Achievement Standard

Subject Reference	CAS Calculus 3.4				
Title	Demonstrate an understanding of mathematical concepts without the use of electronic technology				
Level	3	**Credits**	5	**Assessment**	Internal
Subfield	Mathematics				
Domain	Calculus				
Status	Expiring			**Status date**	4 December 2012

This achievement standard is expiring. Assessment against the standard must take place before the expiry date set out below.

Expiry date	31 December 2013	**Date version published**	4 December 2012

This achievement standard involves demonstrating an understanding of mathematical concepts without the use of electronic technology (including calculators).

Note: Candidates cannot use credit for both this achievement standard and either AS90635, AS90636, AS 90637, AS90638 or AS90639 (Calculus 3.1 - 3.5) towards a national qualification including a National Certificate of Educational Achievement.

<table>
<tr><th></th><th>Achievement Criteria</th><th>Explanatory Notes</th></tr>
<tr><td>Achievement</td><td>• Demonstrate an understanding of mathematical concepts without the use of electronic technology.</td><td rowspan="2">Mathematical concepts will be selected from:
• limits, and continuity
• differentiation
○ from first principles for polynomial functions of degree ≤3
○ differentiability
○ chain rule, product rule, quotient rule, and their application
○ parametric functions
○ implicit.
• integration
○ polynomial functions of degree ≤3
○ exponential functions of the form $ae^{bx + c}$
○ rational functions of the type $\frac{f'(x)}{f(x)}$ or $\frac{ax+b}{cx+d}$
○ trigonometric functions relating to exact values.</td></tr>
<tr><td>Achievement with Merit</td><td>• Demonstrate a deeper understanding of mathematical concepts without the use of electronic technology.</td></tr>
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	Achievement Criteria	Explanatory Notes
Achievement with Excellence	• Demonstrate a comprehensive understanding of mathematical concepts without the use of electronic technology.	• equation solving and algebraic manipulation o surds o complex numbers. • using graphs o write equations for and sketch graphs of conic sections o transformations of equations and their graphs.

Explanatory Notes

1 This achievement standard is derived from *Mathematics in the New Zealand Curriculum*, Learning Media, Ministry of Education, 1992:
- achievement objectives pp. 124, 164
- suggested learning experiences pp. 125, 165
- sample assessment activities pp. 126, 166-167
- mathematical processes pp. 24, 26, 28.

2 Demonstrating an *understanding* may include the process of problem solving.

3 In addition to the requirements for achievement a *deeper understanding* would typically include the solution of problems involving:
- areas under and between functions
- rates of change
- optimisation and turning points
- simple volumes of revolution
- area approximations
- proof
- modelling.

4 In addition to the requirements for merit, a *comprehensive understanding* would typically include a solution of a problem, and interpretation and evaluation of that solution. This may involve the linking of different representations of concepts and generalisation.

Quality Assurance

1 Providers and Industry Training Organisations must have been granted consent to assess by NZQA before they can register credits from assessment against achievement standards.

2 Organisations with consent to assess and Industry Training Organisations assessing against achievement standards must engage with the moderation system that applies to those achievement standards.

Consent and Moderation Requirements (CMR) reference 0226