

NATIONAL UNIT SPECIFICATION

Researching Physics: (Higher)

SCQF level 6: credit, 3 points

Unit Code:

Summary

In this unit learners 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. Learners 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. Learners will prepare a scientific communication, presenting the aim, results and conclusions of their practical investigation. This unit is suitable for learners who are interested in pursuing a physics related career, as well as those whose interest is more general.

Learners who complete this unit will be able to:

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.

This unit is a mandatory unit of the physics (Higher) course and is also available as a free-standing unit. The unit specification should be read in conjunction with the *Unit Support Pack* and the *National Assessment Resource* which provides advice and guidance on delivery, assessment approaches and development of skills for learning, life and work.

Entry to this unit is at the discretion of the centre. However, it would be beneficial if learners 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**
- Intermediate 2 Physics
- and**
- Standard Grade Mathematics at 1 or 2 **or** Intermediate 2 Mathematics

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Superclass: EB

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STANDARDS

The standards in this Unit Specification should be used in conjunction with the Unit Support Pack

Outcomes and assessment standards

OUTCOME 1

The learner will:

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

The learner can:

- a) Obtain and record information from suitable sources relating to focus questions from a given brief.
- b) Record the sources of information selected.

OUTCOME 2

The learner will:

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

The learner can:

- a) Plan an appropriate experimental procedure.
- b) Carry out the experimental procedure effectively.

OUTCOME 3

The learner will:

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

The learner can:

- a) Clearly identify the aim of the investigative work.
- b) Analyse recorded information and present it in an appropriate format.
- c) Draw valid conclusions.
- d) Make a valid evaluation of procedures.

Skills and knowledge

The following skills must be covered in this unit:

- research skills
- investigation skills
- analysis and evaluation skills
- communication skills

There is no specified content in this unit and the topic chosen will determine the physics knowledge that learners will develop. The reports they produce and the scientific communication will allow learners to demonstrate their understanding of the physics of the chosen topic.

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Evidence requirements for the Unit

Outcome 1

Learners 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 learner. Learners 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

Learners 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

Learners should produce a single scientific communication describing the investigative activity and its findings. The scientific communication must be the work of the individual learner. 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 the National Assessment Resource and the Unit Support Pack.

OTHER ESSENTIAL INFORMATION

(Note: this information must be read in conjunction with the standards in the Unit specification.)

Development of skills for learning, life and work

It is expected that learners will also develop the following skills for learning, life and work through this unit:

- Literacy skills
- Numeracy skills
- Employability, enterprise and citizenship
- Thinking skills

Further advice and opportunities for developing the stated skills is provided in the Unit Support Pack.

Equality and equity

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative evidence. For further information please refer to the Unit Support Pack.

Unit Support Pack

Further information and guidance relating to this unit is provided in the Unit Support Pack and the National Assessment Resource.

Changes from previous version

No changes – first draft.

UNIT SUPPORT PACK

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The support notes in this unit support pack are 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

Physics is a subject with significant relevance to many topical issues. This unit offers an opportunity for learners to research and investigate the physics underlying a topic which features in the media. The topic chosen should be such that learners 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 National Assessment Resource (NAR). These allow centres the opportunity to select a topical issue suited to the available resources and/or the interests of their learners. Centres may wish to develop their own investigation briefs but these must be of a comparable standard.

Outcome 1

Research briefs should allow learners 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 learners undertaking the unit. The focus questions should be constructed to give a clear indication of the information required from the learner. The information required to answer the questions must also be readily available using printed resources, video or audio materials available to the learner, or from websites which can be identified by use of a search engine. Learners 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 learners have experience of literature based research. In particular, if learners 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

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

Learners 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 learners any unfamiliar equipment that may be useful in carrying out the practical work.

Outcome 3

Prior to the assessment of Outcome 3, learners 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 learners possible formats for the scientific communication.

In analysing results, learners 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

Learners 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 learners to demonstrate their ability to design and evaluate experimental procedures in addition to questions which test a learner's ability to interpret experimental data. The bullet points for Outcome 3 give a clear indication of the likely contexts and data analysis techniques learners may be expected to employ.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Learners 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 learners to create appropriate experimental designs.

In order to be able to evaluate the procedures and draw valid conclusions from experimental data, learners 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 learners.

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 learners 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 assessment standards.

For Outcome 1, it is possible for learners 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 learner must contribute to the planning and carrying out of the investigation. If learners 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 learners have taken an active part in the work.

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

Learners should be encouraged to see risk assessment as a natural part of the planning process for any practical activity. Whilst learners would not be expected to produce a full written risk assessment for their investigation themselves, this unit provides an excellent opportunity to engage learners in the process of assessing risks, taking informed decisions, and deciding on 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.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcome 1 is assessed by a written and/or oral report of the learner's review findings. The learner'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 Assessment Standard 1 for Outcome 1, the learner's record should contain an extract or summary of information relevant to the focus questions.

In relation to Assessment Standard 2, the learner'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 learners to take an active part in planning, designing and carrying out a practical investigation. Teachers/lecturers may find that observation and discussion with the learners is sufficient to allow them to exercise professional judgement in deciding that each learner 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.

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

In relation to the Assessment Standards 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 learner.
- an evaluation of experimental procedures which might include
 - 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.

Learners 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 learners 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 assessment standards. It is appropriate to support learners 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 i.e. the entire scientific communication does not need to be rewritten.

Absence during the unit assessment

At the conclusion of the activities undertaken for unit assessment purposes, it is possible that a learner may fail to have demonstrated attainment in all Assessment Standards. This situation could arise either through absence or by the learner failing to achieve the required standard at the first attempt. Under these circumstances it is not necessary to undertake all the activities again. Learners should be given the opportunity to undertake whatever is necessary to allow them to demonstrate attainment in accordance with the evidence requirements stated in the unit specification.

