
GCSE

Science A (Route 2)

SCA1FP
Final Mark Scheme

4406
June 2017

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 **12(b)** 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)	Kidney		1	AO1 B1.2.2a
1(b)(i)	2300 (cm ³)		1	AO2 B1.2.2a
1(b)(ii)	Breath: no difference	allow correct figures allow 0 (cm ³) allow both lost 400 cm ³	1	AO2 B1.2.2a
	Sweat: more water lost (on a hot day)	allow more sweat lost (on a hot day) allow <u>only</u> 300 cm ³ lost on a cold day	1	
	Urine: less water lost (on a hot day)	allow less urine lost (on a hot day) allow lost 120 cm ³ more on a cold day	1	
1(b)(iii)	(more water in sweat on a hot day) to cool the body		1	AO1 B1.2.2a
Total			6	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.										
2(a)(i)	a stimulus		1	AO1 B1.2.1b										
2(a)(ii)	A (cell) membrane B cytoplasm		1 1	AO1 B1.2.1c										
2(a)(iii)	<table border="0" style="width: 100%;"> <thead> <tr> <th style="width: 30%;">Structure</th> <th style="width: 40%;">Description</th> </tr> </thead> <tbody> <tr> <td></td> <td style="text-align: center;">An electrical impulse</td> </tr> <tr> <td>Brain</td> <td style="text-align: center;">A muscle or a gland</td> </tr> <tr> <td>Effector</td> <td style="text-align: center;">A coordinator</td> </tr> <tr> <td>Synapse</td> <td style="text-align: center;">A gap between two neurones</td> </tr> </tbody> </table>	Structure	Description		An electrical impulse	Brain	A muscle or a gland	Effector	A coordinator	Synapse	A gap between two neurones	extra lines negate the mark	1 1 1	AO1 B1.2.1d,e
Structure	Description													
	An electrical impulse													
Brain	A muscle or a gland													
Effector	A coordinator													
Synapse	A gap between two neurones													
2(b)(i)	all three bars correctly plotted	allow tolerance of \pm half a square ignore width of bar allow 1 mark for one / two bars correctly plotted	2	AO2 B1.2.1b										
2(b)(ii)	<i>Part of body:</i> Fingertips <i>Reason:</i> to detect small details or to manipulate small things	no marks if incorrect part of body named allow example eg to be able to read Braille allow has many / more (touch) receptors	1 1	AO3 B1.2.1b										
Total			10											

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	phototropism		1	AO1 B1.2.3b
3(a)(ii)	gravitropism		1	AO1 B1.2.3b
3(b)	<p>any three from:</p> <ul style="list-style-type: none"> • use same sized area for each test • test all weed killers at the same concentration • use the same volume of weed killer • use a plot of land that has an even covering of dandelion plants <p>or</p> <ul style="list-style-type: none"> • set the investigation up using trays of dandelions • count the number of dandelions at the start • repeat the investigation and calculate a mean • use water on a control patch 	<p>do not allow use the same weed killer</p> <p>allow use manufacturers recommended concentration</p> <p>allow idea of same number of dandelions</p> <p>accept calculate a percentage reduction in dandelions</p> <p>allow <i>idea</i> of a control</p>	3	AO3 B1.2.3d
Total			5	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	any two from: <ul style="list-style-type: none"> • dust (pollution) • noise (pollution) • visual pollution • destruction of habitats • (increased) traffic • damages (local) tourist industry 	ignore pollution unqualified allow air pollution allow destroys landscape	2	AO3 C1.2.1a C1.3.1f
4(b)	3	allow calcium, carbon and oxygen	1	AO2 C1.1.1b
Total			3	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	$\frac{1950}{3000} \times 100$		1	AO2 C1.3.1j C1.3.3a
5(a)(ii)	Copper can be hammered into shape.		1	AO1 C1.3.3a,b
	Copper does not react with water.		1	
5(b)	Recycling uses less energy.		1	AO1 C1.3.1f,j
Total			4	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.												
6(a)	Titanium is corrosion resistant.		1	AO1 C1.3.3c												
6(b) <i>View with Table 2</i>	<table border="1"> <thead> <tr> <th>Symbol</th> <th>Name of element</th> <th>Percentage (%) of metal in alloy</th> </tr> </thead> <tbody> <tr> <td>V</td> <td>(Vanadium)</td> <td>(4)</td> </tr> <tr> <td>Al</td> <td>Aluminium</td> <td>6</td> </tr> <tr> <td>Ti</td> <td>Titanium</td> <td>90</td> </tr> </tbody> </table>	Symbol	Name of element	Percentage (%) of metal in alloy	V	(Vanadium)	(4)	Al	Aluminium	6	Ti	Titanium	90	<p>If no mark obtained, allow 1 mark for naming 2 elements correctly or correctly stating percentages as 6 % and 90 %</p>	1	AO2 C1.3.2c
	Symbol	Name of element	Percentage (%) of metal in alloy													
	V	(Vanadium)	(4)													
	Al	Aluminium	6													
Ti	Titanium	90														
	1															
	1															
6(c)	alloys are harder	<p>ignore references to cost</p> <p>allow alloys are stronger</p> <p>allow alloys are corrosion resistant</p>	1	AO1 C1.3.2c												
Total			4													

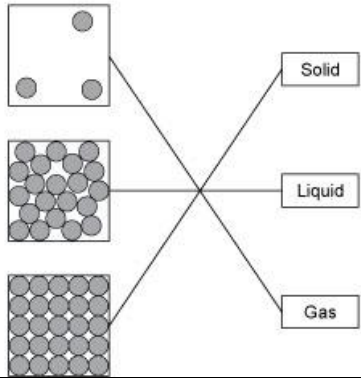
Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)(i)	decomposition		1	AO1 C1.2.1c
7(a)(ii)	22 (kg)		1	AO2 C1.1.3c
7(a)(iii)	limewater	no marks if incorrect solution named allow calcium hydroxide (solution)	1	AO1 C1.2.1e
	(limewater) turns cloudy	allow (limewater) turns milky allow a white precipitate is formed	1	
7(b)(i)	carbon dioxide		1	AO3 C1.3.1i
7(b)(ii)	any two from: <ul style="list-style-type: none"> • so magnesium can be recycled • so chlorine can be recycled • to conserve raw materials • to reduce waste 	ignore references to cost allow as magnesium is used in step 2 allow so magnesium can be reused (in process) allow as chlorine is used in step 1 allow so chlorine can be reused (in process)	2	AO3 C1.3.1i
Total			7	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.	
8(a) <i>View with Table 3</i>				AO2 C1.1.1e,f,g	
		Potassium	Argon		
	Mass number	(39)	(40)		
	Number of protons	(19)	(18)		
	Number of neutrons	(20)	22		1
	Number of electrons	19	(18)	1	
8(b)	protons		1	AO1 C1.1.1f	
Total			3		

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<p>9(a)</p>	<p>Arrangement of particles</p>  <p>State of matter</p> <p>Solid</p> <p>Liquid</p> <p>Gas</p>	<p>2 marks for 3 correct lines 1 mark for 1 or 2 correct lines</p> <p>additional lines negate the mark</p>	<p>2</p>	<p>AO1 P1.1.2a</p>
<p>9(b)</p>	<p>solid</p> <p>gas</p> <p>liquid</p> <p>gas</p>	<p>answers must be in the correct order</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>AO1 P1.1.2a,b</p>
<p>Total</p>			<p>6</p>	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)	change in temperature of the water		1	AO2 P1.1.3c
10(b)(i)	categoric		1	AO2 P1.1.3c
10(b)(ii)	C because it has the smallest temperature change	no mark if incorrect letter given allow least energy lost (by the water in 10 minutes) allow 'heat' for energy allow because the temperature change was <u>only</u> 4 °C	1 1	AO3 P1.1.3c
Total			4	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11(a)(i)	<i>advantages:</i> any one from: <ul style="list-style-type: none"> heats the room faster can be set to switch on / off at a certain time portable 	allow higher power rating ignore more powerful ignore more heat produced unless linked to time	1	AO3 P1.3.1b, c,d
	<i>disadvantages:</i> any one from: <ul style="list-style-type: none"> has <u>only</u> one temperature setting more risk of fire more expensive to run (for same amount of time) 	allow has fewer temperature settings allow has no overheat protection allow uses more energy (in a given time)	1	
11(a)(ii)	15 (kWh)	allow 1 mark for correct substitution 6×2.5 provided no subsequent steps	2	AO2 P1.3.1c
11(b)(i)	(kinetic) energy	ignore 'heat'	1	AO1 P1.1.3a
	less		1	
	rises		1	
	current		1	
11(b)(ii)	300 000	allow 1 mark for correct substitution $50 \times 1000 \times 6$ provided no subsequent steps	2	AO2, AO1 P1.1.4d
	joules		1	
Total			11	

Question 12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(a)	there are antibiotic resistant bacteria / pathogens / strains / fungi	do not allow reference to viruses do not allow bacteria / pathogens are immune ignore people are resistant / immune	1	AO1, AO2 B1.1.2h, i,k
	that a new antibiotic might kill	allow the new antibiotic may treat the pathogen ignore references to drug testing	1	

Question 12 continues on the next page

QWC Mark Scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(b)			6	4 AO1 2 AO2 B1.3.1a,b
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.				
0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)	
No relevant content.	A correctly described stage or reference to validity.	Some correctly described stages or a correctly described stage and reference(s) to validity.	Correctly described stages and references to obtaining valid results.	

<p>examples of the points made in the response</p> <p><i>Laboratory testing:</i></p> <ul style="list-style-type: none"> • test on cells / tissues / animals • to see if the drug is toxic / harmful • to test its efficacy • to determine a safe dose to be used in humans <p><i>(Phase 1 clinical testing):</i></p> <ul style="list-style-type: none"> • tested on (healthy) volunteers • low doses used • to test for side effects / toxicity / safety <p><i>(Phase 2 clinical testing):</i></p> <ul style="list-style-type: none"> • tested on patients • patients given placebo or drug (validity) • (double) blind trial (validity) • to test for side effects / toxicity / safety • to test its efficacy / effectiveness <p><i>(Phase 3 clinical testing):</i></p> <ul style="list-style-type: none"> • larger numbers of patients used (validity) • tested on target groups eg age / gender / pregnant • patients given placebo or drug (validity) • double blind trial (validity) • to verify efficacy / effectiveness • to determine correct dose 	<p>extra information</p> <p>credit each idea relating to validity only once</p> <p>allow to see if it is safe for use in humans allow to see if it works</p> <p>allow volunteers given placebo or drug allow blind trials</p> <p>allow description of (double) blind trial</p> <p>allow to see if it works</p> <p>allow description of double blind trial allow to verify that it works</p>			
<p>12(c)</p>	<p>to avoid bias</p>	<p>ignore references to validity / accuracy / safety</p>	<p>1</p>	<p>AO3 B1.3.1b</p>
<p>Total</p>			<p>9</p>	

Question 13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13(a)	neon	allow Ne	1	AO2 C1.1.1b,h
13(b)	unreactive (as) has a stable arrangement of electrons	allow (as) noble gas allow (as) in group 0 allow (as) has complete outer energy level (of electrons) allow (as) has complete outer shell (of electrons)	1 1	AO1, AO2 C1.1.1h C1.1.2b
Total			3	

Question 14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14(a)(i)	<p>any two gases and linked effects from:</p> <ul style="list-style-type: none"> • carbon dioxide • (causes) global warming <p>or</p> <ul style="list-style-type: none"> • oxides of nitrogen • (causes) acid rain <p>or</p> <ul style="list-style-type: none"> • sulfur dioxide • (causes) acid rain 	<p>the effect mark is dependent on correct gas</p> <p>allow CO₂ ignore greenhouse gas</p> <p>allow specified environmental effects eg rise in sea levels</p> <p>allow nitrogen monoxide or nitrogen dioxide allow NO / NO₂ / NO_x</p> <p>allow specified environmental effects</p> <p>allow SO₂</p> <p>allow specified environmental effects</p> <p>allow for 1 mark carbon monoxide / CO ignore particulates / soot but allow 1 mark for linked effect ignore methane but allow 1 mark for linked effect</p>	4	AO1 C1.4.3a, b,c
14(a)(ii)	<p>biofuels are a renewable resource</p>	<p>ignore references to cost / pollution</p> <p>do not allow can be reused</p> <p>allow biofuels do not produce sulfur dioxide</p> <p>allow biofuels are carbon neutral</p>	1	AO3 C1.4.3e
14(b)	sulfur		1	AO1 C1.4.3d
Total			6	

Question 15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
15(a)(i)	0.35 or 35 %	allow for 1 mark 35 without % or with a different unit or 0.35 with % or another unit or $\frac{7}{20}$ ($\times 100$)	2	AO2 P1.2.1d
15(a)(ii)	(energy is) transferred to the surroundings	do not allow causes global warming / pollution allow 'heat' is transferred to the surroundings 'heat' alone is insufficient	1	AO1 P1.2.1c
15(a)(iii)	(CHP) there is less wasted energy or more energy is transferred usefully	no mark for the power station mark is for the reason if the incorrect power station is chosen, no mark for the reason allow <u>only</u> 20 % of the energy is wasted allow fossil fuel power station wastes 65 % and CHP wastes 20 % allow because its efficiency is 80% / 0.8 allow energy is used to provide heating / hot water and electricity	1	AO2 P1.2.1d

15(b)(i)	(copper) is a better conductor (of energy)	allow (copper) is a good conductor (of energy) ignore (copper) is a good conductor of electricity ignore plastic could melt ignore references to reactivity / strength / flexibility	1	AO1 P1.1.3a
15(b)(ii)	<p><i>improvement:</i> longer pipe</p> <p><i>reason:</i> larger surface area</p> <p><i>improvement:</i> thinner copper (for the pipe)</p> <p><i>reason:</i> energy is transferred across a shorter distance</p> <p><i>improvement:</i> paint the pipe black</p> <p><i>reason:</i> black is a good emitter (of infrared radiation)</p>	any two correct improvements reason must be correctly linked to improvement ignore bigger / larger / wider pipe ignore thinner pipe allow greater rate of conduction allow less energy absorbed by the pipe allow black is a good absorber (of infrared radiation) allow use a metal that has a higher conductivity (than copper)	2 2	AO1 AO3 P1.1.1c P1.1.3c
Total			9	