



GCSE

Science A

SCA1HP

Mark scheme

4406

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Version 1.0: Final

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 6 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	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	nicotine and alcohol	both drugs needed for 1 mark	1	AO1 B1.3.1e
1(a)(ii)	nicotine / alcohol has a <u>greater</u> risk of harming the body (than some illegal drugs) or nicotine / alcohol has a <u>higher</u> risk of addiction (than some illegal drugs)	allow cannabis / ecstasy has <u>less</u> risk of harming the body (than some legal drug) or allow cannabis / ecstasy has <u>less</u> risk of addiction (than some legal drug)	1	AO1, AO2 B1.3.1g
	more people use legal drugs (than illegal drugs)	allow alcohol causes liver damage allow nicotine causes heart / circulatory disease	1	
1(b)(i)	any one from: <ul style="list-style-type: none"> cocaine / heroin has a high risk of addiction and a high risk of harm to the body cocaine / heroin / ecstasy lie on / near the trend line (trend line shows a) positive correlation 	ignore reference to figures allow follow the pattern or are on the line of best fit	1	AO3 B1.3.1e,h

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	reduces the (risk of) growth of pathogens	allow named pathogen allow for pathogens harmful bacteria / fungi / microorganisms ignore virus ignore stops growth of pathogens allow reduces risk of infection ignore disease	1	AO1 B1.1.2n
2(a)(ii)	microorganisms grow faster	allow growth will be faster allow more microorganisms produced in a given time allow provides optimum conditions (for growth)	1	AO1 B1.1.2o
2(b)(i)	7.8 to 22.2 or 7.8 – 22.2	allow converse statements allow 14.4 ignore incorrect subtraction unless 53 or 13.25 is given and then apply the list principle	1	AO2 B1.1.2m,n
2(b)(ii)	gym exercise mat is the surface with the most bacteria reason: (sweaty) people lie on it or it is used on a dirty floor OR canteen service area has the least bacteria reason: it gets cleaned / disinfected regularly	allow dirtiest allow most contaminated allow has (traces of) sweat on it allow it does not get washed allow cleanest allow for 2 marks: laboratory bench has few bacteria because it gets cleaned (regularly)	1 1	AO2, AO3 B1.1.2m,n
Total			5	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	dependent (variable)	allow continuous (variable) allow discrete (variable)	1	AO2 B1.1.1a
3(a)(ii)	any one from: <ul style="list-style-type: none"> lemon juice contained the most vitamin C apple juice contained the least vitamin C 	allow a correct comparison of two or more juices	1	AO3 B1.1.1a
3(b)(i)	62.5 (%)	allow 63 (%) do not allow 62 (%) do not allow 63.0	1	AO2 B1.1.1a
3(b)(ii)	different people need different amounts	allow examples, eg pregnant women may need more	1	AO3 B1.1.1a
Total			4	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	any three from: <ul style="list-style-type: none"> (crude) oil is heated (crude) oil evaporates vapour condenses at different temperatures 	allow fractions condense allow the fractions have different boiling points	3	AO1 C1.4.1a,b C1.4.2b
4(a)(ii)	(as number of carbon atoms increases) (Boiling point) increases (Viscosity) increases		1 1	AO1 C1.4.2c
4(b)(i)	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{H} & & \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & & & \end{array} $		1	AO2 C1.4.2a
4(b)(ii)	any two from: <ul style="list-style-type: none"> carbon dioxide water carbon monoxide carbon 	allow CO ₂ allow H ₂ O allow water vapour allow CO allow soot	2	AO1 C1.4.3a,b
4(b)(iii)	any one from: <ul style="list-style-type: none"> lack of availability of LPG cars need to be modified 	allow LPG cars are more expensive	1	AO3 C1.4
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	<p>any four from:</p> <ul style="list-style-type: none"> • 3 protons • 4 neutrons • 3 electrons • nucleus contains protons and neutrons • electrons in energy levels / shells 	<p>wrong number for any particle max 3 marks references to charges must be correct allow up to 3 marks for a correctly labelled diagram if no written description</p> <p>allow (electronic configuration is) 2.1</p> <p>If no other mark gained, allow 1 mark for mention of protons, neutrons and electrons</p>	4	AO1, AO2 C1.1.1c, e,g,h
5(b)(i)	<p>any one from:</p> <ul style="list-style-type: none"> • sodium • potassium • rubidium • caesium • francium 	<p>allow Na allow K allow Rb allow Cs allow Fr</p>	1	AO2 C1.1.1a C1.1.2a
5(b)(ii)	contain different number of protons	<p>accept different proton / atomic number ignore references to mass (number)</p> <p>do not allow answers which include particles other than protons</p>	1	AO1 C1.1.1f
Total			6	

QWC Mark Scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6			6	AO1, AO2 P1.1.2a,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 creditworthy response	At least one relevant statement is made	Relevant statements are made about two of the states or a relevant statement is made about each state	Relevant statements are made about each of the three states	
Examples of the Physics points made in the response: solids: <ul style="list-style-type: none"> • arranged in a regular pattern • particles vibrate about fixed points • particles have low energy liquids: <ul style="list-style-type: none"> • pattern is irregular • particles are not fixed in place or can move freely / around • particles have more energy than solids and / or less energy than gases gases: <ul style="list-style-type: none"> • particles are in a random pattern • particles move (about) freely / randomly • particles have high energy 		Extra information ignore statements about the states of matter a description without mention of particles, but clearly about particles, can gain max 4 marks allow closely / tightly packed / compact allow cannot move freely / around allow close together allow far apart allow move fast(er)		
Total			6	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	condensation		1	AO1 P1.1.3b
7(b)	larger (exposed) surface area (so) water can evaporate faster or (so) more water (molecules) can escape	allow more water can evaporate	1 1	AO2 P1.1.3b
Total			3	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	reduces random errors	allow to reduce the effect of anomalies / outliers allow to disregard anomalous results ignore references to precision / accuracy / repeatability / reliability	1	AO3 P1.1.3d
8(b)	<u>1 °C</u>	do not allow 1 °C	1	AO2 P1.1.3d
8(c)	calculate temperature drop for 80 °C and 50 °C (so) the higher the starting temperature the greater the temperature drop or (so) the lower the starting temperature the smaller the temperature drop	ignore references to rate of cooling 14 °C for 80 °C 5 °C for 50 °C ignore the lower starting temperature had a lower temperature after 5 minutes accept for two marks: when the starting temperature was 80 °C the temperature drop was 14 °C but at 50 °C the temperature drop was only 5 °C allow for one mark a correct comparison with incorrectly calculated temperature changes.	1 1	AO2, AO3 P1.1.3d

<p>8(d)</p>	<p>(there is a) bigger temperature difference (between the water and its surroundings)</p> <p>the hotter an object is the faster it emits (infrared) radiation</p> <p>or</p> <p>(so) the rate of energy transfer is greater</p>	<p>allow 'heat' for (infrared) radiation or energy</p> <p>accept the converse allow the water is much hotter than room temperature</p> <p>allow a hotter object emits more radiation</p> <p>allow a greater rate of convection ignore faster evaporation unless qualified</p> <p>allow more energy is transferred</p> <p>ignore references to changing temperature</p>	<p>1</p> <p>1</p>	<p>AO1 P1.1.1b P1.1.3d</p>
<p>8(e)</p>	<p>any one from:</p> <ul style="list-style-type: none"> • the water would cool more slowly • the temperature drop would be smaller (after 5 minutes) • the temperature (after 5 minutes) would be higher 		<p>1</p>	<p>AO2 P1.1.1 d</p>
<p>Total</p>			<p>7</p>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(a)	viruses live / reproduce inside cells		1	AO1 B1.1.2h
	(so) the drug cannot reach the virus	allow (so) cell also damaged	1	
9(b)	develop new antibiotics		1	AO1 B1.1.2h,i,k
	not prescribe antibiotics for viral infections / non-serious infections	allow antibiotics should not be prescribed / used inappropriately or allow (patients) should take the complete course of antibiotics	1	
Total			4	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10(a)(i)	synapse		1	AO1 B1.2.1e
10(a)(ii)	chemical	accept neurotransmitter or named neurotransmitter	1	AO1 B1.2.1e
10(b)	3.175 or 3.18 (seconds)	<p>allow 2 marks for a time of 3.2 calculated for the pain impulse or allow 1 mark for a correct substitution or reorganisation: $0.6 = 1.92 / t$ or $t = 1.92 / 0.6$</p> <p>allow 1 mark for an incorrect time for pain impulse – 0.025 correctly subtracted</p>	3	AO2 B1.2.1d
Total			5	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11(a)	<p>any four from:</p> <ul style="list-style-type: none"> • the woman is given FSH / LH • (FSH / LH / hormones) to stimulate egg maturation / release / production • eggs and sperm are collected / mixed • fertilisation happens • embryo(s) form • (embryo(s)) inserted into the woman's <u>uterus</u> /<u>womb</u> 	<p>allow fertility drug do not allow an incorrect hormone eg oestrogen</p> <p>this complete statement gains 2 marks</p>	4	AO1 B1.2.2c,e
11(b)	<p>three arguments given from:</p> <p><i>Arguments for:</i></p> <ul style="list-style-type: none"> • older women (may) have more money / time to support the child • older women may make better parents • allows women who have late marriage / partnership to have a family <p><i>Arguments against:</i></p> <ul style="list-style-type: none"> • mother may die before child has grown up • baby may not be as healthy • mother may have more problems during pregnancy / birth • mother might have less energy (than a younger mother) to look after a child 	<p>arguments for and against required for full marks</p> <p>allow examples of maturity / life experiences</p> <p>allow (higher) risk of genetic disorders / down's syndrome</p>	3	AO3 B1.2.2e
Total			7	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12(a)	clay		1	AO1 C1.2.1g
12(b)(i)	440 kg		1	AO2 C1.1.3b,c C1.2.1a,b
12(b)(ii)	burning of (fossil) fuels (to provide energy)	allow (produced from) other compounds in limestone	1	AO3 C1.4.3a,b
12(c)	increase in strength of concrete is less with increasing percentage of cement	<p>allow for one mark: as the percentage of cement increases, the strength of concrete increases</p> <p>allow for one mark: increase in mass needed to break block / concrete decreases as mass of cement increases</p>	2	AO3 C1.2.1g
Total			5	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13(a)(i)	gold is unreactive		1	AO1 C1.3.1c
13(a)(ii)	$2\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2$	products may be in either order 1 mark for correct symbols 1 mark for correct balancing allow correct multiples	2	AO2 C1.1.3b C1.3.1d
13(a)(iii)	aluminium is high in the reactivity series or aluminium is more reactive than carbon (so) cannot be extracted with carbon or (so) requires electrolysis	allow aluminium is very reactive allow electrolysis is required (1 mark) (but) electricity / technology not available (1 mark)	1 1	AO1 C1.3.1 e
13(b)(i)	lower density and higher strength		1	AO3 C1.3.2b C1.3.3a,c
13(b)(ii)	(high) corrosion resistance	allow titanium doesn't rust	1	AO1 C1.3.3c
13(b)(iii)	titanium extraction uses a large amount of energy titanium extraction requires many stages titanium cannot be extracted using carbon / smelting	ignore references to electrolysis ignore references to abundance of titanium	1 1 1	AO1, AO3 C1.3.1d,i C1.3.2b
Total			10	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
14(a)(i)	black (paint) is a good absorber of (infrared) radiation	allow 'heat' for radiation ignore light / sunlight / energy allow black (paint) is a good emitter of (infrared) radiation to the water	1	AO1 P1.1.1c P1.1.3a,c
	copper pipes are good conductors (of energy)		1	
	the pipes have a large surface area to absorb (a lot of) energy	allow 'heat' for energy ignore light / sunlight for energy	1	
14(a)(ii)	0.7 W/m ² °C	if wrong box ticked 0 marks	1	AO2, AO1 P1.1.4b
	(the lower the U-value) the better the insulator		1	
14(b)(i)	any one from: <ul style="list-style-type: none"> • energy is available 24 hours a day • constant supply of energy all year around • works at night 	ignore no visual pollution	1	AO3 P1.1.4c

14(b)(iii)	94 (kg)	<p>allow 3 marks for an answer with more than 2 significant figures that rounds to 94 kg</p> <p>allow 2 marks for $19\,000\,000 = m \times 4200 \times 48$ or $m = 19\,000\,000 / (4200 \times 48)$ or $m = 19\,000\,000 / 201\,600$ or correctly calculated mass using an incorrect temperature change.</p> <p>allow 1 mark for a temperature rise of 48 °C</p> <p>allow 1 mark for a correct substitution using an incorrect temperature change provided some evidence of working out the temperature change is shown</p> <p>allow 1 mark for an incorrect answer correctly rounded to two significant figures, provided some evidence of working is shown</p>	4	AO2 P1.1.4d
Total			14	