



GCSE

Additional Science (Route 2)

AS1HP

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 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. Boldening

- 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 boldened. 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 **1(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.

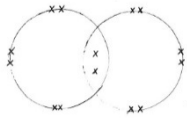
Question 1

Question	Answers	Extra information	Mark	AO / Spec ref
1(a)(i)	diffusion / diffusing	allow active transport ignore absorption	1	AO1 B2.2.1 a
1(a)(ii) Mark with (a)(iii)	(Cell) A		1	AO2 B2.2.1 b
1(a)(iii) Mark with (a)(ii)	concentration (of oxygen molecules) outside cell higher (than inside cell)	allow (oxygen) moves from a high concentration to a low concentration or moves down a concentration gradient ignore reference to more, rather than concentration	1	AO3 B2.2.1 b
1(a)(iv)	for respiration	allow aerobic respiration allow to 'release' energy do not allow anaerobic respiration	1	AO1 B2.1.2 c

QWC Mark Scheme

question	Answers	extra information	mark	AO / Spec ref
1(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.		6	AO1 B2.2.1 a/b/c/d B2.2.2 a/b
0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)	
No relevant content.	A description of a level of organisation or an example of a level.	A description of a level of organisation and an example of a level or a description of levels of organisation or examples of levels.	A description of levels of organisation with some linked examples.	
examples of biology points made in the response: <ul style="list-style-type: none"> • (D) tissues made of groups of (similar) cells (working together) • (E) muscle / epithelium / glandular (in animals) or epidermis / mesophyll / xylem / phloem (in plants) • (D) organ made of groups of (different) tissues (working together) • (E) stomach (in animals) or stem / root / leaf (in plants) • (D) system made of groups of (different) organs (that perform a function) • (E) digestive system (in animals) or flower (in plants) • (D) organism made of groups of organ systems (working together) • (E) animal or human or plant or named example 		extra information accept any named examples of each level in plants or animals		
Total			10	

Question 2

Question	Answers	Extra information	Mark	AO / Spec ref
2(a)(i) View with Table 1	(proton) 1 (electron) very small	ignore positive charge allow $\frac{1}{2000}$ or $\frac{1}{1840}$ or 0.0005 allow negligible do not allow 0 / zero ignore negative charge	1 1	AO1 C2.3.1b
2(a)(ii)	isotopes		1	AO1 C2.3.1d
2(a)(iii)	18		1	AO2 C2.3.1a/c/ d
2(b)(i)	covalent		1	AO1 C2.1.1b/g
2(b)(ii) View with Figure 3	shared pair of electrons complete electronic structure	 allow dots or crosses or e ⁻ for electrons	1 1	AO1, AO2 C2.1.1.b/g
2(c)(i)	sodium + chlorine → sodium chloride	the reactants may be in either order allow Na for sodium allow Cl ₂ for chlorine allow NaCl for sodium chloride	1	AO2 C2.1.1d
2(c)(ii)	2 (or more) elements (chemically) combined	allow fixed ratio of atoms	1	AO2 C2.1.1a/d
Total			9	

Question 3

Question	Answers	Extra information	Mark	AO / Spec ref
3(a)(i)	15 510 000 (J) or 15 510 (kJ) J or kJ	award 1 mark for correct substitution i.e. $141\ 000 \times 110$ or 141×110 provided no subsequent step unit must be consistent with answer allow joule(s) or kilojoule(s) do not allow j or KJ	2 1	2AO2 1AO1 P2.2.1 b
3(a)(ii)	kinetic		1	AO1 P2.2.1 c
3(b)(i) Mark with 3bii	11 655 000 (J)	award 1 mark for correct substitution i.e. $8325 \times 10 \times 140$ provided no subsequent step	2	AO2 P2.2.1 f
3(b)(ii) Mark with 3bi	11 655 000	allow their answer to (b)(i)	1	AO1 P2.2
3(b)(iii)	any one from: <ul style="list-style-type: none"> energy transferred to other forms (due to friction) (due to) air resistance / friction 	allow sound / thermal energy 'lost' allow 'heat' / energy 'lost' / wasted	1	AO1 P2.2.1 d

3(c)	increases	allow faster / quicker	1	AO2 P2.2, 2.2.1 f
3(d)	any one from: yes answers <ul style="list-style-type: none">to protect passengers from harm / danger no answers <ul style="list-style-type: none">passengers can choose to go on the ride or not	allow it would spoil the fun	1	AO3 P2.1
Total			10	

Question 4

Question	Answers	Extra information	Mark	AO / Spec ref
4(a)(i)	glucose / sugar	answers may be in either order ignore starch / carbohydrate allow $C_6H_{12}O_6$	1	AO1 B2.3.1 a
	oxygen	allow O_2	1	
4(a)(ii)	Used to strengthen cell walls	cellulose	1	AO1 B2.3.1 e/f/g
	Used for storage	starch / fat / oil / lipid	1	B2.1.1 b
	Made using nitrate ions	protein	1	
		allow amino acid(s) allow enzymes / named enzyme / chlorophyll / hormones / auxin / DNA / nucleic acids		
4(a)(iii)	phloem or xylem	allow phonetic spelling allow vascular (tissue)	1	AO1 B2.2.2 b
4(b)(i)	idea of factor(s) / condition that prevents photosynthesis / reaction going faster or if increased would increase rate of photosynthesis / reaction	allow slows down the rate of photosynthesis / reaction compared to the maximum	1	AO1 B2.3.1 c/d
4(b)(ii) Mark with (b)(iii)	81	allow in range 80 – 82	1	AO2 B2.3
4(b)(iii) Mark with (b)(ii)	high(er) cost (which may not match extra income)	allow not cost effective	1	AO3 B2.3

<p>4(b)(iv) View with Figure 6</p>	<p>line drawn anywhere below lower curve (sloping down)</p> <p>justification</p> <p>faster / more photosynthesis</p> <p>any one from:</p> <ul style="list-style-type: none"> • (so) faster / more glucose / carbohydrate / biomass production • as carbon dioxide no longer limiting • plateaus because other factors are limiting 	<p>should not cross lower curve at any point</p> <p>do not allow a line which meets the x axis</p>	<p>1</p> <p>1</p> <p>1</p>	<p>AO3 B2.3.1 c/d</p>
<p>Total</p>			<p>12</p>	

Question 5

Question	Answers	Extra information	Mark	AO / Spec ref
5(a)(i)	count all those which are (more than) half inside the grid or ignore all those which are less than half inside the grid (for all edges)	allow other reasonable methods eg count all on edge and divide by 2 ignore rehash of method stated	1	AO3 B2.4.1 b
5(a)(ii)	2800	award 1 mark for clear evidence of 28 award 1 mark for clear evidence of 0.01 (mm ³) if clear evidence of different count allow up to 2 marks for answer based on this	3	AO2 B2.4.1 b
5(b)(i)	any two from: <ul style="list-style-type: none"> increases rapidly (increases) by increasing amount (increases) by 4 times as many each day 	allow increases significantly allow exponential (increase) for 2 marks	2	AO2 B2.4.1 b
5(b)(ii)	any two from: <ul style="list-style-type: none"> lack of food / sugar / nutrients lack of oxygen accumulation of (toxic) waste predation 	ignore death allow lower pH or more acidic	2	AO2 B2.4.1 a
Total			8	

Question 6

Question	Answers	Extra information	Mark	AO / Spec ref
6(a)	any one from: <ul style="list-style-type: none"> • accurate • detect small quantities • sensitive or greater resolution 	ignore references to precision or reliability	1	AO1 C2.3.2a/c
6(b)	any two from: <ul style="list-style-type: none"> • carried by gas • through (column packed with) solid material • at different speeds 	allow sample is vaporised allow substances have different attractions to (solid) material allow compounds with stronger attractions take longer (to go through column) or allow different retention times	2	AO1 C2.3.2c
6(c)	molecular mass / Mr of carbon dioxide (molecular) mass is 44	allow relative formula mass / rfm of carbon dioxide	1 1	AO3 C2.3.2c
6(d)(i)	(contain) intermolecular forces or forces between molecules (intermolecular forces are) weak or (forces / bonds are) easily broken	allow bonds between molecules do not allow reference to ionic or covalent bonds between molecules	1 1	AO1 C2.2.1a/b

6(d)(ii)	no overall charge	allow no ions allow no free / delocalised electrons	1	AO1 C2.2.1c
Total			8	

Question 7

Question	Answers	Extra information	Mark	AO / Spec ref
7(a)	any three from: <ul style="list-style-type: none"> • wood is the least dense material and least strong • carbon nanotube is the strongest material and a comparison of the density with either wood or carbon fibre • carbon fibre is the most dense and a comparison of the strength with either wood or carbon nanotubes • a justified conclusion 	a maximum of 1 mark can be awarded if no comparative statements are made a comparison of strength or of density is not required ignore references to lightness or heaviness	3	AO3 C2.2.3e
7(b)	any three from: <ul style="list-style-type: none"> • giant structure • covalent • strong bonds (between silicon and oxygen atoms) • each silicon atom bonds to 4 oxygen atoms and each oxygen atom bonds to 2 silicon atoms 	allow lattice structure do not allow strong ionic / intermolecular bonds allow each silicon atom forms 4 bonds and each oxygen atom forms 2 bonds	3	AO1 C2.2.3a

7(c)	(similarity) any one from: <ul style="list-style-type: none">• hexagonal structure / rings• each (carbon) atom bonded to 3 other (carbon) atoms• covalent bond(s)• giant structure• contain delocalised electrons		1	AO1, AO2 C2.2.3a/c/ e
	(difference) graphite contains layers or carbon nanotube does not contain layers		1	
Total			8	

Question 8

Question	Answers	Extra information	Mark	AO / Spec ref
8(a)	53%		1	AO2 C2.3.3a
8(b)	$\frac{13}{52}$ $\frac{24}{16}$ 0.25 1.5 1 6 CrO ₆	division of mass by A_r correct ratio correct whole number ratio (allow multiples) correct formula correct formula with no working gains 1 mark ecf allowed from each step	1 1 1 1	AO2 C2.3.3b
Total			5	

Question 9

Question	Answers	Extra information	Mark	AO / Spec ref
9(a)(i)	12 (m/s)	allow 1 mark for correct substitution i.e. $4.8 = \frac{v - 0}{2.5}$	2	AO2 P2.1.2 e
9(a)(ii)	(sprinter's) reaction time	allow it takes time for the sound to reach the sprinter	1	AO2 P2.1
9(a)(iii)	speed	allow velocity do not allow constant speed	1	AO1 P2.1.2 b
9(b)	94 (kg)	allow 2 marks for an answer of 93.75 or 93.8 or allow 1 mark for correct substitution i.e. $4.8 = \frac{450}{m}$ or $450 = m \times 4.8$	3	2AO2 1AO1 P2.1.2 a
9(c)(i)	as the wind speed decreases the world record times decrease	allow converse allow (as the) wind speed decreases (the) world record times are faster ignore references to the year or the speed of the sprinter	1	AO2 P2.1.2 a
9(c)(ii)	any one from: <ul style="list-style-type: none"> insufficient detail about wind speed other factors involved insufficient data 	allow wind direction unknown eg different techniques / training / surfaces eg records for other years not given	1	AO3 P2.1
Total			9	

Question 10

Question	Answers	Extra information	Mark	AO / Spec ref
10(a)	decreases any one from: <ul style="list-style-type: none"> more p.d. / voltage across variable resistor current decreases 		1 1	AO1 P2.3.2 h, i, k
10(b)	there is no effect any one from: <ul style="list-style-type: none"> p.d. / voltage is the same across each component (as the supply) current does not change through the fixed resistor 	allow stays the same	1 1	AO1 P2.3.2 h, i, l
10(c)	zero	allow systematic	1	AO3 P2.3
Total			5	

Question 11

Question	Answers	Extra information	Mark	AO / Spec ref
11(a)(i)	it is less (because the mass has a) lower weight	mark as a whole	1 1	1AO1 1AO2 P2.1.4 d
11(a)(ii)	any one from: <ul style="list-style-type: none"> • can lift more massive objects • less force needed to move around • less force needed to jump / climb / walk 	allow less energy / force needed to lift objects. allow can jump higher	1	AO3 P2.1.4 d
11(b)	friction between boots and Moon / dust / surface (so) electrons are transferred to the boots (and) electrons are negatively charged or (and charge builds up because) the boots are insulators	allow the boots rub against Moon / dust / surface	1 1 1	AO1 P2.3.1 a, b
Total			5	