General Certificate of Secondary Education

Science A 4406

SCA2HP Unit 6

Mark Scheme

2012 examination – June series

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting 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 the standardisation meeting each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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.

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MARK SCHEME

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 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 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 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)

Student	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)

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, 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 8 students 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.

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.

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Question 1

question	answers	extra information	mark
1(a)	camouflaged in summer and winter / all year	allow matches background for (camouflage) all year	1
	(so) fewer eaten (by predators)	allow to avoid / hide from predators	1
	or		
	light coloured coat emits less energy / heat (than darker coat) (1)	accept converse argument but answer must be comparative do **not** accept darker coat absorbs more energy / heat (in summer)	
	(so helps) hare stays warmer in winter (1)		
1(b)	small(er) surface area	allow small(er) surface area : volume ratio do **not** accept small volume : SA **or** large SA : volume ignore references to being less visible	1
	(so) lose less energy / heat	allow retains / conserves more energy / heat ignore prevents / stops heat loss ignore keeps heat in ignore absolutes	1
Total			**4**

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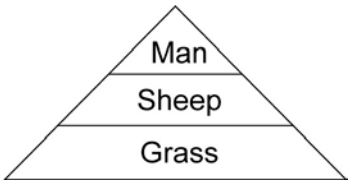
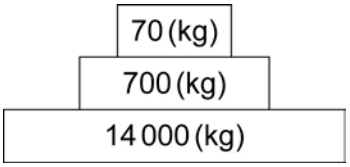
Question 2

question	answers	extra information	mark
2(a)		allow:  allow **1** mark for:  allow **1** mark for:  these are the only acceptable answers	2
2(b)	materials (lost in) wastes / faeces / urine / urea / carbon dioxide not all of the organism is eaten / digested	allow excretion ignore energy loss / heat / movement / growth only accept respiration if related to loss of carbon dioxide accept example eg bones / wool ignore references to size / numbers of organisms	1 1
Total			**4**

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Question 3

question	answers	extra information	mark
3			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 4 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 information	There is a basic description of either differences or explanations only.	There is a clear description of at least **one** difference with a correctly linked attempt at an explanation.	There is a clear and detailed description of at least **two** differences explained and correctly linked. Competition explained.

examples of the points made in the response	extra information
	allow converse statements for trees in forest
description of tree on its own: • is wider / bushier • has more leaves • is shorter • has leaves all over tree	allow (leaves / branches) spread out ignore trunks ignore size of leaves
explanation linked: • more space • more light • more nutrients	allow photosynthesise more ignore reference to being eaten is shorter cannot be linked with more nutrients ignore tree roots unless clearly linked to obtaining nutrients
competition mentioned: • for light • for nutrients • for space	ignore fight ignore water and carbon dioxide ignore evolution / natural selection / adapting

Total			6

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Question 4

question	answers	extra information	mark
4(a)	ethene + water $\rightarrow$ ethanol	ethene and water can be in either order accept steam instead of water accept C_2H_4 for ethene accept H_2O for water accept C_2H_5OH / C_2H_6O for ethanol if formula used letters must be uppercase and numbers must be subscript if name and formula given mark the name and ignore formula ignore balancing of formula do **not** accept ethane or ethanal	1
4(b)	plentiful supply of sugar (cane) **or** sugar (cane) grows there **or** Brazil has limited crude oil resources **or** so Brazil doesn't need to import crude oil	accept sugar (cane) is renewable accept fermentation is sustainable allow no for limited ignore all reference to cost ignore environmental reasons ignore doesn't use oil	1

Question 4 continues on the next page

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Question 4 continued

question	answers	extra information	mark
4(c)	any **two** from: (fermentation) • slow(er) process • a mixture of ethanol and water is formed **or** distillation is needed to obtain pure ethanol • batch process	 ignore takes a few days allow ethanol produced is not pure allow ethanol needs to be separated ignore (dilute) solution allow fermentation is not a continuous process ignore cost ignore pollution ignore reference to land use accept for **2** marks slower batch process	2
Total			**4**

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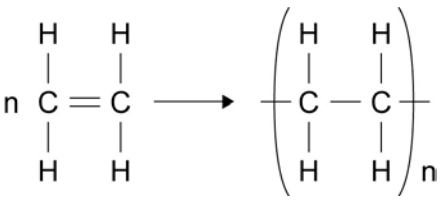
Question 5

question	answers	extra information	mark
5(a)	any **three** from: • (adding) compost increases water holding capacity • (adding) hydrogel increases water holding capacity • hydrogel is more effective than compost (at holding water) **or** smaller mass of hydrogel needed for same effect as compost • combination of compost and hydrogel gives the highest water holding capacity	allow for **1** mark adding compost and / or hydrogel increases water holding capacity ignore incorrect figures	3
5(b)	any **two** from: • double bond changes (to single bond) • many monomers / many small molecules • (monomers / molecules) bond / join together • to form long-chain / (very) large molecules	**idea of many or long-chain or very large needed for 2 marks** maximum **1** mark if cracking mentioned allow double bond opens / breaks allow combine accept for **2** marks displayed formulae written in equation to represent reaction 	2
Total			**5**

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Question 6

question	answers	extra information	mark
6(a)	any **three** from: • ammonia • methane • hydrogen • water vapour • carbon dioxide • carbon monoxide	if only formula given it must be correct accept NH_3 accept CH_4 allow ethane / butane / propane accept H_2 accept H_2O vapour / steam accept CO_2 accept CO allow oxygen / O_2 allow nitrogen / N_2 ignore nitrogen oxide ignore carbon	3
6(b)	(in atmosphere today) (much) less carbon dioxide / CO_2 more nitrogen / N_2 more oxygen / O_2 no ammonia / NH_3 or less methane / CH_4 or more argon / Ar or more noble gases	ignore references to water vapour allow converse allow carbon dioxide was the main gas (in Earth's early atmosphere) allow nitrogen is now the main gas (in the atmosphere today) **or** nitrogen is now 78–80% allow less ammonia / NH_3	 1 1 1 1

Question 6 continues on the next page

SCA2HP

Question 6 continued

question	answers	extra information	mark
6(c)	(fractional) distillation		1
	gases have different boiling points	allow gases condense at different temperatures ignore condensing points / levels ignore evaporating points / levels	1
Total			**9**

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Question 7

question	answers	extra information	mark
7(a)	any **two** similarities and any **two** differences **similarities** • (both can be) reflected • (both can be) refracted • (both can be) diffracted • (both) interfere • (both) transfer energy • (both exhibit) Doppler effect	read whole answer to ensure that there are no contradictory statements which negates that mark ignore reference to senses in similarities and differences allow both travel through any correctly named solid / gas / liquid ignore both are types of energy / waves / oscillations do **not** accept statements like both are transverse as a similarity	4

Question 7 continues on the next page

SCA2HP

Question 7 continued

question	answers	extra information	mark
7(a)	**differences** • light can travel through a vacuum **or** sound cannot travel through a vacuum	allow sound requires a medium / particles to travel through	
	• (different) speed / velocity		
	• one is longitudinal <u>and</u> one is transverse	accept light is faster than sound do **not** accept sound is transverse and light is longitudinal allow correct description: (longitudinal) the oscillations / vibrations are parallel to / same direction as (the direction of energy transfer) **and** (transverse) the oscillations / vibrations are 90° to / perpendicular to (the direction of energy transfer)	
	• sound is a mechanical wave / caused by vibrations <u>and</u> light is an electromagnetic wave	accept sound waves have a longer wavelength / lower frequency if no other marks gained allow **1** mark for any correct difference(s) where the waves are not specified eg one is transverse eg have different wavelengths / frequencies	

Question 7 continues on the next page

SCA2HP

Question 7 continued

question	answers	extra information	mark
7(b)(i)		working must be shown for **3** marks	
	4800 × 0.25		1
	1200(m/s)		1
	(liquid) C	ignore water / named liquid	1
7(b)(ii)	(yes / no)	ignore yes / no, marks are for the explanation	
	speed increases as density increases	allow positive correlation allow the more dense the liquid the less time (for sound to travel through) ignore they both increase ignore there was no pattern	1
	but, mercury should have a (much) greater speed given the higher density	allow mercury does not fit the pattern / is an anomaly	1
Total			**9**

SCA2HP

Question 8

question	answers	extra information	mark
8(a)	carbon dioxide (released from burning fossil fuels) is captured and stored	ignore carbon emissions / carbon ignore containers allow traps carbon dioxide	1
	in (old) gas / oil fields / underground / under the sea (bed) / rocks		1

Question 8 continues on the next page

SCA2HP

Question 8 continued

question	answers	extra information	mark
8(b)		unless answers state otherwise advantages and disadvantages relate to hydroelectric ignore answers that relate to the disadvantages of coal	
	advantages any **two** from: • renewable • can meet electricity demand quickly • pumped storage to store energy for later use • no air pollution / named gas eg sulfur dioxide / nitrogen oxides • no acid rain • no fuel needed / no fuel cost • does not cause global warming	allow idea of pumped storage to meet demand quickly allow short start-up time allow harmful gases ignore no carbon dioxide / greenhouse gases as an advantage ignore reference to running cost ignore can be used as a leisure area	4
	disadvantages any **two** from: • relies on rainfall / not as reliable (as coal) • destruction of wildlife habitats (during construction) • higher set-up cost	accept displacement of people ignore unsightly ignore large area needed	
Total			**6**

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Question 9

question	answers	extra information	mark
9		first **two** points must be comparative	
	quicker	ignore quick	1
	cheaper	ignore cheap	1
	get plants identical to parent plant **or** have same genes as parent plant	allow plants have known / desired characteristics ignore genetically similar to parent ignore produces clones unless qualified do **not** accept get the same plant	1
Total			**3**

SCA2HP

Question 10

question	answers	extra information	mark
10	reduces landfill	accept reduces pollution from burning wastes	1
	scheme self-financing **or** produces compost / fertiliser which can be sold	ignore less waste unqualified	1
	produces nutrients / fertiliser / minerals (ions) for plants	allow returns / recycles nutrients into soil ignore helps plants grow	1
Total			**3**

SCA2HP

Question 11

question	answers	extra information	mark
11		read 'the gas' or 'it' as carbon dioxide	
	(plants) photosynthesise		1
	(plants) absorb carbon dioxide / CO_2 (from the air)	allow take in / use carbon dioxide / CO_2 (from the air)	1
	(overall) more carbon dioxide / CO_2 is being released into the air than is being removed	allow 470 (billion tonnes) released **but / and** 450 (billion tonnes) taken in	1
	(by) respiration (by all organisms / any named organism)	ignore breathing ignore carbon	1
	(and) combustion / burning	ignore carbon	1
	(so) amount of carbon dioxide / CO_2 in air is increasing	allow 20 (billion tonnes) of carbon dioxide / CO_2 added to air each year	1
Total			**6**

SCA2HP

Question 12

question	answers	extra information	mark
12(a)	the birds now arrive earlier (in the UK)	must imply both species of birds	1
	the Sand martin (now) arrives before the Barn swallow **or** the Barn swallow (now) arrives later than the Sand martin **or** arrival time of the two birds has reversed		1
12(b)	any **two** from: • warmer in UK earlier (in year) **or** colder abroad earlier (in year)	allow too hot / cold abroad earlier (in year) ignore global warming	2
	• insects / food appears earlier (in year in UK) **or** shortage of insects / food abroad earlier (in year)	accept feasible reference to competition for food	
	• new genes / mutation	allow evolution / natural selection ignore adapted ignore pollution	
Total			**4**

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Question 13

question	answers	extra information	mark
13(a)(i)	(bromine water) is decolourised / changes (from orange) to colourless	allow brown / red-brown / orange-brown → colourless ignore clear / liquid ignore oil changes colour	1
13(a)(ii)	sunflower (oil) contains the most unsaturated fat	independent marking points allow more for most	1 1
13(a)(iii)	(yes / no) **pattern identified** as the percentage of saturated fat increases the smoke point decreases **or** as the percentage of unsaturated fat decreases the smoke point decreases **anomaly identified** soybean does not fit the pattern	yes / no does not gain mark pattern must be based on more than one substance allow smoking for smoke ignore references to boiling point allow sunflower oil does not fit pattern	 1 1
13(a)(iv)	sunflower (oil) as contains the most unsaturated fat / least saturated fat **or** soybean as has the highest smoke point	ignore more healthy option unless qualified allow more for most allow less for least allow can heat to the highest temperature allow higher for highest ignore boiling point	1

Question 13 continues on the next page

SCA2HP

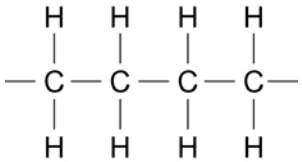
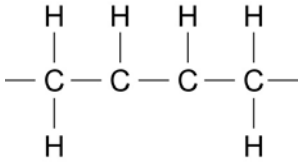
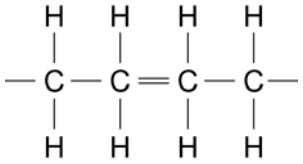
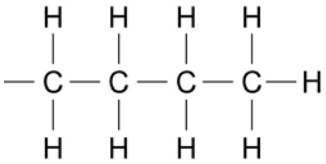
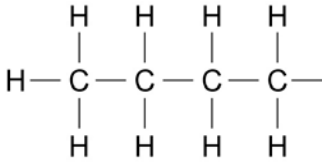
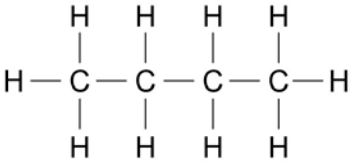
Question 13 continued

question	answers	extra information	mark
13(b)(i)	can be used as spreads / in cakes / in pastries	allow for margarine / in baking ignore shelf-life / forms a solid do **not** accept to make butter	1
13(b)(ii)	(react with) hydrogen	accept reference to hydrogenation	1
	heat to 60 °C	allow values from 50–120 °C	1
	nickel catalyst		1

Question 13 continues on the next page

SCA2HP

Question 13 continued

question	answers	extra information	mark
13(b)(iii)		no marks if number of carbon atoms is not 4 uppercase C and H ignore brackets allow **1** mark for any of the following:     do **not** accept: 	2
Total			**12**

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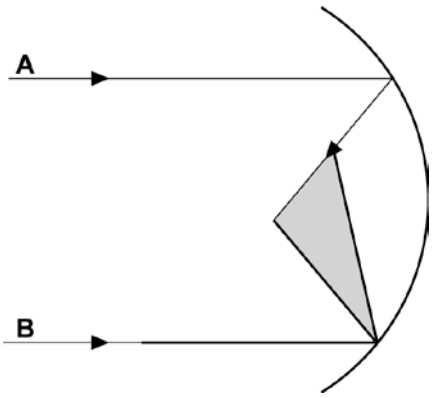
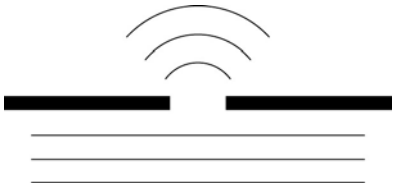
Question 14

question	answers	extra information	mark
14(a)	microwaves can travel through the atmosphere / ionosphere **or** radio waves cannot (escape from the atmosphere)	accept 'they' as referring to microwaves accept not reflected by ionosphere allow cannot penetrate / travel through ignore frequency / wavelength ignore reference to speed of waves	1
14(b)(i)	straight continuous lines drawn to show microwave B reflected by satellite dish	reflected ray should be within limits of grey area  	1
14(b)(ii)	receiver drawn using rectangle symbol where microwaves A and B meet / cross over	allow ecf from (b)(i) if (b)(i) not attempted no marks can be awarded for (b)(ii) if lines do not meet / cross over allow receiver where extended lines would meet allow any clear indication where receiver should be	1

Question 14 continues on the next page

SCA2HP

Question 14 continued

question	answers	extra information	mark
14(c)	**description** spreading of waves	allow curving with reference to after gap ignore bending / change direction	1
	as they pass through a gap / past an obstacle		1
		allow for **2** marks: 	
	explanation the wavelength is (much) bigger than the holes in the mesh	ignore too big to fit through gap ignore can't pass through gap	1
	(significant) diffraction occurs when the holes are the same size as the wavelength		1
Total			**7**

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Question 15

question	answers	extra information	mark
15(a)	Doppler (effect / shift)	do **not** allow red shift do **not** allow blue shift	1
15(b)(i)	shorter / decreased	allow smaller allow radar gun wavelength is longer ignore reference to speed / frequency ignore closer together	1
15(b)(ii)	the same / 300 000 000 (m/s)	accept 3×10^8 (m/s) accept 300 000 km/s	1

Question 15 continues on the next page

SCA2HP

Question 15 continued

question	answers	extra information	mark
15(c)(i)	(speed =) 80 (km/hour) so speeding **or** 10 (km/hour) above speed limit	if answer '**not** speeding' = 0 marks implication that the car is speeding needed to gain **2** marks	2
	or change in frequency 3.5 kHz at 70 km/hour (1) (observed change in frequency =) 4 (kHz) so speeding / 80 km/hour (1)	if no reference to speeding allow **1** mark for 80 (km/hour) if say speeding and 4(kHz) and 80 (km/hour) shown on graph = **2** marks if no reference to speeding 4(kHz) and 80 (km/hour) shown on graph = **1** mark	
15(c)(ii)	40 (km/hour)	accept (observed change in frequency =) (−)2 (kHz) for **1** mark	2
	away from (police officer / radar gun) **or** in opposite direction to other car	allow reversing	1
Total			**8**

UMS Conversion Calculator www.aqa.org.uk/umsconversion