

SQA Advanced Unit specification

General information

Unit title: Mathematics for Construction (SCQF level 6)

Unit code: HR4N 46

Superclass: RB

Publication date: August 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

The Unit is designed to enable candidates to understand and apply algebraic techniques to manipulate expressions and solve equations commonly found in construction. The unit provides candidates with an opportunity to develop the knowledge and skills to carry out operations using algebra, trigonometry, circular measure formulae, calculus, and vector algebra.

Outcomes

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

- 1 Manipulate mathematical expressions and solve equations.
- 2 Use trigonometry and circular measure formulae to solve commonly encountered problems in the construction industry.
- 3 Solve problems using calculus and vectors algebra.

Credit points and level

1 SQA Credit at SCQF level 6: (8 SCQF credit points at SCQF level 6)

Recommended entry to the Unit

It would be beneficial if learners had skills in mathematics as evidenced by possession of an appropriate National Certificate Unit, SCE Standard Grade Mathematics 1/2, Intermediate 2 Maths (including Unit 3) A/ B, National 5, Higher Maths C or above or an equivalent level of experience.

Core Skills

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

Complete Core Skill	None
Core Skill component	Using Number at SCQF level 6

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

SQA Advanced Unit specification: Statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Manipulate mathematical expressions and solve problems.

Knowledge and/or Skills

- ◆ Numerical expressions including scientific/engineering notation
- ◆ Manipulate algebraic expressions including indices and logarithmic functions
- ◆ Transposition of formulae
- ◆ Solve equations

Outcome 2

Use trigonometry and circular measure formulae to solve commonly encountered problems in the construction industry.

Knowledge and/or Skills

- ◆ Trigonometry in a right angled triangle
- ◆ Trigonometry in a non-right angled triangle
- ◆ Trigonometry of three dimensional shapes
- ◆ Circle problems involving arc lengths and sector/segment areas

Outcome 3

Solve problems using calculus and vector algebra.

Knowledge and/or Skills

- ◆ Differentiation — Algebraic functions and negative indices, basic trigonometric functions, brackets to the power of negatives.
- ◆ Integration — Algebraic functions, basic trigonometry, definite and indefinite integrals.
- ◆ Introduction to 2D Vectors — Addition, subtraction and scalar multiplication. Conversions between Cartesian and polar form (and vice versa). Introduce scalar product.
- ◆ Introduction to 3D Vectors — Addition, subtraction and scalar multiplication. Use scalar product and introduce cross product.

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Evidence Requirements for this Unit

Learners will need to provide evidence to demonstrate ALL Knowledge and/or Skills across all Outcomes by showing that they can:

- ◆ apply algebraic techniques to manipulate expressions and solve equations commonly found in the construction industry
- ◆ solve problems involving indices and logarithms
- ◆ solve common building and surveying problems in two and three dimensions using trigonometry
- ◆ determine the area of a sector or segment of a circle and the arc length in context
- ◆ define and solve problems involving differentiation and integration of functions
- ◆ use basic vector operations such as scalar and cross products

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

The total time allowed for the assessment(s) should not exceed two hours.

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

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

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

SQA Advanced Unit Support Notes

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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 has been written in order to allow learners to develop knowledge, understanding and skills in the following areas:

Outcome 1

Manipulate mathematical expressions and solve equations

Factors; removal of brackets; linear, simultaneous and quadratic equations; indices and logarithmic functions; scientific/engineering notation.

Equations: $A = P(1 + r/100)^t$, $ax^2 + bx + c = 0$

Indices: Positive, negative, and fractional

Outcome 2

Use trigonometry and circular measure formulae to solve commonly encountered problems in the construction industry

Trigonometry: Pythagoras, sine ratio, cosine ratio, tangent ratio, sine rule, cosine rule.

Circular measure: arc length, sector area, segmental area.

Angular measure: degrees, minutes, and seconds

Outcome 3

Solve problems using calculus and vector algebra

Differentiation: Introduce standard derivatives to include ax^n , $(ax + b)^n$, trigonometric, $\ln(ax+b)$ and $e^{(ax+b)}$. Utilise negative and fractional indices. Use standard derivatives to find the derivatives of functions containing one or more terms.

Integration: Solve indefinite and definite integrals using standard integrals (standard integrals to include ax^n , $(ax + b)^n$, trigonometric, $1/(ax+b)$ and $e^{(ax+b)}$). Utilise negative and fractional indices. Use standard integrals to find the integrals of functions containing one or more terms.

2D Vectors: Introduce unit vector notation. Addition, subtraction, and scalar multiplication of vectors. Conversion from polar to rectangular form and vice versa. Use scalar product to find angles between two vectors, and perhaps calculate work done.

3D Vectors: Introduce the idea 3D coordinate systems and 3D vectors. Addition, subtraction, and scalar multiplication of vectors. Use scalar product to find angles between two vectors. Introduce concept of cross product, and evaluate $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}| |\mathbf{b}| \sin(\theta)$.

Guidance on approaches to delivery of this Unit

As the Unit provides core mathematical principles, which underpin many of the studies done in the SQA Advanced Diploma awards, it is recommended that the Unit be delivered towards the start of these awards.

The Unit has been designed to incorporate sufficient time to allow lecturers to teach the core Mathematics contained within the Unit. The Unit has also been written to allow learners sufficient time to practice what they have learnt through appropriate formative assessments and exercises.

Delivery of the Unit should focus on, and be within the context of commonly encountered problems in the construction industry.

Guidance on approaches to assessment of this Unit

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.

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.

In any assessment **all** Knowledge and/or Skills items should be included. Learners must provide a satisfactory response to all items.

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ apply algebraic techniques to manipulate expressions and solve equations commonly found in the construction industry
- ◆ solve problems involving indices and logarithms
- ◆ solve common building and surveying problems in two and three dimensions using trigonometry
- ◆ determine the area of a sector, or segment of a circle and the arc length in context
- ◆ solve problems using integration, differentiation and vector algebra

Assessment should be conducted under closed-book conditions and as such learners should not be allowed to bring textbooks, hand-outs or notes to the assessment.

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

In the assessment of this Unit all Outcomes can be combined to form a single assessment paper.

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 Number at SCQF level 6.

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.

SQA Advanced Unit Specification

History of changes to Unit

Version	Description of change	Date

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our [Centre Feedback Form](#).

General information for learners

Unit title: Mathematics for Construction (SCQF level 6)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for 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 SQA Advanced Certificate/SQA Advanced Diploma 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, calculus and vectors algebra

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

Outcome 2 — you will study ways in which trigonometry and circular measure formulae can be used to solve commonly found problems in construction.

Outcome 3 — you will be using techniques learnt from calculus and vectors algebra to solve problems found in construction.

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

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