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GCSE

# Additional Science (Route 2)

AS2HP

Mark scheme

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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](http://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 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 **2(c)** 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.

**MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015**

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec ref</b>
<b>1(a)</b>	amino acid(s)		1	AO2 B2.5.2 e
<b>1(b)(i)</b>	so they reach same temperature / 15°C	allow so they do not react at the wrong temperature <b>or</b> so they react at the right temperature	1	AO3 B2.5.2
<b>1(b)(ii)</b>	3		1	AO3 B2.5.2
<b>1(c)(i)</b>	it doubles for each 10 °C rise	allow exponential increase allow (volume of egg white digested) increases for <b>1</b> mark	2	AO2 B2.5.2
<b>1(c)(ii)</b>	do / repeat at other temperature(s) (in the range 10 – 50 °C)  between 30 and 40 (°C) <b>or</b> between 40 and 50 (°C) <b>or</b> between 30 and 50 (°C) <b>or</b> around 40 (°C)	ignore repeat without qualification  allow eg ref to 37 (°C) ignore ref to 'body temperature'	1  1	AO2 B2.5.2
<b>1(c)(iii)</b>	protease / enzyme is not killed <b>or</b> protease / enzyme is not living  reference to protease / enzyme being denatured / destroyed	mark together  allow description of denaturation, eg active site / shape changed	1  1	AO1 / AO2 B2.5.2 a/j
<b>Total</b>			<b>9</b>	

MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec ref
2(a)	base.		1	AO1 C2.6.2a
2(b)	(s) (aq) (l)	in this order only award <b>2</b> marks for all three correct award <b>1</b> mark if one or two are correct	2	AO1 C2.6.1a

## QWC Mark Scheme

Question	Answers	Extra information	Mark	AO / Spec ref
2(c)			6	AO1, AO2 C2.6.1b/c
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.				
<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 comment.	A simple statement is made about the reaction <b>or</b> separation <b>or</b> crystallisation	Statements are made in a sensible sequence about the reaction and separation <b>or</b> the reaction and crystallisation <b>or</b> separation and crystallisation but some steps may be missing.	Statements are made in a sensible sequence about the reaction, separation and crystallisation in an organised method.	
<b>examples of points made in the response</b>  <b>Reaction</b> <ul style="list-style-type: none"> <li>place sulfuric acid in beaker</li> <li>gently warm sulfuric acid</li> <li>add magnesium oxide (using a spatula)</li> <li>stir mixture of magnesium oxide and sulfuric acid</li> <li>add magnesium oxide until no more will react</li> </ul> <b>Separation</b> <ul style="list-style-type: none"> <li>filter mixture (to remove excess solid/magnesium oxide)</li> </ul> <b>Crystallisation</b> <ul style="list-style-type: none"> <li>heat filtrate</li> <li>in evaporating dish</li> <li>until half volume remains</li> <li>pour into a crystallising dish</li> <li>leave to crystallise</li> </ul>		<b>extra information</b>  ignore references to colours of reactants and products  allow diagrams showing correct use of equipment		
<b>Total</b>			<b>9</b>	

**MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015**

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec ref</b>
<b>3(a)(i)</b>	live (wire)		1	AO1 P2.4.1 f
<b>3(a)(ii)</b>	double insulated <b>or</b> wood is an (electrical) insulator	allow it is not made of metal  allow wood is not an (electrical) conductor  it is wooden is insufficient  ignore it has only two wires in cable	1	AO2 P2.4.1 f / j
<b>3(a)(iii)</b>	because plastic is an (electrical) insulator	allow does not conduct (electricity)  ignore other features of plastic	1	AO1 P2.4.1 f
<b>3(a)(iv)</b>	if the current (in the fuse) exceeds 3 A  the fuse will melt	allow the fuse will blow / break	1  1	AO1 P2.4.1 h
<b>3(b)</b>	it has a frequency of 50 Hz / hertz  the supply is alternating current	allow the current changes direction 50 times per second for <b>2</b> marks	1  1	AO1 P2.4.1 b,c
<b>3(c)</b>	29.9 <b>or</b> 30	allow 1 mark for $230 \times 0.13$ provided no subsequent step	2	AO2 P2.4.2 c
<b>3(d)</b>	A  most efficient	no mark for selection  allow less energy used / input for the same output  allow lowest power input for the same output  allow cheapest to run for the same output  ignore cheapest	1	AO3 P2.4
<b>Total</b>			<b>10</b>	

MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec ref
4(a)	<p>any <b>two</b> from: (anaerobic respiration)</p> <ul style="list-style-type: none"> <li>• does <b>not</b> use oxygen (but aerobic does)</li> <li>• does <b>not</b> produce carbon dioxide (but aerobic does)</li> <li>• does <b>not</b> produce water (but aerobic does)</li> <li>• releases less energy</li> </ul>	<p>for first 3 bullet points assume comparison if not stated</p> <p>allow converse if clearly referring to aerobic respiration</p> <p>allow (anaerobic) causes (muscle) fatigue</p> <p>do <b>not</b> allow no energy released do <b>not</b> allow less energy produced</p> <p>do <b>not</b> allow references to use of glucose as a difference</p>	2	<p>AO1 B2.6.1 b/e B2.6.2 b/c</p>
4(b)(i)	<p>glycogen stored in muscles</p> <p>converted / broken down (to glucose)</p>	<p>correct spelling required</p> <p>allow storage in liver / cells</p> <p>allow fat stored in muscles / liver / cells</p> <p>allow fat is converted (to glucose)</p> <p>allow glucagon (converts glycogen to glucose)</p> <p>if no other mark awarded allow glucose absorbed from (small) intestine / digestive system for <b>1</b> mark</p> <p><b>or</b></p> <p>starch stored in muscles / liver / cells converted (to glucose) for <b>1</b> mark</p>	<p>1 1 1</p>	<p>AO1 B2.6.1i</p>

**MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015**

<b>4(b)(ii)</b>	(amount of) oxygen needed to oxidise lactic acid	allow 'remove / break down' for 'oxidise' allow (amount of) oxygen needed to convert lactic acid into carbon dioxide <b>and</b> water	1	AO1 B2.6.2 a/b/c
<b>Total</b>			<b>6</b>	

**MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015**

Question	Answers	Extra information	Mark	AO / Spec ref												
<p><b>5(a)</b></p>	<table border="1"> <thead> <tr> <th></th> <th>Mitosis</th> <th>Meiosis</th> </tr> </thead> <tbody> <tr> <td>Number of times the cell divides</td> <td>1 / once</td> <td>2 / twice</td> </tr> <tr> <td>Number of cells formed</td> <td>2 / two</td> <td>4 / four</td> </tr> <tr> <td>Number of chromosomes in each of the cell formed in humans</td> <td>46 <b>or</b> 23 pairs</td> <td>23</td> </tr> </tbody> </table>		Mitosis	Meiosis	Number of times the cell divides	1 / once	2 / twice	Number of cells formed	2 / two	4 / four	Number of chromosomes in each of the cell formed in humans	46 <b>or</b> 23 pairs	23	<p>one mark for each correct row</p> <p>if no rows are correct award <b>1</b> mark for a correct column</p> <p>ignore comparative terms such as more / less</p>	<p align="center">3</p>	<p>AO1 B2.7.1 a/c/e/g/h B2.7.2 b</p>
	Mitosis	Meiosis														
Number of times the cell divides	1 / once	2 / twice														
Number of cells formed	2 / two	4 / four														
Number of chromosomes in each of the cell formed in humans	46 <b>or</b> 23 pairs	23														
<p><b>5(b)</b></p>	<p>male is XY</p> <p>gets X chromosome (with colour-blindness allele) from mother</p>	<p>allow male gets Y (chromosome) from father</p>	<p align="center">1</p> <p align="center">1</p>	<p>AO2 B2.7.2 a/b B2.7.3 a</p>												
<p><b>Total</b></p>			<p align="center"><b>5</b></p>													



## MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec ref
7(a)	$2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$	products may be in either order allow correct multiples for balancing  award 1 mark for correct formulae with an arrow drawn after $\text{H}_2\text{O}_2$  ignore silver / catalyst / heat written on the arrow	2	AO2 C2.4
7(b)	increases surface area  which gives more frequent collisions  (so) rate (of reaction / decomposition) is increased	allow (so) increased probability of collisions	1  1  1	AO1, AO2 C2.4.1f/g
7(c)	any <b>two</b> from:  • mass of catalyst  • concentration of hydrogen peroxide  • temperature (of hydrogen peroxide)	ignore references to volume of hydrogen peroxide  allow particle size of catalyst allow amount of catalyst allow mass / amount of manganese (IV) oxide <b>and</b> lead (IV) oxide	2	AO3 C2.4.1g
7(d)(i)	steeper (initial) gradient  levels off sooner	allow reaction is faster  allow reaction finishes earlier  allow for 2 marks produces the same volume of gas more quickly	1  1	AO3 C2.4.1a/g
7(d)(ii)	(because) same volume of hydrogen peroxide used  (and) catalyst has no effect on amount of product <b>or</b> the catalyst is not used up (during the reaction)		1  1	AO2, AO3 C2.4.1a/g
<b>Total</b>			<b>11</b>	

**MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015**

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec ref</b>
<b>8(a)</b>	large amount of electricity needed for process	allow large amount of energy needed for the process allow smaller energy losses during transmission	1	AO3 C2.7.1b/h
<b>8(b)</b>	(mixture) melts at lower temperature (so) less energy is required	allow lowers the melting point (of the mixture) allow less 'heat' / electricity is required allow (so) the process is cheaper	1 1	AO1 C2.7.1a/h
<b>8(c)(i)</b>	$2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$		1	AO2 C2.7.1g
<b>8(c)(ii)</b>	carbon / (positive) electrode reacts with oxygen to form carbon dioxide (so) electrode wears away		1 1 1	AO1, AO3 C2.7.1h
<b>8(d)</b>	any <b>three</b> from: <ul style="list-style-type: none"> <li>• (aluminium ions) are positive</li> <li>• where (ions) gain electrons <b>or</b> where (ions) are reduced</li> <li>• (gain) 3 (electrons)</li> <li>• (so) forming aluminium atoms</li> </ul>	allow $\text{Al}^{3+}$ (ions)	3	AO1, AO2 C2.7.1a/b/c/e
<b>Total</b>			<b>10</b>	

**MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015**

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec ref</b>
<b>9(a)(i)</b>	(different) number of neutrons	allow fewer neutrons <b>or</b> has only 1 neutron  allow different mass <b>or</b> (deuterium has) a lower mass	1	AO1 P2.5.1 e
<b>9(a)(ii)</b>	(same) number of protons	allow (both) positive / +1 / H <sup>+</sup> <b>or</b> both have 1 proton <b>or</b> have the same charge	1	AO1 P2.5.1 e
<b>9(b)(i)</b>	(the) mass of the Sun is very large  (and only a) small proportion of the mass is converted (to energy) each year	ignore the Sun is very large    allow <b>2</b> marks for calculation of $2 \times 10^{14}$ years	1  1	AO2 P2.6.2 b / f
<b>9(b)(ii)</b>	  black hole  neutron star	ignore reference to supernova as a stage	  1  1	AO1 P2.6.2 e
<b>9(b)(iii)</b>	elements heavier than iron are formed in a supernova  (and) Earth is formed from a supernova (explosion)		1  1	AO1 P2.6.2 f
<b>Total</b>			<b>8</b>	

MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015

Question	Answers	Extra information	Mark	AO / Spec ref
10(a)	$4.5 \times 10^8$ or 450 000 000	allow 1 mark for correct substitution. ie $3.0 \times 10^7 \times 15$ or $30\,000\,000 \times 15$ provided no subsequent step	2	AO2 P2.4.2 d
10(b)	gets hot	ignore references to melting	1	AO1 P2.4.2 a
10(c)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• doesn't last long enough</li> <li>• p.d. / voltage / charge / current too high</li> <li>• not a.c.</li> <li>• can't predict where / when it will strike</li> <li>• difficult / impossible to store</li> </ul>	allow it is unreliable	1	AO3 P2.4.1 a, c
<b>Total</b>			<b>4</b>	

**MARK SCHEME – GCSE ADDITIONAL SCIENCE (ROUTE 2) – AS2HP – JUNE 2015**

<b>Question</b>	<b>Answers</b>	<b>Extra information</b>	<b>Mark</b>	<b>AO / Spec ref</b>
<b>11(a)</b>	any <b>one</b> from: <ul style="list-style-type: none"> <li>helium nucleus</li> <li>2 protons <b>and</b> 2 neutrons</li> </ul>	allow ${}^4_2\text{He}^{2+}$	1	AO1 P2.5.2 c
<b>11(b)</b>	a few cm	ignore not very far allow any value above 0 and up to 10 cm	1	AO1 P2.5.2 e
<b>11(c)(i)</b>	(radon is likely to be) breathed in  (radon / alpha radiation is) dangerous / harmful inside the body  alpha radiation is ionising <b>or</b> causes (named) cancer	allow radon accumulates in the house  allow 'particles' for 'radiation'  allow causes mutations <b>or</b> damages DNA / cells	1  1  1	AO1 AO2 P2.5 / 2.5.2 e
<b>11(c)(ii)</b>	any <b>three</b> from: <ul style="list-style-type: none"> <li>radiation is random</li> <li>different rooms may have different levels</li> <li>using two detectors leads to a mean reading</li> <li>needs 3 months to account for variations / anomalies</li> <li>3 months is long enough to detect a measurable amount</li> </ul>	allow 'average' for 'mean'  allow needs three months to get mean / average readings  if marking points three and four are not given, allow <b>1</b> mark for mean / average	3	AO3 P2.5
<b>Total</b>			<b>8</b>	

