GCSE
ADDITIONAL SCIENCE / PHYSICS

PH2HP
Mark scheme

4408/4403
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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 Assessment Objectives and specification content that each question is intended to cover.

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 / ; e.g. 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 3(a)(iii) 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)	450	allow **1** mark for correct substitution, ie 18 × 10 × 2.5 provided no subsequent step	2	AO2 2.2.1f
1(b)(i)	friction between child ('s clothing) and slide	accept friction between two insulators accept child rubs against the slide accept when two insulators rub (together)	1	AO1 2.3.1a
	causes electron / charge transfer (between child and slide)	accept specific reference, eg electrons move onto / off the child / slide reference to positive electrons / protons / positive charge / atoms transfer negates this mark answers in terms of the slide being initially charged score zero	1	
1(b)(ii)	all the charges (on the hair) are the same (polarity)	accept (all) the charge/hair is negative / positive accept it is positive/negative	1	AO3 2.3.1d
	charges / hairs are repelling	both parts should be marked together	1	
1(b)(iii)	charge would pass through the metal (to earth)	accept metal is a conductor accept metal is not an insulator accept there is no charge / electron transfer accept the slide is earthed accept metals contain free electrons	1	AO1 2.3.1e
Total			**7**	

Question	Answers	Extra information	Mark	AO spec ref
2(a)	J (only) stars (about) the same/smaller size/mass as the Sun become black dwarfs	reason only scores if J is chosen accept smaller than the Sun accept it is the smallest accept (only) small stars become black dwarfs	1 1	AO1 AO2 2.6.2e
2(b)(i)	become a supernova **or** it will explode	ignore subsequent correct stages	1	AO1 2.6.2e
2(b)(ii)	cannot take measurements needed **or** do not have the technology	do **not** accept cannot measure mass	1	AO3 2.6.2e
2(b)(iii)	advances in (measuring) techniques / technology / knowledge		1	AO3 2.6.2e

Question 2 continues on the next page . . .

Question 2 continued . . .

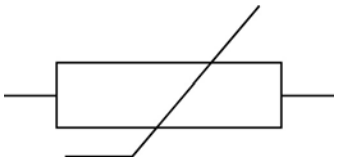
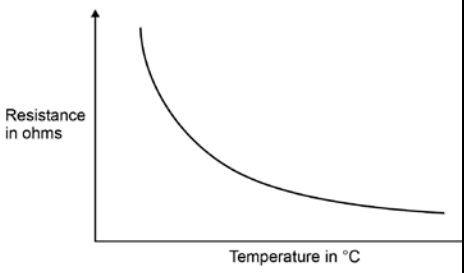
Question	Answers	Extra information	Mark	AO spec ref
2(c)	any **five** from: • star expands (to become) • a red giant • heavier elements are formed (by fusion) • star shrinks (to become) • a white dwarf • star cools / fades • star stops emitting energy / radiation	ignore any information up to the end of the main sequence Apply the list rule if more than 5 points are made red supergiant is incorrect elements heavier than iron are formed is incorrect supernova, neutron star, black hole are incorrect star loses all energy is insufficient	5	AO1 2.6.2 b, d, e
Total			**10**	

Question	Answers	Extra information	Mark	AO spec ref
3(a)(i)	friction		1	AO1 2.1.3a
3(a)(ii)	air resistance	accept drag friction is insufficient	1	AO1 2.1.3a

3(a)(iii)	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.		**Mark** **6**	**AO spec ref**
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**	AO2 AO3 2.1.4c
No relevant content.	There is an attempt to explain in terms of forces A and B why the velocity of the cyclist changes between any two points **or** a description of how the velocity changes between any two points.	There is an explanation in terms of forces A and B of how the velocity changes between X and Y and between Y and Z **or** a complete description of how the velocity changes from X to Z. **or** an explanation and description of velocity change for either X to Y or Y to Z	There is a clear explanation in terms of forces A and B of how the velocity changes between X and Z **and** a description of the change in velocity between X and Z.	

examples of the points made in the response	extra information
X to Y • at X force A is greater than force B • cyclist accelerates • and velocity increases • as cyclist moves toward Y, force B (air resistance) increases (with increasing velocity) • resultant force decreases • cyclist continues to accelerate but at a smaller value • so velocity continues to increase but at a lower rate **Y to Z** • from Y to Z force B (air resistance) increases • acceleration decreases • force B becomes equal to force A • resultant force is now zero • acceleration becomes zero • velocity increases until… • cyclist travels at constant / terminal velocity	accept speed for velocity throughout

Question	Answers	Extra information	Mark	AO spec ref
3(b)(i)	3360	allow **1** mark for correct substitution, ie 140 × 24 provided no subsequent step accept 3400 for **2** marks if correct substitution is shown	2	AO1 AO2 2.2.1b
	joule / J	do **not** accept j do **not** accept Nm	1	
3(b)(ii)	decreases	accept an alternative word / description for decrease do not accept slows down	1	AO1 2.1.3e
	temperature	accept thermal energy accept heat	1	
Total			**13**	

Question	Answers	Extra information	Mark	AO spec ref
4(a)(i)			1	AO1 2.3.2c
4(a)(ii)	360	allow **1** mark for correct substitution, ie 9 = 0.025 × R	2	AO2 2.3.2h
4(a)(iii)	sketch graph of correct shape, ie 		1	AO1 2.3.2g
4(a)(iv)	An automatic circuit to switch a heating system on and off.		1	AO1 2.3.2c

Question 4 continues on the next page . . .

Question 4 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
4(b)	so ammeter reduces / affects current as little as possible	accept so does not reduce / change the current (it is measuring) accurate reading is insufficient not change the resistance is insufficient	1	AO1 2.3.2c
4(c)	gives a common understanding	accept is easier to share results accept can compare results do not need to be converted is insufficient prevent errors is insufficient	1	AO3 2.3.2k
4(d)	replace Bunsen (and water) with a lamp replace thermometer with light sensor	accept any way of changing light level accept any way of measuring a change in light level datalogger alone is insufficient	1 1	AO2 2.3.2p
Total			**9**	

Question	Answers	Extra information	Mark	AO spec ref
5(a)	momentum before (jumping) = momentum after (jumping)	accept momentum (of the skateboard and skateboarder) is conserved	1	AO1 2.2.2b
	before (jumping) momentum of skateboard and skateboarder is zero	accept before (jumping) momentum of skateboard is zero accept before (jumping) total momentum is zero	1	
	after (jumping) skateboarder has momentum (forwards) so skateboard must have (equal) momentum (backwards)	answers only in terms of equal and opposite forces are insufficient	1	
5(b)	7	accept –7 for **3** marks allow **2** marks for momentum of skateboarder equals 12.6 **or** 0 = 42 × 0.3 + (1.8 × –v) **or** allow **1** mark for stating use of conservation of momentum	3	AO2 2.2.2b
Total			**6**	

Question	Answers	Extra information	Mark	AO spec ref
6(a)	(same) number of protons	same atomic number is insufficient	1	AO1 2.5.1e
6(b)(i)	nuclei split	do **not** accept atom for nuclei / nucleus	1	AO1 2.6.1b
6(b)(ii)	(nuclear) reactor		1	AO1 2.6.1a
6(c)	beta any **one** from: • atomic / proton number increases (by 1) • number of neutrons decreases / changes by 1 • mass number does not change • a neutron becomes a proton	 accept atomic / proton number changes by 1 (total) number of protons and neutrons does not change	1 1	AO2 2.5.2d
6(d)	(average) time taken for number of nuclei to halve **or** (average) time taken for count-rate / activity to halve		1	AO1 2.5.2h

Question 6 continues on the next page . . .

Question 6 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
6(e)(i)	6.2 (days)	Accept 6.2 to 6.3 inclusive allow **1** mark for correctly calculating number remaining as 20 000 **or** allow **1** mark for number of 80 000 plus correct use of the graph (gives an answer of 0.8 days)	2	AO2 2.5.2h
6(e)(ii)	radiation causes ionisation that may then harm / kill healthy cells	allow radiation can be ionising accept specific examples of harm, eg alter DNA / cause cancer	1 1	AO3 2.5.2g
6(e)(iii)	benefit (of diagnosis / treatment) greater than risk (of radiation)	accept may be the only procedure available	1	AO3 2.5.2g
Total			**11**	

Question	Answers	Extra information	Mark	AO spec ref
7(a)	drill is double insulated	accept no exposed metal parts accept the outside is an insulator accept plastic is an insulator	1	AO1 2.4.1j
7(b)	4.4	allow **1** mark for correct substitution, ie 1012 = I × 230 provided no subsequent incorrect numerical step	2	AO2 2.4.2c
7(c)	detects a (very small) difference between the current in the live wire and the current in the neutral wire		1	AO1 2.4.1i
Total			**4**	