GCSE

Science A (Route 2)

SCA2HP

Final Mark scheme

4406

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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 **6(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)		no marks if refer to atomic structure apply the list principle		AO1 B1.7.1b
	contains chromosomes	ignore references to numbers	1	
	(chromosomes carry) genes / genetic material		1	
		accept (chromosomes / genes made of) DNA		
1(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 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(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
2(b)(i)	West side		1	AO3 B1.4.2a,c
2(b)(ii)	any **one** from: • 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
2(b)(iii)	any **two** from: • 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 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	extremophile(s)	apply list principle ignore bacteria / fungi / algae	1	AO1 B1.4.1e
3(b)	any **two** from: • (Japanese knotweed) out-competes (native / other plants / species) for light / water / nutrients / space • (its height / cover) blocks light to native / other plants • (its widespread roots) absorb most water / nutrients • grows quickly / extensively to take up most of the space		2	AO2 B1.4.1b B1.4.2a,b
3(c)	<u>asexual</u> reproduction	ignore cloning do **not** allow cuttings / tissue culture	1	AO2 B1.7.2a

3(d)	any **three** from: *Advantages:* • insect will reduce growth / spread of knotweed • insect will not eat other plants • (does not survive winter in UK) so if there is a problem the insect can be eradicated *Disadvantages:* • cannot be certain that insect will not eat / affect other plants • may upset balance of ecosystem / food chain • cost / inconvenience of introducing new stock each year	both pros and cons must be given for max marks allow may introduce pathogens / diseases allow knotweed / plants will grow in winter (when no insects) allow would need a lot of insects	3	AO3 B1.4.2a,b

Total			**7**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	steam (is produced)	allow water vapour (is produced)	1	AO1 C1.6.1a
4(a)(ii)	condensation	allow vapours are condensed	1	AO2 C1.6.1a
4(a)(iii)	oil / water form separate layers		1	AO2 C1.6.2a
4(b)	pressing	allow crushing	1	AO1 C1.6.1a
4(c)(i)	orange	allow brown	1	AO1 C1.5.1d C1.6.3a
4(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

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

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	in the first billion years	allow a value given in the range of 3.6 billion years and 4.6 billion years ago	1	AO1 C1.7.2b
5(a)(ii)	at the boundaries between (tectonic) plates	allow in 'the ring of fire' **or** the circum-pacific belt do **not** allow on (tectonic) plates ignore Iceland ignore named plates ignore constructive / destructive / divergent	1	AO1 C1.7.1d
5(b)(i) *View with Table 2*	(nitrogen) 80 **and** (oxygen) 20	both values required for **1** mark allow values in range 78 – 80 allow values in range 20 - 21	1	AO1 C1.7.2a
5(b)(ii)	any **two** from: • dissolved in oceans • locked up as fossil fuels • locked up in (sedimentary) rocks • photosynthesis (in plants)	ignore carbon sinks allow locked up as carbonates	2	AO1 C1.7.2f,g,h
Total			**5**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(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** for full marks candidates should link low current to reduced energy losses maximum level 2 if any of these misconceptions are apparent in the answer: • energy is created • energy / power is increased or decreased at a transformer • voltage is shared between consumers • energy is stored in transformers ignore references to generating electricity	
• 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	allow power / energy for electricity	
Transformer A: • 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)	ignore steps up the electricity allow to reduce energy losses ignore no energy is lost	
Transformer B: • step down transformer • voltage decreased • current increased (link) • to reduce the voltage to consumers to a safe level (link)	ignore steps down the electricity	

6(b)	any **one** from: • no visual pollution • unlikely to be damaged by (severe) weather • lower shock hazard • less / no risk to aircraft	ignore references to cost / habitats allow lower radiation hazard ignore risk to health unqualified allow require less maintenance	1	AO1 P1.4.2a

6(c)	compare (the health of) people living close to power lines with (the health of) those that do not with a sufficient sample size	allow comparison with control group allow an answer that indicates that a large number of people should be included alternative approach: measure the radiation levels coming from the cables for **1** mark compare the result with recommended safety levels for **1** mark	1 1	AO2, AO3 P1.4.2a

Total			**9**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	any **one** from: • power of the light source • (surface) area of the solar cell	do **not** allow voltage allow same type of bulb do **not** allow distance from the light source do **not** allow light intensity allow size of solar cell allow same solar cell allow same angle of solar cell	1	AO3 P1.4.1c
7(b)(i) *View with Figure 11*	smooth curve through the points		1	AO2 P1.4.1c
7(b)(ii)	(yes) when distance increases the voltage from the solar cell decreases (this means that) as light intensity decreases (when distance increases) the voltage from the solar cell decreases	max **1** mark if answer given is no allow the converse ignore references to figures allow (because) when the distance increases, light intensity decreases	 1 1	AO3 P1.4.1c
Total			**4**	

Question 8

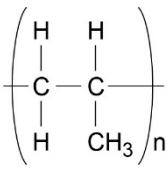
Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	any **three** from: • insulin gene cut out • from human chromosome / DNA • correct reference to enzymes (at any point) • gene (spliced / inserted) into bacterial cell	 allow from human cell accept gene (spliced / inserted) into bacterial chromosome / DNA / plasmid do **not** accept inserted into bacterial nucleus	3	AO1 B1.7.1c B1.7.2d
8(b)	any **three** from: • possible harm (when eaten by humans / animals) • damage to food chains / ecosystems • gene may spread to other plants / species • effect on gene pool	 allow may cause allergies / side effects (when eaten) accept reduced biodiversity allow qualified argument regarding cost of GM seed putting economic pressure on farmers / communities only allow references to religious arguments if fully qualified, eg some religions teach we should not interfere with the organisms God created.	3	AO1, AO3 B1.7.2d,e,f
Total			**6**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)	any **one** from: • 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
9(b)(i)	any **one** from: • moths might have flown away • moths might have died • (scientists) might not have seen / counted all the moths		1	AO3 B1.4.2a,b B1.8.1e
9(b)(ii)	616	allow 615.8 / 615.82 allow **1** mark for: 615 **or** 135 / 135.2 / 135.18 **or** $\frac{82}{100}$ x 751 **or** 511 / 510.7 / 510.68	2	AO2 B1.8.1e

9(b)(iii)	(Figure 13 shows) higher percentage / proportion of dark moths eaten	allow (Figure 13 shows) lower percentage / proportion of light-coloured moths eaten ignore more dark moths eaten **or** fewer light moths eaten	1	AO1, AO2 B1.8.1e
	(this suggests) the light moths were better adapted / camouflaged (against the trees)	allow (this suggests) the dark moths were not as well adapted / camouflaged (against the trees) do **not** allow moths adapt / evolve to survive	1	
	(Table 3 shows) proportion of dark moths in the area is decreasing / (much) lower **or** (Table 3 shows) proportion of light moths in the area is increasing / (much) higher	allow (Table 3 shows) number of dark moths in the area is decreasing **or** allow (Table 3 shows) number of light moths in the area is increasing	1	
	(because) the light / better adapted moths survived **and** reproduced / bred / passed on genes	allow (because) the dark moths did not survive to reproduce / breed / pass on genes do **not** allow moths adapt / evolve to survive if no marks awarded for using data allow more light than dark coloured moths in the population	1	
Total			**8**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)(i)	→ 	award **1** mark for central C – C bond award **1** mark for correct arrangement of atoms award **1** mark for open ended linking bonds **and** $_n$ bottom right outside bracket	3	AO2 C1.5.2a
10(a)(ii)	$(C_{10}H_{22} \rightarrow C_5H_{12}) + C_3H_6 + C_2H_4$	allow correct multiples allow **1** mark for C_3H_6 **or** C_2H_4	2	AO1, AO2 C1.5.1a, b,c
10(a)(iii)	high temperature	ignore references to pressure allow (decane) is vaporised allow temperatures from 300 °C to 900 °C do **not** allow 60 °C ignore heat / hot	1	AO1 C1.5.1a
	catalyst or steam	do **not** allow nickel catalyst or other named catalyst allow zeolites / aluminium oxide / porous pot for catalyst	1	
10(b)	360,000 (tonnes)	allow 0.36 million (tonnes)	1	AO2 C1.5.2c

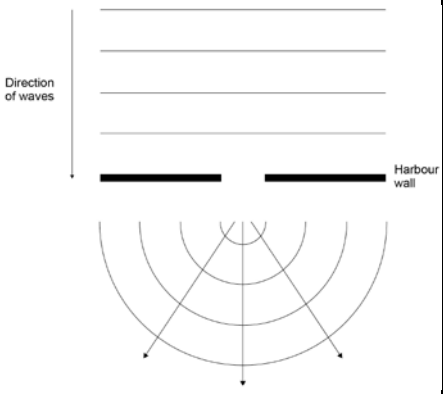
10(c)	(cornstarch is) biodegradable	allow poly(ethene) is not biodegradable	1	AO1, AO3 C1.5.2c,d
	(so) less landfill needed (for cornstarch)	allow fewer problems with waste disposal (for cornstarch) allow more landfill needed for poly(ethene)	1	
	(cornstarch is) made from plants	allow conserves crude oil resources	1	
	which are renewable	allow (as) crude oil is non renewable	1	

10(d)(i)	any **three** from: • rate of absorption is higher / faster with distilled water • rate of absorption of (distilled / tap) water is highest / fastest initially / in first few minutes • rate of absorption of (distilled / tap) water decreases as greater volume absorbed • after 15 minutes rate of absorption is zero	if data given figures must be correct allow faster absorption with distilled water allow rate of absorption decreases after first few minutes allow after 15 minutes no more (distilled / tap) water can be absorbed allow value between 14 and 16 (minutes) if no other mark awarded allow **1** mark for hydrogels absorb more distilled water (than tap water)	3	AO3 C1.5.2b

10(d)(ii)	use urine in the investigation	ignore do investigation at body temperature ignore use different types of hydrogel	1	AO3 C1.5.2b

Total			**16**

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11(a)	the spreading out of a wave when it passes: through a gap **or** round an obstacle	do **not** allow wavelength changes	1	AO1 P1.5.1g
11(b) *View with Figure 16*		 no marks if pattern is incorrectly drawn ignore the first wave drawn at the gap		AO1 P1.5.1g
	diffraction pattern correctly drawn	pattern should be semi-circular	1	
	wavelength of waves remains the same after the gap as it was before the gap	distance between lines on the diagram and the lines drawn by the candidate should be the same by eye	1	

11(c)	14 (m)	allow **2** marks for: 14.3 **or** 14.29 allow **1** mark for: correct substitution 300 000 000 = 21 000 000 × wavelength provided no subsequent steps **or** an answer that has been correctly calculated but incorrectly rounded eg 14.2 / 14.28 allow **1 independent** mark for any calculated answer other than 14 (m) that is correctly rounded to 2 significant figures	3	AO2 P1.5.1j

Total			**6**

Question 12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(a)	any **one** from: • during the day the demand will be lower because offices / factories will be closed • the increase in demand will be later in the morning because people get up later • the decrease in demand in the evening would be later because people stay up later	both the difference **and** the reason for the difference are needed to score the mark allow demand will be lower in the morning because people get up later allow demand would be higher in the evening because people stay up later allow increased demand due to appliance use	1	AO3 P1.4
12(b)	water is pumped uphill (and stored behind a dam) (when there is a sudden demand for electricity) the water is released (and falls) the falling water turns a turbine which turns a generator	max **1** mark if there is reference to electricity being stored or pumped ignore energy is stored	1 1 1	AO1 P1.4.1 b
Total			**4**	

Question 13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13(a)		ignore references to galaxy **A** ignore references to Doppler effect		AO1, AO2 P1.5.4b
	both galaxies are moving away from the Earth	do **not** allow references to galaxies expanding	1	
	(because) both spectra are red shifted		1	
	galaxy **B** is moving faster	allow the converse for galaxy **C**	1	
	galaxy **B** is further away	allow the converse for galaxy **C**	1	
	(because) galaxy **B** has a greater red shift	allow the converse for galaxy **C**	1	
13(b)	(the spectrum from) galaxy **A** shows blue shift	allow there is no red shift ignore galaxy **A** is blue shifted	1	AO3 P1.5.4c
	any **one** from: • (which means that) galaxy **A** is moving towards the Earth • (which suggests that) galaxies are moving closer together • (which suggests that) the universe is not expanding	do **not** allow Earth / world is expanding	1	
Total			**7**	