AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.2.4.2

Energy transfers in everyday appliances

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**5**
Available paper years	**2018–2024**

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.

6.2.4.2 Energy transfers in everyday appliances

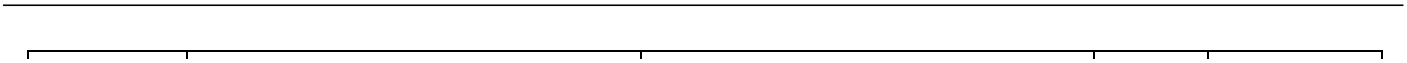
Answer 01 · Mark scheme June 2018 | 8464/P/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the wall has two / three layers	allow the wall is thick	1	AO1 6.1.2.1
	cavity wall insulation / brick / block has a low thermal conductivity		1	
	so less energy is transferred by conduction	allow rate of energy transfer is lower ignore any reference to convection and / or radiation	1	
05.2	$T = 17.4 + \left(\frac{(20.8 - 17.4)}{2}\right)$ **or** $T = 20.8 + \left(\frac{(20.8 - 17.4)}{2}\right)$	an answer in the range 18.5–19.1 scores **2** marks	1	AO3 6.1.2.1
	T = 19.1 (°C)		1	
05.3	chemical energy store of the fuel decreases		1	AO1 6.1.2.1
	thermal energy store of the water increases	allow kinetic energy store of the water particles increases	1	
	thermal energy store of the air / atmosphere increases	allow kinetic energy store of the air particles increases	1	
05.4	E = 15 000 000 (J)	an answer of 25 000 scores **4** marks	1	AO2 6.1.1.4
	t = 600 (s)		1	
	$p = \frac{15\,000\,000}{600}$	allow a correct substitution of incorrectly / not converted values of E and / or t	1	
	P = 25 000 (W)	allow a correct calculation using incorrectly / not converted values of E and / or t	1	
Total			**12**	

6.2.4.2 Energy transfers in everyday appliances

Answer 01 · Mark scheme

June 2018 | 8464/P/1H | Original Q5



6.2.4.2 Energy transfers in everyday appliances

Answer 02 · Mark scheme June 2018 | 8464/P/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	a curve in the first and third quadrants only, passing through origin		1	AO1 6.2.1.4
	decreasing gradient		1	
06.2	any **two** from: • $I_1 = I_2 + I_3$ • $I_2 = I_3$ • $I_1 = 2I_2$ • $I_1 = 2I_3$	allow **1** mark for each correct description given in words	2	AO2 6.2.2
06.3		an answer of 60 scores **5** calculation marks		
	$3 = I^2 \times 12$		1	AO2 6.2.4.1
	$I = \sqrt{\left(\frac{3}{12}\right)}$		1	6.2.4.2
	$I = 0.5$ (A)		1	
	$Q = 0.5 \times 60 = 30$	allow Q = their calculated I × 60	1	
	$Q_{total} = 60$	allow an answer that is consistent with their calculated value of I	1	
	or			
	$3 = I^2 \times 12$ (1)			
	$I = \sqrt{\left(\frac{3}{12}\right)}$ (1)			
	$I = 0.5$ (A) (1)			
	$I_{total} = 1.0$ (A) (1)	allow I_{total} = their I × 2		
	$Q = 1.0 \times 60 = 60$ (1)	allow an answer that is consistent with their calculated value of I		
	coulombs **or** C		1	AO1

6.2.4.2 Energy transfers in everyday appliances

Answer 02 · Mark scheme

June 2018 | 8464/P/1H | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.4	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO2
	No relevant content	0	
	Indicative content • resistance of LDR changes when light intensity changes • when light intensity increase resistance of LDR decreases • overall resistance of circuit decreases • potential difference across total resistance remains unchanged • current in ammeter increases • potential difference across fixed resistor increases • potential difference across LDR decreases • reading on the voltmeter decreases • potential difference is shared between the components in series • the lower the resistance of the LDR the smaller the share of the potential difference • reading on the voltmeter decreases		6.2.1.1 6.2.1.4
Total		**16**	

6.2.4.2 Energy transfers in everyday appliances

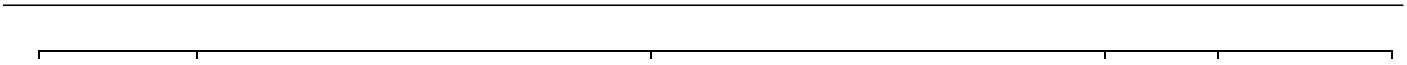
Answer 03 · Mark scheme November 2021 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$V = I R$		1	AO1 6.2.1.3
01.2	$3.9 = 0.12 \times R$ $R = \frac{3.9}{0.12}$ 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**	

6.2.4.2 Energy transfers in everyday appliances

Answer 03 · Mark scheme

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



6.2.4.2 Energy transfers in everyday appliances

Answer 04 · Mark scheme

June 2022 | 8464/P/1H | Original Q2

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.1.1.3 6.3.2.2 RPA14
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • measure mass of oil using the top pan balance • measure start temperature of oil using the thermometer • place beaker of oil on heater • switch on heater to heat oil • measure final temperature of oil using the thermometer • measure energy transferred using joulemeter • calculate increase in temperature ($\Delta\theta$) • use the equation $E = mc\Delta\theta$ to determine c		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	burns / scalds	allow cuts from broken glass ignore the heater / oil is hot	1	AO1 6.1.1.3 RPA14

6.2.4.2 Energy transfers in everyday appliances

Answer 04 · Mark scheme

June 2022 | 8464/P/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	power = $\frac{\text{energy transferred}}{\text{time}}$ **or** $P = \frac{E}{t}$		1	AO1 6.1.1.4 6.2.4.2 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	$50 = \frac{4750}{t}$ **or** $4750 = 50 \times t$ $t = \frac{4750}{50}$ t = 95 (s)		1 1 1	AO2 6.1.1.4 6.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	thermistor		1	AO1 6.2.1.4

6.2.4.2 Energy transfers in everyday appliances

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	250 (Ω)	allow an answer in the range 240 (Ω) to 260 (Ω) allow **1** mark for temperature = 160 (°C)	2	AO3 6.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	the water will recover its original properties if the steam is cooled		1	AO1 6.3.1.2

Total Question 2		**15**

6.2.4.2 Energy transfers in everyday appliances

Answer 05 · 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

6.2.4.2 Energy transfers in everyday appliances

Answer 05 · Mark scheme

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

Answer 01 · Examiner comments

June 2018 | 8464/P/1H | Original Q5

Question 5 (Standard/high and High demand)

05.1 Very few students gained more than one mark on this question. This is a new specification point this year but the answer to the question is straight recall from the specification.
Most students wrote vague answers about heat being contained inside and the cold not being allowed to enter. The starting point about the thickness of the wall was rarely mentioned and nor was the low thermal conductivity of the material.

05.2 72% of students calculated this correctly, either using the method in the mark scheme, or by calculating the midpoint using (20.8 + 17.4) /2. Of the incorrect responses, some students attempted to adjust the result to take into account the decreasing rate at which the temperature decreased, but were not always successful. Some students calculated the differences between the given temperatures, then the differences between the differences in order to determine the trend and then estimated the temperature at 30 minutes. Some students attempted to find an average temperature over a range of time, using various ranges.

05.3 49% of students scored no marks. Only 17% of students scored more than one mark and fewer than 2% scored three marks. Many students appeared confused by the reference to energy stores, rather than being asked to simply identify a chain of energy changes. Most commonly, one mark was scored for referring to thermal energy being added to the water. There were very few who considered the thermal store of the air.

A fairly common misconception was that, despite clearly shown exiting the boiler as hot water, the water would be heated enough to boil and leave the boiler as steam – the implication being that the hot exhaust gas was formed in this way.

05.4 75% of students gained at least one mark. Just over a tenth of students correctly carried out both conversions and achieved four marks. The most common mistake was in the conversion of 15 MJ into J but most students knew the equation and could substitute their sometimes incorrect conversions into the equation and calculate it correctly. A very simple answer saw 15 / 10 = 1.5 often written down and this gave the student two marks. Unfortunately a few students calculated energy × time and could only obtain the conversion marks if done correctly.

Answer 02 · Examiner comments

June 2018 | 8464/P/1H | Original Q6

Question 6 (Standard/high and High demand)

06.1 33% of students drew a curve in the correct quadrants which passed through the origin with decreasing gradient to score two marks. 25% of students then curved their lines back towards the *x*-axis at the ends and so did not score the gradient mark. The most common mistake was to draw a straight line in the correct quadrants through the origin as for a fixed resistor. A few drew the graph for a diode. Some students drew a curve or straight line through the second and fourth quadrants, and some drew a line or curve which was in one quadrant only, or intersected more than two quadrants.

06.2 Responses to this question were very mixed. 24% of students scored two marks and 24% of students scored one mark. Many students talked about the current being strongest close to the battery, and weaker further away. Voltage was also discussed in some responses.

Many students just stated that the current split which was not sufficient. However, there were some excellent concise answers that demonstrated a very good understanding of current in parallel circuits.

06.3 Half of the students found this multistep calculation question very challenging and scored no marks. 13 % of students scored five marks for correctly calculating a charge flow of 30 C but did not double this to determine the total.

Those who were unable to calculate the correct current could still have scored three marks for multiplying their incorrectly calculated current by 60, then doubling this number and finally naming the correct unit. Very few of these scored anything other than the unit mark. Those that did multiply a number by 60 often did not gain credit because it was unclear what their number represented.

06.4 Very few students achieved a level 3 response in this question. 38% of students gained at least one mark. A large number of students listed what they could recall about circuits despite this not being relevant to the question – information such as which meter is connected in series, which in parallel and what other components are in the circuit.

The majority of students were unable to recognise the symbol for the LDR with many stating it was a thermistor. Those that did recognise the symbol for the LDR often did not recall the correct link between light intensity and resistance or even the function of the LDR. Many students thought that the LDR was the actual light that was switched on and off by the light intensity. Many students who started the question well, correctly identifying the LDR and linking that correctly to how the resistance of the LDR would change, failed to explain how this change in resistance would affect the readings on the ammeter and voltmeter. Very few students demonstrated an understanding of how resistance affects current.

6.2.4.2 Energy transfers in everyday appliances

Answer 02 · Examiner comments

June 2018 | 8464/P/1H | Original Q6

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

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

6.2.4.2 Energy transfers in everyday appliances

Answer 03 · 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.

Answer 03 · 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 04 · Examiner comments

June 2022 | 8464/P/1H | Original Q2

Question 02 (Standard demand)

02.1 Almost all students gained some marks on this question, with about half of students accessing level 2 of the mark scheme and gaining 3 or 4 marks. Just over 15% of students gave answers which scored in level 3.

It was clear that a lot of students were not aware of what a top pan balance is, with many thinking that it is a device to help prevent things from falling over, or that the pan of the top pan balance was to be used for heating the oil. As a consequence of this misunderstanding, many students placed the top pan balance on the heater. Of the students who did know what a top pan balance is, a sizeable minority thought that it is used to find the weight of oil, rather than the mass of oil.

While most students realised that the thermometer should be used to measure temperature, some students measured the heat with the thermometer, which was worth no credit.

The joulemeter was often confused with a voltmeter, or students did not appreciate the function of a joulemeter. Common suggestions included setting the joulemeter to 10 and leaving it for a fixed time, for example.

A lot of students did not mention the measuring equipment at all, and simply stated that they would weigh the oil and measure its temperature. Students who did this were unable to access level 3 on the mark scheme, but could gain some credit for these statements.

Some students described the use of a voltmeter, ammeter, and stopclock to determine the energy supplied to the heater. Although a method determining specific heat capacity of oil using this equipment would lead to a valid outcome, this did not use the equipment given in the question, so would not be able to score all 6 marks.

Many students described the wrong experiment, either finding the boiling point of the oil, carrying out a cooling-curve experiment, or describing how to use an immersion heater to find the specific heat capacity of a block of metal. These responses could still gain some credit, for example by correctly stating how to use the thermometer.

02.2 Approximately 60% of students could identify the risk when using the given equipment.

It was clear that many students were unable to distinguish between risks, hazards, and precautions. Some students did not talk about safety at all, instead suggesting that a risk might be inaccurate results, for example.

02.3 As students were given an equation sheet for this exam, almost 100% of students gave the correct equation.

02.4 Nearly 90% of students gained full marks on this question, with just over 5% of students scoring 0 marks.

6.2.4.2 Energy transfers in everyday appliances

Answer 04 · Examiner comments

June 2022 | 8464/P/1H | Original Q2

02.5 Only about a fifth of students recognised that the electrical component whose resistance decreases as temperature increases is a thermistor.

02.6 Just over 40% of students gained both marks, with around a quarter gaining one mark on this question.

Some students misread the temperature scale, deciding that the maximum temperature reached was 152 °C or 170 °C, for example. Some students thought that the relevant temperature was the change in temperature of 140 °C. Of those students who correctly read 160 °C from figure 4, but did not then use figure 3, many decided to divide the temperature by a time read from the graph, or tried to use the equation $R = V / I$ or $P = I^2 R$. Some students used their temperature with the maximum resistance of 1000 Ω shown on figure 3.

Students who read 160 °C on figure 3 and decided that this was the resistance of the resistor by writing 160 on the answer line gained no marks.

02.7 Just under 40% of students chose the correct answer to why this was a physical change.

Answer 05 · Examiner comments

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

Question 1 (standard demand)

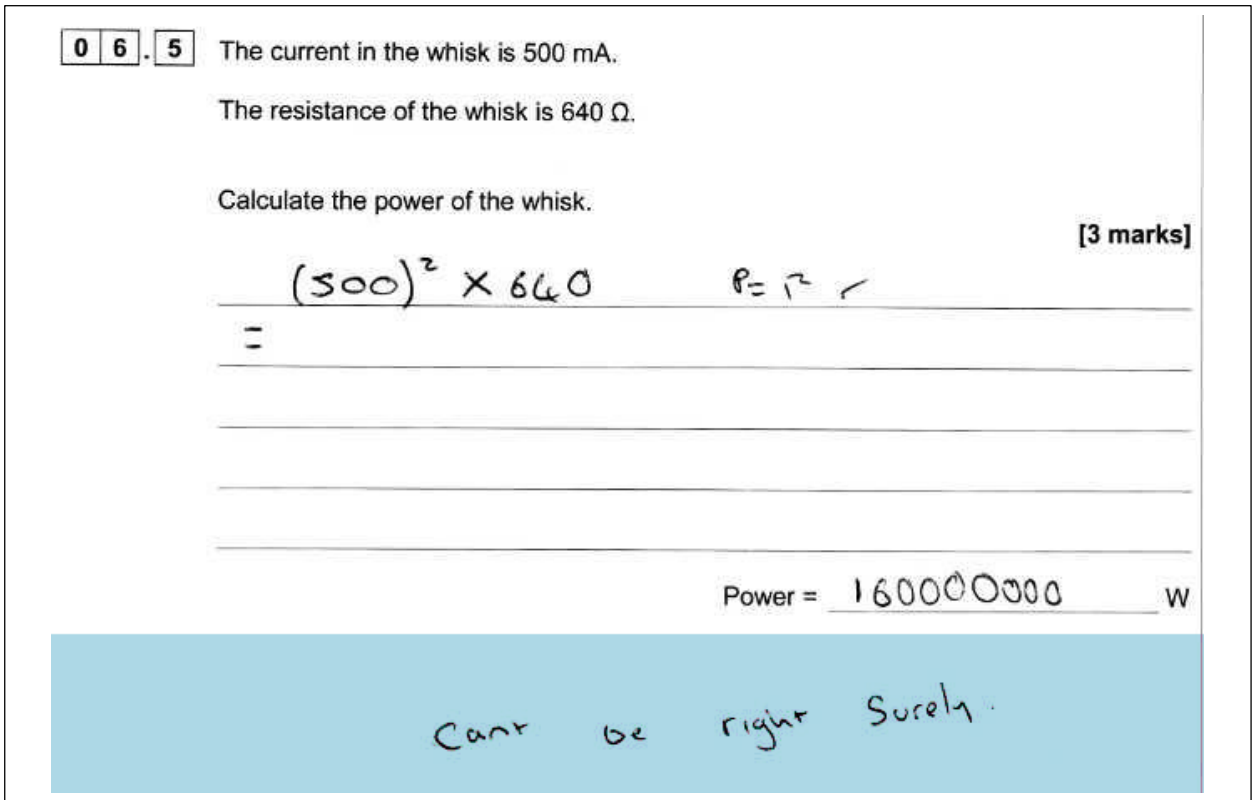
01.1 Almost all students scored at least 1 mark on this question, with nearly two-thirds scoring both marks. The most common incorrect answers were an increase in electrical energy and an increase in chemical energy.

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.

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