National Unit specification: general information

Unit title: Electricity (SCQF level 6)

Unit code: FE44 12

COURSE Physics (Revised) Higher

Superclass: RC

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Summary

This Unit develops knowledge and understanding and skills in physics related to electricity. The Unit offers opportunities for collaborative and independent learning set within familiar and unfamiliar contexts. It provides opportunities to develop and apply concepts and principles in a wide variety of situations involving the study of electrical circuits and semiconductors. Activities are undertaken which develop experimental, investigative and analytical skills. This Unit is suitable for those who are interested in pursuing a physics related career, as well as those whose interest is more general.

Outcomes

1 Demonstrate and apply knowledge and understanding of electricity.
2. Demonstrate skills of scientific experimentation, investigation and analysis in electricity.

Recommended entry

While entry is at the discretion of the centre, candidates would normally be expected to have attained one 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

General information (cont)

Unit title: Electricity (Higher)

Credit points and level

0.5 National Unit credit at SCQF level 3: (6 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

Demonstrate and apply knowledge and understanding of electricity.

Performance Criteria

(a) Make accurate statements about electricity facts, concepts and relationships.
(b) Use relationships to solve electricity problems.
(c) Use knowledge of electricity to explain observations and phenomena.

Outcome 2

Demonstrate skills of scientific experimentation, investigation and analysis in electricity.

Performance Criteria

(a) Use a range of data-handling skills in a scientific context.
(b) Use a range of skills related to experimental design.
(c) Use a range of skills related to the evaluation of scientific evidence.

Evidence Requirements for this Unit

Evidence is required to demonstrate that candidates have met the requirements of the Outcomes.

For each of the Unit Outcomes, written and/or recorded oral evidence of the appropriate level of achievement is required. This evidence must be produced under closed-book, supervised conditions within a time limit of 45 minutes.

The Instrument of Assessment must sample the content in each of the following areas:

- Electrons and Energy
- Electrons at Work

An appropriate Instrument of Assessment would be a closed-book, supervised test with a time limit of 45 minutes. Items in the test should cover all of the Performance Criteria associated with both Outcomes 1 and 2 and could be set in familiar or unfamiliar contexts.

Further detail on the breadth and depth of content is provided in the content tables included in this specification.

National Unit specification: statement of standards (cont)

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For Outcome 2, PC(a), candidates are required to demonstrate that they can use a range of data-handling skills. These skills include selecting, processing and presenting information. Information can be presented in a number of formats including: line graphs, scatter graphs, bar and pie charts, tables, diagrams and text.

For Outcome 2, PC(b), candidates are required to demonstrate they can use a range of skills associated with experimental design. These skills include planning, designing and evaluating experimental procedures.

For Outcome 2, PC(c), candidates are required to demonstrate they can use a range of skills associated with the evaluation of scientific evidence. These skills include drawing valid conclusions and making predictions.

The standard to be applied and the breadth of coverage are illustrated in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit they should be of a comparable standard.

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

The recommended content together with suggestions for possible contexts and activities to support and enrich learning and teaching are detailed in the appendix to this Unit specification.

This Unit builds on candidates' knowledge of electricity. The content covered in the first part of the topic Electrons and Energy is set in the context of alternating current. Candidates study how to monitor and measure a.c. signals. Electrical circuits are studied, including a consideration of d.c. electrical sources of power and internal resistance. The topic is completed with a study of capacitors.

Electrons at Work considers conductors, semiconductors and insulators and in particular, a number of semiconductor devices are studied.

This Unit offers a wide variety of contexts and opportunities for practical work as highlighted in the 'Contexts'column of the content tables. Opportunities exist for candidates to learn as part of a group through practical work undertaken in partnership or in teams.

Guidance on learning and teaching approaches for this Unit

General advice on approaches to learning and teaching is contained in the Course specification.

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, PC(b) and (c) develop a candidate's ability to communicate effectively key concepts and to explain clearly physics concepts in written media.

Within this Unit candidates will need to extract and process information presented in both tabular and graphical formats developing the Core Skill of numeracy. Candidates will gain experience in a range of calculations building competence in number.

The Content Table, included in this Unit specification contains a column labelled 'Contexts' which include a large number of web based activities, computer simulations and modelling opportunities which all serve to develop higher levels of competence in the key *ICT* skills including; accessing information and providing/creating information. Also included are suggestions for practical investigations which provide candidates with the opportunity of working co-operatively with others.

Problem Solving skills are central to the sciences and are assessed through Outcome 1, PCs (b) and (c) and also through Outcome 2, PCs (a), (b) and (c).

Guidance on approaches to assessment for this Unit

Outcomes 1 and 2

It is recommended that an holistic approach is taken for assessment of these Outcomes. Outcomes 1 and 2 can be assessed by an integrated end of Unit test with questions covering all the Performance Criteria. Within one question, assessment of knowledge and understanding and skills of experimentation, investigation and analysis can occur. Each question can address a number of Performance Criteria from either Outcome 1 or 2.

Appropriate assessment items are available from the National Assessment Bank.

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**

National Unit specification: content tables

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The left hand column below details the content in which candidates should develop knowledge and understanding. The middle column contains notes, which give further details of the content.

The right-hand column gives suggested contexts in which knowledge and understanding and skills can be developed.

Content	Notes	Contexts
1 Electrons and Energy		
a) Monitoring and measuring a.c.	a.c. as a current which changes direction and instantaneous value with time. Monitoring a.c. signals with an oscilloscope, including measuring frequency, and peak and r.m.s. values.	Using a multimeter as an ammeter, voltmeter and ohmmeter. Oscilloscope as a voltmeter and waveform monitor.
b) Current, potential difference (p.d.), power and resistance	Current, potential difference and power in series and parallel circuits. Calculations involving p.d., current and resistance may involve several steps. Potential dividers as voltage controllers.	Investigating simple a.c. or d.c. circuits with switches and resistive components. Potential dividers in measurement circuits and used with variable resistors to set and control voltages in electronic circuits.
c) Electrical sources and internal resistance.	Electromotive force, internal resistance and terminal potential difference. Ideal supplies, short circuits and open circuits. Determining internal resistance and electromotive force using graphical analysis.	Investigating the reduction in voltage as additional devices are connected. Investigating internal resistance of low voltage power supplies. Load matching.

National Unit specification: content tables (cont)

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Content	Notes	Contexts
d) Capacitors	Capacitors and the relationship between capacitance, charge and potential difference. The total energy stored in a charged capacitor is the area under the charge against potential difference graph. Use the relationships between energy, charge, capacitance and potential difference. Variation of current and potential difference against time for both charging and discharging. The effect of resistance and capacitance on charging and discharging curves.	Energy storage. Flash photography. Smoothing and suppressing. Capacitance based touch screens.
2 Electrons at Work		
a) Conductors, semiconductors and insulators	Solids can be categorised into conductors, semiconductors or insulators by their ability to conduct electricity. The electrons in atoms are contained in energy levels. When the atoms come together to form solids, the electrons then become contained in energy bands separated by gaps. In metals which are good conductors, the highest occupied band is not completely full and this allows the electrons to move and therefore conduct. This band is known as the conduction band. In an insulator the highest occupied band (called the valence band) is full. The first unfilled band above the valence band is the conduction band.	Conducting cables and insulating material.

National Unit specification: content tables (cont)

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Content	Notes	Contexts
	For an insulator the gap between the valence band and the conduction band is large and at room temperature there is not enough energy available to move electrons from the valence band into the conduction band where they would be able to contribute to conduction. There is no electrical conduction in an insulator.	Breakdown voltage and lightning.
	In a semiconductor the gap between the valence band and conduction band is smaller and at room temperature there is sufficient energy available to move some electrons from the valence band into the conduction band allowing some conduction to take place. An increase in temperature increases the conductivity of a semiconductor.	Hall effect sensor. Investigating the change in resistance of a negative temperature coefficient thermistor as its temperature is increased.
b) p-n junctions	During manufacture, the conductivity of semiconductors can be controlled, resulting in two types: p-type and n-type. When p-type and n-type material are joined, a layer is formed at the junction. The electrical properties of this layer are used in a number of devices. Solar cells are p-n junctions designed so that a potential difference is produced when photons enter the layer. This is the photovoltaic effect.	Investigating the output voltage of a solar cell and its dependence on the irradiance and frequency of incident light.
	LEDs are p-n junctions which emit photons when a current is passed through the junction.	Investigating the switch on voltage of different coloured LEDs.

History of changes to Unit

Version	Description of change	Date

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