AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.1

# Transverse and longitudinal waves

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **5** |
| Available paper years | **2006–2023** |

## 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.

### 4.6.1.1 Transverse and longitudinal waves

**Answer 01 · Mark scheme**

June 2006 | 3451 | Original Q2 | Legacy

The full source mark scheme begins on page 8. Follow original question 2 in that document.

**Answer 02 · Mark scheme**

June 2006 | 3462 | Original Q2 | Legacy

The full source mark scheme begins on page 28. Follow original question 2 in that document.

**Answer 03 · Mark scheme**

June 2016 | PH1HP | Original Q1 | Legacy

The full source mark scheme begins on page 42. Follow original question 1 in that document.

4.6.1.1 Transverse and longitudinal waves

Answer 04 · Mark scheme

November 2021 | 8463/2H | Original Q5

## Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.1** | any **one** from:<br>• (sun) tan<br>• energy efficient lamps | allow<br>• (invisible) security coding<br>• detecting forged bank notes<br>• kill microbes<br>• attract insects<br>• sterilise (surgical) equipment<br>• cause the body to produce vitamin D<br>• increasing the growth rate of plants<br>• water purification | 1 | AO1<br>4.6.2.4 |
| **05.2** | $3 \times 10^{-7}$ m | | 1 | AO1<br>4.6.2.1 |
| **05.3** | $3.0 \times 10^{8} = \text{frequency} \times 3 \times 10^{-7}$<br>$\text{frequency} = \frac{3.0 \times 10^{8}}{3 \times 10^{-7}}$<br>$\text{frequency} = 1 \times 10^{15}$ (Hz) | allow ecf from question **05.2** | 1<br>1<br>1 | AO2<br>4.6.1.2 |
| **05.4** | **Wave** / **Name**<br>Wave E → Infrared<br>Wave F → Visible light<br>Wave G → X-rays<br>all three lines correct for **1** mark | | 1 | AO3<br>4.6.2.1 |

4.6.1.1 Transverse and longitudinal waves

Answer 04 · Mark scheme



| | | | | |
|---|---|---|---|---|
| **05.5** | in a transverse wave, the oscillations / vibrations are perpendicular to the direction of energy transfer<br><br>in a longitudinal wave, the oscillations / vibrations are parallel to the direction of energy transfer | allow direction of wave travel for direction of energy transfer | 1<br><br>1 | AO1<br>4.6.1.1 |

| | | | |
|---|---|---|---|
| **Total** | | | **8** |

4.6.1.1 Transverse and longitudinal waves

Answer 05 · Mark scheme

June 2023 | 8463/2H | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.1 | perpendicular | | 1 | AO1<br>4.6.1.1 |

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 01.2 | **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced. | 5-6 | AO3 |
| | **Level 2:** The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced. | 3-4 | AO1 |
| | **Level 1:** The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. | 1-2 | AO1 |
| | **No relevant content** | 0 | |
| | **Indicative content**<br><br>**Method:**<br>• heat the water / kettle<br>• add an equal volume of (hot) water to each flask<br>• insert a thermometer into each flask<br>• record the initial temperature from both flasks<br>OR<br>• place an IR detector near each flask<br>• the distance between the IR detector and the flask should be the same each time<br>• record initial reading from IR detectors<br><br>• (and) start a stop clock<br>• record the temperatures / readings after 10 minutes from both flasks<br>• calculate the change in temperatures / readings during the 10 minutes<br><br>• compare the results to test the hypothesis<br><br>to access level 3 the method must allow the correct consideration of a temperature decrease for both flasks or the correct comparison of IR detected from both flasks | | 4.6.2.2 |

4.6.1.1 Transverse and longitudinal waves

Answer 05 · Mark scheme

June 2023 | 8463/2H | Original Q1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.3 | during the 1st minute<br><br>there is the greatest temperature difference (between the hot water and the surroundings) | <br><br>allow highest temperature or hottest<br><br>MP 2 dependent on scoring MP 1 | 1<br><br>1 | AO2<br><br>AO1<br><br>4.6.3.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.4 | the temperature (increase / change after 10 minutes) | allow the final temperature<br><br>do not allow temperature decrease | 1 | AO1<br>4.6.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.5 | black surfaces absorb more (infrared than white surfaces)<br><br>matt surfaces absorb more (infrared) than shiny surfaces of the same colour | allow black surfaces have a greater temperature increase (than white surfaces)<br><br>allow matt surfaces have a greater temperature increase than shiny surfaces of the same colour<br><br>if no other marks scored, allow 1 mark for matt black surface is the best absorber and shiny white surface is the worst absorber<br><br>if no other marks scored, allow 1 mark for matt black has the greatest temperature increase and shiny white has the smallest temperature increase | 1<br><br>1 | AO3<br>4.6.2.2<br>4.6.3.1 |

4.6.1.1 Transverse and longitudinal waves



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.6** | pressure = $\frac{\text{force}}{\text{area}}$ | | 1 | AO1 4.5.5.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.7** | area of base = 0.0144 ($m^2$) | do not allow this or subsequent marks unless base area is used | 1 | AO2 4.5.5.1.1 |
| | $1500 = \frac{F}{0.0144}$ | this mark may be awarded if base area is incorrectly calculated | 1 | |
| | $F = 1500 \times 0.0144$ | this mark may be awarded if base area is incorrectly calculated | 1 | |
| | $F = 21.6$ (N) | this mark may be awarded if base area is incorrectly calculated<br><br>allow 22 (N) | 1 | |

| | |
|---|---|
| **Total Question 1** | **17** |

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

# General Certificate of Secondary Education

# Physics 3451/F
*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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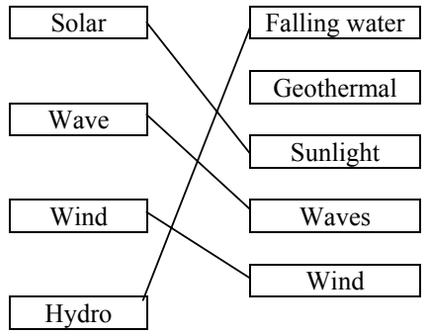
### 4.6.1.1 Transverse and longitudinal waves





# 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 |

## 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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<br>swap the brown and blue wires round | accept wires must be connected to screws | 1<br>1 |
| total | | | 4 |

**3451/F Q6**

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

## 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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>

### 4.6.1.1 Transverse and longitudinal waves





**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 |

## 4.6.1.1 Transverse and longitudinal waves





**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**

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**3451/F Q13**

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

### 4.6.1.1 Transverse and longitudinal waves





**3451/F Q14**

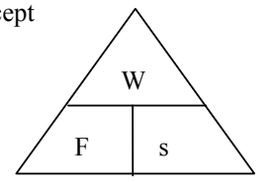
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer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

## 4.6.1.1 Transverse and longitudinal waves





**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 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 |

**Continued**

### 4.6.1.1 Transverse and longitudinal waves





**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 |

## 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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**

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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*

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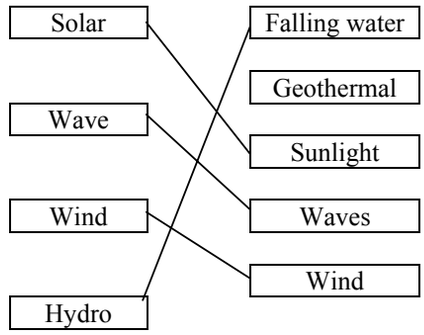
4.6.1.1 Transverse and longitudinal waves



*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 |

### 4.6.1.1 Transverse and longitudinal waves





**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 and time in hours or seconds | 2 |
| total | | | 5 |

### 4.6.1.1 Transverse and longitudinal waves



*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 |

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves



*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 |

### 4.6.1.1 Transverse and longitudinal waves





**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**

### 4.6.1.1 Transverse and longitudinal waves



*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 |

## 4.6.1.1 Transverse and longitudinal waves





**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 |

### 4.6.1.1 Transverse and longitudinal waves



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

**3462/3F Q12**

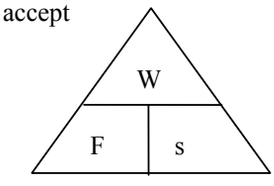
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | W | | 1 |
| | has only two states<br>**or**<br>is either on or off | accept discrete values only<br><br>do **not** credit answer purely in terms of shape | 1 |
| (b) | any **one** from: | | 1 |
| | • higher quality | accept clearer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

## 4.6.1.1 Transverse and longitudinal waves





**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 <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 |
| (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 |

### 4.6.1.1 Transverse and longitudinal waves



*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 |

4.6.1.1 Transverse and longitudinal waves



AQA

GCSE

# Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

### 4.6.1.1 Transverse and longitudinal waves



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Further copies of this mark scheme are available from aqa.org.uk

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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 |

**3.2 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 **2(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.

### 4.6.1.1 Transverse and longitudinal waves



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 1(a) | frequency | | 1 | AO1<br>1.5.3b |
| 1(b) | echo(es) | | 1 | AO1<br>1.5.3c |
| 1(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 |
| 1(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 |
| 1(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 | <br><br>1<br><br>1 | AO1<br>1.5.1b |
| **Total** | | | **8** | |

4.6.1.1 Transverse and longitudinal waves







| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 2(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 2 continues on the next page . . .**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 2(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><br>ignore payback time unless no other relevant points made<br>ignore time to build for both |

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

### 4.6.1.1 Transverse and longitudinal waves



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 3(a) | a proportion / percentage of the energy is wasted | allow heat for energy<br>allow some energy is wasted | 1 | AO2<br>1.2.1b<br>1.2.1c |
| | (wasted) energy is transferred to surroundings<br>**or**<br>energy is needed to heat pan (before food is heated) | | 1 | |
| 3(b) | (fins have a) large(r) surface area | accept fins increase the surface area | 1 | AO1<br>1.1.1c<br>1.1.1e<br>1.1.3c |
| | (black metal surface is a) good / better absorber of infrared radiation | allow 'heat' or 'energy' for infrared radiation<br>ignore good emitter of infrared radiation<br>not a good reflector is insufficient | 1 | |
| 3(c) | the higher the temperature (of the saucepan) the greater the rate at which infrared radiation is emitted | accept converse answer<br>allow the higher the temperature the more infrared radiation is emitted<br>allow there is a positive correlation | 1 | AO2<br>1.1.1b |
| **Total** | | | **5** | |

### 4.6.1.1 Transverse and longitudinal waves







| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 4(a)(i) | **use of infrared:**<br>remote controls<br>fibre optic (communications)<br><br>**use of microwaves:**<br>mobile/cell phones<br><br>satellite (communications/TV)<br>wi-fi<br>Bluetooth | <br><br><br><br><br>accept mobiles<br>accept phone signals | 1<br><br><br>1 | AO1<br>1.5.1k |
| 4(a)(ii) | any **two** from<br>• same speed<br>**or**<br>travel at the speed of light (in a vacuum)<br>• transverse<br><br>• transfer energy (from one place to another)<br>• can be reflected<br>• can be refracted<br>• can be diffracted<br>• can be absorbed / transmitted<br>• can travel through a vacuum/space<br>• can be polarised | <br><br><br><br>accept a full description of a transverse wave<br><br><br><br><br><br><br><br>travels in straight lines is insufficient | 2 | AO1<br>1.5.1c<br>1.5.1d<br>1.5.1e<br>1.5.1g |
| 4(b)(i) | Cosmic Microwave Background (Radiation) | accept CMBR | 1 | AO1<br>1.5.4d |
| 4(b)(ii) | <br><br>the Big Bang (theory) predicted the existence of CMBR<br>**or**<br>only the Big Bang (theory) supports the existence of CMBR | allow microwave radiation for CMBR throughout<br><br>allow it supports / proves the Big Bang (theory)<br><br>accept CMBR disproved other theories, eg steady state | <br><br>1 | AO1<br>1.5.4e |
| **Total** | | | **6** | |

### 4.6.1.1 Transverse and longitudinal waves



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **5(a)** | no particles (in a vacuum)<br><br>(so) no / reduced conduction and no / reduced convection | <br><br>both energy transfer methods needed for the mark | 1<br><br>1 | AO1<br>1.1.3a |
| **5(b)(i)** | 78 (°C) | allow **2** marks for correct temperature change ie 22 ˚C<br><br>allow **1** mark for correct substitution<br>ie 46 200 = 0.5 x 4200 x θ<br><br>**or** $\frac{46200}{0.5\times4200}=\theta$ | 3 | AO2<br>1.1.4d |
| **5(b)(ii)** | 6.4 (W) | allow **2** marks for an answer that rounds to 6.4<br><br>allow **1** mark for correct substitution<br>ie 46 200 = P x 7200<br><br>an answer of 23 000 or 23 100 or 385 gains 1 mark | 2 | AO2<br>1.3.1c |
| **Total** | | | **7** | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 6(a) | any **two** from:<br>• cost per kWh is lower (than all other energy resources)<br>• infrastructure for nuclear power already exists<br>• more reliable (than renewable energy resources) | allow it is cheaper<br>ignore fuel cost<br>ignore energy released per kg of nuclear fuel<br>accept cost of setting up renewable energy resources is high<br>accept many renewable power stations would be needed to replace one nuclear power station<br>accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future<br>accept France benefits economically from selling electricity<br>accept (nuclear) fuel is readily available<br>ignore destruction of habitats for renewables | 2 | AO1<br>AO2<br>1.4 |
| 6(b) | any **two** from:<br>• non-renewable<br>• high decommissioning costs<br>• produces radioactive / nuclear waste<br>• long start-up time<br>• nuclear accidents have widespread implications | allow nuclear fuel is running out<br>accept high commissioning costs<br>allow waste has a long half-life<br>allow for nuclear accident a named nuclear accident<br>eg Fukushima, Chernobyl<br>ignore visual pollution | 2 | AO1<br>1.4.1f |

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

### 4.6.1.1 Transverse and longitudinal waves



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **6(c)** | 0.48 (kW) | allow **1** mark for correct substitution<br>ie 0.15 = P / 3.2<br><br>an answer of 480 W gains **2** marks<br><br>an answer of 48 or 480 scores **1** mark | 2 | AO2<br>1.2.1d |
| **6(d)** | the higher the efficiency, the higher the cost (per $m^2$ to manufacture) | accept a specific numerical example | 1 | AO2<br>AO3<br>1.4.1c |
| | more electricity could be generated for the same (manufacturing) cost using lower efficiency solar panels<br>**or**<br>(reducing the cost) allows more solar panels to be bought | accept a specific numerical example | 1 | |
| **Total** | | | **8** | |

4.6.1.1 Transverse and longitudinal waves



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 7(a) | surface area<br>**or**<br>duration of experiment | accept shape of beaker<br><br>size of beaker is insufficient | 1 | AO3<br>1.1.3b |
| 7(b) | any **two** from:<br>• takes readings automatically<br>• takes readings more frequently<br>• reduces / no instrument reading error<br>• higher resolution<br>• don't need to remove probe to take reading<br>• more accurate | ignore easier **or** takes readings for you<br><br>ignore human error<br><br>allow better resolution | 2 | AO3<br>1.1.3 |
| 7(c)(i) | 0.07 (°C/s) | allow **1** mark for obtaining a temperature drop of 7(ºC)<br><br>allow **1** mark for an answer between 0.068 and 0.069 (°C/s) | 2 | AO2<br>1.1.3d |
| 7(c)(ii) | rate of temperature change is greater at the start<br>**or**<br>rate of temperature change decreases | accept rate of evaporation is greater at the start<br><br>allow rate of evaporation decreases<br><br>allow temperature decreases faster at the start | 1 | AO3<br>1.1.3b |

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

### 4.6.1.1 Transverse and longitudinal waves



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 7(c)(iii) | A<br><br>lower temperature decrease (over 200 seconds) | reason only scores if A is chosen<br><br>accept lower gradient | <br><br>1 | AO3 1.1.3b |
| 7(c)(iv) | no effect (as rate of evaporation is unchanged) | allow larger temperature change (per second as mass of liquid is lower) | 1 | AO3 1.1.3b |
| 7(d) | particles with more energy<br><br>leave the (surface of the) liquid<br><br>(which) reduces the average (kinetic) energy (of the remaining particles) | accept particles with higher speeds<br><br><br><br>allow reference to the total energy of the liquid reducing | 1<br><br>1<br><br>1 | AO1 1.1.3b |
| Total | | | 11 | |

### 4.6.1.1 Transverse and longitudinal waves



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 8(a) | any **two** factors:<br>• surface area (of mug in contact with cup warmer)<br>• thickness of mug<br>• temperature of heater / coffee<br>• power of the heater | <br><br><br>accept temperature difference (between heater and coffee)<br>accept power of the laptop<br>ignore efficiency of the heater | 2 | AO3<br>1.1.3c |
| 8(b) | <br>atoms (gain kinetic energy and) vibrate faster / more<br>energy is passed on from atom to atom by collision | allow particles / molecules for atoms<br>allow bigger / faster vibrations<br>do not accept start to vibrate<br>accept vibrations for energy<br>an answer in terms of free electrons scores zero | <br>1<br>1 | AO1<br>1.1.3a |
| 8(c) | <br>the particles spread out<br>(so) coffee becomes less dense<br>(so) the heated coffee rises<br>(and) cooler / denser coffee falls | allow fluid / liquid / water for coffee throughout answer<br>allow particles move further apart<br>allow (coffee) expands<br>particles rise is insufficient<br>particles fall is insufficient | <br>1<br>1<br>1<br>1 | AO1<br>1.1.3a |
| Total | | | 8 | |

4.6.1.1 Transverse and longitudinal waves

**Answer 04 · Examiner comments** November 2021 | 8463/2H | Original Q5

**Question 5**

Although a number of correct uses were given for ultraviolet a number of the students appeared to confuse UV with ultrasound. The meaning of the prefix 'nano' was not well known. However the students that knew the correct equation for part **05.3** (about 35% did not) did go on to use the value chosen in **05.2** to calculate a correct answer. Only about half of the students could use the data presented in Table 1 to correctly answer part **05.4.** Most of the students scored no marks for part **05.5**, with many either simply giving an example of each type of wave, or failing to link the direction of oscillation to either direction of energy transfer or direction of wave travel.

**Answer 05 · Examiner comments** June 2023 | 8463/2H | Original Q1

**01.1**

72% scored a mark on this question. The most frequent incorrect response was 'parallel'.

**01.2**

Most responses were levels 1 and 2. Many failed to gain marks because they did not think it was necessary to explain the need for additional equipment. Very few students explained the need to calculate the temperature change or to compare the readings on infrared detectors, which was a requirement to get into level 3. A number of students suggested using cold water, or even described a different practical. Students were not penalised for using tiny volumes of water, but it is clear that students have no concept of how much 50 ml is, for example. There was a lot of confusion relating to use of infra red detectors and what they measured.
Many students stated they would take readings every minute, and lots suggested repeating to get averages, or producing graphs. This was not required by the question.
There were some pleasing summaries referring to the evidence and the hypothesis.

**01.3**

80 % of students scored the first mark, but only 47% scored both marks. Some students simply reworded the stem. There was a small amount of confusion with radioactivity, because of the use of the word radiation, and a number who seemed to think a chemical reaction was taking place.

**01.4**

A majority of students gained this mark, but there seemed to be some confusion as to what is meant by the dependent variable.

**01.5**

The most common response related to the matt black surface and the shiny white surface. This was awarded 1 mark. Some did mention that black was the best absorber but failed to adequately describe the relative absorbance of matt versus shiny surfaces, as they did not explain this only applied for the same colour surface. In addition, some gave their response in terms of emission or reflection of IR radiation, both of which scored zero. Only 3% of students successfully gave both conclusions.

**01.6**

99% of students identified the equation for calculating pressure.

### 4.6.1.1 Transverse and longitudinal waves

**Answer 05 · Examiner comments** June 2023 | 8463/2H | Original Q1

**01.7**

78% of students scored all 4 marks for this calculation. Some scored zero, as they calculated the total surface area, the volume or used the length of the cube.