Advanced Higher Physics

Draft National Course Assessment Specification

Valid from August 2015

This edition: December 2012, draft version 1.0

Please refer to the note of changes at the end of this Course Assessment Specification for details of changes from previous version (where applicable).

Contents

Course outline

Course title:	Advanced Higher Physics
SCQF level:	7 (32 SCQF credit points)
Course code:	to be advised
Course assessment code:	to be advised

The purpose of the Course Assessment Specification is to ensure consistent and transparent assessment year on year. It describes the structure of the Course assessment and the mandatory skills, knowledge and understanding that will be assessed.

Course assessment structure

Component 1 — question paper	100 marks
Component 2 — project	30 marks
Total marks	**130 marks**

This Course includes eight SCQF credit points to allow additional time for preparation for Course assessment. The Course assessment covers the added value of the Course.

Equality and inclusion

This Course Assessment Specification has been designed to ensure that there are no unnecessary barriers to assessment. Assessments have been designed to promote equal opportunities while maintaining the integrity of the qualification.

For guidance on assessment arrangements for disabled learners and/or those with additional support needs, please follow the link to the Assessment Arrangements web page: www.sqa.org.uk/sqa/14977.html.

Guidance on inclusive approaches to delivery and assessment of this Course is provided in the *Course Support Notes*.

Assessment

To gain the award of the Course, the learner must pass all of the Units as well as the Course assessment. Course assessment will provide the basis for grading attainment in the Course award.

Course assessment

SQA will produce and give instructions for the production and conduct of Course assessments based on the information provided in this document.

Added value

The purpose of the Course assessment is to assess added value of the Course as well as confirming attainment in the Course and providing a grade. The added value for the Course will address the key purposes and aims of the Course as defined in the Course Rationale. It will do this by addressing one or more of challenge, or application.

In this Course assessment, added value will focus on the following:

- challenge — requiring greater depth or extension of knowledge and/or skills
- application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

This added value consists of:

- a question paper, which requires learners to demonstrate aspects of challenge and application; learners will apply breadth and depth of skills, knowledge and understanding from across the Course to answer questions in physics
- a project which requires learners to demonstrate aspects of challenge and application; learners will apply skills of scientific inquiry, using related knowledge, to carry out a meaningful and appropriately challenging task in physics and communicate findings

Grading

Course assessment will provide the basis for grading attainment in the Course award.

The Course assessment is graded A–D. The grade is determined on the basis of the total mark for all Course assessments together.

A learner's overall grade will be determined by their performance across the Course assessment.

Grade description for C
For the award of Grade C, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have demonstrated successful performance in relation to the mandatory skills, knowledge and understanding for the Course, by:

- retaining knowledge and scientific skills over an extended period of time
- integrating knowledge and understanding and scientific skills acquired through the study of the component Units
- applying knowledge and understanding and scientific skills set in contexts similar to those associated with the component Units
- applying knowledge and understanding, and scientific skills, to solve problems
- selecting, analysing and presenting relevant information collected through experimental, observational or research work
- reporting in a scientific manner that communicates the physics relating to the Course

Grade description for A
For the award of Grade A, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have demonstrated a consistently high level of performance in relation to the mandatory skills, knowledge and understanding for the Course. In addition, learners achieving a Grade A will have demonstrated a high overall level of performance by:

- retaining an extensive range of knowledge and scientific skills over an extended period of time
- integrating an extensive range of knowledge and understanding and scientific skills acquired across the component Units
- applying knowledge and understanding and scientific skills in less familiar and/or more complex contexts than in the component Units
- integrating knowledge and understanding and scientific skills to solve problems in less familiar and more complex contexts
- showing proficiency in selecting, analysing and presenting relevant information collected through experimental, observational or research work
- showing proficiency in reporting in a scientific manner that communicates the physics relating to the Course by analysing and interpreting information in a critical and scientific manner and demonstrating depth of knowledge and understanding

Credit
To take account of the extended range of learning and teaching approaches, remediation, consolidation of learning and integration needed for preparation for external assessment, six SCQF credit points are available in Courses at National 5 and Higher, and eight SCQF credit points in Courses at Advanced Higher. These points will be awarded when a Grade D or better is achieved.

Structure and coverage of the Course assessment

The Course assessment will consist of two Components: a question paper and a project.

Component 1 — question paper

The purpose of the question paper is to assess breadth and depth of knowledge and understanding from across the Units.

The question paper will assess scientific inquiry skills and analytical thinking skills.

The question paper will give learners an opportunity to demonstrate the following skills, knowledge and understanding by:

- demonstrating knowledge and understanding of physics by making statements, describing information, providing explanations and integrating knowledge
- applying knowledge of physics to new situations, interpreting information and solving problems
- selecting and presenting information appropriately in a variety of forms
- processing information (using calculations and units, where appropriate)
- making predictions based on evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- identifying sources of uncertainty and suggesting improvements to experiments

The mandatory skills and knowledge are specified in the 'Further mandatory information on Course coverage' section at the end of this Course Assessment Specification.

The question paper will have 100 marks (77% of the total mark)

The question paper will contain restricted and extended response questions.

Marks will be distributed approximately proportionately across the Units.

The majority of the marks will be awarded for applying knowledge and understanding. The other marks will be awarded for applying scientific inquiry and problem solving skills.

A data booklet containing relevant data and formulae will be provided.

Component 2 — project

The purpose of the project is to allow the learner to carry out an in-depth study of a physics topic. The topic will be chosen by the learner, who will investigate/research the underlying physics. This is an open-ended task which may involve a significant part of the work being carried out without close supervision. The learner will extend and apply the skills of independent/autonomous working. This includes making independent and rational decisions based on evidence and interpretation of scientific information, and the analysis and evaluation of their results. This will further develop and enhance their scientific literacy.

The project will assess the application of skills of scientific inquiry and related physics knowledge and understanding.

The project will have 30 marks (23% of the total marks).

The majority of the marks will be awarded for applying scientific inquiry skills. The other marks will be awarded for applying related knowledge and understanding.

In preparation for the assessment, the learner will:

- select an appropriate physics topic within the set guidelines provided by SQA
- plan the project
- investigate/research the topic
- process the information/data collected
- review and evaluate their findings
- produce a scientific report

The learner will then submit their project report as evidence.

The project report will be externally assessed using the following assessment categories:

(a) Underlying physics
(b) Procedures
(c) Results
(d) Conclusion and evaluation
(e) Presentation

Setting, conducting and marking of assessment

Question paper

This question paper will be set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA. Learners will complete this in 2 hours and 30 minutes.

Controlled assessment — project

This project is:

- set by centres within SQA guidelines
- conducted under some supervision and control

The production of evidence for the assessment will be conducted:

- in time to meet a submission date set by SQA
- independently by the learner

Evidence will be submitted to SQA for external marking.

All marking will be quality assured by SQA.

Further mandatory information on Course coverage

The following gives details of mandatory skills, knowledge and understanding for the Advanced Higher Physics Course. Course assessment will involve sampling the skills, knowledge and understanding. This list of skills, knowledge and understanding also provides the basis for the assessment of Units of the Course.

The following gives details of the skills:

- extending and applying knowledge of physics to new situations, interpreting and analysing information to solve more complex problems
- planning and designing physics experiments/investigations, using reference material to test a hypothesis or to illustrate particular effects
- carrying out complex experiments in physics safely, recording systematic detailed observations and collecting data
- selecting and presenting detailed information appropriately in a variety of forms
- processing and analysing physics information (using calculations, significant figures and units, where appropriate)
- making reasoned predictions from a range of evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- critically evaluating experimental procedures by identifying sources of uncertainty, suggesting and implementing improvements
- drawing on knowledge and understanding of physics to make accurate statements, describe complex information, provide detailed explanations and integrate knowledge
- communicating physics findings/information fully and effectively
- analysing and evaluating scientific publications and media reports

These skills will be assessed, across the Course, in the context of the mandatory knowledge.

The following table provides further detail of the mandatory knowledge for the Advanced Higher Physics Course.

Units, prefixes and scientific notation

Units and prefixes

- electronvolt
- light year
- significant figures
- scientific notation

Uncertainties

- Types of uncertainties
- Absolute uncertainties
- Percentage uncertainties
- Random uncertainties
- Reading uncertainties
- Systematic uncertainties
- Uncertainties and data analysis
- Appropriate use of significant figures
- Combination of various types of uncertainties to obtain the total uncertainty in a measurement

Rotational Motion and Astrophysics

Kinematic relationships

- Calculus methods with the kinematic relationships for straight line motion with a constant acceleration
- Gradient represents instantaneous rate of change
- Area under a graph by integration

Angular motion

- Angular displacement, velocity and acceleration
- Centripetal force and acceleration

Rotational dynamics

- Turning effect (moment) of a force — torque
- Moment of inertia
- Angular momentum and rotational kinetic energy

Gravitation

- Gravitational field strength
- Universal law of gravitation
- Gravitational potential
- Escape velocity

General relativity

- Equivalence principle and its consequences

Stellar physics

- Properties of stars
- Hydrogen and helium fusion reactions — production of deuterium, helium 3, helium 4, positrons, neutrinos and gamma rays
- Stellar evolution
- The Hertzsprung-Russell (Hr) diagram

Electromagnetism

Fields

- Electric field as the force per unit positive charge
- Coulomb's Inverse Square Law for interacting point charges
- Potential difference and electric field strength around a point charge and a system of charges and for a uniform field
- Motion of charged particles in uniform electric fields
- The electronvolt as a unit of energy
- Magnetic fields produced by moving electric charges
- Ferromagnetism
- Magnetic field patterns
- Magnetic induction
- Magnetic induction at a distance from a long current carrying wire
- Magnitude of the force on a current carrying conductor in a magnetic field
- Compare gravitational, electrostatic, magnetic and nuclear forces

Circuits

- Capacitors in d.c. circuits
- Current and potential difference in CR circuits during charging and discharging
- The time constant for a CR circuit
- Capacitors in a.c. circuits
- Capacitive reactance
- Relationship between current, frequency and capacitive reactance
- Electromagnetic induction
- Self-inductance
- Lenz's Law. The magnitude of the induced e.m.f.
- Self-inductance of a coil
- Energy stored by an inductor
- Inductors in a.c. circuits
- Inductive reactance

Electromagnetic radiation

- The unification of electricity and magnetism
- Electromagnetic radiation (EMR)
- EMR exhibits wave properties
- Electric and magnetic field components of EMR
- Relationship between the speed of light and the permittivity and permeability of free space

Quanta and Waves

Introduction to quantum theory

- Challenges to classical theory
- Black body radiation
- Photoelectric effect
- Bohr model of the atom
- De Broglie waves
- Wave particle duality

Particles from space

Simple harmonic motion

- Dynamics of simple harmonic motion (SHM)
- Angular frequency and period
- Solutions of the SHM equation
- Kinetic and potential energy in SHM~

Waves

- Mathematical representation of travelling waves
- Phase difference and phase angle
- Superposition of waves
- Stationary waves

Interference

- Interference by division of amplitude
- Coherence
- Optical path length, geometrical path length, phase difference and optical path difference
- Conditions for constructive and destructive interference
- Beam splitting at a reflective boundary
- Thin film interference
- Wedge fringes
- Young's slits interference

Polarisation

- Plane polarisation of transverse waves
- Brewster's angle

Administrative information

Published: December 2012 (draft version 1.0)

Superclass: to be advised

History of changes to Course Assessment Specification

Course details	Version	Description of change	Authorised by	Date