



## National Unit Specification: general information

**Unit title:** Electromagnetism (SCQF level 7)

**Unit code:** H1FN 13

**Course:** Physics (Revised) Advanced Higher

**Superclass** RC

**Publication date** April 2012

**Source** Scottish Qualifications Authority

**Version** 01

## Summary

This Unit develops knowledge and understanding and skills in physics related to electromagnetism. 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 electromagnetism. The Unit develops knowledge and understanding of electric and magnetic fields and capacitors and inductors used in dc and ac circuits. 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 electromagnetism.
- 2 Demonstrate skills of scientific experimentation, investigation and analysis in electromagnetism.

## Recommended entry

While entry is at the discretion of the centre, candidates would normally be expected to have attained the following, or equivalent:

- ◆ Higher Physics (Revised) or the Unit *Electricity (revised Higher)*
- and
- ◆ Higher Mathematics

## General information (cont)

**Unit title:** Electromagnetism (SCQF level 7)

### Credit value

0.5 National Unit credit at SCQF level 7: (4 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.*

### Core Skills

Achievement of this Unit gives automatic certification of the following:

Complete Core Skill                      Numeracy at SCQF level 6

Core Skill component                      Critical Thinking at SCQF level 6

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

## **National Unit Specification: statement of standards**

**Unit title:** Electromagnetism (SCQF level 7)

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 electromagnetism.

#### **Performance Criteria**

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

### **Outcome 2**

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

#### **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.

## **National Unit Specification: statement of standards (cont)**

**Unit title:** Electromagnetism (SCQF level 7)

### **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 30 minutes.

The instrument of assessment must sample the content in each of the following areas:

- ◆ Fields
- ◆ Circuits
- ◆ Electromagnetic Radiation

An appropriate Instrument of Assessment would be a closed-book, supervised test with a time limit of 30 minutes. Items in the test should cover all the Performance Criteria associated with both Outcomes 1 and 2 and should 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.

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, 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**

**Unit title:** Electromagnetism (SCQF level 7)

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 this Unit specification.

This Unit builds on candidates' knowledge of fields and circuits. The content of the first topic develops previous work on electric fields and in particular, a mathematical approach is adopted to describe the interaction of charged particles. Magnetic fields and magnetic induction are treated in a similar way. The nature of electromagnetic radiation is considered. Components used in dc and ac circuits include capacitors and inductors and an understanding of electric and magnetic fields is used to investigate their operation. 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.

### **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 assessment 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 wishing to use e-assessment must ensure that the national standard is applied to all candidate evidence and that the 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)*.

## National Unit Specification: support notes (cont)

**Unit title:** Electromagnetism (SCQF level 7)

### 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) & (c) and also through Outcome 2, PCs (a), (b) and (c).

This Unit has the Core Skill of Numeracy, and the Critical Thinking component of Problem Solving, embedded in it. This means that when candidates achieve the Unit, their Core Skills profile will also be updated to show that they have achieved Numeracy and Critical Thinking at SCQF level 6.

### 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 in the SQA website [www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements)

## National Course Specification: content tables

### Advanced Higher Physics: Electromagnetism

The left hand column below details the content in which students 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
<b>1 Fields</b>		
a) Electric fields and Coulomb's Law	<p>An electric field is the space that surrounds electrically charged particles and in which a force is exerted on other electrically charged particles. Electric field as the force per Unit positive charge.</p> <p>Coulomb's Inverse Square Law for interacting point charges.</p> <p>Electric potential and electric field strength around a point charge and system of charges. Potential difference and electric field strength for a uniform electric field.</p> <p>Investigate the motion of charged particles in uniform electric fields.</p> <p>The electronvolt is the energy acquired when one electron accelerates through a potential difference of one volt. It is a unit commonly used in high energy particle physics.</p>	<p>Electrostatic spray painting. Electrostatic forces and the structure of matter. Lightning, cosmic rays, Compton scattering, electron gun, oscilloscope deflecting plates Particle accelerators</p> <p>Particle accelerators. Astronomical measurement of the energy of electromagnetic radiation.</p>

## National Course Specification: content tables (cont)

<p>b) Magnetic fields and magnetic induction</p>	<p>Magnetic effects arise when electric charges are in motion. An electric current consists of moving electric charges and so produces magnetic effects. Also, electrons are in motion around atomic nuclei and individually produce a magnetic effect. Iron, nickel, cobalt and some rare earths exhibit a magnetic effect called ferromagnetism, in which magnetic dipoles can be made to line up, resulting in the material becoming magnetised.</p> <p>Magnetic field patterns around permanent magnets and electromagnets, including a straight wire and a coil. Magnetic induction at a point is the strength of a magnetic field at the point.</p> <p>Investigate the magnitude of the force on a current carrying conductor in a magnetic field. Investigate the magnetic induction at a distance from a long current carrying wire. Comparing gravitational, electrostatic, magnetic and nuclear forces.</p>	<p>Electric motors, electromagnetic pump.</p> <p>Induction cookers, induction welding</p> <p>Use of Hall Probe to measure magnetic induction.</p>
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## National Course Specification: content tables (cont)

3 Electromagnetic Radiation		
<p>The unification of electricity and magnetism</p>	<p>The nature of electromagnetic radiation (EMR). EMR exhibits wave properties as it transfers energy through space. It has both electric and magnetic field components which oscillate in phase, perpendicular to each other and to the direction of energy propagation.</p> <p>The relationship between the speed of light and the permittivity and permeability of free space.</p> <p>Estimate the speed of light by determining permittivity using a parallel plate capacitor and determining permeability using a current balance.</p>	<p>Unification of electricity and magnetism by J C Maxwell</p> <p>Wireless technology. Mobile phones and Bluetooth.</p>

## History of changes

Version	Description of change	Date

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