edexcel

INTERNATIONAL ADVANCED LEVEL

CHEMISTRY

GETTING STARTED GUIDE

Pearson Edexcel International Advanced Subsidiary in Chemistry (XCH11)
Pearson Edexcel International Advanced Level in Chemistry (YCH11)
First teaching September 2018
First examination from January 2019
First certification from August 2019 (International Advanced Subsidiary) and August 2020 (International Advanced Level)

Pearson

Contents

Introduction

This Getting Started Guide provides an overview of the new Pearson Edexcel International A level in Chemistry (2018), to provide information about the content and assessment, and to give you a better understanding of what these mean for you and your students.

Support for delivering the new specification

Our package of support to help you plan and implement the new specification includes:

Planning – In addition to this Guide, we will provide a course planner and an editable scheme of work that you can adapt to suit your department.

Teaching and learning – To support you in delivering the new specification, we will provide Guides for Practical Skills and for Mathematical Skills, for you and for your students.

In addition, we will provide two **Topic Guides**, giving further background information to support your teaching of Chemical Thermodynamics and Instrumental Methods for Analysis.

Understanding the standard – A full set of **sample assessment materials** is provided.

Tracking learner progress – **Results Plus** provides the most detailed analysis available of your students' exam performance. It can help you identify topics and skills where students could benefit from further learning.

We will also offer **examWizard**, which is a free exam preparation tool containing a bank of past Edexcel exam questions, mark schemes and examiner reports for a range of International A level subjects.

Support – Our **Subject Advisor** service will ensure you receive help and guidance from us as well as enabling you to share ideas and information with each other.

You can sign up to receive e-newsletters to keep up to date with qualification updates, and product and service news.
You can email our Subject Advisor at: TeachingScience@pearson.com

Key features of the qualification

- The specification content has been designed to be similar to that of the existing International A level. However, some changes have been made to the content. These changes are mostly influenced by changes made in the new GCE A level (2015) specifications used by schools in the UK.

- The assessment model has six question papers (Units) in total: Units 1 – 3 make up the International AS level and Units 4 – 6 make up the International A2 level. Students who complete all six Units are eligible for the full International A level award.

- The specification is modular. Students can sit units in any of the examination series in which they are offered and cash-in for the qualification when they have completed the required number of units. Each unit is designed to cover a particular area of specification content, although some units may also draw on knowledge from other areas of the specification.

- All units will have a range of question styles, including calculations for which calculators may be used.

- Practical skills will be assessed in two units: Unit 3 at IAS and Unit 6 at IAL. There is no coursework or practical exam.

- Students will develop analytical and logic skills by applying understanding of scientific concepts and principles to a range of situations. Some examination questions will be more problem solving in style; and may also address the need for mathematical skills to complement students' knowledge.

- We have designed our International A level qualification to be of equivalent standard to the GCE A level (2015) in Chemistry used by schools in the UK. This ensures that International A levels are recognised globally and provide students with the same progression routes.

- The specification content also gives you the opportunity to consider key transferrable skills whilst teaching the subject. These skills are key for students to progress to Higher Education or the workplace.

Qualification overview

This section provides an overview of the course to help you see what you will need to teach. The overview gives a general summary of each of the Unit examinations.

Unit 1: Structure, Bonding and Introduction to Organic Chemistry	**Unit code: WCH11/01**
• Externally assessed • 1 hour 30 minutes, 80 marks • Availability: January, June & October • First assessment: January 2019	40% of the total IAS 20% of the total IAL
Content summary • Formulae, Equations and Amount of Substances • Atomic structure and the Periodic Table • Bonding and Structure • Introductory Organic Chemistry and Alkanes • Alkenes	
Assessment • This paper has two sections: 1. Section A: multiple choice questions 2. Section B: mixture of short-open, open-response and calculation questions. • This paper will include a minimum of 18 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*). • Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts.	

Unit 2: Energetics, Group Chemistry, Halogenoalkanes and Alcohols	**Unit code: WCH12/01**
• Externally assessed • 1 hour 30 minutes, 80 marks • Availability: January, June & October • First assessment: June 2019	40% of the total IAS 20% of the total IAL
Content summary • Energetics • Intermolecular Forces • Redox Chemistry and Groups 1, 2 and 7 • Introduction to Kinetics and Equilibria • Organic Chemistry: Alcohols, Halogenoalkanes and Spectra	
Assessment • This paper has three sections: 1. Section A: multiple choice questions 2. Section B: mixture of short-open, open-response, calculations and extended response questions. 3. Section C: contemporary context question • This paper may contain questions that require information from the Data Booklet (see *Appendix 9*). • This paper will include a minimum of 18 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*). • Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts. • This paper may contain some synoptic questions which require knowledge and understanding from Unit 1.	

Unit 3: Practical Skills in Chemistry I	**Unit code: WCH13/01**
• Externally assessed • 1 hour 20 minutes, 50 marks • Availability: January, June & October • First assessment: June 2019	20% of the total IAS 10% of the total IAL
Content summary This unit will assess students' knowledge and understanding of experimental procedures and techniques that were developed in Units 1 and 2.	
Assessment • This paper may include short-open, open-response and calculation questions. • This paper will include a minimum of 6 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*). • Students will be expected to apply their knowledge and understanding of practical skills in familiar and unfamiliar situations.	

Unit 4: Rates, Equilibria and Further Organic Chemistry	Unit code: WCH14/01
• Externally assessed • 1 hour 45 minutes, 90 marks • Availability: January, June & October • First assessment: January 2020	40% of the total IA2 20% of the total IAL
Content summary • Kinetics • Entropy and Energetics • Chemical Equilibria • Acid-base Equilibria • Organic Chemistry: Carbonyls, Carboxylic Acids and Chirality	
Assessment • This paper has three sections: 1. Section A: multiple choice questions 2. Section B: mixture of short-open, open-response, calculations and extended response questions. 3. Section C: data or calculation question • This paper may contain questions that require information from the Data Booklet (see *Appendix 9*). • This paper will include a minimum of 24 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*). • Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts. • This paper may contain some synoptic questions which require knowledge and understanding from Unit 1 and 2.	

Unit 5: Transition Metals and Organic Nitrogen Chemistry	**Unit code: WCH15/01**
• Externally assessed • 1 hour 45 minutes, 90 marks • Availability: January, June & October • First assessment: June 2020	40% of the total IA2 20% of the total IAL
Content summary • Redox Equilibria • Transition Metals and their Chemistry • Organic Chemistry: Arenes • Organic Nitrogen Compounds: Amines, Amides, Amino Acids and Proteins • Organic Synthesis	
Assessment • This paper has three sections: 1. Section A: multiple choice questions 2. Section B: mixture of short-open, open-response, calculations and extended response questions. 3. Section C: contemporary context question • This paper may contain questions that require information from the Data Booklet (see *Appendix 9*). • This paper will include a minimum of 14 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*). • Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts. • This paper may contain some synoptic questions which require knowledge and understanding from Unit 1, 2 and 4.	

Unit 6: Practical Skills in Chemistry II	Unit code: WCH16/01
• Externally assessed • 1 hour 20 minutes, 50 marks • Availability: January, June & October • First assessment: June 2020	20% of the total IAS 10% of the total IAL
Content summary This unit will assess students' knowledge and understanding of experimental procedures and techniques that were developed in Units 4 and 5.	
Assessment • This paper may include short-open, open-response and calculation questions. • This paper will include a minimum of 6 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*). • Students will be expected to apply their knowledge and understanding of practical skills in familiar and unfamiliar situations.	

Assessment Objectives

		% in IAS	% in IA2	% in IAL
AO1	Demonstrate knowledge and understanding of chemistry	34 – 36	29 – 31	32 – 34
AO2	(a) Application of knowledge and understanding of chemistry in familiar and unfamiliar contexts. (b) Analysis and evaluation of scientific information to make judgements and reach conclusions.	34 – 36 9 – 11	33 – 36 14 – 16	33 – 36 11 – 14
AO3	Experimental skills in chemistry, including analysis and evaluation of data and methods.	20	20	20

A more detailed breakdown showing the proportion of each Assessment Objective in each Unit can be found in the specification.

Unit availability

The assessment for this qualification is modular and Units may be sat in any examination series in which they are offered.

The revised specification is designed for first teaching in September 2018, and Units will be examined from January 2019. The Units will be introduced so that AS units will be offered first, then A2 units once students start the second year of the IAL after September 2019.

At the same time, Units from the existing 2013 specification will be phased out. **Please note that Units from the existing specification and the new specification cannot be combined together**. Please note carefully, which Units will be offered in which exam session, and when the qualification can be cashed-in for a grade.

	June 2018	October 2018	January 2019	June 2019	October 2019	January 2020	June 2020	October 2020
IAL (2013) – legacy								
WCH01	✓	✓	✓	✓	×	×	×	×
WCH02	✓	✓	✓	✓	×	×	×	×
WCH03	✓	✓	✓	✓	×	×	×	×
WCH04	✓	✓	✓	✓	✓	×	✓	×
WCH05	✓	✓	✓	✓	✓	×	✓	×
WCH06	✓	✓	✓	✓	✓	×	✓	×
AS CASH-IN	✓	✓	✓	✓	×	×	×	×
IAL CASH-IN	✓	✓	✓	✓	✓	×	✓	×
IAL (2018) – new								
WCH11	×	×	✓	✓	✓	✓	✓	✓
WCH12	×	×	×	✓	✓	✓	✓	✓
WCH13	×	×	×	✓	✓	✓	✓	✓
WCH14	×	×	×	×	×	✓	✓	✓
WCH15	×	×	×	×	×	×	✓	✓
WCH16	×	×	×	×	×	×	✓	✓
AS CASH-IN	×	×	×	✓	✓	✓	✓	✓
IAL CASH-IN	×	×	×	×	×	×	✓	✓

Assessment guidance

Changes to assessment

Some changes have been made to the question papers for the new IAL specification.

- Exam papers for AS Unit 1 and 2 will be 1h 30 minutes and contain 80 marks
- Exam papers for A2 Units 4 and 5 will be 1h 45 minutes and contain 90 marks
- Exam papers for AS Unit 3 and A2 Unit 6 will be 1h 20 minutes and contain 50 marks

- Exam papers will contain a proportion of marks which assess mathematical skills. This will be a total of 20% of marks across the suite of Chemistry examinations.

- At least one question on Units 2, 4 and 5 will be an extended-response question worth 6 marks. These questions will assess chemical knowledge and understanding, but also the ability to structure an answer in a logical and reasoned order.

Features of our question papers

Units 1, 2, 4 and 5 are divided into Sections.

The first Section consists of 20 multiple choice questions. Section B consists of a range of short-answer questions, calculations and extended open-response questions. Section C (Units 2, 4 and 5) involves a more structured task which may be based on data or on a contemporary context.

Some of the question contexts will be unfamiliar to students; these questions are designed to assess the ability to apply scientific principles to unfamiliar situations, as well as data-handling skills.

Units 3 and 6 will assess practical and experimental skills which students have developed during the course. Questions on these units will consist of a range of short-answer questions. Students may be required to perform calculations, draw graphs and describe, explain and interpret experimental methods and observations.

Command words

All our examination papers in Science subjects – across the threes sciences and across both our home and international specifications – use a consistent set of command words in examination questions.

The use of a particular command word gives candidates an indication of the nature of answer that is expected. For example, a question using "Describe…" is asking for a series of factual statements to be presented in order; but a question using "Explain…" is asking for any points made to be justified, or reasons given for their inclusion.

Mark schemes are developed with the command word in mind so that, to score full credit, a student must address the demand of the question. Some students find this hard, and may take a "scatter gun" approach, simply focusing on a key word in the question and writing all they know about that topic.

Students are advised to look closely at the command word before answering. For example, a student who answers an "Explain…" question by giving a number of factual statements without reasoning or justification (i.e. gives a description) is likely to score few marks.

Assessment of practical skills

Throughout the IAL Chemistry course, students should be completing a series of practical activities. These activities are likely to correspond to the Core Practicals or additional suggested practicals included in the specification content, but further activities may also be selected by the teacher.. Hands-on experience of practical work may be supplemented with teacher demonstrations or by using videos.

When considering how to deliver practical activities, teachers should be aware that the inclusion of practical work in the IAL specification is not intended to simply involve factual recall of practical methods. Instead, students should be using practical activities to develop competency in a range of chemical techniques across a variety of experimental situations.

Manipulative practical skills cannot easily be assessed through written questions on Unit 3 and Unit 6 examinations. Therefore, questions on these papers are likely to assess understanding of techniques, as well as aspects of planning, and the evaluation of data and methods.

Students with a familiarity of practical scenarios, gained from consistent practical work throughout the IAL course, are much more likely to be successful in answering questions in Unit 3 and Unit 6. This is especially the case because a number of questions will be set in the context of unfamiliar practical situations, where students will need to apply their experience of practical work in order to answer.

Teachers and students should be aware that some questions placed in a practical context may appear on Units 1, 2, 4 and 5. These questions should focus on theoretical chemical knowledge that derives from practical activities. For example, a Unit 2 paper may contain a question involving a titration calculation, but this would not involve evaluation of the method used.

Assessment of mathematical skills

The use of relevant mathematical techniques is an integral part of any student of the Science subjects.

As part of the IAL Chemistry, students will encounter a number of different mathematical skills. This may include simple calculations, re-arranging equations, using standard form, taking logs, plotting and interpreting graphs, and considering significant figures.

Questions on examination papers have always tested the ability of students to use relevant mathematical skills. Although this does not change with the new IAL specification, there will be a greater consistency about the assessment of mathematical skills in the new examination papers.

This means two things:
firstly that examination papers will assess a defined range of mathematical skills (these can be found in an Appendix in the specification),
and secondly that the proportion of marks assessing mathematical skills will be more consistent.

For Chemistry, this means approximately 20% of marks on examination papers will assess these skills. The exact number of marks assigned to mathematical skills will vary across the Units (because, for example, there are many more opportunities to assess mathematical skills in Unit 4 than in Unit 5). Please refer to the specification for more details.

Course planner

This course planner is designed to give an overview of how the topics making up IAL Chemistry can be delivered over a two-year period.

You will find a more detailed lesson plan in the **Scheme of Work** document on the IAL Chemistry page of the Pearson Qualifications website. This gives more detailed information on a week-by-week basis, giving suggestion of the teaching times for each unit. This is editable so that you can customise it to meet your own needs.

An overview of a two-year course planner might be as follows:

Note that, in common with GCE A level qualifications, there is a recommendation that the total Guided Learning Hours for the whole IAL is 360 hours.

Week number	IAS Lesson content
1	Topic 1: Formulae, Equations and Amount of Substance (1–4, 6)
2	Topic 1: Formulae, Equations and Amount of Substance (7, 8, 10, 11)
3	Topic 1: Formulae, Equations and Amount of Substance (7, 8, 10, 11)
4	Topic 1: Formulae, Equations and Amount of Substance (5, 9, 12)
5	Topic 2: Atomic Structure and the Periodic Table (1–7)
6	Topic 2: Atomic Structure and the Periodic Table (8–13)
7	Topic 2: Atomic Structure and the Periodic Table (14–18)
8	Topic 3A: Ionic bonding (1–9)
9	Topic 3B: Covalent bonding (10-15)
10	Topic 3C: Shapes of molecules and Topic 3D: Metallic bonding (20-22)
11	Topic 4A: Introduction to Organic Chemistry (1-8) and Topic 4B: Alkanes (9-11)
12	Topic 4B: Alkanes (12–16)
13	Topic 4B: Alkanes (17, 18)
14	Topic 5: Alkenes (1-3)
15	Topic 5: Alkenes (4-8)
16	Topic 6: Energetics (1–5)
17	Topic 6: Energetics (6-8)
18	Topic 6: Energetics (9-11)
19	Topic 7: Intermolecular forces (1-6)
20	Topic 8A: Redox Chemistry (1–10)
21	Topic 8B: The elements of Groups 1 and 2 (11–18)

Week number	IAS Lesson content
22	Topic 8B: The elements of Groups 1 and 2 (19-23)
23	Topic 8C: Inorganic chemistry of Group 7 (24, 25, 27ii, 28)
24	Topic 8C: Inorganic chemistry of Group 7 (26, 27i, 27iii)
25	Topic 9A: Kinetics (1-8)
26	Topic 9B: Equilibria (9-11)
27	Topic 10A: General Principles (1-5) and Topic 10B: Halogenoalkanes (6-9)
28	Topic 10B: Halogenoalkanes (10-14)
29	Topic 10C: Alcohols (15-20)
30	Topic 10D: Mass spectra and IR (21-23)

Week number	IA2 Lesson content
31	Topic 11: Kinetics (1–4i, 12b)
32	Topic 11: Kinetics (4ii, 5, 12a)
33	Topic 11: Kinetics (6-9)
34	Topic 11: Kinetics (10, 11, 13)
35	Topic 12A: Entropy (1-11)
36	Topic 12B: Lattice Energy (12-19)
37	Topic 13: Chemical Equilibria (1-4)
38	Topic 13: Chemical Equilibria (5-9)
39	Topic 14: Acid-base Equilibria (1–7)
40	Topic 14: Acid-base Equilibria (8-14, 23)
41	Topic 14: Acid-base Equilibria (15-22)
42	Topic 15A: Chirality (1-5)
43	Topic 15B: Carbonyl compounds (6-8)
44	Topic 15C: Carboxylic acids (9-12) and Topic 15D: Carboxylic acid derivatives (13-16)
45	Topic 15E: Spectroscopy and chromatography (17-23)
46	Topic 16: Redox Equilibria (1-6)
47	Topic 16: Redox Equilibria (7-11)
48	Topic 16: Redox Equilibria (12-14, 18, 19)
49	Topic 16: Redox Equilibria (15-17)
50	Topic 17: Transition metals and their chemistry (1-11)
51	Topic 17: Transition metals and their chemistry (12-17)
52	Topic 17: Transition metals and their chemistry (18-25)
53	Topic 17: Transition metals and their chemistry (26-33)
54	Topic 18: Organic Chemistry - arenes (1–3)
55	Topic 18: Organic Chemistry - arenes (4-6)

Week number	IA2 Lesson content
56	Topic 19: Organic nitrogen compounds: amines, amides, amino acids and proteins (1-6)
57	Topic 19: Organic nitrogen compounds: amines, amides, amino acids and proteins (7-12)
58	Topic 20: Organic synthesis (1-2)
59	Topic 20: Organic synthesis (3)
60	Topic 20: Organic synthesis (4, 5)

Delivery of the qualification – transferable skills

Why transferable skills?

Ensuring that our International A level qualifications will help improve student outcomes through the acquisition of transferable skills, as well as subject content and skills, is a key aim for Pearson.

In recent years, Higher Education Institutions and employers have flagged the need for students to develop a range of transferable skills to enable them to respond with confidence to the demands of undergraduate study and the world of work.

Through our teaching materials and support offered we want to:

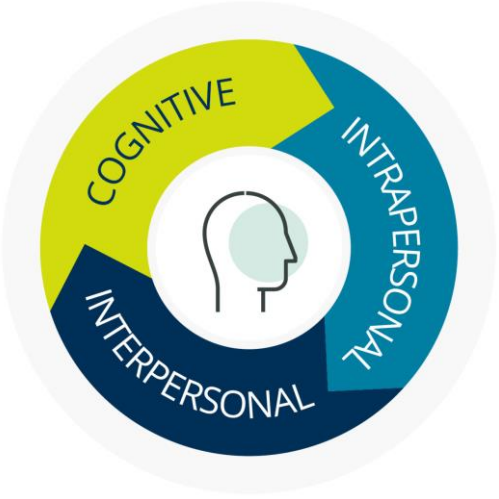
1. increase awareness, for both students and teachers, of transferable skills that are already being assessed,
2. indicate where, for teachers, there are opportunities to teach additional skills that won't be formally assessed, but that would be of benefit to students.

What are transferable skills?

The Organisation for Economic Co-operation and Development (OECD) defines skills, or competencies, as 'the bundle of knowledge, attributes and capacities that can be learned and enable individuals to successfully and consistently perform an activity or task and can be built upon and extended through learning.'[1]

To support the design of our qualifications, the Pearson Research Team selected and evaluated seven global 21st-century skills frameworks. Following on from this process, we identified the National Research Council's (NRC) framework [2] as the most evidence-based and robust skills framework, and have used this as a basis for our adapted skills framework.

The framework includes cognitive, intrapersonal skills and interpersonal skills.



The skills have been interpreted for this specification to ensure they are appropriate for the subject. All of the skills listed are evident or accessible in the teaching, learning and/or assessment of the qualifications. Some skills are directly assessed. Pearson materials will support you in identifying these skills and developing these skills in students.

The table below sets out the framework and gives an indication of the skills that can be found in Chemistry and indicates the interpretation of the skill in this area. A full subject interpretation of each skill, with mapping to show opportunities for student development is outline in **Appendix A** in this document.

<table>
<tr><td rowspan="2">COGNITIVE SKILLS</td><td>Cognitive processes and strategies</td><td rowspan="5">• Critical thinking
• Problem solving
• Analysis
• Reasoning / argumentation
• Creativity
• Adaptability
• Personal & social responsibility
• Initiative
• Self-direction
• Responsibility
• Perseverance
• Productivity
• Self-monitoring / self-evaluation / self-reinforcement
• Communication
• Collaboration
• Teamwork
• Responsibility
• Assertive communication</td><td rowspan="5">• Interpretation
• Decision making
• Adaptive learning
• Executive function
• Innovation
• Continuous learning
• Intellectual interest and curiosity
• Self-regulation (metacognition, forethought, reflection)
• Ethics
• Integrity
• Cooperation
• Empathy / perspective taking
• Negotiation
• Self-presentation</td></tr>
<tr><td>Creativity</td></tr>
<tr><td rowspan="3">INTRAPERSONAL SKILLS</td><td>Intellectual openness</td></tr>
<tr><td>Work ethic/ conscientiousness</td></tr>
<tr><td>Positive core self-evaluation</td></tr>
<tr><td rowspan="2">INTERPERSONAL SKILLS</td><td>Teamwork and collaboration</td></tr>
<tr><td>Leadership</td></tr>
</table>

[1] (OECD (2012), Better Skills, Better Jobs, Better Lives (2012):http://skills.oecd.org/documents/OECDSkillsStrategyFINALENG.pdf)

[2] Koenig, J. A. (2011) Assessing 21st Century Skills: Summary of a Workshop, National Research Council)

Suggested resources

It is hard to give a complete list of all resources that will be relevant for IAL Chemistry, as this will change over time. Also, a number of potential resources which are available online may not be available in all countries.

Teachers are recommended to check the IAL Chemistry (2018) page on the Pearson Qualifications website on a regular basis.

Name of resource	Link and information
Dedicated Science Subject Advisor	Email: TeachingScience@pearson.com Telephone UK: +44 (0)20 7010 2190 Twitter: @PearsonSciences Our Subject Advisor team is here to help with any questions about the content or delivery of any of our Science qualifications. The Subject Advisor team can also forward questions, using the Ask The Expert service, to our team of senior examiners.
examWizard	examWizard is a free online resource for teachers containing a huge bank of past paper questions and support materials to help you create your own mock exam and tests. http://qualifications.pearson.com/en/support/Services/examwizard.html
ResultsPlus	ResultsPlus is a free online results tool analysis for teachers that gives a detailed breakdown of your students' performance in Pearson Edexcel exams. https://qualifications.pearson.com/en/support/Services/ResultsPlus.html
Sample assessment material and past papers	A complete set of Sample Assessment Materials is available on the IAL Chemistry page of the Pearson Qualifications website. Past papers are also available on the equivalent IAL Chemistry (2013) page.
Guides for teachers	The "Course materials" tab of the IAL Chemistry page contains a number of guidance documents including a Getting Started Guide, Scheme of Work, Mapping Documents and Guides to Practical and Mathematical skills.
Textbooks	Details of published resources for the new IAL specifications can be found through the Pearson Global Schools website: www.pearsonglobalschools.com

APPENDIX A – NRC FRAMEWORK SKILLS

Sources: Cognitive/Intrapersonal and Interpersonal skills adapted and taken from the NRC framework

NRC framework skill	Skill interpretation in IAL Chemistry	Examples of where this skill is covered in specification	Examples of where this skill is explicitly assessed in examination, include SAM q refs	Opportunity for the skill to be covered in teaching and learning approaches
Cognitive skills				
Cognitive Processes and Strategies				
Critical thinking	Discuss uncertainty of measurements in practical work	8.22, 16.16,	Unit 2 Q19b Criticising an incorrect student's suggested mechanism Unit 4 Q5b Measurement uncertainty in experiment Unit 6 Q4b,d Identification of errors and calculation of uncertainties	This is possible in all core practicals
Problem solving	Calculate formulae from data	1.6, 1.10, 20.1	Unit 1 Q23b Predicting an unfamiliar reaction mechanism Unit 1 Q20c Rearrange a formula and convert data in to appropriate units Unit 5 Q18b Calculation of mass of products from combustion of butan-2-ol (a reverse calculation) Unit 5 Q16c Interpretation of standard electrode potential data Unit 5 Q19c Calculate the percentage of copper in Prince's metal from data and equations	All six topics provide opportunities to manipulate data
Analysis	Interpret mass spectra, infrared spectra and nmr spectra	10.21, 10.22, 15.17, 15.18, 15.19, 15.20, 20.1	Unit 1 Q5 Interpretation of data from mass spectrum Unit 1 Q20bii Drawing a mass spectrum from data Unit2 Q22a,c Interpreting infrared and mass spectra Unit 3 Q3 Interpretation of an infrared spectrum Unit 4 Q19b Interpretation of IR spectrum of chemical responsible for the smell of bananas Unit 4 Q19c,d Interpretation of nmr spectra Unit 6 Q2d Analysis of nmr spectrum	Analysing spectra occur in all six units

Reasoning/argumentation	Analysis of unknown organic and inorganic compounds	CP15 19.12	Unit 3 Q2 Identification of unknown inorganic compounds Unit 6 Q1abc Identification of inorganic compounds	There are opportunities for suggesting explanations for observed phenomena in all six units
Interpretation	Ability to interpret graphs	2.17, 6.3, 9.3, 9.8, 11.2, 11.5, 11.10, 12.13, 14.15,	Unit 1 Q19b,c Interpretation of graph of ionisation energies Unit 2 Q17a,b Interpretation of Maxwell-Boltzmann graph Unit 3 Q1aii Interpretation of a cooling curve graph Unit 4 Q20bi,ii Interpretation of pH graph Unit 4 Q22ai,ii Interpretation of Born-Haber cycle diagram Unit 5 Q7a,b Interpretation of enthalpy profile diagram Unit 5 Q8 Interpretation of rates of reaction graphs Unit 5 Q15d Ability to draw chromatogram	Interpretation of graphical data and the plotting of suitable graphs occur in all six units
Decision making	Plan organic reaction schemes (with up to 4 steps)	20.3ii	Unit 1 Q23a reaction sequence of propene Unit 3 Q3 Interpreting a reaction sequence Unit 5 Q17b Devise a reaction sequence to make phenylethanone Unit 5 Q18a Devise a four step reaction sequence	Choosing appropriate chemicals and reaction sequences occur in all six units
Adaptive learning	Predictions from data Select equipment and methods for carrying out practical work	3.19. 7.4, 8.28, 9.10, 11.6, 13.9 11.3	Unit 1 Q22c Make predictions on formula and boiling temperature from data Unit 2 Q20c Describing how to obtain reliable results in a titration Unit 3 Q4e Devising a titration experiment Un it 4 Q22aiii Interpretation of data on lattice energy	Selecting appropriate apparatus and making predictions from data occur in all six units
Executive function				
Creativity				
Creativity	Devising experimental procedures Identify errors and uncertainties and how to improve outcomes	CP2 6.7 8.8, 16.16	Unit 2 Q3 Suggesting correct properties resulting from hydrogen bonds Unit 3 Q4c,d Identifying errors in measurement and practical procedure Unit 4 Q21b Solving an unfamiliar calculation of activation energy	Deducing reaction sequences occurs in the organic topics

			Unit 4 Q21ci,ii Interpretation of unfamiliar experimental information	
Innovation	Suggest uses of new materials eg graphene	3.12		
Intrapersonal skills				
Intellectual openness				
Adaptability	This occurs in any practical		Unit 2 Q23eii Explaining unexpected experimental results Unit 5 Q14 Interpreting diagram of apparatus for organic practical technique	This is possible in all core practicals
Personal and social responsibility	Soluble laundry bags Catalytic converters	19.8 17.29		
Continuous learning				
Intellectual interest and curiosity	Use of Chemistry in biological systems Eg buffers in blood and food Haemoglobin in blood Cancer drugs *cis*-platin	 14.22 17.17 17.15	Unit 1 Q22d the toxicity of carbon monoxide Unit 5 Q1a Structure of *cis*-platin	
Work ethic/conscientiousness				
Initiative	Investigation of chemical reactions	CP5 10.11		
Self-direction	Preparations	CP4 10.14	Unit 6 Q3c,d Able to draw apparatus used in preparations and explain the reasons for various procedures	
Responsibility	Health and safety and the difference between hazard and risk	4.1, 4.2	Unit 5 Q19b Identification of hazard and precaution in reacting Prince's metal with concentrated nitric acid	This is possible in all core practicals
Perseverance	Purification of an organic compound	20.5 ii, iii and iv	Unit 6 Q4a Explanation of experimental procedure	This is possible in all core practicals
Productivity	Improving manufacturing processes	9.7, 17.28	Unit 4 Q11a method for improving yield of industrial process	

Self-regulation (metacognition, forethought, reflection)	Suggest ways to reduce risks when dealing with chemicals	4.3	Unit 6 Q1cii Identification of hazard symbol and precaution necessary	This is possible in all core practicals
Ethics	Use of chromatography in drug testing Climate change Carbon neutrality fuels Pollution Biodegradable polymers/ incineration of polymers	15.23 4.15 4.16 4.13 5.8	Unit 1 Q7 renewable fuels	
Integrity				
Positive Core Self Evaluation				
Self-monitoring/self-evaluation/self-reinforcement	Carrying out practical work individually	Throughout course	Units 3 and 6	This is possible in all core practicals
Interpersonal skills				
Teamwork and collaboration				
Communication	This occurs in any practical when working with a partner			This is possible in all core practicals
Collaboration	This occurs in any practical when working with a partner	CP 9a,b 11.12		This is possible in all core practicals
Teamwork	Preparation of aspirin in a group	CP 16 20.3		
Co-operation	This occurs in any practical when working with a partner	CP6 10.14 CP7 10.20		This is possible in all core practicals
Interpersonal skills	This occurs in any practical when working with a partner			This is possible in all core practicals

Empathy/perspective taking	This occurs in any practical when working with a partner	CP 10 11.13		This is possible in all core practicals
Negotiation	This occurs in any practical when working with a partner			This is possible in all core practicals
Leadership				
Leadership	This occurs in any practical when working with a partner			This is possible in all core practicals
Responsibility	This occurs in any practical when working with a partner			This is possible in all core practicals
Assertive communication	This occurs in any practical when working with a partner			This is possible in all core practicals
Self-presentation				