



Cambridge O Level

COMBINED SCIENCE

5129/02

Paper 2 Theory

For examination from 2023

MARK SCHEME

Maximum Mark: 80

Specimen

This document has **12** pages. Any blank pages are indicated.

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.

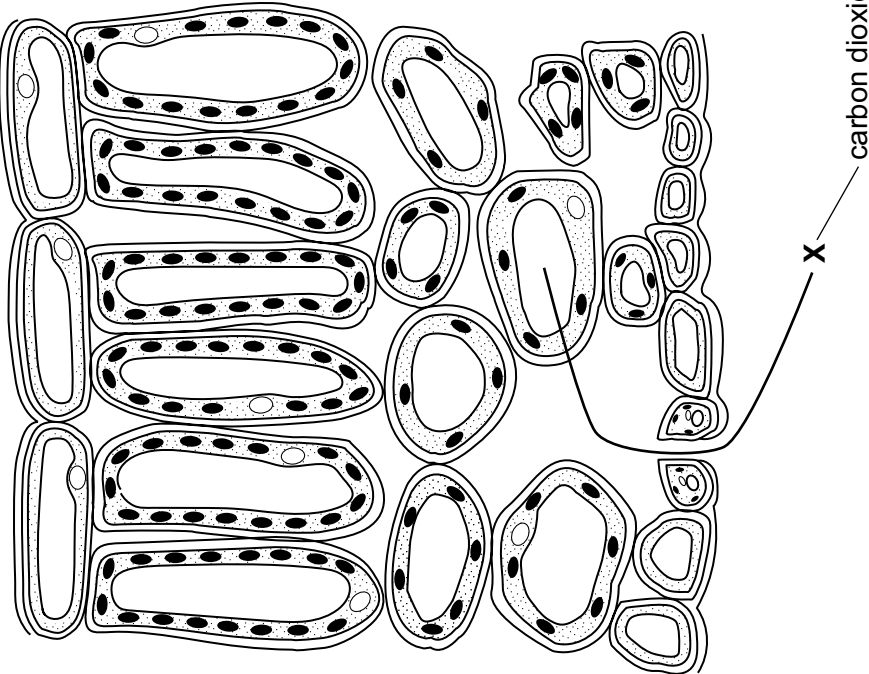
Abbreviations used in the Mark Scheme

- ; separates marking points
- / separates alternatives within a marking point
- **OR** gives alternative marking point
- **AND** statements on both sides of the **AND** are needed for that mark
- **Reject** reject
- **Ignore** ignore (mark as if this material was not present)
- **Accept** accept (a less than ideal answer which should be marked correct)
- **max** indicates the maximum number of marks that can be awarded
- **ecf** credit a correct statement that follows a previous wrong response
- () the word / phrase in brackets is not required, but sets the context
- **underline** actual word given must be used by candidate

| Question | Answer | Marks |
|----------|--|-------|
| 1 | (sap / central / permanent) vacuole ; cell wall ; Accept hair-like protrusion | 2 |

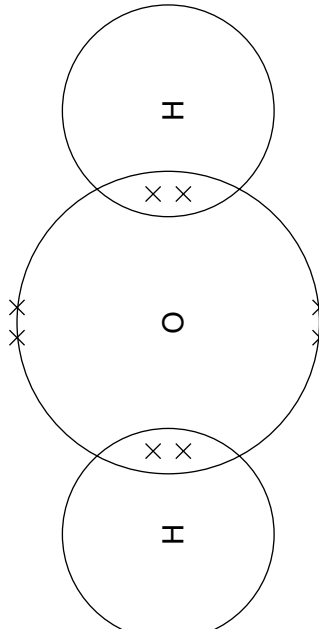
| Question | Answer | Marks |
|----------|---|-------|
| 2(a)(i) | C_6H_{14} | 1 |
| 2(a)(ii) | high temperature ; catalyst ; | 2 |
| 2(b) | complete combustion ; incomplete combustion ; addition / polymerisation ; | 3 |

| Question | Answer | Marks |
|----------|--|-------|
| 3(a)(i) | 3.5 (s) ; | 1 |
| 3(a)(ii) | 3.0 (m / s) ; | 1 |
| 3(b) | $d = s \times t$ or 6.5 s ; 19.5 (m) ; Accept ecf on answer to (a)(ii) | 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 4(a) | <p>line from X, going through stoma ; ending on / in any spongy mesophyll cell ; e.g.</p>  <p>The diagram shows a cross-section of a leaf. On the left, there is a stoma consisting of two guard cells. A line labeled 'X' originates from the stoma and points to a large, irregularly shaped cell in the spongy mesophyll layer. This cell contains several small, dark, oval-shaped chloroplasts. The line 'X' represents the path of a carbon dioxide molecule entering the leaf.</p> | 2 |
| 4(b)(i) | chloroplast ; | 1 |
| 4(b)(ii) | transfers light energy into chemical energy ; | 1 |
| 4(b)(iii) | to produce glucose / carbohydrates ; | 1 |
| 4(c) | provides oxygen (to the atmosphere) ; provides food / glucose / carbohydrate ; | 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 5(a) | 160 ; 88 ; 20 ; | 3 |
| 5(b) | limewater ; turns milky ; | 2 |
| 5(c) | increased global warming / climate change ; Allow effects of increased global warming / climate change | 1 |
| Question | Answer | Marks |
| 6(a) | internal / thermal / heat ; kinetic ; | 2 |
| 6(b)(i) | vertical arrow pointing upwards from the flame ; | 1 |
| 6(b)(ii) | (molecules have) increased speed / increased kinetic energy ; (molecules) move further apart / separation increases ; | 2 |
| 6(b)(iii) | $(1.2 \times 10^{-5} \times 3.0 \times 10^{-2}) = 3.6 \times 10^{-7}$ (N m) | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 7 | <p>1 mark for each correct line ; ; ; ;</p> <p>process</p> <p>breaks down excess amino acids</p> <p>transports blood towards the heart</p> <p>excretes urea</p> <p>pumps blood to the lungs</p> <p>structure</p> <p>vein</p> <p>liver</p> <p>heart</p> <p>artery</p> <p>kidney</p> <pre> graph TD subgraph Process_Boxes [process] P1[breaks down excess amino acids] P2[transports blood towards the heart] P3[excretes urea] P4[pumps blood to the lungs] end subgraph Structure_Boxes [structure] S1[vein] S2[liver] S3[heart] S4[artery] S5[kidney] end P1 --- S2 P2 --- S3 P3 --- S5 P4 --- S1 </pre> | 4 |

| Question | Answer | Marks |
|----------|---|-------|
| 8(a) | insoluble material / solids ; carbon ; kill microbes / sterilise water ; | 3 |
| 8(b)(i) | 2 bonding pairs only ; 2 lone pairs on oxygen only ; as shown on diagram  | 2 |
| 8(b)(ii) | weak intermolecular forces ; | 1 |

| Question | Answer | Marks |
|-----------|---|-------|
| 9(a)(i) | 4.5 (V) ; | 1 |
| 9(a)(ii) | $R = \frac{V}{I}$ 12 (Ω) ; | 2 |
| 9(a)(iii) | $P = VI$ OR $(4.5 - 2.4 =) 2.1$ (V) ; $(2.1 \times 0.20 =) 0.42$ (W) ; ecf on answers to (a)(i) | 2 |
| 9(b) | electrons ; movement of free / delocalised electrons ; (also gains first marking point) | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 10(a) | $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ 1 mark for chemicals ; 1 mark for balancing ; | 2 |
| 10(b) | Any two from: lactic acid is produced by anaerobic respiration ; less energy (per molecule of glucose) is produced ; water is not produced ; carbon dioxide is not produced ; oxygen is not used ; | 2 |

| Question | Answer | Marks |
|-----------|---|-------|
| 11(a)(i) | time between 1–29 inclusive ; time greater than 30 ; | 2 |
| 11(a)(ii) | line starting at 0, 0 with same or lower gradient ; line levels off at half the height ; | 2 |
| 11(b) | decreases ; | 1 |

| Question | Answer | Marks |
|-----------|---|-------|
| 12(a) | mobile (cell) phone / Bluetooth / microwave ovens ; hospital use in medical imaging / security scanners / killing cancerous cells ; photography / vision ; Accept alternative correct responses | 3 |
| 12(b)(i) | same ; | 1 |
| 12(b)(ii) | microwave is lower OR gamma is higher ; | 1 |

| Question | Answer | Marks |
|-----------|--|-------|
| 13(a)(i) | lipase ; | 1 |
| 13(a)(ii) | fatty acids AND glycerol ; | 1 |
| 13(b)(i) | X = ileum ; Ignore small intestine Y = colon ; Ignore large intestine | 2 |
| 13(b)(ii) | 77 – 69 ; 8 ; Accept graph readings to \pm half a small square | 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 14(a)(i) | orange ; | 1 |
| 14(a)(ii) | $2\text{NaBr} + \text{Cl}_2 \rightarrow 2\text{NaCl} + \text{Br}_2$; | 1 |
| 14(b) | iodine less reactive than bromine / bromine is more reactive than iodine ; | 1 |
| 14(c) | value >0 , <3.2 ; | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 15(a) | unstable nucleus changes ; (emits) α , β or γ radiation ; | 2 |
| 15(b) | alpha ; | 1 |
| 15(c) | kills bacteria ; food stays fresh longer ; | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 16 | energy is lost between each stage of the food chain ; more energy is lost if there are two stages / less energy is lost if there is only one stage ; (by) movement / growth / respiration / defecation / excretion / inedible parts of the livestock ; | 3 |

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