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	Registered	**Status date**		17 December 2008	
Planned review date	28 February 2011	**Date version published**		17 December 2008	

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.

	Achievement Criteria	Explanatory Notes
Achievement	• Demonstrate an understanding of mathematical concepts without the use of electronic technology.	Mathematical concepts will be selected from: • limits, and continuity • differentiation o from first principles for polynomial functions of degree ≤3 o differentiability o chain rule, product rule, quotient rule, and their application o parametric functions o implicit. • integration o polynomial functions of degree ≤3 o exponential functions of the form ae^{bx+c} o rational functions of the type $\frac{f'(x)}{f(x)}$ or $\frac{ax+b}{cx+d}$. o trigonometric functions relating to exact values.
Achievement with Merit	• Demonstrate a deeper understanding of mathematical concepts without the use of electronic technology.	

	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.

General 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 be accredited by NZQA before they can register credits from assessment against achievement standards.

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

Accreditation and Moderation Action Plan (AMAP) reference 0226