Advanced Higher Chemistry Investigation Guidance

A copy of this document should be issued to all AH Chemistry candidates.

General Information

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 commensurate with the demands of AH Chemistry. **Candidates must not submit the same investigation for more than one of AH Chemistry, AH Biology and AH Physics.**

(c) The topic for investigation may be outwith the chemistry covered in the other units of the Advanced Higher Chemistry course.

(d) Group work and joint investigations are not permitted.

(e) The Investigation must involve planning, collection and analysis of information through experimental work carried out by the candidate.

(f) 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 sources 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 of a suitable level of demand
- journals and periodicals, eg School Science Review, New Scientist, Scientific American
- internet web sites.

(g) 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. Focused investigations completed in the time available are likely to be the most successful. Well-controlled investigations will score higher marks than investigations with too many input variables from which valid conclusions cannot be drawn.

(h) Time constraints, laboratory facilities, availability of equipment, chemicals, costs and safety are all factors that need to be considered when candidates choose investigation topics.

(i) 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. Both the teacher/lecturer and the candidate are required to sign the flyleaf which accompanies the Investigation Report to indicate that the Report is the candidate's work and in so doing indicate that the data are genuine.

(j) 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 all performance criteria 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 (c) 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 should 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'.

Centres may be selected for moderation of the 'Chemistry Investigation' Unit and would be required to submit the candidates' lab notebooks to SQA. Centres must therefore retain this evidence for this purpose. Centres must <u>not</u> send in the candidates' lab notebooks to SQA with the Investigation Reports.

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.

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 is externally marked ie there are **no** marks awarded by the centre for course assessment.

The Investigation Report will be marked using the following categories:

1 Presentation (3 marks)
2 Introduction (4 marks)
3 Procedures (6 marks)
4 Results (5 marks)
5 Discussion (7 marks)

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 around the end of April. The actual submission date will be notified to centres via the Operational Guide; Appendix 2: National Qualifications - Calendar of key dates and Appendix 3: Subject-specific submission deadlines.

1 Presentation (3 marks)

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

- a title page with a title for the Investigation, the candidate's name and number and the name and number of the centre.

- a contents page which lists the contents and page numbers for ease of cross-referencing. All pages must be numbered throughout the report.
- a brief summary must immediately follow the contents page and must state the main aim(s) **and** overall finding(s) of the Investigation.
- an introduction, procedures, results and discussion (see later).
- references (minimum of 3 sources).
- appropriate acknowledgements.

There must be references from a **minimum of 3 sources** with entries made in standard form. These references should be consulted during the planning stage of the Investigation and not just when writing up the report.

References

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.

Each reference must be cited in the main body of the text using the author's surname and the year of publication as in the exemplar below:

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

References should be listed in alphabetical order and 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 material was accessed (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.

(b) The Report must be clear and concise.

The Report should be **about 2000-2500** words in length excluding the title page, contents page, tables, graphs, diagrams, references, 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.

2 Introduction (4 marks)

(a) The introduction must include a clear statement of the aim(s) of the Investigation.

(b) The introduction must include an account of the underlying chemistry in which terms are used accurately and ideas are clearly explained.

This section must include a concise account of the relevant background theory to the investigation and must justify the chemical importance of the Investigation. It must also include an outline of the chemistry underlying the procedures employed. Diagrams, formulae and equations should be included as appropriate. There should also be some background information to set the Investigation in context.

3 Procedures (6 marks)

(a) The procedures must be appropriate to the aim(s) of the Investigation.

(b) The procedures must be clearly described and in sufficient detail to allow the Investigation to be repeated.

(c) The procedures must be at an appropriate level of demand for Advanced Higher Chemistry in relation to factors such as:

- the complexity of the design of the experiments
- creativity and originality
- modifications to procedures in the light of experience
- consideration of the need for controls and control of variables
- replicates and sample size
- accuracy of measurements.

The procedures must be written in the past tense and the impersonal passive voice. It would be appropriate in this section to include labelled diagrams or photographs of assembled apparatus. There must be evidence that the candidate has been involved in the planning of the Investigation and not simply followed a given set of instructions.

4 Results (5 marks)

(i) Quantitative type investigation

(a) The results must be relevant to the aim(s) of the Investigation and readings (raw data) must be recorded and within the limits of accuracy of measurement.

(b) Raw and processed results must be presented in a clear and concise manner with appropriate use of tables, graphs, diagrams and calculations.

(c) In descriptive components of the work, observations must be detailed and suitably recorded.

Raw data may be presented in an appendix. Where Excel or other software packages are used to present graphs, it is important that axes are adapted to suit the data in order that the results are presented in the most appropriate way.

(ii) Qualitative type investigation

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

(b) Raw and processed results must be presented in a clear and concise manner using an appropriate format.

(c) In descriptive components of the work, observations must be detailed, suitably recorded and, where appropriate, quantitative.

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.

5 Discussion (7 marks)

(a) (i) The overall conclusions must relate to the aim(s) of the Investigation.

(ii) The overall conclusions must be valid for the results obtained.

(b) The evaluation of the **procedures** addresses points such 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
- ways in which procedures might have been modified to improve the Investigation.

In the evaluation of procedures it is appropriate to emphasise positive aspects relating to procedures.

(c) The evaluation of the **results** includes as appropriate:

- analysis and interpretation of the results
- an account taken of the errors described
- consideration of the effect of error on the outcome(s)
- suggestions for further work
- discussion of the significance of the findings in a critical and scientific manner
- demonstration of a reasonable depth of chemical knowledge and understanding.

The discussion section must include a clear statement of the **overall** conclusion(s) and a critical evaluation of the Investigation **as a whole**. It would be appropriate in this section to include a discussion of any experiments which were carried out and which did not produce results or for which results were not presented.