National Unit Specification

General information

Unit title: Mathematics for Science 2 (SCQF level 5)

Unit code: HP9W 45

Superclass: RB

Publication date: September 2017

Source: Scottish Qualifications Authority

Version: 2

Unit purpose

The unit is intended for those learners who wish to gain the foundations of the Mathematics underpinning studies in all branches of science. The unit develops basic skills in calculation, algebra, graph reading and drawing.

Outcomes

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

1 Understand and perform basic calculations.
2 Employ algebraic methods.
3 Read and construct statistical graphs and calculate statistical measures.

Credit points and level

1 National Unit credit at SCQF level 5: (6 SCQF credit points at SCQF level 5)

Recommended entry to the unit

Entry to the course is at the discretion of the centre, although a background in Numeracy and Mathematics at SCQF level 4 would be advantageous.

National Unit Specification: General information (cont)

Unit title: Mathematics for Science 2 (SCQF level 5)

Core Skills

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

Complete Core Skill *Numeracy* at SCQF level 5

Core Skill component *Critical Thinking* at SCQF level 5

Context for delivery

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

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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.

Outcome 1

Understand and perform scientific calculations.

Performance criteria

(a) Convert between normal and scientific notation.
(b) Perform calculations using scientific notation.
(c) Perform reverse percentage calculations.
(d) Perform compound appreciation and depreciation calculations.
(e) Convert between SI unit prefixes.

Outcome 2

Employ algebraic methods:

Performance criteria

(a) Use laws of indices (powers and roots).
(b) Multiply out double brackets.
(c) Factorise quadratic equations (x^2).
(d) Factorise using difference of two squares.
(e) Transpose equations involving addition, subtraction, multiplication, division, powers and roots.

Outcome 3

Read and construct statistical graphs and calculate statistical measures.

Performance criteria

(a) Calculate arithmetic mean and standard deviation (sample statistics).
(b) Compare data sets.
(c) Draw scatter graphs and estimate lines of best fit graphically.
(d) Calculate equations of a straight lines of best fit.
(e) Make predictions from a line of best fit.
(f) Identify simple correlation by inspection (positive or negative, high or low).

National Unit Specification: Statement of standards (cont)

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Evidence requirements for this unit

Evidence is required to demonstrate that learners have achieved all outcomes and performance criteria.

Assessment may be carried out:

- Outcome by outcome
- Two or more outcomes together

Evidence should be produced under closed-book, supervised conditions.

Learners should not have information in advance about the content of the assessment.

Scientific calculators may be used, but computer algebra packages, graphical calculators or programmable calculators should not be used.

Sufficient working must be shown to demonstrate the method of solution.

Where reassessment is needed, an alternative instrument of assessment must be used.

Total assessment time should not exceed 2 hours.

Outcome 1

Understand and perform basic calculations.

- Convert between normal and scientific notation:
  - Convert one number to scientific notation, one number from scientific notation.
  - One number must have a scientific notation exponent >0, the other an exponent <0.
- Perform calculations using scientific notation:
  - Perform two calculations involving scientific notation, one multiplication and one division.
- Perform a reverse percentage calculation:
  - Calculate at least one reverse percentage.
- Perform a compound appreciation/depreciation calculation:
  - Perform at least one calculation involving compound appreciation or depreciation. Note the percentage changes may be constant or variable.
- Convert between SI unit prefixes:
  - Perform at least one calculation converting between SI units with different prefixes.

National Unit Specification: Statement of standards (cont)

Unit title: Mathematics for Science 2 (SCQF level 5)

Outcome 2

Employ algebraic methods.

- Use laws of indices (powers and roots):
  - Perform two calculations, one involving multiplication of terms with powers and division of terms with powers.
  - Perform at least one calculation of the form $(ax^b)^c$.
  - At least one calculation should involve a fractional power, and one a negative power.
- Multiply out double brackets:
  - Perform at least one calculation multiplying out double brackets of the form (ax+b)(cx+d) a, b, c, d positive or negative.
  - Perform at least one calculation multiplying out $(ax+b)^2$.
- Factorise a quadratic equation (x^2):
  - Factorise at least one quadratic of the form x^2+bx+c. (b, c positive or negative)
- Factorise using difference of two squares:
  - Factorise using a difference of two squares of the form x^2-y^2.
  - Factorise using a difference of two squares of the form ax^2-by^2 where a and b are perfect squares.
- Transpose equations involving addition, subtraction, multiplication, division, powers and roots:
  - Transpose a minimum of two formulae each including at least two of multiplication, division, addition and subtraction. At least one formula must include a root, the other a power.

Outcome 3

Read and construct statistical graphs and calculate statistical measures.

- Calculate arithmetic mean and standard deviation (sample statistics):
  - Calculate one arithmetic mean and standard deviation using one data set or more.
- Compare data sets:
  - Compare two data sets using arithmetic mean and standard deviation.
- Draw a scatter plot, calculate the equation of a straight line of best fit, and make a prediction:
  - Construct a scatter plot using five to seven points and estimate the line of best fit by inspection.
  - Calculate the equation of a line of best fit (where c can be read from the y axis directly, or where two points can be used).
  - Make a prediction from the equation of the line of best fit (either interpolation or extrapolation).
- Recognise simple correlation by inspection (positive or negative, high or low):
  - State for at least two given examples of scatter graphs whether the correlation of the data sets is high or low, positive or negative.

National Unit Support Notes

Unit title: Mathematics for Science 2 (SCQF level 5)

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 part of the National Certificate Group Awards in Applied Science, 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 scientific contexts appropriate to the learner, whether as a unit of the group award or as a free-standing unit.

Applying the mathematical skills of the unit in meaningful scientific scenarios will enable the learner to appreciate that those skills are essential tools for scientific analysis.

Consideration of this list of topics alongside the assessment support pack for this unit will provide clear indication of the standard expected.

Outcome 1

Understand and perform basic calculations:

- Convert between normal and scientific notation:
  - Learn how to convert numbers between scientific notation and normal numeric notation. Consider large and small numbers, as well as what happens when the exponent is zero.
- Perform calculations using scientific notation:
  - Learn how to add, subtract, multiply and divide numbers in scientific notation.
- Reverse percentage calculation:
  - Learn how to calculate reverse percentages, for example, if a gas has a volume of 45 litres after a 10% increase, then what was its original volume?
- Compound appreciation and depreciation:
  - Compound interest calculations can be used to model the amount of money in a bank account, interest repayments, bacterial numbers, population growth, etc. Depreciation could be used to model value depreciation, radioactive decay, population decreases, etc.

National Unit Support Notes (cont)

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- Convert between SI unit prefixes:
  - Convert between SI units with different prefixes, for example express 0.0023kW in mW.
  - The opportunity could be taken to review other conversions not involving SI prefixes, for example conversions between cm^3 and litres, conversions between temperature scales, etc.

Outcome 2

Employ algebraic methods:

- Use laws of indices (powers and roots):
  - Learn how to handle the laws in indices in simplifying expressions.
- Multiply out double brackets:
  - Learn how to multiply out expressions of the form $(ax+b)(cx+d)$, as well as variants of this such as $(ax+b)^2$. Examples with positive, negative and fractional values of a, b, c, and d could be used.
- Factorise quadratic equations (x^2):
  - Factorise quadratics of the form x^2+bx+c, where b, c are positive or negative. Examples of the form ax^2+bx+c could be explored if time allows, but these are dealt with in a later unit.
- Factorise difference of two squares:
  - Factorise simple cases of difference of two squares $x^2-y^2=(x-y)(x+y)$.
  - Look at examples where there are constant multipliers ax^2-by^2. Select numbers a and b as perfect squares to simplify algebra. If time allows examples which require factorisation to reveal the perfect squares, or examples which are not perfect squares may be considered.
- Transpose equations involving addition, subtraction, multiplication, division, powers and roots.

Outcome 3

Read and construct statistical graphs and calculate statistical measures:

- Calculate arithmetic mean and standard deviation:
  - Use sample statistics. If time allows population statistics may also be considered.
- Compare data sets:
  - Use arithmetic mean and standard deviation to compare two sets of data. Stress should be placed on the meaning of the comparisons.

- Draw a scatter plot, calculate the equation of a straight line of best fit, and make a prediction:
  - Construct scatter graphs, estimate the line of best fit by inspection, and make a prediction (either interpolation or extrapolation). A variety of contexts should be used, and both positive and negative gradients should be examined.
  - Calculate the equation of a line of best fit. This could be done using either cases where the y-axis intercept can be read from the diagram, but could also involve cases where the y-axis intercept cannot be read from the diagram, thus requiring a substitution strategy to find c.
  - Make a prediction from the equation of the line of best fit (either interpolation or extrapolation). At this point an elementary review of the reliability of the prediction could be made.
- Recognise simple correlation by inspection (positive or negative/high or low):
  - For given examples of scatter graphs whether the correlation of the data sets is high or low, positive or negative. No calculation is required at this level, but learners should be able to distinguish whether correlation coefficients are high or low with a view to making some judgement about the reliability of an estimate, as well as identifying the sign of a correlation coefficient.

Guidance on approaches to delivery of this unit

This unit provides skills, techniques and processes underpinning studies undertaken in Science, and as such, opportunities should be taken to contextualise delivery where possible.

Centres may deliver the outcomes in any order they wish.

All teaching input should be supplemented by formative assessment in which learners are provided with opportunities to develop their knowledge, understanding and skills.

Computer software, computer algebra, and graphical calculators may be used to support learning (eg to confirm the solutions of mathematical problems).

Guidance on approaches to assessment of this unit

Evidence may be generated using different types of assessment. The following are suggestions only and 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 combining some or all outcomes into one assessment event. Centres may assess the outcomes in any order they wish.

The assessment papers could be composed of an appropriate balance of short answer, restricted response and structured questions. Most parts of this unit lend themselves to assessment using straightforward scientific contexts, and questions should be contextualised where appropriate. Some part of the unit, however, such as those dealing with basic algebraic skills might be better assessed without context.

Care should be taken to avoid excessively elaborate contexts or language.

National Unit Support Notes (cont)

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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

This unit has the Core Skill of *Numeracy* embedded in it, so when learners 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 learners 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
2	Core Skill Numeracy at SCQF level 5 embedded. Core Skill Component Critical Thinking at SCQF level 5 embedded.	12/09/2017

General information for learners

Unit title: Mathematics for Science 2 (SCQF level 5)

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.

The unit is intended to help you consolidate and develop you knowledge of the Mathematics underpinning studies in Science, and is designed to lead, if desired, on to other Mathematics units in the NQ Applied Science framework. The unit develops basic skills in calculation, algebra, solving equations, graphs and statistics.

The unit covers the following topics:

- Understand and perform basic calculations:
  - In this section you'll learn some basic methods of calculation. It includes understanding scientific notation, handling percentage change, and handling understanding SI units.

- Employ algebraic methods:
  - Algebra is the basic language of Science and Scientific analysis. In this section you'll develop your algebraic skills to handle powers, roots, brackets, factorisation of various forms, as well as changing the subject of formulae.

- Read and construct statistical graphs and calculate statistical measures:
  - Collation, comparison and interpretation of data are fundamental to Science. In this section you'll learn how to calculate some basic statistical measures used to compare sets of data, as well as learning how to draw scatter graphs, estimate trends, how to extrapolate data from them, and estimate the accuracy of your predictions.

Assessment

The assessments for this unit may be distributed though the course, or at the end of the unit, and will be closed book (that is, you cannot take notes into the assessment). You'll be allowed to use a scientific calculator, but not an advanced programmable or graphing calculator. Total assessment time will be a maximum of 2 hours.

Core Skills

This unit has the Core Skill of *Numeracy* embedded in it, so when you achieve this unit your Core Skills profile will be updated to show that you have achieved *Numeracy* at SCQF level 5.

This unit also has the *Critical Thinking* component of *Problem Solving* embedded in it. This means that when you achieve the unit, your Core Skills profile will also be updated to show you have achieved *Critical Thinking* at SCQF level 5.