AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.2.3.2

Mains electricity

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**8**
Available paper years	**2019–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

6.2.3.2 Mains electricity

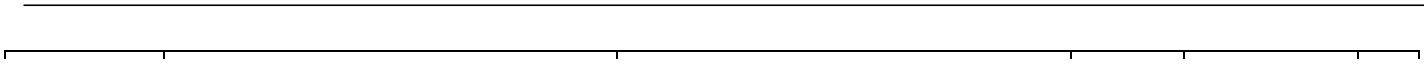
Answer 01 · Mark scheme June 2019 | 8464/P/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	an energy resource that cannot be replenished as it is used	allow an energy resource that will run out ignore cannot be re-used	1	AO1.1 AO1 in isolation 6.1.3	E
03.2		an answer of 30 (A) scores **4** marks		AO2.1 6.2.4.1	E
	6.9 k(W) = 6900 (W)		1		
	6900 = 230 × I	allow correct substitution of an incorrectly/not converted value for power	1		
	$I = \frac{6900}{230}$	allow a correct transformation using an incorrectly/not converted value for power	1		
	I = 30 (A)	allow a correct calculation using an incorrectly/not converted value for power	1		
03.3	direct potential difference is always in the same direction	allow direct current is always in the same direction	1	AO1.1 6.2.3.1	E
	alternating potential difference changes direction	allow alternating current changes direction	1		
03.4	lower potential difference across the cable	allow lower power/energy dissipation	1	AO1.1 6.1.2.2	E
	it is more efficient	allow it won't get as hot	1	6.2.4.1	
	OR (lower resistance gives) a greater current (for the same potential difference) (1) so the car battery can charge faster (1)				
Total			**9**		

6.2.3.2 Mains electricity

Answer 01 · Mark scheme

June 2019 | 8464/P/1H | Original Q3



6.2.3.2 Mains electricity

Answer 02 · Mark scheme June 2019 | 8464/P/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	electrons collide with particles in the heating element which increases the (kinetic) energy of the particles (in the heating element)	allow there is a current in the heating element allow internal store of energy increases allow the particles (in the heating element) vibrate more rapidly	1 1	AO1.1 6.2.4.2 6.3.2.1 WS 1.2	E
05.2	the starting temperature of the water	allow the starting temperature of the kettle	1	AO3.3a 6.2.4.2 WS 2.2	E
05.3	(the heating element of) the kettle took time to heat up		1	AO3.1a 6.2.4.2 WS 3.7	E
05.4	the (rate of) energy transfer (per kg of water) to the surroundings decreases as the mass of water increases **or** the efficiency of the kettle increases as the mass of water increases	allow the (rate of) energy transfer (per kg of water) to the surroundings changes as the mass of water changes allow the efficiency of the kettle changes as the mass of water changes	1	AO3.1b 6.2.4.2 WS 3.7	E

6.2.3.2 Mains electricity

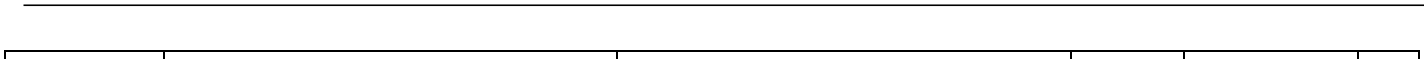
Answer 02 · Mark scheme

05.5	E = 2600 × 120 E = 312 000 (J) 312 000 = 0.80 × c × (100-18) **or** 312 000 = 0.80 × c × (82) $c = \frac{312\,000}{0.80 \times 82}$ c = 4 756 c = 4 800 (J/kg °C) (2 s.f.)	an answer of 4800 (J/kg °C) scores **6** marks a correct answer given to more than 2 s.f. scores **5** marks allow a correct substitution of an incorrectly/not converted value of P and/or t. this answer only the equation E=Pt must have been used to score subsequent marks. allow use of their value of E calculated using E =Pt for this and subsequent steps this mark can only be scored for a correct rounding of a value of c calculated using correct equations	1 1 1 1 1	AO2.1 6.3.2.2 6.1.1.3 6.1.1.4 WS 3.3	E
Total			**11**		

6.2.3.2 Mains electricity

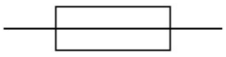
Answer 02 · Mark scheme

June 2019 | 8464/P/1H | Original Q5



6.2.3.2 Mains electricity

Answer 03 · Mark scheme November 2020 | 8464/P/1H | Original Q1

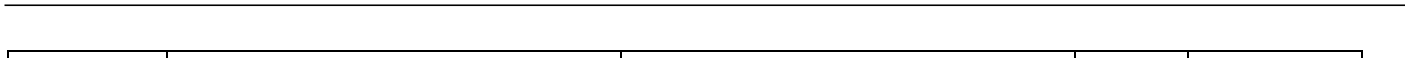
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	swap the blue wire and the green and yellow wire	allow connect the blue wire to the neutral pin and the yellow and green wire to the earth pin. allow swap the earth and neutral wires ignore the earth wire and neutral wire are wrongly connected	1	AO2 6.2.3.2
01.2	230 (V) 50 (Hz)		1 1	AO1 6.2.3.1 6.2.3.2
01.3	0 (V)		1	AO1 6.2.3.2
01.4			1	AO1 6.2.1.1
01.5	the person could get an electric shock because there is a current in the person	allow so the person could be electrocuted allow because the person provides a connection (from the washing machine) to earth allow because there is a potential difference across the person	1 1	AO3 6.2.3.2

01.6	the charge flows through the earth wire (instead of the person) because the resistance of the earth wire is much less than that of a person	 allow so the case does not become live allow so the fuse will break / melt / blow	1 1	AO3 6.2.3.2
Total			**9**	

6.2.3.2 Mains electricity

Answer 03 · Mark scheme

November 2020 | 8464/P/1H | Original Q1



6.2.3.2 Mains electricity

Answer 04 · Mark scheme

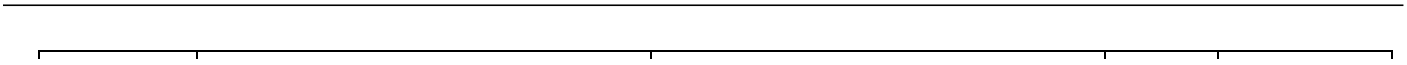
November 2021 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$V = I R$		1	AO1 6.2.1.3
01.2	3.9 = 0.12 × R $R = \frac{3.9}{0.12}$ R = 32.5 (Ω)	 allow R = 33 (Ω)	1 1 1	AO2 6.2.1.3
01.3	energy = power × time **or** E = P t		1	AO1 6.2.4.2
01.4	time = 150 000s energy = 0.46 × 150 000 energy = 69 000 (J)	 allow a substitution using an incorrectly/not converted value of time allow a correct calculation using an incorrectly/not converted value of time	1 1 1	AO2 6.2.4.2
01.5	thermistor		1	AO1 6.2.1.1
01.6	the current will increase (because) the resistance decreases		1 1	AO1 6.2.1.4
Total			11	

6.2.3.2 Mains electricity

Answer 04 · Mark scheme

November 2021 | 8464/P/1H | Original Q1



6.2.3.2 Mains electricity

Answer 05 · Mark scheme November 2021 | 8464/P/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the kinetic energy (and the potential energy) of the particles increases so the internal energy increases because it is the sum of kinetic and potential energy (of the particles)	allow the speed of the particles increases	1 1	AO1 6.3.2.1 6.3.2.3
06.2	latent heat (of vaporisation)	allow specific latent heat (of vaporisation)	1	AO1 6.3.2.3
06.3	stays the same		1	AO1 6.3.1.2
06.4	more collisions per second a greater force per collision		1 1	AO1 6.3.3.1

6.2.3.2 Mains electricity

Answer 05 · Mark scheme

06.5	$0.875 = \frac{\text{useful output energy transfer}}{1\ 560\ 000}$	allow a correct substitution using incorrectly/not converted values of efficiency and/or energy	1	AO2 6.1.2.2 6.1.1.3 6.3.2.2
	useful output energy transfer = 1 365 000(J)	this answer only	1	
		the equation efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ must have been used to score subsequent marks		
	1 365 000 = 125 × c × (22.1–11.6)	allow a correct substitution using their calculated value of useful output energy	1	
	$c = \frac{1\ 365\ 000}{125 \times 10.5}$	allow a correct re-arrangement using their value of useful output energy	1	
	c = 1040 (J/kg °C)	allow a correct calculation using with their value of useful output energy	1	
	$c = 1.04 \times 10^3$ (J/kg °C)	this mark can only be awarded for a calculation using the correct equations	1	

06.6	the advertisement has ignored the energy input from the surrounding air so the total energy input is greater than the energy supplied from the electricity the efficiency must be less than 100%	an answer that the total energy input comes from the electricity supply and the air outside the building gains the first two marking points	1 1 1	AO3 AO2 AO1 6.1.2.2
Total			**15**	

6.2.3.2 Mains electricity

Answer 06 · Mark scheme

June 2023 | 8464/P/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	inertia		1	AO1 6.5.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	→		1	AO2 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	increase the current so that the (resultant) force increases	allow use a stronger magnet	1 1	AO1 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	bring the (same end of the) iron bar close to each pole / end of the permanent magnet any repulsion shows the iron bar is a permanent magnet **or** if one end of the iron bar is attracted to both poles it is not a permanent magnet	allow bring each end of the iron bar to the same pole of the magnet	1 1	AO3 6.7.1.1

6.2.3.2 Mains electricity

Answer 06 · Mark scheme

June 2023 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	the compass (needle always) points in the same direction because it aligns itself with the Earth's magnetic field	allow the compass (needle always) points north dependent on MP1	1 1	AO1 6.7.1.2

Total Question 4	8

6.2.3.2 Mains electricity

Answer 07 · Mark scheme

June 2024 | 8464/P/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	kinetic energy (of the beater / food) internal / thermal energy (of the surroundings / whisk / food)	ignore sound	1 1	AO1 6.2.4.2 6.1.2.1 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	power = $\frac{\text{work done}}{\text{time}}$ or $P = \frac{W}{t}$		1	AO1 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$92 = \frac{23\,000}{\text{time}}$ $\text{time} = \frac{23\,000}{92}$ 250 (s)		1 1 1	AO2 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$P = I^2 R$		1	AO1 6.2.4.1

6.2.3.2 Mains electricity

Answer 07 · Mark scheme

June 2024 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	I = 0.500 A		1	AO2 6.2.4.1
	$P = 0.500^2 \times 640$	allow a correct substitution of an incorrectly / not converted current	1	
	P = 160 (W)	allow a correct calculation using an incorrectly / not converted current	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	230 (V)		1	AO1 6.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	decreases		1	AO1 6.2.4.1

Total Question 1	**12**

6.2.3.2 Mains electricity

Answer 08 · Mark scheme

June 2025 | 8464/P/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	230 (V) 50 (Hz)	allow about 230 (V)	1 1	AO1 6.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	live – brown neutral – blue		1 1	AO1 6.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	alternating (potential difference) continuously changes direction direct (potential difference) is always in the same direction		1 1	AO1 6.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	energy / power is transferred by the laptop (when being used) (so) the power delivered to the battery is reduced	 allow (so) the rate at which energy is transferred to the battery is lower	1 1	AO2 AO3 6.1.1.4 6.1.2.1

6.2.3.2 Mains electricity

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$P = 15 \times 4.8$		1	AO2 6.2.4.1
	$P = 72$ (W)		1	6.2.4.2 6.1.1.4
	$\Delta P = 97 - 72 = 25$ (W)		1	
	$25 = \frac{225\,000}{t}$	subsequent marks may be awarded if an incorrect / not converted value of E is used.	1	
	$t = 9000$ (s)		1	
	$t = 2.5$ (hours)		1	

Total Question 5	14

6.2.3.2 Mains electricity

Answer 01 · Examiner comments — June 2019 | 8464/P/1H | Original Q3

Question 3 (Standard/high demand)

03.1 Just over 70% of students described a non-renewable resource correctly, as either a resource which is not replenished as it is used, or as a resource which is finite and will run out.

03.2 Slightly more than 40% of students gained full marks on this question. Around one in seven students gained 3 marks, mostly for failing to convert 6.9 kW into watts, or for making an incorrect conversion. Around 35% of students gained no marks on this question.

03.3 About a third of students gained 2 marks on this question but over half the students gained 0 marks. Answers describing current or potential difference were accepted, but a proportion of students incorrectly described direct current as what happens in a series circuit, and alternating as what happens in a parallel circuit. Other misconceptions included students who suggested that direct potential difference takes a constant value but alternating potential difference changes value. While this may be true, it does not explain the difference between direct and alternating.

Answer 01 · Examiner comments — June 2019 | 8464/P/1H | Original Q3

03.4 Just under half of students scored 1 mark, with around a further 15% of students gaining both marks. Many students gave answers in terms of the risk of electrocution or safety, which did not gain credit. Many students wrote of more electricity going through a lower resistance cable, which was not sufficient: they needed to either mention a lower potential difference across the cable, or a greater current in the cable for the same potential difference.

Answer 02 · Examiner comments — June 2019 | 8464/P/1H | Original Q5

Question 5 (High demand)

05.1 Just over 40% of students scored at least 1 mark on this question and just below 5% of students gained both marks. Of those gaining no marks, some stated that the hot water in the kettle increased the temperature of the heating element. Many students wrote about friction in the circuit causing heating, although some of these answers gained one mark by also mentioning that a current was involved.

05.2 Slightly more than 15% of students identified that the starting temperature of the kettle, water, or heating element needed to be controlled. A small proportion of students suggested that the kettle itself was a control variable, but this was not allowed as if this had been changed, the investigation would not then have been about a particular electric kettle.

05.3 Around 1 in 10 students gained this mark for either suggesting that the kettle or element took time to heat up, or for suggesting that the kettle took time to detect that there was no

6.2.3.2 Mains electricity

Answer 02 · Examiner comments June 2019 | 8464/P/1H | Original Q5

water in the kettle. The data for this question was taken from a real kettle. Many students stated that the kettle took time to switch off when it was empty, which is effectively saying the same as the line does not go through the origin, so and gained no credit. A large number of students stated that it is not possible to put no water in a kettle, and again this scored no marks.

05.4 Only a very small proportion of students gained this mark. Most students did not appear to realise that they had to suggest what caused the curve to be non-linear, and instead described what was meant by a non-linear trend or pointed out that the graph was not directly proportional.

05.5 Just over 60% of students scored 0 marks on this level 8-9 calculation question. However, the students who did manage to access the question generally scored rather well, with more than 25% of all students gaining 5 or 6 marks.

Answer 04 · Examiner comments November 2021 | 8464/P/1H | Original Q1

Question 01 (Standard demand)

01.1 Slightly over two thirds of students selected the correct equation.

01.2 Full marks were gained by over 60% of the students, with about 35% failing to gain any credit.

01.3 This equation was correctly recalled by around 70% of students.

01.4 Most students did not attempt to convert 2500 minutes into seconds. Nearly a quarter of students gained all 3 marks, with just over half of students gaining 2 marks.

01.5 Slightly less than 40% of higher tier students were able to correctly identify the symbol for a thermistor.

6.2.3.2 Mains electricity

Answer 04 · Examiner comments November 2021 | 8464/P/1H | Original Q1

01.6 Most students failed to recognise that the resistance of the thermistor would decrease as temperature increased, with many students stating that because the potential different across the thermistor was constant, the current in the thermistor must also be constant. Another misconception demonstrated in a number of responses was that the current would increase because the increased temperature gives the current more energy. Roughly one in ten students gained 2 marks, with just over a third gaining 1 mark.

Answer 05 · Examiner comments November 2021 | 8464/P/1H | Original Q6

Question 6 (High demand)

06.1 The concept of internal energy is challenging to many students, and only around 15% of students gained any credit on this question.

06.2 Just over 10% of students answered this correctly.

06.3 This was correctly answered by just over a third of all students. Over half of all the students thought that the mass of the coolant decreases when it evaporates.

06.4 While many students realised that pressure was due to collisions between the particles and the pipe, it was uncommon for students to mention that the rate or frequency of those collisions would increase with temperature and density. Very few students recognised that with increased temperature each collision would exert a greater force on the pipe. Roughly 10% of students gained at least one mark on this question.

06.5 This question was targeted students working at grade 8-9. It required students to realise that the efficiency equation needed to be used before the equation for specific heat capacity could be applied. A fair proportion of students made errors in using the efficiency equation, ending up with an incorrect energy value. Of students who did this, the most common error was to calculate the useful energy, and then to subtract this from the total energy supplied, so that they ended up with 12.5% of 1560 kJ, rather than 87.5% of 1560 kJ. Although their incorrect use of the efficiency equation gained them no marks, these students were able to apply their calculated energy value to the specific heat capacity equation and still gain some credit on this question. Around 15% of students gained at least 4 marks.

6.2.3.2 Mains electricity

Answer 05 · Examiner comments November 2021 | 8464/P/1H | Original Q6

06.6 Many students did not appear to have assimilated all of the information in the question, and used the information to incorrectly calculate that the efficiency of the heat pump was actually 25%, rather than the 400% advertised. A few students referred to the previous question and stated that the efficiency of the heat pump is 87.5%, which gained no credit. It was uncommon for students to realise that the energy transferred to the coolant comprised of energy transferred from the air outside the building in addition to the energy transferred from the mains electricity supply. The most common mark scored in this question was by those students who recognised that efficiency cannot exceed 100%. Nearly a fifth of all students made no attempt to answer the question.

6.2.3.2 Mains electricity

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

6.2.3.2 Mains electricity

Answer 06 · Examiner comments — June 2023 | 8464/P/2H | Original Q4

Question 4 (standard demand and standard/high demand)

04.1 Fewer than 20% of students correctly answered inertia.

04.2 Just over 50% of students gave the correct direction for the acceleration.

Answer 06 · Examiner comments — June 2023 | 8464/P/2H | Original Q4

04.3 Approximately 50% of students gained one mark on this question. Most of those that did suggested increasing the current or the strength of the magnet. Very few went on to explain that this would increase the force on the copper rod.

04.4 Approximately 20% scored two marks on this question. Of the 20% that scored 1 mark, most suggested bringing both sides of the magnet close to the iron bar (or vice versa) but then incorrectly stated that any attraction proves it is a magnet.

04.5 Approximately 40% of students gained at least one mark on this question. Even the credit worthy responses mostly contained simple statements like ‘it always points north’. Only a small percentage explained that this was because the magnet aligns itself with the Earth’s magnetic field.

Answer 07 · Examiner comments

June 2024 | 8464/P/1H | Original Q1

Question 1 (standard demand)

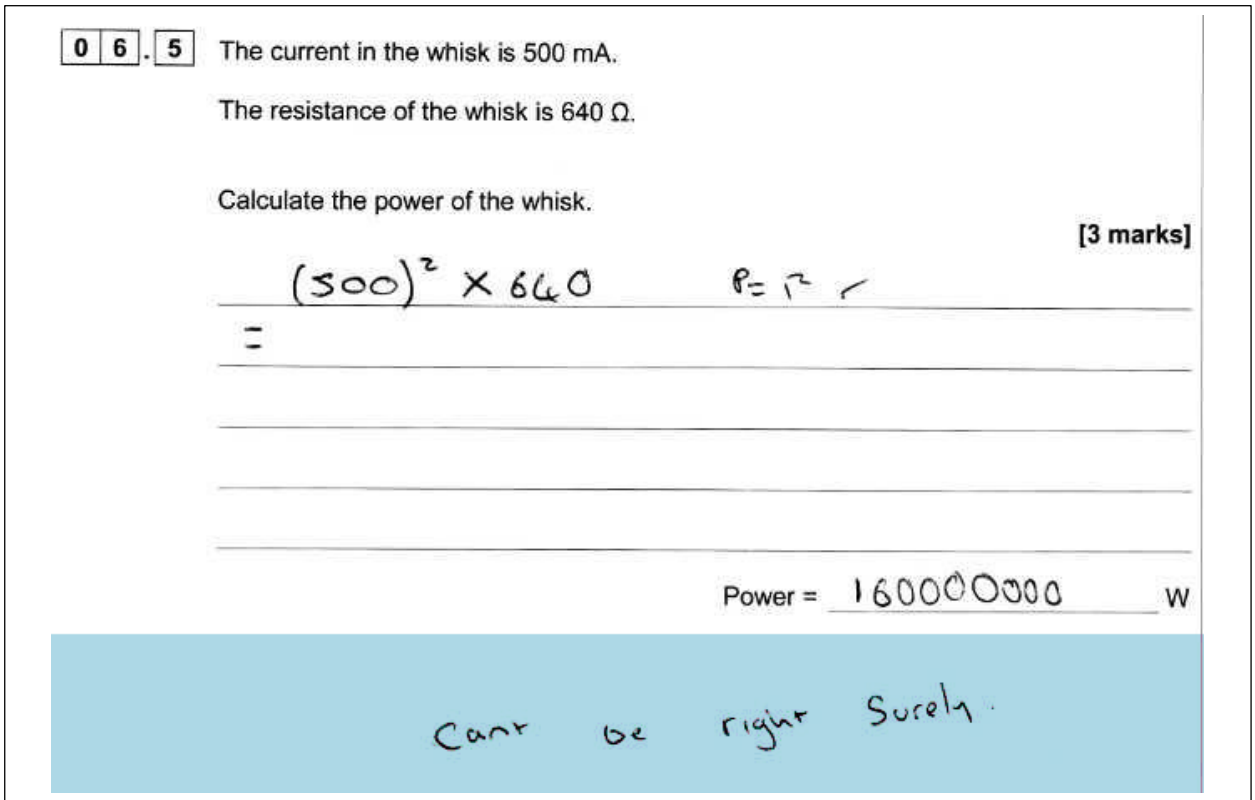
01.1 Almost all students scored at least 1 mark on this question, with nearly two-thirds scoring both marks. The most common incorrect answers were an increase in electrical energy and an increase in chemical energy.

01.2 A very low proportion of students answered this incorrectly.

01.3 Nearly 90% of students arrived at the correct final answer for this calculation, gaining 3 marks.

01.4 Most students selected the correct equation, with about 1% of students not gaining this mark.

01.5 For this calculation, many students did not correctly convert the current into amps. Some students forgot to show that the current should be squared in their substitution. Others showed a valid substitution but forgot to square the current when they entered it in their calculator. About 40% scored all 3 marks, but about 50% gained 2 marks, and over 95% scored at least 1 mark.



This student did not realise that the current was given in milliamps, so only scored marking points 2 and 3. However, the comment 'Can't be right, surely' indicates that they realise that the power of an electric whisk ought to be a lot lower. Students who think about how realistic their answer is may give themselves a much better chance of spotting their mistakes and doing something to rectify them.

01.6 Slightly more than one in two students could recall the potential difference between the live and neutral wires.

01.7 Over 80% of students identified that an increase in current would be caused by a decrease in resistance.

© 2024 AQA and its licensors. All rights reserved.

Answer 08 · Examiner comments

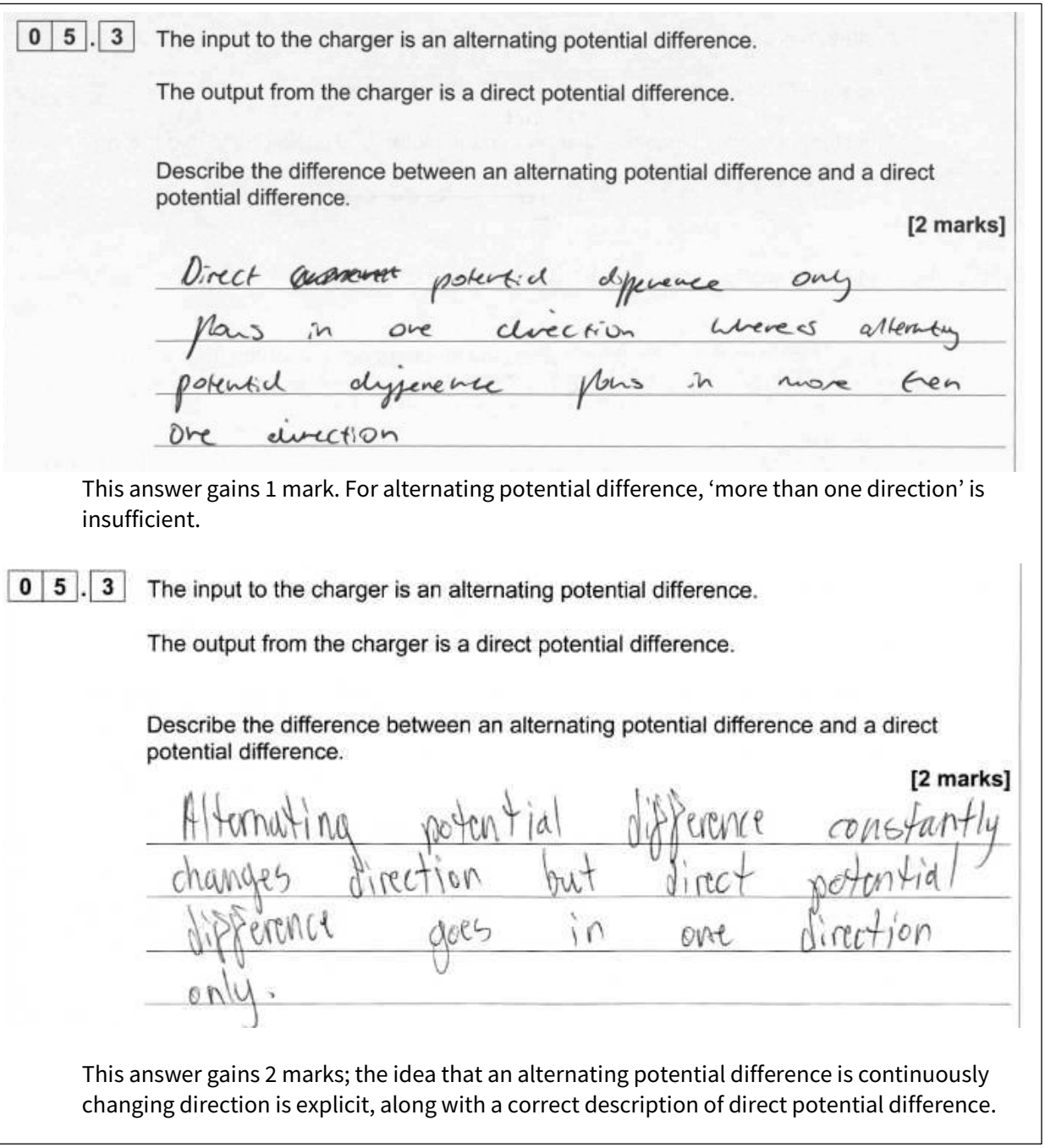
June 2025 | 8464/P/1H | Original Q5

Question 5 (Standard/high and high demand)

05.1 55% of students gave one correct value and 20% gave both correct. Where, only one was correct, the frequency was more commonly known.

05.2 75% of students correctly named both wires and the correct colour of insulation. Where only one mark was awarded, it was most common to see the live wire and colour correct, but the name of the second wire was incorrect. Incorrect responses often gave the colour of the earth wire.

05.3 43% gained 1 mark. The vast majority of these were awarded the mark for direct (potential difference) is always in the same direction. Under 10% of students also gained the mark for the alternating potential difference. For alternating potential difference, the idea that it is continuously changing direction must be explicit.



0 5 . 3 The input to the charger is an alternating potential difference.

The output from the charger is a direct potential difference.

Describe the difference between an alternating potential difference and a direct potential difference.

[2 marks]

Direct potential difference only flows in one direction whereas alternating potential difference flows in more than one direction

This answer gains 1 mark. For alternating potential difference, 'more than one direction' is insufficient.

0 5 . 3 The input to the charger is an alternating potential difference.

The output from the charger is a direct potential difference.

Describe the difference between an alternating potential difference and a direct potential difference.

[2 marks]

Alternating potential difference constantly changes direction but direct potential difference goes in one direction only.

This answer gains 2 marks; the idea that an alternating potential difference is continuously changing direction is explicit, along with a correct description of direct potential difference.

© 2024 AQA and its licensors. All rights reserved.

6.2.3.2 Mains electricity

Answer 08 · Examiner comments June 2025 | 8464/P/1H | Original Q5

05.4 60% of students correctly identified that the laptop is using energy as it is still being used. Only a very small number correctly explained that this meant that the rate at which the energy is stored in the battery decreases.

05.5 This multi-step calculation proved to be more challenging than in previous years. Only approximately 15% of students gained full marks. 50% of students calculated the power of the laptop but could not get any further. Some students calculated the time in seconds correctly but could not convert the answer to hours. Students are reminded that they should show their working for multi-step calculations.