AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.2.1.4

Resistors

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**6**
Available paper years	**2018–2025**

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.

6.2.1.4 Resistors

Answer 01 · 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

6.2.1.4 Resistors

Answer 01 · 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**	

6.2.1.4 Resistors

Answer 02 · Mark scheme June 2019 | 8464/P/1H | Original Q1

01.1	ammeter in series with the resistor, voltmeter in parallel with the resistor		1	AO1/1 6.2.1.4 RP 16 WS 2.4	A
01.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
01.3	reverse the connections to the cell	allow battery for cell allow reverse the cell	1	AO1/2 6.2.1.3 RP 16 WS 2.2	E
01.4	(directly) proportional	do not allow inversely proportional do not allow indirectly proportional	1	AO1/2 6.2.1.3 RP 16 WS 3.5	G
01.5	potential difference = current × resistance **or** V=IR	allow voltage for potential difference allow any correct re-arrangement	1	AO1/1 6.2.1.3 RP 16 WS 3.3	E
01.6	 3.0 = 0.12 × R $R = \frac{3.0}{0.12}$ R = 25 (Ω)	an answer of 25 (Ω) scores **3** marks	 1 1 1	AO2/1 6.2.1.3 RP 16 WS 3.3	E
Total			**8**		

6.2.1.4 Resistors

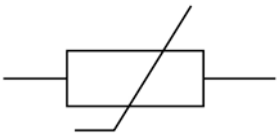
Answer 02 · Mark scheme

June 2019 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID

6.2.1.4 Resistors

Answer 03 · Mark scheme June 2019 | 8464/P/1H | Original Q4

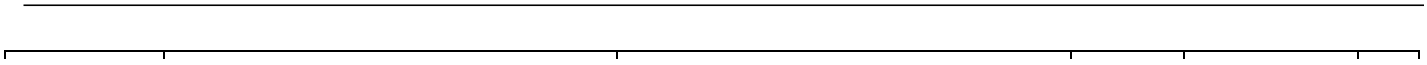
Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	less than 20 Ω		1	AO2/1 6.2.2	A
04.2	the resistance of the lamp is added to the total resistance of the resistors in parallel	allow resistors in series add up	1	AO3/1a 6.2.2	E
	the resistors in parallel have a total resistance of less than 10 ohms	allow resistors in parallel have a smaller resistance than the lowest value resistor	1		E
04.3			1	AO1.1 AO1 in isolation 6.2.1.1	E
04.4	the current increased (because) the resistance (of the thermistor) decreased	 allow because the resistance of the circuit decreased	1 1	AO1.1 AO1 in isolation 6.2.1.4 6.2.1.3	E

04.5	**the resistor** the potential difference across the resistor becomes 0V because there is a short circuit across the resistor **the lamp** the potential difference across the lamp increases because the current increases	 allow because there is no current in the resistor allow switch has no resistance If neither of the first two marking points awarded, allow **1** mark for p.d. decreases because there is less current in the resistor **or** p.d. decreases because components in parallel have less resistance **or** p.d. decreases because there is an alternative route for the current allow the potential difference across the lamp will be the same as the battery allow because the resistance of the circuit decreases allow because there is less p.d. across the resistor	 1 1 1 1	AO2.2 6.2.2 6.2.1.1 6.2.1.3 WS 3.6	E
Total			**10**		

6.2.1.4 Resistors

Answer 03 · Mark scheme

June 2019 | 8464/P/1H | Original Q4



6.2.1.4 Resistors

Answer 04 · Mark scheme

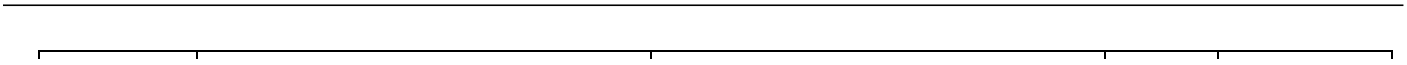
November 2021 | 8464/P/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$V = I R$		1	AO1 6.2.1.3
01.2	$3.9 = 0.12 \times R$ $R = \frac{3.9}{0.12}$ $R = 32.5\ (\Omega)$	 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**	

6.2.1.4 Resistors

Answer 04 · Mark scheme

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



6.2.1.4 Resistors

Answer 05 · Mark scheme

June 2023 | 8464/P/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	potential difference is increased (and) current decreases (so) energy/power losses in the transmission cables decrease	allow transformer **X** is a step up transformer allow (so) there is less heating in the transmission cables	1 1 1	AO1 6.2.4.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$11\,000 \times I_s = 400\,000 \times 660$ $I_s = \frac{400\,000 \times 660}{11\,000}$ $I_s = 24\,000$ (A)		1 1 1	AO2 6.2.4.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the street lamps are connected in parallel		1	AO3 6.2.2

Answer 05 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	resistance (of the LDR) increases	allow resistance (of the circuit) increases	1	AO1
	(so) the current decreases	allow so the LDR has a greater (share of the) potential difference	1	AO3
	(so) the potential difference across R decreases	dependent on MP1	1	AO3 6.2.1.4 6.2.1.3 6.2.2 6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	20 mA = 0.020 A		1	AO2 6.2.4.1
	$6.0 = 0.020^2 \times R$	allow a correct substitution using an incorrectly / not converted value of current.	1	
	$R = \frac{6.0}{0.020^2}$	allow a correct re-arrangement using their incorrectly / not converted value of current.	1	
	R = 15000 (Ω)	allow an answer consistent with their incorrectly / not converted value of current	1	
	OR			
	20 mA = 0.020 A (1)			
	$V = \frac{6.0}{0.020} = 300$ (1)			
	$R = \frac{300}{0.020}$ (1)			
	R = 15000 (Ω) (1)			

Total Question 3	14

6.2.1.4 Resistors

Answer 06 · Mark scheme

June 2025 | 8464/P/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	circuit with a cell, (switch) and resistor in series	allow battery for cell	1	AO2
	ammeter in series (with the resistor and the cell)		1	AO1
	voltmeter in parallel with resistor		1	AO1 6.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	I = 0.45 (A)	subsequent marks may be awarded if an incorrectly / not converted value of I is used	1	AO2 6.2.1.3
	$2.7 = 0.45 \times R$		1	
	$R = \frac{2.7}{0.45}$		1	
	R = 6 (Ω)	allow 6.0 (Ω)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	straight line through the origin in **both** 1st and 3rd quadrant		1	AO1 6.2.1.4

6.2.1.4 Resistors

Answer 06 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	R = 2200 (Ω)	subsequent marks may be awarded if an incorrectly / not converted value of R is used	1	AO2
	$P = 0.012^2 \times 2200$		1	AO2
	P = 0.3168 (W)	allow P = 0.32 allow P = 0.317	1	AO2
	resistors **A**, **B** and **C**	dependent on MP1 **and** MP3	1	AO3
	OR			6.2.4.1
		the first three marks may be awarded for calculating I_{max} for any of the resistors		
	R = 2200 (Ω) (1)	subsequent marks may be awarded if an incorrectly / not converted value of R is used		
	$2.0 = I^2 \times 2200$ (1)			
	I = 0.030…(1)			
	resistors **A**, **B** and **C** (1)	dependent on MP1 **and** MP3		

Total Question 3	12

6.2.1.4 Resistors

Answer 01 · 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.

6.2.1.4 Resistors

Answer 01 · 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.

6.2.1.4 Resistors

Answer 02 · Examiner comments

June 2019 | 8464/P/1H | Original Q1

Question 1 (Standard demand)

01.1 The majority of students correctly identified that the ammeter needed to be connected in series with the resistor and the voltmeter in parallel with the resistor. Some students who used a computer to type their answer did not gain the mark because they typed answers such as 'the ammeter is in series and the voltmeter in parallel' which could have meant either the third or fourth options in the table.

01.2 Most students correctly identified that the current decreased when the resistance of the variable resistor increased. Current slowing down was not an acceptable alternative but a reduced rate of flow of charge was accepted.

01.3 About a fifth of students were able to answer this question correctly. Common incorrect answers included students swapping the positions of the meters, adjusting the variable resistor, or adding more resistors. Others suggested using a 'negative battery'. A small proportion of students stated that the direction of the current needed to be reversed but did not describe how the circuit should have been changed to achieve this.

01.4 Just under half of students were able to recall that current is directly proportional to potential difference.

01.5 Slightly more than three quarters of students correctly recalled this equation. Many students used lower case letters i, v and r to represent current, potential difference and resistance, which was allowed. Also acceptable was a correct combination of symbols and words, such as V = current × R, for example.

01.6 Nearly three quarters of students gained 3 marks on this question, with about one quarter of students gaining no marks, and only a small fraction gaining 1 or 2 marks.

6.2.1.4 Resistors

Answer 03 · Examiner comments June 2019 | 8464/P/1H | Original Q4

Question 4 (Standard / high demand)

04.1 Around 15% of students correctly identified the total resistance.

04.2 Fewer than 5% of students gained both marks on this question, although just under a third of students scored 1 mark. The concept of parts of a circuit being in series and other parts being in parallel seemed to cause problems. Many students seemed to know that resistors in series are added together, but then proceeded to add 10 plus 10 plus 10, demonstrating that they had not appreciated that the two resistors are in parallel. Many students ignored the resistance of the lamp because it was not a resistor. Another common misconception was that resistance is shared, and to discuss resistance as if it behaves like potential difference.

04.3 Around two fifths of students could draw the correct circuit symbol for a thermistor. Many students drew the correct symbol but then added an arrow to the line through the resistor, which meant they did not gain the mark.

04.4 Slightly less than 60% of students gained at least one mark, with just less than 15% of students scoring both. It was not uncommon for students to erroneously suggest that current increases because it gains more energy from the increase in temperature.

04.5 Very few students recognised that the potential difference across the resistor would drop to zero and across the lamp the potential difference would be the same as the battery. Around 45% of students gained at least 1 mark, usually for mentioning that the potential difference across the lamp would increase. Many students stated that the switch controlled the entire circuit, turning it on or off. Many students appeared to be confused by the difference between current, potential difference and resistance, and many did not write about potential difference (or voltage) at all in their answers.

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.

6.2.1.4 Resistors

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 June 2023 | 8464/P/1H | Original Q3

Question 03 (Standard/high and high demand)

03.1 Just over half of all students gained at least one mark on this question. Many students seemed to think that greater efficiency means that energy is transferred at a greater rate. It was also common for answers to suggest that the transformer either increases or decreases resistance, which was ignored.

03.2 Slightly less than 60% of students gained full marks on this calculation. Many students who did not score anything attempted to use $V=IR$ for the primary coil and then the secondary coil. Students who used the correct equation but gained or lost a zero in their answer at some point could score a maximum of 2 marks.

03.3 Only about 25% of students answered this multiple-choice question correctly. This was the third most common answer, with more students selecting that current is dissipated to the surroundings, and that the cables have electrical resistance.

03.4 About a quarter of students scored at least one mark, but very few gained more than this. Some thought that the LDR was an LED, suggesting that as it gets darker the LDR needs to emit more light so the current must increase, for example. Some thought that the total resistance of the circuit must remain constant, so as the resistance of the LDR decreased, the resistance of the fixed resistor must increase. Many students struggled to express themselves, finding it difficult to

Answer 05 · Examiner comments June 2023 | 8464/P/1H | Original Q3

express which potential difference they were writing about – the potential difference across the battery, the fixed resistor or the LDR.

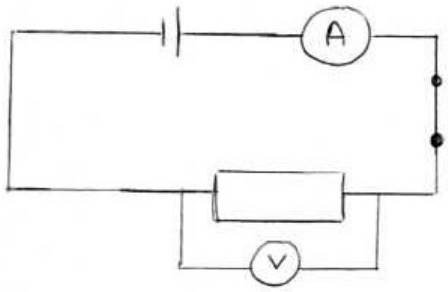
03.5 Approximately a fifth of students gained all 4 marks, with about half of all students scoring 3 marks on this calculation. Many students did not attempt to convert mA to A, and of those who did many conversions were incorrect. Of the students scoring 0 marks, it was reasonably common for them to neglect to square the current when using $P = I^2 R$.

Answer 06 · Examiner comments

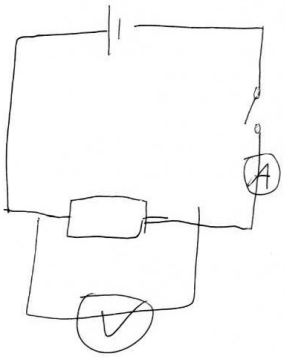
June 2025 | 8464/P/1H | Original Q3

Question 3 (Standard and standard/high demand)

03.1 Nearly 90% of students gained at least 1 mark on this question. 40% gained all three marks for using all the correct circuit symbols and drawing an ammeter in series and voltmeter in parallel with the resistor. 25% of students gained 2 marks due to having one error, which most commonly was having an incorrect circuit symbol or having the voltmeter in series.



It is expected that students draw circuit diagram accurately. This an excellent example, scoring all 3 marks.



There should be no lines through the symbols, this example shows incorrect circuit symbols and there is a significant gap in the circuit next to the cell.

03.2 This calculation was reasonably well answered. Over 70% of students gained at least 3 marks. Nearly all students that did a correct substitution were able to rearrange correctly and calculate the final answer. 45% of students did a correct conversion of the current to amps and did the calculation correctly so gained 4 marks.

03.3 75% of students draw a straight line through the origin in both 1st and 3rd quadrant so gained the mark. A number of students only drew the line in the 1st quadrant, so did not gain the mark. Some students drew the IV curve for a lamp.

03.4 There were two different valid calculations students could do to determine which resistors in figure 3 were suitable to be used. The most common method was to determine the power when a current of 0.012A was in a resistor. 10% of students gained a mark for converting the resistance in ohms but could not get any further. 45% of students completed a valid calculation so gained 3 marks. Only 15% went on to draw the correct conclusion based on their calculation and were awarded 4 marks.

© 2024 AQA and its licensors. All rights reserved.