AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.2.1 CURRENT, POTENTIAL DIFFERENCE AND RESISTANCE (PACK 4)

SCORE	PERCENTAGE
/129	%

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Q1.

(a) a curve in the first and third quadrants only, passing through origin

1

decreasing gradient

1

(b) 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

(c) $3 = I^2 \times 12$

1

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

1

$I = 0.5$ (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)

$$I = \sqrt{\left(\frac{3}{12}\right)}$$

$I = 0.5$ (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

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coulombs **or** C

1

*an answer of 60 scores **5** calculation marks*

(d) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

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

[16]

Q2.

(a) switch

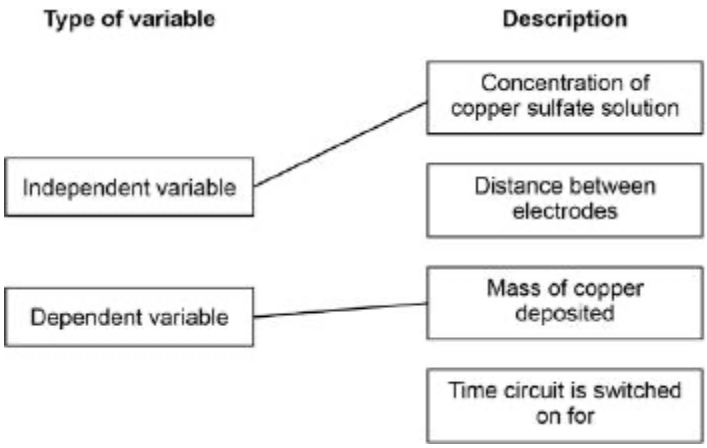
1

(b) electrolysis

1

(c)

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1 mark for each correct line

2

(d) some copper fell off the electrode

1

(e) 0.16 (g)

1

(f) a positive charge

answer line takes precedence

1

(g) the ions cannot move

1

(h) (charge flow =) 0.6 × 300

1

(charge flow =) 180 (coulombs)

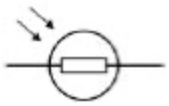
1

*an answer of 180 (coulombs) scores **2** marks*

[10]

Q3.

(a)



1

(b) in series with LDR — in parallel with LDR

1

(c) (graph shows) <u>direct</u> proportion

1

(because) it is a straight line through the origin

allow inverse proportion would show a curve with a negative gradient

1

(d) straight line through the origin with a positive gradient

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1

current is always of smaller magnitude than line already plotted for a given potential difference

this mark only scores if first mark is awarded

1

*allow for **2** marks a straight horizontal line along the x-axis*

(e) potential difference = current × resistance

allow V = IR

1

(f) 12.5 mA = 0.0125 A

1

5.50 = 0.0125 × R

this mark may be awarded if current is incorrectly / not converted

1

$$(R=)\frac{5.50}{0.0125}$$

this mark may be awarded if current is incorrectly / not converted

1

(R =) 440 (Ω)

allow an answer consistent with incorrectly / not converted current

1

*an answer of 440 (Ω) scores **4** marks*

*an answer of 0.44 (Ω) scores **3** marks*

[11]

Q4.

(a) **A**

1

(b) **C**

1

(c) **C**

1

(d) **B**

1

(e) a series circuit has only one path/loop/branch

1

a parallel circuit has a branch(es) to provide more than one path / loop

allow answers that describe the difference in terms of potential difference, current or resistance

1

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(f) **R**

1

(g) **P**

1

(h) Q = 0.97 × 60

1

Q = 58.2 (C)

1

Q = 58 (C)

*an answer of 58 (C) scores **3** marks*

1

[11]

Q5.

(a) ammeter

1

voltmeter

must be in the correct order

1

(b) 0.300 (m)

1

there is the smallest spread about the mean

1

(c) to reduce the effect of random errors

1

(d) potential difference = current × resistance

allow V = I × R

1

(e) R = V / I

1

R = 2.1 / 0.30

1

R = 7.0 Ω

*an answer of 7.0 Ω scores **3** marks*

1

(f) length in m

1

resistance in Ω

must be in the correct order
allow other correct labelling eg
length / m
length (m)
allow 1 mark if units are omitted

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1

(g) resistance is directly proportional to length

1

[12]

Q6.

(a) mains electricity is an alternating current (ac) which is constantly changing direction

1

a battery supplies a direct current (dc) which flows in one direction only

1

(b) one watt = one volt × one amp

1

(c) green and yellow - brown - blue

1

(d) the potential of the live wire is 230 V

1

a person's potential is 0 V

1

(so) there is a large potential difference between live wire and a person

1

and so the charge / current passes through the person's body

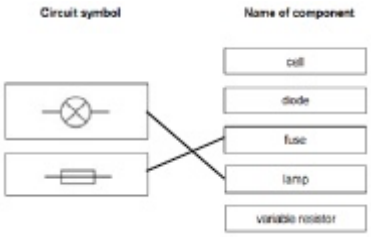
allow would result in an electric shock

1

[8]

Q7.

(a)



extra lines from circuit symbols negate the mark

1
1

(b) charge

1

(c) 0.13 (A)

1

(d) 0.56 × 300

1

168 (C)

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*an answer of 168 (C) scores **2** marks*

1

(e) 168 × 4.5

1

756 (J)

an answer of 756 (J) scores 2 marks
allow ecf from part (d)

1

(f) decreases to zero

allow reads zero

1

(g) (A1) decreases to zero

allow reads zero

1

(A2) decreases

*do **not** accept 'to zero' for A2*

1

(h) thermistor

1

(i) answer in range 160–165 (Ω)

1

[13]

Q8.

(a) 17.8

accept 17.7 or 17.9

1

(b) potential difference = current × resistance

accept V = I R

1

(c) 3.22 = 2.18 × R

1

R = 3.22/2.18

1

R = 1.477(064...) Ω

1

R = 1.48 (Ω)

*an answer of 1.48 (Ω) scores **4** marks*
*an answer that rounds to 1.48 (Ω) scores **3** marks*

1

(d) temperature of wire will increase during experiment

allow description of this in terms of energy being dissipated,
$P = I^2R$

1

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if constantan is used, this will not have a significant effect on results

1

(e) 50.0 cm

allow other ways of indicating the anomalous result in the table (eg ringing 5.26)

1

(f) the ammeter gave a reading that was too low

1

[10]

Q9.

(a) 1 950 / 2 500 × 100

1

78 (%)

1

(b) expected mass of aluminium

1950 × 54 / 102

1

= 1032.35

1

mass not collected

1032.35 − 1 000

= 32.4

*allow 32.4 with no working shown for **3** marks*

1

*incorrect number of sig. figs max **2** marks*

(c) because oxygen is formed at the anode

1

which reacts with the carbon anode to produce carbon dioxide

1

and wears it away

1

(d) power = $1.5 \times 10^5 \times 4$

1

= 6.0×10^5 W

1

24 hours = $24 \times 60 \times 60 = 8.64 \times 10^4$ seconds

1

energy transferred = $6.0 \times 10^5 \times 8.64 \times 10^4$

allow ecf from power calculation

1

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= 5.184×10^{10}

*allow 5.184×10^{10} with no working for **5** marks*

1

(e) 3 moles of electrons are needed to produce 27 g or 0.027 kg aluminium

1

so moles of electrons to produce 1 000 kg = 1 000 / 0.027 × 3

1

= 111 000

*allow 111 000 with no working shown for **3** marks*

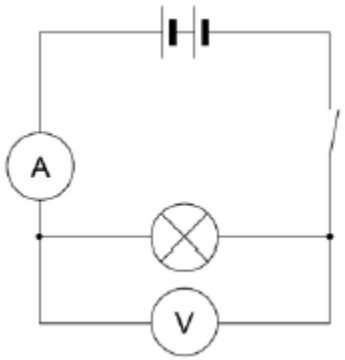
1

*incorrect no. of sig. figs max **2** marks*

[16]

Q10.

(a)



battery connected correct way round

1

ammeter and voltmeter correct way round

1

(b) 6.4 V

1

(c) (the lamp will) get dimmer

1

because increasing the resistance decreases the current

1

(d) potential difference = current × resistance

allow $V = IR$

1

(e) $3.3 = 0.15 \times R$

1

$R = 3.3 \div 0.15$

1

= 22(Ω)

1

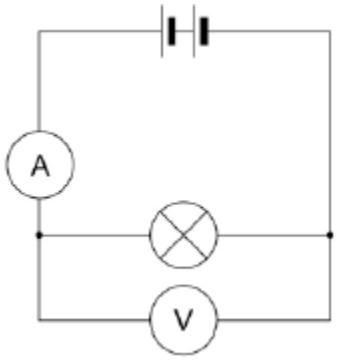
*allow 22 with no working shown for **3** marks*

[9]

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Q11.

(a)



ammeter connected in series

1

voltmeter connected in parallel

1

measure the potential difference across the lamp at known current

1

calculate resistance from measured values using V = IR

1

(b) for ohmic conductors the current is directly proportional to the potential difference applied across it

1

this graph is curved so it is not an ohmic conductor

1

(c) diode

1

because it has a high resistance with negative potential differences

1

and a low resistance for positive potential differences.

1

allow answers in terms of current

(d) tangent to the curve drawn at 2.3 V

1

correct reading of Δy and Δx from graph

1

either

substitution of values into $V = IR$ (1)

1

value of R calculated (1)

accept values in the range 0.50 to 0.65

1

or

calculation of gradient (1)

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allow ecf from incorrect readings of Δy and Δx

calculation of R = 1 / gradient (1)

accept values in the range 0.50 to 0.65

[13]

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Q1.

(a) 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.

(b) 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.

(c) 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.

(d) 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.

Q2.

(a) More than three quarters of students identified the given circuit symbol as a switch. Of the remaining responses, more chose the fuse than the other two options.

(b) More than three quarters of students chose the correct response of ‘electrolysis’, with ‘distillation’ being the next most popular choice.

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(c) Around 17% of students gained both marks for this question. Students who scored one mark usually did so for correctly identifying the independent variable of 'concentration of copper sulfate solution'.

Although both 'concentration of copper sulfate solution' and 'mass of copper deposited' were chosen by a good number of students, these were often paired to the incorrect variable.

Other incorrect answers included various combinations of the type of variable and the description. Despite the instruction to draw one line from each type of variable, several students showed two lines from each.

(d) Slightly more than one third of students chose the correct response that some copper fell off the electrode. The other two options were as popular as each other.

(e) Around half of students were able to identify the pattern in the results and state the correct value of 0.16 g.

A common incorrect answer was 16 g, indicating that students had recognised the pattern, but had forgotten to include the decimal point.

Another common incorrect response was 0.07 g, which was the result given in the table; perhaps students had not taken on board the previous question which referred to this result as being anomalous.

(f) Around 70% of students correctly identified that copper ions have a positive charge. Of the incorrect responses, 'a negative charge' was more popular.

(g) Just over half of students realised that solid copper sulfate does not conduct electricity because the ions cannot move. The other three choices had a similar number of responses, with 'the ions are too big' being the least popular choice.

(h) Around 8% of students did not attempt this question. Most of those who attempted it were able to substitute the given values into the equation and work out the correct answer, thus scoring two marks.

Some students substituted other values for current, such as 0.06 A or 6 A, rather than the given 0.6 A. It was not clear whether they had deliberately converted the value, or just made an error in writing it down. A few students divided the two values rather than multiplying them. It should be noted that in a low demand question where the equation is provided, it is always in the form needed, so no re-arrangement is necessary.

Q3.

Foundation

(a) Around one third of students left this blank. Of those who attempted an answer, many did not draw anything resembling any recognised circuit symbol.

Some students realised that a resistor symbol would be part of the diagram, and some remembered that the symbol included arrows. Less than 2% gave a completely correct symbol.

(b) Just over two thirds of students knew that one component would be in series and the other in parallel. The choices were fairly evenly matched, with the correct answer of ammeter in series and voltmeter in parallel gaining slightly more responses. Of the other two options, the two components in parallel was a more popular choice than

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them being in series.

(c) More than one third of students did not attempt this question.

Many students realised that the given graph showed a directly proportional relationship; this gave them one mark. However, not many were able to correctly identify the features of the graph which showed this, or which would show an inverse proportional relationship.

Some students attempted to explain an experimental error which led to incorrect results.

(d) More students left this question blank than attempted it. The vast majority of those who attempted the question drew a straight line through the origin with a negative gradient.

Fewer than 3% of students drew a correct line.

(e) More than 20% of students left this blank. Of those who wrote something, some wrote an equation which was totally unconnected to the quantities listed. Some wrote expressions which were not equations, i.e. did not have an equals sign. Quite a number looked on to the following question and performed a calculation using the values given.

Of those who wrote a mathematical equation connecting the given quantities, just over 20% gave a correct form of the equation to gain the mark.

(f) Linking to the previous question, as many students did not give the correct equation, they were unable to perform the calculation correctly, the most common error being to multiply the two given numbers.

Of those who divided the potential difference by the current, the majority did not attempt to convert the current value from mA to A; nevertheless, they were able to gain some credit. Of the few students who tried to do this conversion, most multiplied by a power of ten rather than dividing by 1000. Very few students scored all four marks.

Higher

(a) Fewer than 5 % of students drew the correct circuit symbol for the LDR. Some made some mistake such as arrows pointing away or an arrow through the resistor itself. A variety of different circuit symbols was seen, including many made-up ones. A common incorrect symbol was that for an LED, or an approximation of this.

(b) Around half of students knew the correct arrangement of the ammeter and voltmeter in a circuit. A further quarter knew that one was in series and one was in parallel but chose the wrong way round. The remaining responses were fairly evenly spread between both in series and both in parallel.

(c) Just under half of students gained at least one mark for stating that the given graph showed direct proportionality. Many attempted to describe why the graph showed this, but answers tended to be incomplete, either just saying that it was a straight line, or that it went through the origin, but rarely saying both. Some students attempted to describe what a graph showing inverse proportion would look like, but again, answers tended to be incomplete. Around 7% of students did not attempt this question.

(d) The vast majority of students incorrectly drew a line from top left to bottom right

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through the origin. A few students drew a straight line through the origin with a positive gradient. Some of these were steeper than the given graph line. The number who correctly drew the line with a shallower gradient was small.

(e) A few students gave equations which did not connect all the quantities shown, for instance the equation for electrical power or for a transformer were seen several times.

About half of the students were able to write the equation in one of its correct forms. Credit was given for answers in terms of symbols, for instance V = IR, but incorrect symbols such as C for current were not credited. Students would be advised to write the equation in words if they are unsure of the correct symbols. The triangle notation which helps students with re-arranging was not acceptable as an equation.

(f) Around 5% of students achieved the correct answer of 440Ω. A further 40 % scored three of the four marks for doing a correct calculation with a value of the current which had not been converted from milliamps into amps. In many cases, the conversion had not been attempted at all, leading to an answer of 0.44Ω. In other cases, students had attempted to convert by multiplying or dividing by a power of 10. Multiplying by 1000, rather than dividing, was a common mistake.

Students who gained no marks tended to multiply the values for the potential difference and current.

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