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General Certificate of Secondary Education
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Additional Science / Physics PH2FP

(Specification 4408 / 4403)

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 / ; 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 8(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.

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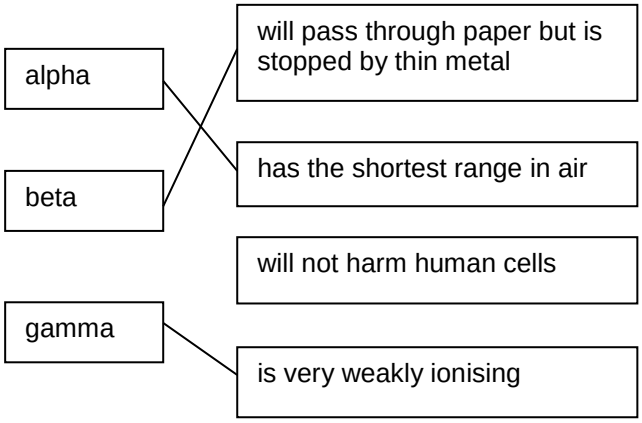
Question 1

question	answers	extra information	mark
1(a)	3 lines correct  	allow **1** mark for each correct line if more than one line is drawn from any type of radiation box then all of those lines are wrong	3
1(b)	Gamma radiation will pass through the body		1
1(c)	half		1
1(d)	protons		1
Total			**6**

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Question 2

question	answers	extra information	mark
2(a)	L		1
2(b)	6 (V)		1
2(c)	horizontal line drawn drawn in correct position	 judge by eye	1 1
Total			**4**

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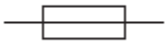
Question 3

question	answers	extra information	mark
3(a)(i)	neutral		1
3(a)(ii)	brown		1
3(b)(i)	centre symbol ringed 	accept any correct indication	1
3(b)(ii)	fuse (wire) melts	accept fuse blows accept fuse breaks / snaps accept burns out appliance doesn't work is insufficient overheat is insufficient do **not** accept blows up	1
3(c)(i)	Toaster (only one with) a metal case / outside	 reason only scores if toaster chosen accept it is metal accept outside / case / metal conducts (electricity) do **not** accept it conducts electricity	1 1
3(c)(ii)	electric shock / electrocution	do **not** accept explosion	1

Question 3 continues on the next page . . .

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Question 3 continued . . .

question	answers	extra information	mark
3(d)	overheating of cables **or** fire	it refers to the electric cable accept short circuit / sparking overheating of tape is insufficient do **not** accept electrocution / shock	1
3(e)	stop cable(s) being pulled loose / free and so breaking the circuit **or** and shorting (one wire to another) **or** and causing a fire risk / sparking	accept wire(s) for cable(s) accept to hold cables in place accept appliance / plug would not work	1 1
Total			**10**

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Question 4

question	answers	extra information	mark
4(a)	potential		1
4(b)(i)	13 200	allow **1** mark for correct substitution, ie 660 × 20 provided no subsequent step shown	2
4(b)(ii)	16.5 **or** $\frac{\text{their (b)(i)}}{800}$ correctly calculated	allow **1** mark for correct substitution, ie $\frac{13\,200}{800}$ **or** $\frac{\text{their (b)(i)}}{800}$ provided no subsequent step shown	2
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)	uranium-235	accept any correct indication	1
5(b)	splits / breaks (into two smaller parts) and (two / three) neutrons	nucleus is separated is insufficient do **not** accept atom splits – on its own	1 1
5(c)	steam turbine generator	correct order only	1 1 1
Total			**6**

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Question 6

question	answers	extra information	mark
6(a)	time force	correct order only	1 1
6(b)	The car tyres being badly worn		1
6(c)(i)	braking distance increases with speed relevant further details, eg • but not in direct proportion • and increases more rapidly after 15 m/s • double the speed, braking distance increases × 4	accept positive correlation do **not** accept stopping distance for braking distance accept any speed between 10 and 20 accept numerical example	1 1
6(c)(ii)	line drawn above existing line starting at the origin	as speed increases braking distance must increase each speed must have a single braking distance	1
6(d)(i)	reaction time / reaction (of driver) does not depend on speed (of car)		1

Question 6 continues on the next page . . .

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Question 6 continued . . .

question	answers	extra information	mark
6(d)(ii)	(on the reduced speed limit roads) over the same period of time monitor number of accidents before and after (speed limit reduced)	accept a specific time, eg 1 year allow **1** mark only for record number of vehicles / cars using the (20 mph) roads **or** collect data on accidents on the (20 mph) roads to score both marks the answer must refer to the roads with the reduced speed limit	1 1
Total			**9**

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Question 7

question	answers	extra information	mark
7(a)	(produces) a force from water on the boat		1
	in the forward direction	accept in the opposite direction this must refer to the direction of the force not simply the boat moves forwards an answer produces an (equal and) opposite force gains **1** mark	1
7(b)(i)	1.5	allow **1** mark for correct substitution, ie $\frac{16-4}{8}$ **or** $\frac{12}{8}$ provided no subsequent step shown ignore sign	2
	m/s^2		1
7(b)(ii)	102 **or** their (b)(i) × 68 correctly calculated	allow **1** mark for correct substitution, ie 1.5 × 68 **or** their (b)(i) × 68 provided no subsequent step shown	2
7(b)(iii)	greater than	reason only scores if greater than chosen	1
	need to overcome resistance forces	accept named resistance force accept resistance forces act (on the water skier) do **not** accept gravity	1
Total			**9**

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Question 8

question	answers	extra information	mark
8(a)(i)	to obtain a range of p.d. values	accept increase / decrease current / p.d. / voltage / resistance accept to change / control the current / p.d. / voltage / resistance to provide resistance is insufficient a variable resistor is insufficient do **not** accept electricity for current	1
8(a)(ii)	temperature of the bulb increases	accept bulb gets hot(ter) accept answers correctly expressed in terms of collisions between (free) electrons and ions / atoms bulb gets brighter is insufficient	1
8(a)(iii)	36 watt(s) / W	 allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown accept joules per second / J/s do **not** accept w	2 1

Question 8 continues on the next page . . .

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Question 8 continued . . .

question	answers	extra information	mark
8(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

0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content.	There is a basic comparison of either a cost aspect or an energy efficiency aspect.	There is a clear comparison of either the cost aspect or energy efficiency aspect **OR** a basic comparison of both cost and energy efficiency aspects.	There is a detailed comparison of both the cost aspect and the energy efficiency aspect. For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost
- halogen are cheaper to buy
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

energy efficiency
- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

simply giving cost figures is insufficient

Total			**11**

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