SQA Advanced Unit Specification

General information for centres

Unit title: Fundamental Chemistry: Theory and Practice

Unit code: HV4H 47

Unit purpose: This unit is designed to give candidates the underpinning chemistry knowledge and practical skills necessary to work in a laboratory.

On completion of the unit the candidate should be able to:

1 describe and use the basic chemical principles associated with chemical equations, organic chemistry and chemical equilibria
2 perform a range of chemical techniques and report the results.

Credit points and level: 2 SQA Credits at SCQF level 7: (16 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Recommended prior knowledge and skills: Entry is at the discretion of the centre although it is recommended that candidates possess Chemistry at SCQF level 5 or equivalent.

Core Skills: There may be opportunities to gather evidence towards core skills in this unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: If this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Assessment: Outcome 1 will be assessed using a closed-book assessment.

Outcome 2 should be assessed using a range of practical activities. Candidates should be assessed on both their practical ability and on the quality of their laboratory reports.

SQA Advanced Unit Specification: statement of standards

Unit title: Fundamental Chemistry: Theory and Practice

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The sections of the unit stating the outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe and use the basic chemical principles associated with chemical equations, organic chemistry and chemical equilibria

Knowledge and/or Skills

- atomic theory, chemical bonding and chemical formula
- calculations involving chemical equations for a range of reaction types
- organic functional groups and the description of their main reactions
- principles of chemical equilibria and their application to a range of chemical systems

Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- link atomic theory to types of chemical bonding and determine the chemical formula of a range of compounds
- calculate reacting quantities and amount of product expected for a range of reaction types
- identify organic functional groups and describe their main reaction types
- explain the principles of chemical equilibria and apply them to a range of chemical systems

Evidence should be gathered using a holistic closed-book assessment under supervised conditions. The assessment could contain a mixture of short answer and structured questions. The allocation of marks per question should be weighted on the basis of the level of response and the amount of effort required.

Students should have access to the SQA Databook for Higher/Advanced Higher Chemistry or any suitable replacement when sitting the assessment.

Assessment guidelines

It is suggested that the questions set in the assessment could cover a representative sample of the topics suggested in the support notes. In the assessment there could be a mixture of short answer and structured questions in each part of the assessment. It is also recommended that the following weighting is used for the assessment:

Calculations including chemical equations: 20–25% of assessment
Atomic theory, chemical bonding and chemical formula: 15–20% of assessment
Organic functional groups and main reactions: 35–40% of assessment
Chemical equilibria 15–20% of assessment

Outcome 2

Perform a range of chemical experiments and report the results

Knowledge and/or skills

- follow instructions to perform a range of chemical experiments
- work in a safe manner regarding current health and safety regulations
- achieves consistent and accurate results
- reports the results clearly and concisely
- identify sources of experimental errors as appropriate

Evidence requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can perform a range of practical techniques. The practical work selected for assessment purposes should cover a range of techniques to provide a guide to the candidates' all round practical ability. A checklist should be used to record the results of the candidate's practical work on at least five occasions. Candidates must also complete a laboratory diary or pro forma. For three of the experiments carried out the candidate must also produce a laboratory report which demonstrates the candidates' ability to plan and evaluate the laboratory exercise.

Candidates should be assessed on both their performance in completing the laboratory work and on their ability to produce satisfactory laboratory reports.

Assessment guidelines

It is recommended that the candidate should perform a wide range of practical techniques. A checklist and the record of results in a lab diary should be used to assess performance in the laboratory. This checklist should recognise the need for accuracy in analytical work and place an emphasis on yield and quality of product in any preparative work. A laboratory report for three practicals should be produced to assess the candidate's ability to plan, analyse and discuss laboratory work.

An example of suitable practical techniques chosen for assessment could include a titration, a gravimetric analysis and an organic preparation. It is not envisaged that three different titrations would be an appropriate selection.

Administrative information

Unit code: HV4H 47

Unit title: Fundamental Chemistry: Theory and Practice

Superclass category: RD

Original date of publication: November 2017

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History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

For further information, please call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Unit Specification: support notes

Unit title: Fundamental Chemistry: Theory and Practice

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this unit

This unit is a mandatory unit in SQA Advanced Certificate Applied Sciences and associated SQA Advanced Diploma awards. It may also be suitable for inclusion in other science SQA Advanced Certificate/SQA Advanced Diploma awards. The aim is to give candidates the underpinning theoretical and practical chemical knowledge to allow them to function as an effective technician and progress to further study.

Outcome 1

In Outcome 1 candidates may be able to write balanced chemical equations for a range of reaction types, in particular, acid/base, redox, and precipitation. To ensure candidates can achieve this it may be necessary to cover, atomic theory, including s,p,d and f orbitals, chemical formula, bonding: chemical, ionic, covalent, polar covalent; polar/non-polar molecules, formula weight, the mole, molar gas volume.

It is also recommended that trends in the periodic table, ionisation enthalpy, electron attachment enthalpy, electronegativity are also covered

Calculation of reacting quantities involving solid, liquids, gases and solutions for a range of reaction types.

In the organic chemistry knowledge and skills, candidates should be introduced to International Union of Pure and Applied Chemistry (IUPAC) nomenclature for a wide range of functional groups. This may include alkanes, alkenes, alkynes, haloalkanes, aminoalkanes, alcohols, aldehydes, ketones, carboxylic acids, esters, thiols. Candidates should be able to recognise the functional groups in large molecules and to be familiar with the main reaction types. This may include electrophilic addition, nucleophilic substitution, free-radical substitution, oxidation, reduction, hydrolysis, elimination and esterification.

The main classes of biomolecules could be introduced — carbohydrates, lipids, proteins, nucleic acids

In the chemical equilibrium knowledge and skills, candidates could be introduced to the concept of acidity and alkalinity. Strong and weak acids and bases could be discussed hence introducing the concept of equilibrium, Le Chatelier's Principle, equilibrium constants and dissociation constants, and pH calculations for salt solutions and for buffer solutions could also be included.

Outcome 2

Candidates may be introduced to a wide range of practical techniques including:

1 volumetric analysis, involving acid/base, redox, precipitation and titrations. Serial dilution calculations and techniques could also be covered.
2 gravimetric analysis, which could include organic precipitants.
3 organic and inorganic synthesis reactions using some or all of the following techniques: melting point and boiling point determination, reflux, extraction, distillation and recrystalisation.

The above list is not exhaustive and centres can perform their own practical work, as appropriate.

A lab diary should be kept and the students should be introduced to Standard Operating Procedures (SOPs). Laboratory reports should be in an appropriate format. Health and safety, in regard to risk and Control of Substances Hazardous to Health (COSHH) assessments should be emphasised at all times.

Guidance on the delivery and assessment of this unit

This unit is likely to form part of a group award, which is primarily designed to prepare candidates for employment in a science related post. The emphasis should be on encouraging the candidates to think about the practical implications of the theory they study.

Independent study should be encouraged by using candidate-centred, resource-based methodologies.

The assessment for Outcome 1 could be by a single closed-book assessment. It is suggested that the following allocation of knowledge and skills items in the assessment is:

Calculations including chemical equations: 20–25% of assessment
Atomic theory, chemical bonding and chemical formula: 15–20% of assessment
Organic functional groups and main reactions: 35–40% of assessment
Chemical equilibria: 15–20% of assessment

In Outcome 2 candidates should be assessed on their ability to perform laboratory work to a required standard. For example titration results should be both accurate and consistent. Gravimetric analysis must give accurate results and any preparative work should produce compounds which are pure and in reasonable quantity. Ideally all practical work should be carried out individually, although resources may lead to some experiments being done in groups. This should be the exception rather than the norm.

Laboratory reports should be clear and concise, with all results and calculations reported. Candidates should discuss the results in terms of their accuracy and reliability, taking into account inherent experimental errors.

Should a candidate fail to carry out five experiments to the required standard, further attempts can be offered. Ideally candidates will be participating in many experiments, with only three required for assessment purposes, so re-assessment should not be a major concern.

Open learning

If this unit is delivered by open or distance learning methods, additional planning resources may be required for candidate support, assessment and quality assurance.

A combination of new and traditional authentication tools may have to be devised for assessment and re-assessment purposes.

For further information and guidance, please see Assessment and Quality Assurance of Open and Distance Learning *(SQA, February 2001, publication code A1030).*

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Fundamental Chemistry: Theory and Practice

This is a 2-credit SQCF level 7 unit, intended to be delivered as part of an SQA Advanced Certificate/SQA Advanced Diploma science qualification. It is likely to be delivered in the first year of an SQA Advanced Diploma programme.

It is designed to give you the basic chemistry knowledge and practical skills you will need to undertake training as a higher-grade technician in a wide range of science based industries. The emphasis will be on applying the theoretical knowledge in practical situations.

On completion of this unit you should be able to:

1 describe and use the basic chemical principles associated with chemical equations, organic chemistry and chemical equilibria
2 perform a range of chemical techniques and report the results

The main components of the unit are described in more detail below.

Outcome 1

In this outcome you will cover the basic concept of atomic theory and chemical bonding allowing you to predict chemical formula. You will study the main reaction types, acid/base, redox, precipitation, writing balanced chemical equations and performing calculations from them.

You will study the range of compounds formed by carbon, cover the IUPAC nomenclature system, and the main reactions of the functional groups.

You will also study the concept of reversible reactions, consider Le Chatelier's Principle, and equilibrium constants. This knowledge will be applied to range of systems including gas phase reactions and ionic equilibria, in particular acid/base reactions involving weak acids or bases.

Outcome 2

In this outcome you will carry out a range of practical techniques including volumetric and gravimetric analysis and chemical synthesis. You will be encouraged to understand the need for accuracy and the underlying principles behind the experiments you undertake.