National Unit Specification: general information

UNIT Researching Chemistry (SCQF 6)

CODE FE4J 12

COURSE Chemistry (Revised)

SUMMARY

In this Unit candidates will develop the key skills necessary to undertake research in Chemistry and demonstrate the relevance of chemical theory to everyday life by exploring the Chemistry behind a topical issue. Candidates will develop skills associated with collecting and synthesising information from a number of different sources. Equipped with a knowledge of common apparatus and techniques they will plan and undertake a practical investigation related to the topical issue. Candidates will prepare a scientific communication presenting the aim, results and conclusions of their practical investigation. The Unit offers opportunities for candidates to work in partnership and in teams set within the context of the evaluation of a current scientific issue. This Unit is suitable for candidates who are interested in pursuing a career in Chemistry, as well as those whose interest is more general.

OUTCOMES

1. Research the Chemistry underlying a topical issue to a given brief.

2. Plan and carry out investigative practical work related to a topical issue in Chemistry

3. Prepare a scientific communication which presents the aim, results and conclusions from a practical investigation related to a topical issue in Chemistry.

Administrative Information

Superclass: RD

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Version: 01

National Unit Specification: general information (cont)

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RECOMMENDED ENTRY

Entry for this Unit is at the discretion of the centre. However candidates would normally be expected to have attained the skills and knowledge required by one or more of the following or equivalent:

- Standard Grade Chemistry at Credit level in both Knowledge and Understanding and Problem Solving

or

- the Intermediate 2 Chemistry course at grade B

and

- Standard Grade Mathematics at Credit level or Intermediate 2 Mathematics.

CREDIT VALUE

0.5 credit(s) at Higher (3 SCQF credit points at SCQF level 6).

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

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

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 the Scottish Qualifications Authority.

OUTCOME 1

Research the Chemistry underlying a topical issue to a given brief.

Performance Criteria

(a) Information from suitable sources relating to a focus question from a given brief is obtained and recorded.
(b) The sources of information selected are recorded.

OUTCOME 2

Plan and carry out investigative practical work related to a topical issue in Chemistry.

Performance Criteria

(a) An appropriate experimental procedure is planned.
(b) The experimental procedure is carried out effectively.

OUTCOME 3

Prepare a scientific communication which presents the aim, results and conclusions from a practical investigation related to a topical issue in Chemistry.

Performance Criteria

(a) The aim of the investigative work is clearly stated.
(b) Information is analysed and presented in an appropriate format.
(c) Valid conclusions are drawn.
(d) A valid evaluation of procedures is made.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have met the requirements of the Outcomes. Assessors should use their professional judgement to determine the most appropriate instruments of assessments for generating evidence and the conditions and contexts in which they are used. Exemplification of possible approaches may be found in the Appendix to this Unit and the National Assessment Bank.

Outcome 1
Candidates will be provided with a briefing document which contains focus questions relating to key points of background information and/or chemical theory likely to be unfamiliar to the candidate. Candidates must produce:

- A clear and accurate answer to a focus question selected from those contained in the brief.

- A record of at least two sources of information relating to the answer provided. These should be identified in sufficient detail to allow a third party to retrieve the source article.

Outcome 2
Candidates will contribute to the planning and carrying out of investigative practical work. The assessor should record the date upon which the candidate was observed to have achieved the assessment standards.

Outcome 3
Outcome 3 is assessed by a single scientific communication describing the investigative activity and its findings. The scientific communication must be the individual work of the candidate. Depending on the activity, the collection of information may involve group work. The scientific communication can take any format in which the results of scientific research are commonly reported including: conference poster format, scientific paper format, PowerPoint presentation, video presentation, web page or traditional lab report.

Written and/or video and/or electronic and/or recorded oral evidence may be used to provide evidence that: the aim of the investigative work is clearly identified; information is analysed and presented in an appropriate format; valid conclusions are drawn and procedures are evaluated with respect to the selection of apparatus, the details of experimental method and/or the reliability of results as appropriate.

National Unit Specification: support notes

UNIT Researching Chemistry (SCQF 6)

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

While the time allocated to this Unit is at the discretion of the centre, the notional design length is 20 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

In this Unit candidates will develop the key skills necessary to undertake research in Chemistry and demonstrate the relevance of chemical theory to everyday life by exploring the Chemistry behind a topical issue. Candidates will develop skills associated with collecting and synthesising information from a number of different sources. Equipped with a knowledge of common Chemistry apparatus and techniques they will plan and undertake a practical investigation related to the topical issue. Candidates will prepare a scientific communication presenting the aim, results and conclusions of their practical investigation. The Unit offers opportunities for candidates to work in partnership and in teams set within the context of the evaluation of a current scientific issue. This Unit is suitable for candidates who are interested in pursuing a career in Chemistry, as well as those whose interest is more general.

Learning and Teaching Scotland website (LTS) provides exemplar investigation briefs, containing focus questions, to allow centres the opportunity to select a topical issue suited to the available resources and/or the interests of their candidates. Centres may wish to develop their own investigation briefs but these must be of a comparable standard.

Outcome 1

Research briefs should allow candidates to investigate the Chemistry underlying an issue or story featured in broadcast and publishing media. The research brief should contain a number of 'focus questions' relating to key points of background information or chemical theory which are likely to be unfamiliar to candidates undertaking the Unit. The focus questions should be constructed to give a clear indication of the information required from the candidate. The information required to answer the questions must also be readily available using printed resources, video or audio materials available to the candidate, or from websites which can be identified by use of a search engine. Candidates must not be provided with extracts from any of these sources compiled by a third party. Prior to undertaking the assessment of Outcome 1, teachers/lecturers should ensure that candidates have experience of literature based research. In particular, if candidates are carrying out web-based research, then they should be familiar with issues of reliability and they should be able to clearly state the source of the information they find.

Outcome 2

In order to be able to make informed choices and decisions during the planning stage of the investigation teachers/lecturers should ensure that candidates are familiar with the following practical techniques prior to undertaking the investigation.

- Filtration
- Distillation
- Use of a balance
- Titration
- Methods for the collection of a gas: over water, using a gas syringe
- Safe Methods for heating: Bunsen burners, water baths or heating mantles

National Unit Specification: support notes (cont)

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Candidates should have knowledge of the following pieces of general laboratory apparatus:

- Conical flask
- Beaker
- Measuring cylinder
- Delivery tubes
- Dropper
- Test tubes/Boiling tubes
- Evaporating basin
- Pipette with safety filler
- Burette
- Volumetric flask
- Funnel
- Thermometer

National Unit Specification: support notes (cont)

UNIT Researching Chemistry (SCQF 6)

Outcome 3

In order to be able to evaluate their procedures, and to arrive at valid conclusions, candidates should have experience of the following techniques and concepts:

- Representing experimental data using a scatter graph.
- Sketching lines or curves of best fit.
- Calculation of averages (means) for experiments.
- Identification and elimination of 'rogue' points from the analysis of results.
- **Qualitative** appreciation of the relative accuracy of apparatus used to measure the volume of liquids. Candidates would be expected to know that the volume markings on beakers only provide a very rough indication of volume. While measuring cylinders generally provide sufficient accuracy for preparative work, analytic work will normally require the use of burettes, pipettes and volumetric flasks.
- When a measurement has been repeated, candidates should appreciate that any variations in the value obtained give an indication of the reproducibility of the technique.
- The uncertainty associated with a measurement can be indicated in the form, *measurement* ± *uncertainty.* Candidates are not expected to conduct any form of quantitative error analysis.

Teachers/lecturers should note that the external examination for this Course contains questions requiring candidates to demonstrate their ability to design and evaluate experimental procedures in addition to questions which test a candidate's ability to interpret experimental data. The bullet points for Outcomes 2 and 3 listed give a clear indication of the likely contexts and data analysis techniques candidates may be expected to employ.

The appendix to the Unit specification provides an example of a record sheet which could be used to record candidate success in overtaking the Unit Performance Criteria.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The Researching Chemistry Unit (20 hours) develops and assesses key Chemistry skills identified by Higher Education and Industry. It is intended that the majority of this time be spent in teaching activities which develop the skills necessary to conduct investigative work in Chemistry. In addition to ensuring that candidates are suitably prepared to conduct simple background research using the internet, candidates should also have the opportunity to become familiar with the apparatus, practical techniques and data analysis strategies indicated below.

Candidates should be familiar with the following apparatus

- Conical flask
- Beaker
- Measuring cylinder
- Delivery tubes
- Dropper
- Test tubes / Boiling tubes
- Evaporating basin
- Pipette with safety filler
- Burette
- Volumetric flask
- Funnel
- Thermometer

Candidates should be familiar with the following techniques

- Filtration
- Distillation
- Use of a balance
- Titration
- Methods for the collection of a gas: over water, using a gas syringe
- Safe Methods for heating: Bunsen burners, water baths or heating mantles

Candidates should be able to process experimental results by

- Representing experimental data using a scatter graph.
- Sketching lines or curves of best fit.
- Calculation of averages (means) for experiments.
- Identification and elimination of "rogue" points from the analysis of results.
- Qualitative appreciation of the relative accuracy of apparatus used to measure the volume of liquids. Candidates would be expected to know that the volume markings on beakers provide only a rough indication of volume. While measuring cylinders generally provide sufficient accuracy for preparative work, for analytic work, burettes, pipettes and volumetric flasks are more appropriate.
- When a measurement has been repeated, candidates should appreciate that any variations in the value obtained give an indication of the reproducibility of the technique.
- The uncertainty associated with a measurement can be indicated in the form, *measurement* ± *uncertainty.* Candidates are not expected to conduct any form of quantitative error analysis.

Whilst centres are free to deliver this Unit at any point during the Higher Chemistry Course, the '*Possible Contexts and Activities'* associated with the other Units of the Course may be used to provide real-life contexts within which candidates can become familiar with all of the practical techniques and apparatus listed above. Many teachers/lecturers may wish to delay the Unit assessment investigation until the latter stages of the Course in recognition of the considerable exposure to relevant experimental techniques candidates may experience whilst undertaking the other Higher Chemistry Units. This Unit allows the candidates to link and apply different kinds of learning in new situations.

Candidates should be encouraged to see risk assessment as a natural part of the planning process for any practical activity. Whilst candidates would **not** be expected to produce a full written risk assessment for their investigation themselves, this Unit provides an excellent opportunity to assess risks and take informed decisions regarding the use of appropriate control measures during the planning stage of the practical investigation.

As with all practical investigative work in Science, centres must ensure that appropriate risk assessments have been carried out for all practical activities and must comply with current health and safety legislation and regulation.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

This Unit provides opportunities to develop Communication, Numeracy, Information and Communication Technology and Problem Solving skills in addition to providing contexts and activities within which the skills associated with Working with Others can be developed.

Outcome 1 focuses upon a candidate's ability to research a chemistry topic. Information and Communication Technology skills are developed as candidates become proficient in using the internet to retrieve information on a topical science matter.

The planning and execution of the practical investigative work, associated with Outcome 2, provides a highly effective context within which candidates can develop both Problem Solving skills and those associated with working co-operatively with others.

In overtaking Outcome 3, the preparation of a scientific communication, candidates will develop numeracy and communication skills as they process their experimental results and communicate these effectively to others.

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GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcome 1 is assessed by a written and/or oral report of the candidate's review findings. The candidate's report should be the result of his/her individual research into one of the focus questions contained in the investigation brief.

- The candidate's record should contain an extract or summary of information relevant to a focus question provided in the briefing document.

- The candidate's record should contain mention of at least two sources of relevant information. The precise format in which these reference sources are to be recorded is not prescribed and any format that would successfully allow the source to be retrieved by a third party is sufficient.

Outcome 2 requires candidates to take an active part in planning, designing and carrying out a practical investigation.

If candidates are working as part of a group, it is unlikely that they will take an equal or similar role in the investigation. Teachers/lecturers should exercise professional judgement in deciding if candidates have taken an active part in the work.

Outcome 3 requires candidates to produce, individually, a scientific communication which presents the results of the practical investigation undertaken. The table below is provided to indicate what might be addressed to achieve a specific assessment standard. The relevance of the items will vary according to the research activity being undertaken. The professional judgement of the teacher/lecturer will be important in deciding if an assessment standard has been met for a particular activity.

All the assessment standards given in the left-hand column must be achieved in order to attain Outcome 3. The right-hand column gives suggestions which might aid the professional judgement of the assessor.

Outcome 3 Performance Criteria	**Suggestions to aid professional judgement**
(a) The aim of the investigative work is clearly stated.	The communication should contain a clear statement of the aim of the research.
(b) Information is analysed and presented in an appropriate format.	The analysis might include: ♦ correctly executed calculations ♦ comparison of values with those in the literature ♦ experimental observations
(c) Valid conclusions are drawn.	The communication should contain a conclusion which is valid on the basis of the evidence available to the candidate.
(d) A valid evaluation of procedures is made. .	The evaluation might include: ♦ an assessment of the effectiveness of the procedure ♦ suggestions for alternative or modified strategies, further work, predictions or generalisations ♦ an assessment/explanation of the relevance of the results.

The relevance of the bullet points listed above will vary according to the nature of research undertaken. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to verification) against the assessment standards. It is appropriate to support candidates in producing a scientific communication to meet the assessment standards. Re-drafting of the communication after necessary supportive criticism is to be encouraged both as part of the learning and teaching process and to produce evidence for assessment. Redrafting and resubmission of the parts requiring attention only is required ie the entire scientific communication does not need to be redone.

Conditions required to prepare the scientific communication

Teachers and lecturers may wish candidates to prepare their communications under direct supervision so that appropriate advice and support can be provided. However, they may feel confident that any redrafting required need not be undertaken under such close supervision as it will be evident in the candidates' response that it is his or her unaided work. Under such circumstances it would be acceptable for such redrafting to take place outwith class time.

Candidate absence during the Unit assessment

At the conclusion of an investigation conducted for Unit assessment purposes, it is possible that a candidate may fail to have demonstrated attainment in all Outcomes and assessment standards. This situation could arise either through absence or by the candidate failing to achieve the required standard at the first attempt. Candidates need only undertake those part(s) of an investigation required to allow them to demonstrate attainment in accordance with the evidence requirements stated in the Unit specification.

Example Teacher/lecturer Record Sheet.

This grid may be used to record candidates' achievement in the assessment standards for each Outcome.

	Literature based research		**Plan and carry out an investigation**		**Scientific Communication**			
	Report		Observation/ discussion		Report in any format			
Name	Information obtained and recorded	Sources of information recorded	Contributed to planning	Contributed to carrying out	Aim clearly identified	Results presented and analysed	Valid conclusion	Evaluation of procedure

History of changes

Version	Description of change	Date