



D&D Resources Ltd
Mathematics Exam Preparation Made Easy

Calculus Methods - 91262

Practice External Assessments 2

CALCULUS METHODS

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NCEA 2 Maths

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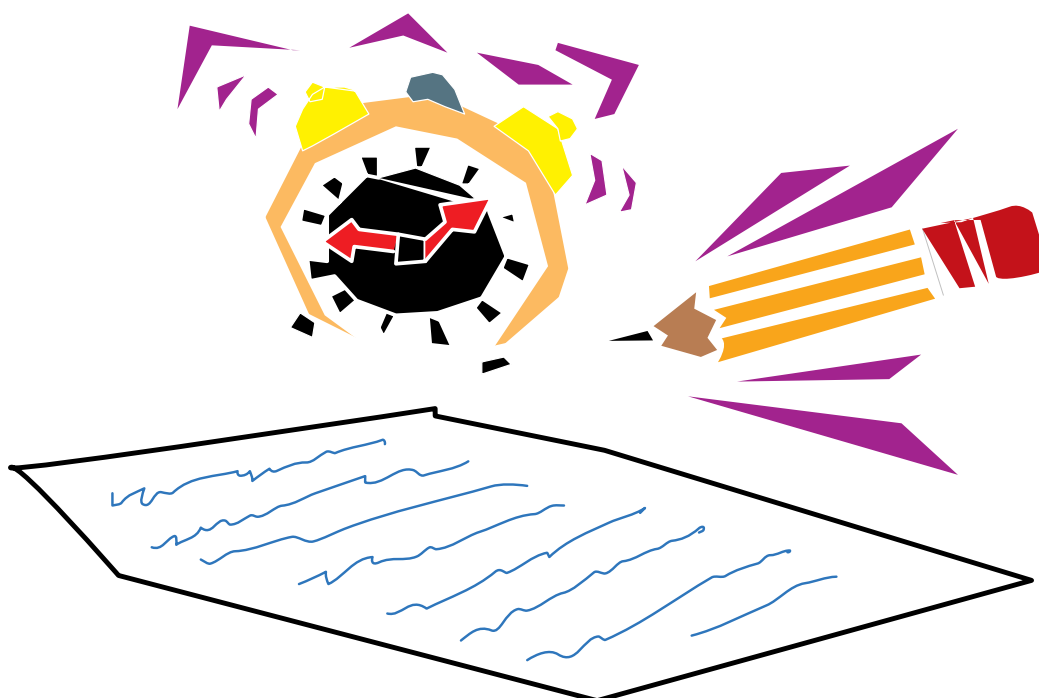
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The questions in the practice assessments are NOT in order of difficulty. Attempt all questions or you may not provide enough evidence to achieve the required standard. You must show the use of calculus in answering all questions.

Achievement Standard

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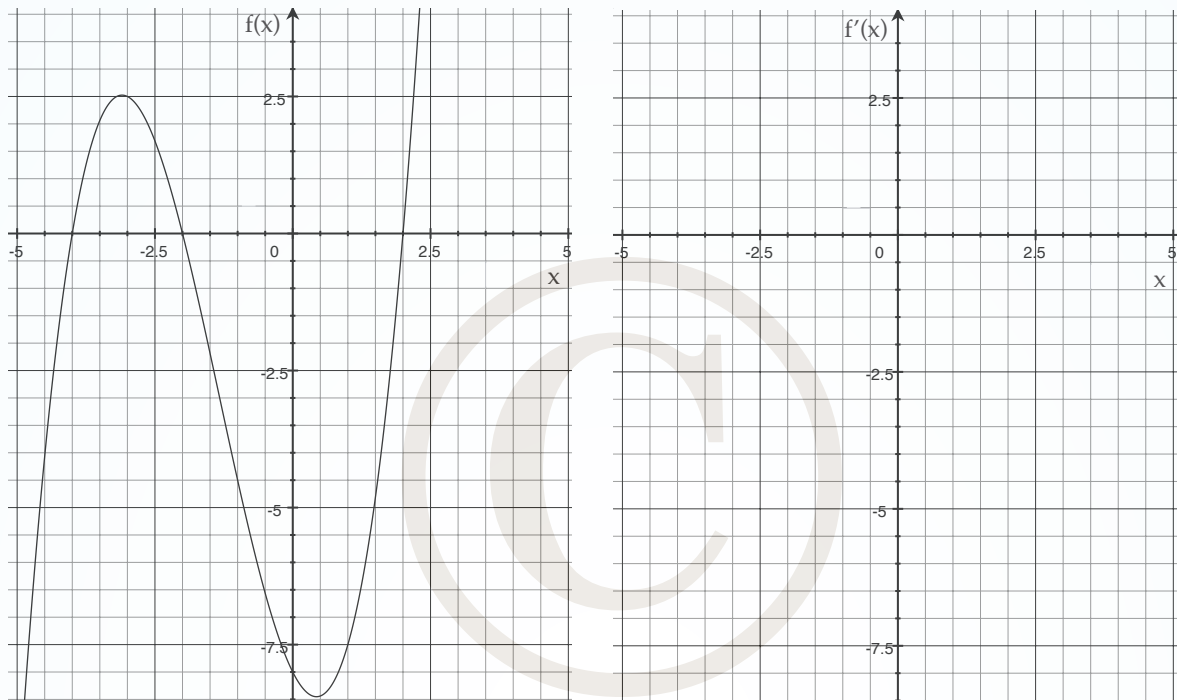
Apply calculus methods in solving problems

Achievement	Achievement with Merit	Achievement with Excellence
<ul style="list-style-type: none"> Apply calculus methods in solving problems. 	<ul style="list-style-type: none"> Apply calculus methods using relational thinking in solving problems. 	<ul style="list-style-type: none"> Apply calculus methods using extended abstract thinking in solving problems.

- ◆ This achievement standard is derived from Level 7 of The New Zealand Curriculum, Learning Media and is related to the achievement objectives:
 - ❖ Sketch the graphs of functions and their gradient functions and describe the relationship between these graphs.
 - ❖ Apply differentiation and anti-differentiation techniques to polynomials.
- ◆ Apply calculus methods in solving problems involves:
 - ❖ selecting and using methods
 - ❖ demonstrating knowledge of calculus concepts and terms
 - ❖ communicating using appropriate representations.
- ◆ Relational thinking involves one or more of:
 - ❖ selecting and using a logical sequence of steps
 - ❖ connecting different concepts or representations
 - ❖ demonstrating understanding of concepts
 - ❖ forming and using a model;
 and also relating findings to a context, or communicating thinking using appropriate mathematical statements.
- ◆ Extended abstract thinking involves one or more of:
 - ❖ devising a strategy to investigate a situation
 - ❖ demonstrating understanding of abstract concepts
 - ❖ developing a chain of logical reasoning, or proof
 - ❖ forming a generalisation;
 and also using correct mathematical statements, or communicating mathematical insight.
- ◆ Problems are situations which provide opportunities to apply knowledge or understanding of mathematical concepts and methods. Situations will be set in real-life or mathematical contexts.
- ◆ Methods include a selection from those related to:
 - ❖ derivatives and anti-derivatives of polynomials given in expanded form
 - ❖ gradient functions
 - ❖ gradient at a point
 - ❖ equation of a tangent
 - ❖ turning points where $f'(x) = 0$ and their nature
 - ❖ function from a derived function
 - ❖ rate of change problems (such as kinematics).

QUESTION TWO

- (a) Sketch the gradient function $f'(x)$ for the function $f(x)$ below.



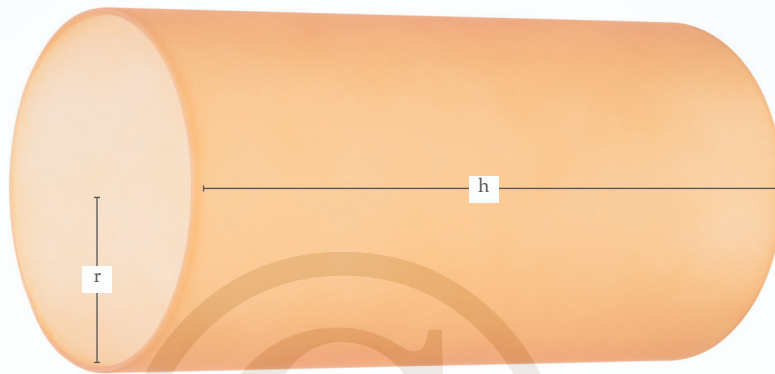
- (b) The height of a seedling can be modelled by the equation $h = 3.2 + 2.8t - 0.04t^2$ where h is the height in mm and t is the time in days.

- (i) When is the seedling growing at a rate of 2 mm per day?

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- (ii) After how many days will the seedling achieve its maximum height and what is the maximum height?

- (c) The formula for the volume of a cylinder is $V = \pi r^2 h$. The cylinder shown in the diagram has its height equal to three times its radius. Find the rate of change of the volume with respect to the radius when the volume of the cylinder is 375π .

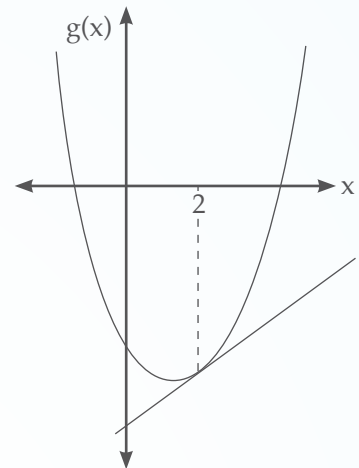


- (d) A curve has a stationary point at $(3, -13)$ and $f'(x) = 3x^2 + kx - 9$. Find the coordinates of the other stationary point.

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- (d) The graph of the function $g(x) = x^2 - 3x - 4$ is shown below. Find the equation of the tangent to the curve.



- (e) A new website has just been launched. The number of people, in thousands, viewing it can be modelled by the equation $P = \frac{2m^3}{3} - 8m^2 + 24m + 4$, where m is the number of months and $0 < m < 7$. Fully describe this curve in the context of the problem, including its turning points. You must show the use of calculus.

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PEA 2

Quest.	Evidence	Achievement	Merit	Excellence
		Apply calculus methods in solving problems	Apply calculus methods using relational thinking in solving problems	Apply calculus methods using extended abstract thinking in solving problems by
ONE		TWO of:	TWO of:	ONE of:
(a)	$f'(x) = 3x^2 + 13x - 10$ $f'(-2) = -24$	<ul style="list-style-type: none"> expression differentiated and gradient found. 		
(b)	$\frac{dy}{dx} = -2 - 2x$ $-2 - 2x = 6$ $x = -4, y = -5$ $y + 5 = 6(x + 4)$ $y = 6x + 19$	<ul style="list-style-type: none"> expression differentiated and x and y coordinates found. 	<ul style="list-style-type: none"> equation of tangent found. 	
(c)	$v = 3t^2 - 8t + 2$ $a = 6t - 8$ At $t = 2, a = 4 \text{ ms}^{-2}$	<ul style="list-style-type: none"> expression for velocity found. 	<ul style="list-style-type: none"> expression for acceleration found and calculated. 	
(d)	$500 = x^2 + 4xy$ $y = \frac{500 - x^2}{4x} = \frac{125}{x} - \frac{x}{4}$ $V = x^2y$ $V = x^2\left(\frac{125}{x} - \frac{x}{4}\right)$ $V = 125x - \frac{x^3}{4}$ $\frac{dV}{dx} = 125 - \frac{3x^2}{4}$ $\frac{dV}{dx} = 0$ $x = 12.9$ and $y = 6.455$ Max volume = 1075 cm^3	<ul style="list-style-type: none"> $\frac{dV}{dx}$ found. 	<ul style="list-style-type: none"> $\frac{dV}{dx}$ found, equated to 0 and solved. 	<ul style="list-style-type: none"> maximum volume found.
(e)	$y = \frac{ax^2}{2} - 2a^2x + c$ $\frac{dy}{dx} = ax - 2a^2 = 0$ at stationary point $a(x - 2a) = 0$ $x = 2a$ At $(2a, 0)$ $0 = 2a^3 - 4a^3 + c$ $c = 2a^3$ $y = \frac{ax^2}{2} - 2a^2x + 2a^3$	<ul style="list-style-type: none"> equation for y found by integration. 	<ul style="list-style-type: none"> x coordinate of stationary point found. 	<ul style="list-style-type: none"> correct value of c with equation.