



Cambridge IGCSE™

COMBINED SCIENCE

0653/41

Paper 4 Theory (Extended)

October/November 2023

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **11** printed pages.

PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.

2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.

3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).

4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

5 'List rule' guidance

For questions that require *n* responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided.
- Any response marked *ignore* in the mark scheme should not count towards *n*.
- Incorrect responses should not be awarded credit but will still count towards *n*.
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.
- Non-contradictory responses after the first *n* responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

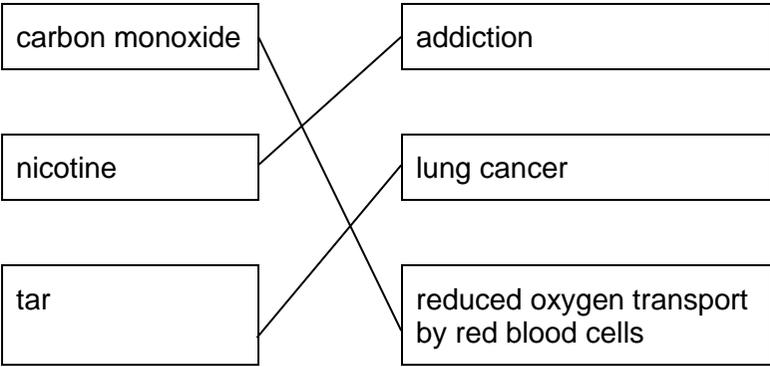
Mark scheme abbreviations

| | |
|------------------|---|
| ; | separates marking points |
| / | separates alternative responses for the same marking point |
| ecf | error carried forward |
| AVP | any valid point |
| ORA | or reverse argument |
| AW | alternative wording |
| <u>underline</u> | actual word given must be used by candidate (grammatical variants accepted) |
| () | the word / phrase in brackets is not required but sets the context |

| Question | Answer | Marks | | | | | | | | | | | | |
|---------------------|--|---|------|----------|----------|------------------|----------------------|------------|----------|---|------------|------|------------|----------|
| 1(a)(i) | <p><i>one mark for each correct row</i></p> <table border="1" data-bbox="338 292 1144 587"> <thead> <tr> <th data-bbox="338 292 580 355">letter in Fig. 1.1.</th> <th data-bbox="580 292 824 355">name</th> <th data-bbox="824 292 1144 355">function</th> </tr> </thead> <tbody> <tr> <td data-bbox="338 355 580 419">A</td> <td data-bbox="580 355 824 419">(salivary gland)</td> <td data-bbox="824 355 1144 419">(secretes amylase) ;</td> </tr> <tr> <td data-bbox="338 419 580 523">(B)</td> <td data-bbox="580 419 824 523">pancreas</td> <td data-bbox="824 419 1144 523">(secretes amylase, protease and lipase) ;</td> </tr> <tr> <td data-bbox="338 523 580 587">(D)</td> <td data-bbox="580 523 824 587">anus</td> <td data-bbox="824 523 1144 587">egestion ;</td> </tr> </tbody> </table> | letter in Fig. 1.1. | name | function | A | (salivary gland) | (secretes amylase) ; | (B) | pancreas | (secretes amylase, protease and lipase) ; | (D) | anus | egestion ; | 3 |
| letter in Fig. 1.1. | name | function | | | | | | | | | | | | |
| A | (salivary gland) | (secretes amylase) ; | | | | | | | | | | | | |
| (B) | pancreas | (secretes amylase, protease and lipase) ; | | | | | | | | | | | | |
| (D) | anus | egestion ; | | | | | | | | | | | | |
| 1(a)(ii) | <p>(mechanical) breakdown of food into smaller pieces / AW ;</p> <p><i>then any one from:</i></p> <p>to increase surface area ; without chemical change (to molecules) ;</p> | 2 | | | | | | | | | | | | |
| 1(b)(i) | pH 4–5 ; | 1 | | | | | | | | | | | | |
| 1(b)(ii) | <p><i>any three from:</i></p> <p>reference to, strongly acidic / low pH conditions (in stomach) ; R is <u>denatured</u> ; <u>active site</u> changes shape ; substrate no longer fits into <u>active site</u> ;</p> | 3 | | | | | | | | | | | | |

| Question | Answer | Marks |
|----------|---|-------|
| 2(a) | does not react / is unreactive ; | 1 |
| 2(b)(i) | lead(II) bromide, is still solid / has not reached melting point / AW ; | 1 |
| 2(b)(ii) | idea that charge can flow (in molten lead(II) bromide) ; idea that the orange vapour is <u>bromine</u> (gas forming) ; idea that the grey shiny liquid is <u>lead</u> (forming) ; | 3 |
| 2(c)(i) | lead AND chlorine ; Pb AND Cl ₂ ; | 2 |
| 2(c)(ii) | different coloured, gas / vapour (formed) ; | 1 |

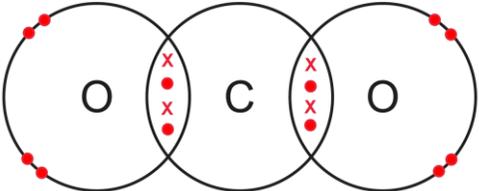
| Question | Answer | Marks |
|----------|---|-------|
| 3(a)(i) | air resistance ; | 1 |
| 3(a)(ii) | air resistance, lift, weight (<i>all required</i>) ; | 1 |
| 3(b) | evidence of, speed = distance ÷ time / 2170 ÷ 620 ; 3.5 (h) ; | 2 |
| 3(c) | unit conversion, 720 000 ÷ 3600 / 200 (m / s) ; evidence of, $KE = \frac{1}{2} m v^2$ / $\frac{1}{2} \times 190\,000 \times 200 \times 200$; 3.8×10^9 / 3 800 000 000 (J) ; | 3 |

| Question | Answer | Marks |
|----------|---|-------|
| 4(a) | intercostal muscle ; | 1 |
| 4(b) | <i>any one from:</i> large (surface) area ; thin (surface) ; good blood supply ; good ventilation (with air) ; AVP ; | 1 |
| 4(c) | (aerobic) respiration ; water (vapour) ; | 2 |
| 4(d) | ciliated / has cilia ; to move mucus (away from lungs) ; | 2 |
| 4(e) |  <p>only three lines and all correct ;</p> | 1 |

| Question | Answer | Marks |
|----------|---|-------|
| 5(a) | > 0 to < 20 (°C) ; > 0 to < 1.0 (mol / dm ³) ; | 2 |
| 5(b) | more (acid) particles (per unit volume) in experiment 2 / concentration (of acid) in experiment 2 is higher, ORA ; so more frequent collisions (between particles) ; | 2 |
| 5(c) | experiment 3 ; it is the highest temperature / the most gas is produced (in 10 s) ; | 2 |
| 5(d)(i) | idea that the metals have different reactivities / correct order of reactivity implied, Mg > Zn > Fe ; higher reactivity causes higher rate of gas production / reaction ; | 2 |
| 5(d)(ii) | no gas collected / no reaction AND copper, is unreactive / does not react with acids ; | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 6(a)(i) | one correct switch symbol ; one switch labelled S2 in heater branch / switch labelled S1 between battery and lamps AND not in heater branch ; correct circuit with no extra components or short circuit ; | 3 |
| 6(a)(ii) | total resistance of rear lamps = 7.0 (Ω) / total resistance of headlamps = 14.0 (Ω) ; evidence of, $R = R_1 \times R_2 \div (R_1 + R_2)$ / $7.0 \times 14.0 \div (7.0 + 14.0)$; 4.7 (Ω) ; | 3 |
| 6(b)(i) | evidence of, $Q = It$ / 150×30 ; 4500 (C) ; | 2 |
| 6(b)(ii) | large (cross-sectional) area means low resistance ORA ; reference to the need to, carry a (very) high current / avoid overheating ; | 2 |

| Question | Answer | Marks |
|-----------------|---|--------------|
| 7(a)(i) | carpel labelled ; | 1 |
| 7(a)(ii) | <i>any two from:</i> (large) petals ; stigma inside flower ; anther inside flower ; | 2 |
| 7(b) | light (energy) AND chemical ; synthesis ; | 2 |
| 7(c)(i) | phloem ; | 1 |
| 7(c)(ii) | starch ; | 1 |
| 7(d) | concentrated sugar solution has a lower water potential / cells have a higher water potential ; water moves out of, the cells / plant ; by osmosis ; through partially permeable membranes ; | 4 |

| Question | Answer | Marks |
|-----------|---|-------|
| 8(a)(i) | the values, only add to 98.8% / do not add up to 100% ; | 1 |
| 8(a)(ii) | <i>any three from:</i> Earth has (a significant amount of), oxygen / water vapour ; Earth has less carbon dioxide ; Earth has more nitrogen ; Earth has less argon ; | 3 |
| 8(b)(i) | 6 ; | 1 |
| 8(b)(ii) |  <p>bonding electrons correct ; non-bonding electrons correct ;</p> | 2 |
| 8(b)(iii) | (causes) <u>enhanced</u> greenhouse effect ; leading to, climate change / stated outcome of climate change, e.g. sea level rise, melting of ice caps, extreme weather events, flooding, crop failure ; | 2 |

| Question | Answer | Marks |
|-----------|---|----------|
| 9(a)(i) | compression correctly labelled with label line and letter C AND rarefaction correctly labelled with label line and letter R ; | 1 |
| 9(a)(ii) | evidence of, $v = f \lambda / 330 \div 1.5$; 220 ; Hz / hertz ; | 3 |
| 9(b)(i) | radio waves ; | 1 |
| 9(b)(ii) | 3.0×10^8 m / s ; | 1 |
| 9(b)(iii) | for longitudinal/sound waves, the direction of oscillation/vibration (of particles) is parallel to the (direction of) energy transfer / AW ; for transverse/electromagnetic waves, the direction of oscillation/vibration (of particles) is perpendicular to the (direction of) energy transfer / AW ; | 2 |
| 9(c) | <i>any two from:</i> incident rays now, parallel to axis / form a beam; idea that refracted rays now pass through, F / (principal) focus; lens must be moved so, (principal) focus / F , is, on / closer to, the screen (for focused image) ; | 2 |