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General Certificate of Secondary Education
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Additional Science / Physics (Specification 4408 / 4403) PH2FP

Unit: 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.

Further copies of this Mark Scheme are available from: aqa.org.uk

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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. 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.

Quality of Written Communication and levels marking

In Question 9(c) 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.

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Question 1

question	answers	extra information	mark
1(a)	4 N to the right		1
1(b)(i)	bigger than equal to		1 1
1(b)(ii)	reduces it increases air resistance / drag / force C	 accept parachute has large(r) (surface) area	1 1
Total			**5**

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Question 2

question	answers	extra information	mark
2(a)	cosmic rays radon gas		1 1
2(b)(i)	Radioactive decay is a random process		1
2(b)(ii)	19		1
2(b)(iii)	140	accept 159 – their (b)(i) correctly calculated	1
2(b)(iv)	gamma the count stayed the same **or** gamma does not have a charge (so) gamma is not deflected / affected by the magnetic field	 accept gamma is an electromagnetic wave accept magnet for magnetic field do **not** accept is not attracted to the magnet last two marks may be scored for an answer in terms of why it cannot be alpha or beta only answer simply in terms of general properties of gamma are insufficient	1 1 1

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(c)	lead absorbs (some of the) radiation **or** less radiation emitted into the (storage) room	accept radiation cannot pass through (the lead)	1
2(d)	Should radioactive waste be dumped in the oceans		1
Total			**10**

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Question 3

question	answers	extra information	mark
3(a)	25(Ω)		1
3(b)(i)	2(V)	allow **1** mark for showing a correct method, ie 6/3	2
3(b)(ii)	equal to		1
Total			**4**

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Question 4

question	answers	extra information	mark
4(a)(i)	50 (Hz)		1
4(a)(ii)	2760 (W)		1
4(b)	12 amps	allow **1** mark for correct substitution, ie 2400/200 **or** allow **1** mark for 2760/230 provided no subsequent step shown	2 1
4(c)	the charge is <u>directly</u> proportional to the time switched on for	accept for **1** mark the longer time (to boil), the greater amount of charge **or** positive correlation **or** they are proportional	2
Total			**7**

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Question 5

question	answers	extra information	mark
5(a)(i)	electrons a positive		1 1
5(a)(ii)	(forces are) equal (forces act in) opposite directions	accept (forces are)the same forces are balanced is insufficient accept (forces) repel both sides have the same charge is insufficient	1 1
5(b)	aluminium		1
Total			**5**

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Question 6

question	answers	extra information	mark
6(a)	any **two** from: • (make shape / body) more streamlined • increase power of engine • reduce mass / weight (of go-kart)	accept a correct description accept lower the seating position of the driver faster engine is insufficient change wheel size is insufficient	2
6(b)(i)	A–B steepest / steeper gradient / slope	reason only scores if A–B is chosen	1 1
6(b)(ii)	1820	allow **1** mark for correct substitution, ie 140 × 13 provided no subsequent step shown	2
Total			**6**

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Question 7

question	answers	extra information	mark
7(a)	neutron discovered		1
7(b)	neutron electron proton	all 3 in correct order allow **1** mark for 1 correct	2
Total			**3**

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Question 8

question	answers	extra information	mark
8(a)	gravitational / gravity / weight	do **not** accept gravitational potential	1
8(b)	accelerating	accept speed / velocity increases	1
	the distance between the drops increases		1
	but the time between the drops is the same	accept the time between drops is (always) 5 seconds accept the drops fall at the same rate	1
8(c)(i)	any **one** from: • speed / velocity • (condition of) brakes / road surface / tyres • weather (conditions)	accept specific examples, eg wet / icy roads accept mass / weight of car friction is insufficient reference to any factor affecting thinking distance negates this answer	1

Question 8 continues on the next page . . .

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Question 8 continued . . .

question	answers	extra information	mark
8(c)(ii)	75 000	allow **1** mark for correct substitution, ie 3000 × 25 provided no subsequent step shown **or** allow **1** mark for an answer 75 **or** allow **2** marks for 75 k(+ incorrect unit), eg 75 kN	2
	joules / J	do **not** accept j an answer 75 kJ gains **3** marks for full marks the unit and numerical answer must be consistent	1
Total			**8**

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Question 9

question	answers	extra information	mark
9(a)	forces (within the star) are balanced	if specific forces are mentioned they must be appropriate	1
9(b)(i)	bigger the mass (of the star) the shorter the 'main sequence' period	accept bigger the star the shorter the time	1
9(b)(ii)	any **one** from: • insufficient evidence • do not know (exact) amount of hydrogen in star • time too long (to measure directly) • may be other factors (not yet known) that determine length of 'main sequence' period • values are based on theory / calculation	accept do not know (exact) mass of star	1
9(b)(iii)	faster than		1
	larger stars have a shorter 'main sequence' period so they must have the faster (rate of) nuclear fusion	there must be a link between shorter 'main sequence' and nuclear fusion, this may be implied from the first marking point	1
	the end of 'main sequence' happens as the hydrogen in (the core of) a star is used up **or** (since) they use up hydrogen at a faster (rate)	accept more massive stars (are brighter so) release energy faster	1

Question 9 continues on the next page . . .

question	answers	extra information	mark
9(c)	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

0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content.	There is a basic description of what happens to a star much larger than the Sun after the 'main sequence' period. **OR** Two stages are correctly named and are in the correct sequence.	There is a clear description of what happens to a star much larger than the Sun after the 'main sequence' period. **AND** At least two stages are correctly named and are in the correct sequence.	There is a detailed description of what happens to a star much larger than the Sun after the 'main sequence' period. **AND** At least three stages are named, in the correct sequence. There are no additional incorrect stages given.

Examples of the points made in the response:	**extra information**
• (the core of the) star runs out of hydrogen	
• (the star) expands (to form)	
• (the star) cools (to form)	
	• the core shrinks
	• helium starts to fuse to form other elements
• a red supergiant	accept super red giant do **not** accept red giant
• (outer layers) explode	
	• fusion of lighter elements to form heavier elements (up to iron)
• as a supernova	
• elements heavier than iron are formed	accept heaviest elements are formed
• core shrinks	
• becoming a neutron star	
• if mass large enough (core collapses)	
• (to form) a black hole	if a correct description and sequence for a star the same size as the Sun and much bigger than the Sun given without clearly indicating which is which is limited to Level 2

Total			**12**

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