



Cambridge IGCSE™

CO-ORDINATED SCIENCES

0654/32

Paper 3 Theory (Core)

May/June 2023

MARK SCHEME

Maximum Mark: 120

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 May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **14** 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.

Acronyms and shorthand in the mark scheme

| Acronym / shorthand | Explanation |
|----------------------------|--|
| Brackets () | Words not explicitly needed in an answer, however if a contradictory word / phrase / unit to that in the brackets is seen the mark is not awarded. |
| <u>Underlining</u> | The underlined word (or a synonym) must be present for the mark to be scored. If the word is a technical scientific term, the word must be there. |
| / or OR | Alternative answers any one of which gains the credit for that mark. |
| owtte | Or words to that effect. |
| ORA | Or reverse argument. |
| AW | Alternative wording |
| AVP | Alternative valid point |

| Question | Answer | Marks | | | | | | | | | | | | |
|--|---|---------------------|----------------------|---------------------|------------------|--|---|---|---|---|--|---|--|---|
| 1(a) | A ; E ; C ; | 3 | | | | | | | | | | | | |
| 1(b) | oviduct ; | 1 | | | | | | | | | | | | |
| 1(c) | <table border="1"> <thead> <tr> <th></th> <th>asexual reproduction</th> <th>sexual reproduction</th> </tr> </thead> <tbody> <tr> <td>involves gametes</td> <td></td> <td>✓</td> </tr> <tr> <td>involves inheritance of genetic information</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>offspring is genetically identical to the parent</td> <td>✓</td> <td></td> </tr> </tbody> </table> ;; | | asexual reproduction | sexual reproduction | involves gametes | | ✓ | involves inheritance of genetic information | ✓ | ✓ | offspring is genetically identical to the parent | ✓ | | 2 |
| | asexual reproduction | sexual reproduction | | | | | | | | | | | | |
| involves gametes | | ✓ | | | | | | | | | | | | |
| involves inheritance of genetic information | ✓ | ✓ | | | | | | | | | | | | |
| offspring is genetically identical to the parent | ✓ | | | | | | | | | | | | | |
| 1(d) | ref to 8 divisions ; $2^8 = 256$; | 2 | | | | | | | | | | | | |
| 1(e) | <i>any three from:</i> movement ; respiration ; sensitivity ; growth ; excretion ; nutrition ; | 3 | | | | | | | | | | | | |

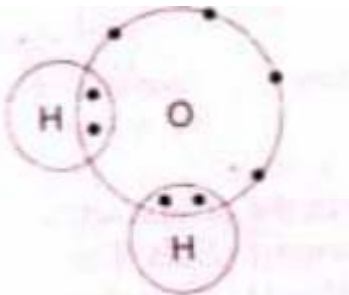
| Question | Answer | Marks |
|-----------|-----------------------------------|-------|
| 2(a)(i) | lead bromide ; | 1 |
| 2(a)(ii) | ammonium nitrate ; | 1 |
| 2(a)(iii) | carbon dioxide / sulfur dioxide ; | 1 |

| Question | Answer | Marks |
|----------|--|-------|
| 2(a)(iv) | carbon dioxide ; | 1 |
| 2(a)(v) | aluminium oxide ; | 1 |
| 2(b) | <i>any three from:</i> conducts heat ; conducts electricity ; malleable ; high melting/boiling point ; | 3 |
| 2(c)(i) | $95 / 100 \times 20$ $= 19$ (kg) ; | 1 |
| 2(c)(ii) | because it is not a pure substance / it is a mixture ; | 1 |

| Question | Answer | Marks |
|----------|---|-------|
| 3(a) | 78 hours = $78 \times 3600 = 280\,800$ seconds ; speed = distance / time (in any form) or $384\,000 / 280\,800$; $= 1.37$ (km / s) ; | 3 |
| 3(b)(i) | weight = mass \times g (in any form) or 90×10 ; $= 900$ (N) ; | 2 |
| 3(b)(ii) | 90 (kg) ; | 1 |
| 3(c)(i) | radio (waves) in right hand box ; | 1 |
| 3(c)(ii) | sound waves need a medium / sound waves do not travel through a vacuum ; | 1 |
| 3(d)(i) | atoms of the same element that have different numbers of neutrons ; OR atoms which have the same number of protons and different numbers of neutrons ; OR atoms which have the same atomic number but different mass number ; | 1 |

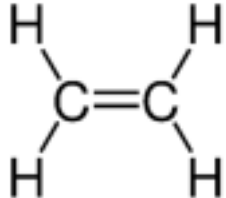
| Question | Answer | Marks |
|----------|---------------------------|-------|
| 3(d)(ii) | electrons ; negative ; | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 4(a)(i) | infections in 1998 – 4600 and infections in 2002 – 7000 ; $((7000 - 4600) / 4600) \times 100 = 52$; | 2 |
| 4(a)(ii) | <i>any three from:</i> increased education / awareness ; use of condoms ; screening of blood transfusions ; use of clean needles ; increased screening ; AVP ; | 3 |
| 4(b) | <i>cell type A</i> red blood cell ; transport of oxygen ; <i>cell type B</i> white blood cell ; production of antibodies / phagocytosis ; | 4 |
| 4(c) | heart ; | 1 |

| Question | Answer | Marks |
|-----------|---|-------|
| 5(a) | oxygen – 21% ; nitrogen – 78% ; | 2 |
| 5(b) | named noble gas ; correct use ; | 2 |
| 5(c)(i) | nos of oxygen atoms is different on LHS to RHS ; | 1 |
| 5(c)(ii) | $2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2\text{O} + \text{O}_2$; | 1 |
| 5(c)(iii) |  <p>1 shared pair ; all else correct ;</p> | 2 |
| 5(c)(iv) | covalent (bonds) ; | 1 |
| 5(c)(v) | anhydrous copper sulfate ; white to blue ; OR cobalt chloride (paper) ; blue to pink ; | 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 6(a)(i) | bat ; | 1 |
| 6(a)(ii) | elephant ; | 1 |
| 6(a)(iii) | 20 (Hz) to 20 000 (Hz) ; | 1 |
| 6(b) | mass = density \times volume (in any form) or 1030×3.4 ; = 3500 (kg) ; | 2 |
| 6(c)(i) | fastest moving molecules escape ; from the surface of the liquid ; | 2 |
| 6(c)(ii) | evaporation has a cooling effect ; | 1 |
| 6(c)(iii) | liquid – all molecules touching random arrangement ; gas – molecules widely separated (no more than seven shown) and random arrangement ; | 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 7(a) | differences between individuals (of the same species) / AW ; | 1 |
| 7(b)(i) | 150.0–154.9 (cm) ; | 1 |
| 7(b)(ii) | phenotypes ; two ; | 2 |
| 7(b)(iii) | tongue rolling / AVP ; | 1 |
| 7(c)(i) | carnivore ; | 1 |
| 7(c)(ii) | died ; alleles ; generations ; | 3 |
| 7(c)(iii) | natural selection ; | 1 |

| Question | Answer | Marks |
|-----------|--|-------|
| 8(a)(i) | coal / natural gas ; | 1 |
| 8(a)(ii) | fractional distillation ; | 1 |
| 8(a)(iii) | gasoline / naphtha / bitumen ; | 1 |
| 8(a)(iv) | (bottled gas for) heating and cooking ; fuel for diesel engines ; | 2 |
| 8(b) |  carbon carbon double bond ; all else correct ; | 2 |
| 8(c)(i) | poly(ethene) ; | 1 |
| 8(c)(ii) | addition (polymerisation) ; | 1 |

| Question | Answer | Marks |
|----------|---|-------|
| 9(a)(i) | 0.6(A) ; | 1 |
| 9(a)(ii) | correct symbol ; across lamp Y ; | 2 |
| 9(b) | PD = current x resistance (in any form) or 0.6×4 ; = 2.4 ; volts / V ; | 3 |
| 9(c)(i) | light ; thermal ; (in either order) | 2 |

| Question | Answer | Marks |
|----------|------------------------|-------|
| 9(c)(ii) | chemical (potential) ; | 1 |

| Question | Answer | Marks |
|------------|---|-------|
| 10(a)(i) | arrow drawn from left to right ; | 1 |
| 10(a)(ii) | cell membrane ; | 1 |
| 10(a)(iii) | <i>similarity:</i> <ul style="list-style-type: none"> both involve random movement of particles / movement is down a concentration gradient ; <i>difference:</i> <ul style="list-style-type: none"> osmosis is the movement of water (only) / osmosis (only) occurs across partially permeable membrane ; | 2 |
| 10(b)(i) | carbon dioxide ; water ; | 2 |
| 10(b)(ii) | muscle ; synthesis ; cell ; | 3 |

| Question | Answer | Marks |
|------------|--|-------|
| 11(a)(i) | 20 (electrons) ; | 1 |
| 11(a)(ii) | 18 (electrons) ; | 1 |
| 11(b)(i) | calcium carbonate → calcium oxide + carbon dioxide ; | 1 |
| 11(b)(ii) | carbon dioxide released ; | 1 |
| 11(b)(iii) | (thermal) energy taken in ; | 1 |
| 11(b)(iv) | neutralising acidified soil ; | 1 |

| Question | Answer | Marks |
|-----------|--|-------|
| 11(b)(v) | to increase surface area ; so that reaction is faster ; | 2 |
| 11(c)(i) | three ; | 1 |
| 11(c)(ii) | five ; | 1 |

| Question | Answer | Marks | | | | | | | | | | | | | | | | | | |
|---------------------|---|---------------|-----------|---------------|------|--|---|---------------------|---|--|-------------|--|---|-------|---|--|-------|---|--|---|
| 12(a) | <table border="1"> <thead> <tr> <th>energy source</th> <th>renewable</th> <th>non-renewable</th> </tr> </thead> <tbody> <tr> <td>coal</td> <td></td> <td>✓</td> </tr> <tr> <td>hydroelectric (HEP)</td> <td>✓</td> <td></td> </tr> <tr> <td>natural gas</td> <td></td> <td>✓</td> </tr> <tr> <td>solar</td> <td>✓</td> <td></td> </tr> <tr> <td>tidal</td> <td>✓</td> <td></td> </tr> </tbody> </table> <p>2 or 3 correct ; 4 correct ;</p> | energy source | renewable | non-renewable | coal | | ✓ | hydroelectric (HEP) | ✓ | | natural gas | | ✓ | solar | ✓ | | tidal | ✓ | | 2 |
| energy source | renewable | non-renewable | | | | | | | | | | | | | | | | | | |
| coal | | ✓ | | | | | | | | | | | | | | | | | | |
| hydroelectric (HEP) | ✓ | | | | | | | | | | | | | | | | | | | |
| natural gas | | ✓ | | | | | | | | | | | | | | | | | | |
| solar | ✓ | | | | | | | | | | | | | | | | | | | |
| tidal | ✓ | | | | | | | | | | | | | | | | | | | |
| 12(b)(i) | section Q and 1 (m / s) OR section S and 5 (m / s) ; | 1 | | | | | | | | | | | | | | | | | | |
| 12(b)(ii) | section R AND greatest gradient ; | 1 | | | | | | | | | | | | | | | | | | |
| 12(b)(iii) | area under graph or $1/2 \times 1 \times 300$; 150 (m) ; | 2 | | | | | | | | | | | | | | | | | | |
| 12(c)(i) | both rays meet at F ; | 1 | | | | | | | | | | | | | | | | | | |
| 12(c)(ii) | principal focus ; | 1 | | | | | | | | | | | | | | | | | | |

| Question | Answer | Marks |
|-----------------|---------------|--------------|
| 12(d)(i) | B ; | 1 |
| 12(d)(ii) | E ; | 1 |