



**General Certificate of Secondary Education  
June 2013**

**Physics**

**PH3HP**

**(Specification 4403)**

**Unit: Physics 3**

**Final**

**Mark Scheme**

---

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process 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 standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised 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.

Further copies of this Mark Scheme are available from: [aqa.org.uk](http://aqa.org.uk)

Copyright © 2013 AQA and its licensors. All rights reserved.

**Copyright**

AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

## 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. Boldening

- 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 boldened. 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.

### 3. Marking points

#### 3.1 Marking of lists

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

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

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

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

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

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

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

### 3.2 Use of chemical symbols / formulae

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

### 3.3 Marking procedure for calculations

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

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

### 3.4 Interpretation of 'it'

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

### 3.5 Errors carried forward

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

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

### 3.6 Phonetic spelling

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

### 3.7 Brackets

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

### 3.8 Ignore / Insufficient / Do not allow

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

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

### **Quality of Written Communication and levels marking**

In Question 3(a) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

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

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

#### **Level 1: basic**

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

#### **Level 2: clear**

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

#### **Level 3: detailed**

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

**PH3HP**
**Question 1**

question	answers	extra information	mark
<b>1(a)</b>	cornea (LHS gap)	must be in correct space	1
	retina (RHS gap)		1
<b>1(b)</b>	iris <b>or</b> pupil		1
	to change the shape / curvature (of the surface) of the <u>lens</u>	accept to make the <u>lens</u> thinner / fatter	1
	to focus the light (from the object, onto the retina)	to contract and relax is insufficient accept to refract / change direction of light accept rays for light accept to form / focus an image (on the retina) to focus is insufficient	1
<b>1(c)</b>	the older (a human), the longer the <u>near point</u> (or vice versa) <b>or</b> young people have the shortest <u>near point</u> (or vice versa)	answer must be in terms of <u>near point</u> (or a description of), eg become increasingly long sighted as you get older allow near point increases with age do <b>not</b> accept eye sight deteriorates as you get older answers must be comparative	1
	the (rate of) change of the <u>near point</u> increases as you get older (or vice versa)	accept <u>near point</u> increases most rapidly after 40  this statement alone gains <b>2</b> marks: the (rate of) increase of the <u>near point</u> gets greater as you get older	1

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

**PH3HP**

**Question 1 continued . . .**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>1(d)</b>	test / measure / use more people (to increase the range of ages) <b>or</b> test / measure / use more people with ages in between (those already measured)	accept test older / younger people accept increase sample size  repeat the measurements (of the same people) is insufficient	<b>1</b>
<b>1(e)</b>	2.5	allow <b>1</b> mark for correct substitution and conversion to metres, ie $\frac{1}{0.4}$ provided no subsequent step shown  an answer of 0.025 gains <b>1</b> mark	<b>2</b>
<b>Total</b>			<b>10</b>

**PH3HP**

**Question 2**

question	answers	extra information	mark
<p><b>2(a)</b></p>	<p>raft A is more stable</p> <p>raft A has the lower <u>centre of gravity / mass</u></p> <p>raft A has the wider base / is the widest</p> <p><b>OR</b></p> <p>raft B is less stable</p> <p>raft B has the higher <u>centre of gravity / mass</u> (1)</p> <p>raft B has the narrower base / is the widest (1)</p>	<p>no mark for identifying raft, marks for explanation</p> <p>must be direct / implied comparison to the other raft</p> <p>accept the barrels are spread out the most</p> <p><b>or</b></p> <p>the base / surface area is the largest</p> <p>if wrong or no raft identified as being most / least stable, <b>1</b> mark maximum for BOTH correct explanations of C of G &amp; base width</p>	<p>1</p> <p>1</p>

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



PH3HP

Question 2 continued . . .

question	answers	extra information	mark
<p><b>2(b)</b></p>	<p>any <b>two</b> correct construction lines:</p> <ul style="list-style-type: none"> <li>• line passing straight through centre of lens (&amp; out other side)</li> <li>• line travelling parallel to principal axis &amp; then being refracted through principal focus (on RHS)</li> <li>• line travelling through principal focus (on LHS) &amp; then being refracted to be parallel to principal axis (on RHS)</li> </ul> <p><u>inverted</u> image drawn (with arrow) in correct location</p> <p>one arrowhead from object to image on any construction ray</p>	<p>if more than 2 construction lines treat as a list</p> <p>conflicting arrowheads negate this mark</p>	<p>2</p> <p>1</p> <p>1</p>
<p><b>2(c)</b></p>	<p>any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• inverted</li> <li>• real</li> <li>• diminished / smaller</li> </ul>	<p>accept upside down</p> <p>allow ecf if ray diagram wrongly drawn but descriptions must relate to <b>their image</b></p> <p>a converse negates mark, eg real and virtual scores zero</p>	<p>2</p>
<p><b>Total</b></p>			<p><b>8</b></p>

**PH3HP**

**Question 3**

question	answers	extra information	mark
<b>3(a)</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
<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 / correct content.	There is a basic description of either wave <b>OR</b> What happens to either wave when they enter the body. However there is little other detail.	There is either: A clear description of BOTH waves <b>OR</b> A clear description as to what happens to BOTH waves inside the body <b>OR</b> A clear description of ONE of the waves with clear detail as to what happens to either wave inside the body.	There is a detailed description of BOTH of the waves <b>AND</b> A detailed description as to what happens to EITHER wave inside the body.

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

**PH3HP**

**Question 3 continued . . .**

<p><b>Examples of the points made in the response:</b></p> <p><b><u>Description of an X-ray</u></b></p> <ul style="list-style-type: none"> <li>• X-rays are electromagnetic waves / part of the electromagnetic spectrum</li> <li>• X-rays are (very) high frequency (waves)</li> <li>• X-rays are (very) high energy (waves)</li> <li>• X-rays have a (very) short wavelength</li> <li>• Wavelength (of X-rays) is of a similar size to (the diameter of) an atom</li> <li>• X-rays are a transverse wave</li> <li>• X-rays are ionising radiation</li> </ul> <p><b><u>Description of ultrasound</u></b></p> <ul style="list-style-type: none"> <li>• ultrasound has a <u>frequency</u> above 20 000 (hertz)</li> </ul> <p><b>OR</b></p> <p>ultra sound is above 20 000 hertz</p> <ul style="list-style-type: none"> <li>• ultrasound is above / beyond the human (upper) limit (of hearing)</li> <li>• ultrasound is a longitudinal wave</li> </ul> <p><b><u>Statement(s) as to what happens to X-rays inside the human body:</u></b></p> <ul style="list-style-type: none"> <li>• X-rays are absorbed by bone</li> <li>• X-rays travel through / are transmitted by tissue / skin</li> </ul> <p><b><u>Statement as to what happens to ultrasound inside body:</u></b></p> <ul style="list-style-type: none"> <li>• ultrasound is (partially) reflected at / when it meets a boundary between two different media</li> <li>• travel at different speeds through different media</li> </ul>	<p>do <b>not</b> allow a description of a property – eg X-rays travel through a vacuum / at the speed of light</p> <p>correct description acceptable – oscillations / vibrations are perpendicular (at 90°) to direction of energy transfer</p> <p>accept ultrasound cannot be heard by humans</p> <p>correct description acceptable – oscillations / vibrations (of particles) are parallel (in same direction) to direction of energy transfer</p>	
--	--	--

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

PH3HP

Question 3 continued . . .

question	answers	extra information	mark
3(b)	(because the X-rays) are <u>ionising</u>	accept a description of what ionising is	1
	(they will) damage cells <b>or</b> mutate cells / cause mutations / increase chances of mutations <b>or</b> turn cells cancerous / produce abnormal growths / produce rapidly growing cells <b>or</b> kill cells	instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus  do <b>not</b> accept they can be dangerous (to human health) do <b>not</b> accept damage to soft tissue	1
3(c)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• removal / destruction of kidney / gall stones</li> <li>• repair of damaged tissue / muscle</li> <li>• removing plaque from teeth</li> </ul>	accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation accept physiotherapy  accept curing prostate cancer <b>or</b> killing prostate cancer cells  cleaning teeth is insufficient	1
<b>Total</b>			<b>9</b>

**PH3HP**

**Question 4**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>4(a)</b>	liquids are (virtually) incompressible		1
<b>4(b)</b>	84	allow 1 mark for correct substitution, ie $1.5 \times 10^6 = \frac{F}{5.6 \times 10^{-5}}$ numbers may not be written in standard form, ie $1\,500\,000 = \frac{F}{0.000\,056}$ allow 1 mark for an answer 216	2
<b>4(c)</b>	it (the force on the slave pistons) is greater / larger  the area (touching the liquid) of the slave piston is greater than the area of the master piston	accept force (at slave piston) = 216 (N)  accept it has a bigger area  just quoting numbers, eg the master piston is $5 \times 10^{-5}$ and the slave piston is $14.4 \times 10^{-5}$ is insufficient	1  1
<b>Total</b>			<b>5</b>

## PH3HP

## Question 5

question	answers	extra information	mark
5(a)	centripetal (force)	allow tension (between astronaut and seatbelt)	1
	towards the centre (of the G-machine / circle)	do <b>not</b> accept towards the centre of the Earth  allow inwards	1
5(b)(i)	the <u>greater</u> the speed (of a centrifuge), the <u>greater</u> the force	answers must be comparative  accept velocity for speed  accept positive correlation between speed and force  speed and force are not proportional – treat as neutral	1
	the <u>smaller</u> the radius, the <u>greater</u> the force (at a given speed)	allow ( <b>G machine 1</b> ) has / produces a <u>greater</u> force (than <b>G machine 2</b> ) at the same speed  must be comparative, eg a small radius produces a large force = 0 marks on own	1
	as the speed increases the rate of change in force increases	accept force is proportional to the square of the speed <b>or</b> doubling speed, quadruples the force  accept any clearly correct conclusion	1
5(b)(ii)	12000 (N) <b>or</b> 12 k(N)		1

Question 5 continues on the next page . . .

**PH3HP**

**Question 5 continued . . .**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>5(c)(i)</b>	the current (in the coil) creates a magnetic field (around the coil)	accept the coil is an electromagnet	1
	so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)	accept the two magnetic fields interact (producing a force)  if no marks scored an answer in terms of current is perpendicular to the (permanent) magnetic field is worth max <b>1</b> mark	1
<b>5(c)(ii)</b>	vertically downwards arrow on side A <b>and</b> vertically upwards arrow on side C	one arrow insufficient	1
<b>5(c)(iii)</b>	the current is parallel to the magnetic field	allow the current and magnetic field are in the same direction  allow it / the wire is parallel to the magnetic field	1
<b>5(d)</b>	increase the current / p.d. (of the coil)	accept decrease resistance accept voltage for p.d. accept increase strength of magnetic field / electromagnet	1

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

**PH3HP**

**Question 5 continued . . .**

question	answers	extra information	mark
5(e)	yes with suitable reason <b>or</b> no with suitable reason	<p><b>eg</b>  <b>yes</b> – it has increased our knowledge  <b>yes</b> – It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific examples  <b>no</b> – the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough)</p> <p><b>no</b> mark for just <b>yes</b> / <b>no</b>                      reason must match <b>yes</b> / <b>no</b></p>	1
<b>Total</b>			<b>12</b>



**PH3HP**
**Question 6**

question	answers	extra information	mark
<b>6(a)</b>	60	allow <b>1</b> mark for correct substitution (with d in metres), ie $36 = F \times 0.6$  an answer of 0.6 <b>or</b> 6 gains <b>1</b> mark	<b>2</b>
<b>6(b)</b>	the line of action of the weight lies outside the base / bottom (of the bag)	accept line of action of the weight acts through the side  accept the weight (of the bag) acts outside the base / bottom (of the bag)	<b>1</b>
	a resultant / overall / unbalanced moment acts (on the bag)	accept the bag is not in equilibrium  do <b>not</b> accept the bag is unbalanced	<b>1</b>
<b>6(c)</b>	0.0625	allow <b>1</b> mark for correct substitution, ie $16 = \frac{1}{f}$  an answer of 0.00625 gains <b>1</b> mark	<b>2</b>
	hertz / Hz	do <b>not</b> accept HZ <b>or</b> hz	<b>1</b>
<b>Total</b>			<b>7</b>

**PH3HP**

**Question 7**

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

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

## PH3HP

## Question 7 continued . . .

question	answers	extra information	mark
7(b)(ii)	0.3 <b>or</b> correct calculation using $230 \times I_p = \text{their (b)(i)} \times 3.45$	allow <b>1</b> mark for correct substitution, ie $230 \times I_p = 20 \times 3.45$  allow ecf from (b)(i) for 20 <b>OR</b> substitution into this equation $\frac{I_p}{I_s} = \frac{N_s}{N_p}$	2
7(c)	(switch mode transformers) use (very) little power / current / energy when switched on but no load is applied  <b>or</b> it is more efficient	accept no for little  ignore it is more portable  do <b>not</b> accept electricity for power / current / energy  accept does not get as hot <b>or</b> less heat produced	1
7(d)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• fewer (waste) batteries have to be sent to / buried in land-fill</li> <li>• the soil is polluted less by batteries in land-fill</li> <li>• fewer (waste) batteries have to be recycled</li> <li>• fewer batteries have to be made</li> <li>• less raw materials are used in making batteries</li> <li>• customers have to replace their batteries less often</li> <li>• customers have to buy fewer (replacement) batteries</li> </ul>	longer lifetime is insufficient  it costs less is insufficient	1
<b>Total</b>			<b>9</b>

 UMS Conversion Calculator: [www.aqa.org.uk/umsconversion](http://www.aqa.org.uk/umsconversion)