

Achievement Standard

Subject Reference Mathematics and Statistics 3.7

Title Apply integration 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 2020 **Date version published** 17 November 2016

This achievement standard involves applying integration methods in solving problems.

Achievement Criteria

Achievement	Achievement with Merit	Achievement with Excellence
<ul style="list-style-type: none"> Apply integration methods in solving problems. 	<ul style="list-style-type: none"> Apply integration methods, using relational thinking, in solving problems. 	<ul style="list-style-type: none"> Apply integration 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:
- Choose and apply a variety of integration and anti-differentiation techniques to functions and relations using both analytical and numerical methods
 - Form differential equations and interpret the solutions
- 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 integration 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:
 - integrating power, polynomial, exponential (base e only), trigonometric, and rational functions
 - reverse chain rule, trigonometric formulae
 - rates of change problems
 - areas under or between graphs of functions, by integration
 - finding areas using numerical methods, eg the rectangle or trapezium rule
 - differential equations of the forms $y' = f(x)$ or $y'' = f(x)$ for the above functions or situations where the variables are separable (eg $y' = ky$) in applications such as growth and decay, inflation, Newton's Law of Cooling and similar situations.
- 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 20660, unit standard 20905, and AS90636.

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 3.7		
Ingoa	Te whakamahi tikanga kimi pāwhaitua hei whakaoti rapanga		
Kaupae	3	Whiwhinga	6
		Aromatawai	Ā-waho
Marau akoranga	Te Marautanga o Aotearoa		
Kokonga akoranga	Pāngarau		
Mana rēhita	Kua rēhitatia	Te rā i mana ai	4 Hakihea 2012
Te rā e arotakengia ai	31 Hakihea 2020	Te rā i puta ai	17 Whiringa-ā-rangi 2016

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

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

12 *Ka hanga whārite pārōnaki, ka whakamārama hoki i ngā otinga.*

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

<p>Paetae Te whakamahi tikanga kimi pāwhaitua hei whakaoti rapanga.</p>	<p>Hei tohu i te paetae:</p> <ul style="list-style-type: none"> • 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.
<p>Kaiaka He kaiaka te whakamahi tikanga kimi pāwhaitua hei whakaoti rapanga.</p>	<p>Hei tohu i te kaiaka:</p> <ul style="list-style-type: none"> • Ko te whakaaro tūhonohono te mea nui. Arā, kia kotahi, nui ake rānei o ēnei: <ul style="list-style-type: none"> – 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.
<p>Kairangi He kairangi te whakamahi tikanga kimi pāwhaitua hei whakaoti rapanga.</p>	<p>Hei tohu i te kairangi:</p> <ul style="list-style-type: none"> • Ko te whakaaro waitara te mea nui. Arā, kia kotahi, nui ake rānei o ēnei: <ul style="list-style-type: none"> – 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.
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2 Kia taunga te ākonga ki ngā tikanga kimi pāwhaitua:

- o ngā kīanga pūrau, ngā kīanga taupūtanga, ngā kīanga taupūtanga kōaro māori (pūtake 'e' anake), ngā kīanga pākoki me ngā kīanga hautanga
- te kimi i te pāwhaitua mā te tikanga whakauru kōaro hei kimi i te pāwhaitua o ngā kīanga pākoki

- te whakamahi i ngā pāwhaitua hei tātai i ngā pāpātanga
- te tātai i te horahanga i waenga i te kauwhata me te tuaka x mā te pāwhaitua
- te tātai i te horahanga i waenga i te kauwhata me te tuaka x mā ngā tikanga maha, mā te tikanga tapawhā roa me te tikanga taparara
- te whakamahi i ngā whārite pāronaki $y' = f(x)$ rānei, $y'' = f(x)$ rānei mō ngā momo kīanga katoa o runga akei nei e noho pēnei ana ngā taurangi ($y' = ky$) e whai wāhi ana ki te whakapikinga, ki te whakahekenga rānei; ki te whakatupuranga rānei, ki te whakapirauhanga rānei; ki te Ture a Newton mō te whakahekenga o te wera; ki te aha atu rānei.

Kuputaka:

aroā pāngarau	mathematical insight
kīanga pāngarau	mathematical statement
whakaaro arorau	logical thinking, reasoning
whakaaro tūhonohono	relational thinking
whakaaro waitara	abstract thinking

He Kōrero mō te Whakakapi

Koinei hei whakakapi i ngā paerewa 20660 me te 20905, me te paerewa paetae 90636.

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