Assessment Schedule – 2007

Physics: Demonstrate understanding of electricity and electromagnetism (90257)

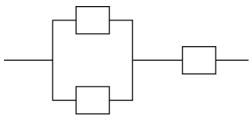
Evidence Statement

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. Such evidence includes:

- 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.

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	Left to right.	[1] Correct answer.		
(b)	Electrical/potential to kinetic.	[1] Correct answer. Electrical to kinetic Potential to kinetic		
(c)	$\Delta E_k = \frac{1}{2} m \Delta v_f^{\,2} - \frac{1}{2} m \Delta v_i^{\,2}$ $\Delta E_k = \frac{1}{2} \times 1.67 \times 10^{-27} \times ((8.8 \times 10^5)^2 - (6.2 \times 10^5)^2)$ $\Delta E_k = 3.25 \times 10^{-16}$ J $E = \frac{\Delta E_k}{qd} = \frac{3.25 \times 10^{-16}}{1.6 \times 10^{-19} \times 0.02} = 1.0 \times 10^5$ V m^{-1} **Or** $v_f^2 = v_1^2 = 2ad$ gives $a = 9.75 \times 10^{12}$ $F = ma$ *and* $F = Eq$ *give* $E = \frac{1.67 \times 10^{-27} \times 9.75 \times 10^{12}}{1.6 \times 10^{-19}}$ $= 101\,765 = 100\,000$	[2] Calculates **a** kinetic energy. [2] Attempts to use or states $\Delta E = Eqd$ [2] Finds a	[2] Calculates the gain in energy **OR** correctly uses $\Delta E = Eqd$ [2] uses $F = ma$	[2] Correct working and answer.
(d)	N C^{-1}	[1] Correct unit.		
(e)	$V = Ed = 100\,000 \times 0.02 = 2000$ V	[2] Correct answer.		
(f)	Towards the top of the page.	[1] Correct answer. Upward.		
(g)	$F = Bvq$ $F = 3.5 \times 10^{-3} \times 8.8 \times 10^5 \times 1.6 \times 10^{-19}$ $F = 4.9 \times 10^{-16}$ Unrounded is 4.928×10^{-16}	[2] Correct answer [2] Accept correct substitution into formula.		
	2 sig figs.	[2] Correct sf. For **any** attempt to find ***F.***		
TWO (a)	$R = \frac{V}{I} = \frac{4.5}{25 \times 10^{-3}} = 180\ \Omega$	[2] Correct except for unit conversion.	[2] Correct answer.	

(b)	$V = 12.0 - 4.5 = 7.5$ V	[2] Correct working.		
(c)	$I_t = \frac{V}{R} = \frac{7.5}{214} = 0.035$ A current through $R = 0.035 - 0.025$ $= 0.010$ A $R = \frac{V}{I} = \frac{4.5}{0.01} = 450\ \Omega$ **Or** Circuit $R = \frac{12}{0.035} = 342.4$ R of parallel branch = 342.4 – 214 = 128.4 And $\frac{1}{R} = \frac{1}{128.4} - \frac{1}{180}$ gives $R = 450$	[2] Calculates total current. **0.035**	[2] Calculates current through R. **0.035 -0.025=0.01** [2] Correct method but makes a computational error [2] **Calculates** $R_t = 342.4$	[2] All working correct. **Needs 4.5/0.01=450 or equiv** **Or** **Evidence of solving R in parallel combination**
(d)	Total resistance increases. (to 664) Total current decreases. (was 0.03 now 0.018) Current through 214 Ω resistor decreases. Voltage across 214 Ω resistor decreases ($V = IR$). (was 7.5 now 3.85)	[1] Voltage decreases (across 214) [1] Voltage increases across **R** (450 Ω) [1] Total R increases [1] Current decreases	[1] Two ideas [1] Voltage decreases because current decreases	[1] Full and clear explanation clearly linking ideas. (Can have maths but needs written explanation)
(e)	Both resistors are in series, therefore carry same current. 450 Ω resistor has higher resistance therefore higher voltage. ($V = IR$) Therefore higher power output, (P=VI), therefore more heat output in the same time $P = I^2R$ so same current means bigger resistor (450/R) gives more power and more heat.	[1] 450 Ω/**R** resistor produces more heat. [1] Current through both 214 and R the same [1] Biggest V gives biggest power [1] 214 produces less [1] Now a series circuit [1] links power to heat	[1] Two linked ideas ie [1] same current- higher V (gives more heat) [1] same current so higher R (gives more heat) [1] R as larger	[1] Full and clear explanation clearly linking ideas. Should mention that heat relates to power or (energy and volts)could be explicitly stated or by stating P=IV or $P = I^2R$
(f)		[2] Correct answer.		
THREE (a)	Battery causes electrons to flow in axle. These electrons are moving perpendicular to a magnetic field. The electrons experience a force perpendicular to the axle and the field. The electrons are trapped in the axle so the whole axle experiences a force.	[1] one idea [1] Charge moving through a field experiences a force [1] Current flowing makes magnetic field.	[1] Force on charges. moving in magnetic field results in **force** on the **axles**. [1] The two magnetic fields interact and produce force (on axle).	
(b)	In / (arrow indicating left to right)	[1] Correct answer.		

(c)	$F = BIl$ $F = \frac{0.052}{2}$ $I = \frac{F}{Bl} = \frac{0.026}{0.25 \times 35 \times 10^{-3}}$ $I = 2.97$ A battery current = 5.94 A $V = IR$ $V = 5.94 \times 0.55$ $V = 3.3$ V	[2] Correct equation and calculation of current. **2.97 or rounded** **OR 5.94**	[2] Correct process for calculating voltage but with one error. Eg does not double = 1.6 / allow incorrect length conversion but **not 35.**	[2] Correct working and answer. **Accept any rounding eg 3.2, 3.27 etc.**
(d)	$V = Bvl$ $V = 0.25 \times 0.29 \times 35 \times 10^{-3}$ $V = 2.5$ mV **Only penalise the same incorrect length conversion once from c and d**	[2] Correct answer except for one error eg for unit conversion of either length or to mV **OR** incorrect length **OR** combining both axles.	[2] Correct answer.	
(e)	As the carriage rolls, the axles (and the electrons) cut across the magnetic field, the electrons in the wire get pushed to one end of the wire. This causes a build-up of negative charge at one end of the axle.	[1] One correct idea. [1] **Force /push** on electrons [1] Charge moving through mag field	[1] Full and clear explanation clearly linking ideas. [1] electrons then move / shift towards one end.	
(f)	The axle has an induced voltage across it, but the connecting wire is also cutting across the magnetic field. It also has an induced voltage. The two voltages oppose each other, so the induced current is zero.	[1] No current flows, [1] Induced voltage in axle [1] Induced voltage in wire	[1] Idea of two induced voltages. [1] lamp does not operate. **Contradictory statements will not negate achievement.**	[1] Full and clear explanation clearly linking ideas. [1] Two opposite induced Voltages cancel. [1] No change in flux as entire circuit / loop in field means no light / current.

Judgement Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criterion One	3 × A1	3 × A1 + 1 × M1	3 × A1 + 1 × M1 + 1 × E1
Criterion Two	3 × A2	3 × A2 + 2 × M2	3 × A2 + 2 × M2 + 1 × E2