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General Certificate of Secondary Education

Additional Science 4463/ Physics 4451

PHY2H Unit Physics 2

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.

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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 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.

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Question 1

question	answers	extra information	mark
1(a)	96	allow **1** mark for correct substitution ie 80 × 1.2	2
	newton or N	allow Newton do **not** allow n	1
1(b)(i)	direction		1
1(b)(ii)	velocity <u>and</u> time are continuous (variables)	answers must refer to both variables accept the variables are continuous / not categoric accept the data / 'it' is continuous accept the data / 'it' is not categoric	1
1(b)(iii)	**C**		1
	velocity is not changing	the **2** marks for reason may be scored even if **A** or **B** are chosen accept speed for velocity accept speed is constant (9 m/s) accept **not** decelerating accept **not** accelerating accept reached terminal velocity	1
	forces must be balanced **or** resultant force is zero	accept forces are equal accept arrows are the same length / size do **not** accept the arrows are equal	1
Total			**8**

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Question 2

question	answers	extra information	mark
2(a)(i)	(two) nuclei (of light elements) join forming a larger / heavier nucleus / one	accept hydrogen atoms for nuclei accept comparative term equivalent to larger accept forms a helium (nucleus / atom) this mark only scores if fusion is in terms of hydrogen atoms	1 1
2(a)(ii)	stars	accept a named star e.g. the Sun accept nebula mention of planets negates answer	1
2(b)(i)	any **one** from: • (currently) only experimental • reaction does not last long enough • use more energy than they produce	 allow difficult to control do **not** allow inefficient on its own	1
2(b)(ii)	any **one** from: • will give another source of energy • unlimited fuel supplies / energy • would not produce any radioactive waste • want to show that it can be done	do **not** accept answers only in terms of fossil fuels or carbon dioxide accept unlimited hydrogen accept less radioactive waste accept nuclear for radioactive do **not** accept toxic waste accept any sensible suggestion	1

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(c)(i)	any **one** from: • repeating did not produce the same results / data • experiments were not / may not be reproducible • data / experiments were not valid	accept could not be repeated accept has not been repeated do **not** accept answers in terms of scientists being biased	1
2(c)(ii)	any **one** from: • cannot trust journalists • newspaper journalist may not have a science background • newspaper may publish what people want to read • newspaper may simplify ideas • people believe / trust the scientists writing the journal • people have heard of the scientists writing in the journal • scientists writing in the journal are famous • journal only publishes the work of respected / famous scientists • data is checked by other scientists before published in the journal	bias is insufficient on its own accept any sensible suggestion, these are examples they do not constitute a full list	1
Total			**7**

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Question 3

question	answers	extra information	mark
3(a)(i)	**K** and **L**	both answers required either order	1
3(a)(ii)	(1) same number of protons (2) different numbers of neutrons	accept same number of electrons accept same atomic number	1 1
3(b)(i)	90		1
3(b)(ii)	140		1
3(c)	alpha (particle) mass number goes down by 4 **or** number of protons and neutrons goes down by 4 **or** number of neutrons goes down by 2 atomic / proton number goes down by 2 **or** number of protons goes down by 2	reason may score even if beta or gamma is chosen candidates that answer correctly in terms of why gamma **and** beta decay are not possible gain full credit accept an alpha particle consists of 2 neutrons and 2 protons for **1** mark accept alpha equals $^{4}_{2}$He or $^{4}_{2}\alpha$ for **1** mark an alpha particle is a helium nucleus is insufficient for this mark	1 1 1
Total			**8**

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Question 4

question	answers	extra information	mark
4(a)(i)	light dependent resistor / LDR	accept ldr	1
4(a)(ii)	25 (kilohms)	accept 24 - 26 inclusive accept 25 000 Ω	1
4(a)(iii)	5 (V) or their (a)(ii) correctly converted to ohms × 0.0002 correctly calculated	allow **1** mark for converting 25 kΩ / their (a)(ii) to ohms **or** allow **1** mark for correct substitution ie 0.0002 × 25(000) **or** 0.0002 × their (a)(ii) allow an incorrect conversion from kilohms providing this is clearly shown	2
4(b)(i)	linear scale	using all of the available axis must cover the range 4 - 6 v **or** their (a)(iii) − 6 v and lie within the range 0 – 15 inc.	1
4(b)(ii)	negative gradient line passing through 20 lux and their (a)(iii)	do **not** allow lines with both positive and negative gradients only scores if the first mark is awarded only scores if line does not go above 6 volts	1 1
4(c)(i)	37.5 (kΩ) or their (a)(ii) + 50 % (a)(ii) correctly calculated		1

Question 4 continues on the next page . . .

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Question 4 continued . . .

question	answers	extra information	mark
4(c)(ii)	light intensity value would be unreliable / not accurate		1
	due to variation in <u>resistance</u> value	accept because resistance varies by ± 50 % accept tolerance of resistor is too great do **not** accept results are not accurate	1
Total			**10**

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Question 5

question	answers	extra information	mark
5(a)	each hair gains the same (type of) charge **or** (each) hair is negatively charged **or** (each) hair gains electrons	 do **not** accept hair becomes positively charged	1
	similar charges repel **or** negative charges repel **or** electrons repel	accept positive charges repel providing first marking point is in terms of positive charge	1
5(b)	0.000002 **or** 2×10^{-6} **or** $2\,\mu C$	accept correct substitution and transformation for **1** mark ie 30 / 15 or .03 / 15000 or 30 / 15000 or .03 / 15 answers 2 and 0.002 gain **1** mark	2
5(c)	current	do **not** accept amp / amperes	1
Total			**5**

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Question 6

question	answers	extra information	mark
6(a)(i)	momentum before = momentum after **or** (total) momentum stays the same	accept no momentum is lost accept no momentum is gained	1
6(a)(ii)	an external force acts (on the colliding objects)	accept colliding objects are not isolated	1
6(b)(i)	9600 kg m/s **or** Ns	allow **1** mark for correct calculation of momentum before or after ie 12000 or 2400 **or** correct substitution using change in velocity = 8 m/s ie 1200 × 8 this may be given in words rather than symbols	2 1
6(b)(ii)	3 or their (b)(i) ÷ 3200 correctly calculated	allow **1** mark for stating momentum before = momentum after **or** clear attempt to use conservation of momentum	2
Total			**7**