NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 2, 2003

Physics: Demonstrate understanding of electricity and electromagnetism (90257)

National Statistics

Assessment Report

Assessment Schedule

Physics: Demonstrate understanding of electricity and electromagnetism (90257)

National Statistics

Number of Results	Percentage achieved			
	Not Achieved	Achieved	Merit	Excellence
9,145	32.2%	40.7%	19.4%	7.7%

Assessment Report

General Comments

Every candidate for a National Certificate of Educational Achievement examination paper is expected to:

- read the question and do what the question asks
- allow adequate time to complete answers
- be accurate: check and/or proofread
- use appropriate technical terms
- bring the correct equipment
- write and/or draw clearly
- use pen if work is to be eligible for reconsideration.

Candidates showed common misconceptions and problems in a number of areas relating to this achievement standard. It was also very clear that candidates have greater difficulty explaining concepts than solving numerical questions.

Aspects of electricity where problems were identified included:
- confusion between conventional current and ‘electron’ current
- magnetic poles are charged (and therefore attract charged particles)
- confusion between magnetic and electric fields.

Diagrams can be extremely useful in answers, however candidates need to take care to ensure they are accurately drawn. Problems with diagrams included:
- the electric field shape in Question 3(c) frequently had field lines that did not contact the plates; were not perpendicular to the plates; were not sufficiently evenly spaced to clearly demonstrate understanding of that concept
- very few candidates attempted to show the weakening field at the ends of the plates, even fewer did it correctly.

In problem solving questions, candidates need to provide a unit with numerical answers and to round to the correct significant figures. Candidates also had difficulties handling powers of 10 and reciprocals on calculators. In questions that asked candidates to ‘show’ how an answer is obtained, the solution needs to contain the formula(e) that was used and show clear logical progression.

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Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct provided there is sufficient evidence that the mistake is not due to a lack of understanding of the concepts in Physics.
Such evidence includes the following:

- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Evidence Statement

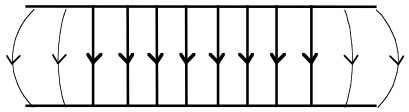
Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
Question One				
(a)	$R_T = 6.40 + 9.60 =$ **16.0 Ω**	[2] Correct answer.		
(b)	V = I R $I = \frac{V}{R} = \frac{24}{16.0}$ = **1.5 A**	[2] Correct answer.		
(c)	Current is a flow of charge / electrons.	[1] Definition given is consistent with the evidence required.		
(d)	$I = \frac{V}{R} = \frac{24}{17.5} = 1.37143$ q = It = 1.37143 × 60 = **82 C**	[2] *Merit*	[2] Correct q consistent with using time as one minute (q = 1.4 C) or Correct q consistent with incorrectly calculated I (**not** current from (b)).	[2] Correct answer.
(e)	$\frac{1}{R_t} = \frac{1}{R_4} + \frac{1}{R_3} \Rightarrow \frac{1}{R_4} = \frac{1}{5.72} - \frac{1}{17.5}$ = **8.49745 Ω**	[2] *Merit*	[2] Correct answer.	
Sf	8.50	[1] Correct sf.		

(f)	$V = I R \Rightarrow I = \frac{V}{R} = \frac{24}{9.60} = 2.5$ A P = V I = 24 × 2.5 = 60 W	[2] *Merit*	[2] Correct calculation of power consistent with incorrect calculation (V = IR) of current.	[2] Correct working. Synthesis of the formulae P = IV and V = IR indicated.
(g)	E = P × t = 60 × (30 × 60) = 108 000 J or E = V I t = 24 × 2.5 × (30 × 60) = **110 000 J**	[2] Calculation using 30 min = 1800 J	[2] Correct answer.	
(h)	Charge flow (current) depends on the total resistance of the circuit. The total resistance in position B (9.60 Ω) is greater than the total resistance in position C (5.72 Ω) and so the charge flow is less.	[1] A correct and relevant statement is deduced from the information given.	[1] Explanation or mathematical calculation links the lower current in B to a greater total resistance in B.	[1] Explanation is clear, concise and free of irrelevant references to parallel branches.

Question Two

(a)	Along the direction DCBA.			
(b)	Using the (*any appropriate*) rule, the field direction is left to right, the force on AB is upwards, so the current is from B to A.	[1] *A correct statement relating to the force on charges or direction of magnetic field is deduced from the information given.*	[1] Correct current direction, from (a), is linked to the field and force directions either explicitly or by the use of a valid hand rule.	
(c)	F = BIL = 0.55 × 0.65 × 0.045 = **0.016 N**	[2] Correct answer.		
(d)	V = Bvl = 5.0×10^{-5} x 28 × 1.2 = 0.00168 V **= 1.7 mV**	[2] Correct answer in volts.	[2] Correct answer in mV.	
(e)	The magnetic force on the electrons is upwards and they move towards the top of the aerial. This leaves the bottom end positively charged.	[1] *A correct statement relating to the force on / movement of charge in the aerial is deduced from the information given.*	[1] The positive charge at the bottom is linked to either an upwards movement of electrons leaving behind an excess of positive charge, or to an induced magnetic force causing charge movement.	[1] The upwards movement of **electrons** is linked both to a magnetic force causing it and to a resultant positive charge at the bottom.

Question Three

(a)	Positive charge	[1] Correct answer.		
(b)	$V = \Delta E/q \Rightarrow \Delta E = Vq = 5000 \times (1.6\times10^{-19})$ $= \mathbf{8.0 \times 10^{-16}\ J}$	[2] Correct answer.		
(c)		[1] Lines are drawn in-between the plates with correct direction.	[1] Straight, perpendicular and equidistant lines are drawn in-between the plates with correct direction.	Weakening of field at ends shown by bowing out of lines and increased distance apart.
(d)	$F = E\ q$ $E = F/q = 2.10 \times 10^{-14} / 1.60 \times 10^{-19} = 131\ 250$ $= \mathbf{1.3 \times 10^{5}}$	[2] Correct answer.		
unit	NC^{-1} or Vm^{-1}	[1] Nq^{-1}	[1] Correct unit.	
(e)	$F = Bqv = (9.8 \times 10^{-2}) \times (1.6 \times 10^{-19}) \times (4.2 \times 10^{6})$ $= 6.587 \times 10^{-14} = \mathbf{6.6 \times 10^{-14}}$ N	[2] Correct answer.		
(f)	When electrons move at an angle through a magnetic field they experience a force. OR The electrons experience a force that is at an angle to their direction of motion.	[1] A correct and relevant statement is deduced from the information given.	[1] The force on the electrons is linked to their movement through a magnetic field.	
(g)	$F_{elect} = Eq$ and $F_{mag} = Bqv$ $Eq = Bqv \Rightarrow E = Bv = (9.8\times10^{-2}) \times (4.2\times10^{6})$ $= 411600\ Vm^{-1}$ or $F_{elect} = F_{mag} \Rightarrow E = F/q = 6.587\times10^{-14} / 1.6 \times 10^{-19}$ $= 411600\ NC^{-1} = \mathbf{4.1 \times 10^{5}\ NC^{-1}}$	[2] *Merit*	[2] Correctly identifies that $F_{elect} = F_{mag}$ is the main concept but cannot use it successfully to complete the calculation.	[2] Correct answer.

Judgement Statement

Judgement statements (formerly referred to as sufficiency statements) help candidates understand how their overall results for each standard were arrived at.

The grade awarded is the highest one that has been demonstrated in all achievement criteria up to and including that grade.

The following is a guide to the standard required for each grade in the two criteria.

Criterion 1
- Achievement is demonstrated if the candidate is successful in **3** opportunities.
- Achievement with Merit is demonstrated if the candidate is successful in **3** opportunities at the Merit level or above.
- Achievement with Excellence is demonstrated if the candidate is successful in **3** opportunities at the Merit level or above, **2** of which must be at the Excellence level.

Criterion 2
- Achievement is demonstrated if the candidate is successful in **4** opportunities.
- Achievement with Merit is demonstrated if the candidate is successful in **6** opportunities, **3** of which are at the Merit level or above.
- Achievement with Excellence is demonstrated if the candidate is successful in **6** opportunities, **4** of which are at the Merit level or above, **2** of which are at the Excellence level.