



**General Certificate of Secondary Education**

**Physics 4451**

**PHY3F      Unit Physics 3**

**Mark Scheme**

*2010 examination - January 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.

Further copies of this Mark Scheme are available to download from the AQA Website: [www.aqa.org.uk](http://www.aqa.org.uk)

Copyright © **2010**. AQA and its licensors. All rights reserved.

#### COPYRIGHT

AQA retains the copyright on all its publications. However, registered centres 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 centres 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.

---

## 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.

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.

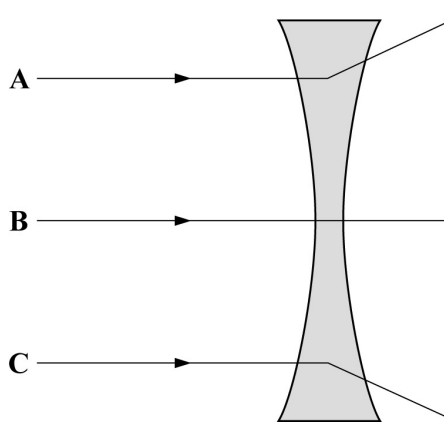
### 3.6 Phonetic spelling

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

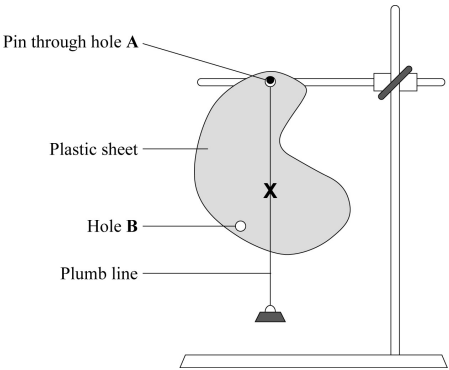
### 3.7 Brackets

(.....) 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.

**PHY3F****Question 1**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>1(a)(i)</b>	plane	accept any unambiguous indication	1
<b>1(a)(ii)</b>	normal		1
<b>1(a)(iii)</b>	incidence	accept any unambiguous indication	1
<b>1(a)(iv)</b>	be doubled	accept any unambiguous indication	1
<b>1(b)(i)</b>	diverging	accept any unambiguous indication	1
<b>1(b)(ii)</b>	<p><b>B</b> continues in a straight line (1)</p> <p><b>A</b> refracted upwards and <b>C</b> refracted downwards (1)</p>	<p>accept any reasonable freehand attempt by eye ignore what happens in the lens</p> <p><b>example</b></p> 	2
<b>Total</b>			<b>7</b>

**PHY3F****Question 2**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>2(a)</b>	centre of <b>X</b> on the plumb line and between the level of the captions 'plastic sheet' and 'hole <b>B</b> '	<b>example</b> 	1
<b>2(b)</b>	centre of mass	accept any unambiguous indication	1
<b>2(c)</b>	vertical	accept any unambiguous indication	1
<b>Total</b>			<b>3</b>

**PHY3F****Question 3**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>3(a)(i)</b>	greater than	accept any unambiguous indication	1
<b>3(a)(ii)</b>	less than	accept any unambiguous indication	1
<b>3(a)(iii)</b>	centripetal	accept any unambiguous indication	1
<b>3(a)(iv)</b>	24 hours	accept any unambiguous indication	1
<b>3(b)(i)</b>	geostationary (orbit)		1
<b>3(b)(ii)</b>	low polar (orbit)	do <b>not</b> accept just 'polar (orbit)'	1
<b>Total</b>			<b>6</b>

**PHY3F****Question 4**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>4(a)(i)</b>	bat(s)		1
<b>4(a)(ii)</b>	elephant(s)		1
<b>4(a)(iii)</b>	any example in the inclusive range 5 ↔ 29 Hz / hertz	appropriate number and unit both required	1
<b>4(b)(i)</b>	<b>B</b>		1
<b>4(b)(ii)</b>	<b>F</b>		1
<b>Total</b>			<b>5</b>

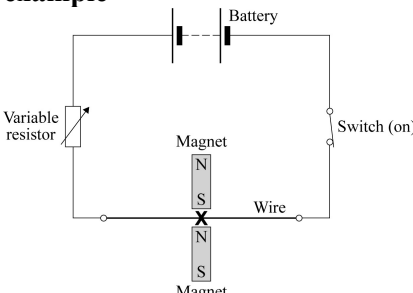


**PHY3F****Question 5**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>5(a)(i)</b>	gravitational	accept any unambiguous indication	1
<b>5(a)(ii)</b>	joining	accept any unambiguous indication	1
<b>5(a)(iii)</b>	stable	accept any unambiguous indication	1
<b>5(b)(i)</b>	collection of <u>billions of stars</u>	do <b>not</b> credit just 'millions of stars' ignore reference to planets, moons etc	1
<b>5(b)(ii)</b>	Milky Way	allow 'milky way' and other minor misspellings	1
<b>Total</b>			<b>5</b>

## PHY3F

## Question 6

question	answers	extra information	mark
6(a)	centre of the <b>X</b> midway between the poles	intention correct as judged by eye  <b>example</b> 	1
6(b)	move the poles further apart	accept turn for move  accept ends / magnets for poles  accept use weaker magnets  do <b>not</b> accept use smaller magnets	1
6(c)(i)	add more cells (to the battery)  <b>or</b> reduce the resistance (of the variable resistor)	do <b>not</b> accept 'use a bigger battery'  accept increase the potential difference / voltage  accept increase the current  do <b>not</b> accept any changes to the magnets, to the wire or to their relative positions	1

Question 6 continues on the next page . . .

---

**PHY3F****Question 6 continued . . .**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>6(c)(ii)</b>	reverse (the polarity of) the battery	accept turn the battery / cells round  accept swap the connections to the battery  do <b>not</b> accept any changes to the magnets, to the wire or to their relative positions	1
<b>Total</b>			<b>4</b>

**PHY3F****Question 7**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
7(a)	distance (from the Sun in millions of km)  and time taken for <u>orbit</u>	both required in either order  <b>not</b> just 'time taken'	1
7(b)(i)	<b>either</b> distance (from the Sun in millions of km) <b>or</b> time taken for <u>orbit</u>  (and) (average) temperature	    <b>not</b> just 'time taken'  both required in either order	1
7(b)(ii)	(+) 430 / (+) 470  <b>or</b>  Mercury / Venus		1
7(c)	25 (hours)	do <b>not</b> accept 24 (hours)	1
7(d)	...different positions at different times		1
7(e)	...direction...speed  gravitational	both and in the correct order	1  1
<b>Total</b>			<b>7</b>

**PHY3F****Question 8**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>8(a)(i)</b>	answer in the range 3.0 ↔ 3.1 inclusive	accept for 1 3.6 ÷ 1.2 or 3.7÷1.2 or 36 ÷ 12 or 37÷12 or 18 ÷ 6 or 18.5 ÷ 6 or 10.2 ÷ 3.4 or 102 ÷ 34 or answer in the range but with a unit eg 3 cm	2
<b>8(a)(ii)</b>	(principal) focus / focal (point(s)) / foci / focus	accept 'focusses' accept focals do <b>not</b> accept focal length	1
<b>8(a)(iii)</b>	at the intersection of virtual / imaginary rays	<b>or</b> 'where virtual / imaginary rays cross'  <b>or</b> the rays of (real) light do not cross  <b>or</b> the image on the same side (of the lens) as the object  <b>or</b> the image is drawn as a dotted line  <b>or</b> the image is upright  do <b>not</b> accept 'cannot be put on a screen'  do <b>not</b> accept any response which refers to reflected rays	1

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

**PHY3F****Question 8 continued . . .**

<b>question</b>	<b>answers</b>	<b>extra information</b>	<b>mark</b>
<b>8(b)(i)</b>	another correct observation about relationship between values of <b>d</b> (1)  (but) not the same relationship between corresponding values for magnification (1)	<b>example</b> 15 is three times bigger than 5 but 2.0 is not three times bigger than 1.2	2
<b>8(b)(ii)</b>	when the distance / <b>d</b> increases the magnification increases	<b>or</b> the converse accept 'there is a (strong) <u>positive</u> correlation'  do <b>not</b> accept any response in terms of proportion / inverse proportion	1
<b>8(b)(iii)</b>	(student has) no evidence (outside this range)	accept data / results / facts for 'evidence'	1
<b>Total</b>			<b>8</b>