AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.2.1.3

Current, resistance and potential difference

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**17**
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.

6.2.1.3 Current, resistance and potential difference

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

6.2.1.3 Current, resistance and potential difference

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**	

6.2.1.3 Current, resistance and potential difference

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**		

6.2.1.3 Current, resistance and potential difference

Answer 02 · Mark scheme

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

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

6.2.1.3 Current, resistance and potential difference

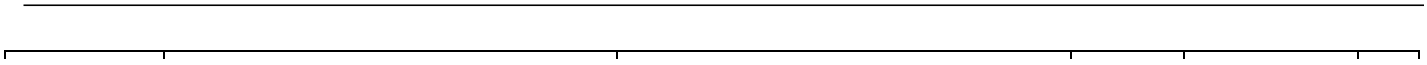
Answer 03 · Mark scheme June 2019 | 8464/P/1H | Original Q3

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	6.9 k(W) = 6900 (W) 6900 = 230 × I $I = \frac{6900}{230}$ I = 30 (A)	an answer of 30 (A) scores **4** marks allow correct substitution of an incorrectly/not converted value for power allow a correct transformation using an incorrectly/not converted value for power allow a correct calculation using an incorrectly/not converted value for power	1 1 1 1	AO2.1 6.2.4.1	E
03.3	direct potential difference is always in the same direction alternating potential difference changes direction	allow direct current is always in the same direction allow alternating current changes direction	1 1	AO1.1 6.2.3.1	E
03.4	lower potential difference across the cable it is more efficient **OR** (lower resistance gives) a greater current (for the same potential difference) (1) so the car battery can charge faster (1)	allow lower power/energy dissipation allow it won't get as hot	1 1	AO1.1 6.1.2.2 6.2.4.1	E
Total			**9**		

6.2.1.3 Current, resistance and potential difference

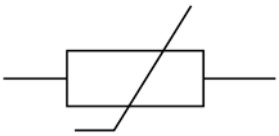
Answer 03 · Mark scheme

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



6.2.1.3 Current, resistance and potential difference

Answer 04 · 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		

6.2.1.3 Current, resistance and potential difference

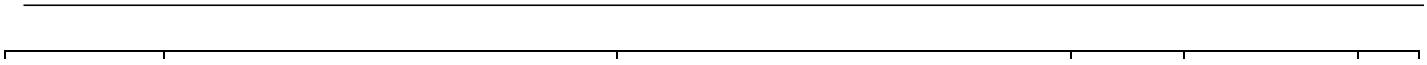
Answer 04 · Mark scheme

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**		

6.2.1.3 Current, resistance and potential difference

Answer 04 · Mark scheme

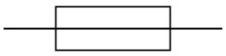
June 2019 | 8464/P/1H | Original Q4



6.2.1.3 Current, resistance and potential difference

Answer 05 · Mark scheme

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

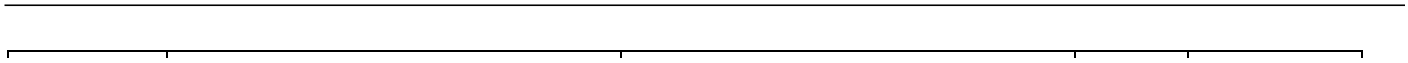
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	swap the blue wire and the green and yellow wire	allow connect the blue wire to the neutral pin and the yellow and green wire to the earth pin. allow swap the earth and neutral wires ignore the earth wire and neutral wire are wrongly connected	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**	

6.2.1.3 Current, resistance and potential difference

Answer 05 · Mark scheme

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



6.2.1.3 Current, resistance and potential difference

Answer 06 · Mark scheme

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

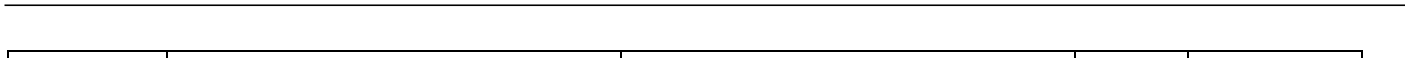
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(the variable resistor) changes the resistance of the circuit to keep the current the same so the temperature of the wire is kept constant	 allow to control the temperature of the wire	1 1 1	AO1 6.2.1.3 6.2.1.4 RPA 15
03.2	$0.17 = \frac{X+0.18+0.15}{3}$ X = 0.18 (V)	allow X = 3 × 0.17 – 0.18-0.15	1 1	AO2 6.2.1.3 RPA 15
03.3	resistance is directly proportional to length	allow length is directly proportional to resistance allow as length increases resistance increases for 1 mark allow positive correlation for 1 mark	2	AO1 6.2.1.3 RPA 15
03.4	resistance = 7.5 (Ω) 0.90 = I × 7.5 $I = \frac{0.90}{7.5}$ I = 0.12 (A)	allow a range from 7.4 to 7.6 allow their value of R read from the graph correctly substituted allow a correct re-arrangement using their value of R read from the graph allow a value consistent with their value of R read from the graph	1 1 1 1	AO3 6.2.1.3

03.5	the length/width/volume (of the blood sample) affects the resistance of the blood sample so only glucose concentration affects resistance	allow length/width/volume (of the blood sample) should be a control variable allow shape/size of the tube should be a control variable ignore amount of blood	1 1	AO3 6.2.1.3
Total			**13**	

6.2.1.3 Current, resistance and potential difference

Answer 06 · Mark scheme

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



6.2.1.3 Current, resistance and potential difference

Answer 07 · Mark scheme

November 2020 | 8464/P/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	the downward force on the balance increased	allow when there is a current in the wire there is a magnetic field around the wire (which causes a magnetic force)	1	AO3 6.7.2.2 6.5.4.2.3
	therefore the wire must experience an equal and opposite force (which is upwards)		1	
07.2	calculate the difference between the two mass readings	allow 254.8 – 252.3 = 2.5	1	AO1 6.7.2.2
	convert to kg **and** multiply by gravitational field strength	allow (2.5 / 1000) × 9.8 = 0.02375 (N)	1	
07.3	gradient $= \frac{(0.0210 - 0.0)}{(0.70 - 0.02)}$		1	AO3
	gradient = 0.031	allow answer correctly given to any number of significant figures	1	AO3
	0.031 = B × 0.125	allow correct substitution using correctly calculated value given to any number of significant figures	1	AO2
	B = 0.25 T	allow answer correctly given to any number of significant figures	1	AO2
		any rounding must be correct for subsequent marks to be awarded.		6.7.2.2
		max **2** marks if a pair of readings from the graph are used instead of gradient calculation		
Total			**8**	

6.2.1.3 Current, resistance and potential difference

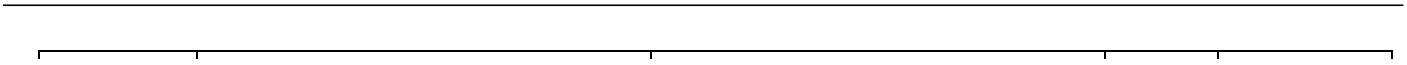
Answer 08 · Mark scheme November 2021 | 8464/P/1H | Original Q1

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**	

6.2.1.3 Current, resistance and potential difference

Answer 08 · Mark scheme

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



6.2.1.3 Current, resistance and potential difference

Answer 09 · Mark scheme

November 2021 | 8464/P/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	more than 10 000 times bigger		1	AO1 6.4.1.1
02.2	the atom becomes a positive ion the atom loses an electron		1 1	AO1 6.4.1.2
02.3	beta radiation is only weakly ionising		1	AO3 6.4.2.1

Answer 09 · Mark scheme

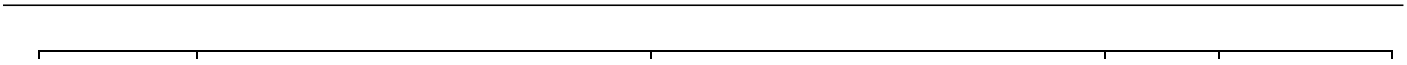
November 2021 | 8464/P/1H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.4	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO3 6.4.2.1
	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 • move the detector very close to the source • record the count rate • position the paper between the source and the detector • record the new count rate • alpha radiation will not penetrate through paper • if the count rate with the paper is (significantly) less than without then the source emits alpha radiation • remove the paper and position the aluminium between the source and the detector • record the new count rate • (alpha and) beta radiation will not penetrate through the aluminium • if the count rate has (significantly) reduced compared with using paper then beta radiation is present • if radiation penetrates through the aluminium then gamma radiation is present • the experiment should be repeated and mean results calculated because radioactivity is a random process To access level 3, the candidate must use the paper sheet, the aluminium sheet and no sheet, and describe how the results would indicate the presence of alpha, beta or gamma radiation.		
Total		**10**	

6.2.1.3 Current, resistance and potential difference

Answer 09 · Mark scheme

November 2021 | 8464/P/1H | Original Q2



6.2.1.3 Current, resistance and potential difference

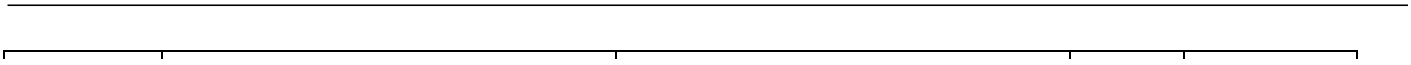
Answer 10 · Mark scheme November 2021 | 8464/P/1H | Original Q5

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**	

6.2.1.3 Current, resistance and potential difference

Answer 10 · Mark scheme

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



6.2.1.3 Current, resistance and potential difference

Answer 11 · Mark scheme

June 2022 | 8464/P/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	reverse the connections to the LED / battery	allow reverse the potential difference across the LED / diode	1	AO3 6.2.1.4
	because an LED / diode only allows current through in one direction	allow because an LED / diode has a large resistance in the reverse direction	1	

6.2.1.3 Current, resistance and potential difference

Answer 11 · Mark scheme

June 2022 | 8464/P/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	290 mA = 0.29 A		1	AO2 6.2.4.1
	$0.98 = V \times 0.29$ **or** $R = \frac{0.98}{0.29^2}$	allow a correct substitution of an incorrectly / not converted current allow R = 11.652… ignore $0.98 = (0.29)^2 \times R$	1	
	$V = \frac{0.98}{0.29}$	allow $V = 11.65 \times 0.29$ allow a correct substitution of an incorrectly / not converted current	1	
	V = 3.379…	allow a correct rearrangement using an incorrectly / not converted current	1	
	V = 3.4 (V)	allow a correct calculation using an incorrectly / not converted current allow a correctly rounded answer to 2 sig figs consistent with their calculated value of V using numbers from the question	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	electrons in the atom fall to a lower energy level		1	AO1 6.4.1.1

6.2.1.3 Current, resistance and potential difference

Answer 11 · Mark scheme

June 2022 | 8464/P/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	$1.4 = Q \times 200$		1	AO2 6.2.4.2
	$Q = \frac{1.4}{200}$		1	6.2.1.2
	$Q = 0.0070$ (C)		1	
	$0.0070 = I \times 2.8 \times 10^{-4}$	allow a correct substitution of their calculated value of Q	1	
	$I = \frac{0.0070}{2.8\times10^{-4}}$	allow a correct re-arrangement using their value of Q	1	
	$I = 25$ (A)	allow an answer consistent with their value of Q	1	
	OR			
	$1.4 = P \times 2.8 \times 10^{-4}$ (1)			
	$P = \frac{1.4}{2.8\times10^{-4}}$ (1)			
	$P = 5000$ (W) (1)			
	$5000 = 200 \times I$ (1)	allow a correct substitution of their calculated value of P		
	$I = \frac{5000}{200}$ (1)	allow a correct re-arrangement using their value of P		
	$I = 25$ (A) (1)	allow an answer consistent with their value of P		

Total Question 5		14

6.2.1.3 Current, resistance and potential difference

Answer 12 · 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

6.2.1.3 Current, resistance and potential difference

Answer 12 · 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
	$V = 0.48 \times 7.5$	allow a correct substitution of an incorrectly / not converted value for current	1	RPA15
	$V = 3.6$ (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

6.2.1.3 Current, resistance and potential difference

Answer 12 · 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**

6.2.1.3 Current, resistance and potential difference

Answer 13 · 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 13 · Mark scheme

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

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) **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)	allow an answer consistent with their incorrectly / not converted value of current	1	

Total Question 3	14

6.2.1.3 Current, resistance and potential difference

Answer 14 · 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

6.2.1.3 Current, resistance and potential difference

Answer 14 · 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 15 · Mark scheme

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	correct symbol for voltmeter connected across LED correct symbol for ammeter in series with LED		1 1	AO1 6.2.1.4 6.2.1.1 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	change the number of cells in the battery reverse the connections to the LED / battery	allow use batteries with different potential differences allow adjust the variable resistor allow adjust the potential difference across the power supply allow reverse the connections to the power supply	1 1	AO1 6.2.1.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	4 points plotted correctly line of best fit	allow a tolerance of ± ½ small square allow **1** mark for 3 points plotted correctly ignore line before 1.8 V	2 1	AO2 6.2.1.4 RPA16

6.2.1.3 Current, resistance and potential difference

Answer 15 · Mark scheme

June 2024 | 8464/P/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	the current is zero because the LED / diode has a very high resistance (in the reverse direction)	allow the current stops allow because the LED / diode only allows current in one direction	1 1	AO1 6.2.1.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	the investigation is reproducible		1	AO3 6.2.1.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.6	resistor at constant temperature		1	AO1 6.2.1.4

Total Question 3	**11**

Answer 16 · Mark scheme

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

Answer 17 · Mark scheme

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

6.2.1.3 Current, resistance and potential difference

Answer 17 · Mark scheme

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

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

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.

6.2.1.3 Current, resistance and potential difference

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.

6.2.1.3 Current, resistance and potential difference

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.

6.2.1.3 Current, resistance and potential difference

Answer 03 · 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 03 · 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.

6.2.1.3 Current, resistance and potential difference

Answer 04 · 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 08 · 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.

6.2.1.3 Current, resistance and potential difference

Answer 08 · 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 09 · Examiner comments November 2021 | 8464/P/1H | Original Q2

Question 02 (Standard demand)

02.1 This question was answered correctly by roughly 40% of students.

02.2 Around a third of students gained both marks, with approximately half gaining one mark.

02.3 Many students gave answers which were too vague, such as “beta radiation is not strong enough”, or stated that beta radiation is not ionising, which is incorrect. The mark was gained by just under a fifth of students.

02.4 Most students struggled to answer this question, with many struggling to write answers containing any relevant content. Many answers suggested placing the piece of paper or aluminium into the radioactive source holder, for example. A fair proportion of students did not read the question carefully, and suggested changing the radioactive source to test the equipment using one source of just alpha radiation, one of just beta, and one that emits just gamma radiation, although it was still possible to gain full credit if they did this. Some students recalled that paper stops alpha radiation, that aluminium stops beta radiation, and that gamma would penetrate both, but didn’t describe how to set up the equipment. Others described how to set up the equipment, but not how to use any measurements to draw conclusions.
Nearly one in ten students did not attempt to answer the question, and most answers did not give enough information to move out of level 1.

Answer 10 · 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.

Answer 11 · Examiner comments June 2022 | 8464/P/1H | Original Q5

Question 05 (Standard/high and high demand)

05.1 Most students were unable to answer this question correctly, with only about 10% of students gaining any marks, and less than 5% gaining both marks.

Common suggestions which would not work included moving the LED closer to the battery, swapping the voltmeter and ammeter, moving the resistor, removing the resistor, reducing the resistance of the resistor, or placing the resistor after the LED.

05.2 Around a fifth of students gained full marks on this question, with a third of students gaining 4 marks.

Although the simplest way to calculate the answer was to use $P = VI$, a significant minority of students decided that a 5-mark calculation needed two equations to arrive at the correct answer. This was possible, by using $P = I^2R$ and then $V = IR$, an approach which could gain full marks. However, most students who attempted this alternative route neglected to convert mA to A.

05.3 Around 15% of students chose the correct description.

05.4 This extended calculation was answered well, with around 45% of students gaining all 6 marks. Just under 10% of students gained 3 marks, and about 35% gaining no marks.

Answer 12 · 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 12 · 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.

6.2.1.3 Current, resistance and potential difference

Answer 13 · 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 13 · 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 14 · Examiner comments

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

Question 1 (standard demand)

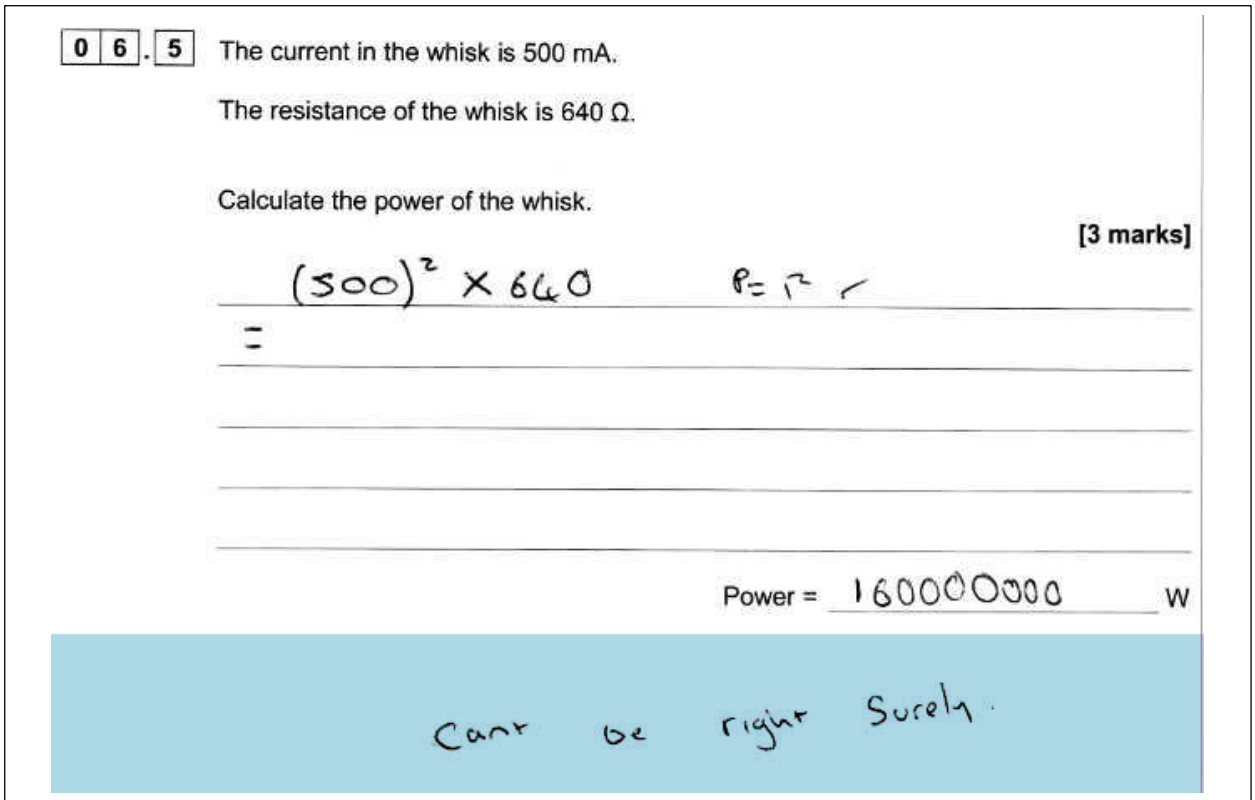
01.1 Almost all students scored at least 1 mark on this question, with nearly two-thirds scoring both marks. The most common incorrect answers were an increase in electrical energy and an increase in chemical energy.

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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Answer 15 · Examiner comments

June 2024 | 8464/P/1H | Original Q3

Question 3 (standard & standard/high demand)

03.1 Approximately half the students gained both marks, with roughly a quarter scoring 1 mark. The vast majority of students were able to draw the correct symbols for a voltmeter and ammeter, but positioning the voltmeter correctly caused a problem for many students.

03.2 While most students attempted to describe a way to vary the magnitude of the potential difference across the LED, the majority of students did not address how to change the potential difference to obtain negative values.

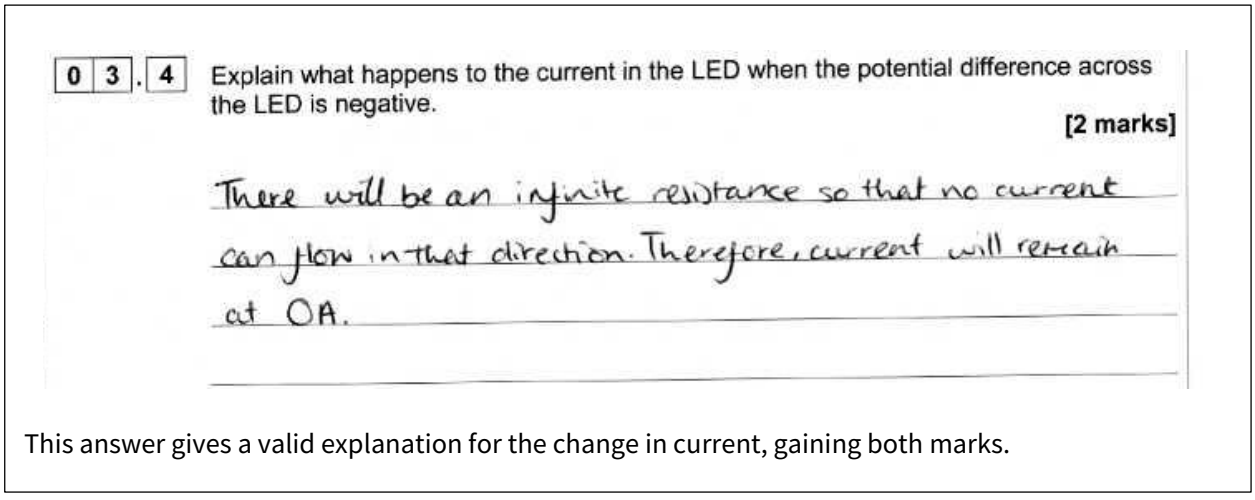
There were some misconceptions demonstrated by a number of students, with suggestions that moving the LED closer to or further from the battery would increase or decrease the potential difference being relatively common. Many students also incorrectly suggested that connecting all the components in parallel rather than in series would vary the potential difference as required.

A very low proportion of students scored both marks, but over 25% gained at least 1 mark.

03.3 A significant minority of students made errors in reading either the *x*-axis scale or the *y*-axis scale when plotting their points. Points plotted at 18 mA, 42 mA and 68 mA were within half a small square, so credit could still be awarded, but students who made errors on the *x*-axis scale tended to be less fortunate. Even if points were not correctly plotted, the line of best fit mark could still be scored. Slightly over half the students gained all 3 marks.

03.4 Fewer than 1 in 10 students scored both marks on this question, with about 20% scoring 1 mark.

It was common for students to incorrectly suggest that the current would reverse, or just to state that the current would decrease. Very few students gave a reason why the current would be zero.



This answer gives a valid explanation for the change in current, gaining both marks.

03.5 The difference between repeatability and reproducibility was misunderstood by many students, with nearly 50% choosing the incorrect answer that the results showed repeatability. Just over a third of students gave the correct answer.

03.6 Just under 60% of students recalled that a resistor at constant temperature shows a linear relationship between current and potential difference.

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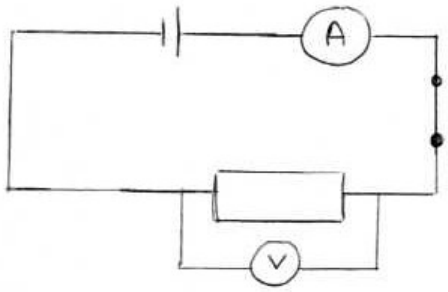
Answer 16 · Examiner comments

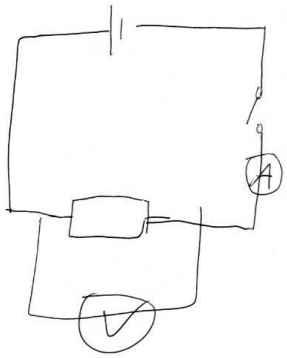
June 2025 | 8464/P/1H | Original Q3

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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Answer 17 · 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.

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6.2.1.3 Current, resistance and potential difference

Answer 17 · 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.