



National Unit specification

General information

Unit title: Mathematics for Construction Technicians (SCQF level 6)

Unit code: H70S 46

Superclass: RB

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Version: 02

Unit purpose

The Unit is intended for those learners who wish to develop their knowledge and understanding of Mathematics at SCQF level 6 with a view to supporting and underpinning their studies in civil engineering discipline. The Unit is designed to further develop aspects of the learner's skills in numeracy, trigonometry, algebra and vector algebra and to apply these skills in the civil engineering context. The content of each Outcome is to be delivered and assessed with specific reference to civil engineering.

Outcomes

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

- 1 Evaluate and transpose engineering formulae and apply algebraic techniques to simplify mathematical expressions.
- 2 Solve linear, simultaneous and quadratic equations, sketch, evaluate and manipulate exponential and logarithmic functions.
- 3 Differentiate and integrate basic mathematical functions.
- 4 Solve problems on two dimensional vectors.

Credit points and level

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

National Unit specification: General information (cont)

Unit title: Mathematics for Construction Technicians (SCQF level 6)

Recommended entry to the Unit

While entry is at the discretion of the centre, learners would normally be expected to have attained one of the following:

- ◆ NQ Unit *Mathematics: Craft 1* (SCQF level 5)
- ◆ Mathematics — Intermediate 2 or Standard Grade Mathematics — Credit Level
- ◆ National 5 Mathematics

Core Skills

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

Complete Core Skill	Numeracy at SCQF level 6
Core Skill component	Critical Thinking at SCQF level 5

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

Context for delivery

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

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

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

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

National Unit specification: Statement of standards

Unit title: Mathematics for Construction Technicians (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.

Outcome 1

Evaluate and transpose engineering formulae and apply algebraic techniques to simplify mathematical expressions.

Performance Criteria

- (a) Evaluate engineering formulae correctly, giving appropriate Units with results.
- (b) Transpose engineering formulae correctly.
- (c) Expand and simplify correctly expressions involving brackets.
- (d) Manipulate and simplify mathematical expressions containing fractions correctly.
- (e) Apply the laws of indices correctly.

Outcome 2

Solve linear, simultaneous and quadratic equations, sketch, evaluate and manipulate exponential and logarithmic functions.

Performance Criteria

- (a) Determine correctly the equation of a straight line from a given or constructed graph.
- (b) Construct appropriate simultaneous equations from given data and solve simultaneous equations correctly.
- (c) Determine correctly the roots of quadratic equations using factorisation or formula.
- (d) Solve a pair of simultaneous equations, one linear and one quadratic, correctly using substitution techniques.
- (e) Sketch graphs of exponential and logarithmic functions correctly.
- (f) Evaluate mathematical expressions containing exponential and logarithmic functions correctly.
- (g) Apply the appropriate laws of logarithms to mathematical expressions containing exponentials and logarithms.
- (h) Convert between exponential and logarithmic form correctly.

Outcome 3

Differentiate and integrate basic mathematical functions.

Performance Criteria

- (a) Differentiate mathematical expressions of the form $ax + b$ and $(ax + b)^n$ correctly, including sums and differences.
- (b) Integrate mathematical expressions of the form $ax + b$ and $(ax + b)^n$ ($n \neq -1$) correctly, to include both indefinite and definite integrals, and including sums and differences.

National Unit specification: Statement of standards (cont)

Unit title: Mathematics for Construction Technicians (SCQF level 6)

Outcome 4

Solve problems on two dimensional vectors.

Performance Criteria

- (a) Describe correctly the difference between a scalar quantity and a vector quantity.
- (b) Express correctly a vector written in component form into a form with magnitude and direction, and vice versa.
- (c) Add and subtract vectors correctly using graphical and algebraic methods.
- (d) Illustrate correctly the relationship between a rotating vector (a phasor) and a sine wave.

Evidence Requirements for this Unit

Evidence is required to demonstrate that learners have achieved all Outcomes and Performance Criteria.

Evidence should be produced under closed-book, supervised conditions in response to an appropriate set of questions. And as such learners should not be allowed to bring textbooks, hard and/or soft hand-outs or notes to the assessment.

Assessment may be carried out:

- ◆ *Outcome by Outcome*
- ◆ *Two or more Outcomes together*
- ◆ *All Outcomes together — holistic assessment of the Unit*

Learners should be given access to calculators. Sufficient working must be shown to demonstrate the method of solution.

Where reassessment is needed, a different set of questions must be used on each assessment occasion.

Under no circumstances the learners should be notified of the assessment questions prior to the assessment.



National Unit Support Notes

Unit title: Mathematics for Construction Technicians (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 a mandatory Unit of the National Certificate Group Awards in Civil Engineering at SCQF level 6, but can also be a free-standing Unit. This Unit aims to build on and extend the learner's mathematical knowledge and skills.

It is envisaged that the content of this Unit is delivered in the civil engineering context appropriate to the learner, whether as a mandatory Unit of the Group Award or as a free-standing Unit.

Applying the mathematical skills of the Unit in meaningful civil engineering scenarios will enable the learner to appreciate that those skills are essential tools for civil engineering.

Outcome 1

Evaluate and transpose engineering formulae and apply algebraic techniques to simplify mathematical expressions.

Perform numerical evaluation of expressions.

Carry out simplification of algebraic expressions (to include brackets, fractions, and indices, exponential and logarithmic).

Manipulate, simplify and correctly change the subject of formula (to include exponential and logarithmic) including fractions.

Outcome 2

Solve linear, simultaneous and quadratic equations, sketch, evaluate and manipulate exponential and logarithmic functions.

Correctly solve equations (to include simultaneous linear equations with two variables and quadratic equations)

Determine correctly the equation of a straight line from a given or constructed graph.

Construct appropriate simultaneous equations from given data and solve simultaneous equations correctly.

Determine correctly the roots of quadratic equations using factorisation or formula.

Solve a pair of simultaneous equations, one linear and one quadratic, correctly using substitution techniques.

National Unit Support Notes (cont)

Unit title: Mathematics for Construction Technicians (SCQF level 6)

Outcome 2 (cont)

Sketch graphs of exponential and logarithmic functions correctly.

Evaluate mathematical expressions containing exponential and logarithmic functions correctly.

Apply the appropriate laws of logarithms to mathematical expressions containing exponentials and logarithms.

Convert between exponential and logarithmic form correctly.

Outcome 3

Differentiate and integrate basic mathematical functions.

Introduction to Differentiation

Finding the Derivative

Differentiating with Respect to Other Variables

Rates of Change

Equations of Tangents

Increasing and Decreasing Curves

Stationary Points

Determining the Nature of Stationary Points

Curve Sketching

Closed Intervals

Graphs of Derivatives

Optimisation

Integration: Indefinite Integrals

Preparing to Integrate

Differential Equations

Definite Integrals

Geometric Interpretation of Integration

Areas between Curves

Integrating along the y -axis

National Unit Support Notes (cont)

Unit title: Mathematics for Construction Technicians (SCQF level 6)

Outcome 4

Solve problems on two dimensional vectors.

Explain what is meant by a scalar and a vector quantity.

Provide examples of scalars and vectors from civil engineering.

Represent vectors in terms of horizontal and vertical components (Cartesian form) and in the context of magnitude and direction (polar form).

Undertake conversions between the two forms of representation.

Multiply vectors by scalar quantities.

Add two or more vectors together graphically using scaled diagrams.

Subtract vectors using scaled diagrams.

Add and subtract vectors using algebraic techniques.

Guidance on approaches to delivery of this Unit

As this Unit provides mathematical principles which underpin further studies in other areas of HNC/HND Civil Engineering it is recommended that this Unit be delivered early on in this course.

Delivery of the Unit can be an appropriate mixture of lecturer-led/student-centred activities; individual/group work; classroom/workshop assignments. Use of online resources could be included to support and underpin learning.

The sensible and correct use of calculators should be demonstrated and encouraged where appropriate. At the same time, learners should be guided and encouraged to identify when working without a calculator is more appropriate.

Guidance on approaches to assessment of this Unit

The Unit has been designed to incorporate sufficient time to allow lecturers to teach the core mathematics contained within this Unit. This Unit has also been written such that there is sufficient time inbuilt for learners to practice what they have learned using appropriate formative assessment exercises.

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

It is possible to assess learners either on an Outcome by Outcome basis or by a single holistic assessment combining all Outcomes or combinations of more than one learning Outcome. 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 closed-book conditions.

National Unit Support Notes (cont)

Unit title: Mathematics for Construction Technicians (SCQF level 6)

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

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

Achievement of this Unit gives automatic certification of 'Using Numbers' at SCQF level 6.

This Unit has the Core Skill of Numeracy embedded in it, so when candidates achieve this Unit their Core Skills profile will be updated to show that they have achieved Numeracy at SCQF Level 5.

This Unit has 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 Critical Thinking at SCQF level 5.

History of changes to Unit

Version	Description of change	Date
02	Core Skill Numeracy at SCQF level 6 embedded. Core Skills Component Critical Thinking at SCQF level 5 embedded.	28/11/2014

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General information for learners

Unit title: Mathematics for Construction Technicians

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 further learning and employment.

This Unit has been designed to allow you to develop your knowledge, understanding and skills in mathematics that underpin many of the subjects studied in the NC Built Environment and Civil Engineering awards. If you have studied some of these topics before, the early part of the Unit will provide you with an opportunity to revise the techniques you have learned on other courses.

By the end of the Unit you will be expected to apply algebraic techniques to manipulate and solve equations commonly found in construction. You will also be expected to carry out operations using trigonometry and finally you will be expected to analyse graphs of experimental data and use statistical data as an evaluation tool.

Outcome 1 — you will be introduced to applying algebraic techniques to manipulate expressions and solve equations commonly found in construction that underpins your later studies.

Outcome 2 — you will study ways in which linear, simultaneous and quadratic equations and how to evaluate, manipulate exponential and logarithmic functions which can be used to solve various problems within the construction industry.

Outcome 3 is an introduction to differentiation and integration. You will learn how these two are the reverse processes of each other and how these can be applied to solve various problems within the construction industry.

Outcome 4 is an introduction to vector algebra. You will learn what the scalar and vector quantities are and how these are efficiently used in solving various problems within the construction industry.

The precise form of assessment will depend on the centre where you are taking the Unit.

Opportunities for developing Core Skills are described in the section above.

Achievement of this Unit gives automatic certification of 'Using Numbers' at SCQF level 6.