SCOTTISH QUALIFICATIONS AUTHORITY

Higher National Unit Specification

General information for centres

Unit title: Physics 2

Unit code: DN34 34

Unit purpose: This unit is designed to give candidates underpinning physics knowledge and practical skills. It is intended primarily for candidates who are studying a science course to Higher National Diploma level in further education.

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

1. Demonstrate knowledge and understanding related to radioactivity.
2. Demonstrate knowledge and understanding related to electromagnetic radiation and spectra.
3. Demonstrate knowledge and understanding related to fluids.
4. Collect, report and analyse information from experiments.

Credit points and level: 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

**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 completed Higher national unit - Physics 1 or a NQ Higher Physics unit and that they have experience of Mathematics at a minimum of Standard Grade at grade 2.

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 a 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 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.

Higher National Unit specification: statement of standards

Unit title: Physics 2

Unit code: DN34 34

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 radioactivity

Knowledge and/or skills

- Radioactive decay mechanisms - alpha, beta particles and gamma radiation
- Background radiation
- Radiation detection and monitoring
- Half life
- Half value thickness
- Dosimetry – activity, absorbed dose, radiation weighting factor, equivalent dose
- Gray, Sievert
- Safety limits for members of the public and workers
- Safe handling procedures – shield, distance, time reduction
- Uses of isotopes in society – medical and industrial

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 the candidate is able to:

- state the mechanisms of radioactive decay correctly
- solve problems relating to half life, half value thickness, dosimetry correctly
- describe the methods of reduction of dose received correctly
- explain the methods of radiation detection and monitoring correctly
- describe the uses of isotopes providing a valid evaluation of the advantages and disadvantages of their use

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.

A sheet of the relevant relationships, as indicated in the guidance notes, should be given to candidates.

Higher National Unit specification: statement of standards (cont)

Unit title: Physics 2

Assessment guidelines

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. This assessment could take the form of a mixture of questions requiring a short descriptive answer, a response in the form of a numerical calculation or a restricted response. 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 electromagnetic radiation and spectra

Knowledge and/or skills

- Irradiance inversely proportional to the square of the distance from point source
- Electromagnetic spectrum
- Energy levels of atoms and molecules- ground state, excited state, ionisation level
- Spectra – absorption, emission, atomic, molecular
- Planck's constant and relationship E = hf
- Spectrometer
- Photons

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 the candidate is able to:

- carry out calculations involving the inverse square law relationship correctly
- explain the origins of spectra in terms of energy levels of atoms correctly
- carry out calculations involving the relationship E = hf correctly
- describe the functions of the components of spectrometers accurately

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.

A sheet of the relevant relationships, as indicated in the guidance notes, should be given to candidates.

Assessment guidelines

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. This assessment could take the form of a mixture of questions requiring a short descriptive answer, a response in the form of a numerical calculation or a restricted response. 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 2

Outcome 3

Demonstrate knowledge and understanding related to fluids

Knowledge and/or skills

- Density
- Pressure
- Variation of pressure with depth of fluid
- Ideal Gas Laws – Boyles, Charles, Pressure law
- Kelvin temperature and absolute zero of temperature
- The continuity equation
- Bernouilli's equation and applications
- Streamline, laminar and turbulent flow
- Surface tension and capillary action
- Viscosity

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 the candidate is able to :

- carry out calculations involving pressure in a fluid
- carry out calculations relating to the Ideal Gas laws correctly
- describe streamline and turbulent flow and applications of Bernouilli's principle correctly
- solve problems involving the equation of continuity and Bernouilli's equation correctly
- describe correctly surface tension, capillary action and viscosity of a fluid

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.

A sheet of the relevant relationships, as indicated in the guidance notes, should be given to candidates.

Assessment guidelines

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. This assessment could take the form of a mixture of questions requiring a short descriptive answer, a response in the form of a numerical calculation or a restricted response. 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 2

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 – 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 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. 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: DN34 34

Unit title: Physics 2

Superclass category: RC

Date of publication: August 2005

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Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Physics 2

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 academically.

Outcome 1 provides an overview of radioactivity. The mechanisms of radioactive decay are described. Problems relating to half life, half value thickness and dosimetry should be tackled. Methods of reduction of the dose received and the health and safety aspects of radiation should be considered. The methods of radiation detection and monitoring should be investigated. The uses of isotopes by society and the advantages and disadvantages of their use should be discussed.

Outcome 2 looks at the properties and types of electromagnetic radiation and the inverse square law relationship. It considers the origins of spectra in terms of energy levels of atoms and calculations involving the relationship $E = hf$. The use of spectrometers to carry out experimental investigation of spectra should be considered.

Outcome 3 provides the underpinning knowledge and understanding of fluids, both liquid and gas. The quantities density and pressure are defined. The pressure in a liquid and in gases is quantified. These should be linked to the kinetic theory of matter. How fluid move in pipes and in capillaries is investigated. The properties of surface tension and viscosity are described.

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 half value thickness of lead
- demonstrating a physical law such as inverse square law for radiation
- testing a hypothesis such as pressure in a gas increases with the decrease in the volume of an ideal gas.

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 2

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 radioactivity, electromagnetic radiation and spectra, and fluids. 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 work using the given checklist of required relationships (see below). The whole of the content list must be taught, however the evidence for assessment may be on a sample basis. Where sampling takes place , a candidates 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 requirements. 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 measurement of the half value thickness of lead when studying for Outcome 1, the confirmation of Boyles Law during studies for Outcome 3 and the investigation of the inverse square law for a point source of light or gamma radiation for Outcome 2. 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 2

$v = \lambda f$	$I = k / d^2$
$T = \frac{1}{f}$	$P = F/A$
$E = hf$	$P = \rho g h$
$W_2 - W_1 = hf$	$\rho = m / V$
$A = N/t$	$\frac{PV}{T} = \text{constant}$
$D = E/m$	$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$
$H = D w_R$	$p + \frac{1}{2} \rho v^2 + h \rho g = \text{constant}$

$$\text{Random uncertainty} = \frac{\text{max.value - min.value}}{\text{number of values}}$$

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.

Higher National Unit specification: support notes (cont)

Unit title: Physics 2

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 2

This is a 1 credit HN unit at SCQF level 7 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 radioactivity
2 Demonstrate knowledge and understanding related to electromagnetic radiation and spectra.
3 Demonstrate knowledge and understanding related to fluids
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 describe the mechanisms of radioactive decay and solve problems relating to half life, half value thickness, dosimetry. Also you should be able to explain the methods of radiation detection and radiation monitoring, describe the methods of reduction of dose received and describe the uses of isotopes providing a valid evaluation of the advantages and disadvantages of their use.

Outcome 2

For this outcome you should be able to carry out calculations involving the inverse square law relationship and explain the origins of spectra in terms of energy levels of atoms. Also to be able to carry out calculations involving the relationship E = hf, and describe the functions of the components of spectrometers.

Outcome 3

For this outcome you should be able to carry out calculations involving pressure in a fluid and calculations relating to the Ideal Gas laws. Also you should be able to describe streamline and turbulent flow and applications of Bernouilli's principle, surface tension, capillary action and viscosity of a fluid and solve problems involving the equation of continuity and Bernouilli's equation.

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, analyse recorded information and present the 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 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.