Higher National Unit specification

General information

Unit title: Mathematics for Science 1 (SCQF level 6)

Unit code: H8XP 33

Superclass: RB

Publication date: August 2018

Source: Scottish Qualifications Authority

Version: 03

Unit purpose

This Unit is designed to enable learners to utilise basic mathematical techniques used in scientific analysis. 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. Successful achievement of this Unit can lead on to the Unit H8XR 34 *Mathematics for Science 2*.

Outcomes

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

1 Apply algebraic methods.
2 Solve problems using differential calculus.
3 Solve problems using integral calculus.

Credit points and level

1 Higher National Unit credit at SCQF level 6: (8 SCQF credit points at SCQF level 6)

Recommended entry to the Unit

Entry to this Unit is at the discretion of the centre, but learners would normally be expected to hold appropriate mathematics Units at SCQF level 5. This could include National 5 *Mathematics*, or equivalent NQ level modules.

Higher National Unit specification: General information (cont)

Unit title: Mathematics for Science 1 (SCQF level 6)

Core Skills

Core Skills

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

Core Skill component	Using Number at SCQF Level 6 Critical Thinking at SCQF level 6

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

Unit title: Mathematics for Science 1 (SCQF level 6)

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

Apply algebraic methods.

Knowledge and/or Skills

- Evaluate expressions involving powers, natural logarithms, common logarithms, exponentials, powers of 10, and trigonometrical functions
- Solve equations including quadratic equations and simultaneous equations (using algebraic methods)
- Change the subject of a formula involving powers, natural logarithms, common logarithms, exponentials, and powers of 10
- Calculations must include values in scientific or engineering notation

Outcome 2

Solve problems using differential calculus.

Knowledge and/or Skills

- Differentiate standard functions (polynomials, $(ax+b)^n$, $\sin$, $\cos$ as well as sums and differences of these)
- Calculate rates of change for the above functions
- Find the second derivatives of functions
- Find the turning points of cubic equations

Outcome 3

Solve problems using integral calculus.

Knowledge and/or Skills

- Perform the indefinite integration of standard functions, polynomials, $(ax+b)^n$, $\sin$, $\cos$ as well as sums and differences of these)
- Perform the definite integration of the above functions
- Calculate areas between the x-axis and curves. Calculate areas under curves where the curve is above the x-axis and where the curve is below the x- axis.

Higher National Unit specification: Statement of standards (cont)

Unit title: Mathematics for Science 1 (SCQF level 6)

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

Apply algebraic methods:

- Evaluate two equations, each involving a minimum of two of the following:
  - a power $\left(x^n\right)$,
  - either ln or $\log_{10}$,
  - either e^x or power of 10^x
  - a trigonometrical function

  Note that all four points must be tested.

  Calculations must include values in scientific notation or engineering notation.

- Solve a problem including the solution of a quadratic equation.
- Solve a problem including a system of two simultaneous equations in two variables using algebraic methods.
- Change the subject of two formula, each involving at least one of:
  - a power $\left(x^n\right)$
  - either ln or $\log_{10}$
  - an exponential or power of 10

Higher National Unit specification: Statement of standards (cont)

Unit title: Mathematics for Science 1 (SCQF level 6)

Outcome 2

Solve problems using differential calculus:

- Differentiate at least one of each of the following three types of expression:
  - polynomial
  - $(ax+b)^n$,
  - $\sin(ax+b)$ or $\cos(ax+b)$,

  The terms may be expressions which can be presented as separate problems or in combination.
- Evaluate a rate of change for one of the following functions:
  - polynomial
  - $(ax+b)^n$,
  - $\sin(ax+b)$ or $\cos(ax+b)$,
- Find the locations and nature (using the second derivative method) of the stationary points on the graph of a cubic equation.

Outcome 3

Solve problems using integral calculus:

- Obtain the indefinite integral for all of the following types of expression, and evaluate definite integrals for two:
  - polynomial
  - $(ax+b)^n$,
  - $\sin(ax+b)$ or $\cos(ax+b)$,
- Calculate the area between a curve and the x-axis where the area is entirely above the x-axis.
- Calculate the area between a curve and the x-axis where the area is entirely below the x-axis.

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, standard derivatives and standard integrals may be provided where appropriate.

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.

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

Higher National Unit Support Notes

Unit title: Mathematics for Science 1 (SCQF level 6)

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 to the *Mathematics for Science 2* 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

Apply algebraic methods.

- Revise basic algebraic methods.
- Evaluate algebraic expressions by substituting values. A range of functions should be explored, including expressions used in various scientific contexts.
- Solve problems using quadratic equations. Appropriate scientific contexts could be explored where appropriate to the course.
- Solve systems of linear equations using algebraic methods. The relationship between intersections of straight lines and the algebraic solution of simultaneous equations could be explored.
- Change the subject of various types of formulae. Contexts appropriate to the course should be explored where possible.

Higher National Unit Support Notes (cont)

Unit title: Mathematics for Science 1 (SCQF level 6)

Outcome 2

Solve problems using differential calculus:

- Perform the Differentiation of standard functions, and functions commonly used in scientific contexts. Simple applications of the chain rule could be used as a strategy for differentiating functions like $f(ax+b)$, given the derivative of $f(x)$. Eg showing how to find the derivative of $\sin(ax+b)$ given the derivative of $\sin x$, etc.
- The relationship between derivatives and gradients and rates of change should be considered.
- Find the locations and nature (using the second derivative method) of the stationary points on the graph of a cubic equation (incorporating the use of quadratic equation solutions). If time permits, the location and nature of the stationary points of non-polynomial equations could be explored.
- Scientific contexts should be explored where appropriate.

Outcome 3

Solve problems using integral calculus:

- Perform the Integration of standard functions, and functions commonly used in scientific contexts. The indefinite integral as an anti-derivative should be explored. Contexts should be selected from the course being studied.
- The relationship between definite integrals and areas under curves should be considered. Appropriate scientific contexts may be used here.
- Calculate the area between a curve and the x-axis. Consideration should be given to curves above and below the x-axis. It would be beneficial to show examples of definite integration where the curve crosses the x-axis between the lower and upper limits should be used.

Guidance on approaches to delivery of this Unit

This Unit provides core mathematical principles and processes which underpin the studies undertaken in a number of Higher National Qualifications across a range of scientific disciplines. It is recommended that the Unit be delivered towards the beginning of these awards.

Centres may deliver the Outcomes in any order they wish, but it is recommended that Outcome 1 is delivered first followed by Outcomes 2 and then Outcome 3.

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.

Higher National Unit Support Notes (cont)

Unit title: Mathematics for Science 1 (SCQF level 6)

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 three 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 the Critical Thinking component of Problem Solving embedded 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 6.

History of changes to Unit

Version	Description of change	Date
03	Content removed to ensure that the unit does not exceed the notional design length of 40 hours.	10/08/18
02	Core Skills Components Using Number and Critical Thinking at SCQF level 6	June 2015

General information for learners

Unit title: Mathematics for Science 1 (SCQF level 6)

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 1* 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 Higher Mathematics.

In this unit, you will learn to:

1 Apply algebraic methods.

- Evaluate expressions involving powers, natural logarithms, common logarithms, exponentials, powers of 10, and trigonometrical functions
- Solve quadratic equations
- Solve simultaneous equations
- Change the subject of a formula involving powers, natural logarithms, common logarithms, exponentials, and powers of 10.

2 Solve problems using differential calculus.

- Differentiate standard functions (polynomials, $(ax+b)^n$, $\sin$, $\cos$, as well as sums and differences of these)
- Calculate rates of change
- Find the second derivatives of functions
- Find the turning points of cubic equations

3 Solve problems using integral calculus.

- Perform the indefinite integration of standard functions (polynomials, $(ax+b)^n$, $\sin$, $\cos$, as well as sums and differences of these)
- Perform the Definite Integration of the above functions
- Calculate the area between curves and the x-axis for curves both above and below the x-axis

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 a course at Intermediate 2 or National 5 in Mathematics or equivalent.