



Mathematics of Mechanics: Force, Energy and Periodic Motion (Advanced Higher) Unit

SCQF: level 7 (8 SCQF credit points)

Unit code: H7VN 77

Unit outline

The general aim of the Unit is to develop advanced mathematical knowledge and skills to be applied to the mechanics of force, energy and periodic motion. Learners will interpret the effects of both constant and variable forces on a body and will use mathematical models in problems where the acceleration is dependent on displacement or velocity, and where interpretation and solution of problems involving first order differential equations is required. The principles of momentum and impulse and those of work, power and energy are developed, and include the work-energy principle and the use of conservation of energy.

Learners explore problems involving motion in a horizontal circle with uniform angular velocity. In particular, banked tracks and skidding are considered, as is Newton's Law of Gravitation and its application to the circular orbit of satellites. Learners will look at simple harmonic motion, consider force associated with elastic strings and springs, and consider the centres of mass for rigid bodies, including those of uniform and composite plane, as well as statics of rigid bodies.

Learners who complete this Unit will be able to:

- 1 Use mathematical operational and reasoning skills linked to force, energy and periodic motion

This Unit is a mandatory Unit of the Advanced Higher Mathematics of Mechanics Course and is also 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*.

The *Course Assessment Specification* for the Advanced Higher Mathematics of Mechanics Course gives further mandatory information on Course coverage for learners taking this Unit as part of the Advanced Higher Mathematics of Mechanics Course.

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:

- ◆ Higher Mathematics 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 Use mathematical operational and reasoning skills linked to force, energy and periodic motion by:**
 - 1.1 Applying skills to principles of momentum, impulse, work, power and energy
 - 1.2 Applying skills to motion in a horizontal circle with uniform angular velocity
 - 1.3 Applying skills to simple harmonic motion
 - 1.4 Applying skills to centres of mass

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. They should ensure there is sufficient evidence of competence in mathematical skills from the Outcomes and Assessment Standards to allow a judgement to be made that the learner has achieved the Unit.

Assessors should use their professional judgement when giving learners credit for an appropriate degree of accuracy. This may mean giving credit for incomplete solutions or numerically incorrect solutions which show correct methodology, therefore demonstrating required knowledge and understanding of the mathematical processes involved.

A calculator or equivalent technologies may be used.

For this Unit, learners will be required to produce evidence as follows:

For Outcome 1, learners will be required to provide evidence for each Assessment Standard by drawing on the following:

Skills appropriate to application (1.1)

- ◆ Working with impulse as the change in momentum, and/or force as the rate of change of momentum.
- ◆ Working with the concept of conservation of linear momentum.
- ◆ Determining work done by a constant force in one or two dimensions, or a variable force during rectilinear motion.
- ◆ Using the concepts of kinetic (E_K) and/or potential (E_P) energy to applying the work–energy principle.
- ◆ Using the concepts of kinetic (E_K) and/or potential (E_P) energy within the concept of conservation of energy.

Skills appropriate to application (1.2)

- ◆ Applying equations to motion in a horizontal circle with uniform angular velocity.
- ◆ Using equations for horizontal circular motion alongside Newton's Inverse Square Law of Gravitation.

Skills appropriate to application (1.3)

- ◆ Working with the concept of Simple Harmonic Motion (SHM).
- ◆ Applying Hooke's Law to problems involving Simple Harmonic Motion.

Skills appropriate to application (1.4)

- ◆ Determining the turning effect of force.
- ◆ Using moments to find the centre of mass of a body.

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

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 as 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

Published: April 2015 (version 2.0)

Superclass: RB

History of changes to National Unit Specification

Version	Description of change	Authorised by	Date
2.0	Unit title amended to include 'Mathematics of Mechanics:' prefix. Evidence Requirements relating to sub-skills updated.	Qualifications Development Manager	April 2015

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Note: readers are advised to check SQA's website: www.sqa.org.uk to ensure they are using the most up-to-date version of the Unit Specification.

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