National 5 Course Specification

National 5 Mathematics

Course code:	C847 75
Course assessment code:	X847 75
SCQF:	level 5 (24 SCQF credit points)
Valid from:	session 2017–18

The course specification 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.

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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 a candidate to complete the course is 160 hours.

The course assessment has two components.

Component	Marks	Duration
Component 1: question paper — paper 1 (non-calculator)	50	1 hour and 15 minutes
Component 2: question paper — paper 2	60	1 hour and 50 minutes

Recommended entry	Progression
Entry to this course is at the discretion of the centre. Candidates should have achieved the fourth curriculum level or the National 4 Mathematics course or equivalent qualifications and/or experience prior to starting this course.	♦ other qualifications in mathematics or related areas, eg Higher Mathematics, Skills for Work courses, National Progression Awards, National Certificate Group Awards ♦ further study, employment 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 5

Course rationale

National Courses reflect Curriculum for Excellence values, purposes and principles. They offer flexibility, provide more time for learning, more focus on skills and applying learning, and 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 National 5 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

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 and real-life situations
- develop confidence in the subject and a positive attitude towards further study in mathematics
- develop skills in manipulation of abstract terms to generalise and to solve problems
- allow candidates to interpret, communicate and manage information in mathematical form: skills which are vital to scientific and technological research and development
- develop candidates' skills in using mathematical language and in exploring mathematical ideas
- develop skills relevant to learning, life and work in an engaging and enjoyable way

Who is this course for?

This is a suitable course for learners who have achieved the fourth level of learning across the mathematics experiences and outcomes in the broad general education, or who have attained the National 4 Mathematics course, or who have equivalent qualifications or experience.

This course is particularly suitable for learners who wish to develop mathematical techniques for use in further study of mathematics or other curriculum areas, or in workplaces.

Course content

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 mathematical concepts and relationships
- select and apply numerical skills
- select and apply skills in algebra, geometry, trigonometry and statistics
- use mathematical models
- use mathematical reasoning skills to interpret information, to select a strategy to solve a problem, and to communicate solutions

Skills, knowledge and understanding for the course assessment

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

Numerical skills	
Skills	**Explanation**
Working with surds	♦ Simplification ♦ Rationalising denominators
Simplifying expressions using the laws of indices	♦ Multiplication and division using positive and negative indices including fractions ♦ $(ab)^m = a^m b^m$ ♦ $(a^m)^n = a^{mn}$ ♦ $a^{m/n} = \sqrt[n]{a^m}$ ♦ Calculations using scientific notation
Rounding	♦ To a given number of significant figures

Numerical skills	
Skills	**Explanation**
Working with reverse percentages	♦ Use reverse percentages to calculate an original quantity
Working with appreciation/depreciation	♦ Appreciation including compound interest ♦ Depreciation
Working with fractions	♦ Operations and combinations of operations on fractions including mixed numbers (addition, subtraction, multiplication, division)

Algebraic skills	
Skills	**Explanation**
Working with algebraic expressions involving expansion of brackets	♦ $a(bx+c)+d(ex+f)$ ♦ $ax(bx+c)$ ♦ $(ax+b)(cx+d)$ ♦ $(ax+b)(cx^2+dx+e)$ where $a,b,c,d,e,f \in \mathbb{Z}$
Factorising an algebraic expression	♦ Common factor ♦ Difference of squares $p^2x^2-a^2$ ♦ Trinomials with unitary and non-unitary x^2 coefficient ♦ Combinations of the above
Completing the square in a quadratic expression with unitary x^2 coefficient	♦ Writing quadratics of the form x^2+bx+c in the form $(x+p)^2+q$ where $b,c \in \mathbb{Z}$ and $p,q \in \mathbb{Q}$
Reducing an algebraic fraction to its simplest form	♦ $\frac{a}{b}$ where a,b are of the form $(mx+p)^n$ or $(mx+p)(nx+q)$ and $b \neq 0$
Applying the four operations to algebraic fractions	♦ $\frac{a}{b} * \frac{c}{d}$ where a,b,c,d can be simple constants, variables or expressions; $*$ can be add, subtract, multiply or divide; and $b \neq 0, d \neq 0$

Algebraic skills	
Skills	**Explanation**
Determining the equation of a straight line	♦ Use the formula $y-b=m(x-a)$ or equivalent to find the equation of a straight line, given two points or one point and the gradient of the line ♦ Use functional notation, $f(x)$ ♦ Identify gradient and *y*-intercept from various forms of the equation of a straight line
Working with linear equations and inequations	♦ Where numerical coefficients are rational numbers, $\mathbb{Q}$ ♦ Where numerical solutions are rational numbers, $\mathbb{Q}$
Working with simultaneous equations	♦ Construct from text ♦ Graphical solution ♦ Algebraic solution
Changing the subject of a formula	♦ Linear formula ♦ Formula involving a simple square or square root
Recognise and determine the equation of a quadratic function from its graph	♦ Equations of the form $y=kx^2$ and $y=k(x+p)^2+q$ where $k, p, q \in \mathbb{Z}$
Sketching a quadratic function	♦ Equations of the form $y=(ax-m)(bx-n)$ where $a, b, m, n \in \mathbb{Z}$ ♦ Equations of the form $y=k(x+p)^2+q$ where $k, p, q \in \mathbb{Z}$
Identifying features of a quadratic function	Identify: ♦ the nature and coordinates of the turning point ♦ the equation of the axis of symmetry of a quadratic of the form $y=k(x+p)^2+q$ where $k, p, q \in \mathbb{Z}$
Solving a quadratic equation	♦ Solving from factorised form ♦ Solving having factorised first ♦ Graphical treatment

Algebraic skills	
Skills	**Explanation**
Solving a quadratic equation using the quadratic formula	♦ Solving using the quadratic formula
Using the discriminant to determine the number of roots	♦ Know and use the discriminant ♦ Determine the number and describe the nature of roots using the language 'two real and distinct roots', 'one repeated real root', 'two equal real roots' and 'no real roots'

Geometric skills	
Skills	**Explanation**
Determining the gradient of a straight line, given two points	♦ $m = \frac{y_2 - y_1}{x_2 - x_1}$
Circle geometry	♦ Calculating the length of an arc ♦ Calculating the area of a sector
Calculating the volume of a standard solid	♦ Sphere, cone, pyramid
Applying Pythagoras' theorem	♦ Using Pythagoras' theorem in complex situations including converse and three dimensions
Applying the properties of shapes to determine an angle involving at least two steps	♦ Quadrilaterals/triangles/polygons/circles ♦ Relationship in a circle between the centre, chord and perpendicular bisector
Using similarity	♦ Interrelationship of scale — length, area and volume
Working with two-dimensional vectors	♦ Adding or subtracting two-dimensional vectors using directed line segments
Working with three-dimensional coordinates	♦ Determining coordinates of a point from a diagram representing a three-dimensional object
Using vector components	♦ Adding or subtracting two- or three-dimensional vectors using components

Geometric skills	
Skills	**Explanation**
Calculating the magnitude of a vector	♦ Magnitude of a two- or three-dimensional vector

Trigonometric skills	
Skills	**Explanation**
Working with the graphs of trigonometric functions	♦ Basic graphs ♦ Amplitude ♦ Vertical translation ♦ Multiple angle ♦ Phase angle
Working with trigonometric relationships in degrees	♦ Sine, cosine and tangent of angles from $0°$ to $360°$ ♦ Period ♦ Related angles ♦ Solve basic equations ♦ Use the identities $\cos^2 x° + \sin^2 x° = 1$ and $\tan x° = \frac{\sin x°}{\cos x°}$
Calculating the area of a triangle using trigonometry	♦ Area $= \frac{1}{2}ab\sin C$
Using the sine and cosine rules to find a side or angle in a triangle	♦ Sine rule for side and angle ♦ Cosine rule for side and angle
Using bearings with trigonometry	♦ To find a distance or direction

Statistical skills	
Skills	**Explanation**
Comparing data sets using statistics	Compare data sets using calculated/determined: ♦ semi-interquartile range ♦ standard deviation
Forming a linear model from a given set of data	♦ Determine the equation of a best-fitting straight line on a scattergraph and use it to estimate y given x

Reasoning skills	
Skills	**Explanation**
Interpreting a situation where mathematics can be used and identifying a strategy	♦ Can be attached to any operational skills to require analysis of a situation
Explaining a solution and relating it to context	♦ Can be attached to any operational skills to require explanation of the solution given

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 (www.scqf.org.uk).

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

These skills must be built into the course where there are appropriate opportunities and the level should be appropriate to the level of the course.

Further information on building in skills for learning, skills for life and skills for work is given in the course support notes.

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:

- demonstrate mathematical operational skills
- integrate mathematical operational skills developed throughout the course
- demonstrate mathematical reasoning skills
- apply numerical calculation skills without the use of a calculator to demonstrate an underlying grasp of mathematical processes

Course assessment structure

Component 1: question paper 1 (non-calculator) 50 marks

The purpose of this question paper is to allow candidates to demonstrate the application of mathematical skills, knowledge and understanding from across the course. A calculator cannot be used.

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

These skills are those in which the candidate is required to demonstrate an understanding of the underlying processes. They involve the ability to use numerical skills within mathematical contexts in cases where a calculator may compromise the assessment of this understanding.

This question paper has 50 marks out of a total of 110 marks.

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 complete this in 1 hour and 15 minutes.

Component 2: question paper 2 60 marks

The purpose of this question paper is to assess mathematical skills. A calculator may be used.

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

These skills are those which may be facilitated by the use of a calculator, allowing more opportunity for application.

This question paper has 60 marks out of a total of 110 marks.

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 complete this in 1 hour and 50 minutes.

Specimen question papers for National 5 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

A candidate's overall grade is 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.

- National 5 Mathematics subject page
- Assessment arrangements web page
- Building the Curriculum 3–5
- Design Principles for National Courses
- Guide to Assessment
- SCQF Framework and SCQF level descriptors
- SCQF Handbook
- 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

Appendix 1: course support notes

Introduction

These support notes are not mandatory. They provide advice and guidance to teachers and lecturers on approaches to delivering the course. They should be read in conjunction with this course specification and the specimen question paper.

Approaches to learning and teaching

The purpose of this section is to provide general advice and guidance on approaches to learning and teaching across the course.

The overall aim of the course is to develop a range of mathematical operational and reasoning skills that can be used to solve mathematical and real-life problems. Approaches to learning and teaching should be engaging, with opportunities for personalisation and choice built in where possible.

A rich and supportive learning environment should be provided to enable candidates to achieve the best they can. This could include learning and teaching approaches such as:

- investigative or project-based tasks such as investigating the graphs of quadratic functions, perhaps using calculators or other technologies
- a mix of collaborative and independent tasks which engage candidates, eg identifying gradient and y-intercept values from various forms of the equation of a straight line
- using materials available from service providers and authorities, eg working with real-life plans and drawings, using trigonometric skills to calculate line lengths and angle sizes
- problem-solving and critical thinking
- explaining thinking and presenting strategies and solutions to others — candidates may be provided with information which could be used to solve a problem, eg using simultaneous equations, and could then discuss their strategies in groups
- effective use of questioning and discussion to encourage more candidates to explain their thinking and to determine their understanding of fundamental concepts
- making links across the curriculum to encourage the transfer of skills, knowledge and understanding such as in science, technology, social subjects and health and wellbeing, eg liaising with physics on applications of appropriate formulae, such as $F = ma$, $v = u + at$, and $s = ut + \frac{1}{2}at^2$ — there should be a shared understanding across curriculum areas regarding approaches to changing the subject of a formula
- using technology to provide richer learning experiences and to develop confidence

Developing mathematical skills is an active and productive process, building on candidates' current knowledge, understanding and capabilities. Existing knowledge should form the starting point for any learning and teaching situation, with new knowledge being linked to existing knowledge and built on. Presenting candidates with an investigative or practical task is a useful way of allowing them to appreciate how a new idea relates to their existing knowledge and understanding.

Questions can be used to ascertain a candidate's level of understanding and provide a basis for consolidation or remediation where necessary.

Examples of probing questions include:

- How did you decide what to do?
- How did you approach exploring and solving this task or problem?
- Could this task or problem have been solved in a different way? If yes, what would you have done differently?

As candidates develop concepts in mathematics, they will benefit from continual reinforcement and consolidation to build a foundation for progression.

Throughout learning and teaching, candidates should be encouraged to:

- process numbers without using a calculator
- practise and apply the skills associated with mental calculations wherever possible
- develop and improve their skills in completing written and mental calculations in order to develop fluency and efficiency

The use of a calculator should complement these skills, not replace them.

Integrating skills

Integrating with other operational skills

Skills, knowledge and understanding may be integrated with other operational skills, for example:

- expressions could be combined with equations
- gradients could be combined with the equation of a straight line
- indices could be combined with fractions
- completing the square could be combined with sketching a quadratic function
- related angles could be combined with sine and cosine rules
- vectors could be combined with Pythagoras' theorem for vectors at right angles
- area of a triangle could be combined with area of sector

Integrating with reasoning skills

Skills, knowledge and understanding may be integrated with reasoning skills, for example:

- expressions could be derived from a mathematical problem before simplification
- compound solids could be broken down into simple solids to enable a volume to be calculated — this could be enclosed in a design problem
- an algebraic fraction could be derived from a mathematical situation before simplifying
- accuracy in rounding answers could be required to suit a given situation
- simultaneous equations could be derived from a problem before solving

- a quadratic equation and graph could be used in a context-based problem
- a problem involving the use of Pythagoras' theorem could be set in a real-life context
- a problem involving the use of similarity could be set in a real-life context
- sine and cosine rules could be used in a problem situation involving bearings
- vectors could be used in a context-based problem
- a problem involving the use of line of best fit could be set in a scientific context

Useful websites

The table below lists organisations that may provide resources suitable for the National 5 Mathematics course.

Organisation	Possible resources or support materials
BBC Bitesize Maths (National 5)	This website provides online resources for teaching and learning mathematics.
BBC Skillswise Maths	A free-to-access website for teachers, lecturers and students, with printable worksheets and factsheets and online games, videos and quizzes.
National Centre for Excellence in the Teaching of Mathematics (NCETM)	The NCETM aims to meet the needs of teachers of mathematics and realise the potential of learners through a national infrastructure for mathematics-specific continuing professional development (CPD). The NCETM provides and signposts resources to teachers, mathematics education networks, HEIs and CPD providers. At the same time, the NCETM encourages schools and colleges to learn from their own best practice through collaboration and by sharing good practice locally, regionally and nationally.
NRICH Maths	This website offers thousands of free mathematics enrichment materials (problems, articles and games) for teachers and learners from ages 5 to 19 years. All the resources are designed to develop subject knowledge, problem-solving and mathematical thinking skills. The website is updated with new material on the first day of every month.
STEM Central	This online resource supports learning and teaching relating to sciences, technologies, engineering and mathematics (STEM). It includes classroom resources and video playlists.
STEM Central in Motion	STEM Central in Motion provides an opportunity for practitioners and Education Scotland's partner organisations to share ideas and materials relating to the STEM central learning contexts and enriching STEM in the classroom context.
Teaching Ideas	This website provides free online resources for mathematics and numeracy. Many examples are contextualised and age-graded.

The above resources were correct at the time of publication and may be subject to change.

Preparing for course assessment

The course assessment focuses on breadth, challenge and application. Candidates draw on and extend the skills they have learned during the course. These are assessed through two question papers: one non-calculator and a second paper in which a calculator may be used.

In preparation for the course assessment, candidates should be given the opportunity to:

- analyse a range of real-life problems and situations involving mathematics
- select and adapt appropriate mathematical skills
- apply mathematical skills with and without the use of a calculator
- determine solutions
- explain solutions and/or relate them to context
- present mathematical information appropriately

The question papers assess a selection of knowledge and skills acquired in the course and provide opportunities to apply skills in a wide range of situations, some of which may be new to the candidate.

Prior to the course assessment, candidates may benefit from responding to short-answer questions, multiple-choice questions and extended-answer questions.

Developing skills for learning, skills for life and skills for work

Course planners should identify opportunities throughout the course for candidates to develop skills for learning, skills for life and skills for work.

Candidates should be aware of the skills they are developing and teachers and lecturers can provide advice on opportunities to practise and improve them.

SQA does not formally assess skills for learning, skills for life and skills for work.

There may also be opportunities to develop additional skills depending on approaches being used to deliver the course in each centre. This is for individual teachers and lecturers to manage.

Significant opportunities to develop the skills for learning, skills for life and skills for work are described in the table below.

SQA skills for learning, skills for life and skills for work framework definition	Suggested approaches for learning and teaching
Numeracy is the ability to use numbers to solve problems by counting, doing calculations, measuring, and understanding graphs and charts. This is also the ability to understand the results.	Candidates could be given the opportunity to develop their numerical skills throughout the course. For example, by using numbers to solve mathematical problems involving surds, simplifying expressions using the laws of indices and rounding to a given number of significant figures. Candidates could be given opportunities to use numbers to solve contextualised problems involving other STEM-based subjects. Candidates could be encouraged to manage problems, tasks and case studies involving numeracy by analysing the context, carrying out calculations, drawing conclusions, making deductions and informed decisions.
Applying is the ability to use existing information to solve a problem in a different context, and to plan, organise and complete a task.	Candidates could be given the opportunity to apply the skills, knowledge and understanding they have developed to solve mathematical problems in a range of real-life contexts. Candidates could be encouraged to think creatively to adapt strategies to suit the given problem or situation. Candidates could be encouraged to show and explain their thinking to determine their level of understanding. Candidates could be encouraged to think about how they are going to tackle problems or situations, decide which skills to use and then carry out the calculations necessary to complete the task, for example using the sine rule.

SQA skills for learning, skills for life and skills for work framework definition	Suggested approaches for learning and teaching
Analysing and evaluating is the ability to identify and weigh-up the features of a situation or issue and to use judgement to come to a conclusion. It includes reviewing and considering any potential solutions.	Candidates could be given the opportunity to identify which real-life tasks or situations require the use of mathematics. Candidates could be provided with opportunities to interpret the results of their calculations and to draw conclusions. Conclusions drawn by the candidate could be used to form the basis of making choices or decisions. Candidates could be given the chance to identify and analyse situations which are of personal interest and involve mathematics.

During the course there are opportunities for candidates to develop their literacy skills and employability skills.

Literacy skills are particularly important as these skills allow candidates to access, engage in and understand their learning, and to communicate their thoughts, ideas and opinions. This course provides candidates with the opportunity to develop their literacy skills by analysing real-life contexts and communicating their thinking by presenting mathematical information in a variety of ways. This could include the use of numbers, formulae, diagrams, graphs, symbols and words.

Employability skills are the personal qualities, skills, knowledge, understanding, and attitudes required in changing economic environments. The mathematical operational and reasoning skills developed in this course aim to enable candidates to confidently respond to the mathematical situations that can arise in the workplace. It aims to provide candidates with the opportunity to analyse a situation, decide which mathematical strategies to apply, work through those strategies effectively, and make informed decisions based on the results.

Additional skills for learning, skills for life and skills for work may also be developed during this course. These opportunities may vary and are at the discretion of the centre.

Appendix 2: skills, knowledge and understanding with suggested learning and teaching contexts

Examples of learning and teaching contexts that could be used for the course can be found below.

The first two columns are identical to the tables of 'Skills, knowledge and understanding for the course assessment' in this course specification.

The third column gives suggested learning and teaching contexts. These provide examples of where the skills could be used in individual activities or pieces of work.

Numerical skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Working with surds	♦ Simplification ♦ Rationalising denominators	Explore the properties of square roots. Exact values are an important method of communication in maths, science and technology.
Simplifying expressions using the laws of indices	♦ Multiplication and division using positive and negative indices including fractions ♦ $(ab)^m = a^m b^m$ ♦ $(a^m)^n = a^{mn}$ ♦ $a^{m/n} = \sqrt[n]{a^m}$ ♦ Calculations using scientific notation	Introduce notation and why it is written that way, eg $\mathrm{m\,s^{-1}}$. Emphasise the relationship between fractional indices and surds. Use examples of scientific notation within science and technology. Where possible applying the laws in combination is desirable — and is essential preparation for Higher Maths.

Numerical skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Rounding	♦ To a given number of significant figures	Consider the effects of rounding and using rounding appropriately and inappropriately. Investigate contexts for different levels of accuracy and precision. Consider the effect of rounding an angle after calculating it using trigonometry. There is a precision limitation if it is rounded to the nearest degree especially as distance increases.
Working with reverse percentages	♦ Use reverse percentages to calculate an original quantity	Use contexts such as finance, social sciences, demographics, science and technology. Health and wellbeing data such as body mass index (BMI). Given the price including value added tax (VAT), calculate the price excluding VAT.
Working with appreciation/depreciation	♦ Appreciation including compound interest ♦ Depreciation	
Working with fractions	♦ Operations and combinations of operations on fractions including mixed numbers (addition, subtraction, multiplication, division)	Links to probability, percentages and indices. Use contexts in geometric problems such as fraction of a circle, volume of a cone. Use in finance, science and technology.

Algebraic skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Working with algebraic expressions involving expansion of brackets	♦ $a(bx+c)+d(ex+f)$ ♦ $ax(bx+c)$ ♦ $(ax+b)(cx+d)$ ♦ $(ax+b)(cx^2+dx+e)$ where $a,b,c,d,e,f \in \mathbb{Z}$	Make connections with geometrical representations. Emphasise a systematic approach to expansion of brackets. Candidates should be encouraged to expand expressions of the form $(x-2)(x+3)(x+5)$ as this skill is important beyond National 5.
Factorising an algebraic expression	♦ Common factor ♦ Difference of squares $p^2x^2-a^2$ ♦ Trinomials with unitary and non-unitary x^2 coefficient ♦ Combinations of the above	Explore algebraic and numerical uses of the difference of squares. Use practical examples including calculation of areas. Emphasise that factorising is the inverse process to expanding brackets.
Completing the square in a quadratic expression with unitary x^2 coefficient	♦ Writing quadratics of the form x^2+bx+c in the form $(x+p)^2+q$ where $b,c \in \mathbb{Z}$ and $p,q \in \mathbb{Q}$	Connect features of graphs to the equations of quadratic functions.
Reducing an algebraic fraction to its simplest form	♦ $\frac{a}{b}$ where a,b are of the form $(mx+p)^n$ or $(mx+p)(nx+q)$ and $b \neq 0$	Link to factorisation.

Algebraic skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Applying the four operations to algebraic fractions	♦ $\frac{a}{b} * \frac{c}{d}$ where a, b, c, d can be simple constants, variables or expressions; $*$ can be add, subtract, multiply or divide; and $b \neq 0, d \neq 0$	This could be extended to net resistance from two resistors in parallel, ie: convert $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ to $\frac{R_1 R_2}{R_1 + R_2}$
Determining the equation of a straight line	♦ Use the formula $y - b = m(x - a)$ or equivalent to find the equation of a straight line, given two points or one point and the gradient of the line ♦ Use functional notation, $f(x)$ ♦ Identify gradient and y-intercept from various forms of the equation of a straight line	Use of graphing packages to investigate the equation of a straight line including parallel lines, lines with zero gradient, and gradients that are undefined. Use a variety of contexts such as science, finance, commerce, experimental data, population statistics, life expectancy. Discuss importance of functional notation as an alternative mathematical language to Leibniz's notation.
Working with linear equations and inequations	♦ Where numerical coefficients are rational numbers, $\mathbb{Q}$ ♦ Where numerical solutions are rational numbers, $\mathbb{Q}$	Real-life limitations should be considered for inequations, eg maximum safe load for a concrete beam of given cross-section area.
Working with simultaneous equations	♦ Construct from text ♦ Graphical solution ♦ Algebraic solution	Investigate real-life situations such as hiring a car, mobile phone charges, health and fitness. Intersection of paths of moving objects described by equations. Use of graphing packages is encouraged to enable more complex realistic contexts to be investigated.

Algebraic skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Changing the subject of a formula	♦ Linear formula ♦ Formula involving a simple square or square root	Contexts using formulae from science, technology, health and wellbeing and finance. $s = ut + \frac{1}{2}at^2$ $E = \frac{1}{2}mv^2$ Further contexts could include situations involving more complex powers and roots, eg determine the radius of a sphere given its volume.
Recognise and determine the equation of a quadratic function from its graph	♦ Equations of the form $y = kx^2$ and $y = k(x+p)^2 + q$ where $k, p, q \in \mathbb{Z}$	Use of graphics software may be beneficial.
Sketching a quadratic function	♦ Equations of the form $y = (ax-m)(bx-n)$ where $a, b, m, n \in \mathbb{Z}$ ♦ Equations of the form $y = k(x+p)^2 + q$ where $k, p, q \in \mathbb{Z}$	Graphing packages can be used to investigate the graphs of quadratic functions including zooming in on non-integer solutions of roots.
Identifying features of a quadratic function	Identify: ♦ the nature and coordinates of the turning point ♦ the equation of the axis of symmetry of a quadratic of the form $y = k(x+p)^2 + q$ where $k, p, q \in \mathbb{Z}$	Examples of quadratic functions should include real-life contexts such as projectile motion.

Algebraic skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Solving a quadratic equation	♦ Solving from factorised form ♦ Solving having factorised first ♦ Graphical treatment	Emphasis of the connection between the algebraic and graphical aspects of quadratic equations, eg solving $(2x+3)(x-5)=0$ or $2x^2-7x-15=0$.
Solving a quadratic equation using the quadratic formula	♦ Solving using the quadratic formula	Using $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$
Using the discriminant to determine the number of roots	♦ Know and use the discriminant ♦ Determine the number and describe the nature of roots using the language 'two real and distinct roots', 'one repeated real root', 'two equal real roots' and 'no real roots'	Using the correct terminology for nature of roots should be encouraged: real and distinct roots, real and equal roots, and no real roots.

Geometric skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Determining the gradient of a straight line, given two points	♦ $m = \frac{y_2 - y_1}{x_2 - x_1}$	Deduce the formula from a coordinate diagram. Link to the equation of a straight line and the line of best fit. Use contexts such as rates of change, and steepness of slope. Discuss zero gradients and when the gradient is undefined. Parallel lines have equal gradients. Explore the full range of gradient values, eg by the rotation of a line fixed at the origin.
Circle geometry	♦ Calculating the length of an arc ♦ Calculating the area of a sector	Deduce formulae from practical approaches emphasising fractions. Opportunities to use examples from designing, manufacturing and decorating.
Calculating the volume of a standard solid	♦ Sphere, cone, pyramid	Use practical and investigative approaches to confirm formulae. Use combinations of solids (including prisms from National 4). Opportunities to use examples from designing, manufacturing and packaging.

Geometric skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Applying Pythagoras' theorem	♦ Using Pythagoras' theorem in complex situations including converse and three dimensions	Link to three-dimensional coordinates. Contexts such as construction, engineering, home improvement, and graphic design can be used. Distance between two points on a coordinate diagram, eg by using the distance formula.
Applying the properties of shapes to determine an angle involving at least two steps	♦ Quadrilaterals/triangles/polygons/circles ♦ Relationship in a circle between the centre, chord and perpendicular bisector	Use of geometry software packages may be beneficial.
Using similarity	♦ Interrelationship of scale — length, area and volume	Link to surds and indices (eg volume to length or length to volume). It is important to develop confidence in handling the closely related ideas of similarity, proportion and ratio. There are many suitable contexts: dilutions and reactions in chemistry, recipe scaling, and power supply. Geometric examples include scale plans and engineering diagrams where the angles stay the same, distances scale in simple proportion, areas in square proportion, and volumes in cubic proportion. Real-life contexts and problem-solving approaches such as cost in proportion to volume could be used.
Working with two-dimensional vectors	♦ Adding or subtracting two-dimensional vectors using directed line segments	Real-life contexts could be used, eg combination of forces, crossing a stream in a boat, or the collision of two snooker balls.
Working with three-dimensional coordinates	♦ Determining coordinates of a point from a diagram representing a three-dimensional object	

Geometric skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Using vector components	♦ Adding or subtracting two- or three-dimensional vectors using components	
Calculating the magnitude of a vector	♦ Magnitude of a two- or three-dimensional vector	

Trigonometric skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Working with the graphs of trigonometric functions	♦ Basic graphs ♦ Amplitude ♦ Vertical translation ♦ Multiple angle ♦ Phase angle	Use of graphing software packages is encouraged. Real-life contexts should be used including applications in wave theory. Use the graphs of sine/cosine to increase understanding and use symmetry in these graphs to find further solutions to trigonometric equations.
Working with trigonometric relationships in degrees	♦ Sine, cosine and tangent of angles from $0°$ to $360°$ ♦ Period ♦ Related angles ♦ Solve basic equations ♦ Use the identities $\cos^2 x° + \sin^2 x° = 1$ and $\tan x° = \frac{\sin x°}{\cos x°}$	Introduce the quadrant diagram linked to graphs as a possible method of finding further solutions to trigonometric equations. Consider including software displays involving addition (superposition/interference) of two waves (eg same wavelength, different phase or same phase at origin, slightly different wavelengths).

Trigonometric skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Calculating the area of a triangle using trigonometry	♦ Area $= \frac{1}{2}ab\sin C$	Real-life contexts could be used, such as in navigation and manufacturing.
Using the sine and cosine rules to find a side or angle in a triangle	♦ Sine rule for side and angle ♦ Cosine rule for side and angle	
Using bearings with trigonometry	♦ To find a distance or direction	

Statistical skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Comparing data sets using statistics	Compare data sets using calculated/determined: ♦ semi-interquartile range ♦ standard deviation	Use a variety of contexts such as those drawn from science, health and wellbeing, environmental studies, geography, social sciences, economics, current affairs, factory production, failure-in-use data for automotive components, quality assurance, medical statistics, crime rates, government statistical data (food data, climate data, and class data).
Forming a linear model from a given set of data	♦ Determine the equation of a best-fitting straight line on a scattergraph and use it to estimate y given x	Have a supply of examples of real experimental data where a linear model is approximately valid but the data has limited precision. An extension of this could be to use transposition to estimate x given y.

Reasoning skills		
Skills	**Explanation**	**Suggested learning and teaching contexts**
Interpreting a situation where mathematics can be used and identifying a strategy	♦ Can be attached to any operational skills to require analysis of a situation	This should include mathematical or real-life problems in which some analysis is required. The candidate should choose an appropriate strategy and use mathematics to solve the problem. Examples of contexts include: health and wellbeing, finance (inflation and interest rates), science (energy consumption in the home or car), technology (manufacturing), social sciences (population, statistics).
Explaining a solution and relating it to context	♦ Can be attached to any operational skills to require explanation of the solution given	The candidate should explain their solution in everyday language.

Appendix 3: question paper brief

The course assessment consists of two question papers which will assess:

- the development of mathematical operational skills
- the integration of mathematical operational skills
- the development of mathematical reasoning skills
- the application of skills of numerical calculation, without the aid of a calculator, in order to demonstrate that the candidate has an underlying grasp of mathematical processes

The question papers will sample the ‘Skills, knowledge and understanding’ section of the course specification.

This sample will draw on all of the skills, knowledge and understanding from each of the following areas:

- algebraic skills
- geometric skills
- trigonometric skills
- numerical skills
- statistical skills
- reasoning skills

Command words are the verbs or verbal phrases used in questions and tasks which ask candidates to demonstrate specific skills, knowledge or understanding. For examples of some of the command words used in this assessment, refer to the past papers and specimen question paper.

The course assessment will consist of two question papers:

	Paper 1 (non-calculator)	Paper 2
Time	75 minutes	110 minutes
Marks	50	60
Skills	This question paper will give candidates an opportunity to apply numerical, algebraic, geometric, trigonometric, statistical and reasoning skills, **without the aid of a calculator**. These skills are the ones in which the candidate is required to show an understanding of underlying processes. They will involve the ability to use numerical skills within mathematical contexts in cases where a calculator may compromise the assessment of this understanding.	This question paper will give learners an opportunity to apply numerical, algebraic, geometric, trigonometric, statistical and reasoning skills. These skills are the ones which may be facilitated by the use of a calculator, allowing more opportunity for application.
Percentage of marks across the papers	Approximately 30–45% of the overall marks relate to algebra. Approximately 15–35% of the overall marks relate to geometry. Approximately 10–25% of the overall marks relate to trigonometry. Approximately 10–25% of the overall marks relate to numerical skills. Approximately 5–15% of the overall marks relate to statistics.	
Type of question	Short answer and extended response.	Short answer and extended response.
Type of question paper	Structured question papers: both papers are question-and-answer papers which have spaces for answers.	
Proportion of level 'C' questions	Many questions will use a stepped approach to ensure that there are opportunities for candidates to demonstrate their abilities beyond level 'C'. Approximately 65% of the marks will be available for level 'C' responses.	
Balance of skills	Operational and reasoning skills will be assessed in both question papers. Some questions will assess only operational skills (approximately 65% of the marks), but other questions will require operational and reasoning skills (approximately 35% of the marks).	

Administrative information

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History of changes to course specification

Version	Description of change	Date
2.0	Course support notes added as appendix.	May 2017
2.1	Question paper brief added as appendix.	September 2017