

GCSE ADDITIONAL SCIENCE COMBINED (ROUTE 2)

AS2HP Paper 6 Higher Tier
Mark scheme

4409
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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 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 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 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)

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	Pluto, Mars, Moon	1
2	Pluto, 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 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 **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.

Quality of Written Communication and levels marking

In Question 4(d) 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 1

question	answers	extra information	mark	spec ref	ID
1(a)	carbon dioxide water	in either order allow CO ₂ / CO2 allow H ₂ O / H2O	1 1	B2.6.1e	G
1(b)(i) <i>Clip to include table</i> <i>Clip with (b)(ii)</i>	2400		1	B2.6.1g	E
1(b)(ii) <i>Clip with (b)(i)</i>	1392	accept 1400 or 1390 award 2 marks for correct answer to (answer given in bi) x 58/100 award 1 mark to 2400 x 58/100 or equivalent with no answer or incorrect answer award 1 mark to (answer to bi) x 58/100 with no answer or incorrect answer allow 1416 or 1420 for 1 mark (as ecf from misreading graph as 59)	2	B2.6.1	E

Question 1 continues on the next page

Question 1 cont'd

question	answers	extra information	mark	spec ref	ID
1(b)(iii)	<p>any four from:</p> <p>(ref aerobic respiration)</p> <ul style="list-style-type: none"> • (at first) aerobic • uses oxygen (from air in lungs) • (large lung capacity means) more oxygen available • (more oxygen available so) aerobic respiration lasts longer <p>(ref anaerobic respiration)</p> <ul style="list-style-type: none"> • later, or when all / most oxygen used, anaerobic • no oxygen needed • no carbon dioxide released • (anaerobic respiration) releases lactic acid • tolerance of (high) lactic acid no / reduces pain / fatigue <p>(ref blood flow)</p> <ul style="list-style-type: none"> • low / less blood to kidney / liver / skin • so less / low respiration in kidney / liver / skin • high / more / most blood to muscles • so more / high respiration in muscles • reduced heart rate (reduces demand for energy by heart) 	<p>max 3 marks for reference to respiration</p> <p>max 3 marks for ref to blood flow</p> <p>accept blood diverted from kidney / liver / skin</p> <p>accept blood diverted to muscles</p> <p>allow glycogen converted to glucose</p> <p>allow (extra) blood (to muscles) transports glucose</p>	4	B2.6.1h	E
Total			9		

Question 2

question	answers	extra information	mark	spec ref	ID
2(a)	carbon dioxide + water \rightleftharpoons carbonic acid	carbon dioxide + water can be in either order allow CO ₂ for carbon dioxide allow H ₂ O for water allow H ₂ CO ₃ for carbonic acid ignore state symbols	1	C2.6.2b	E
2(b)(i)	citric acid	in either order	1	C2.6.2d	E
	carbonated water	allow carbonic acid	1		
2(b)(ii)	hydrogen	accept H ⁺	1	C2.6.2d	E
Total			4		

Question 3

question	answers	extra information	mark	spec ref	ID
3(a)(i)	base.		1	C2.6.2a	A
3(a)(ii)	sulfuric (acid)	allow sulphuric (acid) allow H ₂ SO ₄	1	C2.6.2b	G
3(b)(i)	any one from: <ul style="list-style-type: none"> • black solid remains in excess • all acid has reacted 	allow (the black solid) does not dissolve	1	C2.6.1b	E
3(b)(ii)	filter (then) heat (the solution) or (then) leave to crystallise	allow decant or centrifuge accept evaporate allow boil	1 1	C2.6.1b/c	E
3(c)	particles have more energy (so) move faster (so) collide more often	ignore move more accept (so) more chance of collision or (so) more energetic collisions allow (so) have (sufficient) activation energy	1 1 1	C2.4.1c	E
Total			8		

Question 4

question	answers	extra information	mark	spec ref	ID
4(a)	joining of two (atomic) nuclei (to form a larger one)	accept hydrogen or helium for atomic allow fusion for joining ignore radioactive	1	P2.6.2a	E
4(b)	supernova (explosion)		1	P2.6.2f	E
4(c)(i)	the greater the (relative) <u>mass</u> of the star, the shorter the life cycle or the smaller the (relative) <u>mass</u> of the star, the longer the life cycle	do not accept inversely proportional	1	P2.6.2	E
4(c)(ii)	any one from: <ul style="list-style-type: none"> • <i>idea of no</i> (actual life cycle) data to use • not enough evidence • scientists make estimates based on partial scientific information gathered 	accept too long to measure	1	SALoSE	E
question	answers	extra information	mark	spec ref	ID
4(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 5 and apply a 'best-fit' approach to the marking.		6	P2.6	E

Question 4 continues on the next page

0 marks	Level 1 (1 - 2 marks)	Level 2 (3 - 4 marks)	Level 3 (5 - 6 marks)
No relevant Information.	At least one relevant statement about the process of nuclear fission and/or at least one idea about how the energy is used.	There is a brief description of the process of nuclear fission and/or a brief description of how the energy is used.	There is a description of the process of nuclear fission and a description of how the energy is used.
<p>Examples of the points made in the response:</p> <p><i>Process of nuclear fission:</i></p> <ul style="list-style-type: none"> • (nuclear fission is the) splitting of an atomic nucleus • the U-235 nucleus • absorbs a neutron • making it unstable • (it) splits into two (different) elements / nuclei • (and 2 / 3) neutrons are released • which can go on to hit other nuclei / U-235 • (which) starts a chain reaction • splitting (of nucleus) releases energy • as kinetic energy or in the form of radiation • the remaining nuclei are stable. <p><i>How the energy is used in nuclear power stations:</i></p> <ul style="list-style-type: none"> • (following the fission reaction) the particles have kinetic energy • the energy (released in the fission process) heats water • heated water turns to steam • (the) steam drives a turbine • energy transferred to kinetic • (turbine) turns a generator • transferring kinetic to electrical energy. 		<p>Extra information</p> <p>allow particle for neutron once allow atom for nucleus once</p> <p>accept neutron fired</p> <p>accept smaller for two</p> <p>allow reference to chain reaction</p> <p>allow energy is released as "heat"</p>	
Total			10

Question 6

question	answers	extra information	mark	spec ref	ID
6(a)	<p>had soft bodies</p> <p>any one from:</p> <ul style="list-style-type: none"> so they left few / no fossils / traces (traces) destroyed by geological activity 	<p>allow had single / few cells</p> <p>accept so decayed / rotted / decomposed</p> <p>allow lack of evidence for 1 mark if no other marks awarded</p>	<p>1</p> <p>1</p>	B2.8.1c	E
6(b)(i)	<p>any four from:</p> <ul style="list-style-type: none"> (two ancestral populations) separated / isolated (by geographical barrier / by land) genetic variation (in each population) or different / new alleles or mutations occur different environment / conditions natural selection occurs or some phenotypes survived or some genotypes survived (favourable) alleles / genes / mutations passed on (in each population) 	<p>allow abiotic or biotic example</p> <p>accept those best adapted survive</p> <p>ignore characteristics passed on</p>	4	B2.8.1f	E
6 (b)(ii)	so different	<p>allow (too) many differences / very different from one another</p> <p>ignore (genetically) different unless qualified eg allow different numbers of chromosomes</p>	1	B2.8.1f	E
Total			7		

Question 7

question	answers	extra information	mark	spec ref	ID
7(a)	(gene / allele for) normal (-sized wings) is dominant normal (parent) homozygous	accept as genetic diagram or as symbols in prose. accept small (wings) recessive assume upper case symbol is dominant unless with key showing otherwise accept normal (-sized wings parent) homozygous dominant for 2 marks	1 1	B2.7.2d/e	E
7(b)(i)	parents Aa Aa gametes A a A a offspring correctly derived from gametes AA Aa Aa aa phenotypes linked correctly to genotypes to show 3 : 1 ratio (normal : small)	accept any format of genetic diagram. Must link appropriately throughout AA and Aa identified as normal and aa identified as small allow ecf from incorrect parents for max 2 marks (2 nd and 3 rd) accept if different letters used, on normal convention of upper case = dominant (& lower case = recessive) or accept any symbols with key	1 1 1 1	B2.7.2	E
7(b)(ii)	any one from: <ul style="list-style-type: none">chance(fertilisation is) random	ignore reference to anomaly	1	B2.7.2	E
Total			7		

Question 8

question	answers	extra information	mark	spec ref	ID
8(a)(i)	curve starting at 0,0 and to left of original		1	C2.4.1a/e	E
	levels out and finishes at 80cm ³		1		
8(a)(ii)	any two from: <ul style="list-style-type: none"> • (same) mass / surface area of tablets • (same) number of tablets • (same) type of tablets • (same) volume of acid • (same) temperature (of acid) 	ignore references to time do not accept (same) concentration of acid allow (same) size of tablets allow (same) amount of acid	2	C2.4.1e	E
8(b)	smaller pieces		1	C2.4.1f	E
	(so) greater surface area		1		
	(so) reaction is faster	accept (so) more frequent collisions accept (so) more chance of collisions	1		
Total			7		

Question 9

question	answers	extra information	mark	spec ref	ID
9(a)	$2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$	<p>1 mark for correct symbols and formulae</p> <p>1 mark for correct balancing of correct symbol equation</p> <p>the reactants may be in either order</p> <p>If no other mark awarded, allow for 1 mark:</p> $\text{SO}_2 + \text{O} \rightarrow \text{SO}_3$	2	C2.4.1d	E
9(b)	<p>speed up reaction</p> <p>to reduce cost</p>	allow lower energy usage	1 1	C2.4.1g/ h	E
9(c)	<p>concentration increases or particles are closer together</p> <p>(so) there are more frequent collisions</p>	allow (so) more chance of collisions	1 1	C2.4.1d	E
Total			6		

Question 10

question	answers	extra information	mark	spec ref	ID
10(a)	ions are free to move (in solution)		1	C2.7.1a	E
10(b)	Ag ⁺ e ⁻	in either order ignore attempts at balancing	1 1	C2.7.1g	E
10(c)	stays the same (as) silver transfers from the positive electrode to negative electrode	accept anode or silver electrode for positive electrode accept cathode or copper electrode for negative electrode	1 1	C2.7.1d	E
Total			5		

Question 11

question	answers	extra information	mark	spec ref	ID								
11(a)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Relative charge</th> <th>Relative mass</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> </tr> <tr> <td>+1</td> <td>1</td> </tr> <tr> <td>0 or Zero</td> <td></td> </tr> </tbody> </table> <p>1 mark for each correct cell</p>	Relative charge	Relative mass			+1	1	0 or Zero			3	P2.5.1a/b	G
Relative charge	Relative mass												
+1	1												
0 or Zero													
11(b)	an <u>atom</u> which has lost / gained electrons	ignore charged atom	1	P2.5.1d	E								
Total			4										

Question 12

question	answers	extra information	mark	spec ref	ID
12(a)	radiation is random or to improve the accuracy / reduce the effect of a random error	allow improve reliability do not accept precision ignore to identify anomalies	1	P2.5.2a	E
12(b)	(counts remaining are due to the) background radiation / count		1	P2.5	E
12(c)(i)	alpha / α only travels a few centimetres in air is stopped / absorbed by paper	answers which give the wrong type of radiation lose the 1 st mark, but may still qualify for the 2 nd and 3 rd marks allow numbers from the graph if qualified allow stopped / absorbed by aluminium if neither reason given, allow for 1 mark reduced by paper / aluminium	1 1 1	P2.5.2e	E
12(c)(ii)	beta / β any 2 from: <ul style="list-style-type: none">• travels many centimetres in air• not stopped by paper• partly absorbed by aluminium	answers which give the wrong type of radiation lose the 1 st mark, but may still qualify for the 2 nd and 3 rd marks allow numbers from the graph if qualified allow some stopped by aluminium	1 2	P2.5.2e	E
Total			8		

Question 13

question	answers	extra information	mark	spec ref	ID
13(a)	a large / increased current will flow through the earth (wire)	allow a large / increased current will flow to the earth	1	P2.4.1g/h/k	E
	the fuse melts (as the current will exceed the rating of the fuse)	allow fuse blows do not accept fuse sets on fire or explodes	1		
	breaking the circuit	accept stops the current (flowing through the live wire)	1		
	(so) the casing is no longer live		1		
13(b)	any four from: <i>for RCCBs:</i> <ul style="list-style-type: none"> • safer • work more quickly • easier / quicker to reset • large currents are not allowed to build up when a fault occurs • don't need any fuse wire 	allow reverse arguments if clearly referring to fuses	4	P2.4.1	E
Total			8		