



**General Certificate of Secondary Education
January 2013**

Physics

PHY3H

(Specification 4451)

Unit 3: 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.

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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.

PHY3H

Question 1

question	answers	extra information	mark
1(a)	any two from: <ul style="list-style-type: none"> • (sound with frequency) above 20 000 hertz / 20 kHz • frequencies above (human) audible range • (sound) cannot be heard by humans 		2
1(b)	<p>either two appropriate points gain 1 mark each</p> <p>or one appropriate point (and) appropriate qualification / amplification</p>	<p>either both pro / con or one of each</p> <p>examples</p> <p>other mammals (sufficiently) similar to humans (1) so results appropriate (1)</p> <p>unethical to experiment on humans (1) so it is better to experiment on mice (1)</p> <p>knowledge / techniques will benefit humans (1) and also other animals (1)</p> <p>experiments were justified because ultrasound has proved useful (1)</p>	2

Question 1 continues on the next page . . .

PHY3H

Question 1 continued . . .

question	answers	extra information	mark
1(c)	examples publish / tell doctors / the public (1) ...their evidence / results / research / data (1) carry out more research / tests (1) ...to make sure / check reliability (1)	allow a wide variety of appropriate responses valid point (1) appropriate example / qualification / expansion / etc (1) allow just 'stop using them / ultrasonic waves' for 1 mark only allow using them (only) for industrial purposes for 1 mark only	2
Total			6

PHY3H
Question 2

question	answers	extra information	mark
2(a)(i)	answer in the range 3.0 ↔ 3.1 inclusive	accept for 1 mark 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
2(a)(ii)	(principal) focus / focal (point(s)) / foci / focus	accept 'focusses' accept focals do not accept focal length	1
2(a)(iii)	at the intersection of virtual / imaginary rays	or 'where virtual / imaginary rays cross' or the rays of (real) light do not cross or the image on the same side (of the lens) as the object or the image is drawn as a dotted line or the image is upright do not accept 'cannot be put on a screen' do not accept any response which refers to reflected rays	1
2(b)(i)	another correct observation about relationship between values of d (but) not the relationship between corresponding values for magnification	example 15 is three times bigger than 5 but 2.0 is not three times bigger than 1.2	1 1

Question 2 continues on the next page . . .

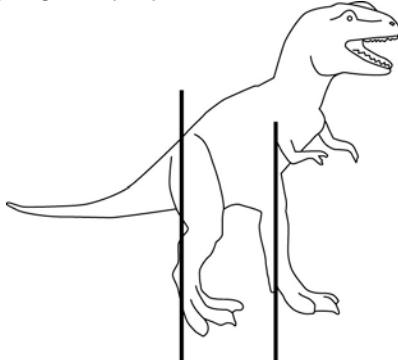
PHY3H

Question 2 continued . . .

question	answers	extra information	mark
2(b)(ii)	when the distance / d increases the magnification increases	<p>or the converse</p> <p>accept 'there is a <u>positive</u> correlation'</p> <p>do not accept any response in terms of proportion / inverse proportion</p>	1
2(b)(iii)	(student has) no evidence (outside this range)	accept data / results / facts for 'evidence'	1
Total			8

PHY3H

Question 3

question	answers	extra information	mark
3(a)(i)	centre of X above the feet and in the body	a vertical line from their X falls between two lines in diagram – judged by eye 	1
3(a)(ii)	where the mass seems to be concentrated	accept it's above the <u>base</u> (area) accept because otherwise it would topple accept line of action (of weight) passes through the <u>base</u> do not accept where the mass is concentrated	1
3(b)	any two from: <ul style="list-style-type: none"> • make (the area of) feet / base bigger • make feet wider apart • make legs shorter / heavier • make head smaller / lighter • make tail touch the ground / make the tail longer 	accept 'make centre of mass / gravity lower'	2
Total			4

PHY3H

Question 4

question	answers	extra information	mark
4(a)	fusion	do not credit any response which looks like 'fission'	1
	of hydrogen / H (atoms)	credit only if 1 st mark point scores	1
4(b)	fusion of other / lighter atoms / elements	reference to big bang nullifies both marks	1
	during supernova / explosion of star(s)		1
4(c)	the (available) evidence: supports this idea or does not contradict this idea or can be extrapolated to this idea or (electromagnetic) spectrum from other stars is similar to sun		1
Total			5

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Question 5

question	answers	extra information	mark
5(a)	400 000	allow 1 mark for correct substitution ie $\frac{25\ 000}{?} = \frac{800}{12\ 800}$ or $\frac{25}{?} = \frac{800}{12\ 800}$	2
5(b)(i)	any one from: <ul style="list-style-type: none"> • (so that there is) no short circuit • (so that the) current goes around the coil • (so that the) current does not enter the core 	do not accept any response in terms of heat insulation, safety or electric shock do not accept electricity for current	1
5(b)(ii)	(easily) magnetised (and demagnetised)	accept '(it's) magnetic' do not accept 'because it's a conductor'	1
5(b)(iii)	alternating current in the primary (coil)		1
	produces a <u>changing</u> magnetic field (in the core)		1
	this <u>induces</u> an (alternating) potential difference across the secondary (coil)		1

Question 5 continues on the next page . . .

PHY3H

Question 5 continued . . .

question	answers	extra information	mark
5(c)	any two from: <ul style="list-style-type: none"> • if the (local) power station breaks down / fails / demand / load exceeds supply • electricity / power can be switched from elsewhere in the system / from other power station(s) • electricity can be generated in places remote from customers • (in total) fewer power stations are needed • power available in rural / remote areas • National Grid allows for (better) control of supply and demand 		2
Total			9

PHY3H

Question 6

question	answers	extra information	mark
6(a)	38 400	allow 6.4×6000 for 1 mark	2
	Nm or newton metres	do not credit 'nm', 'mN' or 'metre newtons'	1
6(b)	16 000 (N) or 16 <u>k</u> N	allow 1 mark for $38\,400 \div 2.4$ accept their (a) $\div 2.4$ correctly calculated for 2 marks accept their (a) $\div 2.4$ for 1 mark	2
Total			5

PHY3H

Question 7

question	answers	extra information	mark
<p>7(a)</p>	<p>which causes the magnet to turn / spin / rotate</p>		<p>1</p>
	<p>(magnetic) field / lines of force / flux rotate(s) / move(s) / through / in / cut(s) the coil</p>	<p>do not credit the idea that movement 'creates' the magnetic field</p>	<p>1</p>
	<p>potential difference / p.d. / voltage <u>induced</u> across the coil</p>	<p>do not credit just 'current induced'</p>	<p>1</p>
<p>7(b)</p>	<p>any one from:</p> <ul style="list-style-type: none"> • more powerful / stronger / lighter magnet • larger / more / bigger / lighter cups / with a bigger surface area • longer arms • lubricate the spindle • add more turns to the coil 	<p>do not credit 'a bigger magnet'</p>	<p>1</p>
<p>Total</p>			<p>4</p>

PHY3H

Question 8

question	answers	extra information	mark
8(a)	any two from: <ul style="list-style-type: none"> • (acceleration occurs when) the direction (of each capsule) changes • velocity has direction • acceleration is (rate of) change of velocity 		2
8(b)	to(wards) the centre (of the wheel)		1
8(c)	the greater the radius / diameter / circumference (of the wheel) the smaller the (resultant) force (required)	accept 'the size' for radius both parts required for the mark	1
Total			4

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