



National Unit specification: general information

Unit title: Researching Physics (SCQF level 6)

Unit code: FE45 12

COURSE Physics (Revised) Higher

Superclass: RC

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Summary

In this Unit candidates will develop the key skills necessary to undertake research in physics and demonstrate the relevance to everyday life by exploring the physics behind a topical issue. The Unit offers opportunities for collaborative and independent learning set within the context of an evaluation of scientific issues. Candidates will develop skills associated with collecting and synthesizing information from a number of different sources. Equipped with a knowledge of standard laboratory apparatus, 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. This Unit is suitable for candidates who are interested in pursuing a physics related career, as well as those whose interest is more general.

Outcomes

- 1 Research the physics underlying a topical issue to a given brief.
- 2 Plan and carry out investigative practical work related to a topical issue in physics.
- 3 Prepare a scientific communication which presents the aim, results and conclusions from a practical investigation related to a topical issue in physics.

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 Physics with Knowledge and Understanding and Problem Solving at grade 1 or 2
- or
- ◆ the Intermediate 2 Physics
- and
- ◆ Mathematics at Credit level or Intermediate 2 Mathematics.

Credit points and level

0.5 National Unit credit at SCQF level 6: (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 SQA.

Outcome 1

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

Performance Criteria

- (a) Obtain and record information from suitable sources relating to focus questions from a given brief.
- (b) The sources of information selected and recorded are identified.

Outcome 2

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

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 physics.

Performance Criteria

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

National Unit specification: statement of standards (cont)

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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 assessment for generating evidence and the conditions and contexts in which they are used. Exemplification of possible approaches may be found in the Unit support notes.

Outcome 1

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

- ◆ Clear and accurate answers to at least two focus questions selected from those contained in the brief.
- ◆ A record of at least two sources of information relating to each of the answers provided.

These should be identified in sufficient detail to allow a third party to retrieve the source article.

Outcome 2

Candidates should make an effective contribution to the planning and carrying out of investigative practical work. The teacher/lecturer must attest that this is the case.

Outcome 3

Candidates should produce a single scientific communication describing the investigative activity and its findings. The scientific communication must be the work of the individual 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.

For this Unit, evidence may be written and/or oral and may be stored electronically. Assessor observation checklists may be used for recording purposes.

Exemplification of possible approaches may be found in topic exemplar material (available from LTS) and the Unit support notes.

National Unit specification: support notes

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

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

Guidance on the content and context for this Unit

Physics is a subject with significant relevance to many topical issues. This Unit offers an opportunity for candidates to research and investigate the physics underlying a topic which features in the media. The topic chosen should be such that candidates can research physics at an appropriate level. It should also be possible to undertake practical investigative work.

Exemplar investigation briefs containing focus questions are available in the topic exemplars (available from LTS). These 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 physics underlying an issue or story currently featured in broadcast and publishing media. The research brief should contain a number of “focus questions” relating to key points of background information or physics 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.

In selecting the focus questions, there are opportunities for personalisation and choice, together with the development of scientific literacy.

Prior to undertaking the assessment 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.

National Unit specification: support notes (cont)

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Outcome 2

Prior to the assessment of Outcome 2, candidates should have had experience of planning and carrying out practical investigative work.

Candidates should be familiar with standard laboratory equipment to enable them to plan and carry out investigative practical work. Teachers/lecturers may wish to introduce and demonstrate to candidates any unfamiliar equipment that may be useful in carrying out the practical work.

Outcome 3

Prior to the assessment of Outcome 3, candidates should have had experience of analysing results, drawing valid conclusions and making reasoned evaluations, particularly of experimental procedures. Teachers/lecturers may wish to discuss with candidates possible formats for the scientific communication.

In analysing results, candidates should take account of the following:

- ◆ Numerical results should be recorded in tables and graphs as appropriate. Headings and axes should be labelled and appropriate scales used.
- ◆ Lines of best fit to curves or straight lines should be drawn.
- ◆ Relationships should be expressed in the form $y=mx+c$ as appropriate and the gradient and intercept on the y axis used to find m and c .
- ◆ Measurements should be repeated as appropriate and a mean value calculated.
- ◆ Scale-reading uncertainties should be estimated and expressed in absolute or percentage form.
- ◆ When measuring more than one physical quantity, the quantity with the largest percentage uncertainty should be identified and this can be used as an estimate of the percentage uncertainty in the final result.
- ◆ The final numerical result of an experiment should be expressed in the form:
final value \pm uncertainty

Candidates may use data-handling software to aid their analysis of results.

Teachers/lecturers should note that the external examination for Higher Physics 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 Outcome 3 give a clear indication of the likely contexts and data analysis techniques candidates may be expected to employ.

National Unit specification: support notes (cont)

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Guidance on learning and teaching approaches for this Unit

Candidates are likely to become familiar with the experimental techniques and basic laboratory apparatus whilst undertaking practical work associated with the other Units of the Higher Physics Course. The suggested activities indicated in the content tables provide a rich variety of experimental and investigative experiences which would provide the background knowledge and experience required to allow candidates to create appropriate experimental designs.

In order to be able to evaluate the procedures and draw valid conclusions from experimental data, candidates should have an opportunity to analyse and discuss experimental data presented in a variety of formats. The Outcome 3 bullet points mentioned in *Guidance on Content and Contexts* provide an indication of the range and depth of experience expected of candidates.

Whilst centres are free to deliver this Unit at any point during the Higher Physics Course, the suggested activities associated with the other Units of the Course provide ample opportunity for candidates to develop the skills required to undertake the activities in this Unit. Many teachers may wish to delay the Unit assessment until the latter stages of the Course in recognition of the considerable exposure to relevant experimental techniques and the development of research skills whilst undertaking the other Higher Physics Units.

Classroom management issues will probably dictate that much of the work in this Unit is undertaken through collaborative learning or group work. Working in this way can be extremely beneficial although consideration needs to be given to ensure that each individual contributes in an appropriate way, and meets the Performance Criteria.

For Outcome 1, it is possible for candidates to work in groups and for them to allocate focus questions within the group. It is also possible for a group to produce a single report, as long as each individual clearly identifies the focus questions they have answered and the sources that they have used in answering the questions.

For Outcome 2, each candidate must contribute to the planning and carrying out of the 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.

For Outcome 3, candidates are likely to analyse results which have been collected in a group activity. Teachers/lecturers should ensure that each individual can meet the Performance Criteria, whilst recognizing that it is likely that there will be similarities between candidates' communications due to them being based on the same raw data.

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 engage candidates in the process of assessing risks, taking informed decisions, and deciding on appropriate control measures during the planning stage of the practical investigation.

National Unit specification: support notes (cont)

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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 developing Core Skills

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 physics 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.

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 their individual research into a minimum of two of the focus questions contained in the briefing document.

In relation to Performance Criteria (a) for Outcome 1, the candidate's record should contain an extract or summary of information relevant to the focus questions.

In relation to Performance Criteria (b), the candidate's record should clearly state the sources of the information included in the report. 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. Teachers/lecturers may find that observation and discussion with the candidates is sufficient to allow them to exercise professional judgement in deciding that each candidate has taken an active part in the planning and carrying out. In practice, the planning cycle is unlikely to be completed in a single stage. Rather, a preliminary plan may need to be modified in the light of initial practical work. In this way, planning and carrying out can be viewed as an iterative cycle in which the strategy for carrying out the investigation is developed as the work is undertaken.

National Unit specification: support notes (cont)

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Outcome 3 requires candidates to produce an individual scientific communication which presents the results of the practical investigation undertaken.

In relation to the Performance Criteria for Outcome 3, the scientific communication should include the following:

- ◆ a clear statement of the aim of the practical investigation.
- ◆ results of the investigation presented in an appropriate format, with tables and graphs drawn correctly. Also, there should be an analysis of results which interprets tabular and graphical data as appropriate, including an appropriate treatment of uncertainties.
- ◆ a conclusion which is valid on the basis of the evidence available to the candidate.
- ◆ an evaluation of experimental procedures which should include one or more of the following:
 - (i) an assessment of the effectiveness of the procedure
 - (ii) suggestions for alternative or modified strategies, further work and predictions
 - (iii) an assessment/explanation of the relevance of the results.

Candidates may choose to present their scientific communication using any suitable format. Classroom management issues will determine the variety and number of communications which are undertaken. Whilst candidates may wish to present their scientific communication to a live audience if it is of an appropriate format, time constraints may dictate that this may not be possible for all. For those that do not make a live presentation, the electronic or paper copy of the presentation will be considered suitable evidence for assessment.

The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to verification) against the Performance Criteria. It is appropriate to support candidates in producing a scientific communication to meet the Performance Criteria. Redrafting 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.

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 Performance Criteria. 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.

National Unit specification: support notes (cont)

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Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements

History of changes to Unit

Version	Description of change	Date

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