
GCSE

Additional Science / Physics

PH2HP

Mark scheme

4408/4403

June 2015

Version/Stage: 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

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 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 / ; eg allow smooth / free movement.
- 2.4** Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students 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 errors / 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)

| Student | 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)

| Student | Response | Marks awarded |
|---------|--------------------------|---------------|
| 1 | Neptune, Mars, Moon | 1 |
| 2 | Neptune, Sun, Mars, Moon | 0 |

3.2 Use of chemical symbols / formulae

If a student 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 is 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 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not 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.

4. Quality of Communication and levels marking

In Question **2c** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students 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

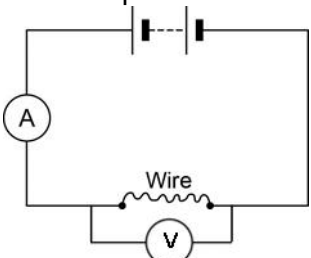
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

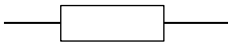
Level 2: clear

- 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. | ID |
|-----------------------------------|---|--|------------|-------------------|----|
| 1(a)(i) | p.d. is (directly) proportional to current or gradient/slope is constant or the lines show constant resistance | accept lines are straight / diagonal | 1 | AO2 2.3.2d/e/g | E |
| 1(a)(ii) | C for the same p.d. the current is the smallest | reason only scores if C is chosen accept lowest gradient and the gradient = $1/R$ | 1 1 | AO2 2.3.2i | E |
| 1(b)(i) clip with table in (b) | ohm | accept correct symbol Ω accept an answer written in Table 1 if not given in answer space | 1 | AO1 2.3.2h | E |
| 1(b)(ii) | K and L only length varies | reason only scores if both K and L are chosen accept type of metal and the diameter are the same | 1 1 | AO3 2.3.2 | E |
| 1(b)(iii) | measure the resistance of more wires made from different metals | accept test more (types of) metals measure the resistance of more wires is insufficient they only use two metals is insufficient | 1 | AO3 2.3.2 | E |
| 1(c)(i) | voltmeter symbol correct and drawn in parallel with the wire  | accept voltmeter symbol correct and drawn in parallel with the battery | 1 | AO1 2.3.2c/f | E |

| | | | | | |
|-----------------|---|----------------------------|----------|---------------|----------|
| 1(c)(ii) | correct symbol drawn  | symbol must be rectangular | 1 | AO1 2.3.2c | E |
| Total | | | 9 | | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|-----------------|--|---|-------------|------------------------|-----------|
| 2(a) | (an equal amount of) positive (charge) | do not accept charge on the atom / nucleus is positive | 1 | AO3 2.5.1 | E |
| 2(b)(i) | a (significant) number of alpha particles were scattered by more than 4° or alpha particles deflected backwards measurements / results could not be explained by 'plum pudding' model or measurements / results did not support predictions | accept (some) measurements / results were unexpected can be explained by the nuclear model is insufficient accept measurements / results did not support hypothesis | 1 1 | AO1 2.5 | E |
| 2(b)(ii) | many/(over)100 000 measurements/results taken | accept Rutherford(and Marsden) were respected scientists or scientists were respected accept measurements / results taken over several months the experiment was repeated many times is insufficient | 1 | AO3 2.5 | E |

Question 2 continues on the next page . . .

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|--|---|---|-------------------|----|
| 2(c) | | | 6 | | |
| 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 4 and apply a 'best-fit' approach to the marking. | | | | AO1 2.5.1a/b/c | E |
| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) | | |
| no relevant content | A brief description is given with some particles correctly named | A description is given with all three particles named and either the polarity of charge associated with the three particles or the relative mass of the three particles or the relative mass for one particle and the relative charge for one particle given | A more detailed description is given, naming the particles and polarity of charge and either the relative mass is given for at least two particles or the relative charge is given for at least two particles | | |

| | | | |
|--|--|------------------|--|
| <p>examples of the points made in the response</p> <p>brief description contains protons, neutrons and electrons</p> <p>protons are positive electrons are negative neutrons are uncharged</p> <p>has a nucleus</p> <p>relative charge proton +1 electron – 1 neutron 0</p> <p>relative mass proton 1 neutron 1 electron (about) 1/2000</p> <p>more detailed description protons and neutrons make up the nucleus electrons orbit the nucleus electrons are in shells most of the atom is empty space nucleus occupies a very small fraction of the volume of the atom electrons orbit at a relatively large distance from the nucleus most of the mass of the atom is contained in the nucleus the nucleus as a whole is positively charged total number of protons in the nucleus equals the total number of electrons orbiting it in an atom</p> | <p>extra information</p> <p>accept protons and neutrons have the same mass</p> <p>accept electrons have tiny / negligible mass zero mass is neutral</p> | | |
| <p>Total</p> | | <p>10</p> | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|----------|---|---|------|-----------------|----|
| 3(a)(i) | splitting of a(n atomic) nucleus | do not accept splitting an atom | 1 | AO1 2.6.1b | E |
| 3(a)(ii) | Neutron | | 1 | AO1 2.6.1c | E |
| 3(b)(i) | nuclei have the same charge or nuclei are positive | accept protons have the same charge | 1 | AO1 2.3.1d | E |
| 3(b)(ii) | (main sequence) star | accept Sun or any correctly named star accept red (super) giant | 1 | AO1 2.6.2b | E |
| 3(c)(i) | any two from: <ul style="list-style-type: none"> • easy to obtain / extract • available in (very) large amounts • releases more energy (per kg) • produces little/no radioactive waste | do not accept figures <i>only</i> naturally occurring is insufficient seawater is renewable is insufficient less cost is insufficient | 2 | AO2/3 2.6 | E |
| 3(c)(ii) | any one from: <ul style="list-style-type: none"> • makes another source of energy available • increases supply of electricity • able to meet global demand • less environmental damage • reduces amount of other fuels used | accept any sensible suggestion accept a specific example accept a specific example | 1 | AO3 2.6 | E |
| 3(d) | 12 | allow 1 mark for obtaining 3 half-lives | 2 | AO2 2.5.2h | E |

| | | | |
|--------------|--|--|----------|
| Total | | | 9 |
|--------------|--|--|----------|

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|-----------|--|--|------|-----------------|----|
| 4(a)(i) | distance travelled under the braking force | accept distance travelled between applying the brakes and stopping | 1 | AO1 2.1.3c | E |
| 4(a)(ii) | any one from: <ul style="list-style-type: none"> • icy/wet roads • (worn) tyres • road surface • mass (of car and passengers) • (efficiency/condition of the) brakes | accept weather (conditions) accept gradient of road accept number of passengers friction/traction is insufficient | 1 | AO1 2.1.3f | E |
| 4(a)(iii) | greater the speed the greater the braking force (required) | must mention both speed and force | 1 | AO1 2.1.3b | E |
| 4(b) | 22.5 | allow 1 mark for showing correct use of the graph with misread figures or for showing e.g. $90 \div 4$ an answer 17 gains 1 mark any answer such as 17.4 or 17.5 scores 0 | 2 | AO2 2.1.2b/c | E |
| 4(c)(i) | momentum before = momentum after or (total) momentum stays the same | accept no momentum is lost accept no momentum is gained ignore statements referring to energy | 1 | AO1 2.2.2b | E |

Question 4 continues on the next page . . .

Question 4 continued . . .

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|----------|---|--|------------------------------|-----------------|----|
| 4(c)(ii) | 5 | allow 2 marks for correctly obtaining momentum before as 12 000 or allow 2 marks for $1500 \times 8 = 2400 \times v$ or allow 1 mark for a relevant statement re conservation of momentum or allow 1 mark for momentum before = 1500×8 | 3 | AO2 2.2.2a/b | E |
| 4(d) | the seat belt stretches driver takes a longer (<i>impact</i>) time to slow down and stop (than a driver hitting a hard surface/windscreen/ steering wheel) for the (same) change of momentum a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt) or the seat belt stretches (1) driver travels a greater distance while slowing down and stopping (than a driver hitting a hard surface/windscreen/ steering wheel) (1) for (same) amount of work done (1) a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt) (1) | accept so smaller deceleration/negative acceleration do not accept impact for force accept for (same) change of KE do not accept impact for force | 1 1 1 1 | AO1/3 2.2 | E |

| Total | | | 13 | | |
|--|--|---|--------------------|------------------------|-----------|
| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
| 5(a)(i) mark with 5aii 5aiii | 1.7 | | 1 | AO2 2.3.2 | E |
| 5(a)(ii) mark with 5ai 5aiii | 51 or 30 x their (a)(i) correctly calculated coulomb / C | allow 1 mark for correct substitution i.e. $1.7 = \frac{Q}{30}$ or their (a)(i) = $\frac{Q}{30}$ do not accept c | 2 1 | AO1/AO2 2.3.2a | E |
| 5(a)(iii) mark with 5ai 5aii | 612 or their(a)(ii)x 12 correctly calculated or their (a)(i) x 360 correctly calculated | allow 1 mark for correct substitution i.e. $E = 12 \times 51$ or $12 \times$ their (a)(ii) or their (a)(i) x 360 | 2 | AO2 2.4.2d | E |
| 5(b) | ions vibrate faster or ions vibrate with a bigger amplitude electrons collide more (frequently) with the ions or (drift) velocity of electrons decreases | accept atoms for ions throughout accept ions gain energy accept ions vibrate more ions start to vibrate is insufficient electrons start to collide is insufficient there are more collisions is insufficient, unless both electrons and ions are implied | 1 1 | AO1 2.3.2m | E |
| Total | | | 8 | | |

| Question | Answers | Extra information | Mark | AO / Spec. ref. | ID |
|---|---|--|------------|-----------------|----------|
| 6(a)(i) | decreases (to zero) resultant force acts in opposite direction to motion | accept air resistance and weight for resultant force accept resultant force acts downwards do not accept air resistance increases | 1 1 | AO1 2.1.1c/e | E |
| 6(a)(ii) | velocity includes direction or velocity is a vector (quantity) | | 1 | AO1 2.1.2d | E |
| 6(b)(i) mark with 6bii 6biii | 3.6 | allow 1 mark for correct substitution i.e. $\frac{1}{2} \times 0.05 \times 12^2$ provided no subsequent step | 2 | AO2 2.2.1g | E |
| 6(b)(ii) mark with 6bi, 6biii | 3.6 or their (b)(i) | | 1 | AO1 2.2 | E |
| 6(b)(iii) mark with 6bi, 6bii | 7.2 or their (b)(ii) $\div 0.5$ correctly calculated | allow 1 mark for correct substitution i.e. 3.6 or their (b)(ii) = $0.05 \times 10 \times h$ | 2 | AO2 2.2.1f | E |
| 6(b)(iv) | B | | 1 | AO3 2.1 | A |
| 6(c) | range increases up to 45° range decreases from 45° | the range is a maximum at 45° gains both marks for any two angles that add up | 1 1 | AO3 2.1 | E |

| | | | | | |
|--------------|--|--|-----------|--|--|
| | | <p>to 90° the range is the same gains both marks</p> <p>the range increases then decreases gains 1 mark</p> | | | |
| Total | | | 11 | | |