Mark Scheme

Q1.

Question Number	Answer	Mark
	The only correct answer is D  **A is incorrect** because that is the symbol for a diode **B is incorrect** because that is the symbol for a light dependent resistor **C is incorrect** because that is a symbol for a motor	**(1)**

Q2.

Question Number:	Answer	Additional Guidance	Mark
	an explanation linking: collisions between electrons and lattice (1) lattice {vibrates / moves} **more** (1)	throughout accept atoms / ions for lattice accept charges / charged particles for electrons allow collision between electrons in this context KE of lattice increases KE of electrons decreases	**(2)** AO 1 1

Q3.

Question Number:	Answer	Additional Guidance	Mark
	an explanation linking:	allow alternative arguments such as if resistors had been in series, then...	**(3)** AO 3 2a AO 3 2b
	relevant calculation (1) R (between P and Q) = $\frac{6}{1.2}$ = 5Ω	I = $\frac{6}{20}$ = 0.3A V (between P and Q) = 1.2 x 10 = 12V	
	reasoning / interpretation of result (1) this is less than {a single resistor / two resistors in series}	current is more (than 0.3A) total p.d. is less than 12 V	
	conclusion (1) resistors must be connected <u>in parallel</u>		

Q4.

Question Number	Answer	Additional guidance	Mark
(i)	recall and substitution into $P = I^2 \times R$ (1) $130 = 14^2 \times R$ rearrangement (1) $R = \frac{130}{14^2}$ evaluation to **2 sig fig** (1) (R =) 0.66 (Ω)	substitution and rearrangement may be in either order alternative route: $\mathbf{V}\ (= \frac{P}{I}) = \frac{130}{14}$ OR 9.3 V (1) $R\ (= \frac{V}{I}) = \frac{9.3}{14}$ (1) award full marks for the correct answer without working award 2 marks for 0.663.. or 0.67	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	**rate** of flow of charge in the immersion heater is greater than in the kettle / heating element (1)	accept reverse arguments more charge per second in the immersion heater allow (in this context) faster (rate of) flow in immersion heater 14 coulombs per sec in immersion heater and 8.3 coulombs per sec in kettle / heating element	(2)
	the direction of the flow of charge in the kettle / heating element keeps changing (whereas it remains in the same direction in the immersion heater) (1)	flows both ways in the kettle / heating element (one way in the heater) simply referring to alternating current and direct current is not enough	

Q5.

Question Number:	Answer	Additional Guidance	Mark
(i)	1.5 (V)	accept $\frac{12}{8}$ or $\frac{3}{2}$ or $1\frac{1}{2}$	(1) AO 3 1b

Question Number:	Answer	Additional Guidance	Mark
(ii)		allow ecf from a(i) for all marking points	**(4)** AO 2 1
	recall and substitution (1) $0.75 = I \times 1.5$	substitution and rearrangement in either order	
	rearrangement (1) $(I =) \frac{0.75}{1.5} (= 0.5)$		
	recall, substitution and rearrangement (1) $R = \frac{1.5}{0.5}$	allow ecf of current from MP2 for this mark point only	
	evaluation (1) (R =) 3.0 (Ω)	allow other approaches such as $P = \frac{V^2}{R}$ scores 1 mark $0.75 = \frac{1.5^2}{R}$ scores 2 marks $R = \frac{(1.5)^2}{0.75}$ scores 3 marks award full marks for correct answer without working	

Q6.

Question Number	Answer	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1(6 marks) Circuit diagram including • power supply • ammeter • voltmeter • filament lamp • means of varying potential difference Description of method • measure current with ammeter • measure potential difference with voltmeter • vary the potential difference • calculate the resistance • repeat and compare	**(6)** AO 1 2

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• An explanation that demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents an explanation that is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• An explanation that demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents an explanation of the procedure that has a structure, which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	• An explanation that demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure, which is clear, coherent and logical. (AO1)

Q7.

Question Number	Answer	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1(6 marks) AO1 Earth • earth wire connected to metal case • metal case is a conductor • (when live touches case) resistance between live and earth is very low • (very) large current to earth through (low resistance) earth wire • case is kept at same potential as earth • so cannot get a shock if (earthed) person touches metal case Fuse • made of thin wire • fuse connected between live pin and wire to kettle • temperature of wire depends on current in it • when the current is (very) large, the temperature of the wire increases beyond melting point of wire • fuse (wire) breaks • disconnects mains supply to kettle • prevents damage to house wiring • (now) there is no possibility of live wire in kettle being at mains voltage	**(6)**

Descriptor
• No rewardable material.
• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Summary for guidance			
Level	**Mark**	**Additional Guidance**	**General additional guidance – the decision within levels** e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated facts about either fuse or earth	Possible candidate responses The fuse blows when there is a fault. The earth stops you from getting shock
Level 2	3–4	Additional guidance facts about fuse and earth that are linked to provide an explanation of the operation of either the fuse or the earth. OR a well-developed explanation of the operation of fuse or earth	Possible candidate responses The earth wire is connected to the (metal) case of the kettle. The wire in fuse melts when current becomes too big. OR A large current flows through the wires in the kettle. The wire in the fuse heats up and melts. This disconnects the kettle from the mains supply.
Level 3	5–6	Additional guidance explanation of the operation of both the fuse and the earth one explanation may be more developed than the other but both fuse and earth must be explained.	Possible candidate responses A large current flows through the wires in the kettle. The wire in the fuse heats up and melts. The earth wire keeps (exposed) metal parts at earth potential and prevents shocks

Q8.

Question Number:	Answer	Mark
(i)	C 6.0 joules per coulomb **The only correct answer is C** ***A*** *is not correct because 1 volt is 1 joule per coulomb* ***B*** *is not correct because 1 volt is 1 joule per coulomb* ***D*** *is not correct because 1 volt is 1 joule per coulomb*	**(1)** AO 1 1

Question Number:	Answer	Additional Guidance	Mark
(ii)	recall and substitution (1) $42 = \frac{200 \times t}{(1000)}$ rearrangement (1) $t = \frac{42\ (\times 1000)}{200\ (\times 60)}$ evaluation (1) (t =) 3.5 (minutes)	accept substitution and rearrangement in either order 2.1 to any power of 10 or 3.5 to any power of 10 scores 2 marks 3 minutes 30 seconds award full marks for correct answer without working	**(3)** AO 1 1 AO 2 1

Question Number:	Answer	Additional Guidance	Mark
(iii)	recall and substitution (1) (E =) 42 x 6.0 evaluation (1) (energy =) 250 (J)	(using E = VIt) (E =) 6.0 x 200 (x 10^{-3}) x 2.10 (x 10^{2}) accept 252 (J) award full marks for correct answer without working	**(2)** AO 1 1 AO 2 1

Q9.

Question Number	Answer	Acceptable answers	Mark
(i)	Substitution (1) 2900 = 230 × current Transposition (1) $\frac{2900}{230}$ Evaluation (1) 13 (A)	Award full marks for correct answer with no working Allow substitution and transposition in either order Ignore powers of ten errors until evaluation Allow numbers which round up to 13	**(3)**

Question Number	Answer	Acceptable answers	Mark
(ii)	Substitution (1) 97 = 2.9 × time × 17 Transposition (1) $\frac{97}{2.9 \times 17}$ OR $\frac{97}{49.3}$ Evaluation (1) 2.0 (h)	Award full marks for correct answer with no working Allow substitution and transposition in either order Ignore powers of ten errors until evaluation Allow $\frac{97}{17}$ = 5.7 for 1 mark Allow numbers which round up to 2.0	**(3)**

Q10.

	Answer	Acceptable answers	Mark
(a)(i)	C		**(1)**
(a)(ii)	B		**(1)**
(b)	substitution (1) 3.7 x 13 evaluation (1) 48 (C)	 48.1 Correct answer with no calculation scores 2 marks	**(2)**
(c)(i)	Correct responses can be seen in (i) or (ii) An explanation linking • <u>electrons</u> (1) and <u>one</u> of • removed by friction (1)	 ["positive electrons/ protons moving", seen anywhere in part (i) or (ii) loses this mark] ignore reference to charge before rubbing transferred from cloth	**(2)**

	• (transferred) <u>to</u> plastic (1)		
(c)(ii)	opposite to charge on plastic (1) <u>equal</u> to charge on the plastic (1)	charge on cloth is positive <u>same size</u> as charge on plastic electrons transferred from the cloth equal to electrons lost by cloth	**(2)**

Total question = 8 marks

Q11.

Question Number	Answer	Additional guidance	Mark
(i)	recall and substitution into V = IR (1) 5.0 = 0.26 × R rearrangement (1) (R=) $\frac{5.0}{0.26}$ evaluation (1) 19 (Ω)	accept substitution and rearrangement in either order (R=) $\frac{V}{I}$ $\frac{5.0}{0.26}$ scores 2 marks accept answers that round to 19 (Ω) (e.g. 19.23) accept answer written table if not written on answer line. award full marks for the correct answer without working	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	a comment that includes the following points idea that resistance increases with potential difference (1) idea that doubling the potential difference does not result in doubling of resistance (1) **OR** V = constant x R is not supported by this data (1) correct processing of data from the table to support either of the above mark points (1)	idea that equal increments of potential difference do not cause equal increments of resistance reverse argument e.g. if student was correct then equal increments of p.d. would cause equal increment of resistance if student was correct then current would be constant ignore simple quoting of data for this mark	(3)

Question Number	Answer	Additional guidance	Mark
(iii)	A description that includes add a variable resistor (1) **with** in series (with the lamp / power supply) (1) **OR** add a potential divider (1) **with** in parallel with power supply (1)	marks may be obtained from a circuit diagram rheostat accept between / before / after for in series potentiometer across the power supply ignore replacing power supply / using fixed resistor(s) / LDR / thermistor in both cases, second mark conditional on first mark	**(2)**

Q12.

Question Number	Answer	Acceptable answers	Mark
(a)	C (gain electrons)		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking • (Force of) attraction (1) • (plates have) opposite charge (to dust) (1)	Plates have a positive charge Ignore different charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	transferred to plate / lost (1)	neutral / become discharged	**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	An explanation linking any two of • Metal is a conductor (1) • Electrons / (negative) charge moves (through the plates/ wire) (1) • Towards the voltage supply / earth /ground (1)	 Metal not an insulator Plates / charges are earthed	**(2)**

Question Number	Answer	Acceptable answers	Mark
(d)	Substitution: $Q = 1.2 \times 10^{-3} \times 40$ (1) Evaluation: 0.048 or 4.8×10^{-2} (1) C / coulombs (1)	Give 2 marks for correct answer with no working shown Unit mark is independent Allow for 1 mark 48 (with incorrect or no units) Allow for 2 marks 48 C Allow for all 3 marks 48 mC	**(3)**

Q13.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	60 (kW h/ units) (1) 60 x 20 (= 1200) (p) (1)	15459 - 15399 £12 ecf Award full marks for correct answer with no working £12 scores 2 Power of Ten error scores maximum 1 60 in answer space with no working scores 1	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	60 / 15 (1) 4 (kW) (1)	Allow ecf from 6(a)(i) marking point 1 Award full marks for correct answer with no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation linking any two of: • increase voltage (1) • decrease current (1) • reduce {loss / waste} of {energy / heat} (1)	Increase efficiency (of energy transmission) Ignore "more efficient" by itself Accept power instead of energy Accept no energy loss	**(2)**

Question Number		Indicative content	Mark
QWC	*** (c)**	A description to include some of the following points • speed of movement • stronger / more powerful (ORA) magnet • more turns / coils (ORA) • iron core • reversing movement • turning the magnet round • effect of any / each change • more conducting / less resistant wire • allow stronger current • allow ammeter reading / recording / voltage for current • allow moving coil Correct ideas but using inaccurate scientific terminology • larger / bigger magnet • more / longer movement Ignore • irrelevant information • speeds up current or more electricity	**(6)**
Level	**0**	no rewardable material	
1	**1-2**	• a limited description of any one change e.g. use more coils **OR** a stronger magnet. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3-4**	• a simple description of any two different changes **OR** one change and its effect e.g. use more coils and a weaker magnet **OR** more coils more current • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description of a change linked to its effect and a second different change e.g. using more turns of wire makes a bigger current. Moving the magnet out. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Q14.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	**B**		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	substitution V = 0.039 x 185 (1) evaluation 7.215 (which is about 7.2) (V) (1)	Substitution 7.2 = I x 185 (1) transposition I = 7.2 ÷ 185 (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	**C** (same as)		**(1)**

Question Number	Answer	Acceptable answers	Mark
(a)(iv)	An explanation to include The resistance (of the LDR) changes Greater resistance when in the dark	 LDR has less resistance in the light	**(2)**

Question Number		Indicative Content	Mark
QWC	***(b)**	An explanation linking some of the following. • less current is used at night-time • Resistance (of LDR or circuit) would increase with less ambient light • Higher resistance will allow less current (in the circuit) (ORA) • Less current in circuit means less energy from the battery • Less power required in the dark ORA for light conditions • Less current means less energy transferred (per second) • Total energy transferred is less during night time (than it would otherwise have been) due to the higher resistance of the LDR	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation linking the light level to EITHER resistance OR current. eg. It increases the resistance in the dark. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• A simple explanation linking the light level to TWO of resistance, current, energy. eg. At night-time its resistance would increase. This would reduce the current from the battery • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• A detailed explanation linking the light level to resistance AND current, AND energy. e.g. At night-time the resistance would be more. This would reduce the current and mean that the battery will not have to supply as much energy. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	