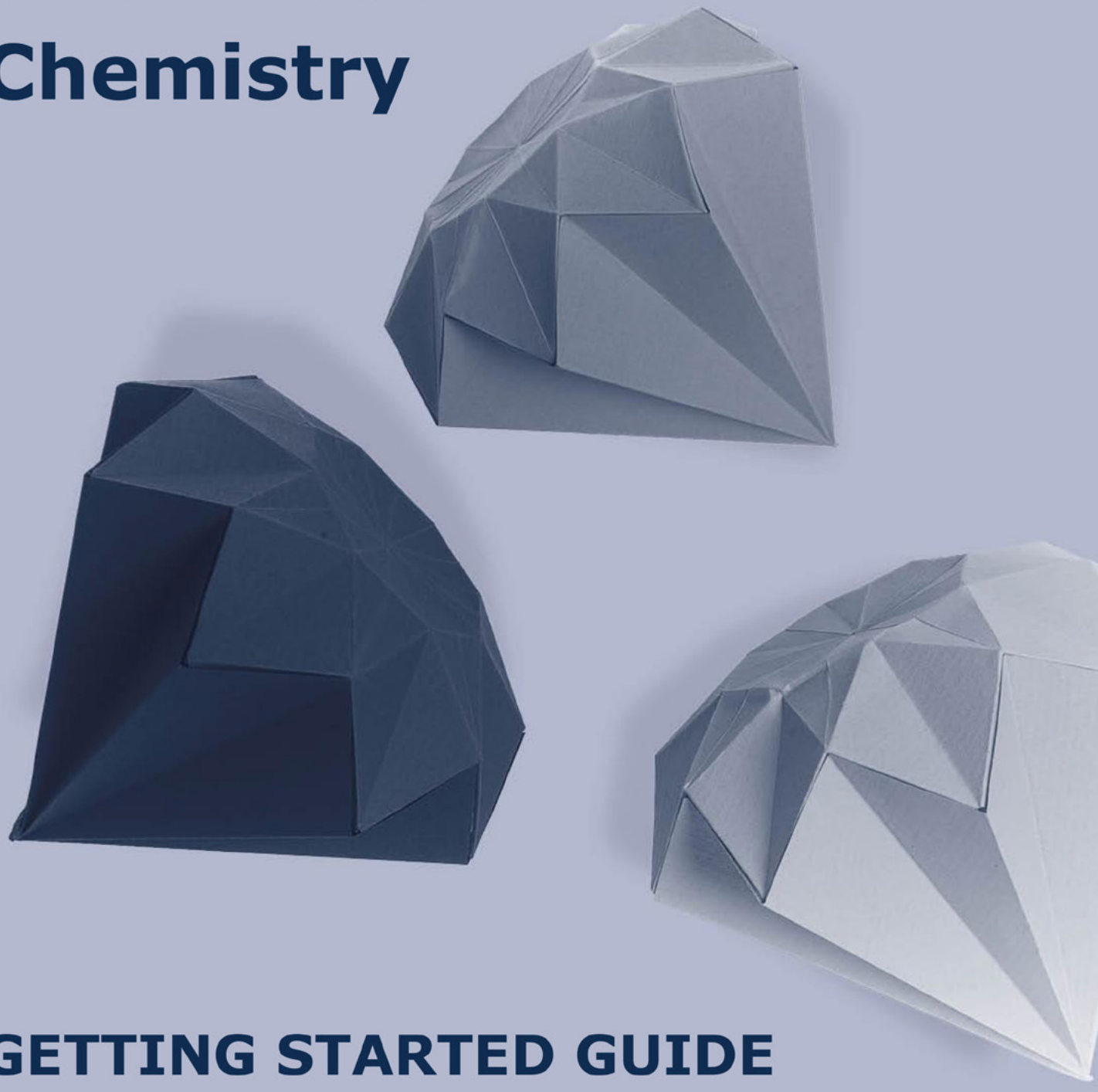
Pearson Edexcel

AS and A Level Chemistry



GETTING STARTED GUIDE

Pearson Edexcel Level 3 Advanced Subsidiary GCE in Chemistry

Pearson Edexcel Level 3 Advanced Level GCE in Chemistry

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Getting Started: AS and A level Chemistry 2015

Contents

1. Introduction

This revised specification, for first teaching from September 2015, has been developed in consultation with a variety of contributors. Teachers have been involved – through surveys, focus groups and one-to-one interviews – at each stage of the development from initial conversations about the current specification, as well as at each draft stage. We have also worked with a number of different universities to help ensure that the content of the specification provides a good foundation for further study at university, not just of Chemistry, but of related subjects. In addition, we have also reviewed both the content and the assessment models of Chemistry specifications in a number of other countries. This research means that we can be confident that this new Edexcel specification offers students a Chemistry qualification that is world-class.

Informed by this range of feedback, the revised 2015 Chemistry specification that we have developed:

- gives a coherent approach for linear teaching of Chemistry
- allows the co-delivery of AS Chemistry alongside A level
- encourages acquisition of key chemical principles
- puts practical chemistry at the heart of the specification and assessments
- provides clear examination papers, using a variety of question styles.

This Getting Started guide provides an overview of the new AS and A level specifications, to help you get to grips with the changes to content and assessment, and to help you understand what this new specification entails for you and your students.

Support for the new specification

We will be providing a package of support to help you plan and implement the new specification.

- Planning: In addition to the section in this guide, we will be providing a course planner and schemes of work that you can adapt to suit your department.
- Mapping: Mapping documents will show you clearly what has changed between the existing GCE 2008 specifications and the new ones, from September 2015
- Understanding the standard: For some questions in the specimen papers, we will be providing marked student exemplars, with an examiner commentary.
- Practical work and mathematics: Guidance will be provided for both these areas, in terms of delivering the skills as well as how they will be assessed.
- Personal, local support: Can support you with getting started and with further questions through our local network groups and the on-going support from your local Pearson curriculum support team and from our Science Subject Advisor.

Support documents will be available on the AS and A level 2015 Chemistry pages on our website.

2. What's changed?

2.1 How have AS and A level changed?

Changes to AS and A level qualifications

From September 2015, A level Chemistry will be a linear qualification. This means that all examinations must be sat – and non-examination assessment submitted – at the end of the course. This move to linear assessment has implications for the teaching of the subject, which will be addressed in Section 3 of this Guide; as well as on the assessment of the subject, addressed in Section 5.

From September 2015, AS level Chemistry will be a stand-alone qualification. This means that it cannot be used to contribute towards an A level Chemistry grade. More information about the relationship between AS and A level is covered in Section 3 of this Guide.

Changes to subject criteria

The subject criteria for AS and A level Chemistry have been revised. All awarding organisations' specifications for AS and A level Chemistry must meet these criteria.

The final subject criteria, published by the Department for Education, show the core content which must be present in all A level Chemistry specifications. This core content makes up 60% of the course and is largely unchanged from the subject criteria for the GCE 2008 specifications.

In addition, the subject criteria also contain revised appendices for the delivery and assessment of practical and mathematical skills within Chemistry.

The following **practical** requirements apply to A level Chemistry specifications:

A level Chemistry specifications must:

- contain a minimum of 12 core practical activities
- provide opportunities for students to use and develop the techniques listed in Appendix 5c
- assess practical skills within externally-assessed examinations
- provide opportunities for students to develop competency in practical work, which can be assessed by teachers.

The following **mathematical** requirements apply to A level Chemistry specifications:

A level Chemistry specifications must:

- provide opportunities for students to use and develop the mathematical techniques listed in Appendix 6
- assess mathematical skills within externally-assessed examinations, with at least 20% of marks assessing mathematical competency at Level 2 or above
- ensure that a range of mathematical skills are tested over time.

Changes to Assessment Objectives

The AS and A level Assessment Objectives (AOs) for all science subjects have been revised. The Assessment Objectives are the same for both AS and A level, although the weighting differs slightly between the two levels.

Notice that, compared to the GCE 2008 Assessment Objectives, these contain no explicit references to *How Science Works* (although these statements still form part of the subject criteria).

Within AO1, there is a limit on the proportion of questions that can test simple factual recall; the rest of the marks for AO1 should require a demonstration of understanding of material in the specification content.

AO2 still retains a higher weighting that the other Assessment Objectives, and retains its emphasis on applying skills and knowledge, either through performing calculations and other procedures, or by applying chemical knowledge to new contexts or scenarios.

The last Assessment Objective – AO3 – is new to science subjects. In part, questions that meet AO3 will be drawn from some aspects of practical work in the area of planning and critique of methods. However, other questions which allow students to draw conclusions from data or information will also count towards AO3.

		A level	AS level
AO1	Demonstrate knowledge and understanding of scientific ideas, processes, techniques and procedures	30–35%	35–40%
AO2	Apply knowledge and understanding of scientific ideas, processes, techniques and procedures: • in a theoretical context • in a practical context • when handling qualitative data • when handling quantitative data	40–45%	40–45%
AO3	Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to: • make judgements and reach conclusions • develop and refine practical design and procedures	25–30%	20–25%

As mentioned earlier, 20% of marks on question papers must assess mathematical applications within Chemistry. In addition, at least 15% of marks at A level must assess practical scenarios. In some cases, questions may count towards both targets, for example where experimental data is processed and interpreted.

2.2 Changes to the specification

Specification overview

Probably the most useful way to look at the content is to see where ideas come back in the second year of the A level course. This is shown in the table below. Remember that the column for A level Year 1 is the same content as for AS level.

A level Year 1	A level Year 2
Atomic Structure and the Periodic Table Bonding and Structure Inorganic Chemistry and the Periodic Table	Transition Metals
Formulae, Equations and Amounts of Substance	
Redox I	Redox II (electrochemistry)
Modern Analytical Techniques I	Modern Analytical Techniques II
Energetics I	Energetics II – lattice energy and entropy
Kinetics I	Kinetics II
Equilibrium I	Equilibrium II Acid-base equilibria
Organic Chemistry I – alkanes, alkenes, halogenoalkanes and alcohols	Organic Chemistry II – chirality, carbonyls and carboxylic acids Organic Chemistry III – aromatic compounds, organic nitrogen compounds and organic synthesis

Please note that the ordering of topics within this table does not imply a particular teaching order: the topics may be organised in a variety of different orders. In particular, this table shows the topics that make up AS Chemistry as those covered in Year 1 of the A level course. Teachers who plan a linear approach to A level over two years may, for example, choose to vary this presentation to allow related topics to be considered together. Further information on planning a route through the specification appears in the planning section of this Guide.

Changes to specification content

The subject criteria for Chemistry, common to all specifications, are defined by the DfE and must be met by all accredited A level Chemistry specifications after 2015. These subject criteria – making up 60% of the specification content – are very similar to those used for the previous GCE 2008 specification.

The remaining 40% of the AS and A level specifications is at the discretion of each Awarding organisation. Using feedback from teachers, as well as taking into account the needs of students going on to study Chemistry or related subjects, we had taken the opportunity to alter, re-word and re-organise some of the discretionary content in the new Edexcel A level. Some of the changes that you will notice include:

- the removal of the section called 'Green Chemistry' from AS
- the movement of Born-Haber cycles from AS to A level
- an approach to thermodynamics which includes Gibbs energy changes as well as entropy changes
- the removal of some organic reactions, including the formation of diazonium ions and subsequent coupling reactions
- the inclusion of the use of Grignard reagents as part of organic syntheses
- a greater focus on principles of transition metal chemistry, with less emphasis on learning of colours and reactions.

Changes to assessment

We have already seen two important changes to the assessment of Chemistry at AS and A level i.e. the mandatory assessment of:

- a minimum proportion of mathematical skills
- practical skills within written question papers.

Further regulatory requirements for new AS and A level subjects have been provided by Ofqual, following consultation with teachers and other stakeholders. These requirements provide a common assessment framework, to ensure comparability between different awarding organisations. These requirements include:

- a minimum of 3 hours of assessment for AS Chemistry
- a maximum of two assessment components i.e. question papers for AS Chemistry
- a minimum of 6 hours of assessment for A level Chemistry
- a maximum of three assessment components i.e. question papers for A level Chemistry.

It is also a regulatory requirement that AS and A level are 100% externally assessed i.e. there can be no coursework or other internal assessment units.

Further information on the new assessment model can be found in Section 5 of this Guide.

3. Planning and delivering AS and A level

The new courses, both for AS and for A level, are linear courses. This means that all assessment takes place only in the May / June examination series. When you are planning how to deliver the course, there are several factors which you should consider.

3.1 The function of AS level

For the revised Chemistry 2015 specification, the AS level is now a stand-alone qualification, rather than forming one-half of the A level, as with the 2008 specifications. This means that there is no obligation for students taking A level Chemistry to take AS level examinations. If students do complete the AS level examinations they will, of course, receive an AS level certificate; but the results of these examinations do not form a part of the final A level grade.

The A level grade depends solely on the performance of students on the final A level examination papers at the end of the two-year course. These final A level papers will test students on material that they have learned over the whole A level course – in other words, these papers will test topics that you may consider as 'AS topics'.

You may decide that there are still good reasons for A level students to sit the AS level examination, in terms of motivation, performance monitoring, or to provide a possible 'fall back' grade.

However, A level students who do not sit AS level are in no way disadvantaged. Indeed, time that might be otherwise spent on revising for, and sitting, AS level examination papers can instead be used by A level students for further coverage of theory or practical.

3.2 Co-teaching AS and A level

The new specification has been designed in such a way that the AS and A level courses are co-teachable; in other words, the AS level Chemistry specification represents a sensible first year of the A level course.

Not all students will know, at the start of the course, whether they are likely to take a full A level, or just an AS level. Therefore, many centres will not separate students into different teaching sets based on their likely pathway. This is not a problem, because of the flexibility to co-teach AS alongside A level.

However, some centres may decide that there is merit in having different teaching sets for A level students and AS level students, as teachers may wish to deliver the content in a different order, or to a different level, for their A level students.

3.3 Ordering the topics into a teaching route

The two most important questions to consider when building a possible teaching route for this specification are:

1. are students taking AS and A level going to be taught together i.e. will the class be a mixture of AS and A level students?
2. will the specification content be delivered by one member of staff, or will the teaching be split between different content?

Co-teaching AS and A level together

For classes with a mixture of AS and A level students, the content to be covered in the first year of the course is fairly fixed, and is very likely to be the AS topics of the course only. Once you have completed delivery of the AS topics, those students taking AS examinations will need revision time, study leave, and time off to sit examinations. Those students aiming for A level may also be taking the AS examinations although, as we have seen earlier in this guide, there is no necessity for them to do so.

For A level students not taking AS examinations, this period of study leave and examinations for AS students may be a good time to explore further practical opportunities, to consolidate learning of AS topics, to prepare for some of the mathematical aspects of the second year of the A level course, or to consider other aspects of their curriculum such as Extended Projects or other research activities.

Students returning from AS study leave can then rejoin the class for the final weeks of the summer term.

The advantages to separating AS and A level students

In many schools, having separate classes for AS and A level students will not be possible, for reasons of student numbers, teacher availability, or simply because students have not made a final decision on this issue.

However, where it is possible to separate students out, there are some advantages – both in terms of the flexibility that becomes possible in delivering topics (e.g. Kinetics I and Kinetics II can be delivered together, rather than in different years). It also means that no breaks in teaching occur, driven by students needing to revise for AS examinations.

Groups with more than one teacher

It is a fairly common practice to have more than one teacher involved in the delivery of the course to the same group of students. Just as with the current specification, the revised specification lends itself easily to this splitting of material. Indeed, the new specification may make this clearer, as there are two topics in the first year of the course – Bonding & Structure and Formulae, Equations and Amounts of Substance – that are integral to both AS examination papers. These two topics, proceeded in the case of Bonding & Structure by Atomic Structure, would make a good start to the course.

Other factors to consider

When planning the delivery of the specification, you will also need to bear in mind that:

- there are no January examinations, so that all exams fall in the May / June window. At this stage, we have to wait for JCQ guidance on the timings of these examinations for the first 'live' examination series.
- most students, on a linear course, benefit from a route through the specification which builds in revision of key principles. You will also want to build in opportunities for end-of-course revision, as well as for sufficient checkpoint assessments to allow tracking of progress to take place.
- although there are some changes to the specification content, these have involved both deletions and additions, so that the specification should be the same, in terms of teaching time, as the current course.

3.4 Delivery models

With changes to the specification being relatively small, there should be few barriers, in terms of content, to delivery. More challenging is the change in the structure of the qualification to one that is linear. As it is many years since A level specifications were linear, many teachers will have limited, or in many cases, no experience of teaching a linear A level.

Planning the delivery of a modular A level is relatively easy, as it is strongly dictated by the nature of the modules. Although some preparation is needed where the teaching is split between more than one teacher, it is usually fairly simple to deliver the topics that make up a module, have students sit that module, and then move on to the next. Modular specifications have therefore usually been arranged to break up topics over different modules to allow revisiting of key ideas, and to allow a variety of synoptic links to be drawn out through the teaching process.

Planning a linear course needs a little more consideration, and usually follows one of two patterns: the block curriculum or the spiral curriculum.

Block curriculum

For Chemistry, a block curriculum approach to the A level specification would involve combining together topics that are split between AS and A level only, such as Kinetics and Equilibrium. Such a teaching approach could organise the following route through the topics:

- Formulae, Equations and Amounts of Substance
- Atomic structure; Bonding and Structure
- Redox I; Groups 1, 2 & 7
- Organic Chemistry I (alkanes and alkenes)
- Energetics I and II
- Organic Chemistry I (halogenoalkanes and alcohols) and II
- Kinetics I and II
- Equilibrium I and II; Acid-base equilibria
- Transition metal chemistry; Redox II
- Organic Chemistry III
- Modern analytical techniques I and II

There are some advantages to this approach: the longer periods of study of particular topics can encourage students to make a deeper connection with the material covered. Also, longer teaching blocks mean that end of topic tests cover a larger volume of material, so that these tests can become more substantial and provide more detail on the level of understanding developed. The effect on revision can be positive, too, with students being able to locate notes on a particular area more easily that they can if the delivery of the subject is more piecemeal. On the other hand, long periods of study of the same topic can lead to some disengagement if the topic, or the methods used, are too 'dry'. Also, larger teaching blocks means that concepts are rarely re-visited, so that on-going revision is not always facilitated.

Spiral curriculum

This approach tends to keep the content in smaller topics – for example, keeping the AS topics separate to those that are A level only – and tends to ensure that topics are introduced in such a way that refreshes the memory of a topic that has been taught previously.

As might be expected, the advantages and disadvantages of this approach are the reverse of those for the block curriculum model. So, supporters of this curriculum model see benefits in the on-going revision that is built into this model, as well as the shorter topic blocks providing greater freshness of delivery and learning. On the negative side, some students can find the frequent movement from one topic to the next confusing.

Using this approach, the AS year (year 1) of the Chemistry course may look something like this:

- Atomic structure
- Formulae, Equations and Amounts of Substance
- Redox I (preceded by revision of electronic structure of atoms)
- Kinetics I
- Bonding and structure (preceded by revision of atomic structure)
- Equilibrium I
- Organic Chemistry introduction, alkanes and alkenes (preceded by revision of covalent bonding / intermolecular forces)
- Groups 1, 2 & 7 (preceded by revision of ionic bonding / redox)
- Organic Chemistry alcohols / halogenoalkanes (preceded by revision of introduction to organic)
- Energetics I (preceded by revision of calculations)
- Modern analytical techniques (preceded by revision of mass spectrometry and organic chemistry)

And the A level year (year 2) may look like:

- Equilibrium II (preceded by revision of equilibrium I)
- Acid-base equilibria
- Redox II (preceded by revision of redox in terms of both electron transfer and change in oxidation number / use of ionic half-equations to construct full ionic equations)
- Transition Metals
- Organic Chemistry II – chirality, carbonyls and carboxylic acids
- Energetics II
- Organic Chemistry III – arenes and organic nitrogen compounds
- Modern Analytical techniques II
- Organic Chemistry III – organic synthesis

4. Content guidance

4.1 Overview

The main drivers behind the changes to the content in the new specification were not wholesale changes to the material students can be expect to be assessed on, but rather to clarify this section of the specification to make it more user-friendly for both teachers and students. For instance generic statements, followed by examples, have been replaced by details of the specific content required. This may mean on paper the specification looks longer, but it is simply more detail of the precise expectations.

Some large sections of the old specification are no longer evident. For instance a separate section on 'Green Chemistry' is not in the new specification. Examples of using chemistry sustainably still exist but are found in with the relevant functional group or reaction, rather as a standalone topic.

Statements to carry out particular experiments within the content of the previous specification have been removed. Whilst these experiments are often useful teaching tools, it is the content they help embed, rather than the experiment itself, which is assessable. Any exceptions to this (e.g. techniques such as recrystallisation) are clearly shown in the new specification.

4.2 AS / A level Year 1

Topic One – Structure of the Atom and the Periodic Table

The progression from GCSE is now obvious, with the initial part of the topic clearly showing the knowledge of sub-atomic particles required before the introduction of new concepts such as mass spectrometry. There is no longer the need for students to describe how a mass spectrometer works as the sector instruments are largely being superseded by 'Time of Flight' and 'Quadrupole' machines. In addition recall of uses of mass spectrometers is not now expected. Processing data from a mass spectrum, for example to calculate an average atomic mass, is still required.

The need to recall that any orbital holds up to two electrons is now an explicit statement on the new specification.

Topic 2A – Bonding

There has been a shift in emphasis in some content to focus on understanding rather than recall. For instance the previous specification required students to know the trend in ionic radii down a group; the new specification requires understanding of the trend.

Born–Haber cycles and polarisation of ions are no longer expected at AS and it is expected that they will be taught in year 2 of the full A level.

Topic 2B – Structure

Recall of the structure and uses of fullerenes and carbon nanotubes have been replaced by knowledge of the structure of graphene. Students are still expected to know the structures of diamond and graphite and the new specification makes it clear that if students are given information about structure and/or bonding in a substance, they can be expected to predict its properties.

Topic 4B – Group 7

Understanding of trends in physical properties and chemical reactivity is now required, rather than recall. There is no expectation that students are expected to recall the colours of the elements, for instance, in different solvents.

Knowledge of iodine – thiosulfate titrations are no longer required at AS / Year 1.

Topic 5 - Formulae, Equations and Amounts of Substance

Calculation of empirical and molecular formulae is an addition to the new specification in AS / Year 1. However there is no longer a need for students to understand and use the term 'parts per million'. Reference to the knowledge of specific experiments has been removed (e.g. making a salt and determining the percentage yield), though one might expect a teaching programme to still use such experiments as part of a balanced curriculum.

Topic 6A – Introduction to Organic Chemistry

This is not an addition to the specification. It merely brings together key synoptic concepts such as homologous series, reaction types and drawing / naming compounds into one place. When devising teaching programmes centres can decide whether to teach some / all of this content as an introductory module or whether to embed the concepts when studying specific functional groups.

Topic 6B – Alkanes

The formation of specific pollutants from combustion of alkanes and the role of catalytic converters have been added to this section. However detailed knowledge of the role of CO_2 in climate change is now not needed.

The section on the radical substitution reaction with halogens has been amplified to make it clear that an understanding of its limitations as a synthetic reaction is required. Knowledge of radical reactions in the ozone layer is not required.

Topic 6C – Alkenes

Students should be able to recall the reaction between an alkene and steam as a way to make an alcohol. The section regarding addition of hydrogen halides has been clarified to make it clear that knowledge of carbocation stability is required.

The section on polymers has been extended slightly by the introduction of specific examples showing how chemists contribute to the sustainable use of polymers.

Topic 6D – Halogenoalkanes

Recall of some uses of halogenoalkanes is not required, but the reaction with KCN to increase chain length has been introduced into AS / Year 1.

Topic 6E – Alcohols

Recall of the elimination reactions of alcohols has been reintroduced to the specification, though knowledge of the mechanism is not needed. The reaction with sodium has also been removed from the required content. To enable students to appreciate the steps required to, for instance, use an alcohol to prepare a liquid halogenoalkane, some additional detailed has been added to the practical techniques we expect students to understand at AS / Year 1. This will ensure students understand how to separate, dry and identify a liquid product.

Topic 7 - Modern Analytical Techniques I

The emphasis on the use of IR is focused on its use to identify bonds within molecules in the new specification. Its link to polarity in molecules and role in climate change are no longer present.

Topic 8 – Energetics I

Standard conditions have been clearly defined in the new specification but the need to define the enthalpy change of atomisation is no longer required at AS / Year 1, because of the transfer of Born-Haber cycles to Year 2.

Topic 9 – Equilibrium I

It is expected that students will continue to evaluate data to show the need for a compromise between rate and yield in industrial reactions. In a change from the previous specification, the requirement to write an equilibrium expression is now a core concept for AS / Year 1. Quantitative use of such expressions is not expected at AS level, though such use is required for the A level qualification. Centres may decide to run Equilibrium I straight into Equilibrium II to avoid this disconnect.

4.3 A level Year 2

Topic 11 – Equilibrium II

There is no requirement to recall steps taken in Industry to maximise Atom Economy in the new specification.

Topic 12 – Acid–Base Equilibria

The recall of the historical development of acid theory from the 19th century onwards is no longer required. An understanding of how acidic strength affects the enthalpy change of neutralisation is needed.

The section on buffer solutions has been clarified to remove the list of possible examples that could be studied (e.g. to prevent food deterioration) and now focuses specifically on the role of buffers in maintaining blood pH.

Topic 13A – Lattice Energy

The ability to construct Born–Haber Cycles as well as define and use all the key terms associated with the process has been transferred from year 1 (AS) on the previous specification, back into Year 2 (A level). This also includes polarisation of ions and comparison to theoretical lattice energies.

Topic 13B – Entropy

The calculation and use of Gibbs Energy is an addition to the specification. Rather than simply recall the equation and use it to compare the relative sizes of ΔH and $T\Delta S$, centres are encouraged to explore the relationships between $\Delta S_{surroundings}$, ΔS_{system}, ΔH and ΔG.

Topic 14 – Redox II

The section on electrochemical cells has been clarified to make sure it is evident that students are expected to be able to describe how to set up a simple cell, as well as represent cells as cell diagrams. Whilst students are not expected to recall details of specific storage cells they should be able to apply the concept of electrode potential to a given cell. The role of redox reactions in breathalysers is no longer required.

Topic 15A – Principles of Transition Metal Chemistry

The understanding of some key concepts in this topic was implied rather than stated in the previous specification. This anomaly has been addressed by including the specific statement to show understanding of ligands and coordination number. The notion that a complex ion of a particular metal may change colour dependent on oxidation number, ligand and coordination number is also included. However

the need to discuss evidence for electronic configurations in terms of ionisation energies has been removed from this section as it is present in AS / Year 1.

Generic statements regarding examples of the role of transition metals in biological systems have been deleted. The new specification is much more specific and requires knowledge of the use of *cis*-platin and haemoglobin only. Recall of specific uses of transition metals is no longer required. Students are also not expected to describe the development of new catalysts from transition elements, though the chemistry of some specific examples is required (see Topic 15B.)

Topic 15B – Reactions of Transition Metal Elements

The section of the reactions of copper and chromium complexes has been amended to include specific details of the reactions of which students are expected to have knowledge. The redox reactions of vanadium have been introduced to allow application of concepts from Redox II in this context. However the reactions of Mn(II) and Zn(II) have been deleted. Specific examples of catalytic processes to illustrate homogenous and heterogeneous have been included to help centres and students, for example the role of V_2O_5 in the Contact Process.

Topic 17C – Carboxylic Acids

Knowledge of esterification reactions in the context of the production of biodiesel and low fat spreads is not required.

Topic 18A – Arenes-Benzene

The new specification makes it clear that data about bond lengths and the enthalpy of hydrogenation should be used to support the model of bonding in benzene. Use of data from IR spectroscopy and X-ray diffraction is no longer required. Students are now required to understand the resistance of benzene to bromination and to compare this, in terms of their structures, with the ease of bromination of alkenes. Knowledge of the reaction of arenes with fuming sulfuric acid is not now needed, nor is addition reactions, other than the use of hydrogenation data to support the delocalised model.

Topic 18B – Amines, Amides, Amino Acids and Proteins

Rather than simply requiring recall of the basic nature of amines, students are now expected to understand the reasons for differences in basicity. Recall of the characteristic smell of amines has been removed from the new specification. Students are no longer expected to describe the formation of azo-dyes, but the new specification does expect them to describe reactions to prepare primary aliphatic amines.

Formation of polyamides is still on the new specification but students are no longer required to comment on their physical properties.

Topic 18C – Organic Synthesis

The use of Grignard reactions to increase chain length has been introduced to this section. This replaces the need to give examples of organic synthesis in research and to explain the use of combinatorial chemistry in drug research.

Topic 19A – Mass Spectroscopy

Use of fragmentation patterns to interpret mass spectra is not noted specifically here as it is present in Topic 7 (AS / Year 1). The use of very accurate molecular masses, from mass spectra, to help identify compounds is now included.

Topic 19B – Nuclear Magnetic Resonance

Students will not be assessed on their knowledge of how radio waves interact with nuclei and the emphasis is very much on their ability to interpret data from spectra. Carbon-13 NMR is introduced into the specification as a more straight forward introduction to the technique. The section on hydrogen-1 NMR has been exemplified to make it clear that use of relative peak areas, as well as chemical shifts and simple splitting pattern is required.

Students no longer have to describe uses of NMR in medicine, nor the use of microwaves for heating.

Topic 19C – Chromatography

The requirement for students to calculate R_f values has been re-introduced.

5. Assessment guidance

5.1 Implications of linear assessment

As has been mentioned elsewhere in this Guide, the assessment of both AS and A level is linear in style. This means:

- examinations are available in the May / June session only
- students must sit all assessment components in the same session. Note that students entering for A level Chemistry would not need to take any AS Chemistry examinations (except if, under exceptional circumstances, they are taking AS and A level in the same examination series)
- schools will enter for the qualification ('AS Chemistry') rather than for a series of units
- if a student is absent for an examination, then centres would need to apply for Special Consideration, under the usual conditions, to allow a grade to be awarded to that student. If the request for Special Consideration is not successful, then the student would need to sit all examination papers again in a future examination series.

5.2 Assessment models

Our assessment model provides question papers that allow students to revise a set of topics to show their knowledge in depth on these topics. It also provides question papers that allow them to show the breadth of their knowledge across all topics in the specification.

AS assessment model

At AS, there are two examination papers. The papers will both contain 10 multiple choice questions, along with a variety of short and long response questions. Some of the questions may require more extended responses, worth up to 6 marks, and requiring students to follow a line of reasoning to complete an answer.

Across the two papers, the total proportion of questions assessing mathematical skills will reach the required 20%, although this may not be evenly balanced across both papers. The two papers will also meet the minimum requirement of 15% of marks testing practical skills.

Each paper has a focus within a particular set of topics from within the AS specification:

Paper 1 – Core inorganic and physical chemistry (50% of AS level)
1h 30 minutes; 80 marks

- Atomic structure and the Periodic Table
- Bonding and structure
- Redox I
- Inorganic chemistry and the Periodic Table
- Formulae, equations and amounts of substance

Paper 2 – Core organic and physical chemistry (50% of AS level)
1h 30 minutes; 80 marks

- Bonding and structure
- Formulae, equations and amounts of substance
- Organic chemistry I
- Modern analytical techniques I
- Energetics I
- Kinetics I
- Equilibrium I

A level assessment model

At A level, there are three question papers. The papers will both contain a variety of short and long response questions. Some of the questions may require more extended responses, worth up to 8 marks, and requiring students to follow a line of reasoning to complete an answer. Paper 1 and Paper 2 will also contain 10 multiple choice questions.

Across the two papers, the total proportion of questions assessing mathematical skills will reach the required 20%, although this may not be evenly balanced across the three papers.

Approximately half the marks of Paper 3 will focus on the assessment of practical skills, meeting the minimum requirement of 15% of marks testing practical skills.

Paper 1 and Paper 2 each have a focus within a particular set of topics from within the A level specification, which will include material from both years of the course:

Paper 1 – Advanced inorganic and physical chemistry (30% of A level)
1h 45 minutes; 90 marks

- Atomic structure and the Periodic Table
- Bonding and structure
- Redox I & II
- Inorganic chemistry and the Periodic Table
- Formulae, equations and amounts of substance
- Energetics I & II
- Equilibrium I & II
- Acid-base equilibria
- Transition metals

Paper 2 – Advanced organic and physical chemistry (30% of A level)
1h 45 minutes; 90 marks

- Bonding and structure
- Formulae, equations and amounts of substance
- Organic chemistry I, II & III
- Modern analytical techniques I & II
- Kinetics I & II

Paper 3 meets the requirement within A level for students to make links between different topics. The paper contains a variety of short and longer response questions, some of which will be longer responses where students can demonstrate their understanding of the chemistry.

Approximately half of the paper will test practical skills within chemistry.

Paper 3 – General and practical principles in chemistry (40% of A level)

2h 30 minutes; 120 marks

- All topics
- Written assessment of practical skills

5.3 Re-sitting

Students are permitted to resit both AS and A level qualifications. Any resit must abide by the same linear rules, so that a resitting student must resit all units that make up the qualification. A new grade will be issued, based on the results of the new linear sitting of the qualification.

It is not permitted for students to combine results from examination components sat in different examination series e.g. Paper 1 from June 2017 and Paper 2 from June 2018.

Where a student resits, the higher grade will be credited to the student (although note that performance measures will usually relate to the first attempt).

5.4 Assessing mathematical and practical skills

As has been seen elsewhere in this Guide, it is a regulatory requirement for all AS and A level examinations to test mathematical and practical skills, in line with the weighting required by the subject criteria.

Mathematical skills

Appendix 6, at the back of the specification, lists the mathematical skills that should be developed in students during the teaching of A level Chemistry. For each skill, there is some exemplification to illustrate some areas of the specification where this skill may be encountered. Note that this exemplification is not comprehensive: the skills may be tested in the context of any area of the specification.

In addition, each topic in the specification content has an introductory paragraph, giving further examples of where mathematics can be addressed within that topic.

Further guidance on the delivery of mathematics within Chemistry can be found in the Edexcel teacher and student guides to mathematical skills.

Practical skills

Appendix 5, at the back of the specification, lists the practical skills that should be developed in students during the teaching of A level Chemistry. This appendix has four separate sections:

Appendix 5a details the practical skills which will be tested within written examination papers

Appendix 5b details the practical skills which will be tested through the teacher assessment of practical competency i.e. through lab practical work

Appendix 5c details the apparatus and techniques that must be covered, through the core practicals, for all students studying A level Chemistry.

Note that Appendices 5a, 5b and 5c are common to all A level specifications across the science subjects.

Appendix 5d – this shows the core practicals that have been selected for the Edexcel Chemistry specification; and also maps these practical activities to the apparatus and techniques in Appendix 5c, allowing you to see how those skills are to be developed in your students.

The core practical activities that you should carry out with your students are also clearly marked in the specification. These practical activities make up, effectively, a minimum syllabus for practical work for A level Chemistry. Knowledge of these techniques, including processing of data or results for these practical activities, will form the basis for the written assessment of practical skills within examination papers.

Additional practical activities are to be encouraged, so that students develop a genuine competence in practical work, both in terms of manipulative skills as well as in data analysis. With this in mind, each topic in the specification content has an introductory paragraph, giving further examples of practical activities that can be carried out within that topic.

Further guidance on the delivery of practical skills within Chemistry can be found in the Edexcel teacher and student guides to investigative skills.

5.5 Core practicals

Introduction

The subject criteria for A level Chemistry contain, as well as the chemistry content that must be present in all specifications, a list of apparatus and techniques that must be taught to students studying A level Chemistry. These 12 techniques can be found in Appendix 5c of the specification.

To ensure that A level specifications give clear opportunities for you to cover the content of Appendix 5c, all specifications need to indicate a series of core practical activities. These core practical activities make up, essentially, a minimum syllabus of practical activities that accompany the theoretical teaching of A level. The

subject criteria specify that the number of core practical activities must be a minimum of 12, across the whole A level course.

In developing the Edexcel specification, we considered a number of practical activities that led, in the opinion of the teachers writing the specification, to be key to the teaching and learning in Chemistry. This led to the total number of core practical activities in our final specification being 16.

Completing the core practicals

We would recommend that you timetable all 16 core practical activities with your students, as knowledge of these techniques can be tested within examination papers. Part of the resources accompanying the specification will include a series of teacher worksheets, student worksheets and technician worksheets covering all the core practical techniques.

Remember that the techniques are associated with topics from both the AS and A level topics in the specification, so that core practicals should be scheduled alongside both AS and A level topics

Flexibility in completing the core practicals

Whilst there is some flexibility in core practical activities, it should be remembered that examination papers will have questions based within the context of these practical activities, so that students need to be familiar with these techniques. However, it is not the intention of questions in examination papers to ask for recall of particular methods – it is the apparatus and techniques in Appendix 5c that are being tested, not a particular activity.

One aspect of flexibility, therefore, is the method chosen for each core practical. As mentioned above, part of the free support for the qualification includes a teacher worksheet, student worksheet and technician worksheet for each core practical; but you may select a different method should you wish. For example, Core Practical #3 is 'Finding the concentration of a solution of hydrochloric acid' and the free worksheet may do this by titration with standardised sodium hydroxide solution, with phenolphthalein indicator. However, you may choose to do the same practical by making up a standard solution of sodium carbonate, then titrating with methyl orange indicator. Either way, students will gain skills in performing a titration, knowledge of indicators, knowing how to find a mean of concordant titres, and performing both titration and error calculations; all of which could feature in a question on the examination paper.

A second aspect of flexibility comes in which practicals to do. Appendix 5d maps all the core practicals to the apparatus and techniques – remember that it is these apparatus and techniques that feature on the subject criteria. So, you may chose to replace the core practical chosen with an alternative practical which meets the same skills. Taking Core Practical 3 as an example again, the apparatus and techniques here could equally be covered with another acid-base titration, perhaps finding the concentration of a solution of ammonia by titration with a standardised solution of an acid.

There is one other important piece of flexibility, resulting from the relationship between the core practicals and the assessment of practical competency. The criteria for practical competency require students to have completed a minimum of 12 core practical activities. As the Edexcel specification contains 16 core practicals, if a student misses a core practical lesson, then there is no necessity to re-run a 'catch-up' practical class – provided that the student has covered the necessary apparatus and techniques elsewhere with a different core practical activity.

5.6 Science Practical Endorsement ('Practical Competency')

Overview

A level qualifications in each science must give students opportunities to use relevant apparatus and techniques to develop and demonstrate specific practical skills.

These skills will be assessed through identified practical activities within each specification. The assessment outcomes will be reported separately on students' certificates as either 'pass' or not reported.

To achieve a pass, students must demonstrate that they are competent in all of the areas listed in Appendix 5c of the specification. Performance will be assessed by teachers against common assessment criteria that will be consistent across exam boards.

Supporting students

Especially at the start of the course, students will need support and feedback in order to master the techniques of practical work. During the course of their studies, as they grow in confidence and experience, students will require less support. By the end of the course, in order to obtain a 'pass' grade, students should be independently competent.

Marking guidance

The specification gives the 'Common Practical Assessment Criteria' (CPAC) that will be used by all awarding bodies. Note that these criteria do not require work to be marked (in the sense of following a mark scheme and assigning numerical marks); rather the criteria list a series of competencies against which each student can be assessed.

Moderation process

Details of the process for authenticating centre judgements on the practical competency of their students will be confirmed in the summer of 2015, following a trial of the process.

However, centres will need to collect evidence to show that enough practical work has been carried out to meet the minimum requirement; and that students have reached the level of competency described in the assessment criteria.

Examples of such evidence could include:

- plans to cover all practical requirements, such as a scheme of work to show how sufficient practical activities will be carried out to meet the requirements of CPAC, incorporating all the skills and techniques required over the course of the A level
- a record of each practical activity that is carried out and the date it was done
- a record of the criteria assessed in each practical activity
- a record of student attendance
- a record of which students met which criteria and which did not
- evidence of students' work associated with particular tasks, such as records of observations/measurements and associated calculations and conclusions, background research carried out, notes of any planning activity or modifications made to provided procedures, etc.

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