



---

GCSE

# Additional Science / Physics

PH2FP

Mark scheme

---

4408/4403

June 2016

---

Version: 1.0 Final Mark Scheme

---

---

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](http://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 **9(d)** 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.
<b>1(a)</b>	gas gravity protostar	correct order only  accept correct word circled in box provided no answer given in answer space	1 1 1	AO1 2.6.2c
<b>1(b)</b>	the explosion of a massive star		1	AO1 2.6.2f
<b>1(c)</b>	The telescopes and measuring instruments were not sensitive enough.		1	AO3 2.6
<b>Total</b>			<b>5</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	20		1	AO2 2.4.1b
2(b)	50		1	AO1 2.4.1c
2(c)(i)	115		1	AO2 2.3.2k
2(c)(ii)	230		1	AO1 2.3.2l
2(c)(iii)	if one goes out the other still works <b>or</b> brighter	accept power (output) is greater  can be switched on/off independently is insufficient	1	AO2 2.3
2(d)	the outside/casing is plastic  and plastic is an insulator	there is plastic around the wires is insufficient it is plastic is insufficient  an answer the light fitting is double insulated gains both marks	1  1	AO1 2.4.1j
2(e)	(residual current) circuit breaker	accept RCCB accept RCBO accept RCCD accept RCB  accept miniature circuit breaker / MCB trip switch is insufficient breaker is insufficient do not accept earth wire	1	AO1 2.4.1i
<b>Total</b>			<b>8</b>	


Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	$0.15 \times 0.08 = 0.012$		1	AO2 2.2.2a
3(a)(ii)	kg m/s		1	AO1 2.2.2a
3(a)(iii)	equal to		1	AO1 2.2.2b
3(b)	momentum of the air increases <b>or</b> force backwards increases	it = toy  accept air moves faster accept momentum backwards increases accept pushes more air back(wards)	1	AO2 2.2.2b
	so momentum of the toy must increase <b>or</b> the force forwards (on the toy) increases	accept momentum forwards must increase	1	
<b>Total</b>			<b>5</b>	



Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	neutrons		1	AO1 2.5.1e
4(b)	generate electricity	accept produce electricity accept heat water accept produce steam turns turbines is insufficient	1	AO1 2.6
4(c)(i)	a neutron		1	AO1 2.6.1c
4(c)(ii)	two particles <b>X</b> released from the uranium-235  uranium-235 shown splitting into two fragments  <b>or</b>  each particle <b>X</b> shown colliding with a uranium-235 and producing 2 further particles <b>X</b>	one uranium-235 shown splitting is sufficient, provided no contradiction shown	1  1	AO1 2.6.1e
<b>Total</b>			<b>5</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	4		1	AO2 2.3.2j
5(b)(i)	2	allow 1 mark for correct substitution ie $I = \frac{20}{10}$ provided no subsequent step	2	AO2 2.3.2a
5(b)(ii)	5	allow 1 mark for correct substitution ie $V = \frac{100}{20}$ provided no subsequent step	2	AO2 2.3.2b
<b>Total</b>			<b>5</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	gravity	accept weight for gravity air resistance is insufficient	1	AO1 2.2.1f
6(b)(i)	800	allow 1 mark for correct substitution ie $P = \frac{2240}{2.8}$ provided no subsequent step	2	AO2 2.2.1e
6(b)(ii)	2240 J		1	AO1 2.2.1f
6(c)(i)	(vertical) height	accept (height of) stairs	1	AO3 2.2.1f
6(c)(ii)	a fast / short time (for a lighter student) may give the greatest power or a slow / long time (for a heavy student) may give the least power	accept time is a factor  fitness is insufficient	1	AO3 2.2.1e
<b>Total</b>			<b>6</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	last box ticked 		1	AO1 2.3.2c
7(b)(i)	use hotter water (than 60 °C)  or  add ice cubes	accept use boiling water accept use water at any stated temperature above 60 °C  accept add water at any stated temperature below 12 °C  use different temperatures is insufficient	1	AO3 2.3.2q
7(b)(ii)	the current increases as the temperature increases		1	AO2 2.3.2q
7(b)(iii)	0.02 (A)		1	AO2 2.3.2q
7(b)(iv)	5 (V) or their (b)(iii) × 250 correctly calculated	allow 1 mark for correct substitution ie $V = 0.02 \times 250$ or $V = \text{their (b)(iii)} \times 250$	2	AO2 2.3.2h
7(b)(v)	the resistance increases		1	AO3 2.3.2q
<b>Total</b>			<b>7</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>8(a)</b>	starting / stopping the stopwatch <b>or</b> timing over the smaller distances	human error is insufficient reaction time is insufficient  accept not timing accurately  do not accept references to measuring distance incorrectly	1	AO3 2.1
<b>8(b)(i)</b>	before		1	AO3 2.1
<b>8(b)(ii)</b>	increasing	accept accelerating  it is not constant is insufficient it is less than after four seconds is insufficient  it reaches a constant speed negates	1	AO3 2.1.2b
<b>8(b)(iii)</b>	calculate the gradient of the straight/steepest/constant section	accept gradient of any section after 5.5 seconds/30 cm	1	AO1 2.1.2b
<b>8(b)(iv)</b>	drag (force) increases (as the ball bearing gets faster)  (until) drag (force) = weight <b>or</b> (until) resultant force is zero	accept frictional/upward force for drag  accept upward force = downward force accept till forces are balanced	1  1	AO1 2.1.4b

<b>8(c)</b>	less than		1	AO3 2.1.4a/b
	ball bearing increases speed at a greater rate <b>or</b> ball bearing has a greater acceleration <b>or</b> terminal velocity has not been reached	accept it travels the same distance in less time  accept the ball bearing is going faster	1	
	so resultant force must be greater <b>or</b> as weight is the same (the drag must be less)	accept warmer oil has a lower density/viscosity for 1 mark if neither of the two reason marks score	1	
<b>Total</b>			<b>9</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)	2 protons and 2 neutrons	accept 2p and 2 n accept (the same as a) helium <u>nucleus</u> symbol is insufficient  do not accept 2 protons and neutrons	1	AO1 2.5.2c
9(b)(i)	gamma rays		1	AO1 2.5.2e
9(b)(ii)	loses/gains (one or more) <u>electron(s)</u>		1	AO1 2.5.1d
9(c)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• wear protective clothing</li> <li>• work behind lead/concrete/glass shielding</li> <li>• limit time of exposure</li> <li>• use remote handling</li> </ul>	accept wear mask/gloves wear goggles is insufficient wear protective equipment/gear is insufficient  accept wear a film badge  accept handle with (long) tongs accept maintain a safe distance accept avoid direct contact	1	AO2 2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(d)	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.		6	AO1 2.5.2e 2.5.2f
<b>0 marks</b>	<b>Level 1 (1-2 marks)</b>	<b>Level 2 (3-4 marks)</b>	<b>Level 3 (5-6 marks)</b>	
No relevant information	There is a description of at least one type of radiation in terms of one or more properties.	There is a description of at least two types of radiation in terms of some properties <b>or</b> a full description of one type of radiation in terms of all three properties <b>or</b> the same property is described for all three radiations	There is a description of all three types of radiation in terms of at least two of their properties <b>or</b> a full description of two types of radiation in terms of all three properties.	
<b>examples of physics points made in the response</b>  <b>alpha particles</b> <ul style="list-style-type: none"> <li>• are least penetrating</li> <li>• are stopped by paper / card</li> <li>• have the shortest range</li> <li>• can travel (about) 5cm in air</li> <li>• are (slightly) deflected by a magnetic field</li> <li>• alpha particles are deflected in the opposite direction to beta particles by a magnetic field</li> </ul> <b>beta particles</b> <ul style="list-style-type: none"> <li>• (some are) stopped by (about) 2mm (or more) of aluminium/metal</li> <li>• can travel (about) 1 metre in air</li> <li>• are deflected by a magnetic field</li> <li>• beta particles are deflected in the opposite direction to alpha particles by a magnetic field</li> </ul> <b>gamma rays</b> <ul style="list-style-type: none"> <li>• are the most penetrating</li> <li>• are stopped by (about) 10cm of lead</li> <li>• have the longest range</li> <li>• can travel at least 1 km in air</li> <li>• are not deflected by a magnetic field</li> </ul>			<b>extra information</b>  accept (some are) stopped by aluminium foil	
<b>Total</b>				<b>10</b>