



General Certificate of Secondary Education

Science A 4406

SCA1HP Unit 5

Mark Scheme

2012 Examination – January 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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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 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	Pluto, Mars, Moon	1
2	Pluto, 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 3 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) E clip with 1(b)	shaded grows longer / faster / more	ignore grows better allow correct figures	1
1(b) E clip with 1(a)	(more) auxin / hormone on shaded side so stimulates (more) growth on shaded side / cells elongate more on shaded side	accept auxin / hormone moves to shaded side accept auxin / hormone destroyed by light do not accept auxin / hormone killed OWTTE	1 1
1(c) E	<u>w</u> eed killer rooting powder / cuttings	ignore pests accept effect on fruit <u>ripening</u> / <u>setting</u> ignore increased growth / fruit growth ignore increased yield do not accept fertiliser	1 1
Total			5

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Question 2

question	answers	extra information	mark
2(a) G	FSH LH	allow lower case answers can be in either order accept follicle stimulating hormone ignore FHS accept luteinising hormone do not accept oestrogen / progesterone	1 1
2(b)(i) E	the older the woman, the less successful the treatment	OWTTE relationship needed to obtain mark	1
2(b)(ii) E	(many) embryos die / destroyed / do not survive	answer must relate to data in table allow low success rate / often does not work allow could lead to multiple births ignore older women should not have babies ignore not natural / finance ignore religion / 'against God's will'	1
Total			4

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Question 3

question	answers	extra information	mark
3 E			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 content	There is a brief description of the evidence for or against the newspaper's claim, including either evidence for or evidence against.	There is a description of some of the evidence for and evidence against the newspaper's claim, with at least one example of evidence for and one example of evidence against. There is an attempt at a conclusion.	There is a clear and detailed description of the evidence for and evidence against the newspaper's claim, with at least one example for and at least two examples against. A reasoned conclusion is given. The description must include reference to polyphenols.

Question 3 continues on the next page . . .

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Question 3 continued . . .

question	answers	extra information	mark
	<p>examples of the points made in the response</p> <p>Evidence supporting the newspaper claim:</p> <ul style="list-style-type: none"> • the study included a control group / one group given a placebo • all participants ate the same amount of chocolate each day • results showed a decrease in total cholesterol / an increase in ‘good’ cholesterol / a decrease in ‘bad’ cholesterol in the group that ate the dark chocolate <p>Evidence against the newspaper claim:</p> <ul style="list-style-type: none"> • no results given for (dark) chocolate without polyphenols • only type 2 diabetes patients tested • small sample tested / only 12 tested • unequal numbers of males and females • other health issues / age not controlled • rest of diet not controlled • chocolate contains high levels of fat / sugar / could cause other health issues eg weight gain • long term effects not known / trial only 16 weeks <p>Argued conclusion made with an attempted justification</p>	<p>extra information</p> <p>allow (dark) chocolate worked / reduced (risk of) heart disease</p>	
Total			6

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Question 4

question	answers	extra information	mark
4(a) G	11.35	only acceptable answer	1
4(b) E	increases (tensile) strength	allow stronger	1
	decreases melting point	allow mp	1
	decreases density	ignore figures	1
4(c) E	(joint / solder) stronger or lower working temperature / so lead pipes do not melt	allow firmer / more solid ignore lower melting point unqualified ignore references to poison / weight	1
Total			5

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Question 5

question	answers	extra information	mark
5(a) E	helps to distribute energy throughout beaker	allow heat / thermal energy allow keeps all water at same temperature	1
	all of oil (in tube) more likely to be at same temperature / oil likely to be at same temperature as thermometer		1
5(b)(i) E	any two from: <ul style="list-style-type: none"> • ball falls faster in A than in B • A has a lower viscosity than B • increasing the temperature decreases the viscosity / increases the speed of the ball • increasing temperature has a greater effect on the viscosity of A than B 	allow descriptions of viscosity eg A is thinner ignore lighter / heavier ignore references to density ignore reference to size of molecules	2
5(b)(ii) E	B has a longer chain than A / B has more carbon atoms than A	allow they have different numbers of carbon atoms / chain lengths / size of molecules	1
Total			5

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Question 6

question	answers	extra information	mark
6(a)(i) E	carbon is more reactive than iron / higher in reactivity series	accept carbon displaces / replaces iron 'it' = carbon	1
	therefore can reduce (iron oxide) / reduction reaction occurs	accept therefore removes oxygen from iron (oxide) ignore carbon displaces oxygen ignore carbon reacts with oxygen do not accept iron reacts with carbon	1
6(a)(ii) G	left hand side correct: $2\text{Fe}_2\text{O}_3 + 3\text{C}$	accept as correct if all numbers multiplied by same number eg	1
	right hand side correct: $4\text{Fe} + 3\text{CO}_2$	$4\text{Fe}_2\text{O}_3 + 6\text{C} \rightarrow 8\text{Fe} + 6\text{CO}_2$	1

Question 6 continues on the next page . . .

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Question 6 continued . . .

question	answers	extra information	mark
<p>6(b) E</p>	<p>(phytomining) any two from:</p> <ul style="list-style-type: none"> • less atmospheric pollution / named pollutant eg sulfur dioxide • phytomining (more) carbon neutral / less global warming • phytomining helps clean polluted sites • plants are a renewable (resource) • uses less energy / fuel 	<p>allow harmful gases / fumes / smoke / metal particles</p> <p>ignore less waste ignore no pollution ignore carbon dioxide for this marking point</p> <p>allow phytomining produces <u>less</u> carbon dioxide / greenhouse gases or smelting produces large amounts of carbon dioxide / greenhouse gases</p>	<p>2</p>
<p>Total</p>			<p>6</p>

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Question 7

question	answers	extra information	mark
7(a) E	highest <u>proportion</u> / <u>percentage</u> of (input) energy wasted	NB this answer gains 2 marks allow higher / greater allow ratio accept for 1 mark lots of energy wasted or allow for 1 mark wastes most energy	2
7(b) E	10% (or 0.1 if % sign crossed out)	efficiency = $\frac{\text{useful energy out}}{\text{total energy in}} \times 100\%$ allow 1 mark for the correct substitution into the correct equation eg $(5/50) \times 100$ or $(1/10) \times 100$ allow 1 mark if 0.1 is given as the answer, but % sign is still present	2
7(c) E	heats it (the surroundings) or increases the temperature	allow given off as heat ignore global warming	1
7(d) E	<u>lowest</u> energy input / needed / used	allow input only 2 J	1

Question 7 continues on the next page . . .

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Question 7 continued . . .

question	answers	extra information	mark
7(e)(i) E	filament (bulb)	allow 1 mark for filament bulb being chosen provided a reason is given (reason may be incorrect, but sensible eg cheapest)	1
	lifespan is <u>longest</u> for the purchase cost	this mark only scores if the first mark is given accept cost per hour is least / hours per £ is most accept relevant calculation	1
7(e)(ii) E	<u>longest</u> lifespan	allow lasts 25 000 hours do not accept most cost-effective	1
Total			9

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Question 8

question	answers	extra information	mark
8(a) E	water filled heater		1
	highest power / highest amount of watts / most energy transferred <u>per second</u>	only scores if first marking point correct allow most powerful ignore input ignore heat	1
8(b)(i) E	how effective / good a material is as an insulator / at keeping energy in	allow heat accept the lower the U-value the better insulator accept <u>rate</u> of energy / heat transfer	1
8(b)(ii) A	low		1
8(b)(iii) E	any two from: <ul style="list-style-type: none"> temperature outside temperature inside size / surface area of house <u>amount</u> of (loft / cavity) insulation double versus single glazing or thickness of glazing constructional detail eg number of windows 	allow number of heaters ignore colour ignore type of insulation allow presence of draught excluders or not ignore double glazing unqualified	2
Total			6

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Question 9

question	answers	extra information	mark
9(a) E	dead / inactive form of pathogen / microorganism / bacterium / virus	ignore disease (for organism) ignore toxins / antibodies	1
9(b)(i) E clip with 9(b)(ii)	any three from: (after exposure): <ul style="list-style-type: none"> greater number of antibodies produced / higher concentration antibodies stay (in higher concentration) for longer antibodies produced quicker quantitative, eg 9 times higher / 0.8 to 7.2 	scores 2 marks for increased to 9 times higher / from 0.8 to 7.2	3
9(b)(ii) E clip with 9(b)(i)	white cells have had previous exposure to pathogen / recognise pathogen on re-entry / familiar with pathogen / reference to memory cells <u>therefore</u> antibodies produced (more) rapidly	allow lymphocytes / leucocytes do not accept phagocytes / macrophage ignore knows how to kill pathogen ignore live pathogen introduced on exposure this marking point dependent on previous marking point	1 1 1
Total			7

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Question 10

question	answers	extra information	mark
<p>10(a)(i) E clip with 10(a)(ii) & 10(a)(iii)</p>	<p>stimulants</p> <p>or (anabolic) steroids</p>	<p>accept a named stimulant eg caffeine accept speed / amphetamine</p> <p>do not accept stimulus / stimuli</p> <p>accept named anabolic steroid eg testosterone / nandrolone / growth hormone</p> <p>accept beta blockers</p>	1
<p>10(a)(ii) E clip with 10(a)(i) & 10(a)(iii)</p>	<p>(stimulant) boosts bodily functions / metabolic rate / heart rate / nervous (system)</p> <p>or (anabolic steroid) stimulates <u>muscle growth</u></p> <p>or (beta blockers) decreases heart rate</p>	<p>effect must link to correct type of drug named in (a)(i)</p> <p>allow body building</p> <p>ignore body stronger / more energy / more endurance</p>	1

Question 10 continues on the next page . . .

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Question 10 continued . . .

question	answers	extra information	mark
<p>10(a)(iii) E clip with 10(a)(i) & 10(a)(ii)</p>	<p>(stimulant) to improve concentration / transport food or oxygen to muscles faster / more energy / faster reaction time or (anabolic steroid) to make athlete stronger / faster / more powerful / improve endurance or (beta blocker) calming effect improves accuracy</p>	<p>explanation must link to effect described in (a)(ii) only allow increased blood flow ignore mental effects</p>	<p>1</p>
<p>10(b) E</p>	<p><u>for</u> any one from:</p> <ul style="list-style-type: none"> • makes all competitors equal / fairer • saves money on testing • avoids unfair penalties for athletes who accidentally take a banned substance <p><u>against</u> any one from:</p> <ul style="list-style-type: none"> • competitions no longer based on human ability • health risks / risk of addiction / overdose / side-effects • favours wealthy athletes / countries • not all athletes would <u>want</u> / be able to take drugs • unfair advantage qualified 	<p>allow makes more competitive ignore improves performance / better world records ignore more exciting ignore unethical unless qualified ignore some might take more than other</p>	<p>1 1</p>
<p>Total</p>			<p>5</p>

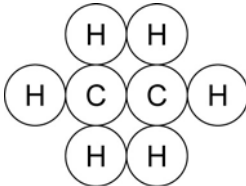
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Question 11

question	answers	extra information	mark
11(a) G	X – relay (neurone) Y – motor (neurone)	both required for mark must be in correct order	1
11(b) E	chemical (released from X) (crosses) <u>synapse</u>	do not accept electrical impulse accept chemical messenger / transmitter accept neurotransmitter accept named transmitter substance eg acetylcholine allow for 2 marks diffusion of the chemical across the synapse	1 1
Total			3

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Question 12

question	answers	extra information	mark
12(a) E	they have different boiling points	allow evaporate at different temperatures	1
	and will therefore condense at different temperatures (after evaporation)	ignore different melting points allow smaller molecules or molecules with lower boiling points will condense at top of column where cooler	1
12(b) G	C_nH_{2n+2}	C and H must be upper case allow n_{2+2} for $_{2n+2}$ allow $H_{2n+2}C_n$	1
12(c) E	for 2 marks: $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	allow 1 mark for 6 hydrogen and 2 carbon atoms shown in an incorrect attempt at a displayed formula allow for 1 mark:  ignore C_2H_6 ignore circles drawn around symbols	2

Question 12 continues on the next page . . .

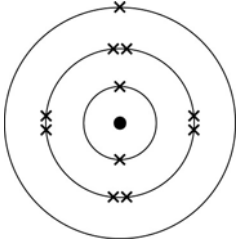
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Question 12 continued . . .

question	answers	extra information	mark
12(d) E	$2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$	<p>1 mark for correct formulae on left hand side</p> <p>1 mark for correct formulae on right hand side</p> <p>1 mark for correct balancing of correct symbol equation</p> <p>allow correct multiples for balancing</p> <p>allow for 2 marks: $\text{C}_4\text{H}_{10} + 13\text{O} \rightarrow 4\text{CO}_2 + 5\text{H}_2\text{O}$</p> <p>accept formulae in either order on each side</p>	3
Total			8

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Question 13

question	answers	extra information	mark
<p>13(a) E</p>		<p>1 mark for 11 electrons shown</p> <p>1 mark for 2:8:1 arrangement</p> <p>accept any symbol for electrons</p>	<p>1</p> <p>1</p>
<p>13(b) E</p>	<p>a sodium atom loses one electron</p> <p>to become sodium / positive ion(s)</p> <p>a chlorine atom gains one electron</p> <p>to become chloride / negative ion(s)</p>	<p>max 3 marks if reference to covalent bonding or sharing electrons</p> <p>do not accept gains 7 electrons</p> <p>do not accept loses 7 electrons</p> <p>allow 1 mark for sodium loses electrons <u>and</u> chlorine gains electrons</p> <p>allow chlorine ion</p> <p>for 2 marks accept: chlorine gains an electron from sodium or chlorine and sodium become ions</p> <p>if no other marks scored allow 2 marks for sodium loses electrons and chlorine gains electrons to form ionic bonds</p> <p>if no other marks scored allow 1 mark for: both sodium and chlorine get full outer shells or reference to ionic bonding</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>
<p>Total</p>			<p>6</p>

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Question 14

question	answers	extra information	mark
14(a) E	the larger the animal the smaller its surface area to volume ratio	ignore elephant has a large surface area if not qualified by correct reference to volume	1
	insufficient surface area from which to lose sufficient energy	if no other marks scored allow 1 mark for dark colour absorbs <u>more</u> energy / heat but do not accept dark colours attract heat	1
14(b) E	energy transferred from elephant to water or water heated by elephant	allow heat	1
	water evaporates	ignore effect of Sun	1
	more energetic (water) particles escape from the skin		1
	lowering average energy of the (water) particles		1
Total			6

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Question 15

question	answers	extra information	mark
15(a) E	conduction	allow iron is a good conductor	1
	<u>electrons</u> are delocalised / free to move	allow there are free electrons	1
	<u>electrons</u> gain (kinetic) energy	do not accept thermal / heat energy for this marking point	1
	<u>electrons</u> collide with ions / atoms / other electrons / particles or <u>electrons</u> transfer energy to ions / atoms / other electrons / particles	if no mention of electrons allow for 1 mark: increased vibration in atoms / ions / particles (in metal) or atoms / ions / particles (in metal) gain (kinetic) energy do not accept thermal / heat energy for this marking point	1
15(b)(i) E	as temperature difference increases, power output increases <u>at an increasing rate</u> / as temperature difference doubles, power output <u>more than doubles</u>		1
15(b)(ii) E	reduce the temperature difference (between air and water)	ignore turn power / heating down ignore insulation	1

Question 15 continues on the next page . . .

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Question 15 continued . . .

question	answers	extra information	mark
15(c) E	1000 J/kg °C	$E = m \times c \times \theta$ allow 2 marks for 1000 allow 1 mark for correct substitution and correct rearrangement of correct equation, eg $c = \frac{580\,000}{58 \times 10}$ give 1 mark for unit (allow J/kgK)	3
Total			9

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