SCQF level 6
Unit Specification

Physics: Our Dynamic Universe

SCQF: level 6 (6 SCQF credit points)

Unit code: J20B 76

Unit outline

The general aim of this Unit is to develop skills of scientific inquiry, investigation, analytical thinking and independent working, along with knowledge and understanding of our dynamic universe. Learners will apply these skills when considering the applications of our dynamic universe on our lives. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of motion – equations and graphs; forces, energy, and power; collisions, explosions, and impulse; gravitation; special relativity; the expanding Universe.

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 5 Physics Course or relevant 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:

- motion - equations and graphs
- forces, energy, and power
- collisions, explosions, and impulse
- gravitation
- special relativity
- the expanding Universe

The *Unit Support Notes* (Appendix) provide details of skills, knowledge and understanding sampled in the Unit assessment.

The following table describes the evidence for the Assessment Standards.

Assessment Standard	Evidence Requirements
Planning an experiment or practical investigation	A plan that must include: ♦ a clear statement of the aim ♦ a dependent and independent variable ♦ variables to be kept constant ♦ measurements and/or observations to be made ♦ necessary equipment and/or materials ♦ a clear and detailed description of how the experiment or practical investigation should be carried out, including safety considerations
Following procedures safely	Record showing the learner was observed following procedures safely
Making and recording observations/measurements correctly	Raw data recorded in a relevant format, for example, a table Repeated measurements, where appropriate Where measurements are repeated, averages must be calculated.
Presenting results in an appropriate format	Results presented in a scatter graph
Drawing a valid conclusion	A conclusion that includes reference to the aim and is supported by the data
Evaluating experimental procedures	Two evaluative statements, with justifications, about the procedures used
Making accurate statements and solving problems	Achievement of at least 50% of the total marks available in a holistic assessment The assessment must **not** be split into smaller sections, such as individual key areas

Exemplification of assessment is provided in *Unit Assessment Support*.

Assessment Standard Thresholds

Outcome 1
Learners are not 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. Learners must be given the opportunity to meet all Assessment Standards.

Outcome 2
Learners are assessed using a holistic test that covers Assessment Standards 2.1 and 2.2. For Outcome 2, learners must achieve 50% or more of the total marks available in the assessment.

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 SCQF level 6 Units *Physics: Particles and Waves* (J20C 76) and *Physics: Electricity* (J20A 76).

Evidence for the achievement of Outcome 2 for this Unit is **not** transferable between the SCQF level 6 Units *Physics: Particles and Waves* (J20C 76) and *Physics: Electricity* (J20A 76).

Re-assessment

SQA's guidance on re-assessment is that there should be one or, in exceptional circumstances, two re-assessment opportunities. Re-assessment must be carried out under the same conditions as the original assessment and must be of equal demand.

Outcome 1
Learners can either re-draft their original Outcome 1 report or carry out a new experiment and/or practical investigation.

Outcome 2
Learners must have a full re-assessment opportunity that consists of a holistic assessment. For Outcome 2, learners must achieve 50% of the total marks available in the re-assessment.

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.

1 Literacy
1.2 Writing

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
5.5 Creating

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.*

Appendix: Unit Support Notes

Introduction

These support notes provide advice and guidance on developing skills, knowledge and understanding for the Unit assessment. They should be read in conjunction with:

- *Unit Assessment Support*

Developing skills, knowledge and understanding

Teachers and lecturers are free to select the skills, knowledge and understanding, and contexts that are most appropriate for delivery in their centres.

Skills, knowledge and understanding for the unit assessment

The following information provides details of skills, knowledge and understanding sampled in the Unit Assessment.

Motion — equations and graphs

- Use of appropriate relationships to solve problems involving distance, displacement, speed, velocity, and acceleration for objects moving with constant acceleration in a straight line.

  $$d = \bar{v}t$$

  $$s = \bar{v}t$$

  $$v = u + at$$

  $$s = ut + \tfrac{1}{2}at^2$$

  $$v^2 = u^2 + 2as$$

  $$s = \tfrac{1}{2}(u + v)t$$

- Interpretation and drawing of motion-time graphs for motion with constant acceleration in a straight line, including graphs for bouncing objects and objects thrown vertically upwards.
- Knowledge of the interrelationship of displacement-time, velocity-time and acceleration-time graphs
  Calculation of displacement, velocity, and acceleration from appropriate graphs.
  All graphs restricted to constant acceleration in one dimension, inclusive of change of direction.

Forces, energy, and power

- Use of appropriate relationships to solve problems involving balanced and unbalanced forces, mass, acceleration, and gravitational field strength.

  $$F = ma$$

  $$W = mg$$

- Knowledge of the effects of friction on a moving object (no reference to static and dynamic friction).
- Explanation, in terms of forces, of an object moving with terminal velocity.
- Interpretation of velocity-time graphs for a falling object when air resistance is taken into account
- Use of Newton's first and second laws to explain the motion of an object
- Use of free body diagrams and appropriate relationships to solve problems involving friction and tension (as a pulling force exerted by a string or cable).

  $$F = ma$$

  $$W = mg$$

- Resolution of a force into to two perpendicular components, including the resolution of the weight of an object on a slope into component forces parallel and normal to the surface of the slope.

- Use of the principle of conservation of energy and appropriate relationships to solve problems involving work done, potential energy, kinetic energy, and power.

  $E_W = Fd$, or $W = Fd$

  $E_p = mgh$

  $E_k = \frac{1}{2}mv^2$

  $P = \dfrac{E}{t}$

Collisions, explosions and impulse

- Use of the principle of conservation of momentum and an appropriate relationship to solve problems involving the momentum, mass, and velocity of objects interacting in one dimension.

  $p = mv$

- Knowledge of energy interactions involving the total kinetic energy of systems of objects undergoing inelastic collisions, elastic collisions, and explosions
- Use of an appropriate relationship to solve problems involving the total kinetic energy of systems of interacting objects.

  $E_k = \frac{1}{2}mv^2$

- Use of Newton's third law to explain the motion of objects involved in interactions.
- Interpretation of force-time graphs during contact of interacting objects. Knowledge that the impulse of a force is equal to the area under a force-time graph, and is equal to the change in momentum of an object involved in the interaction.
- Use of data from a force-time graph to solve problems involving the impulse of a force, the average force, and its duration.
- Use of an appropriate relationship to solve problems involving the mass, change in velocity, average force, and duration of the force for an object involved in an interaction.

  $Ft = mv - mu$

Gravitation

- Knowledge that satellites are in free fall around a planet or star. Resolution of the initial velocity of a projectile into horizontal and vertical components and their use in calculations.
- Use of appropriate relationships to solve problems involving projectiles

  $d = \bar{v}t$

  $s = \bar{v}t$

  $v = u + at$

  $s = ut + \frac{1}{2}at^2$

  $v^2 = u^2 + 2as$

  $s = \frac{1}{2}(u + v)t$

- Knowledge that the horizontal motion and vertical motion of a projectile are independent of each other.
- Use of Newton's Law of Universal Gravitation to solve problems involving force, masses, and their separation

$$F = G\frac{m_1 m_2}{r^2}$$

Special relativity

- Knowledge that the speed of light in a vacuum is the same for all observers. Knowledge that measurements of space and time for a moving observer are changed relative to those for a stationary observer, giving rise to time dilation.
- Use of appropriate relationships to solve problems involving length contraction, time dilation, and speed

$$t' = \frac{t}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$$

$$l' = l\sqrt{1-\left(\frac{v}{c}\right)^2}$$

The expanding Universe

- Knowledge that the Doppler effect causes shifts in wavelengths of sound and light.

- Use of an appropriate relationship to solve problems involving the observed frequency, source frequency, source speed, and wave speed.

$$f_o = f_s\left(\frac{v}{v \pm v_s}\right)$$

- Knowledge that the light from objects moving away from us is shifted to longer (more red) wavelengths.
- Knowledge that the redshift of a galaxy is the change in wavelength divided by the emitted wavelength. For slowly moving galaxies, redshift is the ratio of the velocity of the galaxy to the velocity of light.
- Use of appropriate relationships to solve problems involving redshift, observed wavelength, emitted wavelength and recessional velocity.

$$z = \frac{\lambda_{observed} - \lambda_{rest}}{\lambda_{rest}}$$

$$z = \frac{v}{c}$$

- Use of an appropriate relationship to solve problems involving the Hubble constant, the recessional velocity of a galaxy, and its distance from us.

$$v = H_0 d$$

- Knowledge that the Hubble-Lemaître law allows us to estimate the age of the Universe.

- Knowledge of evidence supporting the expanding Universe theory.
- Knowledge that the mass of a galaxy can be estimated by the orbital speed of stars within it.
- Knowledge that evidence supporting the existence of dark matter comes from estimations of the mass of galaxies.
- Knowledge that evidence supporting the existence of dark energy comes from the accelerating rate of expansion of the Universe.
- Knowledge that the temperature of stellar objects is related to the distribution of emitted radiation over a wide range of wavelengths.
  Knowledge that the wavelength of the peak wavelength of this distribution is shorter for hotter objects than for cooler objects.
- Knowledge of the qualitative relationship between radiation emitted per unit surface area per unit time and the temperature of a star.
- Knowledge of evidence supporting the Big Bang theory and subsequent expansion of the Universe, for example: cosmic microwave background radiation, the abundance of the elements hydrogen and helium, the darkness of the sky (Olbers' paradox), and the large number of galaxies showing redshift, rather than blueshift.

Units, prefixes, and uncertainties

Units, prefixes and scientific notation	Notes
Appropriate use of units and prefixes. Use of the appropriate number of significant figures in final answers. Appropriate use of scientific notation.	SI units should be used with all the physical quantities. Prefixes should be used where appropriate. These include pico (p), nano (n), micro (μ), milli (m), kilo (k), mega (M), giga (G) and tera (T). In carrying out calculations and using relationships to solve problems, it is important to give answers to an appropriate number of significant figures. This means that the final answer can have no more significant figures than the value with least number of significant figures used in the calculation. Candidates should be familiar with the use of scientific notation and this may be used as appropriate when large and small numbers are used in calculations.
Uncertainties	
Awareness of random and systematic uncertainties in a measured quantity. Use of an appropriate relationship to determine the random uncertainty in a value using repeated measurements. Appropriate use of uncertainties in data analysis.	All measurements of physical quantities are liable to uncertainty, which should be expressed in absolute or percentage form. Random uncertainties occur when an experiment is repeated and slight variations occur. Scale reading uncertainty is a measure of how well an instrument scale can be read. Random uncertainties can be reduced by taking repeated measurements. Systematic uncertainties occur when readings taken are either all too small or all too large. They can arise due to measurement techniques or experimental design. The random uncertainty is calculated by dividing the difference between the largest and smallest measured value by the number of trials. $\Delta x = \frac{(\max - \min)}{n}$ The mean of a set of readings is the best estimate of a 'true' value of the quantity being measured. When systematic uncertainties are present, the mean value of measurements will be offset. When mean values are used, the approximate random uncertainty should be calculated. When an experiment is being undertaken and more than one physical quantity is measured, the quantity with the largest percentage uncertainty should be identified and this may often be used as a good estimate of the percentage uncertainty in the final numerical result of an experiment. The numerical result of an experiment should be expressed in the form final value $\pm$uncertainty.

Administrative information

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Superclass: RC

History of changes to National Unit Specification

Version	Description of change	Authorised by	Date
2.0	Page 1 – the description of key areas under 'Unit outline' has been revised to give more information Page 4 – in Outcome 1.3, the word 'accurately' has been replaced by 'correctly'. Pages 4-5 – the Evidence requirements have been rewritten to better explain what is required; information has been added on Transfer of Evidence	Qualifications Development Manager	April 2014
3.0	Assessment Standards 2.2 & 2.3 removed	Qualifications Development Manager	June 2014
4.0	Level changed from Higher to SCQF level 6. Assessment standard threshold added.	Qualifications Manager	September 2018
5.0	Unit code updated	Qualifications Manager	July 2019
6.0	Information that had been omitted regarding assessment methodologies now added.	Qualifications Manager	October 2020
7.0	Refined guidance on Evidence Requirements; removed option for assessment-standard-specific evidence for Outcome 2. Added 'Assessment Standards thresholds' heading to existing information. Refined guidance on re-assessment. Some changes made to the format throughout the document to improve accessibility.	Qualifications Manager	August 2025

Version	Description of change	Authorised by	Date
7.0 (cont)	**What you need to do differently** ♦ If you are already assessing outcome 2 holistically at the end of the unit, by using the assessment as a single test with marks and a cut-off score, you don't need to do anything differently. ♦ If you have been assessing outcome 2 atomistically, by assessing each key area and each problem-solving skill separately, you must change to using the holistic approach for outcome 2. You must do this by administering the test in a single sitting, at the end of the unit, and applying the marks and cut-off score in the unit assessment support pack.	Qualifications Manager	August 2025