SCQF level 5
Unit Specification

Nature's Chemistry

SCQF: level 5 (6 SCQF credit points)

Unit code: J23B 75

Unit outline

The general aim of this Unit is to develop skills of scientific inquiry, investigation, analytical thinking and knowledge and understanding of nature's chemistry. Learners will apply these skills when considering the applications of nature's chemistry on our lives, as well as the implications on the environment/society. This can be done using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of homologous series, everyday consumer products and energy of fuels. Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Learners who complete this Unit will be able to:

1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment

2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills

This Unit is available as a free-standing Unit. The Unit Specification should be read in conjunction with the *Unit Support Notes*, which provide advice and guidance on delivery, assessment approaches and development of skills for learning, skills for life and skills for work. Exemplification of the standards in this Unit is given in *Unit Assessment Support*.

Recommended entry

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by one or more of the following or equivalent qualifications and/or experience:

- National 4 Chemistry Course or relevant component Units
- National 4 Science Course or relevant component Units

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. For further information, please refer to the *Unit Support Notes.*

Standards

Outcomes and Assessment Standards

Outcome 1

The learner will:

1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment by:

1.1 Planning an experiment
1.2 Following procedures safely
1.3 Making and recording observations/measurements correctly
1.4 Presenting results in an appropriate format
1.5 Drawing valid conclusions
1.6 Evaluating experimental procedures

Outcome 2

The learner will:

2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills by:

2.1 Making accurate statements
2.2 Solving problems

Evidence Requirements for the Unit

Assessors should use their professional judgement, subject knowledge and experience, and understanding of their learners, to determine the most appropriate ways to generate evidence and the conditions and contexts in which they are used.

The key areas covered in this Unit are:

- **homologous series**
- **everyday consumer products**
- **energy from fuels**

Evidence can be drawn from a variety of sources and presented in a variety of formats. The table below describes the evidence for the Assessment Standards which require exemplification. Evidence may be presented for individual Outcomes, or gathered for the Unit. If the latter approach is used, it must be clear how the evidence covers each Outcome.

Assessment Standard	**SCQF Level 5**
Planning an experiment	The plan should include: ♦ an aim ♦ a dependent and independent variable ♦ key variables to be kept constant ♦ measurements/observations to be made ♦ the resources ♦ the method including safety considerations
Presenting results in an appropriate format	One format from: table, line graph, chart, key, diagram, flow chart, summaries or other appropriate formats
Draw a valid conclusion	Include reference to the aim
Evaluating experimental procedures	Suggest an improvement with justification
Accurate statements	At least half of the statements should be correct across the key areas of this Unit.
Solving problems	One of each: ♦ make generalisation/predictions ♦ selecting information ♦ processing information including calculations as appropriate ♦ analyse information

Transfer of evidence

Evidence for the achievement of Outcome 1 and Assessment Standard 2.2, for this Unit can be used as evidence of the achievement of Outcome 1 and Assessment Standard 2.2 in the freestanding SCQF level 5 *Chemistry in Society* and *Chemical Changes and Structure* Units.

Exemplification of assessment is provided in *Unit Assessment Support*. Advice and guidance on possible approaches to assessment is provided in the *Unit Support Notes.*

Assessment Standard Thresholds

Outcome 1:
Candidates are not required to show full mastery of the Assessment Standards to achieve Outcome 1. Instead, five out of the six Assessment Standards for Outcome 1 must be met to achieve a pass. There is still the requirement for candidates to be given the opportunity to meet all Assessment Standards. The above threshold is in place to reduce the volume of re-assessment where that is required.

Candidates have the opportunity to re-draft their original Outcome 1 report or to carry out a new experiment/practical investigation.

Outcome 2:
Assessment Standards 2.1 (making accurate statements) and 2.2 (solving problems) are not required to be passed independently. Assessment Standards 2.1 and 2.2 can be assessed by means of a single assessment for each Unit.

Outcome 2 assessment

Centres have two options when assessing Outcome 2 (AS 2.1 and 2.2).

Option 1: Single Assessment
Candidates are assessed by means of a single test that contains marks and a cut-off score. A suitable Unit assessment will cover all of the key areas (AS 2.1) and assess each of the problem solving skills (AS 2.2). Where a candidate achieves 50% or more of the total marks available in a single Unit assessment they will pass Outcome 2 for that Unit. Existing Unit assessment support packs can be used.

Option 2:
If this option is chosen, 50% or more of the KU statements (AS 2.1) made by candidates must be correct in the Unit assessment and at least one correct response for each problem solving skill (AS 2.2) is required to pass Outcome 2. However, if a candidate is given more than one opportunity in a Unit assessment to provide a response for a problem solving skill, then they must answer 50% or more correctly.

Centres can use the Unit assessment support packs from SQA's secure site or centre devised assessments.

Guidance on Outcome 2 (Option 1) Assessment

Unit assessment support pack 1 (Unit-by-Unit approach)
As these packages contain questions on all of the key areas (AS 2.1) and questions covering each of the problem solving skills (AS 2.2), Unit assessment support pack 1 is suitable for use as a single assessment for its associated Unit. The number of marks available for each question should be combined to give the total number of marks available. A cut-off score of 50% should be applied to each of these Unit assessments.

Unit assessment support pack 2 (combined approach)

As this package contains questions covering Assessment Standard 2.1 for each Unit and a set of questions assessing the problem solving skills, they may be suitable for use as a single assessment for their associated Units. If a centre wishes to use Unit assessment support pack 2 as a single Unit assessment, the existing problem solving questions could be used for one of the Units and different questions, covering each of the four problem solving skills, would need to be added to the tests for the other Units. A minimum of 1 mark per problem solving skill per unit would be acceptable.

These marks should be combined with the marks added to assess the problem solving skills (AS 2.2) before the 50% cut-off score is applied.

The problem solving questions included in package 2 would be allocated a total of 5 marks. As with the Unit-by-Unit approach, centres may wish to supplement the existing questions in the Unit assessment support packs with additional questions, so that the sampling of each Unit is increased, the tests are out of the same total mark and that total is an even number so that the cut-off is actually 50%. Where centres are adding additional questions, care should be taken that these questions are of an appropriate standard for Unit assessment and are not 'A grade' type questions that would appear in an exam.

Unit assessment support pack 3 (portfolio approach)
It is still acceptable for centres to use this method of assessment. Candidates should be given the opportunity to make accurate statements for all of the key areas of each Unit (AS 2.1). They must also be given opportunities throughout the session to answer questions on each of the four problem solving skills (AS 2.2). Evidence should be collected as candidates progress through the session. For Assessment Standard 2.1, candidates must achieve 50% or more of the total KU marks available for each Unit. For Assessment Standard 2.2, candidates must achieve 50% or more of the total marks available for all four problem solving skills.

Development of skills for learning, skills for life and skills for work

It is expected that learners will develop broad, generic skills through this Unit. The skills that learners will be expected to improve on and develop through the Unit are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and drawn from the main skills areas listed below. These must be built into the Unit where there are appropriate opportunities.

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

Amplification of these is given in SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work.* The level of these skills should be at the same SCQF level of the Unit and be consistent with the SCQF level descriptor. Further information on building in skills for learning, skills for life and skills for work is given in the *Unit Support Notes.*

Appendix: Unit support notes

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing this Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Unit Assessment Support packs*

Developing skills, knowledge and understanding

Teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

Approaches to learning and teaching

Key areas	Exemplification of key areas
Learners should be familiar with systematic naming, molecular formulae and full structural formulae for straight chain alkanes and alkenes containing up to eight carbons. They should also be familiar with the term hydrocarbon	Hydrocarbon is a compound containing hydrogen and carbon only.
Homologous series Definition of a homologous series.	A homologous series is a family of compounds with the same general formula and similar chemical properties.
General formulae and shortened structural formulae for alkanes and alkenes.	
Alkanes are described as saturated.	The carbon to carbon bonds in saturated hydrocarbons are all single bonds.
Naming straight chain alkenes to show the position of the double bond.	
Alkenes are described as unsaturated.	Unsaturated hydrocarbons contain at least one double or triple carbon to carbon bond.
Addition reactions of alkenes with hydrogen and halogens.	Alkenes undergo addition reactions with hydrogen that convert them into alkanes. Alkenes also undergo addition reactions with halogens.
The test for unsaturation.	Balanced chemical equations and structures of reactants/products for addition reactions of alkenes.

Key areas	Exemplification of key areas
	The test for unsaturation is addition of a few drops of bromine water which will quickly be decolourised The cycloalkane family is a homologous series of hydrocarbons and is identified from the name and the general formula.
The cycloalkane homologous series. Cycloalkanes, with no more than eight carbon atoms in their longest chain, can be named from their full structural formulae, shortened structural formulae and molecular formulae.	
Naming and formulae for branched chain alkanes, branched chain alkenes and cycloalkanes containing up to eight carbons in their longest chain.	For branched chain alkanes, branched chain alkenes and cycloalkanes containing up to eight carbons in their longest chain: ♦ structural formulae can be drawn from systematic names ♦ molecular formulae can be written from systematic names ♦ systematic names, including the position of any double bond, can be written from structural formulae . Structural formulae can be shortened or full.
	Identifying products and writing balanced equations for combustion of hydrocarbons. Isomers have the same molecular formula but different structural formulae
Combustion reactions for hydrocarbons.	

Key areas	Exemplification of key areas
Definition of isomers. Isomers of alkanes, alkenes and cycloalkanes. Isomers have different physical properties. Physical properties of the following homologous series: cycloalkanes, alkanes and alkenes containing up to eight carbons in their longest chain. Uses of cycloalkanes, branched chain alkanes and branched chain alkenes containing up to eight carbons in their longest chain.	Names, full structural formulae, and shortened structural formulae for isomers of: ♦ alkanes ♦ branched alkanes ♦ alkenes ♦ branched alkenes ♦ cycloalkanes. Isomers have different physical properties including melting point and boiling point. Physical properties to include melting point and boiling point. Explaining trends in melting or boiling point in terms of intermolecular forces. Uses of branched chain alkanes should include fuels and uses of branched chain alkenes should include making plastics.
Everyday consumer products **Alcohols** An alcohol is identified from the hydroxyl group, the –OH group and the ending '-ol'.	For straight chain alcohols (C1 to C8) determine the:

Key areas	Exemplification of key areas
Naming and formulae for straight chain alcohols containing up to eight carbons in their longest chain.	♦ systematic name from the structural formulae including the position of the hydroxyl group ♦ full structural formulae, shortened structural formulae and molecular formulae from the systematic name ♦ general formula
Explain the physical properties of alcohols in terms of the intermolecular forces of attraction.	Physical properties of alcohols including melting point, boiling point and solubility in water. Explain these properties in terms of the intermolecular forces of attraction.
Chemical properties of alcohols.	Chemical properties of alcohols to include that they are flammable and they react with carboxylic acids to form esters. Alcohols are used as fuels as they are highly flammable, and burn with very clean flames.
Uses of alcohols as solvents and fuels.	
Carboxylic acids Carboxylic acids can be identified by the carboxyl functional group, –COOH functional group, and the '-oic' name ending.	For straight-chained carboxylic acids, C1 to C8, determine the:
Naming and formulae for straight chain carboxylic acids containing up to eight carbons in their longest chain.	♦ systematic name from the structural formulae ♦ full structural formulae, shortened structural formulae and molecular formulae from the systematic name. ♦ general formula

Key areas	Exemplification of key areas
Explain the physical properties of carboxylic acids in terms of the intermolecular forces of attraction. Chemical properties of carboxylic acids. Uses of carboxylic acids to make esters. Vinegar and its uses.	Physical properties of carboxylic acids including melting point, boiling point and solubility in water. Explain these properties in terms of the intermolecular forces of attraction. Chemical properties of carboxylic acids to include ♦ pH ♦ Reactions with metals, oxides, hydroxides and carbonates ♦ reaction with alcohols to form esters Naming and structures of esters from their parent alcohol and acid is not required. Vinegar is a solution of ethanoic acid. Vinegar is used in household cleaning products designed to remove lime scale (a build-up of insoluble carbonates on plumbing fixtures) and as a preservative in the food industry. Naming and structures of esters from their parent alcohol and acid is not required. Uses of esters including food flavouring, industrial solvents, fragrances and materials.

Key areas	Exemplification of key areas
Esters Esters can be identified by the, –COO– functional group in a structural formula and from the '-oate' name ending. An ester can be made by reacting a carboxylic acid and an alcohol. Uses of esters.	
Energy from fuels Combustion reactions are exothermic reactions. The opposite of this is an endothermic reaction. Energy from fuels can be determined experimentally and calculated using $E_h = cm\Delta T$ The quantities c, m and ΔT can be calculated given relevant data.	When a substance is combusted the reaction can be represented using a balanced equation. Different fuels provide different quantities of energy and this can be determined experimentally and calculated using $E_h = cm\Delta T$ *(There is no requirement to calculate enthalpy per mole.)* Awareness of appropriate units eg kJ or kJ kg^{-1} $°C^{-1}$, etc. Candidates can be asked to determine specific heat capacity for substances other than water. These calculations can be based on any balanced equation eg displacement, combustion, oxidation, reduction, etc.

Key areas	Exemplification of key areas
Calculations based on a balanced equation to determine the quantity of reactants or products.	

Combining assessment within Units

Assessment could be combined in this Unit by holistically assessing all the Outcomes of the Unit in a single assessment. When assessment within the Unit is holistic, teachers and lecturers should take particular care to track the evidence for each individual Outcome. Centres should adhere to the conditions of assessment, outlined within the unit assessment support packs available via SQA secure.

Re-assessment

SQA's guidance on re-assessment is that there should be one or, in exceptional circumstances, two re-assessment opportunities. Re-assessment should be carried out under the same conditions as the original assessment. It is at a centre's discretion as to how they re-assess their candidates. Candidates may be given a full re-assessment opportunity, or be re-assessed on individual key areas and/or problem solving skills. Regardless of which option is chosen, candidates must achieve 50% or more of each re-assessment opportunity.

Transfer of evidence

Evidence for the achievement of Outcome 1 and Assessment Standard 2.2, for this Unit can be used as evidence of the achievement of Outcome 1 and Assessment Standard 2.2 in the freestanding SCQF level 5 *Chemistry in Society* and *Chemical Changes and Structure* Units.

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Administrative information

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Superclass: RD

History of changes to National Unit Specification

Version	Description of change	Authorised by	Date
1.1	Assessment standard thresholds added Unit support notes added	Qualifications Manager	September 2018
2.0	Unit code updated	Qualifications Manager	July 2019