AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.2.2

# Efficiency

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Higher** |
| Question groups | **90** |
| Available paper years | **2004–2025** |

## Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

**Name:** _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

### 4.1.2.2 Efficiency

**Answer 01 · Mark scheme** June 2004 | 3451H | Original Q6 | Legacy

The full source mark scheme begins on page 99. Follow original question 6 in that document.

**Answer 02 · Mark scheme** June 2004 | 3462H3 | Original Q6 | Legacy

The full source mark scheme begins on page 120. Follow original question 6 in that document.

**Answer 03 · Mark scheme** June 2005 | 3451 | Original Q13 | Legacy

The full source mark scheme begins on page 137. Follow original question 13 in that document.

**Answer 04 · Mark scheme** June 2005 | 3462 | Original Q10 | Legacy

The full source mark scheme begins on page 155. Follow original question 10 in that document.

**Answer 05 · Mark scheme** March 2007 | PHY1A | Original Q3 | Legacy

| | | | |
|---|---|---|---|
| Three | **A** | conduction | **3** |
| | **B** | convection | **4** |
| | **C** | radiation | **1** |
| | **D** | reflection | **2** |
| | | | |

### 4.1.2.2 Efficiency

**Answer 06 · Mark scheme** March 2007 | PHY1A | Original Q6 | Legacy

| | | | |
|---|---|---|---|
| Six | **A** conclusion | **3** | |
| | **B** control | **1** | |
| | **C** environment | **4** | |
| | **D** evidence | **2** | |

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

**Answer 07 · Mark scheme** June 2007 | PHY1A | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** electrical energy | **1** | |
| | **B** gravitational potential energy | **2** | |
| | **C** sound energy | **4** | |
| | **D** thermal energy | **3** | |

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

**Answer 08 · Mark scheme** June 2007 | PHY1A | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **3** | **3** | **2** | **4** |

**Answer 09 · Mark scheme** June 2007 | PHY1H | Original Q6 | Legacy

The full source mark scheme begins on page 169. Follow original question 6 in that document.

**Answer 10 · Mark scheme** November 2007 | PHY1A | Original Q3 | Legacy

| | | | | |
|---|---|---|---|---|
| Three | **1** | **1** | **1** | **4** |

**Answer 11 · Mark scheme** November 2007 | PHY1A | Original Q8 | Legacy

| | | | | |
|---|---|---|---|---|
| Eight | **3** | **3** | **2** | **1** |

4.1.2.2 Efficiency

Answer 12 · Mark scheme



**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | any **one** from:<br>• coal<br>• oil<br>• (natural) gas | do **not** accept fossil fuels<br><br>accept diesel<br><br>accept biofuel or a named biofuel eg wood / straw<br><br>accept household / industrial waste owtte | 1 |
| (ii) | 0.3 | accept 30%<br><br>if **2** marks not awarded then:<br><br>allow **1** mark for 30 (without %)<br><br>allow **1** mark for 0.3 with a unit or %<br><br>allow **1** mark for identification of energy input and output eg<br>20 sq input and 6 sq output<br>**or**<br>4 sq input and 1.2 sq output<br>**or**<br>40 sq input and 12 sq output<br>even if subsequent working incorrect<br><br>allow **1** mark for correct expression of 1.2 over 4<br>**or**<br>12 over 40<br>**or**<br>6 over 20 (squares) | 2 |
| (iii) | (nuclear) fission | accept fision provided it is **not** fusion | 1 |

**Question 1 continues on the next page**

4.1.2.2 Efficiency



**PHY1H**

**Question 1 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| (b)(i) | small proportion of energy / power is wasted<br><br>**or**<br><br>transfers most / more / a lot of energy power usefully | accept little / less energy / power / heat is wasted<br><br>do **not** accept it wastes no energy / power | 1 |
| (ii) | it decreases the current / uses low current<br><br>**or**<br><br>it increases the voltage / potential difference<br><br>**or**<br><br>uses high voltage / potential difference<br><br>smaller the current the smaller the energy loss | <br><br><br>accept pd for potential difference<br><br><br><br>accept power / heat for energy | 1<br><br>1 |
| (c)(i) | as a control | accept to make a comparison<br><br>do **not** accept fair test on its own | 1 |
| (c)(ii) | so people know how much data the link was based on<br><br>**or**<br><br>people can judge the significance / reliability of the link | accept idea that larger numbers are better<br><br><br>do **not** accept significance / reliability on its own<br><br>ignore reference to accuracy | 1 |

**Question 1 continues on the next page**

4.1.2.2 Efficiency



**PHY1H**

**Question 1 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| (iii) | other possible factors may be responsible<br>**or**<br>have not been investigated<br><br>named factor<br>eg environment / genetic | | 1<br><br><br><br>1 |
| (iv) | first box ticked plus reason<br><br><br><br>**or**<br>second box plus reason | acceptable reason such as so people know there may be a risk as soon as possible / so that other scientists can use findings<br><br>acceptable reason such as no point to worry / confuse / panic people *(*until the research has been confirmed*)*<br><br>accept idea that it may lead to wrong advice<br><br>do **not** accept in case they are wrong | 1 |
| total | | | 12 |

### 4.1.2.2 Efficiency

**Answer 12 · Mark scheme**

January 2008 | PHY1H | Original Q1 | Legacy

**PHY1H**

4.1.2.2 Efficiency

Answer 13 · Mark scheme



**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | £15 | allow **1** mark for use of 125 (kWh)<br>allow **1** mark for an answer 1500<br>allow **both** marks for 1500 pence / p<br>allow **1** mark for correct calculation of annual cost for either freezer (£27 and £42) | 2 |
| (b) | £45<br>**or**<br>their (a) × 3 | allow **1** mark for correct use of 3<br>allow **1** mark for 12 – 9 = 3 | 2 |

**Question 2 continues on the next page**

4.1.2.2 Efficiency



**PHY1H**

**Question 2 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| (c) | any **two** from:<br><br>yes **plus** explanation<br><br>• less electricity / energy needed / used<br><br>• less (fossil) fuels burned<br><br>• less polluting gases emitted<br><br>**or**<br><br>no **plus** explanation<br><br>• old freezer must be disposed of<br><br>• hazardous chemicals inside freezer<br><br>• *(*lot of*)* energy used in producing new freezer | the marks are for the explanation<br><br>accept less energy wasted<br><br>accept a named fossil fuel<br>do **not** accept conserving (fossil) fuels<br><br>accept a named polluting gas / greenhouse gases / carbon emissions / reduce global warming<br>accept an answer in terms of nuclear fuel<br>eg less nuclear fuel required (1)<br>less nuclear waste (1)<br><br>accept CFC gases | 2 |
| total | | | 6 |

### 4.1.2.2 Efficiency

**Answer 13 · Mark scheme**

January 2008 | PHY1H | Original Q2 | Legacy

**PHY1H**

4.1.2.2 Efficiency

Answer 14 · Mark scheme

January 2008 | PHY1H | Original Q3 | Legacy

**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | makes it warmer / raises the temperature | accept produces convection *(current)*<br><br>accept makes it less dense | 1 |
| (ii) | reduced **or** slows down | | 1 |
| (b)(i) | electrical energy (to run the pump) must be paid for | accept electricity for electrical energy<br><br>accept electricity is needed for the pump<br><br>accept it uses electricity<br><br>accept because of the pump | 1 |
| (ii) | more useful (heat) energy is transferred into the house than the energy used to operate the pump<br>**or**<br>reduced cost of heating the house is greater than the cost of running the (electrical) pump<br>**or**<br>costs little to run compared to the savings made | accept for **1** mark<br>reduces energy bills<br>**or**<br>reduced fuel costs / heating costs owtte<br>do **not** accept it's cheap | 2 |
| total | | | 5 |

### 4.1.2.2 Efficiency

**Answer 14 · Mark scheme**

January 2008 | PHY1H | Original Q3 | Legacy

**PHY1H**

**Answer 15 · Mark scheme**

March 2008 | PHY1AP | Original Q8 | Legacy

| | | | | |
|---|---|---|---|---|
| Eight | **2** | **4** | **4** | **1** |

**Answer 16 · Mark scheme**

June 2008 | PHY1AP | Original Q1 | Legacy

No matching mark scheme was available in the supplied archive for this question.

4.1.2.2 Efficiency

Answer 17 · Mark scheme



**Question 4**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | replaced faster than it is used | accept replaced as quick as it is used<br>accept will never run out<br>do **not** accept can be used again | 1 |
| (a)(ii) | any **two** from:<br>• wind<br>• waves<br>• tides<br>• fall of water<br>• biomass<br>• geothermal | **two** sources required for the mark<br>do **not** accept water / oceans<br>accept OTEC<br>accept hydroelectric<br>accept a named biomass / biofuel eg wood | 1 |
| (b)(i) | any **two** from:<br>• increases from 20 $^{o}$ to 30 $^{o}$<br>• reaches maximum value at 30 $^{o}$<br>• then decreases from 30 $^{o}$<br>• same pattern for each month | accept peaks at 30 $^{o}$ for **both** marks<br>accept goes up then down for **1** mark<br>ignore it's always the lowest at 50$^{o}$ | 2 |
| (b)(ii) | 864 | an answer of 108 gains **2** marks<br>allow **1** mark for using 720 value only from table<br>allow **2** marks for answers 852, 816, 768, 825<br>allow **1** mark for answers 106.5, 102, 96, 103 (.125) | 3 |

**Question 4 continues on the next page**

4.1.2.2 Efficiency



**PHY1H**

**Question 4 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| (c) | the solar cells will not meet demand at all times of the year / day<br><br>**or**<br><br>to make up the shortfall in energy required at certain times of the year<br><br>**or**<br><br>to be able to sell surplus electricity (to the National Grid) | accept to maintain a constant supply of electricity / energy<br><br>accept to provide energy at night<br>do **not** accept because it's cloudy on it's own | 1 |
| total | | | 8 |

### 4.1.2.2 Efficiency

**Answer 17 · Mark scheme** June 2008 | PHY1H | Original Q4 | Legacy

**PHY1H**

**Answer 18 · Mark scheme** November 2008 | PHY1AP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | 0.6 | **4** |
| | **B** | 5 | **3** |
| | **C** | 15 | **2** |
| | **D** | 30 | **1** |
| | | | |

**Answer 19 · Mark scheme** November 2008 | PHY1AP | Original Q5 | Legacy

| | | | | |
|---|---|---|---|---|
| Five | **3** | **1** | **3** | **2** |

**Answer 20 · Mark scheme** November 2008 | PHY1AP | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **3** | **2** | **1** | **2** |

**Answer 21 · Mark scheme** November 2008 | PHY1AP | Original Q9 | Legacy

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

* The whole of question two was removed from the mark scheme and this test was marked out of 32.

4.1.2.2 Efficiency

Answer 22 · Mark scheme



**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a) | 9 | allow **1** mark for correct substitution (1.8 × 5)<br><br>an answer of 9000 gains **1** mark<br><br>an answer of 2 or 15 gains **1** mark | 2 |
| **2**(b) | (3 kW) fan heater | accept 3 kW<br>accept the middle one | 1 |

**Question 2 continues on the next page**

**PHY1H**

**Question 2 continued**

| | | | |
|---|---|---|---|
| **2**(c) | | features common to more than one heater, treat as neutral | |
| | <u>oil-filled</u> | | |
| | low level heat | | 1 |
| | cannot be knocked over / space saving / no trailing wires<br>**or**<br>more control over heat output | do **not** accept just wall-mounted<br><br>do **not** accept just 3 heat settings | |
| | <u>fan</u> | | |
| | warms (office) rapidly<br>**or**<br>can be used to cool air (in summer) | <br><br>accept can be used as a fan<br>accept cool air fan (setting)<br>accept 'it has a cool air setting in case it gets too hot'<br>do **not** accept a specific reference to cooling the heater | 1 |
| | <u>ceramic</u> | | |
| | can be switched on for set periods of time<br>**or**<br>can be switched on before office is used / switched off automatically at night | do **not** accept just has a timer | 1 |
| **Total** | | | **6** |

### 4.1.2.2 Efficiency

**Answer 22 · Mark scheme** January 2009 | PHY1H | Original Q2 | Legacy

**PHY1H**

**Answer 23 · Mark scheme** March 2009 | PHY1AP | Original Q9 | Legacy

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

4.1.2.2 Efficiency

Answer 23 · Mark scheme



# SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

## PHY1AP (Energy and Electricity)

## March 2009

Higher Tier

| Question | Key | | |
|---|---|---|---|
| One | **A** | conduction | **1** |
| | **B** | convection | **2** |
| | **C** | insulation | **4** |
| | **D** | radiation | **3** |
| | | | |
| Two | **A** | generator | **2** |
| | **B** | grid | **4** |
| | **C** | transformer | **3** |
| | **D** | turbine | **1** |

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

### 4.1.2.2 Efficiency

**Answer 24 · Mark scheme** June 2009 | PHY1AP | Original Q4 | Legacy

| | | | | |
|---|---|---|---|---|
| Four | **3** | **3** | **1** | **2** |

**Answer 25 · Mark scheme** June 2009 | PHY1AP | Original Q7 | Legacy

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

**Answer 26 · Mark scheme** June 2009 | PHY1AP | Original Q8 | Legacy

| | | | | |
|---|---|---|---|---|
| Eight | **4** | **2** | **1** | **4** |

**Answer 27 · Mark scheme** June 2009 | PHY1AP | Original Q9 | Legacy

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

4.1.2.2 Efficiency

Answer 28 · Mark scheme



**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a)(i) | 0.6 | accept 60%<br>allow **1** mark for useful energy = 480<br>answer 0.6 with any unit or 60 gains **1** mark only | 2 |
| **3**(a)(ii) | transferred to surroundings | accept goes into the air<br>accept heats the surroundings up<br>accept gets spread out<br>accept transferred into heat (only)<br><br>do **not** accept wasted / lost unless qualified<br>destroyed negates mark<br>transferred into light / sound negates mark | 1 |
| **3**(b)(i) | 1.75 | allow **1** mark for converting to kW<br><br>answers of 0.7, 0.525, 0.35, 0.875, 1.05, 5.25 gains **1** mark<br>answers of 1750 or 17.5 gains **1** mark | 2 |
| **3**(b)(ii) | 21p or £0.21 or their (b)(i) × 12 | | 1 |

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

4.1.2.2 Efficiency



**PHY1H**

**Question 3 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(c) | any **two** from:<br>• (more) electricity needs to be generated<br>• (more) power stations needed<br>• (more) fossil fuels burnt<br>• (more) pollutant gases emitted | (more) electricity is being used<br><br>accept named fossil fuel<br><br>accept named gas<br>accept harmful for pollutant<br>accept greenhouse gases<br>accept atmospheric pollution<br><br>accept answer in terms of any form of electricity generation and an associated environmental problem | 2 |
| **Total** | | | **8** |

### 4.1.2.2 Efficiency

**Answer 28 · Mark scheme**

June 2009 | PHY1H | Original Q3 | Legacy

**PHY1H**

**Answer 29 · Mark scheme**

November 2009 | PHY1AP | Original Q1 | Legacy

| Question | Key | | |
|---|---|---|---|
| One | **A** | 0.6 | **4** |
| | **B** | 140 | **2** |
| | **C** | 200 | **3** |
| | **D** | 300 | **1** |

**Answer 30 · Mark scheme**

November 2009 | PHY1AP | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | chemical | **2** |
| | **B** | electrical | **3** |
| | **C** | kinetic | **1** |
| | **D** | light | **4** |

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

**Answer 31 · Mark scheme**

November 2009 | PHY1AP | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **1** | **4** | **4** | **2** |

4.1.2.2 Efficiency

Answer 32 · Mark scheme



**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a)(i) | kinetic | do **not** accept movement | 1 |
| **2**(a)(ii) | thermal<br>sound | accept heat for thermal<br>do **not** accept noise for sound<br><br>both answers required in either order | 1 |
| **2**(b) | transferred to surroundings / surrounding molecules / atmosphere<br>**or**<br>becomes dissipated / spread out | 'it escapes' is insufficient<br><br>accept warms the surroundings<br>accept degraded / diluted<br>accept a correct description for surroundings eg to the washing machine<br><br>do **not** accept transformed into heat on its own | 1 |
| **2**(c) | a smaller proportion / percentage of the energy supplied is wasted | owtte<br><br>accept a statement such as 'less energy is wasted' for **1** mark<br><br>do **not** accept costs less to run<br><br>ignore references to uses less energy | 2 |
| **2**(d)(i) | 2.4 (p) | accept 2 p if it is clear from the working out this is rounded from 2.4 p<br><br>allow **1** mark for correct substitution of correct values<br>ie 0.2 × 12<br><br>allow **1** mark for calculating cost at 40 °C (13.2 p)<br>**or**<br>cost at 30 °C (10.8 p) | 2 |

**Question 2 continues on the next page . . .**

4.1.2.2 Efficiency



**PHY1H**

**Question 2 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(d)(ii) | any **one** from:<br>• less electricity needed<br>• fewer power stations needed<br>• less fuel is <u>burned</u> | ignore answers in terms of the washing machine releasing less energy<br>an answer in terms of the washing machine releasing $CO_2$ negates the mark<br>do **not** accept less energy is produced<br>accept a correctly named fuel<br>do **not** accept less fuel is needed | 1 |
| **Total** | | | **8** |

### 4.1.2.2 Efficiency

**Answer 32 · Mark scheme**

January 2010 | PHY1H | Original Q2 | Legacy

**PHY1H**

4.1.2.2 Efficiency

Answer 33 · Mark scheme

January 2010 | PHY1H | Original Q5 | Legacy

**Question 5**

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(a)(i) | (dismantle and) remove radioactive waste / materials / fuels | accept nuclear for radioactive<br><br>do **not** accept knock down / shut down | 1 |
| **5**(a)(ii) | increases it | do **not** accept it has a negative effect | 1 |
| **5**(b)(i) | **K** most efficient<br>**or**<br>**M** least efficient<br><br>(efficiency) of **K** and **L** increases, (efficiency) of **M** (almost) constant / slightly reduced | if efficiency is not mentioned it must be implied<br>answers in terms of energy generated only gains no credit<br><br>accept **K** and / or **L** are more efficient than **M**<br><br>all 3 power stations must be mentioned to get this mark | <br><br>1<br><br>1 |
| **5**(b)(ii) | any **two** from:<br>• do not know how many (nuclear) power stations there will be<br>• power stations may continue to increase in efficiency<br>• do not know what type of power station new ones will be<br>• do not know future energy / electricity demands<br>• may be new uses for uranium | <br><br><br>accept new methods may be found to generate electricity / energy<br>accept other ways of generating energy may be expanded<br><br>accept we may become more energy efficient | 2 |
| **Total** | | | **6** |

### 4.1.2.2 Efficiency

**Answer 33 · Mark scheme**

January 2010 | PHY1H | Original Q5 | Legacy

**PHY1H**

4.1.2.2 Efficiency

Answer 34 · Mark scheme



**Question 7**

| question | answers | extra information | mark |
|---|---|---|---|
| **7**(a)(i) | 0.75 | allow **1** mark for correct transformation and substitution<br>ie 0.15 × 5 | 2 |
| **7**(a)(ii) | 2 | accept 1.5 ÷ their (a)(i) correctly calculated | 1 |
| **7**(b) | any **one** from:<br>• seasonal changes<br>• cloud cover | accept specific changes in conditions<br>eg shorter hours of daylight in winter<br><br>accept idea of change<br>must be stated or unambiguously implied<br>eg demand for water will not (always) match supply of solar energy<br><br>do **not** accept figures are average on its own<br>do **not** accept solar panels are in the shade | 1 |
| **Total** | | | **4** |

### 4.1.2.2 Efficiency

**Answer 35 · Mark scheme** March 2010 | PHY1AP | Original Q1 | Legacy

| Question | | | Key |
|---|---|---|---|
| One | **A** | conduction | **4** |
| | **B** | convection | **3** |
| | **C** | insulation | **2** |
| | **D** | radiation | **1** |
| | | | |

**Answer 36 · Mark scheme** March 2010 | PHY1AP | Original Q2 | Legacy

| | | | |
|---|---|---|---|
| Two | **A** | heat (thermal energy) | **1** |
| | **B** | light | **3** |
| | **C** | movement (kinetic energy) | **4** |
| | **D** | sound | **2** |
| | | | |

**Answer 37 · Mark scheme** March 2010 | PHY1AP | Original Q6 | Legacy

| | | | | |
|---|---|---|---|---|
| Six | **3** | **4** | **2** | **1** |

**Answer 38 · Mark scheme** June 2010 | PHY1AP | Original Q4 | Legacy

| | | | | |
|---|---|---|---|---|
| Four | 3 | 2 | 4 | 3 |

**Answer 39 · Mark scheme** June 2010 | PHY1AP | Original Q5 | Legacy

| | | | | |
|---|---|---|---|---|
| Five | 2 | 2 | 3 | 2 |

**Answer 40 · Mark scheme** June 2010 | PHY1AP | Original Q7 | Legacy

| | | | | |
|---|---|---|---|---|
| Seven | 4 | 3 | 4 | 4 |

### 4.1.2.2 Efficiency

**Answer 41 · Mark scheme**

June 2010 | PHY1AP | Original Q9 | Legacy

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

4.1.2.2 Efficiency

Answer 42 · Mark scheme



## Question 1

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(a) | conduction | | 1 |
| **1**(b)(i) | any **one** from:<br>• starting temperature (of cold water)<br>• pipe length<br>• pipe diameter<br>• pipe (wall) thickness<br>• volume of cold water<br>• temperature of hot water (in)<br>• time | temperature is insufficient<br>accept size of pipe<br>accept amount for volume | 1 |
| **1**(b)(ii) | (type of) material is categoric | accept one variable is categoric<br>accept variable(s) are categoric<br>accept it is categoric<br>accept variable(s) are not continuous<br>descriptions of variables ie names and numbers is insufficient | 1 |
| **1**(b)(iii) | copper<br>greatest temperature change | only scores if copper chosen<br>accept heat for temperature<br>accept heated water the fastest<br>accept it was hottest (after 10 minutes)<br>accept it is the best / a good conductor | 1<br>1 |

**Question 1 continues on the next page . . .**

4.1.2.2 Efficiency



**PHY1H**

**Question 1 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(c) | larger (surface) area | accept the pipe is longer<br><br>accept hot (dirty) water (inside pipe) is in contact with the cold water (outside pipe) for a longer time<br><br>the pipe is a spiral is insufficient | 1 |
| **Total** | | | **6** |

### 4.1.2.2 Efficiency

**Answer 42 · Mark scheme** June 2010 | PHY1H | Original Q1 | Legacy

**PHY1H**

4.1.2.2 Efficiency

Answer 43 · Mark scheme



## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a)(i) | 2.1 | correct answer only | 1 |
| **3**(a)(ii) | 3.15<br>**or**<br>their (a)(i) × 1.5 correctly calculated | allow **1** mark for correct substitution<br>ie 2.1 × 1.5<br>**or**<br>their (a)(i) × 1.5 | 2 |
| | kilowatt-hour | accept kWh<br><br>**or**<br>a substitution 2100 × 5400 scores **1** mark<br><br>2100 × 5400 incorrectly calculated with answer in joules scores **2** marks<br><br>an answer of 11 340 000 scores **2** marks<br><br>an answer of 11 340 000 J scores **3** marks | 1 |
| **3**(a)(iii) | most (input) energy is usefully transformed | accept does not waste a lot of energy<br><br>accept most of the output / energy is useful<br><br>do **not** accept it does not waste energy | 1 |

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

4.1.2.2 Efficiency



**PHY1H**

**Question 3 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(b) | the room is losing energy / heat | | 1 |
| | at the same rate as the heater supplies it | this mark only scores if the first is scored<br><br>do **not** accept heater reaches same temperature as room / surroundings<br><br>rate of heat gain = rate of heat loss scores both marks | 1 |
| **Total** | | | **7** |

### 4.1.2.2 Efficiency

**Answer 43 · Mark scheme** June 2010 | PHY1H | Original Q3 | Legacy

**PHY1H**

4.1.2.2 Efficiency

Answer 44 · Mark scheme

June 2010 | PHY1H | Original Q5 | Legacy

## Question 5

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(a)(i) | tidal / tides | do **not** accept water / waves | 1 |
| **5**(a)(ii) | any **three** from:<br>• shorter journey time<br>• less pollution from traffic<br>• energy source is free<br>• energy source / tides are predictable<br>• produces less / no pollutant gases (than fuel burning power stations)<br>• conserves supplies of fossil fuels<br>• uses renewable energy (to generate electricity)<br>• provides employment<br>• no visual / noise pollution | accept easier to go from town to town<br>accept less petrol / fuel used<br>accept $CO_2$ / carbon emissions reduced<br>accept no $CO_2$ / greenhouse gases produced<br>accept air pollution for pollutant gases<br>less harm to the environment is insufficient<br>the electricity is cheaper is insufficient<br>do **not** accept produces no radioactive waste<br>the pollution mark scores twice only if it is clear one reference is to traffic and the other is to electricity generation | 3 |

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

4.1.2.2 Efficiency



**PHY1H**

**Question 5 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(b)(i) | (sometimes) electricity demand may be greater than supply (of electricity from the system)<br>**or**<br>can sell (excess) electricity (to the National Grid) | accept in case turbines / generators fail | 1 |
| **5**(b)(ii) | decreases the current<br><br>reducing energy loss (along cables) | accept increases the voltage<br><br>accept less heat / thermal energy lost / produced | 1<br><br>1 |
| **Total** | | | **7** |

### 4.1.2.2 Efficiency

**Answer 44 · Mark scheme** June 2010 | PHY1H | Original Q5 | Legacy

**PHY1H**

**Answer 45 · Mark scheme** November 2010 | PHY1AP | Original Q2 | Legacy

| | | | | |
|---|---|---|---|---|
| Two | **A** electrical to light **1**<br>**B** electrical to sound **2**<br>**C** light to electrical **4**<br>**D** sound to electrical **3** | | | |
| | **A** | **B** | **C** | **D** |

**Answer 46 · Mark scheme** November 2010 | PHY1AP | Original Q7 | Legacy

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

**Answer 47 · Mark scheme** November 2010 | PHY1AP | Original Q9 | Legacy

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

4.1.2.2 Efficiency

Answer 48 · Mark scheme



## Question 4

| question | answers | extra information | mark |
|---|---|---|---|
| **4**(a)(i) | kinetic | accept KE<br><br>do **not** accept movement | 1 |
| **4**(a)(ii) | 0.75<br><br>**or**<br><br>75 % | allow **1** mark for correct substitution<br><br>ie $\frac{60\,000}{80\,000}$<br><br>an answer 0.75 %<br>**or** 0.75 with a unit gains **1** mark only<br><br>an answer 75 with or without a unit gains **1** mark only | 2 |
| **4**(b) | any **one** from:<br><br>• large areas of land are flooded<br><br>• peoples homes may be destroyed<br><br>• habitat (of animals and plants) lost / damaged | <br><br>uses large areas of land / takes up large areas of land is insufficient<br><br><br><br><br>construct is neutral<br>very noisy is neutral | 1 |

**Question 4 continues on the next page . . .**

4.1.2.2 Efficiency



**PHY1H**

**Question 4 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **4**(c)(i) | system of cables <u>and</u> transformers | both required for the mark<br><br>accept power lines / wires for cables<br>ignore reference to pylons<br><br>inclusions of power stations / consumers negates answer | 1 |
| **4**(c)(ii) | less energy loss / wasted (in the cables)<br><br>as the cables are shorter | accept heat for energy<br>do **not** accept no energy loss<br>do **not** accept electricity for energy | 1<br><br>1 |
| **Total** | | | **7** |

### 4.1.2.2 Efficiency

**Answer 48 · Mark scheme** January 2011 | PHY1H | Original Q4 | Legacy

**PHY1H**

**Answer 49 · Mark scheme** March 2011 | PHY1AP | Original Q1 | Legacy

| Question | | | Key |
|---|---|---|---|
| One | **A** | falling water | **4** |
| | **B** | sunlight | **1** |
| | **C** | waves | **2** |
| | **D** | wind | **3** |

**Answer 50 · Mark scheme** March 2011 | PHY1AP | Original Q4 | Legacy

| | | | |
|---|---|---|---|
| Four | **A** | coal-fired | **1** |
| | **B** | geothermal | **3** |
| | **C** | nuclear | **2** |
| | **D** | wind farm | **4** |

**Answer 51 · Mark scheme** March 2011 | PHY1AP | Original Q5 | Legacy

| | | | |
|---|---|---|---|
| Five | **A** | economical | **2** |
| | **B** | efficient | **1** |
| | **C** | environmental | **3** |
| | **D** | ethical | **4** |

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

**Answer 52 · Mark scheme** March 2011 | PHY1AP | Original Q7 | Legacy

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

**Answer 53 · Mark scheme** March 2011 | PHY1AP | Original Q8 | Legacy

| | | | | |
|---|---|---|---|---|
| Eight | **2** | **4** | **2** | **4** |

**Answer 54 · Mark scheme** March 2011 | PHY1AP | Original Q9 | Legacy

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

4.1.2.2 Efficiency

Answer 54 · Mark scheme



# GCSE

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

Objective Test Answer Key

## PHY1AP (Energy and Electricity)

## March 2011

Higher Tier

| Question | Key | | |
|---|---|---|---|
| One | **A** | economical | **2** |
| | **B** | efficient | **1** |
| | **C** | environmental | **3** |
| | **D** | ethical | **4** |
| | | | |
| Two | **A** | . . . increase the rate at which infra red radiation is absorbed | **4** |
| | **B** | . . . increase the rate at which infra red radiation is emitted | **3** |
| | **C** | . . . improve the ability to reflect visible light | **1** |
| | **D** | . . . prevent the reflection of visible light | **2** |

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

### 4.1.2.2 Efficiency

**Answer 55 · Mark scheme** June 2011 | PHY1AP | Original Q2 | Legacy

| | | | | | |
|---|---|---|---|---|---|
| Two | **A** | food mixer | | | **2** |
| | **B** | iron | | | **1** |
| | **C** | radio | | | **3** |
| | **D** | television | | | **4** |
| | | | | | |
| | **A** | | **B** | **C** | **D** |

**Answer 56 · Mark scheme** June 2011 | PHY1AP | Original Q7 | Legacy

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

**Answer 57 · Mark scheme** June 2011 | PHY1AP | Original Q8 | Legacy

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

**Answer 58 · Mark scheme** June 2011 | PHY1AP | Original Q9 | Legacy

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

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

4.1.2.2 Efficiency

Answer 59 · Mark scheme

June 2011 | PHY1H | Original Q1 | Legacy

## Question 1

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(a)(i) | radiation | ignore thermal / infrared | 1 |
| **1**(a)(ii) | black is a better / good absorber (of heat / radiation)<br><br>(so) temperature rises faster<br><br>**or**<br><br>white is a worse / poor absorber (of heat / radiation) (1)<br><br>(so if white faces) temperature would rise slower (1) | ignore reference to black being a good emitter<br><br>black absorbs heat is insufficient<br><br>do **not** accept black attracts / absorbs the Sun<br><br>do **not** accept black attracts heat<br><br>must be an indication of heating up quicker<br><br>accept white is a better / good reflector (of heat / radiation)<br><br>ignore any reference to light | 1<br><br>1 |
| **1**(b)(i) | 1.2 (hours) **or** 1 hour 12 minutes | no tolerance | 1 |
| **1**(b)(ii) | increases (rapidly at first then increases at a slower rate) | do **not** accept increases at a steady rate | 1 |

**Question 1 continues on the next page**

**PHY1H**

**Question 1 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(c)(i) | any **two** from:<br>• (fill with) same mass / volume / amount of water<br>• same level of (sun)light / sunshine<br>• outside for the same (length of) time<br>• outside at same time (of day / year)<br>• initial water temperature<br>• the side of the bag facing the Sun | accept same heat / light source<br>accept same place<br>do **not** accept any factors to do with the construction of plastic bags eg thickness | 2 |
| **1**(c)(ii) | curved line drawn above given line | both lines must start from the same point<br>ignore if continues beyond one hour or levels off after 1 hour<br>do **not** accept a straight line | 1 |
| **Total** | | | **8** |

### 4.1.2.2 Efficiency

**Answer 59 · Mark scheme** June 2011 | PHY1H | Original Q1 | Legacy

**PHY1H**

4.1.2.2 Efficiency

Answer 60 · Mark scheme



## Question 4

| question | answers | extra information | mark |
|---|---|---|---|
| **4**(a)(i) | 4 | allow **1** mark for correct transformation and substitution<br><br>ie $\frac{0.6}{0.15}$<br><br>substitution only scores if no subsequent steps are shown | 2 |
| **4**(a)(ii) | diagram showing two output arrows with one arrow wider than the other with the narrower arrow labelled electrical / electricity / useful | | 1 |
| **4**(a)(iii) | any **one** from:<br><br>• time of day / year<br>• position of solar cells<br>• angle of solar cells (to the Sun)<br>• latitude<br>• cloud cover<br>• solar cells covered in dust / dirt | accept charger for solar cells | 1 |
| | causes a change in intensity of sun(light) | accept any reasonable suggestion that would lead to a change in intensity of sun(light)<br><br>the weather is insufficient<br><br>do **not** accept any physical changes to the charger eg area<br><br>accept brightness for intensity<br>accept a description of the reduction of intensity | 1 |

**Question 4 continues on the next page**

**PHY1H**

**Question 4 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **4**(b) | any **one** from:<br>• to check reliability / validity / accuracy<br>• to avoid bias | | 1 |
| **4**(c) | any **two** from:<br>• produce no / less (air) pollution<br>• energy is free<br>• (energy) is renewable<br>• conserves fossil fuel stocks<br>• can be used in remote areas<br>• do not need to connect to the National Grid | accept named pollutant<br>accept produces no waste (gases)<br>accept it is a free resource<br>do **not** accept it is free | 2 |
| **Total** | | | **8** |

### 4.1.2.2 Efficiency

**Answer 60 · Mark scheme** June 2011 | PHY1H | Original Q4 | Legacy

**PHY1H**

**Answer 61 · Mark scheme** November 2011 | PHY1AP | Original Q3 | Legacy

| | | | | |
|---|---|---|---|---|
| Three | **4** | **2** | **4** | **2** |

**Answer 62 · Mark scheme** November 2011 | PHY1AP | Original Q5 | Legacy

| | | | | |
|---|---|---|---|---|
| Five | **1** | **3** | **4** | **2** |

4.1.2.2 Efficiency

Answer 63 · Mark scheme

June 2012 | PH1HP | Original Q1 | Legacy

## Question 1

| question | answers | extra information | mark |
|---|---|---|---|
| 1(a) | any **two** from:<br>• black is a good emitter of (infrared radiation)<br>• large surface (area)<br>• matt surfaces are better emitters (than shiny surfaces) | accept heat for radiation<br>ignore reference to absorbing radiation<br>accept matt surfaces are good emitters<br>ignore reference to good conductor | 2 |
| 1(b) | 90 % or 0.9(0) | efficiency = useful energy out / total energy in (×100%)<br>allow **1** mark for correct substitution<br>ie 13.5 / 15<br>provided no subsequent step shown<br>an answer of 90 scores **1** mark<br>an answer of 90 / 0.90 with a unit scores **1** mark | 2 |
| 1(c) | (producing) light | allow (producing) sound | 1 |

**Question 1 continues on the next page**

**PH1HP**

**Question 1 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **1(d)** | any **two** from:<br>• wood is renewable<br><br>• (using wood) conserves fossil fuels<br><br>• wood is carbon neutral | <br>accept wood grows again / quickly<br>accept wood can be replanted<br><br>accept doesn't use fossil fuels<br><br>accept a description<br><br>cheaper / saves money is insufficient | 2 |
| **1(e)** | 2 550 000<br><br><br><br><br><br>joules /J | $E = m \times c \times \theta$<br><br>allow **1** mark for correct substitution<br>ie 100 × 510 x 50<br>provided no subsequent step shown<br><br>answers of 1 020 000, 3 570 000 gain **1** mark<br><br>accept kJ / MJ<br><br>do **not** accept j<br><br><br><br>for full credit the unit and numerical answer must be consistent | 2<br><br><br><br><br><br>1 |
| **Total** | | | **10** |

### 4.1.2.2 Efficiency

**Answer 63 · Mark scheme**

June 2012 | PH1HP | Original Q1 | Legacy

**PH1HP**

4.1.2.2 Efficiency

Answer 64 · Mark scheme



## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| 2(a)(i) | kinetic (energy) | allow gravitational potential (energy) / gpe<br><br>movement is insufficient | 1 |
| 2(a)(ii) | dissipates into the surroundings | allow warms up the surroundings / air / motor<br><br>accept lost to the surroundings<br>accept lost as heat<br><br>ignore reference to sound<br><br>it is lost is insufficient | 1 |
| 2(b) | energy (required) increases with load<br><br>further amplification eg increases slowly at first (or up to 4 / 5 N), then increases rapidly | accept positive correlation<br><br>do **not** accept (directly) proportional<br><br>simply quoting figures is insufficient<br><br>an answer that only describes the shape of the line gains **no** marks | 1<br><br>1 |

**Question 2 continues on the next page**

**PH1HP**

**Question 2 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(c)(i)** | 2880 | $E = P \times t$<br>accept £28.80 for all **3** marks<br>an answer £2880 gains **2** marks<br>allow **1** mark for obtaining 48 h **or** converting to kW<br>allow **2** marks for correct substitution<br>ie $4 \times 48 \times 15$<br>note: this substitution may be shown as two steps<br>an answer 2 880 000 gains **2** marks<br>an answer £4.80 / 480 gains **2** marks<br>an answer of 192 (ie calculation of energy without subsequent calculation of cost) gains **1** mark) | 3 |
| **2(c)(ii)** | any sensible suggestion eg<br>conserves fossil fuels<br>less (fossil) fuels burned<br>less pollutant gas (produced)<br>less greenhouse gas (produced) | accept a named pollutant gas<br>saves energy is insufficient | 1 |
| **Total** | | | **8** |

### 4.1.2.2 Efficiency

**Answer 64 · Mark scheme**

June 2012 | PH1HP | Original Q2 | Legacy

**PH1HP**

4.1.2.2 Efficiency

Answer 65 · Mark scheme



## Question 2

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)** | (matt) black is a good <u>emitter</u> of infrared / radiation | accept heat for infrared / radiation<br>ignore reference to good absorber<br>attracts heat negates this marking point | 1 |
| | to give maximum (rate of) energy transfer (to surroundings) | accept temperature (of coolant) falls fast(er)<br><br>accept black emits more radiation for **1** mark<br><br>black emits most radiation / black is the best emitter of radiation for **2** marks | 1 |
| **2(b)** | the fins increase the surface area | accept heat for energy | 1 |
| | so increasing the (rate of) energy transfer<br>**or**<br>so more fins greater (rate of) energy transfer | | 1 |
| **2(c)** | 114 000 | allow **1** mark for correct temperature change, ie 15 (°C)<br>**or**<br>allow **2** marks for correct substitution, ie 2 × 3800 × 15<br><br>answers of 851 200 **or** 737 200 gain **2** marks<br>**or**<br>substitution 2 × 3800 × 112 **or** 2 × 3800 × 97 gains **1** mark<br><br>an answer of 114 kJ gains **3** marks | 3 |

**Question 2 continues on the next page . . .**

4.1.2.2 Efficiency

Answer 65 · Mark scheme



**PH1HP**

**Question 2 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(d)** | increases the efficiency | | 1 |
| | less (input) energy is wasted<br>**or**<br>more (input) energy is usefully used | accept some of the energy that would have been wasted is (usefully) used<br>accept heat for energy | 1 |
| **Total** | | | **9** |

### 4.1.2.2 Efficiency

**Answer 65 · Mark scheme**

January 2013 | PH1HP | Original Q2 | Legacy

**PH1HP**

4.1.2.2 Efficiency

Answer 66 · Mark scheme

June 2013 | PH1HP | Original Q1 | Legacy

## Question 1

| question | answers | extra information | mark |
|---|---|---|---|
| **1(a)** | warms it | do **not** accept answers in terms of waste gases **or** pollution | 1 |
| **1(b)** | 80% **or** 0.8 | answers of 80 **or** 0.8 plus a unit gain **1** mark **only**<br>**or** allow **1** mark for a correct substitution, ie $\frac{16}{20}$<br><br>an answer of 35% **or** 0.35 gains **1** mark<br><br>answers of 85%, 75%, 0.85 **or** 0.75 gain **1** mark | 2 |
| **1(c)** | some of the energy that would be wasted (by a coal-burning power station)<br><br>is usefully used (to heat homes etc) | accept less waste energy<br><br>accept energy used to heat homes etc | 1<br><br>1 |
| **1(d)(i)** | A system of cables and transformers | | 1 |
| **1(d)(ii)** | less energy / power loss / wasted (in shorter cables) | accept no energy / power loss / wasted (in shorter cables)<br><br>accept energy is lost when transmitted through cables<br><br>do **not** accept electricity for energy | 1 |
| **Total** | | | **7** |

### 4.1.2.2 Efficiency

**Answer 66 · Mark scheme**

June 2013 | PH1HP | Original Q1 | Legacy

**PH1HP**

4.1.2.2 Efficiency

Answer 67 · Mark scheme

June 2013 | PH2HP | Original Q2 | Legacy

**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)(i)** | to obtain a range of p.d. values | accept increase / decrease current / p.d. / voltage / resistance<br><br>accept to change / control the current / p.d. / voltage / resistance<br><br>to provide resistance is insufficient<br><br>a variable resistor is insufficient<br><br>do **not** accept electricity for current | 1 |
| **2(a)(ii)** | temperature of the bulb increases | accept bulb gets hot(ter)<br><br>accept answers correctly expressed in terms of collisions between (free) electrons and ions / atoms<br><br>bulb gets brighter is insufficient | 1 |
| **2(a)(iii)** | 36<br><br>watt(s) / W | allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown<br><br>accept joules per second / J/s<br><br>do **not** accept w | 2<br><br>1 |

**Question 2 continues on the next page . . .**

**PH2HP**

**Question 2 continued . . .**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(b)** | Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking. | | 6 |

| **0 marks** | **Level 1 (1–2 marks)** | **Level 2 (3–4 marks)** | **Level 3 (5–6 marks)** |
|---|---|---|---|
| No relevant content. | There is a basic comparison of either a cost aspect or an energy efficiency aspect. | There is a clear comparison of either the cost aspect or energy efficiency aspect<br>**OR**<br>a basic comparison of both cost and energy efficiency aspects. | There is a detailed comparison of both the cost aspect and the energy efficiency aspect.<br>For full marks the comparisons made should support a conclusion as to which type of bulb is preferable. |

**Examples of the points made in the response:**

**cost**
- halogen are cheaper to buy
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

**energy efficiency**
- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

simply giving cost figures is insufficient

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

### 4.1.2.2 Efficiency

**Answer 67 · Mark scheme**

June 2013 | PH2HP | Original Q2 | Legacy

**PH2HP**

4.1.2.2 Efficiency

Answer 68 · Mark scheme

June 2013 | PH3HP | Original Q7 | Legacy

## Question 7

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

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

**PH3HP**

**Question 7 continued . . .**

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

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

4.1.2.2 Efficiency

Answer 69 · Mark scheme

June 2014 | PH1HP | Original Q5 | Legacy

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| 5(a) | water moves (from a higher level to a lower level)<br><br>transferring GPE to KE<br><br>rotating a turbine to turn a generator<br><br>transferring KE to electrical energy | <br><br><br><br>accept driving or turning or spinning for rotating moving is insufficient<br><br><br>transferring GPE to electrical energy gains **1** mark of the **2** marks available for energy transfers | 1<br><br>1<br><br>1<br><br>1 | AO1 1.4.1b |
| 5(b) | (TVs in stand-by) use electricity<br><br>generating electricity (from fossil fuels) produces $CO_2$<br><br>($CO_2$) contributes to global warming | accept power / energy<br><br>accept greenhouse gas<br>accept sulfur dioxide<br><br>accept climate change for global warming<br>accept greenhouse effect if $CO_2$ given<br><br>accept acid rain if linked to sulfur dioxide | 1<br><br>1<br><br>1 | AO1<br>AO2<br>1.4.1f |
| 5(c) | a factor other than scientific is given, eg economic, political or legal | personal choice is insufficient | 1 | AO3 1.2 |
| **Total** | | | **8** | |

### 4.1.2.2 Efficiency

**Answer 70 · Mark scheme** June 2014 | PH1HP | Original Q6 | Legacy

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| **6(a)** | air near freezer compartment is cooled or loses energy | accept air at the top is cold | 1 | AO1 1.1.3a |
| | cool air is (more) dense or particles close(r) together (than warmer air) | do **not** allow the particles get smaller / condense | 1 | |
| | so (cooler) air falls | | 1 | |
| | air (at bottom) is displaced / moves upwards / rises | do **not** allow heat rises<br>accept warm air (at the bottom) rises | 1 | |
| **6(b)** | if volume is doubled, energy use is not doubled<br>**or**<br>volume ÷ energy not a constant ratio | | 1 | AO3 1.1.3 |
| | correct reference to data, eg<br>500 is 2×250 but 630 not 2×300 | | 1 | |
| **6(c)** | accept suitable examples, eg | | | AO3 1.2 |
| | advantage:<br>• reduces emissions into atmosphere<br>• lower input power or uses less energy or wastes less energy<br>• costs less to run | cost of buying or installing new fridge is insufficient<br><br>ignore reference to size of fridge | 1 | |
| | disadvantage:<br>• land fill<br>• energy waste in production<br>• cost or difficulty of disposal<br>• transport costs | | 1 | |
| **Total** | | | **8** | |

4.1.2.2 Efficiency

Answer 71 · Mark scheme

June 2014 | PH1HP | Original Q8 | Legacy

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| 8(a)(i) | 5.88 (watts) | an answer of 5.9 scores **2** marks<br>allow **1** mark for correct substitution ie<br>$0.42 = \frac{\text{power out}}{14}$<br>allow **1** mark for an answer of 0.0588 or 0.059 | 2 | AO2 1.2.1d |
| 8(a)(ii) | 8.12 | allow 14 – their 8(a)(i) correctly calculated | 1 | AO2 1.2.1a |
| 8(b)(i) | input power/energy would be (much) less<br>(reducing cost of running) | accept the converse<br>electricity is insufficient | 1 | AO1 AO2 1.2 |
| | (also) produce less waste energy / power | accept 'heat' for waste energy | 1 | |
| | (as the waste energy / power) increases temperature of the cabinet | | 1 | |
| | so cooler on for less time | | 1 | |
| 8(b)(ii) | line graph<br>both variables are continuous | need to get both parts correct<br>accept scattergram or scatter graph<br>allow the data is continuous | 1 | AO3 1.2c |

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

4.1.2.2 Efficiency

Answer 71 · Mark scheme

June 2014 | PH1HP | Original Q8 | Legacy

**Question 8 continued . . .**

| Question | Answers | Extra information | Mark | AO spec ref |
|---|---|---|---|---|
| 8(c) | number of bulbs used-halogen=24 (LED=1) | | 1 | AO2 AO3 1.2 |
| | total cost of LED = £30 + £67.20 = £97.20 | accept a comparison of buying costs of halogen £36 and LED £30 | 1 | |
| | total cost of halogen= 24 x £1.50 + 24 x £16.00 = £420<br>**or**<br>buying cost of halogen is £36 **and** operating cost is £384 | accept a comparison of operating costs of halogen £384 and LED £67.20<br><br>allow for **3** marks the difference in total cost is £322.80 if the number 24 has not been credited | 1 | |
| | statement based on correct calculations that overall LED is cheaper | must be **both** buying **and** operating costs | 1 | |
| | an alternative way of answering is in terms of cost per hour: | | | |
| | buying cost per hour for LED = $\left(\frac{£30.00}{48000}\right)$ = 0.0625p/£0.000625<br><br>buying cost per hour for halogen = $\left(\frac{£1.50}{2000}\right)$ = 0.075p/£0.00075 | a calculation of both buying costs scores **1** mark | | |
| | operating cost per hour for LED = $\left(\frac{£67.20}{48000}\right)$ = 0.14p/£0.0014<br><br>operating cost per hour for halogen = $\left(\frac{£16.00}{2000}\right)$ = 0.8p/£0.008 | a calculation of both operating costs scores **1** mark | | |
| | **all** calculations show a correct unit | **all** units correct scores **1** mark | | |
| | statement based on correct calculations of **both** buying **and** operating costs, that overall LED is cheaper | correct statement scores **1** mark | | |
| **Total** | | | **12** | |

### 4.1.2.2 Efficiency

**Answer 72 · Mark scheme** June 2015 | PH1HP | Original Q1 | Legacy

The full source mark scheme begins on page 182. Follow original question 1 in that document.

**Answer 73 · Mark scheme** June 2015 | PH1HP | Original Q2 | Legacy

The full source mark scheme begins on page 182. Follow original question 2 in that document.

**Answer 74 · Mark scheme** June 2016 | PH1HP | Original Q3 | Legacy

The full source mark scheme begins on page 198. Follow original question 3 in that document.

**Answer 75 · Mark scheme** June 2016 | PH1HP | Original Q6 | Legacy

The full source mark scheme begins on page 198. Follow original question 6 in that document.

### 4.1.2.2 Efficiency

**Answer 76 · Mark scheme** June 2017 | PH1HP | Original Q6 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **6(a)** | 6.3 (W) | accept an answer that rounds to 6.3 W<br><br>allow **1** mark for correct substitution<br>ie $0.40 = \left(\frac{2.5}{\text{total power}}\right)$<br><br>**or** $40 = \left(\frac{2.5}{\text{total power}}\right) \times 100$ | 2 | AO2<br>1.2.1d |
| **6(b)** | 4 (hours) | allow **2** marks for an answer of 14 400 (seconds)<br>**or**<br>allow **2** marks for an answer of 240 (minutes)<br><br>allow **1** mark for correct substitution<br>ie 36 000 = 2.5 x t<br><br>allow **2** marks for an answer of 0.004<br><br>allow **1** mark for an answer of 14.4<br><br>for a student who uses 6.3 W or 6.25 W allow **2** marks for an answer of 1.6 hours<br><br>allow **1** mark for an answer of 5714 or 5760 or 5.71 or 5.76 | 3 | AO2<br>1.3.1c |
| **6(c)** | lower power input<br><br>(because)<br>solar cells not pointed directly at Sun<br>**or**<br>large amount of cloud<br>**or**<br>solar cells in shade<br>**or**<br>dust on solar cells | allow less light<br><br>ignore efficiency or description of energy transfer to the surroundings<br><br>weather is insufficient | 1<br><br>1 | AO1<br>1.4.1c |

4.1.2.2 Efficiency

Answer 76 · Mark scheme

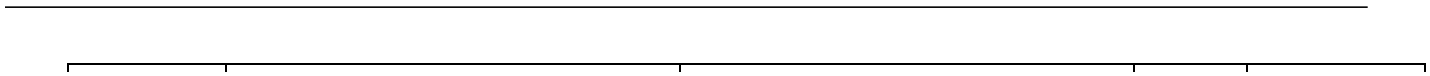


| | | | | |
|---|---|---|---|---|
| **6(d)** | | accept converse answers which refer to the phone switched off | | AO2 1.3.1a,b |
| | (when the phone is switched on) energy from the solar cell is transferred to the battery and the phone **or** only some of the energy from the solar cell charges the battery | accept power for energy in first marking point only | 1 | |
| | (so) the battery stores less energy per second | takes less time to charge when switched off is insufficient | 1 | |
| **Total** | | | **9** | |

### 4.1.2.2 Efficiency

**Answer 76 · Mark scheme**

June 2017 | PH1HP | Original Q6 | Legacy



### 4.1.2.2 Efficiency

**Answer 77 · Mark scheme** June 2018 | 8463/1H | Original Q5

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

4.1.2.2 Efficiency

Answer 77 · Mark scheme



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

### 4.1.2.2 Efficiency

**Answer 78 · Mark scheme** June 2018 | 8463/1H | Original Q10

| Question | Answers | Extra information | Mark | AO/ Spec. Ref |
|---|---|---|---|---|
| **10.1** | | an answer of 27 600 (kg) scores **3** marks | | AO2 4.3.1.1 |
| | $1.2 = \frac{m}{2.3 \times 10^4}$ | | 1 | |
| | $m = 1.2 \times 2.3 \times 10^4$ | | 1 | |
| | m = 27 600 (kg)<br>**or**<br>$m = 2.76 \times 10^4$ (kg) | allow an answer of 28 000 (kg) or $2.8 \times 10^4$ (kg) | 1 | |
| **10.2** | | allow power output for kinetic energy throughout | | AO3 4.1.1.2 |
| | mass of air passing the turbine blades is halved which decreases kinetic energy by a factor of two | | 1 | |
| | (wind speed is halved) decreasing kinetic energy by a factor of four | | 1 | |
| | so kinetic energy decreases by a factor of eight | | 1 | |
| **10.3** | | an answer that rounds to 7.50 (m/s) scores **3** marks | | AO2 4.1.1.2 |
| | $388\,000 = 0.5 \times 13\,800 \times v^2$ | this mark may be awarded if P is incorrectly / not converted | 1 | |
| | $v^2 = \frac{(2 \times 388\,000)}{13\,800}$ | this mark may be awarded if P is incorrectly / not converted | 1 | |
| | **or** | | | |
| | $v^2 = \frac{388\,000}{(0.5 \times 13\,800)}$ | | | |
| | **or** | | | |
| | $v^2 = 56.2$ | | | |
| | v = 7.50 (m/s) | an answer that rounds to 7.50 (m/s) only | 1 | |
| **Total** | | | **9** | |

4.1.2.2 Efficiency

Answer 79 · Mark scheme

June 2018 | 8463/2H | Original Q7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.1 | any **one** from:<br>• too few turns / coils on the secondary<br>• p.d. across the primary was reduced | allow number of turns / coils on the primary was increased<br><br>ignore human error | 1 | AO3<br>4.7.3.4 |
| 07.2 | the p.d. (across the secondary) goes above 2V | allow p.d. across secondary is higher than p.d. across primary after 20 turns | 1 | AO3<br>4.7.3.4 |
| 07.3 | it increases (until the nails reach a constant temperature) | | 1 | AO1<br>4.6.3.1 |

4.1.2.2 Efficiency

Answer 79 · Mark scheme

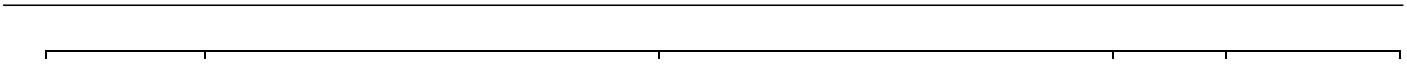
June 2018 | 8463/2H | Original Q7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 07.4 | | an answer of 1.2 (A) scores **5** marks | | AO2 4.7.3.4 |
| | $\frac{640}{4} = \frac{V_p}{1.75}$ | | 1 | |
| | $V_p = \frac{640 \times 1.75}{4}$ | | 1 | |
| | $V_p = 280$ (V) | | 1 | |
| | $280 \times I_p = 336$ | allow their calculated $V_p \times I_p = 336$ | 1 | |
| | $I_p = 1.2$ (A) | allow an answer that is consistent with their calculated value of $V_p$ | 1 | |
| | **or** | | | |
| | $336 = I_s \times 1.75$ (1) | | | |
| | $I_s = \frac{336}{1.75}$ (1) | | | |
| | $I_s = 192$ (A) (1) | | | |
| | $I_p = 192 \times \frac{4}{640}$ (1) | allow $I_p$ = their calculated $I_s \times \frac{4}{640}$ | | |
| | $I_p = 1.2$ (A) (1) | allow an answer that is consistent with their calculated value of $I_s$ | | |
| **Total** | | | **8** | |

### 4.1.2.2 Efficiency

**Answer 79 · Mark scheme**

June 2018 | 8463/2H | Original Q7



4.1.2.2 Efficiency

Answer 80 · Mark scheme

June 2019 | 8463/1H | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 1.1 | The energy transferred each second to the bulb. | | 1 | 4.1.1.4 AO1 |
| 1.2 | power = potential difference × current<br>**or**<br>$P = VI$ | | 1 | 4.2.4.1 AO1 |
| 1.3 | $40 = I \times 230$<br>$I = \frac{40}{230}$<br>I = 0.17 (A) | an answer of 0.17 (A) scores **3** marks<br><br><br>a correct answer that rounds to 0.17 (A) scores **3** marks | 1<br>1<br>1 | 4.2.4.1 AO2 |
| 1.4 | efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ | | 1 | 4.1.2.2 AO1 |
| 1.5 | $0.30 = \frac{\text{useful power output}}{9.0}$<br>useful power output = 0.30 × 9.0<br>useful power output = 2.7 (W) | an answer of 2.7 (W) scores **3** marks | 1<br>1<br>1 | 4.1.2.2 AO2 |
| 1.6 | bulbs also transfer thermal energy<br><br>the efficiency of the light bulb also needs to be considered | allow light bulbs emit infrared radiation as well as visible light<br>ignore so people know how bright the bulb is<br><br>allow the cost to power the light bulb depends on the efficiency<br>allow to see how much energy is wasted | 1<br><br>1 | 4.1.2.2 4.1.1.4 AO1 AO3 |
| **Total** | | | **11** | |

4.1.2.2 Efficiency

Answer 81 · Mark scheme

June 2019 | 8463/1H | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **4.1** | electric car journey will take a (much) longer time<br><br>(because) battery will need recharging<br>**or**<br>(because) the car will need to stop for 40 minutes | allow diesel car journey will take a shorter time<br><br>allow diesel car will not need to be refuelled | 1<br><br>1 | 4.1.3<br>AO3 |
| **4.2** | energy stored in diesel = 45 × 51 = 2295 (MJ)<br><br>energy stored in batteries = 0.95 × 280 = 266 (MJ)<br><br>(so) the diesel stores more energy than the battery (and the diesel car has a higher range) | <br><br><br><br>this mark is dependent on correct calculations of energy stored | 1<br><br>1<br><br>1 | 4.1.3<br>1AO1<br>1AO2<br>1AO3 |
| **4.3** | any **2** from:<br>• recharging is a continuous process<br><br>• fewer cells needed in the car<br><br>• more cars can be charged at the same time | <br>allow cars do not need to stop to recharge<br>allow shorter journey times<br>allow don't have to wait for battery to recharge<br>allow longer time between recharges<br>allow the range of the electric car is increased<br>allow smaller battery needed in the car<br><br>allow do not need to find a charging point<br>allow fewer charging stations needed<br>ignore it is quicker<br>ignore cost of charging<br>ignore methods of electricity generation | 2 | 4.1.3<br>AO1 |

4.1.2.2 Efficiency

Answer 81 · Mark scheme

June 2019 | 8463/1H | Original Q4

| | | | | |
|---|---|---|---|---|
| **4.4** | when cars are plugged in<br><br>the energy from car batteries could be transferred back to the National Grid | <br><br>allow mains supply for National Grid<br>allow energy from car batteries could be used to power household appliances | 1<br><br>1 | 4.1.3 AO1 |
| **Total** | | | **9** | |

4.1.2.2 Efficiency

Answer 82 · Mark scheme

June 2019 | 8463/1H | Original Q6

## Question 6

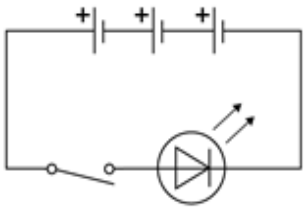
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **6.1** | 50<br><br>Hz / hertz | <br><br>allow Hertz | 1<br><br>1 | 4.2.3.1 AO1 |
| **6.2** | (both) switches need to be closed / on<br><br>to complete the series circuit<br>**or**<br>to allow charge to flow<br>**or**<br>so there is a current in the circuit | | 1<br><br>1 | 4.2.2 AO1 |
| **6.3** | <br><br><br><br>$1800 = I^2 \times 32$<br><br>$I^2 = \frac{1800}{32}$<br>**or**<br>$I^2 = 56.25$<br><br>$I = 7.5$ (A) | an answer of 7.5 (A) scores **3** marks<br>an answer of 0.237(A) scores **2** marks<br><br>this mark may be awarded if P is incorrectly or not converted<br><br>this mark may be awarded if P is incorrectly or not converted<br><br><br><br>this answer only | <br><br><br><br>1<br><br>1<br><br><br><br>1 | 4.2.4.1 AO2 |
| **6.4** | <br><br><br><br>$1500 = \frac{450\ 000}{t}$<br><br>$t = \frac{450\ 000}{1500}$<br><br>$t = 300$ (s) | an answer of 300 (s) scores **3** marks<br>an answer of 300 000 (s) scores **2** marks<br><br>this mark may be awarded if P is incorrectly or not converted<br><br>this mark may be awarded if P is incorrectly or not converted<br><br>this answer only | <br><br><br><br>1<br><br>1<br><br>1 | 4.1.1.4 AO2 |
| **Total** | | | **10** | |

4.1.2.2 Efficiency

Answer 83 · Mark scheme

November 2020 | 8463/1H | Original Q2

## Question 2

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

4.1.2.2 Efficiency

Answer 83 · Mark scheme

November 2020 | 8463/1H | Original Q2

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

4.1.2.2 Efficiency

Answer 84 · Mark scheme

November 2020 | 8463/1H | Original Q7

## Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.1** | the heating element of the kettle takes time to heat up | allow the kettle takes time to heat up | 1 | AO3<br>4.1.1.3 |
| **07.2** | ΔΘ = 78 (°C)<br><br>155 000 = m × 4200 × 78<br><br>$m = \frac{155\,000}{4200 \times 78}$<br><br>m = 0.4731 (kg)<br><br>m = 0.47 (kg) | <br><br>allow a correct substitution using an incorrect value of ΔΘ<br><br>allow a correct rearrangement using an incorrect value of ΔΘ<br><br>allow a correct calculation of mass using an incorrect value of ΔΘ | 1<br><br>1<br><br>1<br><br>1<br><br>1 | AO2<br>4.1.1.3<br>4.3.2.2 |
| **07.3** | Gradient = $\frac{\Delta\theta}{t}$<br><br>Pt = mcΔΘ<br><br>P = gradient × mc | allow gradient = rate of temperature increase<br>allow calculation of gradient | 1<br><br>1<br><br>1 | AO1<br>4.1.1.3<br>4.3.2.2<br>4.1.1.4 |
| **Total** | | | **9** | |

4.1.2.2 Efficiency

Answer 85 · Mark scheme

November 2021 | 8463/1H | Original Q5

## Question 5

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

4.1.2.2 Efficiency

Answer 85 · Mark scheme

November 2021 | 8463/1H | Original Q5

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

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

4.1.2.2 Efficiency

Answer 86 · Mark scheme

June 2022 | 8463/1H | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.1 | *P* = 696 000 000 (W)<br><br>*P* = 1200 (W) | <br><br>allow an answer consistent with their incorrectly / not converted value of *P* | 1<br><br>1 | AO2<br>4.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.2 | any **2** from:<br>• wind is unreliable<br><br>• wind turbines don't turn when the wind is too strong/weak<br>• there are not enough wind turbines (in the UK) | <br>allow it was not windy (on that day)<br><br><br><br>allow some wind turbines may be offline for maintenance<br><br>allow energy from wind may not be enough (to generate 34 000 MW)<br><br>ignore weather conditions unqualified | 2 | AO2<br>4.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.3 | the efficiency would increase<br><br>because the percentage / proportion / amount of energy usefully transferred would increase<br>**or**<br>because the percentage / proportion / amount of energy wasted would decrease<br><br>(because) less (work is done against) friction | <br><br>ignore more electricity generated<br><br><br>allow less energy wasted | 1<br><br>1<br><br><br><br><br>1 | AO3<br><br>AO1<br><br><br><br><br>AO1<br>4.1.2.1<br>4.1.2.2 |

4.1.2.2 Efficiency

Answer 86 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.4 | more efficient devices waste less energy<br>**or**<br>more efficient devices need a lower energy input (for the same energy output) | ignore use less electricity | 1 | AO3<br>4.1.2.2<br>4.1.3 |
| | which would minimise the electricity / energy demand<br><br>**or**<br><br>which would minimise the environmental impact from (fossil fuel) electricity generation | allow less electricity needs to be generated<br>allow lower energy / electricity bill<br><br>allow examples of environmental impact<br>e.g. lower $CO_2$ emissions<br><br>ignore 'better for the environment' unless qualified<br><br>ignore answers that discuss 'saving energy' unless qualified<br><br>ignore answers that discuss alternative methods of generating electricity | 1 | |

| Total Question 1 | | 9 |
|---|---|---|

4.1.2.2 Efficiency

Answer 87 · Mark scheme

June 2022 | 8463/1H | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.1 | $P = V \times I$ | | 1 | AO1 4.2.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.2 | $4.4 = 40 \times I$<br>$I = \frac{4.4}{40}$<br>$I = 0.11$ (A) | | 1<br>1<br>1 | AO2 4.2.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.3 | efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ | | 1 | AO1 4.1.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.4 | $0.85 = \frac{P}{4.0}$<br>$P = 0.85 \times 4.0$<br>$P = 3.4$ (W) | | 1<br>1<br>1 | AO2 4.1.2.2 |

| Total Question 3 | | 8 |
|---|---|---|

4.1.2.2 Efficiency

Answer 88 · Mark scheme

June 2023 | 8463/1H | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.1 | increase<br><br>decrease | must be in this order | 1<br><br>1 | AO1<br>4.2.4.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.2 | $P = I^2R$ | | 1 | AO1<br>4.2.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.3 | $1.60 \times 10^9 = 2000^2 \times R$<br><br>$R = \frac{1.60 \times 10^9}{2000^2}$<br><br>$R = 400\ (\Omega)$ | | 1<br><br>1<br><br>1 | AO2<br>4.2.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.4 | efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$<br>**or**<br>efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ | | 1 | AO1<br>4.1.2.2 |

4.1.2.2 Efficiency

Answer 88 · Mark scheme

June 2023 | 8463/1H | Original Q1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.5 | $0.992 = \frac{\text{useful energy output}}{34.2}$<br><br>useful energy output<br>= 0.992 × 34.2<br><br>useful energy output<br>= 33.9 (GJ) | <br><br><br><br>allow a correct answer given to more than 3 s.f. | 1<br><br>1<br><br>1 | AO2<br>4.1.2.2 |

| Total Question 1 | 10 |
|---|---|

4.1.2.2 Efficiency

Answer 89 · Mark scheme

June 2023 | 8463/2H | Original Q8

## Question 8

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.1 | iron | allow nickel / cobalt<br>do not allow steel | 1 | AO1<br>4.7.3.4 |
| | it is easily magnetised (and demagnetised) | allow it is a magnetic material<br><br>MP 2 is dependent on MP 1 | 1 | |

4.1.2.2 Efficiency

Answer 89 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.2 | $\frac{230}{V_s} = \frac{2000}{40}$ | | 1 | AO2 4.7.3.4 |
| | $V_s = \frac{40}{2000} \times 230$ | subsequent marks can only be awarded if the first equation is correct and has been used | 1 | |
| | $V_s = 4.6$ (V) | | 1 | |
| | $4.6 \times I_s = 6.9$ | this mark may be awarded if the pd is incorrectly calculated | 1 | |
| | $I_s = 1.5$ A | allow a correctly calculated $I_s$ using an incorrectly calculated pd | 1 | |
| | **OR** | | | |
| | $6.9 = I_p \times 230$ (1) | | | |
| | $I_p = \frac{6.9}{230}$ (1) | subsequent marks can only be awarded if the first equation is correct and has been used | | |
| | $I_p = 0.03$ (A) (1) | | | |
| | $I_s = 0.03 \times \frac{2000}{40}$ (1) | this mark may be awarded if $I_p$ is incorrectly calculated | | |
| | $I_s = 1.5$ (A) (1) | allow a correctly calculated $I_s$ using an incorrectly calculated $I_p$ | | |

| Total Question 8 | 7 |
|---|---|

4.1.2.2 Efficiency

Answer 90 · Mark scheme

June 2025 | 8463/1H | Original Q9

## Question 9

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

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

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

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

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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### 4.1.2.2 Efficiency



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4.1.2.2 Efficiency





# 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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### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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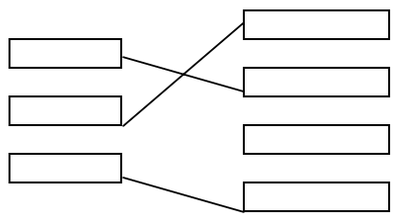
### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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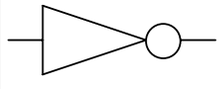
### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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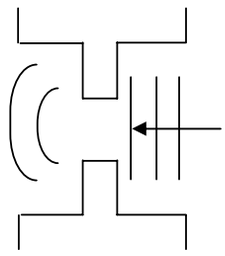
## 4.1.2.2 Efficiency





**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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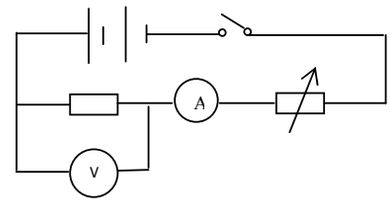
### 4.1.2.2 Efficiency





**3451F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | all symbols correct |  accept push switch symbol<br>switch may be open or closed<br>any lines through symbols = **0** marks | 1 |
| | correct circuit drawn<br><br>voltmeter must be across resistor only | polarity of cells not relevant provided they are joined correctly<br>two cells are required in the diagram<br>ignore the order of the components<br>allow small gaps in circuit<br><br>omission of any component = **0** marks | 1 |
| (b)(i) | potential difference<br>= current × resistance | accept voltage or p.d. for potential difference<br><br>accept $V = I \times R$<br><br>accept  provided<br>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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## 4.1.2.2 Efficiency





**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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## 4.1.2.2 Efficiency





**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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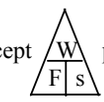
### 4.1.2.2 Efficiency





**3451F Q13**

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



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### 4.1.2.2 Efficiency





**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) | input sensor → controlled by the processor<br>processor → detects changes in the environment<br>output device → decides what action is needed | 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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### 4.1.2.2 Efficiency





**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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## 4.1.2.2 Efficiency





**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 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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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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### 4.1.2.2 Efficiency



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4.1.2.2 Efficiency





# 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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### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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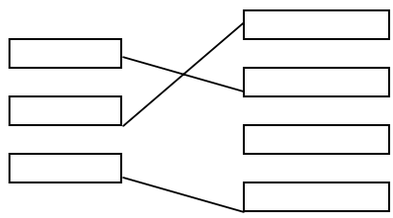
## 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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### 4.1.2.2 Efficiency





**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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## 4.1.2.2 Efficiency





**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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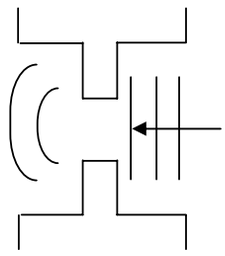
## 4.1.2.2 Efficiency





**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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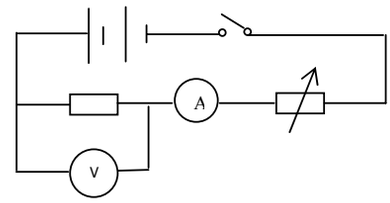
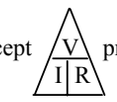
### 4.1.2.2 Efficiency





**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>subsequent use correct<br><br>do **not** accept C for current | 1 |
| (ii) | 2 | <br>allow **1** mark for correct substitution<br>wrong working loses both marks | 2 |
| (iii) | straight line drawn <u>through the origin</u><br><br>straight line passes through<br>$I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0 | judge by eye<br><br>this mark may be awarded if all points shown including these points are correct even if no line is drawn<br>N.B. a curve scores **0** marks | 1<br><br>1 dep |
| (c) | temperature <u>increases</u> | accept filament lamp / it gets <u>hotter</u><br>allow heat for temperature | 1 |
| total | | | 8 |

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## 4.1.2.2 Efficiency





**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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## 4.1.2.2 Efficiency





**3462/3F Q10**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | accelerating | accept getting faster<br>accept speed / velocity increasing | 1 |
| (ii) | acceleration <u>increases</u> | accept velocity / speed increases <u>more</u> 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 <u>correct</u> 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 <u>shuttle</u> and Earth)<br><br>plus correct orbital speed (makes <u>shuttle</u> 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 <u>centripetal</u> 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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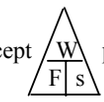
### 4.1.2.2 Efficiency





**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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## 4.1.2.2 Efficiency





**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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Version 1.0: *27092005*

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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4.1.2.2 Efficiency





# 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 |

### 4.1.2.2 Efficiency





**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 |

**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 |

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency



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

**3451/F Q7**

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

### 4.1.2.2 Efficiency





**3451/F Q8**

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

### 4.1.2.2 Efficiency





**3451/F Q9**

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

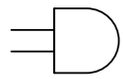
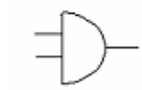
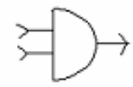
**cont…**

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency





**3451/F Q10**

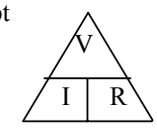
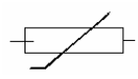
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | rays continued to meet on the right hand side of the lens and beyond | must be straight lines from the right hand side of the lens<br>ignore details through the lens<br>allow if no arrows | 1 |
| | meet exactly on the axis | 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 | <br>allow film<br><br><br>allow real image has light travelling through it<br>**or** virtual image is where rays seem to come from | 3 |
| total | | | 13 |

### 4.1.2.2 Efficiency





**3451/F Q11**

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

### 4.1.2.2 Efficiency



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

**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 |

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency





**3451/F Q14**

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

**cont…**

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency





**3451/F Q16**

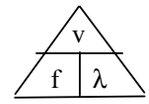
| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | **X** at the centre of the lifebelt | measuring from the centre of **X**, allow 2 mm tolerance in any direction | 1 |
| (ii) | any **two** from:<br><br>below the point of suspension<br><br>at the centre (of the lifebelt)<br>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

### 4.1.2.2 Efficiency





**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.

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# Double Award
# Foundation Tier 3462/3F

**3462/3F Q1**

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

**3462/ 3F Q2**

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

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency



*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 |

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency



*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 |

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency



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

**3462/3F Q8**

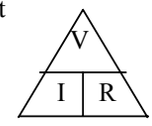
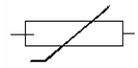
| question | answers | extra information | mark |
|---|---|---|---|
| (a) | fossils of Cynognathus are found in Africa and South America | | 1 |
| | the shapes ……. almost fit together | only two boxes should be ticked<br>deduct **1** mark for each additional box to a minimum mark of **0** | 1 |
| (b)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

### 4.1.2.2 Efficiency





**3462/3F Q9**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | $A_1 = 0.5$ | ignore any units | 1 |
| | $A_4 = 0.5$ | allow **1** mark for $A_1 = A_4 \neq 0.5$ | 1 |
| (ii) | the resistance of **P** is more than 20 Ω | | 1 |
| | a smaller current goes through P / $A_2$ (than 20 Ω) | dependent on getting 1st mark correct<br>accept converse | 1 |
| (b)(i) | potential difference = current × resistance | accept pd / voltage for potential difference<br>accept V = I × R, correct symbols and correct case only<br>accept volts = amps × ohms<br>accept <br>provided subsequent method is correct<br>allow combination of physical quantities and named units<br>allow voltage = I × R | 1 |
| (ii) | 6 | allow **1** mark for correct substitution | 2 |
| (iii) | 6 | accept their (b)(ii) | 1 |
| (c) | <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 |

### 4.1.2.2 Efficiency



*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 |

### 4.1.2.2 Efficiency





**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 |

### 4.1.2.2 Efficiency



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

**3462/3F Q12**

| question | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | <u>constant</u> 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 = <u>change in velocity</u><br>time (taken) | do **not** accept velocity for change in velocity<br>accept change in speed<br>accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$<br>**or** a = $\frac{\Delta v}{t}$<br>do **not** accept $a = \frac{v}{t}$ | 1 |
| (iii) | 4<br>**or** their (b)(i) ÷ 5 | allow **1** mark for correct substitution | 2 |
| | $m/s^2$ | m/s/s **or** $ms^{-2}$ **or** metres per second squared **or** metres per second per second | 1 |
| (c) | vehicle may skid / slide | loss of control / brakes lock / wheels lock<br>accept greater stopping distance **or** difficult to stop | 1 |
| | due to reduced friction (between tyre(s) and road) | accept due to less grip<br>do **not** accept <u>no</u> friction | 1 |

**cont…**

### 4.1.2.2 Efficiency





**3462/3F Q12 cont**…

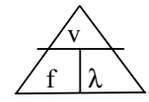
| | | | |
|---|---|---|---|
| (d) | any **three** from:<br>• <u>increased</u> speed<br>• <u>reduced</u> braking force<br>• <u>slower</u> (driver) reactions<br>• <u>poor</u> vehicle maintenance<br>• <u>increased</u> mass / weight of vehicle<br>• <u>poor</u> road surface<br>• <u>more</u> streamlined |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

### 4.1.2.2 Efficiency



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

**3462/3F Q13**

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

4.1.2.2 Efficiency



Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Secondary Education

# Science B 4462 / Physics 4451

## PHY1H Unit Physics 1

# Mark Scheme

*2007 examination - June series*

### 4.1.2.2 Efficiency



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*Dr Michael Cresswell*, Director General.

### 4.1.2.2 Efficiency





## MARK SCHEME

## Information to Examiners

### 1. General

The mark scheme for each question shows:

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

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

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

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

### 2. Emboldening

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

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

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

### 3. Marking points

#### 3.1 Marking of lists

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

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

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

4.1.2.2 Efficiency





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

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

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

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

**3.2 Use of chemical symbols / formulae**

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

**3.3 Marking procedure for calculations**

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

**3.4 Interpretation of 'it'**

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

**3.5 Errors carried forward**

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

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

**3.6 Phonetic spelling**

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

**3.7 Brackets**

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

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

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

### 4.1.2.2 Efficiency





**PHY1H Question 1**

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

**Continued on next page**

### 4.1.2.2 Efficiency





**Question 1 continued**

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

### 4.1.2.2 Efficiency





**PHY1H Question 2**

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

### 4.1.2.2 Efficiency





**PHY1H Question 3**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | national grid | | 1 |
| (ii) | increases voltage / potential difference | accept decrease current<br>accept step-up / boosts the voltage<br>do **not** accept increases energy / power / current<br>ignore reference to voltage going through | 1 |
| (iii) | any **two** from:<br>• reduce current<br>• reduces energy loss / power loss (from cables)<br>• increases efficiency (of distribution) | ignore increased voltage / pd<br>accept reduces heat loss<br>do **not** accept stops energy loss | 2 |
| (b) | any **one** from:<br>• produces pollutant gases<br>• produces solid waste / ash / smoke | accept produces carbon dioxide / sulfur dioxide / nitrogen oxides<br>accept global warming / greenhouse effect / carbon emissions / air pollution / acid rain<br>ignore ozone layer<br>do **not** accept carbon monoxide<br>accept global dimming<br>ignore produces pollution | 1 |

**Continued on next page**

### 4.1.2.2 Efficiency





**Question 3 continued**

| | answers | extra information | mark |
|---|---|---|---|
| (c)(i) | any **two** from:<br>• using renewable energy<br>• make non-renewable fuels last longer<br>• non-renewable fuels can be used for other processes<br>• no pollutant gases produced<br>• land can still be used for farming | any two valid points gains the marks<br><br>accept don't use up non-renewable / fossil fuels<br>accept named fuels<br><br>accept the opposite of (b)<br>ignore no pollution<br><br>ignore economic issues | 2 |
| (ii) | any **two** from:<br>• cause <u>noise</u> pollution<br>• cause <u>visual</u> pollution<br>• may interfere with TV / radio / mobile phone signals<br>• need to put in new infrastructure<br>• not reliable owtte<br>• dangerous to birds<br>• lots of concrete needed for the bases<br>**or**<br>producing cement is environmentally damaging | <br><br>accept spoils the landscape<br>accept sunlight flicker<br><br><br>accept new roads needed<br><br><br><br><br>accept reduces house prices<br><br>ignore any references to cost / jobs / number required<br><br>ignore takes up a lot of land<br><br>accept reference to obstruction of shipping etc. if clear reference to offshore wind farm | 2 |
| total | | | 9 |

### 4.1.2.2 Efficiency





**PHY1H Question 4**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | wavelength increases | accept the crests are further apart<br><br>ignore waves are further apart | 1 |
| | frequency decreases | accept pitch decreases<br><br>ignore references to amplitude | 1 |
| (b) | stars / galaxies / sources emit all / different types of electromagnetic waves / radiation | accept two or more named electromagnetic waves<br><br>accept answers in terms of frequencies / wavelengths | 1 |
| (c)(i) | wavelength (of light) increases<br>**or**<br>light moves to red end of spectrum | accept frequency decreases<br><br>accept redder but do **not** accept red alone | 1 |
| (ii) | it is the star (detected) <u>furthest</u> from the Earth<br>**or**<br>it is moving <u>away</u> the fast<u>est</u> | accept galaxy for stars<br><br>ignore reference to universe expanding | 1 |
| (d)(i) | all matter compressed to / starts at / comes from a single point | do **not** accept increasing gravitational pull<br><br>accept everything / the universe for all matter | 1 |
| | (massive) <u>explosion</u> sends matter outwards | accept <u>explosion</u> causes universe to expand<br><br>ignore explosion creates the universe **or** further reference to star / Earth formation | 1 |

**Continued on next page**

### 4.1.2.2 Efficiency





**Question 4 continued**

| | | | |
|---|---|---|---|
| (ii) | check validity / reliability of the evidence<br>**or**<br>change the theory to match the new evidence | accept comparison of new and old evidence | 1 |
| total | | | 8 |

**PHY1H Question 5**

| | answers | extra information | mark |
|---|---|---|---|
| (a)(i) | a signal that has only two states / only discrete states | accept can only be on or off<br><br>accept made up of 1 and 0 only<br><br>accept high and low<br><br>accept diagram with all amplitudes equal | 1 |
| (ii) | 400 000 000<br>**or**<br>correct equivalent | allow **1** mark for correct transformation **and** substitution (of 75)<br><br>answer 4 000 000 gains **1** mark only | 2 |

**Continued on next page**

### 4.1.2.2 Efficiency





**Question 5 continued**

| | answers | extra information | mark |
|---|---|---|---|
| (b)(i) | | any mention of alpha, beta, gamma waves scores **0** marks | |
| | emit / uses / transmit / receive microwaves | accept radiation for microwaves throughout<br><br>ignore radio waves | 1 |
| | some microwave / energy absorbed by / enters the body | ecf for their given electromagnetic wave<br><br>do **not** accept goes through the body | 1 |
| | raises temperature of (body) cells / tissue / water | accept reference to water molecules vibrating faster<br><br>accept it could cause mutation / harm / kill cells<br><br>do **not** accept answers in terms of ionisation<br><br>ignore references to cancer | 1 |
| (ii) | any **two** from:<br>• research (may be) biased **or** may have been misled in the past<br>• some research suggests a link<br>• long-term effect not proven / studied<br>• residents may not have seen the research | accept not independent **or** may be lying<br><br>accept not studied for long enough | 2 |
| total | | | 8 |

### 4.1.2.2 Efficiency





**PHY1H Question 6**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | four calculations correctly shown | 200 × 10 – 1800 = £200<br>100 × 10 – 2400 = –£1400<br>50 × 10 – 600 = –£100<br>20 × 10 – 75 = 125<br><br>accept four final answers only<br>**or**<br>obvious rejection of solar water heater and underfloor heating, with other two calculations completed<br><br>any 1 complete calculation correctly shown<br>**or**<br>showing each saving × 10 of all four calculations = **1** mark<br><br>answers in terms of savings as a percentage of installation cost **may** score savings mark only | 2 |
| | hot water boiler | correct answers only | 1 |
| (b) | less electricity / energy to be generated / needed from power stations | accept less demand | 1 |
| | reduction in (fossil) fuels being burnt | accept correctly named fuel<br><br>accept answer in terms of:<br>fewer light bulbs required because they last longer (1 mark)<br>less energy used / fuels burnt in production / transport etc. (1 mark)<br><br>ignore reference to $CO_2$ or global warming<br><br>ignore reference to conservation of energy | 1 |
| total | | | 5 |

4.1.2.2 Efficiency



AQA

GCSE

# Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

### 4.1.2.2 Efficiency



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4.1.2.2 Efficiency





**Mark Scheme**

**Information to Examiners**

## 1. General

The mark scheme for each question shows:

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

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

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

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

## 2. Emboldening

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

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

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

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

## 3. Marking points

### 3.1 Marking of lists

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

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

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

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

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

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

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

**3.1 Use of chemical symbols / formulae**

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

**3.2 Marking procedure for calculations**

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

**3.3 Interpretation of 'it'**

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

**3.4 Errors carried forward**

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

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

**3.5 Phonetic spelling**

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

**3.6 Brackets**

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

4.1.2.2 Efficiency



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

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

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

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

In Question **2a** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

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

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

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

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

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

### 4.1.2.2 Efficiency



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| 1(a) | chemical<br>kinetic<br>sound | correct order only | 1<br>1<br>1 | AO1<br>P1.2.1a |
| 1(b) | 37.5% or 0.375 | an answer rounded to 0.38 or 38% scores both marks<br>an answer of 0.375 with a unit gains **1** mark<br>an answer of 0.375% gains **1** mark<br>an answer of 37.5 with or without a unit gains **1** mark<br>allow **1** mark for an answer 3/8<br>3/8 with a unit scores 0 | 2 | AO2<br>P1.2.1d |
| **Total** | | | **5** | |

4.1.2.2 Efficiency



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| 2 (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 4 and apply a 'best-fit' approach to the marking. | | 6 | AO2<br>AO3<br>P1.2<br>HSW | E |

| 0 marks | Level 1 (1-2 marks) | Level 2 (3-4 marks) | Level 3 (5-6 marks) |
|---|---|---|---|
| No relevant information | There is a relevant statement about an energy saving method | There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation | There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail. |

| examples of physics points made in the response | extra information |
|---|---|
| **examples of relevant statements**<br>• energy efficient boiler saves the most (energy / money) per year<br>• loft insulation costs the least to install<br>• double-glazing costs the most to install<br>**examples of statements that include cost effectiveness**<br>• loft insulation is the most cost effective in the long term<br>• double-glazing is the least cost effective<br>• loft insulation has the shortest payback time<br>• double-glazing has the longest payback time<br>• payback time calculated for any method<br>**examples of further detail**<br>• for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing<br>• for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing<br>• don't install double-glazing for insulation purposes<br>• double-glazing won't pay for itself in your lifetime<br>• justified choice of best / worst method | payback times:<br>energy efficient boiler: 6.25 years<br>loft insulation: 2 years<br>double glazing: 100 years<br>cavity wall insulation: 2.86 years |

4.1.2.2 Efficiency



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

**Question 2 continued . . .**

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| 2(b)(i) | how effective a material is as an insulator | accept 'heat' for energy<br><br>accept how effective a material is at keeping energy in<br><br>accept the lower the U-value the better the insulator<br><br>accept the lower the U-value the lower the rate of energy transfer | 1 | AO1<br><br>P1.1.4a |
| 2(b)(ii) | (the U-value) decreases | | 1 | AO1<br>P1.1.4b |
| **Total** | | | **8** | |

### 4.1.2.2 Efficiency



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **3(a)(i)** | 0.5 °C | | 1 | AO3 P1.1 |
| **3(a)(ii)** | data is continuous<br>**or**<br>both variables are continuous<br>**or**<br>independent variable is continuous<br>**or**<br>time is continuous | accept results / measurements for data<br><br>accept data is not categoric<br><br>one variable is continuous is insufficient<br>air temperature is continuous is insufficient | 1 | AO3 P1.1 |
| **3(b)(i)** | 20.5 (°C) | | 1 | AO2 P1.1 |
| **3(b)(ii)** | 60 (minutes) | accept 1 hour | 1 | AO2 P1.1 |
| **3(c)(i)** | so a comparison can be made<br>**or**<br>outside temperature is a control variable | accept:<br>(outside) temperature would affect energy required ( to maintain temperature of the house)<br>**or**<br>(outside) temperature would affect internal temperature (of the house)<br>**or**<br>heat loss will be faster on a cold day<br><br>outside temperature will affect the results is insufficient<br><br>fair test is insufficient | 1 | AO3 P1.1 |

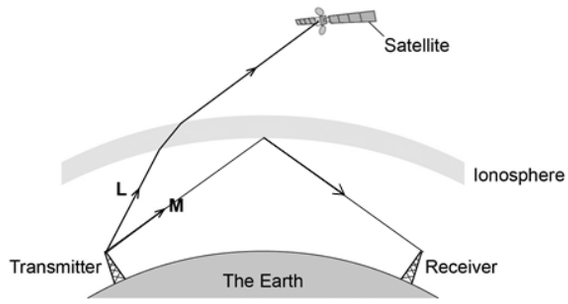
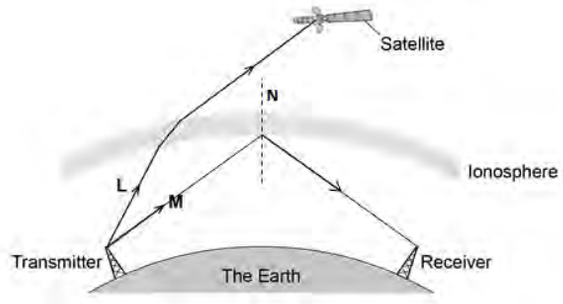
**Question 3 continues on the next page . . .**

### 4.1.2.2 Efficiency



MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **3(c)(ii)** | the cost is equal to the number of kWh x the cost per kWh<br><br>calculation<br>0.8 / 8.0 = 0.1 or 10% | accept (heating) bill depends on (number of) kWh used<br>accept energy for kWh<br><br>allow 7.2 / 8.0 = 0.9 or 90% | 1<br><br>1 | AO3<br>AO2<br>P1.1 |
| **3(c)(iii)** | heating is on for more / less time (than anticipated)<br><br>because some days it is cooler / warmer (than anticipated) | <br><br>accept other sensible suggestions<br><br>an answer giving two sensible situations gains **2** marks<br>possible examples:<br>• some houses have different amounts of insulation<br>• there are different styles of house<br><br>temperature (inside / outside) is always changing is insufficient | 1<br><br>1 | AO3<br>P1.1 |
| **Total** | | | **9** | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| 4(a)(i) | microwave | | 1 | AO1<br>P1.5.1k |
| 4(a)(ii) | refraction | | 1 | AO1<br>P1.5.1g |
| 4(b)(i) | wave M continues as a straight line to the ionosphere and shown reflected<br><br>correctly reflected wave shown as a straight line reaching the top of the receiver<br><br><br> | accept reflection at or within the ionosphere<br><br>if more than 2 rays shown 1 mark maximum<br><br>ignore arrows | 1<br><br>1 | AO2<br><br>P1.5.2b |
| 4(b)(ii) | normal drawn at point where their **M** meets the ionosphere<br><br><br> | | 1 | AO1<br>P1.5.2a |

**Question 4 continues on the next page. . .**

**Question 4 continued…**

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **4(c)** | any **two** from:<br>• transverse<br>• same speed (through air)<br><br>• can be reflected<br>• can be refracted<br>• can be diffracted<br>• can be absorbed<br>• transfer energy<br>• can travel through a vacuum<br>• can be polarised<br>• show interference | accept speed of light **or** $3 \times 10^8$ m/s<br><br>an answer travel at the same speed though a vacuum scores **2** marks<br><br>travel in straight lines is insufficient | 2 | AO1 P1.5.1a,bc, d,g |
| **Total** | | | **7** | |

### 4.1.2.2 Efficiency



| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **5(a)(i)** | infrared (radiation) | accept IR (radiation) | 1 | AO1<br>P1.1.1b |
| **5(a)(ii)** | (heated) water turns to steam | ignore reference to fossil fuels<br><br>do **not** accept water evaporates to steam | 1 | AO1<br>P1.4.1a |
| | steam turns a turbine | | 1 | |
| | turbine turns a generator | accept turbine connected to a generator | 1 | |
| **5(b)(i)** | (so the molten salts) can store large amounts of energy | accept there is a small temperature change for a large energy transfer<br><br>accept heat for energy | 1 | AO2<br>P1.1.4d |
| **5(b)(ii)** | 16 (hours) | an answer that rounds to 16 gains **2** marks eg 15.71<br><br>allow **1** mark for a correct substitution<br>ie 2 200 000 = 140 000 x t | 3 | AO2<br>AO1<br>P1.3.1c |
| **5(b)(iii)** | the number of daylight hours varies | less sunlight is insufficient | 1 | AO2<br>AO3<br>P1.4 |
| | the (mean) power (received from the Sun per square metre) varies | accept an answer in terms of maximum possible electrical output only possible during Summer for **1** mark | 1 | |

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

### 4.1.2.2 Efficiency



**Question 5 continued . . .**

| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| 5(c)(i) | non-renewable power stations have higher Capacity Factors than renewable power stations | | 1 | AO1<br>AO3<br>P1.4 |
| | fuel (for non-renewable power stations) is always available | reference to non-renewable power stations operating all the time is insufficient<br>non-renewable energy sources are reliable is insufficient | 1 | |
| | (most) renewable energy sources are unpredictable / unreliable | accept (most) renewable energy sources depend on the weather | 1 | |
| 5(c)(ii) | the (proportion of) time that solar storage power stations can generate electricity is greater (than for other renewable energy sources) | | 1 | AO1<br>P1.4 |
| **Total** | | | **14** | |

### 4.1.2.2 Efficiency







| Question | Answers | Extra information | Mark | AO/Spec ref. |
|---|---|---|---|---|
| 6(a) | Doppler (effect) | | 1 | AO1 P1.5.4a |
| 6(b) | (reflected microwaves) wavelength decreased<br><br>(reflected microwaves) frequency increased<br><br>(reflected microwaves) have same speed | | 1<br><br>1<br><br>1 | AO1 P1.5.4a P1.5.1d |
| Total | | | 4 | |

### 4.1.2.2 Efficiency







| Question | Answers | Extra information | Mark | AO / Spec. ref. |
|---|---|---|---|---|
| **7(a)** | 4200 | allow **2** marks for correct substitution<br>ie 6930 = 0.330 x c x 5.0<br><br>answers of 1050 **or** 840<br>**or**<br>correctly calculated answer from correct substitution of incorrect temperature change<br>**or**<br>identification of temperature change ie 5 ˚C<br>gain **1** mark | 3 | AO2<br>AO1<br>P1.1.4d |
| | J/kg˚C | accept J/kg K | 1 | |
| **7(b)** | (in a metal) free electrons | to gain full credit the answer must be in terms of free electrons | 1 | AO1<br>P1.1.3a |
| | gain kinetic energy | accept move faster | 1 | |
| | (free electrons) transfer energy to other electrons / ions / atoms | do **not** accept particles | 1 | |
| | by collision | | 1 | |
| | | allow a maximum of **2** marks for answers in terms of atoms / ions / particles<br>• gaining kinetic energy or vibrating faster / more<br>• transferring energy by collisions | | |
| **7(c)** | (air) particles spread out | | 1 | AO1<br>P1.1.3a |
| | (which causes the) air to become less dense / expand | do **not** accept particles become less dense | 1 | |
| | (so the) warm air rises | do **not** accept heat rises<br>particles rise is insufficient | 1 | |
| **7(d)** | large surface area | ignore references to type of metal or external conditions | 1 | AO1<br>P1.1.3c |
| | black / dark (colour) | | 1 | |
| **Total** | | | **13** | |

4.1.2.2 Efficiency



AQA

GCSE

# Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

### 4.1.2.2 Efficiency



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4.1.2.2 Efficiency





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## Information to Examiners

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

4.1.2.2 Efficiency







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

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

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

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

**3.2 Use of chemical symbols / formulae**

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

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

**3.7 Brackets**

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

PMT



**3.8 Accept / allow**

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

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

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

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

## 4. Quality of Communication and levels marking

In Question **2(b)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

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

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

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

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

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

### 4.1.2.2 Efficiency



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

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

### 4.1.2.2 Efficiency







| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 2(a) | any **one** from:<br>• high cost of installing overhead power lines or underground cables or pylons<br>• high cost as (very) long cables needed<br>• amount of electricity required is too low | allow not enough (surplus) electricity would be generated | 1 | AO1<br>1.4.1e |

**Question 2 continues on the next page . . .**

### 4.1.2.2 Efficiency







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

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

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

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

### 4.1.2.2 Efficiency



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

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

4.1.2.2 Efficiency







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

### 4.1.2.2 Efficiency







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

### 4.1.2.2 Efficiency



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

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

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

### 4.1.2.2 Efficiency



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

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

4.1.2.2 Efficiency







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

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

### 4.1.2.2 Efficiency







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

### 4.1.2.2 Efficiency







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

4.1.2.2 Efficiency

Answer 79 · Examiner comments

June 2018 | 8463/2H | Original Q7

## Question 7 (Standard/high and High demand)

**07.1** Many students had the correct idea, but imprecise detail such as ‘wrong number of turns’ or ‘number of turns was miscounted’ were insufficient to score the mark.

**07.2** Many students tried to answer the question from a general knowledge about transformers, rather than using information from the graph, and so did not gain credit.

**07.3** Most of the answers were correct. A very small number of students wrote ‘hotter’ but made no reference to infrared or thought it was just a temperature increase.

**07.4** This question involved a two stage calculation, a new feature of the examination. Nearly 33 % of students knew the equations to use and how to use them, scoring all five marks. A further 35% of students correctly used one equation to give a partially correct answer, scoring three marks.

4.1.2.2 Efficiency

Answer 83 · Examiner comments — November 2020 | 8463/1H | Original Q2

**Question 2 (Standard demand)**

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

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

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

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

Answer 83 · Examiner comments — November 2020 | 8463/1H | Original Q2

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

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

### 4.1.2.2 Efficiency

**Answer 84 · Examiner comments** November 2020 | 8463/1H | Original Q7

**Question 7 (High demand)**

**07.1** 31% of students answered this question correctly. 'Takes time for electrical energy store to transfer to thermal energy store' was a common answer but insufficient. 'The charge flow takes time' or 'the current is slow to start with' were also insufficient. 'Water has a high specific heat capacity' was also insufficient.

**07.2** 49% of students scored all 5 marks, while 22% of students scored 4 marks for this calculation. A common answer was 0.37 using the temperature change of 100 °C. This answer would score 4 marks for an incorrect temperature change. An answer given to 2 s.f. scored 1 mark as long as students had used the values in the question to calculate something. At grade 6-7, students are expected to be able to convert units and rearrange equations.

**07.3** Very few students scored 2 or 3 marks on this question, 10% of students scored 1 mark. Weaker students misunderstood which straight section the question referred to thinking it was the horizontal section. Only the highest-scoring students understood that the rate of temperature increase (from the gradient of the diagonal line) could be used in conjunction with the equations for specific heat capacity and $E = Pt$ to calculate useful power output. A lot of students thought that the efficiency equation could be used, but usually failed to score any marks.

**Answer 85 · Examiner comments** November 2021 | 8463/1H | Original Q5

**Question 5**

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

**Answer 88 · Examiner comments** June 2023 | 8463/1H | Original Q1

**Question 1 (Standard Demand)**

**01.1** 71% of students scored 2 marks on this question about transformers.

**01.2** 98% of students identified the correct equation. In this exam series, students were provided with all the equations on an Equations Sheet.

**01.3** 86% of students scored 3 marks. Many students failed to square the current so scored zero for the substitution and subsequent rearrangement.

**01.4** 84% of students answered correctly. In this exam series, students were provided with all the equations on an Equations Sheet. Students who quoted the version of the efficiency equation with power input and power output scored zero.

**01.5** 95% of students scored 3 marks. An answer of 33.9264 scored 3 marks as significant figures was not being tested in this question part. An answer given to 2 s.f. could score 3 marks with working. If the answer was rounded, the rounding needed to be correct.

### 4.1.2.2 Efficiency

**Answer 89 · Examiner comments** June 2023 | 8463/2H | Original Q8

**08.1**

Most students knew that iron is used for the core of a transformer and most of those were able to give an explanation. A significant number of students thought that iron was used because it is a good conductor of electricity, which demonstrates a misunderstanding of how transformers work.

**08.2**

55% of students gainiedall5 marks Most of the other students scored at least 3 marks for a partially correct answer. There were alternative ways of calculating the correct answer using the transformer and power equations, and it was pleasing to see so many students having the confidence to use them appropriately.

**Answer 90 · Examiner comments** June 2025 | 8463/1H | Original Q9

09.1

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

09.2

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

**Answer 90 · Examiner comments** June 2025 | 8463/1H | Original Q9

09.3

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

### 4.1.2.2 Efficiency



AQA

# GCSE
# PHYSICS

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

8463
June 2022

Version: 1.0

### 4.1.2.2 Efficiency



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4.1.2.2 Efficiency





**General**

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

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

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

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

**Question 11**

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

**Levels of demand**

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

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

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

4.1.2.2 Efficiency





**Question 1 (Standard demand)**

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

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

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

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

**Question 2 (Standard demand)**

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

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

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

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

4.1.2.2 Efficiency





**Question 3 (Standard demand)**

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

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

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

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

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

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

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

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

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

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

4.1.2.2 Efficiency





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

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

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

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

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

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

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

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

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

4.1.2.2 Efficiency





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

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

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

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

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

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

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

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

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

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

4.1.2.2 Efficiency





**Question 9 (High demand)**

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

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

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

**Question 10 (High demand)**

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

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

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

**Question 11 (High demand)**

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

4.1.2.2 Efficiency





**Use of statistics**

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of how students have performed for each question.

**Mark Ranges and Award of Grades**

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