AQA GCSE Physics | 8463

SPECIFICATION POINT 4.7.2.1

# Electromagnetism

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **102** |
| 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.

### 4.7.2.1 Electromagnetism

**Answer 01 · Mark scheme** June 2003 | 3451F | Original Q13 | Legacy

The full source mark scheme begins on page 96. Follow original question 13 in that document.

**Answer 02 · Mark scheme** June 2004 | 3451F | Original Q11 | Legacy

The full source mark scheme begins on page 118. Follow original question 11 in that document.

**Answer 03 · Mark scheme** June 2004 | 3462F3 | Original Q9 | Legacy

The full source mark scheme begins on page 139. Follow original question 9 in that document.

**Answer 04 · Mark scheme** June 2005 | 3451 | Original Q3 | Legacy

The full source mark scheme begins on page 156. Follow original question 3 in that document.

**Answer 05 · Mark scheme** June 2005 | 3462 | Original Q3 | Legacy

The full source mark scheme begins on page 174. Follow original question 3 in that document.

### 4.7.2.1 Electromagnetism

**Answer 06 · Mark scheme**

June 2006 | 3451 | Original Q8 | Legacy

The full source mark scheme begins on page 188. Follow original question 8 in that document.

**Answer 07 · Mark scheme**

June 2006 | 3462 | Original Q8 | Legacy

The full source mark scheme begins on page 208. Follow original question 8 in that document.

**Answer 08 · Mark scheme**

November 2006 | PHY1B | Original Q1 | Legacy

| | | | |
|---|---|---|---|
| One | **A** | infra red rays | **1** |
| | **B** | ultraviolet waves | **3** |
| | **C** | visible light | **2** |
| | **D** | X-rays | **4** |
| | | | |

**Answer 09 · Mark scheme**

November 2006 | PHY1B | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | gamma rays | **1** |
| | **B** | infra red rays | **3** |
| | **C** | radio waves | **4** |
| | **D** | ultraviolet waves | **2** |
| | | | |

### 4.7.2.1 Electromagnetism

**Answer 10 · Mark scheme**



**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | B | | 1 |
| (b) | G | | 1 |
| (c) | D | | 1 |
| (d) | A | | 1 |
| total | | | 4 |

4.7.2.1 Electromagnetism

Answer 11 · Mark scheme



**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | diagram showing only on / off discrete values | 'ON' pulses must be equal amplitude | 1 |
| (ii) | microwave | | 1 |
| (b)(i) | identical | | 1 |
| (ii) | • increased risk of cancerous growth (between ear and brain)<br>• complaints of headaches and tiredness | | 1<br>1 |
| (iii) | any **two** from:<br>• tests in a laboratory did not give effects of tiredness or headaches<br>• waves not strong enough to cause long term heat damage to cells<br>• evidence to link mobile phones and ill health is not reliable | | 2 |
| total | | | 7 |

4.7.2.1 Electromagnetism

Answer 12 · Mark scheme



**Question 4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | red shift | accept Doppler effect | 1 |
| (ii) | the universe is expanding | | 1 |
| (b)(i) | big bang | | 1 |
| (ii) | at the moment it is the best way of explaining……. | | 1 |
| (c)(i) | visible / light | | 1 |
| (ii) | the atmosphere does not block…….. | | 1 |
| (iii) | difficult to maintain<br>**or**<br>high cost to get into space | accept any feasible reason<br>do not accept expensive on its own | 1 |
| total | | | 7 |

### 4.7.2.1 Electromagnetism

**Answer 13 · Mark scheme**

March 2007 | PHY1B | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | infra red | **3** |
| | **B** | radio waves | **4** |
| | **C** | ultraviolet | **2** |
| | **D** | visible light | **1** |
| | | | |

**Answer 14 · Mark scheme**

March 2007 | PHY1B | Original Q4 | Legacy

| | | | |
|---|---|---|---|
| Four | **A** | away from | **2** |
| | **B** | beyond | **4** |
| | **C** | furthest | **3** |
| | **D** | towards | **1** |
| | | | |

**Answer 15 · Mark scheme**

March 2007 | PHY1B | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **4** | **1** | **1** | **2** |

**Answer 16 · Mark scheme**

March 2007 | PHY1B | Original Q9 | Legacy

| | | | | |
|---|---|---|---|---|
| Nine | **4** | **4** | **3** | **3** |

4.7.2.1 Electromagnetism

Answer 16 · Mark scheme

March 2007 | PHY1B | Original Q9 | Legacy

## PHY1B (Radiation and the Universe) Higher Tier

| Question | Key | | |
|---|---|---|---|
| One | **A** | conclusion | **3** |
| | **B** | confidentiality | **4** |
| | **C** | control | **1** |
| | **D** | evidence | **2** |
| | | | |
| Two | **A** | gamma rays | **3** |
| | **B** | microwaves | **2** |
| | **C** | ultraviolet rays | **1** |
| | **D** | X-rays | **4** |

| | A | B | C | D |
|---|---|---|---|---|
| Three | **2** | **4** | **1** | **4** |
| Four | **4** | **4** | **3** | **3** |
| Five | **1** | **4** | **1** | **4** |
| Six | **3** | **4** | **4** | **2** |
| Seven | **2** | **4** | **3** | **4** |
| Eight | **4** | **1** | **1** | **1** |
| Nine | **2** | **1** | **3** | **3** |

### 4.7.2.1 Electromagnetism

**Answer 17 · Mark scheme** June 2007 | PHY1B | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | gamma rays | **1** |
| | **B** | infra red rays | **3** |
| | **C** | ultraviolet rays | **4** |
| | **D** | X-rays | **2** |

**Answer 18 · Mark scheme** June 2007 | PHY1B | Original Q5 | Legacy

| | | | |
|---|---|---|---|
| Five | **A** | gamma radiation | **4** |
| | **B** | X-ray radiation | **3** |
| | **C** | alpha radiation | **1** |
| | **D** | beta radiation | **2** |

**Answer 19 · Mark scheme** June 2007 | PHY1B | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **3** | **4** | **1** | **2** |

**Answer 20 · Mark scheme** June 2007 | PHY1F | Original Q4 | Legacy

The full source mark scheme begins on page 222. Follow original question 4 in that document.

**Answer 21 · Mark scheme** November 2007 | PHY1B | Original Q1 | Legacy

| | | | |
|---|---|---|---|
| One | **A** | gamma rays | **2** |
| | **B** | infra red rays | **1** |
| | **C** | radio waves | **4** |
| | **D** | visible light | **3** |

**Answer 22 · Mark scheme** November 2007 | PHY1B | Original Q3 | Legacy

| | | |
|---|---|---|
| Three | **A** | **3** |
| | **B** | **4** |
| | **C** | **2** |
| | **D** | **1** |

### 4.7.2.1 Electromagnetism

**Answer 23 · Mark scheme**



| | | | |
|---|---|---|---|
| Five | **A** | 0.42 | **1** |
| | **B** | 3 | **2** |
| | **C** | 27.5 | **4** |
| | **D** | 68.5 | **3** |
| | | | |

### 4.7.2.1 Electromagnetism

**Answer 24 · Mark scheme** January 2008 | PHY1F | Original Q2 | Legacy

**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | digital | correct answer only | 1 |
| (ii) | (visible) light<br><br>infra red | answer in either order<br><br>accept IR | 1<br><br>1 |
| (b)(i) | 25 (%) | do **not** accept ¼ | 1 |
| (ii) | increases | | 1 |
| (c) | tick (✓) in top and bottom box | both required | 1 |
| (d) | SHINY surfaces are good reflectors of infra-red radiation<br>**or**<br>black surfaces are POOR reflectors of infra-red radiation<br>**or**<br>black surfaces are good EMITTERS of infra-red radiation<br>**or**<br>black surfaces are good ABSORBERS of infra red radiation | accept white for shiny<br><br>accept bad for poor<br>accept insertion of 'not' before 'good' in statement | 1 |
| total | | | 7 |

### 4.7.2.1 Electromagnetism

**Answer 24 · Mark scheme**

January 2008 | PHY1F | Original Q2 | Legacy

**PHY1F**

4.7.2.1 Electromagnetism

Answer 25 · Mark scheme



**Question 4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | less / no light pollution | accept no / fewer streetlights | 1 |
| | less cloud cover / above clouds | | 1 |
| | less atmospheric pollution | accept air for atmospheric | 1 |
| | | accept idea of thinner atmosphere | |
| (b) | microwave | correct answer only | 1 |
| (c) | the atmosphere absorbs X-rays | | 1 |
| total | | | 5 |

### 4.7.2.1 Electromagnetism

**Answer 25 · Mark scheme**

January 2008 | PHY1F | Original Q4 | Legacy

**PHY1F**

4.7.2.1 Electromagnetism

Answer 26 · Mark scheme



## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | increase the current (1) | credit increase the p.d./voltage<br>credit reduce the resistance<br>credit have thicker wiring<br>credit add extra / more cells | 1 |
| | increase the magnetic field (strength) (1) | credit 'have stronger magnet(s)<br>do **not** credit 'bigger magnets'<br><br>**either order** | 1 |
| (b) | **either** reverse polarity<br>**or**<br>connect the battery the other way round | | 1 |
| | **either** reverse direction of the magnetic field<br>**or**<br>put the magnet the other way round / reverse the magnet | do **not** give any credit to a response in which both are done at the same time<br><br>**either order** | 1 |
| (c) | **either**<br>conductor parallel to the magnetic field<br>**or**<br>lines of magnetic force and path of electricity do not cross | | 1 |
| total | | | 5 |

### 4.7.2.1 Electromagnetism

**Answer 26 · Mark scheme** January 2008 | PHY3F | Original Q6 | Legacy

**PHY3F**

**Answer 27 · Mark scheme** March 2008 | PHY1BP | Original Q1 | Legacy

| Question | | | Key |
|---|---|---|---|
| One | **A** | infra red radiation | **3** |
| | **B** | gamma radiation | **4** |
| | **C** | visible light | **1** |
| | **D** | ultraviolet radiation | **2** |
| | | | |

**Answer 28 · Mark scheme** March 2008 | PHY1BP | Original Q3 | Legacy

| | | | |
|---|---|---|---|
| Three | **A** | SIRTF | **2** |
| | **B** | Hubble | **4** |
| | **C** | Chandra | **3** |
| | **D** | Compton | **1** |
| | | | |

**Answer 29 · Mark scheme** June 2008 | PHY1BP | Original Q1 | Legacy

| Question | | | Key |
|---|---|---|---|
| One | **A** | infra red | **3** |
| | **B** | ultraviolet | **2** |
| | **C** | visible light | **1** |
| | **D** | gamma | **4** |
| | | | |

**Answer 30 · Mark scheme** June 2008 | PHY1BP | Original Q4 | Legacy

| | | | |
|---|---|---|---|
| Four | **A** | gamma | **1** |
| | **B** | infra red | **3** |
| | **C** | radio waves | **4** |
| | **D** | ultraviolet | **2** |
| | | | |

4.7.2.1 Electromagnetism

Answer 31 · Mark scheme

June 2008 | PHY1F | Original Q4 | Legacy

## Question 4

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | atmosphere distorts / blocks image | accept clouds block light / global dimming<br>accept because of the atmosphere | 1 |
| | | accept weather conditions | |
| | **or** | | |
| | atmosphere scatters light | accept light pollution | |
| (b) | | do **not** accept answers in terms of mirror size | |
| | Correct statement related to distance | | 1 |
| | Sensible comment related to access | | 1 |
| | eg | | |
| | Hubble telescope is close enough (1)<br>for a spacecraft / astronauts to reach (1) | | |
| | **or** | | |
| | James Webb is too far away (1)<br>for astronauts to travel to (1) | | |
| | | do **not** accept easier to service on it's own | |
| (c) | To test the design …. | | 1 |
| (d) | gamma rays | answers in any order | 1 |
| | X-rays | | 1 |
| (e) | Big bang | | 1 |
| total | | | 7 |

### 4.7.2.1 Electromagnetism

**Answer 31 · Mark scheme** June 2008 | PHY1F | Original Q4 | Legacy

**PHY1F**

**Answer 32 · Mark scheme** June 2008 | PHY3F | Original Q2 | Legacy

**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | step-down (transformer) | | 1 |
| (b) | alternating current | accept minor misspellings but<br>do **not** credit 'alternative current' | 1 |
| (c)(i) & (ii) | magnet<br>attracts<br>upwards | <br>correct order essential<br>accept 'up' | 3 |
| total | | | 5 |

**Answer 32 · Mark scheme** June 2008 | PHY3F | Original Q2 | Legacy

**PHY3F**

**Answer 33 · Mark scheme** November 2008 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | infra red rays | **4** |
| | **B** | visible light | **2** |
| | **C** | ultraviolet rays | **3** |
| | **D** | X-rays | **1** |
| | | | |

### 4.7.2.1 Electromagnetism

**Answer 34 · Mark scheme**

November 2008 | PHY1BP | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | gamma rays | **1** |
| | **B** | radio waves | **4** |
| | **C** | ultraviolet rays | **2** |
| | **D** | visible light | **3** |
| | | | |

**Answer 35 · Mark scheme**

November 2008 | PHY1BP | Original Q4 | Legacy

| | | | |
|---|---|---|---|
| Four | **A** | microwaves | **4** |
| | **B** | radio waves | **2** |
| | **C** | visible light | **1** |
| | **D** | X-rays | **3** |
| | | | |

4.7.2.1 Electromagnetism

Answer 36 · Mark scheme



**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(a)(i) | X-rays<br>infra red (rays)<br>radio (waves) | all three in correct order<br><br>allow **1** mark for **1** correct | 2 |
| **1**(a)(ii) | to kill cancer cells | | 1 |
| **1**(a)(iii) | energy | | 1 |
| **Total** | | | **4** |

### 4.7.2.1 Electromagnetism

**Answer 36 · Mark scheme** January 2009 | PHY1F | Original Q1 | Legacy

**PHY1F**

**Answer 37 · Mark scheme** March 2009 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | infra red | **4** |
| | **B** | visible light | **1** |
| | **C** | ultraviolet | **3** |
| | **D** | X-rays | **2** |
| | | | |

**Answer 38 · Mark scheme** March 2009 | PHY1BP | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **2** | **1** | **2** | **1** |

**Answer 39 · Mark scheme** March 2009 | PHY1BP | Original Q9 | Legacy

| | | | | |
|---|---|---|---|---|
| Nine | **2** | **3** | **2** | **3** |

**Answer 40 · Mark scheme** June 2009 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | infra red | **2** |
| | **B** | microwaves | **3** |
| | **C** | radio waves | **4** |
| | **D** | visible light | **1** |
| | | | |

**Answer 41 · Mark scheme** June 2009 | PHY1BP | Original Q3 | Legacy

| | | | |
|---|---|---|---|
| Three | **A** | wearing thick, insulating gloves | **4** |
| | **B** | leaving the room | **1** |
| | **C** | looking through blackened glass | **3** |
| | **D** | using sun cream | **2** |
| | | | |

### 4.7.2.1 Electromagnetism

**Answer 42 · Mark scheme**



| | | | | |
|---|---|---|---|---|
| Five | **A** microwaves **3**<br>**B** X-rays **1**<br>**C** visible light **2**<br>**D** radio waves **4** | | | |
| | | | | |
| | **A** | **B** | **C** | **D** |

4.7.2.1 Electromagnetism

Answer 43 · Mark scheme

June 2009 | PHY1F | Original Q6 | Legacy

**Question 6**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a)(i) | HESS | accept gamma | 1 |
| **6**(a)(ii) | infra red | accept IR<br>accept answers written in table<br><br>do **not** accept heat | 1 |
| **6**(b) | clearer / more detailed / sharper / less distorted image<br><br>any **one** from:<br>• no light pollution<br>• light is not scattered by the atmosphere | do **not** accept image is bigger<br><br><br>accept no clouds to prevent observations<br><br>accept light is scattered by the atmosphere (implies William Herschel)<br>accept light does (not have to) pass through the atmosphere<br>accept air for atmosphere<br><br>do **not** accept answers in terms of distance | 1<br><br>1 |

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

4.7.2.1 Electromagnetism



**PHY1F**

**Question 6 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(c) | any **two** from:<br>• <u>microwaves absorbed</u> by water (molecules)<br>• signal strength greater (in dry environment)<br>• more sensitive (in dry environment)<br>• detect weaker signals (in dry environment)<br>• more detailed / clearer image (in dry environment) | accept more microwaves reach telescope<br>accept harder to detect signals in a humid environment<br>accept image contains more information<br>do **not** accept better image | 2 |
| **6**(d) | a fourth / extra galaxy / star | accept a planet / another object / source | 1 |
| **Total** | | | **7** |

### 4.7.2.1 Electromagnetism

**Answer 43 · Mark scheme**

June 2009 | PHY1F | Original Q6 | Legacy

**PHY1F**

4.7.2.1 Electromagnetism

Answer 44 · Mark scheme

June 2009 | PHY3F | Original Q7 | Legacy

**Question 7**

| question | answers | extra information | mark |
|---|---|---|---|
| **7**(a)(i) | secondary(coil) / output (coil) | do **not** accept just coil | 1 |
| **7**(a)(ii) | core<br><br>(laminated soft) iron | do **not** accept for either mark it is made out of iron ore<br><br>allow **1** mark for 'it is made out of iron core' | 1<br><br>1 |
| **7**(a)(iii) | magnetic field<br><br>(which is) changing / alternating | accept magnetism / magnetic force<br><br>direction (of field) changes / strength (of field) varies<br><br>scoring second mark is dependent on first mark | 1<br><br>1 |
| **7**(b) | ...step-up .... step-down ... | both in the correct order | 1 |
| **7**(c) | Do not build new houses ....<br><br>Build new power lines away .... | <br><br><br><br>deduct **1** mark for any other(s) to a minimum total of (0) | 1<br><br>1 |
| **Total** | | | **8** |

### 4.7.2.1 Electromagnetism

**Answer 44 · Mark scheme** June 2009 | PHY3F | Original Q7 | Legacy

**PHY3F**

**Answer 45 · Mark scheme** November 2009 | PHY1BP | Original Q1 | Legacy

| Question | | | Key |
|---|---|---|---|
| One | **A** | infra red | **2** |
| | **B** | microwaves | **1** |
| | **C** | ultraviolet | **4** |
| | **D** | X-rays | **3** |
| | | | |

**Answer 46 · Mark scheme** November 2009 | PHY1BP | Original Q2 | Legacy

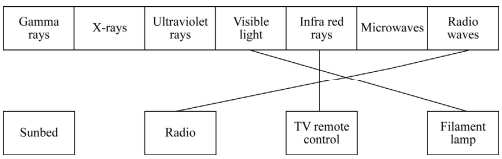
| | | | |
|---|---|---|---|
| Two | **A** | gamma | **2** |
| | **B** | infra red | **3** |
| | **C** | radio | **1** |
| | **D** | visible light | **4** |
| | | | |

### 4.7.2.1 Electromagnetism

**Answer 47 · Mark scheme**



**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(a) | all three lines correct<br><br> | allow **1** mark for each correct line<br><br>if more than one line goes from a device then all lines from that device are wrong | 3 |
| **1**(b)(i) | <u>skin</u> cancer | do **not** accept cancer<br>do **not** accept sunburn<br><br>correct answer only | 1 |
| **1**(b)(ii) | other factors may be involved | accept may have been in the Sun too long<br><br>accept (over)-use of sunbeds and (over)-exposure to the Sun (both) give the same symptoms<br><br>accept any other sensible factor that could lead to doubt<br><br>do **not** accept irrelevant answers eg may be run over by a car<br><br>do **not** accept large numbers killed by exposure to the Sun | 1 |
| **1**(b)(iii) | can assess risk<br>**or**<br>make your own decision | answers should be in terms of assessing your own health risk<br><br>accept so you limit its use / don't use one<br><br>do **not** accept so you don't get skin cancer<br><br>do **not** accept so you don't get sunburn | 1 |
| **Total** | | | **6** |

### 4.7.2.1 Electromagnetism

**Answer 47 · Mark scheme**

January 2010 | PHY1F | Original Q1 | Legacy

**PHY1F**

4.7.2.1 Electromagnetism

Answer 48 · Mark scheme



**Question 5**

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(a)(i) | (visible) light | | 1 |
| **5**(a)(ii) | any **one** from:<br>• less / no light pollution<br>• less atmospheric distortion / interference<br>• less / no cloud cover<br>• **image / picture** is clearer | <br>accept no street lights<br>accept less / thinner atmosphere<br>do **not** accept no atmosphere<br>accept less atmospheric pollution<br>do **not** accept less pollution<br>accept above the clouds<br>do **not** accept gives a clearer view / signal | 1 |
| **5**(b) | on a satellite | accept in orbit / space<br>accept in a high altitude balloon<br>accept above the atmosphere<br>do **not** accept on top of a mountain<br>do **not** accept on a plane<br>ignore any reason given correct or otherwise | 1 |
| **5**(c) | The Universe began from a very small point. | | 1 |
| **Total** | | | **4** |

### 4.7.2.1 Electromagnetism

**Answer 48 · Mark scheme**

January 2010 | PHY1F | Original Q5 | Legacy

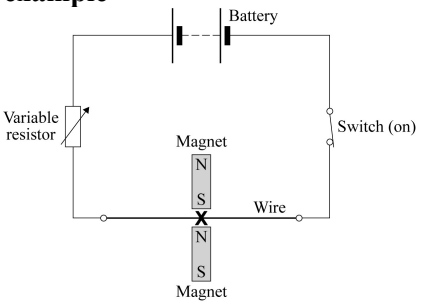
**PHY1F**

4.7.2.1 Electromagnetism

Answer 49 · Mark scheme



## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a) | centre of the **X** midway between the poles | intention correct as judged by eye<br><br>**example**<br><br> | 1 |
| **6**(b) | move the poles further apart | accept turn for move<br><br>accept ends / magnets for poles<br><br>accept use weaker magnets<br><br>do **not** accept use smaller magnets | 1 |
| **6**(c)(i) | add more cells (to the battery)<br><br>**or**<br>reduce the resistance<br>(of the variable resistor) | do **not** accept 'use a bigger battery'<br><br>accept increase the potential difference / voltage<br><br>accept increase the current<br><br>do **not** accept any changes to the magnets, to the wire or to their relative positions | 1 |

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

4.7.2.1 Electromagnetism

Answer 49 · Mark scheme



**PHY3F**

**Question 6 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(c)(ii) | reverse (the polarity of) the battery | accept turn the battery / cells round<br><br>accept swap the connections to the battery<br><br>do **not** accept any changes to the magnets, to the wire or to their relative positions | 1 |
| **Total** | | | **4** |

### 4.7.2.1 Electromagnetism

**Answer 49 · Mark scheme** January 2010 | PHY3F | Original Q6 | Legacy

**PHY3F**

**Answer 50 · Mark scheme** March 2010 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | microwaves | **4** |
| | **B** | ultraviolet rays | **1** |
| | **C** | visible light | **2** |
| | **D** | X-rays | **3** |
| | | | |

**Answer 51 · Mark scheme** March 2010 | PHY1BP | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | gamma | **3** |
| | **B** | infra red | **4** |
| | **C** | radio | **1** |
| | **D** | ultraviolet | **2** |
| | | | |

**Answer 52 · Mark scheme** March 2010 | PHY1BP | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **1** | **2** | **2** | **1** |

**Answer 53 · Mark scheme** June 2010 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | gamma rays | **1** |
| | **B** | microwaves | **4** |
| | **C** | visible light | **3** |
| | **D** | X-rays | **2** |
| | | | |

**Answer 54 · Mark scheme** June 2010 | PHY1BP | Original Q8 | Legacy

| | | | | |
|---|---|---|---|---|
| Eight | 3 | 3 | 4 | 2 |

4.7.2.1 Electromagnetism

Answer 55 · Mark scheme

June 2010 | PHY1F | Original Q2 | Legacy

## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a)(i) | infra red (rays)<br>**or**<br>radio (waves) | accept IR<br>do **not** accept heat waves<br>do **not** accept TV waves | 1 |
| **2**(a)(ii) | radio (waves) | this answer only | 1 |
| **2**(b) | frequency | | 1 |
| **2**(c)(i) | need to know if it is harmful / makes you ill | answer should be in terms of establishing if harmful or not harmful ie trying to clear up any uncertainty<br><br>do **not** accept answers that assume it is harmful eg Wi-Fi systems will make you ill<br><br>accept idea that safety issue may worry people<br><br>accept idea that (more) research may reassure people<br><br>accept idea of finding out (the truth) | 1 |
| **2**(c)(ii) | an opinion | | 1 |
| **Total** | | | **5** |

### 4.7.2.1 Electromagnetism

**Answer 55 · Mark scheme** June 2010 | PHY1F | Original Q2 | Legacy

**PHY1F**

4.7.2.1 Electromagnetism

Answer 56 · Mark scheme



## Question 4

| question | answers | extra information | mark |
|---|---|---|---|
| **4**(a)(i) | iron | | 1 |
| **4**(a)(ii) | step-down (transformer) | | 1 |
| **4**(b) | any **one** from:<br>• after the power station<br>• after the generator<br>• before the power lines<br>• before the pylons | | 1 |
| **4**(c) | each correct (1)<br>current<br>coil<br>field<br>core<br>ends | in its correct place | 5 |
| **Total** | | | **8** |

### 4.7.2.1 Electromagnetism

**Answer 56 · Mark scheme** June 2010 | PHY3F | Original Q4 | Legacy

**PHY3F**

**Answer 57 · Mark scheme** November 2010 | PHY1BP | Original Q1 | Legacy

| Question | | | Key |
|---|---|---|---|
| One | **A** | infra red | **1** |
| | **B** | ultraviolet | **4** |
| | **C** | visible light | **3** |
| | **D** | X-rays | **2** |
| | | | |

**Answer 58 · Mark scheme** November 2010 | PHY1BP | Original Q3 | Legacy

| | | | |
|---|---|---|---|
| Three | **A** | infra red | **4** |
| | **B** | microwaves | **3** |
| | **C** | radio waves | **1** |
| | **D** | visible light | **2** |
| | | | |

**Answer 59 · Mark scheme** November 2010 | PHY1BP | Original Q4 | Legacy

| | | | |
|---|---|---|---|
| Four | **A** | gamma | **1** |
| | **B** | infra red | **3** |
| | **C** | radio | **4** |
| | **D** | ultraviolet | **2** |
| | | | |

**Answer 60 · Mark scheme** November 2010 | PHY1BP | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | **1** | **1** | **2** | **3** |

4.7.2.1 Electromagnetism

Answer 61 · Mark scheme



## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a) | higher frequency<br><br>**or**<br><br>shorter wavelength<br><br>**or**<br><br>greater energy | general properties / uses are neutral<br><br>do **not** accept different frequency / wavelength / energy | 1 |
| **6**(b) | the same (speed) | accept they travel at the speed of light | 1 |
| **6**(c) | pass through / transmitted by the plastic / casing<br><br>reflected by the metal / plates | <br><br>do **not** accept bounce / deflected etc for reflected<br><br>if neither marking point scores an answer reflected (back to boat / from the device) scores **1** mark | 1<br><br>1 |
| **6**(d)(i) | waves are not reflected from the walls<br><br>**or**<br><br>only waves (reflected) from the device are detected | accept microwaves / radar for waves<br>do **not** accept bounce / deflected etc for reflected<br><br>accept to stop reflected waves affecting results | 1 |

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

**PHY1F**

**Question 6 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(d)(ii) | different types (of device) can be compared | fair test is insufficient<br><br>accept idea that only one variable is then changed | 1 |
| **6**(d)(iii) | so (measurements / results / scientists) are not biased towards one type / manufacturer of device/s | accept to avoid bias<br>accept so they are not biased | 1 |
| **6**(e)(i) | any **two** from:<br><br>• (for any angle) **A** values < **B** values<br><br>• **A** values increase with (increasing) angle<br><br>• **B** values decrease with (increasing) angle<br><br>• **A** values do not vary as much (as **B** values) | if temperature is mentioned rather than angle a maximum of **1** mark can be scored<br><br>**or** converse eg **B** values are higher / better / stronger<br><br>accept weakest at $0^{o}$ strongest at $15^{o}$<br>values go up is insufficient<br><br>accept strongest at $0^{o}$ weakest at $15^{o}$<br>values go down is insufficient | 2 |
| **6**(e)(ii) | **D**<br><br>values are always over 2(.0) | mark is for the reason<br>reason cannot score if **D** is not chosen | 1 |
| **Total** | | | **10** |

### 4.7.2.1 Electromagnetism

**Answer 61 · Mark scheme** January 2011 | PHY1F | Original Q6 | Legacy

**PHY1F**

**Answer 62 · Mark scheme** March 2011 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | infra red | **3** |
| | **B** | microwaves | **2** |
| | **C** | radio waves | **1** |
| | **D** | visible light | **4** |
| | | | |

**Answer 63 · Mark scheme** March 2011 | PHY1BP | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | infra red | **3** |
| | **B** | microwaves | **2** |
| | **C** | visible light | **1** |
| | **D** | X-rays | **4** |
| | | | |

**Answer 64 · Mark scheme** March 2011 | PHY1BP | Original Q4 | Legacy

| | | | |
|---|---|---|---|
| Four | **A** | gamma rays | **1** |
| | **B** | infra red rays | **3** |
| | **C** | radio waves | **4** |
| | **D** | ultraviolet rays | **2** |
| | | | |

**Answer 65 · Mark scheme** March 2011 | PHY1BP | Original Q9 | Legacy

| | | | | |
|---|---|---|---|---|
| Nine | **4** | **1** | **2** | **2** |

4.7.2.1 Electromagnetism

Answer 65 · Mark scheme

March 2011 | PHY1BP | Original Q9 | Legacy

# GCSE

## SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

## PHY1BP (Radiation and the Universe)

## March 2011

Higher Tier

| Question | Key | | |
|---|---|---|---|
| One | **A** | a belief that science cannot disprove | **1** |
| | **B** | a conclusion based on observations of red-shift | **3** |
| | **C** | a theory supported by scientific evidence but not direct observations | **4** |
| | **D** | a theory that science has disproved | **2** |
| | | | |
| Two | **A** | Isotope **A** | **4** |
| | **B** | Isotope **B** | **1** |
| | **C** | Isotope **C** | **3** |
| | **D** | Isotope **D** | **2** |

| | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| Three | **1** | **3** | **2** | **1** |
| Four | **4** | **1** | **2** | **2** |
| Five | **4** | **3** | **4** | **3** |
| Six | **2** | **3** | **2** | **4** |
| Seven | **1** | **2** | **3** | **4** |
| Eight | **3** | **2** | **4** | **2** |
| Nine | **2** | **3** | **4** | **3** |

### 4.7.2.1 Electromagnetism

**Answer 66 · Mark scheme**

June 2011 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | infra red | **1** |
| | **B** | ultraviolet | **3** |
| | **C** | visible light | **2** |
| | **D** | X-rays | **4** |
| | | | |

**Answer 67 · Mark scheme**

June 2011 | PHY1BP | Original Q3 | Legacy

| | | | |
|---|---|---|---|
| Three | **A** | leaving the room to switch on the equipment | **2** |
| | **B** | looking through blackened glass | **1** |
| | **C** | wearing thick, insulating gloves | **3** |
| | **D** | using remotely controlled equipment | **4** |
| | | | |

**Answer 68 · Mark scheme**

June 2011 | PHY1BP | Original Q9 | Legacy

| | | | | |
|---|---|---|---|---|
| Nine | **2** | **3** | **4** | **1** |

4.7.2.1 Electromagnetism

Answer 69 · Mark scheme

June 2011 | PHY1F | Original Q2 | Legacy

## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a)(i) | microwave | | 1 |
| **2**(a)(ii) | **C** | | 1 |
| **2**(a)(iii) | Digital signals are less affected by interference. | | 1 |
| **2**(b)(i) | infra red | | 1 |
| **2**(b)(ii) | 2 or 3 reflections shown | lines are straight and most angles look correct by eye<br><br>four or more reflections gains **1** mark only<br><br>ray must touch side of the fibre to qualify as a reflection<br><br>ray must reach end of the fibre | 2 |
| **Total** | | | **6** |

### 4.7.2.1 Electromagnetism

**Answer 69 · Mark scheme** June 2011 | PHY1F | Original Q2 | Legacy

**PHY1F**

**Answer 70 · Mark scheme** November 2011 | PHY1BP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | gamma rays | **1** |
| | **B** | infra red rays | **3** |
| | **C** | radio waves | **4** |
| | **D** | visible light | **2** |
| | | | |

**Answer 71 · Mark scheme** November 2011 | PHY1BP | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | alpha particle | **4** |
| | **B** | beta particle | **2** |
| | **C** | gamma ray | **1** |
| | **D** | X-rays | **3** |
| | | | |

**Answer 72 · Mark scheme** November 2011 | PHY1BP | Original Q5 | Legacy

| | | | |
|---|---|---|---|
| Five | **A** | gamma rays | **1** |
| | **B** | infra red rays | **3** |
| | **C** | radio waves | **2** |
| | **D** | ultraviolet rays | **4** |
| | | | |

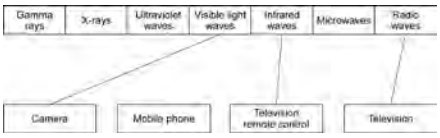
| | | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |

4.7.2.1 Electromagnetism

Answer 73 · Mark scheme

June 2012 | PH1FP | Original Q2 | Legacy

## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| 2(a) | 3 lines drawn linking:<br>camera to visible light<br>television to radio waves<br>remote control to infrared<br> | <br><br><br><br>if more than one line is drawn from any device all those lines are incorrect | <br>1<br>1<br>1 |
| 2(b) | 300 000 km/s<br>**or**<br>300 000 000 m/s | unit required<br><br>accept the same (as light)<br>accept the speed of light | 1 |
| 2(c) | a longer wavelength than | | 1 |
| 2(d)(i) | refraction | do **not** allow a misspelling that might be reflection | 1 |
| 2(d)(ii) | travelling along the normal | accept light is at 90° to the surface / block<br>light is not entering at an angle is insufficient | 1 |
| **Total** | | | **7** |

### 4.7.2.1 Electromagnetism

**Answer 73 · Mark scheme**

June 2012 | PH1FP | Original Q2 | Legacy

**PH1FP**

4.7.2.1 Electromagnetism

Answer 74 · Mark scheme

June 2013 | PH1FP | Original Q2 | Legacy

## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)(i)** | (visible) light | accept visible | 1 |
| **2(a)(ii)** | microwaves | | 1 |
| **2(b)** | J | | 1 |
| **2(c)(i)** | B | | 1 |
| **2(c)(ii)** | shorter than | | 1 |
| **2(d)(i)** | To find out if using a mobile phone is harmful to health | | 1 |
| **2(d)(ii)** | any **two** from:<br>• (X has a) low(er) SAR value<br>• (maximum) energy absorbed (by the head) is less<br>• (if mobiles are harmful) less likely to cause harm | "it" refers to mobile phone<br>accept has a low(er) rate<br>accept energy emitted (by phone) is less<br>accept radiation for energy<br>accept will not cause harm<br>accept it is safer | 2 |
| **Total** | | | **8** |

### 4.7.2.1 Electromagnetism

**Answer 74 · Mark scheme**

June 2013 | PH1FP | Original Q2 | Legacy

**PH1FP**

4.7.2.1 Electromagnetism

Answer 75 · Mark scheme

June 2013 | PH3FP | Original Q5 | Legacy

## Question 5

| question | answers | extra information | mark |
|---|---|---|---|
| **5(a)** | A | | 1 |
| **5(b)(i)** | 9000 | an answer of 9 k(N) gains **1** mark | 1 |
| **5(b)(ii)** | increase | accept other comparative terms, eg give a bigger<br><br>affect / change is insufficient | 1 |
| **5(b)(iii)** | smaller | accept other comparative terms, eg less | 1 |
| **5(c)** | Q N M | all three in correct boxes<br><br>one statement in correct box gains **1** mark | 2 |
| **5(d)** | any **two** from:<br>• increase the current / p.d. (supplied to the coil)<br>• increase number of turns (on the coil)<br>• increase the area (of the coil)<br>• increase the (strength of the permanent) magnetic field | accept reduce the resistance of the coil **or** increase cross sectional area of wire<br>accept more cells / batteries **or** turn up the power supply<br>increase power is insufficient<br><br>accept increase the width of the coil<br>increase width / size is insufficient<br><br>accept move the magnets closer to the coil<br>accept use stronger magnets<br>do **not** accept use larger magnets | 2 |
| **5(e)** | an economic | | 1 |
| **Total** | | | **9** |

### 4.7.2.1 Electromagnetism

**Answer 75 · Mark scheme**

June 2013 | PH3FP | Original Q5 | Legacy

**PH3FP**

4.7.2.1 Electromagnetism

Answer 76 · Mark scheme

June 2014 | PH1FP | Original Q8 | Legacy

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| 8(a) | infrared / IR | correct answer only | 1 | AO1 1.1.1a |
| 8(b) | any **two** from:<br>• increase the power / watts<br>• decrease the speed<br>• put biscuits through again | <br>allow increase the temperature of the oven or make the oven hotter<br>allow leave the biscuits in for longer<br>increase radiation is insufficient<br>ignore changes to the design of the oven | 2 | AO2 1.3.1c |
| 8(c) | (inside) surface is a (good) reflector or poor absorber (of IR)<br>(and) <u>outside</u> surface is poor emitter (of IR)<br>(so) increases the energy reaching the biscuits | Ignore bounce for reflect<br>surface is a (good) reflector of light does not score<br>surface is a (good) reflector of light and infrared / heat does score<br><br>allow reduces energy loss or makes oven more efficient<br>do **not** accept no energy losses<br>keeps oven hotter is insufficient | 1<br>1<br>1 | AO1 1.1.1c, d |
| **Total** | | | **6** | |

### 4.7.2.1 Electromagnetism

**Answer 77 · Mark scheme** June 2014 | PH3FP | Original Q6 | Legacy

The full source mark scheme begins on page 234. Follow original question 6 in that document.

**Answer 78 · Mark scheme** June 2015 | PH1FP | Original Q1 | Legacy

The full source mark scheme begins on page 251. Follow original question 1 in that document.

4.7.2.1 Electromagnetism

Answer 79 · Mark scheme

June 2015 | PH3FP | Original Q4 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| 4(a) | motor | | 1 | AO1 P3.3.1b |
| 4(b) | increase the strength of the magnetic field | accept use a stronger magnet<br>use a larger / bigger magnet is insufficient<br><br>do **not** accept move magnets closer | 1 | AO1 P3.3.1c |
| | increase the (size of the) current | accept use a current greater than 2 (A)<br>accept increase the p.d./voltage (of the power supply)<br>increase the power supply is insufficient | 1 | |
| 4(c) | any **one** from:<br>• (reverse the) direction of the current | accept swap the wires at the power supply connections<br><br>swap the wires around is insufficient | 1 | AO1 P3.3.1e |
| | • (change the) direction of the magnetic field | accept turn the magnet around<br><br>do **not** accept use an a.c. supply | | |
| 4(d) | The wire is parallel to the direction of the magnetic field. | | 1 | AO1 P3.3.1d |
| **Total** | | | 5 | |

### 4.7.2.1 Electromagnetism

**Answer 79 · Mark scheme**

June 2015 | PH3FP | Original Q4 | Legacy



**Answer 80 · Mark scheme**

June 2016 | PH1FP | Original Q3 | Legacy

The full source mark scheme begins on page 267. Follow original question 3 in that document.

4.7.2.1 Electromagnetism

Answer 81 · Mark scheme

June 2016 | PH3FP | Original Q8 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 8(a) | an electromagnet can be switched off<br><br>**or**<br><br>an electromagnet is stronger | accept a permanent magnet cannot be switched off<br><br><br><br>accept control the strength | 1 | AO1<br>P3.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 8(b) | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking. | | 6 | AO1<br>AO2<br>P3.3.1a<br>P3.3.1c |

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| No relevant / correct content | there is a basic description of how to make an electromagnet<br>**or**<br>there is a basic description of how the strength of the electromagnet can be varied<br>**or**<br>there is a basic description of how the electromagnet can be tested | there is a description of how the electromagnet is made<br>**and either**<br>there is a description of how the strength of the electromagnet can be varied<br>**or**<br>there is a description of how the electromagnet can be tested | there is a description of how the electromagnet is made<br>**and**<br>there is a description of how the strength of the electromagnet can be varied<br>**and**<br>there is a description of how the strength of the electromagnet can be tested |

**Question 8 continues on the next page . . .**

Answer 81 · Mark scheme



| examples of the points made in the response | extra information | |
|---|---|---|
| Details of how to make an electromagnet<br>• wrap the wire around the nail<br>• connect the wire to the power supply (with connecting leads and croc clips)<br>• switch on the power supply | accept a current should be sent along the wire | |
| Details of how to vary the strength of the electromagnet<br>• change the number of turns (on the coil)<br>• change the current (through the coil)<br>• change the separation of the turns | allow change the potential difference (across the coil)<br>accept wrap the coil more tightly | |
| Details of how to test the electromagnet<br>• suspend paperclips from the electromagnet<br>• the more paperclips suspended, the stronger the electromagnet is<br>• clamp the electromagnet at different distances from the paperclip(s)<br>• the further the distance from which paperclips can be attracted the stronger the electromagnet is<br>• test before and after making alterations to change the strength<br>• compare the results from before and after making alterations<br>• use de-magnetised paper clips | accept count the number of paperclips with different current **or** p.d. **or** no. of turns **or** core and see if the number changes/increases | |

| | | | |
|---|---|---|---|
| **Total** | | | 7 |

### 4.7.2.1 Electromagnetism

**Answer 81 · Mark scheme**

June 2016 | PH3FP | Original Q8 | Legacy



4.7.2.1 Electromagnetism

Answer 82 · Mark scheme

June 2016 | PH3FP | Original Q9 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 9(a) | a magnetic field<br><br>that is alternating / changing | accept electromagnetic field<br><br>heat is insufficient | 1<br><br>1 | AO1<br>3.3.2d |
| 9(b) | 20 | allow **1** mark for correct substitution, ie $\frac{230}{11.5}$<br>provided no subsequent step | 2 | AO2<br>3.3.2g |
| 9(c) | (most) transformers are not 100% efficient | allow energy / power is lost to the surroundings<br><br>allow energy / power is lost as heat / sound<br><br>power is lost is insufficient | 1 | AO1<br>3.3.2h |
| 9(d)(i) | 0.01 (V)<br><br>because there is a change in p.d. each time (the number of turns changes) | <br><br>allow because all the results (to 2 decimal places) are different<br><br>accept if results were to 1 decimal place, there might not be a difference | 1<br><br>1 | AO3<br>3.3.2a<br>3.3.2b |
| 9(d)(ii) | student 2 moved the coil more slowly (than student 1) | accept student 2 moved the coil at a different speed to student 1<br><br>do not accept student 2 moved the coil faster (than student 1) | 1 | AO3<br>3.3.2a<br>3.3.2b |
| 9(d)(iii) | both sets of results show the same pattern | accept trend for pattern<br><br>results are similar is insufficient<br>results follow a pattern is insufficient | 1 | AO3<br>3.3.2a<br>3.3.2b |

**Question 9 continues on the next page . . .**

4.7.2.1 Electromagnetism

Answer 82 · Mark scheme

June 2016 | PH3FP | Original Q9 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 9(d)(iv) | (electromagnetic) induction | accept it is induced<br>do not accept electric / magnetic induction | 1 | AO1<br>3.3.2a |
| 9(e) | any **one** from:<br>• more economical / cheaper for the consumer<br>• easier/cheaper to replace if broken/lost<br>• since fewer transformers need to be made less resources are used | allow more convenient<br><br>allow in case one gets lost<br><br>allow fewer plug sockets are needed<br><br>allow fewer transformers are needed<br><br>environmentally friendly is insufficient | 1 | AO3<br>3.3.2 |
| Total | | | 11 | |

4.7.2.1 Electromagnetism

Answer 83 · Mark scheme

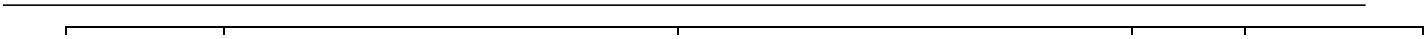
June 2017 | PH1FP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 3(a)(i) | wavelength = N | | 1 | AO1 1.5.1i |
| 3(a)(ii) | amplitude = L | | 1 | AO1 1.5.1i |
| 3(b) | B | | 1 | AO1 1.5.1e |
| 3(c)(i) | equal to | accept the same as | 1 | AO1 1.5.2b |
| 3(c)(ii) | the laser light is absorbed (by burglar's clothing)<br>**or**<br>the laser light is reflected (in a different direction) | | 1 | AO2 1.5.1g |
| **Total** | | | **5** | |

### 4.7.2.1 Electromagnetism

**Answer 83 · Mark scheme**

June 2017 | PH1FP | Original Q3 | Legacy



4.7.2.1 Electromagnetism

Answer 84 · Mark scheme

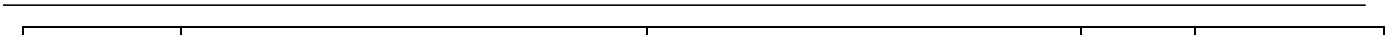


| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 7(a) | any **two** from:<br>• The number of turns on the coil<br>• The strength of the magnet<br>• The (stiffness of the) elastic bands | do not accept number of coils<br>allow how tightly the turns are wrapped<br>allow distance between the magnet and coil / cone<br>allow strength/elasticity/tension for stiffness<br>ignore references to size of paper cone<br>change direction of current or magnet is insufficient | 2 | AO3<br>3.3.1c |
| 7(b)(i) | 1.3 (cm) | two values (1.4 and 2.7) correctly taken from the graph scores **1** mark | 2 | AO2<br>3.3.1b |
| 7(b)(ii) | any **two** from:<br>• (Below 1A) as the current increases the distance increases<br>• Above 1A the distance does not change (with current)<br>• Between 0.3A and 0.7A the relationship is linear | accept the maximum distance (that the cone can move) is 2.8 cm<br>accept between 0.6 cm and 2.2 cm the relationship is linear<br>ignore references to positive correlation and direct proportionality<br>a description of the shape of the graph is insufficient eg the line levels off after 1A. | 2 | AO3<br>3.3.1c |
| **Total** | | | **6** | |

### 4.7.2.1 Electromagnetism

**Answer 84 · Mark scheme**

June 2017 | PH3FP | Original Q7 | Legacy



4.7.2.1 Electromagnetism

Answer 85 · Mark scheme

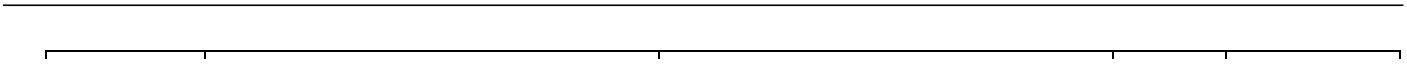
June 2018 | 8463/1F | Original Q6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.1** | nucleus<br>neutron<br>gamma rays | in this order only | 1<br>1<br>1 | AO1<br>4.4.4.1 |
| **06.2** | $\frac{25\,000\,000}{2\,400\,000}$<br>11 | an answer of 11 scores **2** marks<br>an answer of 10.4 with no working scores **1** mark | 1<br>1 | AO2<br>4.1.3 |
| **06.3** | any **two** from:<br>• waste is radioactive<br>• waste has a long half-life<br>• waste is toxic<br>• waste needs to be buried<br>• risk of catastrophic accidents<br>• fuel is non-renewable | allow nuclear waste<br>allow waste remains dangerous for a long time<br>allow waste is difficult to dispose of<br>allow named accident eg Fukushima, Chernobyl, Three Mile Island | 2 | AO1<br>4.1.3 |
| **06.4** | **similarity:**<br>(carbon dioxide concentration and global temperature have) both increased<br>**difference:**<br>the carbon dioxide (concentration) continues to increase whereas temperature (increase) levels off | allow they both show a positive correlation<br>allow carbon dioxide (concentration) increases more quickly than temperature (increase) | 1<br>1 | AO3<br>4.1.3 |
| **Total** | | | **9** | |

### 4.7.2.1 Electromagnetism

**Answer 85 · Mark scheme**

June 2018 | 8463/1F | Original Q6



4.7.2.1 Electromagnetism

Answer 86 · Mark scheme

June 2018 | 8463/2F | Original Q4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.1** | top of each paper clip labelled N / north<br>**and**<br>bottom of each paper clip labelled S / south | both parts required | 1 | AO2<br>4.7.1.1 |
| **04.2** | so the paper clips have the same weight / mass<br><br>which allows the results for different numbers of turns to be compared (fairly) | <br><br>allow fair test<br>allow the control variable (is the weight / mass of a paper clip)<br>allow to obtain valid results<br>ignore accurate results | 1<br><br>1 | AO3<br>4.7.2.1 |
| **04.3** | as the number of turns increases so does the number of paper clips (held)<br><br>in a linear pattern | allow positive correlation<br><br>directly proportional scores **2** marks<br>allow a correct description of directly proportional for **2** marks | 1<br><br>1 | AO3<br>4.7.2.1 |
| **04.4** | some of the paper clips were already magnetised | | 1 | AO3<br>4.7.2.1 |

4.7.2.1 Electromagnetism

Answer 86 · Mark scheme

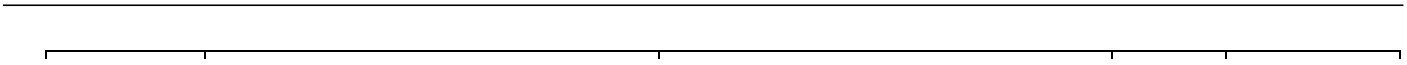
June 2018 | 8463/2F | Original Q4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.5** | discount the result of 18 | ignore repeat experiment / measurements | 1 | AO3 4.7.2.1 |
| | as the three new results are similar (and not close to 18) | | 1 | |
| | and use 15 (the mean of the new results) | allow find the mean of the remaining results (16,14 and 15)<br><br>if no other marks have been awarded:<br>calculate the mean (of all four results) (1)<br><br>round down to 15 (1) – this mark only scores if the mean of 15.75 has been calculated | 1 | |
| **04.6** | keep number of turns constant | allow a specific number of turns | 1 | AO3 4.7.2.1 |
| | (use the variable resistor to) change the current (several times) | change the p.d. is insufficient | 1 | |
| | (for each current value) count how many paper clips the electromagnet will hold | | 1 | |
| **Total** | | | **12** | |

### 4.7.2.1 Electromagnetism

**Answer 86 · Mark scheme**

June 2018 | 8463/2F | Original Q4



4.7.2.1 Electromagnetism

Answer 87 · Mark scheme

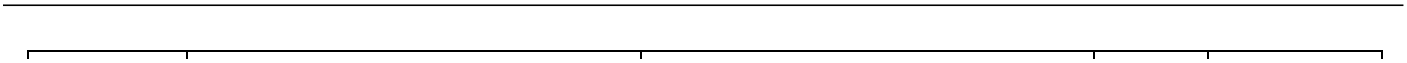
June 2018 | 8463/2F | Original Q8

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.1** | C | | 1 | AO1<br>4.6.2.1 |
| **08.2** | radio waves have a longer wavelength than ultraviolet | | 1 | AO1<br>4.6.2.1 |
| **08.3** | (risk of) skin cancer<br>**or**<br>(prematurely) ageing skin | cancer is insufficient<br><br>skin damage is insufficient<br>ignore kills skin cells | 1 | AO1<br>4.6.2.3 |
| **08.4** | risk is higher (for X-ray of uds than X-ray of chest)<br><br>by a factor of 50<br><br>**or**<br><br>risk calculated for each type of X-ray<br>chest X-ray = 1:200 000 (1)<br>uds = 1:4000 (1) | | 1<br><br>1 | AO2<br>4.6.2.3 |
| **Total** | | | **5** | |

### 4.7.2.1 Electromagnetism

**Answer 87 · Mark scheme**

June 2018 | 8463/2F | Original Q8



4.7.2.1 Electromagnetism

Answer 88 · Mark scheme

June 2019 | 8463/2F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **3.1** | both arrows pointing horizontally and to the right | judged by eye | 1 | AO1/1<br>4.7.1.2 |
| **3.2** | (two south) poles would repel<br><br>so the coat would not be held together | allow magnets would repel<br><br>allow so the coat would not fasten | 1<br><br>1 | AO1/1<br>AO2/1<br>4.7.1.1 |
| **3.3** | C | | 1 | AO1/1<br>4.7.2.1 |
| **3.4** | steel rod | | 1 | AO1/1<br>4.7.2.1 |
| **3.5** | electromagnet exerts a downwards force on the iron bar | allow electromagnet pulls the iron (bar) down(wards)<br>allow electromagnet attracts the iron (bar) | 1 | AO1/1<br>4.7.2.1 |
| **3.6** | 1.5 (cm) | | 1 | AO2/2<br>4.5.3 |
| **3.7** | <br><br>F = 0.18 × 1.5<br>OR<br>F = 0.18 × their 3.6<br><br>F = 0.27 (N) | an answer 0.27 (N) scores **2** marks<br><br><br><br><br>allow 0.18 × their 3.6 correctly calculated | <br><br>1<br><br><br>1 | AO2/1<br>4.5.3 |
| **3.8** | it increases<br><br>and reaches a maximum | <br><br>allow and then does not change<br><br>any change other than current causing strength to increase scores **0** | 1<br><br>1 | AO3/1a<br>4.7.2.1<br>WS3.5 |
| **Total** | | | **11** | |

4.7.2.1 Electromagnetism

Answer 89 · Mark scheme

June 2019 | 8463/2F | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **4.1** | B | | 1 | AO1/1<br>4.6.2.1 |
| **4.2** | electrical heating | | 1 | AO1/1<br>4.6.2.4 |
| **4.3** | orange | allow a correct answer indicated in the box provided the answer space is blank | 1 | AO3/1a<br>4.6.2.4<br>WS3.5 |
| **4.4** | becomes (more) red | allow changes from mainly orange to mainly red | 1 | AO3/2a<br>4.6.2.4<br>WS3.5 |
| **4.5** | the independent | allow a correct answer indicated in the box provided the answer space is blank | 1 | AO2/2<br>4.6.2.2<br>WS2.2 |
| **4.6** | pour (hot) water into the (hollow metal) cube<br><br>point the IR detector at each / a side and take a reading<br><br>keep the detector the same distance from each surface | <br><br>allow point the IR detector at the cube and take a reading<br>allow IR detector touching the surface and take a reading<br>allow take the temperature for take a reading | 1<br><br>1<br><br>1 | AO1/2<br>4.6.2.2<br>WS2.2 |
| **4.7** | 0.1 °C | | 1 | AO2/2<br>4.6.2.2<br>WS2.3 |
| **4.8** | one bar drawn to 68.0 (°C)<br><br>one bar drawn to 28.0 (°C)<br><br>tallest bar labelled Matt black and shortest bar labelled Shiny silver | ignore the position of the bars on the x-axis | 1<br><br>1<br><br>1 | AO2/2<br>4.6.2.2<br>WS3.1 |

4.7.2.1 Electromagnetism

Answer 89 · Mark scheme

June 2019 | 8463/2F | Original Q4

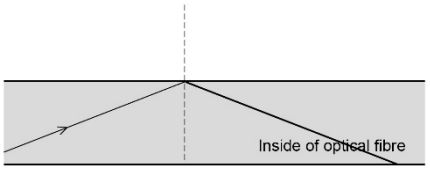
| | | | | |
|---|---|---|---|---|
| **4.9** | any **one** from:<br><br>• (matt) black is the best emitter<br>• shiny silver is the worst emitter | <br><br>allow matt white and shiny black are (almost) the same at emitting<br><br>allow black is a good emitter<br>allow silver is a poor emitter<br><br>allow an answer in terms of highest / lowest temperature<br><br>ignore any reference to absorption / reflection | 1 | AO3/2b<br>4.6.2.2<br>WS3.5 |
| **Total** | | | **13** | |

4.7.2.1 Electromagnetism

Answer 90 · Mark scheme

November 2020 | 8463/2F | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.1** | Microwaves<br><br>Radio waves | | 1<br><br>1 | AO1<br>4.6.2.4 |
| **04.2** | normal | | 1 | AO1<br>4.6.1.3 |
| **04.3** | reflected ray drawn to the right of the normal<br><br>correct ray of light drawn using a ruler with i = r | ignore arrows<br><br> | 1<br><br>1 | AO2<br>4.6.1.3 |
| **04.4** | they need to be flexible | ignore bendy / ductile / malleable / elastic | 1 | AO3<br>4.6.2.4 |
| **04.5** | transmitted<br><br>absorbed<br><br>absorbed | | 1<br><br>1<br><br>1 | AO1<br>4.6.2.6 |
| **Total** | | | **9** | |

4.7.2.1 Electromagnetism

Answer 91 · Mark scheme

November 2020 | 8463/2F | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.1** | (the north pole of the floating magnet is) repelled from the north pole (of the fixed magnet)<br><br>and attracted to the south pole (of the fixed magnet) | allow following a magnetic field line for **1 mark** if no other marks scored | 1<br><br>1 | AO3<br>4.7.1.1<br>4.7.1.2 |
| **05.2** | it was attracted (to the fixed magnet) | allow it sticks / joins to the (fixed) magnet<br><br>allow it becomes an induced magnet<br><br>allow it becomes magnetised | 1 | AO1<br>4.7.1.2 |
| **05.3** | **Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced. | | 3–4 | AO1<br>4.7.1.2 |
| | **Level 1**: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. | | 1–2 | |
| | **No relevant content** | | 0 | |
| | **Indicative content:**<br><br>• mark where the compass points on the paper<br>• move the compass to the marked point<br>• repeat until you go back to the magnet<br>• join up the points<br>• add an arrow pointing from the north pole to the south pole<br>• repeat for positions (above and below the bar magnet) | | | |
| **05.4** | C B A | allow **1** mark for one letter in the correct box | 2 | AO2<br>4.7.2.1 |
| **05.5** | $E_e = 0.5 \times 200 \times 0.040^2$<br><br>$E_e = 0.16$ (J) | | 1<br><br>1 | AO2<br>4.5.3 |
| **Total** | | | **11** | |

4.7.2.1 Electromagnetism

Answer 92 · Mark scheme

November 2020 | 8463/2F | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.1** | D | | 1 | AO1 4.6.2.1 |
| **06.2** | Any **one** from:<br>• mutation (of genes/DNA/ chromosomes)<br><br>• cancer/tumour<br><br>• cell death | allow can damage OR destroy genes/DNA/chromosomes<br><br>ignore damage/destroy cells/ tissues/organs<br><br>ignore mutates cells<br><br>allow kills cells | 1 | AO1 4.6.2.1 |
| **06.3** | the risk of harm is lower from the X-ray<br><br>by a factor of 60 | | 1<br><br>1 | AO3 4.6.2.3 |
| **06.4** | 0.0060 sieverts | | 1 | AO1 4.6.2.3 |
| **06.5** | $\frac{0.1}{2.5} \times 100$<br><br>4 (%) | <br><br>allow 0.04 for **1** mark | 1<br><br>1 | AO2 4.6.2.3 |
| **Total** | | | **7** | |

4.7.2.1 Electromagnetism

Answer 93 · Mark scheme

November 2021 | 8463/2F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | **B** | | 1 | AO1<br>4.6.2.1 |
| **03.2** | a control | | 1 | AO1<br>4.6.2.2<br>RPA10 |
| **03.3** | record the initial temperature of the two thermometers in each flask | allow initial temperature is a control variable<br>**or**<br>ensure initial temperature is the same in both flasks | 1 | AO1<br>4.6.2.2<br>RPA10 |
| | switch the infrared heater on and start the stop clock (at the same time) | allow switch on the power supply for switch on the heater | 1 | |
| | after five minutes record the (final) temperature from both flasks | allow calculate the temperature increase / change after five minutes | 1 | |
| | see / check if the temperature inside the flasks had increased by different amounts | | 1 | |
| **03.4** | 27 (°C) | allow 27 (°C) identified on the table<br>allow test 3 | 1 | AO3<br>4.6.2.2<br>RPA10 |
| **03.5** | ignore (the result) | allow repeat (the result) | 1 | AO1<br>4.6.2.2<br>RPA10 |
| **03.6** | (33/3 = ) 11 | | 1 | AO2<br>4.6.2.2<br>RPA10 |

4.7.2.1 Electromagnetism

Answer 93 · Mark scheme



| | | | | |
|---|---|---|---|---|
| **03.7** | the black flask absorbed the most infrared during the five minutes | | 1 | AO3<br>4.6.2.2<br>RPA10 |

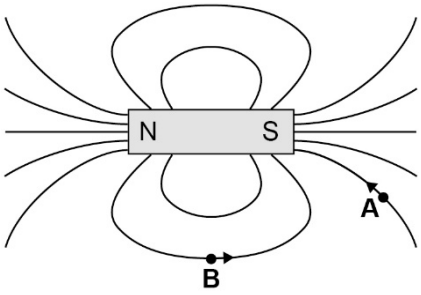
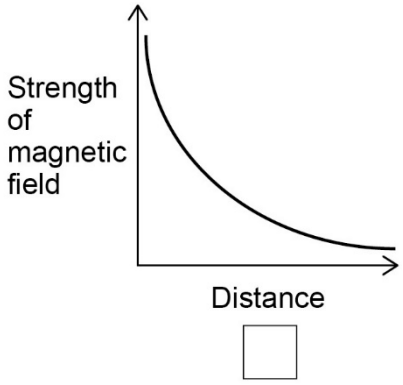
| | | | |
|---|---|---|---|
| **Total** | | | **10** |

4.7.2.1 Electromagnetism

Answer 94 · Mark scheme

November 2021 | 8463/2F | Original Q7

## Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.1** | both arrows correct |  | 1 | AO1<br>4.7.1.2 |
| **07.2** | a permanent magnet | | 1 | AO1<br>4.7.1.1 |
| **07.3** | third box ticked<br><br>any **one** from<br>• (the only graph) that shows the magnetic field getting weaker (as distance increases)<br>• both other graphs show the magnetic field getting stronger (as the distance increases) | <br><br>only scores if correct box is chosen | 1<br><br>1 | AO3<br>4.7.1.2 |
| **07.4** | steel cans are attracted to the electromagnet and are transferred to the container (by the conveyor belt)<br><br>aluminium cans are not attracted to the electromagnet | | 1<br><br>1 | AO1<br>4.7.1.2 |

Answer 94 · Mark scheme



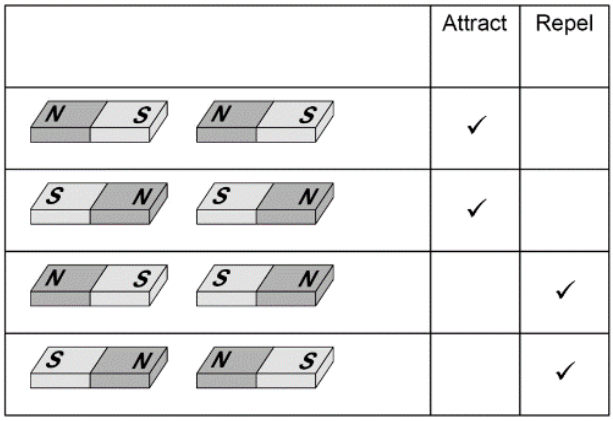
| | | | | |
|---|---|---|---|---|
| | and are left behind on the table | If no other mark scored:<br>Steel cans are attracted (to the electromagnet) but aluminium cans are not – scores one mark | | |
| **07.5** | raise the height of the table<br><br>use a larger potential difference / current<br>**or**<br>use a stronger electromagnet | allow longer legs on the table<br>allow put a (non-magnetic) box on top of the table<br>allow lower the electromagnet<br><br>allow more turns on the coil (of the electromagnet)<br><br>do **not** accept insert a (soft) iron core | 1<br><br>1 | AO3<br>4.7.2.1 |
| **07.6** | distance travelled = speed × time<br>**or**<br>$s = v\,t$ | | 1 | AO1<br>4.5.6.1.2 |
| **07.7** | $3.3 = 1.7 \times t$<br><br>$t = \frac{3.3}{1.7}$<br><br>$t = 1.941$ (s)<br><br>$t = 1.9$ (s) | <br><br><br><br><br><br>allow a calculation using the given data incorrectly but correctly rounded to 2 sig figs | 1<br><br>1<br><br><br>1<br><br>1 | AO2<br>4.5.6.1.2 |
| **Total** | | | **13** | |

4.7.2.1 Electromagnetism

Answer 95 · Mark scheme

June 2022 | 8463/2F | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.1 | all ticks correct<br><br><br>allow **1** mark for 3 correct ticks | | 2 | AO2<br>4.7.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.2 | the magnetic field gets weaker further from the magnet<br><br>the magnetic field is strongest at the poles | | 1<br><br>1 | AO1<br>4.7.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.3 | iron | | 1 | AO1<br>4.7.1.2 |

4.7.2.1 Electromagnetism

Answer 95 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.4** | coil | | 1 | AO1 4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.5** | the magnetic field would be stronger | | 1 | AO1 4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.6** | the magnetic field would be weaker | | 1 | AO1 4.7.2.1 |

| | | |
|---|---|---|
| **Total Question 1** | | **8** |

4.7.2.1 Electromagnetism

Answer 96 · Mark scheme

June 2022 | 8463/2F | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.1** | ultraviolet travels at the same speed as visible light | | 1 | AO1 4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.2** | D<br><br>C | this order only | 1<br><br>1 | AO1 4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.3** | A 400 – 315 = 85 (nm)<br>B 315 – 280 = 35 (nm)<br>C 280 – 100 = 180 (nm)<br><br>(ultraviolet) C (UVC) | three calculations correct 2 marks<br>one or two calculations correct 1 mark<br><br>mark dependent on all three calculations being made | 2<br><br>1 | AO2 4.6.2.1 |

4.7.2.1 Electromagnetism

Answer 96 · Mark scheme

June 2022 | 8463/2F | Original Q5

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 05.4 | **Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account. | 3–4 | AO3 4.6.2.3 |
| | **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>• ozone absorbs all of the UVC<br>• UVC is the most dangerous<br>• ozone absorbs nearly all (95%) of the UVB<br>• UVB has a medium risk<br>• ozone does not absorb any UVA<br>• ozone does not reduce risk from UVA<br>• UVA is the least dangerous<br>• the greater the ionising power the greater the absorption by ozone<br>• the greater the ionising power the greater the risk<br>• UV damages skin cells<br>• can lead to skin cancer<br>• can cause sunburn<br>• UV can damage eyes<br>• leads to problems with eyesight | | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 05.5 | our eyes detect visible light | allow it would be dark all the time<br>allow specific effect ie plants couldn't grow | 1 | AO1 4.6.2.1 |

4.7.2.1 Electromagnetism

Answer 96 · Mark scheme

June 2022 | 8463/2F | Original Q5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.6** | transmitted<br>absorbed | this order only | 1<br>1 | AO1<br>4.6.2.6 |

| | | |
|---|---|---|
| **Total Question 5** | | **13** |

4.7.2.1 Electromagnetism

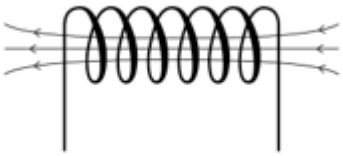
Answer 97 · Mark scheme

June 2023 | 8463/2F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | direction (of the magnetic field) | | 1 | AO1<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.2** | increase the current in the wire | | 1 | AO1<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.3** |  | | 1 | AO1<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.4** | **D A B C** | allow **1** mark for D B A C | 2 | AO2<br>4.7.2.1<br>4.2.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.5** | decrease the distance between the electromagnet and the iron arm | | 1 | AO3<br>4.7.1.2<br>4.7.2.1 |

4.7.2.1 Electromagnetism

Answer 97 · Mark scheme

June 2023 | 8463/2F | Original Q3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.6 | period = $\frac{1}{6.25}$<br>period = 0.16 (s) | | 1<br>1 | AO2<br>4.6.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.7 | B | | 1 | AO1<br>4.6.1.1 |

| Total Question 3 | 9 |
|---|---|

4.7.2.1 Electromagnetism

Answer 98 · Mark scheme

June 2023 | 8463/2F | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.1** | wavelength = Q | | 1 | AO1<br>4.6.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.2** | amplitude = $\frac{R}{2}$ | | 1 | AO1<br>4.6.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.3** | radio waves | | 1 | AO1<br>4.6.2.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.4** | s = 300 000 000 × 0.000009<br><br>s = 2700 (m) | | 1<br><br>1 | AO2<br>4.5.6.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.5** | satellite communications<br>**or**<br>cooking /heating food | allow WiFi | 1 | AO1<br>4.6.2.4 |

| **Total Question 5** | **6** |
|---|---|

4.7.2.1 Electromagnetism

Answer 99 · Mark scheme

June 2024 | 8463/1F | Original Q10

## Question 10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 10.1 | nuclei<br>neutrons<br>gamma rays | this order only | 1<br>1<br>1 | AO1<br>4.4.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 10.2 | energy = power × time<br>**or**<br>$E = P \times t$ | | 1 | AO1<br>4.2.4.2<br>4.1.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 10.3 | $P$ = 500 000 000 (W)<br>$E$ = 500 000 000 × 3600<br>$E$ = 1 800 000 000 000 (J)<br>**or**<br>$E = 1.8 \times 10^{12}$ (J) | <br>allow a correct substitution of an incorrectly / not converted value of $P$<br>allow an answer consistent with an incorrectly / not converted value of $P$ | 1<br>1<br>1 | AO2<br>4.2.4.2<br>4.1.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 10.4 | any **one** from:<br>• bury the radioactive waste<br>• put the radioactive waste in cooling ponds<br>• transport the radioactive waste in secure vessels<br>• store the radioactive waste in metal containers<br>• cover the radioactive waste in concrete | allow store it for (at least) one half-life<br>ignore references to high / medium / low level waste<br>ignore label the waste as hazardous | 1 | AO3<br>4.4.2.4 |

4.7.2.1 Electromagnetism

Answer 99 · Mark scheme

June 2024 | 8463/1F | Original Q10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.5** | number of days = $\frac{92}{100} \times 365$ | | 1 | AO2 4.1.3 |
| | number of days = 335.8 | allow answers of 335 and 336 days<br><br>allow an answer of 29.2 (days) for 1 mark | 1 | |

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

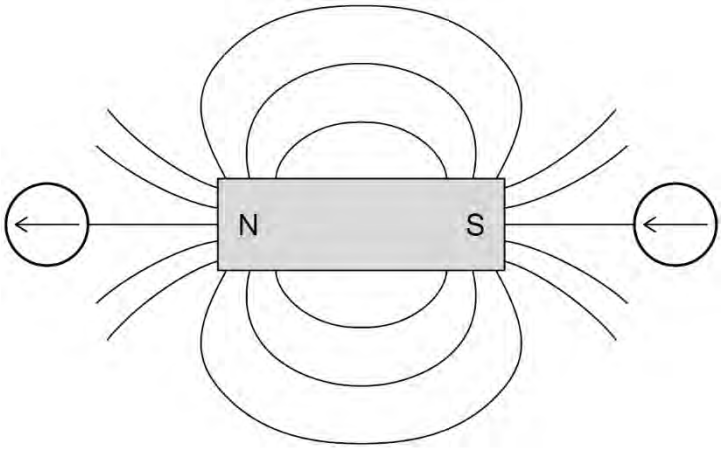
4.7.2.1 Electromagnetism

Answer 100 · Mark scheme

June 2024 | 8463/2F | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.1** | cobalt | | 1 | AO1 4.7.1.2 |

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| **02.2** | <br>2 arrows pointing left<br>allow 1 mark for 1 correct arrow | 2 | AO1 4.7.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.3** | A | | 1 | AO1 4.7.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.4** | S-S | | 1 | AO1 4.7.1.2 |

4.7.2.1 Electromagnetism

Answer 100 · Mark scheme

June 2024 | 8463/2F | Original Q2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.5 | switching the current on / off<br><br>causes the compass needle to move<br><br>**OR**<br><br>moving the compass (around the wire) (1)<br><br>changes the direction of the compass needle (1) | MP2 dependent on MP1 | 1<br><br>1 | AO3<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.6 | decreases | | 1 | AO1<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.7 | it reverses (direction) | allow it changes direction<br><br>allow it goes clockwise | 1 | AO3<br>4.7.2.1 |

| Total Question 2 | 9 |
|---|---|

Answer 101 · Mark scheme

June 2024 | 8463/2F | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.1** | infrared camera | allow thermometer, thermal imaging camera, night vision goggles | 1 | AO3<br>4.6.2.4<br>4.6.3.2<br>RPA10 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.2** | 690 nm | | 1 | AO3<br>4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.3** | bees cannot detect all the colours (a human can)<br><br>bees can detect UV radiation (but humans can't) | allow bees cannot detect red (light but humans can) | 1<br><br>1 | AO3<br>4.6.2.6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.4** | reflected<br><br>absorbed | this order only | 1<br><br>1 | AO1<br>4.6.2.6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.5** | black | | 1 | AO1<br>4.6.2.6 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.6** | diffuse | | 1 | AO1<br>4.6.2.6 |

| **Total Question 6** | **8** |
|---|---|

4.7.2.1 Electromagnetism

Answer 102 · Mark scheme

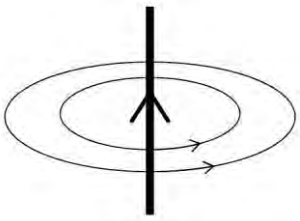
June 2025 | 8463/2F | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.1 | cobalt<br><br>steel | | 1<br><br>1 | AO1<br>4.7.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.2 | induced magnets | | 1 | AO1<br>4.7.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.3 | ← | | 1 | AO3<br>4.7.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.4 |  | | 1 | AO1<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.5 | increase the current<br><br>shape the wire into a solenoid | | 1<br><br>1 | AO1<br>4.7.2.1 |

| Total Question 6 | 7 |
|---|---|

4.7.2.1 Electromagnetism



ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Physics

## 3451

## Foundation

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Kathleen Tattersall: *Director General*

### 4.7.2.1 Electromagnetism





## 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).

## 4.7.2.1 Electromagnetism





**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**

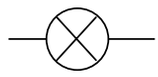
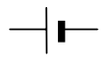
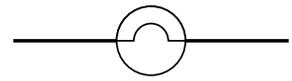
The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner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

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**3451/F 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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 $\frac{120}{200}$<br>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 |

### 4.7.2.1 Electromagnetism





**3451/F Q5**

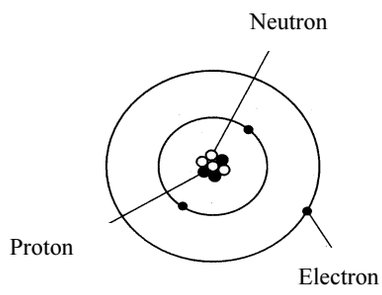
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds<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 |

### 4.7.2.1 Electromagnetism





**3451/F Q6**

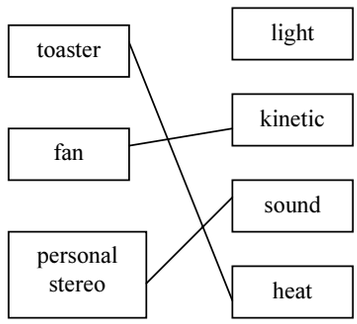
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles 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 |

### 4.7.2.1 Electromagnetism





**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 |

## 4.7.2.1 Electromagnetism





**3451/F Q8**

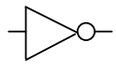
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | point where the rays cross | do not credit if ambiguous | 1 |
| (ii) | converging (lens) | do **not** accept convex | 1 |
| (b)(i) | point where the rays appear to diverge from | this should appear to be within 10mm in front 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>1 |
| total | | | 12 |

### 4.7.2.1 Electromagnetism





**3451/F Q9**

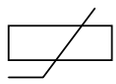
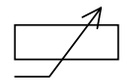
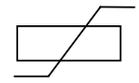
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | off<br>off<br>on | all correct | 1 |
| (ii) | AND (gate) | accept and (gate) | 1 |
| (iii) | on<br>on<br>on | all correct | 1 |
| (iv) | OR (gate) | accept or (gate) | 1 |
| (b)(i) | 1 0 **or** 0 1<br>0 1 1 0 | do **not** 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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

## 4.7.2.1 Electromagnetism





**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 |

## 4.7.2.1 Electromagnetism





**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 |

## 4.7.2.1 Electromagnetism





**3451/F Q14**

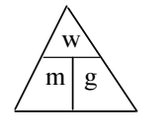
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from: | | 1 |
| | the ground | do **not** accept mobile phones | |
| | the air | | |
| | radon (gas) | | |
| | building materials | | |
| | buildings | | |
| | rocks / granite | | |
| | food | | |
| | cosmic rays **or** solar rays | 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 but not betas | accept paper for the card | 1 |
| | 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) | 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 much more than 3 mm of metal | accept aluminium for the metal<br>accept lead / aluminium for the metal | 1 |
| total | | | 6 |

### 4.7.2.1 Electromagnetism





**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 |

## 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

GCSE 2004
*June Series*

ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark Scheme

## Physics Specification B
*3451/F*

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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### 4.7.2.1 Electromagnetism



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# GCSE PHYSICS

# 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

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

### 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'.

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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;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

**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.


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**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 Interpretation of marginal points**

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

**3.11 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.

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### 4.7.2.1 Electromagnetism





**GCSE Physics**
**Foundation Tier 3451/F**

**3451F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | comet | correct order only | 1 |
| | elliptical | | 1 |
| | Milky Way | | 1 |
| | Universe | | 1 |
| (b)(i) | D A C B | allow **2** marks for two letters in the correct place<br>allow **1** mark for one letter in the correct place | 3 |
| (ii) | A | | 1 |
| total | | | 8 |



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### 4.7.2.1 Electromagnetism





**3451F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 95 | | 1 |
| (b) | alpha | accept correct symbol | 1 |
| (c) | any **two** from:<br>• radiation is outside the body<br>• radiation will not reach (living) cells<br>• radiation absorbed by the air | <br>accept detector is on ceiling or high up the wall<br>accept radiation cannot pass through the body / skin<br>accept cannot pass through the plastic casing<br>do **not** accept because it is alpha radiation – unless qualified<br>do **not** accept does not give off harmful substance<br>do **not** accept cannot pass through building materials etc. | 2 |
| (d) | less (than) | | 1 |
| total | | | 5 |

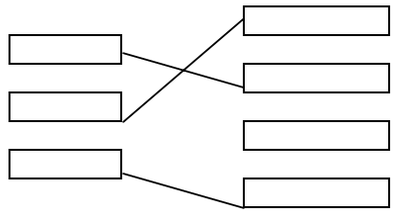
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### 4.7.2.1 Electromagnetism





**3451F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | generator | accept dynamo<br>accept alternator | 1 |
| (b)(i) | 1400 | ignore units | 1 |
| (ii) | 0.3 or 30% | any incorrect unit penalise **1** mark<br>allow **1** mark for the correct use of 600 **or** 0.3% **or** 30 | 2 |
| (c) | **1** mark for each correct link<br> | if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect | 3 |
| (d)(i) | 110 | no tolerance | 1 |
| (ii) | 12 | no tolerance | 1 |
| (iii) | wind speed may be too low to operate the generator | accept wind may not always blow<br>accept power depends on wind speed<br>accept does not generate if wind speed is too high<br>accept does not generate if wind speed is above 12 (m/s)<br>accept does not generate if wind speed is below 1.6 (m/s)<br>accept it is unreliable<br>do **not** accept answers referring to cost only | 1 |
| total | | | 10 |



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### 4.7.2.1 Electromagnetism





**3451F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | B E A D | allow **1** mark for each letter in the correct place, to a maximum of **3** marks | 3 |
| (b) | (a spark) may cause the (petrol vapour) to explode / ignite | accept petrol for (petrol vapour)<br>accept catch fire for explode | 1 |
| | connect tanker to earth with a (conducting) wire / chain **or** earth the tanker | accept ground for earth | 1 |
| (c) | **Quality of written communication** | for a logical sequence | 1 |
| | any **two** from: | | 2 |
| | • when current greater than fuse rating / value | accept when current too great for appliance<br>do **not** accept 'if there is too much current'<br>do **not** accept voltage or electricity | |
| | • fuse (becomes hot and) melts / burns out | accept fuse blows / breaks | |
| | • circuit is broken | accept circuit switched off<br>this cannot score credit on its own | |
| total | | | 8 |

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### 4.7.2.1 Electromagnetism





**3451F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | crust | | 1 |
| (ii) | inner core is <u>solid</u><br><br>outer core is liquid | do **not** accept just rock<br><br>inner core is denser / hotter than outer core gets **2** marks<br>accept one is solid and one is liquid for **1** mark<br>accept they are different densities for **1** mark<br>wrong way round = **0** marks | 1<br><br>1 |
| (b) | seismograph | | 1 |
| (c) | difficult to measure (slow) movement (1)<br>of plates (1) dependent mark<br>**or**<br>difficult to measure friction / forces (1)<br>between plates (1) dependent mark | | 1<br><br>1 |
| (d) | geothermal | | 1 |
| (e)(i) | 5000 | | 1 |
| (ii) | 2500 | | 1 |
| total | | | 9 |



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### 4.7.2.1 Electromagnetism





**3451F Q6**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | converging<br>image<br>object<br>image<br>object<br>shorter | | 1<br>1<br>1<br>1<br>1<br>1 |
| (b)(i) | (Earth's) gravity | accept centripetal<br>accept minor misspellings, however, do **not** credit any response which could be 'centrifugal' | 1 |
| (ii) | to(wards) (the centre of the) Earth | allow inwards<br>do **not** accept downwards | 1 |
| (c)(i) | **either**<br><br>friction (force)<br>**or** centripetal force<br><br>between the tyres / wheels and (the surface of) the road | <br><br>allow grip<br><br>allow on the tyres / wheels<br>**or** towards the centre of the bend / arc / circle | <br><br>1<br><br>1 |
| (ii) | mass<br>**or** speed<br>**or** momentum<br><br>radius / diameter | allow weight<br>allow velocity<br><br>do **not** credit 'curvature' or 'circumference' | 1<br><br><br>1 |
| (d) | centripetal | accept minor misspellings (see above) | 1 |
| total | | | 13 |

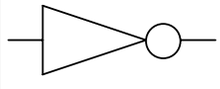
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## 4.7.2.1 Electromagnetism





**3451F Q7**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | two switches in series **and** circuit complete | ignore small imperfections | 1 |
| (ii) | two switches in parallel **and** circuit complete | ignore small imperfections | 1 |
| (iii) | one switch in parallel with the cell / lamp (but **not** both) | ignore small imperfections | 1 |
| (iv) | (i) AND<br>(ii) OR<br>(iii) NOT | accept 'and'<br>accept 'or'<br>accept 'not' | 1<br>1<br>1 |
| (b)(i) | when it is light the sensor sends on / high / 1 signal to the gate<br>off / low / 0 sent to the lamp<br>**or**<br>when it is dark the sensor sends off / low / 0 signal to the gate (1)<br>on / high / 1 sent to the lamp (1) | | 1<br>1 |
| (ii) | any suitable application | e.g. to switch a security light on (and off)<br>e.g. to switch a light on when it is dark<br>do **not** credit just '… to switch a light on / off' | 1 |
| (c)(i) |  | accept shading-in of either or both parts<br>end connections are not required<br>accept any orientation | 1 |
| (ii) | 1 0 **or** 0 1<br>0 1 1 0 | all correct | 1 |
| (iii) | truth (table) | | 1 |
| total | | | 12 |



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### 4.7.2.1 Electromagnetism





**3451F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 60 | | 1 |
| (b) | $5\frac{1}{2}$ hours | must include unit | 1 |
| (c) | 30 | | 1 |
| (d) | 30 minutes<br>or $\frac{1}{2}$ hour | must include unit | 1 |
| (e) | D **and** E | accept finish for E<br>accept correct numbers from axes with units | 1 |
| | least steep part of the graph | accept covers smallest distance in a set time<br>accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6)<br>ignore horse is tired | 1 |
| total | | | 6 |

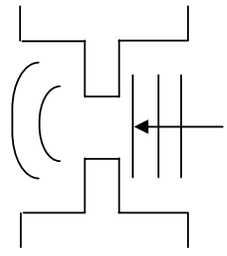
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### 4.7.2.1 Electromagnetism





**3451F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from: | | 1 |
| | • (doctors) to see inside a patients body **or** endoscope | accept keyhole surgery | |
| | • telephone cables | do **not** accept flex **or** wires for cable | |
| | • optical fibre / fibre optic lamps **or** (artificial) Christmas trees | accept decorative / ornamental lighting<br>accept any feasible practical suggestion for taking light to a difficult to access place<br>do **not** accept lighting unqualified<br>do **not** accept lamp unqualified | |
| | • data transfer **or** internet connection | do **not** accept communications unless clarified | |
| (ii) | (incident) ray angle greater than critical angle | either order<br>accept (incident) ray greater than 42° | 1 |
| | total internal reflection occurs | accept TIR<br>do **not** accept just description of TIR | 1 |
| (b)(i) | waves shown diffracting in the correct direction  | ignore wavelength | 1 |
| (ii) | diffraction | accept diffract / diffracted | 1 |
| total | | | 5 |



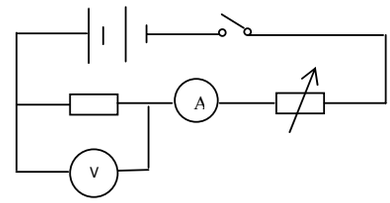
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### 4.7.2.1 Electromagnetism





**3451F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | all symbols correct | <br>accept push switch symbol<br>switch may be open or closed<br>any lines through symbols = **0** marks | 1 |
| | correct circuit drawn<br><br>voltmeter must be across resistor only | polarity of cells not relevant provided they are joined correctly<br>two cells are required in the diagram<br>ignore the order of the components<br>allow small gaps in circuit<br><br>omission of any component = **0** marks | 1 |
| (b)(i) | potential difference<br>= current × resistance | accept voltage or p.d. for potential difference<br><br>accept $V = I \times R$<br><br>accept  provided<br>subsequent use correct<br><br>do **not** accept C for current | 1 |
| (ii) | 2 | <br>allow **1** mark for correct substitution<br>wrong working loses both marks | 2 |
| (iii) | straight line drawn <u>through the origin</u><br><br>straight line passes through<br>$I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0 | judge by eye<br><br>this mark may be awarded if all points shown including these points are correct even if no line is drawn<br>N.B. a curve scores **0** marks | 1<br><br>1 dep |
| (c) | temperature <u>increases</u> | accept filament lamp / it gets <u>hotter</u><br>allow heat for temperature | 1 |
| total | | | 8 |

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### 4.7.2.1 Electromagnetism





**3451F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | gamma rays | accept gamma<br>accept correct symbol | 1 |
| (ii) | infra red | accept IR | 1 |
| (b) | ultraviolet <u>absorbed</u> by ink<br><br>(energy) given out as light | <br><br>accept glows / luminous<br>accept for **both** marks the ink is fluorescent<br>do **not** accept answers in terms of uv being reflected | 1<br><br>1 |
| (c) | any **two** from:<br><br>• UV can damage / kill / ionise / alter (normal) cells<br><br>• change DNA structure **or** mutate<br><br>• (normal) cells may become cancerous | <br><br>do **not** accept attacks cells **or** burns skin<br><br><br><br>accept may cause (skin) cancer<br>accept abnormal cell multiplication | 2 |
| (d)(i) | microwaves **and** infra red | both answers needed in either order<br><br>do **not** accept heat for IR | 1 |
| (ii) | 0.9 | <br><br>allow **1** mark for the <u>correct</u> use of<br>1.8 (kW) ($1.8 \times \frac{1}{2}$ or $1.8 \times 30$)<br>i.e. adding the correct 2 power values | 2 |
| total | | | 9 |



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### 4.7.2.1 Electromagnetism





**3451F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | accelerating | accept getting faster<br>accept speed / velocity increasing | 1 |
| (ii) | acceleration increases | accept velocity / speed increases more rapidly<br>do **not** accept velocity / speed increases | 1 |
| (b)(i) | $\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$ | accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$<br>do **not** accept velocity for change in velocity<br>do **not** accept change in speed<br>do **not** accept $a = \frac{v}{t}$ | 1 |
| (ii) | 15 | allow **1** mark for an answer of 900 **or** for correct use of 540 seconds | 2 |
| (iii) | velocity includes direction | accept velocity is a vector (quantity)<br>accept converse answer | 1 |
| (c) | force of gravity (between shuttle and Earth)<br><br>plus correct orbital speed (makes shuttle move in a curve) | accept gravitational pull if used correctly<br><br>accept forward motion **or** constant speed for orbital speed<br>accept it is travelling fast enough<br>accept for **2** marks the force of gravity provides the centripetal force | 1<br><br>1 |
| (d) | black is a good emitter of radiation<br>**or** to limit the temperature rise inside the shuttle | accept heat for radiation<br>accept the tiles are good insulation<br>do **not** accept black absorbs heat on its own<br>do **not** accept tiles are heat proof | 1 |
| total | | | 9 |

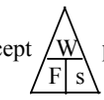
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### 4.7.2.1 Electromagnetism





**3451F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | work (done)<br>= force (applied) × distance (moved) | accept W = F × s or W = F × d<br><br>accept  provided<br><br>subsequent method is correct | 1 |
| (ii) | 240 000<br><br>joules | allow **1** mark for correct substitution **or** correct use of 1200 (N)<br><br>accept J<br>do **not** accept j / Nm | 2<br><br>1 |
| (b) | 800 (watts) | accept 0.8 kW<br>accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks<br><br>allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark | 2 |
| (c)(i) | any **one** from:<br>• needs to raise the chair / lift<br>• lifting more than one chair<br>• energy transfer to the surroundings correctly qualified | <br><br>allow lifting more than 2 people<br>implication of a heavier weight<br><br>accept loss for transfer<br>do **not** accept motor inefficient<br>do **not** accept motor gets hot<br>do **not** accept friction unless the location is specified as external to the motor | 1 |
| (ii) | electrical<br><br>potential | accept electric<br><br>**both** answers required for the mark | 1 |
| total | | | 8 |



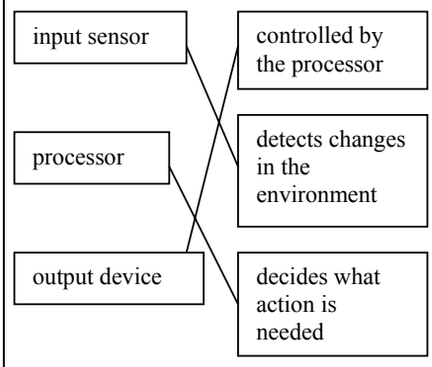
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### 4.7.2.1 Electromagnetism





**3451F Q14**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | current | | 1 |
| (ii) | resistance<br><br>decreases | <br><br>accept 'the flow of electrons / current (through it) increases' for **1** mark<br><br>do **not** credit just '… it will get warmer' | 1<br><br>1 |
| (b) |  | all pairs correct<br><br>one pair correct for **1** mark | 2 |
| (c)(i) | potential divider | accept voltage divider | 1 |
| (ii) | 4 (volts) | $6 \times \frac{30}{45}$ for **1** mark | 2 |
| (iii) | across the new resistor…(will) increase<br><br>across $R_2$ … (will) decrease | <br><br>N.B. independent marks | 1<br><br>1 |
| total | | | 10 |

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## 4.7.2.1 Electromagnetism





**3451F Q15**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | relay (normally open) (switch) | each mark is independent | 1 |
| | … switch on a (larger) current (in another circuit) **or** switch on a higher voltage circuit | do **not** accept switch on another circuit **or** smaller / equal current | 1 |
| | light emitting diode / LED | do **not** credit LDR | 1 |
| | … in one / direct / certain direction **or** from left to right | **or** when the cathode is connected to the negative terminal / side<br>**or** when the left-hand side is connected to the positive terminal / side<br>do **not** credit just '… is big enough'<br>do **not** accept 'positive direction' | 1 |
| | AND gate | accept 'and' gate | 1 |
| | … (both) inputs are on / high / 1 **or** current flows in both inputs | do **not** accept numerical values unless expanded | 1 |
| (b) | **Quality of written communication** | If in a sensible order which clearly indicates advantages or disadvantages, including answers in the form of a table **or** as bullet points<br>Q ✓ Q X | 1 |
| | any **three** from:<br>• advantage of mobile phones | e.g. more convenient for service engineers<br>e.g. calls can be received away from base | 3 |
| | • drawback of mobile phones | e.g. privacy can be more easily invaded<br>e.g. drivers can be distracted<br>e.g. microwaves / radio waves can / may cause damage to the brain | |
| | • benefit of the Internet | e.g. access to educational material | |
| | • drawback of the Internet | e.g. some material is salacious<br>e.g. spam (on external e-mail)<br>these are examples<br>candidates may be credited for a variety of responses | |
| total | | | 10 |



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### 4.7.2.1 Electromagnetism





**3451F Q16**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | **Y** and **Z** | | 1 |
| | they have the same number of protons **or** same atomic number | accept they have the same number of electrons **or** same number of protons **and** electrons<br>allow only different in number of neutrons<br>N.B. independent marks | 1 |
| (b) | **Quality of written communication** | for correct use of terms underlined in B **or** C<br><br>Q ✓ Q X | 1 |
| | A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus<br><br>B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u><br><br>C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards | describes 3 tracks correctly for **2** marks<br>describes 2 or 1 track correctly for **1** mark<br><br>do **not** accept hits the nucleus<br>do **not** accept answers referring to refraction<br>do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion<br><br>mention of difference in charge on nucleus negates that track | max 2 |
| total | | | 5 |

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GCSE 2004
*June Series*

ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark Scheme

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

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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### 4.7.2.1 Electromagnetism



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# SCIENCE: DOUBLE AWARD CO-ORDINATED

# 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

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

### 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'.

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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;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

**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.


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### 4.7.2.1 Electromagnetism





**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 Interpretation of marginal points**

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

**3.11 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.

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### 4.7.2.1 Electromagnetism





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

**3462/3F Q1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | comet | correct order only | 1 |
| | elliptical | | 1 |
| | Milky Way | | 1 |
| | Universe | | 1 |
| (b)(i) | D A C B | allow **2** marks for two letters in the correct place<br>allow **1** mark for one letter in the correct place | 3 |
| (ii) | A | | 1 |
| total | | | 8 |


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### 4.7.2.1 Electromagnetism





**3462/3F Q2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 95 | | 1 |
| (b) | alpha | accept correct symbol | 1 |
| (c) | any **two** from:<br>• radiation is outside the body<br>• radiation will not reach (living) cells<br>• radiation absorbed by the air | <br>accept detector is on ceiling or high up the wall<br>accept radiation cannot pass through the body / skin<br>accept cannot pass through the plastic casing<br>do **not** accept because it is alpha radiation – unless qualified<br>do **not** accept does not give off harmful substance<br>do **not** accept cannot pass through building materials etc. | 2 |
| (d) | less (than) | | 1 |
| total | | | 5 |

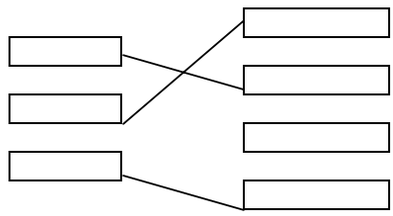
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### 4.7.2.1 Electromagnetism





**3462/3F Q3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | generator | accept dynamo<br>accept alternator | 1 |
| (b)(i) | 1400 | ignore units | 1 |
| (ii) | 0.3 or 30% | any incorrect unit penalise **1** mark<br>allow **1** mark for the correct use of 600 **or** 0.3% **or** 30 | 2 |
| (c) | **1** mark for each correct link<br> | if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect | 3 |
| (d)(i) | 110 | no tolerance | 1 |
| (ii) | 12 | no tolerance | 1 |
| (iii) | wind speed may be too low to operate the generator | accept wind may not always blow<br>accept power depends on wind speed<br>accept does not generate if wind speed is too high<br>accept does not generate if wind speed is above 12 (m/s)<br>accept does not generate if wind speed is below 1.6 (m/s)<br>accept it is unreliable<br>do **not** accept answers referring to cost only | 1 |
| total | | | 10 |


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### 4.7.2.1 Electromagnetism





**3462/3F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | B E A D | allow **1** mark for each letter in the correct place, to a maximum of **3** marks | 3 |
| (b) | (a spark) may cause the (petrol vapour) to explode / ignite | accept petrol for (petrol vapour)<br>accept catch fire for explode | 1 |
| | connect tanker to earth with a (conducting) wire / chain **or** earth the tanker | accept ground for earth | 1 |
| (c) | **Quality of written communication** | for a logical sequence | 1 |
| | any **two** from: | | 2 |
| | • when current greater than fuse rating / value | accept when current too great for appliance<br>do **not** accept 'if there is too much current'<br>do **not** accept voltage or electricity | |
| | • fuse (becomes hot and) melts / burns out | accept fuse blows / breaks | |
| | • circuit is broken | accept circuit switched off<br>this cannot score credit on its own | |
| total | | | 8 |

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### 4.7.2.1 Electromagnetism





**3462/3F Q5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | crust | | 1 |
| (ii) | inner core is <u>solid</u><br><br>outer core is liquid | do **not** accept just rock<br><br>inner core is denser / hotter than outer core gets **2** marks<br>accept one is solid and one is liquid for **1** mark<br>accept they are different densities for **1** mark<br>wrong way round = **0** marks | 1<br><br>1 |
| (b) | seismograph | | 1 |
| (c) | difficult to measure (slow) movement (1)<br>of plates (1) dependent mark<br>**or**<br>difficult to measure friction / forces (1)<br>between plates (1) dependent mark | | 1<br><br>1 |
| (d) | geothermal | | 1 |
| (e)(i) | 5000 | | 1 |
| (ii) | 2500 | | 1 |
| total | | | 9 |


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## 4.7.2.1 Electromagnetism





**3462/3F Q6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 60 | | 1 |
| (b) | $5\frac{1}{2}$ hours | must include unit | 1 |
| (c) | 30 | | 1 |
| (d) | 30 minutes<br>or $\frac{1}{2}$ hour | must include unit | 1 |
| (e) | D **and** E<br><br>least steep part of the graph | accept finish for E<br>accept correct numbers from axes with units<br><br>accept covers smallest distance in a set time<br>accept only moves 5 km in<br>$1\frac{1}{2}$ hours (accept anything between 5 and 6)<br><br>ignore horse is tired | 1<br><br>1 |
| total | | | 6 |

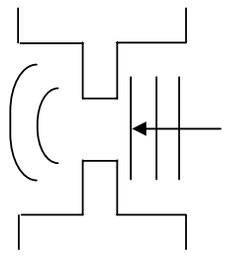
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## 4.7.2.1 Electromagnetism





**3462/3F Q7**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br><br>• (doctors) to see inside a patients body **or** endoscope<br><br>• telephone cables<br><br>• optical fibre / fibre optic lamps **or** (artificial) Christmas trees<br><br>• data transfer **or** internet connection | <br><br>accept keyhole surgery<br><br>do **not** accept flex **or** wires for cable<br><br>accept decorative / ornamental lighting<br>accept any feasible practical suggestion for taking light to a difficult to access place<br>do **not** accept lighting unqualified<br>do **not** accept lamp unqualified<br><br>do **not** accept communications unless clarified | 1 |
| (ii) | (incident) ray angle greater than critical angle<br><br>total internal reflection occurs | either order<br>accept (incident) ray greater than 42°<br><br>accept TIR<br>do **not** accept just description of TIR | 1<br><br>1 |
| (b)(i) | waves shown diffracting in the correct direction<br> | ignore wavelength | 1 |
| (ii) | diffraction | accept diffract / diffracted | 1 |
| total | | | 5 |

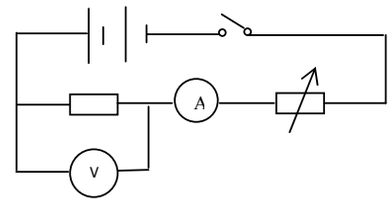
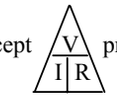

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## 4.7.2.1 Electromagnetism





**3462/3F Q8**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | all symbols correct |   accept push switch symbol<br>switch may be open or closed<br>any lines through symbols = **0** marks | 1 |
| | correct circuit drawn<br><br>voltmeter must be across resistor only | polarity of cells not relevant provided they are joined correctly<br>two cells are required in the diagram<br>ignore the order of the components<br>allow small gaps in circuit<br><br>omission of any component = **0** marks | 1 |
| (b)(i) | potential difference<br>= current × resistance | accept voltage or p.d. for potential difference<br><br>accept $V = I \times R$<br><br>accept   provided<br><br>subsequent use correct<br><br>do **not** accept C for current | 1 |
| (ii) | 2 | <br><br>allow **1** mark for correct substitution<br>wrong working loses both marks | 2 |
| (iii) | straight line drawn <u>through the origin</u><br><br>straight line passes through<br>$I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0 | judge by eye<br><br>this mark may be awarded if all points shown including these points are correct even if no line is drawn<br>N.B. a curve scores **0** marks | 1<br><br>1 dep |
| (c) | temperature <u>increases</u> | accept filament lamp / it gets <u>hotter</u><br>allow heat for temperature | 1 |
| total | | | 8 |

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## 4.7.2.1 Electromagnetism





**3462/3F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | gamma rays | accept gamma<br>accept correct symbol | 1 |
| (ii) | infra red | accept IR | 1 |
| (b) | ultraviolet <u>absorbed</u> by ink<br><br>(energy) given out as light | <br><br>accept glows / luminous<br>accept for **both** marks the ink is fluorescent<br>do **not** accept answers in terms of uv being reflected | 1<br><br>1 |
| (c) | any **two** from:<br><br>• UV can damage / kill / ionise / alter (normal) cells<br><br>• change DNA structure **or** mutate<br><br>• (normal) cells may become cancerous | <br><br>do **not** accept attacks cells **or** burns skin<br><br><br><br>accept may cause (skin) cancer<br>accept abnormal cell multiplication | 2 |
| (d)(i) | microwaves **and** infra red | both answers needed in either order<br><br>do **not** accept heat for IR | 1 |
| (ii) | 0.9 | <br><br>allow **1** mark for the <u>correct</u> use of<br>1.8 (kW) $(1.8 \times \frac{1}{2}$ or $1.8 \times 30)$<br>i.e. adding the correct 2 power values | 2 |
| total | | | 9 |


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### 4.7.2.1 Electromagnetism





**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | accelerating | accept getting faster<br>accept speed / velocity increasing | 1 |
| (ii) | acceleration increases | accept velocity / speed increases more rapidly<br>do **not** accept velocity / speed increases | 1 |
| (b)(i) | $\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$ | accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$<br>do **not** accept velocity for change in velocity<br>do **not** accept change in speed<br>do **not** accept $a = \frac{v}{t}$ | 1 |
| (ii) | 15 | allow **1** mark for an answer of 900 **or** for correct use of 540 seconds | 2 |
| (iii) | velocity includes direction | accept velocity is a vector (quantity)<br>accept converse answer | 1 |
| (c) | force of gravity (between shuttle and Earth)<br><br>plus correct orbital speed (makes shuttle move in a curve) | accept gravitational pull if used correctly<br><br>accept forward motion **or** constant speed for orbital speed<br>accept it is travelling fast enough<br>accept for **2** marks the force of gravity provides the centripetal force | 1<br><br>1 |
| (d) | black is a good emitter of radiation<br>**or** to limit the temperature rise inside the shuttle | accept heat for radiation<br>accept the tiles are good insulation<br>do **not** accept black absorbs heat on its own<br>do **not** accept tiles are heat proof | 1 |
| total | | | 9 |

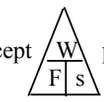
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### 4.7.2.1 Electromagnetism





**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | work (done)<br>= force (applied) × distance (moved) | accept W = F × s or W = F × d<br><br>accept  provided<br><br>subsequent method is correct | 1 |
| (ii) | 240 000<br><br>joules | allow **1** mark for correct substitution **or** correct use of 1200 (N)<br><br>accept J<br>do **not** accept j / Nm | 2<br><br>1 |
| (b) | 800 (watts) | accept 0.8 kW<br>accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks<br><br>allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark | 2 |
| (c)(i) | any **one** from:<br>• needs to raise the chair / lift<br>• lifting more than one chair<br>• energy transfer to the surroundings correctly qualified | <br><br>allow lifting more than 2 people<br>implication of a heavier weight<br><br>accept loss for transfer<br>do **not** accept motor inefficient<br>do **not** accept motor gets hot<br>do **not** accept friction unless the location is specified as external to the motor | 1 |
| (ii) | electrical<br><br>potential | accept electric<br><br>**both** answers required for the mark | 1 |
| total | | | 8 |


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## 4.7.2.1 Electromagnetism





**3462/3F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | **Y** and **Z** | | 1 |
| | they have the same number of protons **or** same atomic number | accept they have the same number of electrons **or** same number of protons **and** electrons<br>allow only different in number of neutrons<br>N.B. independent marks | 1 |
| (b) | **Quality of written communication** | for correct use of terms underlined in B **or** C<br><br>Q ✓ Q X | 1 |
| | A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus<br><br>B – alpha particle deflected / repelled / repulsed by the (positive) nucleus<br><br>C – alpha particle heading straight for the nucleus is deflected / repelled / repulsed backwards | describes 3 tracks correctly for **2** marks<br>describes 2 or 1 track correctly for **1** mark<br><br>do **not** accept hits the nucleus<br>do **not** accept answers referring to refraction<br>do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion<br><br>mention of difference in charge on nucleus negates that track | max 2 |
| total | | | 5 |

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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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

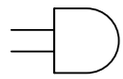
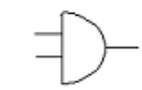
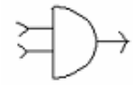
**cont…**

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**3451/F Q10**

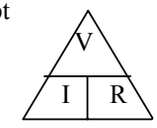
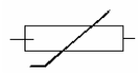
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | rays continued to meet on the right hand side of the lens and beyond | must be straight lines from the right hand side of the lens<br>ignore details through the lens<br>allow if no arrows | 1 |
| | meet exactly on the axis | 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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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** $a = \frac{v_1 - v_2}{t}$<br>**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…**

**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 |

### 4.7.2.1 Electromagnetism



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

**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 |

### 4.7.2.1 Electromagnetism





**3451/F Q16**

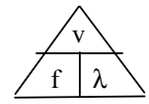
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | **X** at the centre of the lifebelt | measuring from the centre of **X**, allow 2 mm tolerance in any direction | 1 |
| (ii) | any **two** from:<br><br>below the point of suspension<br><br>at the centre (of the lifebelt)<br><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 |

### 4.7.2.1 Electromagnetism





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 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 | 2 |
| | **Quality of written communication** | contradictory statements within each point lose the mark<br><br>all emboldened terms in candidate's answer used correctly | 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 λ<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*

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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# 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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



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

**3462/3F Q8**

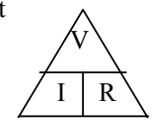
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils of Cynognathus are found in Africa and South America | | 1 |
| | the shapes ……. almost fit together | only two boxes should be ticked<br>deduct **1** mark for each additional box to a minimum mark of **0** | 1 |
| (b)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

### 4.7.2.1 Electromagnetism





**3462/3F Q9**

| 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 |

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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 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 |

### 4.7.2.1 Electromagnetism



*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…**

**3462/3F Q12 cont**…

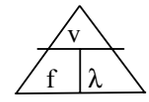
| | | | |
|---|---|---|---|
| (d) | any **three** from:<br>• <u>increased</u> speed<br>• <u>reduced</u> braking force<br>• <u>slower</u> (driver) reactions<br>• <u>poor</u> vehicle maintenance<br>• <u>increased</u> mass / weight of vehicle<br>• <u>poor</u> road surface<br>• <u>more</u> streamlined |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

### 4.7.2.1 Electromagnetism



*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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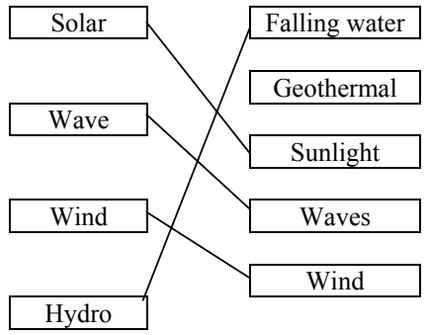
4.7.2.1 Electromagnetism





# 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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*Physics B* – AQA GCSE Mark Scheme, 2006 June series

**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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>

### 4.7.2.1 Electromagnetism





**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><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 |

**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**

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | 0.5<br><br>hertz | <br><br>accept Hz but **not** HZ / hz / hZ<br><br>accept (waves) per second **or** / sec **or** / s **or** $s^{-1}$ **or** $sec^{-1}$ | 1<br><br>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<br><br>longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel | accept a correctly labelled diagram<br><br>accept a correctly labelled diagram<br><br>part explanation of the difference between transverse **and** longitudinal gains **1** mark | 1<br><br>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 |

### 4.7.2.1 Electromagnetism





**3451/F Q14**

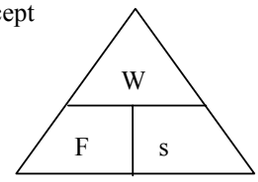
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer<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 |

### 4.7.2.1 Electromagnetism





**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>provided subsequent method is correct | 1 |

**Continued**

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism





**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**

### 4.7.2.1 Electromagnetism





**3451/F Q17**

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

### 4.7.2.1 Electromagnetism





**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.

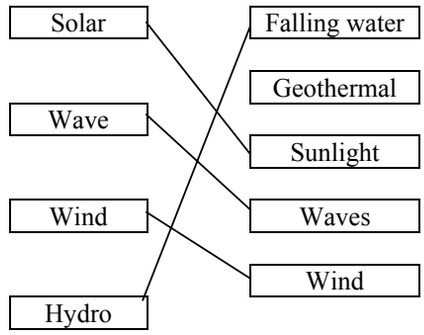
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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**

### 4.7.2.1 Electromagnetism



*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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



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

**3462/3F Q12**

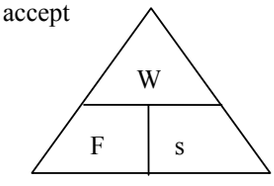
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer<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 |

### 4.7.2.1 Electromagnetism





**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 |

### 4.7.2.1 Electromagnetism



*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 |

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Secondary Education

# Science B 4462 / Physics 4451

## PHY1F Unit Physics 1

# Mark Scheme

*2007 examination - June series*

### 4.7.2.1 Electromagnetism



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.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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*Dr Michael Cresswell*, Director General.

### 4.7.2.1 Electromagnetism





## MARK SCHEME

## Information to 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 / ; eg allow smooth / free movement.)

### 3. Marking points

#### 3.1 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 |

**3.2 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.

**3.3 Marking procedure for calculations**

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;

**3.4 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.

**3.5 Errors carried forward**

Any error in the answers to a structured question should be penalised once only.

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.

**3.6 Phonetic spelling**

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

**3.7 Brackets**

(…..) are 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.

**3.8 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.

### 4.7.2.1 Electromagnetism





**PHY1F Question 1**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | grid | accept any way of indicating correct answer | 1 |
| (ii) | increases voltage | accept any way of indicating correct answer | 1 |
| (iii) | 230 V | accept any way of indicating correct answer | 1 |
| (iv) | reduce | accept any way of indicating correct answer | 1 |
| (b)(i) | increases the temperature | accept make it hotter / heat goes into the air<br><br>accept convection currents<br><br>accept sensible comment<br>eg sound energy / it buzzes<br><br>ignore pollutes the air | 1 |
| (ii) | less than 100% | | 1 |
| total | | | 6 |

### 4.7.2.1 Electromagnetism





**PHY1F Question 2**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | coal | | 1 |
| (b) | fossil fuels can be used to generate electricity at any time<br><br>a few large power stations can generate the electricity for a million homes | if more than 2 boxes ticked, mark incorrect boxes first | 1<br><br>1 |
| (c)(i) | no fuel is burnt | accept a named fuel<br><br>accept nothing is burnt<br><br>accept does not use (fossil) fuel | 1 |
| (ii) | kinetic | | 1 |
| (iii) | any **two** from:<br>• cause <u>noise</u> pollution<br>• cause <u>visual</u> pollution<br>• need concrete for bases<br>• new roads / infrastructure needed<br>• may interfere with TV / radio / mobile phone signals<br>• dangerous to birds<br>• do not generate all of the time<br>• need a lot of generators<br>• high <u>initial</u> / <u>capital</u> costs<br>• reduces house prices | accept causes pollution for **1** mark<br><br>accept generates <u>only</u> when the wind blows<br>do **not** accept 'generate when the wind blows'<br><br>do **not** accept 'take up a lot of space / land' | 2 |
| total | | | 7 |

### 4.7.2.1 Electromagnetism





**PHY1F Question 3**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | 7pm | accept 19.00 / 1900 | 1 |
| (ii) | 8pm | accept 20.00 / 2000 | 1 |
| | temperature drops more slowly | accept heat for temperature<br>accept line is less steep | 1 |
| (b) | insulator | | 1 |
| | conduction* | *answers can be either way around | 1 |
| | convection* | | 1 |
| (c)(i) | 4 (years) | | 1 |
| (ii) | it is the cheapest / cheaper / cheap | do **not** accept answers in terms of heat rising or DIY | 1 |
| | has the shortest / shorter payback time | do **not** accept short payback time | 1 |
| total | | | 9 |

### 4.7.2.1 Electromagnetism





**PHY1F Question 4**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br>• gamma<br>• X-rays<br>• infra red<br>• microwaves<br>• radio | <br>accept correct symbol<br><br>accept IR<br>do **not** accept heat<br><br>do **not** accept TV | 1 |
| (ii) | all the waves travel at the same speed | | 1 |
| (b)(i) | (skin) cancer / melanoma | accept damage eyesight<br>accept sunburn<br>do **not** accept sun tan<br>do **not** accept sunstroke | 1 |
| (ii) | higher levels of UV<br><br>greater risk to health / risk of skin cancer / (more) protection needed / most likely to get burnt / damage skin | accept UV at its strongest / sun's rays are strongest<br>ignore 'sun is at its hottest'<br>ignore 'sun is at its highest'<br><br>accept greater damage to / easier to damage cells / mutate cells<br>ignore just 'affect your health'<br>must be idea of greater adverse effect on health | 1<br><br>1 |
| total | | | 5 |

### 4.7.2.1 Electromagnetism





**PHY1F Question 5**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | C | | 1 |
| (b)(i) | easy to maintain / access<br>**or**<br>(currently) cheaper than a space telescope<br>**or**<br>can modify (easily) an existing telescope<br>**or**<br>telescopes can be larger<br>**or**<br>can test new types of telescope (easily) | do **not** accept 'easier to use'<br><br>do **not** accept easier to supply with power | 1 |
| (ii) | atmosphere does not block / distort the image | accept picture / data for image<br><br>accept 'more detailed / clearer image / data / picture<br><br>accept 'no light pollution'<br><br>accept 'can look at the Earth'<br><br>do **not** accept 'can see further'<br><br>do **not** accept 'better view'<br><br>do **not** accept 'clear view'<br><br>do **not** accept 'can see more clearly' | 1 |
| total | | | 3 |

### 4.7.2.1 Electromagnetism





**PHY1F Question 6**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | electromagnetic (wave / radiation) | accept em (wave / radiation)<br><br>ignore reference to frequency | 1 |
| (ii) | gamma can penetrate the crate / box / packaging | accept converse (but must relate to both alpha and beta)<br><br>ignore just gamma radiation kills bacteria<br><br>accept can get through to food | 1 |
| (iii) | neutrons | | 1 |
| (b)(i) | absorb gamma / radiation | accept it stops / reduces the radiation | 1 |
| (ii) | any **one** from:<br>• slow down the conveyor belt<br>• food does more than one circuit<br>• stay on the conveyor belt longer<br>• food closer to the source / radiation | ignore larger doses / use more of the source<br><br>ignore thinner packaging | 1 |

**Continued on next page**

**Question 6 continued**

| | answers | extra information | mark |
|---|---|---|---|
| (c)(i) | idea of testing food on humans / animals | | 1 |
| | no (measured) ill effects **or** monitor their health | accept monitor people that have eaten the food<br><br>accept a measurement / comparison for **1** mark<br>eg measure the amount of radiation in treated food<br><br>comparison plus a reason for the comparison would get **2** marks<br><br>eg idea of measuring level of radiation in treated food **with** no measurable increase in level = **2** marks **or** comparing it to untreated food = **2** marks | 1 |
| (ii) | so can make own decision about eating or not eating treated food | accept may be against their religious / moral views<br><br>accept some people prefer food that hasn't been tampered with<br><br>ignore in case they don't like the idea of eating treated food<br><br>accept don't want to eat treated food<br><br>ignore might be allergic to the food<br><br>eg think it will give them cancer = **0** marks<br>think it will give you cancer so I need to know so that I can choose = **1** mark | 1 |
| total | | | 8 |

### 4.7.2.1 Electromagnetism





**PHY1F Question 7**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | the outside colour of the cans | | 1 |
| (b)(i) | 18 (°C) **or** 88 to 70 | ignore negative sign | 1 |
| (ii) | 8 (°C) **or** 70 to 62 | ignore negative sign | 1 |
| (c) | greater temperature difference between water and surroundings (at start) | must mention temperature difference<br><br>ignore just water hotter<br><br>accept energy used to heat cans initially | 1 |
| (d) | black<br><br>temperature falls the fastest (in L)<br><br>black is a good / the best / better emitter (of heat / radiation) | <br><br>accept (can L) loses more heat / cools quicker<br><br>accept heat for temperature<br><br>accept converse<br><br>ignore black is best absorber | 1<br><br>1<br><br>1 |
| total | | | 7 |

### 4.7.2.1 Electromagnetism



# GCSE
# PHYSICS

PH3FP
Mark scheme

4403
June 2014

Version: 1.0 Final

### 4.7.2.1 Electromagnetism



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## Information to Examiners

### 1. General

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- the Assessment Objectives and specification content that each question is intended to cover.

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.

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**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 bullet points 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 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 | green, 5 | 0 |
| 2 | red*, 5 | 1 |
| 3 | red*, 8 | 0 |

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

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

**3.2 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.

**3.3 Marking procedure for calculations**

Full marks can be given for a correct numerical answer, 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 or by each stage of a longer calculation.

**3.4 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.

**3.5 Errors carried forward**

Any error in the answers to a structured question should be penalised once only.

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.

**3.6 Phonetic spelling**

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

**3.7 Brackets**

(…..) are 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.

**3.8 Ignore / Insufficient / Do <u>not</u> allow**

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

**Quality of Written Communication and levels marking**

In Question 9(a) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: basic**

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: clear**

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: detailed**

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **1(a)** | transmits<br>absorbs | correct order | 1<br>1 | AO1<br>3.1.1b |
| **1(b)** | light | allow ultra violet **or** UV **or** infrared **or** IR **or** gamma | 1 | AO1<br>3.1.1b |
| **1(c)** | 20 | allow **1** mark for correct working, ie $\frac{60}{3}$ provided no subsequent step | 2 | AO2<br>3.1.1b |
| **1(d)** | Killing cancer cells | | 1 | AO1<br>3.1.1b |
| **Total** | | | **6** | |

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **2(a)** | 3000 | allow **1** mark for correct substitution, ie 600 × 5 provided no subsequent step | 2 | AO2<br>3.2.2b |
| **2(b)** | anticlockwise moment | must be both words | 1 | AO1<br>3.2.2c |
| **2(c)(i)** | 3400 | allow 3.4 kilo (newtons) | 1 | AO2<br>3.2.2c |
| **2(c)(ii)** | as the distance (of the girl from point A) increases, force F increases | allow gets bigger for increases<br><br>force is (directly) proportional to distance will negate any correct response | 1 | AO3<br>4.5.3 |
| **Total** | | | **5** | |

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **3(a)** | <table><tr><th></th><th>Digital Camera</th><th>Eye</th></tr><tr><td>Cornea</td><td></td><td>✓</td></tr><tr><td>Lens</td><td>✓</td><td>✓</td></tr><tr><td>Pupil</td><td></td><td>✓</td></tr><tr><td>CCD</td><td>✓</td><td></td></tr></table> | ignore shaded row<br>each correct row = **1** mark | 3 | AO1<br>3.1.4a, d |
| **3(b)** | long | | 1 | AO1<br>3.1.4b |
| **3(c)** | lens A<br>it is a concave / diverging lens | <br>this mark is only gained if lens A is stated<br>any reference to lens material or mass of lens negates this mark<br>allow it will focus light onto the retina | 1<br>1 | AO1<br>3.1, 3.1.4b |
| **3(d)** | The refractive index of the lens material | | 1 | AO1<br>3.1.4f |
| **3(e)** | 4 | ignore any signs<br>allow **1** mark for correct substitution, ie $\frac{1}{0.25}$ provided no subsequent step | 2 | AO2<br>3.1.4e |

**Question 3 continues on the next page . . .**

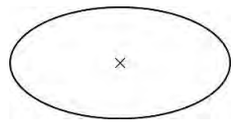
**Question 3 continued . . .**

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **3(f)** | Cauterising open blood vessels | | 1 | AO1<br>3.1.5f |
| **3(g)** | 5 | allow **1** mark for correct substitution, ie $\frac{70}{14}$ provided no subsequent step | 2 | AO2<br>3.1.3i |
| **Total** | | | **12** | |

### 4.7.2.1 Electromagnetism



MARK SCHEME – GCSE Physics – PH3FP – June 2014

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **4(a)** | concentrated | | 1 | AO1<br>3.2.1a |
| **4(b)** |  | judge by eye | 1 | AO2<br>3.2.1c |
| **4(c)** | C A D | 3 correct = **2** marks<br>1 or 2 correct = **1** mark | 2 | AO1<br>3.2.1a |
| **4(d)** | Lower the athlete's seating position<br>Move the wheels further apart | | 1<br>1 | AO2<br>3.2 |
| **Total** | | | **6** | |

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **5(a)** | hydraulic | | 1 | AO1<br>3.2.3 |
| **5(b)** | 9 | allow **1** mark for a correct substitution, ie $\frac{1800}{200}$ provided no subsequent step | 2 | AO2<br>3.2.3c |
| **5(c)** | an environmental | | 1 | AO3<br>SALoSE |
| **Total** | | | **4** | |

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **6(a)(i)** | increase | | 1 | AO3<br><br>3.3.1a, 4.5.4 |
| **6(a)(ii)** | A and B<br>and<br>B and C | both required for the mark<br>either order | 1 | AO3<br><br>3.3.1a, 4.5.4 |
| **6(a)(iii)** | any **two** from:<br><br>• size of nail<br>**or**<br>nail material<br><br>• current<br><br><br><br>• (size of) paper clip<br><br>• length of wire | <br><br>allow (same) nail<br><br><br>allow (same) cell<br>allow p.d.<br><br>same amount of electricity is insufficient<br><br><br>accept type/thickness of wire | 2 | AO3<br><br>4.1b |
| **6(b)** | 4<br><br>B picks up the same number as C, so this electromagnet would pick up the same number as A<br>**or**<br>direction of current does not affect the strength of the electromagnet | <br><br>allow it has got the same number of turns as A | 1<br><br>1 | AO3<br><br>3.3.1a, 4.5.4 |
| **6(c)** | 2 | allow 1 or 3 | 1 | AO3<br><br>3.3.1a, 4.5.4 |
| **Total** | | | **7** | |

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **7(a)** | (sound waves) which have a frequency higher than the upper limit of hearing for humans<br>**or**<br>a (sound) wave (of frequency) above 20 000 Hz | sound waves that cannot be heard is insufficient<br><br>a wave of frequency 20 000 Hz is insufficient | 1 | AO1<br><br>3.1.2a |
| **7(b)** | 640 | an answer of 1280 gains **2** marks<br><br>allow **2** marks for the correct substitution<br>ie 1600 × 0.40 provided no subsequent step<br><br>allow **2** marks for the substitution $\frac{1600 \times 0.80}{2}$<br>provided no subsequent step<br><br>allow **1** mark for the substitution 1600 × 0.80 provided no subsequent step<br><br>allow **1** mark for the identification that time (boat to bed) is 0.4 | 3 | AO2<br><br>3.1.2c |
| **7(c)** | any **one** from:<br>• pre-natal scanning / imaging<br>• imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles<br>• Doppler scanning blood flow | accept heart<br><br>do **not** allow brain **or** lungs (either of these negates a correct answer) | 1 | AO1<br><br>3.1.2d |

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

**Question 7 continued . . .**

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **7(d)** | advantage<br>any **one** from:<br>• (images are) high quality or detailed or high resolution<br>• (scan) produces a slice through the body<br>• image can be viewed from any direction<br>• an image can be made of <u>any</u> part (inside the body)<br>• easier to diagnose **or** see a problem (on the image)<br><br>disadvantage<br>any **one** from:<br>• (the X-rays used **or** scans) are <u>ionising</u><br><br>• mutate cells **or** cause mutations **or** increase chances of mutations<br><br>• turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells<br><br>• kill cells<br><br>• shielding is needed | <br><br>clearer / better image is sufficient<br><br>allow images are (always) 3D / 360°<br>allow whole body can be scanned<br><br><br><br><br>allow a description of what ionising is<br><br>allow for cells: DNA / genes / chromosomes / nucleus / tissue<br><br><br><br>damage cells is insufficient<br><br>can be dangerous (to human health) unqualified, is insufficient | 1<br><br><br><br><br><br><br><br><br>1 | AO1<br><br>3.1 |
| **Total** | | | **7** | |

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **8(a)** | gravitational attraction (between the satellite and the Earth) | allow gravity<br>allow weight of the satellite | 1 | AO1<br><br>3.2.4b |
| **8(b)** | any **two** from:<br>• mass of satellite<br>• speed / velocity (of satellite)<br>• radius of orbit / circle | allow height above the Earth<br>radius / height alone is insufficient | 2 | AO1<br><br>3.2.4c |
| **8(c)(i)** | increasing the height (above the Earth's surface) increases the time (for one orbit) | allow a positive correlation<br><br>allow as one gets bigger, the other gets bigger, or vice versa<br><br>ignore they are directly proportional | 1 | AO3<br><br>4.5.3 |
| **8(c)(ii)** | there is no relationship / correlation | | 1 | AO3<br><br>4.5.3 |
| **8(d)** | Isaac Newton was a respected scientist who had made new discoveries before | | 1 | AO3<br><br>3.2.4, SALoSE |
| **Total** | | | **6** | |

| Question | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking. | | Mark | AO spec ref |
|---|---|---|---|---|
| 9(a) | | | 6 | |
| **0 marks** | **Level 1 (1–2 marks)** | **Level 2 (3–4 marks)** | **Level 3 (5–6 marks)** | AO1 3.3.2 |
| No relevant / correct content. | **Either**<br>there is an attempt at a description of the construction of a transformer<br><br>**or**<br><br>a correct statement of the effect of one type of transformer on the input p.d. | There is a description of the construction of a transformer<br>**and**<br>a correct statement of the effect of one type of transformer on the input p.d. | There is a clear description of the construction of a transformer<br>**and**<br>there is a correct description of how transformers affect the input p.d. | |

| | |
|---|---|
| **details of construction:** | extra information |
| a (laminated) core | |
| core is made from a magnetic material / iron | |
| 2 coils | |
| the coils are made from an electrical conductor / copper | |
| the coils are covered in plastic / insulation | |
| the coils are (usually) on opposite sides | |
| step-up transformer has more turns on secondary coil than (its) primary (or vice versa) | |
| step-down transformer has less turns on secondary coil than (its) primary (or vice versa) | |
| **effect on input p.d. :** | |
| step-up transformer, the output p.d. is greater (than the input p.d.) | accept voltage for p.d. |
| step-down transformer, the output p.d. is lower (than the input p.d.) | |

**Question 9 continues on the next page . . .**

**Question 9 continued . . .**

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| 9(b) | switch mode (transformer) | | 1 | AO1<br>3.3.2j |
| Total | | | 7 | |

4.7.2.1 Electromagnetism



AQA

GCSE

# Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

### 4.7.2.1 Electromagnetism



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**Mark Scheme**

**Information to 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 Assessment Objectives and specification content that each question is intended to cover.

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 bullet points 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 / ; eg allow smooth / free movement.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

## 3. Marking points

### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students 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 errors / 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)

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

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

| Student | Response | Marks awarded |
|---|---|---|
| 1 | Neptune, Mars, Moon | 1 |
| 2 | Neptune, Sun, Mars, Moon | 0 |

**3.1 Use of chemical symbols / formulae**

If a student 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.

**3.2 Marking procedure for calculations**

Full marks can be given for a correct numerical answer, 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 or by each stage of a longer calculation.

**3.3 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.

**3.4 Errors carried forward**

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is 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.

**3.5 Phonetic spelling**

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

**3.6 Brackets**

(.....) are 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.

**3.2 Ignore / Insufficient / Do not allow**

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

**4. Quality of Communication and levels marking**

In Question **7a** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

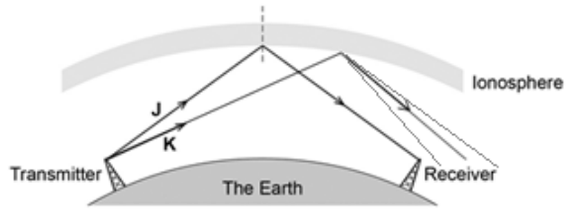
Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: basic**
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: clear**
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: detailed**
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| 1(a)(i) | reflection of wave **K** at or within the ionosphere<br><br>angle i = angle r<br><br><br> | allow dashed lines<br>'judge by eye'<br><br>tolerance for the reflected ray is between the first e and last r<br><br>ignore arrows<br><br>a reflected ray to the receiver doesn't score 2nd mark<br><br>additional rays shown doesn't score 2nd mark | 1<br><br>1 | AO2 P1.5.2b |
| 1(a)(ii) | normal | | 1 | AO1 P1.5.2a |
| 1(b)(i) | microwave | | 1 | AO1 P1.5.1k |
| 1(b)(ii) | refraction | | 1 | AO1 P1.5.1g |
| 1(c) | All electromagnetic waves are transverse.<br><br>All electromagnetic waves have the same speed in a vacuum. | | 1<br><br>1 | AO1 P1.5.1b, c, d |
| Total | | | 7 | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **2(a)** | chemical<br>kinetic<br>sound | correct order only | 1<br>1<br>1 | AO1<br>P1.2.1a |
| **2(b)** | 48% or 0.48 | an answer of 0.48 with a unit gains **1** mark<br>an answer of 0.48% gains **1** mark<br>an answer of 48 with or without a unit gains **1** mark | 2 | AO2<br>P1.2.1d |
| **Total** | | | **5** | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **3(a)(i)** | because they contain free electrons | | 1 | AO1 P1.1.3a |
| **3(a)(ii)** | because they are good absorbers of infrared radiation | | 1 | AO1 P1.1.1c |
| **3(b)(i)** | insulators | | 1 | AO1 P1.1.3a |
| **3(b)(ii)** | the rate of energy transfer would be lower. | | 1 | AO1 P1.1.3c |
| **3(c)** | power<br><br>time | allow the temperature (of the oven)<br><br>watts or wattage is insufficient | 1<br><br>1 | AO1 P1.3.1b |
| **3(d)** | it can be switched on / off remotely | accept sensible suggestions about remote operation<br>eg<br>can be turned on / off from work<br>**or**<br>food can be cooked before you get home | 1 | AO3 P1.1 |
| **Total** | | | **7** | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **4(a)** | 20 790 (J) | an answer of 21 000 (J) (2 s.f.) gains **2** marks<br><br>allow **1** mark for correct substitution:<br>ie E = 0.33 x 4200 x 15 provided no subsequent step shown | 2 | AO2<br>P1.1.4d |
| **4(b)** | temperature | | 1 | AO1<br>P1.1.4d |
| **4(c)** | (top pan) balance | accept scales<br><br>do **not** accept a scale<br>do **not** accept weighing scales<br>do **not** accept newtonmeter<br>do **not** accept spring balance | 1 | AO1<br>P1.1.4d |
| **4(d)** | dark / black / (dark) grey<br><br>convection | <br><br>correct order only | 1<br><br>1 | AO1<br>P1.1.1c<br>P1.1.3c |
| **4(e)(i)** | created | accept made | 1 | AO1<br>P1.2.1a |
| **4(e)(ii)** | increases | | 1 | AO1<br>P1.2.1c |
| **Total** | | | **8** | |

| Question | Answers | Extra information | Mark | AO/Spec. ref. |
|---|---|---|---|---|
| **5(a)(i)** | high levels of infrared radiation (from the Sun) | allow lots of (solar) energy (available)<br><br>do **not** accept 'heat' for infrared<br><br>'it is hot' is insufficient<br>'lots of sunlight' is insufficient | 1 | AO2<br>P1.4.1a |
| **5(a)(ii)** | reflected | | 1 | AO1<br>P1.5.1g |
| **5(a)(iii)** | boiler<br><br>turbine<br><br>transformer | correct order only | 1<br><br>1<br><br>1 | AO1<br>P1.4.1a |
| **5(b)** | 2 100 000 (kWh) | allow **1** mark for correct substitution i.e. 140 000 x 15 provided no subsequent step | 2 | AO2<br>P1.3.1c |
| **5(c)(i)** | only 1 wind turbine was considered<br>**or**<br>other wind turbines may have generated more electricity<br><br>only 1 week's weather was reported on<br>**or**<br>wind speed varies from one week to another | accept only one location is considered<br><br>accept insufficient sample size<br><br>'wind speed varies' is insufficient | 1<br><br>1 | AO3<br>P1.4 |
| **5(c)(ii)** | any **one** from:<br>• wind speed is too high / low<br><br>• wind is unreliable | allow no wind<br>allow too windy<br>allow wind is variable | 1 | AO1<br>P1.4 |

**Question 5 continues on the next page . . .**

**Question 5 continued . . .**

| Question | Answers | Extra information | Mark | AO/Spec. ref. |
|---|---|---|---|---|
| **5(c)(iii)** | any **one** from:<br>• wind is a renewable energy source<br>• do not use fuel<br>• energy source is free<br>• do not release carbon dioxide<br>• do not release greenhouse gases<br>• do not release sulfur dioxide<br>• do not cause acid rain<br>• do not cause climate change<br>• do not cause global warming<br>• do not cause global dimming | answer must be an advantage of wind, converse answers in terms of fossil fuels are insufficient<br>accept do not release pollutant gases<br>'no pollution' is insufficient | 1 | AO1<br>P1.4.1f |
| **Total** | | | **11** | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **6(a)(i)** | C | | 1 | AO2<br><br>P1.5.4a |
| **6(a)(ii)** | The speed of star **B** is less than the speed of star **D**. | | 1 | AO3<br>P1.5.4b |
| **6(b)** | 300 000 000<br><br><br><br>m/s | allow **1** mark for correct substitution<br>ie 200 000 x 1500 provided no subsequent step shown<br><br>allow unit correctly indicated in list if not written in answer space | 2<br><br><br><br>1 | AO2<br>AO1<br>P1.5.1j |
| **Total** | | | **5** | |

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>7 (a)</td><td colspan="2">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a ‘best-fit’ approach to the marking.</td><td>6</td><td rowspan="4">AO2<br>AO3<br>P1.2<br>HSW</td></tr>
<tr><td>0 marks</td><td>Level 1 (1-2 marks)</td><td>Level 2 (3-4 marks)</td><td>Level 3 (5-6 marks)</td></tr>
<tr><td>No relevant information</td><td>There is a relevant statement about an energy saving method</td><td>There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation</td><td>There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.</td></tr>
<tr><td colspan="2">examples of physics points made in the response<br>examples of relevant statements<br>• energy efficient boiler saves the most (energy / money) per year<br>• loft insulation costs the least to install<br>• double-glazing costs the most to install<br>examples of statements that include cost effectiveness<br>• loft insulation is the most cost effective in the long term<br>• double-glazing is the least cost effective<br>• loft insulation has the shortest payback time<br>• double-glazing has the longest payback time<br>• payback time calculated for any method<br>examples of further detail<br>• for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing<br>• for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing<br>• don’t install double-glazing for insulation purposes<br>• double-glazing won’t pay for itself in your lifetime<br>• justified choice of best / worst method</td><td colspan="2">extra information<br>payback times:<br>energy efficient boiler: 6.25 years<br>loft insulation: 2 years<br>double glazing: 100 years<br>cavity wall insulation: 2.86 years</td></tr>
</table>

**Question 7 continued . . .**

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **7(b)(i)** | how effective a material is as an insulator | accept 'heat' for energy<br><br>accept how effective a material is at keeping energy in<br><br>accept the lower the U-value the better the insulator<br><br>accept the lower the U-value the lower the rate of energy transfer | 1 | AO1<br><br>P1.1.4a |
| **7(b)(ii)** | (the U-value) decreases | | 1 | AO1<br>P1.1.4b |
| **Total** | | | **8** | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **8(a)(i)** | 0.5 °C | | 1 | AO3<br>P1.1 |
| **8(a)(ii)** | data is continuous<br>**or**<br>both variables are continuous<br>**or**<br>independent variable is continuous<br>**or**<br>time is continuous | accept results / measurements for data<br><br>accept data is not categoric<br><br>one variable is continuous is insufficient<br>air temperature is continuous is insufficient | 1 | AO3<br>P1.1 |
| **8(b)(i)** | 20.5 (°C) | | 1 | AO2<br>P1.1 |
| **8(b)(ii)** | 60 (minutes) | accept 1 hour | 1 | AO2<br>P1.1 |
| **8(c)(i)** | so a comparison can be made<br>**or**<br>outside temperature is a control variable | accept:<br>(outside) temperature would affect energy required (to maintain temperature of the house)<br>**or**<br>(outside) temperature would affect internal temperature (of the house)<br>**or**<br>heat loss will be faster on a cold day<br><br>outside temperature will affect the results is insufficient<br><br>fair test is insufficient | 1 | AO3<br>P1.1 |

**Question 8 continues on the next page . . .**

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **8(c)(ii)** | the cost is equal to the number of kWh x the cost per kWh<br><br>calculation<br>0.8 / 8.0 = 0.1 or 10% | accept (heating) bill depends on (number of) kWh used<br>accept energy for kWh<br><br>allow 7.2 / 8.0 = 0.9 or 90% | 1<br><br><br><br>1 | AO3<br>AO2<br>P1.1 |
| **8(c)(iii)** | heating is on for more / less time (than anticipated)<br><br>because some days it is cooler / warmer (than anticipated) | <br><br>accept other sensible suggestions<br><br>an answer giving two sensible situations gains **2** marks<br>possible examples:<br>• some houses have different amounts of insulation<br>• there are different styles of house<br><br>temperature (inside / outside) is always changing is insufficient | 1<br><br>1 | AO3<br>P1.1 |
| **Total** | | | **9** | |

4.7.2.1 Electromagnetism



AQA

GCSE

# Science A / Physics

PH1FP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

### 4.7.2.1 Electromagnetism



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PMT

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

## Mark Scheme

## Information to Examiners

### 1. General

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### 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 bullet points 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 / ; eg allow smooth / free movement.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 3. Marking points

#### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students 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 errors / 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.

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

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

| Student | Response | Marks awarded |
|---|---|---|
| 1 | Neptune, Mars, Moon | 1 |
| 2 | Neptune, Sun, Mars, Moon | 0 |

**3.2 Use of chemical symbols / formulae**

If a student 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.

**3.3 Marking procedure for calculations**

Full marks can be given for a correct numerical answer, 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 or by each stage of a longer calculation.

**3.4 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.

**3.5 Errors carried forward**

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is 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.

**3.6 Phonetic spelling**

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

**3.7 Brackets**

(.....) are 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.

**3.8 Accept / allow**

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

**3.9 Ignore / Insufficient / Do not allow**

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

## 4. Quality of Communication and levels marking

In Question **7(b)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

**Level 1: basic**
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

**Level 2: clear**
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

**Level 3: detailed**
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 1(a) | geothermal<br>nuclear<br>biofuel | | 1<br>1<br>1 | AO1<br>1.4.1a<br>1.4.1d |
| 1(b) | gravitational (potential)<br>kinetic<br>sound | | 1<br>1<br>1 | AO1<br>1.3.1a<br>1.4.1b |
| 1(c)(i) | 90% or 0.9(0) | an answer of 0.9(0) with a unit gains **1** mark<br><br>an answer of 90 with no unit or an incorrect unit gains **1** mark | 2 | AO2<br>1.2.1d |
| 1(c)(ii) | 60 (MW) | allow 10% | 1 | AO2<br>1.2.1b |
| 1(c)(iii) | increased | | 1 | AO1<br>1.2.1c |
| **Total** | | | **10** | |

### 4.7.2.1 Electromagnetism



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **2(a)** | 46 200 | accept 46 000<br><br>allow **1** mark for correct substitution<br>ie 0.5 x 4200 x 22<br>provided no subsequent step | 2 | AO2<br>1.1.4d |
| **2(b)** | Energy is used to heat the kettle. | | 1 | AO2<br>1.2.1b |
| **2(c)** | 9 (pence) | allow **1** mark for correct substitution ie 0.6 x 15<br>provided no subsequent step | 2 | AO2<br>1.3.1d |
| **2(d)(i)** | conduction and convection | | 1 | AO1<br>1.1.3a |
| **2(d)(ii)** | any **one** from:<br>• water stays hotter for longer (than a 'conventional' kettle)<br>• water boiled less often<br>• less energy transferred to the surroundings<br>• (new design is) more efficient | | 1 | AO2<br>1.2 |
| **Total** | | | **7** | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **3(a)(i)** | any **one** from:<br>• (visible) light<br>• UV / ultra violet<br>• X-ray<br>• gamma / γ-ray | | 1 | AO1<br>1.5.1e |
| **3(a)(ii)** | less than<br><br>less than<br><br>the same as | | 1<br><br>1<br><br>1 | AO1<br>1.5.1d<br>1.5.1e |
| **3(b)(i)** | (the) Big Bang (theory) | | 1 | AO1<br>1.5.4e |
| **3(b)(ii)** | the red-shift of light from distant galaxies | | 1 | AO1<br>1.5.4c |
| **Total** | | | **6** | |

PMT

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 4(a) | dependent | | 1 | AO3 1.1.3b |
| 4(b) | The equipment has a better resolution. | | 1 | AO3 1.1.3 |
| 4(c) | (probe) C<br><br>largest difference between reading and actual temperature | allow 103.2<br><br>reason only scores if C chosen<br><br>accept larger<br><br>it is 3.2 greater is insufficient<br><br>comparing C with only one other probe is insufficient | 1<br><br>1 | AO3 1.1.3 |
| 4(d)(i) | 12(°C) | accept a value between 12.0 and 12.2 inclusive | 1 | AO2 1.1.3d |
| 4(d)(ii) | 140 (seconds)<br><br><u>temperature</u> starts to rise | accept an answer between 130 and 150 inclusive<br><br>only scores if time mark awarded<br><br>accept the <u>temperature</u> was lowest (at this time) | 1<br><br>1 | AO2 AO3 1.1.3b |
| 4(d)(iii) | increase | accept faster (rate) | 1 | AO1 1.1.3b |
| Total | | | 8 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **5(a)** | it would decrease the time | | 1 | AO3<br>1.2.1a |
| **5(b)** | 720 (J) | allow **1** mark for correct substitution<br>ie 12 x 60<br>provided no subsequent step | 2 | AO2<br>1.3.1c |
| **5(c)** | dense<br>rises<br>falls | <br>accept equivalent words<br>accept equivalent words | 1<br>1<br>1 | AO1<br>1.1.3a |
| **5(d)** | <br>decreases<br>decreases<br>decreases | more than one tick in any row negates the mark | <br>1<br>1<br>1 | AO3<br>1.1.3c<br>1.1.3d |
| **Total** | | | **9** | |

### 4.7.2.1 Electromagnetism







| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **6(a)** | frequency | | 1 | AO1<br>1.5.3b |
| **6(b)** | echo(es) | | 1 | AO1<br>1.5.3c |
| **6(c)** | spreading (out)<br><br>equal to | changing direction is insufficient<br>moving apart is insufficient<br>bending is insufficient<br><br>accept:<br>similar to<br>same (order of magnitude) as<br>slightly smaller than<br>slightly larger than | 1<br><br>1 | AO1<br>1.5.1g |
| **6(d)** | 340 (m/s) | allow **1** mark for correct substitution<br>ie 25 000 x 0.0136<br>provided no subsequent step<br>or<br>allow 1 mark for a correct calculation showing an incorrect value from conversion to hertz x 0.0136<br><br>an answer of 0.34 gains **1** mark | 2 | AO2<br>1.5.1j |
| **6(e)** | (a wave where the) oscillations are parallel to the direction of energy transfer<br><br>causing (areas of) compression and rarefaction | both marking points may appear as labels on a diagram<br><br>accept vibrations for oscillations<br>accept in same direction as for parallel to<br>allow direction of wave (motion) for direction of energy transfer<br><br>accept correct description in terms of particles<br><br>mechanical wave is insufficient<br>needs a medium to travel through is insufficient | 1<br><br>1 | AO1<br>1.5.1b |
| **Total** | | | **8** | |

4.7.2.1 Electromagnetism



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 7(a) | any **one** from:<br>• high cost of installing overhead power lines or underground cables or pylons<br>• high cost as (very) long cables needed<br>• amount of electricity required is too low | allow not enough (surplus) electricity would be generated | 1 | AO1<br>1.4.1e |

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

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 7 (b) | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking. | | 6 | 3 AO1<br>2 AO2<br>1 AO3<br>1.4.1b |

| 0 marks | Level 1 (1-2 marks) | Level 2 (3-4 marks) | Level 3 (5-6 marks) |
|---|---|---|---|
| No relevant information | at least **one** advantage **or one** disadvantage of either method | at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method | clear comparison of advantages **and** disadvantages of **each** method |

| examples of physics points made in the response | extra information |
|---|---|
| **Advantages of both methods:**<br>• both renewable sources of energy<br>• both have no fuel (cost)<br>• both have very small (allow 'no') running costs<br>• no carbon dioxide produced | <br><br>accept carbon neutral<br>accept no greenhouse gases<br>accept doesn't contribute to global warming |
| **Advantages of wind:**<br>• higher average power output | <br>produces more energy is insufficient |
| **Advantages of hydroelectric:**<br>• constant / reliable power (output)<br>• lower (installation) cost | |
| **Disadvantages of wind:**<br>• higher (installation) cost<br>• variable / unreliable power output<br>• (may) kill birds / bats | |
| **Disadvantages of hydroelectric:**<br>• lower power output<br>• (may) kill fish or (may) damage habitats<br>• more difficult to set up (within river) | |
| **Disadvantages of both methods**<br>• (may be) noisy<br>• visual pollution | <br>ignore payback time unless no other relevant points made<br>ignore time to build for both |

| Total | | | 7 |
|---|---|---|---|

### 4.7.2.1 Electromagnetism



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1FP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **8(a)** | a proportion / percentage of the energy is wasted<br><br>(wasted) energy is transferred to surroundings<br>**or**<br>energy is needed to heat pan (before food is heated) | allow heat for energy<br>allow some energy is wasted | 1<br><br>1 | AO2<br>1.2.1b<br>1.2.1c |
| **8(b)** | (fins have a) large(r) surface area<br><br>(black metal surface is a) good / better absorber of infrared radiation | accept fins increase the surface area<br><br>allow 'heat' or 'energy' for infrared radiation<br>ignore good emitter of infrared radiation<br>not a good reflector is insufficient | 1<br><br>1 | AO1<br>1.1.1c<br>1.1.1e<br>1.1.3c |
| **8(c)** | the higher the temperature (of the saucepan) the greater the rate at which infrared radiation is emitted | accept converse answer<br><br>allow the higher the temperature the more infrared radiation is emitted<br><br>allow there is a positive correlation | 1 | AO2<br>1.1.1b |
| **Total** | | | **5** | |

4.7.2.1 Electromagnetism

Answer 86 · Examiner comments — June 2018 | 8463/2F | Original Q4

**Question 4 (Low demand)**

**04.1** Just over 60% of the students correctly indicated the north and south ends of both paper clips. Most of the other students indicated only a north pole on the top paper clip and a south pole at the lower end of the second paper clip.

**04.2** Many of the students stated that keeping all of the paper clips the same size would make it a 'fair test'. Fewer suggested that the paper clips should all have the same weight or mass to allow for a fair comparison of the results. Common incorrect answers referred to current travelling in the paper clips or implied that larger paper clips would take more of a share of the magnetic field.

**04.3** 92% of the students scored at least one mark. Few of the students failed to recognise that the number of paper clips increased as the number of turns of wire increased. Many scored two marks by stating that the relationship was directly proportional or described the number of paper clips held increasing by three for every ten extra turns of wire on the electromagnet.

**04.4** Just over 80% of the students scored this mark.

**04.5** 78% of students scored one mark for this question. Few of the students picked up on 18 paper clips being an anomalous result and as such should be disregarded as the three remaining results were similar. A mean of the three similar results could then be found and used in the table. Students scoring one mark calculated the mean of all four results but did not gain a second mark for rounding down to the nearest whole paper clip.

**04.6** Most of the students appreciated that the current would need to be changed, with many specifying how. Fewer students explicitly stated that the number of turns needed to be kept constant. Only a minority explained that the number of paper clips held could be used to show the strength of the electromagnet.

Answer 87 · Examiner comments — June 2018 | 8463/2F | Original Q8

**Question 8 (Low and Standard demand)**

**08.1** Position 'C' was the most popular answer with 65% of the students scoring the mark.

**08.2** The direction in which the wavelength and the frequency change in the electromagnetic spectrum was less well known, with 45 % of the students choosing the correct answer,

**08.3** Of the students that scored this mark (44%) most responded with 'skin cancer', fewer referred to 'premature aging of the skin'**.** The majority of the students gave responses that were too general and often not related to the skin. The most common was to state that the radiation causes cancer, rather than specifying skin cancer.

**08.4** 78% scored at least one mark for recognising that the risk of developing cancer increased with increased radiation dose. Fewer were able to quantify that it was fifty times more likely. Some of the students assumed that having an X-ray on a part of the body would mean that the cancer would be in the same part of the body.

Answer 88 · Examiner comments

June 2019 | 8463/2F | Original Q3

## Question 3 (Low demand)

**03.1** Only 11% of the students scored this mark. Although the arrows were generally in the circles as requested, the majority of incorrect answers had arrows pointing towards each pole of the magnet or both arrows pointing away from the magnet.

**03.2** Students were asked to explain why the coat must not have two south poles facing each other. The first mark was for stating that two south poles would repel and the second mark was for stating what that would mean for the coat e.g. it would not fasten. 85 % of the students did score the first marking point.

**03.3** Just under half of the students recognised that the arrows should point in the same direction and made the correct choice.

**03.4** Most of the students knew that steel is a magnetic material, with 95% scoring this mark.

**03.5** This was well answered with students explaining that the iron bar was attracted to the electromagnet causing the spring to stretch. A number of students who did not score the mark described the electromagnet stretching the spring.

**03.6** Students were expected to use the graph to calculate the spring extension between the currents of 0.6 A to 1.2 A. While 65% of the students scored the mark, most of the others simply subtracted the two current values.

**03.7** Just over 77% of the students scored both marks. However this was sometimes due to error carried forward from part 03.6.

**03.8** Very few of the students scored both marks. Approximately 50% scored 1 mark. A significant number of the students gave an answer in terms of the spring reaching its elastic limit. Some students appeared to misinterpret the graph, saw the gradient decrease, and stated incorrectly that the electromagnet was decreasing in strength. For the second mark students were expected to state that the electromagnet reached a maximum strength or that the strength levelled off - only 4% of the students did this.

Answer 89 · Examiner comments

June 2019 | 8463/2F | Original Q4

## Question 4 (Low demand)

**04.1** Just over 50% of the students scored this mark.

**04.2** Only 40% of the students knew that infrared is used for electrical heating. The incorrect answers were equally represented.

**04.3** Nearly 90% of the students picked the correct colour.

**04.4** About 75% of the students answered this correctly. Common incorrect answers indicated a colour change to yellow with some changes to blue or green.

**04.5** Just over half of the students identified the type of surface as the independent variable.

**04.6** Nearly 9% of the students did not attempt this question with only 10% of the students scoring three marks. About 60% of the students realised that the first thing to do was pour the hot water into the cube. However beyond this, the procedure was often inaccurately described eg the ruler being used to measure the height of the hot water in the cube or used to measure the area of each side of the cube. Most of the students did not realise that the distance from each side of the cube to the infra-red detector needed to be the same. Many students incorrectly completed their answer by describing the amount of radiation given off from each of the different surfaces, possibly having looked at **04.7**.

**04.7** About 50% of the students correctly identified the resolution.

**04.8** This question was well answered with nearly 85% of the students scoring full marks. Students not gaining full marks usually did not label one of the bars.

**04.9** About half of the students gave an acceptable conclusion. Common errors were to give answers in terms of conduction of heat or absorption of radiation, however, the question needed an explanation of emission.

4.7.2.1 Electromagnetism

**Answer 95 · Examiner comments** June 2022 | 8463/2F | Original Q1

**Question 1 (Low demand)**

01.1 Most of the students were able to identify correctly which pairs of magnets would attract and which would repel.

01.2 Most of the students scored at least one mark with just over half of the students scoring both marks.

01.3 This was not well known with only just over half of the students choosing iron.

01.4 Just over half of the students knew that when the circuit was complete there would be a current in the coil

01.5 Approximately three quarters of the students realised that the magnetic field would be stronger.

01.6 Around three quarters of the students realised that the magnetic field would be weaker.

**Answer 96 · Examiner comments** June 2022 | 8463/2F | Original Q5

**Question 5 (Low and standard demand)**

05.1 Very few of the students seemed to know that all electromagnetic waves travel at the same speed in a vacuum.

05.2 The order of the waves in the electromagnetic spectrum was not well known with only about 40% of the students scoring both marks.

05.3 The majority of the students demonstrated an understanding of ‘range’. About 10% of students did not attempt the question.

05.4 Very few of the students related the information in Table 4 and Figure 10 to the relative risk of harm to people. Few of the students scored more than 1 mark with about 13% of the students not attempting the question. Most of the students that scored 1 mark did so for giving a general trend or stating that UV can cause skin cancer.

05.5 Many of the students tried to give a more complex answer than required, which were commonly incorrect. The most common correct answers involved being able to see or the idea that if light did not get through it would be dark all the time.

05.6 Nearly three quarters of the students scored at least one mark, often for completing the second blank space correctly.

4.7.2.1 Electromagnetism

Answer 97 · Examiner comments

June 2023 | 8463/2F | Original Q3

**03.1**

Many students confused the arrows with the direction of current.

**03.2**

Almost 88% of students knew that increasing the current in the wire would increase the strength of the magnetic field.

**03.3**

62% identified the correct magnetic field pattern for a solenoid.

**03.4**

Most students identified the correct sequence, or got a mark for identifying the first and last letters correctly.

**03.6**

Most students calculated the  period correctly.

**03.7**

75% of students recognised an area of compression in a longitudinal wave.

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Answer 98 · Examiner comments

June 2023 | 8463/2F | Original Q5

**05.1**

48% of students recognised the wavelength of a transverse wave.

**05.2**

47% of students recognised the correct amplitude of a transverse wave.

**05.3**

93% of students knew that radio waves are used for communication.,

**05.4**

The majority of students calculated the distance correctly

**05.5**

The majority of students scored this mark. The most common correct answer was heating food. Common incorrect answers included TV and computers.

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4.7.2.1 Electromagnetism

**Answer 99 · Examiner comments** June 2024 | 8463/1F | Original Q10

**Question 10 (Standard demand)**

**10.1** 15 % of students scored 3 marks, 39% scored 2 marks and 30% scored 1 mark. The most common mark to score was either 'nuclei' or 'gamma rays'.

**10.2** In this exam series all equations were provided for the students on the Physics Equations Sheet. 94% of students scored the mark.

**10.3** 67% of students scored 2 marks for multiplying the power by the time, whether they had converted the power or not. Most attempts to convert the power were incorrect. Only 3% of students scored all 3 marks for this calculation of energy.

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**Answer 99 · Examiner comments** June 2024 | 8463/1F | Original Q10

**10.4** 13% of students scored a mark. 'Wear protective clothing' or 'hazmat suits' were common incorrect answers. Any idea of burying the radioactive waste was credited, so 'bury it in a field' was ok, as was 'bury it in landfill', which from a student's perspective is equivalent to burying it underground. 'Keeping it away from people' was insufficient.

**10.5** 74% of students scored 2 marks, while 3% scored 1 mark. The answer of 29.2 days was worth 1 mark as this could only have been calculated by doing the correct calculation and then subtracting the result from 365.

**Answer 100 · Examiner comments** June 2024 | 8463/2F | Original Q2

**02.1**
33% of students were able to identify cobalt as a magnetic material. Copper was a common wrong choice.

**02.2**
22% of students scored both marks and 46 % scored one for showing the direction of the magnetic field in the circles. Despite clear instructions, many students put their arrows on the magnetic field lines

**02.3**
46% of students knew where the magnetic field was strongest.

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4.7.2.1 Electromagnetism

**Answer 100 · Examiner comments** June 2024 | 8463/2F | Original Q2

**02.4**
Most students choose identified the correct arrangement of the bar magnets.

**02.5**
This proved to be a very difficult question. Students often thought that the compass needle pointed in the direction of the current. Only 7% scored 2 marks. Approximately 16 % of students did not attempt this question.

**02.6**
Most students knew that decreasing the current would decrease the strength of the magnetic field.

**02.7**
Many responses to this question were unclear or vague. Students do not understand that the magnetic file around a straight wire does not have poles.

**Answer 101 · Examiner comments** June 2024 | 8463/2F | Original Q6

**06.1**
Many responses for this question were too vague. The questions asked for equipment that can be used to detect infrared waves, so responses that involved emitters of IR waves were incorrect. A significant number focussed on the word radiation and gave their response as a Geiger counter.

**06.2**
23% of students interpreted the information correctly and chose the correct wavelength.

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**Answer 101 · Examiner comments** June 2024 | 8463/2F | Original Q6

**06.3**
A correct response required the use of the information given to identify differences between the sight of bees and humans. Simply quoting wavelengths that could and could not be detected was not sufficient. A minority of students gained marks.

**06.4**
This question was about white light shining onto a coloured flower. A significant number of students chose the correct words but not always in the incorrect order.

**06.5**
60% of students were aware of the affect a filter has on the appearance of a coloured object.

**06.6**
Less than 2% of students were able to name diffuse reflection.

4.7.2.1 Electromagnetism



Questions matter

# GCSE
# Physics
## 8463/2F

## Report on the examination

Version: 1.0
June 2025

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### 4.7.2.1 Electromagnetism



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Report on the examination – GCSE - Physics – 8463/2H – June 2025

## General comments

Students should pay attention to the number of options that need to be ticked when doing multiple choice questions. They should make sure they cross out wrong options when they change their minds, as marks cannot be awarded where there are multiple ticks instead of one.

Many students demonstrated good maths skills, although there are always issues with rearrangements. Formula triangles are not always helpful. Students who had correctly written down an equation in a previous question and then tried to use a formula triangle often scored no marks, because they don't understand how to use them. If they had substituted into the equation from the equations sheet they would have scored the 1st mark.

Students had access to the equations sheet for this examination series. A minority of the students however did not use them to find the appropriate equation.

## Levels of demand

Questions are set at two levels of demand on this paper:

- Low demand questions are targeted at students working at grades 1–3.
- Standard demand questions are targeted at students working at grades 4–5.

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

## 01.1

Over 90 % of the students knew that a protractor is used to measure angles. The phonetic spelling of protractor was allowed.

## 01.2

Almost 70% of the students scored all four marks for completing the graph. Despite a clear instruction a significant number did not label the y-axis.  A number of the students did not use a ruler to draw the line of best fit.

## 01.3

Most of the students correctly identified the relationship between the angle of incidence and the angle of reflection.

## 01.4

Half of the students knew which measurement was the amplitude of a wave. Most of the others thought the vertical distance between a peak and a trough was the amplitude.

## 01.5

About 80 % of the students knew which line showed the wavelength of the wave. The most common incorrect answer was the distance showing half the wavelength.

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4.7.2.1 Electromagnetism



Report on the examination – GCSE - Physics – 8463/2H – June 2025

## 01.6

Over 90 % of the students correctly calculated the wavelength. Those who did not achieve full marks mainly did so by not choosing the correct unit for wavelength, with Pa being a popular incorrect choice.

## 01.7

This was well answered, with most of the students scoring both marks. A few inverted the equation and thus calculated the period incorrectly.

## 02.1

Most of the students correctly calculated the weight of coal.

## 02.2

Just over 90% of the students were able to use the work done equation correctly. Those that did not get full marks tended to put an additional step into the calculation by dividing the answer 68 000 000 by 4; the number of engines in total.
Occasionally a student would attempt to convert the number calculated into standard form. Whilst not being penalised, this was not required.

## 02.3

Well answered by most students. As with part 02.2, occasionally a student would attempt to convert the number calculated into standard form.

## 02.4

Nearly 90% of the students could identify that friction was a contact force.

## 02.5

Most of the students identified the correct distance-time graph for constant speed.

## 02.6

This was the 1st calculation that was more challenging for many students. A common error was to use only one of the quoted velocities to calculate the acceleration rather than using the difference between the velocities. However just over 80 % did score full marks, with 10 % scoring zero or not attempting the question.

## 03.1

Approximately 60% of the students scored both marks. Often students did not know the correct word for a natural satellite. However, many correctly identified ‘star’ for the second word.

## 03.2

Most of the students knew that we are part of the Milky Way galaxy.

## 03.3

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Only about 40 % of the students knew that the Sun will eventually become a black dwarf. The most popular wrong answer was that it would become a black hole.

## 03.4

Just fewer than 40 % of the students knew that a very distant galaxy moves faster than a nearer galaxy.

## 03.5

About 70 % of the students knew that an increase in the wavelength of light from a distant galaxy is called red-shift.

## 03.6

About 60 % of the students selected the correct word to describe the beginning of the universe.

## 03.7

Almost 80 % of the students knew that the universe is expanding.

## 04.1

Just over 70 % of the students were able to make the connection between the mass of a vehicle and how it would affect the maximum acceleration.

## 04.2

Over 90 % of the students scored full marks for calculating the resultant force using F = ma. However, some of the students thought that the value of acceleration needed to be squared and then multiplied by mass.

## 04.3

This level of response question proved too challenging for many. Only just over 1 % of the students scored full marks. Most identified that the driving force would increase, but fewer recognised that as this happened the air resistance would also increase, with many stating that the air resistance would decrease as the cars speed increased.

## 04.4

Most of the students knew that the thinking distance is affected by the driver's reaction time.

## 04.5

Just fewer than 70 % of the students were aware that the braking distance is the distance travelled under the braking force.

## 04.6

Only just over 20 % of the students scored full marks for using the graph of distance against speed to find the stopping distance. The correct distances were often identified from the graph. However, these were then either subtracted from each other, divided or multiplied rather than added.

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## 04.7

Nearly 80 % of the students identified factors that would increase the stopping distance of a car. Despite two being emboldened twice in the question, some students only ticked one box.

## 05.1

The principal focus was correctly identified by just over 60 % of the students.

## 05.2

About 80 % of the students knew that the change in direction of light as it enters a lens is called refraction.

## 05.3

Nearly 70 % the students recognised the shape of a convex lens.

## 05.4

Under a half of the students managed to correctly measure the object height and image height. This may have been due to a lack of skill or a lack of equipment.

## 05.5

This was much more successfully answered than part 05.4 with nearly 90 % of the students scoring both marks. These students used their values from part 05.4 to calculate magnification.

## 05.6

Just fewer than 50 % of the students knew that magnification is a ratio, but almost the same number thought it is a power.

## 05.7

This was a challenging question. Most of the students that did score a mark were awarded only the first mark point. This was for explaining that white light is transmitted through colourless glass. A lot of the students think of white light as an entity in itself rather than the result of the colours of the visible light combined. Few used the word transmitted but rather described it as passing through or goes through.
For the 2nd and 3rd mark points many of the students decided that white light was reflected or refracted, reinforcing the misconception that white light is a single entity rather than being made up of a combination of wavelengths. The idea that filters would absorb different wavelengths of light seemed to be difficult for the students to express, with very few achieving the third mark.

## 06.1

Only just over 30 % of the students could identify two magnetic materials from the list, with about 60 % being able to identify one. Again, a number of students ticked just one box or more than two boxes.

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## 06.2

Just over 70 % of the students correctly named the iron nails as induced magnets.

## 06.3

Just fewer than 40 % of the students knew the direction of the magnetic field.

## 06.4

Nearly 80 % of the students recognised the shape of the magnetic field around a current carrying wire.

## 06.5

Very few of the students could give two changes that would increase the magnetic field strength. 'Increasing the current' was a common correct response. Many of the students answered 'increasing the number of coils' as such they were implying the wire was already coiled and not answering the question asked, which was about the straight wire shown in Figure 10.

## 07.1

Nearly 60 % of the students understood what is meant by the moment of a force. The most common incorrect option was 'The direction of the force.'

## 07.2

The correct resultant moment was selected by just over 80 % of the students.

## 07.3

Students generally answered this well, identifying position 7 and on which side of the balance the tag should be placed. Some indicated this on the diagram which was an accepted alternative response, provided what was written did not contradict it.

## 07.4

Some students wrote the equation for the moment of a force in words and then in symbols. This risks not gaining the mark if either is incorrect. Also, correct use of symbols should be stressed, especially when they are given in the question. It was surprising that some of the students scored zero or did not attempt to write down an equation despite having the equations sheet.

## 07.5

Almost three quarters of the students were able to rearrange the equation and then calculate the distance between the pivot and the tag on the balance.

## 08.1

Most of the students found this level of response question difficult to answer. Only just over 1 % gave a level 2 answer. Many of the students scored 2, 1 or 0 marks. Of those that scored a mark the most common response was light travels faster than sound. Many also tried to describe light and sound as transverse and longitudinal waves, with the majority getting this

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confused. Very few identified acceptable similarities. Common answers that did not gain credit included light travels at the speed of light, sound travels at the speed of sound, light can be seen and sound cannot be seen.

## 08.2

Just fewer than 80 % of the students choose the correct equation for calculating speed.

## 08.3

This question required students to rearrange the equation. About three quarters of the students scored all three marks.

## 09.1

About 65 % of the students correctly stated the independent variable in this investigation.

## 09.2

Just over 40 % of the students scored both marks for identifying a risk of harm and a suitable safety precaution to reduce the risk. Too few students connected a hazard, such as a falling weight, becoming a risk of harm when it hit or hurt the student.

## 09.3

Students were expected to clearly describe two improvements to the arrangement shown that would improve the accuracy of the results. Many had difficulty describing their ideas clearly and answers were often too vague to gain credit.

## 09.4

Almost 40 % of the students scored this mark usually by explaining that the spring length was not 0 cm rather than describing the relationship between spring length and force.

## 09.5

This was not successfully answered, with only about 2 % of the students scoring both marks and a further 13 % scoring one mark. The 1st mark point was for stating or giving a clear description of inelastic deformation. Of those who were awarded marks most of them described how the spring had reached or passed its limit of proportionality.

## 09.6

Over 90 % of the students selected the correct equation.

## 09.7

Nearly 80 % of the students scored all three marks. Those that did not often rearranged the equation incorrectly.

## 10.1

Only about 5% of the students correctly calculated the uncertainty correctly from either the range or the mean.

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4.7.2.1 Electromagnetism





## 10.2

Just over 40 % of the students identified that a random error had caused the variation in this investigation. A greater proportion of the students thought there was a systematic error but this would not have accounted for the variation in the results.

## 10.3

This mark was awarded for a clear description of variation in the way the ball was dropped. For example, through different heights, at different speeds, or a different delay each time. Common answers giving reaction time or human error were too vague, to be awarded marks unless qualified.

## 10.4

Just fewer than 30 % of the students scored all three marks. Many of the students took only one value from the graph rather than a corresponding pair of values and so scored 0. Those that used a pair of correct values often then used them the wrong way round when calculating the gradient.

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4.7.2.1 Electromagnetism



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## 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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