Higher
Course
Specification

Higher Mathematics

Course code:	C847 76
Course assessment code:	X847 76
SCQF:	level 6 (24 SCQF credit points)
Valid from:	session 2018–19

This document provides detailed information about the course and course assessment to ensure consistent and transparent assessment year on year. It describes the structure of the course and the course assessment in terms of the skills, knowledge and understanding that are assessed.

This document is for teachers and lecturers and contains all the mandatory information you need to deliver the course.

This edition: April 2018 (version 1.0)

Contents

Course overview

The course consists of 24 SCQF credit points which includes time for preparation for course assessment. The notional length of time for candidates to complete the course is 160 hours.

The course assessment has two components.

Component	Marks	Duration
Component 1: question paper 1 (non-calculator)	70	1 hour and 30 minutes
Component 2: question paper 2	80	1 hour and 45 minutes

Recommended entry	Progression
Entry to this course is at the discretion of the centre. Candidates should have achieved the National 5 Mathematics course or equivalent qualifications and/or experience prior to starting this course.	♦ other qualifications in mathematics or related areas, for example Advanced Higher Mathematics, Advanced Higher Mathematics of Mechanics, Advanced Higher Statistics ♦ further study, employment and/or training

Conditions of award

The grade awarded is based on the total marks achieved across all course assessment components.

Achievement of this course gives automatic certification of the following Core Skill:

♦ Numeracy at SCQF level 6

Course rationale

National Courses reflect Curriculum for Excellence values, purposes and principles. They offer flexibility, provide time for learning, focus on skills and applying learning, and provide scope for personalisation and choice.

Every course provides opportunities for candidates to develop breadth, challenge and application. The focus and balance of assessment is tailored to each subject area.

Mathematics engages learners of all ages, interests and abilities. Learning mathematics develops logical reasoning, analysis, problem-solving skills, creativity, and the ability to think in abstract ways. It uses a universal language of numbers and symbols, which allows us to communicate ideas in a concise, unambiguous and rigorous way.

The course develops important mathematical techniques which are critical to successful progression beyond Higher level in Mathematics and many other curriculum areas. The skills, knowledge and understanding in the course also support learning in technology, health and wellbeing, science, and social studies.

Purpose and aims

Mathematics is important in everyday life. It helps us to make sense of the world we live in and to manage our lives.

Using mathematics enables us to model real-life situations and make connections and informed predictions. It equips us with the skills we need to interpret and analyse information, simplify and solve problems, assess risk and make informed decisions.

The course aims to:

- motivate and challenge candidates by enabling them to select and apply mathematical techniques in a variety of mathematical situations
- develop confidence in the subject and a positive attitude towards further study in mathematics and the use of mathematics in employment
- deliver in-depth study of mathematical concepts and the ways in which mathematics describes our world
- allow candidates to interpret, communicate and manage information in mathematical form, skills which are vital to scientific and technological research and development
- deepen candidates' skills in using mathematical language and exploring advanced mathematical ideas

Who is this course for?

This course is particularly suitable for candidates who:

- have demonstrated an aptitude for National 5 Mathematics
- are interested in developing mathematical techniques to use in further study or in the workplace

Course content

The Higher Mathematics course develops, deepens and extends the mathematical skills necessary at this level and beyond. Throughout this course, candidates acquire and apply operational skills necessary for developing mathematical ideas through symbolic representation and diagrams. They select and apply mathematical techniques and develop their understanding of the interdependencies within mathematics.

Candidates develop mathematical reasoning skills and gain experience in making informed decisions.

Skills, knowledge and understanding

Skills, knowledge and understanding for the course

The following provides a broad overview of the subject skills, knowledge and understanding developed in the course:

- understand and use a range of complex mathematical concepts and relationships
- select and apply operational skills in algebra, geometry, trigonometry, calculus and statistics within mathematical contexts
- select and apply skills in numeracy
- use mathematical reasoning skills to extract and interpret information and to use complex mathematical models
- use mathematical reasoning skills to think logically, provide justification or proof, and solve problems
- communicate mathematical information with complex features

Skills, knowledge and understanding for the course assessment

The following provides details of skills, knowledge and understanding sampled in the course assessment:

Algebraic and trigonometric skills	
Skills	**Explanation**
Manipulating algebraic expressions	♦ factorising a cubic or quartic polynomial expression ♦ simplifying a numerical expression using the laws of logarithms and exponents
Manipulating trigonometric expressions	♦ applying the addition formulae and/or double angle formulae ♦ applying trigonometric identities ♦ converting $a\cos x + b\sin x$ to $k\cos(x \pm \alpha)$ or $k\sin(x \pm \alpha),\ k > 0$
Identifying and sketching related functions	♦ identifying a function from a graph, or sketching a function after a transformation of the form $kf(x)$, $f(kx)$, $f(x)+k$, $f(x+k)$ or a combination of these ♦ sketching $y = f'(x)$ given the graph of $y = f(x)$ ♦ sketching the inverse of a logarithmic or an exponential function ♦ completing the square in a quadratic expression where the coefficient of x^2 is non-unitary
Determining composite and inverse functions	♦ knowledge and use of the terms domain and range is expected ♦ determining a composite function given $f(x)$ and $g(x)$, where $f(x)$ and $g(x)$ can be trigonometric, logarithmic, exponential or algebraic functions ♦ determining $f^{-1}(x)$ of functions

Algebraic and trigonometric skills	
Skills	**Explanation**
Solving algebraic equations	♦ solving a cubic or quartic polynomial equation ♦ using the discriminant to find an unknown, given the nature of the roots of an equation ♦ solving quadratic inequalities, $ax^2 + bx + c \geq 0$ (or ≤ 0) ♦ solving logarithmic and exponential equations ♦ using the laws of logarithms and exponents ♦ solving equations of the following forms for a and b, given two pairs of corresponding values of x and y: $\log y = b \log x + \log a,\ y = ax^b$ and $\log y = x \log b + \log a,\ y = ab^x$ ♦ using a straight-line graph to confirm relationships of the form $y = ax^b,\ y = ab^x$ ♦ mathematically modelling situations involving the logarithmic or exponential function ♦ finding the coordinates of the point(s) of intersection of a straight line and a curve or of two curves
Solving trigonometric equations	♦ solving trigonometric equations in degrees or radians, including those involving the wave function or trigonometric formulae or identities, in a given interval

Geometric skills	
Skills	**Explanation**
Determining vector connections	♦ determining the resultant of vector pathways in three dimensions ♦ working with collinearity ♦ determining the coordinates of an internal division point of a line
Working with vectors	♦ evaluating a scalar product given suitable information and determining the angle between two vectors ♦ applying properties of the scalar product ♦ using and finding unit vectors including $\mathbf{i}$, $\mathbf{j}$, $\mathbf{k}$ as a basis

Calculus skills	
Skills	**Explanation**
Differentiating functions	♦ differentiating an algebraic function which is, or can be simplified to, an expression in powers of x ♦ differentiating $k\sin x$ and $k\cos x$ ♦ differentiating a composite function using the chain rule
Using differentiation to investigate the nature and properties of functions	♦ determining the equation of a tangent to a curve at a given point by differentiation ♦ determining where a function is strictly increasing or decreasing ♦ sketching the graph of an algebraic function by determining stationary points and their nature as well as intersections with the axes and behaviour of $f(x)$ for large positive and negative values of x

Calculus skills	
Skills	**Explanation**
Integrating functions	♦ integrating an algebraic function which is, or can be, simplified to an expression of powers of x ♦ integrating functions of the form $f(x)=(x+q)^n,\ n\neq -1$ ♦ integrating functions of the form $f(x)=p\cos x$ and $f(x)=p\sin x$ ♦ integrating functions of the form $f(x)=(px+q)^n,\ n\neq -1$ ♦ integrating functions of the form $f(x)=p\cos(qx+r)$ and $p\sin(qx+r)$ ♦ solving differential equations of the form $\frac{dy}{dx}=f(x)$
Using integration to calculate definite integrals	♦ calculating definite integrals of functions with limits which are integers, radians, surds or fractions
Applying differential calculus	♦ determining the optimal solution for a given problem ♦ determining the greatest and/or least values of a function on a closed interval ♦ solving problems using rate of change
Applying integral calculus	♦ finding the area between a curve and the x-axis ♦ finding the area between a straight line and a curve or two curves ♦ determining and using a function from a given rate of change and initial conditions

Algebraic and geometric skills	
Skills	**Explanation**
Applying algebraic skills to rectilinear shapes	♦ finding the equation of a line parallel to and a line perpendicular to a given line ♦ using $m = \tan\theta$ to calculate a gradient or angle ♦ using properties of medians, altitudes and perpendicular bisectors in problems involving the equation of a line and intersection of lines ♦ determining whether or not two lines are perpendicular
Applying algebraic skills to circles and graphs	♦ determining and using the equation of a circle ♦ using properties of tangency in the solution of a problem ♦ determining the intersection of circles or a line and a circle
Modelling situations using sequences	♦ determining a recurrence relation from given information and using it to calculate a required term ♦ finding and interpreting the limit of a sequence, where it exists

Reasoning skills	
Skills	**Explanation**
Interpreting a situation where mathematics can be used and identifying a strategy	♦ analysing a situation and identifying an appropriate use of mathematical skills
Explaining a solution and, where appropriate, relating it to context	♦ explaining why a particular solution is appropriate in a given context

Additional information
The following symbols, terms and sets may appear in the question papers. Candidates are expected to understand their use but they are not required to use them in their answers. ♦ the symbols: $\in$, $\notin$, $\{\ \}$ ♦ the terms: set, subset, empty set, member, element ♦ the conventions for representing sets, namely: — $\mathbb{N}$, the set of natural numbers, $\{1, 2, 3, \ldots\}$ — $\mathbb{W}$, the set of whole numbers, $\{0, 1, 2, 3, \ldots\}$ — $\mathbb{Z}$, the set of integers — $\mathbb{Q}$, the set of rational numbers — $\mathbb{R}$, the set of real numbers

Skills, knowledge and understanding included in the course are appropriate to the SCQF level of the course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level, and can be found on the SCQF website.

Skills for learning, skills for life and skills for work

This course helps candidates to develop broad, generic skills. These skills are based on SQA's Skills Framework: Skills for Learning, Skills for Life and Skills for Work and draw from the following main skills areas:

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

You must build these skills into the course at an appropriate level, where there are suitable opportunities.

Course assessment

Course assessment is based on the information provided in this document.

The course assessment meets the key purposes and aims of the course by addressing:

- breadth — drawing on knowledge and skills from across the course
- challenge — requiring greater depth or extension of knowledge and/or skills
- application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

This enables candidates to:

- develop mathematical operational skills
- combine mathematical operational skills developed throughout the course
- develop mathematical reasoning skills
- apply skills, without the aid of a calculator, in order to demonstrate that they have an underlying grasp of mathematical concepts and processes

Course assessment structure

Component 1: question paper 1 (non-calculator) 70 marks

This question paper allows candidates to demonstrate the application of mathematical skills, knowledge and understanding from across the course. Candidates must not use a calculator.

This question paper gives candidates an opportunity to apply an understanding of the underlying processes involved in numerical, algebraic, geometric, trigonometric, calculus, and reasoning skills specified in the 'Skills, knowledge and understanding for the course assessment' section.

This question paper has 70 marks out of a total of 150 marks for the course assessment. It consists of short-answer and extended-response questions.

Setting, conducting and marking question paper 1 (non-calculator)

This question paper is set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA.

Candidates have 1 hour and 30 minutes to complete this question paper.

Component 2: question paper 2 80 marks

This question paper assesses mathematical skills. Candidates may use a calculator.

This question paper gives candidates an opportunity to apply numerical, algebraic, geometric, trigonometric, calculus, and reasoning skills specified in the 'Skills, knowledge and understanding for the course assessment' section.

Using a calculator can facilitate these skills and allow more opportunity for application and reasoning. Candidates typically use calculators where more complex calculations are required to solve problems.

This question paper has 80 marks out of a total of 150 marks for the course assessment. It consists of short-answer and extended-response questions.

Setting, conducting and marking question paper 2

This question paper is set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA.

Candidates have 1 hour and 45 minutes to complete this question paper.

Specimen question papers for Higher courses are published on SQA's website. These illustrate the standard, structure and requirements of the question papers candidates sit. The specimen papers also include marking instructions.

Grading

Candidates' overall grades are determined by their performance across the course assessment. The course assessment is graded A–D on the basis of the total mark for all course assessment components.

Grade description for C

For the award of grade C, candidates will typically have demonstrated successful performance in relation to the skills, knowledge and understanding for the course.

Grade description for A

For the award of grade A, candidates will typically have demonstrated a consistently high level of performance in relation to the skills, knowledge and understanding for the course.

Equality and inclusion

This course is designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

For guidance on assessment arrangements for disabled candidates and/or those with additional support needs, please follow the link to the assessment arrangements web page: www.sqa.org.uk/assessmentarrangements.

Further information

The following reference documents provide useful information and background.

- Higher Mathematics subject page
- Assessment arrangements web page
- Building the Curriculum 3–5
- Guide to Assessment
- Guidance on conditions of assessment for coursework
- SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work
- Coursework Authenticity: A Guide for Teachers and Lecturers
- Educational Research Reports
- SQA Guidelines on e-assessment for Schools
- SQA e-assessment web page

The SCQF framework, level descriptors and handbook are available on the SCQF website.

Administrative information

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History of changes

Version	Description of change	Date

Note: you are advised to check SQA's website to ensure you are using the most up-to-date version of this document.