Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1			B ✓	1 (AO1.2)	**Examiner's Comments** Overall this question was very well answered. Some lower ability candidates incorrectly selected response C.
			Total	**1**	
2		i	Simple use of P = V × I / idea of ratios using transformer equations (1) Current reduced by 16 times (1)	2	**ALLOW** current reduced (1)
		ii	Very large decrease in power loss (1) Power loss is related to the square of the current / **AW** (1)	2	
			Total	**4**	
3	a	i	variable resistor ✓	1 (AO1.2)	**ALLOW** rheostat **IGNORE** potentiometer **Examiner's Comments** Most named this correctly as a variable resistor for 1 mark. 'LDR' or 'resistor' and 'thermistor' were common incorrect answers.
		ii	Control / change / vary / increase / decrease / AW the resistance / current in the circuit ✓	1 (AO1.2)	**DO NOT ALLOW** merely 'changes the voltage or changes p.d.' **BUT ALLOW**: changes the potential difference or voltage **across (component) X** **Examiner's Comments** About half of candidates referred correctly to changing, varying or controlling the current or resistance for 1 mark. Incorrect answers varied but frequently seen were a device to measure current or resistance.
	b	i	(filament) bulb / lamp ✓	1 (AO3.2a)	**Examiner's Comments** Most gave the correct answer as a filament lamp. Lamp or bulb was acceptable also.
		ii	gradient / slope (of graph) changes (as potential difference / voltage changes) ✓ idea of increasing resistance (with more p.d.) / ORA ✓	3 (AO3.1a) (AO1.2)	**ALLOW** 'graph / line / slope levels off' / non-linear

			idea of increasing temperature / AW ✓	(AO2.2)	Resistance increases with greater temperature ✓✓ **Examiner's Comments** Many of the answers here did not refer to the graph so these did not secure the first marking point about the slope or the gradient changing. Other marks were available for increasing resistance (often given) and increasing temperature (less often seen). The answered covered the whole range here with only about 10% gaining all three. About a third of candidates gained 1 mark only, usually for the idea of increasing resistance.
	c	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4 (V) award 2 marks** 0.25 × 16 ✓ 4 (V) ✓	2 (AO2.1) (AO2.1)	**Examiner's Comments** This standard demand Ohm's law calculation was very well answered by almost all candidates. As, on this occasion, the formula was given in the question then the mark total was limited to 2 marks.
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1 (W) award 3 marks** P = IV ✓ P = 0.25 × 4 ✓ P = 1 (W) ✓ **OR** $P = I^2R$ ✓ $P = 0.25^2 \times 16$ ✓ P = 1 (W) ✓	3 (AO1.2) (AO2.1) (AO2.1) (AO1.2) (AO2.1) (AO2.1)	**ALLOW e.c.f. from part ci** **Examiner's Comments** About two thirds of candidates gained all 3 marks here for the calculation on power.
			Total	**11**	
4	a	i	as the length of the wire increases the resistance increases / proportional relationship / ORA ✓ **BUT** idea of **directly** proportional ✓ ✓	2 (AO2 × 3.2b)	**IGNORE** positive correlation Numerical answers must **USE** values rather than merely quoting values Eg. (approximately) doubling the length, doubles the resistance / ORA ✓ ✓ Eg. Increases by 7 to 8Ω per 25cm / 0.3Ω (allow 0.28 to 0.32) per cm ✓✓ **Examiner's Comments** Most answers indicated the correct relationship between the length of the wire

					and its resistance for 1 mark. It was common in answers for values to be merely quoted rather than used. For example, better answers (from about a fifth of candidates) that stated 'doubling the length doubles the resistance' were credited both marks.
		ii	mean for 25cm (is recorded to 3 decimal places) **and** it should be recorded to one decimal place ✓ mean for 50cm is incorrect **and** it should be 16.2Ω ✓	2 (AO2 × 3.3a)	Error **and** a solution required for each marking point. **ALLOW** answer in terms of sig. figs: Eg. mean for 25cm is recorded to 4 sig. figs. − it should be recorded to 2 sig. figs. **Examiner's Comments** About third of answers identified clearly the mean for 25cm was recorded to three decimal places and it should only be one. Also shown in about a fifth of answers was the mean at 50cm should be 16.2.
		iii	75cm attempt 3 or 18.7 (is an anomaly) ✓ it has not been included in the **mean** ✓	2 (AO2 × 3.2a)	**Examiner's Comments** There was an erratum included for this question. Virtually all candidates edited their question to include this. There was no evidence at all that any candidates were disadvantaged by this and 80% gained full marks.
		iv	**straight** line **through the origin** scores ✓✓ **straight** line / linear relationship / proportional and not through origin scores ✓	2 (AO2 × 3.1a)	**ALLOW** answers shown on a diagram **ALLOW** directly proportional ✓ ✓ **DO NOT ALLOW** a curved line through origin **IGNORE** positive correlation (in written comments) **Examiner's Comments** Some sketched a straight line graph through the origin for 2 marks here. Some described it as a straight line through the origin [2] or it was directly proportional [2]. Others described the shape as a straight line or proportional [1] but did not mention the origin.
	b	i	**Any two from:** (extra resistance due to) connecting leads too long / too thin ✓ (extra) resistance of the croc clips / connections ✓	2 (AO2 × 3.1b)	**DO NOT ALLOW** idea of less resistance Eg. Crocodile clips rusted / poor conductor / bad or loose connections

			croc clip is not at 0cm / the end of the ruler / length of resistance wire **longer** than intended / AW ✓ Heating effect of wires ✓		**IGNORE** crocodile clips in wrong place unless qualified correctly. Eg. croc clips too far apart **ALLOW** Parallax error on meter (if it is analogue) / meter not calibrated (so resistance higher) **Examiner's Comments** Answers her were often vague here and examiners were seeking to award marks for clearly described errors. About a third gained one mark for either the idea of the crocodile clip not being at zero or the meter not being zeroed or calibrated.
		ii	**Any one from:** make the connecting wires as short as possible ✓ keep croc clips clean / solder connections ✓ place croc clip exactly at the end of the ruler / at 0cm / AW✓	1 (AO3.3b)	Solution needs to be consistent with an error identified in part i. OR a new specified error **ALLOW**: use **thicker** connecting wires **ALLOW** let wire(s) cool between readings / Securely fix croc clip / calibrate meter / avoid parallax error **Examiner's Comments** About a quarter gained one mark here for taking an error from part (i) and providing a solution.
			Total	**11**	
5		i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 2.8 (kW) award 4 marks** (P =) $I^2 \times R$ ✓ 11 x 11 x 23 or 11^2 x 23 or 121 x 23 ✓ = 2783 ✓ Conversion to kW = 2.8 ✓	**4** (AO1.2) (AO2.1) (AO2.1) (AO2.1)	**ALLOW** 2.78 kW or 2.783 kW ✓✓✓✓ **ALLOW** equation in any form **ALLOW ECF** candidates answer to 3rd marking point converted to kW **Examiner's Comments** This question required candidates to recall the equation: *power = current² x resistance* before converting their answers into kW. Out of the candidates who gained credit, most were credited with all four marks. A few candidates were only credited with one mark for converting the power output in W into kW. A significant number of candidates used an

					incorrect equation for power, most commonly using *current* rather than *current*^{2} **AfL** When a physics question requires candidates to apply their mathematical skills they should always write down how they are answering the question. Using brief notes is and writing down intermediate calculations helps the examiner to see what the candidate is doing. A single finger error will result in many candidates receiving no credit because they only write down their final answer. Marks may be available for each stage of the process, using the correct equation, rearranging the equation, substituting in correct values. Choosing to access these compensatory marks by showing workings is good examination technique.
		ii	Wind speed varies / AW ✓	**1** (AO2.1)	**ALLOW** it depends on the strength of the wind / how windy it is / AW **IGNORE** there might not be any wind / wind changes direction / AW
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	**1** (AO2.1)	**ALLOW** (it) may not generate enough power / energy / AW **Examiner's Comments** Most candidates gained full credit for Q16(d)(ii) and (d)(iii). Those who did not gain credit often provided non-specific generalised reasons about the weather or the wind turbine 'breaking'.
			Total	**6**	
6			**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 38.28 (W) award 3 marks** Recall (Power =) potential difference x current ✓ 12 × 3.19 ✓ (P =) 38.28 (W) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	**ALLOW** correct equation in any form **ALLOW** 38.3 (W) or 38 (W) **Examiner's Comments** Candidates had to recall the equation: power = potential difference x current and substitute the values provided in the question. Most candidates achieved full marks although some of the less able candidates could not recall the equation and therefore gained no credit.

					 **AfL** Candidates would benefit from writing down the equation and their calculations rather than just their final answer so that compensatory marks may possibly be awarded.
			Total	**3**	
7	a		A.C. (transmitted in power lines) / (electrical/electron/particle) oscillations / AW ✓ **BUT** Alternating currents/(electrical/electron/particle) oscillations produce (radio) waves/electromagnetic radiation ✓✓	2 (AO2×1.1)	**Examiner's Comments** This Assessment Objective 1 question assessed candidates' knowledge and understanding of how radio waves are produced. This proved to be one of the most difficult questions on the paper but also discriminated well. Only the most able candidates gained marks for relating the production of radio waves to the oscillations of electrons in the transmission lines.  **Misconception** Common misconceptions included radio waves being produced by something in the house or because the transmission lines produced heat.
	b		(High voltage means) lower current ✓ Less heating/heat loss/power loss/energy wasted or more useful energy transmitted / ORA ✓	2 (AO2×1.1)	**IGNORE** no energy losses / prevent energy loss / AW **ALLOW** more efficient / (wires at) lower temperature **Examiner's Comments** Although this question has been asked often in past GCSE Physics papers, over one quarter of candidates did not gain credit. Many gained 1 mark for the idea of less energy lost (as heat) but only the more able candidates were able to link this to higher voltages resulting in a lower current.  **AfL**

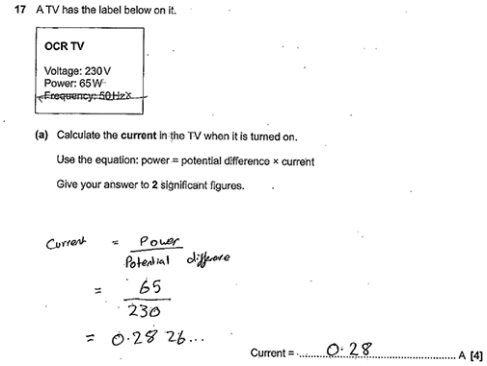
					Candidates had many misconceptions about why energy should be transferred at high voltages. The responses often referred to incorrect ideas e.g. 'to make the energy move faster/further' or 'to transfer enough power to the home' or 'to reduce the resistance'. Candidates should also be aware that the idea of **NO** energy losses will not gain credit.
	c		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 20 (A) award 5 marks** Recall $I^2 = P / R$ ✓ 6.156 kW = 6156 W ✓ (I^2 =) 6156 / 15.39 **OR** (I^2=) 400 ✓ (I =) √400 ✓ (I =) 20 (A) ✓	2 (AO 1.2) (AO 2.1) (AO 2.1) (AO 2.1)	**ALLOW** correct equation in any form **DO NOT ALLOW** marks to be awarded from incorrect equation e.g. I = P / R Award marks if 6.156kW has not been correctly converted to W E.g. (I^2 =) 0.4 or 6.156/15.39 ✓✓ (I=) √0.4 ✓✓✓ I = 0.63 ✓✓✓✓ **Examiner's Comments** The majority of candidates scored either zero marks or 5 marks for this question. Over a quarter of candidates did not know the correct equation: power = (current)^2 x resistance. It was common to see an incorrect version of the equation (power = current x resistance) used instead. Some candidates did show their calculations and could therefore score 1 mark for converting kW into W.
			Total	**9**	
8	a		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.28 (A) award 4 marks** Rearrange equation current = power ÷ potential difference/ I = P ÷ V ✓ I = 65 ÷ 230 ✓ I = 0.2826086 ✓ I = 0.28 (A) ✓	4 (AO1.2) (AO2.1) (AO2.1) (AO1.2)	**NOTE** If answer not to 2 sig figs max 3 marks **ALLOW** one mark for any calculated answer to 2sf

Examiner's Comments

Higher ability candidates rearranged the equation, substituted the numbers and wrote the answer as 0.2826 before rounding the answer as 0.28 (two significant figures).

A number of candidates wrote their answer exactly from the calculator as 0.28 which was not acceptable for two significant figures.

Exemplar 1



17 A TV has the label below on it.

OCR TV
Voltage: 230 V
Power: 65 W
~~Frequency: 50 Hz~~

(a) Calculate the **current** in the TV when it is turned on.
Use the equation: power = potential difference × current
Give your answer to **2** significant figures.

Current = Power / Potential difference
= 65 / 230
= 0·28 26...

Current = 0·28 A [4]

This candidate has clearly rearranged the equation and then substituted the correct numbers from the data box. It is then clear that the candidate has then calculated the correct answer before rounding it correctly to two significant figures.

The candidate has perhaps helpfully crossed out the frequency as this is not needed for this part. Candidates need to be careful about crossing out quantities as the crossed out quantities might be needed in later parts. Underlining the quantities needed is probably a better method.

AfL

For calculations, candidates should show their working.

The following steps are useful:

1. Recall equation or select the appropriate equation from the data sheet (if not given in the question)
2. rearrange equation, if necessary

					3. substitute the numbers into the equation 4. calculate the answer 5. consider significant figures or decimal places.
	b		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 117000 (or 116000) (J) award 4 marks** E = P x t ✓ Unit conversion 30 minutes = 1800 seconds ✓ E = 65 x 1800 ✓ E = 117000 (J) ✓	4 (AO1.2) (AO1.2) (AO2.1) (AO2.1)	**ALLOW ECF** from **(a)** E = Q x V or I x t x V E = 0.28 ×1800 × 230 **ALLOW ECF for incorrect time conversion** **ALLOW** three marks for 1950 (J) E = 116000 (J) ✓ **Examiner's Comments** Candidates did not always know which equation to use. Many recalled correctly the equation relating energy, power and time but did not always remember that the energy needed to be measured in seconds. Higher ability candidates clearly showed their working including the conversion of 30 minutes to 1800 seconds. Some candidates recalled that E = Q × V and Q = I × t or E = I × t × V and used the answer from 17(a). This was correct physics and thus gained full credit. **AfL** When carrying out calculations, candidates should consider units. Normally time is measured in second. Candidates should be aware of exceptions to the normal units, e.g. when energy transferred is measured in kW h, then the power is measured in kilowatt, kW and time in hour h. Similarly, if a speed is measured in measured in km / h, then the distance should

					be measured in kilometre, km and the time in hour, h.
			Total	**8**	
9	a	i	LED / cells connected the wrong way around OR ✓ Voltmeter is across the battery/cells OR voltmeter should be across the LED ✓	2 (AO2x3.2a)	**ALLOW** diode **IGNORE** voltmeter in wrong place **Examiner's Comments** The majority of the candidates gained at least one mark. Vague answers such as "voltmeter is in the wrong place" did not gain credit. Higher ability candidates stated for one of the errors that the LED (or cells) were connected the wrong way around or the LED (or cells) needed to be reversed. For the other error, it was expected that the candidates would indicate that the voltmeter was not measuring the potential difference across just the LED, but across the battery. Candidates gained a mark for this error by suggesting connecting the voltmeter across the LED. Incorrect answers given by many candidates included the ammeter being in the wrong place or the variable resistor being in the wrong place. Often candidates incorrectly suggested that the order of the components mattered.
		ii	**Any one from:** Control/change/alter the current (in the circuit) ✓ Control/change/alter the potential difference/voltage(across the LED) ✓	1 (AO1.2)	**DO NOT ALLOW** to vary the resistan **Examiner's Comments** A large number of candidates answered this question by stating that the component was a variable resistor or to vary the resistance of the circuit. Few candidates answered the question in term of the purpose of the variable resistor was to vary the potential difference across the LED or vary the current through the LED (by varying the resistance in the circuit).
	b	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 100 (Ω) award 3 marks** Resistance = potential difference ÷ current / R = V ÷ I ✓ R = 3.0 ÷ 0.03 ✓	3 (AO1.2) (AO2.1)	**Examiner's Comments** The majority of the candidates were able to rearrange the given equation and substitute into the rearranged equation the correct values to give an answer of 100 Ω. A very small minority of candidates used 0.3 A rather than 0.03 A. Candidates often

			R = 100 (Ω) ✓	(AO2.1)	underline the quantities in the question, which was good practice.
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 4.5 (C) award 4 marks** Charge flow = current × time / Q = I × t ✓ t = 2.5 minutes = 150 seconds ✓ Q = 0.03 x 150 ✓ Q = 4.5 (C) ✓	4 (AO1.2) (AO1.2) (AO2.1) (AO2.1)	**ALLOW** 3 marks for an answer of 0.075 (C) (time not converted to seconds) ✓✓✓ **Examiner's Comments** In this question, higher ability candidates who did not obtain the correct answer, but showed their working, could still gain marks from their working. In this case, the equation for charge flow needed to be recalled and the time of 2.5 minutes needs to be changed to 150 seconds, before the answer could be calculated.
		iii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 13.5 (J) award 2 marks** E = 4.5 x 3.0 ✓ E = 13.5 (J) ✓	2 (AO2.1) (AO2.1)	**ECF** from **(ii)** **ALLOW** 14(J) **Examiner's Comments** Most candidates were able to multiply their answer to (ii) by 3.0 to gain the correct answer.
			Total	**12**	
10			**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5(.00) (C) award 3 marks** (Rearrange equation) (charge =) energy transferred / potential difference ✓ (charge =) 200 / 40 ✓ (charge =) 5 (C) ✓	3 (AO1.2) (AO2.1) (AO2.1)	
			Total	**3**	
11	a		(Circuit) A - the total resistance is half the value of one of the resistors / less than the smallest resistor value ✓	2 (AO2x2.1)	Assume answer refers to circuit A unless indicated otherwise **ALLOW** (Circuit A) is parallel **and** has 2 loops/paths (for the current to flow through) / AW **ALLOW** higher level response i.e. correct equation for resistors in parallel **ALLOW** (Circuit) B is series **and** has only 1

			(Circuit) B - the total resistance is double the value of one of the resistors / adding the two resistances together ✓		loop/path (for the current to flow through) / AW **ALLOW** maximum of 1 mark for (circuit) A is parallel/has two loops/paths **and** (circuit) B is series/has one loop/path
	b	i	**Any two from:** (more current means) ions vibrate **more** / AW✓ (more current means) **more** electrons collide with ions (in the lattice) / AW ✓ (more collisions mean) hard**er** for electrons to pass (through wire/lamp) / AW ✓ (which) increases temperature (and therefore resistance) / AW ✓	2 (AO2x1.1)	**ALLOW** atoms/particles/molecules for ions **ALLOW** (lamp) heats up / high(er) temperature
		ii	Lamp, cell, ammeter and variable resistor in series ✓ Voltmeter in parallel with the lamp ✓	2 (AO2x2.2)	**IGNORE** voltmeter in series for this mark **ALLOW** voltmeter in parallel with ammeter and lamp but not variable resistor
		iii	Measure current **and** potential difference/voltage ✓ **Any two from:** Change current/variable resistor/pd (value) ✓ Take at least 3 sets of different V and I readings ✓ Calculate the resistance using V/I or using the current and pd values / plot a graph of V against I ✓	3 (AO3x1.2)	**ALLOW** take readings on ammeter **and** voltmeter **IGNORE** repeating same V and I readings **ALLOW** graph of I against V / graph of I against R
			Total	**9**	
12			**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 0.9 (A) award 2 marks** (Rearrangement: I_p =) $I_s \times V_s / V_p$ ✓ **OR** (I_p =) 12 × 9.0 / 120 ✓ (I_p =) 0.9 (A) ✓	2 (AO1.2) (AO2.1)	
			Total	**2**	