

Advanced Higher Chemistry Investigation

Teacher/Lecturer Information

General

The Investigation seeks to develop the candidate's investigative skills and to provide opportunities for self-motivation, independent learning and the planning and designing of appropriate experiments. It also provides the candidate with an opportunity to write in a scientific manner which reveals the significance of the findings of the Investigation by analysing and interpreting the results in a critical and scientific manner and demonstrating knowledge and understanding of the chemical basis of the Investigation.

The Investigation is assessed internally through the Unit assessment and externally through the Course assessment.

The length of the Investigation Unit is 20 hours and this includes the planning stage of the Investigation and the experimental work. After completion of the Unit, the Report for the course assessment is likely to take a further 5-10 hours.

Choice of an Investigation topic

It is likely that the supervising teacher/lecturer will ensure an early focus and clear direction as to the suitability of the topic chosen for investigation. While candidates will be involved in initial reading and research, it is important that this aspect of the investigation does not absorb too much time. Some early discussion with the candidate is desirable.

- (a) Topics for investigation do not require prior approval by the Scottish Qualifications Authority.
- (b) The investigation must consist of a chemistry topic.
- (c) Group work and joint investigations are not permitted.
- (d) The investigation will involve planning, collection and analysis of information through experimental work.
- (e) Any suitable topic for investigation can be selected provided the chemistry is commensurate with the demands of Advanced Higher Chemistry.
- (f) While the topic for investigation may be outwith the chemistry covered in the other units of the Advanced Higher Chemistry course, care must be taken to ensure that the investigation is not purely a technical exercise in, for example, statistics or computing.

- (g) In consultation with the teacher/lecturer, candidates should try to select topics in which they are genuinely interested.

The teacher/lecturer should encourage candidates to consult a wide variety of sources in selecting topics for investigation. The type of literature that might be consulted could include:

- the 'Starter Investigations' support package produced by the Higher Still Development Unit in partnership with the Royal Society of Chemistry
 - textbooks
 - journals and periodicals, eg Education in Chemistry, School Science Review, Chemistry in Britain, New Scientist, Scientific American
 - medical or government reports
 - newspapers.
- (h) While not wishing to stifle a candidate's enthusiasm, the teacher/lecturer must sound a note of realism and discourage candidates from embarking on over-ambitious investigations. Simple investigations completed in the time available are likely to be the most successful.
- (i) Time constraints, laboratory facilities, availability of equipment and costs are all factors that need to be considered when candidates choose investigation topics.
- (j) Teachers/lecturers must ensure that the investigation is the candidate's own work and that any help received should not be excessive and must be acknowledged.
- (k) While teachers/lecturers should encourage the candidate to be creative and original, the Investigation does not require to be a piece of original research but should be new to the candidate.

Unit Assessment

The Investigation Unit has two outcomes and within each there are three performance criteria that must be met for success in unit assessment.

Outcome 1: Develop a plan for an investigation.

- PC (a) A record is maintained in a regular manner.
- PC (b) The aims of the investigation are clearly stated.
- PC (c) Experimental techniques and apparatus are appropriate for the investigation.

Outcome 2: Collect and analyse information obtained from the investigation.

- PC (a) The collection of experimental information is carried out with due accuracy.
- PC (b) Relevant measurements and observations are recorded in an appropriate format.
- PC (b) Recorded experimental information is analysed and presented in an appropriate format.

Evidence for Outcomes 1 and 2 requires the candidate to submit records of the planning stage and the collection and analysis of the information obtained from the investigation. These records can be in the form of a lab notebook.

For both outcomes it is appropriate to support candidates in meeting the performance criteria. Such supportive criticism is to be encouraged as part of the on-going learning and teaching process.

Guidance on approaches to assessment of the Investigation unit is provided in the Support Notes in the Unit Specification included in the Arrangements document and more detailed information is provided in 'Chemistry Investigation D075 13/NAB001'.

Course Assessment

For course assessment the candidate is required to write and submit a final Investigation Report.

A total of 25 marks, representing 20% of the total marks for the course, are awarded for the Investigation Report.

The Report should be about 2000-2500 words in length excluding the title page, contents page, tables, graphs, diagrams, references/bibliography, acknowledgements and any appendices.

The Report should be written in the past tense and the impersonal voice should be used.

While the Report may be word-processed, a handwritten Report is equally acceptable. Candidates may also wish to consider word-processing the bulk of the Report leaving gaps to later enter subscripts, superscripts, equations, structural formulae, calculations, graphs etc by hand.

The candidate should carry out risk assessments for the Investigation but since these are relevant to the internal assessment of the Unit, there is no requirement for them to be included in the Course Report.

The centre will be supplied with a flyleaf and a clear-faced bag for the submission of each candidate's Report. The use of ring binders or other bulky folders **must** be avoided to ensure the Report fits into the supplied stationery.

The submission date for the Investigation Report in Chemistry will be 30 April.

The Investigation Report should have a logical structure and must include the following.

- **Title page**

This page must display an appropriate and informative title for the Investigation, the candidate's name and number and the name and number of the centre.

- **Contents page**

The contents must be listed and page numbers must be included for ease of cross-referencing.

- **Summary**

The summary should be at the beginning of the Report and must state the main aim(s) **and** overall finding(s) of the Investigation.

- **Introduction**

This section must include a clear statement of the aim(s) of the Investigation together with any hypotheses or questions relevant to the aim(s). It should also include a brief outline of the relative background theory to the Investigation.

- **Procedures**

The procedures must be described in sufficient detail to allow the Investigation to be repeated by another person. The procedures must be presented as paragraphs of prose rather than a numbered list of procedural points.

- **Results**

All raw as well as processed data must be presented in a clear and concise manner using tables, graphs, diagrams and suitable calculations as appropriate. A graph must be supported by a table containing the relevant raw or processed data. A statement of results from tables and/or graphs must also be included where appropriate.

NB How the sections on **Procedures** and **Results** are structured is entirely up to the candidate, eg if the investigation falls into two distinct parts then the candidate may wish to describe the two procedures before going on to give the results of both parts or describe the first procedure and immediately follow this up with the results pertaining to that part before going on to the procedure and results of the second part.

- **Discussion**

The discussion section must include a clear statement of the **overall** conclusion(s) and a critical evaluation of the investigation **as a whole**.

- **References/Bibliography**

A **reference** is any piece of material to which a writer '**refers**' in the text. More specifically, it is an entry at the end of the Report giving information about the source of the material '**referred to**'. Such an entry allows the reader of the Report to consult the original work if necessary and is also an acknowledgement of the work of other authors.

A **bibliography** is a list of material which relates to the topic being addressed. The writer will usually have used the material listed in the bibliography as a source of information or background reading but will not have actively referred to it in the text.

It should be noted that the list of references mentioned in the Report should be placed **before** the bibliography and that any entries in the reference list should **not** be repeated in the bibliography.

References and bibliography entries must be written in standard form as follows:

Books

Author(s), (surname followed by initials) (Year of publication) *Title*, Publisher, Place of publication, Page number(s).

eg Aldridge, S (1998) *Magic Molecules: how drugs work*, Cambridge University Press, Cambridge, p134.

Journals/Periodicals

Author(s), (surname followed by initials) (Year of publication) Title of article, *Name of Journal*, **Volume number** (Part number if appropriate), Page number(s).

eg Brown, TM, Cooksey, CJ and Dronsfield, AT (2001) Indigo – forever in blue jeans, *Education in Chemistry*, **38**(3), pp69-71.

Websites

As many of the following items as are available should be given: author, date, title, publisher, date you accessed the material (because the 'site' may be updated between the time the writer uses it and the point at which a reader refers to it) and the URL.

eg Nixon, W (1999) Why energy efficiency? The EIC Guide Online. Visited: May, 2002. URL: <http://www.eic-guide.co.uk/tech1.html>.

References should be listed in alphabetical order and each one cited in the main body of the text using the author's surname and the year of publication.

eg The reduced form of indigo is soluble and colourless while the oxidised form is insoluble and blue (Brown et al, 2001).

The bibliography should be listed in alphabetical order after the references and should not contain any entries already given in the list of references.

and where appropriate

- **Acknowledgements**

Any assistance received while the Investigation was carried out should be acknowledged.

The Investigation Report will be marked externally using the following assessment categories:

1 Presentation (3 marks)

(a) The Report has a logical structure appropriate to the Investigation and must include:

- an appropriate and informative title
- a contents page

- a brief summary stating the aim(s) and overall finding(s) of the Investigation
- references/bibliography (minimum of 3) with entries made in a standard way
- acknowledgements where appropriate.

(b) The Report is clear and concise.

2 Introduction (4 marks)

- (a) A clear statement of the aim(s) of the Investigation together with any hypotheses or questions.
- (b) An account of the underlying chemistry in which terms are used accurately and ideas are clearly explained.

3 Procedures (6 marks)

- (a) The procedures are appropriate to the aim(s) of the Investigation.
- (b) The procedures are clearly described and in sufficient detail to allow the Investigation to be repeated.
- (c) The procedures are at an appropriate level of demand for Advanced Higher Chemistry in relation to:
- the complexity of the design of the experiments
 - creativity and originality
 - the need for controls, replicates, sample size and control of variables
 - accuracy of measurements
 - modifications to procedures in the light of experience.

4 Results (5 marks)

(i) **Quantitative** type investigation

- (a) The results are relevant to the aim(s) of the Investigation and readings (raw data) are recorded and are within the limits of accuracy of measurement.
- (b) Raw and processed results are presented in a clear and concise manner with appropriate use of tables, graphs, diagrams and calculations.
- (c) A statement of results from tables and/or graphs is included.
- (d) In descriptive components of the work, observations are detailed and suitably recorded. Statements of results from tables and/or graphs are included.

(ii) **Qualitative** type investigation

- (a) The results are relevant to the aim(s) of the Investigation and observations (raw data) are recorded.

- (b) Raw and processed results are presented in a clear and concise manner using an appropriate format.
- (c) A statement of results is included.
- (d) In descriptive components of the work, observations are detailed, suitably recorded and, where appropriate, quantitative.

5 Discussion (7 marks)

- (a) The overall conclusions relate to the aim(s) of the Investigation and are valid for the results obtained.
- (b) The evaluation of the procedures addresses such points as:
 - accuracy of measurement
 - adequate replication
 - adequate sampling
 - adequate controls
 - sources of error in relation to measurements
 - the ways in which problems encountered in the Investigation were dealt with
 - modifications to procedures.
- (c) The evaluation of the results, includes analysis and interpretation of the results taking into account the errors described and considers the effect of error on the outcome and gives suggestions for further work. The significance of the results are discussed in a critical and scientific manner and demonstrate a reasonable depth of chemical knowledge and understanding.