Name: ____

Edexcel_Resistivity_Old

Mark Scheme

Date:

Time:

Total marks available:

Total marks achieved: ______

Mark Scheme

Q1.

Question Number	Answer	Mark
	A	**(1)**

Q2.

Question Number	Answer	Mark
10	D	**1**

Q3.

Question Number	Answer		Mark
	<u>Effect of stretching wire</u>		
	Refers to $R = \rho l/A$	**(1)**	
	Increasing length leads to increase in resistance	**(1)**	
	Thinner wire has smaller CSA which leads to increase in resistance	**(1)**	
	[last two points may be combined to give single statement, can score both marks]		**3**

Q4.

Question Number	Answer		Mark
	Use of $R = \rho l/A$	**(1)**	
	$\times 8$	**(1)**	
	$R = 0.28$ (Ω)	**(1)**	
	[Omitting x8 gives R = 0.035 Ω scores 1]		**3**
	<u>Example of calculation</u>		
	$R = (9.9 \times 10^{-8}\ \Omega\ \text{m}) \times (8 \times 0.03\ \text{m}) \div 8.5 \times 10^{-8}\ \text{m}^2$		
	$R = 0.2795\ \Omega$		

Q5.

Question Number	Answer		Mark
(a)	Use of $R = \rho l/A$	(1)	
	$R = 17\ \Omega$	(1)	2
	Example of calculation $R = 4.9 \times 10^{-7}\ \Omega\ \text{m} \times 1.0\ \text{m} / 2.9 \times 10^{-8}\ \text{m}^2$ $R = 17\ \Omega$		
(b)	Area decreases	(1)	
	Resistance inversely proportional to area **Or** quote $R = \rho l/A$	(1)	
	So this change (also) increases resistance	(1)	3
	(Accept for 2nd mark, $I = nAqv$, I decreases if A decreases, $R = V/I$) (Final mark dependent on presenting a logical explanation linking area change and resistance – not just stating increased resistance.)		
	Total for question		**5**

Q6.

Question Number	Answer		Mark
(i)	Attempts to substitute for $A = V/l$ in $R = \rho l/A$	(1)	
	See $R = \rho l^2/V$	(1)	2
(ii)	**Either**		
	Any attempt to relate original resistance of gauge to 3.0^2 (possibly × 8,	(1)	
	cm or m)	(1)	
	Relates this to resistance associated with increase in length	(1)	
	Change in resistance = $4.0 \times 10^{-3}\ \Omega$		
	Or	(1)	
	Uses $V=lA$ to find new area	(1)	
	Use of $R = \rho l/A$ with new length to find new R	(1)	
	Change in resistance = $4.0 \times 10^{-3}\ \Omega$		3
	[if candidate assumes A constant and finds new R and ΔR scores 1 mark]		
	Example of Calculation $R = \frac{(3.02\times10^{-2}\ \text{m})^2}{(3.00\times10^{-2}\ \text{m})^2} \times 0.28\ \Omega = 0.284\ (\Omega)$ $\Delta R = 0.284\ \Omega - 0.280\ \Omega = 4.0 \times 10^{-3}\ \Omega$		

Q7.

Question Number	Answer		Mark
(a)	State (V =) $E - Ir$ Correct substitution p.d. = 11V **OR** Use of (V =) Ir to attempt to find lost volts Subtraction from E p.d. = 11V **OR** Use of $E = I(R+r)$ to attempt to find R Use of $V = IR$ with the value of R calculated p.d. = 11V <u>Example of calculation</u> $V = 12\text{ V} - 3 \times 10^{-3}\ \Omega \times 400\text{ A}$ p.d. = 10.8 V	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**	**3**
(b)	To prevent large energy dissipation / wire heating up / wire melting / large pd across the wires OR to allow a large current Resistance of cable low (cross-sectional) area large [Not surface area] [Reverse argument in terms of a thin wire acceptable for all points]	**(1)** **(1)** **(1)**	**3**
	Total for question		**6**

Q8.

Question Number	Answer		Mark
(a)	Use of $Q = It$ $Q = 450$ C / A s <u>Example of calculation</u> $Q = 15\ 000$ A × 3.0 × 10 $^{-2}$ s $Q = 450$ C	(1) (1)	**2**
(b)	Use of $R = \rho l/A$ Length of conductor = 24 (m) Height of statue = length – 1 m = 23 m *Assumption:* **ANY ONE** Included height of plinth. Conductor/wire doesn't carry on in ground Conductor/wire vertical/straight/parallel <u>Example of calculation</u> $l = \frac{RA}{\rho}$ $l = \frac{2.7 \times 10^{-3}\ \Omega \times 1.5 \times 10^{-4}\ \text{m}^2}{1.7 \times 10^{-8}\ \Omega\ m}$ $l = 23.8$ m Height of statue = 23.8 – 1 = 22.8 m	(1) (1) (1) (1)	**4**
(c)	**ANY ONE** The idea that the lightning is attracted to /strikes/hits the conductor **OR** Lightning takes shortest path (from cloud) /strikes highest point **OR** Action of points	(1)	**1**
	Total for question		**7**

Q9.

Question Number	Answer	Mark
(a)	Substitution into $R = \rho l/A$ (ignore powers of 10) (1) Conversion cm to m (1) $R = 540$ (Ω) (1) <u>Example of calculation</u> $R = (5.4 \times 10^{-3}\ \Omega\ \text{m} \times 0.15\ \text{m})/1.5 \times 10^{-6}\ \text{m}^2$ $R = 540\ \Omega$	3
(b)(i)	Resistance/resistivity changes with temperature (allow wire gets hotter etc)(1) As <u>temperature</u> increases, resistance/resistivity decreases (this statement implies 1st mark so scores 2)	2
(b)(ii)	Current flow causes a heating effect (1) Resistance of lead decreases/ number of charge carriers increases (1) Relates to $V = IR$ e.g. $R \alpha 1/I$ or 'because V is constant, as R↓ I↑' (1)	3
	Total for question	**8**

Q10.

Question Number	Answer	Mark
(a)	Conversion of kW to W **(1)** Use of $P = V^2/R$ **OR** $P = VI$ **and** $V = IR$ **(1)** $R = 53$ (Ω) (to at least 2 s.f.) [no ue] **(1)** <u>Example of calculation</u> $R = (230\ \text{V} \times 230\ \text{V}) / 1000\ \text{A}$ $R = 52.9\ \Omega$	3
(b)	Use of $R = \rho l/A$ **(1)** $l = 6.3$ m ('Show that' value gives 5.9 m) **(1)** <u>Example of calculation</u> $l = RA/\rho$ $l = 53\ \Omega \times 1.3 \times 10^{-7}\ \text{m}^2/1.1 \times 10^{-6}\ \Omega\ \text{m}$ $l = 6.3$ m	2
(c)	If length halved, area must half (for same resistance) / state $A \alpha l$ **(1)** Use of area = πr^2 **(1)** Diameter = 0.28 mm or 0.29 mm **(1)** **OR** Use of the resistivity formula **(1)** Use of area = πr^2 **(1)** To give correct diameter for their values of length and resistance **(1)** (0.14 mm scores 2 marks)	3
	Total for question	**8**

Q11.

Question Number	Answer		Mark
(a)	best fit line use of gradient **Or** use of R/l from graph or table use of $\rho = RA/l$ resistivity = $4.7 \times 10^{-7}\ \Omega$ m (range 4.5 to $4.8 \times 10^{-7}\ \Omega$ m) <u>Example of calculation</u> gradient = $4.4\ \Omega \div 1.0$ m = $4.4\ \Omega\ m^{-1}$ $\rho = A \times$ gradient = $1.06 \times 10^{-7}\ m^2 \times 4.4\ \Omega\ m^{-1}$ resistivity = $4.66 \times 10^{-7}\ \Omega$ m	**(1)** **(1)** **(1)** **(1)**	**4**
(b)	temperature increases (with increasing current) resistance/resistivity would have increased (with temperature)	**(1)** **(1)**	**2**
(c)	Precaution Explanation E.g. ensure good contact (e.g. tight croc clips); so pd across contact resistance doesn't make V results inaccurate E.g. Avoid pressing too hard on wire; as a deformation would affect cross-sectional area and therefore resistance e.g. ensure wire is straight so length measurement is accurate e.g ensure eyes perpendicular to scale to avoid parallax errors **Do not credit:** diameter of wire since area is not in the table repeat and average high resistance voltmeter keep temperature constant	**(1)** **(1)**	**2**
	Total for question		**8**

Q12.

Question Number	Answer		Mark
(a)	The (maximum) length is (directly) proportional to the area	(1)	1
(b)(i)	Use of $\rho l/A = R$ $R = 1.34$ (Ω) <u>Example of calculation</u> $R = 1.68 \times 10^{-8}\ \Omega\ \text{m} \times 80\ \text{m} \div 1.0 \times 10^{-6}\ \text{m}^2$ $R = 1.34\ \Omega$	(1) (1)	2
(b)(ii)	Use of $P = I^2R$ $P = 160$ W allow ecf from (i) <u>Example of calculation</u> $P = (11\ \text{A})^2 \times 1.34\ \Omega$ $P = 162$ W (157 W if they use 1.3 Ω)	(1) (1)	2
(b)(iii)	Use of $V = IR$ **Or** use of $P = VI$ **Or** use of $P = V^2/R$ $V = 15$ V allow ecf from (i) and/or (ii) <u>Example of calculation</u> $V = 11\ \text{A} \times 1.34\ \Omega = 14.7$ V (14.3 V if 1.3 Ω is used)	(1) (1)	2
(c)	To prevent (use of a cable with) resistance that is too large (Accept answers that refer to maintaining or not exceeding a resistance of about 1.3 Ω) Meaning more energy / power / p.d. available for the shredder	(1) (1)	2
	Total for Question		**9**

Q13.

Question Number	Answer		Mark
(a)(i)	Determines width of at least 9 coils Use of half of their diameter in πr^2 Area = (1.96 to 2.42) × 10^{-7}(m^2) <u>Example of calculation</u> 18 coils = 1.00 cm Diameter = 0.0100 m ÷ 18 = 5.56 × 10^{-4} m Area = π × (5.56 × 10^{-4} ÷ 2)^2 Area = 2.42 × 10^{-7} m^2	(1) (1) (1)	3
(a)(ii)	Use of $R=\rho l/A$ Resistivity magnitude = 4.4 × 10^{-7} (show that value gives 3.7× 10^{-7}) Unit Ωm <u>Example of calculation</u> $\rho=RA\ /\ l$ = 22 Ω x 2.4 × 10^{-7} m^2 / 12 m = 4.4 × 10^{-7} Ωm	(1) (1) (1)	3
(a)(iii)	A sensible response with some detail, e.g. • Avoid difficulty in reading a small scale while holding it and counting turns • it can be enlarged and done more accurately • compare with unravelling and using a micrometer • remains stationary, so easier to measure accurately • you can mark the coils as you go so you don't lose count (treat parallax as neutral and)	(1)	1
(b)	Use of ratio of lengths × pd V = 8.2 V <u>Example of calculation</u> V = (7.0 cm / 10.2 cm) × 12 V = 8.2 V	(1) (1)	2
	Total for question		**9**

Q14.

Question Number	Answer	Mark
(a)	<u>Effect of stretching wire</u>	
	Refers to $R = \rho l / A$	1
	Increasing length leads to increase in resistance	1
	Decreasing area leads to increase in resistance [must relate thinner to area]	1
	[last two points may be combined to give single statement, can score both marks]	
(b)	<u>Resistance calculation</u>	
	Use of $R = \rho l / A$	1
	× 8	1
	R = 0.22 (Ω)	1
	[Omitting x8 gives R = 0.028 Ω scores 1]	
	Example of answer	
	$R = (9.9 \times 10^{-8}\ \Omega\ \text{m}) \times (8 \times 0.025\ \text{m}) \div 0.9 \times 10^{-7}\ \text{m}^2$	
	R = 0.22 Ω	

(c)	<u>Relationship and increase in R</u>	
(i)	Attempts to substitute for $A = V/l$ in $R = \rho l / A$	1
	$R = \rho l^2 / V$	1
(ii)	Any attempt to relate original resistance of gauge to 2.5^2 (possibly × 8, cm or m)	1
	Relates this to resistance associated with increase in length	1
	Change in resistance = 1.76×10^{-3} Ω	1
	OR	
	Uses $V = lA$ to find new area	1
	Uses this A with new length to find new R	1
	Change in resistance = 1.76×10^{-3} Ω	1
	[if candidate assumes A constant and finds new R and ΔR = 0.001 Ω, score 1 mark]	
	Example of answer	

	New R = $(\frac{2.51^2}{2.5^2} \times 0.22)$ - 0.22 ΔR = 1.76 × 10 $^{-3}$ Ω	
(d)	<u>Zigzag pattern</u> Each section of wire increases in length/gives a longer total length/long wire in small space Small change in length of gauge leads to larger change in resistance	1 1
	Total for question	**13**