

- 1 (a) energy transferred per coulomb/unit charge
OR energy supplied in driving coulomb/unit charge around a circuit
ACCEPT p.d./voltage across battery/power supply B1
- (b) (i) $V = IR$ in any form OR $(I =) V \div R$ C1
2.0 A OR 2 A A1
- (ii) electrons B1
- (iii) arrow right to left by heater OR indication of clockwise B1
- (c) $(E =) VI t$ OR $V^2 t/R$ OR $I^2 R t$ in any form C1
14 000 J A1
- 2 (a) (i) NAND B1
- (ii) output and one input correctly labelled B1
- (b) rectangle with longitudinal line in middle third, no input or output wire required B1
- (c) (i) temperature (decreases) B1
- (ii) correctly relates change of resistance to change of temperature B1
voltage of mid-point (of potential divider)/left of LED increases OR higher V across thermistor B1
current flows through/enough V to light LED B1
- (d) $1/R_p = 1/R_1 + 1/R_2$ or $(R_p) = R_1 R_2 / (R_1 + R_2)$ C
 $(R = 1 / (1/4 - 1/6) =) 12 \Omega$ A1

[Total: 9]

- 3 (a) (i) rectifier/diode
- (ii) frequency (of A.C. supply) B1
- (b) $(P =) IV$ OR 0.5×5.3 OR 500×5.3 C1
 2.6 W OR 2600 mW
- (ii) $(E =) Pt$ OR IVt OR $2.65 \times 1.5 \times 3600$ OR $0.5 \times 5.3 \times 1.5 \times 3600$ C1
 14000 J A1
- (c) energy only underlined B1
- [Total: 7]**

- 4 (a)(i)(ii) $R \propto L$ in words or symbols
- (ii) AND $R \propto 1/A$ in words or symbols B1
- (b) $P = IV$ OR $(I =) P/V$ OR $60/230$ A1
 0.26 A
- (c) length change divides resistance by 2/multiplies current by 2 C1
cross-section change multiplies resistance by 3/divides current by 3 C1
(overall) resistance of Y is $3/2$ times bigger/ $3/2 \times 885 \Omega / 1327 \Omega$
OR current in Y $2/3$ of $0.26 \text{ A} = 0.17 \text{ A}$ C
current in Y/Current in X = $2/3$ A1
- [Total: 7]**

- 5 (a) (one third length so) one third R , accept any division by 3 C1
 (half area so) twice R , accept any doubling, including divide by $\frac{1}{2}$ C1
 (resistance = $0.45 \times 2/3$) = $0.3(0)\Omega$ accept 1 sig. fig. A1 [3]
- (b) $1(\Omega)$ and $3(\Omega)$ used in correct parallel formula C1
 $2(\Omega)$ added to candidate's parallel resistance C1
 2.7 or 2.8 or 2.75Ω A1 [3]
- (ii) any 2 from:
 $I_1 = I_4$ OR $I_1 = I_2 + I_3$ OR $I_4 = I_2 + I_3$
 OR other correct relevant equation/inequality e.g. $I_4 = 4I_3$, $I_4 > I_3$ B2 [2]
- (iii) any 2 from:
 $V_1 = V_4$ OR $V_1 = V_2 + V_3$ OR $V_4 = V_2 + V_3$
 OR correct relevant inequality e.g. $V_1 > V_3$ B2 [2]

[Total: 10]

- 6 (a) triangle with bar at apex, pointing either way NOT circle at apex B1 [1]
 condone:
 enclosing circle (but must have horizontal lines to/from triangle), no line through
 triangle, triangle filled in
- (b) deflection/reasonable value/no deflection B1 [1]
 must be consistent with direction of recognisable arrow
 if no recognisable direction in symbol of (a), assume arrow L to R
- (ii) his (i) different way round B1 [1]
 i.e. if deflection in (i) must be no deflection in (ii);
 if no deflection in (i) must be deflection in (ii);
- (c) half waves up or down on alternate half cycles B1
 reasonable shapes of correct frequency AND amplitude 2.5–3V AND flats 0V
 (± 1 small square) B1 [2]
- (d) (i) transistor B1 [1]
- (ii) 1st line of table : both off B1
 2nd line of table : both on B1 [2]
 give one compensatory mark : 1st line both on AND 2nd line both off
 accept HIGH/LOW or 1/0 for on/off ignore ticks/crosses/yes/no

- 7 (a) rheostat/variable resistor AND control/vary/change/ limit current /resistance/power/voltage across heater B1
- (b) $P = VI$ in any form OR $(I =) P/V$ C1
1.25 A A1
- (ii) $(R =) V/I$ in any form words or numbers C1
(voltage across X =) 2.4 (V) OR 6 - 3.6 (V) C1
1.92 Ω e.c.f. from (b) (i) A1
- (c) battery running down/going flat/energy of battery used up OR V or e.m.f. less OR more/increasing resistance (of heater) NOT resistance of X increases B1
- (d) (transformer condone step-up OR potential divider/potentiometer NOT extras B1
(ii) diode OR rectifier OR L.E.D. NOT extras B1 [9]
- 8 (a) increases (as current increases) M1
at an increasing rate A1
- (b) 25 Ω B1
- (ii) IR in any form OR 0.070×25 C1
1.7/1.8 V A1
- (iii) $(P =) IV$ OR I^2R OR V^2/R in any form, numbers, symbols or words C1
0.12 W e.c.f. from (i)/(ii) A1
- (c) answer to (b)(ii) B1
- (ii) use of $1/R = 1/R_1 + 1/R_2$ OR $R = R_1R_2/(R_1 + R_2)$ C
12.5 Ω A1
- [Total: 10]

9 (a)	current = power/voltage or $150/12$ value is 12.5 A	C1 A1	2
(b) (i)	sum of currents at junction = current after junction/ $12.5 \text{ A} = 5.0 \text{ A} + I$ value is 7.5 A	C1 A1	
(ii)	power = VI or is 7.5×12 e.c.f from (i) value is 90 W	C1 A1	
(iii)	resistance = voltage/current or $12/7.5$ e.c.f. from (i) but not from (a) value is 1.6Ω	C1 A1	6
			[8]