



GCSE

Science A (Route 2)

SCA1HP
Final Mark Scheme

4406
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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. 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 **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)	there are antibiotic resistant bacteria / pathogens / strains / fungi	do not allow reference to viruses do not allow bacteria / pathogens are immune ignore people are resistant / immune	1	AO1, AO2 B1.1.2h, i,k
	that a new antibiotic might kill	allow the new antibiotic may treat the pathogen ignore references to drug testing	1	

Question 1 continues on the next page

QWC Mark Scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(b)			6	4 AO1 2 AO2 B1.3.1a,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 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.	A correctly described stage or reference to validity.	Some correctly described stages or a correctly described stage and reference(s) to validity.	Correctly described stages and references to obtaining valid results.	

<p>examples of the points made in the response</p> <p><i>Laboratory testing:</i></p> <ul style="list-style-type: none"> • test on cells / tissues / animals • to see if the drug is toxic / harmful • to test its efficacy • to determine a safe dose to be used in humans <p><i>(Phase 1 clinical testing):</i></p> <ul style="list-style-type: none"> • tested on (healthy) volunteers • low doses used • to test for side effects / toxicity / safety <p><i>(Phase 2 clinical testing):</i></p> <ul style="list-style-type: none"> • tested on patients • patients given placebo or drug (validity) • (double) blind trial (validity) • to test for side effects / toxicity / safety • to test its efficacy / effectiveness <p><i>(Phase 3 clinical testing):</i></p> <ul style="list-style-type: none"> • larger numbers of patients used (validity) • tested on target groups eg age / gender / pregnant • patients given placebo or drug (validity) • double blind trial (validity) • to verify efficacy / effectiveness • to determine correct dose 	<p>extra information</p> <p>credit each idea relating to validity only once</p> <p>allow to see if it is safe for use in humans allow to see if it works</p> <p>allow volunteers given placebo or drug allow blind trials</p> <p>allow description of (double) blind trial</p> <p>allow to see if it works</p> <p>allow description of double blind trial allow to verify that it works</p>			
<p>1(c)</p>	<p>to avoid bias</p>	<p>ignore references to validity / accuracy / safety</p>	<p>1</p>	<p>AO3 B1.3.1b</p>
<p>Total</p>			<p>9</p>	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	phototropism	ignore negative / positive do <u>not</u> allow phototrophic	1	AO1 B1.2.3b
2(a)(ii)	unequal distribution of auxin / hormone or (more) hormone on side away from light / shaded side (so) side away from light grows more / faster	allow cell elongation for growth	1	AO1 B1.2.3a, b,c
			1	
2(b)(i)	any one from: <ul style="list-style-type: none"> • intensity of light • type /species of shoot • height / size / age of shoot (at start) • temperature • amount of water 	ignore direction of light	1	AO3 B1.2.3a
2(b)(ii)	<i>Shoot B:</i> any one from: <ul style="list-style-type: none"> • tip produces auxin / (growth) hormone • tip stimulates growth <i>Shoots C and D:</i> any one from: <ul style="list-style-type: none"> • tip is sensitive to light • sides are not sensitive to light 	allow tip is needed for growth allow tip required for phototropism	1	AO3 B1.2.3a, b,c
			1	
Total			6	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	neon	allow Ne	1	AO2 C1.1.1b,h
3(b)	unreactive (as) has a stable arrangement of electrons	allow (as) noble gas allow (as) in group 0 allow (as) has complete outer energy level (of electrons) allow (as) has complete outer shell (of electrons)	1 1	AO1, AO2 C1.1.1h C1.1.2b
Total			3	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	<p>any two gases and linked effects from:</p> <ul style="list-style-type: none"> • carbon dioxide • (causes) global warming <p>or</p> <ul style="list-style-type: none"> • oxides of nitrogen • (causes) acid rain <p>or</p> <ul style="list-style-type: none"> • sulfur dioxide • (causes) acid rain 	<p>the effect mark is dependent on correct gas</p> <p>allow CO₂ ignore greenhouse gas</p> <p>allow specified environmental effects eg rise in sea levels</p> <p>allow nitrogen monoxide or nitrogen dioxide allow NO / NO₂ / NO_x</p> <p>allow specified environmental effects</p> <p>allow SO₂</p> <p>allow specified environmental effects</p> <p>allow for 1 mark carbon monoxide / CO ignore particulates / soot but allow 1 mark for linked effect ignore methane but allow 1 mark for linked effect</p>	4	AO1 C1.4.3a, b,c
4(a)(ii)	biofuels are a renewable resource	<p>ignore references to cost / pollution</p> <p>do not allow can be reused</p> <p>allow biofuels do not produce sulfur dioxide</p> <p>allow biofuels are carbon neutral</p>	1	AO3 C1.4.3e
4(b)	sulfur		1	AO1 C1.4.3d
Total			6	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	65 (%)		1	AO2 C1.3.1j C1.3.3a
5(a)(ii)	<p>any two from:</p> <ul style="list-style-type: none"> less energy used less mining less space used in landfill qualified example of pollution issues caused by copper extraction 	<p>ignore conserves copper ores ignore references to cost / electricity ignore pollution unqualified</p> <p>allow a consequence of using less energy eg fewer greenhouse gas emissions allow a consequence of mining eg fewer spoil heaps allow less quarrying</p>	2	AO1, AO2 C1.3.1j
5(b)	<p>any three from:</p> <ul style="list-style-type: none"> plants are grown on ground containing copper (ores) plants are burnt to produce ash the ash contains copper compounds 	<p>ignore references to electrolysis</p> <p>allow plants absorb metal compounds</p> <p>if no other mark awarded allow 1 mark for reference to plants</p>	3	AO1 C1.3.1g
Total			6	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	0.35 or 35 %	allow for 1 mark 35 without % or with a different unit or 0.35 with % or another unit or $\frac{7}{20} (\times 100)$	2	AO2 P1.2.1d
6(a)(ii)	(energy is) transferred to the surroundings	do not allow causes global warming / pollution allow 'heat' is transferred to the surroundings 'heat' alone is insufficient	1	AO1 P1.2.1c
6(a)(iii)	(CHP) there is less wasted energy or more energy is transferred usefully	no mark for the power station mark is for the reason if the incorrect power station is chosen, no mark for the reason allow <u>only</u> 20 % of the energy is wasted allow fossil fuel power station wastes 65 % and CHP wastes 20 % allow because its efficiency is 80% / 0.8 allow energy is used to provide heating / hot water and electricity	1	AO2 P1.2.1d

6(b)(i)	(copper) is a better conductor (of energy)	allow (copper) is a good conductor (of energy) ignore (copper) is a good conductor of electricity ignore plastic could melt ignore references to reactivity / strength / flexibility	1	AO1 P1.1.3a
6(b)(ii)	<p><i>improvement:</i> longer pipe</p> <p><i>reason:</i> larger surface area</p> <p><i>improvement:</i> thinner copper (for the pipe)</p> <p><i>reason:</i> energy is transferred across a shorter distance</p> <p><i>improvement:</i> paint the pipe black</p> <p><i>reason:</i> black is a good emitter (of infrared radiation)</p>	any two correct improvements reason must be correctly linked to improvement ignore bigger / larger / wider pipe ignore thinner pipe allow greater rate of conduction allow less energy absorbed by the pipe allow black is a good absorber (of infrared radiation) allow use a metal that has a higher conductivity (than copper)	2 2	AO1 AO3 P1.1.1c P1.1.3c
Total			9	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	any four from: <ul style="list-style-type: none"> • (greater power output so) heats the room faster • (has an automatic timer so) can heat the room before he goes into it • (has an automatic timer so) will switch itself off • (wall mounted so) does not take up much space • (wall mounted so) less likely to trip over it • (has protection against overheating so) there is less risk of fire 	allow (has an automatic timer so) can be set to reduce wasting energy / electricity allow safer	4	AO3 P1.3.1b,c
7(b)	36 000 000 (J)	allow for 1 mark: a correct substitution 2500×14400 provided no subsequent steps or 10 kWh or 10 000 (J) or correctly calculated answer from an incorrect conversion of time only if working shown	2	AO2 P1.3.1c
Total			6	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	13.2 / 13.16 / 13.158 (cm ³)	do not allow 13.1 / 13.15 / 13.157	1	AO2 B1.3.1e
8(b)(i)	(to allow time) for alcohol to enter blood stream / nervous system		1	AO3 B1.2.1a, d,e
8(b)(ii)	<p>any two improvements with correctly linked reason:</p> <ul style="list-style-type: none"> measure reaction time at start Reason: for comparison use 0 units of alcohol Reason: to see if 0.5 / lower units of alcohol had an effect use bigger range of alcohol units Reason: to see a trend use smaller intervals of alcohol Reason: to confirm a trend use the same student for the range of alcohol units Reason: some people will be less / more affected by alcohol control for gender Reason: men and women are affected differently <p>or women are affected by alcohol more than men</p>	<p>two marks for improvements</p> <p>two marks for correctly linked reasons</p> <p>allow as a control</p> <p>ignore more units of alcohol</p>	2 2	AO2, AO3 B1.2.1a, d,e B1.3.1e

	<ul style="list-style-type: none"> • control for age Reason: very young / very old people are (usually) affected by alcohol more • control for mass Reason: greater the mass less affected the person will be • control amount eaten before test Reason: food slows absorption of alcohol • each student should not have drunk alcohol before the test Reason: their reactions will already be affected • control for general level of alcohol intake Reason: affects ability to cope with alcohol • control length of time over which alcohol is drunk Reason: affects level in the blood • use a bigger sample size of students Reason: reduce the effect of anomalies • control for race Reason: race can affect response to alcohol 			
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<p>8(c)(i)</p>	<p>any four from: (receptor)</p> <ul style="list-style-type: none"> • to sensory neurone • to brain • to motor neurone • to effector / muscle • muscle contracts • chemical transmission across synapse 	<p>max 3 marks if any structure in wrong order max 3 marks if brain not mentioned as coordinator max 3 marks if confused electrical and chemical transmission</p> <p>allow coordinator / CNS allow relay neurone if clearly indicated coordination is within the brain do not allow spinal cord</p>	<p>4</p>	<p>AO1 B1.2.1a,d, e</p>
<p>8(c)(ii)</p>	<p>any one from:</p> <ul style="list-style-type: none"> • slows transmission / diffusion across synapse • slows coordination in brain 	<p>allow slows transmission along neurones / nerves allow reduces concentration</p> <p>allow affects vision</p>	<p>1</p>	<p>AO2 B1.2.1e B1.3.1e</p>
<p>Total</p>			<p>11</p>	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9	dead / inactive / weakened form of pathogen / bacterium / virus / microorganism is introduced / injected into person	ignore disease / germ	1	AO1 B1.1.2I
	(this stimulates) white blood cells	accept (B) lymphocytes / leucocytes / plasma cells	1	
	to produce <u>antibodies</u>		1	
	on re-infection (specific) antibodies can be made (very) quickly	accept reference to memory cells	1	
Total			4	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)(i)	MgCO ₃		1	AO2 C1.1.3b
10(a)(ii)	magnesium oxide and carbon dioxide	allow MgO for magnesium oxide allow CO ₂ for carbon dioxide	1	AO1 C1.2.1b,c
	(thermal) decomposition	allow endothermic	1	
10(b)	any three from: <ul style="list-style-type: none"> (only) waste product is carbon dioxide magnesium chloride converted / electrolysed to magnesium and / or chlorine magnesium produced in electrolysis is used in Reaction 2 chlorine produced in electrolysis is used in Reaction 1 titanium chloride is an intermediary 	ignore symbol equation allow magnesium is recycled allow chlorine is recycled	3	AO3 C1.3.1i
10(c)	any two from: <ul style="list-style-type: none"> attracted / move to negative electrode / cathode gain (2) electrons form magnesium <u>atoms</u> 	allow reduced allow forms Mg allow for 2 marks Mg ²⁺ + 2e ⁻ → Mg	2	AO1, AO2 C1.3.1h
Total			8	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11(a)(i)	$C_{20}H_{42}$	ignore C_nH_{2n+2}	1	AO2 C1.4.1c C1.4.2a
11(a)(ii)	any three from: <ul style="list-style-type: none"> (crude) oil is heated or (crude) oil vaporised temperature gradient in column <u>kerosene</u> fraction condenses (fraction condenses) at boiling point 	allow hydrocarbon vaporises allow column cooler at top allow boiling point range between 150 °C and 300 °C which must include 216 °C allow (condenses at) a boiling point of 216 °C	3	AO1, AO2 C1.4.1b C1.4.2b
11(b)	any three from: <ul style="list-style-type: none"> kerosene releases the most energy petrol has lowest flash point so most flammable petrol has lowest viscosity so will flow most easily correct comparison for one fuel of all three properties 	allow petrol releases the least energy allow diesel has highest flash point so least flammable allow diesel has highest viscosity so doesn't flow as well	3	AO2 AO3 C1.4.2c
Total			7	

Question 12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(a)(i)	kinetic	ignore particle	1	AO1 P1.1.2a
12(a)(ii)	<p>any three from:</p> <ul style="list-style-type: none"> the particles in a solid vibrate (about a fixed point) and the particles in a liquid can move past each other the particles in a solid are in a regular arrangement and the particles in a liquid are arranged randomly the particles in a solid have less energy than the particles in a liquid a solid has stronger forces of attraction between particles (than a liquid) 	<p>max 2 marks if no mention of particles allow atoms / molecules for particles ignore reference to gases ignore properties of liquids and gases</p> <p>ignore cannot move</p> <p>allow particles in a liquid can move around ignore particles in a liquid vibrate</p> <p>allow the particles in a solid are arranged in rows ignore close together</p> <p>allow the particles in a liquid are not in a regular arrangement ignore spread out</p> <p>allow converse for a liquid</p> <p>allow converse for a liquid</p>	3	AO1 P1.1.2a,b

<p>12(b)(i) <i>View with Figure 8</i></p>	<p>(water) particles (close to the ice) lose (kinetic) energy</p> <p>the particles move closer together or the water becomes more dense</p> <p>the cooler water sinks</p> <p>less dense water (at the bottom) rises</p>	<p>max 3 marks for correct description of convection in air</p> <p>allow water (close to the ice) cools down ignore (water) particles cool down</p> <p>do not allow references to particles becoming more dense or particles contracting</p> <p>do not allow 'cold' sinks</p> <p>allow warm(er) water rises do not allow 'heat' rises</p> <p>if no marks awarded for water rising and sinking allow for 1 mark cooler particles fall and warmer particles rises</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO1, AO2 P1.1.3a</p>
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12(c)	(water has a higher specific heat capacity (shc) so) more energy is required to warm water	allow (a high specific heat capacity (shc) means that) a large amount of energy is transferred to water allow converse argument for ice	1	AO1, AO2 P1.1.4d
	for a given temperature change or for a temperature change of 1 °C	allow shc is the energy required to raise the temperature of 1 kg of a substance by 1 °C	1	
	(so) the rate of warming is lower for water (compared to ice)	allow (so) the water takes a long time to warm (compared to ice) allow (so) the water warms more slowly (than ice) ignore reference to rate of cooling allow converse argument for ice	1	
Total			15	