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GCSE

# Science A

SCA2HP

Mark scheme

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Version 1.0: Final

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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)

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## 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

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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.

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#### 4. Quality of Communication and levels marking

In Question 4(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	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	lichens	allow phonetic spelling	1	AO1 B1.4.2c
1(b)	number of (cress) seeds that grew		1	AO2 B1.4.2b
1(c)(i)	35 (%)		1	AO2 B1.4.2b
1(c)(ii)	<u>sulfur dioxide</u> reduces the growth of seeds	allow SO <sub>2</sub> for sulfur dioxide  accept <u>sulfur dioxide</u> reduces the germination of seeds  do <b>not</b> allow sulfur dioxide prevents the growth of seeds  ignore references to sodium metabisulfite (solution) or water	1	AO3 B1.4.2b
<b>Total</b>			<b>4</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	214 (billion tonnes)	allow <b>1</b> mark for reading 122 and 92 correctly  allow <b>1</b> mark for the correct addition of incorrect readings	2	AO2 B1.6.2a
2(a)(ii)	18.35	allow 18.4 do <b>not</b> allow 18.3	1	AO2 B1.6.2a
2(b)(i)	(only) a small mass of carbon (dioxide) is released from burning fuels (compared to other processes)	allow the carbon (dioxide) released from other processes / respiration and decomposition is (much) greater	1	AO3 B1.6.2a
2(b)(ii)	any <b>two</b> from: <ul style="list-style-type: none"> <li>• (more) plants would absorb (more) carbon (dioxide)</li> <li>• (due to more) photosynthesis</li> <li>• fewer animals would release less carbon (dioxide)</li> <li>• (due to less) respiration (in animals)</li> </ul>	] an idea of more is needed at least once  ] an idea of a reduction is needed at least once  ] ignore references to oxygen	2	AO1, AO3 B1.5.1a B1.6.2a
<b>Total</b>			<b>6</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	<p>any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>disposes of his kitchen waste</li> <li>releases nutrients for his plants</li> <li>saves him money on fertiliser</li> <li>improves soil structure</li> </ul>	allow will help his plants / vegetables to grow	2	AO1, AO2 B1.6.1c
3(b)	<p>any <b>three</b> from:</p> <ul style="list-style-type: none"> <li>earthworms allow (more) air / oxygen to enter</li> <li>earthworms break wastes into small(er) pieces</li> <li>plastic sheet keeps the heap warm</li> <li>plastic sheet keeps in water</li> <li>microorganisms / bacteria / fungi cause decay / breakdown / decomposition / digestion (of waste)</li> <li>(microorganisms / bacteria / fungi) are more active / digest / breakdown materials faster in warm / moist / aerobic conditions</li> </ul>	<p>need reference to earthworms <b>and</b> sheet for full marks</p> <p>accept earthworms increase surface area of wastes</p> <p>allow decomposers ignore detritivores / earthworms</p> <p>allow decomposers rate must be linked to microorganism <b>and</b> a factor</p>	3	AO1,AO2, AO3 B1.6.1b
<b>Total</b>			<b>5</b>	



Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	crust (35) (mantle) 2865 core (3500)	ignore 2900  allow inner + outer core do <b>not</b> allow inner core do <b>not</b> allow outer core	1  1  1	AO1, AO2 C1.7.1a

## QWC Mark Scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(b)			6	AO1, AO2 C1.7.1a,b,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 content	At least <b>one</b> relevant statement is made about a continental change <b>or</b> a process causing the change.	Relevant statements are made about continental changes <b>and / or</b> the processes causing the changes.	Relevant statements are made about continental changes <b>and</b> the processes causing the changes. A detailed description of the processes is needed for full marks.
<b>Examples of the points made in the response:</b>		<b>Extra information</b>		
<p><b>continental changes</b></p> <ul style="list-style-type: none"> <li>(250 million years ago was a) super continent</li> <li>continents have separated</li> <li>(and continents have) moved</li> <li>oceans formed between continents</li> </ul> <p><b>processes</b></p> <ul style="list-style-type: none"> <li>continental drift</li> <li>(crust and upper part of mantle) cracked into plates / large pieces</li> <li>continents are on different plates</li> <li>(plates) float on mantle</li> <li>driven by heat</li> <li>(heat released) by radioactive processes</li> <li>(radioactive processes) in core</li> <li>(causes) convection currents</li> <li>(convection currents) in mantle</li> <li>(causes) plates to move</li> <li>(plates move) very slowly</li> </ul>		<p>allow land masses for continents</p> <p>allow Pangaea</p> <p>allow continents were joined / very close together</p> <p>allow description of named continents in new positions eg Africa and South America no longer joined together</p> <p>allow description of position of (named) ocean</p> <p>allow (plates move) at a speed of a few centimetres a year</p>		
<b>Total</b>				<b>9</b>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	glucose → ethanol + carbon dioxide	allow sugar for glucose allow correct formulae ignore attempts at balancing	1	AO1 C1.5.3b
5(b)(i)	filtration		1	AO2 C1.5.3b
5(b)(ii)	(fractional) distillation	allow evaporation then condensation	1	AO2 C1.5.3b
5(c)	<p><i>(advantage)</i> any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• uses a renewable resource</li> <li>• less energy used</li> </ul> <p><i>(disadvantage)</i> any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• slower process</li> <li>• ethanol is impure</li> <li>• batch process</li> </ul>	<p>ignore references to pollution ignore references to cost</p> <p>accept ethanol has to be separated from solution</p>	1  1	AO2, AO3 C1.5.3a,b
<b>Total</b>			<b>5</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	one of the areas where particles are spread out labelled R		1	AO1 P1.5.1f
6(b)	parallel		1	AO1 P1.5.1b
6(c)	340 (m/s)	allow <b>1</b> mark for correct substitution i.e. speed = $400 \times 0.85$ provided that no subsequent steps are shown	2	AO2 P1.5.1j
6(d)(i)	Doppler (effect)	allow phonetic spelling	1	AO1 P1.5.4a
6(d)(ii)	<p><b>two</b> from:</p> <ul style="list-style-type: none"> <li>the frequency is higher (than 400 Hz) as the car moves towards the person</li> <li>the frequency is lower (than 400 Hz) as the car moves away from the person</li> <li>the higher the speed the car moves towards the person, the higher the frequency</li> <li>the higher the speed the car moves away from the person, the lower the frequency</li> </ul>	<p>accept pitch for frequency ignore references to figures unless qualified</p> <p>accept the higher the speed the greater the change in frequency (compared to 400 Hz)</p>	2	AO3 P1.5.4a
6(d)(iii)	3		1	AO2 P1.5.1i
6(d)(iv)	C		1	AO3 P1.5.4a
<b>Total</b>			<b>9</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)(i)	(The angle of incidence) is equal to (the angle of reflection)		1	AO1 P1.5.2b
7(a)(ii)	virtual	<p>allow not real</p> <p>allow correct descriptions of virtual</p> <p>allow the same size as the object</p> <p>allow same distance behind the mirror (as the object is in front)</p> <p>allow laterally inverted or correct descriptions of</p> <p>ignore upright / reflected</p>	1	AO1 P1.5.2c
7(b)(i)	a ray drawn leaving the block parallel to the incident ray	<p>straight, continuous line judged by eye</p> <p>do <b>not</b> accept a ray of light with an arrow towards the block</p>	1	AO2 P1.5.1h
7(b)(ii)	normal		1	AO1 P1.5.2a
7(c)(i)	a smooth <u>curve</u> drawn through the points		1	AO2 P1.5.1g/h
7(c)(ii)	<p>as the angle of incidence increases the angle of refraction increases</p> <p>it is a non-linear graph <b>or</b> not directly proportional</p>	<p>allow correct description of their answer to 7(c)(i)</p> <p>ignore the angle of incidence is always larger than the angle of refraction</p> <p>allow a correct description of the graph / points</p>	1  1	AO2 P1.5.1g/h
<b>Total</b>			<b>7</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>8(a)</b>	any <b>four</b> from: <ul style="list-style-type: none"> <li>• mutation (produces striped fur)</li> <li>• there is variation in fur pattern / colour</li> <li>• camouflaged / striped animals (more likely to survive <b>or</b> catch food / prey</li> <li>• (survivors) reproduce / breed</li> <li>• gene / allele / mutation passed on to offspring / next generation</li> </ul>	max <b>3</b> marks if no reference to tiger / stripes  do <b>not</b> allow intention to mutate  do <b>not</b> allow intention to adapt / become camouflaged allow stripes give a <u>selective advantage</u> ignore natural selection unqualified  allow mate  allow characteristic / trait passed on <b>or</b> inherited by next generation	4	AO1 B1.8.1e,f
<b>8(b)</b>	animal developed stripes during its lifetime	accept stripes are an acquired characteristic do <b>not</b> allow any reference to mutation or inheritance from parents	1	AO1, AO2 B1.8.1c
	stripes inherited by offspring	do <b>not</b> allow if any reference made to Darwinism / natural selection / genes  accept for <b>2</b> marks acquired characteristics are inherited by offspring	1	
<b>Total</b>			<b>6</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)	genetic engineering	allow genetic modification ignore GE or GM	1	AO1 B1.7.2d
9(b)	<p>any <b>three</b> from:</p> <p><i>(advantages):</i></p> <ul style="list-style-type: none"> <li>• increases yield</li> <li>• longer growing period</li> <li>• (grower) can make more money</li> <li>• can produce plants with desired characteristics</li> </ul> <p><i>(disadvantages):</i></p> <ul style="list-style-type: none"> <li>• gene could be passed onto wild plants</li> <li>• effects on ecosystem / food chain</li> <li>• adverse effects on gene pool</li> <li>• possible adverse effects on human health</li> </ul>	<p>maximum <b>two</b> advantages</p> <p>allow example eg develop plants with pest resistance</p> <p>maximum <b>two</b> disadvantages</p> <p>allow example, eg bee population</p> <p>allow example eg less genetic variation ignore clones</p> <p>ignore damage to soil ignore references to cost ignore references to ethical issues</p>	3	AO1, AO2, AO3 B1.7.2e,f
<b>Total</b>			<b>4</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)(i)	sexual reproduction		1	AO1, AO2 B1.7.1a B1.7.2a
	(each embryo produced from) different sperm and egg <b>or</b> from different gametes		1	
	(so have) different genetic information	allow (so have) different genes / DNA / chromosomes / alleles	1	
10(a)(ii)	embryo transplant	allow embryo cell transplant allow embryo splitting ignore cloning do <b>not</b> allow adult cell cloning	1	AO1 B1.7.2c
10(a)(iii)	any <b>one</b> from: <ul style="list-style-type: none"> <li><i>idea</i> that not all individuals would be killed by a change in the environment eg disease</li> <li>more variation in the population increases chance of survival</li> </ul>	allow species less likely to die out  allow <i>idea</i> of restricted gene pool makes species more vulnerable to diseases	1	AO3 B1.8.1e
<b>Total</b>			<b>5</b>	



Question	Answers	Extra information	Mark	AO / Spec. Ref.
11(a)(i)	demand (for petrol) is greater than supply	ignore reference to figures unless qualified	1	AO3 C1.5.1a,b
11(a)(ii)	kerosene		1	AO3 C1.5.1a,b
11(a)(iii)	supply (of kerosene) is greater than demand		1	AO1, AO2 C1.5.1a,b
	contains larger molecules (which can be split into smaller molecules)		1	
11(b)	heat to vaporise (hydrocarbons)		1	AO1 C1.5.1a
	(then pass the vapours over a) hot catalyst	allow zeolites / aluminium oxide for catalyst  accept as an alternative approach:  mix (the vapours) with steam (1 mark)  (then) heat to a (very) high temperature (1 mark)	1	
<b>Total</b>			<b>6</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(a)	40 (%)	allow <b>1</b> mark for evidence of $\frac{18}{45} (\times 100)$ <b>or</b> <u>incorrect calculation</u> $\times 100$ 45 <b>and</b> percentage correctly calculated	2	AO2 C1.5.2b
12(b)(i)	$\begin{array}{cc} \text{H} & \text{H} \\   &   \\ \text{C} = & \text{C} \\   &   \\ \text{H} & \text{H} \end{array}$		1	AO2 C1.5.1b/c
12(b)(ii)	many monomers / small molecules  join together  to form very large molecules  <b>or</b>  polymers		1  1  1	AO1 C1.5.2a

<p><b>12(c)</b></p> <p>any <b>four</b> from:</p> <p><i>advantages:</i></p> <ul style="list-style-type: none"> <li>• cornstarch is produced from a renewable resource <b>or</b> poly(ethene) is produced from a non-renewable resource</li> <li>• cornstarch is biodegradable <b>or</b> poly(ethene) is non-biodegradable</li> <li>• less need for landfill with cornstarch</li> </ul> <p><i>disadvantages:</i></p> <ul style="list-style-type: none"> <li>• crop could be used for food <b>or</b> land could be used for food crops</li> <li>• growing crop takes up large amounts of land</li> <li>• justified conclusion</li> </ul>	<p>advantages and disadvantages needed for full marks</p> <p>allow fewer problems of waste disposal with cornstarch</p> <p>allow carbon neutral</p>	<p>4</p>	<p>AO1, AO3 C1.5.2c,d</p>
<p><b>Total</b></p>		<p><b>10</b></p>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13(a)	<p>any <b>four</b> from:</p> <p><i>similarities:</i></p> <p>(both) heat water to produce steam (which turns a turbine linked to turning a generator)</p> <p>(both are) reliable / can generate electricity 24 hours per day</p> <p><i>differences:</i></p> <ul style="list-style-type: none"> <li>• nuclear power uses nuclear <u>fission</u> to release energy</li> <li>• fossil fuels are burnt</li> <li>• fossil fuels releases carbon dioxide</li> <li>• nuclear fuels produce radioactive waste</li> <li>• nuclear fuels generate more energy per kilogram</li> </ul>	<p>for full marks similarities and differences must be given</p> <p>ignore they are both non-renewable</p> <p>allow (both) provide base load energy / power</p> <p>allow nuclear fuels transfer nuclear energy to thermal / electrical energy but fossil fuels transfer chemical energy to thermal / electrical energy</p>	4	AO1 P1.4.1a,f

<p><b>13(b)(i)</b></p>	<p>any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• nuclear power stations have high commissioning / decommissioning costs</li> <li>• nuclear fuels produce <u>radioactive</u> waste</li> <li>• storage / disposal of (nuclear) waste a problem</li> </ul>	<p>ignore cost and availability of fuel</p> <p>allow fossil fuel power stations do not have high commissioning / decommissioning costs</p> <p>allow there is no <u>radioactive</u> waste produced from fossil fuels</p> <p>allow (nuclear) waste takes many years to decay</p> <p>allow nuclear power stations have a longer start-up time</p> <p>allow for <b>2</b> marks (nuclear) waste stays radioactive for many years</p>	<p>2</p>	<p>AO2 P1.4.1 a,f</p>
<p><b>13(b)(ii)</b></p>	<p>any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• an increase in use of renewable energy sources</li> <li>• supply of fossil fuels is decreasing</li> <li>• improved technologies for storing (nuclear) waste <b>or</b> decommissioning of (nuclear) power stations</li> <li>• to meet targets for reduction of greenhouse gases</li> </ul>	<p>allow increased use of nuclear fuels</p> <p>allow named examples of renewable energy sources</p> <p>allow to reduce carbon dioxide emissions</p> <p>allow for <b>2</b> marks: fossil fuels will become more expensive as the supply decreases</p>	<p>2</p>	<p>AO3 P1.4.1f</p>

<b>13(c)</b>	to increase the voltage  (so) reduce current  (which) reduces energy losses (due to heating effects in the cables)	do <b>not</b> allow power / energy for voltage or current   allow “heat” for energy  allow more efficient energy transfer / transmission  do <b>not</b> allow stops energy losses	1  1  1	AO1 P1.4.2b,c
<b>13(d)</b>	any <b>three</b> from: <ul style="list-style-type: none"> <li>• chemicals used are a risk to health</li> <li>• (more) traffic on the roads would cause pollution / danger to locals</li> <li>• (Earth tremors) could damage buildings / houses</li> <li>• the sites may spoil the landscape / destroy habitats</li> <li>• the sites may devalue properties</li> <li>• money will be spent on fossil fuels rather than renewables so CO<sub>2</sub> emissions don't reduce</li> </ul>	no credit given for just repeating points given in the question.   eg contaminated water supply may make people ill	3	AO3 P1.4.1f
<b>Total</b>			<b>14</b>	