripts made by the English Group. In the other case, the judgment of the group was that the Grade A script in the A Level examination would have received a B1/B2 Grade at Higher Level in the ILC examination. The Mathematics Group judged that a Grade A at A Level would align with an ILC Higher Grade A2, with an ILC Grade D3 aligning with an A Level Grade E. However, the English Group judged that scripts awarded Grade E in two A Level units would have been given ILC Ordinary Level grades between B2 and C1. Using the CAO scale this would align the E grades achieved on these English A Level modules below a Higher Level Grade D3. However, the judgment of the English Group was that an overall Grade E at A Level would be similar to attainment at Grade D in the ILC Higher.

The work of both the Chemistry and the Mathematics groups made a distinction between the level of attainment needed to achieve similar grades in AS and A2 units. For example, the Mathematics Group aligned an AS Grade E with an ILC Higher Grade E (a fail grade at Higher Level) and an ILC Ordinary Grade C1. Again using the CAO scale, this level of attainment is below the level of a Grade D3 in the ILC Higher. The Chemistry Group aligned the AS Grade E scripts that they examined with the D2/D3 grade boundary in the ILC Higher. The Chemistry Group also aligned an AS Grade A with the A2/B1 borderline in the ILC Higher. However, both the Mathematics and Chemistry groups agreed that attainment at Grades A and E on the A Level A2 modules would command higher grades in the ILC Higher. Thus both groups judged that an A2 Grade A aligns with the A1/A2 grades in the ILC Higher, and the A2 Grade E with D1 in the Higher. These differences are taken account of when modelling the final allocation of UCAS Tariff Points to the ILC below.

The relative size of the two awards

The UCAS Tariff works by allocating points to a qualification by taking account of both the level of demand expressed through the grading system of the qualification and the volume of study undertaken. The protocol procedures currently require that the size of the qualification seeking entry to the Tariff be assessed relative to the benchmarking award by comparing the study hours needed to complete the qualification, and by careful matching of the content laid out in the specifications or syllabuses of the two awards. An important lesson we have learnt as a result of the work on the ILC is that this process does not work well for subjects such as English where there is a large ‘skills’ component. This reflects the different nature of subjects and the different types of knowledge, skills and understanding that they seek to develop in young people. Work is under way to find a solution to this issue in the application of the protocol.

However, this difficulty does raise an important point for this report. Making a comparison using a benchmarking process, such as the one that underpins the application of the protocol, is only valid between similar subjects in the two **different** qualifications systems; it tells us nothing about the relative size or demand of subjects being examined within the same qualification system. Thus, all we can say is that mathematics within the ILC is more or less like A Level mathematics in terms of demand and volume of study. It would be invalid to say that mathematics is less demanding than English, or more demanding than chemistry, in either the ILC or A Level systems on the basis of the outcomes of the benchmarking procedures used in this study. To make such comparisons between subjects within a qualification system requires a quite different methodology.

The outcome of the deliberations of the English Group was that in terms of the outcomes assessed by the two examinations it was not possible to distinguish between A Level and ILC candidates in terms of the volume of study undertaken. However, though they disagreed about the relative sizes of the two awards, both the Chemistry and Mathematics Groups agreed that the volume of study undertaken by an ILC candidate was less than the volume of study undertaken by an A Level candidate in their respective subjects. This raises a major challenge. An instrument such as the UCAS Tariff would become overly cumbersome, and so less useful to Higher Education admissions tutors, if candidates with similar levels of attainment in different subjects from within the same qualification system were allocated differing numbers of UCAS Tariff points. In addition, it could create perverse incentives to take certain subjects which attract more UCAS Tariff points on the basis of a benchmarking process not designed to compare different subjects within the same qualification system (see above).

In order to resolve this issue, a further meeting was held, attended by members of UCAS and representatives from the Irish Department of Education and Science, the National Council for Curriculum and Assessment and the State Examinations Commission. Largely for pragmatic reasons, it was agreed to set the volume of study represented by a single ILC subject at two thirds of an A Level. This value corresponds exactly with the volume of study estimated by the Chemistry Group and is close to the volume (3.5 units) estimated by the Mathematics Group.

Modelling equivalence between the ILC Higher Level and the A Level

Given that the volume of study for an ILC subject is two-thirds of the volume of study involved in taking an A Level, then this suggests that the maximum number of UCAS Tariff Points that can be allocated to an ILC subject would be 80 (120 x 0.66). However this value needs to be adjusted to take account of demand, a process that has to recognise the differing demands of the AS compared with the A2 papers in the A Level system.

Only the Chemistry and Mathematics Groups made separate judgments for the alignment of ILC Higher Grades with AS and A2 grades (see Table 4 in previous section). From their work we assume that the

- ILC Higher Grade A2/B1 aligns with a Grade A at AS
- ILC Higher Grade D3 aligns with a Grade E at AS
- ILC Higher Grade A1/A2 aligns with a Grade A at A2
- ILC Higher Grade C3/D1 aligns with a Grade E at A2.

In the case of English, whilst the view was that Grade Es on the A Level papers examined would align slightly below an ILC Higher Grade D3, the group did agree that overall an ILC Higher Grade D would align with an A Level Grade E and the ILC Higher Grade A would align with a Grade A at A Level. This is at least in line with the judgments of Chemistry and Mathematics Groups.

We next construct the relationship between the ILC Higher Grades and the AS and A2 grades, assuming a linear relationship between the ILC Grades and the AS/A2 grades. For the AS model we allocated 80 UCAS Tariff Points to the A2 ILC Grade (120 x 0.66) and 26 UCAS Tariff points to the ILC Grade D3 (40 x 0.66). For the A2 model we allocated 80 UCAS Tariff Points to the A1 ILC Grade and 26 UCAS Tariff Points to the D1 ILC Grade. The two relationships so constructed are

AS model: UCAS Tariff Points = 20 + (6 x ILC Grade)

A2 model: UCAS Tariff Points = 5.75 + (6.75 x ILC Grade) with, in both cases, the ILC Grades converted to a scale running from 1 (D3) to 11 (A1).

Finally, we take the mean of the values calculated for each ILC Higher Grade using the above models to reflect the intermediate level of demand of the ILC as reported by the Chemistry expert group. Table 6 gives the number of UCAS Tariff Points allocated to the ILC Higher Grades using these three approaches.

Table 6: The allocation of UCAS Tariff Points to the ILC Higher Grades using three different models

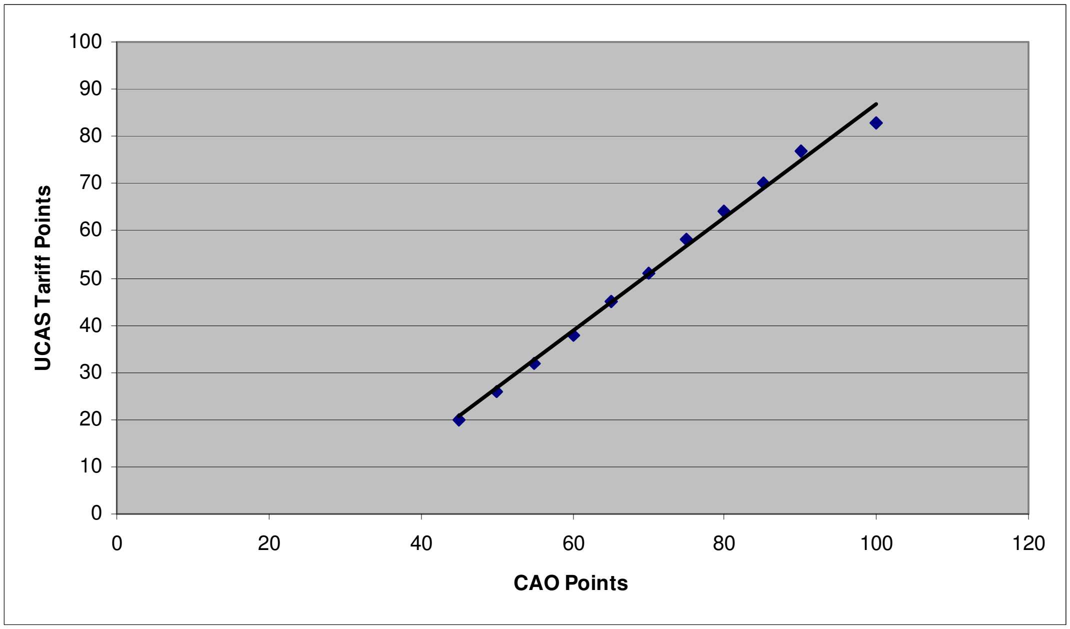
ILC Higher Grade	UCAS Tariff points – AS model	UCAS Tariff points – A2 model	Average of AS and A2 points	Rounded average
A1	86	80	83	83
A2	80	73.25	76.63	77
B1	74	66.5	70.25	70
B2	68	59.75	63.875	64
B3	62	53	57.5	58
C1	56	46.25	51.125	51
C2	50	39.5	44.75	45
C3	44	32.75	38.375	38
D1	38	26	32	32
D2	32	19.25	25.625	26
D3	26	12.5	19.25	20

At the meeting between UCAS and representatives from Ireland it was agreed to adopt the rounded average model as the basis for further modelling using the CAO scale.

Allocating UCAS Tariff Points to the ILC using the CAO scale

For the purpose of establishing the number of UCAS Tariff Points to be allocated to differing levels of attainment at ILC Higher and Ordinary Level, it makes sense to employ the CAO scale as it provides a common metric for both levels of the ILC. Converting the ILC Higher Grades to the equivalent points on the CAO scale, and regressing these values against the UCAS Tariff Points allocated to those Grades in Table 6 above, gives us Figure 1.

Figure 1: The relationship between CAO and UCAS Tariff Points for the ILC Higher Grade.



The anomaly with the A1 grade (100 CAO points) arises because the CAO recognises the extra achievement needed to obtain this grade within the ILC Higher. Preserving this relationship, Table 7 below shows the UCAS Tariff Points allocated by this model to differing levels of achievement in the ILC Higher. Apart from the allocation of 7 extra UCAS Tariff points to the ILC Higher A1 Grade, this new model produces only very minor differences, compared to Table 6, in the allocation of UCAS Tariff Points due to slight changes in rounding.

Table 7: Allocation of UCAS Tariff Points to Higher and Ordinary Grades in the ILC using the CAO Model.

ILC Higher Grade	CAO Points	UCAS Tariff Points	ILC Ordinary Grade	CAO Points	UCAS Tariff Points
A1	100	90			
A2	90	77			
B1	85	71			
B2	80	64			
B3	75	58			
C1	70	52			
C2	65	45			
C3	60	39	A1	60	39
D1	55	33			
D2	50	26	A2	50	26
D3	45	20	B1	45	20
			B2	40	14
			B3	35	7

Extrapolating the relationship shown in Figure 1 downwards gives the allocation of UCAS Tariff points to the ILC Ordinary Grades A1 to B3 shown in Table 7. We feel that this extrapolation is justified on the basis of the judgments made during the benchmarking process by the subject groups. For example, the English Group equated performance at Grade E in an A Level English unit with attainment between grades C1 and B2 in the ILC Ordinary Level, and the Mathematics Group saw attainment at Grade E in an AS unit aligning with grade C1 at Ordinary Level on the ILC. We therefore recommend that, subject to the normal processes of review, UCAS Tariff Points should be allocated to the Irish Leaving Certificate as shown in Table 7.

Modelling possible UCAS Tariff Point scores for ILC Candidates

The tariff works by acknowledging all attainment deemed relevant for progression to Higher Education by allocating points to that attainment. However, an ILC candidate may take six or more subjects so we need to examine the allocation of UCAS Tariff Points to ILC applicants, with differing profiles of achievement using the values from Table 7. Some examples are shown in Table 8 below. Note we have assumed that in each case the candidate has achieved six pass grades at Higher Level. In reality, many candidates will have a mixture of Higher and Ordinary Level passes.

Table 8: The allocation of UCAS Tariff points to hypothetical grade profiles of ILC candidates using all 4 models developed in this paper.

ILC Grades	UCAS Tariff points – AS model	UCAS Tariff points – A2 model	Average of AS and A2 points	CAO model
A1A1A1A1A1A1	516	480	498	540
A1A1A1A2A2A2	498	460	480	501
A2A2A2A2A2A2	480	440	462	462
A2A2A2B1B1B1	462	419	441	444
B1B1B1B1B1B1	444	399	420	426
B1B1B1B2B2B2	426	379	402	405
B2B2B2B2B2B2	408	359	384	384
B2B2B2B3B3B3	390	338	366	366
B3B3B3B3B3B3	372	318	348	348
B3B3B3C1C1C1	354	298	327	330
C1C1C1C1C1C1	336	278	306	312
C1C1C1C2C2C2	318	257	288	291
C2C2C2C2C2C2	300	237	270	270
C2C2C2C3C3C3	282	217	249	252
C3C3C3C3C3C3	264	197	228	234
C3C3C3D1D1D1	246	176	210	216
D1D1D1D1D1D1	228	156	192	198
D1D1D1D2D2D2	210	136	174	177
D2D2D2DD2D2D2	192	116	156	156
D2D2D2D3D3D3	174	95	138	138
D3D3D3D3D3D3	156	75	120	120

Adopting the CAO model, a top ILC candidate gaining 6 Grade A1s would receive 540 UCAS Tariff Points. By comparison an A Level student gaining 4 Grade As at A Level would receive 480 UCAS Tariff Points. However, in 2003, out of a total candidature of 59,525 only 101 candidates (less than 0.2%) achieved 6 ILC Higher Grade A1s. Indeed, only 0.86% of the candidature in 2003 achieved 6 ILC Higher Grade As. An A Level student with twenty one units (1AS, plus 3 A Levels) at Grade C would receive 280 UCAS Tariff Points, a similar number to the ILC student gaining 6 Grade C2s. The weakest ILC candidate in Table 8 above, with 6 Grade D3s, would receive, on the basis of the CAO model, 120 UCAS Tariff Points, the same as an A Level student gaining 3 Grade Es. Thus, the CAO model does appear to have some face validity in that students with similar levels of attainment in the two systems would be allocated a similar number of UCAS Tariff Points.

APPENDIX 1

CURRICULA VITAE

Edexcel Chief Examiner for Mathematics	Gordon Skipworth
ILC Mathematics, Examinations and Assessment Manager	Hugh McManus
HE representative for Mathematics	Andy Walker
OCR Chair of Examiners for Chemistry	Helen Eccles
ILC Chemistry, Chief Advising Examiner, Ordinary Level	Terrence White
ILC Chemistry, Assistant Examiner Higher Level	Declan Cahalane
HE representative for Chemistry	Gordon McDougall
AQA Principal Examiner for English	Andy Archibald
ILC English, Chief Examiner	Raymond Fawley
ILC English, Chief Examiner Higher Level	Alec MacAlister
HE representative for English	Anne McCartney

Curriculum Vitae

Gordon E Skipworth

Qualifications:	B.Sc.	University of Bradford, 1964
	F.S.S.	1964
	A.F.I.M.A	1968
	C.Stat	1993
	F.I.M.A.	
	C.MATH	1993

Employment:	1964-66	Research Assistant, University of Hull
	1966-67	Lecturer in Mathematics, Wolverhampton Polytechnic
	1967-69	Lecturer in Statistics, Sheffield Polytechnic
	1969-72	Research Officer, University of Hull
	1972-89	Senior Lecturer in Statistics, Teesside Polytechnic
	1989-93	Head of Access and Continuing Education, Teesside Polytechnic/University of Teesside
	1993-96	Head of Ralph Ward Jackson Centre for Higher Education, Hartlepool College of FE (secondment from University of Teesside)
	1996-	Self employed – Examiner, Author, Lecturer

Consultancy:
- Heinemann Education Books Ltd
- E J Arnold Ltd
- Black and Decker
- Tees, Hartlepool, Tyne and Wear Pilotage Authorities
- Publishers Association
- McCain Foods

Professional Activities: 1969- Assistant Examiner, UCLES, Mathematics/Statistics

1976-1981	Assistant Examiner, AEB, O level Statistics
1982-1988	Chief Examiner, AEB, O level Statistics
1988-1995	Chief Examiner, AEB, A level Statistics
1982-1996	Chief Examiner/Principal Examiner, ULEAC, A/O Applied Statistics/A level Statistics
1997-	Chief Examiner, Edexcel, GCE Statistics

Curriculum Vitae

Name:
Hugh McManus, M.A., H.Dip.Ed.

Education:
Second level:
1979 - 85: Belvedere College, S.J. 6 Great Denmark Street, Dublin 1.

Undergraduate:
1985 - 89: Trinity College Dublin – B.A.(mod.) in Mathematics (1st hons.)

Postgraduate:
1989 - 90: Trinity College Dublin – H. Dip. Ed. (Higher Diploma in Education) (1st hons.)
1995 - 97: University College, Cork – M.A. in Curriculum Studies, Mathematics (1st hons.)

Appointments held:
1990 - 98: *Secondary School Teacher* at Sacred Heart Secondary School, Clonakilty, teaching mathematics, applied mathematics, technology, and computer studies. *Mathematics Coordinator* for three years.

1998 - March 2003: *Postprimary Inspector* with the Department of Education and Science. Until March 2003, the postprimary inspectorate was responsible for the preparation of the state examination papers and the management of the marking process.

Dec 2000 - June 2001: *Education Specialist* with the World Bank, Washington DC, (on secondment from Department of Education and Science). Working on a project to provide, primarily through the World Bank website, support to policy makers in the developing world on the design, administration and reform of Public Examination Systems.

March 2003 - date: *Examinations and Assessment Manager* with the State Examinations Commission.

Principal current responsibilities:
Management of Leaving Certificate Mathematics examinations. Membership of working parties on security issues in examination paper preparation, and on development of training for professional contract staff. Co-ordinating the development of R&D capacity in the commission.

Research interests:
Cross-subject and longitudinal comparability in public examinations.
Measuring various types of reliability in public examinations.

Curriculum Vitae

Name: A. N. Walker, MA, PhD, FRAS, MBCS. **Age:** 60
Family: Married, two children

Education:
1953-61: Nottingham High School.
1961-65: Cambridge University (Sidney Sussex College), BA Mathematics, and Mathematics Tripos, part III.
1965-8: Manchester University, PhD Astronomy.

Appointments held:
1968-9: Temporary Assistant Lecturer, Department of Applied Mathematics, Liverpool University.
1969-date: Lecturer, School of Mathematical Sciences (formerly Department of Mathematics), Nottingham University.

Principal current responsibilities:
Admissions Tutor for Single Honours [2000-date] [previously Admissions panel 1972-85, AT for Jt Hons Maths/CS 1985-97, and for Jt Hons Maths/Econ 1997-2000].
Examinations Officer for Honours Courses [2002-date].
Member of University Senate [1997-date].

Principal research interests:
Game theory [esp computer chess].
Algorithms [esp those associated with above, eg tree searching].
Computing [Unix, algorithms].
Astrophysics [evolution of binary star systems].
Automation of various academic activities [algorithms -- eg for timetabling, exam mark processing, setting and marking worksheets].

Academic Qualifications
Ph.D. University of Cambridge
B.Sc. ARCS Imperial College of Science and Technology, University of London
PGCE University of Cambridge
Fellow, Royal Society of Chemistry
Associate Fellow, Clare College Cambridge
Fellow, Cambridge Philosophical Society

Present Employment

Assistant Director, Quality and Standards Division, OCR.

Recent Previous Experience

Chair of Examiners, Science, OCR.
This post carried responsibility for the quality and standards of all general qualifications in science subjects.

Hills Road Sixth Form College, Cambridge
At this leading sixth form college Dr Eccles was an A-level Chemistry Teacher.

Homerton College, University of Cambridge
Dr Eccles taught on the B.Ed course, the Science Conversion Course PGCE and the JYA course.

Education

Dr Eccles received her education at Loughborough High School and Queen Anne's Grammar School for Girls, York.

CURRICULUM VITAE

PERSONAL	
Name	Terence White
EDUCATION	
Second Level	Waterpark College Waterford (1960-'66)
Third Level	University College Cork (1966-'71)
QUALIFICATIONS	BSc (Honours) – 1970 (Chemistry - Hons, Mathematics – Pass) Higher Diploma in Education (Hons) - 1971
TEACHING	Midleton College, Co. Cork (1970-'71) Waterpark College, Waterford (1971-'78) St Paul's Community College, Waterford (1978-'99)
SECONDMENT	Leaving Certificate Chemistry Support Service (1999-2002)
PRESENT	Headmaster of Presentation Secondary School, Wateford
EXAMINATION WORK	Chief Advising Examiner for Chemistry at Leaving Certificate Ordinary Level

Declan Cahalane

Post-Primary Inspector
Department of Education and Science, Block 3, Marlborough Street, Dublin 1.

Qualifications

B.Sc. (University College Cork) 1983
Higher Diploma in Education (University College Cork) 1984
M. Science Education (University College Cork) 2002

Work Experience

Teacher of Chemistry, Biology, Science and Mathematics, Coláiste an Chroi Naofa, Carraig na bhFear, Co. Cork. 1984 - 1999
National Coordinator, Chemistry Support Service 1999 - 2002
Assistant Examiner, Junior Certificate Science and Leaving Certificate Chemistry 1990-2001

Gordon Shepherd M^{c}Dougall

Curriculum Vitae
(June 2001)

Qualifications / Employment

First Degree	Bachelor of Science with first class Honours in Chemistry Faculty of Science, Glasgow University, 1977-1981
Postgraduate	Doctor of Philosophy, School of Chemical Sciences, University of East Anglia, Norwich NR4 7TJ, 1981-1984.
Postdoctoral Research	Science & Engineering Research Council Postdoctoral Fellowship, Department of Chemistry, Queen Mary College, Mile End Road, London E1 4NS, 1984-1985
Employment	Lecturer, Department of Chemistry, Edinburgh University Jan'86, Senior Lecturer 1996
External	Contracted to Learning and Teaching Scotland to produce and deliver a series of seminars to Chemistry teachers in support of the introduction of the Principles of Chemicals Reactions Unit of the Advanced Higher (1999-00) Conducted 'in service day' seminar on AH material for Dumfries and Galloway District Council Education Dept. (Dec '00) Physical Chemistry Revision 'Master Class' for Higher Chemistry students (Edinburgh and Lothian Region) (April '01)

Research

Research Area	Surface Chemistry and Catalysis: preparation, characterisation and of catalyst materials and i*n situ* studies of reaction over both high surface area and single crystal catalyst materials using vibrational spectroscopy and associated techniques.

Outside recognition/contribution:

Examiner for PhD theses, Dundee, Coleraine, York, Nottingham, Strathclyde, Hull, QMWC and UMIST. Invited to give lectures most recently at Dundee 2001 and the RSC/ICE joint meeting on in situ methods Edinburgh March 2000 and previously:- Liverpool IRC in Surface Chemistry, Royal Society of Edinburgh, IRDG meeting QMWC, Coleraine. Consultancies with Ethicon, Proctor and Gamble, Tioxide, Gasgen, Rotech.

Organise meetings of the Scottish Universities Catalysis Groups (SURCAT Ecosse) and the annual Edinburgh/Dundee/Glasgow catalysis Firbush meeting, Secretary to the Surface Reactivity and Catalysis Group of the RSC, Social Secretary, Local Section, Royal Society of Chemistry, Treasurer, Local Section, Royal Society of Chemistry.

ANDY ARCHIBALD

EXAMINING:

	Principal Examiner – Unit 2 AQA GCE English Lang. & Lit. Spec B.
1996-2001	Assistant Examiner/ Team Leader AQA Eng. Lang & Lit. (0623)
2001-	Assistant Examiner UCLES English Lang/1 O level

TEACHING EXPERIENCE:

2000-01	Royal Russell School, Croydon: A Level/ GCSE English
1993-99	Trinity School, Croydon: A Level/ GCSE English
1991-92	University of Houston: BA. English classes.
1978-91	Dulwich College, London SE21: Drama/ A Level / GCSE English.
1974-77	Whitgift School, Croydon: English teacher (A level).
TEFL/ ESL	
1997-99	Language Solutions, London: EFL Business Teaching.
1995-00	Hong Kong Summer Language School, Bromley: Centre Head.
1973-74	Executive Language School, Tokyo: EFL Teacher.

EDUCATION:

1999-00	University College, London: M.A.Phonetics.
1992-93	University of Sussex: M.A. English Lit.
1991-92	University of Houston: M.A. Eng.Lit. /Creative Writing.
1989-89	University of Houston: B.A. Drama classes
1988-88	Marble Arch Institute, London: RSA Certificate: TEFL.
1969-73	Loughborough University: B.Ed.(Hons.2:1) Eng.Lit/Phys.Ed./Ed.

Raymond Frawley

Employment Experience Summary

Following an initial teaching career in secondary education in Ireland, Raymond Frawley spent 15 years working as an inspector for English with the Department of Education and Science. During that period much of his work was concerned with revision and renewal of the English syllabuses for post-primary schools, and he devised and directed an action research project to chart developments in the English curriculum. In addition, he was chief examiner for English in the State Examinations and was responsible for significant innovations in this work. He had an extensive role in the delivery of in-career development programmes for post-primary teachers.

Raymond was seconded to the European Schools in Luxembourg for a nine-year period. In addition to teaching duties, he was a member of a central expert group charged with the development of the syllabus and the examination system for the European Baccalaureate. At the end of his period of secondment, he returned to Ireland to take up duty as an inspector in the Department of Education and Science.

Qualifications

1970	BA(Hons) English Language and Literature University College Dublin
1971	Higher Diploma in Education(Hons) University College Dublin
1976	M ED.(Hons) University College Cork

Employment History

1999 – present	Senior Inspector, Department of Education and Science
1990 –1999	Seconded to European School Luxembourg
1975 –1990	Inspector Department of Education and Science
1971 – 1975	Secondary School Teacher

Curriculum Vitae.

Alec MacAlister.

Chief Examiner (external) for English at Leaving Certificate (Ordinary Level) Sate Examinations Commission, Ireland.

Career Experience Summary.

Having qualified as a Secondary teacher in 1973, Alec MacAlister taught English for 25 years at Colāiste Choilm, a private voluntary secondary school for boys in north county Dublin. His interest in curriculum development began early in his career as a result of experience working in a streamed environment. In 1977 he joined the team of examiners for English at the Department of Education Leaving Certificate Examinations. Between 1989 and 1993, he was involved with the Department of Education national team of trainers established to introduce a revised curriculum in English for the junior cycle of secondary school. During this time, he became a tutor with the Marino Institute of Education's action research teacher development programme. In 1995 he was seconded on a full-time basis to the Transition Year Support Service to work with another system wide curriculum innovation. In 1997 he was appointed as a trainer to the Teaching English Support Service to introduce a revised English curriculum for senior cycle students. During these secondments, he continued to work with the Department of Education Examinations being promoted to Advising Examiner for Ordinary Level English in 1994, and in 1997, to Chief Advising Examiner for Ordinary Level English a management position he now holds with the State Examinations Commission. His responsibilities include the development of marking schemes and materials: the maintenance of standardised marking, and the day to day management of personnel and processes during the marking period in June – July.

Qualifications.

1972 BA in English and Philosophy (ethics), University College Dublin, (National University of Ireland)
1973 1973 Higher Diploma and Education, University College Dublin, (National University of Ireland)
1986 Diploma in Educational Administration, Maynooth University, (National University of Ireland)
1997 M.Ed. University of the West of England, Bristol / Marino Institute of Education

Curriculum Vitae

Name: **Evelyn Anne McCartney**

School Languages & Literature , University of Ulster, Coleraine

Position: British Academy Joint Institutional Research Fellow

Academic and Professional Qualifications/Membership:

D.Phil. University of Ulster 1994
M.A. (With Distinction) 1988
B.A. (Hons) English & Philosophy 1986

Member of The Society for the History of Authorship, Readership and Publishing
International Association for the Study of Irish Literatures
Society for the Study of 19th Century Ireland

Teaching Disciplines:
English, Irish Literature in English, Critical Theory, American Literature, Gender Studies, Film Studies

Current Responsibilities:
Director of Admissions, Faculty of Arts
Acting Head of Research Graduate School, Faculty of Arts
English Admissions Tutor

Professional Activities Outside the University:
Member of the Advisory Committee for the Arts, Humanities and Social Sciences of the British Library
Advisor, History of the Book in Scotland, 19c volume.
Advisor, UCAS Benchmark Committee

Research Interests:
Irish Literature in English (all periods but particularly 19c and contemporary); Women's literature (all nationalities) ; Critical Theory; Book history.

On-Going Projects and Publications

History of the Irish Book
Editor of 19c Volume of *A History of the Irish Book* (to be published by Oxford University Press)
Currently Editing – To go to OUP Dec 2003

Double-Take: A Joint Swedish-Irish Project with Dr Heidi Hansson on 19c Irish Women Writers

Publications
- *Out of Context: 19c Irish Women Writers* - Currently Editing to be completed by September 2003 (Presently being considered by Cork University Press)
- *Behind the Book: A Study of Emily Lawless* Almost complete – 3 chapters remaining. (To be published by Ashgate Press USA)
- *Beleaguered Fields: The Land War in Irish Fiction* (Four Courts Press)
- Canvassing Complexities: A Feminist Reading of Harriet Martin' to be published in Haberstroh, P. and St. Peter, C., *Feminist Approaches to Irish Literature,* Maunsell & Co., Maryland (To be published 2004)
- 'And Other Stories: Feminising Irish Short Fiction' (Presently with reader for *The Canadian Journal of Irish Literature*)
- 'Blacklists and Redemptions: The Publishing History of Francis Stuart' in *Twentieth Century Irish Book History* (Dublin: Irish Academic Press, 2002)
- 'Waking from the Dark: Women and Political Change in Northern Ireland' *Humanities and Sciences* (Kobe: Kobe-Gakuin University Press, 2001)
- 'Gender and Genre: Feminising the Irish Short Story', *Fortnight* (Belfast, 2001)
- *Francis Stuart – Face to Face: A Critical Study* (Belfast: IIS Press, 2000)

APPENDIX 2

EVIDENCE EXAMINED FOR THE ILC AND GCE A LEVEL

Syllabuses and specifications:

ILC syllabuses

Mathematics, 1992
Chemistry, 2000
English, 1992

GCE A Level Specifications

Edexcel Specification for GCE A Level Mathematics, July 2002
OCR Specification for GCE A Level Chemistry, June 2002
AQA Specification A for GCE A Level English Language and Literature, 2003

Examination papers and marking schemes

ILC documents

Mathematics paper and marking scheme, June 2002
Chemistry paper and marking scheme, June 2002
English papers and marking schemes, June 2002

GCE A Level documents

Edexcel Mathematics examination papers and marking schemes, June 2002
OCR Chemistry examination papers and marking schemes, June 2002
AQA English examination papers and marking schemes, June 2002

Candidate materials

A selection of candidate scripts from all of the above examinations was available for scrutiny. Those selected for the comparative grading exercises are detailed in Section 4 of the report.

APPENDIX 3

This section contains the following appendices:

3.1 Mapping of content of ILC Higher Level Mathematics and Edexcel GCE A Level (A2 and AS) Mathematics (Algebra and Calculus details only)

3.2 Analysis of teaching time for content present only on one or other of the Mathematic awards

3.3 Mapping of ILC Higher Level Chemistry to GCE A Level Chemistry

NB: Various mapping exercises were produced for English, but, in the light of the findings of the English Group, it was not thought helpful to reproduce them here.

APPENDIX 3.1

Content of ILC Higher mathematics and Edexcel AL (A2 and AS) mathematics (Algebra and Calculus details only)

	ILC Higher	Edexcel AL
Structure	Core plus one option	AL - Six units out of choice of 20, three at AS level and three at A2 level AS – Three units out of choice of 20, level not restricted (p3) or two at AS and one at A2 (p12)
Content	Core consists of: Algebra Geometry Trigonometry Sequences and series Functions and calculus Discrete mathematics and statistics Options include: Further calculus and series Further probability and statistics Groups Further geometry	Example of three AS and three A2 units (P1, P2, P3, M1, S1, S2) P1 (AS) consists of: Proof Algebra Trigonometry Coordinate geometry in the (x, y) plane Sequences and series Differentiation and integration P2 (A2) consist of: Algebra and functions Functions Sequences and series Trigonometry Exponentials and logarithms Differentiation Integration Numerical methods P3 (A2) consists of: Algebra Coordinate geometry in the (x, y) plane Series Differentiation Integration Vectors M1 (AS) consists of: Mathematical models in mechanics Vectors in mechanics Kinematics of a particle moving in a straight line Dynamics of a particle moving in a straight line or plane Statics of a particle Moments S1 (AS) consists of: Mathematical models in probability and statistics Representation and summary of data Probability Correlation and regression Discrete random variables Discrete distributions Normal distribution S2 (A2) consists of: Binomial and Poisson distributions Continuous random variables Continuous distributions Samples

		Hypothesis tests
Aims	Personal development Mathematical knowledge, skills & understanding (pi)	As objectives
Objectives	A Knowledge B Instrumental understanding (know how & when) C Relational understanding (concepts & interpretation) D Application (in familiar contexts) E Psycho-motor & communicative skills F Appreciation of mathematics G Analysis (proof, modelling, problem-solving) H Creativity I Awareness of history of mathematics (pp2, 3)	A understanding → confidence & enjoyment B logical reasoning, generalisation & mathematical proof C extension of skills to more difficult unstructured problems D coherence & progression in mathematics – connections E mathematical modelling of real world situations F mathematics as effective communication G comprehension of mathematical arguments H skills to use technology & recognise its limitations I relevance of mathematics to other fields J responsibility for own learning (p6)
Rationale	Aimed at more able students – mathematical specialists for careers or further study Emphasis on problem-solving, abstracting, generalising & proving (p5)	
Teaching time		
Age	No age limit, typically 18 years old	No age limit, typically 17 or 18 years old
Assessment	Two 2½ hour externally set papers (5 hours) No apparent grade descriptions	One 1½ hour externally set paper per unit (A2 - 6 papers, 9 hours) (AS – 3 papers, 4.5 hours). All papers equally weighted In S3 and S6 one project is also required Grade descriptions for Grades A, C, E (pp86, 87)
	Assessment objectives are fundamental objectives A, B, C, D, E (above) interpreted in the context of: • deepened understanding of mathematical ideas • appreciation of powerful concepts & methods • ability to solve problems, abstract & generalise & prove specified results • competency in algebraic manipulation (p5)	Assessment objectives for P1, P2, P3 (min weight) AO1 knowledge of facts, concepts and techniques (30%) AO2 argument, proof and inference, problems in unstructured (30%) AO3 knowledge, understanding and interpretation of models (10%) AO4 understanding realistic contexts translated into mathematics, predictions, arguments, applications (5%) AO5 use of technology & its limitations (5%) (p7) Synoptic assessment of connections between different elements of the subject (20% of the assessment) (p9)
Grading	13 Grades A1, A2, B1, B2, B3, C1, C2, C3, D1, D2, D3, E, F (for set % range of marks)	Five Grades A – E for qualification Unit results also reported (p16)
Prior knowledge	Junior Certificate Higher	At least Grade C in GCSE & covered all material in the Intermediate Tier. In addition, a list of assumed background knowledge

ILC Higher		Edexcel AL	
Algebra 1 Core	Algebraic operations on polynomials & rational functions. Addition, subtraction, multiplication and division and use of brackets and surds. (Use of Remainder Theorem not required)	P1 Algebra P2 Algebra P3 Algebra	Use & manipulation of surds Algebraic manipulation of polynomials, including expanding brackets and collecting like terms Identities. Algebraic division Simplification of rational expressions including factorising and cancelling Rational functions. Decomposition of rational functions into partial fractions The Remainder Theorem applied to polynomials with real coefficients
	Laws of indices and logarithms	P1 Algebra	Laws of indices for all rational components
	The Factor Theorem for polynomials of degree two or three (formal proof may be examined)	P1 Algebra	Factorisation; use of the Factor Theorem
	Factorisation of such polynomials (linear and quadratic factors having integer coefficients)	P1 Algebra	Quadratic functions and their graphs The discriminant of a quadratic function
	Solution of cubic equations with at least one integer root	P1 Algebra	Completing the square. Solution of quadratic equations
	Sums and products of roots of quadratic equations (Cubics excluded)		
Algebra 2 Core	Unique solution of simultaneous linear with two or three unknowns (Sets of equations with non-unique solutions or no solutions excluded)	P1 Algebra	Solution of simultaneous equations. Analytical solution by substitution
	Solution of one linear and one quadratic equation with two unknowns		
Algebra 3 Core	Inequalities: solution of inequalities of the form $g(x) < k$, $x \in R$, where $g(x) = ax^2 + bx + c$ or $g(x) = (ax + b)/(cx + d)$	P1 Algebra	Solution of linear and quadratic inequalities
	Use of the notation x|; solution of $x – a < b$		
Algebra 4 Core	Complex numbers: Argand diagram; +, -, ×, ÷; modulus; conjugate, conjugates of sums & products, conjugate root theorem		
	De Moivre's theorem: prrof by induction for $n \in Z$; applications such as nth roots of unity, $n \in Q$ and identities such as $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$		
Algebra 5 Core	Proof by induction of simple identities such as the sum of the first n integers and the sum of a geometric series, simple inequalities such as $n! \geq 2^n$, $2^n \geq n^2$ $(n \geq 4)$, and $(1 + x)^n \geq 1 + nx$ $(x \geq -1)$, and factorisation results such as: 3 is a factor of $4^n – 1$		
Algebra 6 Core	Matrices: dimension, 1 × 2, 2 × 1, and 2 × 2 matrices; addition; multiplication by a scalar; product		
	Properties: addition of matrices is commutative, multiplication of matrices is not necessarily commutative		
	Identities for addition and multiplication. Inverse of a 2 × 2 matrix		
	Application to solution of two linear equations in two unknowns		
Functions and calculus 1 Core Functions	Finding the period and range of a continuous periodic function, given its graph on scaled and labelled axis		
	Informal treatment of limits of functions; rules for sums, products and quotients		
Functions and calculus 2 Core Differential	Derivations from first principles of x^2, x^3, sin x, cos x, $\sqrt{x}$, and 1/x		

calculus			
	First derivatives of: polynomials, rational, power and trigonometric functions $\tan^{-1}$, $\sin^{-1}$, exponential and logarithmic functions sums, products, differences, quotients, compositions of these	P1 P2 P3	Algebraic differentiation of x^p, where p is rational Differentiation of e^x, l_n x and their sums and differences Differentiation of sin x, cos x, tan x and their sums and differences, products and quotients
	Proof by induction that $(d/dx)(x^n) = nx^{n-1}$		
	Application to finding tangents to curves	P2	Applications of differentiation to tangents and normals to a curve
	Simple second derivatives	P1	Second order derivatives. Increasing and decreasing functions
	First derivatives of implicit and parametric functions	P3	Differentiation of simple functions defined implicitly or parametrically
	Rates of change	P1	The derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at a point; the gradient of the tangent as a limit; interpretation as a rate of change
	Maxima and minima	P1	Application of differentiation to gradients, maxima and minima and stationary points
	Curve sketching of polynomials and of functions of form a/(x+b) and x/(x+b), with reference to turning points, points of inflection, asymptotes		
	Newton-Raphson method for finding approximate roots of cubic equations		
Functions and calculus 3 Core Integral calculus	Integration techniques (integrals of sums, multiplying constants, and substitution) applied to: x^n sin nx, cos nx, $\sin^2$nx, $\cos^2$nx e^{nx} functions of the form $1/(x+a)$, $1/(a^2+x^2)$, $1/\sqrt{(a^2-x^2)}$, $\sqrt{(a^2-x^2)}$	P1 P2 P3	Indefinite integration as the reverse of differentiation The general and particular solution of dy/dx = f(x) Integration of x^p, where p is rational, $p \neq 1$ Integration of e^x, 1/x and their sums and differences Integration of sin x, cos x and related functions Simple cases of integration by substitution and integration by parts. These methods as the reverse process of the chain and product rules respectively Simple cases of integration using trigonometrical identities
	Definite integrals with applications to areas and volumes of revolution (confined to cones and spheres)	P1 P2	Evaluation of definite integrals. Interpretation of the definite integral as the area under a curve Evaluation of volume of revolution about one of the coordinate axes
Further calculus and series 1 Option	Maximum & minimum: applications to problems		
2	Integration by parts	P3	integration by parts
3	The ratio test confined to series of the form $\sum a_n x^n$		
4	n^{th} derivatives; Maclaurin series for $(1+x)^2$, e^x, $\log_e(1+x)$, cos x, sin x, $\tan^{-1}$ x		
5	Series expansion of π, using $\tan^{-1} x + \tan^{-1} a = \tan^{-1} (x+a)/(1-xa)$ (|ax < 1)		
		P3	Analytical solution of simple first order differential equations with separable variables
		P3	Differentiation using the product rule, the quotient rule, the chain rule and by the use of dy/dx = 1/(dx/dy)
		P3	Exponential growth and decay
		P3	Formation of simple differential equations
		P3	The area under a curve when the curve is given parametrically as either an algebraic or a trigonometric formula
		P3	Simple cases of integration using partial fractions

Analysis of teaching time

Teaching time	Teaching time as a %	Not covered by ILC Higher- Core + Option 1	Not covered by A level P1, P2, P3	Teaching time	Teaching time as a %
		P1 Trigonometry			
2 weeks	10%	Trig functions in radians and degrees – graphs, symmetries and periodicity.			
		P2 Trigonometry			
N/A		Knowledge of secant, cosecant and cotangent			
N/A		Knowledge and use of $1 + \tan^2\theta \equiv \sec^2\theta$, $1 + \cot^2\theta \equiv \operatorname{cosec}^2\theta$, $\cot\theta \equiv \frac{\cos\theta}{\sin\theta}$			
	2%	Knowledge of expressions for $a\cos\theta + b\sin\theta$ in the equivalent forms of $r\cos(\theta \pm \alpha)$ or $r\sin(\theta \pm \alpha)$.			
		P2 Functions			
As above		Simple transformations on the graph of $y=f(x)$ as represented by $y=af(x)$, $y=f(x)+a$, $Y=f(x+a)$, $y=f(ax)$ and combinations of these transformations			
		P2 Exponentials and logarithms			
2 weeks	10%	The function a^x, $a > 0$, and its graph			
		P2 Numerical methods			
	2%	Numerical integration of functions			
		P2 Differentiation	**Differentiation**		
	N/A	Applications of differentiation to normals to a curve	* Proof by induction that $d/dx\,(x^n) = nx^{n-1}$	N/A	
		P3 Differentiation			
As above		Exponential growth and decay			
As above		Formation of simple differential equations			

		P2 Integration	**Integration**		
	2%	Evaluation of volume of revolution about one of the coordinate axes – restricted to cones and spheres	Functions of form $1/(a^2+x^2)$, $1/\sqrt{(a^2-x^2)}$, $\sqrt{(a^2-x^2)}$	1 week	5%
		P3 Integration			
	N/A	Simple cases of integration by substitution and integration by parts understanding that as the reverse process of the chain and product rules respectively.			
1 week	5%	The area under a curve when the curve is given parametrically as either an algebraic or a trigonometric formula			
2 weeks	10%	Simple cases of integration using partial fractions			
As above		Analytical solution of simple first order differential equations with separable variables			
		P3 Algebra	**Algebra**		
1 week	5%	Decomposition of rational functions into partial fractions	Complex numbers: Argand diagram; addition, subtraction, multiplication, division, modulus, conjugate, conjugates of sums and products; conjugate root theorem.	3 weeks	15%
			Proof by induction of simple identities such as the sum of the first n integers and the sum of a geometric series, simple inequalities such as $n! >= 2^n$, $2^n >= n^2$ (n>=4), and $(1+x)^n >= 1+nx$ (x>-1), and factorisation results such as: 3 is a factor of 4^n-1.	2 weeks	10%
			De Moivre's theorem: proof by induction for n Є Z.; applications such as nth roots of unity, n Є q, and identities such as $\cos 3\theta = 4\cos^3 \theta - 3 \cos \theta$	As above	
	2%	The remainder theorem applied to polynomials with real coefficients other than the factor theorem.	Matrices: dimension, 1x2, 2x1 and 2x2 matrices; addition; multiplication by a scalar; product.	As above	
		P3 Coordinate geometry in the *(x,y)* plane	**Transformation geometry**		
2 weeks	10%	Cartesian and parametric equations of curves and conversion between the two forms – restricted, other than lines and circles.	Each transformation f of the plane M which has the coordinate form (x,y) → (x',y',) where x' = ax+by, y' = cx+dy, and ad-bc ≠ 0, maps each line to a line, each line segment to a line segment, each pair of parallel lines to a pair of parallel lines, and consequently each parallelogram to a parallelogram. Examples of the invariance or non-variance of	2 weeks	10%

			perpendicularity, distance, ratio of 2 distances, area, and ratio of two areas connected with specific parallelograms (including rectangles and squares) under transformations of the form: $x' = ax + by$ $y' = cx + dy$ with numerical coefficients		
		P3 Vectors			
2 weeks	10%	Vectors in three dimensions.			
As above		Vector equations of lines			
			Sequences and series		
			Sums of infinite series such as Σnx^n.	1 week	5%
			The ratio test confined to series of the form $\sum a_n x^n$.	1 week	5%
			Nth derivatives; Maclaurin series for $(1+x)^2$, e^x, $\log_e(1+x)$, cos x, sin x, $\tan^{-1}x$.	2 weeks	10%
			Series expansion of π, using $\tan^{-1}x.+ \tan^{-1}a = \tan^{-1}$ (x+a)/1-xa)	As above	
			Discrete maths and statistics		
			Discrete probability; simple cases, with probability treated as relative frequency. For equally likely outcomes probability equals (number of outcomes of interest)/(number of possible outcomes).	GCSE	- 2%
			Statistics: calculations and interpretation of weighted mean and standard deviation.	As above	
			Difference equations: if a and b are the roots of the quadratic equation $px^2 +qx+r = 0$, and $s_n = la^n + mb^n$ for all n, then $ps_{n+2} + qs_{n+1} + rs_n = 0$ for all n.	1 week	5%

Total: 68%

Total: 63%

APPENDIX 3.3

Mapping the content of the OCR and Irish Leaving Certificate Chemistry Content

A Preliminary Analysis

The comparison made is of the core content only and does not include the optional courses that learners in both qualifications can take. This means that 5.5 units of the OCR specification are mapped against 9 units of the ILC Higher syllabus.

The level of overlap is very high with the vast majority of the ILC sitting inside the OCR specification. For the purposes of bench marking this is extremely encouraging.

OCR	Irish Leaving Certificate Higher Level
2 Specification Aims The aims of these Advanced Subsidiary GCE and Advanced GCE specifications in chemistry are to encourage students to: . develop essential knowledge and understanding of the concepts of chemistry, and the skills needed for the use of these in new and changing situations; . develop an understanding of the link between theory and experiment; . be aware of how advances in information technology and instrumentation are used in chemistry; . appreciate the contributions of chemistry to society and the responsible use of scientific knowledge and evidence; . sustain and develop their enjoyment of, and interest in, chemistry. In addition, the aims of the Advanced GCE specification encourage students to: . bring together knowledge of ways in which different areas of chemistry relate to each other. **3 Assessment Objectives** Knowledge, understanding and skills are closely linked. These specifications require that candidates demonstrate the following assessment objectives in the context of the content and skills prescribed. Assessment Objectives AO1–AO3 are the same for Advanced Subsidiary GCE and Advanced GCE; AO4 applies only to the A2 part of the Advanced GCE course. . Assessment objectives AO1–AO3 are tested using the context of the content and skills within each teaching module. . Assessment objective AO4 will be tested using contexts which bring together content and skills from different teaching modules. **AO1 Knowledge with understanding** Candidates should be able to: (a) recognise, recall and show understanding of specific chemical facts, terminology,	The objectives of the syllabus are: 1. Knowledge Students should have knowledge of • basic chemical terminology, facts, principles and methods • scientific theories and their limitations • social, historical, environmental, technological and economic aspects of chemistry 2. Understanding Students should understand • how chemistry related to everyday life • scientific information in verbal, graphical and mathematical form • basic chemical principles • how chemical problems can be solved • how the scientific method applies to chemistry 3. Skills Students should be able to • follow instructions given in a suitable form • perform experiments safely and co-operatively • select and manipulate suitable apparatus to perform specific tasks • make accurate observations and measurements • interpret experimental data and assess the accuracy of experimental results 4. Competence Students should be able to • Translate scientific information in verbal, graphical and mathematical form • Organise chemical ideas and statements and write clearly about chemical concepts and theories • Report experimental procedures and results in a concise, accurate and comprehensible manner • Explain both familiar and unfamiliar phenomena by applying known laws and principles • Use chemical facts and principles to make chemical predictions • Perform simple chemical calculations • Identify public issues and misconceptions relating to chemistry and analyse them critically.

principles, concepts and practical techniques; (b) draw on existing knowledge to show understanding of the responsible use of chemistry in society; (c) select, organise and present relevant information clearly and logically, using specialist vocabulary where appropriate. **AO2 Application of knowledge and understanding, analysis, synthesis and evaluation** Candidates should be able to: (a) describe, explain and interpret phenomena and effects in terms of chemical principles and concepts, presenting arguments and ideas clearly and logically, using specialist vocabulary where appropriate; (b) interpret and translate, from one form into another, data presented as continuous prose or in tables, diagrams and graphs; (c) carry out relevant calculations; (d) apply chemical principles and concepts to unfamiliar situations, including those related to the responsible use of chemistry in society; (e) assess the validity of chemical information, experiments, inferences and statements. **AO3 Experiment and investigation** Candidates should be able to: (a) devise and plan experimental and investigative activities, selecting appropriate techniques; (b) demonstrate safe and skilful practical techniques; (c) make observations and measurements with appropriate precision and record these methodically; (d) interpret, explain, evaluate and communicate the results of their experimental and investigative activities clearly and logically using chemical knowledge and understanding, and using appropriate specialist vocabulary. In addition, when planning practical activities, candidates should use their own chemical knowledge and suitable reference sources to: (e) identify any hazards in the chemicals to be used or made, or in the procedures to be followed; (f) evaluate how likely it is that the hazard will actually cause harm and, if so, how serious the harm would be; (g) identify appropriate control measures (e.g. fume cupboard, eye protection, protective gloves, extinguishing naked flames). **AO4 Synthesis of knowledge, understanding and skills** In addition, for A2, candidates should be able to: (a) bring together knowledge, principles and concepts from different areas of chemistry, including experiment and investigation, and apply them in a particular context, expressing ideas clearly and logically and using appropriate specialist vocabulary; (b) use chemical skills in contexts which bring together different areas of the subject.	5. Attitudes Students should appreciate • Advances in chemistry and their influences on our lves • That the understanding of chemistry contributes to the social and economic development of society • The range of vocational opportunities that use chemistry, and how chemists work

5.1 Module 2811: Foundation Chemistry	1. Periodic Table and Atomic Structure
5.1.1 Atoms, Molecules and Stoichiometry **Content** . Relative masses of atoms and molecules. . The mole, the Avogadro constant. . The determination of relative atomic masses, *Ar*, from mass spectra. . Chemical equations. . The calculation of empirical and molecular formulae. . The calculation of reacting masses, mole concentrations and volumes of gases. **Assessment outcomes** (The term relative formula mass or *Mr* will be used for ionic compounds.) Candidates should be able to: (a) define the terms relative atomic, isotopic, molecular and formula masses, based on the 12C scale. (b) describe the basic principles of the mass spectrometer limited to ionisation, acceleration, deflection and detection. . *Limited to ions with single charges.* . *Detailed knowledge of the mass spectrometer is **not** required.* (c) outline the use of mass spectrometry (i) in the determination of relative isotopic masses; (ii) as a method for identifying elements, for example: use in Mars space probe. (d) interpret mass spectra in terms of isotopic abundances. (e) calculate the relative atomic mass of an element given the relative abundances of its isotopes, or its mass spectrum. (f) define the mole in terms of the Avogadro constant; molar mass as the mass of 1 mole of a substance. (g) define the terms empirical formula and molecular formula. (h) calculate empirical and molecular formulae, using composition by mass. (i) construct balanced chemical equations (full and ionic). (j) perform calculations (including use of the Mole Concept, formulae and equations) involving (i) reacting masses; (ii) volumes of gases; (iii) volumes and concentrations of solutions in simple acid-base titrations. (k) deduce stoichiometric relationships from calculations such as those in (j).	**1.2 Atomic Structure** Relative atomic mass (A_r). The ^{12}C scale for relative atomic mass. **2.1 Chemical Compounds.** Simple chemical formulas. **3.3 The Mole** Avogadro constant. The mole as the SI unit for amount of substance containing the Avogadro number of particles. Standard temperature and pressure (s.t.p.) Molar volume at s.t.p., molar mass, relative molecular mass (M_r). **3.4 Chemical Formulas** Empirical and molecular formulas. Percentage composition by mass. **3.5 Chemical Equations** Chemical equations. Balancing simple chemical equations. Calculations based on balanced equations using the mole concept (balanced equations will be given for all calculations). **7.5 Chromatography and Instrumentation in Organic Chemistry** Instrumental methods of separation or analysis, or both: Mass spectrometry Brief reference to the principles … Interpretation of spectra etc, **not** required).
5.1.2 Atomic Structure **Content** . The nucleus of the atom: protons and neutrons, atomic (proton) and mass (nucleon) numbers. . Ionisation energies. . Electrons: electronic energy levels, atomic orbitals, electronic configuration. **Assessment outcomes** Candidates should be able to: (a) recognise and describe protons, neutrons and electrons in terms of relative charge andrelative mass. (b) describe the distribution of mass and charge within an atom. (c) describe the contribution of protons and neutrons to the nucleus of an atom, in terms of atomic number and mass number.	**1.2 Atomic Structure** Matter is composed of particles which may be atoms, molecules or ions Atoms. Minute size of atoms. Law of Conservation of Mass. Properties of electrons, protons and neutrons (relative mass, relative charge, location within atom). Atomic number (z), mass number (A), isotopes; hydrogen and carbon as examples of isotopes. **1.4 Electronic Structure of Atoms** Energy levels in Atoms. Classification of the first twenty elements in the periodic table on the basis of the number of outer electrons. Energy sub-levels Atomic orbitals. Shapes of s and p orbitals.

(d) deduce the numbers of protons, neutrons and electrons in (i) an atom given its atomic and mass number; (ii) an ion given its atomic number, mass number and ionic charge. (e) distinguish between the isotopes of an element in terms of their different masses and different numbers of neutrons. (f) explain the terms first ionisation energy and successive ionisation energy of an element in terms of 1 mole of gaseous atoms or ions (see also 5.1.4(e), (f)). (g) explain that ionisation energies are influenced by nuclear charge, electron shielding and the distance of the outermost electron from the nucleus. (h) predict the number of electrons in each principal quantum shell of an element from its successive ionisation energies. (i) describe the shapes of s- and p- orbitals. (j) describe the numbers and relative energies of s-, p- and d- orbitals for the principal quantum numbers 1, 2, 3 and also the 4s- and 4p- orbitals. (k) deduce the electronic configurations of (i) atoms, given the atomic number, up to *Z*=36; (ii) ions, given the atomic number and ionic charge, limited to s and p blocks up to *Z* = 36. . *Candidates should use sub-shell notation, i.e. for oxygen: 1s22s22p4.*	*Emission and absorption spectra of the hydrogen atom – Balmer series in the emission spectrum as an example?.* *Line spectra as evidence for energy levels.?*
5.1.3 Chemical Bonding and Structure **Content** . Ionic bonding. . Covalent bonding and dative covalent (co-ordinate) bonding. . The shapes of simple molecules. . Electronegativity and bond polarity. . Intermolecular forces. . Metallic bonding. . Bonding and physical properties. **Assessment outcomes** Candidates should be able to: (a) describe ionic bonding as the electrostatic attraction between two oppositely-charged ions. (b) describe, including the use of 'dot-and-cross' diagrams, ionic bonding, for example, as in sodium chloride and magnesium oxide. (c) describe, in simple terms, the lattice structure of sodium chloride. (d) describe a covalent bond as a shared pair of electrons. (e) describe, including the use of 'dot-and-cross' diagrams, (i) covalent bonding, for example, as in hydrogen, chlorine, oxygen, hydrogen chloride,water, ammonia, methane, carbon dioxide and ethene; (ii) dative covalent (co-ordinate) bonding, for example, as in the ammonium ion. (f) explain the shapes of, and bond angles in, molecules and ions by using the qualitative model of electron-pair repulsion for up to 4 electron pairs (including lone pairs), for example, as in BF3 (trigonal), CO2 (linear), CH4 and NH4 + (tetrahedral), NH3 (pyramidal) and H2O (nonlinear). (g) predict the shapes of, and bond angles in, molecules and ions analogous to those specified in (f). (h) appreciate that, between the extremes of ionic and covalent bonding, there is a gradual transition from one extreme to the other. (i) describe electronegativity as the ability of an atom to attract the bonding electrons in a covalent bond. (j) explain that	**2.1 Chemical compounds** Compounds. Simple chemical formulas. **2.2 Ionic bonding** Positive and negative ions. Minute size of ions. Ionic bonding as electron transfer. Sodium chloride crystal structure. Characteristics of ionic substances. **2.3 Covalent bonding** Molecules. Minute size of molecules. Covalent bonding as the sharing of pairs of electrons. Single, double and triple covalent bonds. Distinction between sigma and pi bonding. Polar and non-polar covalent bonding. Characteristics of covalent substances. **2.4 Electronegativity** Electronegativity differences and polarity of bonds. **2.5 Shapes of molecules and intermolecular forces** Shapes of some simple molecules. Using electron pair repulsion theory to explain shapes of molecules of type AB_n for up to four pairs of electrons round the central atom (refer to bond angles). (Shapes of molecules with pi bonds not to be considered). Relationship between symmetry and polarity in a molecule (dipole moments not required). Distinction between intramolecular bonding and intermolecular forces. Intermolecular forces: van der Waals'. Dipole-dipole, hydrogen bonding. Effect of the intermolecular forces on the boiling point of a covalent substance.

(i) bond polarity may arise when covalently-bonded atoms have different electronegativities; (ii) polarisation may occur between cations of high charge density and anions of low charge density. (k) describe intermolecular forces based on permanent dipoles, as in hydrogen chloride, and instantaneous dipoles (van der Waals' forces), as in the noble gases. (l) describe hydrogen bonding between molecules containing –OH and –NH groups, typified by water and ammonia. (m) describe and explain the anomalous properties of water resulting from hydrogen bonding, for example: (i) the density of ice compared with water; (ii) its relatively high freezing point and boiling point. (n) describe, in simple terms, the giant molecular structures of diamond and graphite. (o) describe metallic bonding, present in a giant metallic lattice structure, as the attraction of a lattice of positive ions to a sea of mobile electrons. (p) describe, interpret and/or predict physical properties, for example: melting and boiling points, electrical conductivity and solubility in terms of (i) the types, motion and arrangement of particles (atoms, molecules and ions) and the forces between them; (ii) the different types of bonding (ionic bonding, covalent bonding, hydrogen bonding, other intermolecular interactions, metallic bonding). (q) deduce the type of bonding present from given information.	

5.1.4 The Periodic Table: Introduction **Content** . The structure of the Periodic Table in terms of groups and periods. . Periodicity of physical properties of elements. **Assessment outcomes** Candidates should be able to: (a) describe the Periodic Table in terms of the arrangement of elements (i) by increasing atomic number; (ii) in periods showing repeating trends in physical and chemical properties; (iii) in groups having similar physical and chemical properties. (b) describe, for the elements of Period 3, the variation in electronic configurations, atomic radii, electrical conductivities, melting points and boiling points. (c) explain variations in (b) in terms of the structure and bonding of the elements. (d) classify the elements into s-, p- and d- blocks. (e) interpret successive ionization energies of an element in terms of its position in the Periodic Table (see also 5.1.2(f)–(h)). (f) describe and explain the variation of the first ionization energies of elements shown by (i) a decrease down a group in terms of increasing atomic radius and electron shielding; (ii) a general increase across a period, in terms of increasing nuclear charge; (iii) the periodic decrease between Groups 2 and 3, in terms of the higher energy level of the p sub-shell compared with that of the s sub-shell; (iv) the periodic decrease between Groups 5 and 6, in terms of an increase in energy from mutual repulsion of paired electrons in a Group 6 p-orbital. *. Periodic trends in ionization energies will consider s and p blocks only.* (g) interpret data on electronic configurations, atomic radii, electrical conductivities, first ionization energies, melting points and boiling points to demonstrate periodicity.	**1.1 Periodic Table** Elements. Symbols of elements. The periodic table as a list of elements arranged so as to demonstrate trends in their physical and chemical properties. Brief statements of the principal resemblances of elements within each main group, in particular alkali metals, alkaline earth metals, halogens and noble gases. **1.4 Electronic Structure of Atoms** Classification of the first twenty elements in the periodic table on the basis of the number of outer electrons. Building up of the electronic structure of the first 36 elements. Arrangement of electrons in individual orbitals of p-block atoms. Atomic radii. Explanations for general trends down and across groups. First ionisation energies. Explanations for general trends in values down a group and across a period, and for exceptions to the general trends across a period. Second and successive ionisation energies. Evidence for energy levels provided by successive ionisation energy values. Electronic configuration of ions of s- and p-block elements. Dependence of chemical properties of elements on their electronic structure. Explanations in terms of atomic radius, screening effects and nuclear charge for general trends in properties of elements in groups I and VII

5.1.5 The Periodic Table: The Group 2 elements and their compounds **Content** . Similarities and trends in the properties of the Group 2 metals magnesium to barium and their compounds. . Oxidation number. . Redox processes as electron transfer and changes in oxidation number. . The relative reactivity of the Group 2 elements. . Trends in some reactions of Group 2 compounds. **Assessment outcomes** Candidates should be able to: (a) describe and explain the trends in electronic configurations, atomic radii and ionization energies of the Group 2 elements, Mg to Ba. (b) use the rules for assigning oxidation state (number) with elements, compounds and ions. (c) describe oxidation and reduction in terms of (i) electron transfer; (ii) changes in oxidation state. (d) describe the redox reactions of the elements (Mg to Ba) with oxygen and with water and explain the trend in reactivity in terms of ionisation energies. (e) describe the reactions of Mg, MgO and MgCO3 with hydrochloric acid (see also 5.3.3(f), (g)). (f) describe the thermal decomposition of CaCO3 (limestone) to form CaO (lime) and the subsequent formation of Ca(OH)2 (slaked lime) with water. (g) describe lime water as an aqueous solution of Ca(OH)2 and state its approximate pH. (h) describe the reaction of lime water (i) with carbon dioxide forming CaCO3(s); (ii) with excess carbon dioxide, forming Ca(HCO3)2(aq), as in hard water. (i) interpret and make predictions from the chemical and physical properties of the Group 2 elements and their compounds. (j) show awareness of the importance and use of Group 2 elements and their compounds, with appropriate chemical explanations, for example: the use of Ca(OH)2 in agriculture to neutralise acid soils; the use of Mg(OH)2 in some indigestion tablets as an antacid.	**1.5 Oxidation and Reduction** Introduction to oxidation and reduction: simple examples only, e.g. Na with Cl_2, Mg with O_2, Zn with Cu^{2+} Oxidation and reduction in terms of loss and gain of electrons. The electrochemical series as a series of metals arranged in order of their ability to be oxidisied (reactions, other than displacement reactions, not required).
5.1.6 The Periodic Table: The Group 7 elements and their compounds **Content** . Similarities and trends in the properties of the Group 7 non-metals chlorine to iodine. . Characteristic physical properties. . The relative reactivity of the elements. . Characteristic reactions of halide ions. . The reaction of chlorine with water and with sodium hydroxide . **Assessment outcomes** Candidates should be able to: (a) explain the trend in the volatilities of chlorine, bromine and iodine in terms of van der Waals' forces. (b) describe the relative reactivity of the elements Cl2, Br2 and I2 in displacement reactions. (c) explain the trend in (b) in terms of oxidising power, i.e. the relative ease with which an electron can be captured. (d) describe the characteristic reactions of the ions Cl–, Br– and I– with aqueous silver ions followed by aqueous ammonia (knowledge of complex formulae **not** required). (e) describe and interpret, in terms of changes in oxidation state, (i) the reaction of chlorine with water, as used in water purification to prevent lifethreatening	

diseases; (ii) the reaction of chlorine with cold, dilute aqueous sodium hydroxide, as used to form bleach.	

5.2 Module 2812: Chains and Rings	
5.2.1 Basic Concepts **Content** . Representing formulae of organic compounds. . Functional groups and the naming of organic compounds. . Structural and *cis-trans* isomerism. . Percentage yields. **Assessment outcomes** Candidates should be able to: (a) interpret, and use the terms: nomenclature, molecular formula, general formula, structural formula, displayed formula, skeletal formula, homologous series and functional group. . Nomenclature should follow IUPAC rules for naming of organic compounds, for example: 3-methylhexane for CH3CH2CHCH3CH2CH2CH3. . A general formula is used to represent any member of a homologous series, for example: CnH2n+2 for an alkane. . A structural formula is accepted as the minimal detail, using conventional groups, for an unambiguous structure, for example: CH3CH2CH2CH3 for butane, not C4H10 (the molecular formula). . A displayed formula should show both the relative placing of atoms and the number of bonds between them. The displayed formula for ethanoic acid is shown below. C C O O H H H H . A skeletal formula is used to show a simplified organic formula by removing hydrogen atoms from alkyl chains, leaving just a carbon skeleton and associated functional groups. The skeletal formula for butan-2-ol is shown below. OH . In structural formulae, the carboxyl group will be represented as COOH and the ester group as COOR. . The symbols below for cyclohexane and benzene are acceptable. (b) describe and explain (i) structural isomerism in compounds with the same molecular formula but different structural formulae; (ii) *cis-trans* isomerism in alkenes, in terms of restricted rotation about a double bond. (c) determine the possible structural and/or *cis-trans* isomers of an organic molecule of given molecular formula. (d) perform calculations, involving use of the Mole Concept and reacting quantities, to determine the percentage yield of a reaction (see also 5.1.1(j) ,(k)).	**3.4 Chemical formulas** Structural formulas. **3.5 Chemical Equations.** Percentage yields **5.2 Structure of aliphatic hydrocarbons** Alkanes, alkenes and alkynes as homologous series.

5.2.2 Hydrocarbons: Alkanes **Content** . Physical properties of alkanes. . Chemical reactions of alkanes. [For simplicity, this module refers to substitution reactions of methane. It is more convenient to use a liquid alkane in practical work. For example, cyclohexane can be used to demonstrate the reactions specified below.] See also 5.2.3 Hydrocarbons: Fuels. **Assessment outcomes** Candidates should be able to: **5.** state that alkanes are saturated hydrocarbons. (b) explain, in terms of van der Waals' forces, the variations in boiling points of alkanes with different carbon chain length and branching. I describe the lack of reactivity of alkanes, in terms of the non-polarity of C–H bonds. (d) describe the chemistry of alkanes, typified by the following reactions of methane: **5.** combustion (see also, 5.2.3I); (ii) substitution by chlorine and by bromine to form halogenoalkanes. (e) describe how renasic fission leads to the mechanism of free-radical substitution in alkanes, typified by methane and chlorine, in terms of initiation, propagation and termination reactions. . Candidates are not required to use 'half curly arrows' in this mechanism. Equations should clearly show which species are free radicals using a single 'dot' to represent the unpaired electron.	**5.2 Structure of Aliphatic Hydrocarbons** Systematic names, structural formulas and structural isomers of alkanes to C-5. Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents]. **7.1 Tetrahedral carbon** Saturated organic compounds. Alkanes. **7.3 Organic Chemical Reaction Types (a) Substitution Reactions** *Students are not, in general, required to know the conditions (temperature, pressure, catalyst, solvent) for these reactions except where specified in this syllabus. They are required to be able to write balanced equations for the reactions, using structural formulas, unless otherwise indicated.* Halogenation of alkanes. Mechanism of free radical substitution (monochlorination of methane and ethane only) Evidence for this mechanism: (i) use of ultraviolet light even for very short period causes a chain reaction; (ii) formation of trace quantities of ethane and butane in the monochlorination of methane and ethane respectively); (iii) these reactions are speeded up by addition of a known source of free radicals, such as tetraethyllead
5.2.3 Hydrocarbons: Fuels **Content** . Crude oil as a source of organic chemicals. . Cracking, isomerisation and reforming. . Hydrocarbons as fuels. **Assessment outcomes** Candidates should be able to: **5.** explain the use of crude oil as a source of hydrocarbons (separated by fractional distillation) which can be used directly as fuels or for processing into petrochemicals. (b) describe the use of **5.** cracking to obtain more useful alkanes and alkenes; (ii) isomerisation to obtain branched alkanes; **5.** reforming to obtain cycloalkanes and renas. I describe and explain how the combustion reactions of alkanes (see also, 5.2.2(d)) lead to their use as fuels in industry, in the home and in transport. (d) state that branched alkanes, cycloalkanes and renas are used in petrol to promote efficient combustion (see also, 5.2.5(g), alcohols as fuels; 5.3.2(i)–(k), catalytic converters). (e) outline **5.** the value to society of fossil fuels in relation to needs for energy and raw materials; (ii) the non-renewable nature of fossil fuel reserves; **5.** the need to develop renewable fuels, for example biofuels, which do not further deplete finite energy resources.	**5.1 Sources of hydrocarbons** Coal, natural gas and petroleum as sources of hydrocarbons. **5.4 Exothermic and Endothermic Reactions** Combustion of alkanes and other hydrocarbons. **5.5 Oil refining and products** Fractionation of crude oil. Production of the refinery gas, light gasoline, naptha, kerosene, gas oil and reside fractions.

5.2.4 Hydrocarbons: Alkenes
Content
. Reactions of alkenes.
. Polymers.
. Industrial importance of alkenes.
[For simplicity, this module refers to reactions of ethene and propene. It is more convenient to use a liquid alkene in practical work. For example, cyclohexene can be used to demonstrate the reactions specified below.]
See also 5.2.3 Hydrocarbons: Fuels.
Assessment outcomes
Candidates should be able to:
(a) state that alkenes are unsaturated hydrocarbons.
(b) state and explain the bonding in alkenes in terms of the overlap of adjacent p-orbitals to form a π-bond.
. *Treatment in terms of hybridisation is* ***not*** *required.*
(c) state and explain the shape of ethene and other related molecules (see also 5.1.3(f)).
(d) describe the chemistry of alkenes, for example, by the addition reactions of ethene and propene with:
(i) hydrogen in the presence of a suitable catalyst, for example Ni, to form alkanes;
(ii) halogens to form dihalogenoalkanes, including the use of bromine to detect the presence of a double C=C bond as a test for unsaturation;
(iii) hydrogen halides to form halogenoalkanes;
(iv) steam in the presence of an acid catalyst, for example H3PO4, to form alcohols (see also 5.2.5(b)).
. *Candidates are expected to realise that addition to an unsymmetrical alkene such as propene may result in two isomeric products. However candidates will* ***not*** *be required to predict the relative proportions of these isomers,* ***nor*** *to apply or explain Markovnikoff's rule.*
(e) define the term electrophile as an electron pair acceptor.
(f) describe how heterolytic fission leads to the mechanism of electrophilic addition in alkenes, typified by bromine and ethene to form 1,2-dibromoethane.
. *Candidates should show 'curly arrows' in this mechanism and include any relevant lone pairs and dipoles.*
(g) describe the addition polymerisation of alkenes, for example: ethene and propene.
(h) deduce the repeat unit of an addition polymer obtained from a given monomer.
(i) identify, in a given section of an addition polymer, the monomer from which it was obtained.
(j) outline the use of alkenes in the industrial production of organic compounds, typified by:
(i) the manufacture of margarine by catalytic hydrogenation of unsaturated vegetable oils using hydrogen and a nickel catalyst;
(ii) the formation of a range of polymers using unsaturated monomer units based on the ethene molecule, for example, CH2CHCl, CF2CF2 (see also, 5.2.6(f)).
(k) outline the difficulties in disposing of polymers, for example: non-biodegradability or toxic combustion products.
(l) outline, for waste polymers, the movement towards
(i) recycling,
(ii) combustion for energy production,
(iii) use as a feedstock for cracking in the production of useful organic compounds.
(m) outline the role of chemists in minimising damage to the environment by, for example, the removal of toxic waste products (such as HCl) during disposal by combustion of halogenated plastics (such as *pvc*) (see also, 5.2.6(f)).

5.2 Structure of Aliphatic Hydrocarbons

Systematic names, structural formulas and structural isomers of alkenes to C-4.

Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents].

7.2 Planar carbon

Unsaturated organic molecules. Alkenes: non-polar double bond.

7.3 Organic Chemical Reaction Types (a) Addition Reactions

Students are not, in general, required to know the conditions (temperature, pressure, catalyst, solvent) for these reactions except where specified in this syllabus. They are required to be able to write balanced equations for the reactions, using structural formulas, unless otherwise indicated.

Alkenes – reactions with hydrogen, chlorine, bromine, water and hydrogen chloride.

Mechanisms of ionic addition (addition of HCl, Br_2, Cl_2, only to ethane)

Evidence for this mechanism: reaction of ethane with bromine water containing sodium chloride results in the formation of 2-bromoethanol, 1-bromo-2-chloroethane and 1,2-dibromoethane

Polymerisation reaction (of ethane and propene only – reaction mechanism not required).

(f) Organic synthesis: principles and examples

Chemical synthesis involves (i) bond breaking and (ii) bond forming.

Example of organic synthesis: PVC from ethane (structures [sic]

<table>
<tr>
<td>
5.2.5 Alcohols
Content
. Preparation of ethanol.
. Properties of alcohols.
. Reactions of alcohols.
. Infra-red absorption of O.H and C=O bonds.
Assessment outcomes
Candidates should be able to:
(a) explain, in terms of hydrogen bonding, the water solubility and the relatively low volatility of alcohols.
(b) describe and explain the industrial production of ethanol by
(i) fermentation from sugars, for example glucose;
(ii) the reaction of steam with ethene in the presence of H3PO4 (see also 5.2.4(d)).
(c) describe the classification of alcohols into primary, secondary and tertiary alcohols.
(d) describe the chemistry of alcohols, typified by the following reactions of ethanol:
(i) combustion;
(ii) substitution using HBr (e.g. NaBr/H2SO4) to form a bromoalkane;
(iii) reaction with sodium to form a sodium alkoxide and hydrogen;
(iv) dehydration with hot, concentrated sulphuric acid or hot pumice/Al2O3 to form an alkene;
(v) esterification with carboxylic acids in the presence of an acid catalyst.
(e) describe the action of Cr2O72./H+ (e.g. K2Cr2O7/H2SO4) on alcohols, typified by
(i) the oxidation of primary alcohols to form aldehydes and carboxylic acids, and the control of the oxidation product using different reaction conditions;
(ii) the oxidation of secondary alcohols to form ketones;
(iii) the resistance to oxidation of tertiary alcohols.
. In equations for organic oxidation reactions, the symbol [O] is acceptable.
(f) identify, using an infra-red spectrum,
(i) an alcohol from absorption of the O.H bond;
(ii) a carbonyl compound from absorption of the C=O bond;
(iii) a carboxylic acid from absorption of the C=O bond and broad absorption of the O.H bond.
. [In examinations, infra-red absorption data will be provided on the Data Sheet (see page 132).]
. Candidates will only be required to use an infra-red spectrum as an analytical tool to show the presence of O .H and C=O bonds in alcohols and theiroxidation products. No background theory will be tested. Infra-red spectroscopy is built upon in Section 5.4.7(a) of the A2 module: Chains, Rings and Spectroscopy.
(g) outline the use of:
(i) ethanol in alcoholic drinks, as a solvent in the form of methylated spirits, and as a fuel, particularly as a petrol substitute in countries with limited oil reserves;
(ii) methanol as a petrol additive to improve combustion and its increasing importance as a feedstock in the production of organic chemicals.
(See also, 5.2.3(d), petrol as a fuel).
</td>
<td>
7.1 Tetrahedral Carbon

Alcohols: structure and nomenclature up to C-4.

Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents].

7.2 Planar Carbon

Carboxylic acids: polar double bonds.

7.3 Organic Chemical Reaction Types (c) Elimination Reactions

Students are not, in general, required to know the conditions (temperature, pressure, catalyst, solvent) for these reactions except where specified in this syllabus. They are required to be able to write balanced equations for the reactions, using structural formulas, unless otherwise indicated.

Dehydration of alcohol

7.3 Organic Chemical Reaction Types (d) Redox Reactions

Alcohols: Oxidation using $KMnO_4$ or Na Cr_2O_7 to (i) aldehydes and (ii) acids (half equations only required).

Combustion of alcohols.

7.3 Organic Chemical Reaction Types (e) Reactions as Acids

Reactions of alcohols with sodium

7.5 Chromatography and Instrumentation in Organic Chemistry

Infra-red absorption spectrophotometry (IR) as a finger printing technique involving absorption of infra-red radiation (reference to molecular vibrations not required).
</td>
</tr>
</table>

5.2.6 Halogenoalkanes **Content** . Reactions of halogenoalkanes. . Relative strength of carbon–halogen bonds. . Uses of halogenoalkanes and synthetic importance. **Assessment outcomes** Candidates should be able to: (a) describe substitution reactions of halogenoalkanes, typified by the following reactions of bromoethane: (i) hydrolysis with hot aqueous alkali to form alcohols; (ii) reaction with excess ethanolic ammonia to form primary amines. (b) define the term nucleophile as an electron pair donor. (c) describe the mechanism of nucleophilic substitution in the hydrolysis of primary halogenoalkanes. *. Candidates should show 'curly arrows' in this mechanism and include any relevant lone pairs and dipoles.* (d) explain the rates of hydrolysis of primary halogenoalkanes in terms of the bond enthalpies of carbon–halogen bonds (C–F, C–Cl, C–Br and C–I). (See also 5.3.1(f).) *. aqueous silver nitrate in ethanol can be used to compare these rates.* (e) describe the elimination of hydrogen bromide from halogenoalkanes, typified by bromoethane, with hot ethanolic sodium hydroxide. (f) outline the uses of (i) fluoroalkanes and fluorohalogenoalkanes, for example: chlorofluorocarbons, CFCs (refrigerants, propellants, blowing polystyrene, dry cleaning, degreasing agents); (ii) chloroethene and tetrafluroethene to produce the plastics *pvc* and *ptfe*. (See also 5.2.4(g)–(m)) and 5.4.6(a).) (iii) halogenoalkanes as synthetic intermediates in chemistry. (g) outline the role of chemists in minimising damage to the environment by, for example, the development of alternatives to CFCs so that depletion of the ozone layer (see also 5.3.2 (i), (l))can be reversed. *The equations will **not** be tested in Unit 2812.)*	**7.1 Tetrahedral Carbon** Chloroalkanes: structure and nomenclature up to C-4. Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents]. **7.3 Organic Chemical Reaction Types (c) Elimination reactions** Non-flammability of fully halogenated alkanes.
5.3 Module 2813, Component 01: How Far, How Fast?	
5.3.1 Enthalpy changes **Content** . Enthalpy changes: *.H* of reaction, formation, combustion. . Bond enthalpy. . Hess's Law and enthalpy cycles. **Assessment outcomes** Candidates should be able to: (a) explain that some chemical reactions are accompanied by enthalpy changes, principally in the form of heat energy; the enthalpy changes can be exothermic (ΔH, negative) or endothermic (ΔH, positive). (b) recognise the importance of oxidation as an exothermic process, for example, in the combustion of fuels and the oxidation of carbohydrates such as glucose in respiration. (c) recognise that endothermic processes require an input of heat energy, for example, the thermal decomposition of calcium carbonate (see also 5.1.5(f)) and in photosynthesis. (d) construct a simple enthalpy profile diagram for a reaction to show the difference in the enthalpy of the reactants compared with that of the products. (e) explain chemical reactions in terms of enthalpy changes associated with the breaking and	**5.4 Exothermic and endothermic reactions** Chemical reactions can result in a change in temperature. Exothermic and endothermic reactions (and changes of state). Heat of reaction (general term) Sign of ΔH Bond energy (concept only – no calculation except for the illustrative example indicated, the C-H bond energy in methane) Hess's law

making of chemical bonds. (f) explain and use the terms: (i) *enthalpy change of reaction* and *standard conditions*, with particular reference to formation and combustion; . *standard conditions can be considered as 100 kPa and a stated temperature, e.g. 298 K.* (ii) *average bond enthalpy* (ΔH positive; bond breaking of 1 mole of bonds). (g) calculate enthalpy changes from appropriate experimental results directly, including the use of the relationship: energy change = *mc.T*. (h) use Hess's Law to construct enthalpy cycles and carry out calculations using such cycles and relevant enthalpy terms, with particular reference to enthalpy changes that cannot be found by direct experiment, for example: (i) an enthalpy change of formation from enthalpy changes of combustion; (ii) an enthalpy change of reaction from enthalpy changes of formation; (iii) an enthalpy change of reaction from average bond enthalpies.	
5.3.2 Reaction rates **Content** . Simple collision theory. . Effect of temperature and concentration on reaction rate. . Activation energy. . Use of catalysts. **Assessment outcomes** Candidates should be able to: (a) describe qualitatively, in terms of collision theory, the effect of concentration changes on the rate of a reaction. (b) explain why an increase in the pressure of a gas, increasing its concentration, may increase the rate of a reaction involving gases. (c) explain qualitatively, using the Boltzmann distribution and enthalpy profile diagrams, what is meant by the term *activation energy*. (d) describe qualitatively, using the Boltzmann distribution, the effect of temperature changes on the rate of a reaction. (e) explain what is meant by a *catalyst*. (f) describe catalysts as having great economic importance, for example: in fertiliser production (see also 5.3.3(c), (d)), petroleum processing (see also 5.2.3(b)) and margarine production (see also 5.2.4(j)). (g) explain that, in the presence of a catalyst, a reaction proceeds via a different route, i.e. one of lower activation energy, giving rise to an increased reaction rate. (h) interpret the catalytic behaviour in (g) in terms of the Boltzmann distribution and enthalpy profile diagrams. (i) state what is meant by (i) homogeneous catalysis, for example: H+(aq) in esterification (see also 5.2.5(d)) and chlorine free radicals with ozone (see also (l) below); (ii) heterogeneous catalysis, for example: Fe in the Haber process (see also 5.3.3(c)) and Rh/Pt/Pd in catalytic converters (see also (k) below). (j) for carbon monoxide, oxides of nitrogen and unburnt hydrocarbons: (i) describe their presence and/or formation from the internal combustion engine; (ii) state their environmental consequences in terms of low-level ozone and photochemical smog (equations not required). (k) outline, as an example of heterogeneous catalysis, how a catalytic converter decreases carbon monoxide and nitrogen monoxide emissions from internal combustion engines (see	**6. 1. Reaction Rates** Rates of reaction **6.2 Factors affecting Rates of Reaction** Concentration. Particle size. Nature of reactants. Catalysts. Activation energy and influence of temperature on the rate of reaction using reaction profile diagrams. Surface adsorption and intermediate formation theories of catalysis; the effect of catalysts on activation energies.

also 5.3.2(i); 5.7.1(h)) by: (i) adsorption of carbon monoxide and nitrogen monoxide to the catalyst surface; (ii) chemical reaction; (iii) subsequent desorption of carbon dioxide and nitrogen from the catalyst surface. . *Candidates should understand that bonding to the catalyst surface must be weak enough for adsorption/desorption to take place but strong enough to weaken bonds and allow reaction to take place.* (l) outline, as an example of homogeneous catalysis, how gaseous chlorine free radicals, formed by the action of ultraviolet radiation on CFCs, catalyse the breakdown of the gaseous ozone layer into oxygen (see also 5.2.2(g); 5.2.6(g); 5.7.1(e)) by a reaction route via ClO radicals (as the intermediate), for example: Cl + O3 . ClO + O2; ClO + O . Cl + O2. . *No equations will be required beyond a simple representation of this catalysis such as that shown in the equations above.* . *Note that O is continuously being formed in the stratosphere by the action of ultraviolet radiation on O2 and O3. This will* ***not*** *be tested in this unit 2813, (component 01).*	
5.3.3 Chemical Equilibrium **Content** . Chemical equilibria: reversible reactions, dynamic equilibria. . Factors affecting chemical equilibria in terms of le Chatelier's principle. . Industrial processes: the Haber process. . Acid-base equilibria: strong and weak acids. **Assessment outcomes** Candidates should be able to: (a) explain the features of a *dynamic equilibrium*. . *Reference should be made to the need for a closed system, the equal rates of the forward and reverse reactions and the constancy of macroscopic properties.* (b) state le Chatelier's principle and apply it to deduce qualitatively (from appropriate information) the effect of a change in temperature, concentration or pressure, on a homogeneous system in equilibrium. (c) describe and explain the conditions used in the Haber process for the formation of ammonia, as an example of the importance of a compromise between chemical equilibrium and reaction rate in the chemical industry. (d) outline the importance of ammonia and nitrogen compounds derived from ammonia, for example, fertilizers, polyamides and explosives. (e) describe an acid as a species that can donate a proton. (f) describe the reactions of an acid, typified by hydrochloric acid with metals, carbonates, bases and alkalis (see also 5.1.5(e)). (g) interpret the reactions in (f) using ionic equations to emphasise the role of H+(aq). (h) explain qualitatively, in terms of dissociation, the differences between strong and weak acids. (i) describe ammonia as a base, in terms of its reaction with an acid (e.g. sulphuric acid) to form ammonium salts, used in fertilizers.	**8.1 Chemical equilibrium** Reversible reactions – dynamic equilibrium. At equilibrium, the rate of the forward reaction equals the rate of the reverse reaction. Equlibrium law and constant (K_c only). Le Chatelier's principle. Effect (if any) on equilibrium position of concentration, pressure, temperature and catalyst. **4.2 Acids and Bases** Acids, bases and salts. Neutralisation – formation of a salt from an acid and a base. Arrhenius and Brønsted-Lowry theoires of acids and bases (for aqueous solutions only). Conjugate acid-base pairs.

5.4 Module 2814: Chains, Rings and Spectroscopy	
5.4.1 Arenes **Content** . Review of appropriate material from AS Chemistry – Module B: Chains and Rings, 5.2.2 Hydrocarbons: Alkanes; 5.2.3 Hydrocarbons: Fuels; 5.2.4 Hydrocarbons: Alkenes. . Structure of arenes, typified by benzene. . Nitration, halogenation and alkylation of arenes. . Phenols. [For simplicity, the module refers to reactions of benzene and phenol. However, because of the toxic nature of benzene and the caustic character of phenol, safer alternatives should be used in any practical work. For example, the nitration of arenes can be performed experimentally using methyl benzoate instead of benzene. For reactions involving phenol, methyl 4-hydroxybenzoate is a far safer alternative.] **Assessment outcomes** Candidates should be able to: (a) show understanding of the concept of delocalisation of electrons as used in a model of benzene. (b) describe the electrophilic substitution of arenes with: (i) concentrated nitric acid in the presence of concentrated sulphuric acid; (ii) a halogen in the presence of a halogen carrier; (iii) a halogenoalkane such as chloromethane in the presence of a halogen carrier (Friedel-Crafts reaction). . *Halogen carriers include iron, iron halides and aluminium halides.* (c) describe the mechanism of electrophilic substitution in arenes, using the mononitration of benzene as an example. . *Candidates should show 'curly arrows' in this mechanism and include an equation to show formation of the nitronium ion.* (d) understand that reactions of arenes, such as those in (b), are used by industry during the synthesis of commercially important materials, for example: explosives, pharmaceuticals and dyes (from nitration) – see also 5.4.4(d), and polymers such as polystyrene (from alkylation) – see also 5.4.6(a). . *Details of the reaction schemes are **not** required.* (e) explain the relative resistance to bromination of benzene compared with cyclohexene (see also 5.2.4(d)) in terms of delocalisation of the benzene ring. (f) describe the reactions of phenol (i) with bases and with sodium to form salts; (ii) with bromine to form 2,4,6-tribromophenol.	**5.3 Aromatic Hydrocarbons** Structure of benzene, methylbenzene and ethylbenzene as examples of aromatic compounds. Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents]. **7.2 Planar Carbon** Simple explanation of the use of the circle to represent the identical bonds in benzene, intermediate between double and single. Sigma and pi bonding in benzene. Aromatic compounds An indication of the range and scope of aromatic chemistry. 7.3 Organic Chemical Reaction Types (a) Addition reactions Unreactivity of benzene with regard to addition reactions relative to ethene.
5.4.2 Carbonyl compounds **Content** . Reactions of carbonyl compounds. . Characteristic tests for carbonyl compounds. **Assessment outcomes** Candidates should be able to: (a) describe the reduction of carbonyl compounds using NaBH4 to form alcohols. . *In equations, for organic reduction reactions, the symbol [H] is acceptable.* (b) describe the mechanism for nucleophilic addition reactions of hydrogen cyanide (in the presence of potassium cyanide) with aldehydes and ketones (see also 5.4.5(c)).	**7.2 Planar Carbon** Carbonyl compounds (aldehydes only): polar double bond. Structure and nomenclature up to C-4. Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents]. Ketones: structure and nomenclature up to C-4. Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents]. **7.3 Organic reaction types (c) Redox reactions.** Oxidation of aldehydes to acids (half equation only required).

. *Because of the toxic nature of hydrogen cyanide and cyanide ions, this reaction should* ***not*** *be performed. The reaction is included solely to illustrate nucleophilic addition.* . *Candidates should show 'curly arrows', relevant lone pairs and dipoles in this mechanism.* (c) describe the use of 2,4-dinitrophenylhydrazine (i) to detect the presence of a carbonyl group in an organic compound; (ii) to identify a carbonyl compound from the melting point of the derivative. . *The equation for this reaction is* ***not*** *required.* (d) describe the use of Tollens' reagent (ammoniacal silver nitrate) (i) to detect the presence of an aldehyde group; (ii) to distinguish between aldehydes and ketones, explained in terms of the oxidation of aldehydes to carboxylic acids with reduction of silver ions to silver.	Ketones are not easily oxidised. Reduction of carbonyl compounds using H_2/Ni catalysts.
5.4.3 Carboxylic Acids and Esters **N3.2** **Content** . Review of appropriate material from AS Chemistry – Module 2812: Chains and Rings, 5.2.5 Alcohols. . Carboxylic acids; formation of salts. . Esterification of carboxylic acids. . Hydrolysis of esters. **Assessment outcomes** Candidates should be able to: (a) describe carboxylic acids as proton donors. (b) describe the reactions of carboxylic acids, typified by ethanoic acid: (i) with aqueous alkalis to form carboxylates (salts); (ii) with alcohols, in the presence of an acid catalyst, to form esters (see also 5.2.5(d)). (c) state the uses of esters in perfumes and flavourings. (d) describe the acid and base hydrolysis of esters to form carboxylic acids and carboxylates respectively.	**7.2 Planar Carbon** Carboxylic acids: polar double bond. Structure and nomenclature up to C-4. Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents]. Esters: structural formulas and nomenclature up to C-4. Physical properties [physical state, solubility (qualitative only) in water and in non-polar solvents]. **7.3 Organic reaction types (b) Substitution reactions.** Esterification. Base hydrolysis of esters. **(e) Reactions as acids** Acidic nature of the carboxylic acid group. Reactions of carboxylic acids with magnesium, with sodium hydroxide and with sodium carbonate.
5.4.4 Nitrogen compounds **Content** . Properties of primary amines. . Amino acids; peptide formation. . Hydrolysis of proteins. **Assessment outcomes** Candidates should be able to: (a) describe the formation of phenylamine by reduction of nitrobenzene using tin and concentrated hydrochloric acid. (b) describe the reactions of primary amines with acids to form salts. (c) explain the basicity of primary amines and the relative basicities of ethylamine and phenylamine in terms of the inductive effect and the influence of the delocalised electrons in the benzene ring. (d) describe the synthesis of an azo-dye by reaction of phenylamine with nitrous acid (HNO2/HCl, <10°C) with the formation of a diazonium salt, followed by coupling with phenols under alkaline conditions; the use of such reactions in the formation of dyestuffs. (e) state the general formula for an ⟨-amino acid as RCH(NH2)COOH. (f) describe the acid-base properties of ⟨-amino acids and the formation of zwitterions. (g) explain the formation of a peptide linkage between ⟨-amino acids leading to the idea that	

polypeptides and proteins are condensation polymers (see also Section 5.4.6(b)). (h) describe the acid hydrolysis, for example with hot HCl(aq), of proteins and peptides to form 〈-amino acids.	
5.4.5 Stereoisomerism and organic synthesis **Content** . Stereoisomerism. . Organic synthesis of 2-hydroxypropanoic acid (lactic acid). . Chirality and its importance in pharmaceuticals. **Assessment outcomes** Candidates should be able to: (a) interpret and use the term stereoisomerism in terms of *cis-trans* and optical isomerism. (b) explain the term chiral centre and identify any chiral centres in a molecule of given structural formula (for example, amino acids (see also 5.4.4(e)) and 2-hydroxypropanoic acid (lactic acid)). (c) describe the two-stage synthesis of 2-hydroxypropanoic acid (lactic acid) by the addition of hydrogen cyanide to ethanal (see also 5.4.2(b)) followed by acid hydrolysis; explain the use of such reactions in synthesis by providing a route for lengthening a carbon chain. . *Because of the toxic nature of hydrogen cyanide and cyanide ions, this synthesis should* ***not*** *be performed.* (d) understand that chiral molecules prepared synthetically in the laboratory may contain a mixture of optical isomers, whereas molecules of the same compound produced naturally in living systems will often be present as one optical isomer only (for example: L-amino acids). (e) understand that the synthesis of pharmaceuticals often requires the production of chiral drugs containing a single optical isomer, resulting in smaller doses (only half the drug is needed), reduced side effects and improved pharmacological activity. . *Candidates will* ***not*** *be expected to memorise the structures of any pharmaceuticals but they will be expected to identify the presence of chiral centres in a given structure.*	
5.4.6 Polymerisation **Content** . Review of appropriate material from AS Chemistry – Module 2812: Chains and Rings, 5.2.4 Hydrocarbons: Alkenes. . Addition polymerisation. . Condensation polymerisation. . Uses of polymers. **Assessment outcomes** Candidates should be able to: (a) describe the characteristics of addition polymerisation, typified by poly(phenylethene) (see also 5.2.4(g)–(m), 5.2.6(f)). (b) identify that some alkenes, typified by propene, can produce addition polymers that are atactic, isotactic or syndiotactic. (c) describe the characteristics of condensation polymerisation: (i) in polyesters, typified by *Terylene* (from benzene-1,4-dicarboxylic acid and ethane-1,2-diol); (ii) in polyamides, typified by nylon-6,6 (from 1-6-diaminohexane and hexane-1,6- dicarboxylic acid) and Kevlar (from benzene-1,4-diamine and benzene-1,4-dicarboxylic acid); (iii) in polypeptides and proteins (see also Section 5.4.4(g)). (d) suggest the type of polymerisation reaction from (i) a given monomer or pair of monomers; (ii) a given section of a polymer molecule.	

(e) deduce the repeat unit of a polymer obtained from a given monomer or pair of monomers. (f) identify, in a given section of polymer, the monomer(s) from which it was obtained. (g) state the use of polyesters and polyamides as fibres in clothing.	
5.4.7 Spectroscopy **Content** . Review of appropriate material on infra-red spectroscopy from AS Chemistry – Module 2812: Chains and Rings, 5.2.5(f). . Mass spectrometry: molecular mass determination. . n.m.r. spectroscopy: structure elucidation. [In examinations, infra-red absorption data and n.m.r. chemical shift values will be provided on the *Data Sheet* (Appendix G).] **Assessment outcomes** Candidates should be able to: (a) use a simple infra-red spectrum to identify the presence of functional groups in a molecule (limited to alcohols (O.H), carbonyl compounds (C=O), carboxylic acids (COOH) and esters (COOR) (see also 5.2.5(f)). (b) use the molecular ion peak in a mass spectrum to determine the relative molecular mass of an organic molecule. (c) predict, from the high resolution n.m.r. spectrum of a simple molecule containing carbon, hydrogen and/or oxygen, (i) the different types of proton present from chemical shift values; (ii) the relative numbers of each type of proton present from the relative peak area; (iii) the number of protons adjacent to a given proton from the spin-spin splitting pattern, limited to splitting patterns up to a quadruplet only. (iv) possible structures for the molecule. (d) predict the chemical shifts and splitting patterns of the protons in a given molecule. *. Background theory will **not** be tested on examination papers: the emphasis is on the interpretation of spectra. Thus, candidates will not be tested on why nuclear magnetic resonance takes place, the reasons for different chemical shift values or why spin-spin splitting occurs.* *. The relative peak areas will be given on any provided spectra.* *. For splitting patterns, the n + 1 rule can be used, where n is the number of H atoms on adjacent carbon atoms. Limited to singlet, doublet, triplet and quadruplet.* (e) describe the use of D2O to identify the n.m.r. signal from –OH groups.	**7.5 Chromatography and Instrumentation in Organic Chemistry** Instrumental methods of separation or analysis, or both: Mass spectrometry Infra-red absorption spectrophotometry (IR) as a finger printing technique involving absorption of infra-red radiation (reference to molecular vibrations not required). Brief reference to the principles … Interpretation of spectra etc, **not** required).
5.5 Module 2815, Component 01: Trends and patterns Module 2815, (component 01) is a half-module which, along with **one** of five optional half-modules 2815 (component 02–06), comprises Module 2815.	
5.5.1 Lattice enthalpy **Content** . Review of appropriate material from AS Chemistry – Module 2813 (component 01): How Far, How Fast?, 5.3.1 Enthalpy changes. . Lattice enthalpy. . Born-Haber cycles. **Assessment outcomes** Candidates should be able to:	

(a) explain and use the term *lattice enthalpy* (.*H* negative, i.e. gaseous ions to the solid lattice) as a measure of ionic bond strength. (b) construct Born-Haber cycles to calculate the lattice enthalpy of a simple ionic solid (e.g. NaCl, $MgCl_2$) using relevant energy terms (enthalpy change of formation, ionisation energy, enthalpy change of atomisation and electron affinity). (c) explain, in qualitative terms, the effect of ionic charge and of ionic radius on the numerical magnitude of a lattice enthalpy. (d) describe the thermal decomposition of the Group 2 carbonates ($MgCO_3$ to $BaCO_3$) and explain the trend in terms of lattice enthalpy, the polarisation of the anions and the charge density of the cations (see also 5.1.3(j), 5.1.5(f)). (e) relate the high lattice enthalpy of MgO to its use as a refractory lining.	
5.5.2 Periodic Table: Period 3 **Content** . Review of appropriate material from AS Chemistry – Module 2811: Foundation Chemistry, 5.1.4 Periodic Table: Introduction. . Preparation of Period 3 oxides and chlorides. . Periodic trends of oxides and chlorides. **Assessment outcomes** Candidates should be able to: (a) describe redox reactions of Period 3 elements (i) with oxygen to give MgO, Al_2O_3 and SO_2; (ii) with chlorine to give NaCl, $MgCl_2$, $AlCl_3$, $SiCl_4$ and PCl_5; (ii) with water to give NaOH and $Mg(OH)_2$. (b) describe the action of water, if any, on the compounds in (a) and the pH of any resulting solutions. (c) explain the trends in (a) and (b) above in terms of the structure and bonding of the oxides and chlorides involved.	
5.5.3 Periodic Table: Transition elements **Content** . Properties of transition elements. . Ligands, complex ions and ligand exchange. . Precipitation reactions. . Redox reactions. . Colorimetry. **Assessment outcomes** Candidates should be able to: (a) describe a *transition element* as a d-block element forming one or more stable ions with incompletely filled d-orbitals. (b) deduce the electronic configurations of atoms and ions of the d-block elements of Period 4 (Sc Zn) , given the atomic number and charge. . *Candidates should use sub-shell notation, i.e. for Fe: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$.* (c) illustrate, using the transition elements iron and copper as appropriate, (i) the existence of more than one oxidation state for each element in its compounds; (ii) the formation of coloured ions; (iii) the catalytic behaviour of the elements and/or their compounds. (d) describe the simple precipitation reactions and the accompanying colour changes of $Cu^{2+}(aq)$, $Fe^{2+}(aq)$ and $Fe^{3+}(aq)$ with aqueous sodium hydroxide to form $Cu(OH)_2$, $Fe(OH)_2$ and $Fe(OH)_3$ respectively.	**2.6 Oxidation Numbers** Oxidation states and numbers. Rules for oxidation numbers. Oxidation and reduction in terms of oxidation numbers.

(e) explain and use the terms *complex ion* and *ligand* in terms of co-ordinate bonding. (f) describe the process of ligand substitution and the accompanying colour changes, for example in the formation of: (i) [Cu(NH3)4(H2O)2]2+ and [CuCl4]2. from [Cu(H2O)6]2+; (ii) [Fe(SCN)(H2O)5]2+ from [Fe(H2O)6]3+. (g) predict from data, the formula and possible shape of a complex ion, limited to tetrahedral and octahedral complexes. (h) explain how colorimetry can be used to determine the formula of a complex ion, for example [Fe(SCN)(H2O)5]2+. (i) predict the colour of a transition element complex from its ultraviolet/visible spectrum. (j) describe redox behaviour in transition elements, for example by Fe3+/Fe2+ and MnO4–/Mn2+. (k) construct redox equations, such as those in (j) above, using relevant half-equations. (l) perform calculations involving simple redox titrations, for example MnO4–/Fe2+ in acid solution.	
Not covered in OCR syllabus – probably physics?	1.3 Radioactivity
Not covered in OCR syllabus – possibly physics?	1.4 Electronic structure of atoms Heisenberg uncertainty principle. Wave nature of the electron. (Non-mathematical treatment in both cases).
An industrial application?	1.5 Oxidation and Reduction Electrolysis of (i) copper sulphate solution with copper electrodes and (ii) acidified water with inert electrodes. (Half equations only required)
Normally done at GCSE?	2.1 Chemical Compounds Stability of noble gas electron configurations Bonding and valency in terms of the attainment of a stable electronic structure. Octet rule and its limitations.
GCSE?	3.1 States of Matter
Used to be done but does not seem to appear as a discrete topic in the OCR syllabus.	3.2 Gas Laws
Covered in practical work?	4.1 Concentrations of solutions.
Covered in practical work?	4.3 Volumetric analysis
Covered in practical work?	5.4 Exothermic and Endothermic reactions Heat of combustion. Bomb calorimeter as an instrument for accurately measuring heats of combustion. Heats of combustion of different fuels. Heats of formation. Law of conservation of energy.
Not in OCR syllabus but an application?	5.6 Other chemical fuels Ethyne: preparation, combustion, tests for unsaturation. Hydrogen: manufacture by (i) electrolysis of water (ii) steam reforming of natural gas (simple treatment onlt)
No obvious analogue in OCR syllabus	7.4 Organic Natural Products
Covered in practical work?	7.5 Chromatography and Instrumentation in Organic Chemistry Chromatography as a separation technique in which a mobile phase carrying a mixture is caused to move in contact with a selectively absorbent stationary phase. Gas Chromatography High Performance Liquid Chromatography Ultra violet absorption spectrophotometry as a quantitative technique involving the absorption of ultraviolet light.
No analogue in OCR chemistry	Unit 9 Environmental chemistry.