

# Cambridge IGCSE™

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**CO-ORDINATED SCIENCES****0654/33**

Paper 3 Theory (Core)

**October/November 2024**

MARK SCHEME

Maximum Mark: 120

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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 October/November 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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This document consists of **13** 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 descriptions 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.

| Question | Answer                                                                                                                          | Marks    |
|----------|---------------------------------------------------------------------------------------------------------------------------------|----------|
| 1(a)(i)  | <b>B ;</b><br><b>D ;</b><br><b>A ;</b>                                                                                          | <b>3</b> |
| 1(a)(ii) | <b>X</b> drawn on prostate gland ;                                                                                              | <b>1</b> |
| 1(b)(i)  | egg / ova / ovum ;                                                                                                              | <b>1</b> |
| 1(b)(ii) | (0.1 / 0.05 =) 2 ;                                                                                                              | <b>1</b> |
| 1(c)(i)  | glucose + oxygen → carbon dioxide + water<br>1 mark for reactants ;<br>1 mark for products ;                                    | <b>2</b> |
| 1(c)(ii) | energy ;                                                                                                                        | <b>1</b> |
| 1(d)     | fusion of the, sperm / male gamete, and, egg / female gamete ;<br>ref to nuclei ;<br>fertilisation takes place in the oviduct ; | <b>3</b> |

| Question  | Answer           | Marks    |
|-----------|------------------|----------|
| 2(a)(i)   | copper sulfate ; | <b>1</b> |
| 2(a)(ii)  | ethanol ;        | <b>1</b> |
| 2(a)(iii) | aluminium ;      | <b>1</b> |
| 2(a)(iv)  | sulfur ;         | <b>1</b> |
| 2(a)(v)   | chlorine ;       | <b>1</b> |
| 2(a)(vi)  | limestone ;      | <b>1</b> |

| Question | Answer                            | Marks |
|----------|-----------------------------------|-------|
| 2(b)(i)  | 7 ;                               | 1     |
| 2(b)(ii) | 3 ;                               | 1     |
| 2(c)(i)  | magnesium sulfate ;<br>hydrogen ; | 2     |
| 2(c)(ii) | filtration ;                      | 1     |

| Question | Answer                                                                                             |  |          |               |             |  |          | Marks |
|----------|----------------------------------------------------------------------------------------------------|--|----------|---------------|-------------|--|----------|-------|
| 3(a)(i)  | radio waves                                                                                        |  | infrared | visible light | ultraviolet |  | γ - rays | 2     |
|          | infrared correct ;<br>ultraviolet correct ;                                                        |  |          |               |             |  |          |       |
| 3(a)(ii) | 300 000 000 (m / s) ;                                                                              |  |          |               |             |  |          | 1     |
| 3(b)     | the reflection of sound ;                                                                          |  |          |               |             |  |          | 1     |
| 3(c)(i)  | principal focus / focal point ;                                                                    |  |          |               |             |  |          | 1     |
| 3(c)(ii) | horizontal line drawn from lens to intersect with ray 1 ;<br>inverted (labelled) arrow for image ; |  |          |               |             |  |          | 2     |
| 3(d)     | total distance 180 m ;<br>evidence of speed = distance ÷ time / 180 ÷ 6.0 ;<br>30 (m/s) ;          |  |          |               |             |  |          | 3     |

| Question       | Answer                                                                                                                                                                                                                                                                                                     | Marks  |                |        |                |                |   |  |   |             |  |   |  |   |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------|--------|----------------|----------------|---|--|---|-------------|--|---|--|---|
| 4(a)           | <div><div>X</div><div>Y</div><div>absorption of water</div><div>photosynthesis</div><div>maintain a constant internal temperature</div><div>transport of mineral ions</div><div>transport of water</div><div>transfers electrical impulses</div></div> <p>one mark for each correct line<br/>...<br/>;</p> | 3      |                |        |                |                |   |  |   |             |  |   |  |   |
| 4(b)           | transport of, dissolved sugars / sucrose / amino acids ;                                                                                                                                                                                                                                                   | 1      |                |        |                |                |   |  |   |             |  |   |  |   |
| 4(c)(i)        | (nitrate ions) are needed to, synthesise / make, amino acids ;<br>amino acids make up proteins (which are required for growth) ;                                                                                                                                                                           | 2      |                |        |                |                |   |  |   |             |  |   |  |   |
| 4(c)(ii)       | chlorophyll ;                                                                                                                                                                                                                                                                                              | 1      |                |        |                |                |   |  |   |             |  |   |  |   |
| 4(d)           | <table><tr><td></td><td>light</td><td>oxygen</td><td>carbon dioxide</td></tr><tr><td>photosynthesis</td><td>✓</td><td></td><td>✓</td></tr><tr><td>germination</td><td></td><td>✓</td><td></td></tr></table> <p>1 mark for each correct row ;;</p>                                                          |        | light          | oxygen | carbon dioxide | photosynthesis | ✓ |  | ✓ | germination |  | ✓ |  | 2 |
|                | light                                                                                                                                                                                                                                                                                                      | oxygen | carbon dioxide |        |                |                |   |  |   |             |  |   |  |   |
| photosynthesis | ✓                                                                                                                                                                                                                                                                                                          |        | ✓              |        |                |                |   |  |   |             |  |   |  |   |
| germination    |                                                                                                                                                                                                                                                                                                            | ✓      |                |        |                |                |   |  |   |             |  |   |  |   |

| Question  | Answer                                                                                                                                                                                                                                                                                                                                                |                    |                         |  | Marks   |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------|--|---------|---------|--------------------|-------------------------|----------|-----------------|------|-----|---------|-----------------|----|--------|--------|----------------|-----|-------|---|
| 5(a)(i)   | hydrogen + chlorine → hydrogen chloride ;                                                                                                                                                                                                                                                                                                             |                    |                         |  | 1       |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| 5(a)(ii)  | two non-metals bonding ;                                                                                                                                                                                                                                                                                                                              |                    |                         |  | 1       |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| 5(a)(iii) | one pair of bonding electrons ;<br>all else correct ;                                                                                                                                                                                                                                                                                                 |                    |                         |  | 2       |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| 5(a)(iv)  | use universal indicator ;<br>colour indicates the pH ;                                                                                                                                                                                                                                                                                                |                    |                         |  | 2       |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| 5(a)(v)   | any value between 1 and 3 ;                                                                                                                                                                                                                                                                                                                           |                    |                         |  | 1       |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| 5(b)(i)   | <table><tr><th>element</th><th>formula</th><th>melting point / °C</th><th>physical state at 20 °C</th></tr><tr><td>chlorine</td><td>Cl<sub>2</sub></td><td>-101</td><td>gas</td></tr><tr><td>bromine</td><td>Br<sub>2</sub></td><td>-7</td><td>liquid</td></tr><tr><td>iodine</td><td>I<sub>2</sub></td><td>113</td><td>solid</td></tr></table><br>;; |                    |                         |  | element | formula | melting point / °C | physical state at 20 °C | chlorine | Cl <sub>2</sub> | -101 | gas | bromine | Br <sub>2</sub> | -7 | liquid | iodine | I <sub>2</sub> | 113 | solid | 2 |
| element   | formula                                                                                                                                                                                                                                                                                                                                               | melting point / °C | physical state at 20 °C |  |         |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| chlorine  | Cl <sub>2</sub>                                                                                                                                                                                                                                                                                                                                       | -101               | gas                     |  |         |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| bromine   | Br <sub>2</sub>                                                                                                                                                                                                                                                                                                                                       | -7                 | liquid                  |  |         |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| iodine    | I <sub>2</sub>                                                                                                                                                                                                                                                                                                                                        | 113                | solid                   |  |         |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| 5(b)(ii)  | halogens ;                                                                                                                                                                                                                                                                                                                                            |                    |                         |  | 1       |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |
| 5(b)(iii) | all have 7 electrons in their outer shell ;                                                                                                                                                                                                                                                                                                           |                    |                         |  | 1       |         |                    |                         |          |                 |      |     |         |                 |    |        |        |                |     |       |   |

| Question            | Answer                                                                                                                                                                                                                                                                                                                                                                                                           | Marks            |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------|--------|---------------------|----------------|----------|--------------------|----------|----------|----------------|----------------------|------------------|---|
| 6(a)(i)             | <table border="1"> <tr> <td>radiation</td><td>nature</td><td>charge</td></tr> <tr> <td><math>\alpha</math>-particles</td><td>helium nucleus</td><td>positive</td></tr> <tr> <td><math>\beta</math>-particles</td><td>electron</td><td>negative</td></tr> <tr> <td><math>\gamma</math>-rays</td><td>electromagnetic wave</td><td>no charge / zero</td></tr> </table> <p>;;;<br/>one mark for each correct row</p> | radiation        | nature | charge | $\alpha$ -particles | helium nucleus | positive | $\beta$ -particles | electron | negative | $\gamma$ -rays | electromagnetic wave | no charge / zero | 3 |
| radiation           | nature                                                                                                                                                                                                                                                                                                                                                                                                           | charge           |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| $\alpha$ -particles | helium nucleus                                                                                                                                                                                                                                                                                                                                                                                                   | positive         |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| $\beta$ -particles  | electron                                                                                                                                                                                                                                                                                                                                                                                                         | negative         |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| $\gamma$ -rays      | electromagnetic wave                                                                                                                                                                                                                                                                                                                                                                                             | no charge / zero |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| 6(a)(ii)            | <p>(in order)<br/> <math>\alpha</math> (-particles)<br/> <math>\beta</math> (-particles)<br/> <math>\gamma</math> (-rays)<br/> ;</p>                                                                                                                                                                                                                                                                             | 1                |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| 6(a)(iii)           | $\gamma$ -rays ;                                                                                                                                                                                                                                                                                                                                                                                                 | 1                |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| 6(b)(i)             | scanning / imaging (tissues) inside the body ;                                                                                                                                                                                                                                                                                                                                                                   | 1                |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| 6(b)(ii)            | any value above 20 000 (Hz) ;                                                                                                                                                                                                                                                                                                                                                                                    | 1                |        |        |                     |                |          |                    |          |          |                |                      |                  |   |
| 6(c)                | <p>most energetic molecules escape ;<br/> from surface of liquid ;<br/> lowering the temperature of the remaining ethanol molecules ;</p>                                                                                                                                                                                                                                                                        | 3                |        |        |                     |                |          |                    |          |          |                |                      |                  |   |

| Question | Answer                                                                        | Marks    |
|----------|-------------------------------------------------------------------------------|----------|
| 7(a)(i)  | A <b>AND</b> C ;<br>A ;<br>C ;                                                | <b>3</b> |
| 7(a)(ii) | temperature / AVP ;                                                           | <b>1</b> |
| 7(b)     | proteins circled ;<br>catalysts circled ;                                     | <b>2</b> |
| 7(c)     | mouth ;<br>anus ;<br>mouth ;                                                  | <b>3</b> |
| 7(d)     | both involve the movement of, digested food / molecules / soluble nutrients ; | <b>1</b> |

| Question  | Answer                                                                                                                                                         | Marks    |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 8(a)(i)   | copper (ore) is a finite resource ;                                                                                                                            | <b>1</b> |
| 8(a)(ii)  | arrangement – solid regular and liquid irregular ;<br>motion – solid vibrate (about fixed point) only / do not move <b>AND</b> liquid are able to move about ; | <b>2</b> |
| 8(b)(i)   | cathode ;                                                                                                                                                      | <b>1</b> |
| 8(b)(ii)  | copper sulfate / copper chloride ;                                                                                                                             | <b>1</b> |
| 8(b)(iii) | covalent ;<br>solid ;                                                                                                                                          | <b>2</b> |

| Question | Answer                                                                                                                                                       | Marks    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 9(a)     | coal to non-renewable and polluting ;<br>geothermal to renewable and non-polluting ;                                                                         | <b>2</b> |
| 9(b)(i)  | A → E → C → D → B<br><br>E and C correct ;<br>D and B correct ;                                                                                              | <b>2</b> |
| 9(b)(ii) | 100 (°C) ;                                                                                                                                                   | <b>1</b> |
| 9(c)(i)  | numbers add up to a hundred ;                                                                                                                                | <b>1</b> |
| 9(c)(ii) | thermal energy is not useful / useful energy output is only 25% ;                                                                                            | <b>1</b> |
| 9(d)(i)  | correct symbol for lamp ;<br>series circuit correct ;<br>parallel circuit correct ;                                                                          | <b>3</b> |
| 9(d)(ii) | any one from :<br><br>all the lamps can be switched on independently<br>all lamps get full mains voltage<br>if one lamp fails the others can still work<br>; | <b>1</b> |

| Question  | Answer                                                       | Marks |
|-----------|--------------------------------------------------------------|-------|
| 10(a)(i)  | 800 (g) ;<br>2400 (g) ;<br>range / AW ;<br>observable / AW ; | 4     |
| 10(a)(ii) | height / AVP ;                                               | 1     |
| 10(b)     | D in first box ;<br>B, E, C ;                                | 2     |
| 10(c)(i)  | a version of a gene ;                                        | 1     |
| 10(c)(ii) | nucleus ;                                                    | 1     |

| Question   | Answer                                                                       | Marks |
|------------|------------------------------------------------------------------------------|-------|
| 11(a)(i)   | carbon = 6 ;<br>hydrogen = 0 ;                                               | 2     |
| 11(a)(ii)  | 6 ;                                                                          | 1     |
| 11(b)(i)   | unsaturated has a C=C double bond ;                                          | 1     |
| 11(b)(ii)  | aqueous bromine remains orange ;                                             | 1     |
| 11(c)(i)   | speed up the reaction ;                                                      | 1     |
| 11(c)(ii)  | temperature decreases / thermal energy is absorbed (from the surroundings) ; | 1     |
| 11(d)(i)   | methane ;                                                                    | 1     |
| 11(d)(ii)  | oxygen ;                                                                     | 1     |
| 11(d)(iii) | oxygen ;<br>nitrogen ;                                                       | 2     |

| Question   | Answer                                                                                                                                                             | Marks    |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 12(a)(i)   | arrow<br>across the top<br>then dropping down<br>then left to right along floor<br><br>1 mark for any one correct arrow ;<br>1 mark for all three arrows correct ; | <b>2</b> |
| 12(a)(ii)  | convection ;                                                                                                                                                       | <b>1</b> |
| 12(b)(i)   | celsius ;                                                                                                                                                          | <b>1</b> |
| 12(b)(ii)  | alcohol or mercury ;                                                                                                                                               | <b>1</b> |
| 12(b)(iii) | volume / density ;                                                                                                                                                 | <b>1</b> |
| 12(c)(i)   | There is no medium (for the propagation of the sound wave) ;                                                                                                       | <b>1</b> |
| 12(c)(ii)  | at least two lines going all the way through coil ;<br>line curving upwards and line curving downwards ;                                                           | <b>2</b> |