GCSE

Additional Science (Route 2)

AS2HP

Mark scheme

4409

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Version/Stage: 1.1 Final

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. 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 <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.

4. Quality of Communication and levels marking

In Question **1(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.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. ref.
1(a)	protein	allow amino acids	1	AO1 B2.5.1b
1(b)(i)	for slimming foods	allow it is sweeter allow less needs to be used (for the same sweetness)	1	AO1 B2.5.2i
1(b)(ii)	enzyme / isomerase shape changed	allow enzyme / isomerase denatured / destroyed / damaged do **not** allow killed	1	AO2 B2.5.2a/b

Question 1 continued

Question	Answers	Extra information	Mark	AO / Spec. ref.
1(c)			6	AO1 B2.5.2c/d/e/f/g/h/i

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.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	identifies at least one digestive enzyme **or** a food substance that is broken down in digestion **or** the product(s) of the digestion of a food substance.	identifies at least **one** link between a digestive enzyme and a food substance broken down by the enzyme **or** a digestive enzyme and a product of digestion by that enzyme **or** a food substance and its product of digestion.	identifies digestive enzymes and at least one food substance broken down by an enzyme and a product of digestion by that enzyme.

examples of biology points made in the response:	extra information
• (E) amylase • (F) starch • (P) sugar • (E) protease • (F) protein • (P) amino acids • (E) lipase • (F) fat / lipid • (P) fatty acid • (P) glycerol	allow ref to carbohydrase for amylase allow pepsin for protease accept names of other digestive enzymes and their functions ignore ref to acid / bile ignore the parts of the digestive system where reactions occur ignore industrial uses of enzymes

Total			9

Question 2

Question	Answers	Extra information	Mark	AO / Spec. ref.
2(a)	rate of reaction = $\frac{\text{volume of gas prodcued}}{\text{time}}$		1	AO1 C2.4.1a
2(b)(i)	0.28 (arbitrary units)	allow any value in the range 0.27–0.29	1	AO2 C2.4.1a
2(b)(ii)	**supports** (conclusion is correct) between 10 °C and 20 °C **does not support** temperatures above 20 °C values of rate given 10 °C apart to support either answer	 allow specific values 10 ^{o}C apart above 20 ^{o}C 	1 1 1	AO3 C2.4.1c
2(c)(i)	particles move faster **or** particles have more energy so the particles collide more often / frequently	 allow for **2** marks more particles have necessary activation energy to react	1 1	AO1 C2.4.1b/c
2(c)(ii)	 increase surface area of calcium carbonate increase concentration of hydrochloric acid	ignore references to temperature allow use smaller pieces of calcium carbonate allow use a catalyst	 1 1	AO1 C2.4.1e/f
Total			**9**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)	(atomic) nuclei join	allow nuclei fuse / combine ignore nuclei meet / collide / come together	1	AO1 P2.6.2a
3(b)	it has a high mass (of hydrogen)	allow it is massive allow a lot of hydrogen ignore it is big ignore high weight	1	AO1 P2.6.2e
3(c)(i)	gas / dust pulled (together) by gravity		1 1	AO1 P2.6.2c
3(c)(ii)	main sequence (star)		1	AO1 P2.6.2e
3(d)(i)	explosion (of a (massive) star)	allow explosion of a red super giant	1	AO1 P2.6.2f
3(d)(ii)	any **one** from: • neutron star • black hole	 do **not** allow neutral star do **not** allow black dwarf	1	AO1 P2.6.2e
3(d)(iii)	iron	allow Fe	1	AO1 P2.6.2f

Question 3 continues on the next page

Question 3 continued

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(d)(iv)	its mass is too low	allow mass is lower than the Sun allow only massive stars will supernova ignore it is too small ignore weight is too low **or** it is not heavy enough do **not** allow references to temperature	1	AO2 P2.6.2e
Total			**9**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)(i)	male has XY (chromosomes) **and** female has XX (chromosomes)	allow male has a Y (chromosome) **and** female has not	1	AO1 B2.7.2b
4(a)(ii)	DNA / genetic fingerprinting	allow DNA / genetic screening / profiling	1	AO1 B2.7.2i
4(b)	PKU recessive (allele) both parents or A **and** B are heterozygous / carriers / are Rr both parents pass on recessive / PKU allele or r to D	allow answers shown clearly in annotated genetic diagram if a Punnett square or equivalent is drawn, D must be identified allow ecf from incorrect parents	1 1 1	AO2 AO3 B2.7a B2.7.2c/d/e B2.7.3c

Question 4 continues on the next page

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(c)	**advantages of embryo screening:** • earlier diagnosis • (which leads to) earlier 'treatment' • allows opportunity for abortion / termination • preparation for child with PKU • less damage due to PKU (to embryo) **disadvantages:** • possible harm to mother • possible harm to embryo / foetus / baby • **idea of** moral dilemma to abort or not • high cost of procedure	allow max **3** marks for only advantages or for only disadvantages allow reverse arguments for blood test, where relevant do **not** allow the idea of embryo selection (eg via IVF) allow possible miscarriage	4	AO2 AO3 B2.7.3d
Total			**9**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(a)(i)	20 000		1	AO2 B2.6.1g
5(a)(ii)	800	award **1** mark for (20 000 × 4) ÷ 100 or equivalent, with no answer or the incorrect answer accept ecf from **(a)(i)** for up to **2** marks	2	AO2 B2.6.1g/h
5(b)(i)	**idea of** same volume of air / oxygen breathed in (at 40 as at 30) so no extra oxygen (for aerobic respiration)	allow 28 000 cm^3 (of air) breathed in for both (30 and 40)	1 1	AO2 AO3 B2.6.1b B2.6.2a
5(b)(ii)	any **one** from: • less energy released • oxygen debt • lactic acid produced • muscle fatigue	allow converse if answer clearly indicates ref to aerobic respiration do **not** allow less energy produced / made	1	AO1 B2.6.2a/b/c/d
Total			**6**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. ref.
6(a)	differentiation cell becomes specialised	 allow description / example allow reference to mitosis / cell division	1 1	AO1 B2.7.1j
6(b)(i)	4.5×10^6 **or** 4 500 000 **or** 4.5 million	allow **1** mark for 4.5 **or** allow **1** mark for: $\frac{414 \times 10^6}{92}$ with no answer or incorrect answer	2	AO2 B2.7.1k
6(b)(ii)	(grow new nerve cells) to treat paralysis	allow other medical uses of stem cells	1	AO1 B2.7.1l/m
6(b)(iii)	any **one** from: • **ref to** ethical / moral issues • more available / accessible • **idea that** treatments needing bone marrow stem cells are more common than those needing embryonic stem cells	 eg ref to adults can give consent **or** collection may (be more likely to) harm embryo allow destroys embryos	1	AO3 B2.7.1l/k
Total			**6**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)(i)	H^+ (aq) + OH^- (aq) → H_2O (l)	allow correct multiples	1	AO1 C2.6.1a C2.6.2e
7(a)(ii)	to ensure all acid reacted		1	AO1 C2.6.1b
7(a)(iii)	add named indicator colour produced by named indicator in alkaline solution **or** alternative approach of: use pH meter (reading of) pH is above 7	accept add an indicator	1 1	AO1 AO2 C2.6.2c/d
7(a)(iv)	evaporate and leave to crystallise		1	AO1 C2.6.1c
7(b)(i)	endothermic because temperature goes down so taking in energy		1 1 1	AO1 AO2 AO3 C2.5.1a/c
7(b)(ii)	**similarity** 340 J (will be transferred) **difference** exothermic reaction **or** energy given out	accept same amount of energy (transferred) allow ecf from answer in part **(b)(i)** accept for **2** marks energy change is −340 J	1 1	AO1 AO2 C2.5.1d
Total			**10**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. ref.
8(a)	H^+ and Na^+ attracted as positively / oppositely charged hydrogen is less reactive (than sodium) so hydrogen gas is produced	 accept hydrogen ions gain electrons allow hydrogen ions are reduced allow hydrogen ions form atoms / molecules do **not** allow sodium is produced	1 1 1	AO1 AO2 C2.7.1a/c/e/f/i
8(b)	$2Cl^- \rightarrow Cl_2 + 2e^-$ **or** $2Cl^- - 2e^- \rightarrow Cl_2$	award **1** mark for e^- award **1** mark for correct balancing (allow correct multiples)	2	AO1 C2.7.1g
8(c)	any **one** from: • to allow ions to pass through • to keep gases apart • to prevent gases reacting		1	AO3 C2.7.1i
Total			**6**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. ref.
9(a)	$Pb(NO_3)_2$ (aq) + 2KI (aq) → PbI_2 (s) + $2KNO_3$ (aq)	allow correct multiples	1	AO2 C2.6.1d
9(b)	precipitation		1	AO1 C2.6.1d
9(c)	lead nitrate **and** potassium iodide		1	AO2 C2.6.1d
9(d)	any **two** from: • add potassium iodide to the waste water • (to) produce an insoluble (lead) salt • filter **or** (leave to) allow to settle out	 allow add KI to the waste water allow ecf for addition of incorrectly named iodide salt in part **(c)** to waste water allow (to) produce lead iodide allow (to) produce a precipitate	2	AO1 AO2 C2.6.1d
Total			**5**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. ref.
10(a)(i)	alternating current (constantly) changes direction direct current (always) goes in the same direction		1 1	AO1 P2.4.1b
10(a)(ii)	40 Hz / hertz	 allow for **1** mark (5 × 0.005 =) 0.025 **or** allow for **2** marks 1 / 0.025 allow ecf for up to **2** marks	3 1	AO1 AO2 P2.4.1b
10(b)(i)	1.3 (amps)	 allow **1** mark for correct substitution ie 300 = 230 × I	2	AO2 P2.4.2c
10(b)(ii)	 1 A is not suitable because it will melt (when supply is switched on) 3 A is suitable because the current is (slightly) lower than 3 A 13 A is not suitable because it will not melt if there is a current overload	allow blow / break for melt allow the fuse rating is (just) higher than the current 	 1 1 1	AO3 P2.4.1h
Total			**11**	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. ref.
11(a)(i)	the radiation that is all around us		1	AO1 P2.5.2b
11(a)(ii)	yes: it is an additional risk / danger (so is not acceptable) **or** no: the dose is (very) small (compared to other sources)	there is no mark for the yes / no answer, the mark is for the reason allow other sources give a (much) larger dose	1	AO3 P2.5.2b
11(b)	31 (years)	allow in range 30.1–31.9 allow **1** mark for an incorrect answer with evidence of appropriate construction line(s) on figure 11 that would lead to a correct answer **or** allow **1** mark for 30 or 32	2	AO2 P2.5.2h
11(c)	electromagnetic radiation / wave		1	AO1 P2.5.2c
11(d)(i)	mark shown below gamma and greater deflection than alpha particle (as) the beta particle has an opposite charge to the alpha particle (as) the mass of the beta particle is less than the alpha particle	judge greater deflection by eye allow (as) a beta particle is negative but an alpha particle is positive	1 1 1	AO1 AO2 P2.5.2f

Question 11 continues on the next page

Question 11 continued

Question	Answers	Extra information	Mark	AO / Spec. ref.
11(d)(ii)	any **two** from: • so that radiation travels in one direction • to produce a narrow beam or target the beam • so results are valid / useful	mark as a whole if no other mark is awarded allow reduces risk of cancer for **1** mark	2	AO2 AO3 P2.5.2e
Total			**10**	