

Higher National Unit Specification

General information for centres

Unit title: Physics 1

Unit code: DN33 33

Unit purpose: This unit is designed to give candidates underpinning physics knowledge and practical skills. It is intended primarily for candidates who are in the early stages of a science programme in further education.

On completion of the Unit the candidate should be able to:

1. Demonstrate knowledge and understanding related to waves and optics.
2. Demonstrate knowledge and understanding related to heat energy.
3. Demonstrate knowledge and understanding related to electricity.
4. Collect, report and analyse information from experiments.

Credit points and level: 1 HN Credit at SCQF level 6: (8 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.*

Recommended prior knowledge and skills: Access to this unit is at the discretion of the centre. It would, however, be recommended that candidates should have experience of Physics and Mathematics at Standard Grade at grade 3 or an equivalent qualification.

Core skills: There may be opportunities to gather evidence towards core skills in Numeracy, Communication and Problem Solving at Higher level in this Unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: This Unit is intended to be part of the HN framework for the group awards in Science. It will also be suitable as an introductory physics unit in all HNC/HND science programmes.

Assessment: This unit should be assessed by a closed book assessment with candidates producing evidence to meet the requirements of outcomes 1, 2 and 3 in a single piece of written/oral work and a practical activity for evidence of Outcome 4. In the latter, candidates should be assessed on both their practical activity and on the quality of their laboratory report. Evidence could be recorded in the form of a checklist. Candidates must meet the level of performance specified in the evidence requirements for all outcomes to achieve this unit. An exemplar instrument of assessment and marking guidelines have been produced to indicate the national standard of achievement required at SCQF level 6.

Higher National Unit specification: statement of standards

Unit title: Physics 1

Unit code: DN33 33

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Demonstrate knowledge and understanding related to waves and optics

Knowledge and/or skills

- ◆ Reflection
- ◆ Refraction – Snell’s Law
- ◆ Optical fibres
- ◆ Mirrors – plane and curved
- ◆ Thin lenses – optical instruments including the eye, microscope, magnifying glass, telescope
- ◆ Wave motion – types and the relationship between wavelength, frequency, velocity, period
- ◆ Electromagnetic spectrum

Evidence requirements

Using holistic assessment, a candidate’s response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain the action and use of optical fibres accurately
- ◆ explain the action of optical instruments in terms of the laws of reflection and refraction accurately
- ◆ solve problems relating to waves and the electromagnetic spectrum correctly

Evidence should be gathered using a written/oral assessment under closed book conditions with a list of relevant relationships supplied as detailed in the guidance section.

Outcomes 1, 2 and 3 will be assessed by a single, closed book, holistic assessment under supervised conditions which should be completed in about 60 minutes.

Higher National Unit specification: statement of standards (cont)

Unit title: Physics 1

Assessment guidelines

This assessment could take the form of a mixture of questions requiring a short answer, a response in the form of a numerical calculation or a restricted response. A sheet of the relevant relationships, as indicated in the guidance notes, should be given to candidates. Should candidates fail to meet the pass criteria they should be offered a second attempt after sufficient remediation.

Outcome 2

Demonstrate knowledge and understanding related to heat energy

Knowledge and/or skills

- ◆ Transfer of heat energy – conduction, convection and radiation
- ◆ Temperature
- ◆ Thermometers
- ◆ Heat capacity – specific heat capacity
- ◆ Change of phase – specific latent heat
- ◆ Kinetic model of matter

Evidence requirements

Using holistic assessment, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ describe the methods of transfer of heat energy and the strategies to reduce the transfer accurately
- ◆ describe the kinetic model of matter correctly
- ◆ solve problems relating to the change of state and the change in temperature of a material correctly
- ◆ describe methods of measuring the temperature of a material correctly.

Evidence should be gathered using a written/oral assessment under closed book conditions with a list of relevant relationships supplied as detailed in the guidance section.

Outcomes 1, 2 and 3 will be assessed by a single, closed book, holistic assessment under supervised conditions which should be completed in about 60 minutes.

Assessment guidelines

This assessment could take the form of a mixture of questions requiring a short answer, a response in the form of a numerical calculation or a restricted response. A sheet of the relevant relationships, as indicated in the guidance notes, should be given to candidates. Should candidates fail to meet the pass criteria they should be offered a second attempt after sufficient remediation.

Higher National Unit specification: statement of standards (cont)

Unit title: Physics 1

Outcome 3

Demonstrate knowledge and understanding related to electricity

Knowledge and/or skills

- ◆ Electromotive force
- ◆ Electric current
- ◆ Electrical resistance
- ◆ Ohm's Law
- ◆ Basic circuitry – I, V and R in simple series and parallel circuits.
- ◆ Electrical energy and power
- ◆ Mains electricity and fuse values

Evidence requirements

Using holistic assessment, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ solve problems involving potential differences, currents and resistances in circuits containing resistors correctly
- ◆ carry out calculations involving the relationships between power, current, voltage and resistance correctly
- ◆ describe a simple ac mains circuit and calculate the appropriate fuse value correctly
- ◆ describe the measurement of the resistance of a component using an ammeter and a voltmeter accurately

Evidence should be gathered using a written/oral assessment under closed book conditions with a list of relevant relationships supplied as detailed in the guidance section.

Outcomes 1, 2 and 3 will be assessed by a single, closed book, holistic assessment under supervised conditions which should be completed in about 60 minutes.

Assessment guidelines

This assessment could take the form of a mixture of questions requiring a short answer, a response in the form of a numerical calculation or a restricted response. A sheet of the relevant relationships, as indicated in the guidance notes, should be given to candidates. Should candidates fail to meet the pass criteria they should be offered a second attempt after sufficient remediation.

Higher National Unit specification: statement of standards (cont)

Unit title: Physics 1

Outcome 4

Collect, report and analyse information from experiments

Knowledge and/or skills

- ◆ Setting up of relevant equipment from experimental instructions
- ◆ Safe methods of use of equipment regarding health and safety regulations
- ◆ Presentation of scientific information
- ◆ Recording of procedures, observations and measurements
- ◆ Experimental uncertainties and their treatment – systematic and reading
- ◆ Evaluation methods

Evidence requirements

Candidates will need evidence to demonstrate the knowledge and/or skills by showing that they can:

- ◆ perform the experimental procedure from the instructions correctly
- ◆ describe the experimental procedures accurately, clearly and concisely
- ◆ record relevant measurements and observations in an appropriate format accurately
- ◆ analyse recorded information and present the information in an appropriate format
- ◆ treat uncertainties appropriately
- ◆ draw valid conclusions
- ◆ evaluate the experimental procedures with supporting argument.

Evidence for this outcome will be provided by the candidate performing one experimental assignment related to the theory covered in Outcomes 1, 2 and 3 and producing 1 laboratory report. Candidates should be assessed on their performance in carrying out the experiment, on their ability to record the observations and measurements correctly and on the analysis and conclusions provided. Candidates will need to successfully meet all of the requirements for this outcome in order to pass the unit.

Assessment guidelines

This outcome will be assessed by practical activities and all knowledge and skills must be assessed. Candidates should be assessed on both their practical activity by observation and on the quality of their laboratory report. Evidence could be recorded in the form of a checklist.

It is strongly encouraged that formative exercises are utilised to enable candidates to develop their skills in carrying out and reporting experimental work.

If the practical report fails to meet the required criteria, the report may be returned to the candidate and remediation be offered. The report may be resubmitted once.

Administrative Information

Unit code:	DN33 33
Unit title: Physics 1	Physics 1
Superclass category:	RC
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Higher National Unit specification: support notes

Unit title: Physics 1

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 40 hours.

Guidance on the content and context for this Unit

This unit is primarily intended to provide the candidate with an understanding of some underpinning physical concepts that may be met when working in a laboratory or studying other science subjects. In addition the integration of practical activities not only enhances the theory components of the course but also allows the candidate to gain experience of equipment that might be used in a laboratory. The essential underpinning knowledge and skills gained here will be useful in the function as an effective technician and for progression to a further physics unit such as Physics 2.

Outcome 1 provides an overview of the reflection and refraction of waves including Snell's Law. The use of plane and curved mirrors and of thin lenses in optical instruments including the linear magnification should be investigated. The effect of total internal reflection and the application in optical fibres for a variety of uses should be considered. Wave motion and problems involving the wave equation should be tackled. The properties of electromagnetic waves and the waves making up the electromagnetic spectrum should be noted.

Outcome 2 looks at the methods of transmission of thermal energy – conduction, convection and radiation. Prevention of heat loss particularly real-world situations should be considered. The effects of addition or subtraction of heat energy from a material on its temperature and the state should be investigated. Melting and freezing should be explained in terms of the kinetic theory of matter.

Outcome 3 provides the underpinning knowledge of basic electricity. The current and voltage in simple circuits and Ohm's law and resistance should be studied. Problems involving series and parallel circuits should be solved. Power in an electric circuit and electrical energy calculations should be tackled. Mains electricity - simple ac mains circuits, fuses, alternating current and voltages values should be considered.

Outcome 4 develops a wide range of skills associated with scientific enquiry and practical problem solving. Suggested practical activities could include:

- ◆ measuring a physical quantity such as the specific heat capacity of a material
- ◆ demonstrating a physical law such as Ohm's Law
- ◆ testing a hypothesis such as series addition of resistors increases the total resistance whereas parallel addition reduces the overall resistance.

The use of microcomputers is a powerful aid to learning and experimenting. When interfaced to suitable sensors, the microcomputer can assist investigations where readings have to be taken very rapidly or over a period of time, or where several different variables have to be recorded simultaneously. Data obtained can be analysed and presented in graphical displays. Care, however, should be taken to ensure candidates fully understand the presentation of such data when computer programmes are utilised.

Higher National Unit specification: support notes (cont)

Unit title: Physics 1

Guidance on the delivery and assessment of this Unit

Opportunities for developing Core Skills

This unit is designed to form part of the group awards in HNC/D Science. The unit requires the candidate to be familiar with the main concepts of optics and waves, heat and current electricity.

It is essential that this unit is delivered in such a way as to emphasise the links between these concepts and the other sciences in the awards and also the relevant practical applications of the concepts considered. Instruments of assessment should be constructed with this in mind.

This unit should be assessed holistically with candidates producing evidence to meet the requirements for outcomes 1, 2 and 3 in a single piece of closed book written/oral work using a given checklist of the required relationships (see below). The whole of the content must be taught, however the evidence for assessment may be on a sample basis. Where sampling takes place, a candidate's response in an assessment can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item specified in the evidence requirement statements. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

The practical work should relate to the theory being considered – for example, the investigation of refraction of light through a rectangular glass block during study of

Outcome 1, a measurement of specific heat of a material or the investigation of the melting point of stearic acid could be found during studies for Outcome 2, and the measurement of resistance using a voltmeter and ammeter may be considered when studying for Outcome 3. It is advisable that several experiments are carried out during the delivery of the unit to enable skills to be developed and practise at recording and reporting on experimental work can be gained.

Relationships required for Physics 1

$$v = \lambda f$$

$$T = \frac{1}{f}$$

$$n = \frac{\sin \theta_1}{\sin \theta_2}$$

$$Q = It$$

$$V = IR$$

$$\Sigma E = \Sigma IR$$

$$R_T = R_1 + R_2 + \dots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

$$E_h = cm\Delta T$$

$$E_h = ml$$

$$P = IV = I^2 R = \frac{V^2}{R}$$

$$V_{\text{peak}} = \sqrt{2} V_{\text{rms}}$$

$$I_{\text{peak}} = \sqrt{2} I_{\text{rms}}$$

Higher National Unit specification: support notes (cont)

Unit title: Physics 1

Open learning

If this unit is delivered by open or distance learning methods, additional planning and resources may be required for candidate support, assessment and quality assurance.

A combination of new and traditional authentication tools may be devised for assessment and reassessment purposes.

For further information and advice, please see *Assessment and Quality Assurance of Open and Distance Learning* (SQA, February 2001 – publication code A1030)

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website www.sqa.org.uk.

General information for candidates

Unit title: Physics 1

This is a 1 credit HN unit at SCQF level 6 intended for candidates undertaking an HNC/D in Science. It is designed to provide you with an introduction to some of the main concepts of physics that are relevant to the other sciences that you are studying.

On completion of this unit you should be able to:

- 1 Demonstrate knowledge and understanding related to waves and optics
- 2 Demonstrate knowledge and understanding related to heat energy
- 3 Demonstrate knowledge and understanding related to electricity
- 4 Collect, report and analyse information from experiments

The four outcomes which make up the unit are described below:

Outcome 1

For this outcome you should be able to explain the action and use of optical fibres and describe the construction of optical instruments including the eye in terms of the laws of reflection and refraction. Also you should be able to solve problems relating to waves and the electromagnetic spectrum.

Outcome 2

For this outcome you should be able to describe the methods of transfer of heat energy and strategies to reduce such transfer, the kinetic model of matter and the methods of measuring the temperature of a material. You should also be able to solve problems relating to the change of state and the change in temperature of a material.

Outcome 3

For this outcome you should be able to solve problems involving potential differences, currents and resistances in circuits containing resistors and carry out calculations involving the relationships between power, current, voltage and resistance. You should also be able to describe a simple ac mains circuit with fuse values and the measurement of the resistance of a component using an ammeter and voltmeter.

Outcome 4

For this outcome you should be able to perform the experimental procedure from the written instructions, describe the experimental procedures, record relevant measurements and observations in an appropriate format. Also you should be able to analyse and present recorded information in an appropriate format, treat uncertainties appropriately, draw valid conclusions and evaluate the experimental procedures with a supporting argument.

Your knowledge of the topics covered in outcomes 1, 2 and 3 will be tested by production of written/oral evidence in the form of a single closed book assessment under supervised conditions. A sheet of the relevant relationships involved will be supplied. In addition you will be required to carry out an experiment and produce a report of the practical activity.

To succeed in this unit you must achieve a satisfactory level of performance in both the assessments.