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**	20 October 2005		
Planned review date	28 February 2009	**Date version published**	10 November 2006		

This achievement standard involves knowledge and understanding of phenomena, concepts, principles and/or relationships related to translational; circular and rotational; and simple harmonic motion; and the use of appropriate methods to solve related problems.

Achievement Criteria

Achievement	Achievement with Merit	Achievement with Excellence
• Identify or describe aspects of phenomena, concepts or principles.	• Give descriptions or explanations in terms of phenomena, concepts, principles and/or relationships.	• Give explanations that show clear understanding in terms of phenomena, concepts, principles and/or relationships.
• Solve straightforward problems.	• Solve problems.	• Solve complex problems.

Explanatory Notes

1 This achievement standard is derived from *Physics in the New Zealand Curriculum,* Learning Media, Ministry of Education, 1994; Level 8, achievement objectives, p. 32.

2 Assessment will be limited to a selection of the following:

Phenomena, concepts and principles of mechanical systems:

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

Circular and Rotational Motion
Velocity and acceleration of, and resultant force on, objects moving in a circle under the influence of 2 or more forces, eg banked corners, vertical circles; Newton's Law of gravitation, satellite motion.

Rotational motion with constant angular speed and with constant angular acceleration; torque; rotational inertia; angular momentum; rotational kinetic energy; conservation of angular momentum; conservation of energy.

Simple Harmonic Motion (SHM)
Displacement; velocity; acceleration; time and frequency of a particle undergoing SHM; forced SHM; resonance; the reference circle; phasors; conservation of energy.

Relationships:

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

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

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

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

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

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

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

3 Real life situations will be used wherever possible. Requisite information about the context used will be supplied.

4 The following descriptions provide guidance on the typical level of performance for achievement, achievement with merit, and achievement with excellence. Both the complexity of the situation and problem-solving process will determine the level.

a Statements, descriptions and explanations can be written, diagrammatic or graphical.

- Achievement will typically involve single aspects related to phenomena, concepts or principles.
- Achievement with merit will typically involve reasons.
- Achievement with excellence will typically have minimal irrelevancies and convey full understanding clearly.

b A physics problem involves a process(es) to find a physical quantity. A process involves recognising the relevant concept or principle; selecting the method (eg formula, graph, diagram, logical deduction); selecting the relevant information.

- A *straightforward problem* is one involving a single process. The relevant concept or principle will be transparent, the method will be straightforward (a formula will need no more than a simple rearrangement), and the information will be directly usable.
- For achievement with merit, a *problem* is typically one in which the relevant concept or principle may not be immediately obvious, the method may involve the use of a complex formula or rearrangement, or the information may not be directly usable or immediately obvious.
- A *complex problem* will typically involve more than one process. The recognition of two different concepts must be involved.

5 Formulae applicable to this achievement standard will be supplied.

6 Minor computational or transcription errors will not be penalised if the process used to determine the solution is clearly indicated and is valid.

7 Students must be aware of the appropriate use of significant figures and units. Both negative index (eg m s^{-2}) and slash (eg m/s^2) notation will be acceptable when writing units. Negative index notation will be used when supplying data.

Quality Assurance

1 Providers and Industry Training Organisations must be accredited by the Qualifications Authority before they can register credits from assessment against achievement standards.

2 Accredited providers and Industry Training Organisations assessing against achievement standards must engage with the moderation system that applies to those achievement standards.

Accreditation and Moderation Action Plan (AMAP) reference 0226