

Physics: Waves and Radiation

SCQF: level 5 (6 SCQF credit points)

Unit code: J2CL 75

Unit outline

The general aim of this Unit is to develop skills of scientific inquiry, investigation and analytical thinking, along with knowledge and understanding of waves and radiation. Learners will apply these skills when considering the applications of waves and radiation on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of waves and nuclear radiation. Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Learners who complete this Unit will be able to:

- 1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment/practical investigation
- 2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills

This Unit is available as a free-standing Unit. The Unit Specification should be read in conjunction with the *Unit Support Notes*, which provide advice and guidance on delivery, assessment approaches and development of skills for learning, skills for life and skills for work. Exemplification of the standards in this Unit is given in *Unit Assessment Support*.

Recommended entry

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by one or more of the following or equivalent qualifications and/or experience:

- ◆ National 4 Physics Course or relevant component Units
- ◆ National 4 Science Course or relevant component Units

Equality and inclusion

This Unit Specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence. For further information, please refer to the *Unit Support Notes*.

Standards

Outcomes and Assessment Standards

Outcome 1

The learner will:

- 1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment/practical investigation by:**
 - 1.1 Planning an experiment/practical investigation
 - 1.2 Following procedures safely
 - 1.3 Making and recording observations/measurements correctly
 - 1.4 Presenting results in an appropriate format
 - 1.5 Drawing valid conclusions
 - 1.6 Evaluating experimental procedures

Outcome 2

The learner will:

- 2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills by:**
 - 2.1 Making accurate statements
 - 2.2 Solving problems

Evidence Requirements for the Unit

Assessors should use their professional judgement, subject knowledge and experience, and understanding of their learners, to determine the most appropriate ways to generate evidence and the conditions and contexts in which they are used.

The key areas covered in this Unit are:

Waves

- ◆ wave parameters and behaviours
- ◆ electromagnetic spectrum
- ◆ light

Nuclear radiation

Waves and Radiation

Wave parameters and behaviours

- ◆ Knowledge that energy can be transferred as waves.
- ◆ Determination of frequency, period, wavelength, amplitude and wave speed for longitudinal and transverse waves.
- ◆ Use of appropriate relationships to solve problems involving wave speed, frequency, period, wavelength, distance and time.
- ◆ Awareness of the practical limitations of demonstrating diffraction.
- ◆ Comparison of long wave and short-wave diffraction.

Electromagnetic spectrum

- ◆ Knowledge of the relative frequency and wavelength of bands of the electromagnetic spectrum with reference to typical sources, detectors and applications.
- ◆ Knowledge of the qualitative relationship between the frequency and energy associated with a form of radiation.
- ◆ Knowledge that all radiations in the electromagnetic spectrum travel at the speed of light.

Light

- ◆ In ray diagrams showing refraction, identification of the normal, angle of incidence and angle of refraction.
- ◆ Description of refraction in terms of change of wave speed, change of wavelength and change of direction (where the angle of incidence is greater than 0°).

Nuclear radiation

- ◆ Knowledge of the nature of alpha, beta and gamma radiation, the relative effect of their ionisation, and their relative penetration.
- ◆ Use of an appropriate relationship to solve problems involving activity, number of nuclear disintegrations and time.
- ◆ Knowledge of background radiation sources.
- ◆ Use of appropriate relationships to solve problems involving absorbed dose, equivalent dose, energy, mass and radiation weighting factor.
- ◆ Comparison of equivalent dose due to a variety of natural and artificial sources.
- ◆ Awareness of equivalent dose rate and exposure safety limits for the public and for workers in radiation industries in terms of annual effective equivalent dose.
- ◆ Use of an appropriate relationship to carry out calculations involving equivalent dose rate, equivalent dose and time.
- ◆ Awareness of applications of nuclear radiation.
- ◆ Definition of *half-life*.
- ◆ Use of graphical or numerical data to determine the half-life of a radioactive material.
- ◆ Qualitative description of fission and fusion, with emphasis on the importance of these processes in the generation of energy.

Evidence can be drawn from a variety of sources and presented in a variety of formats. The table below describes the evidence for the Assessment Standards which require exemplification. Evidence may be presented for individual Outcomes, or gathered for the Unit. If the latter approach is used, it must be clear how the evidence covers each Outcome.

Assessment Standard	Evidence Requirements
Planning an experiment/practical investigation	The plan should include: <ul style="list-style-type: none"> ◆ an aim ◆ a dependent and independent variable ◆ variables to be kept constant ◆ measurements/observations to be made ◆ the resources ◆ the method, including safety considerations if appropriate
Presenting results in an appropriate format	One format from: table, line graph, chart, key, diagram, summaries or other appropriate formats.
Drawing valid conclusions	Include reference to the aim.
Evaluating experimental procedures	Suggest an improvement with justification.
Making accurate statements	At least half of the statements should be correct across the key areas of each Unit.
Solving problems	One of each: <ul style="list-style-type: none"> ◆ make predictions ◆ select information ◆ process information including calculations as appropriate ◆ analyse information
Outcome 2: Making accurate statements and solving problems may be combined into one holistic assessment, with marks allocated to each question. In this case, to achieve Outcome 2 the candidate must achieve at least 50% of the marks available in the set of questions.	

Outcome 1: Candidates must achieve at least 5 out of the 6 Assessment Standards to achieve a pass.

Transfer of evidence: Evidence for the achievement of Outcome 1 for this Unit can be used as evidence for the achievement of Outcome 1 in the Units J26L 75 *Physics: Electricity and Energy* and J2CK 75 *Dynamics and Space*.

Where Assessment Standard 2.2 is being assessed separately from Assessment Standard 2.1, evidence of achievement of Assessment Standard 2.2 for this Unit can be used as evidence of achievement of Assessment Standard 2.2 in the Units J26L 75 *Physics: Electricity and Energy* and J2CK 75 *Dynamics and Space*.

Note: this does not apply when Outcome 2 is being assessed holistically.

As Assessment Standard 2.1 (Making accurate statements) relates specifically to the key areas of each Unit, evidence is **not transferable** between the Units for this Assessment Standard.

Exemplification of assessment is provided in *Unit Assessment Support*. Advice and guidance on possible approaches to assessment is provided in the *Unit Support Notes*.

Assessment Standard Thresholds

Outcome 1

Candidates are no longer required to show full mastery of the Assessment Standards to achieve Outcome 1. Instead, five out of the six Assessment Standards for Outcome 1 must be met to achieve a pass.

There is still the requirement for candidates to be given the opportunity to meet all Assessment Standards. The above threshold has been put in place to reduce the volume of re-assessment where that is required.

Re-assessment

Candidates may be given the opportunity to re-draft their original Outcome 1 report or to carry out a new experiment/practical investigation.

Outcome 2

Assessment Standards 2.1 and 2.2

Assessment Standards 2.1 (making accurate statements) and 2.2 (solving problems) are no longer required to be passed independently. Assessment Standards 2.1 and 2.2 can now be assessed by means of a single assessment for each Unit.

Centres have two possible options when assessing Outcome 2 (AS 2.1 and 2.2).

Option 1: Single assessment

Candidates can be assessed by means of a single test that contains marks and a cut-off score. A suitable Unit assessment will cover all of the key areas (AS 2.1) and assess each of the problem solving skills (AS 2.2).

Where a candidate achieves 50% or more of the total marks available in a single Unit assessment they will pass Outcome 2 for that Unit. Existing Unit assessment support packs can be used. Guidance on the use of each pack is noted below.

Unit assessment support pack 1 (Unit-by-Unit approach)

As these packages contain questions on all of the key areas (AS 2.1) and questions covering each of the problem solving skills (AS 2.2), Unit assessment support pack 1 may be adapted for use as a single assessment for its associated Unit.

The number of marks available for each question should be combined to give the total number of marks available. A cut-off score of 50% should be applied to each of these Unit assessments.

The balance of knowledge and skills in the current Unit assessment support packs does not reflect the relative importance of these within physics, since they do not adequately assess physics based calculations.

Centres should either replace some of the questions in the Unit assessment support packs or supplement the existing questions with additional questions. In particular, centres may wish to replace existing questions with questions testing physics calculations or add additional questions of this type, so that the tests better reflect the relative importance of calculations in physics.

Where a calculation is of the type known as a 'standard three marker', it should be allocated 3 marks and the general marking principles in the National 5 to Advanced Higher exams used.

Marks for questions testing KU would be allocated on a 1 mark for one response basis, using the marking guidance in the Unit assessment support packs.

If centres are replacing questions, it is important that each key area is still sampled.

Where centres are adding additional questions, care should be taken that these questions are of an appropriate standard for Unit assessment and are not 'A grade' type questions. For example, two stage calculations should be split into two separate parts rather than being presented as a 4 or 5 mark calculation question.

Unit assessment support pack 2 (combined approach)

As these packages contain questions covering only Assessment Standard 2.1 they are not suitable for use as a single assessment for their associated Units.

If a centre wishes to use Unit assessment support pack 2 as a single Unit assessment, questions covering each of the four problem solving skills would need to be added, with an emphasis on 'standard three marker' type calculation questions.

Marks for questions testing KU (AS 2.1) would be allocated on a 1 mark for one response basis, using the marking guidance in the Unit assessment support packs.

The marks available for the key areas (AS 2.1) in each of these Unit assessments should be combined with the marks added to assess the problem solving skills (AS 2.2) before the 50% cut-off score is applied.

Where centres are adding additional questions, care should be taken that these questions are of an appropriate standard for Unit assessment and are not 'A grade' type questions.

Option 2: Assessment

Centres can continue to use the Unit assessment support packs from SQA's secure site or their own centre devised assessments following the guidance in the Unit assessment support packs.

If this option is chosen, 50% or more of the KU statements (AS 2.1) made by candidates must be correct in the Unit assessment and at least one correct response for each problem solving skill (AS 2.2) is required to pass Outcome 2. However, if a candidate is given more than one opportunity in a Unit assessment to provide a response for a problem solving skill, then they must answer 50% or more correctly.

Re-assessment

SQA's guidance on re-assessment is that there should be one or, in exceptional circumstances, two re-assessment opportunities. Re-assessment should be carried out under the same conditions as the original assessment. It is at a centre's discretion as to how they re-assess their candidates. Candidates may be given a full re-assessment opportunity, or be re-assessed on individual key areas and/or problem solving skills. Regardless of which KU option is chosen, candidates must achieve 50% or more of each re-assessment opportunity.

Development of skills for learning, skills for life and skills for work

It is expected that learners will develop broad, generic skills through this Unit. The skills that learners will be expected to improve on and develop through the Unit are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and drawn from the main skills areas listed below. These must be built into the Unit where there are appropriate opportunities.

2 Numeracy

- 2.1 Number processes
- 2.2 Money, time and measurement
- 2.3 Information handling

5 Thinking skills

- 5.3 Applying
- 5.4 Analysing and evaluating

Amplification of these is given in SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work*. The level of these skills should be at the same SCQF level of the Unit and be consistent with the SCQF level descriptor. Further information on building in skills for learning, skills for life and skills for work is given in the *Unit Support Notes*.

Administrative information

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Superclass: RC

History of changes to National Unit Specification

Version	Description of change	Authorised by	Date
2.0	Added table detailing content to be covered. Transfer of evidence updated. Evidence requirements updated.	Qualifications Manager	April 2018
2.1	Assessment standard threshold added.	Qualifications Manager	September 2018
3.0	Unit code updated	Qualifications Manager	July 2019

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