Electricity Past Paper Answers WJEC Eduqas Physics A Level

1.

(a)	(i)	Electrons transferred from [polythene] rod to [metal cap] [or equiv] [**Not** just –ve charge]	1
	(ii)	+ve (1) because electrons [accept: negative charges] transferred from duster to rod (1).	2
(b)	(i)	Number of charged particles $= \frac{64\times10^{-9}}{1.6\times10^{-19}\,(1)} = 4\times10^{11}$ (1) [Division by e ✓, answer ✓]	2
	(ii)	$I = \frac{Q}{t}$ **or** rearranged **or** $\frac{64\times10^{-9}}{2\times10^{-6}}$ (1) [or by impl.] $t = 32$ ms (1)	2
			[7]

2.

(a)		$V \propto I$ [or equiv. or in words] (1) provided that temperature remains constant (1)	2
(b)	(i)	Parallel sect: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ **or** $\frac{1}{80} + \frac{1}{80}$ **or** $R = \frac{R_1R_2}{R_1+R_2}$ **or** $\frac{80\times80}{80+80}$ (1) [or equiv or by impl.] $R_{parallel} = 40\ \Omega$ (1) Total circuit resistance = 240 Ω (1) [no e.c.f.]	3
	(ii)	I. $I = \frac{V}{R}$ **or** $\frac{9}{240\text{e.c.f.}}$ (1) = 37.5 mA (1) [Or potential divider approach with 7.5 V and 200 Ω]	2
		II. 18.75 mA e.c.f.	1
	(iii)	Use of $P = I^2R$ or $\frac{V^2}{R}$ or IV (1) P dissipated in **A** $= (37.5\times10^{-3})^2 \times 200 = 0.28$ W (1) e.c.f. P dissipated in **C** $= (18.75\times10^{-3})^2 \times 80 = 0.028$ W (1) e.c.f. $P_A : P_C = 10:1$ ∴ A appears brighter. (1) [e.c.f. on a power attempt] [Bulb B instead of bulb A used −1]	4
			[12]

3.

(a)		Resistance of wire = 40 Ω	1
(b)		Temperature remains constant [**or** temperature change is (too) small (to affect resistance noticeably)] (1) Constant gradient → constant resistance [both parts needed] (1) [Accept: Voltage ∝ current <u>and</u> Ohm's Law obeyed] [Accept other well argued answer, e.g. wire could be constantan, which has negligible temperature variation of resistance, so graph doesn't tell us much.]	2
(c)		$\rho = \frac{RA}{l}$ [or by impl.](1) [i.e rearrangement of $R = \frac{\rho l}{A}$] $\rho = \frac{40\text{e.c.f.} \times \pi (1.0 \times 10^{-4})^2}{2.5}$ [Correct expression for area →(1)] $\rho = 5.0 \times 10^{-7}$ Ω m(1) ((**unit**))	3
(d)		**Graph**: Straight line graph through origin with lower gradient than original (1). With correct gradient [i.e. $^1/_3$ original] (1)	2
			[8]

4.

(a)		Flow of charge [accept ….charge/ions] **or** $\frac{[\Delta]Q}{[\Delta]t}$, if the symbols defined	1
(b)	(i)	Sum of areas of triangle and rectangle areas attempted [or reasonable attempt at area of trapezium] (1) Q = 3.0 C ((**unit**))(1)	2
	(ii)	No. of electrons = $\frac{3.0(\text{e.c.f.})}{1.6 \times 10^{-19}(1)}$ = 1.9×10^{-19} (1) [1st mark div by e]	2
	(iii)	I = 1.2(0) A (from graph) (1); $v = \frac{I}{nAe}$ [manipulation shown – could be in following substitution – or by impl.](e.c.f. on I)(1) = 3.75×10^{-5} m s^{-1} [accept 3.8×10^{-5} m s^{-1}] (e.c.f. on I) (1)	3
			[8]

5.

(a)		<u>Free</u> [or equiv, e.g. conducting / moving / delocalised] electrons (1) collide / interact / hindered [by] (1) with atoms / ions of metal conductor / lattice ["particles" b.o.d.](1)	3
(b)	(i)	I. [0 – 2 V]: Resistance constant / changes by v. small amount II. [2 – 8 V]: Resistance increases	1 1
	(ii)	**Either** $R_{bulb} = \frac{6.0}{0.8(1)} = 7.5\ \Omega$ (1) Total resistance = 5 Ω (1) [ecf] [Correct use of $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$] $I = 1.2$ A (1) [ecf on R] **Or** I through $15\Omega = \frac{6.0}{15}$ (1)= 0.4 A (1) I through bulb = 0.8 A (1) ∴ Total current = 1.2 A (1)	4
	(iii)	Subst in $P = I^2R$ [ecf on R and I] **or** in $P = \frac{V^2}{R}$ [ecf on R only] **or** $P=IV$ [ecf on I only] (1) $P = 7.2$ W (1)	2
			[11]

6.

(a)	(i)	Wire with rule positioned (1) and labelled moving pointer / jockey / croc clip (1) **Either** correctly positioned ohm-meter with no power supply **or** correctly position ammeter and voltmeter with power supply (1)	3
	(ii)	[Different] length[s] of wire (1) **Either** measure V and I **or** measure / read R (1)	2
	(iii)	Diameter of wire [not radius or csa by accept "thickness"] with micrometer / vernier calliper	1
	(iv)	cross-sectional area fro πr^2 or $\pi(d/2)^2$ (1) graph of R against l [**or** mean value of R/l] (1) ρ = gradient × [cs]a [**or** mean value of R/l × csa] (1) [NB $R = V/I$ given here can be used to credit 2nd mark of (ii)] [NB Finding R for a measured length and [cs] area and then ρ calculated → 1 only]	3
(b)	(i)	$R \propto l$ (1) ∴ R increases as strain gauge gets longer (1) $R \propto {}^1/A$ (1) ∴ R increases as the strain gauge gets thinner (1) [**or** $R = \frac{\rho l}{A}$ or $\rho = \frac{RA}{l}$ (1), A increases & l decreases (1) ρ doesn't change /constant (1) so resistance increases (1)]	4
	(ii)	[csa =] $0.2 \times 10^{-3} \times 0.0012 \times 10^{-3}$ [or equiv.] (1) $\rho = 4.9 \times 10^{-7}\ \Omega$ m ((**unit**)) (1) [ecf from csa calculation] [ecf on powers of 10 in both A and l]	2
	(iii)	**Either** $1.6 = \frac{650}{650 + R} \times 6$ (1) Manipulation (1); $R = 1788\ \Omega$ (1) **Or** $I = \frac{1.6}{650}$ (=2.46×10^{-3} A) (1) $R = \frac{(6 - 1.6)(1)}{2.46 \times 10^{-3}} = 1788\ \Omega$ (1)	3
			[18]

7.

(a)	(i)	[For a metallic conductor] the potential difference and current are [directly] proportional/ I α V (1), provided the temperature remains constant / all physical factors remain constant (1) V = IR only no marks	2
	(ii)	It is constant / stays the same /increases as the temperature increases	1
(b)	(i)	$A = 1.5(3) \times 10^{-8}$ [m²](1) $R = \frac{\rho l}{A} = \frac{95\times10^{-8}\times3.2}{1.5(3)\times10^{-8}}$ (1) = 199 [Ω] (1)	3
	(ii)	$\frac{230^2}{200}$ = 265 [W] allow e.c.f. from (b)(i)	1
	(iii)	$\frac{1}{66.7(1)} = \frac{1}{200} + \frac{1}{R_2}$ (1) R_2 = 100 [Ω] (1)	3
	(iv)	R_2 (1) **either** reference to $\frac{V^2}{R}$ so lower *R* / same V across lower R **or** reference to I^2R so greater *I* **or** reference to *IV* so *I* increased [for constant *V*] **or** correct calculation of R_2 (1)	2
	(v)	$\frac{230}{66.7}$ = 3.5 [A] allow e.c.f. from (b)(iii)	1
		Question 1 total	**[13]**

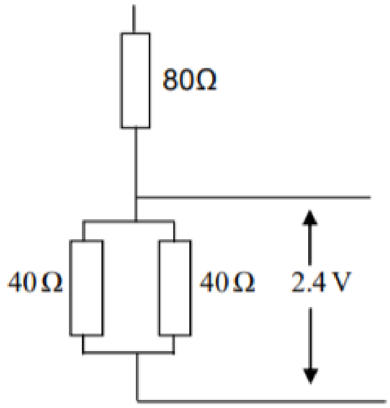
8.

(a)	(i)	Diagram to include • Correct electric circuit with ohmmeter **or** power supply with ammeter + voltmeter with correct symbols and positioning (1) • Method of heating shown (1) • Method of recording temperature shown (1)	3
	(ii)	Linear [or approximately linear] graph with positive gradient (1) and positive intercept on *R* axis (1).	2
(b)	(i)	Conducting / delocalised / free electrons (1) collide (1) with metal lattice / atoms / ions (1) [not with other free electrons]	3
	(ii)	The greater the temperature the greater the vibrational energy of the lattice / metal ions (1) producing a greater chance [or rate] of collisions/ collisions more often / greater frequency of collisions (1) [not harder] .	2
		Question 2 total	**[10]**

9.

(a)	(i)	Electron	1
	(ii)	Negative charges repelled [by rod] (1) and move from A to B/ to the right (1) leaving A with a net positive charge (1)	3
	(iii)	Diagram with A shown as positive and B as negative (1) and the charges shown on the sides of the sphere which are nearly touching.(1)	2
(b)	(i)	$[1.6 \times 10^{-19} \times 300 \times 10^{9} =]\ 4.8 \times 10^{-8}$ C UNIT mark	1
	(ii)	$I = \dfrac{4.8\times10^{-8}}{20\times10^{-12}}$ (1) $= 2.4 \times 10^{3}$ [A] (1) allow e.c.f from (b)(i)	2
		Question 5 Total	**[9]**

10.

(a)	(i)	*Resistance* $= \dfrac{pd}{current}$ (accept: voltage / if V and I written must be qualified)	[1]
	(ii)	$V = \text{J C}^{-1}$ (1); $I = \text{C s}^{-1}$ (1); Convincing working (1) Don't accept use of t -award **ecf** for 3rd mark. Alternative route using power formulae is acceptable.	[3]
(b)	(i)	$I = \dfrac{V_{in}}{R_1 + R_2}$	[1]
	(ii)	$V_{out} = IR_2$ (1); I (from (i)) used correctly (1)	[2]
(c)	(i)	Any parallel combination shown (1); 40 [Ω] used correctly (1)	[2]
	(ii)	 Resistor combination shown (1) **ecf** from *(c)*(i) 2.4 [V] or V_{out} labelled correctly (1)	[2]
		Question 2 total	**[11]**

11.

(a)	(i)	Point where entire **weight** of object acts. Don't accept mass.	[1]
	(ii)	Tan θ = 40/60 (1); θ = 33.7° (1)	[2]
(b)	(i)	V = 0.6.x 0.4 x 0.1 (1); $M = \rho$ x V used correctly (1)	[2]
	(ii)	$T\sin\theta$ or equivalent (1) x 1.2 (1) = 9.6 x 9.81 x 1.8 (1) T = 220 [N] (1)	[4]
	(iii)	F = 220 (**ecf**) cos40° or equivalent (1) F = 169 [N] (1) Accept Pythagoras solution.	[2]
		Question 5 Total	**[11]**
(a)	(i)	Correct and convincing use of $\rho = \dfrac{RA}{l}$ (including unit conversion)	[1]
	(ii)	$\left(\dfrac{2000}{11.2}\right)$ = 179 A **unit** mark	[1]
	(iii)	$v = \dfrac{I}{nAe}$ rearranged (or shown numerically) (1) n = 6.0 x 10^{28} x 3 (1) v = 1.55 x 10^{-5} [m s^{-1}] (**ecf** on I and n) (1)	[3]
(b)	(i)	Same (or equivalent)	[1]
	(ii)	v increased (1) because…; A decreased, I,n,e unchanged by implicaton (1)	[2]
	(iii)	Increased frequency / more collisions **between electrons and lattice** / atoms / ions **or** electrons carry greater kinetic energy (1) leading to **increased vibrational / kinetic energy of lattice atoms** (1)	[2]
		Question 6 Total	**[10]**