N5 National 5 Course Specification

National 5 Chemistry

Course code:	C813 75
Course assessment code:	X813 75
SCQF:	level 5 (24 SCQF credit points)
Valid from:	session 2017–18

The course specification provides detailed information about the course and course assessment to ensure consistent and transparent assessment year on year. It describes the structure of the course and the course assessment in terms of the skills, knowledge and understanding that are assessed.

This document is for teachers and lecturers and contains all the mandatory information you need to deliver the course.

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Contents

Course overview

The course consists of 24 SCQF credit points which includes time for preparation for course assessment. The notional length of time for a candidate to complete the course is 160 hours.

The course assessment has two components.

Component	Marks	Scaled mark	Duration
Component 1: question paper	100	n/a	2 hours and 30 minutes
Component 2: assignment	20	25	8 hours of which a maximum of 1 hour and 30 minutes is allocated to the reporting stage — see course assessment section

Recommended entry	Progression
Entry to this course is at the discretion of the centre. Candidates should have achieved the fourth curriculum level or the National 4 Chemistry course or equivalent qualifications and/or experience prior to starting this course. Candidates may also progress from relevant biology, environmental science, physics or science courses.	♦ other qualifications in chemistry or related areas ♦ further study, employment or training

Conditions of award

The grade awarded is based on the total marks achieved across all course assessment components.

Course rationale

National Courses reflect Curriculum for Excellence values, purposes and principles. They offer flexibility, provide more time for learning, more focus on skills and applying learning, and scope for personalisation and choice.

Every course provides opportunities for candidates to develop breadth, challenge and application. The focus and balance of assessment is tailored to each subject area.

Chemistry is the study of matter at the level of atoms, molecules, ions and compounds. These substances are the building blocks of life and all of the materials that surround us. Chemists play a vital role in the production of everyday commodities. Chemistry research and development is essential for the introduction of new products. The study of chemistry is of benefit not only to those intending to pursue a career in science, but also to those intending to work in areas such as the food, health, textile or manufacturing industries.

An experimental and investigative approach is used to develop knowledge and understanding of chemical concepts.

Purpose and aims

The purpose of the course is to develop candidates' curiosity, interest and enthusiasm for chemistry in a range of contexts. The skills of scientific inquiry are integrated and developed throughout the course. The relevance of chemistry is highlighted by the study of the applications of chemistry in everyday contexts. This enables candidates to become scientifically literate citizens, able to review the science-based claims they will meet.

The course offers opportunities for candidates to develop the ability to think analytically and to make reasoned evaluations. The course covers a variety of relevant contexts including the chemistry of the Earth's resources, the chemistry of everyday products and chemical analysis. The course allows flexibility and personalisation by offering candidates the choice of topic for their assignment. It develops a broad, versatile and adaptable skill set which is valued in the workplace, forms the basis for progression to the study of chemistry at a higher level, and provides knowledge useful in the study of all of the sciences.

The aims of the course are for candidates to:

- develop and apply knowledge and understanding of chemistry
- develop an understanding of the impact of chemistry on everyday life
- develop an understanding of chemistry's role in scientific issues and relevant applications of chemistry, including the impact these could make on society and the environment
- develop scientific inquiry and investigative skills
- develop scientific analytical thinking skills in a chemistry context
- develop the skills to use technology, equipment and materials, safely, in practical scientific activities
- develop planning skills
- develop problem-solving skills in a chemistry context

- use and understand scientific literacy, in everyday contexts, to communicate ideas and issues and to make scientifically informed choices
- develop the knowledge and skills for more advanced learning in chemistry
- develop skills of independent working

The course enables candidates to make their own decisions on issues within a modern society, where the body of scientific knowledge and its applications and implications are ever developing.

Who is this course for?

The course is suitable for learners who have experienced learning across the sciences experiences and outcomes. The course may be suitable for those wishing to study chemistry for the first time.

This course has a skills-based approach to learning. It takes account of the needs of all learners and provides sufficient flexibility to enable learners to achieve in different ways.

Course content

Candidates gain an understanding of chemistry and develop this through a variety of approaches, including practical activities, investigations and problem solving. Candidates research topics, apply scientific skills and communicate information related to their findings, which develops skills of scientific literacy.

The course content includes the following areas of chemistry:

Chemical changes and structure
In this area, topics covered are: rates of reaction; atomic structure and bonding related to properties of materials; formulae and reacting quantities; acids and bases.

Nature's chemistry
In this area, topics covered are: homologous series; everyday consumer products; energy from fuels.

Chemistry in society
In this area, topics covered are: metals; plastics; fertilisers; nuclear chemistry; chemical analysis.

Skills, knowledge and understanding

Skills, knowledge and understanding for the course

The following provides a broad overview of the subject skills, knowledge and understanding developed in the course:

- demonstrating knowledge and understanding of chemistry by making accurate statements
- demonstrating knowledge and understanding of chemistry by describing information and providing explanations and integrating knowledge
- applying knowledge of chemistry to new situations, interpreting information and solving problems
- planning or designing experiments to test given hypotheses or to illustrate particular effects, including safety measures
- carrying out experimental procedures safely
- selecting information from a variety of sources
- presenting information appropriately in a variety of forms
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations based on evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- evaluating experimental procedures
- suggesting improvements to experiments/practical investigations
- communicating findings/information

Skills, knowledge and understanding for the course assessment

The following provides details of skills, knowledge and understanding sampled in the course assessment:

Chemical changes and structure
Rates of reaction
To follow the progress of chemical reactions, changes in mass, volume and other quantities can be measured. Graphs can then be drawn and be interpreted in terms of: ♦ end-point of a reaction ♦ quantity of product ♦ quantity of reactant used ♦ effect of changing conditions Rates of reaction can be increased: ♦ by increasing the temperature ♦ by increasing the concentration of a reactant ♦ by increasing surface area/decreasing particle size ♦ through the use of a catalyst Catalysts are substances that speed up chemical reactions but can be recovered chemically unchanged at the end of the reaction. The average rate of a chemical reaction can be calculated, with appropriate units, using the equation: $rate = \frac{\Delta quantity}{\Delta t}$ The rate of a reaction can be shown to decrease over time by calculating the average rate at different stages of the reaction.
Atomic structure and bonding related to properties of materials
Periodic Table and atoms Elements in the Periodic Table are arranged in order of increasing atomic number. The Periodic Table can be used to determine whether an element is a metal or non-metal. Groups are columns in the Periodic Table containing elements with the same number of outer electrons, indicated by the group number. Elements within a group share the same valency and have similar chemical properties because they have the same number of electrons in their outer energy levels. The electron arrangement of the first 20 elements can be written. An atom has a nucleus, containing protons and neutrons, and electrons that orbit the nucleus. Protons have a charge of one-positive, neutrons are neutral and electrons have a charge of one-negative. Protons and neutrons have an approximate mass of one atomic mass unit and electrons, in comparison, have virtually no mass. The number of protons in an atom is given by the atomic number. In a neutral atom the number of electrons is equal to the number of protons.

Chemical changes and structure

The mass number of an atom is equal to the number of protons added to the number of neutrons.
Isotopes are defined as atoms with the same atomic number but different mass numbers, or as atoms with the same number of protons but different numbers of neutrons.
Nuclide notation is used to show the atomic number, mass number (and charge) of atoms (ions) from which the number of protons, electrons and neutrons can be determined.
Most elements have two or more isotopes. The average atomic mass has been calculated for each element using the mass and proportion of each isotope present. These values are known as relative atomic masses.

Covalent bonding

Covalent bonds form between non-metal atoms.
A covalent bond forms when two positive nuclei are held together by their common attraction for a shared pair of electrons.
Diagrams can be drawn to show how outer electrons are shared to form the covalent bond(s) in a molecule.
7 elements exist as diatomic molecules through the formation of covalent bonds: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2.
The shape of simple covalent molecules depends on the number of bonds and the orientation of these bonds around the central atom. These molecules can be described as linear, angular, trigonal pyramidal or tetrahedral.
More than one bond can be formed between atoms leading to double and triple covalent bonds.
Covalent substances can form either discrete molecular or giant network structures.
Covalent molecular substances:

- have strong covalent bonds within the molecules and only weak attractions between the molecules
- have low melting and boiling points as only weak forces of attraction between the molecules are broken when a substance changes state
- do not conduct electricity because they do not have charged particles which are free to move

Covalent molecular substances which are insoluble in water may dissolve in other solvents.

Covalent network structures:

- have a network of strong covalent bonds within one giant structure
- have very high melting and boiling points because the network of strong covalent bonds is not easily broken
- do not dissolve

In general, covalent network substances do not conduct electricity. This is because they do not have charged particles which are free to move.

Chemical changes and structure
Ionic compounds Ions are formed when atoms lose or gain electrons to obtain the stable electron arrangement of a noble gas. In general, metal atoms lose electrons forming positive ions and non-metal atoms gain electrons forming negative ions. Ion-electron equations can be written to show the formation of ions through loss or gain of electrons. Ionic bonds are the electrostatic attraction between positive and negative ions. Ionic compounds form lattice structures of oppositely charged ions with each positive ion surrounded by negative ions and each negative ion surrounded by positive ions. Ionic compounds have high melting and boiling points because strong ionic bonds must be broken in order to break up the lattice. Many ionic compounds are soluble in water. As they dissolve the lattice structure breaks up allowing water molecules to surround the separated ions. Ionic compounds conduct electricity only when molten or in solution as the lattice structure breaks up allowing the ions to be free to move. Conduction in ionic compounds can be explained by the movement of ions towards oppositely charged electrodes.

Formulae and reacting quantities
Chemical formulae Compound names are derived from the names of the elements from which they are formed. Most compounds with a name ending in '-ide' contain the two elements indicated. The ending '-ite' or '-ate' indicates that oxygen is also present. Chemical formulae can be written for two element compounds using valency rules and a Periodic Table. Roman numerals can be used, in the name of a compound, to indicate the valency of an element. The chemical formula can also be determined from names with prefixes. The chemical formula of a covalent molecular substance gives the number of each type of atom present in a molecule. The formula of a covalent network gives the simplest ratio of each type of atom in the substance. Ions containing more than one type of atom are often referred to as group ions. Chemical formulae can be written for compounds containing group ions using valency rules and the data booklet. Ionic formulae give the simplest ratio of each type of ion in the substance and can show the charges on each ion, if required. In formulae, charges must be superscript and numbers of atoms/ions must be subscript. ***Calculations involving the mole and balanced equations*** Chemical equations, using formulae and state symbols, can be written and balanced. The mass of a mole of any substance, in grams (g), is equal to the gram formula mass and can be calculated using relative atomic masses. Calculations can be performed using the relationship between the mass and the number of moles of a substance. A solution is formed when a solute is dissolved in a solvent.

Chemical changes and structure
For solutions, the mass of solute (grams or g), the number of moles of solute (moles or mol), the volume of solution (litres or l) or the concentration of the solution (moles per litre or mol l^{-1}) can be calculated from data provided. Given a balanced equation, the mass or number of moles of a substance can be calculated given the mass or number of moles of another substance in the reaction. ***Percentage composition*** The percentage composition of an element in any compound can be calculated from the formula of the compound.

Acids and bases
pH The pH scale is an indication of the hydrogen ion concentration and runs from below 0 to above 14. A neutral solution has equal concentrations of H^+(aq) and OH^-(aq) ions. Water is neutral as it dissociates according to the equation $H_2O(\ell) \rightleftharpoons H^+(aq) + OH^-(aq)$ producing equal concentrations of hydrogen and hydroxide ions. At any time, only a few water molecules are dissociated into free ions. The $\rightleftharpoons$ symbol indicates that a reaction is reversible and occurs in both directions. Acidic solutions have a higher concentration of H^+(aq) ions than OH^-(aq) and have a pH below 7. Alkaline solutions have a higher concentration of OH^-(aq) ions than H^+(aq) ions and have a pH above 7. Dilution of an acidic solution with water will decrease the concentration of H^+(aq) and the pH will increase towards 7. Dilution of an alkaline solution with water will decrease the concentration of OH^-(aq) and the pH will decrease towards 7. Soluble non-metal oxides dissolve in water forming acidic solutions. Soluble metal oxides dissolve in water to form alkaline solutions: metal oxide + water $\rightarrow$ metal hydroxide Metal oxides, metal hydroxides, metal carbonates and ammonia neutralise acids and are called bases. Those bases that dissolve in water form alkaline solutions. ***Neutralisation reactions*** A neutralisation reaction is one in which a base reacts with an acid to form water. A salt is also formed in this reaction. Equations can be written for the following neutralisation reactions: a metal oxide + an acid $\rightarrow$ a salt + water a metal hydroxide + an acid $\rightarrow$ a salt + water a metal carbonate + an acid $\rightarrow$ a salt + water + carbon dioxide The name of the salt produced depends on the acid and base used. Hydrochloric acid produces chlorides, sulfuric acid produces sulfates and nitric acid produces nitrates. Spectator ions are ions that remain unchanged by the reaction. Reaction equations can be used to identify spectator ions.

Chemical changes and structure

For neutralisation reactions, equations can be written omitting spectator ions:

$2H^+(aq) + O^{2-}(s)$	→	$H_2O(\ell)$	for metal oxides
$H^+(aq) + OH^-(aq)$	→	$H_2O(\ell)$	for metal hydroxides
$2H^+(aq) + CO_3^{2-}(aq)$	→	$H_2O(\ell) + CO_2(g)$	for aqueous metal carbonates
$2H^+(aq) + CO_3^{2-}(s)$	→	$H_2O(\ell) + CO_2(g)$	for insoluble metal carbonates

In an acid-base titration, the concentration of the acid or base is determined by accurately measuring the volumes used in the neutralisation reaction. An indicator can be added to show the end-point of the reaction.

Given a balanced equation for the reaction occurring in any titration:

- the concentration of one reactant can be calculated given the concentration of the other reactant and the volumes of both solutions
- the volume of one reactant can be calculated given the volume of the other reactant and the concentrations of both solutions

Neutralisation reactions can be used to prepare soluble salts

Titration can be used to produce a soluble salt. Once the volumes of acid and alkali have been noted, the reaction can be repeated without the indicator to produce an uncontaminated salt solution. The solution can then be evaporated to dryness.

Insoluble metal carbonates and insoluble metal oxides can be used to produce soluble salts. Excess base is added to the appropriate acid, the mixture is filtered and the filtrate evaporated to dryness.

Nature's chemistry

Homologous series

Systematic carbon chemistry

A homologous series is a family of compounds with the same general formula and similar chemical properties.

Patterns are often seen in the physical properties of the members of a homologous series. The subsequent members of a homologous series show a general increase in their melting and boiling points. This pattern is attributed to increasing strength of the intermolecular forces as the molecular size increases. The type of intermolecular force does not need to be identified.

Hydrocarbons are compounds containing only hydrogen and carbon atoms.

Compounds containing only single carbon–carbon bonds are described as saturated.

Compounds containing at least one carbon–carbon double bond are described as unsaturated.

It is possible to distinguish an unsaturated compound from a saturated compound using bromine solution. Unsaturated compounds decolourise bromine solution quickly.

The structure of any molecule can be drawn as a full or a shortened structural formula.

Isomers:

- are compounds with the same molecular formula but different structural formulae
- may belong to different homologous series
- usually have different physical properties

Given a structural formula for a compound, an isomer can be drawn.

Isomers can be drawn for a given molecular formula.

Alkanes

Alkanes:

- are a homologous series of saturated hydrocarbons
- are commonly used as fuels
- are insoluble in water
- can be represented by the general formula C_nH_{2n+2}

Straight-chain and branched alkanes can be systematically named from structural formulae containing no more than 8 carbons in the longest chain.

Molecular formulae can be written and structural formulae can be drawn, from the systematic names of straight-chain and branched alkanes, containing no more than 8 carbons in the longest chain.

Cycloalkanes

Cycloalkanes:

- are a homologous series of saturated, cyclic hydrocarbons
- are used as fuels and solvents
- are insoluble in water
- can be represented by the general formula C_nH_{2n}

Nature's chemistry

Cycloalkanes (C_3–C_8) can be systematically named from structural formulae. Branched cycloalkanes are not required.
Molecular formulae can be written and structural formulae can be drawn from the systematic names of un-branched cycloalkanes.

Alkenes
Alkenes:

- are a homologous series of unsaturated hydrocarbons
- are used to make polymers and alcohols
- are insoluble in water
- contain the C=C double bond functional group
- can be represented by the general formula C_nH_{2n}

Straight-chain and branched alkenes can be systematically named indicating the position of the double bond, from structural formulae containing no more than 8 carbon atoms in the longest chain.
Molecular formulae can be written and structural formulae can be drawn, from the systematic names of straight-chain and branched alkenes, containing no more than 8 carbons in the longest chain.
Chemical equations can be written for the addition reactions of alkenes, using molecular or structural formulae.

Alkenes undergo addition reactions:

- with hydrogen forming alkanes, known as hydrogenation
- with halogens forming dihaloalkanes
- with water forming alcohols, known as hydration

Everyday consumer products

Alcohols
Alcohols are used as fuels as they are highly flammable and burn with very clean flames.
Alcohols are often used as solvents.
Methanol, ethanol and propanol are miscible with water, thereafter the solubility decreases as size increases.
As alcohols increase in size their melting and boiling points increase due to the increasing strength of the intermolecular forces. The type of intermolecular force does not need to be identified.
An alcohol is a molecule containing a hydroxyl functional group, –OH group.
Saturated, straight-chain alcohols can be represented by the general formula $C_nH_{2n+1}OH$.
Straight-chain alcohols can be systematically named indicating the position of the hydroxyl group from structural formulae containing no more than 8 carbon atoms.
Molecular formulae can be written and structural formulae can be drawn, from the systematic names of straight-chain alcohols, containing no more than 8 carbons.

Nature's chemistry
Carboxylic acids Carboxylic acids are used in the preparation of preservatives, soaps and medicines. Vinegar is a solution of ethanoic acid, with molecular formula CH_3COOH. Vinegar is used in household cleaning products as it is a non-toxic acid so can be used safely in household situations. Methanoic, ethanoic, propanoic and butanoic acid are miscible in water, thereafter the solubility decreases as size increases. As carboxylic acids increase in size their melting and boiling points increase due to the increasing strength of the intermolecular forces. The type of intermolecular force does not need to be identified. Carboxylic acids can be identified by the carboxyl functional group, $-COOH$. Carboxylic acids can be represented by the general formula $C_nH_{2n+1}COOH$. Straight-chain carboxylic acids can be systematically named from structural formulae containing no more than 8 carbons. Molecular formulae can be written and structural formulae drawn, from the systematic names of straight-chain carboxylic acids, containing no more than 8 carbons. Solutions of carboxylic acids have a pH less than 7 and like other acids, can react with metals, metal oxides, hydroxides and carbonates forming salts. Salts formed from straight-chain carboxylic acids containing no more than 8 carbons, can be named.
Energy from fuels
A reaction or process that releases heat energy is described as exothermic. A reaction or process that takes in heat energy is described as endothermic. In combustion, a substance reacts with oxygen releasing energy. Hydrocarbons and alcohols burn in a plentiful supply of oxygen to produce carbon dioxide and water. Equations can be written for the complete combustion of hydrocarbons and alcohols. Fuels burn releasing different quantities of energy. The quantity of heat energy released can be determined experimentally and calculated using, $E_h = cm\Delta T$. The quantities E_h, c, m or ΔT can be calculated, in the correct units, given relevant data. Calculations can involve heating substances other than water. It is not necessary to calculate the enthalpy per mole of substance burned.

Chemistry in society

Metals

Metallic bonding

Metallic bonding is the electrostatic force of attraction between positively charged ions and delocalised electrons.
Metallic elements are conductors of electricity because they contain delocalised electrons.

Reactions of metals

Equations, involving formulae, can be written to show the reaction of metals with oxygen, water, and dilute acids:

metal + oxygen	→	metal oxide
metal + water	→	metal hydroxide + hydrogen
metal + dilute acid	→	salt + hydrogen

Metals can be arranged in order of reactivity by comparing the rates at which they react.
Metals can be used to produce soluble salts. Excess metal is added to the appropriate acid, the mixture is filtered and the filtrate evaporated to dryness.

Redox

Reduction is a gain of electrons by a reactant in any reaction.
Oxidation is a loss of electrons by a reactant in any reaction.
In a redox reaction, reduction and oxidation take place at the same time.
Ion-electron equations can be written for reduction and oxidation reactions.
Ion-electron equations can be combined to produce redox equations.

Extraction of metals

During the extraction of metals, metal ions are reduced forming metal atoms.
The method used to extract a metal from its ore depends on the position of the metal in the reactivity series. Equations can be written to show the extraction of metals.
Methods used are:

- heat alone (for extraction of Ag, Au and Hg)
- heating with carbon or carbon monoxide (for extraction of Cu, Pb, Sn, Fe and Zn)
- electrolysis (for extraction of more reactive metals including aluminium)

Electrolysis is the decomposition of an ionic compound into its elements using electricity.
A d.c. supply must be used if the products of electrolysis are to be identified.
Positive ions gain electrons at the negative electrode and negative ions lose electrons at the positive electrode.

Electrochemical cells

Electrically conducting solutions containing ions are known as electrolytes.
A simple cell can be made by placing two metals in an electrolyte.
Another type of cell can be made using two half-cells (metals in solutions of their own ions).

An ‘ion bridge’ (salt bridge) can be used to link the half-cells. Ions can move across the bridge to complete an electrical circuit.
Electricity can be produced in cells where at least one of the half-cells does not involve metal atoms/ions. A graphite rod can be used as the electrode in such half-cells.

Chemistry in society
Different pairs of metals produce different voltages. These voltages can be used to arrange the elements into an electrochemical series. The further apart elements are in the electrochemical series, the greater the voltage produced when they are used to make an electrochemical cell. Electrons flow in the external circuit from the species higher in the electrochemical series to the one lower in the electrochemical series. For an electrochemical cell, including those involving non-metals, ion-electron equations can be written for: ♦ the oxidation reaction ♦ the reduction reaction ♦ the overall redox reactions The direction of electron flow can be deduced for electrochemical cells including those involving non-metal electrodes.
Plastics
Addition polymerisation Plastics are examples of materials known as polymers. Polymers are long chain molecules formed by joining together a large number of small molecules called monomers. Addition polymerisation is the name given to a chemical reaction in which unsaturated monomers are joined, forming a polymer. The names of addition polymers are derived from the name of the monomer used. Note: brackets can be used in polymer names to aid identification of the monomer unit. ***Representation of the structure of monomers and polymers*** A repeating unit is the shortest section of polymer chain which, if repeated, would yield the complete polymer chain (except for the end-groups). The structure of a polymer can be drawn given either the structure of the monomer or the repeating unit. From the structure of a polymer, the monomer or repeating unit can be drawn.
Fertilisers
Commercial production of fertilisers Growing plants require nutrients, including compounds containing nitrogen, phosphorus or potassium. Fertilisers are substances which restore elements, essential for healthy plant growth, to the soil. Ammonia and nitric acid are important compounds used to produce soluble, nitrogen-containing salts that can be used as fertilisers. Ammonia is a pungent, clear, colourless gas which dissolves in water to produce an alkaline solution. Ammonia solutions react with acids to form soluble salts. ammonia solution + an acid → an ammonium salt + water

Chemistry in society
Haber and Ostwald processes The Haber process is used to produce the ammonia required for fertiliser production. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ At low temperatures the forward reaction is too slow to be economical. If the temperature is increased, the rate of reaction increases but, as the temperature increases, the backward reaction becomes more dominant. An iron catalyst is used to increase reaction rate. Ammonia is the starting material for the commercial production of nitric acid. The Ostwald process uses ammonia, oxygen and water to produce nitric acid. A platinum catalyst is used in this process.
Nuclear chemistry
Radiation Radioactive decay involves changes in the nuclei of atoms. Unstable nuclei (radioisotopes) can become more stable nuclei by giving out alpha, beta or gamma radiation. Alpha particles (α) consist of two protons and two neutrons and carry a double positive charge. They have a range of only a few centimetres in air and are stopped by a piece of paper. Alpha particles will be attracted towards a negatively charged plate. Beta particles (β) are electrons ejected from the nucleus of an atom. They are able to travel over a metre in air but can be stopped by a thin sheet of aluminium. Beta particles will be attracted towards a positively charged plate. Gamma rays (γ) are electromagnetic waves emitted from within the nucleus of an atom. They are able to travel great distances in air. They can be stopped by barriers made of materials such as lead or concrete. Gamma rays are not deflected by an electric field. ***Nuclear equations*** Balanced nuclear equations can be written using nuclide notation. In nuclear equations: ♦ an alpha particle can be represented as ${}^{4}_{2}\text{He}$ ♦ a beta particle can be represented as ${}^{0}_{-1}\text{e}$ ♦ a proton can be represented as ${}^{1}_{1}\text{p}$ ♦ a neutron can be represented as ${}^{1}_{0}\text{n}$ In the course of any nuclear reaction: ♦ The sum of the atomic numbers on the left of the reaction arrow is equal to the sum of the atomic numbers on the right of the reaction arrow. ♦ The sum of the mass numbers on the left of the reaction arrow is equal to the sum of the mass numbers on the right of the reaction arrow. Candidates do not need to show electrical charges when writing balanced equations representing nuclear reactions.

Chemistry in society
Half-life Half-life is the time for half of the nuclei of a particular isotope to decay. The half-life of an isotope is a constant, unaffected by chemical or physical conditions. Radioactive isotopes can be used to date materials. The half-life of an isotope can be determined from a graph showing a decay curve. Calculations can be performed using the link between the number of half-lives, time and the proportion of a radioisotope remaining. ***Use of radioactive isotopes*** Radioisotopes have a range of uses in medicine and in industry. Candidates do not need to be able to name the isotope used in a particular application. Given information on the type of radiation emitted and/or half-lives, the suitability of an isotope for a particular application can be evaluated.

Chemical analysis
Common chemical apparatus Candidates must be familiar with the use(s) of the following types of apparatus: ♦ conical flask ♦ beaker ♦ measuring cylinder ♦ delivery tube ♦ dropper ♦ test tubes/boiling tubes ♦ funnel ♦ filter paper ♦ evaporating basin ♦ pipette with safety filler ♦ burette ♦ thermometer

Chemistry in society

General practical techniques

Candidates must be familiar with the following practical techniques:

- simple filtration using filter paper and a funnel to separate the residue from the filtrate
- use of a balance
- methods for the collection of gases including:
  - — collection over water (for relatively insoluble gases)
  - — downward displacement of air (for soluble gases that are less dense than air)
  - — upward displacement of air (for soluble gases that are more dense than air)
- methods of heating using Bunsen burners and electric hotplates
- preparation of soluble salts by the reaction of acids with metals, metal oxides, metal hydroxides and metal carbonates
- preparation of insoluble salts by precipitation
- testing the electrical conductivity of solids and solutions
- setting up an electrochemical cell using a salt bridge and either metal or carbon electrodes
- electrolysis of solutions using a d.c. supply
- determination of E_h

Analytical methods

Titration is used to determine, accurately, the volumes of solution required to reach the end-point of a chemical reaction. An indicator is normally used to show when the end-point is reached. Titre volumes within 0·2 cm^3 are considered concordant. Solutions of accurately known concentration are known as standard solutions.

Flame tests can identify metals present in a sample.

Simple tests can be used to identify oxygen, hydrogen and carbon dioxide gases.

Precipitation is the reaction of two solutions to form an insoluble salt called a precipitate. Information on the solubility of compounds can be used to predict when a precipitate will form. The formation of a precipitate can be used to identify the presence of a particular ion.

Reporting experimental work

Labelled, sectional diagrams can be drawn for common chemical apparatus.
Data can be presented in tabular form with appropriate headings and units of measurement.
Data can be presented as a bar, line or scatter graph with suitable scale(s) and labels.
A line of best fit (straight or curved) can be used to represent the trend observed in experimental data.
Average (mean) values can be calculated from data.
Given a description of an experimental procedure and/or experimental results, an improvement to the experimental method can be suggested and justified.

Skills, knowledge and understanding included in the course are appropriate to the SCQF level of the course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level (www.scqf.org.uk).

Skills for learning, skills for life and skills for work

This course helps candidates to develop broad, generic skills. These skills are based on SQA's Skills Framework: Skills for Learning, Skills for Life and Skills for Work and draw from the following main skills areas:

2 Numeracy

2.1 Number processes
2.2 Money, time and measurement
2.3 Information handling

5 Thinking skills

5.3 Applying
5.4 Analysing and evaluating

These skills must be built into the course where there are appropriate opportunities and the level should be appropriate to the level of the course.

Further information on building in skills for learning, skills for life and skills for work is given in the course support notes.

Course assessment

Course assessment is based on the information provided in this document.

The course assessment meets the key purposes and aims of the course by addressing:

- breadth — drawing on knowledge and skills from across the course
- challenge — requiring greater depth or extension of knowledge and/or skills
- application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

This enables candidates to:

- apply breadth and depth of skills, knowledge and understanding from across the course to answer questions in chemistry
- apply skills of scientific inquiry, using related knowledge, to carry out a meaningful and appropriately challenging investigation in chemistry and communicate findings

The course assessment has two components, a question paper and an assignment. The relationship between these two components is complementary, to ensure full coverage of the knowledge and skills of the course.

Course assessment structure: question paper

Question paper 100 marks

The purpose of the question paper is to assess breadth, challenge and application of skills, knowledge and understanding from across the course.

The question paper also assesses scientific inquiry skills and analytical thinking skills.

The question paper gives candidates an opportunity to demonstrate skills, knowledge and understanding by:

- making accurate statements
- providing descriptions and explanations
- applying knowledge of chemistry to new situations, interpreting information and solving problems
- planning or designing experiments to test given hypotheses or to illustrate particular effects, including safety measures
- selecting information
- presenting information appropriately in a variety of forms
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations based on evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- evaluating experimental procedures

The question paper has a total of 100 marks and is worth 80% of the overall marks for external assessment.

The question paper has two sections.

- Section 1 (objective test) has 25 marks.
- Section 2 contains restricted and extended response questions and has 75 marks.

The majority of marks are awarded for demonstrating and applying knowledge and understanding. The other marks are awarded for applying scientific inquiry and analytical thinking skills.

A data booklet containing relevant data and formulae is provided.

Setting, conducting and marking the question paper

The question paper is set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA. The question paper is 2 hours and 30 minutes in duration.

Specimen question papers for National 5 courses are published on SQA’s website. These illustrate the standard, structure and requirements of the question papers candidates sit. The specimen papers also include marking instructions.

Course assessment structure: assignment

Assignment 20 marks

The purpose of the assignment is to assess the application of skills of scientific inquiry and related chemistry knowledge and understanding.

This component allows assessment of skills which cannot be assessed through the question paper, for example the handling and processing of data gathered as a result of experimental and research skills.

Assignment overview

The assignment gives candidates an opportunity to demonstrate the following skills, knowledge and understanding:

- applying knowledge of chemistry to new situations, interpreting information and solving problems
- planning, designing and safely carrying out experiments/practical investigations to test given hypotheses or to illustrate particular effects
- selecting information from a variety of sources
- presenting information appropriately in a variety of forms
- processing the information (using calculations and units, where appropriate)
- making predictions and generalisations based on evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- suggesting improvements to experiments/practical investigations
- communicating findings/information

The assignment offers challenge by requiring skills, knowledge and understanding to be applied in a context that is one or more of the following:

- unfamiliar
- familiar but investigated in greater depth
- familiar but integrates a number of concepts

Candidates will research and report on a topic that allows them to apply skills and knowledge in chemistry at a level appropriate to National 5.

The topic should be chosen with guidance from the teacher/lecturer and must involve experimental work.

The assignment has two stages:

- research
- report

The research stage must involve an experiment which allows measurements to be made. Candidates must also gather data from the internet, books or journals to compare against their experimental results.

Candidates must produce a report on their research.

Setting, conducting and marking the assignment

Setting

The assignment is:

- set by centres within SQA guidelines
- set at a time appropriate to the candidate's needs
- set within teaching and learning and includes experimental work at a level appropriate to National 5

Conducting

The assignment is:

- an individually produced piece of work from each candidate
- started at an appropriate point in the course
- conducted under controlled conditions

Marking

The assignment has a total of 20 marks. The table below gives details of the mark allocation for each section of the report.

Section	Expected response	Max marks
Title	The report has an informative title.	1
Aim	A description of the purpose of the investigation.	1
Underlying chemistry relevant to the aim	A description of the chemistry relevant to the aim which shows understanding.	3
Data collection and handling	A brief description of the experiment.	1
	Sufficient raw data from the experiment.	1
	Raw data presented in a table with headings and units.	1
	Values correctly calculated from the raw data.	1
	Data from an internet/literature source.	1
	A reference for the internet/literature source.	1
Graphical presentation	The correct type of graph used to present the experimental data.	1
	Suitable scales.	1
	Suitable labels and units on axes.	1
	All points plotted accurately, with line or curve of best fit if appropriate.	1
Analysis	Experimental data compared to data from internet/literature source.	1
Conclusion	A conclusion related to the aim and supported by data in the report.	1
Evaluation	A discussion of a factor affecting the reliability, accuracy or precision of the results.	2
Structure	A report which can be easily followed.	1
		20

The report is submitted to SQA for external marking.

All marking is quality assured by SQA.

Assessment conditions

Controlled assessment is designed to:

- ensure that all candidates spend approximately the same amount of time on their assignments
- prevent third parties from providing inappropriate levels of guidance and input
- mitigate concerns about plagiarism and improve the reliability and validity of SQA awards
- allow centres a reasonable degree of freedom and control
- allow candidates to produce an original piece of work

Detailed conditions for assessment are given in the assignment assessment task.

Time

It is recommended that no more than 8 hours is spent on the whole assignment. This includes a maximum of 1 hour and 30 minutes which is allocated to the reporting stage.

Supervision, control and authentication

There are two levels of control.

Under a high degree of supervision and control	Under some supervision and control
♦ the use of resources is tightly prescribed ♦ all candidates are within direct sight of the supervisor throughout the session(s) ♦ display materials which might provide assistance are removed or covered ♦ there is no access to e-mail, the internet or mobile phones ♦ candidates complete their work independently ♦ interaction with other candidates does not occur ♦ no assistance of any description is provided	♦ candidates do not need to be directly supervised at all times ♦ the use of resources, including the internet, is not tightly prescribed ♦ the work an individual candidate submits for assessment is their own ♦ teachers/lecturers can provide reasonable assistance

The assignment has two stages.

Stage	Level of control
♦ research	conducted under some supervision and control
♦ report	conducted under a high degree of supervision and control

Resources

Please refer to the instructions for teachers within the assignment assessment task.

In the research stage:

- teachers/lecturers must agree the choice of topic with the candidate
- teachers/lecturers must provide advice on the suitability of the candidate’s aim
- teachers/lecturers can supply instructions for the experimental procedure
- candidates must undertake research using only websites, journals and/or books, to find secondary data/information
- a wide list of URLs and/or a wide range of books and journals may be provided

Teachers/lecturers **must not**:

- provide an aim
- provide candidates with a set of experimental data for the candidate’s experiment
- provide candidates with a set of experimental data to compare with the candidate’s own data
- provide a blank or pre-populated table for experimental results

The only materials which **can** be used in the report stage are:

- the instructions for candidates
- the candidate’s raw experimental data
- the internet or literature data (including a record of the source of the data)
- information on the underlying chemistry
- the experimental method, if appropriate

Candidates **must not** have access to a previously prepared:

- draft of a report
- draft of a description of the underlying chemistry
- specimen calculation or set of calculations for mean or derived values
- graph
- comparison of data
- conclusion
- evaluation of an experimental procedure

In addition, candidates **must not** have access to the assignment marking instructions during the report stage.

Reasonable assistance

Candidates must undertake the assessment independently. However, reasonable assistance may be provided prior to the formal assessment process taking place. The term 'reasonable assistance' is used to try to balance the need for support with the need to avoid giving too much assistance. If any candidates require more than what is deemed to be 'reasonable assistance', they may not be ready for assessment or it may be that they have been entered for the wrong level of qualification.

The assignment assessment task provides guidance on reasonable assistance.

Evidence to be gathered

The following candidate evidence is required for this assessment:

- a report

The report is submitted to SQA, within a given time frame, for marking.

The same report cannot be submitted for more than one subject.

Volume

There is no word count.

Grading

A candidate's overall grade is determined by their performance across the course assessment. The course assessment is graded A–D on the basis of the total mark for all course assessment components.

Grade description for C

For the award of grade C, candidates will typically have demonstrated successful performance in relation to the skills, knowledge and understanding for the course.

Grade description for A

For the award of grade A, candidates will typically have demonstrated a consistently high level of performance in relation to the skills, knowledge and understanding for the course.

Equality and inclusion

This course is designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

For guidance on assessment arrangements for disabled candidates and/or those with additional support needs, please follow the link to the assessment arrangements web page: www.sqa.org.uk/assessmentarrangements.

Further information

The following reference documents provide useful information and background.

- National 5 Chemistry subject page
- Assessment arrangements web page
- Building the Curriculum 3–5
- Design Principles for National Courses
- Guide to Assessment
- SCQF Framework and SCQF level descriptors
- SCQF Handbook
- SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work
- Coursework Authenticity: A Guide for Teachers and Lecturers
- Educational Research Reports
- SQA Guidelines on e-assessment for Schools
- SQA e-assessment web page

Administrative information

Published: April 2017 (version 1.1)

History of changes to course specification

Version	Description of change	Authorised by	Date
1.1	Formula corrected in chemistry in society table, Haber and Ostwald processes section.	Qualifications Manager	April 2017

Note: You are advised to check SQA's website to ensure you are using the most up-to-date version of the course specification.