National Unit specification

General information

Unit title: Chemistry Fundamentals 1 (SCQF level 5)

Unit code: HT6P 45

Superclass: RD

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Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This unit is designed to provide learners with an introduction to the key theoretical aspects of 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 Identify chemical and physical changes and predict the effects of changes to reaction conditions on rates of reaction.
2 Describe the structure of atoms and relate atomic structure to position in periodic table and properties of elements.
3 Apply the concepts of structure and bonding to a variety of substances.
4 Apply concepts of nomenclature and structure relating to organic chemistry.

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.

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

Identify chemical and physical changes and predict the effects of changes to reaction conditions on rates of reaction.

Performance criteria

(a) Identifies changes as chemical or physical.
(b) Predicts effects of changes to reaction conditions on rates of reaction.

Outcome 2

Describe the structure of atoms and relate atomic structure to position in periodic table and properties of elements.

Performance criteria

(a) Identifies the nature and position of electrons, protons and neutrons in atoms.
(b) Identifies the relationship between electronic structure and periodic table.
(c) Predicts the properties of elements from electronic structure.

Outcome 3

Apply the concepts of structure and bonding to a variety of substances.

Performance criteria

(a) Describes the formation of ionic and covalent bonds.
(b) Predicts the bond types in given substances.
(c) Predicts the physical properties of given substances.
(d) Derives formulae and/or names for given inorganic compounds containing up to three elements.

Outcome 4

Apply concepts of nomenclature and structure relating to organic chemistry.

Performance criteria

(a) Determines structural formulae and names of hydrocarbons and substituted hydrocarbons.
(b) Applies the concept of homologous series.
(c) Applies the concept of isomerism.

National Unit specification: Statement of standards (cont)

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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 1 (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 may be suitable for inclusion in other science awards. It is designed, in combination with HT6R 45 *Chemistry Fundamentals 2*, to introduce learners to the key theoretical aspects of chemistry.

Outcome 1 — Identify chemical and physical changes and predict the effects of changes to reaction conditions on rates of reaction

In this outcome learners will be introduced to the concepts of chemical and physical changes and will learn how to distinguish these from experimental observations, eg energy changes or observation of products. Learners should be introduced to the concept of reaction rate and kinetic particle theory and the effects of particle size, temperature and concentration on reaction rates. Examples of catalysts from industry and everyday life should be covered.

Outcome 2 — Describe the structure of atoms and relate atomic structure to position in periodic table and properties of elements

In this outcome learners will be introduced to the classifications of elements in a variety of ways. Learners should become familiar with the periodic table and learn the relevance of its structure, including use of the terms ‘period’ and ‘group’. The similarity of properties within groups and the identification of important families of the main group elements and an outline of their main properties should be covered. The division of metals from non-metals in the periodic table should also be explained.

The concepts of atoms as building blocks of elements should be covered including location, charge and mass of proton, electron and neutron. Electron shell arrangements should be explained and related to the structure of the periodic table. The concepts of atomic and mass numbers, nuclide notations, isotopes and relative atomic mass should be introduced.

National Unit Support Notes (cont)

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Outcome 3 — Apply the concepts of structure and bonding to a variety of substances

In this outcome learners will be introduced to the concepts of ionic and covalent bonding and the application of these concepts to explain properties and derive chemical formulae.

Learners should be introduced to the concept of the 'octet rule' and to ions as atoms having gained or lost electrons. Learners should understand the bond types in elements (monatomic, molecular covalent, giant covalent and metallic) and how the properties of elements are related to these bond types. The bonding in compounds should be explained in terms of sharing or transfer of electrons and the resultant forces of attraction. Learners should be aware how ionic and covalent substances differ in key properties, including electrical conductivity, melting and boiling points and water solubility.

Learners should deploy the concept of valence in the main group elements to determine the formula of compounds. The common group ions should be introduced and learners should be taught the naming of ionic compounds using the 'ide', 'ite' or 'ate' rule. Learners will learn to derive formulae of ionic compounds from application of valence, including formulae with Roman numerals and use of brackets. The application of the 'mono', 'di' and 'tri' system to the formulae and names of covalent substances, including examples that do not obey valence predictions, should be covered.

Outcome 4 — Apply concepts of nomenclature and structure relating to organic chemistry

In this outcome learners will be introduced to key aspects and families of organic compounds and the application of IUPAC nomenclature rules. The major classes of aliphatic hydrocarbons (including alkanes, alkenes, alkynes, alcohols and alkanoic acids) should be covered. Learners will draw full structural formulae from given names and vice versa, including for molecules with simple branches. Learners should be able to identify and explain the concepts of isomerism.

The concept of a homologous series as a group of substances with common general formula and similar properties should be explained with examples of key series, eg the differences between alkanes and alkenes.

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 and model building activities will play a large part in delivery.

Outcome 1 could commence with a brief overview of the definition and history of chemistry. The mixing of methanol and water to produce a volume of less than 100% is a useful illustration of particle theory. The concepts of elements and compounds could be introduced through examples of how compounds can have radically different properties from their component elements. This introduces the idea of chemical change. Physical and chemical changes could then be investigated through a series of laboratory and real life examples. The concept of reaction rates could be explained through the application of kinetic particle theory. The effects of concentration, temperature and particle size could be explained and elucidated with real life examples, eg cooking of food and simple laboratory examples.

National Unit Support Notes (cont)

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There are numerous laboratory practicals which may be used to support learning, eg 'clock' reactions, marble chips vs powder, etc. The concept of catalysts can be introduced with the aid of examples from industry and consumer products, eg catalytic converters, enzymes in washing powders, etc.

Outcome 2 could commence with an overview of the structure of the atom in terms of properties and positions of protons, neutrons and electrons. An overview of the historical development of atomic theory (eg Geiger and Marsden, Rutherford) may help to establish the background to this topic. The structure of the periodic table could then be explained, with an explanation of its creation by Mendeleev. The existence of 'families' of elements in the periodic table could then be explained, as can the separation of metals from non-metals. There are numerous opportunities for investigative tasks relating to the periodic table and a large amount of supporting video material is available, eg on reactions of alkali metals with water. The electron arrangements of atoms could then be introduced and used to explain the structure of the periodic table and properties of groups. The concepts of atomic and mass numbers, nuclide notations, isotopes and relative atomic mass can again be related to the structure of the periodic table and the history of its development.

In Outcome 3 learners' understanding of electronic structure could be built upon with the concept of the 'octet rule' and ions as atoms having gained or lost electrons and the resultant formation of ionic compounds. The bonding types in elements could be explained with the aid of models and modelling activities, and real examples of elements (eg metal, non-metal, semi-metal) can be used to illustrate concepts. The allotropes of carbon could then be introduced, with native graphite forming a useful demonstration tool. The bonding in compounds in terms of sharing or transfer of electrons and the resultant forces of attraction could then be explained. Molecular and crystal models would be useful in developing understanding. The subject of the physical properties of substances in relation to bond type lends itself well to laboratory investigation, where such aspects as conductivity, melting point, solubility and brittleness/malleability can be studied.

The determination of chemical formula could be delivered via a series of tutorial and problem solving exercises in which practical 'charge balancing' activities may assist.

In Outcome 4 learners could first be introduced to the reasons for the pre-eminence and importance of organic chemistry through the concept of carbon being the basis of life, petroleum industry, pharmaceuticals, etc. The major classes of hydrocarbons and their production and uses (eg fuels, solvents, feedstocks, etc) could be introduced. In progressing to structural formulae and isomerism it is envisaged that molecular modelling would play a key role. The application of IUPAC nomenclature rules could be delivered via a series of tutorial and problem solving exercises.

The concept of a homologous series as a group of substances with common general formula and similar properties could be elucidated through laboratory activities, eg alkanes and alkenes reacting with bromine water.

National Unit Support Notes (cont)

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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.

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, Working with Others* and *Information and Communication Technology (ICT)* at SCQF level 4.

Numeracy — Using Graphical Information at SCQF level 4

Learners may be required to use graphical methods to present or interpret data on rates of reaction.

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 co-operatively to achieve end outcomes.

National Unit Support Notes (cont)

Unit title: Chemistry Fundamentals 1 (SCQF level 5)

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

Learners may be required to use online resources to research a given organic chemical and choose a suitable medium to present the findings.

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 (eg of solvents) 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 1 (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 HT6R 45 *Chemistry Fundamentals 2*, to provide you with an introduction to the key theoretical aspects of chemistry.

On completion of this unit you should be able to:

1 Identify chemical and physical changes and predict the effects of changes to reaction conditions on rates of reaction.
2 Describe the structure of atoms and relate atomic structure to position in periodic table and properties of elements.
3 Apply the concepts of structure and bonding to a variety of substances.
4 Apply concepts of nomenclature and structure relating to organic chemistry.

Outcome 1

In this outcome you will learn about elements and compounds as the building blocks of matter. You will be introduced to the concepts of chemical change and how to identify and distinguish these from physical processes. You will also learn about the factors that affect the speed of chemical reactions and how you can control them.

Outcome 2

In this outcome you will learn about the structure of atoms in terms of protons, neutrons and electrons. You will also learn about the development and structure of the periodic table. You will be introduced to key families of elements and how their properties are related to their position in the periodic table.

Outcome 3

In this outcome you will learn about the electron arrangements of atoms, and how chemical reactions involve changes to these arrangements. You will learn how chemical reactions and reactivity are explained in terms of electron arrangements and about the three major classes of chemical bonding — ionic, covalent and metallic. The properties of elements and compounds will be explained in terms of the type of bonding present. You will also learn how to determine the chemical formulae and names of a range of chemical compounds.

Outcome 4

In this outcome you will learn about the chemistry of carbon and why the chemistry of this element carries particular importance. You will be introduced to key families of the compounds of carbon and will gain an understanding of their key properties. You will also learn how to determine the names, formulae and structures of a range of carbon compounds.

General information for learners (cont)

Unit title: Chemistry Fundamentals 1 (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 the unit, you will have opportunities to develop the Core Skills of *Numeracy, Working with Others* and *Information and Communication Technology (ICT)* at SCQF level 4.