GCSE

Science A (Route 2)

SCA2HP

Mark scheme

4406

June 2016

Version 1.0: Final Mark Scheme

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 <u>not</u> 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 **3(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)	(the) Sun	allow light (energy)	1	AO1 B1.5.1a
1(b)(i)	36 (kilograms)	answer line takes precedence if no answer on line, look at **Figure 1**	1	AO2 B1.5.1b
1(b)(ii)	any **one** from: • materials are lost in wastes / faeces • not all of the greenfly is eaten / digested (by the ladybird)	do **not** allow this mark if linked to energy accept lost as carbon dioxide allow excretion / urine ignore respiration ignore references to energy ignore references to size / numbers of organisms / reproduction ignore sweat / water	1	AO1 B1.5.1b,c
Total			**3**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	Chimpanzees **and** Bonobos	apply list principle in either order	1	AO2 B1.8.1d
2(a)(ii)	8 (million years ago)		1	AO2 B1.8.1d
2(b)(i)	any **one** from: • same number of toes / digits • same number of bones in toes • same arrangement of bones	allow 5 toes / digits	1	AO3 B1.8.1d
2(b)(ii)	any **one** from: • (human) does not swing through trees • (human) does not grasp branches • (humans) do not use tools with their feet • (human) puts more pressure on foot	allow converse for primates allow human to stand upright or to balance	1	AO3 B1.8.1d
Total			**4**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)			6	AO1, AO2 B1.4.1d,f
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.				

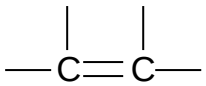
0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content	Adaptations are described **or** an adaptation with a linked explanation is given	Several adaptations with linked explanations are described	A detailed description of adaptations with linked explanations is given, **including** adaptation(s) other than simple ideas for reducing energy loss and / or for predation

examples of the points made in the response	**extra information**
adaptations related to reducing energy loss: • large body size – reduces energy loss • thick fur – for insulation • thick layer of fat / blubber – for insulation • small ears – to reduce energy loss	allow 'heat' for energy or radiation accept black skin - to absorb radiation accept white fur to reduce radiation
adaptations related to predation: • strong muscles –to attack (prey) • white fur – for camouflage • sharp / strong claws – to catch prey • forward facing eyes **or** good eyesight – to see prey • sharp / strong teeth – to catch prey	
other adaptations: • small surface area: volume ratio – reduces energy loss • thick layer of fat / blubber – as a store of energy • large feet – so they do not sink in snow **or** so they can walk on ice • webbed / large feet – to swim fast • strong muscles – to run / swim fast • sharp / strong claws – to dig in snow / ice • small eyes – to protect against snow **or** protect against glare from Sun • strong back / muscles to stand tall – to see prey **or** other polar bears	allow good sense of smell – to detect prey accept oily fur – to repel water accept hollow fur - for insulation

3(b)	higher temperature	for mp 2 and 3, need a comparator at least once	1	AO2, AO3 B1.4.2a,b
	(causes) ice to melt sooner **or** (causes) ice to form later	allow (so) less ice	1	
	(so polar bears have) a shorter hunting / feeding season	ignore less food	1	
Total			**9**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	6300 (J)	allow **1** mark for temperature change of 15 (°C) **or** allow **1** mark for an answer of 7980 (J) **or** 14280 (J) **or** allow ecf from an incorrect subtraction of 34 – 19 correctly calculated	2	AO2 C1.6.1b
4(a)(ii)	630 (kJ)	allow ecf from part **(a)(i)**	1	AO2 C1.6.1b
4(a)(iii)	any **two** from: • energy loss to the surroundings / apparatus • no lid on • did not stir water • oil contained impurities • only one reading taken • thermometer had low resolution • references to incomplete combustion	allow 'heat' for energy allow some water evaporated	2	AO3 C1.6.1b

4(b)	any **two** from • different flavour • potatoes cooked in oil contain more energy / nutrients • potatoes cook in oil at a higher temperature.	ignore references to shape / size / colour / texture / health allow converse for potatoes cooked in water allow potatoes cooked in oil have a higher fat content allow potatoes cooked in oil cook faster	2	AO1 C1.6.1c
4(c)			1	AO1 C1.5.1c,d C1.6.3a
4(d)	any **one** from: • to control energy intake • legal requirement • can make informed choice (of what to buy)		1	AO3 C1.6.1b
Total			**9**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	poly(ethene)	ignore LD / HD / LDPE allow polyethene allow polythene do **not** allow references to ethane	1	AO1 C1.5.2a
5(b)(i)	$(C_{10}H_{22} \rightarrow C_2H_4) + C_8H_{18}$	allow correct multiples	1	AO2 C1.5.1a,b
5(b)(ii)	fuel	ignore references to cracking	1	AO1 C1.5.1e
5(c)(i)	2 billion	accept 2 000 000 000	1	AO2 C1.5.2a,b
5(c)(ii)	any **two** from: • to prevent landfills filling up • to conserve oil stocks • (most) plastic bags are not biodegradable • to reduce litter • to reduce carbon dioxide emissions	ignore references to cost / production / recycling of plastic bags allow to encourage reuse of plastic bags	2	AO2, AO3 C1.5.2c
Total			**6**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	330 (m/s)	allow for **1** mark a correct substitution: speed = 250 × 1.32	2	AO2 P1.5.1j
6(b)		for **2** marks reason must be correctly linked to difference max **2** marks if no comparisons accept the converse for sound B		AO1, AO2 P1.5.3b
	sound A has a lower pitch		1	
	(because it) has a lower frequency	allow sound A has a longer wavelength	1	
	sound A is louder		1	
	(because it) has a bigger amplitude		1	
6(c)(i)	0.01 (s)		1	AO2 P1.5.3a
6(c)(ii)	any **two** from: • repeat the measurements **and** calculate a mean • use different distances • use a greater distance	do **not** allow a shorter distance allow a clear description of an electronic method	2	AO3 P1.5.3a
Total			**9**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)(i)	any **two** from: • they can travel through a vacuum • they are transverse waves • they all travel at the same speed (in a vacuum) • they can be reflected / refracted / diffracted	ignore uses **or** dangers of EMR accept they do not need particles to travel ignore can travel through air / space accept the oscillations / vibrations are perpendicular / 90° to the direction of energy transfer accept they travel at the speed of light / 300 000 km/s **or** 300 000 000 m/s (in a vacuum)	2	AO1 P1.5.1c,d
7(a)(ii)	wavelength frequency	must be in correct order allow energy	1 1	AO1 P1.5.1e,i
7(b)(i)	any **one** from: • phone company records will give more accurate time of use • people may give incorrect information about their phone use	allow people may not remember how much they use their phone allow they can gather (more) data more easily	1	AO3 P1.5.1k

7(b)(ii)	any **one** from: • study does not include people who do not use a mobile phone • people may develop brain cancer years after using mobile phone • there are other reasons for developing brain cancer	allow no control group allow sensible suggestions of factors that could also cause brain cancer	1	AO3 P1.5.1k
Total			**6**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)(i)	(freshwater) <u>invertebrates</u>	ignore fish ignore named invertebrates do **not** allow lichens / microorganisms	1	AO1 B1.4.2c
8(a)(ii)	sulfur dioxide	accept nitrogen oxide(s)	1	AO1 B1.4.2c
8(b)	44 / 43.8 / 43.75 (%)		1	AO2 B1.4.2a,b, c
8(c)(i)	scatter (graph) **or** scattergram		1	AO1 B1.4.2a,c
8(c)(ii)	any **one** from: • as the distance (from the power station) increases the percentage cover increases • the percentage cover increases more towards the south (of the power station)	allow percentage cover increases less towards the north (than towards the south) allow positive correlation for **both**	1	AO2 B1.4.2a,c
Total			**5**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9	any **four** from: • microorganisms / microbes / decomposers / bacteria / fungi • decompose / digest materials • (to) form simple / small chemicals / nutrients / ions / minerals • microorganisms respire • (microorganisms respire) and release carbon dioxide	ignore detritus feeders / detritivores eg worms / maggots allow decay / break down materials ignore references to other organisms respiring must be linked to respiration in microorganisms accept (microorganisms respire) to release water (vapour) ignore photosynthesis ignore references to fossil fuels / burning	4	AO1 B1.6.1a,b, c,d B1.6.2a
Total			**4**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)	environmental factors / conditions any example with its effect, eg: more light and plant grows more **or** more food and animals grow more **or** fight / accident can cause a scar		1 1	AO1, AO2 B1.7.1d
10(b)	any **three** from: *pros*: • disease process can be studied • (new) drugs can be tested • reduces tests on humans *cons*: • ethical issue(s) described regarding use of mice / animals (for experiments) • mice may react differently to cancer / drugs • justified conclusion	to gain full marks at least **one** pro and **one** con must be given allow may find the cause (of a disease) allow may provide cure (for a disease) ignore religious arguments unqualified allow some people object to using mice / animals allow cruel to mice	3	AO3 B1.7.1c B1.7.2d,e
Total			**5**	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11(a)	(fruit / olives) crushed (then oil is removed by) pressing / (steam) distillation		1 1	AO1 C1.6.1a
11(b)(i)	oil does not dissolve in water / vinegar	ignore references to emulsifiers / mustard allow oil is hydrophobic allow oil and water / vinegar are immiscible	1	AO1 C1.6.2a
11(b)(ii)	mustard molecules have a hydrophilic head / end: which is attracted to water / vinegar **or** which dissolves in water / vinegar mustard molecules have a hydrophobic tail / end: which is attracted to (olive) oil **or** which dissolves in (olive) oil (so) forms a (stable) suspension **or** (so emulsion is) droplets of oil in water	allow emulsifier for mustard allow a labelled diagram for any of the marking points allow **1** mark if both attractions are reversed allow (so oil) droplets repel each other allow (so emulsion is) droplets of water in oil if no other mark awarded, allow **1** mark for mustard molecules have a hydrophilic head / end **and** a hydrophobic tail / end	1 1 1	AO1 C1.6.2a,b

11(c)	hydrogen added nickel *(catalyst)* at 60 °C	allow hydrogenation	1 1	AO1 C1.6.3b
Total			**8**	

Question 12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(a)(i)	fractional distillation		1	AO1 C1.7.2j
12(a)(ii)	neon		1	AO2 C1.7.2j
12(a)(iii)	solid at this temperature **or** would block pipes	allow freeze	1	AO3 C1.7.2j
12(b)	carbon dioxide decreased **and** oxygen increased	allow correct numerical comparisons	1	AO1, AO2 C1.7.2a, f,g,h
	carbon dioxide locked up in *(*sedimentary*)* rocks / limestone / fossil fuels **or** carbon dioxide absorbed by plants during photosynthesis	accept carbon dioxide absorbed by oceans	1	
	oxygen produced / released during photosynthesis		1	
12(c)	any **one** from: • ammonia • hydrocarbon • hydrogen • methane • water vapour	allow NH_3 accept named hydrocarbon gas allow H_2 allow CH_4 allow H_2O (g) ignore carbon dioxide, nitrogen and oxygen	1	AO2 C1.7.2c,d, e
Total			**7**	

Question 13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13(a)	any **two** from: • stronger wind out at sea • bigger turbines can be built • technology has improved making construction easier • more space available at sea • Government policy	ignore references to cost ignore general references to why wind turbines are used ignore references to visual / noise pollution	2	AO3 P1.4.1b
13(b)	any **three** from: Iceland: • has mountains **or** has high rainfall **or** has fast flowing rivers • which is needed for hydroelectric power • has hot rocks (near the Earth's surface) • which are needed for geothermal power	 must be linked to previous marking point allow Iceland is volcanic allow has hot water / steam from underground must be linked to previous marking point	3	AO1, AO3 P1.4.1b,d
Total			**5**	

Question 14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14(a)(i)	any **two** from: • (electromagnetic) radiation that fills the universe • it comes from radiation that was present shortly after the beginning of the universe • gamma radiation that has become microwave radiation as the universe expanded	allow it comes from radiation that was left shortly after the Big Bang if no other mark awarded, allow **1** mark for radiation that is in space / universe	2	AO1 P1.5.4d
14(a)(ii)	because the 'Big Bang' theory is currently the only theory that can explain the existence of CMBR	allow the evidence is consistent with the Big Bang theory allow it is evidence that the universe is expanding from an initial point	1	AO1 P1.5.4e

14(b)(i)	calculation to show the effect of doubling distance on speed, eg: 1.63 to 3.26 speed is 4.6 times greater **or** calculation of 2 ratios, eg: (1.63:200) = 0.00815 and (2.61:300) = 0.00870 (therefore) when distance doubles speed does not double so the student is incorrect **or** (therefore) the ratio of distance to speed is not constant so the student is incorrect	allow for **2** marks a calculation that shows the expected speed for double the distance allow **1** mark for recognising that a comparison of doubled quantities is needed allow **1** mark for 1 ratio calculated if no other mark gained allow **1** mark for a statement about expecting a straight line through the origin for a directly proportional relationship ignore the student is wrong unqualified	2 1	AO2, AO3 P1.5.4b
14(b)(ii)	the furthest galaxies show the biggest red-shift (meaning that) the furthest galaxies are moving fastest (so the) universe is expanding (extrapolating backwards this suggests that) the universe started from an initial point	for MP1 and 2 need at least **one** comparator for **2** marks if a correct link is made between red-shift and speed without a comparator allow **1** mark	1 1 1 1	AO1 P1.5.4b,c
Total			**10**	