AQA GCSE Physics | 8463

SPECIFICATION POINT 4.2.1.2

# Electrical charge and current

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **25** |
| Available paper years | **2003–2025** |

## 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.

### 4.2.1.2 Electrical charge and current

**Answer 01 · Mark scheme** June 2003 | 3451H | Original Q12 | Legacy

The full source mark scheme begins on page 39. Follow original question 12 in that document.

**Answer 02 · Mark scheme** June 2003 | 3462H3 | Original Q10 | Legacy

The full source mark scheme begins on page 61. Follow original question 10 in that document.

**Answer 03 · Mark scheme** June 2005 | 3451 | Original Q11 | Legacy

The full source mark scheme begins on page 78. Follow original question 11 in that document.

**Answer 04 · Mark scheme** June 2005 | 3462 | Original Q9 | Legacy

The full source mark scheme begins on page 96. Follow original question 9 in that document.

**Answer 05 · Mark scheme** June 2006 | 3451 | Original Q15 | Legacy

The full source mark scheme begins on page 110. Follow original question 15 in that document.

### 4.2.1.2 Electrical charge and current

**Answer 06 · Mark scheme**

June 2006 | 3462 | Original Q13 | Legacy

The full source mark scheme begins on page 130. Follow original question 13 in that document.

4.2.1.2 Electrical charge and current

Answer 07 · Mark scheme



**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | clothing and seat rub together | accept friction between clothing and seat | 1 |
| | electrons transfer from seat to driver<br>**or**<br>electrons transfer from driver to seat | accept electrons transfer on its own if first mark scores<br><br>an answer in terms of *rubbing* between clothing and seat **and** *charge* transfer without mention of electrons gains **1** mark<br>an answer in terms of *friction* / *rubbing* **and** *electron transfer* without mention of clothing and seat gains **1** mark | 1 |
| (b)(i) | how wet the air is affects charge (build up)<br>**or**<br>damp air is a better conductor<br>**or**<br>damp air has a lower resistance | accept humidity affects charge<br><br>do **not** accept fair test or as a control unless explained | 1 |
| (ii) | No – it was only the lowest under these conditions<br>**or**<br>No – there are lots of other materials that were not tested<br>**or**<br>Yes – the highest value for cotton is smaller than the lowest value for the other materials | accept answer in terms of changing the conditions may change the results<br><br>do **not** accept results show that it is always less / smallest | 1 |
| total | | | 4 |

### 4.2.1.2 Electrical charge and current

**Answer 07 · Mark scheme**

January 2008 | PHY2H | Original Q2 | Legacy

**PHY2H**

### 4.2.1.2 Electrical charge and current

**Answer 08 · Mark scheme** January 2008 | PHY2H | Original Q3 | Legacy

**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | 24(V) | | 1 |
| (ii) | current always flows in the same direction<br>**or**<br>current only flows one way | | 1 |
| (b)(i) | more power / force needed | accept energy transformed faster | 1 |
| | work done to lift the scooter uphill<br>**or**<br>work done against gravity | accept it moves against gravity<br><br>accept energy is transformed to gravitational potential energy | 1 |
| (ii) | reduces it | | 1 |
| (c) | 375 | **1** mark for correct substitution<br>**1** mark for an answer = 250<br>**1** mark for an answer = 125 | 2 |
| (d) | 86400 | **1** mark for correct substitution<br>**1** mark for an answer = 43200<br>answer 24 gains **1** mark<br>answer 24 Ah gains **2** marks<br>answer 12 Ah gains **1** mark only | 2 |
| | coulomb | accept C | 1 |
| total | | | 10 |

### 4.2.1.2 Electrical charge and current

**Answer 08 · Mark scheme**

January 2008 | PHY2H | Original Q3 | Legacy

**PHY2H**

4.2.1.2 Electrical charge and current

Answer 09 · Mark scheme

January 2009 | PHY2H | Original Q3 | Legacy

**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a)(i) | 30 | allow **1** mark for showing correct method<br>i.e. 5 × 6 **or** 12 ÷ 0.4 | 2 |
| **3**(a)(ii) | connected in <u>series</u> | insufficient they are not connected in parallel | 1 |
| **3**(a)(iii) | 0.4 | | 1 |
| **3**(a)(iv) | equally/ evenly | the same is insufficient<br>allow credit for candidates that correctly mention pd across the connecting wires<br><br>accept (nearly) 2 V (each) | 1 |
| **3**(b) | 48<br><br>coulombs | do **not** accept e.c.f. if (a) (iii) = 12 or 5<br><br>accept their (a) (iii) × 120 correctly calculated for both marks<br><br>allow **1** mark for correct substitution and conversion of time to seconds<br>i.e. charge = 0.4 × 120<br>an answer 0.8 scores **1** mark<br>allow **1** mark for their (a) (iii) x 2 correctly calculated<br>accept C<br>do **not** accept c<br><br>do **not** accept amp seconds | 2<br><br>1 |
| **Total** | | | **8** |

### 4.2.1.2 Electrical charge and current

**Answer 09 · Mark scheme**



**PHY2H**

4.2.1.2 Electrical charge and current

Answer 10 · Mark scheme

June 2009 | PHY2H | Original Q6 | Legacy

**Question 6**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a)(i) | 0.0046 | accept 4.6 mA<br>allow **1** mark for correct substitution and transformation<br>i.e. current = $\frac{230}{50\,000}$<br>an answer of 4.6 gains **1** mark | 2 |
| **6**(a)(ii) | • increases overall resistance<br>• (in event of a shock) gives a smaller current | <br>accept gives smaller shock<br>do **not** accept no shock/current | 1<br>1 |
| **6**(b)(i) | 50 (hertz) | ignore units | 1 |
| **6**(b)(ii) | NO<br>has the lowest current at which people cannot let go<br>**or**<br>YES<br>changing the frequency changes the current by only a small amount | answer and reason needed<br>accept a sensible reason in terms of their answer to (b) (i) | 1 |

**Question 6 continues on the next page . . .**

4.2.1.2 Electrical charge and current



**PHY2H**

**Question 6 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(c) | a current flows through from the live wire/metal case to the earth wire | accept a current flows from live to earth<br>do **not** accept on its own if the current is too high | 1 |
| | this current causes the fuse to melt | accept blow for melt | 1 |
| **Total** | | | **8** |

### 4.2.1.2 Electrical charge and current

**Answer 11 · Mark scheme** January 2010 | PHY2H | Original Q5 | Legacy

**Question 5**

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(a) | each hair gains the same (type of) charge<br>**or**<br>(each) hair is negatively charged<br>**or**<br>(each) hair gains electrons | do **not** accept hair becomes positively charged | 1 |
| | similar charges repel<br>**or**<br>negative charges repel<br>**or**<br>electrons repel | accept positive charges repel providing first marking point is in terms of positive charge | 1 |
| **5**(b) | 0.000002<br>**or**<br>$2 \times 10^{-6}$<br>**or**<br>$2\,\mu C$ | accept correct substitution and transformation for **1** mark<br>ie 30 / 15 or .03 / 15000 or 30 / 15000 or .03 / 15<br>answers 2 and 0.002 gain **1** mark | 2 |
| **5**(c) | current | do **not** accept amp / amperes | 1 |
| **Total** | | | **5** |

### 4.2.1.2 Electrical charge and current

**Answer 11 · Mark scheme**

January 2010 | PHY2H | Original Q5 | Legacy

**PHY2H**

4.2.1.2 Electrical charge and current

Answer 12 · Mark scheme

January 2011 | PHY2H | Original Q6 | Legacy

## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a)(i) | 0.25 (A) | | 1 |
| **6**(a)(ii) | 75 | allow **1** mark for converting 5 minutes to 300 seconds<br><br>**or** allow **1** mark for correct substitution<br>ie 0.25 × 300<br><br>allow **1** mark for an answer 1.25<br><br>allow **1** mark only for their (a)(i) × 300 correctly calculated | 2 |
| | coulombs or C | do **not** accept c | 1 |
| **6**(b) | any **two** from:<br>• fault not repaired<br>• larger current will (still) flow<br>• aluminium foil will not melt (if a fault)<br>• wiring will overheat / (may) cause a fire | accept if a fault was to occur<br><br>accept aluminium foil needs a higher current / charge to melt<br><br>accept idea of fire hazard<br><br>do **not** accept explode etc | 2 |
| **Total** | | | **6** |

### 4.2.1.2 Electrical charge and current

**Answer 12 · Mark scheme** January 2011 | PHY2H | Original Q6 | Legacy

**PHY2H**

4.2.1.2 Electrical charge and current

Answer 13 · Mark scheme

January 2013 | PH2HP | Original Q6 | Legacy

## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6(a)(i)** | 50(Hz) | ignore any unit given | 1 |
| **6(a)(ii)** | any **two** from:<br>• (some) current flows to Earth<br>• current flows through copper braid<br>• RCCB detects difference between current in live and neutral wire | <br>accept ground for Earth<br>accept current flows through the earth wire<br>accept electricity for current in either the first or second marking point but not both | 2 |
| **6(a)(iii)** | can be reset<br>**or**<br>faster acting | accept does not need replacing<br>accept switches circuit off faster | 1 |
| **6(b)(i)** | 79 200<br>coulombs / C | allow **1** mark for correct substitution, ie $11 = \frac{Q}{2 \times 3600}$<br>an answer 22 gains **1** mark<br>do **not** accept c | 2<br>1 |
| **6(b)(ii)** | 18 216 000<br>**or**<br>230 × their (b)(i) correctly calculated | accept for **2** marks 18 216 kJ **or** 18.216 MJ<br>allow **1** mark for correct substitution, ie 230 × their (b)(i)<br>**or**<br>allow **1** mark for power calculated as 2530(W) | 2 |

**Question 6 continues on the next page . . .**

**PH2HP**

**Question 6 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **6(c)** | increases temperature of thermistor<br><br>changes resistance (of thermistor) | <br><br>do **not** accept increases resistance (of thermistor)<br><br>an answer decreases resistance (of thermistor) gains **2** marks | 1<br><br>1 |
| **Total** | | | **11** |

**UMS Conversion Calculator**: www.aqa.org.uk/umsconversion

4.2.1.2 Electrical charge and current

Answer 14 · Mark scheme

June 2013 | PH3HP | Original Q7 | Legacy

## Question 7

| question | answers | extra information | mark |
|---|---|---|---|
| 7(a) | (the alternating current creates) a <u>changing / alternating magnetic</u> field | | 1 |
| | (magnetic field) in the (iron) core | accept that links with the secondary coil<br>current in the core negates this mark | 1 |
| | (causing a) potential difference (to be) <u>induced</u> in / across secondary coil | accept voltage for p.d. | 1 |
| 7(b)(i) | 20 | allow **1** mark for correct substitution, ie<br>$\frac{230}{V_s} = \frac{575}{50}$<br>**or**<br>$\frac{V_s}{230} = \frac{50}{575}$ | 2 |

**Question 7 continues on the next page . . .**

Answer 14 · Mark scheme



**PH3HP**

**Question 7 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **7(b)(ii)** | 0.3<br>**or**<br>correct calculation using<br>$230 \times I_p$ = their (b)(i) × 3.45 | allow **1** mark for correct substitution, ie<br>$230 \times I_p = 20 \times 3.45$<br><br>allow ecf from (b)(i) for 20<br>**OR**<br>substitution into this equation<br>$\frac{I_p}{I_s} = \frac{N_s}{N_p}$ | 2 |
| **7(c)** | (switch mode transformers) use (very) little power / current / energy when switched on but no load is applied<br><br>**or**<br><br>it is more efficient | accept no for little<br><br>ignore it is more portable<br><br>do **not** accept electricity for power / current / energy<br><br>accept does not get as hot **or** less heat produced | 1 |
| **7(d)** | any **one** from:<br>• fewer (waste) batteries have to be sent to / buried in land-fill<br>• the soil is polluted less by batteries in land-fill<br>• fewer (waste) batteries have to be recycled<br>• fewer batteries have to be made<br>• less raw materials are used in making batteries<br>• customers have to replace their batteries less often<br>• customers have to buy fewer (replacement) batteries | longer lifetime is insufficient<br><br>it costs less is insufficient | 1 |
| **Total** | | | **9** |

**UMS Conversion Calculator**: www.aqa.org.uk/umsconversion

4.2.1.2 Electrical charge and current

Answer 15 · Mark scheme

June 2017 | PH2HP | Original Q6 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 6(a)(i) | electrons transfer/removed<br><br>from the nylon/rod<br>**or**<br>to the silk/cloth<br><br>making the nylon positive **and** the silk/cloth negative | positive electrons or protons moving negates first and second mark points | 1<br><br>1<br><br><br><br>1 | AO1<br>2.3.1a<br>AO2<br>2.3.1b<br>AO1<br>2.3.1b |
| 6(a)(ii) | electrons would transfer from the silk/cloth<br>**or**<br>electrons would transfer to the PVC/rod<br>**or**<br>the silk/cloth would become positive<br>**or**<br>the PVC/rod would become negative | do not accept positive electrons or protons moving<br><br>"it" refers to the PVC rod | 1 | AO2<br>2.3.1b |
| 6(b) | The reading will increase.<br><br>rods/charges will repel<br><br>and create a downward / extra force (on the balance) | reason is independent of this mark<br><br><br>accept so pushing (bottom) rod downwards<br><br>do not accept increasing the weight | 1<br><br>1<br><br>1 | AO2<br><br>AO1<br><br>AO1<br>2.3.1c, d |
| 6(c)(i) | 9000 (V) | allow **1** mark for correct substitution ie<br>$V = \frac{27}{3 \times 10^{-3}}$<br>**or**<br>$27 = V \times 3 \times 10^{-3}$<br><br>an answer 9 with the unit changed to kV scores **2** marks | 2 | AO2<br>2.3.2b<br>2.4.2d |

4.2.1.2 Electrical charge and current

Answer 15 · Mark scheme

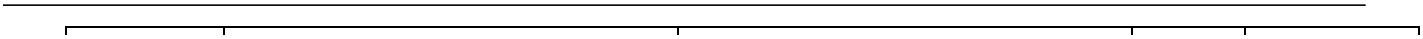


| | | | | |
|---|---|---|---|---|
| **6(c)(ii)** | not all types of material were tested<br><br>other factors may affect the charge (on the driver) | accept only tested 3 materials<br><br>accept a named factor eg material of the seats, temperature, humidity<br><br>some results may be anomalous is insufficient<br>different vehicle is insufficient | 1<br><br>1 | AO3<br>2.3.1 |
| **Total** | | | **11** | |

### 4.2.1.2 Electrical charge and current

**Answer 15 · Mark scheme**

June 2017 | PH2HP | Original Q6 | Legacy



4.2.1.2 Electrical charge and current

Answer 16 · Mark scheme

June 2018 | 8463/1H | Original Q5

| Question | Answers | Extra information | Mark | AO/ Spec. Ref |
|---|---|---|---|---|
| 05.1 | potential difference | in this order only<br>allow p.d.<br>allow voltage | 1 | AO1 4.2.1.4 |
| | temperature | | 1 | |
| 05.2 | the current increases (when the potential difference increases) | | 1 | AO1 4.2.1.4 |
| | (which) causes the temperature of the filament to increase | | 1 | |
| | (so) the resistance increases | do **not** accept resistance increases and then levels off | 1 | |
| 05.3 | a higher proportion / percentage of the (total) power / energy input is usefully transferred<br>**or**<br>higher (useful) power / energy output for the same (total) power / energy input | wastes less energy is insufficient | 1 | AO2 4.1.2.2 |
| 05.4 | potential difference increases | | 1 | AO2 4.2.2 |
| | current decreases | | 1 | AO1 4.2.2 |
| 05.5 | 1000 (Ω) | reason only scores if R =1000 (Ω) | 1 | AO2 4.2.1.3 |
| | potential difference is shared in proportion to the resistance | allow a justification using a correct calculation | 1 | |

4.2.1.2 Electrical charge and current

Answer 16 · Mark scheme

June 2018 | 8463/1H | Original Q5

| Question | Answers | Extra information | Mark | AO/ Spec. Ref |
|---|---|---|---|---|
| 05.6 | | an answer of $1.7 \times 10^{-3}$ (A) scores **4** marks | | AO2 4.2.1.3 |
| | $12 = I \times 7000$ | | 1 | |
| | $I = \frac{12}{7000}$ | | 1 | |
| | $I = 1.71 \times 10^{-3}$ (A) | an answer that rounds to $1.7 \times 10^{-3}$ (A) scores **3** marks | 1 | |
| | $I = 1.7 \times 10^{-3}$ (A)<br>**or**<br>$I = 0.0017$ (A) | this answer only | 1 | |
| | | an answer of $2.4 \times 10^{-3}$ (A) scores **2** marks | | |
| | | if no other marks scored allow **1** mark for calculation of total resistance (7000 Ω) | | |
| **Total** | | | **14** | |

4.2.1.2 Electrical charge and current

Answer 17 · Mark scheme

June 2019 | 8463/1H | Original Q10

## Question 10

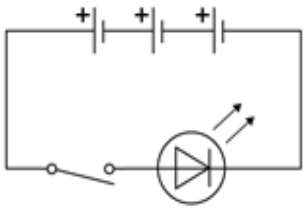
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.1** | non-contact (force) | allow electrostatic (force) | 1 | 4.2.5.2 AO1 |
| | attraction (between hair and balloon) | allow repulsion between the hairs on the head | 1 | |
| **10.2** | | an answer of $2.0 \times 10^{-6}$ (C) scores **3** marks<br>an answer of $2 \times 10^{-3}$ (C) scores **2** marks | | 4.2.4.2 AO2 |
| | $0.0050 = Q \times 2500$ | this mark may be awarded if pd is incorrectly or not converted | 1 | |
| | $Q = \frac{0.0050}{2500}$ | this mark may be awarded if pd is incorrectly or not converted | 1 | |
| | $Q = 2.0 \times 10^{-6}$ (C)<br>**or**<br>Q = 0.0000020 (C) | these answers only | 1 | |
| **10.3** | | an answer of 120 (Ω) scores **5** marks | | 4.2.1.2 4.2.1.3 AO2 |
| | $0.16 = I \times 4.0 \times 10^{-3}$<br>**or**<br>$I = \frac{0.16}{4.0 \times 10^{-3}}$ | this mark may be awarded if time is incorrectly / not converted | 1 | |
| | I = 40 (A) | this value only | 1 | |
| | $4800 = 40 \times R$ | allow 4800 = their calculated I × R | 1 | |
| | $R = \frac{4800}{40}$ | allow R = 4800 / their calculated I | 1 | |
| | R = 120 (Ω) | allow an answer consistent with their calculated I | 1 | |
| **Total** | | | **10** | |

4.2.1.2 Electrical charge and current

Answer 18 · Mark scheme

November 2020 | 8463/1H | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.1 |  | | 1 | AO1<br>4.2.1.1 |
| 02.2 | charge flow = current × time<br>**or**<br>$Q = It$ | | 1 | AO1<br>4.2.1.2 |
| 02.3 | I = 0.050 (A)<br><br>Q = 0.050 × 14 400<br><br>Q = 720 (C) | <br><br>allow a correct substitution using an incorrectly/not converted value of I<br><br>allow a correct calculation using an incorrectly/not converted value of I | 1<br><br>1<br><br>1 | AO2<br>4.2.1.2 |
| 02.4 | there is no current in a diode (in the reverse direction)<br>**or**<br>charge will not flow through a diode (in the reverse direction)<br><br>(because) a diode has a (very) high resistance (in the reverse direction) | allow diode will not conduct (electric charge)<br><br>do not accept the circuit is not complete | 1<br><br>1 | AO1<br>4.2.1.4<br>4.2.1.3 |
| 02.5 | Efficiency = $\frac{\text{Useful power output}}{\text{Total power input}}$ | | 1 | AO1<br>4.1.2.2 |

4.2.1.2 Electrical charge and current

Answer 18 · Mark scheme

November 2020 | 8463/1H | Original Q2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.6 | $0.75 = \frac{\text{Useful power output}}{0.24}$<br><br>Useful power output = 0.75 × 0.24<br><br>Useful power output = 0.18 (W) | | 1<br><br>1<br><br>1 | AO2<br>4.1.2.2 |
| Total | | | 11 | |

4.2.1.2 Electrical charge and current

Answer 19 · Mark scheme

November 2021 | 8463/1H | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.1** | the polarity (of the supply) does not change | allow potential difference in one direction (only) | 1 | AO1<br>4.2.3.1 |
| **01.2** | energy transferred = power × time | | 1 | AO1<br>4.1.1.4<br>4.2.4.2 |
| **01.3** | 162 000 000 = 7200 × t<br>$t = \frac{162\,000\,000}{7200}$<br>t = 22 500 (s) | | 1<br>1<br>1 | AO2<br>4.1.1.4<br>4.2.4.2 |
| **01.4** | $V = I \times R$ | | 1 | AO1<br>4.2.1.3 |
| **01.5** | 480 = 15 × R<br>$R = \frac{480}{15}$<br>R = 32 (Ω) | | 1<br>1<br>1 | AO2<br>4.2.1.3 |
| **01.6** | time taken using system **A** is double the time of system **B** | | 1 | AO3<br>4.2.4.1 |
| **Total** | | | **10** | |

Answer 20 · Mark scheme

November 2021 | 8463/1H | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.1 | $E = \frac{1.25\times10^{18}}{3.16\times10^{7}}$ | | 1 | AO2 4.1.1.4 |
| | $E = 3.96 \times 10^{10}$ (J) | an answer that rounds to $3.96 \times 10^{10}$ (J) scores **1** mark | 1 | |
| 05.2 | t = 86 400 (s) | | 1 | AO2 4.2.1.2 |
| | 27 000 = I × 86 400 | allow a correct substitution of an incorrectly/not converted value of t | 1 | |
| | $I = \frac{27\ 000}{86\ 400}$ | allow a correct rearrangement using an incorrectly/not converted value of t | 1 | |
| | I = 0.3125 (A) | allow a correct calculation using an incorrectly/not converted value of t<br>allow a correctly calculated answer rounded to 2 or 3 sf | 1 | |
| 05.3 | $0.15 = \frac{\text{useful power output}}{7800}$ | allow a correct substitution of an incorrectly/not converted value of total power input | 1 | AO2 4.1.2.2 |
| | useful power output = 0.15 × 7800 | allow a correct rearrangement using an incorrectly/not converted value of total power input | 1 | |
| | useful power output = 1170 (W) | this answer only but allow 1200 (W) if correct working shown | 1 | |
| 05.4 | a really large area of land would need to be covered with solar cells | | 1 | AO2 4.1.3 |
| | due to the low useful power output of the solar cells | allow due to the low efficiency of the solar cells | 1 | |

4.2.1.2 Electrical charge and current

Answer 20 · Mark scheme

November 2021 | 8463/1H | Original Q5

| | | | | |
|---|---|---|---|---|
| | | **or**<br>number of hours of daylight is too low (in UK)<br>**or**<br>low solar intensity (in UK)<br>**or**<br>solar radiation (in UK) is too low<br>**or**<br>material for construction of solar cells and/or lithium batteries is in limited supply | | |

| | | | |
|---|---|---|---|
| **Total** | | | **11** |

4.2.1.2 Electrical charge and current

Answer 21 · Mark scheme

June 2022 | 8463/1H | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.1 | transformer **X** increases potential difference | | 1 | AO1 4.2.4.3 |
| | and decreases current | do not accept if student states that potential difference decreases | 1 | |
| | reducing (thermal) energy transfer to surroundings **or** reducing (thermal) energy transfer from transmission cables | do not accept no energy transfer to surroundings | 1 | |
| | increasing the efficiency (of power transmission) | | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.2 | transformer **Y** decreases the potential difference | | 1 | AO1 4.2.4.3 |
| | to a safe / safer value | dependent on scoring 1st marking point | 1 | |

4.2.1.2 Electrical charge and current

Answer 21 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.3 | $3.24 \times 10^{11} = Q \times 230$ | | 1 | AO2 4.2.4.2 |
| | $Q = \frac{3.24 \times 10^{11}}{230}$ | | 1 | |
| | Q = 1 408 695 652 (C) | | 1 | |
| | $Q = 1.41 \times 10^{9}$ (C)<br>**or**<br>*Q* = 1 410 000 000 (C) | allow correct rounding of an incorrect answer using data from the question | 1 | |

| Total Question 6 | | 10 |
|---|---|---|

4.2.1.2 Electrical charge and current

Answer 22 · Mark scheme

June 2023 | 8463/1H | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | polarity of the potential difference doesn't change | allow direction of the potential difference doesn't change | 1 | AO1 4.2.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.2** | $E = QV$ | | 1 | AO1 4.2.4.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.3** | $5010 = Q \times 12$<br>$Q = \frac{5010}{12}$<br>$Q = 417.5$ (C) | <br><br>allow 418 (C) | 1<br>1<br>1 | AO2 4.2.4.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.4** | $5010 = 0.015 \times L$<br>$L = \frac{5010}{0.015}$<br>$L = 334\,000$ (J/kg) | | 1<br>1<br>1 | AO2 4.3.2.3 |

4.2.1.2 Electrical charge and current

Answer 22 · Mark scheme

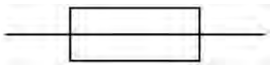
June 2023 | 8463/1H | Original Q3

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 03.5 | **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account. | 5–6 | AO1<br>4.3.1.1<br>4.3.2.1 |
| | **Level 2:** Relevant points (reasons / causes) are identified, and there are attempts at logical 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**<br><br>• particles in a solid are in a regular pattern<br>• particles in a liquid are in a random arrangement<br><br>• particles in a solid are vibrating about fixed positions<br>• particles in a liquid are moving freely<br><br>• as the ice changes to water the temperature remains constant<br>• because as the ice changes to water the potential energy of the particles increases<br><br>• as the water warms the particles move faster<br>• so the kinetic energy of the particles increases<br><br>• internal energy is the total kinetic and potential energy of all the particles<br><br>ignore any references to density of ice vs liquid water<br>ignore any references to spacing of particles | | |

| Total Question 3 | 14 |
|---|---|

## Question 10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.1** | brown | | 1 | AO1 4.2.3.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.2** |  | | 1 | AO1 4.2.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.3** | t = 0.400 (s) | | 1 | AO2 4.2.1.2 |
| | 2.0 = $I$ × 0.400 | allow a correct substitution of an incorrectly / not converted value of $t$ | 1 | |
| | $I = \frac{2.0}{0.400}$ | allow a correct rearrangement using an incorrectly / not converted value of $t$ | 1 | |
| | $I$ = 5.0 (A) | allow an answer consistent with an incorrectly / not converted value of $t$ | 1 | |

4.2.1.2 Electrical charge and current

Answer 23 · Mark scheme

June 2024 | 8463/1H | Original Q10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.4** | $L$ = 60 000 (J/kg) | allow full credit for a correct method using $E$ = 0.00102 (kJ) | 1 | AO2 4.3.2.3 |
| | 1.02 = $m$ × 60 000 | allow a correct substitution of an incorrectly / not converted value of $L$ | 1 | |
| | $m = \frac{1.02}{60\,000}$ | allow a correct rearrangement using an incorrectly / not converted value of $L$ | 1 | |
| | $m$ = 1.7 × $10^{-5}$ (kg) | allow an answer consistent with an incorrectly / not converted value of $L$ | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.5** | time taken would increase | | 1 | AO3 |
| | more energy would need to be transferred (in total) | MP2 dependent on scoring MP1 | 1 | AO1<br>4.1.2.1<br>4.3.2.3 |

| **Total Question 10** | **12** |
|---|---|

4.2.1.2 Electrical charge and current

Answer 24 · Mark scheme

June 2025 | 8463/1H | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.1 | $8000 = 0.20 \times 1600 \times \Delta\theta$<br><br>$\Delta\theta = \frac{8000}{(0.20 \times 1600)}$<br><br>$\Delta\theta = 25$ (°C) | | 1<br><br>1<br><br>1 | AO2<br>4.3.2.2<br>4.1.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.2 | $E = 180\,000$ (J) | all subsequent marks can score using an incorrectly / not converted value of $E$ | 1 | AO2<br>4.2.4.2 |
| | $180\,000 = Q \times 5.0$ | | 1 | |
| | $Q = \frac{180\,000}{5.0}$ | | 1 | |
| | $Q = 36\,000$ (C) | | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.3 | (when both switches are closed) the resistance of the circuit decreases | | 1 | AO1<br>4.2.2 |
| | (so) current increases | MP2 dependent on MP1 | 1 | |
| | (so) power output is greater as potential difference across the battery remains the same and $P = IV$ | ignore reference to $P = I^2R$ unless a quantitative comparison is included | 1 | |

| Total Question 6 | 10 |
|---|---|

4.2.1.2 Electrical charge and current

Answer 25 · Mark scheme

June 2025 | 8463/1H | Original Q9

## Question 9

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 09.1 | $h$ = 0.70 (m) | all subsequent marks can score using an incorrectly / not converted value of $h$ | 1 | AO2 4.1.1.2 |
| | $0.343 = m \times 9.8 \times 0.70$ | | 1 | |
| | $m = \frac{0.343}{9.8 \times 0.70}$ | | 1 | |
| | $m$ = 0.050 (kg) | | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 09.2 | $4.86 = I^2 \times 6.0$ | | 1 | AO2 4.2.1.3 |
| | $I^2 = \frac{4.86}{6.0}$ | | 1 | 4.2.4.1 |
| | $I$ = 0.90 (A) | | 1 | |
| | $t$ = 1800 (s) | all subsequent marks can score using an incorrectly / not converted value of $t$ | 1 | |
| | $Q = 0.90 \times 1800$ | allow a correct substitution using their value of current | 1 | |
| | $Q$ = 1620 (C) | allow a correct calculation using their value of current<br>allow an answer of 1600 (C) | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 09.3 | greater mass / volume of water each second | allow water flow will increase<br>ignore increased water speed | 1 | AO3 |
| | (because) smaller proportion / percentage of energy is wasted | allow greater (useful) power output<br>allow less energy / power wasted | 1 | AO1 4.1.2.2 |

| Total Question 9 | 12 |
|---|---|

ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Physics

## 3451

## Foundation

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Kathleen Tattersall: *Director General*

## 4.2.1.2 Electrical charge and current





# INFORMATION FOR EXAMINERS

**1. General**

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

**2. Emboldening**

**2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

**2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.

**2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

**3. Marking points**

**3.1 Marking of Quality of Written Communication**

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

## 4.2.1.2 Electrical charge and current





**3.2 Marking of lists**

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | 4,8 | 0 |
| 2 | green, 5 | 0 |
| 3 | red*, 5 | 1 |
| 4 | red*, 8 | 0 |

Example 2: Name two planets in the solar system. (2 marks)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | Pluto, Mars, Moon | 1 |
| 2 | Pluto, Sun, Mars, Moon | 0 |

**3.3 Use of chemical symbols/formulae**

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

**3.4 The marking of quantitative relationships**

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

**3.5 Marking procedure for calculations**

**3.5.1** Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

**3.5.2** Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

**3.6 Interpretation of 'it'**

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

**3.7 Errors carried forward**

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

**3.8 Phonetic spelling**

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

**3.9 Brackets**

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

**3.10 Unexpected Correct Answers not in the Mark Scheme**

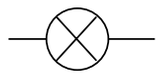
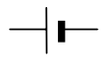
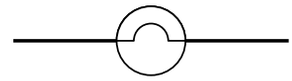
The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

### 4.2.1.2 Electrical charge and current





**3451/F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | circuit symbol for a lamp correct   circuit symbol for a cell correct | accept  accept any standard of drawing providing circuit would work | 1 <br> 1 |
| | 2 lamps drawn in parallel with 3 cells | polarity of cells must be correct (+ to –) but cells may be either way around | 1 |
| (b) | 4.5 | | 1 |
| (c) | the same as | accept any clear indication of the correct answer | 1 |
| total | | | 5 |

## 4.2.1.2 Electrical charge and current





**3451/F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | gas | | 1 |
| (b) | fuel burning stations produce electricity at any time / all the time<br><br>wind generator can only produce when the wind is strong enough | accept fuel available all the time<br><br>accept it's not always windy | 1<br><br>1 |
| (c) | no fuel is burnt **or**<br>no fuel is used **or**<br>uses only energy from wind **or**<br>does not emit harmful gases / soot / smoke | do **not** accept wind is natural / environmentally friendly / renewable<br>answer must be in terms of wind, **not** negative of fuel burning<br><br>specific examples of gases $CO_2$, $SO_2$, acid rain and greenhouse gases can be accepted<br><br>ozone negates credit | 1 |
| total | | | 4 |

## 4.2.1.2 Electrical charge and current





**3451/F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | microwaves | | 1 |
| (ii) | infra red | | 1 |
| (iii) | ultrasonic | | 1 |
| (b)(i) | B | | 1 |
| (ii) | A | | 1 |
| (c) | disturbance / vibration / movement<br><br>direction | accept motion / force<br><br>do **not** accept energy | 1<br><br>1 |
| (d) | sound wave | accept any clear indication of the correct answer | 1 |
| total | | | 8 |

### 4.2.1.2 Electrical charge and current





**3451/F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | heat | | 1 |
| (ii) | temperature increases<br>**or**<br>(cause) convection (currents) | accept gets warmer<br>accept gets hotter | 1 |
| (iii) | 60% **or** 0.6 | 60 without % scores **1** mark<br>0.6 with a unit scores **1** mark<br>60 with incorrect unit scores **1** mark<br><br>**or** correct substitution $\frac{120}{200}$ for **1** mark | 2 |
| (b) | street<br><br>more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest | <br><br>can only score this mark if first mark scored<br><br>all efficiencies calculated correctly score 2nd mark point | 1<br><br>1 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3451/F Q5**

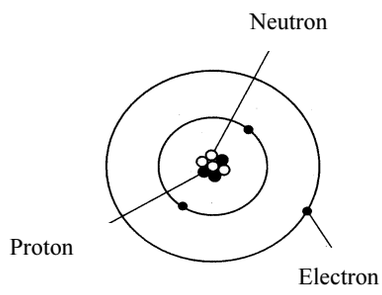
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds<br><br>line drawn steeper than LM starting before L | <br><br>ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating | 1<br><br>1 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3451/F Q6**

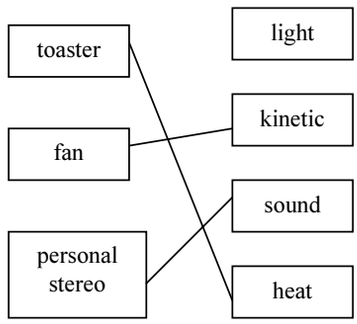
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles in the centre only if first answer = 7 | 1<br><br>1 |
| (b)(i) | 50 ± 5 | | 1 |
| (ii) | 50 ± 5 | accept their (b)(i) | 1 |
| (iii) | less | accept any way of indicating the correct answer | 1 |
| total | | | 9 |

### 4.2.1.2 Electrical charge and current





**3451/F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | each correct line scores 1 mark<br><br> | if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines | 3 |
| (b) | toaster | accept 1.2 kW | 1 |
| (c)(i) | 400 | | 1 |
| (ii) | £24 **or** 2400p | full credit for their (c)(i) × 6p<br><br>for full credit the correct numerical answer must have the correct unit<br><br>an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark<br><br>(c)(i) × 6 incorrectly evaluated scores **1** mark | 2 |
| (d) | 6 | allow 6000 for **1** mark<br><br>allow 3 × 2 for **1** mark | 2 |
| total | | | 9 |

## 4.2.1.2 Electrical charge and current





**3451/F Q8**

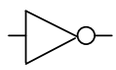
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | point where the rays cross | do not credit if ambiguous | 1 |
| (ii) | converging (lens) | do **not** accept convex | 1 |
| (b)(i) | point where the rays appear to diverge from | this should appear to be within 10mm in front of the back of the arrows on the approximate centre line<br><br>need not be accurately constructed using a ruler | 1 |
| (ii) | diverging (lens) | do **not** accept concave | 1 |
| (c) | converging<br>film<br>smaller than<br>nearer to | accept any clear indication of the correct response e.g. ticking, ringing, writing in after a mistake | 1<br>1<br>1<br>1 |
| (d)(i) | (image) bigger than object / enlarge | accept just 'made bigger' | 1 |
| (ii) | it / real image can be put on a screen<br>**or** real image on the opposite side of the lens to the object | accept 'not an imaginary or virtual image'<br><br>assume 'it' refers to a real image<br><br>do **not** credit 'it can be seen' | 1 |
| (e) | **either** (the converging lens is) thick in the middle<br>thin(ner) at the edge<br><br>**or** (both) sides bend outwards (1)<br>in the middle (1)<br><br>**or** one side bends in the middle (1)<br>more than the other side bends inwards (in the middle) (1) | thickest in the middle gains **2** marks<br><br>convex gains **2** marks<br><br>suitable diagrams gains **2** marks | 1<br><br>1 |
| total | | | 12 |

### 4.2.1.2 Electrical charge and current





**3451/F Q9**

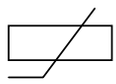
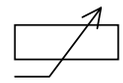
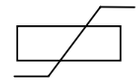
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | off<br>off<br>on | all correct | 1 |
| (ii) | AND (gate) | accept and (gate) | 1 |
| (iii) | on<br>on<br>on | all correct | 1 |
| (iv) | OR (gate) | accept or (gate) | 1 |
| (b)(i) | 1 0 **or** 0 1<br>0 1 1 0 | do **not** credit on / off responses | 1 |
| (ii) |  | accept mirror image<br>accept <br>accept with either or both parts shaded<br>accept line through as shading | 1 |
| (c) | | accept off for 0 and on for 1 throughout | |
| | 0<br>0 | both correct | 1 |
| | 0<br>1 | both correct | 1 |
| | 1<br>1 | both correct | 1 |
| | 1<br>1 | both correct | 1 |

### 4.2.1.2 Electrical charge and current





**3451/F Q9 continued**

| | | | |
|---|---|---|---|
| (d)(i) |  | accept mirror image **or** inverted<br><br>do **not** credit<br> **or** <br><br>or similar | 1 |
| (ii) | resistance decreases / increases / changes<br><br>current (through it) increases / decreases / changes<br><br>**or**<br><br>temperature changes / increases / decreases (1)<br><br>resistance changes / decreases / increases (1)<br>(NTC thermistor)<br><br>both marks independent but must be compatible to score **2** marks | accept 'voltage across it decreases' for **2** marks but only if it is made clear that this refers to a thermistor in series | 1<br><br>1 |
| total | | | 13 |

### 4.2.1.2 Electrical charge and current





**3451/F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | friction | accept any way of indicating the correct answer | 1 |
| (ii) | gravity | accept any way of indicating the correct answer | 1 |
| (b)(i) | accelerates **or** speed / velocity increases | accept faster and faster (**1** mark)<br><br>do **not** accept faster pace / falls faster or suggestions of a greater but constant speed | 1 |
| | downwards / falls | accept towards the Earth / ground<br><br>this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts | 1 |
| (ii) | constant speed / velocity **or** terminal velocity / speed **or** zero acceleration | stays in the same place negates credit | 1 |
| total | | | 5 |

## 4.2.1.2 Electrical charge and current





**3451/F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | X – mantle | | 1 |
| | Y – inner core | do **not** accept solid core | 1 |
| (ii) | different to the crust **or** contains a lot of (heavy) metals | accept iron and nickel for metals | 1 |
| | higher (average) density **or** denser | density higher than 5500 (kg/m$^3$) gets **2** marks | 1 |
| (b) | animals were able to move from one continent to the other | | 1 |
| | (when bridge broke) animals evolved differently | accept animals adapted differently | 1 |
| (c)(i) | earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other | | 1 |
| | there are no plate boundaries running through Britain | accept Britain is not near the edge of a plate | 1 |
| (ii) | convection currents (in the mantle) **or** heat released by (natural) radioactive processes | | 1 |
| total | | | 9 |

## 4.2.1.2 Electrical charge and current





**3451/F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | outside the Earth<br>**or**<br>not from the Earth | accept alien<br>accept life from / on another planet / space<br>accept our planet for Earth | 1 |
| (ii) | radio telescope(s) | do **not** accept telescopes<br>do **not** accept satellite dishes<br>do **not** accept radio receivers **or** transmitters | 1 |
| (b)(i) | galaxies | do **not** accept stars | 1 |
| (ii) | any **one** from:<br>the pulses were regular<br>pulses from space are usually random<br>(scientists) thought technology had been used to produce the pulses<br>neutron stars were unknown<br>signals from a single point | <br>accept signals / beats for pulses<br>accept noise for random pulses<br>idea of regular but not continuous | 1 |
| (iii) | neutron star is (the matter / mass) left behind<br>after a star / red giant explodes (as a super nova) | <br>accept after a super nova (explosion)<br>neutron star causing super nova gets no credit | 1<br>1 |
| (c)(i) | carried on the balloon / equipment | accept carried by a rocket / aircraft / satellite<br>birds negates credit | 1 |
| (ii) | on comets or meteors | accept meteorites / shooting stars<br>accept returning space craft<br>accept solar wind<br>ignore asteroids<br>accept ufo<br>do **not** accept solar flares<br>do **not** accept satellites | 1 |
| total | | | 8 |

## 4.2.1.2 Electrical charge and current





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation) | fact<br>heat = infra red<br>ignore references to light<br>accept shiny for silver<br>good radiator negates the mark<br>ignore references to good conductor<br>do **not** accept bounce back | 1 |
| | less heat is lost through the board **or** more heat is retained by the shirt | explanation<br>accept both sides of shirt heated<br>reflects heat back up gets **1** mark only<br>ignore mention of friction | 1 |
| (b) | metal soleplate | accept soleplate / bottom / metal<br>do **not** accept outside / case | 1 |
| (c) | plastic **or** rubber | accept any named plastic<br>do **not** accept wood | 1 |
| | it is a (good) insulator **or** it is a poor conductor | ignore mention of heat if in conjunction with electricity | 1 |
| (d) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* | *Maximum of **2** marks if ideas not well expressed.* | |
| | pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger | answers in terms of charges attracting or repelling gain no credit | 1 |
| | plunger pushed / moved to the right (by spring) **or** plunger released | | 1 |
| | push switch opens / goes to off / goes to right | accept circuit is broken<br>for maximum credit the points must follow a logical sequence<br>3 correct points but incorrect sequence scores **2** marks only<br>ignore reset action | 1 |
| total | | | 8 |

## 4.2.1.2 Electrical charge and current





**3451/F Q14**

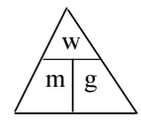
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from: | | 1 |
| | the ground | do **not** accept mobile phones | |
| | the air | | |
| | radon (gas) | | |
| | building materials | | |
| | buildings | | |
| | rocks / granite | | |
| | food | | |
| | cosmic <u>rays</u> **or** solar <u>rays</u> | accept from outer space<br>accept sun but **not** sunlight | |
| | X-rays | accept medical uses | |
| | nuclear weapons testing | | |
| | nuclear power stations / accidents | | |
| (ii) | 2 | allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120<br>for **1** mark | 2 |
| (b) | | answers must be comparative<br>accept converse answers throughout | |
| | alpha: the count rate is (greatly) reduced by the card **or**<br>the card absorbs alphas <u>but not betas</u> | accept paper for the card | 1 |
| | beta: the count rate is (greatly) reduced by the metal **or**<br>the thin metal absorbs alphas <u>and</u> betas **or** the thin metal absorbs all of the radiation (from the source) | accept aluminium for the metal | 1 |
| | gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or**<br>a higher reading would be recorded **or** to reduce the count to 2 would require <u>much more</u> than 3 mm of metal | accept aluminium for the metal<br>accept lead / aluminium for the metal | 1 |
| total | | | 6 |

## 4.2.1.2 Electrical charge and current





**3451/F Q15**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | weight = mass × g.f.s. | accept w = m × g<br>accept gravity for gfs<br>accept  provided<br>subsequent use of Δ correct<br>do **not** accept N = kg × N/kg | 1 |
| (ii) | 675 | 75 × 9 for **1** mark | 2 |
| (iii) | g.(f.s.) is higher (on Earth than Venus) | accept gravity for g.f.s.<br>do **not** accept g.f.s. is lower unless answer states on Venus | 1 |
| (iv) | orbit time for Jupiter is <u>longer</u> / longest (than for the other planets) | do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s. | 1 |
| (b) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*<br>any **two** from:<br>dust <u>and</u> gas **or** remnants of a super nova<br>pulled together by (force of) <u>gravity</u><br>nuclear fusion starts | *Maximum of **1** mark if ideas not well expressed.*<br>accept hydrogen for dust and gas<br>do **not** accept hydrogen burns<br>although candidates may include more detail these points are essential to score the credit | 2 |
| total | | | 7 |

## 4.2.1.2 Electrical charge and current





**3451/F Q16**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | upright with the contacts at the bottom and still in place and unbent | no need for labels but incorrect label(s) cancel the mark<br><br>accept a freehand drawing<br><br>no need for details such as correct dimensions | 1 |
| | one blob of mercury touching <u>both</u> contacts | do **not** award mark if contacts bent to touch | 1 |
| (b)(i) | (X is a) battery | do **not** credit cell<br>accept (set of) cells<br>accept power supply<br>do **not** accept power pack | 1 |
| | (Y is a) LED | **or** light emitting diode | 1 |
| (ii) | longer (time) | do **not** accept 'slower time' | 1 |
| (iii) | any **two** from:<br><br>current less<br><br>(so) rate of flow of charge less **or** less coulombs per second<br><br>(so) discharge is slower | <br><br>do **not** accept current slower<br><br><br><br>accept capacitor has charge for longer **or** charge lasts longer **or** (so total of) electrons take longer to travel round circuit | 2 |
| (c) | 4200 | <br><br>translation correct (= 4000) but percentage addition incorrect gains **1** mark<br><br>translation incorrect but 5% addition is correct gains **1** mark<br><br>accept 422.1 **or** 42.2 **or** 6.3 for **1** mark | 2 |
| | ohms **or** Ω | <br><br>4.2 kilohms **or** 4.2 kΩ gains all **3** marks | 1 |
| total | | | 10 |

## 4.2.1.2 Electrical charge and current





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | point at which its mass (seems to) act<br>**or** point at which gravity (seems to) act | accept …its weight acts<br><br>accept correct statements if the intent is clear<br>e.g. … if suspended, the centre of gravity will be directly under the point of suspension<br>e.g. … (if the object is symmetrical), the centre of gravity is on the **or** an axis (of symmetry)<br><br>do **not** credit just 'it is a point' | 1 |
| (b) | **Quality of written communication**<br>*The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*<br><br>any **five** from:<br><br>clamp (steel) rod (horizontally)<br>hang plastic / sheet by rod through (one) hole<br>hang plumb line from rod<br>mark ends of plumb line on the sheet and use the ruler to draw a straight line<br>repeat with other hole<br>centre of mass is where the lines cross<br>check by balancing at this point | *maximum of **4** marks if ideas not well expressed*<br><br>**no** marks if method quite unworkable<br><br>maximum of **3** marks if no 'repeat with other hole' | 5 |
| (c)(i) | (turning) effect **or** moment<br>force<br>distance | all three correct<br>accept weight<br>accept length | 1 |
| (ii) | 17.6<br><br>Nm **or** newton metre(s) | allow 44 × 0.4 **or** 0.4 × 44 for **1** mark<br><br>do **not** accept N/m **or** N/cm<br><br>1760 Ncm gains all **3** marks | 2<br><br>1 |
| total | | | 10 |

4.2.1.2 Electrical charge and current



ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Science: Double Award Co-ordinated

## 3462

## Paper 3F

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### 4.2.1.2 Electrical charge and current





# INFORMATION FOR EXAMINERS

**1. General**

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

**2. Emboldening**

**2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

**2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.

**2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

**3. Marking points**

**3.1 Marking of Quality of Written Communication**

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

**3.2 Marking of lists**

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | 4,8 | 0 |
| 2 | green, 5 | 0 |
| 3 | red*, 5 | 1 |
| 4 | red*, 8 | 0 |

Example 2: Name two planets in the solar system. (2 marks)

| Candidate | Response | Marks awarded |
|---|---|---|
| 1 | Pluto, Mars, Moon | 1 |
| 2 | Pluto, Sun, Mars, Moon | 0 |

**3.3 Use of chemical symbols/formulae**

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

**3.4 The marking of quantitative relationships**

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

**3.5 Marking procedure for calculations**

**3.5.1** Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

## 4.2.1.2 Electrical charge and current





**3.5.2** Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

**3.6 Interpretation of 'it'**

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

**3.7 Errors carried forward**

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

**3.8 Phonetic spelling**

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

**3.9 Brackets**

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

**3.10 Unexpected Correct Answers not in the Mark Scheme**

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

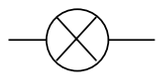
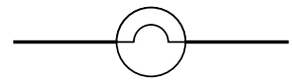
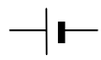
## 4.2.1.2 Electrical charge and current





**Double Award**
**Foundation Tier 3462/3F**

**3462/3F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | circuit symbol for a lamp correct  | accept  accept any standard of drawing providing circuit would work | 1 |
| | circuit symbol for a cell correct  | | 1 |
| | 2 lamps drawn in parallel with 3 cells | polarity of cells must be correct (+ to –) but cells may be either way around | 1 |
| (b) | 4.5 | | 1 |
| (c) | the same as | accept any clear indication of the correct answer | 1 |
| total | | | 5 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | gas | | 1 |
| (b) | fuel burning stations produce electricity at any time / all the time | accept fuel available all the time | 1 |
| | wind generator can only produce when the wind is strong enough | accept it's not always windy | 1 |
| (c) | no fuel is burnt **or**<br>no fuel is used **or**<br>uses only energy from wind **or**<br>does not emit harmful gases / soot / smoke | do **not** accept wind is natural / environmentally friendly / renewable<br>answer must be in terms of wind, **not** negative of fuel burning<br><br>specific examples of gases $CO_2$, $SO_2$, acid rain and greenhouse gases can be accepted<br><br>ozone negates credit | 1 |
| total | | | 4 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | microwaves | | 1 |
| (ii) | infra red | | 1 |
| (iii) | ultrasonic | | 1 |
| (b)(i) | B | | 1 |
| (ii) | A | | 1 |
| (c) | disturbance / vibration / movement<br><br>direction | accept motion / force<br><br>do **not** accept energy | 1<br><br>1 |
| (d) | sound wave | accept any clear indication of the correct answer | 1 |
| total | | | 8 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | heat | | 1 |
| (ii) | temperature increases<br>**or**<br>(cause) convection (currents) | accept gets warmer<br>accept gets hotter | 1 |
| (iii) | 60% **or** 0.6 | 60 without % scores **1** mark<br>0.6 with a unit scores **1** mark<br>60 with incorrect unit scores **1** mark<br><br>**or** correct substitution $\frac{120}{200}$ for **1** mark | 2 |
| (b) | street<br><br>more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest | <br><br>can only score this mark if first mark scored<br><br>all efficiencies calculated correctly score 2nd mark point | 1<br><br>1 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q5**

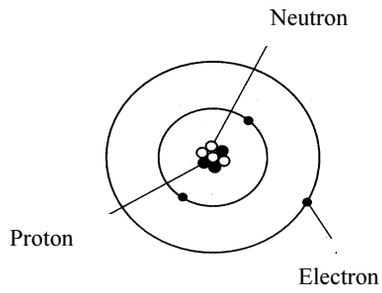
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds<br><br>line drawn steeper than LM starting before L | <br><br>ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating | 1<br><br>1 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q6**

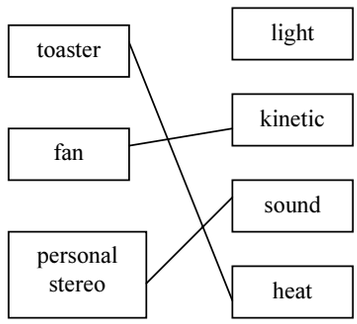
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles in the centre only if first answer = 7 | 1<br><br>1 |
| (b)(i) | 50 ± 5 | | 1 |
| (ii) | 50 ± 5 | accept their (b)(i) | 1 |
| (iii) | less | accept any way of indicating the correct answer | 1 |
| total | | | 9 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | each correct line scores 1 mark<br><br> | if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines | 3 |
| (b) | toaster | accept 1.2 kW | 1 |
| (c)(i) | 400 | | 1 |
| (ii) | £24 **or** 2400p | full credit for their (c)(i) × 6p<br><br>for full credit the correct numerical answer must have the correct unit<br><br>an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark<br><br>(c)(i) × 6 incorrectly evaluated scores **1** mark | 2 |
| (d) | 6 | allow 6000 for **1** mark<br><br>allow 3 × 2 for **1** mark | 2 |
| total | | | 9 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | friction | accept any way of indicating the correct answer | 1 |
| (ii) | gravity | accept any way of indicating the correct answer | 1 |
| (b)(i) | accelerates **or** speed / velocity increases | accept faster and faster (**1** mark)<br><br>do **not** accept faster pace / falls faster or suggestions of a greater but constant speed | 1 |
| | downwards / falls | accept towards the Earth / ground<br><br>this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts | 1 |
| (ii) | constant speed / velocity **or** terminal velocity / speed **or** zero acceleration | stays in the same place negates credit | 1 |
| total | | | 5 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | X – mantle | | 1 |
| | Y – inner core | do **not** accept solid core | 1 |
| (ii) | different to the crust **or** contains a lot of (heavy) metals | accept iron and nickel for metals | 1 |
| | higher (average) density **or** denser | density higher than 5500 ($kg/m^3$) gets **2** marks | 1 |
| (b) | animals were able to move from one continent to the other | | 1 |
| | (when bridge broke) animals evolved differently | accept animals adapted differently | 1 |
| (c)(i) | earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other | | 1 |
| | there are no plate boundaries running through Britain | accept Britain is not near the edge of a plate | 1 |
| (ii) | convection currents (in the mantle) **or** heat released by (natural) radioactive processes | | 1 |
| total | | | 9 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | outside the Earth<br>**or**<br>not from the Earth | accept alien<br>accept life from / on another planet / space<br>accept our planet for Earth | 1 |
| (ii) | radio telescope(s) | do **not** accept telescopes<br>do **not** accept satellite dishes<br>do **not** accept radio receivers **or** transmitters | 1 |
| (b)(i) | galaxies | do **not** accept stars | 1 |
| (ii) | any **one** from:<br>the pulses were regular<br>pulses from space are usually random<br>(scientists) thought technology had been used to produce the pulses<br>neutron stars were unknown signals from a single point | <br>accept signals / beats for pulses<br>accept noise for random pulses<br>idea of regular but not continuous | 1 |
| (iii) | neutron star is (the matter / mass) left behind<br>after a star / red giant explodes (as a super nova) | <br>accept after a super nova (explosion)<br>neutron star causing super nova gets no credit | 1<br>1 |
| (c)(i) | carried on the balloon / equipment | accept carried by a rocket / aircraft / satellite<br>birds negates credit | 1 |
| (ii) | on comets or meteors | accept meteorites / shooting stars<br>accept returning space craft<br>accept solar wind<br>ignore asteroids<br>accept ufo<br>do **not** accept solar flares<br>do **not** accept satellites | 1 |
| total | | | 8 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation) | fact<br>heat = infra red<br>ignore references to light<br>accept shiny for silver<br>good radiator negates the mark<br>ignore references to good conductor<br>do **not** accept bounce back | 1 |
| | less heat is lost through the board **or** more heat is retained by the shirt | explanation<br>accept both sides of shirt heated<br>reflects heat back up gets **1** mark only<br>ignore mention of friction | 1 |
| (b) | metal soleplate | accept soleplate / bottom / metal<br>do **not** accept outside / case | 1 |
| (c) | plastic **or** rubber | accept any named plastic<br>do **not** accept wood | 1 |
| | it is a (good) insulator **or** it is a poor conductor | ignore mention of heat if in conjunction with electricity | 1 |
| (d) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* | *Maximum of **2** marks if ideas not well expressed.* | |
| | pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger | answers in terms of charges attracting or repelling gain no credit | 1 |
| | plunger pushed / moved to the right (by spring) **or** plunger released | | 1 |
| | push switch opens / goes to off / goes to right | accept circuit is broken<br>for maximum credit the points must follow a logical sequence<br>3 correct points but incorrect sequence scores **2** marks only<br>ignore reset action | 1 |
| total | | | 8 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q12**

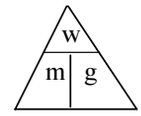
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br><br>the ground<br>the air<br>radon (gas)<br>building materials<br>buildings<br>rocks / granite<br>food<br>cosmic rays **or** solar rays<br><br>X-rays<br>nuclear weapons testing<br>nuclear power stations / accidents | <br><br>do **not** accept mobile phones<br><br><br><br><br><br><br>accept from outer space<br>accept sun but **not** sunlight<br>accept medical uses | 1 |
| (ii) | 2 | allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120<br>for **1** mark | 2 |
| (b) | <br><br><br>alpha: the count rate is (greatly) reduced by the card **or**<br>the card absorbs alphas but not betas<br><br>beta: the count rate is (greatly) reduced by the metal **or**<br>the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source)<br><br>gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or**<br>a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal | answers must be comparative<br><br>accept converse answers throughout<br><br>accept paper for the card<br><br><br>accept aluminium for the metal<br><br><br><br><br>accept aluminium for the metal<br><br><br>accept lead / aluminium for the metal | <br><br><br>1<br><br><br>1<br><br><br><br><br>1 |
| total | | | 6 |

## 4.2.1.2 Electrical charge and current





**3462/3F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | weight = mass × g.f.s. | accept w = m × g<br>accept gravity for gfs<br>accept  provided<br>subsequent use of Δ correct<br>do **not** accept N = kg × N/kg | 1 |
| (ii) | 675 | 75 × 9 for **1** mark | 2 |
| (iii) | g.(f.s.) is higher (on Earth than Venus) | accept gravity for g.f.s.<br>do **not** accept g.f.s. is lower unless answer states on Venus | 1 |
| (iv) | orbit time for Jupiter is <u>longer</u> / longest (than for the other planets) | do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s. | 1 |
| (b) | **Quality of written communication**<br>*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*<br>any **two** from:<br>dust <u>and</u> gas **or** remnants of a super nova<br>pulled together by (force of) <u>gravity</u><br>nuclear fusion starts | *Maximum of **1** mark if ideas not well expressed.*<br>accept hydrogen for dust and gas<br>do **not** accept hydrogen burns<br>although candidates may include more detail these points are essential to score the credit | 2 |
| total | | | 7 |

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ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Secondary Education

# Physics 3451/F
*Specification B*

# Mark Scheme

## *2005 examination – June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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# Physics (Specification B)
# Foundation Tier 3451/F

### 3451/F Q1

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | less than | accept any correct indication | 1 |
| (ii) | more than | accept any correct indication | 1 |
| (b) | any **two** from:<br><br>stays above the same place<br><br>above the equator<br><br>one orbit takes 24 hours | <br><br>do **not** accept stays in the same place<br><br>do **not** accept goes around equator unless qualified<br>do **not** accept orbit at same speed as Earth<br>do **not** accept orbit at a constant speed<br>accept has same angular speed / velocity as Earth | 2 |
| total | | | 4 |

### 3451/F Q2

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | comet | | 1 |
| (b) | large group / number / collection of stars | ignore reference to planets<br>accept millions of stars<br>do **not** accept thousands of stars<br>do **not** accept loads of stars | 1 |
| (c) | giant<br><br>supernova<br><br>neutron | | 1<br><br>1<br><br>1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3451/F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | radio | | 1 |
| (ii) | gamma | accept microwave<br>accept infrared | 1 |
| (iii) | ultra violet | | 1 |
| (iv) | microwaves | | 1 |
| (b) | the same as | | 1 |
| (c) | X-rays do not go through lead | references to gamma rays are incorrect<br>accept lead protects them from the X-rays<br>accept not exposed to X-rays | 1 |
| | lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u> | accept X-rays (may) cause cancer<br>accept organs for cell<br>do **not** accept references to electric shock<br>do **not** accept stops bones of people showing on X-ray<br>answers involving the horse wearing an apron are incorrect | 1 |
| | **Quality of written communication** | award for a sensible sequence of **two** points | 1 |
| total | | | 8 |

*Physics B* – AQA GCSE Mark Scheme, 2005 June series

**3451/F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | light<br><br>electrical | | 1<br><br>1 |
| (b) | 15% **or** 0.15 | correct substitution gains **1** mark only<br>an answer of 15 with no unit **or** an incorrect unit gains **1** mark<br>an answer of 0.15 given with a unit gains **1** mark | 2 |
| (c) | the ticket machine is a long way from other electricity supplies | | 1 |
| (d) | any figure between 5 and 10 inclusive | unit not required but if given must match numerical answer | 1 |
| total | | | 6 |

**3451/F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | radon (gas) | do **not** accept gas | 1 |
| (ii) | background | | 1 |
| (b) | bigger | accept any word which means bigger | 1 |
| (c) | **Z**<br><br>alpha will not pass through aluminium or lead | if Z is not given, the reason does not score<br>accept alpha cannot go through metals / dense material<br>accept there is nothing to stop the radiation<br>accept alpha will not pass through aluminium<br>do **not** accept alpha will not pass through lead<br>do **not** accept alpha stopped by air | 1<br><br>1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3451/F Q6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | loses negative charge / electrons | do **not** accept positive charge transfers to the comb<br>do **not** accept friction | 1 |
| (b) | **A** attract | | 1 |
| | **B** repel | | 1 |
| | **C** attract | | 1 |
| (c) | **F A D E** | allow **2** marks for 2 letters in the correct place<br>allow **1** mark for 1 letter in the correct place | 3 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current



*Physics B* – AQA GCSE Mark Scheme, 2005 June series

**3451/F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | all points correctly plotted | tolerance ± $\frac{1}{2}$ square on y axis only<br>allow **1** mark for 3 correctly plotted points | 2 |
| | attempt made to draw a smooth curve | do **not** accept dot-to-dot line | 1 |
| (b)(i) | 3 days ± 0.2<br>**or**<br>any value correctly obtained using their graph line | if no line drawn in (a), answer must be exactly 3 | 1 |
| (ii) | 3 days or their (b)(i) | | 1 |
| (c) | radon-222 | accept radon **or** 222<br>accept alpha or 3.8<br>correct isotope required for reason to score | 1 |
| | has the shortest half-life | accept the others have longer half-lives | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current





**3451/F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils of Cynognathus are found in Africa and South America | | 1 |
| | the shapes ……. almost fit together | only two boxes should be ticked<br>deduct **1** mark for each additional box<br>to a minimum mark of **0** | 1 |
| (b) | continental | | 1 |
| | crust | | 1 |
| | tectonic | | 1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3451/F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | capacitor | accept condenser | 1 |
| | LDR | **or** light dependent resistor<br>accept 'ldr', 'Ldr' etc. | 1 |
| | relay (normally open) | do **not** accept 'relay normally closed' | 1 |
| (b)(i) | battery | accept '(battery of) cells'<br>do **not** accept 'battery / cell' | 1 |
| (ii) | LED | **or** light emitting diode<br>accept 'led' or 'Led'<br>do **not** accept just 'diode' | 1 |
| (iii) | B will light (but C will not) | accept '(only) B will work'<br>accept 'one is on the other is off'<br>do **not** accept 'C is on and B is off' | 1 |
| (iv) | any **one** from:<br>B is connected the right way round (and C is not)<br>a (light emitting) diode only allows (a significant) current to flow in one direction<br>B's anode is connected to the positive side of the supply<br>B's cathode is connected to the negative terminal | N.B. the candidate's answer to part (b)(iii) may include this mark but do **not** credit if the response to part (b)(iii) is incorrect or there is any other contradiction<br>if (iv) is completely consistent with (iii) which is wrong, allow **1** mark | 1 |
| (c)(i) | first input / second input / output<br>0 / 0 / **0**<br>1 / 0 / **0**<br>0 / 1 / **0**<br>1 / 1 / **1** | **all** correct<br>allow:<br>OFF NO<br>OFF NO<br>OFF NO<br>ON YES | 1 |
| (ii) | truth (table) | | 1 |

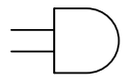
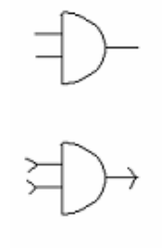
**cont…**

### 4.2.1.2 Electrical charge and current





**3451/F Q9 cont…**

| | | | |
|---|---|---|---|
| (iii) |  | a Roman upper case D in any orientation without contacts is acceptable but if contacts are shown do **not** give the mark if there is any ambiguity or contradiction<br><br>allow  | 1 |
| (d) | light sensor | **or** light dependent resistor<br>**or** LDR<br>accept 'ldr', Ldr' etc<br>allow solar cell, photo cell | 1 |
| | NOT gate | accept 'Not gate' **or** 'not gate'<br><br>if both correct but in the wrong order credit with **1** mark | 1 |
| total | | | 12 |

### 4.2.1.2 Electrical charge and current



*Physics B* – AQA GCSE Mark Scheme, 2005 June series

**3451/F Q10**

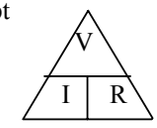
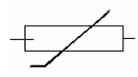
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | rays continued to meet on the right hand side of the lens and beyond | must be straight lines from the right hand side of the lens<br>ignore details through the lens<br>allow if no arrows | 1 |
| | meet exactly on the axis | negate mark if contradictory arrow(s) added<br>do not need to go beyond the focus for this mark | 1 |
| (ii) | (principal) focus | **or** focal (point) | 1 |
| (iii) | converging | **or** convex | 1 |
| (b)(i) | **A** | | 1 |
| (ii) | rays seem to come from this point | **or** words to this effect<br>**or** shows this on the diagram | 1 |
| (iii) | diverging | **or** concave | 1 |
| (c) | film | accept any unambiguous method of showing the correct response | 1 |
| | smaller than | | 1 |
| | further away from | | 1 |
| (d) | any **three** from:<br>• real image can be put on a screen<br>• virtual image cannot be put on a screen / film<br>• virtual image is imaginary<br>• real image is formed where (real) rays cross / converge<br>• virtual image is where virtual / imaginary rays (seem to) come from<br>• virtual image formed where virtual rays intersect / cross | allow film<br><br>allow real image has light travelling through it<br>**or** virtual image is where rays seem to come from | 3 |
| total | | | 13 |

## 4.2.1.2 Electrical charge and current





**3451/F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | $A_1 = 0.5$ | ignore any units | 1 |
| | $A_4 = 0.5$ | allow **1** mark for $A_1 = A_4 \neq 0.5$ | 1 |
| (ii) | the resistance of **P** is more than 20 Ω | | 1 |
| | a smaller current goes through P / $A_2$ (than 20 Ω) | dependent on getting 1st mark correct<br>accept converse | 1 |
| (b)(i) | potential difference = current × resistance | accept pd / voltage for potential difference<br>accept V = I × R, correct symbols and correct case only<br>accept volts = amps × ohms<br>accept <br>provided subsequent method is correct<br>allow combination of physical quantities and named units<br>allow voltage = I × R | 1 |
| (ii) | 6 | allow **1** mark for correct substitution | 2 |
| (iii) | 6 | accept their (b)(ii) | 1 |
| (c) | thermistor or  | accept correct circuit symbol<br>allow phonetic spelling | 1 |
| | resistance goes down (as temperature of thermistor goes up) | do **not** accept changes for goes down<br>do **not** accept an answer in terms of current only<br>answers in terms of other components are incorrect | 1 |
| total | | | 10 |

### 4.2.1.2 Electrical charge and current





**3451/F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | larger the distance, greater the time | accept 'they are proportional'<br>accept converse | 1 |
| (ii) | any value between 6 and 9 years inclusive | | 1 |
| (b)(i) | carbon dioxide | | 1 |
| (ii) | (Venus) has high**er** temperature (than Mercury) | accept has the high**est** temperature<br>accept Venus is hotter / hottest<br><br>do **not** accept has a high / very high temperature | 1 |
| | (Venus) further from the Sun than Mercury | accept 'Venus is not the closest planet to the Sun'<br><br>answer in terms of greenhouse effect only, scores **0** marks | 1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | 20 | | 1 |
| (ii) | convection | | 1 |
| (iii) | fit draughtproof strips | accept lay carpet<br>accept fit curtains<br>accept close doors / windows / curtains<br>accept any reasonable suggestion for reducing a draught<br>'double glazing' alone is insufficient | 1 |
| (b) | air is (a good) insulator<br>**or**<br>air is a poor conductor | accept air cavity / 'it' for air | 1 |
| | reducing heat transfer by <u>conduction</u> | accept stops for reduces<br>ignore convection<br>do **not** accept radiation<br>do **not** accept answers in terms of heat being trapped | 1 |
| (c)(i) | most cost effective | accept it is cheaper or low<u>est</u> cost<br>accept shortest payback time<br>accept in terms of reducing heat loss by the largest amount<br>do **not** accept it is easier<br>ignore most heat is lost through the roof | 1 |
| (ii) | 4 | | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current





**3451/F Q14**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | constant speed | do **not** accept normal speed<br>do **not** accept it is stopped / stationary | 1 |
| | in a straight line | accept any appropriate reference to a direction<br><br>constant velocity gains **2** marks<br>'not accelerating' gains **2** marks<br><br>terminal velocity alone gets **1** mark | 1 |
| (ii) | goes down owtte | accept motorbike (it) slows down | 1 |
| (b)(i) | 20 (m/s) | ignore incorrect units | 1 |
| (ii) | acceleration = change in velocity / time (taken) | do **not** accept velocity for change in velocity<br>accept change in speed<br>accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$<br>do **not** accept $a = \frac{v}{t}$ | 1 |
| (iii) | 4<br>**or** their (b)(i) ÷ 5 | allow **1** mark for correct substitution | 2 |
| | $m/s^2$ | m/s/s **or** $ms^{-2}$ **or** metres per second squared **or** metres per second per second | 1 |
| (c) | vehicle may skid / slide | loss of control / brakes lock / wheels lock<br>accept greater stopping distance **or** difficult to stop | 1 |
| | due to reduced friction (between tyre(s) and road) | accept due to less grip<br>do **not** accept no friction | 1 |

**cont…**

### 4.2.1.2 Electrical charge and current





**3451/F Q14 cont**…

| | | | |
|---|---|---|---|
| (d) | any **three** from:<br>• <u>increased</u> speed<br>• <u>reduced</u> braking force<br>• <u>slower</u> (driver) reactions<br>• <u>poor</u> vehicle maintenance<br>• <u>increased</u> mass / weight of vehicle<br>• <u>poor</u> road surface<br>• <u>more</u> streamlined | do **not** accept night time / poor vision<br>N.B. specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc<br>specific examples may **each** gain credit eg worn brakes or worn tyres etc<br>accept large mass / weight of vehicle<br>if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only | 3 |
| total | | | 13 |

### 4.2.1.2 Electrical charge and current





**3451/F Q15**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | arrow from centre of the ball<br>**and** at right angles to the string<br>**and** in the correct direction | arrow should point to the student's belt<br>accept free-hand 'straight' line<br>do **not** accept curved line | 1 |
| (ii) | increase<br>increase<br>increase | accept 'be stronger / bigger'<br>accept 'be stronger / bigger'<br>accept 'be stronger / bigger' | 1<br>1<br>1 |
| (b) | speed<br>velocity<br>direction | all **three** correct<br><br>any two correct for **1** mark<br>otherwise **0** marks | 2 |
| (c)(i) | centripetal | accept 'centripedal' and other minor misspellings<br>do **not** accept anything which could be 'centrifugal' | 1 |
| (ii) | gravity | accept 'weight'<br>accept 'force of attraction due to mass(es) (of the Moon and the Earth)' | 1 |
| (iii) | electron(s) | | 1 |
| (iv) | electrostatic | accept 'electrical'<br>do **not** accept just 'centripetal' | 1 |
| total | | | 10 |

### 4.2.1.2 Electrical charge and current





**3451/F Q16**

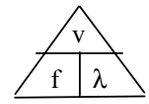
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | **X** at the centre of the lifebelt | measuring from the centre of **X**, allow 2 mm tolerance in any direction | 1 |
| (ii) | any **two** from:<br><br>below the point of suspension<br><br>at the centre (of the lifebelt)<br><br>(because) the lifebelt / it is symmetrical | if X is on vertical line below the hanger (but not at centre) can gain the first point only<br><br>accept '(vertically) below **Y**'<br><br>accept 'in the middle'<br><br>**or** (because) the mass / weight is evenly distributed | 2 |
| (b) | Nm **or** newton metre(s)<br><br>750 | accept Newton metre(s)<br>do **not** accept any ambiguity in the symbol ie NM, nM or nm<br><br>(moment) = force × (perpendicular) distance (between line of action and pivot)<br>**or** (moment) = 500 × 1.5 gains<br>**1** mark | 1<br><br>2 |
| (c) | **Quality of written communication**:<br><br>any **three** connected points from:<br><br>low(er) <u>centre of mass / gravity</u><br><br>(more) <u>stable</u><br><br>less likely to fall over<br><br>the <u>turning effect / moment</u> (of the weight of case) is less<br><br>so the pull on her arm is less | for **2** of the underlined terms used in the correct context<br><br><br>**or** <u>centre of mass / gravity</u> will be close(r) to the wheels / axle / ground<br><br>**or** less <u>unstable</u><br><br>accept 'less likely to overturn'<br>do **not** accept 'will not fall over'<br><br><br>**or** so less effort is needed to hold the case<br>ignore references to pulling the case | 1<br><br>3 |
| total | | | 10 |

### 4.2.1.2 Electrical charge and current





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | any **two** from:<br>• **amplitude** decreasing<br>• **wavelength** increasing<br>• **frequency** decreasing<br><br>**Quality of written communication** | accept siren / sound getting quieter<br>do **not** accept sound decreases<br><br>accept pitch decreasing<br>ignore reference to transverse wave<br>ignore reference to speed<br><br>contradictory statements within each point lose the mark<br><br>all emboldened terms in candidate's answer used correctly | 2<br><br>1 |
| (b)(i) | ultrasound **or** ultrasonic | | 1 |
| (ii) | wave speed = frequency × wavelength | accept speed / velocity for wave speed<br><br>accept $v = f \times \lambda$<br>do **not** accept w for $\lambda$<br>do **not** accept s for v<br><br>accept <br><br><br>provided subsequent calculation shows a correct method | 1 |
| (iii) | 339.2 **or** 340 **or** 339 | allow **1** mark for using 212 000<br>allow **1** mark for correct substitution<br><br>an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only<br>award full credit for a correct numerical answer with the unit changed to km/s | 3 |
| total | | | 8 |

Version 1.0: *27092005*

ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Secondary Education

# Science: Double Award 3462/3F
*Specification B (Co-ordinated)*

# Mark Scheme

## *2005 examination - June series*

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*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2005 June series

# Double Award
# Foundation Tier 3462/3F

**3462/3F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | less than | accept any correct indication | 1 |
| (ii) | more than | accept any correct indication | 1 |
| (b) | any **two** from:<br><br>stays above the same place<br><br>above the equator<br><br>one orbit takes 24 hours | <br><br>do **not** accept stays in the same place<br><br>do **not** accept goes around equator unless qualified<br>do **not** accept orbit at same speed as Earth<br>do **not** accept orbit at a constant speed<br>accept has same angular speed / velocity as Earth | 2 |
| total | | | 4 |

**3462/ 3F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | comet | | 1 |
| (b) | large group / number / collection of stars | ignore reference to planets<br>accept millions of stars<br>do **not** accept thousands of stars<br>do **not** accept loads of stars | 1 |
| (c) | giant<br><br>supernova<br><br>neutron | | 1<br><br>1<br><br>1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | radio | | 1 |
| (ii) | gamma | accept microwave<br>accept infrared | 1 |
| (iii) | ultra violet | | 1 |
| (iv) | microwaves | | 1 |
| (b) | the same as | | 1 |
| (c) | **Quality of written communication** | award for a sensible sequence of **two** points | 1 |
| | X-rays do not go through lead | accept lead protects them from the X-rays<br>accept not exposed to X-rays | 1 |
| | lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u> | accept X-rays (may) cause cancer<br><br>accept organs for cell<br>do **not** accept references to electric shock<br>do **not** accept stops bones of people showing on X-ray<br>answers involving the horse wearing an apron are incorrect<br><br>references to gamma rays are incorrect | 1 |
| total | | | 8 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2005 June series

**3462/3F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | light<br><br>electrical | | 1<br><br>1 |
| (b) | 15% **or** 0.15 | correct substitution gains **1** mark only<br>an answer of 15 with no unit **or** an incorrect unit gains **1** mark<br>an answer of 0.15 given with a unit gains **1** mark | 2 |
| (c) | the ticket machine is a long way from other electricity supplies | | 1 |
| (d) | any figure between 5 and 10 inclusive | unit not required but if given must match numerical answer | 1 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | radon (gas) | do **not** accept gas | 1 |
| (ii) | background | | 1 |
| (b) | bigger | accept any word which means bigger | 1 |
| (c) | **Z**<br><br>alpha will not pass through aluminium or lead | if Z is not given, the reason does not score<br>accept alpha cannot go through metals / dense material<br>accept there is nothing to stop the radiation<br>accept alpha will not pass through aluminium<br>do **not** accept alpha will not pass through lead<br>do **not** accept alpha stopped by air | 1<br><br>1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2005 June series

**3462/3F Q6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | loses negative charge / electrons | do **not** accept positive charge<br>transfers to the comb<br>do **not** accept friction | 1 |
| (b) | **A** attract | | 1 |
| | **B** repel | | 1 |
| | **C** attract | | 1 |
| (c) | **F A D E** | allow **2** marks for 2 letters in the correct place<br>allow **1** mark for 1 letter in the correct place | 3 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | all points correctly plotted | tolerance ± $\frac{1}{2}$ square on y axis only<br>allow **1** mark for 3 correctly plotted points | 2 |
| | attempt made to draw a smooth curve | do **not** accept dot-to-dot line | 1 |
| (b)(i) | 3 days ± 0.2<br>**or**<br>any value correctly obtained using their graph line | if no line drawn in (a), answer must be exactly 3 | 1 |
| (ii) | 3 days or their (b)(i) | | 1 |
| (c) | radon-222 | accept radon **or** 222<br>accept alpha or 3.8<br>correct isotope required for reason to score | 1 |
| | has the shortest <u>half-life</u> | accept the others have longer <u>half-lives</u> | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2005 June series

**3462/3F Q8**

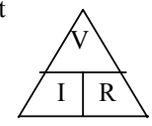
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils of Cynognathus are found in Africa and South America | | 1 |
| | the shapes ……. almost fit together | only two boxes should be ticked<br>deduct **1** mark for each additional box to a minimum mark of **0** | 1 |
| (b) | continental | | 1 |
| | crust | | 1 |
| | tectonic | | 1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | $A_1 = 0.5$<br><br>$A_4 = 0.5$ | ignore any units<br><br>allow **1** mark for $A_1 = A_4 \neq 0.5$ | 1<br><br>1 |
| (ii) | the resistance of **P** is more than 20 Ω<br><br>a smaller current goes through P / $A_2$ (than 20 Ω) | <br><br>dependent on getting 1st mark correct<br>accept converse | 1<br><br>1 |
| (b)(i) | potential difference = current × resistance | accept pd / voltage for potential difference<br>accept V = I × R, correct symbols and correct case only<br>accept volts = amps × ohms<br>accept <br>provided subsequent method is correct<br>allow combination of physical quantities and named units<br>allow voltage = I × R | 1 |
| (ii) | 6 | allow **1** mark for correct substitution | 2 |
| (iii) | 6 | accept their (b)(ii) | 1 |
| (c) | thermistor or <br><br>resistance goes down (as temperature of thermistor goes up) | accept correct circuit symbol<br>allow phonetic spelling<br><br>do **not** accept changes for goes down<br>do **not** accept an answer in terms of current only<br>answers in terms of other components are incorrect | 1<br><br>1 |
| total | | | 10 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2005 June series

**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | larger the distance, greater the time | accept 'they are proportional'<br>accept converse | 1 |
| (ii) | any value between 6 and 9 years inclusive | | 1 |
| (b)(i) | carbon dioxide | | 1 |
| (ii) | (Venus) has high**er** temperature (than Mercury) | accept has the high**est** temperature<br>accept Venus is hotter / hottest<br><br>do **not** accept has a high / very high temperature | 1 |
| | (Venus) further from the Sun than Mercury | accept 'Venus is not the closest planet to the Sun'<br><br>answer in terms of greenhouse effect only, scores **0** marks | 1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | 20 | | 1 |
| (ii) | convection | | 1 |
| (iii) | fit draughtproof strips | accept lay carpet<br>accept fit curtains<br>accept close doors / windows / curtains<br>accept any reasonable suggestion for reducing a draught<br>'double glazing' alone is insufficient | 1 |
| (b) | air is (a good) insulator<br>**or**<br>air is a poor conductor | accept air cavity / 'it' for air | 1 |
| | reducing heat transfer by <u>conduction</u> | accept stops for reduces<br>ignore convection<br>do **not** accept radiation<br>do **not** accept answers in terms of heat being trapped | 1 |
| (c)(i) | most cost effective | accept it is cheaper or lowest cost<br>accept shortest payback time<br>accept in terms of reducing heat loss by the largest amount<br>do **not** accept it is easier<br>ignore most heat is lost through the roof | 1 |
| (ii) | 4 | | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2005 June series

**3462/3F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | constant speed | do **not** accept normal speed<br>do **not** accept it is stopped / stationary | 1 |
| | in a straight line | accept any appropriate reference to a direction<br><br>constant velocity gains **2** marks<br>'not accelerating' gains **2** marks<br><br>terminal velocity alone gets **1** mark | 1 |
| (ii) | goes down owtte | accept motorbike (it) slows down | 1 |
| (b)(i) | 20 (m/s) | ignore incorrect units | 1 |
| (ii) | acceleration = change in velocity / time (taken) | do **not** accept velocity for change in velocity<br>accept change in speed<br>accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$<br>do **not** accept $a = \frac{v}{t}$ | 1 |
| (iii) | 4<br>**or** their (b)(i) ÷ 5 | allow **1** mark for correct substitution | 2 |
| | $m/s^2$ | m/s/s **or** $ms^{-2}$ **or** metres per second squared **or** metres per second per second | 1 |
| (c) | vehicle may skid / slide | loss of control / brakes lock / wheels lock<br>accept greater stopping distance **or** difficult to stop | 1 |
| | due to reduced friction (between tyre(s) and road) | accept due to less grip<br>do **not** accept no friction | 1 |

**cont…**

### 4.2.1.2 Electrical charge and current





**3462/3F Q12 cont**…

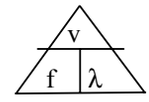
| | | | |
|---|---|---|---|
| (d) | any **three** from:<br>• <u>increased</u> speed<br>• <u>reduced</u> braking force<br>• <u>slower</u> (driver) reactions<br>• <u>poor</u> vehicle maintenance<br>• <u>increased</u> mass / weight of vehicle<br>• <u>poor</u> road surface<br>• <u>more</u> streamlined | do **not** accept night time / poor vision<br>NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc<br>specific examples may **each** gain credit eg worn brakes or worn tyres etc<br>accept large mass / weight of vehicle<br>if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only | 3 |
| total | | | 13 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2005 June series

**3462/3F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | **Quality of written communication** | all emboldened terms in candidate's answer used correctly | 1 |
| | any **two** from:<br>• **amplitude** decreasing<br>• **wavelength** increasing<br>• **frequency** decreasing | accept siren / sound getting quieter<br>do **not** accept sound decreases<br><br>accept pitch decreasing<br>ignore reference to transverse wave<br>ignore reference to speed<br><br>contradictory statements within each point lose the mark | 2 |
| (b)(i) | ultrasound **or** ultrasonic | | 1 |
| (ii) | wave speed = frequency × wavelength | accept speed / velocity for wave speed<br><br>accept $v = f \times \lambda$<br>do **not** accept w for $\lambda$<br>do **not** accept s for v<br><br>accept <br><br><br>provided subsequent calculation shows a correct method | 1 |
| (iii) | 339.2 **or** 340 **or** 339 | allow **1** mark for using 212 000<br>allow **1** mark for correct substitution<br><br>an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only<br>award full credit for a correct numerical answer with the unit changed to km/s | 3 |
| total | | | 8 |

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ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Secondary Education

# Physics 3451/F
*Specification B*

# Mark Scheme

## *2006 examination - June series*

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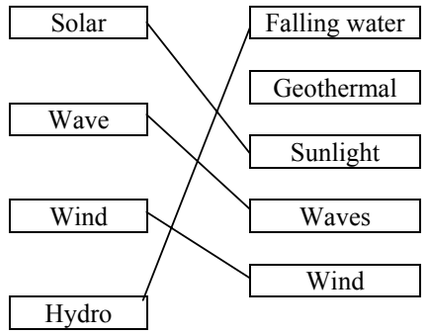
4.2.1.2 Electrical charge and current





# Physics (Specification B)
# Foundation Tier 3451/F

**3451/F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 4 correct lines drawn<br><br> | **1** mark for each correct line<br><br>if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines | 4 |
| (b) | 4 | | 1 |
| (c)(i) | nuclear | | 1 |
| (ii) | (natural) gas | do **not** accept natural | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current





**3451/F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | ultra violet | | 1 |
| (ii) | kill the cells | accept destroys the cells<br>accept makes cells cancerous<br>accept damage cells<br>accept harms cells<br>accept changes DNA<br>accept cause cells to mutate<br>accept skin cells for cells<br>accept cause cancer<br>do **not** accept skin for cells<br>do **not** accept burns the cells | 1 |
| (b)(i) | the sunbed uses an alternating current (a.c.) supply | | 1 |
| (ii) | 10.8 | accept **1** mark for correct substitution of power in W or kW and time in hours or seconds | 2 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3451/F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | M | | 1 |
| (ii) | K | | 1 |
| (iii) | J | | 1 |
| (iv) | O | | 1 |
| (b)(i) | billions of years | | 1 |
| (ii) | red giant | any answer in terms of explosion or supernova is **incorrect** | 1 |
| | contracts / shrinks to | incorrect reference to black hole negates **1** mark | 1 |
| | white dwarf | | 1 |
| total | | | 8 |

### 4.2.1.2 Electrical charge and current





**3451/F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | A and C | **both** answers must be correct<br><br>in either order | 1 |
| (ii) | A and B | **both** answers must be correct<br><br>in either order | 1 |
| (iii) | same number of protons plus neutrons<br>**or**<br>same number of nucleons | accept number of particles in nucleus the same<br><br>do **not** accept they add up to 6 unless qualified | 1 |
| (b)(i) | any **two** from:<br>• boron - 12<br>• carbon - 14<br>• oxygen - 15<br>• lead - 209 | **both** required<br><br>both name **and** number must be given | 1 |
| (ii) | any **two** from:<br>• boron - 11<br>• carbon - 12<br>• oxygen - 16<br>• lead - 207 | **both** required<br><br>both name **and** number must be given | 1 |
| (c) | alpha | | 1 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3451/F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | (good) insulator | accept does not conduct (electricity)<br>accept does not conduct heat or electricity<br>do **not** accept does not conduct heat<br>outside is tough is insufficient | 1 |
| (b) | fuse | | 1 |
| (c) | connect the green and yellow / earth wire | accept wires must be connected to screws | 1 |
| | swap the brown and blue wires round | | 1 |
| total | | | 4 |

**3451/F Q6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils | answers can be in either order | 1 |
| | water | | 1 |
| (b) | increased | | 1 |
| (c) | radio telescope | | 1 |
| total | | | 4 |

## 4.2.1.2 Electrical charge and current





**3451/F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | electrical | | 1 |
| | kinetic | accept movement | 1 |
| (ii) | heat | answers can be in either order | 1 |
| | sound | | 1 |
| (b)(i) | 360 | accept **1** mark for correct substitution | 2 |
| (ii) | watt | | 1 |
| (c) | the stairlift is not moving<br>the stairlift is moving at constant speed | **both** answers are required for the mark | 1 |
| total | | | 8 |

**3451/F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | (up) further<br>**or**<br>(up) faster | any reference to downwards movement loses credit<br>accept <u>with</u> more force<br>accept motion would increase | 1 |
| (ii) | down | accept the opposite way<br>accept drop | 1 |
| (b)(i) | direct current | | 1 |
| (ii) | Z | | 1 |
| total | | | 4 |

### 4.2.1.2 Electrical charge and current





**3451/F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | level of radiation (detected) will not change | ignore reference to particles | 1 |
| | if thickness of aluminium changes | accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same.<br><br>accept for **1** mark gamma will pass through aluminium | 1 |
| | QoWC for 2 points in a sensible sequence | | 1 |
| (b) | S W T V | all in correct order<br><br>accept **2** marks for 2 correct<br><br>accept **1** mark for 1 correct | 3 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3451/F Q10**

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>thermistor(s)<br>LDR(s)<br>switch(es)<br>LED(s)<br>buzzer(s)<br>motor(s)</td><td>1 mark each<br>or light dependent resistor(s)<br>or light emitting diode(s)</td><td>6</td></tr>
<tr><td>(b)(i)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td>both correct</td><td>1</td></tr>
<tr><td>(iii)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(c)(i)</td><td></td><td>do not credit any attempt which could equally well be a poorly drawn attempt at the symbol for a cell</td><td>1</td></tr>
<tr><td>(ii)</td><td>charge<br><br>increases</td><td>accept ‘electrons’<br>accept ‘energy<br>or gets bigger/larger</td><td>1<br><br>1</td></tr>
<tr><td>total</td><td></td><td></td><td>12</td></tr>
</table>

### 4.2.1.2 Electrical charge and current





**3451/F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | A | | 1 |
| (ii) | B | | 1 |
| (iii) | mass is larger | credit if the response is clear by some other means<br>e.g. it is ringed | 1 |
| | wire is shorter | credit if the response is clear by some other means<br>e.g. it is ringed | 1 |
| (b) | moment | | 1 |
| | distance | | 1 |
| (c)(i) | 1 | | 1 |
| (ii) | 5 | | 1 |
| (iii) | any **two** from<br>• remove slotted mass(es)<br>• slide (slotted) masses / weights nearer pivot<br>• slide forcemeter away from the pivot<br>• slide rod to the left | <br><br>**or** ….. to the left<br><br>**or** ….. to the right<br><br>**or** …. so that the slotted masses side is shorter<br>**or** …. so that the forcemeter side is longer | 2 |
| (d) | centre of the rectangle | accept *2*mm tolerance any direction | 1 |
| | centre of the circle | accept *2*mm tolerance any direction | 1 |
| | on centre line<br>and 10mm above base | accept *2*mm tolerance any direction | 1 |
| total | | | 13 |

### 4.2.1.2 Electrical charge and current





**3451/F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.05 (A) | ignore incorrect units if given<br>accept 'the same' / 'the same as K' / 'the same as the other ammeter'<br>do **not** accept 'same as the other meter' | 1 |
| (b)(i) | any **two** from:<br>• two cells are joined + to + | answers in terms of current gain no marks<br>accept one cell in the wrong way<br>accept two cells are joined back-to-back<br>accept two cells are joined – to –<br>accept battery for cell<br>do **not** accept answers in terms of all the cells or in terms of energy only | 2 |
| | • some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components | accept voltage for pd<br>do **not** accept using up pd | |
| | • the other components have a resistance | accept a named component / components / wire has a resistance | |
| | • cells not fully charged **or** cells partially run down | do **not** accept voltage of cells is less than 1.5 unless explained<br>do **not** accept cells are not as powerful unless explained | |
| | • cells have an internal resistance | | |
| (ii) | the diode has a (very) high resistance (in the reverse direction) | | 1 |
| | a diode only conducts / allows current to flow in one direction | accept little / no current flows<br>do **not** accept blocks / cuts flow | 1 |

**Continued**

### 4.2.1.2 Electrical charge and current





**3451/F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (c) | **QoWC** for the use of the word resistance | annotate Q✓ Q✗<br>accept resistant | 1 |
| | accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral | | |
| | as the pd / current increases / changes | accept voltage for pd<br>must be correctly linked to at least one of the following points accept | 1 |
| | the temperature of the filament increases / changes | lamp / bulb for filament<br>accept filament becomes hotter | 1 |
| | increasing / changing the **resistance** of the lamp | | 1 |
| | | accept for **1** mark only the filament lamp does not obey Ohm's law | |
| total | | | 9 |

### 4.2.1.2 Electrical charge and current





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.5 | | 1 |
| | hertz | accept Hz but **not** HZ / hz / hZ<br><br>accept (waves) per second **or** / sec **or** / s **or** $s^{-1}$ **or** $sec^{-1}$ | 1 |
| (b) | any **one** from:<br><br>• any named part of the electromagnetic spectrum<br>• S – waves / secondary waves<br>• wave on a rope | <br><br><br>do **not** accept seismic waves / earthquake<br><br>do **not** accept slinky unless clearly described | 1 |
| (c) | transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel | accept a correctly labelled diagram | 1 |
| | longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel | accept a correctly labelled diagram<br><br>part explanation of the difference between transverse **and** longitudinal gains **1** mark | 1 |
| (d)(i) | TIR shown | needs to stay inside water jet<br><br>ignore number of reflections **or** arrow heads<br><br>lines straight by eye | 1 |
| (ii) | bigger than | any indication of correct answer | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current





**3451/F Q14**

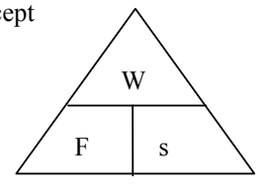
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer<br><br>do **not** accept easier to read<br><br>ignore faster<br><br>accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength<br><br>do **not** accept no distortion / weakening on its own | |
| | • increased carrying capacity | accept more information can be sent **or** more channels | |
| | • errors can be rectified | | |
| total | | | 3 |

### 4.2.1.2 Electrical charge and current





**3451/F Q15**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | all points plotted accurately | accept **1** mark for 5 correct plots<br>± ½ small square on stopping distance | 2 |
| | line of best fit must be continuous | accept attempt at a reasonable curve<br>does not need to go through 0 0<br>do **not** accept a straight line<br>do **not** accept dot-to-dot | 1 |
| (ii) | 4 to 6 (metres) | accept ecf from (a)(i)<br>accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown | 2 |
| (b)(i) | 0.7 (s) | incorrect unit = 0 marks | 1 |
| (ii) | constant speed / velocity | accept (continued as) 30mph<br>accept did not change / stayed the same<br>accept no acceleration | 1 |
| (iii) | 3.3(s) | penalise incorrect unit once only | 1 |
| (iv) | reaction time <u>increases</u> / is <u>longer</u> **or** thinking distance <u>increases</u> | do **not** accept reaction time slower **or** reactions are slower | 1 |
| | stopping distance / it <u>increases</u> | do **not** accept travels at constant speed for longer | 1 |
| (c)(i) | work done =<br>force (applied) × distance (moved) | accept W = F × s or W = F × d<br>accept <br><br>provided subsequent method is correct | 1 |

**Continued**

### 4.2.1.2 Electrical charge and current





**3451/F Q15**

| question | answers | extra information | mark |
|---|---|---|---|
| (ii)<br>**E** | 2100 | accept 2.1 kilo<br>accept **1** mark for using 7000 N | 2 |
| (iii) | 2100 (joules) | accept their (c)(ii) | 1 |
| total | | | 14 |

### 4.2.1.2 Electrical charge and current





**3451/F Q16**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | refraction | | 1 |
| (ii) | it changes speed<br>**or**<br>change in density | accept it speeds up<br><br>do **not** accept it slows down<br><br>do **not** accept air is more dense than glass | 1 |
| (b)(i) | sound / waves <u>diffract</u><br><br>through the gap (in the wall)<br>**or**<br>over the wall<br>**or**<br>because the gate is open | do **not** accept reflection<br><br>this only scores if first marking point is given<br><br>accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates<br><br>if diagram is labelled as diffraction both marks can be scored | 1<br><br>1 |
| (ii) | less diffraction | accept no diffraction<br><br>accept gates <u>absorb</u> sound / noise / waves<br><br>accept gates <u>reflect</u> sound / noise / waves<br><br>do **not** accept rebounds / stops / blocks out | 1 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | both rays brought to a focus at F on the right | do **not** have to be continued beyond F | 1 |
| | lines have been drawn **accurately** with a ruler | only credit if 1st mark credited<br>do **not** credit if contradictory arrow(s) added | 1 |
| (b) | rays seem to come from a focus at G on the left and continued to the right of the lens | this mark is for the current idea of divergence | 1 |
| | lines have been drawn **accurately** with a ruler | only credit if 1st mark credited<br>do **not** credit if contradictory arrow(s) added | 1 |
| (c) | …lens…<br>…image…<br>…object…<br>…image…<br>...object…<br>…lens… | lens as 1st and 6th words (1)<br>image and object in the correct order 2nd and 3rd words (1)<br>image and object in correct order 4th and 5th words (1) | max 3 |
| (d)(i) | correct statement about real image<br>real rays intersect / cross to form a real image<br>**or** a real image can be formed on a screen<br>**or** real image is (always) on the opposite side (of the lens)<br>**or** real image is (always) upside down (to the object) | may be credited from a correct diagram | 1 |
| | correct statement about virtual / imaginary image<br>virtual / imaginary rays intersect / cross to form a virtual image<br>**or** a virtual / imaginary image cannot<br>**or** virtual / imaginary image is (always) on the same side (of the lens)<br>**or** virtual / imaginary image is (always) same way up (as the object) | may be credited from a correct diagram | 1 |

**Continued**

### 4.2.1.2 Electrical charge and current





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (ii) | **either**<br>image needs to fall on / affect the film<br><br>**or** image needs to fall on / affect the light sensors / charged coupled devices (CCDs) (in a digital camera / mobile phone)<br><br>**or** image needs to cause a chemical reaction (in / on the film) | | 1 |
| total | | | 10 |

### 4.2.1.2 Electrical charge and current





**3451/F Q18**

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>AND (gate)<br><br>OR (gate)<br><br>NOT (gate)<br><br>LED or light emitting diode</td><td>accept ‘and’<br><br>accept ‘or’<br><br>accept ‘not’ or invert gate<br><br>accept ‘led’</td><td>1<br><br>1<br><br>1<br><br>1</td></tr>
<tr><td>(b)(i)</td><td>NOT (gate) and AND (gate)</td><td>both in either order or ‘(the) gates’<br><br>any additions lose the mark</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Switch for fire</th><th>Tilt switch</th><th>Signal to relay</th></tr><tr><td>0</td><td>0</td><td>…0…</td></tr><tr><td>0</td><td>1</td><td>…0…</td></tr><tr><td>1</td><td>0</td><td>…1…</td></tr><tr><td>1</td><td>1</td><td>…0…</td></tr></table></td><td>all correct<br><br>allow off or no<br>off no<br>on yes<br>off no</td><td>1</td></tr>
<tr><td>(iii)</td><td>(relay) acts as / is a switch<br><br>either<br>small current from the electronic / control circuit / system (1)<br><br>large current through the output / (electric) fire (1)<br><br>or<br><br>full current through electronic control system (1)<br><br>may damage components / lead to overheating / electric shock (1)<br><br>QoWC for correct use of the scientific term ‘current’</td><td>accept implication that it works as a switch e.g. ‘turns on fire’<br><br>or ‘small current through the coil (of the relay)’<br><br>do not accept small current is turned into a large current<br><br>annotate Q✓ Q×<br><br>if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use</td><td>1<br><br>1<br><br>1<br><br>1</td></tr>
<tr><td>total</td><td></td><td></td><td>10</td></tr>
</table>

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

# Science: Double Award 3462/3F
*Specification B*

# Mark Scheme

## *2006 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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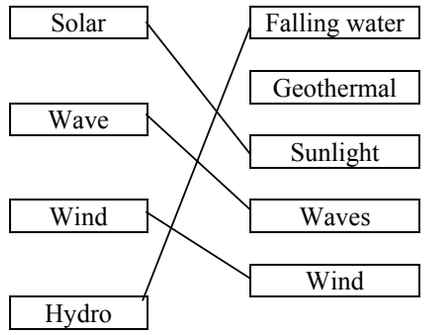
*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

# Double Award (Co-ordinated)
# Foundation Tier 3462/3F

**3462/3F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 4 correct lines drawn<br><br> | **1** mark for each correct line<br><br>if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines | 4 |
| (b) | 4 | | 1 |
| (c)(i) | nuclear | | 1 |
| (ii) | (natural) gas | do **not** accept natural | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | ultra violet | | 1 |
| (ii) | kill the cells | accept destroys the cells<br>accept makes cells cancerous<br>accept damage cells<br>accept harms cells<br>accept changes DNA<br>accept cause cells to mutate<br>accept skin cells for cells<br>accept cause cancer<br>do **not** accept skin for cells<br>do **not** accept burns the cells | 1 |
| (b)(i) | the sunbed uses an alternating current (a.c.) supply | | 1 |
| (ii) | 10.8 | accept **1** mark for correct substitution of power in W or kW <u>and</u> time in hours or seconds | 2 |
| total | | | 5 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | M | | 1 |
| (ii) | K | | 1 |
| (iii) | J | | 1 |
| (iv) | O | | 1 |
| (b)(i) | billions of years | | 1 |
| (ii) | red giant | any answer in terms of explosion or supernova is **incorrect** | 1 |
| | contracts / shrinks to | incorrect reference to black hole negates **1** mark | 1 |
| | white dwarf | | 1 |
| total | | | 8 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | A and C | **both** answers must be correct<br><br>in either order | 1 |
| (ii) | A and B | **both** answers must be correct<br><br>in either order | 1 |
| (iii) | same number of protons plus neutrons<br>**or**<br>same number of nucleons | accept number of particles in nucleus the same<br><br>do **not** accept they add up to 6 unless qualified | 1 |
| (b)(i) | any **two** from:<br>• boron - 12<br>• carbon - 14<br>• oxygen - 15<br>• lead - 209 | **both** required<br><br>both name **and** number must be given | 1 |
| (ii) | any **two** from:<br>• boron - 11<br>• carbon - 12<br>• oxygen - 16<br>• lead - 207 | **both** required<br><br>both name **and** number must be given | 1 |
| (c) | alpha | | 1 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | (good) insulator | accept does not conduct (electricity)<br>accept does not conduct heat or electricity<br>do **not** accept does not conduct heat<br>outside is tough is insufficient | 1 |
| (b) | fuse | | 1 |
| (c) | connect the green and yellow / earth wire | accept wires must be connected to screws | 1 |
| | swap the brown and blue wires round | | 1 |
| total | | | 4 |

**3462/3F Q6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils | answers can be in either order | 1 |
| | water | | 1 |
| (b) | increased | | 1 |
| (c) | radio telescope | | 1 |
| total | | | 4 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | electrical | | 1 |
| | kinetic | accept movement | 1 |
| (ii) | heat | answers can be in either order | 1 |
| | sound | | 1 |
| (b)(i) | 360 | accept **1** mark for correct substitution | 2 |
| (ii) | watt | | 1 |
| (c) | the stairlift is not moving<br>the stairlift is moving at constant speed | **both** answers are required for the mark | 1 |
| total | | | 8 |

**3462/3F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | (up) further<br>**or**<br>(up) faster | any reference to downwards movement loses credit<br>accept <u>with</u> more force<br>accept motion would increase | 1 |
| (ii) | down | accept the opposite way<br>accept drop | 1 |
| (b)(i) | direct current | | 1 |
| (ii) | Z | | 1 |
| total | | | 4 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | level of radiation (detected) will not change | ignore reference to particles | 1 |
| | if thickness of aluminium changes | accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same.<br><br>accept for **1** mark gamma will pass through aluminium | 1 |
| | QoWC for 2 points in a sensible sequence | | 1 |
| (b) | S W T V | all in correct order<br><br>accept **2** marks for 2 correct<br><br>accept **1** mark for 1 correct | 3 |
| total | | | 6 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.05 (A) | ignore incorrect units if given<br>accept 'the same' / 'the same as K' / 'the same as the other ammeter'<br>do **not** accept 'same as the other meter' | 1 |
| (b)(i) | any **two** from:<br>• two cells are joined + to + | answers in terms of current gain no marks<br>accept one cell in the wrong way<br>accept two cells are joined back-to-back<br>accept two cells are joined – to –<br>accept battery for cell<br>do **not** accept answers in terms of all the cells or in terms of energy only | 2 |
| | • some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components | accept voltage for pd<br>do **not** accept using up pd | |
| | • the other components have a resistance | accept a named component / components / wire has a resistance | |
| | • cells not fully charged **or** cells partially run down | do **not** accept voltage of cells is less than 1.5 unless explained<br>do **not** accept cells are not as powerful unless explained | |
| | • cells have an internal resistance | | |
| (ii) | the diode has a (very) high resistance (in the reverse direction) | | 1 |
| | a diode only conducts / allows current to flow in one direction | accept little / no current flows<br>do **not** accept blocks / cuts flow | 1 |

**Continued**

*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (c) | **QoWC** for the use of the word resistance | annotate Q✓ Q✗<br>accept resistant | 1 |
| | accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral | | |
| | as the pd / current increases / changes | accept voltage for pd<br>must be correctly linked to at least one of the following points accept | 1 |
| | the temperature of the filament increases / changes | lamp / bulb for filament<br>accept filament becomes hotter | 1 |
| | increasing / changing the **resistance** of the lamp | accept for **1** mark only the filament lamp does not obey Ohm's law | 1 |
| total | | | 9 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.5 | | 1 |
| | hertz | accept Hz but **not** HZ / hz / hZ<br><br>accept (waves) per second **or** / sec **or** / s **or** $s^{-1}$ **or** $sec^{-1}$ | 1 |
| (b) | any **one** from:<br><br>• any named part of the electromagnetic spectrum<br>• S – waves / secondary waves<br>• wave on a rope | <br><br><br>do **not** accept seismic waves / earthquake<br><br>do **not** accept slinky unless clearly described | 1 |
| (c) | transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel | accept a correctly labelled diagram | 1 |
| | longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel | accept a correctly labelled diagram<br><br>part explanation of the difference between transverse **and** longitudinal gains **1** mark | 1 |
| (d)(i) | TIR shown | needs to stay inside water jet<br><br>ignore number of reflections **or** arrow heads<br><br>lines straight by eye | 1 |
| (ii) | bigger than | any indication of correct answer | 1 |
| total | | | 7 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q12**

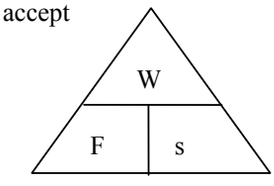
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer<br><br>do **not** accept easier to read<br><br>ignore faster<br><br>accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength<br><br>do **not** accept no distortion / weakening on its own | |
| | • increased carrying capacity | accept more information can be sent **or** more channels | |
| | • errors can be rectified | | |
| total | | | 3 |

### 4.2.1.2 Electrical charge and current





**3462/3F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | all points plotted accurately | accept **1** mark for 5 correct plots<br>± ½ small square on stopping distance | 2 |
| | line of best fit must be continuous | accept attempt at a reasonable curve<br>does not need to go through 0 0<br>do **not** accept a straight line<br>do **not** accept dot-to-dot | 1 |
| (ii) | 4 to 6 (metres) | accept ecf from (a)(i)<br>accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown | 2 |
| (b)(i) | 0.7 (s) | incorrect unit = 0 marks | 1 |
| (ii) | constant speed / velocity | accept (continued as) 30mph<br>accept did not change / stayed the same<br>accept no acceleration | 1 |
| (iii) | 3.3(s) | penalise incorrect unit once only | 1 |
| (iv) | reaction time increases / is longer **or** thinking distance increases | do **not** accept reaction time slower **or** reactions are slower | 1 |
| | stopping distance / it increases | do **not** accept travels at constant speed for longer | 1 |
| (c)(i) | work done =<br>force (applied) × distance (moved) | accept W = F × s or W = F × d<br>accept <br>provided subsequent method is correct | 1 |
| (ii) | 2100 | accept 2.1 kilo<br>accept **1** mark for using 7000 N | 2 |
| (iii) | 2100 (joules) | accept their (c)(ii) | 1 |
| total | | | 14 |

### 4.2.1.2 Electrical charge and current



*Science: Double Award (Co-ordinated)* – AQA GCSE Mark Scheme, 2006 June series

**3462/3F Q14**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | refraction | | 1 |
| (ii) | it changes speed<br>**or**<br>change in density | accept it speeds up<br><br>do **not** accept it slows down<br><br>do **not** accept air is more dense than glass | 1 |
| (b)(i) | sound / waves <u>diffract</u><br><br>through the gap (in the wall)<br>**or**<br>over the wall<br>**or**<br>because the gate is open | do **not** accept reflection<br><br>this only scores if first marking point is given<br><br>accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates<br><br>if diagram is labelled as diffraction both marks can be scored | 1<br><br>1 |
| (ii) | less diffraction | accept no diffraction<br><br>accept gates <u>absorb</u> sound / noise / waves<br><br>accept gates <u>reflect</u> sound / noise / waves<br><br>do **not** accept rebounds / stops / blocks out | 1 |
| total | | | 5 |

Answer 18 · Examiner comments — November 2020 | 8463/1H | Original Q2

**Question 2 (Standard demand)**

**02.1** 69% of students chose the correct circuit.

**02.2** 86% of students answered this question correctly. The equation was acceptable using symbols or words. Students should be encouraged not to give multiple answers due to the list principle being applied: right + wrong = 0 marks. eg Q = It and I = t/Q would score zero.

**02.3** The majority of students who knew the correct equation were able to substitute values of current and time into the equation and work it out. However, the value of current used was often incorrect, either because the student did not realise the need to convert 50 mA to amps, or the conversion was incorrect. Conversion values ranged from 0.00005 A to 50 000 000 A. 40% of students scored all 3 marks, while 43% scored 2 marks.

**02.4** Very few students recognised that the LED is a diode and therefore only allows current in the forward direction. Students who did not refer to the diode mainly answered in one of two ways: thinking that no current can flow if the batteries are reversed in a circuit (no reference to the diode), or taking the question to mean that one of the cells was reversed, rather than all of them, and would therefore be 'working against each other'. Many students incorrectly thought that reversing the cells would make a gap in the circuit. Many students discussed polarity without mentioning the LED, so scored zero. Incorrect charge flow or incorrect current were not enough to score the first mark. Only 10% of students scored both marks, while 15% of students scored 1 mark.

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Answer 18 · Examiner comments — November 2020 | 8463/1H | Original Q2

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**02.5** Students should use the wording of the prompts in the question. For this equation there are no abbreviations for the words 'useful', 'total', 'input' and 'output'. The '×100' is not needed for the equation. 86% of students scored this mark.

**02.6** 88% of students scored 3 marks. However, a common mistake was to multiply the final answer by 100, so only the first two marking points would score.

Answer 19 · Examiner comments — November 2021 | 8463/1H | Original Q1

**Question 1 (Common Question)**
Very few students answered **01.1** correctly, but students were much more successful with equation recall and the subsequent calculations that followed, with around 80% answering **01.2** and **01.3** correctly and over 90% answering **01.4** and **01.5** correctly.

### 4.2.1.2 Electrical charge and current

**Answer 20 · Examiner comments** November 2021 | 8463/1H | Original Q5

**Question 5**

Calculations in question **05** were well answered, but students often failed to convert units, converted units incorrectly or made 'power of ten' errors, so did not gain full marks. Students found **05.4** difficult with almost no students scoring 2 marks and only 25% of students scoring 1 mark.

**Answer 22 · Examiner comments** June 2023 | 8463/1H | Original Q3

**Question 3 (Standard Demand)**

**03.1** Very few correct answers, only 11 % of students scored a mark. Many students gave answers in terms of charge flow and current which were insufficient. The specification does not mention alternating or direct current, only alternating or direct p.d. Answers like ' the potential difference flows in one direction' were insufficient to score.
. Saying the potential difference only travels/goes in one direction was insufficient, as this suggested charge flow. Saying that 'the potential difference is always positive' or 'the potential difference doesn't go negative' were creditworthy. 'The potential difference is in one direction' was creditworthy. 'The potential difference isn't alternating' was insufficient.

**03.2** Almost all students answered correctly. In this exam series, students were provided with all the equations on an Equations Sheet.

**03.3** 98% of students scored 3 marks on this calculation question

**03.4** 95% of students scored 3 marks. A small minority of students scored 2 marks, usually due to a spurious conversion of mass from kg to g.

**03.5** To score in Level 2, students needed to make comparisons of the movement and arrangement of particles in ice and liquid water. In addition to this, for students to score a Level 3 mark they needed to discuss either the change of state at constant temperature increasing the potential energy of the particles or how the warming of liquid water increased the kinetic energy of the particles. For 6 marks, both these aspects needed discussion. Students found this question difficult with only 9 % scoring 5 or 6 marks and48 % scoring 3 or 4 marks. The mean mark was 3.

Answer 23 · Examiner comments



**Question 10 (Standard/High Demand)**

**10.1** 72% of students correctly identified the colour of the live wire insulation.

**10.2** 66% of students scored the mark on this question. Students who made the box for the answer into a fuse symbol did not score the mar nor did a fuse symbol added to any side of the box .

.

**10.3** A grade 6-7 calculation of current. 57% of students scored all 4 marks. 36% of students scored 3 marks, usually for incorrectly converting, or not converting, the unit.

**10.4** A grade 6-7 calculation of mass. 61% of students scored 4 marks. 31% of students scored 3 marks for either incorrectly converting, or not converting, the unit.

**10.5** 40% of students scored 2 marks on this question recognising that the time would be longer because more energy in total would need to be transferred. An answer of 'less energy is melting the wire' was just enough to score the second mark. 15% of students scored zero on this question.

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4.2.1.2 Electrical charge and current

Answer 23 · Examiner comments



**Mark Ranges and Award of Grades**

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

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4.2.1.2 Electrical charge and current

**Answer 24 · Examiner comments** June 2025 | 8463/1H | Original Q6

## 06.1

Just over 90 % of the students scored 3 marks on this grade 4-5 calculation of temperature increase using the specific heat capacity equation.

## 06.2

Just over 80 % of the students scored 4 marks for this calculation of charge flow using the equation $E = QV$. About 15 % of the students scored 3 marks as they had either not converted or converted incorrectly the energy into Joules.

## 06.3

Students found this question difficult with very few scoring marks because of incorrect assumptions about how potential difference, current and resistance are affected by series and parallel circuits. Marking point 2 was dependent on marking point 1 so that students who stated that the current was increased without a valid reason would not score. The third mark was demanding in requiring an understanding of how $P = IV$ related to the circuit being considered. Just over 80% of the students scored no marks.

**Answer 25 · Examiner comments** June 2025 | 8463/1H | Original Q9

## 09.1

Many of the students did not convert the 70 cm into metres and some students converted the energy unnecessarily. Not converting the height stopped marking point 1 from scoring and converting the energy unnecessarily stopped 1 marking point from being scored too. Some students, despite setting out their calculations correctly, did not use brackets around the denominator and arrived at an answer of 0.0245 or 2.45. Nearly 80 % of the students scored full marks on this question.

## 09.2

Many students found it easy to score full marks on this multi-step calculation. The most common mistake was not to convert the time which resulted in an answer of 27 and scored 5 marks. Converting the time incorrectly e.g. converting time into 0.5 hours also scored 5 marks. About 90% of the students scored either 5 or 6 marks.

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**Answer 25 · Examiner comments** June 2025 | 8463/1H | Original Q9

## 09.3

Many students understood that the flow rate would increase. This was often correctly linked to either more useful energy transferred or less wasted energy. Some students expressed their ideas in terms of power. Just over 40 % of the students scored 2 marks, while just over 40 % scored 1 mark.

### 4.2.1.2 Electrical charge and current



AQA

# GCSE
# PHYSICS

8463/1H: Paper 1 (Higher tier)
Report on the Examination

8463
June 2022

Version: 1.0

## 4.2.1.2 Electrical charge and current



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4.2.1.2 Electrical charge and current





**General**

Grade 4-5 calculation questions ask for students to recall an equation, before using it in a subsequent calculation. In the 2022 series, students were given an Equations Sheet which had all the equations printed on it. Subsequently, the performance on the more straightforward calculations has improved on previous years.

The multistep calculations targeted at candidates working at grades 8-9, questions **09.1** and **10.1**, were well attempted with many students answering correctly. Of these two questions, students were slightly more successful on question **09.1** with about 55% of students scoring full marks, whereas for question **10.1** approximately 45% of students scored full marks.

Question **02.1** was generally well attempted and students who had carried out the density required practical had an advantage over those who hadn't. For this question, about 35% of students scored 6 marks and approximately 25% of students scored 5 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. Students who have handwriting that is difficult to read may benefit from a scribe or from word processing their answers in exams.

**Question 11**

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

**Levels of demand**

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

**Question 1 (Standard demand)**

**01.1** About 55% of students scored 2 marks. The unit conversion caused a problem for many students and powers of 10 errors were frequently seen. A correct calculation using an incorrectly or not converted value for power would score 1 mark.

**01.2** Students were generally successful at answering this question with approximately 40% scoring 2 marks and about 50% scoring 1 mark. Most students wrote variations of the first and third bullet points in the markscheme. A number of students wrote that the turbines may be broken, which was enough to score a mark for the idea of maintenance.

**01.3** 'Turbine will rotate faster' was insufficient to score a mark. 'Rotate more smoothly' was not enough to score the 'less friction' mark. Students who stated that 'no energy was wasted' did not score the second marking point. Approximately 35% of students scored 3 marks, 35% of students scored 2 marks and 20% of students scored 1 mark.

**01.4** About 30% of students scored 2 marks, while approximately 50% of students scored 1 mark. Many students answered in terms of 'saving energy' which was insufficient. Other students answered in terms of absolute statements which did not score, 'energy efficient appliances waste no energy' for example.

**Question 2 (Standard demand)**

**02.1** Generally very well answered with about 35% of students gaining 6 marks and 25% scoring 5 marks. Students were told that this required practical would appear in the 2022 series via the Advance Information. A number of students quoted the density equation incorrectly, although this was given on the Equations Sheet for the 2022 series. There were extremely few students who didn't attempt the question and less than 1% of students who attempted the question scored zero.

**02.2** Approximately 85% of students answered this question correctly. Of the incorrect answers seen, a significant proportion gave the maximum and minimum values the wrong way round. Another common mistake was to write maximum: 2.55 and minimum 0.10, which showed a clear misunderstanding of expressing an uncertainty.

**02.3** About 95% of students answered this question correctly.

**02.4** Approximately 45% of students scored 2 marks and 40% scored 1 mark. 'In case an error / mistake was made the first time' was insufficient. 'To check the repeatability of the data' was ignored, as this wouldn't improve the accuracy of the data. 'Get rid of anomalies' was assumed to mean 'remove anomalies', but 'stops anomalies from occurring' did not score. Likewise 'stops random errors' did not score.

4.2.1.2 Electrical charge and current





**Question 3 (Standard demand)**

**03.1** Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

**03.2** Nearly 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the equations sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

**03.3** Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

**03.4** 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the Equations Sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

**Question 4 (Standard/High demand)**

**04.1** A large number of students found it difficult to identify the independent and dependent variables in the investigation that was described. Control variables appeared often in students' answers. 'Temperature change' seemed to be the most common incorrect answer for the dependent variable. About 50% of students scored 2 marks and approximately 35% of students scored 1 mark.

**04.2** 65% of students answered correctly. The most common incorrect answer was 87.4 °C.

**04.3** About 35% of students answered this question correctly. Common incorrect answers referred to the resolution, or just repeated the question and said 'difficult to read' which was insufficient.

**04.4** Approximately 75% of students scored 3 marks and about 10% of students scored 2 marks. Power of 10 errors were common and usually resulted in 2 marks being scored for an incorrectly or not converted value of energy.

**04.5** Many students found relating the time for the temperature to decrease to thermal conductivity difficult. About 15% of students scored 2 marks, while 40% scored 1 mark. Answers in terms of good / bad insulators were insufficient to score a mark.

**Question 5 (Standard/High demand)**

**05.1** Approximately 45% of students scored 1 mark, with about 5% of students scored 3 marks. Around 30% of students scored no marks. The first marking point of this explanation was most likely to score, the third marking point was least likely to score.

**05.2** About 30% of students scored all 3 marks for this explanation. 10% of students scored 2 marks and 10% scored 1 mark. A lot of student answers were not creditworthy, with mixed up descriptions of ion transfer, electron transfer, proton transfer, protons weighing more than electrons and transfer of electrons increasing the mass of the rod on the balance. As a result about 50% of students scored zero.

**05.3** Approximately 60% of students scored the mark. Some students evidently did not know what a zero error was. Answers like 'it means there is no error' being a good example of this. Some answers were insufficient, 'the actual mass of the rod is not required' being not enough to score the mark. 'Weight' was allowed for 'mass' when used correctly as the reading on the balance does depend on the weight of the object. An answer of 'only the change in weight was needed' would have scored the mark.

**05.4** Some very good explanations were seen and about 10% of students scored all 3 marks. The first marking point was least likely to score. The third marking point needed to be linked to the second marking point before it could be scored.

**Question 6 (Standard/High demand)**

**06.1** This question discriminated well between students. About 15% scored 4 marks with 20% gaining 3 marks. The first two marking points were most commonly scored. Students who said that 'no energy was lost' as a consequence of the step-up transformer's effect did not score the third marking point.

**06.2** Approximately 55% of students scored 2 marks, while 15% of students scored 1 mark. Students who scored no marks usually confused the quantity that was decreased (pd) with the quantity that increased (current). Some student answers lacked technical accuracy referring to energy, power or charge incorrectly.

**06.3** Two thirds of students scored 4 marks for this calculation, whereas about 20% of students scored 3 marks. A common mistake was to try to multiply the answer by the number of seconds in a day, which would probably only score the significant figure mark if correct, as the Physics equations were applied incorrectly.
Common mistakes were to round the answer to 1 400 000 000 C, which would score 3 marks if the full s.f. answer was seen, or round the answer to 141, which would score 3 marks for the supporting calculations if seen. A common error was to miscount the number of zeroes, so would only score 3 marks.

4.2.1.2 Electrical charge and current





**Question 7 (Standard/High demand)**

**07.1** 54% of students could state what an alpha particle consists of. The list principle was applied when students wrote '2 protons and 2 neutrons – a helium atom', which did not score.

**07.2** 65% of students completed the nuclear equation correctly, scoring 2 marks, whereas 24% scored just 1 mark.

**07.3** Students generally made good attempts to answer this question and marking points 1, 2 and 4 were seen most often. To score the 5$^{th}$ marking point students need to make a comparative statement, internal versus external damage. The third marking point was least likely to score, as students rarely referred to dose or the living cells / tissues / organs inside the body. Some students incorrectly thought that ionisation was a process that happened to cells, rather than atoms, so often didn't score the fifth marking point for this reason. Very few students scored 5 marks and the question discriminated well between students of differing ability.

**Question 8 (Standard/High demand)**

**08.1** About 90% of students gave the correct measuring instrument. While it wasn't seen often, an answer of a 'volumetric pipette' was also creditworthy. 'Pipette' was insufficient.

**08.2** Around 90% of students correctly identified the hazard in the investigation.

**08.3** For this calculation, about 45% of students scored 5 marks and 20% of students scored 4 marks. A common mistake was to calculate *L* using one of the masses given in the question, rather than the change in mass. The resulting numerical answer would score zero as the equation was not being used correctly.

**08.4** About 15% of students scored 2 marks for this explanation and 10% of students scored 1 mark. Many students reached incorrect conclusions and many students simply reworded the information given in the question.

**08.5** 7% of students scored 2 marks and 3% of students scored 1 mark. Many students reached incorrect conclusions and many students reworded the information given in the question without adding to it.

**Question 9 (High demand)**

**09.1** Approximately 55% of students scored 5 marks, but in the 2022 series students were provided with an Equations Sheet with all the equations. A commonly seen answer was 73 500, which scored 4 marks for not converting the height into metres.

**09.2** 5% scored 2 marks and about 30% scored 1 mark. Many students failed to score a mark by pointing to the 'inaccuracy of the measured mass / height / gravitational field strength', or referring to the measurements as being 'low resolution'. 'Mass may have been greater than 60 kg' or 'time may have been longer / shorter than 1.40 seconds' were other common incorrect answers.

**09.3** About 75% of students identified the correct conclusion.

**Question 10 (High demand)**

**10.1** About 45% of students scored 6 marks for this extended calculation, but in the 2022 series students were provided with an Equations Sheet with all the equations. Therefore, students were supported when it came to attempting this question. With an alternative approach using equations from paper 2, students' answers were marked on whichever approach brought them closest to the correct final answer. An answer of 6 m/s with no supporting working did not score full marks as students could achieve this answer by multiplying the spring constant and the extension together, which would give them the maximum force acting on the toy aeroplane.

**10.2** About 65% of students scored the mark. The most common incorrect answers seen were gravitational potential or elastic potential.

**10.3** Approximately 20% of students scored a mark. Many students failed to score a mark because they gave a factor without a specific change e.g. 'extension of spring', rather than 'increase the extension of the spring'.

**Question 11 (High demand)**

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

4.2.1.2 Electrical charge and current





## Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of 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.