Field Sciences

Review of *Mathematics* and *Statistics and Probability* Level 2 achievement and unit standards

Unit standards

Subfield	Domain	ID
Mathematics	Algebra	5246, 5248, 5253
	Calculus	5244, 5260, 5261
	Geometry	5245, 5249
	Mathematical Processes	5243
	Mathematical Studies	7558, 7560, 7569, 12318, 12323, 12327, 12329
	Number	12331
	Trigonometry	5251, 5255, 90291, 90292
Statistics and Probability	Probability	5250
	Statistics	5247, 7564, 12332, 12333

Achievement standards

Domain	ID	Subject reference
Algebra	90284	Mathematics 2.1
	90285	Mathematics 2.2
	90290	Mathematics 2.7
	90806	CAS Mathematics 2.1
	90809	CAS Mathematics 2.4
Calculus	90286	Mathematics 2.3
	90807	CAS Mathematics 2.2
Geometry	90287	Mathematics 2.4
Trigonometry	90291	Mathematics 2.8
	90292	Mathematics 2.9
	90808	CAS Mathematics 2.3
Probability	90289	Mathematics 2.6
Statistics	90288	Mathematics 2.5

The Ministry of Education and NZQA National Qualifications Services have completed the review of the achievement and unit standards listed above.

New registration date **November 2011**

Date new versions published **November 2011**

Planned review date **December 2014**

Summary of review and consultation process

In 2008 the Ministry of Education (MoE) and NZQA began to review achievement and unit standards in light of the revised New Zealand Curriculum (NZC). This Alignment of Standards (AoS) review also addressed duplication of outcomes, credit parity, fairness, consistency, and coherence. The AoS review was guided by the revised NZC itself and the Principles for Standards Review. A copy of the NZC is available at: http://nzcurriculum.tki.org.nz/Curriculum-documents/The-New-Zealand-Curriculum.

Teacher subject associations were involved in the review, and draft achievement standards were the focus of wide consultation, especially with secondary schools and teachers. Extensive resources, including student exemplars, were also developed to support these standards, and are available on the MoE and/or the NZQA websites.

The review of unit standards included consultation with tertiary providers to assess continued relevance and likely future use of the standards. Unit standards that duplicate achievement standard outcomes and those without the likelihood of future tertiary use were recommended for expiry.

National consultation was undertaken in 2010, with the results analysed by Research New Zealand. The responses were generally positive.

The review of these Level 2 unit and achievement standards was completed in time for implementation in schools in 2012. The review of unit and achievement standards at Level 1 was completed in time for implementation in schools in 2011. Standards at Level 3 will be implemented in 2013.

Main changes resulting from the review

- All NZC Level 7 (NZQF Level 2) outcomes derived from the NZC are now assessed using achievement standards, and there are no longer any unit standards linked to the NZC.
- Existing achievement standards were reviewed and new achievement standards were developed to align with the NZC. See table below.
- Grading criteria for achievement standards were reviewed in accordance with the Standards Review Guidelines.
- Unit standards that recognised similar outcomes as achievement standards were recommended for expiry. See table below.

For a more detailed description of the review of, and the changes to, the Mathematics and Statistics and Probability standards see the appendix at the end of this report.

Impact on Consent and Moderation Requirements (CMR)
(Formerly known as AMAP)

All new achievement standards have been registered on CMR 0233.

Impact on registered qualifications

Key to type of impact	
Affected	The qualification lists a reviewed classification (domain or subfield) in an elective set The qualification lists a standard that has changes to level or credits The qualification lists a C or D category standard
Not materially affected	The qualification lists a standard that has a new title The qualification lists a standard that has a new classification

The following table identifies qualifications developed by other SSBs that are *Affected* by the outcome of this review. The SSBs have been advised that the qualifications require revision.

Ref	Qualification Title	ID	SSB Name
0129	National Certificate in Metal Casting (Technology)	5251	Competenz
0432	National Certificate in Surveying (Assistant) (Level 3)	5245, 5246, 5251, 12318	InfraTrain New Zealand
0672	National Certificate in Engineering and Technology (for the Design and Construction Sector) (Level 4)	5244, 5253, 5260, 5261	
1235	National Certificate in Engineering and Technology (Pharmaceutical and Allied Products) (Level 2)	5251	Plastics and Materials Processing Industry Training Organisation Incorporated
1262	National Certificate in Mechanical Engineering (Level 4) with strands in Fitting and Machining, General Engineering, Machining, Maintenance Engineering, Toolmaking, and Electricity Supply	5251	Competenz
1683	National Certificate in Rail Infrastructure (Level 2)	5245	

Impact of changes on NCEA Exclusions List

For transition purposes, the following exclusions will apply for new achievement standards.

New achievement standard	Excluded against each of these standards
91256 (2.1)	90287 (2.4), 90808 (CAS 2.3), 5245
91257 (2.2)	90285 (2.2), 90292 (2.9), 90806 (CAS 2.1), 90809 (CAS 2.4), 5253, 5255
91258 (2.3)	90290 (2.7), 90806 (CAS 2.1), 5248
91259 (2.4)	90291 (2.8), 90808 (CAS 2.3), 5251
91260 (2.5)	5249
91261 (2.6)	90284 (2.1), 90806 (CAS 2.1), 90809 (CAS 2.4), 5246
91262 (2.7)	90286 (2.3), 90807 (CAS 2.2), 5244, 5260, 5261
91263 (2.8)	12333
91264 (2.9)	90288 (2.5), 5247
91265 (2.10)	7564
91267 (2.12)	90289 (2.6), 5250
91268 (2.13)	90289 (2.6), 5250
91269 (2.14)	90284 (2.1), 90806 (CAS 2.1), 90809 (CAS 2.4), 5246

Review Categories and changes to classification, title, level, and credits

The following summary shows the changes made to the standards as a result of the review. All changes are in **bold**. Where a new externally assessed achievement standard is registered, the following designation appears after the title **[externally assessed]**. Standards with an asterisk (*) appear in the table more than once.

Key to review category	
A	Dates changed, but no other changes are made - the new version of the standard carries the same ID and a new version number
B	Changes made, but the overall outcome remains the same - the new version of the standard carries the same ID and a new version number
C	Major changes that necessitate the registration of a replacement achievement standard with a new ID
D	Achievement standard will expire and not be replaced

Externally assessed achievement standards categorised as category C or D expire at the end of	**December 2011**

Internally assessed achievement standards and unit standards categorised as category C or D expire at the end of	**December 2012**

Sciences > Mathematics > Algebra

ID	Title	Level	Credit	Review Category
5246	Manipulate algebraic expressions and use algebraic methods to solve problems	2	4	C
90284	Manipulate algebraic expressions and solve equations	2	4	C
90806*	Demonstrate an understanding of mathematical relationships	2	6	C
90809*	Demonstrate understanding of straightforward mathematical processes	2	5	C
91261	**Apply algebraic methods in solving problems [externally assessed]**	**2**	**4**	
91269	**Apply systems of equations in solving problems**	**2**	**2**	
5248	Use sequences and series to solve problems	2	2	C
90290	Solve straightforward problems involving arithmetic and geometric sequences	2	2	C
90806*	Demonstrate an understanding of mathematical relationships	2	6	C
91258	**Apply sequences and series in solving problems**	**2**	**2**	
5253	Sketch and describe graphs	2	3	C
5255	Use trigonometry and trigonometrical graphs to solve equations and problems	2	3	C
90285	Draw straightforward non-linear graphs	2	3	C
90292	Solve straightforward trigonometric equations	2	2	C
90806*	Demonstrate an understanding of mathematical relationships	2	6	C
90809*	Demonstrate understanding of straightforward mathematical processes	2	5	C

ID	Title	Level	Credit	Review Category
91257	**Apply graphical methods in solving problems**	**2**	**4**	

Sciences > Mathematics > Calculus

ID	Title	Level	Credit	Review Category
5244	Demonstrate calculus skills	2	2	C
5260	Find and use derivatives to solve problems involving rate of change	2	2	C
5261	Find and use integrals to solve problems	2	2	C
90286	Find and use straightforward derivatives and integrals	2	4	C
90807	Demonstrate an understanding of calculus methods	2	4	C
91262	**Apply calculus methods in solving problems [externally assessed]**	**2**	**5**	

Sciences > Mathematics > Geometry

ID	Title	Level	Credit	Review Category
5245	Solve coordinate geometry problems	2	2	C
90287	Use coordinate geometry methods	2	2	C
90808*	Demonstrate an understanding of processes involving trigonometry and coordinates	2	4	C
91256	**Apply co-ordinate geometry methods in solving problems**	**2**	**2**	
5249	Use networks to find optimal solutions to problems in geometry	2	2	C
91260	**Apply network methods in solving problems**	**2**	**2**	

Sciences > Mathematics > Mathematical Processes

ID	Title	Level	Credit	Review Category
5243	Apply mathematical processes and skills in problems	2	7	D

Sciences > Mathematics > Mathematical Studies

ID	Title	Level	Credit	Review Category
7558	Demonstrate understanding of the mathematics of prime numbers and use it to solve problems	2	3	D
7560	Demonstrate understanding of the mathematics of navigation and use it to solve problems	2	3	D
7569	Plan, carry out and report on a mathematical study into a given area in mathematics	2	3	D
12318	Use surveying techniques and mathematics to solve problems relating to maps or plans	2	3	D
12323	Apply mathematics in the design of an object or process for a given purpose	2	3	D

ID	Title	Level	Credit	Review Category
12327	Demonstrate understanding of geometry of different surfaces	2	3	D
12329	Investigate an aspect of the history of a mathematics topic or mathematician and present results	2	2	D

Sciences > Mathematics > Number

ID	Title	Level	Credit	Review Category
12331	Investigate and report on the mathematics of a given project	2	3	D

Sciences > Mathematics > Trigonometry

ID	Title	Level	Credit	Review Category
5251	Choose and apply trigonometric methods to solve problems involving lengths and angles	2	3	C
90291	Solve trigonometry problems requiring modelling of practical situations	2	2	C
90808*	Demonstrate an understanding of processes involving trigonometry and coordinates	2	4	C
91259	**Apply trigonometric relationships in solving problems**	**2**	**3**	

Sciences > Statistics and Probability > Probability

ID	Title	Level	Credit	Review Category
5250	Use probability techniques to solve problems	2	2	C
90289	Simulate probability situations, and apply the normal distribution	2	2	C
91267	**Apply probability methods in solving problems**	**2**	**4**	
91268	**Investigate a situation involving elements of chance using a simulation**	**2**	**2**	

Sciences > Statistics and Probability > Statistics

ID	Title	Level	Credit	Review Category
5247	Make and evaluate statements about populations based on sample data	2	3	C
90288	Select a sample and use this to make an inference about the population	2	3	C
91264	**Use statistical methods to make an inference**	**2**	**4**	
7564	Plan, carry out and report on a statistical investigation into a given area	2	3	C
91265	**Conduct an experiment to investigate a situation using statistical methods**	**2**	**3**	
12332	Demonstrate knowledge of measures and displays used to compare data sets	2	2	D

ID	Title	Level	Credit	Review Category
12333 **91263**	Demonstrate understanding of, and use, questionnaire design **Design a questionnaire**	2 **2**	3 **3**	C
91266	**Evaluate a statistically based report**	**2**	**2**	**New**

Appendix

Development of Level 2 standards

Process of aligning standards with *the New Zealand Curriculum*

All of the Level 7 Achievement Objectives (AOs) have been included for assessment in the new suite of Level 2 standards.

The relationship between each standard and the achievement objectives is set out in Explanatory Note 1.

Addressing duplication

There is no duplication of achievement objectives within the aligned standards. Any unit or achievement standards that duplicate the final aligned standards have been designated expiring.

Addressing credit parity

Consideration has been given to the widespread opinion that the current Level 2 achievement standards cover too much for a one-year course, and that programmes leading to the assessment of the current Algebra and Calculus standards are rushed. The credit value of the new Calculus standard 2.7 (AS91262) is therefore set at 5 credits and the number of Statistics standards has increased. The total credits now available at Level 2 are more than could reasonably be covered in one course. As with the Level 1 standards, courses will need to be designed according to the needs and capabilities of students by making choices from the matrix.

Some 2 credit standards remain on the matrix. It was considered that combining these into standards with a higher credit value could not overcome the design problem of having to assess two different achievement objectives in one standard. The advantage of retaining these 2 credit standards is that it makes credits more accessible to students, and allows more flexibility in designing courses.

External and internal assessment

A learning programme based on Level 7 curriculum objectives needs to provide foundation skills for both Level 8 'subjects': eg Mathematics (currently Calculus) and Statistics. The needs of both subjects influenced the decision to make 2.12 (AS91267) an externally assessed standard. Apart from this probability standard, the Statistics strand is better covered by internal standards since assessment of the Statistics achievement objectives is generally not appropriate for a time-limited examination session. In the Mathematics strand, Algebra and Calculus standards were designated as externally assessed so that the graphing standard 2.2 (AS91257) could be assessed internally, allowing for a variety of approaches and a greater flexibility in using technology. It was considered that the standards with lower credit values were better assessed internally to give schools greater flexibility to include these in alternative courses.

The design of the standards

According to the Principles for Standards Review, the step-up from Achieved to Merit to Excellence is described in terms of the level of thinking required, not in terms of specific content.

The titles of the standards provide clear and recognisable summaries of the content. Explanatory Note 1 always contains a reference to the New Zealand Curriculum document.

The level of thinking expected for the Achieved, Merit, and Excellence grades is defined in Explanatory Note 2. The first part of this definition describes the evidence required for the Achieved grade. This is tailored to each standard depending on the topic, but generally involves demonstrating knowledge of the relevant concepts and procedures in response to a straightforward problem and communicating appropriately. Where Explanatory Note 2 requires amplification, additional detail is supplied in Explanatory Notes 3, 4 or 5.

The descriptions of the evidence expected for Merit and Excellence are generic to all Mathematics standards because they are about the level of thinking, and are independent of the context or content. Two terms from the Solo Taxonomy have been used as convenient generic labels in the Achievement Criteria. These are 'relational thinking' for Merit and 'extended abstract thinking' for Excellence. These terms have been redefined by the Standards Writing Group (SWG) in Explanatory Note 2. The definitions given here have been crafted to reflect existing practice in NCEA assessment. The SWG looked at Merit grade questions from current assessment tasks and found that these questions consistently required one or more of: modelling, linking different concepts, working through a sequence of more than two steps, or showing understanding rather than just procedural knowledge. In addition, solutions needed to be related to a context or mathematical statements written to convey the working or reasoning. Similarly, the SWG looked at what is currently expected in Excellence questions and wrote a description of these qualities to define the term 'extended abstract thinking'.

The definition of 'problem' is intended to clarify that the term covers problems set in a purely mathematical context as well as problems which require applications in 'real-life' contexts. In an assessment task, an extended question may involve solving several 'problems'.

The inclusion of the term 'in solving problems' in the titles of some of these standards is intended to convey that acceptable evidence could come from a partially successful solution to a problem. Communication of the process of solving a problem may yield the required evidence of knowledge and thinking, even though a correct final solution to the problem is not obtained.

What has changed?

- The matrix is numbered in the order of the curriculum objectives.
- More choice of Statistics is now offered.
- Only three standards are assessed externally.

Comments on individual draft standards

2.1 (AS91256), *Apply co-ordinate geometry methods in solving problems*
This is internally assessed and has been assigned 2 credits.

2.2 (AS91257), *Apply graphical methods in solving problems*
The trigonometric models have been included with the other graphs and the standard has been assigned 4 credits. The emphasis has moved to the interpretation and formation of graphical models rather than simply drawing graphs. Solving problems could involve the solution of trigonometric equations. This is internally assessed and has been assigned 4 credits and technology is expected to be used in assessment.

2.3 (AS91258), *Apply sequences and series in solving problems*
This is internally assessed and has been assigned 2 credits.

2.4 (AS91259), *Apply trigonometric relationships in solving problems*
The standard includes circular measure and triangle rules and does not require practical measuring. It is internally assessed and has been assigned 3 credits.

2.5 (AS91260), *Apply network methods in solving problems*
This is internally assessed and has been assigned 2 credits.

2.6 (AS91261), *Apply algebraic methods in solving problems*
This standard is externally assessed and therefore the technology involved in assessment is limited to a graphic calculator. It has been assigned 4 credits to reflect the teaching time required.

2.7 (AS91262), *Apply calculus methods in solving problems*
This standard is externally assessed and therefore the technology involved in assessment is limited to a graphic calculator. It has been assigned 5 credits to reflect the teaching time required. This credit value was considered fair even though area by integration is no longer included in this standard. The intention is to give increased teaching and learning time to the fundamental concepts of this topic which are new at this level.

2.8 (AS91263), *Design a questionnaire*
This standard involves a detailed coverage of the questionnaire design process.

2.9 (AS91264), *Use statistical methods to make an inference*
In addition to replacing unit standard 5247 and AS90288, this standard covers aspects of 7564. The context is a comparative situation rather than a summary situation as this allows richer analysis at this level. Students will be given population data to sample from; they will not be expected to conduct a survey, however the population size must be large enough as to show a need to sample.

2.10 (AS91265), *Conduct an experiment to investigate a situation using statistical methods*
This standard involves planning and conducting an experiment. While it covers aspects of 7564, it focuses more on the experimental process of statistics.

2.11 (AS91266), *Evaluate a statistically based report*
This is a new standard reflecting the learning objectives of the statistical literacy thread of the New Zealand Curriculum at Level 7.

2.12 (AS91267), *Apply probability methods in solving problems*
This standard focuses on risk and relative risk. The theoretical aspects of 5250 and AS90289 are covered here. It is externally assessed.

While the AO for this standard refers to investigating situations involving elements of chance, the idea of an investigation has been seen as a learning progression to develop the concepts of solving probability problems, and the intent in this standard is to then assess whether students are able to solve them. This also applies to the idea of comparing distributions, but this aspect of the AO has been retained in the standard to help teachers see that the development of the understanding of normal distributions is needed so that students can solve some probability problems using normal distribution models.

As this is not an investigation standard this standard was seen as appropriate for external assessment.

The terminology for describing Achieved, Merit and Excellence has been aligned to the standards in the Mathematical strand, the terminology used in the Statistics strand standards reflects the use of an investigative cycle.

2.13 (AS91268), *Investigate a situation involving elements of chance using a simulation*
This standard covers the practical aspects of 5250 and AS90289. The title emphasises the need for students to use the results of their simulation and promotes the notion of an investigation.

2.14 (AS91269), *Apply systems of equations in solving problems*
This standard is internally assessed and has been assigned 2 credits.