



Higher National Unit specification

General information

Unit title: Mathematics for Science 2 (SCQF level 7)

Unit code: H8XR 34

Superclass: RB

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Version: 03

Unit purpose

This Unit is designed to enable learners to utilise mathematical techniques used in scientific analysis. This Unit leads on from the Unit H8XP 33 *Mathematics for Science 1*. Learners will develop an insight into where and when these mathematical techniques should be employed, and will apply this knowledge in the context of scientific problems.

Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Solve problems using differential calculus.
- 2 Solve problems using integral calculus.

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

Learners would normally be expected to hold appropriate mathematics Units at SCQF level 6. This Unit follows on from the Unit *Mathematics for Science 1* at SCQF level 6, but successful completion of, for example, Higher Mathematics, could be considered.

Higher National Unit specification: General information (cont)

Unit title: Mathematics for Science 2 (SCQF level 7)

Core Skills

Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

Complete Core Skill	None
Core Skill component	Using Number at SCQF Level 6 Critical Thinking at SCQF Level 5

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

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.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

Higher National Unit specification: Statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Solve problems using differential calculus.

Knowledge and/or Skills

- ◆ Differentiate functions using:
 - chain rule
 - product rule
 - quotient rule
- ◆ Use differentiation to solve scientific problems

Outcome 2

Solve problems using integral calculus.

Knowledge and/or Skills

- ◆ Integrate functions using:
 - integration by parts
 - partial fractions (including polynomial denominators which have distinct linear factors, repeated linear factors or are irreducible quadratics)
 - integration by substitution
- ◆ Find the area enclosed between two intersecting curves. The points of intersection should be calculated
- ◆ Solve first order separable differential equations with boundary conditions
- ◆ Apply integration to solve scientific problems

Higher National Unit specification: Statement of standards (cont)

Unit title: Mathematics for Science 2 (SCQF level 7)

Evidence Requirements for this Unit

Learners will need to provide evidence to demonstrate their Knowledge and/or skills across all Outcomes by showing that they can:

Outcome 1

Solve problems using differential calculus:

- ◆ Differentiate at least three functions using each of:
 - chain rule
 - product rule
 - quotient rule
- ◆ The functions should include components which involve:
 - polynomial
 - $(ax + b)^n$,
 - $\sin(ax + b)$, $\cos(ax + b)$, $\tan(ax + b)$
 - $\ln(ax + b)$
 - e^{ax+b}

Learners should not be told which rule to use, but be able to choose the correct rule required for the problem.

- ◆ Solve at least one problem from a scientific context using differentiation.

Outcome 2

Solve problems using integral calculus:

- ◆ Solve two problems using two of the following types of integration:
 - integration by parts
 - partial fractions, and
 - integration by substitution

Learners should not be told which rule to use, but be able to choose the correct rule required for the problem.

- ◆ Find the area enclosed between two intersecting curves. The points of intersection limiting the area must be calculated.
- ◆ Find the particular solution of a first order separable differential equation with boundary conditions.
- ◆ Solve at least one problem from a scientific context using integration.

Outcomes 1 and 2

The assessments should be under closed-book, supervised conditions.

Learners should not have information in advance about the content of the assessment.

Formulae sheets containing the quadratic formula, chain rule, product rule, quotient rule, integration by parts, standard derivatives and standard integrals may be provided where appropriate.

Computer algebra, graphical calculators or programmable calculators should not be used in the assessment of this Unit.

Higher National Unit specification: Statement of standards (cont)

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Assessment may be Outcome by Outcome, in groups of Outcomes, or in a single holistic end of Unit assessment. The questions in the examination should not be grouped by Outcome or be labelled in terms of the Outcomes they relate to when a single end of Unit holistic examination is used.



Higher National Unit Support Notes

Unit title: Mathematics for Science 2 (SCQF level 7)

Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit is one of a suite of four Units in Mathematics and Statistics developed for Higher National Qualifications across a range of Science disciplines. The four Units are:

- ◆ *Statistics for Science 1*
- ◆ *Statistics for Science 2*
- ◆ *Mathematics for Science 1*
- ◆ *Mathematics for Science 2*

This Unit leads on from the *Mathematics for Science 1* Unit.

Consideration of this list of topics alongside the Assessment Support Pack for this Unit will provide clear indication of the standard expected.

Outcome 1

Solve problems using differential calculus:

- ◆ Revise standard derivatives, and include the standard derivatives of $\ln(ax+b)$ and e^{ax+b}
- ◆ Use should be made of the chain rule, product rule and quotient rule to differentiate functions. Examples of functions with a scientific context requiring the use of these rules should be incorporated where appropriate.
- ◆ Every opportunity should be taken to enhance the learner's basic algebraic skills by reducing results to their simplest form (using factorisation, cancellation, etc).

Outcome 2

Solve problems using integral calculus:

- ◆ Revise standard integrals, and include the standard integrals of $1/(ax+b)$ and e^{ax+b}
- ◆ Integration problems should be solved using partial fractions (including polynomial denominators which have distinct linear factors, repeated linear factors or are irreducible quadratics), integration by substitution and integration by parts. Examples of functions with a scientific context requiring the use of these rules should be incorporated where appropriate.
- ◆ Be able to calculate the intersection points of two curves. This would initially be two quadratics, but other cases which can be solved using algebraic skills appropriate to this level could be selected.

- ◆ Find the area enclosed between two curves.
- ◆ Differential equations should be solved, both in general and in particular forms (utilising initial or boundary conditions). Examples with a scientific context should be incorporated where appropriate. If time permits, exploration of solutions to problems with only a second order term (such as the derivation of the formula for the period of a simple pendulum) could be incorporated.

Higher National Unit Support Notes (cont)

Unit title: Mathematics for Science 2 (SCQF level 7)

Guidance on approaches to delivery of this Unit

This Unit provides advanced techniques and processes which underpin the studies undertaken in a number of Higher National Qualifications across a range of scientific disciplines.

Centres may deliver the Outcomes in any order they wish, but it is recommended that Outcome 1 is delivered first followed by Outcome 2.

All teaching input should be supplemented by formative assessment in which learners are provided with opportunities to develop their knowledge, understanding and skills.

Computer software, computer algebra, and graphical calculators may be used to support learning (eg to confirm the solutions of mathematical problems), but it is strongly recommended that such learning resources are only used in a supportive capacity and not as the principal means of delivering Unit content.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. A recommended approach is the use of an examination question paper. The question paper could be composed of an appropriate balance of short answer, restricted response and structured questions.

The summative assessment of all Learning Outcomes — whether individually or at a single assessment event — should not exceed 2 hours. An appropriate threshold score may be set for the assessment of this Unit.

Centres are reminded that submitting centre-devised assessments for prior verification would help to ensure that the national standard is being met.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

This Unit has the Using Number component of Numeracy and Critical Thinking Component of Problem Solving in it. This means that when candidates achieve the Unit, their Core Skills profile will also be updated to show they have achieved Using Number and Critical Thinking at SCQF level 5.

History of changes to Unit

Version	Description of change	Date
03	Content added to ensure that the unit meets the notional design length of 40 hours	10/08/18
02	Core Skilled component Using Critical Thinking and Using Number at SCQF Level 5 embedded	08/06/2015

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General information for learners

Unit title: Mathematics for Science 2 (SCQF level 7)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for the further learning and employment.

The *Mathematics for Science 2* Unit is one of a suite of Mathematics Units developed for Higher National Certificates across a range of Science disciplines. These Units help develop the mathematical skills required for workplace roles and for more advanced studies in Science.

This Unit is designed to develop or consolidate the basic level of mathematical skills required of learners across a range of Science disciplines. The Unit is at the level of Advanced Higher Mathematics.

In this unit, you will learn to:

1 Solve problems using differential calculus

- ◆ Differentiate functions using:
 - chain rule
 - product rule
 - quotient rule
- ◆ Use differentiation to solve scientific problems

2 Solve problems using integral calculus

- ◆ Integrate functions using:
 - integration by parts
 - partial fractions (including polynomial denominators which have distinct linear factors, repeated linear factors or are irreducible quadratics), and
 - integration by substitution
 - Find the area enclosed between two curves.
- ◆ Solve first order separable differential equations with boundary conditions
- ◆ Apply integration to the solve scientific problems

It is likely that Unit delivery will comprise of a significant teaching input from your lecturer. This will be supplemented by tutorial exercises which will allow you to develop the knowledge, understanding and skills to apply the mathematic principles and processes covered in the Unit to a range of scientific problems.

Depending on which centre you attend, formal assessment may be conducted on an Outcome by Outcome basis or by one single assessment. Assessment will be conducted under closed-book, controlled and invigilated conditions.

Learners considering taking this Unit will normally be expected to have passed the Unit *Mathematics for Science 1*, or a course at Higher Level in Mathematics or equivalent.