Achievement Standard

Subject Reference	Mathematics and Statistics 3.6				
Title	Apply differentiation methods in solving problems				
Level	3	**Credits**	6	**Assessment**	External
Subfield	Mathematics				
Domain	Calculus				
Status	Registered	**Status date**		4 December 2012	
Planned review date	31 December 2018	**Date version published**		4 December 2012	

This achievement standard involves applying differentiation methods in solving problems.

Achievement Criteria

Achievement	Achievement with Merit	Achievement with Excellence
• Apply differentiation methods in solving problems.	• Apply differentiation methods, using relational thinking, in solving problems.	• Apply differentiation methods, using extended abstract thinking, in solving problems.

Explanatory Notes

1 This achievement standard is derived from Level 8 of *The New Zealand Curriculum,* Learning Media, Ministry of Education, 2007; and is related to the achievement objectives:
- Identify discontinuities and limits of functions
- Choose and apply a variety of differentiation techniques to functions and relations using analytical methods

in the Mathematics strand of the Mathematics and Statistics Learning Area. It is also related to the material in the *Teaching and Learning Guide for Mathematics and Statistics*, Ministry of Education, 2012, at http://seniorsecondary.tki.org.nz.

This standard is also derived from *Te Marautanga o Aotearoa*. For details of the *Marautanga* achievement objectives to which this standard relates, see the Māori version of the standard

2 *Apply differentiation methods in solving problems* involves:
- selecting and using methods
- demonstrating knowledge of concepts and terms
- communicating using appropriate representations.

Relational thinking involves one or more of:
- selecting and carrying out 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 or solve a problem
- identifying relevant concepts in context
- developing a chain of logical reasoning, or proof
- forming a generalisation;

and also using correct mathematical statements, or communicating mathematical insight.

3 *Problems* are situations that provide opportunities to apply knowledge or understanding of mathematical concepts and methods. Situations will be set in real-life or mathematical contexts.

4 Methods are selected from those related to:
- derivatives of power, exponential, and logarithmic (base e only) functions
- derivatives of trigonometric (including reciprocal) functions
- optimisation
- equations of normals
- maxima and minima and points of inflection
- related rates of change
- derivatives of parametric functions
- chain, product, and quotient rules
- properties of graphs (limits, differentiability, continuity, concavity).

5 Assessment Specifications for this achievement standard can be accessed through the Mathematics and Statistics Resources page found at http://www.nzqa.govt.nz/qualifications-standards/qualifications/ncea/subjects/.

Replacement Information

This achievement standard replaced unit standard 5265 and AS90635.

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 0233

Paerewa Paetae

Aronga	Pāngarau 3.6				
Ingoa	Te whakamahi tikanga kimi pārōnaki hei whakaoti rapanga				
Kaupae	3	**Whiwhinga**	6	**Aromatawai**	Ā-waho
Marau akoranga	Te Marautanga o Aotearoa				
Kokonga akoranga	Pāngarau				
Mana rēhita			**Te rā i mana ai**		
Te rā e arotakengia ai	31 Hakihea 2018		**Te rā i puta ai**		

Te Hononga ki te Marautanga

I ahu mai tēnei paerewa paetae i te Taumata 8 o *Te Marautanga o Aotearoa*, i whakaputaina e Te Pou Taki Kōrero i te tau 2008.

Whāinga Paetae

Te Taurangi me te Tuanaki, Te Tuanaki

10 Ka tautohu i nga aruarunga me ngā tepe o tētahi pānga.

11 Ka whiriwhiri, ka whakamahi i ngā tikanga maha mō te kimi pārōnaki, te kimi pāwhaitua, te kimi pārōnaki kōaro o tētahi pānga, pērā i te tikanga tātari me te tikanga tau.

E hono ana ki te Papa Whakaako mō te Pāngarau kei te pae tukutuku nei:
http://tmoa.tki.org.nz/Te-Marautanga-o-Aotearoa/Taumata-Matauranga-a-Motu-Ka-Taea

Te Hononga ki *The New Zealand Curriculum* (NZC)

I ahu mai hoki tēnei paerewa paetae i *The New Zealand Curriculum*. Mō ngā kōrero e pā ana ki ngā whāinga paetae o te NZC e hāngai ana ki tēnei paerewa, tirohia te putanga reo Pākehā o te paerewa.

Te Hononga ki ngā Paearu Aromatawai

Arā ngā Paearu Aromatawai mō tēnei paerewa paetae, kei te:
http://tmoa.tki.org.nz/Te-Marautanga-o-Aotearoa/Taumata-Matauranga-a-Motu-Ka-Taea

Paerewa Paetae

Paetae Te whakamahi tikanga kimi pārōnaki hei whakaoti rapanga.	Hei tohu i te paetae: • Ka whiriwhiri, ka whakamahi i ētahi tikanga whānui hei whakaoti rapanga. • Ka whakaatu mōhiotanga ki ngā huatau me ngā kupu e hāngai ana hei whakaoti rapanga. • Ka tūhono i ētahi huatau rerekē. • Ka whakamārama i ngā otinga mēnā kotahi, e rua rānei ngā mahi o roto i te tikanga i whakamahia ai.
Kaiaka He kaiaka te whakamahi tikanga kimi pārōnaki hei whakaoti rapanga.	Hei tohu i te kaiaka: • Ko te whakaaro tūhonohono te mea nui. Arā, kia kotahi, nui ake rānei o ēnei: – ka whiriwhiri, ka whakatutuki raupapatanga mahi arorau hei whakaoti rapanga. – ka tūhono i ētahi huatau rerekē, i ētahi whakaahuahanga rerekē rānei hei whakaoti rapanga. – ka whakaatu māramatanga ki ngā huatau e hāngai ana – ka hanga, ka whakamahi tauira. • Ka tūhono i ngā otinga ki tētahi horopaki, ka whakamahi rānei i ngā kīanga pāngarau hei whakawhitiwhiti whakaaro.
Kairangi He kairangi te whakamahi tikanga kimi pārōnaki hei whakaoti rapanga.	Hei tohu i te kairangi: • Ko te whakaaro waitara te mea nui. Arā, kia kotahi, nui ake rānei o ēnei: – ka waihanga rautaki hei tūhura, hei whakaoti rānei i tētahi rapanga. – ka tautohu i ngā huatau e hāngai ana ki te horopaki. – ka whakaputa i tētahi raupapatanga whakaaro arorau, i tētahi hāponotanga rānei. – ka hanga whakawhānuitanga. • Ka whakamahi i ngā kīanga pāngarau tika hei whakawhitiwhiti i te aroā pāngarau.

Kōrero Āpiti

1 E whai ake nei ngā whakamārama o ngā tino kupu, kīanga rānei:

rapanga	Ko ngā āhuatanga o ia rā, ngā āhuatanga pāngarau rānei ka whai wāhi mai te whakamahinga o te mātauranga pāngarau, o ngā huatau pāngarau, o ngā tikanga pāngarau rānei.

2 Kia taunga te ākonga ki ngā tikanga kimi pārōnaki:
- o ngā kīanga pūrau, ngā kīanga taupūtanga me ngā kīanga taupūtanga kōaro māori (pūtake ‘e’ anake)
- o ngā kīanga pākoki me ngā kīanga pākoki kōaro
- te kimi i te otinga e tino whaihua ana
- te kimi i te whārite o ngā rārangi e hono hāngai ana ki te pātapa

- te kimi i ngā taunga o ngā huringa o te kauwhata (te pārōnaki = 0): ko ngā tihi, ko ngā riu, ko ngā huringa ahunga rānei
- te whakamahi i ngā pārōnaki hei tātai i ngā pāpātanga
- o ngā whārite taurangi e toru (ka whai pānga a ‘x’ rāua ko ‘y’ ki a ‘t’)
- te kimi i te pārōnaki mā te tikanga whakauru, mā te tikanga whakarea me te tikanga whakawehe
- te mārama ki ngā āhuatanga o ngā kauwhata: ngā aruarunga me ngā tepe; te āhei ki te kimi i te pārōnaki o te kauwhata me te ahunga o te kauwhata (kei te ahu whakarunga rānei, whakararo rānei).

Kuputaka:

aroā pāngarau	mathematical insight
aruarunga	continuity (of the graph)
huringa ahunga	point of inflexion
kīanga pāngarau	mathematical statement
pāpātanga	rate of change
tepe	limits (of the graph)
whakaaro arorau	logical thinking, reasoning
whakaaro tūhonohono	relational thinking
whakaaro waitara	abstract thinking
whārite taurangi e toru	parametric

He Kōrero mō te Whakakapi

Koinei hei whakakapi i te paerewa 5265 me te paerewa paetae 90635.

Tātari Kounga

1 Me mātua whakamana ngā Kaituku Akoranga me ngā Whakahaere Whakangungu Ahumahi e te Mana Tohu Mātauranga o Aotearoa ka rēhita ai i ngā hua ka puta mai i ngā aromatawai ki ngā paerewa paetae.

2 Ko ngā Kaituku Akoranga me ngā Whakahaere Whakangungu Ahumahi kua mana, ā, e aromatawai ana i ā rātou hōtaka ki ngā paerewa paetae, me uru rātou ki ngā pūnaha whakaōrite e tika ana mō aua paerewa paetae.

Ko te tohutoro ki te Mahere Whakamana, Whakaōritenga hoki 0233