



GCSE

Science A (Route 2)

SCA2FP

Final Mark scheme

4406

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Version/Stage: v1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

- 2.1** In a list of acceptable answers where more than one mark is available ‘any **two** from’ is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.
- 2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.
- 2.4** Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that ‘right + wrong = wrong’.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

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

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

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

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **13(a)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately
- The answer shows almost faultless spelling, punctuation and grammar.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	light chemical photosynthesis	answers in correct order only	1 1 1	AO1 B1.5.1a
1(b)(i)	any one from: <ul style="list-style-type: none"> • lettuces are eaten by slugs or energy is transferred from lettuces to slugs • slugs are eaten by hedgehogs or energy is transferred from slugs to hedgehogs • hedgehogs are eaten by foxes or energy is transferred from hedgehogs to foxes 	apply list principle accept: <ul style="list-style-type: none"> • lettuces are the producers • slugs are the primary consumers • hedgehogs are the secondary consumers • foxes are the tertiary consumers • hedgehog / fox is a predator • foxes are the top predators • slug is a herbivore • hedgehog / fox is a carnivore • hedgehog is the prey of the fox • slug is the prey of the hedgehog allow the flow / direction of energy / biomass transfer	1	AO2 B1.5.1a,b

1(b)(ii)	lettuce		1	AO2 B1.5.1b
1(b)(iii)	any one from: <ul style="list-style-type: none"> • (materials lost in) waste / faeces / urine / carbon dioxide • not all of an organism is eaten / digested 	ignore respiration unqualified allow sweat ignore water do not allow movement / heat loss	1	AO1 B1.5.1b,c
1(c)(i)	(sharp spines) to deter predators (strong back legs with long claws) to burrow / dig or to be able to run fast or to attack (small) animals (good sense of smell) to detect / locate prey / food		1 1 1	AO1, AO2 B1.4.1d,g
1(c)(ii)	any one from: <ul style="list-style-type: none"> • because there is little / no food available • to conserve energy 	ignore because it is cold	1	AO3 B1.4.1a,g B1.4.2a,b
Total			10	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	human cell.		1	AO2, AO1 B1.7.2d
	an enzyme.		1	
	bacterial cell.		1	
2(a)(ii)	<p>any one from:</p> <ul style="list-style-type: none"> • pigs / animals do not need to be killed • more / larger amount of insulin can be produced • process is quicker • process is cheaper • some religions do not allow the use of animal products • less likely to cause an allergic reaction 	<p>allow <i>idea</i> of animal welfare</p> <p>ignore against God's will unqualified</p> <p>allow less likely to be rejected</p> <p>allow produces <u>human</u> insulin allow pig insulin is not identical to human insulin</p>	1	AO3 B1.7.2d,e
2(b)	The gene may be transferred into other plant species.		1	AO1, AO3 B1.7.2e,f
	The rice may be harmful when eaten.		1	
Total			6	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	(Charles) Darwin		1	AO1 B1.8.1a
3(b)(i)	any one from: <ul style="list-style-type: none"> a new form of a gene a (sudden) change in a gene 	allow a (sudden) change in DNA / chromosome / genetic material allow a change in the number of chromosomes	1	AO1 B1.8.1f
3(b)(ii)	any three from: <ul style="list-style-type: none"> (high levels of) pollution (pollution) made trees / bark dark-coloured light-coloured moths not camouflaged (from predators) or light-coloured moths easy to see (by predators) so light-coloured moths were eaten (by birds) or so light-coloured moths did not survive 	max 2 marks if imply moths decided to mutate / evolve accept reference to industry / factories / smoke / burning coal allow dark-coloured moths camouflaged (from predators) or dark-coloured moths not easy to see (by predators) allow so not many dark-coloured moths were eaten or so dark-coloured moths survived accept so dark-coloured moths could pass on their genes to their offspring	3	AO2 B1.8.1e
Total			5	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	In the first billion years of the Earth's existence.		1	AO1 C1.7.2b
4(b)(i) <i>View with Figure 4</i>	nitrogen drawn at 78	allow tolerance \pm half a square ignore shading / width of the bar	1	AO2 C1.7.2a,c
4(b)(ii)	dissolved in oceans locked up in rocks		1 1	AO1 C1.7.2g,h
4(c)	(the percentage of) <u>carbon dioxide</u> (in the atmosphere) is increasing change is non-linear	allow a description of a non-linear change from the graph	1 1	AO2 C1.7.2i
4(d)(i)	crust mantle	must be in this order	1 1	AO1 C1.7.1b
4(d)(ii)	earthquakes	ignore references to volcanoes allow mountain (formation) allow subduction allow tsunamis allow sea floor spreading	1	AO1 C1.7.1d
Total			9	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	C_3H_6		1	AO1 C1.5.1c
5(a)(ii)	(carbon-carbon) double bond	ignore alkene / unsaturated	1	AO1 C1.5.1c
5(a)(iii)	$\left(\begin{array}{cc} H & H \\ & \\ -C & -C- \\ & \\ H & CH_3 \end{array} \right)_n$		1	AO2 C1.5.2a
5(b)(i)	ethene	do not accept ethane ignore alkene	1	AO1 C1.5.2a
5(b)(ii)	<p>cornstarch is biodegradable</p> <p>(so) less landfill needed</p> <p>cornstarch is a renewable resource</p> <p>(as) made from plants</p>	<p>ignore references to cost</p> <p>allow poly(ethene) is not biodegradable</p> <p>allow fewer problems with waste disposal</p> <p>allow crude oil is non-renewable</p> <p>allow (so) conserves crude oil resources</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	AO1, AO3 C1.5.2c,d
5(c)(i)	mass of hydrogel used		1	AO3 C1.5.2b

5(c)(ii)	any two from: <ul style="list-style-type: none"> • distilled water is absorbed more quickly (than tap water) • hydrogels absorb less tap water (than distilled water) • as time increases more (distilled / tap) water absorbed • no water absorbed after 15 minutes • rate of absorption of (distilled / tap) water decreases • rate of absorption is highest initially 	allow more distilled water absorbed (than tap water)	2	AO3 C1.5.2b
5(c)(iii)	Do the investigation using urine.		1	AO3 C1.5.2b
Total			12	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	boiler	answers in correct order only	1	AO1 P1.4.1a
	turbine		1	
	generator		1	
6(b)	any two from: <ul style="list-style-type: none"> • wind (power) • solar (power) • tidal (power) • wave (power) • geothermal (energy) • biofuels 	do not allow nuclear ignore hydroelectric (power)	2	AO1 P1.4.1a,b, c,d
Total			5	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	Reflection Refraction Diffraction	answers in correct order only allow 1 mark for 1 or 2 correct answers	2	AO1 P1.5.1g
7(b)	Sound waves need particles to travel		1	AO1 P1.5.1c P1.5.3a
7(c)(i)	sound travels faster in solids (than in gases)		1	AO3 P1.5.3a
7(c)(ii) <i>Mark with (c)(iii)</i>	4000 (m/s)	allow for 1 mark correct substitution speed = 1600×2.5 provided no subsequent steps	2	AO2 P1.5.1j
7(c)(iii) <i>Mark with (c)(ii)</i>	wood (if answer to 7(c)(ii) is 4000 m/s)	no mark if 7(c)(ii) not attempted apply ecf from (c)(ii)	1	AO3 P1.5.3a
Total			7	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)(i)	50 000 (MW)		1	AO2 P1.4.1
8(a)(ii)	people wake up and start using electricity	allow any sensible example for the use of power	1	AO3 P1.4.1
8(a)(iii)	it has a short start up time	allow it starts quickly	1	AO2 P1.4.1b
8(b)	the demand would be lower	do not allow no energy needed allow less electricity needed allow the line would be lower	1	AO3 P1.4.1
	(because) less (electricity) is needed for heating / lighting	allow any sensible reason allow it is warmer in July allow 2 marks if the demand is higher alongside a suitable reason eg use of aircon / fans	1	
Total			5	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)(i)	They are moving away from the Earth		1	AO1 P1.5.4b
9(a)(ii)	(Galaxy) A it has the biggest red-shift	no marks if incorrect galaxy chosen allow it is the furthest away from Earth	1 1	AO2, AO3 P1.5.4b
9(b)	expanding		1	AO1 P1.5.4c
Total			4	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)	contains chromosomes (chromosomes carry) genes / genetic material	no marks if refer to atomic structure apply the list principle ignore references to numbers accept (chromosomes / genes made of) DNA	1 1	AO1 B1.7.1b
10(b)	any one from: • controls the (activities of the) cell • controls characteristics of the organism	ignore references to what is found in the nucleus accept determines protein / enzyme structure	1	AO1 B1.7.1b
Total			3	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11(a)	36 (%)	allow 1 mark for 9 squares counted allow 1 mark for a correct calculation using an incorrect number of squares	2	AO2 B1.4.2a,c
11(b)(i)	West side		1	AO3 B1.4.2a,c
11(b)(ii)	any one from: <ul style="list-style-type: none"> more lichen grows on red fir trees (than on white fir trees) more lichen on white fir trees (compared to red fir trees) only when bark faces north-east 	allow less lichen grows on white fir trees (than on red fir trees)	1	AO3 B1.4.2a,c
11(b)(iii)	any two from: <ul style="list-style-type: none"> sulfur dioxide wind direction humidity light intensity temperature 	allow acid rain allow air pollution allow time exposed to Sun / light ignore Sun / light / sunlight unqualified	2	AO1, AO2 B1.4.2a,c
Total			6	

Question 12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(a)(i)	steam (is produced)	allow water vapour (is produced)	1	AO1 C1.6.1a
12(a)(ii)	condensation	allow vapours are condensed	1	AO2 C1.6.1a
12(a)(iii)	oil / water form separate layers		1	AO2 C1.6.2a
12(b)	<u>pressing</u>	allow <u>crushing</u>	1	AO1 C1.6.1a
12(c)(i)	orange	allow brown	1	AO1 C1.5.1d C1.6.3a
12(c)(ii)	added tests 1, 3 and 4 together and divided by 3	allow added 25 + 26 + 24 and divided answer by 3 allow for 1 mark left out test 2 (as anomalous) or left out 14 (as anomalous) or added results together and divided by number of tests or added 25 + 14 + 26 + 24 and divided answer by 4	2	AO2 C1.5.1d C1.6.3a

12(c)(iii)	(C) used least amount of bromine water (so C) least unsaturated	ignore references to health	1	AO3 C1.6.3a
		ignore (C) most saturated allow alternative approach: A / B used more bromine water for 1 mark (so) A / B more unsaturated for 1 mark	1	
Total			9	

Question 13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13(a)			6	5 AO1 1 AO2 P1.4.2b,c
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.				
0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)	
No relevant points given.	At least one relevant statement made.	At least one relevant point made about the transformer(s) with at least one link to the purpose of the transformer.	Relevant points are made about the transformers with at least one link to the purpose of a transformer including a correct comment about either reducing energy loss or safety.	

examples of the points made in the response	extra information	
<ul style="list-style-type: none"> • transformers change the voltage • cables transmit electricity at (very) high voltages • (cables transmit electrical energy) over long distances to consumers • the voltage to the consumers is much lower than the voltage from the power station • the voltage to the consumers is much lower than the voltage in the cables <p><i>Transformer A:</i></p> <ul style="list-style-type: none"> • step-up transformer • voltage increased • current decreased (link) • to reduce the energy wasted (raising the temperature of the cables) (link) • which increases the efficiency of transmission (link) <p><i>Transformer B:</i></p> <ul style="list-style-type: none"> • step down transformer • voltage decreased • current increased (link) • to reduce the voltage to consumers to a safe level (link) 	<p>for full marks candidates should link low current to reduced energy losses</p> <p>maximum level 2 if any of these misconceptions are apparent in the answer:</p> <ul style="list-style-type: none"> • energy is created • energy / power is increased or decreased at a transformer • voltage is shared between consumers • energy is stored in transformers <p>ignore references to generating electricity</p> <p>allow power / energy for electricity</p> <p>ignore steps up the electricity</p> <p>allow to reduce energy losses ignore no energy is lost</p> <p>ignore steps down the electricity</p>	

<p>13(b)</p>	<p>any one from:</p> <ul style="list-style-type: none"> • no visual pollution • unlikely to be damaged by (severe) weather • lower shock hazard • less / no risk to aircraft 	<p>ignore references to cost / habitats / wildlife</p> <p>allow lower radiation hazard ignore risk to health unqualified</p> <p>allow require less maintenance</p>	<p>1</p>	<p>AO1 P1.4.2a</p>
<p>13(c)</p>	<p>compare the health of people living close to power lines with (the health of) those that do not with a sufficient sample size</p>	<p>allow comparison with control group</p> <p>allow an answer that indicates that a large number of people should be included</p> <p>alternative approach: measure the radiation levels coming from the cables for 1 mark</p> <p>compare the result with recommended safety levels for 1 mark</p>	<p>1</p> <p>1</p>	<p>AO2, AO3 P1.4.2a</p>
<p>Total</p>			<p>9</p>	