AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.5

# Waves for detection and exploration (physics only) (HT only)

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **22** |
| Available paper years | **2003–2024** |

## 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.

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 01 · Mark scheme** June 2003 | 3451H | Original Q7 | Legacy

The full source mark scheme begins on page 41. Follow original question 7 in that document.

**Answer 02 · Mark scheme** June 2003 | 3462H3 | Original Q5 | Legacy

The full source mark scheme begins on page 63. Follow original question 5 in that document.

**Answer 03 · Mark scheme** June 2004 | 3451H | Original Q14 | Legacy

The full source mark scheme begins on page 80. Follow original question 14 in that document.

**Answer 04 · Mark scheme** June 2004 | 3462H3 | Original Q12 | Legacy

The full source mark scheme begins on page 101. Follow original question 12 in that document.

**Answer 05 · Mark scheme** June 2005 | 3451 | Original Q15 | Legacy

The full source mark scheme begins on page 118. Follow original question 15 in that document.

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 06 · Mark scheme**

June 2005 | 3462 | Original Q11 | Legacy

The full source mark scheme begins on page 136. Follow original question 11 in that document.

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 07 · Mark scheme



**Question 5**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | any **two** points:<br>• humans cannot hear ultrasound<br>• it has a very high frequency / pitch<br>• above the (upper) limit for humans / above 20 000 Hz | do **not** credit features which are true of sound in general eg longitudinal waves<br>do **not** credit just 'has a high frequency / pitch' | 2 |
| (b)(i) | ultrasound / waves are reflected<br>Pulse **A** indicates / is the crack<br>Pulse **B** *i*ndicates / is the back (of the block or crack) | … are bounced is insufficient, but … echo is acceptable<br>need to mention both A and B to get this mark | 1<br>1 |
| (b)(ii) | 90 (mm) | accept any answer in the range 88 – 92 (mm) | 1 |
| total | | | 5 |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 07 · Mark scheme** June 2008 | PHY3H | Original Q5 | Legacy

**PHY3H**

**4.6.1.5 Waves for detection and exploration (physics only) (HT only)**

**Answer 08 · Mark scheme** January 2009 | PHY3H | Original Q1 | Legacy

**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(a) | 20 000 | accept any unambiguous indication | 1 |
| **1**(b) | kilohertz | credit misspellings<br><br>credit '1000 hertz' or '1000 Hz'<br><br>accept 1000 oscillations/beats/waves per second | 1 |
| **1**(c)(i) | cleaning (e.g. something delicate such as a watch) | **or** quality control/flaw detection<br><br>credit any appropriate extra Specification response<br><br>e.g. sonar | 1 |
| **1**(c)(ii) | pre-natal (scanning) | do **not** credit just 'scanning'/medical scanning<br><br>credit any appropriate extra Specification response<br><br>e.g. destruction of (kidney) stones or cleaning teeth | 1 |
| **1**(d) | 8 (μs) | | 1 |
| **1**(e) | distance (1)<br><br>between the boundary and the detector (1) | accept 'between the boundary and the source'<br><br>accept any correct use of speed = distance/time | 2 |

**Question 1 continues on the next page**

**PHY3H**

**Question 1 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(f) | examples<br><br>publish/tell doctors/the public (1)<br>... their evidence/results/ research/data (1)<br><br>carry out more research/ tests (1)<br>... to make sure/check reliability (1) | allow a wide variety of appropriate responses<br>valid point (1)<br>appropriate example/ qualification/expansion/etc. (1)<br><br>allow just 'stop using them/ultrasonic waves' (1)<br><br>allow using them (only) for industrial purposes (1) | 2 |
| **Total** | | | **9** |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 08 · Mark scheme**

January 2009 | PHY3H | Original Q1 | Legacy

**PHY3H**

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 09 · Mark scheme



## Question 5

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(a)(i) | same frequency / period / pitch / wavelength | ignore references to amplitude | 1 |
| **5**(a)(ii) | differences in waveform / shape / quality | accept the diagrams are not identical | 1 |
| **5**(b)(i) | 20 000 Hz / hertz<br><br>**or**<br><br>20 kHz / kilohertz | in both cases, if the **symbol** rather than the name is used, it must be correct in every detail | 1 |
| **5**(b)(ii) | material(s) / substance(s) (through which sound travels) | | 1 |
| **5**(b)(iii) | is absorbed<br><br>is transmitted | accept (some) sound (energy) is transformed / transferred as heat / thermal energy<br><br>accept is refracted<br>accept changes speed<br>accept changes velocity<br><br>do **not** accept is diffracted<br>do **not** accept is diffused<br>do **not** accept is dissipated | 1<br><br>1 |
| **Total** | | | **6** |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 09 · Mark scheme**

June 2009 | PHY3H | Original Q5 | Legacy

**PHY3H**

**4.6.1.5 Waves for detection and exploration (physics only) (HT only)**

**Answer 10 · Mark scheme** January 2010 | PHY3H | Original Q3 | Legacy

**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a) | sound / mechanical / longitudinal (wave )<br><br>any **one** from:<br>• above 20 000 hertz / 20kHz<br>• above (human) audible range<br>• cannot be heard by humans | | 1<br><br>1 |
| **3**(b) | **either**<br><br>particles / molecules / fluid vibrate(s) (1)<br><br>(and) knock particles of dirt off the jewellery (1)<br><br>**or**<br><br>by the process of cavitation (1)<br><br>which breaks up / releases dirt from the surface (1) | <br><br><br><br><br><br>accept 'formation and collapse of tiny bubbles' | 2 |

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

**PHY3H**

**Question 3 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(c) | **either**<br><br>two appropriate points gain **1** mark each<br><br>**or**<br><br>one appropriate point (and) appropriate qualification / amplification | **either** both pro<br>**or** both con<br>**or** one of each<br><br>examples<br>other mammals (sufficiently) similar to humans (1)<br>so results appropriate (1)<br><br>unethical to experiment on humans (1)<br>so it is better to experiment on mice (1)<br><br>knowledge / techniques will benefit humans (1)<br>and also other animals (1)<br><br>experiments were justified because ultrasound has proved useful (1) | 2 |
| **Total** | | | **6** |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 10 · Mark scheme**

January 2010 | PHY3H | Original Q3 | Legacy

**PHY3H**

**Answer 11 · Mark scheme**

June 2010 | PHY1BP | Original Q9 | Legacy

| | | | | |
|---|---|---|---|---|
| Nine | 2 | 4 | 4 | 2 |

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 12 · Mark scheme

June 2013 | PH2HP | Original Q5 | Legacy

## Question 5

| question | answers | extra information | mark |
|---|---|---|---|
| **5(a)** | 78 | | 1 |
| **5(b)** | atomic | | 1 |
| **5(c)(i)** | 131<br><br>54 | correct order only | 1<br><br>1 |
| **5(c)(ii)** | 32 (days) | allow **1** mark for showing 4 half-lives provided no subsequent step | 2 |
| **5(c)(iii)** | limits amount of iodine-131 / radioactive iodine that can be absorbed<br><br>so reducing risk of cancer (of the thyroid) | accept increases level of non-radioactive iodine in thyroid<br><br>do **not** accept cancels out iodine-131<br><br>accept stops risk of cancer (of the thyroid) | 1<br><br>1 |
| **Total** | | | **8** |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 12 · Mark scheme**

June 2013 | PH2HP | Original Q5 | Legacy

**PH2HP**

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 13 · Mark scheme



## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| 3(a) | 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 |

| 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 either wave<br>**OR**<br>What happens to either wave when they enter the body. However there is little other detail. | There is either:<br>A clear description of BOTH waves<br>**OR**<br>A clear description as to what happens to BOTH waves inside the body<br>**OR**<br>A clear description of ONE of the waves with clear detail as to what happens to either wave inside the body. | There is a detailed description of BOTH of the waves<br>**AND**<br>A detailed description as to what happens to EITHER wave inside the body. |

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

**PH3HP**

**Question 3 continued . . .**

| | | |
|---|---|---|
| **Examples of the points made in the response:**<br><br>**<u>Description of an X-ray</u>**<br>• X-rays are electromagnetic waves / part of the electromagnetic spectrum<br>• X-rays are (very) high frequency (waves)<br>• X-rays are (very) high energy (waves)<br>• X-rays have a (very) short wavelength<br>• Wavelength (of X-rays) is of a similar size to (the diameter of) an atom<br>• X-rays are a transverse wave<br>• X-rays are ionising radiation<br><br>**<u>Description of ultrasound</u>**<br>• ultrasound has a <u>frequency</u> above 20 000 (hertz)<br>**OR**<br>ultra sound is above 20 000 hertz<br>• ultrasound is above / beyond the human (upper) limit (of hearing)<br>• ultrasound is a longitudinal wave<br><br>**<u>Statement(s) as to what happens to X-rays inside the human body:</u>**<br>• X-rays are absorbed by bone<br>• X-rays travel through / are transmitted by tissue / skin<br><br>**<u>Statement as to what happens to ultrasound inside body:</u>**<br>• ultrasound is (partially) reflected at / when it meets a boundary between two different media<br>• travel at different speeds through different media | do **not** allow a description of a property – eg X-rays travel through a vacuum / at the speed of light<br><br>correct description acceptable – oscillations / vibrations are perpendicular (at 90°) to direction of energy transfer<br><br>accept ultrasound cannot be heard by humans<br>correct description acceptable – oscillations / vibrations (of particles) are parallel (in same direction) to direction of energy transfer | |

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

**PH3HP**

**Question 3 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(b)** | (because the X-rays) are ionising | accept a description of what ionising is | 1 |
| | (they will) damage cells<br>**or**<br>mutate cells / cause mutations / increase chances of mutations<br>**or**<br>turn cells cancerous / produce abnormal growths / produce rapidly growing cells<br>**or**<br>kill cells | instead of cell, any of these words can be used:<br>DNA / genes / chromosomes / nucleus<br><br>do **not** accept they can be dangerous (to human health)<br>do **not** accept damage to soft tissue | 1 |
| **3(c)** | any **one** from:<br>• removal / destruction of kidney / gall stones | | 1 |
| | • repair of damaged tissue / muscle | accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation<br>accept physiotherapy<br><br>accept curing prostate cancer **or** killing prostate cancer cells | |
| | • removing plaque from teeth | cleaning teeth is insufficient | |
| **Total** | | | **9** |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 13 · Mark scheme**

June 2013 | PH3HP | Original Q3 | Legacy

**PH3HP**

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 14 · Mark scheme

June 2014 | PH3HP | Original Q1 | Legacy

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| 1(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 |
| 1(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 |
| 1(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 1 continues on the next page . . .**

**Question 1 continued . . .**

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| 1(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 ionising<br>• mutate cells **or** cause mutations **or** increase chances of mutations<br>• turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells<br>• kill cells<br>• metal/lead/glass/concrete shielding is needed | clearer / better image is sufficient<br><br>allow images are (always) 3D / 360°<br>allow whole body can be scanned<br><br>allow a description of what ionising is<br><br>allow for cells:<br>DNA / genes / chromosomes / nucleus / tissue<br><br>damage cells is insufficient<br><br>can be dangerous (to human health) unqualified, is insufficient | 1<br><br>1 | AO1<br><br>3.1 |
| **Total** | | | **7** | |

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 15 · Mark scheme

June 2015 | PH3HP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| 3(a) | 20,000 | accept 20 kilo **or** 20 k **or** 20 001 | 1 | AO1 P3.1.2a |
| | an atom | | 1 | AO1 P3.1.1a |

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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 15 · Mark scheme

June 2015 | PH3HP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 3(b) | | | 6 | AO1 P3.1 P3.1.1c |

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.

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| no relevant content | At least one relevant statement is given for either type of wave | **Either**<br>a use, risk and precaution is given for one type of wave<br><br>**Or**<br><br>A medical use is given for both types of wave<br>**plus**<br>a risk or precaution for one type of wave | At least one medical use is given for both types of wave linked to the risks and any precautions necessary |

| examples of the points made in the response | extra information |
|---|---|
| **Medical use of X-rays**<br>Any one from:<br>• Detecting bone fractures<br>• Detecting dental problems<br>• Killing cancer cells<br>• CT scanning | Ignore details about how X-rays/ultrasound work<br><br>accept any specific use of X-rays, eg<br>• detecting heart/lung disorders (with chest X-rays)<br>• mammograms / breast cancer detection<br>• detecting stones / bowel disease (with abdominal X-rays) |
| **Risks with X-rays**<br>X-rays pose a risk / danger / hazard | accept are harmful |
| X-rays cause ionisation / damage to cells<br>**or**<br>mutate cells / cause mutations / increase chances of mutations<br>**or**<br>turn cells cancerous / produce abnormal growths / produce rapidly growing cells<br>**or**<br>kill cells | accept a description of what ionising is<br><br>instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus<br><br>accept (may) cause cancer |

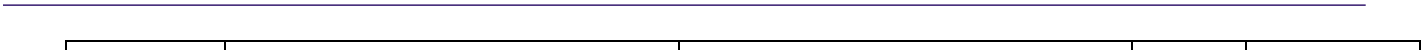
| | | |
|---|---|---|
| **Operator precautions with X-rays**<br>The X-ray operator should go behind a (metal / glass) screen / leave the room when making an X-ray / wear a lead lined apron | accept appropriate precautions for the patient e.g. limit the total exposure/dose (in one year)<br><br>wear a radiation badge is insufficient | |
| **Medical use of ultrasound**<br>Any one from:<br>• Pre-natal scanning<br>• Imaging (a named body part).<br>• removal / destruction of kidney / gall stones<br>• removing plaque from teeth<br>• repair of damaged tissue / muscle | cleaning teeth is insufficient<br><br>accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation<br>accept physiotherapy<br>accept curing prostate cancer **or** killing prostate cancer cells | |
| **Risks with ultrasound**<br>Ultrasound poses no risk / danger / hazard (to the user / patient).<br><br>Ultrasound is not ionising<br><br>or<br><br>Ultrasound does not damage (human) cells | accept ultrasound is safer than using X-rays. | |
| **Precautions with ultrasound**<br><br>The operator needs to take no precautions when making an ultrasound scan. | this can be assumed if it is stated that ultrasound is harmless or it is safer than using x-rays or it is non-ionising | |

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

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 15 · Mark scheme**

June 2015 | PH3HP | Original Q3 | Legacy



4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 16 · Mark scheme

June 2016 | PH3HP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 3(a) | ultrasound is not ionising<br><br>but X-rays are ionising<br><br>so X-rays increase the health risk to the (unborn) baby | allow ultrasound does not harm the (unborn) baby<br><br><br>accept specific examples of health risks, eg cancer, stunted growth, impaired brain function etc<br><br>X-rays are dangerous is insufficient | 1<br><br>1<br><br>1 | AO1<br>3.1 |
| 3(b) | ultrasound/waves are partially <u>reflected</u><br>(when they meet a boundary)<br>(between two different media / substances / tissues)<br><br>the time taken is measured<br>(and is used to determine distances) | must be clear that not all of the wave is reflected<br><br><br><br><br><br> | 1<br><br><br><br><br>1 | AO1<br>3.1.2b |
| 3(c) | 1600 (m/s) | 800 (m/s) gains **2** marks<br>160 000 (m/s) gains **2** marks<br>0.0016 (m/s) gains **2** marks<br><br>allow **2** marks for $\frac{0.04}{25 \times 10^{-6}}$<br>or $\frac{0.08}{50 \times 10^{-6}}$<br><br>80 000 (m/s) gains **1** mark<br><br>0.0008 (m/s) gains **1** mark<br><br>allow **1** mark for $\frac{0.04}{25}$<br>or $\frac{0.08}{50}$<br><br>allow **1** mark for evidence of doubling the distance or halving the time | 3 | AO2<br>3.1.2c |

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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 16 · Mark scheme

June 2016 | PH3HP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 3(d)(i) | they are absorbed by bone | allow stopped for absorbed<br>X-rays are reflected negates this mark | 1 | AO1<br>3.1.1a |
| | they are transmitted by soft tissue | allow pass through for transmitted<br>allow flesh / muscle / fat<br>accept less (optically) dense material for soft tissue | 1 | |
| | (the transmitted) X-rays are detected | | 1 | |
| 3(d)(ii) | short | accept small | 1 | AO1<br>3.1.1a |
| Total | | | 12 | |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 16 · Mark scheme**

June 2016 | PH3HP | Original Q3 | Legacy



4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 17 · Mark scheme

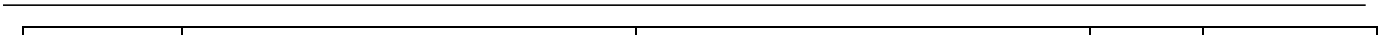
June 2017 | PH3HP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 3(a)(i) | CT scans cause ionisation<br><br>because they use X-rays | <br><br>references to mutations/damage to cells are insufficient | 1<br><br>1 | AO1<br><br>3.1.1a |
| 3(a)(ii) | Because the (potential) benefits outweigh the risks | ignore references to the risk being small | 1 | AO2<br><br>3.1 |
| 3(b) | Wear a lead vest | accept stand behind a safety screen<br><br>accept check if mother is pregnant | 1 | AO1<br><br>3.1.1c |
| 3(c) | (CT scans give) a higher quality image | accept can differentiate between tissues<br><br>accept higher resolution or more detail<br><br>accept a clearer image<br><br>accept (CT scans give) a view of a larger portion of the body<br><br>accept (CT scans give) a useful image more quickly<br><br>the CT scan is quicker is insufficient<br><br>accuracy/precision are insufficient | 1 | AO1<br><br>3.1 |
| Total | | | 5 | |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 17 · Mark scheme**

June 2017 | PH3HP | Original Q3 | Legacy



### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 18 · Mark scheme**

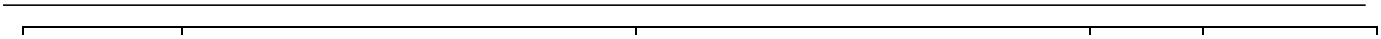
June 2017 | PH3HP | Original Q7 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **7(a)** | 20 001 hertz / Hz | accept 20 000 hertz | 1 | AO1<br>3.1.2a |
| **7(b)(i)** | The time (taken for the pulse to travel to the crack and back) | accept how long it takes (for the pulse to travel to the crack and back) | 1 | AO1<br>3.1.2c |
| **7(b)(ii)** | The speed (of ultrasound in the wing) | | 1 | AO1<br>3.1.2c |
| **7(b)(iii)** | Partially reflected<br>and partially transmitted | accept it is reflected and transmitted for **2** marks | 1<br>1 | AO2<br>3.1.2b |
| **7(c)** | If a fault is missed on an inspection it will still be safe (until the next inspection) | accept there is a far lower risk of the fault being missed and becoming dangerous | 1 | AO3<br>3.1.2 |
| **Total** | | | **6** | |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 18 · Mark scheme**

June 2017 | PH3HP | Original Q7 | Legacy



4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 19 · Mark scheme

June 2018 | 8463/1H | Original Q8

| Question | Answers | Extra information | Mark | AO/ Spec. Ref |
|---|---|---|---|---|
| 08.1 | any **three** from:<br>• no carbon dioxide emitted (to produce electricity)<br>• doesn't cause global warming<br>• nuclear power doesn't cause earthquakes<br>• more energy released per kg of fuel (compared to shale gas) | no greenhouse gases is insufficient<br>allow climate change or greenhouse effect for global warming | 3 | AO1<br>AO2<br>4.1.3 |
| 08.2 | uranium<br>**or**<br>plutonium | ignore any numbers given | 1 | AO1<br>4.4.4.1 |
| 08.3 | a neutron is absorbed by a (large) nucleus<br>the nucleus splits into two (smaller) nuclei<br>releasing energy (and gamma rays)<br>and (two / three) neutrons | a description in terms of only atoms negates first two marking points | 1<br>1<br>1<br>1 | AO1<br>4.4.4.1 |
| **Total** | | | **8** | |

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 20 · Mark scheme

June 2018 | 8463/2H | Original Q3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | P-waves are longitudinal and S-waves are transverse | | 1 | AO1 4.6.1.5 |
| **03.2** | 0.4 | | 1 | AO2 4.6.1.2 |
| **03.3** | wave speed = frequency × wavelength | allow v = f λ | 1 | AO1 4.6.1.2 |
| **03.4** | 7200 = 0.4 × wavelength<br>wavelength = $\frac{7200}{0.4}$<br>wavelength = 18 000 (m) | an answer 18 000 scores **3** marks<br><br><br>allow up to full marks for ecf using their answer to question **03.2**<br><br>a method shown as 7200 × 2.5 = 18 000 scores **0** marks | <br>1<br>1<br><br>1 | AO2 4.6.1.2 |
| **03.5** | because S-waves cannot travel through a liquid<br>and S-waves do not travel through the (outer) core | <br><br><br>allow some (seismic) waves cannot travel through a liquid and do not go through the core for **1** mark | 1<br>1 | AO1 4.6.1.5 |
| **03.6** | magnetic field around the coil changes<br>**or**<br>the magnetic field (lines) cut by the coil | allow the generator effect | 1 | 4.7.3.1 AO2 |

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 20 · Mark scheme

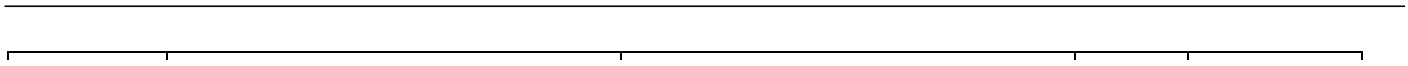
June 2018 | 8463/2H | Original Q3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.7** | because the magnet changes direction | | 1 | 4.7.3.1 AO2 |
| **03.8** | stationary | | 1 | 4.7.3.1 AO2 |
| **03.9** | any **two** from:<br>• stronger magnetic field<br>• more turns on the coil<br>• turns pushed closer together<br>• spring with a lower spring constant | <br>allow stronger magnet<br>allow heavier magnet<br>bigger magnet is insufficient<br>bigger coil is insufficient<br>do **not** accept more coils of wire<br><br>allow less stiff spring<br>allow weaker spring<br>do **not** accept add an iron core | 2 | 4.7.3.1 AO2 |
| **Total** | | | **13** | |

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 20 · Mark scheme**

June 2018 | 8463/2H | Original Q3



4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 21 · Mark scheme

June 2019 | 8463/2H | Original Q9

## Question 9

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **9.1** | chicken | allow a correct answer indicated in Table 3 provided the answer space in blank | 1 | AO3 |
| **9.2** | $2 \times 10^{-6}$ | | 1 | AO1/1<br>4.5.6.1.2<br>WS4.4 |
| **9.3** | time = 8μs = $8 \times 10^{-6}$ (s)<br>or<br>4 × their answer to 9.2 | an answer 0.025 (m) scores **4** marks<br><br>subsequent marks may be scored if the number of squares is miscounted or t = 2μs is used | 1 | AO2/1<br>4.6.1.5<br>4.5.6.1.2 |
| | distance = ½ × 6300 × $8 \times 10^{-6}$ | allow $8 \times 10^{3}$ or $8 \times 10^{-3}$ or $8 \times 10^{-9}$ for $8 \times 10^{-6}$ | 1 | |
| | distance = 0.0252 (m) | allow a correctly calculated answer using $8 \times 10^{3}$ or $8 \times 10^{-3}$ or $8 \times 10^{-9}$ | 1 | |
| | distance = 0.025 (m) | allow a calculated value correctly rounded to 2 sig figs<br><br>an answer 0.050 (m) scores **3** marks<br>an answer 0.05 or 0.0504 (m) scores **2** marks | 1 | |
| **9.4** | to convert (the pressure variations in) sound (waves) into variations in current / p.d | allow electrical signal for variations in current / p.d.<br><br>do not accept amplifies sound | 1 | AO1/1<br>4.7.3.3 |

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 21 · Mark scheme

June 2019 | 8463/2H | Original Q9

| | | | | |
|---|---|---|---|---|
| **9.5** | sound (waves) cause the diaphragm to vibrate<br><br>the diaphragm causes the coil / wire to vibrate<br><br><br><br>the coil / wire moves through the magnetic field<br>**or**<br>the coil / wire cuts magnetic field lines<br><br>a potential difference is <u>induced</u> (across the ends of the coil / wire) | diaphragm moves is insufficient<br><br>do not accept moves the coil / wire up and down<br><br>if m.p.1 and m.p.2 do not score, allow sound (waves) cause the coil / wire to vibrate for **1** mark<br><br><br>allow <u>induced</u> current for <u>induced</u> p.d. | 1<br><br>1<br><br><br><br>1<br><br><br>1 | AO1/1<br>4.7.3.3 |
| **Total** | | | **11** | |

Answer 22 · Mark scheme



## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.1** | the height of the (column of) water above the submarine increases | allow volume / mass for height | 1 | AO1 4.5.5.1.2 |
| | which increases the force / weight (of the water) acting on the submarine so pressure increases | allow $p = \rho gh$ and $\rho$ and $g$ remain constant so pressure increases | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.2** | $p$ = 110 000 000 Pa | | 1 | AO2 4.5.5.1.2 |
| | 110 000 000 = 1026 × 9.8 × $\Delta h$ | allow a correct substitution of an incorrectly / not converted value for $p$ | 1 | |
| | $\Delta h = \frac{110\,000\,000}{1026 \times 9.8}$ | allow a correct re-arrangement using an incorrectly / not converted value for $p$ | 1 | |
| | $\Delta h$ = 10 940 (m) | allow a correct calculation from using an incorrectly / not converted value for $p$<br><br>allow 11 000 (m) if correct working shown | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.3** | P-waves are longitudinal and S-waves are transverse | | 1 | AO1 4.6.1.5 |

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 22 · Mark scheme

June 2024 | 8463/2H | Original Q4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.4 | D<br><br>only P-waves can travel through liquids | <br><br>allow only P-waves can travel through the outer core<br>allow S waves cannot travel through liquids<br>allow S waves cannot travel through the outer core<br><br>MP2 dependent on MP1 | 1<br><br>1 | AO3<br>4.6.1.5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.5 | $4500 = 3.6 \times \lambda$<br><br>$\lambda = \frac{4500}{3.6}$<br><br>$\lambda = 1250$ (m) | allow a correct substitution of an incorrectly / not converted value for $v$<br><br>allow a correct re-arrangement using an incorrectly / not converted value for $v$<br><br>allow 1300 (m)<br>only allow an answer consistent with a correctly converted value for $v$ | 1<br><br>1<br><br>1 | AO2<br>4.6.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.6 | the distance is (directly) proportional to the time between the two waves arriving (at the seismometer) | allow they are (directly) proportional<br><br>allow a greater distance means a greater time for **1** mark<br><br>allow there is a positive correlation for **1** mark | 2 | AO3<br>4.5.6.1.2 |

| Total Question 4 | 14 |
|---|---|

4.6.1.5 Waves for detection and exploration (physics only) (HT only)



AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Physics

## 3451

## Foundation

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Kathleen Tattersall: *Director General*

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





# 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).

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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**

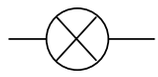
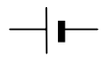
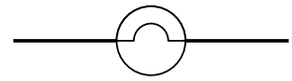
The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q5**

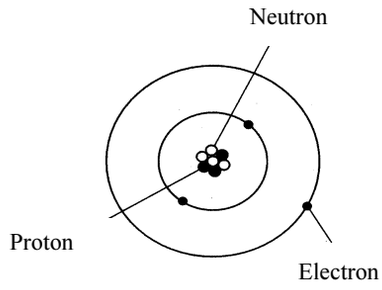
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q6**

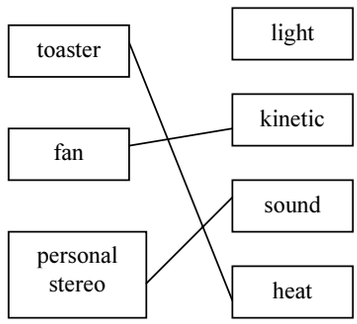
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q8**

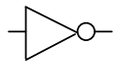
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | point where the rays cross | do not credit if ambiguous | 1 |
| (ii) | converging (lens) | do **not** accept convex | 1 |
| (b)(i) | point where the rays appear to diverge from | this should appear to be within 10mm in front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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q9**

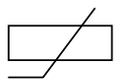
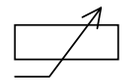
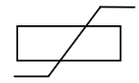
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | off<br>off<br>on | all correct | 1 |
| (ii) | AND (gate) | accept and (gate) | 1 |
| (iii) | on<br>on<br>on | all correct | 1 |
| (iv) | OR (gate) | accept or (gate) | 1 |
| (b)(i) | 1 0 **or** 0 1<br>0 1 1 0 | do **not**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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q13**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of heat (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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q14**

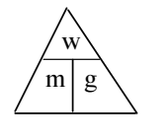
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br><br>the ground<br>the air<br>radon (gas)<br>building materials<br>buildings<br>rocks / granite<br>food<br>cosmic rays **or** solar rays<br><br>X-rays<br>nuclear weapons testing<br>nuclear power stations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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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>accept a freehand drawing<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>current less<br>(so) rate of flow of charge less **or** less coulombs per second<br>(so) discharge is slower | <br>do **not** accept current slower<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 | translation correct (= 4000) but percentage addition incorrect gains **1** mark<br>translation incorrect but 5% addition is correct gains **1** mark<br>accept 422.1 **or** 42.2 **or** 6.3 for **1** mark | 2 |
| | ohms **or** Ω | 4.2 kilohms **or** 4.2 kΩ gains all **3** marks | 1 |
| total | | | 10 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q17**

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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)



ASSESSMENT and QUALIFICATIONS ALLIANCE

# Mark scheme June 2003

# GCSE

## Science: Double Award Co-ordinated

## 3462

## Paper 3F

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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





# 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).

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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.

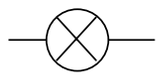
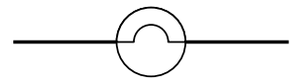
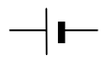
## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





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

**3462/3F Q1**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q2**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q3**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | heat | | 1 |
| (ii) | temperature increases<br>**or**<br>(cause) convection (currents) | accept gets warmer<br>accept gets hotter | 1 |
| (iii) | 60% **or** 0.6 | 60 without % scores **1** mark<br>0.6 with a unit scores **1** mark<br>60 with incorrect unit scores **1** mark<br><br>**or** correct substitution $\frac{120}{200}$<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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q5**

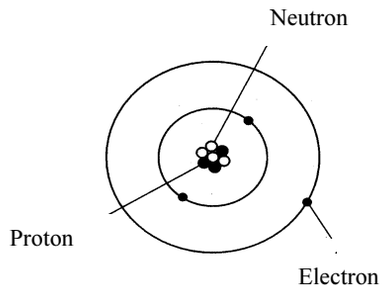
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | MN | accept 5.8, 8 seconds<br>must include unit | 1 |
| (b) | LM | accept 0.8, 5.8 seconds<br>must include unit | 1 |
| (c)(i) | 0.8 | | 1 |
| (ii) | drinking alcohol | | 1 |
| (d) | straight (by eye) line starting at 0.8 seconds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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q6**

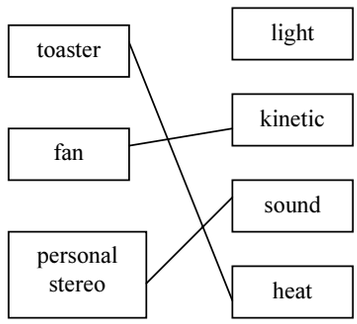
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | each correct label scores 1 mark<br><br> | | 3 |
| (ii) | neutron | | 1 |
| (iii) | 7<br><br>number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus | <br><br>accept number of particles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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q7**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q8**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q9**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q10**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q11**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | silver is a (good) reflector of heat (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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q12**

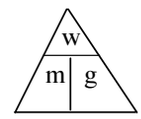
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br><br>the ground<br>the air<br>radon (gas)<br>building materials<br>buildings<br>rocks / granite<br>food<br>cosmic rays **or** solar rays<br><br>X-rays<br>nuclear weapons testing<br>nuclear power stations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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q13**

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

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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### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





# 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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

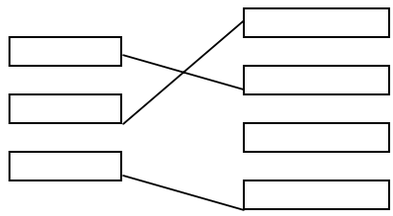
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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<br><br>connect tanker to earth with a (conducting) wire / chain **or** earth the tanker | accept petrol for (petrol vapour)<br>accept catch fire for explode<br><br>accept ground for earth | 1<br><br>1 |
| (c) | **Quality of written communication**<br><br>any **two** from:<br><br>• when current greater than fuse rating / value<br><br>• fuse (becomes hot and) melts / burns out<br><br>• circuit is broken | for a logical sequence<br><br><br><br>accept when current too great for appliance<br>do **not** accept 'if there is too much current'<br>do **not** accept voltage or electricity<br><br>accept fuse blows / breaks<br><br>accept circuit switched off<br>this cannot score credit on its own | 1<br><br>2 |
| total | | | 8 |

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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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>1 |
| (d) | centripetal | accept minor misspellings (see above) | 1 |
| total | | | 13 |

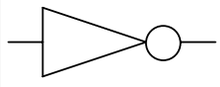
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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<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 |

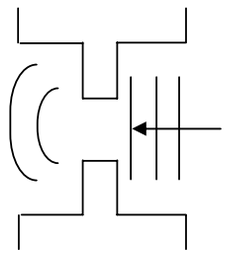
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451F Q9**

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



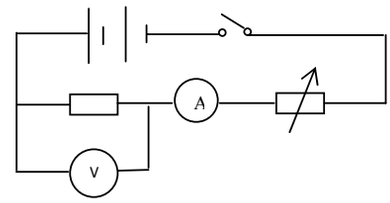
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 | 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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 | 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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

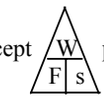
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 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 |



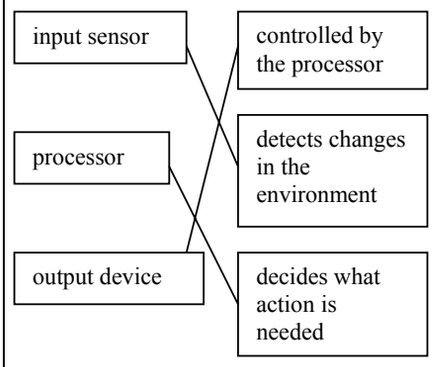
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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<br>do **not** accept numerical values unless expanded | 1 |
| | … (both) inputs are on / high / 1 **or** current flows in both inputs | | 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<br>• drawback of mobile phones<br>• benefit of the Internet<br>• drawback of the Internet | <br>e.g. more convenient for service engineers<br>e.g. calls can be received away from base<br>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<br>e.g. access to educational material<br>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 | 3 |
| total | | | 10 |



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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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> | describes 3 tracks correctly for **2** marks<br>describes 2 or 1 track correctly for **1** mark | max 2 |
| | C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards | 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 | |
| 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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### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





# 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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

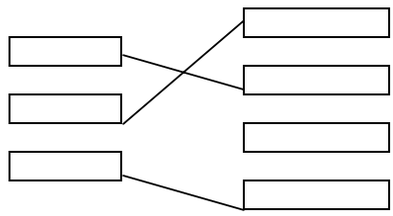
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 $1\frac{1}{2}$ hours (accept anything between 5 and 6)<br><br>ignore horse is tired | 1<br><br>1 |
| total | | | 6 |

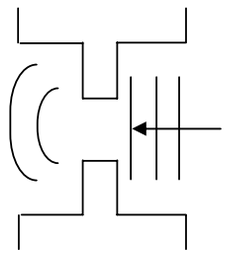
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q7**

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

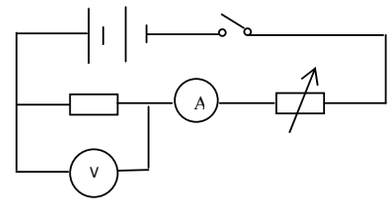
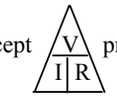

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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q8**

| 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><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><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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 | 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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

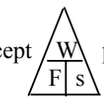
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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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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## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 to a minimum mark of **0** | 1 |
| (b) | continental | | 1 |
| | crust | | 1 |
| | tectonic | | 1 |
| total | | | 5 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | capacitor<br><br>LDR<br><br>relay (normally open) | accept condenser<br><br>**or** light dependent resistor<br>accept 'ldr', 'Ldr' etc.<br><br>do **not** accept 'relay normally closed' | 1<br><br>1<br><br>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><br>B is connected the right way round (and C is not)<br><br>a (light emitting) diode only allows (a significant) current to flow in one direction<br><br>B's anode is connected to the positive side of the supply<br><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><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><br>allow:<br>OFF NO<br>OFF NO<br>OFF NO<br>ON YES | 1 |
| (ii) | truth (table) | | 1 |

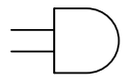
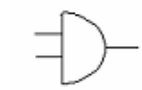
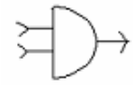
**cont…**

**4.6.1.5 Waves for detection and exploration (physics only) (HT only)**





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q10**

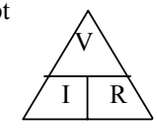
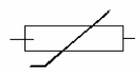
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | rays continued to meet on the right hand side of the lens and beyond | must be straight lines from the right hand side of the lens<br>ignore details through the lens<br>allow if no arrows | 1 |
| | meet exactly on the axis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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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) | <u>thermistor</u> or  | accept correct circuit symbol<br>allow phonetic spelling | 1 |
| | <u>resistance</u> 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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q14**

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

**cont…**

**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q16**

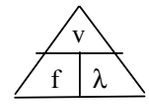
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | **X** at the centre of the lifebelt | measuring from the centre of **X**, allow 2 mm tolerance in any direction | 1 |
| (ii) | any **two** from:<br><br>below the point of suspension<br><br>at the centre (of the lifebelt)<br>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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3451/F Q17**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | any **two** from:<br>• **amplitude** decreasing<br>• **wavelength** increasing<br>• **frequency** decreasing<br><br>**Quality of written communication** | accept siren / sound getting quieter<br>do **not** accept sound decreases<br><br>accept pitch decreasing<br>ignore reference to transverse wave<br>ignore reference to speed<br><br>contradictory statements within each point lose the mark<br><br>all emboldened terms in candidate's answer used correctly | 2<br><br>1 |
| (b)(i) | ultrasound **or** ultrasonic | | 1 |
| (ii) | wave speed = frequency × wavelength | accept speed / velocity for wave speed<br><br>accept $v = f \times \lambda$<br>do **not** accept w for 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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**4.6.1.5 Waves for detection and exploration (physics only) (HT only)**





# 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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



*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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



*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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



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

**3462/3F Q8**

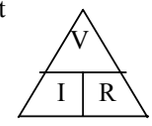
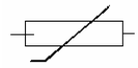
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils of Cynognathus are found in Africa and South America | | 1 |
| | the shapes ……. almost fit together | only two boxes should be ticked<br>deduct **1** mark for each additional box to a minimum mark of **0** | 1 |
| (b)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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**3462/3F Q9**

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

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



*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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)





**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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



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

**3462/3F Q12**

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

**cont…**

**4.6.1.5 Waves for detection and exploration (physics only) (HT only)**





**3462/3F Q12 cont**…

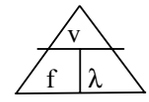
| | | | |
|---|---|---|---|
| (d) | any **three** from:<br>• <u>increased</u> speed<br>• <u>reduced</u> braking force<br>• <u>slower</u> (driver) reactions<br>• <u>poor</u> vehicle maintenance<br>• <u>increased</u> mass / weight of vehicle<br>• <u>poor</u> road surface<br>• <u>more</u> streamlined | 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 |

## 4.6.1.5 Waves for detection and exploration (physics only) (HT only)



*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>accept pitch decreasing<br>ignore reference to transverse wave<br>ignore reference to speed<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>accept $v = f \times \lambda$<br>do **not** accept w for λ<br>do **not** accept s for v<br>accept <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>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 |

Answer 20 · Examiner comments

June 2018 | 8463/2H | Original Q3

## Question 3 (Standard demand)

**03.1** Just over 50% of the students scored this mark

**03.2** Only 30% of students were able to use the information in Figure 3 to calculate the frequency of the wave.

**03.3** Just over 75% of the students were able to write the correct equation.

**03.4** Nearly 70% of the students who could recall the equation calculated the wavelength correctly.

**03.5** This is a topic new to this specification. 19% of the students knew that S-waves do not travel through a liquid and could relate this to the Earth having a liquid (outer) core.

**03.6** 23% of the students scored the mark, generally for simply stating ‘generator effect’.

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Answer 20 · Examiner comments

June 2018 | 8463/2H | Original Q3

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**03.7** 37% of students realised that this was to do with the movement of the magnet.

**03.8** This was well answered with just over 76% of students choosing the correct answer.

**03.9** Just over half of the students scored zero. Answers such as ‘bigger magnet’ or ‘more coils’ were too vague to gain credit.

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Answer 21 · Examiner comments

June 2019 | 8463/2H | Original Q9

**Question 9 (Standard and standard/high and high demand)**

**09.1** Just over 80% of the students correctly chose ‘chicken’.

**09.2** Just over 60% of the students gave the correct answer.

**09.3** Whilst only just over 7% of the students gave the correct value of 0.025 m as their final answer, there were a whole host of alternative wrong answers that gained at least one mark. Many students did not appear to realise that the distance between the pulses showed the time taken for the ultrasound to travel to the crack in the aluminium and back; others appeared to misinterpret the third pulse as the crack in the aluminium and not the edge of the block. A significant proportion of the students made no attempt to give their calculated answer to 2 significant figures.

**09.4** Only just over 13% of the students were able to give the function of a microphone. Most incorrect answers were in terms of amplifying sound. Some answers referred to converting sound into a current but did not indicate that the current would be varying.

**09.5** Nearly half of the students scored zero or did not attempt the question. Only around 3% of the students gave a clear, complete and correct answer. The idea that the sound waves would cause the diaphragm and coil to vibrate was often given but so were vague terms such as ‘moves’. Many students described the motor effect, starting with a current and eventually producing sound from the diaphragm. There were also answers that included referred to spinning coils, electromagnets, split-ring commutators, reversing magnetic fields and occasionally primary and secondary coils.

### 4.6.1.5 Waves for detection and exploration (physics only) (HT only)

**Answer 22 · Examiner comments** June 2024 | 8463/2H | Original Q4

**04.1**
This question asked students to explain the effect of increasing depth on the pressure on a submarine. A common error was repeating the question stem “as depth increases” rather than referring to increasing height (volume or mass) of water above the submarine.

**04.2**
Quite a well answered question with over 72% of students gaining all 4 marks for calculating the depth of the Mariana Trench. Another 20% did not convert the pressure, or converted incorrectly.

**04.3**
75% of students knew what types of waves P and S-waves are.

**04.4**
68% of students selected the position where only P-waves are detected following an earthquake. However, the reasons often referred to “it was in a straight line” or “it was below the earthquake”. A number of students just referred to the core without specifying the inner or outer core. Others confused which layers are liquid and which are solid, even though this information was given in the diagram.

**04.5**
95% of students gained at least 2 marks in this calculation of wavelength. Converting was sometimes unclear, often being done at the end rather than the beginning of the working, preventing students gaining all 3 marks. .

**04.6**
This question was about the relationship between the distance an earthquake is from a seismometer, and the time difference between P and S-waves arriving at it. 15% of students gained both marks and 30% gained 1 mark. Those who didn’t score had misunderstood the question stem. A small number had identified that greater distance meant a greater time difference, but then called this inversely proportional.