



**General Certificate of Secondary
Education**

Science A 4406

SCA2FP 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.

SCA2FP**Question 1**

| question | answers | extra information | mark |
|-----------------|---|--|-------------|
| 1 | (thick fur) insulation / reduces energy loss | allow heat for energy allow traps warm air / keeps it warm | 1 |
| | (large feet) does not sink into <u>snow</u> . | allow to move on <u>snow</u> / <u>ice</u> allow for stability / balance allow for grip ignore to jump / run quickly | 1 |
| | (white fur) camouflage / not easily seen (by predators) | allow to blend with surroundings ignore disguise ignore to hide ignore references to prey / hunting | 1 |
| Total | | | 3 |

SCA2FP**Question 2**

| question | answers | extra information | mark |
|-----------------|---|--------------------------|-------------|
| 2(a) | They produce substances that help plants grow | | 1 |
| | They reduce landfill | | 1 |
| 2(b) | Plenty of oxygen | | 1 |
| | Warm conditions | | 1 |
| Total | | | 4 |

SCA2FP**Question 3**

| question | answers | extra information | mark |
|-----------------|-------------------|---|-------------|
| 3(a) | sexual | must be in correct order | 1 |
| | gametes | | 1 |
| | genes | | 1 |
| 3(b)(i) | clones | must be in correct order | 1 |
| | asexual | ignore twins / genetic engineering | 1 |
| 3(b)(ii) | (take) cutting(s) | accept any correct alternative eg splitting bulbs ignore tissue culture / cloning | 1 |
| Total | | | 6 |

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Question 4

| question | answers | extra information | mark |
|--------------|---|--|----------|
| 4(a)(i) | photosynthesis | allow phonetic spellings | 1 |
| 4(a)(ii) | respiration | allow phonetic spellings ignore breathing / decay | 1 |
| 4(b) | <p>any two from:</p> <ul style="list-style-type: none"> • burn / use less fossil fuels or reduce industrial processes or use cars less • reduce deforestation or plant more trees • use alternative sources of energy • trap CO₂ in sedimentary rocks / underground / under sea or carbon capture / CCS • rear less cattle / animals | <p>allow cycle / use buses / walk / trains / public transport</p> <p>allow stop for reduce in all cases</p> <p>accept named example</p> <p>allow plants</p> <p>accept solar / wind / nuclear / hydroelectric / wave / tidal / geothermal</p> <p>ignore renewable / biomass</p> <p>allow eat less meat allow <u>reduce</u> growth of human population</p> <p>ignore reduce the human population</p> | 2 |
| Total | | | 4 |

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Question 5

| question | answers | extra information | mark |
|---------------------|---|--|-----------------|
| <p>5(a)</p> | <p>Both birds arrive earlier to the UK than they used to</p> | <p>extra ticks negate mark</p> | <p>1</p> |
| | <p>After 1970 the order that the two birds arrive in the UK reversed</p> | | <p>1</p> |
| <p>5(b)</p> | <p>any one from:</p> <ul style="list-style-type: none"> • climate change • change in food availability • change in genes / mutation • change in predation (pressure) | <p>accept named climate change eg global warming / dimming</p> <p>allow change in temperature qualified</p> <p>ignore change in weather</p> <p>ignore availability of plants</p> <p>allow birds evolving / natural selection</p> <p>ignore adapted</p> | <p>1</p> |
| <p>Total</p> | | | <p>3</p> |

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Question 6

| question | answers | extra information | mark |
|----------|--|---|------|
| 6(a) | seeds | | 1 |
| 6(b) | pressing | allow squeezing / compressed ignore crushing / filtering / adding water | 1 |
| | (oil does not) dissolve / mix (in water) | accept correct reference to hydrophobic / immiscible ignore density | 1 |
| | is <u>less</u> dense (than water) | allow lighter (than water) allow oil <u>floats</u> (on water) allow oil does not dissolve / mix in water for third marking point only if second marking point incorrect ignore oil thicker than water | 1 |
| 6(c) | orange | colour change must be in correct order | 1 |
| | colourless | | 1 |
| 6(d)(i) | 15 | correct answer with or without working = 2 marks if answer is incorrect allow $\frac{14 + 15 + 16}{3}$ or $\frac{45}{3}$ or 17 for 1 mark | 2 |

Question 6 continues on the next page

SCA2FP**Question 6 continued**

| question | answers | extra information | mark |
|------------------|--|---|-------------|
| 6(d)(ii) | sunflower | independent marking points if answer to part (d)(i) is greater than 25 allow rapeseed and do not accept sunflower | 1 |
| | highest volume of bromine water added | allow mean of 25(cm ³) allow highest number / mean | 1 |
| 6(d)(iii) | would not be able to see the bromine colour change | allow because bromine water is orange / similar colour allow the oil is too dark do not accept colour would not change | 1 |
| Total | | | 11 |

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Question 7

| question | answers | extra information | mark |
|--------------|---|---|-----------|
| 7(a)(i) | water <u>v</u> <u>a</u> <u>p</u> <u>o</u> <u>u</u> <u>r</u> | allow steam | 1 |
| | condensed | allow <u>c</u> <u>o</u> <u>o</u> <u>l</u> <u>e</u> <u>d</u> to form a liquid / water second marking point can only be awarded if first marking point correct | 1 |
| 7(a)(ii) | carbon dioxide | allow CO ₂ C and O must be upper case numbers in formulae must be subscript do not accept carbon (mon)oxide / CO | 1 |
| 7(a)(iii) | ammonia | | 1 |
| | methane | | 1 |
| 7(b) | nitrogen | | 1 |
| | oxygen | | 1 |
| 7(c)(i) | combustion | | 1 |
| 7(c)(ii) | in calcium carbonate | | 1 |
| | in fossil fuels | | 1 |
| Total | | | 10 |

SCA2FP**Question 8**

| question | answers | extra information | mark |
|------------------|-------------------------------------|--|-------------|
| 8(a)(i) | radio (waves) | | 1 |
| 8(a)(ii) | gamma (rays) | accept γ do not accept α | 1 |
| 8(a)(iii) | X-rays or gamma (rays) | accept γ do not accept α | 1 |
| 8(b)(i) | 2 | | 1 |
| 8(b)(ii) | 4(cm) | | 1 |
| 8(b)(iii) | 3(cm) | ignore + or – in front of 3(cm) | 1 |
| 8(b)(iv) | transverse | | 1 |
| Total | | | 7 |

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Question 9

| question | answers | extra information | mark |
|-----------|---|---|------------|
| 9(a)(i) | generator | | 1 |
| 9(a)(ii) | power line(s) or (power) <u>cab</u> le(s) | ignore National Grid do not accept electrical line allow electric / electrical / high voltage for power ignore wires do not accept electronic | 1 |
| 9(b) | voltage current | correct order only | 1 1 |
| 9(c)(i) | hydroelectric | | 1 |
| 9(c)(ii) | hydroelectric or wind (turbine) | allow solar / tidal / wave | 1 |
| 9(c)(iii) | nuclear | | 1 |

Question 9 continues on the next page

SCA2FP

Question 9 continued

| question | answers | extra information | mark |
|--------------|---|--|----------|
| 9(c)(iv) | any one advantage and any one disadvantage from the following: | | |
| | <p>advantages</p> <ul style="list-style-type: none"> renewable no fuel cost no fuel burnt no air pollution | <p>accept does not produce carbon dioxide / CO₂ / sulfur dioxide / SO₂</p> <p>accept does not cause global warming / acid rain</p> <p>do not accept high power output</p> | 1 |
| | <p>disadvantages</p> <ul style="list-style-type: none"> unreliable / not always windy visual pollution <p>• high set-up cost</p> <p>• many turbines needed</p> <p>• low (power) output</p> | <p>allow eyesore / ugly</p> <p>ignore destroys habitats / landscape</p> <p>ignore cost to run</p> <p>ignore start-up time</p> <p>allow kills birds</p> <p>allow noisy / sound pollution</p> | 1 |
| Total | | | 9 |

SCA2FP**Question 10**

| question | answers | extra information | mark |
|-------------------|----------------------------|--------------------------|-------------|
| 10(a)(i) | expanding | | 1 |
| 10(a)(ii) | a very small point | | 1 |
| 10(b)(i) | moving towards the Earth | | 1 |
| 10(b)(ii) | moving away from the Earth | | 1 |
| 10(b)(iii) | moving faster than star B | | 1 |
| Total | | | 5 |

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Question 12

| question | answers | extra information | mark |
|---|--|--|---|
| 12 | | | 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 description of tree on its own: <ul style="list-style-type: none"> • is wider / bushier • has more leaves • is shorter • has leaves all over tree explanation linked: <ul style="list-style-type: none"> • more space • more light • more nutrients competition mentioned: <ul style="list-style-type: none"> • for light • for nutrients • for space | | extra information allow converse statements for trees in forest allow (leaves / branches) spread out ignore trunks ignore size of leaves allow photosynthesis more ignore reference to being eaten is shorter cannot be linked with more nutrients ignore tree roots unless clearly linked to obtaining nutrients ignore fight ignore water and carbon dioxide ignore evolution / natural selection / adapting | |
| Total | | | 6 |

SCA2FP

Question 13

| question | answers | extra information | mark |
|----------|--|---|------|
| 13(a) | ethene + water → ethanol | <p>ethene and water can be in either order</p> <p>accept steam instead of water</p> <p>accept C₂H₄ for ethene accept H₂O for water accept C₂H₅OH / C₂H₆O for ethanol</p> <p>if formula used letters must be uppercase and numbers must be subscript</p> <p>if name and formula given mark the name and ignore formula</p> <p>ignore balancing of formula</p> <p>do not accept ethane or ethanal</p> | 1 |
| 13(b) | <p>plentiful supply of sugar (cane)</p> <p>or</p> <p>sugar (cane) grows there</p> <p>or</p> <p>Brazil has limited crude oil resources</p> <p>or</p> <p>so Brazil doesn't need to import crude oil</p> | <p>accept sugar (cane) is renewable accept fermentation is sustainable</p> <p>allow no for limited</p> <p>ignore all reference to cost ignore environmental reasons ignore doesn't use oil</p> | 1 |

Question 13 continues on the next page

SCA2FP

Question 13 continued

| question | answers | extra information | mark |
|--------------|---|---|----------|
| 13(c) | any two from: (fermentation) <ul style="list-style-type: none"> • <u>s</u>low(er) process • a mixture of ethanol and water is formed <p>or</p> distillation is needed to obtain pure ethanol <ul style="list-style-type: none"> • 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 14

| question | answers | extra information | mark |
|--------------|--|---|----------|
| 14(a) | any three from: <ul style="list-style-type: none"> • (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 <ul style="list-style-type: none"> • 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 |
| 14(b) | any two from: <ul style="list-style-type: none"> • double bond changes (to single bond) • <u>many</u> monomers / <u>many</u> 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 $ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ n \text{ C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array} \longrightarrow \left(\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right)_n $ | 2 |
| Total | | | 5 |

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Question 15

| question | answers | extra information | mark |
|---------------------------|---|---|----------|
| <p>15(a) E</p> | <p>any two similarities and any two differences</p> <p>similarities</p> <ul style="list-style-type: none"> • (both can be) reflected • (both can be) refracted • (both can be) diffracted • (both) interfere • (both) <u>transfer</u> energy • (both exhibit) Doppler effect | <p>read whole answer to ensure that there are no contradictory statements which negates that mark</p> <p>ignore reference to senses in similarities and differences</p> <p>allow both travel through any correctly named solid / gas / liquid</p> <p>ignore both are types of energy / waves / oscillations</p> <p>do not accept statements like both are transverse as a similarity</p> | <p>4</p> |

Question 15 continues on the next page

SCA2FP

Question 15 continued

| question | answers | extra information | mark |
|----------|---|--|------|
| 15(a) | <p>differences</p> <ul style="list-style-type: none"> • light can travel through a vacuum or • sound cannot travel through a vacuum • (different) speed / velocity • one is longitudinal <u>and</u> one is transverse <ul style="list-style-type: none"> • sound is a mechanical wave / caused by vibrations <u>and</u> light is an electromagnetic wave | <p>allow sound requires a medium / particles to travel through</p> <p>accept light is faster than sound</p> <p>do not accept sound is transverse and light is longitudinal</p> <p>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)</p> <p>accept sound waves have a longer wavelength / lower frequency</p> <p>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</p> | |

Question 15 continues on the next page

SCA2FP**Question 15 continued**

| question | answers | extra information | mark |
|------------------|--|--|-------------|
| 15(b)(i) | 4800 × 0.25 | working must be shown for 3 marks | 1 |
| | 1200(m/s) | | 1 |
| | (liquid) C | ignore water / named liquid | 1 |
| 15(b)(ii) | (yes / no) | ignore yes / no, marks are for the explanation | 1 |
| | speed increases as density increases | allow positive correlation allow the more dense the liquid the less time (for sound to travel through) | |
| | but, mercury should have a (much) greater speed given the higher density | ignore they both increase ignore there was no pattern allow mercury does not fit the pattern / is an anomaly | 1 |
| Total | | | 9 |

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