Assessment Schedule – 2017

Physics: Demonstrate understanding of aspects of electricity and magnetism (90937)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Metal is a good conductor of electricity.	Conducts electricity.		
(b)(i)		Arrows show repulsion. OR Statement that droplets repel. OR Metal is positive by induction and attracts droplets.	Like charges repel. Repulsion pushes droplets further apart so paint is spread over a larger area.	
(ii)	Because the droplets are all negatively charged, they all repel each other and move further apart than they would have been. This spreads the paint over a wider area.			
(c)	The power supply charges the spray gun / droplets negatively and the entire surface of the metal sheet positively. As the droplets are charged oppositely to the metal sheet, they are attracted towards it. Droplets that pass by the edge of the metal sheet can be attracted towards the back of the metal sheet by the electrostatic force.	Droplets and metal sheet oppositely charged. OR Droplets attracted to metal sheet.	Droplets and metal sheet have opposite charges / droplets – and metal +. AND Droplets are attracted to the metal sheet.	
(d)	$P = \frac{E}{t} = \frac{3.8}{2.0} = 1.9$ W $I = \frac{P}{V} = \frac{1.9}{20\,000} = 9.5 \times 10^{-5}$ A This is less than the safe limit, so the spray gun is operating safely. *(Could calculate that the current is* at *the safe limit, but only if P or I is rounded to 1 s.f. → Merit only)* OR Max safe power $P = 1 \times 10^{-4} \times 20 \times 10^{3} = 2.0$ W $1.9 < 2.0$ hence safe	Power calculated correctly.	Power calculated incorrectly but current consequentially correct (e.g. uses $P = E \times t = 7.6$ W to get $I = 3.8 \times 10^{-4}$ A) *OR* does not convert kV to V ($I = \frac{1.9}{20} = 0.095$ A) AND Consequentially correct statement that current is / is not safe (*statement consistent with calculated current*). OR Correct I	Correct working and answer for current. AND States that current is within safe limit. OR Correct comparison and conclusion using power calculations

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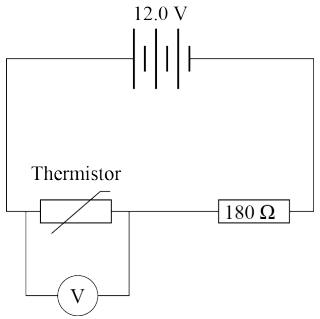
TWO (a)		Correct voltmeter symbol and placement in parallel with thermistor.		
(b)(i) (ii)	$R = \frac{V}{I} = \frac{12}{0.014} = 857 \approx 860\ \Omega$ $R_{\text{therm}} = 860 - 180 = 680\ \Omega$	Correct formula and substitution / working for (i). OR 857 Ω OR Correct value for thermistor resistance (ii).	Correct formula and substitution /working /857 Ω for (i). AND Correct value for thermistor resistance (ii).	
(c)	As temperature decreases, the thermistor resistance increases. This increases the total resistance of the circuit. As the supply voltage is constant and total resistance increases, the current in the circuit decreases.	Total / circuit resistance increases *(not just "resistance increases").* OR Current decreases.	EITHER Circuit resistance increases OR voltage is constant. AND So current decreases (correct link maybe in (d) but mark here).	
(d)	As temperature decreases, the resistance of the thermistor increases. This increases the total resistance of the circuit, so decreases the current as the supply voltage stays constant. This will decrease the power consumed in the 180 Ω resistor. Because the current has decreased and the resistance of the resistor is constant, the voltage across the resistor also decreases. This will decrease the power consumed in the 180 Ω resistor. As both the current through, and voltage across, the 180 Ω resistor are decreased, the power is decreased significantly. (Allow argument *P* increases consistent with incorrect answer from (c))	Resistor voltage decreases *(not just "voltage decreases").* OR Power decreases. *(Only accept "Total resistance increases" OR "Current decreases" as replacement evidence for (c)).*	Links decreased power in 180 Ω the resistor to EITHER decreased current OR decreased voltage.	Links (significantly) decreased power to BOTH decreased current AND decreased voltage. OR Power is proportional to the square of the current ($P = I^2R$), so decrease in current (significantly) decreases power consumption.

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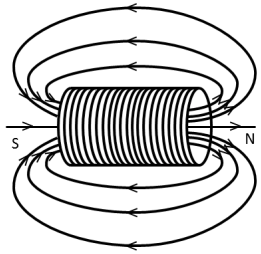
THREE (a)		Correct shape. OR Correct direction with N & S labelled.	Correct shape (at least one magnetic field line / loop connected N to S). AND Correct direction. AND N & S labelled correctly.	
(b)	$I = \frac{V}{R} = \frac{12}{28} = 0.4286 = 0.43$ A	Correct formula and substitution.		
(c)	Magnetic field is into the page at point P. indication maybe on diagram, must be unambiguous $B = \frac{kI}{d} = \frac{2.0 \times 10^{-7} \times 0.43}{0.024} = 3.6 \times 10^{-6}$ T *(unit not needed)*	EITHER Correct direction. OR Correct calculation using d in cm (gives 3.6×10^{-8} T).	Correct value. OR Correct calculation using d in cm (gives 3.6×10^{-8} T) AND correct direction.	Correct direction and value.
(d)	The core and door plate should both be made of soft iron. It becomes magnetised when current flows through the solenoid, strengthening the magnetic field. The door plate and solenoid are attracted to each other and the door is locked. When the solenoid is switched off, soft iron does not retain any of its magnetism, so there is no residual attraction between the door plate and solenoid. Other magnetic materials such as steel may retain some magnetism, so could still hold the door locked when the switch is open. To lock the door, the switch must be closed. This causes a current to flow through the solenoid, which creates a magnetic field (strengthened by the soft iron core). This attracts the soft iron door plate, locking the door.	Switch closed → locked. OR ONLY Magnetic material / s such as iron, soft iron, or steel named.	Switch closed → current flows / magnetic field produced → door plate attracted to solenoid → locked. OR Soft iron named with one reason.	Switch closed → current flows → magnetic field produced → door plate attracted to solenoid → locked. AND Soft iron named because it has no residual magnetism when the switch is opened./ forms temporary magnet/ only magnetic when current flows

Question Sufficiency – All Questions

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No evidence	1 A	2 A OR 1 M / E	3 A OR 1 A + 1 M	4 A OR 2 A + 1 M OR 2 M OR 1 A + 1 E	2 M + 1 A OR 1 M + 1 E *(must have >1 M to get above A4)*	2 M + 2 A OR 3 M	1 E + 1 M + 1 A	1 E + 2 M

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24