Teacher Resource Bank

GCE Physics

Sample AS EMPA:

- Mark Schemes

Sample AS EMPA Mark Scheme

Section A Task 1

Question 1			
(a)	table 1:	three readings, all to 0.01 V, row 1 > row 2 > row 3 ✓	**1**
(b)	table 2:	pd across R_1 = (table 1 row 1 – table 2 row 2) pd across R_2 = (table 1 row 1 – table 1 row 3) pd across R_3 = (table 1 row 3) pd across R_2 ≈ pd across R_3 all 4 criteria met ✓✓ any 3 criteria met ✓	**2**
(c)	explanation:	resistances R_1, R_2 and R_3 are in series ✓ current in resistors is the same ✓ pd across a resistor ∝ resistance of the resistor ✓	**max 2**
	deduction:	R_1 is the smallest resistance ✓ $R_2 = R_3$ ✓	**2**
(d)	table 3:	two readings to 0.01 V, row 1 > row 2 ✓	**1**
(e)	table 4:	pd across R_1 = (table 1 row 1 – table 3 row 1) pd across R_2 and R_4 = (table 3 row 1 – table 3 row 2) pd across R_3 = (table 3 row 2) pd across R_1 ≈ pd across R_2 and R_4 all 4 criteria met ✓✓ any 3 criteria met ✓	**2**
(f)	explanation:	(from observation) pd across R_1 ≈ pd across R_2 and R_4 ✓ hence R_1 = **effective** resistance, R_t, of R_2 and R_4 ✓ R_2 and R_4 are in parallel; $\frac{1}{R_t} = \frac{1}{R_2} + \frac{1}{R_4}$ ✓ hence suggestion is correct ✓ [R_2 and R_4 are in parallel; $\frac{1}{R_t} = \frac{1}{R_2} + \frac{1}{R_4}$ ✓ if suggestion is correct, $R_1 \approx R_t$ ✓ and pd across R_1 ≈ pd across R_2 and R_4 ✓ hence suggestion is correct ✓]	**4**
		Total	**14**

Section A Task 2

Question 1			
(a) & (b)	tabulation:	*V* /V *I* /mA ✓✓	
		insist on valid separator between quantity and unit; penalise if *V*/V is not in the left-hand column of the table (this should also be the case if separate tables are produced for (a) and (b))	**2**
	results:	8 sets of *V* and *I* with both sets positive, as in part (a) ✓	
		8 sets of *V* and *I* with both sets negative, as in part (b) ✓	
		V range ≥ 10 V ✓	**3**
		for 5, 6 or 7 sets positive and 5, 6 or 7 sets negative, lose 1 mark	
	significant figures:	all *V* to 0.01 V or all 0.001 V ✓	
		all *I* to 0.01 mA or all to 0.001 mA ✓	**2**
	quality:	all points to ± 2 mm of suitable line, positive gradient (judge from graph, providing this is suitably-scaled) ✓	**1**
(c)	axes:	marked *I*/mA (vertical) and *V*/V (horizontal) ✓✓	
		deduct ½ for each missing, rounding down; **1 max** if axes reversed	**2**
	scales:	points should cover at least half the grid horizontally ✓ **and** half the grid vertically ✓	
		(if necessary, a false origin should be used to meet these criteria; either or both marks may be lost for use of a difficult or non-linear scale or if the interval between the numerical values are marked on an axis with a frequency of > 5 cm)	**2**
	points:	5 points plotted correctly in positive quadrant (check at least two) and 5 points plotted correctly in negative quadrant (check at least three) ✓✓✓	
		marks are deducted for points > 1 mm from correct position and if poorly marked	**3**
	line:	with 2 straight line (ruled) sections of positive gradients; smooth transition as gradients change ✓	**1**
		Total	**16**

Section B

Question 1		
(a) or (b)	apply to **larger** of gradient triangles *y*-step at least 8 cm and *x*-step at least 8 cm ✓ (if a poorly-scaled graph is drawn the hypotenuse of the gradient triangle should be extended to meet the 8 × 8 criteria) correct transfer of *y*-step and *x*-step data between graph and calculation ✓ (mark is withheld if points used to determine either step > 1 mm from correct position on grid; if tabulated points are used these must lie on the line)	**2**
(c)	$\frac{G_1}{G_2}$,no unit, in range 1.56 to 1.72 or 1.6 ✓✓ [1.48 to 1.81 or 1.7 ✓] no credit here if axes are reversed on graph	**2**
	Total	**4**

Question 2		
	(idea that) Ohm's law obeyed where $I \propto V$ ✓ correct statement for negative *V*, e.g. always Ohmic ✓ correct statement for positive *V*, e.g. Ohmic up to V = 1.2 V ± 0.1 V ✓ (last two points may be earned for an appropriately annotated sketch)	**3**
	Total	**3**

Question 3			
(a)	(i) & (ii)	correct calculation of (R_1 + R_3) from G_1^{-1}, no order of magnitude errors; correct calculation of (R_1 + R_2 + R_3) from G_2^{-1}, no order of magnitude errors ✓	**1**
(b)	(i)	R_2 = difference (a)(ii) – (a)(i); allow order of magnitude error here ✓ R_2 in range 1620 Ω to 1980 Ω ✓	**4**
	(ii)	R_1 = difference (a)(ii) – 2 × (a)(i); allow order of magnitude error here ✓ R_1 in range 800 Ω to 1200 Ω ✓	
		Total	**5**

Question 4			
(a)		percentage uncertainty in pd across R_1 = 3.13% ✓ [allow 3.125% or 3.1%] percentage uncertainty in pd across R_2 = 1.72% ✓ [allow 1.717% or 1.7%]	**2**
(b)	(i)	percentage uncertainty in (pd across) R_1 result added to uncertainty in (pd across) R_2 result ✓ 4.84% ✓ [allow 4.842% or 4.8%]	**4**
	(ii)	absolute uncertainty in $\frac{R_2}{R_1}$ = 1.82 × answer to (b)(i) ✓ absolute uncertainty in $\frac{R_2}{R_1}$ = 0.088, no unit ✓ [allow 0.09]	
		Total	**6**

Question 5			
(a)	(i)	when contact is at T, pd across X = E ✓ when contact is at L, pd across X = 0 ✓	**4**
	(ii)	when contact is at T, pd across X = E ✓ when contact is at L, pd across X > 0 ✓	
(b)	(i)	range of *I* and *V* data is greater ✓	**3**
	(ii)	interval between each set of *I* and *V* data is smaller ✓ greater **precision** can be achieved ✓	
		Total	**7**
		Section B Total	**25**