FIELD SCIENCES

Review of *Mathematics* Level 3 achievement standards

Subfield Mathematics

Domain	Id	Subject reference
Algebra	90638, 90639	Calculus 3.4, 3.5
Calculus	90635, 90636	Calculus 3.1, 3.2
Trigonometry	90637	Calculus 3.3

The Ministry of Education and the Secondary Education Group Assessment business unit of NZQA have completed a review of the achievement standards listed above that were registered in October 2003.

New Registration date **November 2005**

Date new versions published **November 2005**

Planned review date **March 2008**

Summary of review and consultation process

This review is part of the planned cycle of review that takes place after the first year of use of the achievement standards.

- Initial feedback and comments were collated from teachers/schools, moderators, examiners, markers, material developers, and other stakeholders.
- This information was reviewed by a subject expert panel and recommendations were made in March 2005.
- The recommendations were sent out for full consultation to secondary schools, tertiary institutions, and others in the education sector, in April/May 2005.
- Feedback from this full consultation has informed the changes described below.

Main changes resulting from the review

AS90635, Calculus 3.1

Title

- The title has been amended so that it is consistent with the achievement criteria.

Achievement Criteria

- The two achievement with merit criteria have been combined into a single criterion to allow for greater flexibility in the assessment.
- The achievement with excellence criterion has been amended by removing the wording requiring ‘a combination of differentiation techniques’ to allow more variety in the problems that may be included. It was found that this requirement precluded the setting of some otherwise very suitable achievement with excellence type questions.

Explanatory Notes

Achievement

- Clarification is given that polynomials will be in expanded form.
- Differentiation using product and quotient rules for simple examples has been included.

- Reference to related rates of change has been removed as this is beyond the level expected for achievement. However, rates of change problems that may involve kinematics have been included.
- Finding equations of normals has been included to allow for more flexibility in assessment.

Achievement with Merit

- Sketching of a derived function from a graph underpins the understanding of the principles of differentiation and has been included.
- Examples have been added to clarify the required level of performance.

Achievement with Excellence

- Additional examples of the type of problems required have been added.

General Explanatory Notes

- Note 2 has been expanded to ensure that the candidates are aware that they must demonstrate differentiation skills.

AS90636, Calculus 3.2

Title

- The title has been amended to match the form of Calculus 3.1.

Achievement Criteria

Achievement

- The criterion has been amended by removing reference to methods of problem solving. The types of functions required have been included in the explanatory notes.

Achievement with Merit

- This criterion has been amended to more clearly indicate the progression from achievement.

Achievement with Excellence

- The criterion has been amended by removing 'a variety of integration techniques' to allow more variety in the problems that may be included. It was found that the requirement for a variety of integration techniques precluded the setting of some otherwise very suitable achievement with excellence type questions.

Explanatory notes

Achievement

- Clarification has been given that polynomials will be in factorised form and that diagrams will not necessarily be provided for areas and volumes.

Achievement with Merit

- This has been amended to provide a clearer indication that rates of change problems may be included where advanced integration techniques are required.
- The form of differential equation $y' = ky$ has been added for clarification.

General Explanatory Notes

- Note 2 has been expanded to ensure that the candidates are aware that they must demonstrate integration skills.

AS90637, Calculus 3.3

Achievement Criteria

Achievement with Merit

- The first criterion has been amended to clarify that modelling is an important aspect and that problems are required to be solved.

Achievement with Excellence

- The word ‘more’ has been added before ‘complex’ to clarify that complex numbers are not involved here.

Explanatory notes

Achievement

- The note has been amended to clarify that all trigonometric ratios may be involved and that the model will be given.

Achievement with Merit

- This has been amended so that candidates are now required to form the equation for the model and to clarify the level of difficulty and type of model expected at achievement with merit.

Achievement with Excellence

- Solving complex equations and 3-D trigonometric problems have been added to further clarify the type of problems to be expected.
- Clarification has been provided that evaluation of the model is appropriate only if the data has been collected by the candidates.

Some feedback on this achievement standard questioned the reason for it being internally assessed. The expert panel discussed this. The achievement standard is designated as internally assessed so that the candidate can have an extended period of time in which to develop and present their best evidence for the outcome being assessed. There is no expectation or requirement for this achievement standard that the assessment will involve practical work. The modelling is expected to be of a situation that is in a meaningful context for candidates.

AS90638, Calculus 3.4

Explanatory notes

Achievement with Merit

- The solution of $z^n = a + b\text{i}$ has been added to extend the selection of equations that require the use of De Moivre’s theorem.

Achievement with Excellence

- The word ‘extended’ has been removed from the chain of reasoning statement to clarify the progression from this grade to scholarship (which does require ‘extended reasoning’).
- Notes have been added to clarify the progression from achievement with merit.
- Binomial expansions and loci (geometric representations of complex numbers) have been added to increase flexibility in assessment.

General Explanatory Notes

- Note 3 has been added to make the assessment more equitable for candidates who do not have graphics calculators.

AS90639, Calculus 3.5

Title

- The title has been amended to match the reviewed achievement criterion.

Achievement Criteria

Achievement

- The two criteria have been combined into a single criterion to make the assessment more manageable.
- ‘Finding equations of conic sections’ has been amended to ‘writing equations related to conic sections’ to increase the range of equations that may provide opportunities for evidence of achievement.

Achievement with Excellence

- This criterion has been amended to include 'more complex' to align with the excellence criteria in AS90635, Calculus 3.1 and AS90636, Calculus 3.2.

Explanatory notes

Achievement

- Examples of features have been added to clarify what is required.
- An indication has been added that at this grade the graphs of conic sections will be given when equations are required to be written.

Achievement with Merit

- This note has been re-ordered to emphasise the need for modelling of real situations.

Achievement with Excellence

- To clarify that mathematical contexts can be expected the reference to 'real life context' has been removed as this is required for achievement with merit.
- The word 'extended' has been removed to more clearly describe the progression to scholarship.
- Loci, directrix, and eccentricity have been added to clarify the scope of achievement with excellence.

General Explanatory Notes

- Note 2 has been added to emphasise the requirements of sketching.
- Note 3 has been modified to clarify the requirements for the use of technology.

Impact on Accreditation and Moderation Action Plan (AMAP)

None.

Impact on existing qualifications

None.

Impact of changes on NCEA Exclusions List

To be advised.

Summary of main changes to achievement standards' Ids, classification, titles, levels, and credits

The following summary shows the changes made to the achievement standards as a result of the review. All changes are in **bold**.

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

Subfield Mathematics
Domain Algebra

Id	Title	Level	Credit	Review Category
90638	Manipulate real and complex numbers, and solve equations	3	5	B

Id	Title	Level	Credit	Review Category
90639	Sketch graphs and find equations of conic sections **Sketch graphs of conic sections and write equations related to conic sections**	3	3	B

Domain Calculus

Id	Title	Level	Credit	Review Category
90635	Differentiate and use derivatives to solve problems **Differentiate functions and use derivatives to solve problems**	3	6	B
90636	Integrate functions and solve problems by integration, differential equations or numerical methods **Integrate functions and use integrals to solve problems**	3	6	B

Domain Trigonometry

Id	Title	Level	Credit	Review Category
90637	Solve problems and equations involving trigonometric functions	3	4	B