

National Qualifications 2005

Physics Advanced Higher Investigation Report

Guidance on course assessment for candidates

General

For course assessment you are required to write an Investigation Report based on your work on the Advanced Higher Physics Investigation Unit. The Investigation Report is worth 25 marks and this is 20% of the total marks for the Course award in Advanced Higher Physics.

Please note that your *record of work* or ‘*daybook*’ forms the Unit assessment for the Physics Advanced Higher Investigation. It is important that you follow the guidelines in the “Candidates’ Guide” for the Unit. If you do not have a copy of the guide, ask your teacher to supply one.

Your investigation report must be of a standard that is appropriate for Advanced Higher Physics. This applies to the quality of your:

- ◆ account of the underlying physics
- ◆ experimental procedures
- ◆ analysis of experimental results
- ◆ conclusions, evaluation of your experimental work and evaluation of your investigation as a whole

Your centre will be supplied with a flyleaf and a clear-faced bag for the submission of your report. Please note that your report **must not** be submitted in any format (eg ring binder or other bulky folder) that is too big to fit into the clear-faced bag provided.

In previous years, many candidates have chosen to word-process their reports. While this is entirely appropriate please note that this is **not a requirement**; a legible handwritten report is equally acceptable. Similarly, many candidates have used spreadsheet and/or data management software for analysis and/or presentation of experimental results. Again this is **not mandatory**; hand-drawn tables and graphs are acceptable. **You** should decide what is most appropriate for your investigation, your access to computing facilities and your level of IT skills. If you do decide to use IT then it is your responsibility to make sure that you make appropriate use of these powerful tools.

Your report must be clear, concise and easy to read and understand. This implies an accurate title, a logical structure, clear concise text, adequate cross-referencing and a clear statement of your conclusions. While you are writing your report you should be thinking about the people who are going to read your report.

When writing a scientific report it is useful to divide the report into sections. This will help you to make sure that you include all of the important information in your report. You should read over each section of your report to make sure that it makes sense. When it is complete you should read the whole of your report to make sure that it has a logical structure and that the different sections fit well together. You are strongly recommended to base the structure and sequence of your report on assessment categories 1 to 4 detailed below.

Assessment

A Marker appointed by SQA will assess your report using the following assessment categories and mark allocations:

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

Advice on each of these assessment categories is included below:

1 Introduction (4 marks)

The introduction to your report must include a summary of your investigation in which you give a clear statement of the **purpose(s)** and/or aims of your investigation together with your **overall findings**.

You must also include an account of the underlying physics. Make sure that you include **all** of the physics that is **relevant to your investigation**. You should also make sure that you do not include irrelevant information. The physics content of your account must be at a level that is appropriate for Advanced Higher but should not simply be a repetition of physics that is included in the Advanced Higher Physics Course.

You should draw on a variety of sources of information when you are gathering information for the introduction to your report. In your account of the underlying physics terms must be used accurately and ideas must be explained clearly. You should also include diagrams and relationships, as appropriate.

2 Procedures (6 marks)

You must include **labelled diagrams and/or descriptions** of the apparatus that you used for experimental work. Photographs of assembled apparatus, with appropriate labelling, are acceptable. Photographs of electric circuits should be accompanied by the appropriate circuit diagram.

You must also give clear descriptions of **how you used** the apparatus to obtain your experimental results. Your descriptions should outline the sequence of your actions and must have **sufficient detail** to allow your investigation to be repeated by another person.

Please note that the experimental procedures that you use in your investigation must be of an **appropriate level of demand** for Advanced Higher Physics; factors that will be considered in assessing the adequacy of your procedures will include:

- ◆ range of procedures
- ◆ repeatability
- ◆ control of variables
- ◆ accuracy
- ◆ originality of approach and/or experimental techniques
- ◆ degree of sophistication of experimental design and/or equipment

3 Results (6 marks)

The experimental data that you collect must be relevant to the purpose(s) of your investigation. Also, the data you collect and present in your report must be **sufficient in quantity** and with a **degree of accuracy appropriate to your investigation**.

You must include **uncertainties** in the values of each of the physical quantities that you measure in the final result(s) of your investigation. Your analysis should show clearly how you have calculated/estimated the uncertainty in your final result(s). Your treatment of uncertainties must be appropriate for Advanced Higher level and so your report must include evidence that relates to the Content Statements for uncertainties detailed in the Advanced Higher Physics Course. You must quantify all (calibration, reading and random) uncertainties that have a bearing on the accuracy of your experimental work.

Your report must include **analysis of your experimental data** that is appropriate to your investigation. This may involve drawing graphs or calculating and tabulating numerical values.

4 Discussion (6 marks)

You must include overall **conclusion(s)** that are relevant to the purpose(s) of your investigation and which are **valid** for the experimental results obtained.

You must also include a **critical evaluation of your experimental procedures**. This should be a significant part of your report and should focus on the quality of your experimental work. Issues that you could consider in this part of your report include:

- ◆ accuracy of your experimental measurements
- ◆ adequacy of replication
- ◆ adequacy of the sampling strategy you chose
- ◆ how well you controlled variables
- ◆ limitations of the equipment that you used
- ◆ reliability of your experimental methods
- ◆ sources of errors and uncertainties

Finally, you must include a discussion of your overall conclusions together with a **critical evaluation of your investigation as a whole**. This should be a more wide ranging discussion of your investigation and is an opportunity for you to explain what you have learned as a result of your investigation and the significance of your findings, and to demonstrate the depth of your understanding of the physics related to your investigation. This part of your report could include comment on:

- ◆ problems that you experienced and how you dealt with these
- ◆ modifications that you made to procedures in the light of findings
- ◆ the significance of your findings
- ◆ interpretation of your results in the context of the underlying physics, and/or in a wider context
- ◆ suggestions for further improvements to experimental procedures
- ◆ suggestions for further investigative work — for example identification of issues that you would have pursued further if you had had more time available

5 Presentation (3 marks)

Your report must include a **title** page, a **table of contents** page and the pages of your report **must be numbered**.

Your report must be **clear, concise and easy to read and understand**. The sequence and development of ideas must be **logical** and there must be **sufficient detail** to allow the investigation to be repeated.

Your report should be **around 2000–2500 words**, excluding the title and contents pages, tables, figures, graphs, diagrams, references, acknowledgements and any appendices. Please note that you will not lose marks simply because the number of words in your report is outwith the range indicated above; the quality of what you write will determine the number of marks you are awarded. However, you should note that a report which has significantly fewer than 2000 words may not include all of the necessary information, or sufficient detail to gain a high mark. Similarly, a report which contains significantly more than 2500 words may lack clarity, be difficult to understand, include irrelevant information etc.

References must be **sufficient** in quantity, **relevant** to your investigation and **specific**. In the text of your report you can cite a reference by indicating the surname(s) of the author(s), year of publication and page number(s), for example:

“The resultant gravitational force inside a thin uniform spherical shell is zero.
(England et al, 1996, page 215)”

At the end of your report you must include details on all of the references (eg books, journals/periodicals and websites) that you cite. You must include sufficient information to allow a reader to consult the original work to confirm its relevance to your investigation. You should only include details on references; do not include information on materials that were part of your background reading but are not cited as references in your report.

Structure of the report

As indicated earlier, you are strongly recommended to base the structure and sequence of your report on assessment categories 1 to 4 detailed above. One possible structure for your report and some suggested alternatives are outlined below:

- ◆ **Title page** — This page should have the title of your investigation, your name and Scottish Candidate Number and the name and number of your centre. The title of your investigation should be appropriate and informative.
- ◆ **Contents page** — The contents should be listed in the order in which they are included in your report. For ease of cross-referencing, page numbers should be included for the start of each section and sub-section of your report.
- ◆ **Introduction** — This should be at the beginning of your report. Sub-sections in this part of your report could be ‘Summary’ and ‘Underlying physics’.
- ◆ **Procedures** — In this part of your report the sequence of text, diagrams and figures should enable the reader to understand what you did, how you did it and the order in which you did it; the structure of this section of your report will depend very much on the way in which you carried out your investigation.

- ◆ **Results** — This part of your report should include all necessary information on the collection and analysis of experimental data. You should show intermediate steps in processing from initial data to final results. You should also include information on how you quantified uncertainties in your experimental measurements and how you combined these to obtain uncertainties in your final results.

It may be appropriate for you to embed your analysis of results within your description of procedures. This will depend on your investigation. For example, if your investigation involves a series of different experiments, you could include your results for each experiment immediately after the description of that experiment. You should decide what is most appropriate for your investigation.

- ◆ **Discussion** — this part of your report should include valid conclusions, evaluation of experimental procedures and evaluation of the investigation **as a whole**.

It may be appropriate for all of your discussion to be at the end of your report. Alternatively, parts of your discussion could be embedded in earlier sections. For example, if your investigation involves a series of different experiments, your conclusions for the individual experiments together with evaluations of the different experimental procedures could follow the results for each of these.

Your final discussion should be at the end of your report have your **overall conclusions** for your investigation and evaluation of your investigation **as a whole**.

- ◆ **References** — these should be listed in alphabetical order of author surname; include details as specified below, using the formats indicated:

Books

Author surname and initials, (Year of publication), *Title*, Publisher, Place of publication.

eg ELLSE M & HONEYWILL C, (2001), *Waves and Our Universe*, Nelson, Cheltenham.

Journals/Periodicals

Author surname and initials, (Year of publication), Title of article, *Name of Journal*, **Volume number** (and Part number if appropriate), Page numbers

eg WEBSTER B C (1987) Pulsed muons for Europe, *New Scientist*, **113**, pp 31-34.

Website

As a website may be updated between you using it and a reader referring to it, you should give as many of the following details as possible: author, date, title, publisher, date you accessed the material 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>.

- ◆ **Acknowledgements** —Significant assistance you received while carrying out your investigation should be acknowledged.