



GCSE

Science A (Route 2)

SCA1HP

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 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 **4(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) | receptor | ignore type of receptor ignore skin ignore sense organ | 1 | AO1 B1.2.1b,d |
| 1(b)(i) | contracts | allow description of contraction ignore moves | 1 | AO1 B1.2.1e |
| 1(b)(ii) | releases / secretes a chemical | allow a correctly named chemical, eg hormone / enzyme do not allow chemical impulses | 1 | AO1 B1.2.1e |
| 1(b)(iii) | effector | | 1 | AO1 B1.2.1e |
| 1(c) | to protect the body from harm | allow so can respond quickly to avoid danger | 1 | AO2 B1.2.1d,e |
| Total | | | 5 | |

Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|-----------------|---|--|----------|---------------------|
| 2(a) | 24 / 24.4 / 24.39 | do not allow 24.3 / 24.38 | 1 | AO2, AO3 B1.1.1a |
| | Healthy weight | description must agree with calculated BMI allow healthy mass | 1 | |
| 2(b)(i) | The rate of all the chemical reactions in a person's body | | 1 | AO1 B1.1.1c |
| 2(b)(ii) | any one from: <ul style="list-style-type: none"> • amount of activity / exercise • proportion of muscle to fat • inherited factors • age • gender | accept hormone levels allow diseases or infection allow air temperature | 1 | AO1 B1.1.1c |
| Total | | | 4 | |

Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|--|---|----------|------------------|
| 3(a) | pathogen(s) | ignore bacteria / viruses / fungi / germs | 1 | AO1 B1.1.2a |
| 3(b) | (white blood cells): produce <u>antibodies</u> (to kill microorganisms / pathogens) | allow produce <u>antibodies</u> (to kill bacteria / viruses / fungi) | 1 | AO1 B1.1.2c,d |
| | ingest microorganisms pathogens / bacteria / viruses | accept <u>antibodies</u> cause microorganisms to clump together | 1 | |
| | produce <u>antitoxins</u> (to counteract toxins released by pathogens) | | 1 | |
| 3(c) | rapid response / increase of white blood cells | need <i>idea of</i> rapid response or accept <i>idea of</i> recognition of microorganism, eg reference to memory cells | 1 | AO1 B1.1.2e,l |
| | (to) produce the <u>correct / specific antibody</u> | allow a description, eg produce antibodies against the chicken pox virus | 1 | |
| Total | | | 6 | |

Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|-----------|----------------------------------|---------------------------------|------|---------------------------|
| 4(a)(i) | 174 (°C) | allow values in range 166 – 176 | 1 | AO3 C1.4.2c |
| 4(a)(ii) | C ₁₀ H ₂₂ | | 1 | AO2 C1.4.1c C1.4.2a |
| 4(a)(iii) | contain carbon and hydrogen only | | 1 | AO1 C1.4.1c |

QWC Mark Scheme

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|--|---|--|------------------------------|
| 4(b) | | | 6 | AO1, AO2, AO3 C1.4.3a,c,e |
| 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 | At least one effect given for biodiesel or at least two direct comparisons made from the table. | Advantage(s) and disadvantage(s) given for biodiesel, including two effects or advantages or disadvantages given for biodiesel with linked effects or a full comparison using the table with at least one effect. | Advantages and disadvantages of biodiesel, with linked effects given. | |

| | | |
|---|--|--|
| <p>examples of the points made in the response</p> <p>advantages of biodiesel</p> <ul style="list-style-type: none"> • less carbon dioxide (produced) • fewer particulates (produced) • (so) fewer respiratory problems (E) • less greenhouse gases (E) • less global warming (E) • less global dimming (E) • from renewable resource (E) <p>disadvantages of biodiesel</p> <ul style="list-style-type: none"> • more nitrogen oxides (produced) • more acid rain (E) • large area of land needed (E) • fields could be used for crops (E) • deforestation (E) | <p>extra information</p> <p>if formulae given they must be written correctly</p> <p>ignore references to cost, flammability, viscosity, volatility, energy required for production</p> <p>ignore pollution unqualified</p> <p>ignore oil/petroleum diesel is running out</p> <p>allow carbon neutral (E)</p> <p>allow <i>idea of</i> food shortages or increase in food prices (E)</p> <p>allow loss of habitat / biodiversity (E)</p> <p>allow <i>idea of</i> less reliable (E)</p> | |
|---|--|--|

| | | |
|--------------|--|----------|
| Total | | 9 |
|--------------|--|----------|

Question 5

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|--|----------|---------------------------------|
| 5(a) | 4 protons | diagram takes precedence | 1 | AO1, AO2 C1.1.1a,c, e,g,h |
| | 4 electrons | | 1 | |
| | 5 neutrons | | 1 | |
| | protons <u>and</u> neutrons in nucleus and electrons arranged correctly on shells | at least two particles in the nucleus must be touching each other or a nucleus has been indicated | 1 | |
| 5(b) | 4 ⁺ | allow ecf from part (a) allow +4 | 1 | AO2 C1.1.1 d |
| Total | | | 5 | |

Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|--|---|----------|---------------------|
| 6(a)(i) | electrical | answers must be in the correct order ignore electric / electricity | 1 | AO1 P1.3.1a |
| | light | allow sound | 1 | |
| 6(a)(ii) | it is transferred to the surroundings / tablet | allow it goes into the air allow it is wasted as 'heat' / thermal energy | 1 | AO1 P1.2.1c |
| | the surroundings / tablet get(s) warmer | allow the air heats up | 1 | |
| 6(b)(i) | 86 400 (joules) | allow for 1 mark 24 or correctly calculated energy following an incorrect conversion of time allow for 1 mark $3 \times 8 \times 3600$ or $3 \times 28\ 800$ provided no subsequent steps given | 2 | AO2 P1.3.1c |
| 6(b)(ii) | the battery life (of the laptop) is shorter | allow the battery (of laptop) does not last as long | 1 | AO1, AO2 P1.3.1b |
| | (because) more energy is transferred each second | allow energy is transferred faster allow a calculation of time using $\text{time} = \frac{\text{energy}}{\text{power}}$ time = 1728 (s) or 0.48 (h) or 28.8 (minutes) ignore laptop has a higher power | 1 | |
| Total | | | 8 | |

Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|--|---|----------|--------------------------------|
| 7(a) | the cooling fins have a large surface area | reason must be correctly linked to feature allow 'heat' for energy / radiation | 1 | AO1, AO2 P1.1.1c P1.1.3c |
| | (so) energy is transferred more quickly to the surroundings | allow gaps between fins let cool air pass through | 1 | |
| | black (colour) | | 1 | |
| | (because black) is a good emitter of (infrared) radiation | allow (black) is a good absorber of radiation from the engine if no other mark awarded, allow 1 mark for metal being a good conductor | 1 | |
| 7(b) | (rate of energy transfer) increases | no marks awarded if incorrect change in rate is given | 1 | AO1 P1.1.1b P1.1.3d |
| | (because) the hotter an object is the more (infrared) radiation it radiates (in a given time) or (because) there is a bigger temperature difference between the engine and its surroundings | ignore reference to particles | 1 | |
| Total | | | 6 | |

Question 8

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|--|----------|------------------|
| 8 | <i>FSH</i> – any one from: <ul style="list-style-type: none"> • causes eggs to mature (in the ovaries) • stimulates the production of oestrogen / hormones | | 1 | AO1 B1.2.2c,d |
| | <i>oestrogen</i> – any one from: <ul style="list-style-type: none"> • stimulates production of LH • inhibits FSH production | accept stimulates thickening of the uterus / womb lining | 1 | |
| | <i>LH</i> – stimulates the release of eggs (from the ovary) | accept stimulates ovulation | 1 | |
| Total | | | 3 | |

Question 9

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|-------------|--------------------------------|--|------|---------------------|
| 9(a) | stimulates muscle growth | ignore references to the nervous system | 1 | AO1, AO2 B1.3.1i |
| | (so) becomes stronger / faster | allow (so) recover from injury quicker alternative mark scheme: increases red blood cell production (so) increases oxygen carriage or associated effect only allow increased oxygen carriage if first marking point gained | 1 | |

| | | | | |
|---------------------|--|---|-----------------|-----------------------------|
| <p>9(b)</p> | <p>any three trends with correctly linked reasons from:</p> <p><i>Trend 1:</i> (from 1972) to 1988 distance thrown increased</p> <p><i>Reason:</i> any one from:</p> <ul style="list-style-type: none"> • better training • better diet • could take drugs (outside competitions) • poor drug testing regimes <p><i>Trend 2:</i> after 1988 distance thrown decreased</p> <p>or from 1988 to 1993 / 2009 distance thrown decreased</p> <p><i>Reason:</i> any one from:</p> <ul style="list-style-type: none"> • athletes stopped taking drugs / (anabolic) steroids • more drug testing occurred • athletes who had taken drugs were banned <p><i>Trend 3:</i> from 1995 / 1997 to 2009 showed a (small) decrease in distance thrown</p> <p>or from 1995 to 2009 distance thrown remained fairly steady</p> <p><i>Reason:</i></p> <ul style="list-style-type: none"> • few / no new developments in discus throwing <p><i>Trend 4:</i> since 2009 distance thrown has increased</p> <p><i>Reason:</i> any one from:</p> <ul style="list-style-type: none"> • different drugs being used that are not tested for • regimes of drug use developed to avoid detection | <p>Max 3 marks for <u>trends</u> Reason must be correctly linked to a trend</p> <p>allow (any year between 1970 and 1980) to 1988 distance thrown increased</p> <p>allow 1989 for 1988 allow 2008 for 2009</p> <p>accept athletes did not want to risk being caught / banned (due to drug taking)</p> <p>allow since 2008 / 2010 distance thrown has increased</p> <p>allow better training / diet only if not already mentioned for Trend 1</p> <p>If no reference to dates in trends allow 1 mark for distance thrown increased, then decreased, then increased again. Reasons can still be credited if correctly linked.</p> | <p>6</p> | <p>AO2, AO3 B1.3.1i</p> |
| <p>Total</p> | | | <p>8</p> | |

Question 10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|--|---|------|-----------------------|
| 10 | <p><i>Pros:</i></p> <ul style="list-style-type: none"> • do not contain tar / cancer causing chemicals (found in tobacco so less risk of cancer) • smokers can gradually reduce amount of nicotine inhaled • flavour may put them off wanting to smoke tobacco again • actions make smokers think they are smoking tobacco when they are not | <p>must include pros and cons for full marks</p> <p>allow don't cause cancer</p> <p>allow <i>idea that</i> they can wean themselves off nicotine / cigarettes / smoking</p> <p>allow reduce withdrawal symptoms</p> <p>allow positive feelings related to physically smoking or allow mimics social aspects of smoking</p> <p>allow aesthetic reasons, eg teeth colouration or smell</p> | 4 | AO2, AO3 B1.3.1e,h |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|---|------|-----------------------|
| 10 | <p><i>Cons:</i></p> <ul style="list-style-type: none"> • not regulated so uncertainty about what is inhaled • may encourage young people / non-smokers to inhale nicotine • (nicotine) addiction may lead to smoking or other drugs • nicotine has health risks • risk that small children may swallow cartridge • risk of passive inhalation of vapour by others <p>justified conclusion</p> | <p>allow <i>idea that</i> they are used more because people think they are safer</p> <p>allow (poisonous) chemicals may lead to illnesses or harm to the body</p> <p>allow cannot be certain they are safer than smoking tobacco</p> <p>allow may glamorise appearance of smoking</p> <p>allow (E-cigarettes) may be a gateway to other drugs / cigarettes / smoking</p> <p>allow named risks e.g. heart disease</p> <p>allow (E-cigarettes) are addictive</p> | | AO2, AO3 B1.3.1e,h |
| Total | | | | 4 |

Question 11

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|----------|---|--|------|------------------------|
| 11(a) | aluminium used (overhead) as less dense copper (is used underground as it) has a higher conductivity (so) is a better conductor | ignore references to properties not mentioned in Table 3 | 1 | AO3 C1.3.3a,b, c |
| | | ignore is lighter allow aluminium is cheaper but conducts electricity quite well | 1 | |
| 11(b) | any two from: <ul style="list-style-type: none"> • cast iron is more / too brittle • steel is more corrosion resistant • steels can be designed for specific purposes | accept steel more flexible allow cast iron has limited uses | 2 | AO1 C1.3.2a,b, c |
| 11(c) | $\text{Cu}_2\text{S} + \text{O}_2 \rightarrow 2\text{Cu} + \text{SO}_2$ | accept correct multiples 1 for correct symbols 1 for correct balancing accept for 2 marks $\text{CuS} + \text{O}_2 \rightarrow \text{Cu} + \text{SO}_2$ | 2 | AO2 C1.3.1f |

| | | | | |
|--------------|--|---|-----------|---|
| 11(d) | <p>any four from: (<i>economic</i>)</p> <ul style="list-style-type: none"> • cheaper to recycle metal than to extract (from ore) • <i>idea of</i> difficulty in extracting copper from ores containing a very low percentage of copper • many steps in process for aluminium / copper <ul style="list-style-type: none"> • conserves copper / aluminium (ore) • supply of copper (rich) ore is limited <p>(<i>environmental</i>)</p> <ul style="list-style-type: none"> • less sulfur dioxide produced • less carbon dioxide produced • lower energy requirement • less waste produced • less mining | <p>if formulae are given they must be correct max 3 marks for only economic or environmental benefits</p> <p>allow aluminium extracted by electrolysis ignore it takes long time to extract (from the ore)</p> <p>allow low reserves of copper on Earth</p> <p>allow implication of comparison allow less acid rain allow less global warming allow less greenhouse gases produced</p> <p>allow less visual pollution allow less destruction of habitats</p> <p>allow less landfill</p> | <p>4</p> | <p>AO1, AO2, AO3 C1.3.1a,b, f,h,i,j</p> |
| Total | | | 10 | |

Question 12

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|---|----------|---------------------|
| 12(a)(i) | thermal decomposition | both words needed for mark allow endothermic | 1 | AO1 C1.2.1a,b |
| 12(a)(ii) | calcium oxide and carbon dioxide | allow quicklime for calcium oxide allow CaO for calcium oxide allow CO ₂ for carbon dioxide | 1 | AO1 C1.2.1b |
| 12(b)(i) | acid rain | allow sulfur dioxide or nitrogen oxides in solution | 1 | AO1, AO2 C1.2.1f |
| | (acid rain) reacts with calcium carbonate | allow lime mortar for calcium carbonate | 1 | |
| | to produce a gas / carbon dioxide or to produce a soluble salt | | 1 | |
| 12(b)(ii) | to test for carbon dioxide or to neutralise acids | ignore references to slaked lime accept as limewater allow to neutralise (acidic) soil / lakes allow to remove sulfur dioxide from waste gases (in power stations) | 1 | AO1 C1.2.1d,e |
| Total | | | 6 | |

Question 13

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|--------------|---|---|------------------------------|-----------------|
| 13(a) | any two from: <ul style="list-style-type: none"> • length of the metal rods • thickness of the metal rods • volume of wax • mass of drawing pins | do not allow type of metal do not allow time heated for allow distance of wax / pin along the rod accept amount of wax allow size / weight of drawing pins allow distance of rods from flame / Bunsen burner / heat source | 2 | AO3 P1.1.3a |
| 13(b) | metals contain free/ delocalised electrons which can move through the metal (when the metal is heated free) electrons gain <u>kinetic</u> energy (and) can transfer energy faster to ions / other electrons (through collisions) | allow particles / atoms instead of ions allow 'heat' for energy if no other marks gained allow 1 mark for (conduction) takes place when neighbouring particles collide / vibrate | 1 1 1 1 | AO1 P1.1.3a |
| Total | | | 6 | |

Question 14

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|-----------|--|---|------|-----------------|
| 14(a)(i) | 13.5 (kWh) | | 1 | AO2 P1.3.1d |
| 14(a)(ii) | 25 (kWh) | accept for 1 mark correct substitution $\frac{18}{72} \times 100$ provided no subsequent steps | 2 | AO2 P1.3.1c |
| 14(b) | any two from: <ul style="list-style-type: none"> so that they do not exceed their daily target so they can track / monitor their energy use so that they can budget for their next energy bill to find out which times of the day most energy is being used meter readings automatically submitted | do not allow reference to the meter limiting their energy use allow no estimated bills | 2 | AO3 P1.3.1b |

| | | | | |
|--------------|--|--|-----------|-----------------------|
| 14(c) | loft insulation has the lowest U-value so is the most effective insulator | allow loft insulation is the best and draught excluders are the worst insulators | 1 | AO2, AO3 P1.1.4a,b |
| | loft insulation / double glazing covers a large area, so energy losses may be higher than expected | allow converse for draught excluders | 1 | |
| | cost effectiveness calculated for each type of insulation: | allow 1 mark for cost effectiveness correctly calculated for 1 or 2 types of insulation | 2 | |
| | double glazing -£4000 loft insulation £1200 draught excluders £380 | accept for 1 mark correct payback times calculated: double glazing 50 years loft insulation 2 years draught excluders 2.4 years or allow 1 mark for correct savings over 10 years calculated: double glazing £1000 loft insulation £1500 draught excluders £500 | | |
| | correct conclusion linked to their calculations | if no other marks scored for cost effectiveness allow 1 mark for a relevant comparison between insulators linked to cost <u>or</u> savings, eg draught excluders have the lowest installation cost or loft insulation reduces the energy bills by the greatest amount per year | 1 | |
| Total | | | 10 | |

