

# Advanced Higher Mathematics of Mechanics

## Draft Course/Unit Support Notes



This document may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged. Additional copies of these *Course/Unit Support Notes* can be downloaded from SQA's website: [www.sqa.org.uk](http://www.sqa.org.uk).

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

# Contents

Introduction	1
General guidance on the Course/Units	2
Approaches to learning and teaching	5
Approaches to assessment	8
Equality and inclusion	11
Appendix 1: Further information on Units in the Course	12
Appendix 2: Reference documents	13

# Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Advanced Higher Mathematics of Mechanics Course. They are intended for teachers and lecturers who are delivering the Course and its Units. They should be read in conjunction with the *Course Specification*, the *Course Assessment Specification* and the *Unit Specifications* for the Units in the Course.

These support notes cover both the Advanced Higher Course and the Units in it.

Draft

# General guidance on the Course/Units

## Aims

The aims of the Course are to enable learners to:

- ◆ use and extend mathematical skills needed to solve problems in mechanics
- ◆ consider the state of equilibrium or the movement of a body and interpret the underlying factors using known mathematical methods
- ◆ analyse the physical factors impacting bodies
- ◆ understand, interpret and apply the effects of both constant and variable forces on a body
- ◆ create mathematical models to simplify and solve problems
- ◆ analyse results in context, and interpret the solution in terms of the real world
- ◆ develop skills in effectively communicating conclusions reached on the basis of physical factors and calculation

## Progression

In order to do this Course, learners should have achieved the Higher Mathematics of Mechanics Course.

Learners who have achieved this Advanced Higher Course may progress to further study, employment and/or training. Opportunities for progression include:

- ◆ Progression to other SQA qualifications
  - Progression to other qualifications at the same level of the Course, eg Mathematics, Statistics or Professional Development Awards (PDAs) or Higher National Certificates (HNCs)
- ◆ Progression to further/higher education
  - For many learners a key transition point will be to further or higher education, for example to Higher National Certificates (HNCs) or Higher National Diplomas (HNDs) or degree programmes.
  - Advanced Higher Courses provide good preparation for learners progressing to further and higher education as learners doing Advanced Higher Courses must be able to work with more independence and less supervision. This eases their transition to further/higher education. Advanced Higher Courses may also allow 'advanced standing' or partial credit towards the first year of study of a degree programme.
  - Advanced Higher Courses are challenging and testing qualifications — learners who have achieved multiple Advanced Higher Courses are regarded as having a proven level of ability which attests to their

readiness for education in higher education institutions (HEIs) in other parts of the UK as well as in Scotland.

- ◆ Progression to employment
  - For many learners progression will be directly to employment or work-based training programmes.

This Advanced Higher could be part of the Scottish Baccalaureate in Science. The Scottish Baccalaureates in Expressive Arts, Languages, Science and Social Sciences consist of coherent groups of subjects at Higher and Advanced Higher level. Each award consists of two Advanced Highers, one Higher and an Interdisciplinary Project which adds breadth and value and helps learners to develop generic skills, attitudes and confidence that will help them make the transition into higher education or employment.

## Hierarchies

**Hierarchy** is the term used to describe Courses and Units which form a structured progression involving two or more SCQF levels.

This Advanced Higher Course is not in a hierarchy with the Higher Mathematics Course or its Units.

## Skills, knowledge and understanding covered in this Course

This section provides further advice and guidance about skills, knowledge and understanding that could be included in the Course.

Teachers and lecturers should refer to the *Course Assessment Specification* for mandatory information about the skills, knowledge and understanding to be covered in this Course.

The development of subject-specific and generic skills is central to the Course. Learners should be made aware of the skills they are developing and of the transferability of them. It is the transferability that will help learners with further study and enhance their personal effectiveness.

The skills, knowledge and understanding that will be developed in the Advanced Higher Mathematics of Mechanics Course are:

- ◆ knowledge and understanding of a range of straightforward and complex concepts in mechanics
- ◆ the ability to identify and use appropriate techniques in mechanics
- ◆ the ability to use mathematical reasoning and operational skills to extract and interpret information
- ◆ the ability to create and use multifaceted mathematical models

- ◆ the ability to communicate identified strategies of solution and provide justification for the resulting conclusions in a logical way
- ◆ the ability to comprehend both the problem as a whole and its integral parts
- ◆ the ability to select and use numerical skills

Draft

# Approaches to learning and teaching

Advanced Higher Courses place more demands on learners as there will be a higher proportion of independent study and less direct supervision. Some of the approaches to learning and teaching suggested for other levels (in particular, Higher) may also apply at Advanced Higher level but there will be a stronger emphasis on independent learning.

For Advanced Higher Courses, a significant amount of learning may be self-directed and require learners to demonstrate a more mature approach to learning and the ability to work on their own initiative. This can be very challenging for some learners, who may feel isolated at times, and teachers and lecturers should have strategies for addressing this. These could include, for example, planning time for regular feedback sessions/discussions on a one-to-one basis and on a group basis led by the teacher or lecturer (where appropriate).

Teachers and lecturers should encourage learners to use an enquiring, critical and problem-solving approach to their learning. Learners should also be given the opportunity to practise and develop research and investigation skills and higher order evaluation and analytical skills. The use of information and communications technology (ICT) can make a significant contribution to the development of these higher order skills as research and investigation activities become more sophisticated.

Learners will engage in a variety of learning activities as appropriate to the subject, for example:

- ◆ project-based tasks such as investigating the graphs of related functions, which could include using calculators or other technologies
- ◆ a mix of collaborative, co-operative or independent tasks which engage learners
- ◆ using materials available from service providers and authorities
- ◆ problem solving and critical thinking
- ◆ explaining thinking and presenting strategies and solutions to others
- ◆ effective use of questioning and discussion to engage learners in explaining their thinking and checking their understanding of fundamental concepts
- ◆ participating in informed debate and discussion with peers where they can demonstrate skills in constructing and sustaining lines of argument to provide challenge and enjoyment, breadth, and depth, to learning
- ◆ researching information for their subject rather than receiving information from their teacher or lecturer
- ◆ using active and open-ended learning activities such as research, case studies and presentation tasks
- ◆ making use of the internet to draw conclusions about specific issues
- ◆ engaging in wide-ranging independent reading
- ◆ recording in a systematic way the results of research and independent investigation from different sources

- ◆ presenting findings/conclusions of research and investigation activities in a presentation
- ◆ participating in group work with peers and using collaborative learning opportunities to develop teamworking
- ◆ drawing conclusions from complex information
- ◆ using sophisticated written and/or oral communication and presentation skills to present information
- ◆ using appropriate technological resources (eg web-based resources)
- ◆ using appropriate media resources (eg video clips)
- ◆ using real-life contexts and experiences familiar and relevant to young people to meaningfully hone and exemplify skills, knowledge and understanding
- ◆ participating in field trips and visits

Teachers and lecturers should support learners by having regular discussions with them and giving regular feedback. Some learning and teaching activities may be carried out on a group basis and, where this applies, learners could also receive feedback from their peers.

Teachers and lecturers should, where possible, provide opportunities to personalise learning and enable learners to have choices in approaches to learning and teaching. The flexibility in Advanced Higher Courses and the independence with which learners carry out the work lend themselves to this. Teachers and lecturers should also create opportunities for, and use, inclusive approaches to learning and teaching. This can be achieved by encouraging the use of a variety of learning and teaching strategies which suit the needs of all learners. Innovative and creative ways of using technology can also be valuable in creating inclusive learning and teaching approaches.

Centres are free to sequence the teaching of the Outcomes, Units and/or Course in any order they wish. For example:

- ◆ Each Unit could be delivered separately in any sequence.

**And/or:**

- ◆ All Units may be delivered in a combined way as part of the Course. If this approach is used, the Outcomes within Units may either be partially or fully combined.

There may be opportunities to contextualise approaches to learning and teaching to Scottish contexts in this Course. This could be done through mini-projects or case studies.

# Developing skills for learning, skills for life and skills for work

The following skills for learning, skills for life and skills for work should be developed in this Course.

## 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

Teachers and lecturers should ensure that learners have opportunities to develop these skills as an integral part of their learning experience.

It is important that learners are aware of the skills for learning, skills for life and skills for work that they are developing in the Course and the activities they are involved in that provide realistic opportunities to practise and/or improve them.

At Advanced Higher level it is expected that learners will be using a range of higher order thinking skills. They will also develop skills in independent and autonomous learning.

# Approaches to assessment

Assessment in Advanced Higher Courses will generally reflect the investigative nature of Courses at this level, together with high-level problem-solving and critical thinking skills and skills of analysis and synthesis.

This emphasis on higher order skills, together with the more independent learning approaches that learners will use, distinguishes the added value at Advanced Higher level from the added value at other levels.

There are different approaches to assessment, and teachers and lecturers should use their professional judgement, subject knowledge and experience, as well as understanding of their learners and their varying needs, to determine the most appropriate ones and, where necessary, to consider workable alternatives.

Assessments must be fit for purpose and should allow for consistent judgements to be made by all teachers and lecturers. They should also be conducted in a supervised manner to ensure that the evidence provided is valid and reliable.

## Unit assessment

Units will be assessed on a pass/fail basis. All Units are internally assessed against the requirements shown in the *Unit Specification*. Each Unit can be assessed on an individual Outcome-by-Outcome basis or via the use of combined assessment for some or all Outcomes.

Assessments must ensure that the evidence generated demonstrates, at the least, the minimum level of competence for each Unit. Teachers and lecturers preparing assessment methods should be clear about what that evidence will look like.

Sources of evidence likely to be suitable for Advanced Higher Units could include:

- ◆ presentation of information to other groups and/or recorded oral evidence
- ◆ exemplification of concepts using (for example) a diagram
- ◆ interpretation of numerical data
- ◆ investigations
- ◆ case studies
- ◆ answers to (multiple choice) questions

Evidence should include the use of appropriate subject-specific terminology as well as the use of real-life examples where appropriate.

Flexibility in the method of assessment provides opportunities for learners to demonstrate attainment in a variety of ways and so reduce barriers to attainment.

The structure of an assessment used by a centre can take a variety of forms, for example:

- ◆ individual pieces of work could be collected in a folio as evidence for Outcomes and Assessment Standards
- ◆ assessment of each complete Outcome
- ◆ assessment that combines the Outcomes of one or more Units
- ◆ assessment that requires more than the minimum competence, which would allow learners to prepare for the Course assessment

Teachers and lecturers should note that learners' day-to-day work may produce evidence which satisfies assessment requirements of a Unit, or Units, either in full or partially. Such naturally-occurring evidence may be used as a contribution towards Unit assessment. However, such naturally-occurring evidence must still be recorded and evidence such as written reports, recording forms, PowerPoint slides, drawings/graphs, video footage or observational checklists provided.

## **Combining assessment across Units**

A combined approach to assessment will enrich the assessment process for the learner, avoid duplication of tasks and allow more emphasis on learning and teaching. Evidence could be drawn from a range of activities for a combined assessment. Care must be taken to ensure that combined assessments provide appropriate evidence for all the Outcomes that they claim to assess.

Combining assessment will also give centres more time to manage the assessment process more efficiently. When combining assessments across Units, teachers/lecturers should use e-assessment wherever possible. Learners can easily update portfolios, electronic or written diaries, and recording sheets.

For some Advanced Higher Courses, it may be that a strand of work which contributes to a Course assessment method is started when a Unit is being delivered and is completed in the Course assessment. In these cases, it is important that the evidence for the Unit assessment is clearly distinguishable from that required for the Course assessment.

## **Preparation for Course assessment**

Each Course has additional time which may be used at the discretion of the teacher or lecturer to enable learners to prepare for Course assessment. This time may be used near the start of the Course and at various points throughout the Course for consolidation and support. It may also be used for preparation for Unit assessment, and, towards the end of the Course, for further integration, revision and preparation and/or gathering evidence for Course assessment.

For this Advanced Higher Course, the assessment method for Course assessment is a question paper. Learners should be given opportunities to practise this method and prepare for it.

## Authenticity

In terms of authenticity, there are a number of techniques and strategies to ensure that learners present work that is their own. Teachers and lecturers should put in place mechanisms to authenticate learner evidence.

In Advanced Higher Courses, because learners will take greater responsibility for their own learning and work more independently, teachers and lecturers need to have measures in place to ensure that work produced is the learner's own work.

For example:

- ◆ regular checkpoint/progress meetings with learners
- ◆ short spot-check personal interviews
- ◆ checklists which record activity/progress
- ◆ photographs, films or audio records

Group work approaches are acceptable as part of the preparation for assessment and also for formal assessment. However, there must be clear evidence for each learner to show that the learner has met the evidence requirements.

For more information, please refer to SQA's [Guide to Assessment](#).

## Added value

Advanced Higher Courses include assessment of added value which is assessed in the Course assessment.

Information given in the *Course Specification* and the *Course Assessment Specification* about the assessment of added value is mandatory.

In Advanced Higher Courses, added value involves the assessment of higher order skills such as high-level and more sophisticated investigation and research skills, critical thinking skills and skills of analysis and synthesis. Learners may be required to analyse and reflect upon their assessment activity by commenting on it and/or drawing conclusions with commentary/justification. These skills contribute to the uniqueness of Advanced Higher Courses and to the overall higher level of performance expected at this level.

In this Course, added value will be assessed by means of a question paper. This is used to assess whether the learner can retain and consolidate the knowledge and skills gained in individual Units. It assesses knowledge and understanding and the various different applications of knowledge such as reasoning, analysing, evaluating and solving problems.

# Equality and inclusion

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Course/Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Course.

It is important that centres are aware of and understand SQA's assessment arrangements for disabled learners, and those with additional support needs, when making requests for adjustments to published assessment arrangements. Centres will find more guidance on this in the series of publications on Assessment Arrangements on SQA's website: [www.sqa.org.uk/sqa/14977.html](http://www.sqa.org.uk/sqa/14977.html).

The greater flexibility and choice in Advanced Higher Courses provide opportunities to meet a range of learners' needs and may remove the need for learners to have assessment arrangements. However, where a disabled learner needs a reasonable adjustment/assessment arrangements to be made, you should refer to the guidance given in the above link.

# Appendix 1: Further information on Units in the Course

SQA is undertaking engagement on the nature of the Advanced Higher Mathematics of Mechanics Course. Once this engagement is complete additional information will be provided in the Course and Unit Support Notes.

Draft

## Appendix 2: Reference documents

The following reference documents will provide useful information and background.

- ◆ Assessment Arrangements (for disabled candidates and/or those with additional support needs) — various publications are available on SQA's website at: [www.sqa.org.uk/sqa//14977.html](http://www.sqa.org.uk/sqa//14977.html).
- ◆ Building the Curriculum 4: Skills for Learning, Skills for Life and Skills for Work
- ◆ Building the Curriculum 5: A Framework for Assessment
- ◆ [Course Specifications](#)
- ◆ [Design Principles for National Courses](#)
- ◆ [Guide to Assessment](#)
- ◆ [Overview of Qualification Reports](#)
- ◆ Principles and practice papers for curriculum areas
- ◆ [SCQF Handbook: User Guide](#) and [SCQF level descriptors](#)
- ◆ [SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work](#)
- ◆ [Skills for Learning, Skills for Life and Skills for Work: Using the Curriculum Tool](#)
- ◆ [Coursework Authenticity: A Guide for Teachers and Lecturers](#)

## Administrative information

---

**Published:** March 2013 (draft version 1.0)

---

### History of changes to Advanced Higher Draft Course/Unit Support Notes

Course details	Version	Description of change	Authorised by	Date

© Scottish Qualifications Authority 2013

This document may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged. Additional copies can be downloaded from SQA's website at [www.sqa.org.uk](http://www.sqa.org.uk).

Note: You are advised to check SQA's website ([www.sqa.org.uk](http://www.sqa.org.uk)) to ensure you are using the most up-to-date version.