Achievement Standard

Subject Reference Calculus 3.1

Title Differentiate functions and use derivatives to solve problems

Level 3 **Credits** 6 **Assessment** External

Subfield Mathematics

Domain Calculus

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This achievement standard involves differentiating functions and using derivatives to solve problems.

	Achievement Criteria	Explanatory Notes
Achievement	• Differentiate functions and use derivatives to solve problems.	• Types of functions will be selected from: – power – exponential (base e only) – logarithmic (base e only) – trigonometric (including reciprocal functions). • Differentiation of functions may include the use of the chain rule and product and quotient rules for expanded polynomials: – chain rule with polynomials in expanded form such as i $(x^2 + 5x)^7$ ii $\sqrt[3]{2x-3}$ iii $7e^{2x}$ iv $\ln(2x+7)$ v $\sin 5x$ – product and quotient rules for combinations of straightforward functions, at least one of which is in expanded polynomial form, such as i $x^2 . \sin x$ ii $(2x^3 - 4).e^x$ iii $\frac{2x}{(x+3)}$. • Problems may include: – optimisation of a given function – rates of change which may involve kinematics – finding equations of normals and tangents – locating maxima and minima of polynomial functions.

	Achievement Criteria	**Explanatory Notes**
Achievement with Merit	• Demonstrate knowledge of advanced concepts and techniques of differentiation and solve differentiation problems.	• Knowledge, concepts and techniques of differentiation will be selected from the following types: – differentiation from first principles of polynomial functions of degree ≤3 – sketching the graph of a derived function from a given graph – differentiation of combinations of functions including: i products, such as $(3x^2 - 7)^3(4x + 8)$ or $x^2 \sin\sqrt{x}$ ii quotients, such as $\frac{\sqrt{x}}{1+x^2}$ iii implicit differentiation such as $x^2 + 3y^2 = 15$ iv parametric differentiation for first derivative only – identifying features of given graphs involving a selection from: i limits ii differentiability iii discontinuity iv gradients v concavity vi turning points vii points of inflection – sketching graphs to demonstrate knowledge of the above features. • Problems may involve: – interpretation of features of graph – modelling of a situation – optimisation – related rates of change, involving two directly related rates.
Achievement with Excellence	• Solve more complex differentiation problem(s).	• Problems may involve: – establishing a model – a proof – testing the nature of turning points and verifying points of inflection – related rates of change involving more that two related rates, eg dh/dt = dh/dθ.dθ/dv.dv/dt – the use of higher derivatives including parametric and implicit differentiation techniques.

General Explanatory Notes

1 This achievement standard is derived from *Mathematics in the New Zealand Curriculum*, Learning Media, Ministry of Education, 1992:
- achievement objectives p. 86
- suggested learning experiences pp. 25, 27, 29, 87
- sample assessment activities pp. 88–89
- mathematical processes pp. 24, 26, 28.

2 The use of appropriate technology is expected but candidates must be able to demonstrate the skill of differentiation.

Quality Assurance

1 Providers and Industry Training Organisations must be accredited by the Qualifications Authority 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