Achievement Standard

Subject Reference Physics 3.6

Title Demonstrate understanding of electrical systems

Level 3 **Credits** 6 **Assessment** External

Subfield Science

Domain Physics

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This achievement standard involves knowledge and understanding of phenomena, concepts, principles and/or relationships related to direct current (DC) circuits, capacitance, electromagnetic induction, alternating current (AC) circuits, 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 from the following:

Phenomena, concepts and principles of electrical systems:

DC Circuits and Capacitance
Internal resistance; simple application of Kirchhoff's Laws; parallel plate capacitor; capacitance; dielectrics; series and parallel capacitors; charge/discharge characteristics of capacitors in DC RC circuits; voltage/time and current/time graphs for a capacitor; time constant; energy stored in a capacitor.

Electromagnetic Induction and AC Circuits
Magnetic flux; magnetic flux density; Faraday's Law; Lenz's Law; voltage/time and current/time graphs for an inductor; time constant; self inductance; the inductor; energy stored in an inductor; mutual inductance; the transformer; the comparison of the energy dissipation in a resistor carrying direct current and alternating current; peak and rms voltage and current; phase; phasors in AC; reactance and impedance and their frequency dependence in a series circuit; voltage and current and their phase relationship in LR and CR series circuits; resonance in LCR circuits.

Relationships:

$E = \frac{1}{2}QV$ $\quad Q = CV$ $\quad C = \frac{\varepsilon_o \varepsilon_r A}{d}$ $\quad C_T = C_1 + C_2 + \ldots$ $\quad \tau = RC$

$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$ $\quad \phi = BA$ $\quad \varepsilon = -L\frac{\Delta \mathrm{I}}{\Delta t}$ $\quad \varepsilon = -\frac{\Delta \phi}{\Delta t}$

$\varepsilon = -\mathrm{M}\frac{\Delta \mathrm{I}}{\Delta \mathrm{t}}$ $\quad \frac{N_p}{N_s} = \frac{V_p}{V_s}$ $\quad E = \frac{1}{2}L\,\mathrm{I}^2$ $\quad \tau = \frac{L}{R}$

$\mathrm{I} = \mathrm{I}_{MAX} \sin \omega t$ $\quad V = V_{MAX} \sin \omega t$ $\quad \mathrm{I}_{MAX} = \sqrt{2}\,\mathrm{I}_{rms}$

$V_{MAX} = \sqrt{2}V_{rms}$ $\quad X_C = \frac{1}{\omega C}$

$X_L = \omega L$ $\quad V = \mathrm{I}Z$ $\quad \omega = 2\pi f$

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