Achievement Standard

Subject Reference	Physics 3.4	
Title	Demonstrate understanding of mechanical systems	
Level 3	**Credits** 6	**Assessment** External
Subfield Science		
Domain Physics		
Status Registered	**Status date**	4 December 2012
Planned review date 31 December 2019	**Date version published**	17 November 2016

This achievement standard involves demonstrating understanding of mechanical systems.

Achievement Criteria

Achievement	Achievement with Merit	Achievement with Excellence
• Demonstrate understanding of mechanical systems.	• Demonstrate in-depth understanding of mechanical systems.	• Demonstrate comprehensive understanding of mechanical systems.

Explanatory Notes

1   This achievement standard is derived from *The New Zealand Curriculum*, Learning Media, Ministry of Education, 2007, Level 8. The standard is aligned to Physical inquiry and physics concepts in the Physical World strand and Communicating in science in the Nature of Science strand, and is related to the material in the *Teaching and Learning Guide for Physics*, Ministry of Education, 2010 at http://seniorsecondary.tki.org.nz.

This standard is also derived from *Te Marautanga o Aotearoa*. For details of *Te Marautanga o Aotearoa* achievement objectives to which this standard relates, see the Papa Whakaako for the relevant learning area.

2   *Demonstrate understanding* involves showing an awareness of how simple facets of phenomena, concepts, or principles relate to a given situation.

Demonstrate in-depth understanding involves giving explanations for phenomena, concepts, or principles that relate to a given situation.

Demonstrate comprehensive understanding involves connecting concepts or principles that relate to a given situation.

3   *Mechanical systems* include mathematical solutions and/or written descriptions.
     Written descriptions may include graphs or diagrams.

4   Assessment is limited to a selection from the following:

     Translational Motion
     Centre of mass (1 and 2 dimensions); conservation of momentum and impulse (2
     dimensions only).

     Circular Motion and Gravity
     Velocity and acceleration of, and resultant force on, objects moving in a circle under
     the influence of 2 or more forces, Newton's Law of gravitation, satellite motion.

     Rotating Systems
     Rotational motion with constant angular acceleration; torque; rotational inertia;
     conservation of angular momentum; conservation of energy.

     Oscillating Systems
     The conditions for Simple Harmonic Motion, angular frequency, variation of
     displacement, velocity and acceleration with time, phasor diagrams, reference circles,
     damped and driven systems, resonance, conservation of energy.

     Relationships

     $d = r\theta$ $v = r\omega$ $a = r\alpha$ $\omega = \dfrac{\Delta\theta}{\Delta t}$

     $\alpha = \dfrac{\Delta\omega}{\Delta t}$ $\omega = 2\pi f$ $E_{K(ROT)} = \frac{1}{2}I\omega^2$

     $\omega_f = \omega_i + \alpha t$ $\theta = \dfrac{(\omega_i + \omega_f)}{2}t$ $\omega_f^{\,2} = \omega_i^{\,2} + 2\alpha\theta$ $\theta = \omega_i t + \frac{1}{2}\alpha t^2$

     $\tau = I\alpha$ $L = mvr$ $L = I\omega$ $F_g = \dfrac{GMm}{r^2}$

     $T = 2\pi\sqrt{\dfrac{l}{g}}$ $T = 2\pi\sqrt{\dfrac{m}{k}}$

     $y = A\sin\omega t$ $v = A\omega\cos\omega t$ $a = -A\omega^2\sin\omega t$ $a = -\omega^2 y$

     $y = A\cos\omega t$ $v = -A\omega\sin\omega t$ $a = -A\omega^2\cos\omega t$

$$x_{COM} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$$

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

Replacement Information
This achievement standard replaced unit standard 6397 and AS90521.

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