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General Certificate of Secondary Education
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Science A SCA2HP

(Specification 4406)

Unit 6: Science A2

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner 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 examiners 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 examiner understands and applies it in the same correct way. As preparation for standardisation each examiner 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, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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.

Marking Guidance for Examiners

GCSE Science Papers

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 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 lines 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.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates 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 error/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)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate 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, as shown in the column „answers", 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;

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 are 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.

Quality of Written Communication and levels marking

In Question 5(b) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates 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.

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Question 1

question	answers	extra information	mark
1(a)(i)	any **two** from: • food • mates • territory / space	 ignore habitat, land ignore water	2
1(a)(ii)	any **two** adaptations with explanations from: • long / thick hair or wool (for) insulation • small surface area : volume ratio (therefore) lose less energy • small ears / tail (therefore) lose less energy	**1** mark for adaptation **1** mark for correct explanation ignore prevents / no heat loss allow a lot of allow long / thick / a lot of fur ignore fat although reason can still be credited ignore coat allow (to) trap energy / heat / air allow to keep warm ignore large body mass although reason can still be credited allow (to) keep warm allow heat for energy ignore (to) insulate allow (to) keep warm allow heat for energy ignore (to) insulate only allow big tusks if qualified eg digging through snow / ice for (food) for **2** marks ignore references to predators and prey only allow big feet if qualified eg for walking on snow / ice for **2** marks	4

Question 1 continues on the next page

SCA2HP

Question 1 continued

question	answers	extra information	mark
1(b)(i)	natural selection		1
1(b)(ii)	if some animals grew a long nose / acquired characteristic (during their lifetime) their offspring would inherit / also have a long nose	ignore answers about Darwin's theory allow trunk for nose allow used trunk / nose / it a lot allow stretched trunk / nose / it do **not** accept references to genes / DNA / chromosomes	1 1
Total			**9**

Question 2

question	answers	extra information	mark
2(a)	light → chemical	both answers needed	1
2(b)(i)	8.3 / 8 / 8.3 recurring	allow 4/48 or 2/24 or equivalent or 0.08(3) for **1** mark	2
2(b)(ii)	any **three** from: • respiration • to keep warm • for movement • in waste materials / urea / faeces / carbon dioxide • in eggs	 do **not** allow **for** respiration allow (lost as) heat ignore evaporation / sweating allow excretion ignore growth	3
Total			**6**

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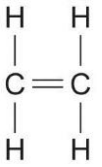
Question 3

question	answers	extra information	mark
3(a)	C_2H_4	allow displayed formula  if both molecular and displayed formulae are given mark the molecular formula allow H_4C_2 upper case letters do **not** accept numbers as superscripts	1
3(b)(i)	catalyst steam	must be in correct order	1 1
3(b)(ii)	cracking	ignore thermal decomposition	1
3(c)(i)	 PLA is biodegradable (so) less need for landfill	it = PLA must relate to waste disposal allow converse answers allow decomposes / decays / rots / breaks down (naturally) ignore easier to dispose allow (so) waste not around as long ignore animals can eat it for 2 marks allow PLA is biodegradable and poly(ethene) is non-biodegradable	 1 1

Question 3 continues on the next page

SCA2HP

Question 3 continued

question	answers	extra information	mark
3(c)(ii)	PLA from renewable resource / doesn't use up finite resources	ignore global warming ignore references to waste disposal eg burning ignore recycling ignore cost accept poly(ethene) is made from oil / non-renewable resource allow cornstarch / it is renewable / can be grown	1
3(c)(iii)	any **one** from: • needs (large amount of) land • destruction of the rainforest • less crops grown for food • food prices may increase • takes time to grow (cornstarch)	ignore properties accept deforestation allow may need to import food allow won't grow all year ignore cost	1
Total			**8**

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Question 4

question	answers	extra information	mark
4(a)(i)	oxygen	allow O_2 must have uppercase O and subscript 2 ignore O	1
4(a)(ii)	20 (cm^3)	allow 18–22 (cm^3)	1
4(a)(iii)	copper + oxygen → copper oxide	ignore any attempts at balancing words take precedence reactants in either order ignore di, tri etc allow Cu for Copper allow O_2 for Oxygen allow CuO for copper oxide	1
4(b)(i)	nitrogen	allow N_2 must have uppercase N and subscript 2 ignore N	1
4(b)(ii)	any **one** from: • carbon dioxide • argon • water vapour	 allow CO_2 must have uppercase letters and subscript 2 accept named noble gas or correct symbol allow Ar do **not** allow Ar_2 ignore steam allow nitrogen / N_2 if not given in 4b(i)	1
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)(i)	coal		1
5(a)(ii)	any **two** from: • tidal • wave • biofuel / biomass • solar • geothermal	ignore coal, oil, natural gas, nuclear, hydroelectricity and wind allow waste incineration / burning allow named biomass eg wood ignore Sun ignore water	2

5(b) 6

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 brief description of an advantage of the chosen energy resource **or** a disadvantage of the rejected energy resource has been given. There is little scientific terminology used.	A clear description of either advantages **and / or** disadvantages have been described. Some scientific terminology is used.	A detailed description of advantages of the chosen energy resource **and** disadvantages for the rejected energy resource have been described. Scientific terminology is used accurately.

Question 5 continues on the next page

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Question 5 continued

question	answer	extra information	mark
	physics responses **nuclear:** **advantage**: • large amount of energy released (per kg of fuel) • large fuel reserves • reliable electricity supply **disadvantage**: • radioactive waste • waste remains radioactive for many years • waste has to be stored (for many years) • non-renewable • high decommissioning cost • high commissioning cost • long time needed to build • long start-up time • risk of meltdown / large scale disaster • (fuel) has to be mined	ignore circling of nuclear / wind ignore references to any other energy resources allow there is a lot of uranium (in the ground) allow waste is harmful / dangerous ignore nuclear waste accept waste has a long half-life allow dangerous / harmful for radioactive allow difficult to dispose of allow unsustainable or will (eventually) run out allow cost more to build allow named disaster eg Chernobyl, Fukushima, Japan ignore visual pollution / eyesore for both energy resources ignore air pollution / greenhouse gases / carbon dioxide for both energy resources ignore cost of electricity for both resources	

Question 5 continues on the next page

SCA2HP

Question 5 continued

question	answer	extra information	mark
		ignore the UK is very windy	
wind:			
advantage:			
• renewable		allow sustainable or won't run out	
• land still useable beneath turbines			
• no fuel cost			
• short start-up time			
• short time needed to build		allow wind is free	
• set up cost is lower			
disadvantage:			
• unreliable (wind / electricity)			
• very large number of turbines needed (1000s)			
• high set up cost (for many turbines)			
• connection to National Grid is difficult / expensive			
• (single turbine has) low output		allow kills birds allow noisy / noise pollution ignore causes headaches / migraines ignore visual pollution / eyesore for both energy resources ignore air pollution / greenhouse gases / carbon dioxide for both energy resources ignore cost of electricity for both resources	
Total			**9**

SCA2HP

Question 6

question	answers	extra information	mark
6(a)	any **three** from: • upright • virtual • laterally inverted • image is the same size as the object	allow description do **not** accept upside down ignore distance from object to mirror = distance from image to mirror ignore image is on the opposite side of the mirror to the object ignore colour of image	3
6(b)	reflection at first mirror (ray reflected down) reflection at second mirror (ray reflected left) a continuous ray entering pupil or would enter pupil if continued and straight lines (judged by eye)	if incorrect arrow(s) max 2 marks angle i = angle r (judged by eye) angle i = angle r (judged by eye)	 1 1 1
Total			**6**

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Question 7

question	answers	extra information	mark
7(a)		allow converse answers	
	more species / greater biodiversity at X	allow more invertebrates at X	1
	invertebrates that need high oxygen levels found there (and not at Y)	allow (more) sewage / more pollution at Y allow only invertebrates that can survive in low / medium-low oxygen levels at Y	1
	(therefore) more oxygen at point X	last point must be comparative **and** refer to oxygen	1
7(b)	temperature	accept any sensible factor eg pH, mineral content, pesticides, fertilisers allow carbon dioxide, sulfur dioxide, light (intensity) allow rainfall ignore (water) pollution / cleanliness / sewage, amount of water	1
7(c)	lichens	allow phonetic spelling	1
Total			**5**

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Question 8

question	answers	extra information	mark
8	conclusion with relevant explanation:	for microorganisms allow microbes, bacteria or fungi	
	<u>Conclusion</u>		1
	as temperature increases the rate of decay increases	may refer to A, B or both	
			1
	<u>Explanation</u>		
	(because) microorganisms / enzymes are more active in warmer conditions	allow microorganisms reproduce quicker	
	<u>Conclusion</u>		1
	(decay of) leaves from region B was affected more by temperature / increases more rapidly with temperature	accept description of this eg below 26-28 °C leaves from region B decay slower (than from region A), but above 26-28 °C leaves from region B decay faster (than from region A)	
	<u>Explanation</u>		1
	(because) there were different types of microorganisms on the leaves	allow (leaves from) different species of beech tree allow difference in water content of leaves ignore different levels of oxygen allow rate of decay of leaves from both regions the same at *26-28 °C* for **1** mark, if no other conclusions made if incorrect / incomplete conclusion ignore explanation	
Total			**4**

SCA2HP

Question 9

question	answers	extra information	mark
9(a)		allow genetic information for DNA	
	gene / DNA for poison	ignore characteristic	1
	is cut from bacterial DNA / chromosome	accept Bacillus thuringiensis / Bt accept plasmid	1
	using enzyme(s)		1
	and transferred to cotton plant cells / DNA / chromosome	allow genes ignore plasmid	1
9(b)	any **two** from: • gene (for poison) could be passed onto wild plants • toxin may kill other / useful insects • concern about effects on ecosystem / food chain • concern about adverse effects on gene pool of cotton plants	allow named insect eg bees allow example eg less variation ignore clones ignore references to humans or quality of cotton ignore damage soil ignore diseases	2
Total			**6**

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Question 10

question	answers	extra information	mark
10(a)	(two) layers of (vegetable oil and lemon juice)	ignore position of layers allow (oil and lemon juice) do not mix allow they separate	1
	(because vegetable) oils do not dissolve in water / lemon juice	accept have different densities unless this contradicts position of layers accept oil (molecule) is hydrophobic allow immiscible as long as do not mix is not given for first mark point	1
10(b)	any **two** from:		2
	• thicker	accept more viscous ignore density ignore more solid	
	• no layers	allow mix together or not separated	
	• texture		
	• coating ability		
	• appearance	allow colour	
10(c)	*(*molecules in*)* egg yolk act as emulsifiers	allow bind oil to water ignore bond oil to water ignore keeps mixture together	1
	(as the molecules) have a hydrophilic / head end which dissolves in / is attracted to water		1
	(and a) hydrophobic / tail end which dissolves in / is attracted to (vegetable) oil		1
Total			**7**

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Question 11

question	answers	extra information	mark
11(a)		ignore seafloor spreading and references to tectonic plates	
	the continents (of South America and Africa) fit together (like a jigsaw)		1
	there are similar fossils (in South America and Africa)	allow same species allow same rock (types)	1
11(b)	there are similar fossils (in South America and Africa)	allow same species ignore same rock (types)	1
11(c)		ignore all references to South America	
	(Glossopteris) fossil (also) found in Australia or Africa	allow found in different continents / countries	1
	(so) presence could have been explained by continents being joined		1
	no land bridge proposed between		1
	Antarctica and Australia / Africa		1
	(so) can't explain how fossils were in the three continents		
11(d)		ignore references to earthquakes / volcanoes	
	convection (currents)		1
	in the mantle	must relate to convection or magma rising	1
	(are) caused by: heat **or** radioactive processes **or** magma / molten rock rising	 ignore lava	1
Total			**10**

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Question 12

question	answers	extra information	mark
12(a)	(solar cells) no moving parts	no mark if wind turbines ignore references to damage / repairs	1
12(b)		allow converse answers allow reference to rising cost of non-renewables / national Grid electricity	
	the overall cost of generating electricity is lower than the cost of buying electricity **or**	ignore “electricity is free” unqualified	1
	electricity can be sold (to National Grid)	allow need to buy less electricity ignore produce own electricity	
12(c)(i)	3400(kWh)		1

Question 12 continues on the next page

SCA2HP

Question 12 continued

question	answers	extra information	mark
12(c)(ii)	ratio of cost to electricity generated:	accept ratios the other way round ratio of electricity generated to cost:	
	wind turbine = 1.47 (1500/1020)	wind turbine = 0.68 (1020/1500)	1
	solar cells = 5.29 (9000/1700)	solar cells = 0.19 (1700/9000)	1
	(therefore) wind turbine	only credit if an attempt at explanation given allow **2** marks for solar cells because they generate the most / more electricity or a bigger percentage **or** wind turbine as it is cheapest / cheaper (to install) **or** shorter payback time	1
Total			**6**

SCA2HP

Question 13

question	answers	extra information	mark
13(a)	X = wavelength		1
	Y= frequency		1
	wavelength in metres / m and frequency in hertz / Hz	both units correct for **1** mark (independent of first two marking points) correct units must match correctly named quantities allow Hertz allow multiples of the units eg kHz, km (or in words)	1
13(b)(i)	galaxy A is stationary (relative to Earth / us)		1
	galaxy B is moving towards (Earth / us)	allow 1 mark for identifying galaxies B and C are moving in opposite directions	1
	galaxy C is moving away from (Earth / us)		1
		allow **1** mark if say <u>all</u> moving away / towards **or** stationary	
13(b)(ii)	galaxy C is fast<u>er</u> (than galaxy B)	allow converse statement do **not** accept galaxy C <u>expanding</u> faster	1
13(b)(iii)	sample is too small	accept three is too few allow not enough evidence ignore inaccurate, invalid, anomalous	1
	compared to the size of the population	accept there are a very large number of galaxies in the Universe allow A, B and C are moving differently (from each other) for **1** mark	1
Total			**9**

UMS Conversion Calculator – http://web.aqa.org.uk/UMS/index.php