Higher National Unit Specification

General information for centres

Unit title: Mathematics for Science 2

Unit code: DV9V 34

Unit purpose: This Unit is designed to enable candidates to apply mathematical techniques in the context of science. This will be achieved by incorporating, where possible, examples from a scientific perspective. It is primarily intended for candidates who wish to progress to higher education to advance their qualifications in this area. It is also be useful to all candidates who expect to work in a scientific environment.

On completion of the Unit the candidate should be able to:

1   Apply algebraic techniques to manipulate expressions and perform calculations in a scientific context.
2   Apply techniques of differential calculus to scientific functions.
3   Apply techniques of integral calculus to scientific functions.

Credit points and level: 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*)

SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.

Recommended prior knowledge and skills: Entry is at the discretion of the centre, however it would be advisable if candidates had a pass at Higher or Intermediate 2 Mathematics or equivalent.

Core Skills: There are opportunities to develop the Core Skill of Numeracy at Higher level in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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. . This Unit is included as an optional Unit in the framework for the HNC Applied Sciences and a number of HND Science awards.

General information for centres (cont)

Assessment: It is possible to assess candidates either on an Outcome by Outcome basis or by a single holistic assessment combining all three Outcomes. The assessment papers could be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be carried out under supervised, controlled conditions.

Candidates must achieve all of the minimum evidence specified for each Outcome in order to pass the Unit.

Higher National Unit specification: statement of standards

Unit title: Mathematics for Science 2

Unit code: DV9V 34

The sections of the Unit stating the Outcomes, knowledge and/or skills, and Evidence Requirements are mandatory.

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. Candidates 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 techniques to manipulate expressions and perform calculations occurring in science

Knowledge and/or skills

♦   Transposition and evaluation of formulae involving logarithmic and exponential functions
♦   Reduction of Rational Functions using Partial Fractions
♦   Reduction of non-linear functions to linear functions algebraically and graphically

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

♦   transpose and evaluation of scientific formula to include exponential and logarithmic expressions. Examples should include the use of scientific notation
♦   reduce rational functions with more than one linear factor in the denominator, repeated linear factors in the denominator and quadratic factors in the denominator
♦   convert non-linear data to linear using logs and analyse function algebraically and graphically

Evidence for the knowledge and/or skills in this Outcome will be provided by an examination taken at a single assessment event lasting 60 minutes and carried out under supervised, controlled conditions. The evidence may be presented in response to specific questions. In any assessment of this Outcome all of the knowledge and/or skills items should be tested.

In order to ensure that candidates will not be able to foresee the exact form of the assessment, a different examination is required each time the Outcome is assessed.

A formula sheet of relevant formula should be given out to candidates.

Higher National Unit specification: statement of standards (cont)

Unit title: Mathematics for Science 2

Assessment guidelines

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions. Questions should be given in a scientific context as much as possible.

The assessment of this Outcome could be combined with Outcomes 2 and 3 to form a single assessment paper lasting approximately 3 hours.

Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment.

Outcome 2

Apply techniques of differential calculus to scientific functions

Knowledge and/or skills

♦ Differentiation of scientific functions
♦ Application of differentiation to the solution of scientific problems

Evidence Requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

♦ differentiate scientific functions including derivatives of e^x, $\ln x$, $\sin x$, $\cos x$ $\tan x$, using the chain rule, product rule and quotient rule
♦ evaluation of rates of change, solution of maxima/minima problems

Evidence for the knowledge and/or skills in this Outcome will be provided by an examination taken at a single assessment event lasting approximately 60 minutes and carried out under supervised, controlled conditions. The evidence may be presented in response to specific questions. In any assessment of this Outcome all of the knowledge and/or skills items should be tested.

In order to ensure that candidates will not be able to for see the exact form of the assessment, a different examination is required each time the Outcome is assessed.

A formula sheet of standard derivatives and the rules should be given out.

Assessment guidelines

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment of this Outcome could be combined with Outcomes 1 and 3 to form a single assessment paper lasting approximately 3 hours.

Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment.

Higher National Unit specification: statement of standards (cont)

Unit title: Mathematics for Science 2

Outcome 3

Apply techniques of integral calculus to scientific functions

Knowledge and/or skills

♦ Integration of Scientific Functions
♦ Application of integration to the solution of scientific problems

Evidence Requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

♦ integrate scientific functions including integrals of polynomials, e^x, $\sin x$, $\cos x$, $\tan x$, and integration using partial fractions
♦ solution of differential equations of the first order, variables separable; evaluation of areas by direct integration and by numerical method using Simpson's Rule

Evidence for the knowledge and/or skills in this Outcome will be provided by an examination taken at a single assessment event lasting approximately 60 minutes and carried out under supervised, controlled conditions. The evidence may be presented in response to specific questions. In any assessment of this Outcome all of the knowledge and/or skills items should be tested.

In order to ensure that candidates will not be able to foresee the exact form of the assessment, a different examination is required each time the Outcome is assessed

A formula sheet with standard integrals and Simpsons rule should be given with assessment.

Assessment guidelines

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment of this Outcome could be combined with Outcomes 1 and 2 to form a single assessment paper.

If it is decided to use a single holistic assessment, then the single assessment paper could be taken at a single assessment event lasting 3 hours and carried out under supervised controlled conditions. Evidence for the knowledge and/or skills for all three Outcomes will be provided by an examination. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment. In any assessment of this Unit all of the knowledge and skills items should be tested.

In order to ensure that candidates will not be able to foresee the exact form of the assessment, a different examination is required each time the Unit is assessed.

Administrative Information

Unit code: DV9V 34

Unit title: Mathematics for Science 2

Superclass category: RB

Date of publication: August 2005

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Source: SQA

Higher National Unit specification: support notes

Unit title: Mathematics for Science 2

This part of the Unit specification is offered as guidance. The support notes 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

The object of the Unit is to enable candidates to apply mathematical methods to problems in science. Where possible this should be taken into account when delivering the Unit by using examples in context.

Outcome 1

Candidates should be able to:

♦ use mathematical techniques to manipulate and evaluate scientific formula
♦ simplify rational functions using partial fractions
♦ reduce non-linear functions to linear functions algebraically and graphically

Outcome 2

Candidates should be able to:

♦ use standard derivatives of e^x, $\ln x$, $\sin x$, $\cos x$, $\tan x$, $\sec x$, $\operatorname{cosec} x$ and $\cot x$; apply chain rule, product rule and quotient rule to differentiate scientific functions
♦ evaluation of rates of change, solution of maxima/minima problems

Outcome 3

Candidates should be able to:

♦ use standard integrals of e^x, $\ln x$, $\sin x$, $\cos x$, $\tan x$, $\sec x$, $\operatorname{cosec} x$ and $\cot x$; apply integration using partial fractions
♦ solve first order differential equations, variables separable; Find area under a curve by direct integration and by approximate numerical method using Simpson's rule

Guidance on the delivery and assessment of this Unit

The delivery should take the form of lecturer exposition with student materials consisting of notes and tutorials with some examples in the context of science. The assessments should all be set in controlled conditions and be closed-book. Any relevant formula should be issued with the assessment. Each assessment should last approximately one hour if assessment is on an Outcome by Outcome basis or approximately 3 ours if assessment is integrated.

Higher National Unit specification: support notes (cont)

Unit title: Mathematics for Science 2

Outcome 1

This assessment could have three sets of questions. The first set could assess manipulation of formulae where possible directly from science. The second set could assess the use of partial fractions. The third set could assess the reduction of non-linear functions to linear. The first two sets will have three problems with 2 correct responses and the third set 1 problem which must be correct to achieve a pass in this Outcome. For Assessment/Reassessment the first question could have both exponential and logarithmic functions, the second question could have all three methods of partial fractions, and the last question may be natural or common logarithms. The assessment will be presented in a controlled situation, be closed-book and should last approximately one hour. Any relevant formula should be given.

Outcome 2

This assessment could have 2 sets of questions. 1 set of questions on differentiation and 1 set on the application of differentiation to the solution of scientific problems. Set 1 will have a question on each rule and 2 of these should all be answered correctly. Set 2 will have three questions and 2 of these should be answered correctly. For Assessment/Reassessment Set 1 should assess all three rules but with different functions, and set 2 should assess rate of change on two occasions and maxima/minima once, again with a selection of functions from the list. The assessment will be presented in a controlled situation, be closed-book and should last approximately one hour. Standard derivatives and the rules may be given out.

Outcome 3

This assessment could have two sets of questions. One set of questions on integration and one set on applications of integration to the solution of scientific problems. Each set will have three different questions and two of these should be answered correctly. The first set will have two questions on integration and one using partial fractions. The second set will have one differential equation problem, one area by integration and one area by Simpsons Rule. For Assessment/Reassessment the different functions from the list should be used. The assessment will be presented in a controlled situation, be closed-book and should last approximately one hour. Standard integrals and Simpsons rule may be given with assessment.

Opportunities for developing Core Skills

There may be opportunities to develop the core skill of Numeracy at Higher level in this Unit, although there is no automatic certification of core skills or core skills components.

Open learning

If this Unit is delivered by open or distance learning methods, additional planning resources may be required for candidate support, assessment and quality assurance.

A combination of new and traditional authentication tools may have to be devised for assessment and reassessment purposes.

For further information and advice, please see "Assessment and Quality Assurance for Open and Distance Learning" (SQA, Feb 2001 — publication code — A4030).

Higher National Unit specification: support notes (cont)

Unit title: Mathematics for Science 2

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs,* which is available on SQA's website: **www.sqa.org.uk**.

General information for candidates

Unit title: Mathematics for Science 2

In this Unit you will learn about and use mathematical techniques that are applicable to science. Where possible throughout the Unit specific examples will be used and their relevance indicated. The Unit consists of three Outcomes:

1   Apply algebraic techniques to manipulate expressions and perform calculations in a scientific context.
2   Apply techniques of differential calculus to scientific functions.
3   Apply techniques of integral calculus to scientific functions.

Outcome 1 covers useful formulae and how to manipulate and evaluate these formulae in a context meaningful to your subject area. Outcome 2 looks at Differential Calculus, which is an area of Mathematics directly applicable to science and therefore very useful. Integral Calculus is covered in Outcome 3 again this applies to various areas in science.

The Unit assessments will be assessed in class under closed-book conditions. You will be expected to have a good level of mathematics on entry, preferably a pass at Higher mathematics or a minimum of a pass at Intermediate 2 Mathematics or equivalent. The Unit is normally for those who wish to progress to higher education but would be of great use to anyone intending to work in a scientific environment.