GCSE
Additional Science
Physics

PH2HP

Final 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

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 <u>not</u> allow

Ignore of 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 **3(b)** 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.
1(a)	uranium (-235)	ignore an incorrect number given with uranium U- 235 is insufficient	1	AO1 2.6.1a
1(b)(i)	neutron		1	AO1 2.6.1c
1(b)(ii)	(nucleus) splits (into two parts) and (two / three) neutrons	do not accept atom splits accept a correctly labelled diagram for full or partial credit ignore reference to energy released	1 1	AO1 2.6.1d
Total			**4**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	15 (%)	accept an answer of 0.15 for both marks allow **1** mark for (total radiation dose =) 2 (.00)	2	AO2 2.5.2b
2(a)(ii)	any one from: • living at altitude • pilot or aircrew • mountaineer • (very frequent) flyer	accept any answer that involves living or working at a height above sea level spending more time outdoors is insufficient ignore references to ozone layer	1	AO2 2.5
2(a)(iii)	any one from: • nuclear power (stations) • nuclear weapons (testing) • nuclear accidents • X rays or CT scan	accept nuclear/radioactive waste accept nuclear bombs/fallout accept named accident eg Chernobyl or Fukushima accept radiotherapy or medical treatments involving radioactive sources nuclear activity/radiation is insufficient smoke detectors is insufficient industrial tracers is insufficient	1	AO1 2.5.2b
2(b)	(radioactive decay) is a random process	accept an answer in terms of background/radiation varies (from one point in time to another) readings taken in different locations is insufficient	1	AO1 2.5.2a

2(c)(i)	**ROUTE A** as thickness increases the count (in one minute) decreases **or** the count (in one minute) falls to background (because) beta radiation is absorbed by the aluminium **ROUTE B** it cannot be alpha because that would be stopped by aluminium (1) it cannot be gamma as that would not be reduced by aluminium (1)	Award highest score from **either** Route A or Route B accept count rate or reading for count (in one minute) accept (because) beta is stopped by aluminium	1 1	AO3 2.5.2e
2(c)(ii)	replace the aluminium with paper/card **or** remove the aluminium and increase the distance (between source and GM tube) will decrease the count (in one minute)	do not accept thin gold foil for paper second mark point is dependent on scoring the first mark point accept count rate or reading for counts (in one minute)	1 1	AO3 2.5.2e
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	explodes	accept elements heavier than iron are formed expands is insufficient	1	AO1 2.6.2f
3(a)(ii)	neutron		1	AO1 2.6.2e
3(a)(iii)	Sun does not have enough mass (to go supernova)	accept Sun is not big enough (to go supernova) accept it does not become a red supergiant it becomes a red giant is insufficient	1	AO1 2.6.2e

Question 3 continues on the next page…

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(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	AO1 2.5.2e 2.5.2f

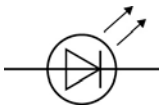
0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	There is a basic description of what happens to a star like the Sun as it passes through its lifecycle **or** At least two stages are correctly named and are in the correct order.	There are basic descriptions of what happens to a star like the Sun as it passes through its lifecycle. **and** At least two stages are correctly named and are in the correct order.	There is a clear description of what happens to a star like the Sun as it passes through its lifecycle. **and** At least three stages are named in the correct order.

examples of physics points made in the response	**extra information**
• (enough) dust and gas (from space)	accept nebula for dust and gas accept hydrogen for gas
• pulled together by gravitational attraction	accept gravity/gravitational force for gravitational attraction
• a <u>protostar</u> is formed	
• temperature increases	
• hydrogen starts to convert to helium	
• by (nuclear) fusion	
• becomes a <u>main sequence star</u>	
• the star is stable	
• (the core of the) star runs out of hydrogen	
• the star expands (to become)	
• a <u>red giant</u>	red supergiant is incorrect
• heavier elements are formed (by fusion)	elements heavier than iron are formed is incorrect
• star shrinks (to become)	
• a <u>white dwarf</u>	
• star cools/fades	
• star stops emitting energy/radiation	
• becoming a <u>black dwarf</u>	star loses all energy is insufficient

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(c)	evidence is known that can only be explained by one theory **or** that is predicted by one particular theory **or** that cannot be explained by some theories **or** theory is supported/provided by famous/respected scientists	 bias is insufficient	1 1	AO3 HSW
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	The distance the lorry travels during the driver's reaction time.		1	AO1 2.1.3c
4(a)(ii)	the greater the speed (of the lorry) the greater the (thinking) distance **or** they are directly proportional		1	AO1 2.1.3b
4(b)(i)	24 (m)	allow **1** mark for ½ x 12 x 4 an answer of 30 gains **1** mark	2	AO2 2.1.2h
4(b)(ii)	15000 (N) **or** 360 000÷ their **(b)(i)** correctly calculated	allow **1** mark for correct substitution ie 360 (000) = F x 24 or their **(b)(i)** an answer 15 with the unit changed to kN gains **2** marks an answer 15 gains **1** mark 360 ÷ their **b(i)** correctly calculated gains **1** mark	2	AO2 2.2.1b
4(c)(i)	any one from: • height (of the ramp) • speed of the trolley at the bottom (of the ramp) • angle (of the ramp) • start point (on the ramp)	the following are insufficient length of ramp or string same trolley or same ramp	1	AO2 HSW
4(c)(ii)	(measure maximum) distance the weight is lifted from the floor		1	AO3 HSW

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(c)(iii)	increase accuracy (in measurement of braking distance) by allowing a mean/average to be calculated **or** by allowing anomalous results to be discarded	accept results would be more reliable ignore reference to validity accept by allowing anomalous results to be identified accept shows results are repeatable reproducible is insufficient	1 1	AO3 HSW
4(c)(iv)	As (braking) force increases (braking) distance decreases justification by correct numerical example eg increasing the force from 2 to 8 you can decrease the braking distance from 80 to 20 cm	accept weight (lifted) for braking force An answer of (braking) distance is inversely proportional to (braking) force gains **2** marks	1 1	AO3 HSW
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)		as shown only	1	AO1 2.3.2c
5(a)(ii)	12 (J)	allow **2** marks for correct substitution ie $40 \times 10^{-3} = \frac{E}{300}$ allow **1** mark for obtaining value of P correctly from the graph as 40, 40 x 10^{-3}, 0.04 **or** allow **1** mark for converting time to seconds answers 12000 or 0.2 gain **2** marks an answer 200 gains **1** mark	3	AO2 2.4.2b
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 do not accept ions start to vibrate do not accept ions move around do not accept electrons start to collide there are more collisions is insufficient, unless both electrons and ions are implied	1 1	AO1 2.3.2m

5(c)	any **one** from: • they use a smaller current (for the same p.d.) • they are more efficient • they have a lower power input	 less energy/power is wasted accept requires less energy ignore use less electricity they last longer is insufficient	1	AO1 2.3.2o
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	electrons transfer/removed from the nylon/rod **or** to the silk/cloth making the nylon positive **and** the silk/cloth negative	positive electrons or protons moving negates first and second mark points	1 1 1	AO1 2.3.1a AO2 2.3.1b AO1 2.3.1b
6(a)(ii)	electrons would transfer from the silk/cloth **or** electrons would transfer to the PVC/rod **or** the silk/cloth would become positive **or** the PVC/rod would become negative	do not accept positive electrons or protons moving "it" refers to the PVC rod	1	AO2 2.3.1b
6(b)	The reading will increase. rods/charges will repel and create a downward / extra force (on the balance)	reason is independent of this mark accept so pushing (bottom) rod downwards do not accept increasing the weight	1 1 1	AO2 AO1 AO1 2.3.1c, d
6(c)(i)	9000 (V)	allow **1** mark for correct substitution ie $V = \frac{27}{3 \times 10^{-3}}$ **or** $27 = V \times 3 \times 10^{-3}$ an answer 9 with the unit changed to kV scores **2** marks	2	AO2 2.3.2b 2.4.2d

6(c)(ii)	not all types of material were tested other factors may affect the charge (on the driver)	accept only tested 3 materials accept a named factor eg material of the seats, temperature, humidity some results may be anomalous is insufficient different vehicle is insufficient	1 1	AO3 2.3.1
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	momentum before (firing) = momentum after (firing) before firing momentum (of cannon and ball) is zero after (firing) the ball has momentum (forwards) so the cannon must have (equal) momentum (backwards)	accept momentum (of the cannon and ball) is conserved if no other marks are awarded answers only in terms of equal **and** opposite forces gain a maximum of **1** mark	1 1 1	AO1 2.2.2b
7(b)	1000 (kg m/s)	allow **2** marks for correctly calculating (final) velocity as 125 (m/s) allow **1** mark for correct substitution ie $2500 = \frac{v\ (-u)}{0.05}$ award **1** mark for an incorrectly calculated value of v correctly substituted and calculated in the equation momentum = m x v	3	AO2 2.1.2e 2.2.2a
Total			**6**	