SCOTTISH QUALIFICATIONS AUTHORITY

PHYSICS
Intermediate 2

For examinations in 2006 and beyond

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SCOTTISH QUALIFICATIONS AUTHORITY

NOTE OF CHANGES TO ARRANGEMENTS FIFTH EDITION PUBLISHED JUNE 2004

COURSE TITLE: Physics (Intermediate 2)

COURSE NUMBER: C069 11

National Course Specification

Minor changes have been made to Content Statements to improve the consistency of style across Physics courses at all levels. The requirement to state some of the mathematical relationships has been removed with emphasis moved to carrying out calculations involving the relationships between quantities.
The Physics Data Booklet should be available to all candidates during assessments.
Tables defining the symbols and units used in all SQA Physics courses can be downloaded from the SQA website http://www.sqa.org.uk .

Course Details:

Content Statements	statement deleted	1.3.9, 1.3.10
	new statement	1.3.9
	subsequent renumbering of statements in area 1.3	
	minor change	2.1.3, 2.1.14, 2.1.15
	statement deleted	2.2.3
	minor change	2.2.4 (old)
	subsequent renumbering of statements in area 2.2	
	minor change	2.4.10
	statement deleted	4.2.1, 4.2.5, 4.2.6, 4.2.7
	new statement	4.2.1, 4.2.2, 4.2.5, 4.2.6, 4.2.7
	minor change	4.2.2 (old) and moved to 4.2.3
	reordering of statements in area 4.2	
Contexts, Applications etc	new text	4.2.5

National Course Specification: general information

PHYSICS (INTERMEDIATE 2)

COURSE NUMBER C069 11

COURSE STRUCTURE

The course has four mandatory units, as follows.

D379 11	***Mechanics and Heat (Int 2)***	***1 credit (40 hours)***
D380 11	***Electricity and Electronics (Int 2)***	***1 credit (40 hours)***
D381 11	***Waves and Optics (Int 2)***	***0.5 credit (20 hours)***
D382 11	***Radioactivity (Int 2)***	***0.5 credit (20 hours)***

This course includes 40 hours over and above the 120 hours for the component units. This may be used for induction, extending the range of learning and teaching approaches, support, consolidation, integration of learning and preparation for external assessment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained the following.

- Standard Grade Physics with Knowledge and Understanding and Problem Solving at grade 3 or 4

or

- Standard Grade Biology, Chemistry or Science with Knowledge and Understanding and Problem Solving at grade 1, 2 or 3

or

- Intermediate 1 Physics

and

- Standard Grade Mathematics at grade 3 or 4 **or** Intermediate 1 Mathematics

Administrative Information

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National Course Specification: general information (cont)

COURSE Physics (Intermediate 2)

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 Course Specification: course details

COURSE Physics (Intermediate 2)

RATIONALE

This course emphasises the contribution which physics makes to the candidate's general education by helping to make sense of the physical environment through the development of skills necessary for the solution of scientific problems. The course aims to provide opportunities to develop the candidate's knowledge and understanding of the concepts of physics and the ability to solve problems and to carry out experimental and investigative work. The course seeks to illustrate and emphasise situations where the principles of physics are used and applied, thus promoting the candidate's awareness that physics involves interaction between theory and practice. The resulting elements of knowledge and understanding, problem solving and practical activities form the basis of the Intermediate 2 Physics course.

As a result of following Intermediate 2 Physics, candidates should acquire:

- an increased knowledge and understanding of facts and ideas, of techniques and of the applications of physics in society
- skill in applying their knowledge and understanding in a wide variety of theoretical and practical problem solving contexts
- skills associated with carrying out experimental and investigative work in physics and analysing the information obtained.

The study of Intermediate 2 Physics should also foster an interest in current developments in, and applications of physics, the willingness to make critical and evaluative comment and the acceptance that physics is a changing subject. Positive attitudes, such as being open-minded and willing to recognise alternative points of view, are promoted.

The course endeavours to provide learning experiences leading to the acquisition of worthwhile knowledge, skills and attitudes which will assist candidates to make their own reasoned decisions on many issues within a modern society increasingly dependent on science and technology. The course will also provide those who wish to proceed to the Higher Physics course with a suitable basis for further study.

COURSE CONTENT

The course is made up of four mandatory units: Mechanics and Heat, Electricity and Electronics, Waves and Optics and Radioactivity. While these units are valuable in their own right, candidates will gain considerable additional benefit from completing this course, since there will be opportunities for the integration of skills developed through study of the units, and for tackling problem solving of a more complex nature than that required for the attainment of the performance criteria of the units. Evidence of achievement of the problem solving core skill will be provided by end of unit assessments, a report on practical work and the external examination. The following Content Statements describe in detail what the candidate should be able to do in order to demonstrate the knowledge and understanding associated with the course. External assessment will sample across all of the Content Statements.

National Course Specification: course details (cont)

Intermediate 2 Physics: Mechanics and Heat

The Content Statements given in the left-hand column of the table below describe in detail what the candidate should be able to do in demonstrating knowledge and understanding associated with Mechanics and Heat.

The right-hand column gives suggested contexts, applications, illustrations and activities associated with the Content Statements.

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
1.1 Kinematics	
1 Describe how to measure an average speed.	Measure average speeds of, eg, walking, running, bicycle and car.
2 Carry out calculations involving distance, time and average speed.	
3 Describe how to measure instantaneous speed.	Measure short time intervals and hence estimate the instantaneous speed at various times.
4 Identify situations where average speed and instantaneous speed are different.	
5 Describe what is meant by vector and scalar quantities.	
6 State the difference between distance and displacement.	Discuss and measure distance and displacement.
7 State the difference between speed and velocity.	Discuss velocity as speed in a given direction along a straight line.
8 Explain the terms ‘speed’, ‘velocity’ and ‘acceleration’.	Obtain, present and discuss information on performance figures for cars.
9 State that acceleration is the change in velocity in unit time.	Measure instantaneous velocity and acceleration as a vehicle runs down a slope for a range of angles of incline. Draw graphs using this data.
10 Draw velocity – time graphs involving more than one constant acceleration.	Discuss equivalence of displacement and distance travelled for the particular case of an object moving in a straight line in one direction only.
11 Describe the motions represented by a velocity–time graph.	Use motion sensor to display graphs on a computer.
12 Calculate displacement and acceleration from velocity–time graphs involving more than one constant acceleration.	
13 Carry out calculations involving the relationship between initial velocity, final velocity, time and uniform acceleration.	

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
1.2 Dynamics	
1 Describe the effects of forces in terms of their ability to change the shape, speed and direction of travel of an object.	Discuss forces and their effects.
2 Describe the use of a newton balance to measure force.	Use newton balance to lift and pull various known masses.
3 State that weight is a force and is the Earth's pull on an object.	
4 Distinguish between mass and weight.	
5 State that weight per unit mass is called the gravitational field strength.	Use results to show that the ratio of weight to mass is approximately 10 N/kg on the Earth. Obtain and present information on values of *g* for other planets.
6 Carry out calculations involving the relationship between weight, mass and gravitational field strength including situations where *g* is not equal to 10 N/kg.	
7 State that the force of friction can oppose the motion of an object.	Obtain and present information on, or investigate, friction, eg, lubrication, car tyres and brakes, effectiveness of bicycle brakes wet and dry, hovercraft. Discuss terminal velocities. Seat belts.
8 Describe and explain situations in which attempts are made to increase or decrease the force of friction.	
9 State that force is a vector quantity.	
10 State that forces which are equal in size but act in opposite directions on an object are called balanced forces and are equivalent to no force at all.	
11 Explain the movement of objects in terms of Newton's First Law.	
12 Describe the qualitative effects of change of mass or of force on the acceleration of an object.	Experiments, eg using a linear air track to investigate the effects of force and mass on acceleration. Direct readout of acceleration is recommended.
13 Define the newton.	
14 Use free body diagrams to analyse the forces on an object.	
15 State what is meant by the resultant of a number of forces.	

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
1.2 Dynamics (cont)	
16 Use a scale diagram, or otherwise, to find the magnitude and direction of the resultant of two forces acting at right angles to each other.	Calculation of resultant force.
17 Carry out calculations using the relationship between acceleration, resultant force and mass, and involving more than one force but in one dimension only.	
18 Explain the equivalence of acceleration due to gravity and gravitational field strength.	
19 Explain the curved path of a projectile in terms of the force of gravity.	Projectile experiments. Computer simulation of projectile motion. Newton's Thought Experiment.
20 Explain how projectile motion can be treated as two independent motions.	
21 Solve numerical problems using the above method for an object projected horizontally. (No knowledge of the equations of motion is expected.)	Calculations involving projectile motion using methods outlined in the kinematics area.
1.3 Momentum and energy	
1 State Newton's Third Law.	
2 Identify 'Newton pairs' in situations involving several forces.	Experiments with balloons, water rockets, soda syphon bulbs, etc.
3 State that momentum is the product of mass and velocity.	Pairs of Forces experiments.
4 State that momentum is a vector quantity.	
5 State that the law of conservation of linear momentum can be applied to the interaction of two objects moving in one direction, in the absence of net external forces.	Discuss collisions. Investigate simple collisions on a linear air track.

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
1.3 Momentum and energy (cont)	
6 Carry out calculations concerned with collisions in which all the objects move in the same direction and with one object initially at rest.	Calculations involving one object colliding with a stationary object and both moving off in the same direction.
7 State that work done is a measure of the energy transferred.	
8 Carry out calculations involving the relationship between work done, force and distance.	
9 Carry out calculations involving the relationship between work done, power and time.	Investigate work done and power of for example: student walking or running upstairs, cyclist travelling a certain distance in each gear, toy car moving up a slope.
10 Carry out calculations involving the relationship between change in gravitational potential energy, mass, gravitational field strength and change in height.	
11 Carry out calculations involving the relationship between kinetic energy, mass and velocity.	Experiments to show dependence of kinetic energy on mass and velocity. Implications of crashing a car at various speeds. Thinking time, vehicle speed and stopping distance.
12 Carry out calculations involving the relationship between efficiency and output power, output energy and input power, input energy.	
1.4 Heat	
1 State that the same mass of different materials needs different quantities of heat energy to change their temperature by one degree celsius.	Investigate the effectiveness of different materials for storing heat. Storage heaters.
2 Carry out calculations involving specific heat capacity.	Measure the specific heat capacity of a solid or liquid.
3 State that heat is gained or lost by a substance when its state is changed.	Measure the specific latent heat of vaporisation of a liquid. Effectiveness of materials to release or take in heat, eg, ice, picnic box coolant. Discuss latent heat of fusion and latent heat of vaporisation.
4 State that a change of state does not involve a change in temperature.	
5 Carry out calculations involving specific latent heat.	Cooling curve for stearic acid, and comparison with oleic acid.
6 Carry out calculations involving energy, work, power and the principle of conservation of energy.	Cooling effect of liquid evaporating.

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
1.5 Units, prefixes and scientific notation 1 Use SI units of all quantities appearing in the above Content Statements. 2 Give answers to calculations to an appropriate number of significant figures. 3 Check answers to calculations. 4 Use prefixes (m, k, M). 5 Use scientific notation.	Check answers in relation to context - reject impossible solutions, use a checking procedure.

National Course Specification: course details (cont)

Intermediate 2 Physics: Electricity and Electronics

The Content Statements given in the left-hand column of the table below describe in detail what the candidate should be able to do in order to demonstrate knowledge and understanding associated with Electricity and Electronics.

The right-hand column gives suggested contexts, applications, illustrations and activities associated with the Content Statements.

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
2.1 Circuits	
1 State that electrons are free to move in a conductor.	Simple electrostatics experiments.
2 Describe electrical current in terms of the movement of charges around a circuit.	
3 Carry out calculations involving the relationship between charge, current and time.	
4 Distinguish between conductors and insulators and give examples of each.	Use simple series circuit to identify conductors and insulators.
5 Draw and identify the circuit symbols for an ammeter, voltmeter, battery, resistor, variable resistor, fuse, switch and lamp.	
6 State that the voltage of a supply is a measure of the energy given to the charges in a circuit.	Investigate the brightness of a lamp when the potential difference (voltage) across the lamp is varied.
7 State that an increase in the resistance of a circuit leads to a decrease in the current in that circuit.	Compare the currents drawn by different known resistors which have the same supply voltage.
8 Draw circuit diagrams to show the correct positions of an ammeter and voltmeter in a circuit.	
9 State that in a series circuit the current is the same at all positions.	Measure current and potential difference in a simple series circuit.
10 State that the sum of the potential differences across the components in series is equal to the voltage of the supply.	Discuss the use of the terms potential difference and voltage.

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
2.1 Circuits (cont)	
11 State that the sum of the currents in parallel branches is equal to the current drawn from the supply	Measure current and potential difference in a circuit containing components in series and parallel.
12 State that the potential difference across components in parallel is the same for each component.	
13 State that V/I for a resistor remains approximately constant for different currents.	Measure the current for different potential differences across a resistor and determine V/I – compare with value of R found using an ohmmeter. Measure resistance of resistor for different currents.
14 Carry out calculations involving the relationship between potential difference, current and resistance.	
15 Carry out calculations involving resistors connected in series and parallel.	Use an ohmmeter to measure resistance of components in series and parallel.
16 State that a potential divider circuit consists of a number of resistors, or a variable resistor, connected across a supply.	Investigate potential divider circuits.
17 Carry out calculations involving potential differences and resistances in a potential divider.	
2.2 Electrical energy	
1 State that when there is an electrical current in a component, there is energy transformation.	Investigate the brightness of a bulb when the measured current through the lamp is increased.
2 State that the electrical energy transformed each second = VI.	Measure the current when known wattage 12V lamps and heaters are operating at their correct voltage.
3 Carry out calculations involving the relationships between power, energy, time, current and potential difference.	
4 Explain the equivalence between VI, I^2R and V^2/R.	From tables of data or experimental results show the equivalence of VI, I^2R and V^2/R.
5 Carry out calculations involving the relationships between power, current, voltage and resistance.	Determine the fuse required for different appliances by calculating the current.
6 State that in a lamp electrical energy is transformed into heat and light.	Discuss energy transformation in lamps and heaters. Heating elements. Investigate how the resistance of a lamp changes with current.

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
2.2 Electrical energy (cont)	
7 State that the energy transformation in an electrical heater occurs in the resistance wire.	
8 Explain in terms of current the terms d.c. and a.c.	Use an oscilloscope to observe and compare the outputs from a battery and low voltage a.c. supply.
9 State that the frequency of the mains supply is 50 Hz.	
10 State that the quoted value of an alternating voltage is less than its peak value.	Measure peak voltage of an a.c. source.
11 State that a d.c. supply and an a.c. supply of the same quoted value will supply the same power to a given resistor.	
2.3 Electromagnetism	
1 State that a magnetic field exists around a current-carrying wire.	Investigate magnetic fields created by a current-carrying wire.
2 Identify circumstances in which a voltage will be induced in a conductor.	Investigate wires moving between magnetic poles; moving magnet and coil. Investigate the factors affecting the size of the induced voltage.
3 State the factors that affect the size of the induced voltage, ie field strength, number of turns on a coil, relative movement.	
4 State that transformers are used to change the magnitude of an alternating voltage.	Investigate the changes in voltage produced by a transformer. National Grid.
5 Carry out calculations involving input and output voltages, turns ratio and primary and secondary currents for an ideal transformer.	
2.4 Electronic components	
1 Give examples of output devices and the energy transformations involved.	Examine a range of output devices, eg, LED, seven-segment display, lamp, loudspeaker, relay.
2 Draw and identify the symbol for an LED.	Carry out experiments to compare electrical and optical properties of filament lamp and LED.
3 State that an LED lights only when connected the correct way round.	
4 Describe by means of a diagram a circuit which will allow an LED to light.	
5 Calculate the value of the series resistor for an LED and explain the need for this resistor.	

National Course Specification: course details (cont)

CONTENT STATEMENTS		CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
2.4	**Electronic components (cont)**	
6	Give examples of input devices.	Examine a range of input devices, eg microphone, thermocouple, solar cell, thermistor.
7	Describe the energy transformations involved in the following devices: microphone, thermocouple, solar cell.	
8	State that, for most common thermistors, the resistance of the thermistor decreases as temperature increases.	Carry out experiments to investigate the behaviour of a thermistor whose resistance decreases as temperature increases.
9	State that the resistance of an LDR decreases with increasing light intensity.	Carry out experiments to investigate the behaviour of an LDR.
10	Carry out calculations involving potential difference, current and resistance for the thermistor and LDR.	
11	Draw and identify the circuit symbol for an n-channel enhancement MOSFET.	Discuss MOSFET, Metal Oxide Semiconductor Field Effect Transistor.
12	Draw and identify the circuit symbol for an NPN transistor.	
13	State that a transistor can be used as a switch.	Investigate the switching action of a transistor in response to changes in temperature or light level.
14	Explain the operation of a simple transistor switching circuit.	
15	Identify, from a list, devices in which amplifiers play an important part.	Discuss various devices containing amplifiers.
16	State that the output signal of an audio amplifier has the same frequency as, but a larger amplitude than, the input signal.	Use an oscilloscope to compare a pure tone input to, and output from, an audio amplifier.
17	Carry out calculations involving input voltage, output voltage and voltage gain of an amplifier.	Measure the voltage gain of an amplifier.
2.5	**Units, prefixes and scientific notation**	
1	Use SI units of all quantities appearing in the above Content Statements.	
2	Give answers to calculations, to an appropriate number of significant figures.	
3	Check answers to calculations.	Check answers in relation to context - reject impossible solutions, use a checking procedure.
4	Use prefixes (μ, m, k, M).	
5	Use scientific notation.	

National Course Specification: course details (cont)

Intermediate 2 Physics: Waves and Optics

The Content Statements given in the left-hand column of the table describe in detail what the candidate should be able to do in order to demonstrate knowledge and understanding associated with Waves and Optics.

The right-hand column gives suggested contexts, applications, illustrations and activities associated with the Content Statements.

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
3.1 Waves	
1 State that a wave transfers energy.	
2 Describe a method of measuring the speed of sound in air, using the relationship between distance, time and speed.	Measure the speed of sound in air, eg sound produced and delay in hearing the sound.
3 State that radio and television signals are transmitted through air at 300 million m/s and that light is also transmitted at this speed.	Discuss the difference in values between the speed of sound and the speed of light, eg thunder and lightning.
4 Carry out calculations involving the relationship between distance, time and speed in problems on water waves, sound waves, radio waves and light waves.	
5 Use the following terms correctly in context: wave, frequency, wavelength, speed, amplitude, period.	Perform experiments, or watch demonstrations or computer simulations, using slinky or ripple tank to illustrate the terms: wavelength, frequency, speed, amplitude, period, transverse and longitudinal.
6 State the difference between a transverse and longitudinal wave and give examples of each.	
7 Carry out calculations involving the relationship between speed, wavelength and frequency for waves.	Applications to sound, water, light, micro or radio waves.
8 State in order of wavelength, the members of the electromagnetic spectrum: gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves, TV and radio.	Discuss the speed, wavelength and frequency of each member of the electromagnetic spectrum.

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
3.2 Reflection	
1 State that light can be reflected.	
2 Use correctly in context the terms: angle of incidence, angle of reflection and normal when a ray of light is reflected from a plane mirror.	Measure the angle of incidence and angle of reflection.
3 State the principle of reversibility of a ray path.	
4 Explain the action of curved reflectors on certain received signals.	Perform experiments to show the focusing effect of curved reflectors; eg visible light, infrared, microwaves or sound waves.
5 Explain the action of curved reflectors on certain transmitted signals.	
6 Describe an application of curved reflectors used in telecommunication.	Satellite communication, TV link, repeaters, boosters.
7 Explain, with the aid of a diagram, what is meant by total internal reflection.	Semi-circular slab to demonstrate total internal reflection.
8 Explain, with the aid of a diagram, what is meant by 'the critical angle'.	
9 Describe the principle of operation of an optical fibre transmission system.	Demonstrate signal transmission along a light pipe or optical fibre.
3.3 Refraction	
1 State what is meant by the refraction of light.	
2 Draw diagrams to show the change in direction as light passes from air to glass and glass to air.	Carry out experiments on refraction using a ray box.
3 Use correctly in context the terms angle of incidence, angle of refraction and normal.	
4 Describe the shapes of converging and diverging lenses.	

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
3.3 Refraction (cont)	
5 Describe the effect of a converging and a diverging lens on parallel rays of light.	Carry out experiments using a ray box and cylindrical lenses.
6 Draw a ray diagram to show how a converging lens forms the image of an object placed at a distance of: a) more than two focal lengths b) between one and two focal lengths c) less than one focal length in front of the lens.	Carry out experiments on image formation using a converging lens.
7 Carry out calculations involving the relationship between power and focal length of a lens.	Applications of thin converging lenses, eg, camera, magnifying glass. Experiment to find focal length of spherical lens.
8 State the meaning of long and short sight.	
9 Explain the use of lenses to correct long and short sight.	Carry out experiments on long and short sight, eg using model eye.
3.4 Units, prefixes and scientific notation	
1 Use SI units of all quantities appearing in the above 'Content Statements'.	
2 Give answers to calculations to an appropriate number of significant figures.	
3 Check answers to calculations.	Check answers in relation to context - reject impossible solutions, use a checking procedure.
4 Use prefixes (m, k, M, G).	
5 Use scientific notation.	

National Course Specification: course details (cont)

Intermediate 2 Physics: Radioactivity

The Content Statements given in the left-hand column of the table describe in detail what the candidate should be able to do in order to demonstrate knowledge and understanding associated with Radioactivity.

The right-hand column gives suggested contexts, applications, illustrations and activities associated with the Content Statements.

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
4.1 Ionising radiations	
1 Describe a simple model of the atom which includes protons, neutrons and electrons.	
2 State what is meant by an alpha particle, beta particle and gamma ray.	Qualitative decay of radio nuclides.
3 State that radiation energy may be absorbed in the medium through which it passes.	Demonstrate, or use, Geiger-Müller tube to examine absorption of alpha, beta and gamma rays, and the range of each in air.
4 State the approximate range through air, and absorption of alpha, beta and gamma radiation.	Absorption of alpha particles by sheet of paper, beta particles by a few mm of aluminium and gamma rays by a few cm of lead.
5 Explain the term ionisation.	
6 State that alpha particles produce much greater ionisation density than beta particles or gamma rays.	Demonstrate, or view video for, the intense ionisation caused by alpha particles. Smoke detectors.
7 Describe how one of the effects of radiation is used in a detector of radiation.	Geiger-Müller tube; film badges; scintillation counters.
8 State that radiation can kill living cells or change the nature of living cells.	
9 Describe one medical use of radiation based on the fact that radiation can destroy cells.	Instrument sterilisation, radiotherapy.
10 Describe one use of radiation based on the fact that radiation is easy to detect.	Use of tracers in medicine, agriculture and industry.

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
4.2 Dosimetry	
1 State that the activity of a radioactive source is the number of decays per second and is measured in becquerels (Bq), where one becquerel is one decay per second.	Examine the values of activities, eg 1g of radium, 1g of uranium-235, 1 litre of milk after Chernobyl.
2 Carry out calculations involving the relationship between activity, number of decays and time.	
3 State that the absorbed dose is the energy absorbed per unit mass of the absorbing material.	
4 State that the gray (Gy) is the unit of absorbed dose and that one gray is one joule per kilogram.	
5 State that a radiation weighting factor is given to each kind of radiation as a measure of its biological effect.	Compare the radiation weighting factors for alpha, beta, gamma and slow neutrons.
6 State that the equivalent dose is the product of absorbed dose and radiation weighting factor and is measured in sieverts (Sv).	Discuss the importance of the unit sievert.
7 Carry out calculations involving the relationship between equivalent dose, absorbed dose and radiation weighting factors.	Discuss information relating to the value in sieverts of the equivalent dose received from various sources of background radiation.
8 State that the risk of biological harm from an exposure to radiation depends on: a) the absorbed dose b) the kind of radiation, e.g. α, β, γ, slow neutron c) the body organs or tissue exposed.	View video on radiological protection.
9 Describe factors affecting the background radiation level.	
4.3 Half-life and safety	
1 State that the activity of a radioactive source decreases with time.	Study activity, radioactive decay and half-life by experiments, simulation, and videos of actual experiments.
2 State the meaning of the term ‘half-life’.	
3 Describe the principles of a method for measuring the half-life of a radioactive source.	
4 Carry out calculations to find the half-life of a radioactive isotope from appropriate data	

National Course Specification: course details (cont)

CONTENT STATEMENTS	CONTEXTS, APPLICATIONS, ILLUSTRATIONS AND ACTIVITIES
4.3 Half-life and safety (cont)	
5 Describe the safety procedures necessary when handling radioactive substances.	Discuss monitoring, the avoidance of contamination, and record keeping. Discuss the practical methods used by industry and in medicine.
6 State that the dose equivalent is reduced by shielding, by limiting the time of exposure or by increasing the distance from a source.	
7 Identify the radioactive hazard sign and state where it should be displayed	
4.4 Nuclear reactors	
1 State the advantages and disadvantages of using nuclear power for the generation of electricity.	Obtain information from various sources, eg nuclear power generation booklets and anti-nuclear groups.
2 Describe in simple terms the process of fission.	
3 Explain in simple terms a chain reaction.	Study models and simulations relating to nuclear structure.
4 Describe the principles of the operation of a nuclear reactor in terms of fuel rods, moderator, control rods, coolant and containment vessel.	
5 Describe the problems associated with the disposal and storage of radioactive waste.	Discuss topical issues.
4.5 Units, prefixes and scientific notation	
1 Use SI units of all quantities appearing in the above Content Statements.	
2 Give answers to calculations to an appropriate number of significant figures.	
3 Check answers to calculations.	
4 Use prefixes (μ, m, k, M, G).	Check answers in relation to context - reject impossible solutions, use a checking procedure.
5 Use scientific notation.	

National Course Specification: course details (cont)

COURSE Physics (Intermediate 2)

ASSESSMENT

To gain the award of the course, the candidate must achieve all the component units as well as the external assessment. External assessment will provide the basis for grading attainment.

When units are taken as component parts of a course, candidates will have the opportunity to demonstrate achievement beyond that required to attain each of the units. This attainment may, where appropriate, be recorded and used to contribute towards course estimates, and to provide evidence for appeals.

Further information on the key principles of assessment is provided in the paper *Assessment* (HSDU, 1996) and in *Managing Assessment* (HSDU, 1998).

Each unit specification gives information on unit assessment.

DETAILS OF THE INSTRUMENT FOR EXTERNAL ASSESSMENT

The instrument of assessment will be an externally set question paper of 2 hours duration. The question paper will sample the Content Statements of all four component units. The question paper will consist of 20 objective questions (each worth 1 mark) and questions requiring: a short answer (a few words); a response in the form of a numerical calculation; a restricted response (a few sentences or a paragraph). Candidates will be expected to answer all of the questions.

There will be a total of 100 marks for the paper.

Approximately 50 marks will be allocated to questions that require candidates to demonstrate achievement of a sample of the performance criteria associated with Outcome 1 for the four component units.

Approximately 50 marks will be allocated to questions that require candidates to:

- demonstrate achievement of a sample of performance criteria associated with Outcome 2 and Outcome 3 for the four component units;
- integrate knowledge and understanding, problem solving and analytical skills acquired through the study of the component units;
- apply knowledge and understanding to solve problems set in contexts less familiar than those associated with a study of the component units;
- solve problems which are less structured or are set in more complex contexts.

National Course Specification: course details (cont)

COURSE Physics (Intermediate 2)

A summary of the breakdown of the marks allocation across the outcomes and component units is as follows.

	Outcomes 1	*Outcomes 2 and 3*	*Total*
Mark allocation for:			
whole paper	50 ± 4	50 ± 4	100
each component unit (40 hour)	17 ± 4	17 ± 4	34 ± 4
each component unit (20 hour)	8 ± 3	8 ± 3	16 ± 4

GRADE DESCRIPTIONS

Course assessment will be based on achievement of the outcomes for the component units but will differ from the unit assessment in a number of regards. In undertaking the course assessment, candidates will be expected to demonstrate that the knowledge and understanding, problem solving and practical skills which they acquired through their study of the component units, have been retained and can be integrated and applied in contexts which are less familiar and more complex than those associated with the study of the units.

The descriptions below indicate the nature of the achievement which is required for the award of a grade C and a grade A in the course assessment.

Grade descriptions at 'C'

Candidates can:

- use the appropriate knowledge and understanding acquired through the study of the component units
- apply knowledge and understanding set in contexts similar to those associated with the component units
- demonstrate the ability to integrate skills acquired in component units to solve problems
- apply knowledge and understanding to solve problems set in less familiar contexts.

Grade descriptions at 'A'

Candidates can:

- solve problems in which the concepts and given information may not be specified in the content statements
- apply knowledge and understanding to solve problems which are less structured or are set in more complex contexts.

The above descriptions indicate the value of the course award over achievement of the individual units.

The overall assessment for the course, ie the combination of internal and external assessment, will provide the necessary evidence for the core skills where an automatic award is made.

National Course Specification: course details (cont)

COURSE Physics (Intermediate 2)

APPROACHES TO LEARNING AND TEACHING

The learning and teaching of physics are most effective when the concepts, principles and theories are set in a relevant context, eg by making reference to applications of physics and to real-world situations. Appropriate contexts, applications, illustrations and activities relating to the Content Statements are provided.

Practical activities provide opportunities to develop a wide range of skills associated with scientific enquiry and problem solving.

Suggested practical activities could include the following.

1 Measuring a physical quantity, eg after a class discussion, candidates could be asked to design an experiment to measure the average speed of a vehicle. After completion of the experiment the readings and results could be analysed and the method evaluated.
2 Demonstrating a physical law, eg candidates could be involved in the design of an experiment to investigate how the current in a circuit changes with resistance.
3 Testing a hypothesis, eg class discussion of the acceleration of an object could lead to the hypothesis that increasing the unbalanced force acting on the object increases the acceleration of the object. Candidates can then design a suitable experiment to test this hypothesis.

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 long time, or where several different variables have to be recorded simultaneously. Data obtained can be analysed and presented in graphical displays.

Use of additional 40 hours

This time may be used:

- to provide an introduction to the course and assessment methods
- to allow candidates to develop their ability to integrate knowledge and understanding, problem solving and practical skills acquired through the study of the different component units
- to allow some more practical work, on an individual basis if appropriate, within the units to enhance skills and understanding
- for consolidation and integration of learning
- for remediation
- for practice in examination techniques and preparation for the external examination.

National Course Specification: course details (cont)

COURSE Physics (Intermediate 2)

SPECIAL NEEDS

This course specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 on Special Assessment Arrangements* (SQA, 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Mechanics and Heat (Intermediate 2)

NUMBER D379 11

COURSE Physics (Intermediate 2)

SUMMARY

The unit seeks to introduce fundamental concepts and principles related to mechanics and heat. The main aim of the unit is to provide opportunities to develop the candidate's knowledge and understanding of the key concepts of mechanics and heat. The unit also provides opportunity for developing the ability to apply these concepts and principles in the analysis of a wide variety of applications.

OUTCOMES

1 Demonstrate knowledge and understanding related to mechanics and heat.
2 Solve problems related to mechanics and heat.
3 Collect and analyse information related to Intermediate 2 Physics obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained the following.

- Standard Grade Physics with Knowledge and Understanding and Problem Solving at grade 3 or 4

or

- Standard Grade Biology, Chemistry or Science with Knowledge and Understanding and Problem Solving at grade 1, 2 or 3

or

- Intermediate 1 Physics

and

- Standard Grade Mathematics at grade 3 or 4 **or** Intermediate 1 Mathematics

Administrative Information

Superclass: RC

Publication date: June 2004

Source: Scottish Qualifications Authority

Version: 05

National Unit Specification: general information (cont)

UNIT Mechanics and Heat (Intermediate 2)

CREDIT VALUE

1 credit at Intermediate 2.

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

UNIT Mechanics and Heat (Intermediate 2)

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 the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding related to mechanics and heat.

Performance criteria

(a) Quantities and their units are used correctly in relation to mechanics and heat.
(b) Relationships and mathematical techniques are used correctly in relation to mechanics and heat.
(c) Principles are used correctly in relation to mechanics and heat.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the Content Statements, given in the National Course Specification: course details, in each of the following areas:

- Kinematics
- Dynamics
- Momentum and energy
- Heat.

OUTCOME 2
Solve problems related to mechanics and heat.

Performance criteria

(a) Relevant information is selected and presented appropriately.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid, and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the areas shown below.

- Kinematics
- Dynamics
- Momentum and energy
- Heat.

National Unit Specification: statement of standards (cont)

UNIT Mechanics and Heat (Intermediate 2)

OUTCOME 3

Collect and analyse information related to Intermediate 2 Physics obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity related to Intermediate 2 Physics covering the above performance criteria is required. Evidence submitted in support of attainment of PC (d) must be in the format of a table or graph as appropriate. The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is to be managed; identifying and obtaining resources, some of which must be unfamiliar; carrying out the experiment. The report must be the individual work of the candidate and must be based on an experiment in which the candidate has been involved. Depending on the activity, the collection of the information may be through group work.

An Outcome 3 report of practical work in this unit may be used as evidence of the achievement of Outcome 3 of the Intermediate 2 Physics units D380 11 Electricity and Electronics, D381 11 Waves and Optics and D382 11 Radioactivity. An Outcome 3 report of practical work in the Intermediate 2 Physics unit D380 11 Electricity and Electronics or D381 11 Waves and Optics may be used as evidence of the achievement of Outcome 3 of this unit.

As simulation is permitted in the assessment of Outcome 3 of the unit D382 11 Radioactivity, a report of practical work in that unit may not be used as evidence of the achievement of Outcome 3 in this unit.

National Unit Specification: support notes

UNIT Mechanics and Heat (Intermediate 2)

This part of the unit specification is 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 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

The content and the suggested contexts, applications, illustrations and activities for this unit are given in the National Course Specification: course details. The subheadings in the tables in the course details correspond to the areas mentioned in the evidence requirements for Outcome 1 and Outcome 2. The practical activities chosen for Outcome 3 must relate to the content of Intermediate 2 Physics and must allow opportunity for all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The learning and teaching of this unit are most effective when the concepts, principles and theories are set in a relevant context, eg by making reference to applications of physics and to real-world situations. Suitable approaches to learning and teaching are detailed in the National Course Specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcomes 1 and 2

It is recommended that a holistic approach is taken for assessment of Outcomes 1 and 2. These outcomes can be assessed by an end of unit test with questions covering all of the associated performance criteria. Within one question, assessment of knowledge and understanding and problem solving can occur. Each question can assess achievement of a number of performance criteria from either Outcome 1 or 2. Assessment items are available from the National Assessment Bank.

Outcome 3

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with the assessment of Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the content of Intermediate 2 Physics and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

In relation to PC (a), the teacher/lecturer should check by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate) and carrying out the experiment.

In relation to PCs (b) to (f), the following provides an indication of what may be included in a candidate's report.

PC (b)
Many experiments will follow a given procedure or method hence there is no need for a detailed description. The procedure may be described briefly in outline. The impersonal passive voice should be encouraged. The following should be included, as appropriate:

- aim of the experiment
- a labelled diagram, description of apparatus, instruments used
- how the independent variable was altered
- how measurements were taken or observations made.

PC (c)
Readings or observations should be recorded in a clear table. The table must include:

- correct headings
- appropriate units
- correctly entered readings/observations.

PC (d)
Readings should be analysed and presented using the following, as appropriate:

- a table with suitable headings and units.
- a table with ascending or descending independent variable
- a table showing appropriate computations
- a graph with independent and dependent variables plotted
- a graph with suitable scales and axes labelled with quantities and units
- a graph with data correctly plotted with a line or a curve of best fit.

PC (e)
Conclusions should contain, as appropriate, a statement relating to:

- overall pattern to readings or observations
- trends in analysed information or results
- connection between variables
- measurement of a physical quantity.

PC (f)
The experimental procedures should be evaluated with supporting argument by including a few brief sentences, as appropriate, commenting on:

- effectiveness of procedures
- control of variables
- limitations of equipment
- possible improvements
- possible sources of error.

National Unit Specification: support notes (cont)

UNIT Mechanic and Heat (Intermediate 2)

The references under each performance criterion give an indication of what should be provided as evidence in order to achieve the criterion. The relevance of these will vary according to the experiment. These references are intended to assist the teacher/lecturer in making a judgement of the candidate's achievement against the performance criteria. It is appropriate to give limited support to candidates in producing their reports. Re-drafting of reports after necessary supportive criticism is to be encouraged, both as part of the learning and teaching process and to produce evidence for assessment.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 on Special Assessment Arrangements* (SQA, 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Electricity and Electronics (Intermediate 2)

NUMBER D380 11

COURSE Physics (Intermediate 2)

SUMMARY

The unit seeks to develop the candidate's knowledge and understanding of the basic concepts and principles behind the electrical and electronic devices which they encounter in their everyday lives. The unit also provides an opportunity for developing the ability to apply these concepts and principles in the analysis of a wide variety of circuits and applications.

OUTCOMES

1 Demonstrate knowledge and understanding related to electricity and electronics.
2 Solve problems related to electricity and electronics.
3 Collect and analyse information related to Intermediate 2 Physics obtained by experiment.

RECOMMENDED ENTRY

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

- Standard Grade Physics with Knowledge and Understanding and Problem Solving at grade 3 or 4

or

- Standard Grade Biology, Chemistry or Science with Knowledge and Understanding and Problem Solving at grade 1, 2 or 3

or

- Intermediate 1 Physics

and

- Standard Grade Mathematics at grade 3 or 4 **or** Intermediate 1 Mathematics

CREDIT VALUE

1 credit at Intermediate 2.

Administrative Information

Superclass: RC

Publication date: June 2004

Source: Scottish Qualifications Authority

Version: 05

National Unit Specification: general information (cont)

UNIT Electricity and Electronics (Intermediate 2)

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

UNIT Electricity and Electronics (Intermediate 2)

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 the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding related to electricity and electronics.

Performance criteria

(a) Quantities, units and symbols are used correctly in relation to electricity and electronics.
(b) Relationships and mathematical techniques are used correctly in relation to electricity and electronics.
(c) Principles are used correctly in relation to electricity and electronics.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the Content Statements, given in the National Course Specification: course details, in each of the following areas:

- Circuits
- Electrical energy
- Electromagnetism
- Electronic components.

OUTCOME 2
Solve problems related to electricity and electronics.

Performance criteria

(a) Relevant information is selected and presented appropriately.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid, and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the areas shown below.

- Circuits
- Electrical energy
- Electromagnetism
- Electronic components.

National Unit Specification: statement of standards (cont)

UNIT Electricity and Electronics (Intermediate 2)

OUTCOME 3

Collect and analyse information related to Intermediate 2 Physics obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity related to Intermediate 2 Physics covering the above performance criteria is required. Evidence submitted in support of attainment of PC (d) must be in the format of a table or graph as appropriate. The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is to be managed; identifying and obtaining resources, some of which must be unfamiliar; carrying out the experiment. The report must be the individual work of the candidate and must be based on an experiment in which the candidate has been involved. Depending on the activity, the collection of the information may be through group work.

An Outcome 3 report of practical work in this unit may be used as evidence of the achievement of Outcome 3 of the Intermediate 2 Physics units D379 11 Mechanics and Heat, D381 11 Waves and Optics and D382 11 Radioactivity. An Outcome 3 report of practical work in the Intermediate 2 Physics unit D379 11 Mechanics and Heat or D381 11 Waves and Optics may be used as evidence of the achievement of Outcome 3 of this unit.

As simulation is permitted in the assessment of Outcome 3 of the unit D382 11 Radioactivity, a report of practical work in that unit may not be used as evidence of the achievement of Outcome 3 in this unit.

National Unit Specification: support notes

UNIT Electricity and Electronics (Intermediate 2)

This part of the unit specification is 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 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

The content and suggested contexts, applications, illustrations and activities for this unit are given in the National Course Specification: course details. The subheadings in the tables in the course details correspond to the areas mentioned in the evidence requirements for Outcome 1 and Outcome 2. The practical activities chosen for Outcome 3 must relate to the content of Intermediate 2 Physics and must allow opportunity for all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The learning and teaching of this unit are most effective when the concepts, principles and theories are set in a relevant context, eg by making reference to applications of physics and to real-world situations. Suitable approaches to learning and teaching are detailed in the National Course Specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcomes 1 and 2

It is recommended that a holistic approach is taken for assessment of Outcomes 1 and 2. These outcomes can be assessed by an end of unit test with questions covering all of the associated performance criteria. Within one question, assessment of knowledge and understanding and problem solving can occur. Each question can assess achievement of a number of performance criteria from either Outcome 1 or 2. Assessment items are available from the National Assessment Bank.

Outcome 3

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with the assessment of Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the content of Intermediate 2 Physics and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

In relation to PC (a), the teacher/lecturer should check by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate) and carrying out the experiment.

In relation to PCs (b) to (f), the following provides an indication of what may be included in a candidate's report.

PC (b)
Many experiments will follow a given procedure or method hence there is no need for a detailed description. The procedure may be described briefly in outline. The impersonal passive voice should be encouraged. The following should be included, as appropriate:

- aim of the experiment
- a labelled diagram, description of apparatus, instruments used
- how the independent variable was altered
- how measurements were taken or observations made.

PC (c)
Readings or observations should be recorded in a clear table. The table must include:

- correct headings
- appropriate units
- correctly entered readings/observations.

PC (d)
Readings should be analysed and presented using the following, as appropriate:

- a table with suitable headings and units
- a table with ascending or descending independent variable
- a table showing appropriate computations
- a graph with independent and dependent variables plotted
- a graph with suitable scales and axes labelled with quantities and units
- a graph with data correctly plotted with a line or a curve of best fit.

PC (e)
Conclusions should contain, as appropriate, a statement relating to:

- overall pattern to readings or observations
- trends in analysed information or results
- connection between variables
- measurement of a physical quantity.

PC (f)
The experimental procedures should be evaluated with supporting argument by including a few brief sentences, as appropriate, commenting on:

- effectiveness of procedures
- control of variables
- limitations of equipment
- possible improvements
- possible sources of error.

National Unit Specification: support notes (cont)

UNIT Electricity and Electronics (Intermediate 2)

The references under each performance criterion give an indication of what should be provided as evidence in order to achieve the criterion. The relevance of these will vary according to the experiment. These references are intended to assist the teacher/lecturer in making a judgement of the candidate's achievement against the performance criteria. It is appropriate to give limited support to candidates in producing their reports. Re-drafting of reports after necessary supportive criticism is to be encouraged, both as part of the learning and teaching process and to produce evidence for assessment.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 on Special Assessment Arrangements* (SQA, 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Waves and Optics (Intermediate 2)

NUMBER D381 11

COURSE Physics (Intermediate 2)

SUMMARY

The unit seeks to develop the candidate's knowledge and understanding of the basic concepts and principles related to waves and optics. The unit also provides an opportunity for developing the ability to apply these concepts and principles in the analysis of a wide variety of applications.

OUTCOMES

1 Demonstrate knowledge and understanding related to waves and optics.
2 Solve problems related to waves and optics.
3 Collect and analyse information related to Intermediate 2 Physics obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained the following.

- Standard Grade Physics with Knowledge and Understanding and Problem Solving at grade 3 or 4

or

- Standard Grade Biology, Chemistry or Science with Knowledge and Understanding and Problem Solving at grade 1, 2 or 3

or

- Intermediate 1 Physics

and

- Standard Grade Mathematics at grade 3 or 4 **or** Intermediate 1 Mathematics

CREDIT VALUE

0.5 credit at Intermediate 2.

Administrative Information

Superclass: RC

Publication date: June 2004

Source: Scottish Qualifications Authority

Version: 05

National Unit Specification: general information (cont)

UNIT Waves and Optics (Intermediate 2)

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

UNIT Waves and Optics (Intermediate 2)

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 the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding related to waves and optics.

Performance criteria

(a) Quantities and their units are used correctly in relation to waves and optics.
(b) Relationships and mathematical techniques are used correctly in relation to waves and optics.
(c) Principles are used correctly in relation to waves and optics.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the Content Statements, given in the National Course Specification: course details, in each of the following areas:

- Waves
- Reflection
- Refraction.

OUTCOME 2
Solve problems related to waves and optics.

Performance criteria

(a) Relevant information is selected and presented appropriately.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid, and explanations given are supported by evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the areas shown below.

- Waves
- Reflection
- Refraction.

National Unit Specification: statement of standards (cont)

UNIT Waves and Optics (Intermediate 2)

OUTCOME 3

Collect and analyse information related to Intermediate 2 Physics obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity related to Intermediate 2 Physics covering the above performance criteria is required. Evidence submitted in support of attainment of PC (d) must be in the format of a table or graph as appropriate. The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is to be managed; identifying and obtaining resources, some of which must be unfamiliar; carrying out the experiment. The report must be the individual work of the candidate and must be based on an experiment in which the candidate has been involved. Depending on the activity, the collection of the information may be through group work.

An Outcome 3 report of practical work in this unit may be used as evidence of the achievement of Outcome 3 of the Intermediate 2 Physics units D379 11 Mechanics and Heat, D380 11 Electricity and Electronics and D382 11 Radioactivity. An Outcome 3 report of practical work in the Intermediate 2 Physics unit D379 11 Mechanics and Heat or D380 11 Electricity and Electronics may be used as evidence of the achievement of Outcome 3 of this unit.

As simulation is permitted in the assessment of Outcome 3 of the unit D382 11 Radioactivity, a report of practical work in that unit may not be used as evidence of the achievement of Outcome 3 in this unit.

National Unit Specification: support notes

UNIT Waves and Optics (Intermediate 2)

This part of the unit specification is 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

The content and the suggested contexts, applications, illustrations and activities for this unit are given in the National Course Specification: course details. The subheadings in the tables in the course details correspond to the areas mentioned in the evidence requirements for Outcome 1 and Outcome 2. The practical activities chosen for Outcome 3 must relate to the content of Intermediate 2 Physics and must allow opportunity for all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The learning and teaching of this unit are most effective when the concepts, principles and theories are set in a relevant context, eg by making reference to applications of physics and to real-world situations. Suitable approaches to learning and teaching are detailed in the National Course Specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcomes 1 and 2

It is recommended that a holistic approach is taken for assessment of Outcomes 1 and 2. These outcomes can be assessed by an end of unit test with questions covering all of the associated performance criteria. Within one question, assessment of knowledge and understanding and problem solving can occur. Each question can assess achievement of a number of performance criteria from either Outcome 1 or 2. Assessment items are available from the National Assessment Bank.

Outcome 3

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with the assessment of Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the content of Intermediate 2 Physics and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

In relation to PC (a), the teacher/lecturer should check by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate) and carrying out the experiment.

In relation to PCs (b) to (f), the following provides an indication of what may be included in a candidate's report.

PC (b)
Many experiments will follow a given procedure or method hence there is no need for a detailed description. The procedure may be described briefly in outline. The impersonal passive voice should be encouraged. The following should be included, as appropriate:

- aim of the experiment
- a labelled diagram, description of apparatus, instruments used
- how the independent variable was altered
- how measurements were taken or observations made.

PC (c)
Readings or observation should be recorded in a clear table. The table must include:

- correct headings
- appropriate units
- correctly entered readings/observations.

PC (d)
Readings should be analysed and presented using the following, as appropriate:

- a table with suitable headings and units
- a table with ascending or descending independent variable
- a table showing appropriate computations
- a graph with independent and dependent variables plotted
- a graph with suitable scales and axes labelled with quantities and units
- a graph with data correctly plotted with a line or a curve of best fit.

PC (e)
Conclusions should contain, as appropriate, a statement relating to:

- overall pattern to readings or observations
- trends in analysed information or results
- connection between variables
- measurement of a physical quantity.

PC (f)
The experimental procedures should be evaluated with supporting argument by including a few brief sentences, as appropriate, commenting on:

- effectiveness of procedures
- control of variables
- limitations of equipment
- possible improvements
- possible sources of error

National Unit Specification: support notes (cont)

UNIT Waves and Optics (Intermediate 2)

The references under each performance criterion give an indication of what should be provided as evidence in order to achieve the criterion. The relevance of these will vary according to the experiment. These references are intended to assist the teacher/lecturer in making a judgement of the candidate's achievement against the performance criteria. It is appropriate to give limited support to candidates in producing their reports. Re-drafting of reports after necessary supportive criticism is to be encouraged, both as part of the learning and teaching process and to produce evidence for assessment.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 on Special Assessment Arrangements* (SQA, 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Radioactivity (Intermediate 2)

NUMBER D382 11

COURSE Physics (Intermediate 2)

SUMMARY

The unit seeks to develop the candidate's knowledge and understanding of the basic concepts and principles related to radioactivity. The unit also provides an opportunity for developing the ability to apply these concepts and principles in the analysis of a wide variety of applications.

OUTCOMES

1 Demonstrate knowledge and understanding related to radioactivity.
2 Solve problems related to radioactivity.
3 Collect and analyse information related to Intermediate 2 Physics obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained the following.

- Standard Grade Physics with Knowledge and Understanding and Problem Solving at grade 3 or 4

or

- Standard Grade Biology, Chemistry or Science with Knowledge and Understanding and Problem Solving at grade 1, 2 or 3

or

- Intermediate 1 Physics

and

- Standard Grade Mathematics at grade 3 or 4 **or** Intermediate 1 Mathematics

CREDIT VALUE

0.5 credit at Intermediate 2.

Administrative Information

Superclass: RC

Publication date: June 2004

Source: Scottish Qualifications Authority

Version: 05

National Unit Specification: general information (cont)

UNIT Radioactivity (Intermediate 2)

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

UNIT Radioactivity (Intermediate 2)

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 the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate knowledge and understanding related to radioactivity.

Performance criteria

(a) Quantities and their units are used correctly in relation to radioactivity.
(b) Relationships and mathematical techniques are used correctly in relation to radioactivity.
(c) Principles are used correctly in relation to radioactivity.
(d) Models are described correctly in relation to radioactivity.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the Content Statements, given in the National Course Specification: course details, in each of the following areas:

- Ionising radiations
- Dosimetry
- Half life and safety
- Nuclear reactors.

OUTCOME 2
Solve problems related to radioactivity.

Performance criteria

(a) Relevant information is selected and presented appropriately.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid, and explanations given are supported by evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the areas shown below.

- Ionising radiations
- Dosimetry
- Half life and safety
- Nuclear reactors.

National Unit Specification: statement of standards (cont)

UNIT Radioactivity (Intermediate 2)

OUTCOME 3

Collect and analyse information related to Intermediate 2 Physics obtained by experiment or radioactivity simulation.

Performance criteria

(a) The information is collected by active participation in the experiment or radioactivity simulation.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity related to Intermediate 2 Physics covering all of the above performance criteria is required. Evidence submitted in support of attainment of PC (d) must be in the format of a table or graph as appropriate. The report must be the individual work of the candidate and must be based on either an experiment, or a suitable radioactivity simulation, in which the candidate has been involved. Depending on the activity, the collection of the information may be through group work.

An Outcome 3 report of practical work in the Intermediate 2 unit, D379 11 Mechanics and Heat or D380 11 Electricity and Electronics or D381 11 Waves and Optics may be used as evidence of the achievement of Outcome 3 of this unit.

As simulation is permitted in the assessment of Outcome 3 of this unit, a report of practical work in this unit may not be used as evidence of the achievement of Outcome 3 in any other Intermediate 2 Physics Unit.

National Unit Specification: support notes

UNIT Radioactivity (Intermediate 2)

This part of the unit specification is 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

The content and suggested contexts, applications, illustrations and activities for this unit are given in the National Course Specification: course details. The subheadings in the tables in the course details correspond to the areas mentioned in the evidence requirements for Outcome 1 and Outcome 2. The practical activities chosen for Outcome 3 must relate to the content of Intermediate 2 Physics and must allow opportunity for all the performance criteria for this outcome to be demonstrated within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The learning and teaching of this unit are most effective when the concepts, principles and theories are set in a relevant context, eg by making reference to applications of physics and to real-world situations. Suitable approaches to learning and teaching are detailed in the National Course Specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcomes 1 and 2

It is recommended that a holistic approach is taken for assessment of the Outcomes 1 and 2. These outcomes can be assessed by an end of unit test with questions covering all of the associated performance criteria. Within one question, assessment of knowledge and understanding and problem solving can occur. Each question can assess achievement of a number of performance criteria from either Outcome 1 or 2. Assessment items are available from the National Assessment Bank.

Outcome 3

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with the assessment of Outcome 3 is at an appropriate level of demand. The experimental activity must relate to the content of Intermediate 2 Physics and candidates should be made aware of the range of skills that must be demonstrated to ensure attainment of Outcome 3.

Due attention to safety requirements and age limitations with regard to the use of radioactive sources is necessary for any experimental work in radioactivity. Thus, simulations and videos on radioactivity are acceptable for this unit. As simulation is permitted in the assessment of Outcome 3 of this unit a report of practical work in this unit may not be used as evidence of the achievement of Outcome 3 in any other Intermediate 2 Physics Unit.

National Unit Specification: support notes (cont)

UNIT Radioactivity (Intermediate 2)

In relation to PC (a), where actual experimental work is undertaken, the teacher/lecturer should check by direct observation that the candidate participates in the collection the experimental information by playing an active part in the experiment.

Alternatively, the candidate could collect experimental information on radioactivity by:
- participating in a simulation
- watching a video of an experiment.

In relation to PCs (b) to (f) the following provides an indication of what may be included in a candidate's report.

PC (b)
Many experiments will follow a given procedure or method hence there is no need for a detailed description. The procedure may be described briefly in outline. The impersonal passive voice should be encouraged. The following should be included, as appropriate:
- aim of the experiment
- a labelled diagram, description of apparatus, instruments used
- how the independent variable was altered
- how measurements were taken or observations made.

PC (c)
Readings or observation should be recorded in a clear table. The table must include:
- correct headings
- appropriate units
- correctly entered readings/observations.

PC (d).
Readings should be analysed and presented using the following, as appropriate:
- a table with suitable headings and units
- a table with ascending or descending independent variable
- a table showing appropriate computations
- a graph with independent and dependent variables plotted
- a graph with suitable scales and axes labelled with quantities and units
- a graph with data correctly plotted with a line or a curve of best fit.

PC (e)
Conclusions should contain, as appropriate, a statement relating to:
- overall pattern to readings or observations
- trends in analysed information or results
- connection between variables
- measurement of a physical quantity.

PC (f)
The experimental procedures should be evaluated with supporting argument by including a few brief sentences, as appropriate, commenting on:

- effectiveness of procedures
- control of variables
- limitations of equipment
- possible improvements
- possible sources of error

The references under each performance criterion give an indication of what should be provided as evidence in order to achieve the criterion. The relevance of these will vary according to the experiment. These references are intended to assist the teacher/lecturer in making a judgement of the candidate's achievement against the performance criteria. It is appropriate to support candidates in producing their reports. Re-drafting of reports after necessary supportive criticism is to be encouraged, both as part of the learning and teaching process and to produce evidence for assessment.

SPECIAL NEEDS
This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 on Special Assessment Arrangements* (SQA, 2003).