9. Electricity

9.3 Resistance and resistivity

Paper 2

Marking Scheme

Q1.

(c)(i)	$R = \rho L / A$	**C1**
	$9.6 = 1.7 \times 10^{-8} \times 95 / \pi r^2$	**C1**
	$r = 2.3 \times 10^{-4}$ m	**A1**
(c)(ii)	(resistance) decreases by a factor of four	**A1**

Q2.

(b)(i)	$R = V / I$	**C1**
	$= (9.0 - 4.0) / 1.1 \times 10^{-2}$ $= 450\,\Omega$	**A1**
(b)(ii)	resistance (of thermistor) = 25 (Ω) (from graph)	**C1**
	$V = E \times R_Y / (R_Y + R_X)$ $= 9 \times 25 / (25 + 450)$ **or** $I = E / R_{Total} = 9 / (25 + 450) = 1.89 \times 10^{-2}$ A $V = IR = 1.89 \times 10^{-2} \times 25$ **or** $V_{(X)} = 9 \times 450 / (25 + 450) = 8.53$ V $V = 9 - 8.53$	**C1**
	$V = 0.47$ V	**A1**

Q3.

(c)(iv)	$P = I^2R$ **and** $R = \rho L / A$	**C1**
	$280 = I^2 \times (1.7 \times 10^{-8} \times 23) / (2.6 \times 10^{-8})$	**C1**
	$I = 4.3$ A	**A1**

Q4.

(a)(ii)	resistance $= V / I$	**C1**
	$= 1.36 / 0.50$ $= 2.7\,\Omega$	**A1**

Q5.

(b)(ii)	(V =) $7.0 \times 0.86 = 6.0$ (V)	**A1**

Q6.

(a)	$9.6 = 6.0 + (I \times 5800)$ **or** $3.6 = I \times 5800$	**C1**
	$I = 6.2 \times 10^{-4}$ A	**A1**
(d)(i)	decrease	**B1**

Q7.

(a)	temperature decreases (so) resistance decreases	**B1**
(b)(i)	current = V / R	**A1**

Q8.

(b)(ii)	• (intensity) increase	**B1**
	• (power) increase	**B1**
	• (length XZ) decrease	**B1**

Q9.

(a)(i)	(I =) 16 / 320 = 0.050 (A)	**A1**
(b)	resistance of LDR decreases	**B1**
	resistance of parallel combination decreases **or** total resistance (of circuit) decreases **or** current in resistor of resistance 320 Ω increases **or** potential difference across parallel combination / LDR / 240 Ω resistor decreases	**M1**
	voltmeter reading increases	**A1**

Q10.

(a)	$R = \rho L / A$	**C1**
	$\rho = 0.92 \times 5.3 \times 10^{-7}$ $= 4.9 \times 10^{-7}\ \Omega\,m$	**A1**
(b)(i)	(current =) 6.4 / 1600 = 4.0×10^{-3} (A)	**A1**
(c)(i)	increase	**B1**

Q11.

(b)(ii)	$R = \rho L / A$ (and $R_X > R_Y$)	**M1**
	(so) Y (has the larger (cross-sectional) area)	**A1**
(c)(i)	current = 5.4 / 1800 $= 3.0 \times 10^{-3}$ A	**A1**
(c)(ii)	5.4 / 9.0 = 1800 / (1800 + R_L) **or** $R_L = (9.0 - 5.4) / 3.0 \times 10^{-3}$	**C1**
	R_L = 1200 Ω	**A1**
(c)(iii)	resistance of LDR / R_L decreases	**B1**
	current (in the circuit) increases (so) voltmeter reading increases	**B1**

Q12.

(c)	thermistor resistance increases	**B1**
	(thermistor resistance increases so total resistance increases so) current decreases (in battery)	**M1**
	($P = EI$ and E constant so) power decreases	**A1**

Q13.

(a)	current (through a conductor is directly) proportional to potential difference (across the conductor)	**M1**
	(provided that) temperature (of conductor remains) constant	**A1**
(b)(i)	(ratio of) V / I increases (as p.d. increases)	**B1**
(b)(ii)	(as p.d. increases, current increases so) temperature increases	**B1**
(c)(i)	I = 1.55 A	**A1**
(c)(iii)	I = 1.78 – 1.55 (= 0.23 A)	**C1**
	R = 12.0 / 0.23 = 52 Ω	**A1**

Q14.

(b)(i)	I = 1.8 / 0.90 = 2.0 A	**A1**

Q15.

(a)	volt / ampere	**B1**
(b)	$R = \rho L / A$	**B1**
	($A = V / L$) (so) $R = \rho L^2 / V$ (with ρ and V constant so $R \propto L^2$)	**B1**

Q16.

(b)(i)	(current in R_4 or R_1 =) 0.30 + 0.30 (= 0.60 A)	**B1**
	(R =) 2.4 / 0.60 = 4.0 (Ω)	**A1**
	or	
	(p.d. across R_3 or R_2 =) 2.4 / 2 (= 1.2 V)	**(B1)**
	(R =) 1.2 / 0.30 = 4.0 (Ω)	**(A1)**
(d)	resistivity = RA / L	**C1**
	= $4.0 \times \pi \times (240 \times 10^{-6})^2 / 0.67$	**C1**
	= 1.1×10^{-6} Ω m	**A1**

Q17.

(a)(i)	$R = \rho L / A$	**C1**
	$A = (2.6 \times 10^{-8} \times 59) / 3.4 = 4.5 \times 10^{-7}$ m^2	**A1**
(a)(ii)	I = 1.8 / 3.4 = 0.53 A	**A1**

Q18.

(c)	$R = \rho L / A$	**C1**
	$\Delta R = \rho \Delta x / A$ $= 3.7 \times 10^{-7} \times 0.12 \times 10^{-3} / (4.1 \times 10^{-7})$	**C1**
	$= 1.1 \times 10^{-4}\ \Omega$	**A1**

Q19.

(a)	volt / ampere	**B1**
(b)	$R = \rho L / A$	**C1**
	$A = 460 \times 10^{-9} \times 2.5 / 3.2$	**C1**
	$= 3.6 \times 10^{-7}\ m^2$	**A1**

Q20.

(d)(i)	$R = 2.1 / 0.50$ $= 4.2\ \Omega$	**A1**

Q21.

(b)	for $V < 0.25$ V resistance is infinite/very high (as current is zero)	**B1**
	for $V > 0.25$ V resistance decreases (as V increases)	**B1**
(c)(i)	$R = V / I$	**C1**
	$= 0.75 / (15 \times 10^{-3})$	**C1**
	$= 50\ \Omega$	**A1**

Q22.

(b)(i)	$R = V / I$	**C1**
	$= 0.60 / 7.5 \times 10^{-3}$	**C1**
	$= 80\ \Omega$	**A1**
(b)(ii)	resistance decreases	**B1**
(c)(i)	$E = 0.60 + 0.30$ $= 0.90$ V	**A1**
(c)(iv)	current = 2.5 mA	**A1**

Q23.

(b)(i)	lamps have same p.d./lamps have p.d. of 2.7 V	**B1**
	current = 0.15 + 0.090 = 0.24 A	**A1**
(b)(ii)	$R = (4.5 - 2.7) / 0.24$ **or** $R_P = 18\,(\Omega)$ and $R_Q = 30\,(\Omega)$ $I/R_T = 1/18 + 1/30$ and so $R_T = 11.25$ $4.5 = 0.24 \times (R + 11.25)$	**C1**
	$R = 7.5\,\Omega$	**A1**
(b)(iii)	$R = \rho l / A$	**C1**
	$R_P / R_Q = [(2.7/0.15)/(2.7/0.09)]$ (= 0.60)	**C1**
	ratio $= 0.60 \times 2^2$ = 2.4	**A1**
(b)(iv)	less p.d. across resistor/greater p.d. across P	**B1**
	greater current through P and so resistance (of P) increases	**B1**

Q24.

(b)(iii)1.	Z has larger radius/diameter/(cross-sectional) area	**B1**
	Z has (material of) smaller resistivity/greater conductivity	**B1**
(b)(iii)2.	current/I (in battery) increases	**M1**
	($P = EI$ so) power/P (produced by battery) increases	**A1**

Q25.

(b)(iii)	**1.** $R = \frac{\rho L}{A}$	**C1**
	ratio $= (2.4/1.2) \times (3/1)$ = 6.0	**A1**
	2. ($I = nAvq$) $I_X / I_Y = 2.5/5.0$ **or** $1.2/2.4$ **or** 0.5	**C1**
	ratio $= (2.5/5.0) \times (1/3)$ **or** $(1.2/2.4) \times (1/3)$ = 0.17	**A1**

Q26.

(b)(i)	$7.0 = (I \times 5.2) + (I \times 6.0) + 1.4$	**C1**
	$I = 0.50$ A	**A1**
(b)(iv)	$R = \rho l / A$	**C1**
	$\alpha = \rho / R$ $= 3.7 \times 10^{-7} / 6.0$ $= 6.2 \times 10^{-8}$ m	**A1**