

# Cambridge IGCSE™

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**COMBINED SCIENCE****0653/42**

Paper 4 Theory (Extended)

**May/June 2023**

MARK SCHEME

Maximum Mark: 80

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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.

## 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 | <p><u>'List rule' guidance</u></p> <p>For questions that require <b><i>n</i></b> responses (e.g. State <b>two</b> reasons ...):</p> <ul style="list-style-type: none"> <li>• The response should be read as continuous prose, even when numbered answer spaces are provided.</li> <li>• Any response marked <i>ignore</i> in the mark scheme should not count towards <b><i>n</i></b>.</li> <li>• Incorrect responses should not be awarded credit but will still count towards <b><i>n</i></b>.</li> <li>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should <b>not</b> 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.</li> <li>• Non-contradictory responses after the first <b><i>n</i></b> responses may be ignored even if they include incorrect science.</li> </ul> |

**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)   | mango (fruit) → (fruit) flies → thrushes → eagle ;;<br><br><i>correct order = one mark</i><br><i>arrows in correct direction = one mark</i> | 2     |
| 1(a)(ii)  | secondary ;<br><br>three ;                                                                                                                  | 2     |
| 1(b)(i)   | $\frac{0.82}{100} \times 85$ ;<br><br>0.697 ;<br><br>0.7 ;                                                                                  | 3     |
| 1(b)(ii)  | lipase ;<br><br>fatty acids <b>and</b> glycerol ;                                                                                           | 2     |
| 1(b)(iii) | contains fibre ;                                                                                                                            | 1     |

| Question | Answer                                                                                                                                                                                      | Marks |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 2(a)(i)  | water ;                                                                                                                                                                                     | 1     |
| 2(a)(ii) | hydrogen <b>ions</b> attracted to / move to, cathode / negative electrode ;<br><br>reference to gain of electrons ;<br><br>(two) hydrogen atoms join to form a molecule (of hydrogen gas) ; | 3     |
| 2(b)(i)  | chlorine ;                                                                                                                                                                                  | 1     |

| Question | Answer                                                       | Marks |
|----------|--------------------------------------------------------------|-------|
| 2(b)(ii) | (damp) litmus (paper) <b>and</b> bleached / goes white ;     | 1     |
| 2(c)(i)  | is inert / is unreactive <b>and</b> conducts (electricity) ; | 1     |
| 2(c)(ii) | transition (elements / metals) ;                             | 1     |

| Question | Answer                                                                                                                                                                                                                                                                        | Marks |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3(a)(i)  | at constant speed / at 20 m / s ;                                                                                                                                                                                                                                             | 1     |
| 3(a)(ii) | <b>X</b> at top / bottom of line between t = 45 s and t = 50 s / between t = 58 s and t = 60 s ;                                                                                                                                                                              | 1     |
| 3(b)     | max speed of car = 25 m / s ;<br>(unit conversions) $100 \times 1000 \div 3600$ / 27.8 m / s (so limit not broken) ;<br><b>OR</b><br>max speed of car = 25 m / s ;<br>(unit conversions) $25 \times 3600 \div 1000$ / 90 km / h (less than 100 km / h (so limit not broken) ; | 2     |
| 3(c)     | use of area under graph (stated or evidence) ;<br>(implementation): $20 \times 10 + \frac{1}{2} \times 20 \times 15$ ;<br>350 (m) ;                                                                                                                                           | 3     |
| 3(d)(i)  | focal length ;                                                                                                                                                                                                                                                                | 1     |
| 3(d)(ii) | <i>speed = distance ÷ time</i> (stated or evidence of use) / $t = 15 \div 3 \times 10^8$ ;<br>$5(.0) \times 10^{-8}$ (s) ;                                                                                                                                                    | 2     |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                        | Marks                             |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------|----------|-----|--------------------------------------|------------------|-----|-----------------|-----------------------|---|----------|-----------------------------------|---|
| 4(a)     | <table border="1"> <thead> <tr> <th>letter</th><th>name of part</th><th>function</th></tr> </thead> <tbody> <tr> <td>(A)</td><td>palisade<br/>(mesophyll cell / layer)</td><td>(photosynthesis)</td></tr> <tr> <td>(D)</td><td>stoma / stomata</td><td>to allow gas exchange</td></tr> <tr> <td>C</td><td>(phloem)</td><td>transport (sucrose / amino acids)</td></tr> </tbody> </table> <p>one mark for each correct row</p> | letter                            | name of part | function | (A) | palisade<br>(mesophyll cell / layer) | (photosynthesis) | (D) | stoma / stomata | to allow gas exchange | C | (phloem) | transport (sucrose / amino acids) | 3 |
| letter   | name of part                                                                                                                                                                                                                                                                                                                                                                                                                  | function                          |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |
| (A)      | palisade<br>(mesophyll cell / layer)                                                                                                                                                                                                                                                                                                                                                                                          | (photosynthesis)                  |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |
| (D)      | stoma / stomata                                                                                                                                                                                                                                                                                                                                                                                                               | to allow gas exchange             |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |
| C        | (phloem)                                                                                                                                                                                                                                                                                                                                                                                                                      | transport (sucrose / amino acids) |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |
| 4(b)(i)  | $6 \text{ (H}_2\text{O)} + 6 \text{ (CO}_2\text{)} ;$<br>$\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 ;$                                                                                                                                                                                                                                                                                                                  | 2                                 |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |
| 4(b)(ii) | <p>any three from:</p> <p>photosynthesis stops / slows down ;</p> <p>enzymes denature ;</p> <p>active site changes shape ;</p> <p>substrate no longer fits active site ;</p>                                                                                                                                                                                                                                                  | 3                                 |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |
| 4(c)     | <p>phototropism ;</p> <p>auxin ;</p> <p>elongation ;</p>                                                                                                                                                                                                                                                                                                                                                                      | 3                                 |              |          |     |                                      |                  |     |                 |                       |   |          |                                   |   |

| Question | Answer                                                                                                                                                                                                                                        | Marks |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 5(a)     | temperature: < 20 ;<br>concentration of acid: < 1.0 ;                                                                                                                                                                                         | 2     |
| 5(b)     | experiment 2 is faster because it is at a higher temperature ;<br>particles, have more energy / move faster / have more frequent collisions ;<br>more particles have energy greater than the activation energy / more successful collisions ; | 3     |
| 5(c)     | experiment 3 ;<br>it is the highest concentration ;                                                                                                                                                                                           | 2     |
| 5(d)(i)  | (no gas given off because) copper, is unreactive / does not react with acids ;                                                                                                                                                                | 1     |
| 5(d)(ii) | named metal, more reactive than calcium / any of the metals in the table ;                                                                                                                                                                    | 1     |

| Question | Answer                                                                                                                                                                                                                                                                                                                                     | Marks |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 6(a)(i)  | nuclear fusion ;                                                                                                                                                                                                                                                                                                                           | 1     |
| 6(a)(ii) | nuclear (fission) / tidal ;                                                                                                                                                                                                                                                                                                                | 1     |
| 6(b)(i)  | boils / turns to steam ;<br>(temperature of rock is) above 100 °C / boiling point of water is 100 °C / higher than the b.pt of water ;                                                                                                                                                                                                     | 2     |
| 6(b)(ii) | pressure = force ÷ area / $F = p \times A$ (stated or evidence of use) ;<br>area of borehole $A = \pi r^2 / 3.14 \times 0.12 \times 0.12 / 0.045 \text{ (m}^2\text{)} ;$<br>$F = 6 \times 10^6 \times 3.14 \times 0.12 \times 0.12 / 6 \times 10^6 \times 0.045 ;$<br>$0.27 \times 10^6 \text{ N} / 270\,000 \text{ N} / 270 \text{ kN} ;$ | 4     |

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| Question | Answer                                                                                                    | Marks    |
|----------|-----------------------------------------------------------------------------------------------------------|----------|
| 6(c)(i)  | <b>gravitational</b> potential ;                                                                          | <b>1</b> |
| 6(c)(ii) | (PE stored =) $mg\Delta h$ (stated or evidence of use) / $1000 \times 10 \times 200$ ;<br>2 000 000 (J) ; | <b>2</b> |

| Question | Answer                                                                                                                                           | Marks    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 7(a)(i)  | diffusion ;                                                                                                                                      | <b>1</b> |
| 7(a)(ii) | <i>any two from:</i><br>large surface area ;<br><br>thin surface ;<br><br>good ventilation ;<br><br>AVP, e.g. moist / short diffusion distance ; | <b>2</b> |
| 7(b)     | produce mucus ;<br><br>(mucus) traps, particles / pathogens / microbes ;                                                                         | <b>2</b> |
| 7(c)     | chronic obstructive pulmonary disease / COPD ;                                                                                                   | <b>1</b> |

| Question | Answer                                                                                                                                                   | Marks |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 8(a)     | decane <b>and</b> pentane ;<br><i>reason:</i> they are saturated (hydrocarbons) / do not contain double (C=C) bonds / contain <b>only</b> single bonds ; | 2     |
| 8(b)     | <i>any two from:</i><br>high temperature ;<br>high pressure ;<br>catalyst ;                                                                              | 2     |
| 8(c)     | (some carbon – carbon single) bonds break ;<br>(some) carbon atoms form double bonds (with each other) ;                                                 | 2     |
| 8(d)     | they have different boiling points ;                                                                                                                     | 1     |
| 8(e)(i)  | bottled gas / heating and cooking ;                                                                                                                      | 1     |
| 8(e)(ii) | (source / reactant for) making (other) chemicals ;                                                                                                       | 1     |

| Question | Answer                                                                                                                                                                                                                     | Marks |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 9(a)(i)  | resistance = p.d. ÷ current (stated or evidence of use) / (R =) $6.0 \div 0.75$ ;<br>8(.0) ( $\Omega$ ) ;                                                                                                                  | 2     |
| 9(a)(ii) | correct symbol connected in parallel ;<br>connection to right of battery made between battery and bell push ;                                                                                                              | 2     |
| 9(b)     | resistance of wiring increases with length / idea that resistance in the bell branch is too high ;<br>p.d. <b>across bell</b> now less (than 6.0 V while still 6.0 V across lamp) / <b>current in the bell</b> decreases ; | 2     |