Version 1.0

General Certificate of Secondary Education
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Additional Science / Physics PHY2H

(Specification 4463 / 4451)

Unit 2: Physics 2

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.

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 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 <u>not</u> 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.

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Question 1

question	answers	extra information	mark
1(a)	3rd box The negative charge in the water is repelled by the rod and the positive charge is attracted to the rod.		1
1(b)(i)	friction between bottles and conveyor belt / (plastic) guides	accept bottles rub against conveyor belt / (plastic) guides	1
	charge transfers between bottles and conveyor belt / (plastic) guides	accept specific reference eg electrons move onto / off the bottles reference to positive electrons / protons negates this mark	1
1(b)(ii)	(the atom) loses or gains one (or more) electrons		1
1(b)(iii)	charge will not (easily) flow off the conveyor belt / bottles	accept the conveyor belt / bottles is an insulator / not a conductor accept conveyor belt is rubber	1
Total			**5**

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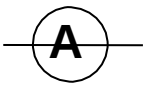
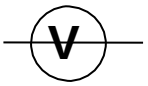
Question 2

question	answers	extra information	mark
2(a)(i)	ammeter symbol correct and drawn in series	accept  do **not** accept lower case a	1
	voltmeter symbol correct and drawn in parallel with the material	do **not** accept 	1
2(a)(ii)	adjust / use the variable resistor **or** change the number of cells	accept change the resistance accept battery for cell accept change the pd / accept change the voltage accept increase / decrease for change	1
2(b)(i)	37.5 (Ω)	accept answer between 36 and 39 inclusive	1
2(b)(ii)	5.6(25) **or** their (b)(i) x 0.15	allow **1** mark for correct substitution ie 37.5 **or** their (b)(i) × 0.15 provided no subsequent step shown	2
2(c)(i)	the thicker the putty the lower the resistance	answer must be comparative accept the converse	1

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(c)(ii)	any **one** from: • measuring length incorrectly • measuring current incorrectly • measuring voltage incorrectly • ammeter / voltmeter incorrectly calibrated • thickness of putty not uniform • meter has a zero error	accept may be different length do **not** accept different currents do **not** accept different voltage do **not** accept pieces of putty not the same unless qualified do **not** accept systematic / random error accept any sensible source of error eg putty at different temperatures do **not** accept human error without an explanation do **not** accept amount of putty not same	1
2(c)(iii)	repeat readings and take a mean	accept check results again accept do experiment again accept do it again and take mean(s) accept compare own results with other groups do **not** accept take more readings	1
Total			**9**

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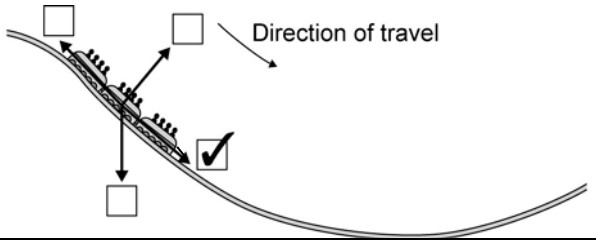
Question 3

question	answers	extra information	mark
3(a)	correct box ticked 		1
3(b)(i)	30	ignore added units	1
3(b)(ii)	2250 **or** their (b)(i) × 75 correctly calculated	allow **1** mark for correct substitution ie 75 × 30 **or** their (b)(i) × 75 provided no subsequent step shown an answer of 750 gains **1** mark only if answer to (b)(i) is 10	2
Total			**4**

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Question 4

question	answers	extra information	mark
4(a)(i)	2.5		1
4(a)(ii)	The radiation dose from natural sources is much greater than from artificial sources		1
4(b)(i)	any **one** from: • different concentrations in different rooms • to average out daily fluctuations	accept to find an average accept to make the result (more) reliable / valid do **not** accept to make more accurate on its own	1
4(b)(ii)	average level (much) higher (in **C** and **D**) some homes have very high level (in **C** and **D**) **or** maximum level in some homes (in **C** and **D**) is very high	accept converse accept maximum level in **A** and **B** is low accept higher radiation levels (in **C** and **D**) for **1** mark	1 1
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)(i)	longer reaction time **or** greater thinking distance **or** greater stopping distance	accept slower reactions do **not** accept slower reaction time unless qualified accept greater thinking time accept greater stopping time greater braking distance negates answer	1
5(a)(ii)	lines / slopes have the same gradient **or** velocity decreases to zero in same time / in 2.6 seconds	accept slopes are the same accept any time between 2.4 and 2.8 accept braking distances are the same	1
5(a)(iii)	12	accept extracting both reaction times correctly for **1** mark (0.6 and 1.4) **or** time = 0.8(s) for **1** mark accept 0.8 × 15 for **2** marks accept calculating the distance travelled by car **A** as 28.5 m **or** the distance travelled by car **B** as 40.5 m for **2** marks	3

Question 5 continues on the next page . . .

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Question 5 continued . . .

question	answers	extra information	mark
5(b)	**Z** different force values give a unique / different resistance	 only scores if **Z** chosen do **not** accept force and resistance are (directly) proportional accept answers in terms of why either **X or Y** would not be best eg **X** – same resistance value is obtained for 2 different force values **Y** – all force values give the same resistance	1 1
Total			**7**

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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 do **not** accept nS	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**

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Question 7

question	answers	extra information	mark
7(a)	d.c. flows in (only) one direction		1
	a.c. changes direction (twice every cycle)	accept a.c. constantly changing direction ignore references to frequency	1
7(b)	a current flows through from the live wire / metal case to the earth wire	accept a current flows from live to earth do **not** accept on its own if the current is too high	1
	this current causes the fuse to melt	accept blow for melt do **not** accept break / snap / blow up for melt	1
Total			**4**

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Question 8

question	answers	extra information	mark
8	any **two** pairs from: • nuclear model mass is concentrated at the centre / nucleus (1) plum pudding model mass is evenly distributed (1) • nuclear model positive charge occupies only a small part of the atom (1) plum pudding model positive charge spread throughout the atom (1) • nuclear model electrons orbit some distance from the centre (1) plum pudding electrons embedded in the (mass) of positive (charge) (1) • nuclear model the atom mainly empty space (1) plum pudding model is a 'solid' mass (1)	to gain credit it must be clear which model is being described do **not** accept simple descriptions of the diagram without comparison accept the nuclear model has a nucleus / the plum pudding model does not have a nucleus for **1** mark accept electrons in shells / orbits provided a valid comparison is made with the plum pudding model do **not** accept electrons at edge of plum pudding	4
Total			**4**

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