



**General Certificate of Secondary  
Education**

**Science A 4405 / Physics 4403**

**PH1HP            Unit Physics 1**

**Mark Scheme**

*2012 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 students' 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 students' 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 students' 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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## 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 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 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)

Student	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)

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

### 3.2 Use of chemical symbols / formulae

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

### 3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, 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.

## Quality of Written Communication and levels marking

In Question 8 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

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.

## PH1HP

## Question 1

question	answers	extra information	mark
1(a)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• black is a good emitter of (infrared radiation)</li> <li>• large surface (area)</li> <li>• matt surfaces are better emitters (than shiny surfaces)</li> </ul>	accept heat for radiation ignore reference to absorbing radiation  accept matt surfaces are good emitters ignore reference to good conductor	2
1(b)	90% or 0.9(0)	efficiency = $\frac{\text{useful energy out}}{\text{total energy in}} (\times 100\%)$ allow <b>1</b> mark for correct substitution ie $\frac{13.5}{15}$ provided no subsequent step shown an answer of 90 scores <b>1</b> mark an answer of 90 / 0.90 with a unit scores <b>1</b> 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 <b>two</b> from: <ul style="list-style-type: none"> <li>• wood is renewable</li> <li>• (using wood) conserves fossil fuels</li> <li>• wood is carbon neutral</li> </ul>	accept wood grows again / quickly accept wood can be replanted  accept doesn't use fossil fuels  accept a description  cheaper / saves money is insufficient	2
1(e)	2550 000          joules /J	$E = m \times c \times \theta$  allow <b>1</b> mark for correct substitution ie $100 \times 510 \times 50$ provided no subsequent step shown  answers of 1 020 000, 3 570 000 gain <b>1</b> mark  accept kJ / MJ  do <b>not</b> accept j   for full credit the unit and numerical answer must be consistent	2          1
<b>Total</b>			<b>10</b>

## PH1HP

## Question 2

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

Question 2 continues on the next page



## PH1HP

## Question 2 continued

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

## PH1HP

## Question 3

question	answers	extra information	mark
3(a)(i)	energy from hot rocks in the Earth	accept heat that occurs naturally in the Earth  accept steam / hot water rising to the Earth's surface  accept an answer in terms of the energy released by radioactive decay in the Earth  heat energy is insufficient	1
3(a)(ii)	water is pumped / moved up (to a higher reservoir)	this mark point only scores if first mark point is awarded	1  1
3(b)			6
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.			
<b>0 marks</b>	<b>Level 1 (1-2 marks)</b>	<b>Level 2 (3-4 marks)</b>	<b>Level 3 (5-6 marks)</b>
No relevant content	There is a brief description of at least one advantage or disadvantage for either the planned wind turbines or the suggested electricity power link.	There is a description of advantages and disadvantages for either the planned wind turbines or the suggested electricity power link. <b>or</b> A description of the advantages or disadvantages for both the planned wind turbines and the suggested electricity power link.	There is a clear and detailed description of at least one advantage and one disadvantage for both the planned wind turbines and suggested electricity power link.

Question 3 continues on the next page

**PH1HP**

**Question 3 continued**

examples of the points made in the response	extra information
<p><b>Offshore wind turbines</b></p>	
<p><b>advantages</b></p>	
<ul style="list-style-type: none"> <li>• renewable (energy resource)</li> <li>• low running costs</li> <li>• energy is free</li> <li>• no gas emissions (when in use)</li>   <li>• land is not used (up)</li> </ul>	<p>accept a named gas eg CO<sub>2</sub>                      accept no fuel is burned                      accept less dependent on fossil fuels</p>
<p><b>disadvantages</b></p>	
<ul style="list-style-type: none"> <li>• unreliable – accept wind does not always blow</li> <li>• hazard to birds / bats</li> <li>• visual pollution – do not accept noise pollution</li>   <li>• difficulty of linking turbines to the National Grid</li> <li>• large initial cost</li> <li>• difficult to erect / maintain</li> <li>• CO<sub>2</sub> emissions in manufacture (of large number of turbines)</li> </ul>	<p>ignore references to destroying or harming habitats</p> <p>do <b>not</b> allow if clearly referring to onshore wind turbines</p> <p>do <b>not</b> accept spoils landscape</p> <p>accept a lot of maintenance needed</p>

**Question 3 continues on the next page**

**PH1HP**

**Question 3 continued**

<p><b>examples of the points made in the response</b></p> <p><b>Suggested Link</b></p> <p><b>advantages</b></p> <ul style="list-style-type: none"> <li>• income for Iceland</li> <li>• using Iceland's (available) energy (resources)</li> <li>• provide electricity when wind does not blow / reliable</li> <li>• provide electricity at times of peak demand</li> <li>• even out fluctuations in supply</li> <li>• excess electricity from Britain (windy days) to Iceland and used to pump water up to store energy</li> <li>• Britain less dependent on fossil fuels</li> </ul> <p><b>disadvantages</b></p> <ul style="list-style-type: none"> <li>• large initial cost</li> <li>• power loss along a long cable</li> <li>• (engineering) difficulties in laying / maintaining the cable</li> </ul>	<p><b>extra information</b></p> <p>accept using (Iceland's) renewable energy (resources)</p> <p>do <b>not</b> accept reduce the amount of Iceland's wasted energy</p> <p>accept Britain needs fewer (new) power stations</p> <p>accept conserves fossil fuels</p> <p>accept expensive (to lay cables)</p> <p>accept difficult to repair (if damaged)</p>	
<b>Total</b>		<b>9</b>

## PH1HP

## Question 4

question	answers	extra information	mark
<b>4(a)</b>	(kinetic) energy (of the particles) is reduced	accept slow down accept transfer energy to (cold) glass / surface accept energy is lost	1
	move closer together	do <b>not</b> accept vibrate less	1
<b>4(b)</b>	double glazing provides (better) insulation	accept double glazing has a lower U-value	1
	(inside of) glass is not as cold	accept less energy / heat transfer through double glazing accept window stays warm(er)	1
<b>4(c)(i)</b>	any <b>one</b> from: <ul style="list-style-type: none"> <li>to avoid bias</li> <li>to make sure results are reproducible</li> </ul>	accept repeatable / reliable for reproducible	1
<b>4(c)(ii)</b>	any <b>three</b> from: <ul style="list-style-type: none"> <li>the lower the <u>U-value</u>, the better the insulator</li> <li>better insulating glass costs more money</li> <li>increasing the (width of) air gap increases cost</li> <li>additional cost of better insulating glass offset by energy savings</li> </ul>	accept Superglaze or G-type for 'better insulating glass' throughout  'better insulating glass' has a lower U-value is insufficient	3
<b>Total</b>			<b>8</b>

## PH1HP

## Question 5

question	answers	extra information	mark
5(a)	<p>any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• travel (at same speed) through a vacuum / space</li> <li>• transverse</li> <li>• transfer energy</li> <li>• can be reflected</li> <li>• can be refracted</li> <li>• can be diffracted</li> <li>• can be absorbed</li> <li>• travel in straight lines</li> </ul>	do <b>not</b> accept air for vacuum	2
5(b)	can pass through the ionosphere	<p>accept atmosphere for ionosphere</p> <p>do <b>not</b> accept air for ionosphere</p> <p>accept travel in straight lines accept not refracted / reflected / absorbed by the ionosphere</p>	1
5(c)	<p>diffraction (of waves around hills)</p> <p>wavelength needs to be similar size to the obstacle / gap</p> <p>radio has a long enough wavelength <b>or</b> TV doesn't have a long enough wavelength</p>	<p>an answer TV (waves / signals) have short wavelengths so do not diffract (around the hill) scores <b>2</b> marks</p>	<p>1</p> <p>1</p> <p>1</p>

Question 5 continues on the next page

## PH1HP

## Question 5 continued

question	answers	extra information	mark
5(d)	$1.2 \times 10^6 / 1200\,000$	$v = f \times \lambda$ allow <b>1</b> mark for correct substitution ie $3.0 \times 10^8 = f \times 2.5 \times 10^2$	2
	hertz / Hz	do <b>not</b> accept hz <b>or</b> HZ  accept kHz <b>or</b> MHz  answers 1.2 MHz <b>or</b> 1200 kHz gain all <b>3</b> marks  for full credit the unit and numerical value must be consistent	1
<b>Total</b>			<b>9</b>

**PH1HP**

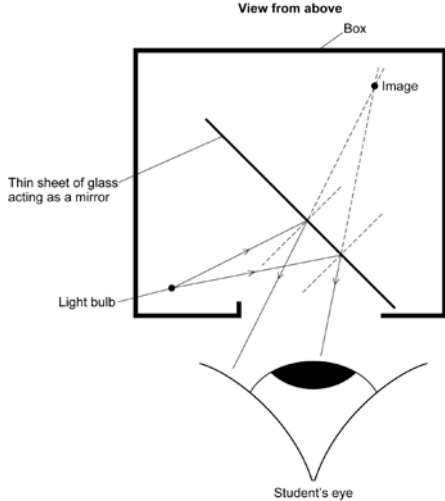
**Question 6**

question	answers	extra information	mark
<p><b>6</b></p>	(a metal has) free <u>electrons</u>	accept atoms / particles for ions throughout	1
	(kinetic) energy of (free) electrons increases	accept mobile for free	
	(free) <u>electrons</u> move faster <b>or</b> electrons move through metal	accept energy of ions increases accept ions vibrate with a bigger amplitude accept ions vibrate more do <b>not</b> accept electrons vibrate more	1
	(so) electrons transfer energy to other electrons / ions	accept electrons collide with other electrons / ions accept ions transfer energy to neighbouring ions	
<b>Total</b>			<b>4</b>



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Question 7

question	answers	extra information	mark
7(a)	<p>two rays drawn from the bulb and reflected by the glass</p> <p>at least one arrow drawn in correct direction</p> <p>position of image correct</p> 	<p>angle <b>I</b> = angle <b>R</b> judged by eye</p> <p>allow <b>1</b> mark for one incident and reflected ray even if angle <b>I</b> doesn't equal angle <b>R</b></p> <p>any conflicting arrows negate this mark</p> <p>ignore any arrows drawn on construction lines behind the glass</p> <p>judged by eye</p>	<p>2</p> <p>1</p> <p>1</p>

Question 7 continues on the next page

**PH1HP**

**Question 7 continued**

question	answers	extra information	mark
7(b)	image is formed by virtual / imaginary rays crossing	accept construction lines only show where the light seems to come from  accept the image is behind the glass / mirror  accept image is seen through the glass / mirror  accept (real) rays of light do not pass through the image  accept (real) rays do not cross  accept the image is a reflection (of the object)  accept the image is formed by reflection  do <b>not</b> accept a virtual image can't be formed on a screen  do <b>not</b> accept the object / image is reflected	1
<b>Total</b>			<b>5</b>

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**Question 8**

question	answers	extra information	mark
<b>8(a)</b>	any <b>three</b> from: <ul style="list-style-type: none"> <li>• red-shift shows galaxies are moving away (from each other / the Earth)</li> <li>• more distant galaxies show bigger red-shift</li> </ul> or <ul style="list-style-type: none"> <li>• more distant galaxies show a greater increase in wavelength</li> <li>• (in all directions) more distant galaxies are moving away faster</li> <li>• suggests single point of origin (of the universe)</li> </ul>	accept correct reference to frequency in place of wavelength  accept (suggests) universe is expanding	3
<b>8(b)(i)</b>	(radiation produced shortly after) 'Big Bang'	accept beginning of time / beginning of the universe for 'Big Bang'	1
<b>8(b)(ii)</b>	any <b>one</b> from: <ul style="list-style-type: none"> <li>• can only be explained by 'Big Bang'</li> <li>• existence predicted by 'Big Bang'</li> <li>• provides (further) evidence for 'Big Bang'</li> </ul>	ignore proves 'Big Bang' (theory)  ignore reference to red-shift	1

**Question 8 continues on the next page**

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**PH1HP****Question 8 continued**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>8(b)(iii)</b>	increase	accept becomes radio waves	1
	universe continues to accelerate outwards  <b>or</b> greater red-shift	accept as universe continues to expand	1
<b>Total</b>			<b>7</b>

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