GCSE
ADDITIONAL SCIENCE M / PHYSICS M

MPH2HP
Mark scheme

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Version 1.0: Final

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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

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 are 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 2(b) 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

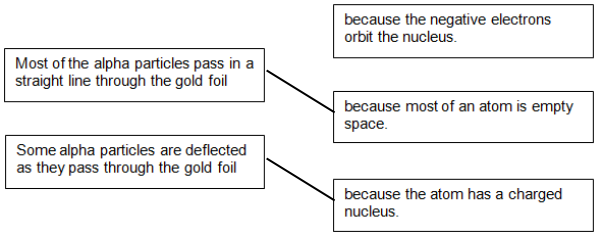
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

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.

Question	Answers	Extra information	Mark	AO / spec ref
1(a)	electrons have a negative charge equal to the positive 'pudding'	accept electrons are negative accept the same as the positive charge accept balance / cancel the positive charge accept cancels the pudding allow for **1** mark charge on electrons equals charge of plum pudding **or** negative and positive charges are equal	1 1	AO1 2.5.1c
1(b)(i)		allow **1** mark for one correct line if more than one line drawn from any observation all those lines are wrong	2	AO1 2.5
1(b)(ii)	any **one** from: • 'plum pudding' atom has no empty space • 'plum pudding' does not have a nucleus • electrons are embedded **or** electrons do not orbit	accept electrons are inside	1	AO2 2.5

Question 1 continues on the next page . . .

Question 1 continued . . .

Question	Answers	Extra information	Mark	AO / spec ref
1(c)	orbit of electrons too close to the nucleus	accept nucleus too big accept electrons are (much) smaller (than protons / neutrons) ignore a gap is shown between neutrons and protons	1	AO2 2.5.1a/b
1(d)	scientists found out new things about the atom		1	AO1 2.5.1d
Total			**7**	

Question	Answers	Extra information	Mark	AO / spec ref
2(a)(i)	radiation in the environment	accept air for environment accept radiation around us all of the time specific examples only is insufficient	1	AO1 2.5.2b
2(a)(ii)	any **one** from: • nuclear power (stations) • nuclear weapons (testing) • nuclear accidents	accept (nuclear) fission accept nuclear waste accept coal power stations accept nuclear bombs / fallout accept named accident, eg Chernobyl or Fukushima accept named medical procedure which involves a radioactive source accept X-rays accept specific industrial examples that involve a radioactive source accept radiotherapy nuclear activity / radiation is insufficient smoke detectors is insufficient	1	AO1 2.5.2b
2(a)(iii)	electromagnetic radiation	accept electromagnetic wave	1	AO1 2.5.2c
2(a)(iv)	decrease <u>beta</u> radiation deflected (away from GM tube) <u>gamma</u> radiation not affected (by electric field)	 accept electric field stops beta particles reaching GM tube accept for **1** mark some radiation is deflected (away from GM tube) and some is not	1 1 1	AO1 2.5.2f

Question 2 continues on the next page . . .

Question 2 continued . . .

Question	Answers	Extra information	Mark	AO / spec ref
2(b)	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	AO3 2.5.2e/h

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	There is a brief evaluation in terms of **either** type of radiation emitted **or** half-life. **Or** a brief evaluation of a source in terms of both type of radiation emitted and half-life. **Or** a conclusion that **B** or **C** is suitable with a reason.	**Either** a clear evaluation to include consideration of type of radiation emitted **or** half-life for all sources. **Or** a full evaluation of C in terms of radiation and half-life.	A detailed evaluation in terms of alpha, beta and gamma and consideration of the importance of a long or short half-life.

Question 2 continues on the next page . . .

Question 2 continued . . .

Question	Answers	Extra information	Mark

examples of the points made in the response	extra information
A – alpha • not able to penetrate the aluminium (foil)	
B and **C** – beta • amount of beta detected depends on the thickness of the foil • so a change in count rate would indicate a change in thickness	
D – gamma • travel through the foil with no attenuation	accept foil would not affect gamma ignore gamma can pass through lead
• change in thickness would not change count rate	
Half-life	
A (and) **C** • appropriate for application • level of radiation would remain (fairly) constant over a long time • source would not need to be changed frequently	have a long half-life is insufficient
B and **D** • rapid decay means levels detected would change rapidly (even if thickness does not change) • control mechanism would need constant recalibration • source need frequent replacement • rapid decay (may) increase radiation levels in workers environment	
Conclusion **C** is the only source suitable for this application	

Total			12

Question	Answers	Extra information	Mark	AO / spec ref
3(a)(i)	zero / 0	do **not** accept nothing ignore any units	1	AO1 2.1.1d
3(a)(ii)	arrow pointing vertically downwards	accept an arrow parallel to track accept arrow drawn anywhere on diagram	1	AO1 2.1.1d
3(b)(i)	45 (N/kg)		1	AO2 2.1.4d
3(b)(ii)	2700 (N) **or** their **(b)(i)** × 60 correctly calculated	allow **1** mark for correct substitution, ie 60 × 45 **or** 60 × their **(b)(i)**	2	AO2 2.1.4d
3(c)	57.6 (m)	$\frac{1}{2}$ x 32 x 3.6 incorrectly calculated scores **1** mark **or** allow **1** mark for correct use of graph but with incorrect values	2	AO2 2.1.2h
3(d)	(velocity includes) direction (which) is changing	velocity includes direction is insufficient	1	AO1 2.1.2d
Total			**8**	

Question	Answers	Extra information	Mark	AO / spec ref
4(a)(i)	beginning	accept first period / stage accept before main sequence accept when dust and gas are pulled together accept before (nuclear) fusion starts	1	AO1 2.6.2e
4(a)(ii)	hydrogen (in the core) runs out	accept fuel runs out accept hydrogen / fuel starts to run out answers in terms of unbalanced forces are insufficient	1	AO1 2.6.2e
4(a)(iii)	size / mass of star		1	AO1 2.6.2e
4(b)(i)	any **one** from: • an answer in terms of % present would be extremely small • an answer in terms of instruments unable to detect tiny amounts **or** lack of technology • an answer in terms of do not know how to do it	do **not** accept answers in terms of can't get to the Sun lack of evidence is insufficient	1	AO3 2.6.2f
4(b)(ii)	hydrogen atoms / nuclei (join to) form helium atoms / nuclei (by the process of nuclear) fusion	accept hydrogen converted / changes to helium hydrogen fuses to helium for **2** marks	1 1	AO1 2.6.2a/f

Question 4 continues on the next page . . .

Question 4 continued . . .

Question	Answers	Extra information	Mark	AO / spec ref
4(b)(iii)	any **two** from: • heavy elements cannot be formed in the Sun / a main sequence star • elements heavier than iron are formed in a supernova • heavy elements must have been present when the Sun was formed		2	AO1 AO3 2.6.2f
Total			**8**	

Question	Answers	Extra information	Mark	AO / spec ref
5(a)(i)	0 – 8	accept any value between 0 and 1 inclusive for 1st value	1	AO2 2.1.5d
	line starts at the origin		1	
	and is straight up to (and including) 8 N	accept line curves after 8 N	1	
5(a)(ii)	longer		1	AO3 2.1.5d
5(a)(iii)	40	allow **1** mark for correct substitution of a pair of values correctly taken from any part of the graph, eg 8 = k × 0.20	2	AO1 AO2 2.1.5d
	N/m **or** newtons per metre **or** Nm^{-1}	do **not** accept any incorrect symbols	1	
5(b)(i)	so data / results are comparable **or** different tests may produce different data	fair test is insufficient accurate / reliable results / bias is insufficient	1	AO3 2.1.5
5(b)(ii)	work is done to stretch the rope		1	AO2 AO3 2.1.5c
	Y will extend / stretch more than X	accept X is stiffer than Y simply quoting percentage values is insufficient	1	
	so maximum force on Y would be smaller than on X		1	
	meaning Y less likely to snap than X	accept for **4** marks a complete answer in terms of change in momentum or deceleration and force	1	
Total			**6**	

Question	Answers	Extra information	Mark	AO / spec ref
6(a)	230 (V)		1	AO1 2.4.1c
6(b)	no change p.d. (across R_1) does not change **or** twice the current drawn from the mains	accept none accept voltage for p.d. it is a parallel circuit is insufficient	1 1	AO1 2.3.2l/h
6(c)	a (conducting) wire connects the (case of) the appliance to the ground / Earth	accept it has an earth wire accept the case is connected to Earth mention of heat conduction negates this mark	1	AO1 2.4.1j
Total			**4**	

Question	Answers	Extra information	Mark	AO / spec ref
7(a)	work done / energy transferred per coulomb of charge (that passes between two points in a circuit)	accept work done / energy transferred per unit charge	1	AO1 2.3.2b
7(b)	86 or 87	an answer that rounds to 86 gains **3** marks allow **2** marks for current = 2.9 (A) **or** a value that rounds to 2.9 (A) allow **1** mark for current = $\frac{10}{3.5}$ clear use of Q=Ixt with incorrectly calculated value of I gains **1** mark. If correctly rounded gains **2** marks	4	AO1 AO2 2.3.2a/h
	coulomb / C	do **not** accept c	1	
7(c)	temperature of the filament / bulb is low		1	AO1 2.3.2m
	(so) ions vibrate slowly / with a small amplitude	accept atoms for ions do **not** accept ions vibrate less	1	
	(and the free) electrons can move easily / freely through the filament / metal **or** (and there are) few collisions between the (free) electrons and ions	accept atoms for ions	1	
Total			**9**	