AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.1.2.1

Energy transfers in a system

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**4**
Available paper years	**2020–2025**

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.

6.1.2.1 Energy transfers in a system

Answer 01 · Mark scheme November 2020 | 8464/P/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	it can be replenished as it is used		1	AO1 6.1.3
03.2	biomass – renewable nuclear – Non-renewable natural gas – Non-renewable Energy resource / Renewable / Non-renewable Biomass / ✓ / Nuclear / / ✓ Natural gas / / ✓	all 3 correct allow 1 mark for two correct answers	2	AO1 6.1.3
03.3	kinetic chemical	answers must be in the correct order	1 1	AO2 6.1.1.1
03.4	less energy is needed to heat the house the roof is a better insulator		1 1	AO3 6.1.2.1
03.5	E = 26 000 × 30 780 000 (J)		1 1	AO2 6.1.1.4 6.2.4.2
03.6	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	AO1 6.1.2.2

6.1.2.1 Energy transfers in a system

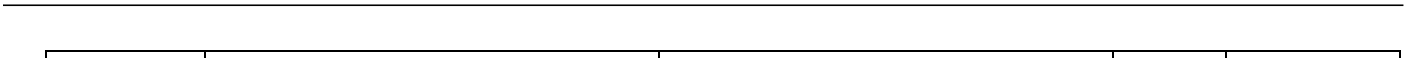
Answer 01 · Mark scheme

03.7	$0.15 = \frac{\text{useful power output}}{26000}$ useful power output = 26000 × 0.15 useful power output = 3900 (W)		1 1 1	AO2 6.1.2.2
03.8	sometimes it is not sunny/windy so there's more chance of electricity being generated at any time **OR** more electricity is generated (1) which reduces the running costs (of the eco-home) (1)	if no other mark scored, allow a reference to reduced greenhouse gas emissions or reduced global warming for 1 mark	1 1	AO3 6.1.3
Total			**15**	

6.1.2.1 Energy transfers in a system

Answer 01 · Mark scheme

November 2020 | 8464/P/1F | Original Q3



6.1.2.1 Energy transfers in a system

Answer 02 · Mark scheme November 2021 | 8464/P/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	300 (W/m^2)		1	AO2 6.1.3
04.2	(cities closer to the equator) receive a greater solar intensity	allow (cities closer to the equator) receive more radiation/energy ignore they get more sunshine ignore they are hotter	1	AO2 6.1.3
04.3	carbon dioxide		1	AO1 6.1.3
04.4	0.61 × 1100 671 (W)	 allow 670 (W)	1 1	AO2 6.1.2.2
04.5	larger heating panels have a greater input power	allow larger heating panels have a greater input energy (per second)	1	AO3 6.1.3
04.6	the energy required to increase the temperature of 1kg of water by 1 °C		1	AO1 6.1.1.3 6.3.2.2
04.7	8 400 000 = 80 × 4200 × Δθ $\Delta\theta = \frac{8400000}{80 \times 4200}$ Δθ = 25 (°C)		1 1 1	AO2 6.1.1.3 6.3.2.2

6.1.2.1 Energy transfers in a system

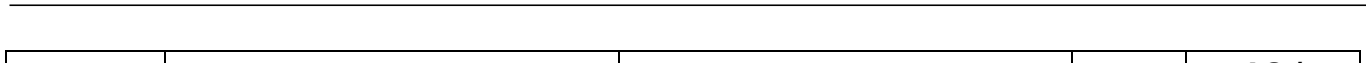
Answer 02 · Mark scheme

04.8	thermal insulation decreases the rate of energy transfer		1	AO1 6.1.2.1
04.9	B		1	AO2 6.1.2.1
Total			**12**	

6.1.2.1 Energy transfers in a system

Answer 02 · Mark scheme

November 2021 | 8464/P/1F | Original Q4



6.1.2.1 Energy transfers in a system

Answer 03 · Mark scheme

June 2022 | 8464/P/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$\Delta\theta = \frac{7.5}{30}$ $\Delta\theta$ = 0.25 (°C)		1 1	AO2 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	bar Y drawn to 16 **and** bar Z drawn to 12 *y*-axis labelled 'temperature in °C'	allow ± half a small square unit must be present	1 1	AO2 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	Y because it showed the smallest change in temperature	 reason only scores if Y is chosen	1 1	AO3 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	less than 12.0 °C		1	AO3 6.1.2.1

Answer 03 · Mark scheme

June 2022 | 8464/P/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	$E = 0.0150 \times 334\,000$ $E = 5010$ (J)		1 1	AO2 6.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	resolution		1	AO3 6.3.1.1 RPA17

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	density $= \frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 6.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	$0.300 = \frac{m}{0.186}$ $m = 0.300 \times 0.186$ $m = 0.0558$ (g)		1 1 1	AO2 6.3.1.1

Total Question 4		14

6.1.2.1 Energy transfers in a system

Answer 04 · Mark scheme June 2025 | 8464/P/1F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$13\,800 = 0.75 \times c \times 20$		1	AO2 6.1.1.3 RPA14
	$c = \dfrac{13\,800}{0.75 \times 20}$		1	
	$c = 920$ (J/kg °C)		1	

6.1.2.1 Energy transfers in a system

Answer 04 · Mark scheme

June 2025 | 8464/P/1F | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 6.1.1.3 RPA14
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method 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 **Mass** • use a top pan balance to measure mass of block **Energy transfer** • use a joulemeter to measure energy transferred to block • connect heater to a joulemeter • measure initial energy and switch on • switch off and measure final energy • calculate the difference between initial and final energy • use an ammeter, voltmeter and stopwatch • calculate energy transferred **Temperature change** • use a thermometer to measure temperature of block • measure the initial temperature • measure the final temperature • calculate the difference between initial and final temperature for **Level 3** answers must describe all three measurements		

6.1.2.1 Energy transfers in a system

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	the amount of wasted energy is less the temperature increase of the aluminium block is greater		1 1	AO3 6.1.1.3 6.1.2.1 RPA14

Total Question 6	**11**

6.1.2.1 Energy transfers in a system

Answer 02 · Examiner comments — November 2021 | 8464/P/1F | Original Q4

Question 4 (Low/standard demand)

04.1 The graph was read correctly by slightly more than 50% of the students.

04.2 Many students did not use the information provided in the question. It was not uncommon to see answers such as the equator being closer to the Sun, which gained no credit. Around one in eight students scored a mark.

04.3 The majority of students recalled that carbon dioxide contributes to global warming and is released when fossil fuels are burned.

04.4 Over 90% of students gained both marks.

04.5 Answers such as “bigger panels will heat more water” or “water can be heated up quicker if the panels have a larger surface area” did not answer the question. There were misconceptions which also arose when answering this question, such as the idea that bigger panels hold more water and therefore would take longer to heat up.

If students are asked how the size of the heating panels affects the input power, then their answers need to be in terms of the size of the heating panels and the input power.

Only about a third of students gained this mark, with nearly 10% of students not attempting to answer the question.

Answer 02 · Examiner comments — November 2021 | 8464/P/1F | Original Q4

04.6 Fewer than half of the students chose the correct definition of specific heat capacity.

04.7 Despite being directed to the Physics Equations Sheet, and being given the specific heat capacity value in the question, more than 5% of students did not make any attempt to answer this question. Nearly a third of students gained full marks, but over half of the students gained no marks.

04.8 Just under a third of students answered correctly, with nearly half thinking that thermal insulation increases the rate of energy transfer.

04.9 Only about one in ten students selected the correct answer, with more than 80% choosing option C. Questions 04.8 and 04.9 together suggest that many of the students were confused about the relationship between thermal conduction and thermal insulation.

Answer 03 · Examiner comments

June 2022 | 8464/P/1F | Original Q4

Question 04 (Low demand and standard demand)

04.1 Just under half of all students gained both marks on this question, with very few students gaining just one mark.

Common incorrect answers included attempts to subtract 7.5°C from 30 seconds, or attempts to convert time into minutes, as well as answers dividing 30 seconds by 7.5 °C.

04.2 The vast majority of students correctly drew the bars, but labelling the y-axis was far more problematic for students. A fair number of students labelled the axis, but forgot to include units, or included an incorrect unit. However, a very large proportion of students labelled the vertical axis "Y".

04.3 Nearly 90% correctly identified Y as the best thermal insulator, but only about 15% were able to give the correct reason.

Most students referred in their answer to the final temperature, but did not mention the change in temperature. It was also not uncommon for students to talk about "heat", which did not gain any credit.

04.4 Only about 15% of students selected the correct temperature.

04.5 Slightly more than 85% of students gained both marks for this calculation.

A common mistake was to attempt a spurious conversion of kg to g. Students who did this were awarded a maximum of 1 mark for this question.

04.6 Only about a fifth of students gained this mark.

04.7 About 85% of students wrote the correct equation, although the students had an equation sheet listing all equations this year.

For the students who did not gain the mark, many looked at the symbols for resistivity (ρ), mass (m) and volume (V), and then looked at the equation sheet to find the equation linking momentum (p), mass (m) and velocity (v).

04.8 Just over half of all students gained all 3 marks in this calculation, with about 10% gaining 2 marks.

Many of those who made mistakes saw that the unit for volume is cm^3 and therefore decided to calculate 0.186^3 as part of their answer; some calculations also included 0.300^3.
Despite the question asking for the answer in grams, and needing no conversion to achieve this, some students attempted to convert to kg, which led to a maximum possible mark of 2 for this question.

Answer 04 · Examiner comments

June 2025 | 8464/P/1F | Original Q6

Question 6 (Standard demand)

06.1 This standard demand calculation performed as expected with 40% of students gaining at least one mark. Many students that did a correct substitution found the rearrangement difficult or could not use their calculator correctly

0 6 . 1 Calculate the specific heat capacity of aluminium.

Use the Physics Equations Sheet.

[3 marks]

F change in thermal = mass x heat cap x temp change
I 13800 = 0.75 x heat x 20
F 13800 ÷ 0.75 x 20
A 368 000

Specific heat capacity = 368 000 J/kg °C

This was a very common error. The student has shown their working clearly, but the rearrangement is ambiguous. Where a rearrangement is ambiguous examiners will look at the final answer to decide if the students means 13800/(0.75×20) or (13800/0.75) × 20.

06.2 Students found this question very demanding. Over 20% of students did not attempt the question. 40% of students were able to write something creditworthy. The majority of Level 1 answers gained some credit for suggesting that the temperature could be measured with a thermometer. The 10% of students that wrote Level 2 or 3 answers went on to describe measuring the energy transferred with either a joulemeter or other method and/or measuring mass using a top pan balance.

© 2024 AQA and its licensors. All rights reserved.

6.1.2.1 Energy transfers in a system

Answer 04 · Examiner comments June 2025 | 8464/P/1F | Original Q6

0 6 . 2 Describe a method the student could have used to obtain the results in **Table 2**.
[6 marks]

outside the box

1. Calculate the mass in kg of our aluminium block.
2. Set up our electric heater facing the aluminium block and turn it on.
3. Calculate the energy transferred in joules from the heater from what it was before the experiment until after.
4. Measure the temperature change in °C from before the experiment until after.
5. Use these results to calculate our specific heat capacity which is $c = \Delta E \div m \times \Delta\theta$.
6. See the outcome and compare our results on a table.

All of the quantaties to be measured were given in the question, so no credit is given for simply stating that they need to be measured.

0 6 . 2 Describe a method the student could have used to obtain the results in **Table 2**.
[6 marks]

outside box

- Place aluminium on top pan balance to find its mass
- place a thermometer in the aluminium to find its starting temperature
- Connect a power supply and a joulemeter to the aluminium
- leave to aluminium to heat for 5 minutes
- Use thermometer to find its new temperature and joulemeter to find how much energy was needed to increase the temperature.

In this response the students has given the equipment needed and stated what it is measuring.

© 2024 AQA and its licensors. All rights reserved.

6.1.2.1 Energy transfers in a system

Answer 04 · Examiner comments June 2025 | 8464/P/1F | Original Q6

Contact us

Our friendly team will be happy to support you between 8am and 5pm, Monday to Friday.

Tel: 01483 477756
Email: gcsescience@aqa.org.uk

aqa.org.uk

© 2024 AQA and its licensors. All rights reserved.