Achievement Standard

Subject Reference   Mathematics and Statistics 2.7

Title   Apply calculus methods in solving problems

Level   2   **Credits**   5   **Assessment**   External

Subfield   Mathematics

Domain   Calculus

Status   Registered   **Status date**   19 November 2015

Planned review date   31 December 2020   **Date version published**   19 November 2015

This achievement standard involves applying calculus methods in solving problems.

Achievement Criteria

Achievement	Achievement with Merit	Achievement with 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.

Explanatory Notes

1   This achievement standard is derived from Level 7 of *The New Zealand Curriculum,* Learning Media, Ministry of Education, 2007; 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
   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, 2010 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 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.

3   *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.

4   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).

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/ncea-subject-resources/.

Replacement Information
This achievement standard replaced AS90286, AS90807, unit standard 5244, unit standard 5260, and unit standard 5261.

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 2.7

Ingoa   Te whakamahi tikanga tuanaki hei whakaoti rapanga

Kaupae   2   **Whiwhinga**   5   **Aromatawai**   Ā-waho

Marau akoranga   Te Marautanga o Aotearoa

Kokonga akoranga   Pāngarau

Mana rēhita   Kua rēhitatia   **Te rā i mana ai**   19 Whiringa-ā-rangi 2015

Te rā e arotakengia ai   31 Hakihea 2020   **Te rā i puta ai**   19 Whiringa-ā-rangi 2015

Te Hononga ki te Marautanga

I ahu mai tēnei paerewa paetae i te Taumata 7 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
9   Ka tūhura kauwhata pānga me ngā pānga rōnaki e hāngai ana, ā, ka whakamārama i te hononga o tētahi ki tētahi.
10   Ka whakamahi tikanga kimi pārōnaki, kimi pārōnaki-kōaro hoki e whai wāhi mai ana te pūrau.

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 tuanaki hei whakaoti rapanga.	Hei tohu i te paetae: • Ka whiriwhiri, ka whakamahi i ētahi tikanga tuanaki whānui hei whakaoti rapanga. • Ka whakaatu mōhiotanga ki ngā huatau tuanaki me ngā kupu e hāngai ana hei whakaoti rapanga. • 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 tuanaki 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 tuanaki 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 o te tuanaki:
   • te kimi pārōnaki me te kimi pārōnaki-kōaro o ngā pūrau kua whakawhānuitia
   • ngā pānga rōnaki
   • te rōnaki i tētahi pūwāhi
   • te whārite o te rārangi pātapa i tētahi pūwāhi
   • te taunga o ngā huringa o te kauwhata i te pūwāhi $f'(x) = 0$ me te āhua o aua

huringa (he tihi rānei, he riu rānei)
- te hoki kōmuri ki te pānga mai i te pānga rōnaki
- te whakaoti i ngā rapanga pāpātanga o te whiti.

Kuputaka:
aroā pāngarau	mathematical insight
kīanga pāngarau	mathematical statement
whakaaro tūhonohono	relational thinking
whakaaro waitara	abstract thinking

He Kōrero mō te Whakakapi

Koinei hei whakakapi i ngā paerewa paetae AS90286 me AS90807, me ngā paerewa 5244, 5260 me 5261.

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