



National Unit specification

General information

Unit title: Chemistry Fundamentals 2 (SCQF level 5)

Unit code: HT6R 45

Superclass: RD

Publication date: July 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This unit is designed to provide learners with an introduction to the basic theoretical concepts of quantitative chemistry, and to provide a background in chemistry for those who have no previous knowledge or experience in the subject. The unit is suitable for learners studying at NC level, and will provide the necessary underpinning knowledge and skills to enable progression to further study of Chemistry at Higher level.

Outcomes

On successful completion of the unit the learner will be able to:

- 1 Apply the mole concept in a variety of simple chemical processes.
- 2 Balance chemical reaction equations and calculate chemical quantities from reaction stoichiometry.
- 3 Relate the nature and use of metals to their properties and apply the concepts of oxidation and reduction to various electrochemical processes.
- 4 Apply the concepts of acidity and alkalinity with relation to neutralisation reactions.

Credit points and level

1 National Unit credit at SCQF level 5: (6 SCQF credit points at SCQF level 5)

Recommended entry to the unit

Entry is at the discretion of the centre, however it is recommended that learners have completed the NQ Unit HT6R 45 *Chemistry Fundamentals 1*, or equivalent.

National Unit specification: General information (cont)

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Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the support notes for this unit specification.

There is no automatic certification of Core Skills or Core Skill components in this unit.

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.

The Assessment Support Pack (ASP) for this unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

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.

National Unit specification: Statement of standards

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Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Outcome 1

Apply the mole concept in a variety of simple chemical processes.

Performance criteria

- (a) Performs calculations involving the relationship between the number of moles and the quantity of a substance either in solid form or in solution.
- (b) Performs calculations involving the relationship between the number of moles and the volume of a gaseous substance.

Outcome 2

Balance chemical reaction equations and calculate chemical quantities from reaction stoichiometry.

Performance criteria

- (a) Derives balanced symbol equations from chemical reaction descriptions.
- (b) Calculates quantities using balanced symbol equations.
- (c) Calculates percentage yields of given chemical reactions.

Outcome 3

Relate the nature and use of metals to their properties and apply the concepts of oxidation and reduction to various electrochemical processes.

Performance criteria

- (a) Predicts the chemical properties of metals from experimental data for the metals and their compounds.
- (b) Identifies the oxidation and reduction ion electron half equations for a given redox reaction.
- (c) Applies the concepts of displacement reactions of metals.
- (d) Predicts the direction of flow of electrons in a simple electrochemical cell.
- (e) Predicts the products at the electrodes during the electrolysis of a given compound.
- (f) Applies the concepts of electrochemistry to the corrosion of metals.

National Unit specification: Statement of standards (cont)

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Outcome 4

Apply the concepts of acidity and alkalinity with relation to neutralisation reactions.

Performance criteria

- (a) Applies the concepts of strong and weak acids and bases.
- (b) Predicts the products of a given neutralisation reaction.
- (c) Calculates an unknown quantity from volumetric analysis results.

Evidence requirements for this unit

Evidence is required to demonstrate that learners have achieved all outcomes and performance criteria.

Written and/or oral recorded evidence for Outcomes 1 to 4 should be assessed using a holistic, closed-book assessment under supervised conditions. It is recommended that the assessment be completed within 45 minutes. Learners can only have access to the SQA Data Booklet for National 5 Chemistry or any suitable replacement when sitting the assessment.



National Unit Support Notes

Unit title: Chemistry Fundamentals 2 (SCQF level 5)

Unit support notes are offered as guidance and are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this unit

This unit is intended as part of the framework for the NC Applied Sciences Group Awards but it may be suitable for inclusion in other science awards. It is designed, in combination with HT6P 45 *Chemistry Fundamentals 1*, to introduce learners to the basic theoretical concepts of quantitative chemistry.

Outcome 1 — Apply the mole concept in a variety of simple chemical processes

In this outcome learners will be introduced to the concept of the mole and its use in a variety of different calculations. Learners should be able to perform calculations involving formula masses, concentrations and volumes, and be taught that the molar volume is the same for all gases at the same temperature and pressure. Learners should be able to calculate the volume of a gas from the number of moles present and vice versa.

Outcome 2 — Balance chemical reaction equations and calculate chemical quantities from reaction stoichiometry

In this outcome learners will be shown how to write balanced symbol equations from written descriptions. These equations should contain chemical formula for simple compounds containing up to three elements. Learners should be introduced to the calculation of reactant and product masses using balanced equations. Learners should be able to calculate percentage yields from the mass of reactant(s) and/or products, also by using balanced equations.

Outcome 3 — Relate the nature and use of metals to their properties and apply the concepts of oxidation and reduction to various electrochemical processes

In this outcome learners will be introduced to the specific characteristics of metals including their density, strength and malleability. The ability of metals to act as thermal and electrical conductors should also be examined. Learners should be made aware of the various methods required for metal extraction and how these methods directly relate to the reactivity of the metal. The reactivity of metals should be covered, with the reaction of metals with oxygen, water and dilute acid all being investigated.

Learners should be introduced to displacement reactions and how the electrochemical series can be used to predict whether a displacement reaction will occur. Ion electron half equations for redox reactions should be explained and learners should be able to write balanced redox reaction equations from the corresponding ion electron half equations.

National Unit Support Notes (cont)

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Learners should be introduced to electrochemical cells and be able to predict the flow of electrons in a cell. The electrolysis of simple melts or ionic compounds in solution should be covered. Learners should be capable of predicting the electrode products of an electrolysis reaction.

Learners should also be introduced to how the concepts of electrochemistry may be applied to the understanding and prevention of the corrosion of metals. Methods of corrosion prevention should include sacrificial and galvanic protection, galvanisation and passivation.

Outcome 4 — Apply the concepts of acidity and alkalinity with relation to neutralisation reactions

In this outcome learners will be introduced to the concept of acidity and alkalinity, which should include strong and weak acids and bases. The fact that equimolar solutions of weak and strong acids (and bases) differ in pH, conductivity, and reaction rates, but not in stoichiometry of reactions, should be illustrated.

Learners should be introduced to common neutralisation reactions, including the reaction of acids with bases, metals, metal oxides and metal carbonates. From the reactants, learners should be able to predict the product of a neutralisation reaction. Calculations from volumetric analysis should be carried out to determine the unknown concentration of one of the reactants in a neutralisation reaction.

Guidance on approaches to delivery of this unit

It is recommended that the outcomes are delivered in numerical order. While there are no assessed practical activities in this unit, it is envisaged that laboratory practicals will play a large part in delivery.

Outcome 1 could begin with a brief introduction to the concept of the mole. A demonstration showing that one mole of different substances results in different masses of materials may be beneficial in demonstrating this concept. Interactive worksheets can be used when carrying out the various calculations. Solutions of differing concentrations can be prepared to emphasise the concept of molarity. Experiments can also be carried out to calculate the molar volume of different gases.

Outcome 2 should introduce the balancing of chemical equations. This could be aided by the use of a computer programme. Learners may also benefit from the use of molecular models to directly compare the atoms present on the reactant and product sides of an equation respectively.

The concept of reacting quantities should be introduced and this can be done using everyday examples, such as baking a cake. Carrying out a series of experiments with limiting and excess reagents could also help to demonstrate the concept. The calculations may be covered using a series of tutorial and problem solving exercises. Interactive worksheets may be useful in the delivery of this outcome.

National Unit Support Notes (cont)

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Outcome 3 is likely to contain a significant amount of laboratory work in order to demonstrate the concepts contained within this outcome. Illustrative practical work can be used to demonstrate the extraction of metals from their compounds in a number of ways and hence their reactivity. The reactivity of metals can be further investigated by carrying out a series of practicals in which the metals are reacted with different compounds. Displacement reactions can also be used for demonstrative purposes. Learners could carry out an electrolysis reaction and observe the products at each electrode in order to determine if their predictions are correct. How electrochemistry relates to the corrosion processes which occur in metals and how to prevent them should be covered. A large range of laboratory tests using Ferroxy indicator to monitor the rate of rusting could be deployed here.

In Outcome 4 the concept of acidity and alkalinity could be introduced by testing the pH of solutions of common household items and laboratory reagents and classifying these as acidic/neutral/alkaline. Furthermore, strong and weak acids and bases could be demonstrated by carrying out a series of tests with hydrochloric acid and ethanoic acid or sodium hydroxide and ammonia (with the same concentration) and directly comparing the results.

An investigation into the pH changes observed in an acid/alkali neutralisation could be carried out by learners. Emphasis should be placed on the neutralisation of the acid. Preparations of different salts using different combinations of acids and bases could be carried out as a class exercise. Furthermore, a literature research project could be conducted by learners into more everyday examples of neutralisation reactions, for example the addition of lime to soil and acid rain water.

Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Outcomes 1 to 4 could be assessed by a single holistic closed-book assessment with an appropriate cut off score that covers the requirements as detailed in the performance criteria. Assessment should be carried out in supervised conditions, and it is recommended that the assessment be completed within 45 minutes. Learners can only have access to the SQA Data Booklet for National 5 Chemistry or any suitable replacement when sitting the assessment.

An exemplar instrument of assessment with marking guidelines has been produced to indicate the national standard of achievement at SCQF level 5.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

National Unit Support Notes (cont)

Unit title: Chemistry Fundamentals 2 (SCQF level 5)

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

The delivery and assessment of this unit will provide learners with the opportunity to develop the Core Skills of *Numeracy* at SCQF level 5 and *Working with Others* and *Information and Communication Technology (ICT)* at SCQF level 4.

Numeracy — Using Number at SCQF level 5

Learners may be required to carry out calculations to solve problems and will have to decide which calculations to use, and the order in which to carry the calculations out.

Working with Others — Working Co-operatively with Others at SCQF level 4

Learners may undertake team work in laboratory activities where tasks must be planned and work carried out cooperatively to achieve end outcomes.

Information and Communication Technology (ICT) — Accessing Information and Providing/Creating Information at SCQF level 4

Learners may be required to carry out a research task into everyday neutralisation reactions and to present their findings in a suitable format.

Sustainability

Sustainability may be embedded in the delivery of this unit in a variety of ways. For example, by encouraging minimum usage, correct disposal procedures and possibly recycling during practical experiments.

History of changes to unit

Version	Description of change	Date

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General information for learners

Unit title: Chemistry Fundamentals 2 (SCQF level 5)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

This is a 1 credit unit at SCQF level 5, which you are likely to be studying as part of a NC Applied Sciences programme. This unit is designed, in combination with HT6P 45 *Chemistry Fundamentals 1*, to provide you with an introduction to some of the basic theoretical concepts of quantitative chemistry.

On completion of this unit you should be able to:

- 1 Apply the mole concept in a variety of simple chemical processes.
- 2 Balance chemical reaction equations and calculate chemical quantities from reaction stoichiometry.
- 3 Relate the nature and use of metals to their properties and apply the concepts of oxidation and reduction to various electrochemical processes.
- 4 Apply the concepts of acidity and alkalinity with relation to neutralisation reactions.

Outcome 1

In this outcome you will learn how to carry out simple calculations which relate different quantities in chemistry. You will also learn which relationship is required in order to complete the calculation successfully.

Outcome 2

In this outcome you will learn how to write and balance chemical equations for simple chemical reactions. This will develop your ability to directly compare reacting quantities. You will also learn how to use balanced equations to calculate the quantities of reactants required to successfully carry out a reaction. In addition, you will learn how to calculate the theoretical yield of a reaction and furthermore the percentage yield from a yield.

Outcome 3

In this outcome you will be introduced to metals and electrochemistry. You will learn about the different properties of metals and how the methods used to extract metals relate to their reactivity. You will be introduced to redox reactions and will learn how to write balanced ion electron half equations for both oxidation and reduction reactions. You will learn the importance of displacement and electrolysis reactions, and you will learn how the concepts of electrochemistry may be applied to the understanding of and the prevention of the corrosion of metals.

Outcome 4

In this outcome you will learn about the concepts of acidity and alkalinity and the impact these can have in everyday life scenarios. You will be introduced to neutralisation reactions and learn how to determine the product of these reactions.

General information for learners (cont)

Unit title: Chemistry Fundamentals 2 (SCQF level 5)

Assessment

For Outcomes 1 to 4 you will take a closed-book, end of unit assessment.

Core Skills

Although there is no automatic certification of Core Skills in this unit you will have the opportunity to develop the Core skills of *Numeracy* at SCQF level 5 and *Working with Others* and *Information and Communication Technology (ICT)* at SCQF level 4.