Title	**Apply electromagnetic theory to a range of problems**		
Level	**2**	**Credits**	**5**

Purpose	This unit standard covers knowledge of electromagnetism theory and is intended for people working in or intending to work in the electrotechnology industry. People credited with this unit standard are able to demonstrate knowledge of: – magnets and magnetism; – a.c. generation; – d.c. generation; and – the simple d.c. motor.

Classification	Electrical Engineering > Core Electrical

Available grade	Achieved

This unit standard is expiring

Guidance Information

1 This unit standard has been developed for learning and assessment off-job.

2 This unit standard and unit standards 29445, 29470, and 29473 together meet the assessment requirements of ERAC EPC 7.
This unit standard and unit standards 25071, 29470, 29476, and 29477 together meet the assessment requirements of ERAC CEPC 8.

3 This unit standard is one of three designed to cover knowledge of magnetism and electricity, the others being Unit 25070, *Explain the properties of conductors, insulators, and semiconductors and their effect on electrical circuits* and Unit 25071, *Demonstrate knowledge of electromotive force (e.m.f.) production*.

4 Definitions
*a.*c. – alternating current.
CEPC – Critical Essential Performance Capability.
d.c. – direct current.
e.m.f. – electromotive force.
ERAC – Electrical Regulatory Authorities Council.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
r.m.s. – root-mean-square.
Safe and sound practice – as it relates to the installation of electrical equipment is defined in AS/NZS 3000:2007, *Electrical Installations (known as the Australian/New Zealand Wiring Rules).*

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5 For assessment purposes:
- a Candidates shall be supplied with formulae involving more than three quantities.
- b Use of a calculator during assessment is permitted.
- c Candidates are expected to express calculated values in the relevant Systeme Internationale (SI) units, including multiples and sub-multiples (pico (p) 10-12 ; nano (n) 10-9; micro (μ) 10-6; milli (m) 10-3; kilo(k) 103; mega (M) 106; etc) and to be able to convert between them.

6 Range
- a Formulae quoted in this unit standard use internationally recognised symbols and units.
- b Conventional current flow direction (positive to negative) is implied. Trainees should be aware of the opposite direction of electron flow.
- c Candidates may refer to current legislation and Standards during assessment.
- d Demonstration of safe working practices and installation in accordance with *safe and sound practice* are essential components of assessment of this unit standard.
- e All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with:
  - i legislation;
  - ii policies and procedures;
  - iii ethical codes;
  - iv Standards – may include but are not limited to those listed in Schedule 2 of the Electricity (Safety) Regulations 2010;
  - v applicable site, enterprise, and industry practice; and,
  - vi where appropriate, manufacturers' instructions, specifications, and data sheets.

7 Recommended skills and knowledge:
Unit 25070, *Explain the properties of conductors, insulators, and semiconductors and their effect on electrical circuits*, and Unit 25071, *Demonstrate knowledge of electromotive force (e.m.f.) production*, or demonstrate equivalent knowledge and skills.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of magnets and magnetism.

Performance criteria

1.1 Explain magnetic terms in relation to permanent magnets, in accordance with industry practice.

Range permanent magnet, magnetic field strength, lines of force, magnetic poles, magnetic flux, flux density.

1.2 Determine the direction of the magnetic field surrounding a current carrying wire using any common rule.

Range any common rule may include but is not limited to – the right-hand screw rule.

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1.3 Describe the construction of an electromagnet with the aid of a sketch indicating current direction and magnet polarity.

1.4 Explain the transformer principle in terms of induced e.m.f. resulting from changing flux linkages.

1.5 Describe devices using electromagnetic and magnetic properties in simple terms.

Range any two of – loudspeaker, relay, electric bell, moving coil instrument, lifting magnet, electric door lock.

1.6 State the purpose and application of magnetic screening in terms of protection of sensitive meters and circuitry from magnetic interference.

Outcome 2

Demonstrate knowledge of a.c. generation.

Performance criteria

2.1 Describe the operation of a simple single-loop, two-pole alternator with slip-rings and brushes with the aid of a sketch.

2.2 Describe alternator output for each quarter-cycle through one revolution with the aid of a sketch, and show a completed resultant waveform.

2.3 Define a.c. terms in accordance with industry practice.

Range cycle, period, frequency, peak, average, instantaneous, r.m.s.

2.4 State the reason for using the r.m.s. value of an a.c. wave form in terms of the equivalence of r.m.s. and steady d.c. values for resistive heating effect.

2.5 Calculate values from a.c. voltage and current wave form data.

Range peak, average, r.m.s., frequency, period.

Outcome 3

Demonstrate knowledge of d.c. generation.

Performance criteria

3.1 Demonstrate the induction of an e.m.f. in a conductor being moved in a magnetic field using Fleming's right-hand rule.

3.2 Describe the operation of a simple d.c. generator with the aid of a sketch.

Range simple generator – permanent magnet, single loop of wire, two-segment commutator, carbon brush.

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3.3 Describe generator output for each quarter-cycle through one revolution and show a completed resultant waveform.

Outcome 4

Demonstrate knowledge of the simple d.c. motor.

Performance criteria

4.1 Determine the direction of the force exerted on a current carrying conductor in a magnetic field using any common rule.

Range any common rule may include but is not limited to – Fleming's left-hand rule.

4.2 Explain the operation of a simple d.c. motor with the aid of a sketch showing direction of current and polarity of the magnet.

Range simple motor – permanent magnet, single loop of wire, two-segment commutator, carbon brush.

Replacement information	This unit standard, unit standard 25070, and unit standard 25071 replaced unit standard 15843.

This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	22 August 2008	31 December 2021
Rollover and Revision	2	15 March 2012	31 December 2021
Revision	3	15 January 2014	31 December 2021
Review	4	21 July 2016	31 December 2027
Revision	5	16 March 2017	31 December 2027
Review	6	25 May 2023	31 December 2027

Consent and Moderation Requirements (CMR) reference	0003

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

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