AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.2.2

Series and parallel circuits

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**5**
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.

6.2.2 Series and parallel circuits

Answer 01 · 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**		

6.2.2 Series and parallel circuits

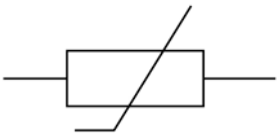
Answer 01 · Mark scheme

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

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

6.2.2 Series and parallel circuits

Answer 02 · Mark scheme June 2019 | 8464/P/1H | Original Q4

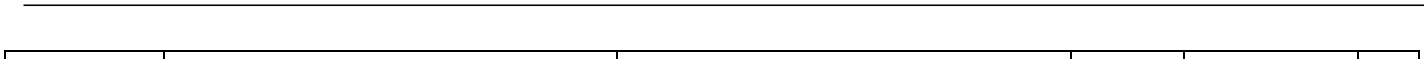
Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	less than 20 Ω		1	AO2/1 6.2.2	A
04.2	the resistance of the lamp is added to the total resistance of the resistors in parallel	allow resistors in series add up	1	AO3/1a 6.2.2	E
	the resistors in parallel have a total resistance of less than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

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**		

6.2.2 Series and parallel circuits

Answer 02 · Mark scheme

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



6.2.2 Series and parallel circuits

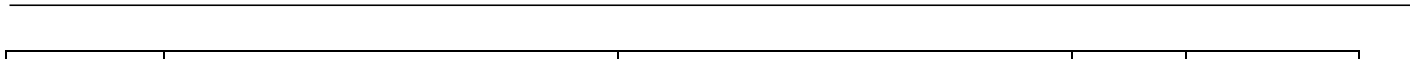
Answer 03 · Mark scheme November 2021 | 8464/P/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	240 mW = 0.24 W		1	AO2 6.2.4.1
	$0.24 = 2.5 \times I$	allow a correct substitution using an incorrectly/not converted value of power	1	
	$I = \frac{0.24}{2.5}$	allow a correct re-arrangement using an incorrectly/not converted value of power	1	
	$I = 0.096$ (A)	allow a correct calculation using an incorrectly/not converted value of power	1	
05.2	because the potential difference is always positive	allow because potential difference does not change direction	1	AO1 6.2.3.1
05.3	potential difference is (directly) proportional to current		1	AO2 6.2.1.4
05.4	voltmeter: the reading is the same in both circuits		1	AO2 6.2.2
	ammeter: the reading in circuit **B** is twice the reading of circuit **A**	allow **1** mark for the reading in circuit **B** is bigger than circuit **A**	2	
Total			**9**	

6.2.2 Series and parallel circuits

Answer 03 · Mark scheme

November 2021 | 8464/P/1H | Original Q5



6.2.2 Series and parallel circuits

Answer 04 · Mark scheme

June 2023 | 8464/P/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	voltmeter symbol correct and connected across the resistors		1	AO1 6.2.1.3 6.2.1.1 6.2.1.4 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	the total resistance must be less than 20 Ω	allow the total resistance cannot be more than 20 Ω	1	AO2
	because the total resistance of the resistors (in parallel) is less than the resistance of the smallest resistor	allow the total resistance of the resistors (in parallel) is less than either resistor	1	AO1 6.2.2 6.2.1.3 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	potential difference = current × resistance **or** $V = IR$		1	AO1 6.2.1.3 RPA15

Answer 04 · Mark scheme

June 2023 | 8464/P/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	480 mA = 0.48 A		1	AO2 6.2.1.3 RPA15
	$V = 0.48 \times 7.5$	allow a correct substitution of an incorrectly / not converted value for current	1	
	$V = 3.6$ (V)	allow an answer consistent with their incorrectly / not converted value for current	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	x-axis labelled resistance of R in Ω **and** y-axis labelled total resistance (of resistors) in Ω		1	AO2 6.2.1.3 RPA15
	both points plotted correctly	points must be plotted within ½ small square	1	
	curved line of best fit drawn	allow a curved line of best fit which ignores an outlier	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	reading from graph consistent with their line of best fit	allow an answer within ½ small square	1	AO3 6.2.1.3 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	random		1	AO3 6.2.1.3

6.2.2 Series and parallel circuits

Answer 04 · Mark scheme

June 2023 | 8464/P/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	in category A the body water percentage is 61%	allow a value for A between 60% and 62%	1	AO3 6.2.1.3
	in category B the body water percentage is 68%		1	
	if in category A they have a healthy body water percentage **and** if in category B they have an unhealthy body water percentage		1	

Total Question 2	**15**

Answer 05 · 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

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**

6.2.2 Series and parallel circuits

Answer 01 · 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.

Answer 02 · 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 03 · Examiner comments November 2021 | 8464/P/1H | Original Q5

Question 5 (High demand)

05.1 Of those students who attempted to convert 240 mW to watts, there was confusion evident about whether mW referred to milliwatts or megawatts. Around 45% of students gained at least 3 marks.

05.2 Many students incorrectly suggested that the changing frequency of the potential difference explained the answer. Only around 15% of students answered correctly.

05.3 Almost 30% of students correctly identified the directly proportional relationship.

05.4 Very few students were able to correctly identify that the potential difference in both circuits would be the same. To gain full marks when discussing the ammeter readings, students had to realise that since the potential difference across each resistor is the same, and all resistors have the same resistance, the current in each resistor is the same. The current in the ammeter in circuit B is therefore double that of circuit A. The question was targeted at the highest ability students, and very few students were able to reason this through and state this relationship.

6.2.2 Series and parallel circuits

Answer 04 · Examiner comments — June 2023 | 8464/P/1H | Original Q2

Question 02 (Standard demand)

02.1 Nearly 40% of students scored this mark, with just under 10% of students not attempting the question. It was very common for those who did attempt the question to place the voltmeter on the left side of the circuit in series with the battery.

02.2 Only about 15% of students gained 1 mark or more on this question. It was very common for students to think that resistors in parallel must have the same value, or that the unknown resistor must also be 20 ohms. It was also common to think that the values of the resistors added in parallel. Many students demonstrated confusion between current, potential difference, and

Answer 04 · Examiner comments — June 2023 | 8464/P/1H | Original Q2

resistance, and it was not uncommon to see incorrect statements that resistance in parallel is shared, for example.

Some students stated that the switch was open so resistance could not be measured, and some of the students who had missed out question 02.2 stated that there was no voltmeter so resistance could not be calculated.

02.3 Almost all students wrote down the correct equation which was given on their equations sheet this year.

02.4 While nearly two thirds of students used the equation and scored 1 or 2 marks, only about a quarter them correctly converted milli-amps to amps and gained all 3 marks on this calculation. It was reasonably common for students to recognise that they needed to do this conversion, but to use a factor of 100 rather than 1000. Some students incorrectly decided to double their answer because there were two resistors, which unfortunately led to them gaining no marks for this question.

02.5 The majority of students gained at least one mark for plotting the graph, but only about 40% gained all three marks. Many thought that the line of best fit should be straight rather than curved.

02.6 About 60% of students gained this mark, which was for reading the value consistent with their line of best fit – whether this was curved or straight – from question 06.5. Many students who did not score the mark either read from the wrong axis, or read the scales on the axes incorrectly.

02.7 Very few students could identify this as a random error. Common wrong answers included human error and mechanical errors.

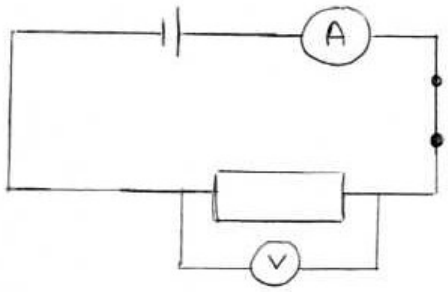
02.8 About a quarter of students gained full marks on this question, but about 45% scored no marks. It was reasonably common for students to read the percentage from the ends of the lines, and base their evaluation on a reading of 80%, which gained no credit.

Answer 05 · Examiner comments

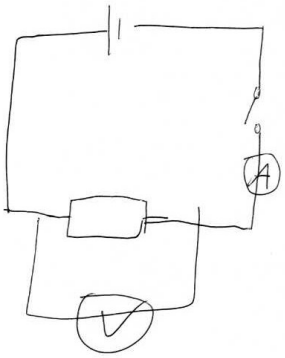
June 2025 | 8464/P/1H | Original Q3

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.

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