

Cambridge IGCSE™

CO-ORDINATED SCIENCES**0654/42**

Paper 4 Theory (Extended)

May/June 2024

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 2024 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 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.

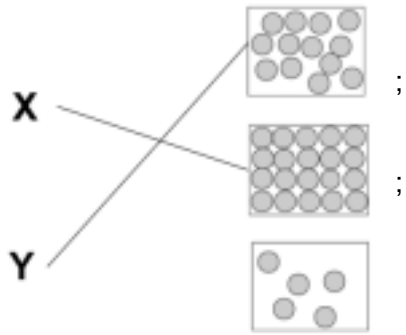
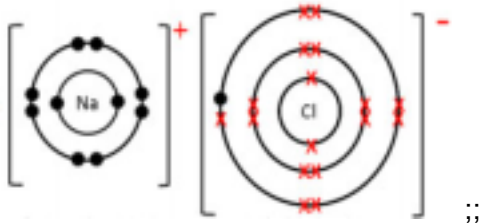
Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

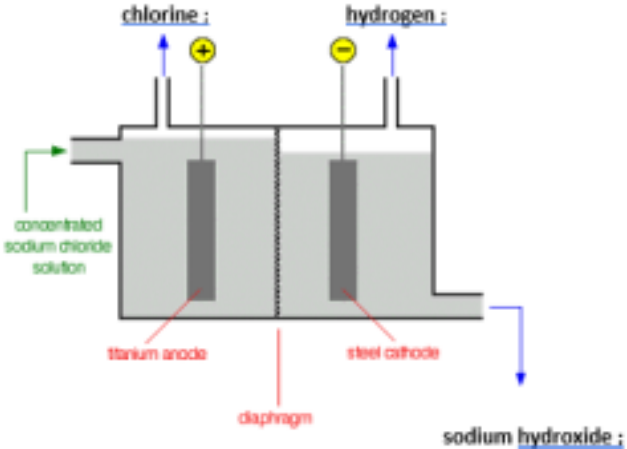
7 Guidance for chemical equations

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) | C ; E ; | 2 |
| 1(a)(ii) | <i>any two from:</i> feathery stigma ; small / no, petals ; anther hangs outside (the, flower / petals) ; stigma hangs outside (the, flower / petals) ; | 2 |
| 1(b) | smooth(er) / not spiky ; small(er) ; | 2 |
| 1(c)(i) | <i>any two from:</i> genetic diversity ; disease unlikely to wipe out all the plants ; able to adapt to changes in the environment ; allows, natural selection / evolution / adaptation ; | 2 |
| 1(c)(ii) | when the plant becomes isolated (from other plants) / when there is a shortage of pollinators / lack of other plants ; | 1 |
| 1(d) | <i>any two from:</i> movement ; respiration ; sensitivity ; growth ; excretion ; nutrition ; | 2 |

| Question | Answer | Marks |
|----------|---|-------|
| 2(a) |  | 2 |
| 2(b) | <p>(solid) idea that particles are vibrating about fixed positions ; (liquid) particles, move around / slide over, <u>each other</u> ;</p> | 2 |
| 2(c) | <p>it is reversible / a chemical change is irreversible ; no new substance is formed / a chemical change produces a new substance ;</p> | 2 |
| 2(d) |  | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 2(e) |  | 3 |

| Question | Answer | Marks |
|----------|--|-------|
| 3(a)(i) | downwards arrow labelled W ; | 1 |
| 3(a)(ii) | gravitational AND mass ; | 1 |
| 3(b) | (t=) 480 (hrs) ; (v=) d / t OR 1200 / 480 ; (v=) 2.5 (km / h) ; | 3 |
| 3(c)(i) | lower AND longer / bigger ; 3×10^8 ; | 2 |
| 3(c)(ii) | $(\lambda=) v / f$ OR $3 \times 10^8 / 1.5 \times 10^9$; $(\lambda=) 0.20$ (m) ; | 2 |

| Question | Answer | Marks |
|-----------|--|-------|
| 3(c)(iii) | (P=) 0.022 (W) ; (I=) P / V OR 0.022 / 11 OR 0.002 ; (t=) Q / I OR 24000 / 0.002 ; (t=) 1.2×10^7 (s) ; | 4 |

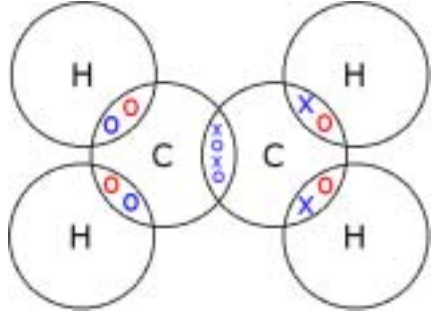
| Question | Answer | Marks | | | | | | | | | | | | | | | | | | |
|------------------------------|---|-------------------|-----------------|------------------|----------------------|--------------------|-------------------|--------------------------|------|------|------------------------------|------------------|-------------------|-----|--|--|-----|--|--|---|
| 4(a) | homeostasis ; | 1 | | | | | | | | | | | | | | | | | | |
| 4(b) | amylase ; 8.0 (mmol per dm ³) ; pancreas ; glycogen ; liver / muscles ; | 5 | | | | | | | | | | | | | | | | | | |
| 4(c) | adrenaline ; glucagon ; | 2 | | | | | | | | | | | | | | | | | | |
| 4(d) | plasma ; | 1 | | | | | | | | | | | | | | | | | | |
| 4(e) | <table border="1"> <tbody> <tr> <td></td> <td>nervous control</td> <td>hormonal control</td> </tr> <tr> <td>form of transmission</td> <td>electrical impulse</td> <td>chemical hormones</td> </tr> <tr> <td>relative speed of action</td> <td>fast</td> <td>slow</td> </tr> <tr> <td>relative longevity of action</td> <td>short-lived / AW</td> <td>long-lasting / AW</td> </tr> <tr> <td>...</td> <td></td> <td></td> </tr> <tr> <td>...</td> <td></td> <td></td> </tr> </tbody> </table> | | nervous control | hormonal control | form of transmission | electrical impulse | chemical hormones | relative speed of action | fast | slow | relative longevity of action | short-lived / AW | long-lasting / AW | ... | | | ... | | | 3 |
| | nervous control | hormonal control | | | | | | | | | | | | | | | | | | |
| form of transmission | electrical impulse | chemical hormones | | | | | | | | | | | | | | | | | | |
| relative speed of action | fast | slow | | | | | | | | | | | | | | | | | | |
| relative longevity of action | short-lived / AW | long-lasting / AW | | | | | | | | | | | | | | | | | | |
| ... | | | | | | | | | | | | | | | | | | | | |
| ... | | | | | | | | | | | | | | | | | | | | |

| Question | Answer | Marks |
|----------|---|-------|
| 5(a)(i) | A ; | 1 |
| 5(a)(ii) | 0–30 s ; | 1 |
| 5(b) | (reaction will be) faster ; (because) <i>Any two from:</i> molecules have higher kinetic energy / molecules are moving faster ; more molecules with activation energy ; frequency of collision (of molecules) is higher / more collisions per second ; more successful collisions ; | 3 |
| 5(c) | (M _r of CO ₂) = 12 + 16 + 16 or 44 ; (moles of CO ₂) = 1.1 ÷ 44 = 0.025 ; (volume of CO ₂) = 0.025 × 24 = 0.60 dm ³ ; | 3 |
| 5(d) | <i>Any two from:</i> enhanced greenhouse effect ; climate change ; correct consequences e.g. altered weather patterns / colder winters / hotter summers / rising sea levels / melting of ice caps / species extinction / loss of habitat / changes to migration patterns / flooding / drought / more forest fires etc. ; ; | 2 |

| Question | Answer | Marks |
|----------|---|-------|
| 6(a) | (F=) P × A or 9.0 × 10 ⁶ × 5.0 × 10 ⁻⁶ ; (F=) 45 (N) ; | 2 |
| 6(b)(i) | arrow drawn upwards ; | 1 |
| 6(b)(ii) | provides an alternating current (in the coil) / current that changes direction every half-turn / to reverse the current every half turn / 180° ; allows coil to continue to turn (in the same direction) ; | 2 |

| Question | Answer | Marks |
|----------|---|-------|
| 6(c)(i) | evaporation ; | 1 |
| 6(c)(ii) | the most energetic molecules ; escape from the surface ; | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 7(a) | B ; largest clear area / AW ; | 2 |
| 7(b)(i) | gene / chromosome / nucleus / DNA ; | 1 |
| 7(b)(ii) | ionising ; | 1 |
| 7(c) | change in <u>adaptive features</u> (over time) ; that results from <u>natural selection</u> ; | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 8(a) | contains a double (carbon to carbon) bond ; contains <u>only</u> hydrogen and carbon (atoms) / AW ; | 2 |
| 8(b) | $C_2H_4 + H_2 \rightarrow C_2H_6$;; | 2 |
| 8(c) |  | 2 |

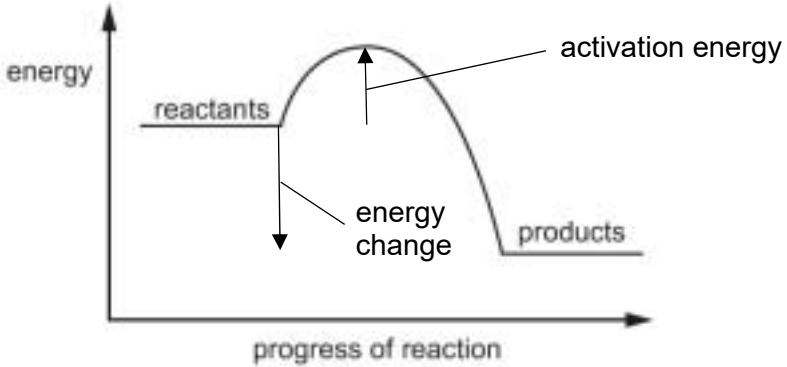
| Question | Answer | Marks |
|----------|--|-------|
| 8(d) | absence of air / no oxygen / anaerobic / yeast / sugar or glucose / water / warm temperature ; | 1 |
| 8(e) | H ₂ O ; | 1 |
| 8(f) | (M _r of C ₂ H ₅ OH) = 46 ; (moles of C ₂ H ₅ OH) = 5.75 ÷ 46 = 0.125 ; 250 cm ³ = 250 ÷ 1000 = 0.250 dm ³ ; (concentration of C ₂ H ₅ OH) = 0.125 ÷ 0.25 = 0.5 mol / dm ³ ; | 4 |

| Question | Answer | Marks |
|----------|---|-------|
| 9(a)(i) | half-life calculated from graph ; strontium-82 ; | 2 |
| 9(a)(ii) | strontium-90 AND it will not need to be replaced for a long time / will last for a long time / will not run out quickly / owtte ; | 1 |
| 9(b) | has a negative charge ; is affected by electric fields AND is affected by magnetic fields ; | 2 |
| 9(c) | (V=) m / ρ OR 7.8 / 2.6 ; (V=) 3.0 (cm ³) ; | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 10(a) | <i>any two from:</i> no nucleus ; large surface area / biconcave (shape) ; contains haemoglobin ; | 2 |
| 10(b)(i) | 8.0 (g per dm ³) ; | 1 |

| Question | Answer | Marks |
|------------|---|-------|
| 10(b)(ii) | water leaves the cell ; by osmosis ; the salt solution has a <u>lower water potential</u> (than the red blood cell) / water moves from an area of high <u>water potential</u> to low <u>water potential</u> ; | 3 |
| 10(c)(i) | presence of cell wall ; strengthens the cell ; | 2 |
| 10(c)(ii) | <i>any two from:</i> solvent ; photosynthesis ; support / ref to turgidity / prevent wilting ; transport of, minerals / mineral ions / ions ; AVP ; | 2 |
| 10(c)(iii) | root hair (cell) ; | 1 |

| Question | Answer | Marks |
|----------|---|-------|
| 11(a) | 450 °C ; 1–2 atmospheres ; | 2 |
| 11(b)(i) | (M _r of SO ₂) = 64 and (M _r of SO ₃) = 80 ; (Mass of SO ₃) = $\frac{80}{64} \times 1.6$; = 2.0 (kg) ; | 3 |

| Question | Answer | Marks |
|-----------|--|-------|
| 11(b)(ii) |  <p>energy change in reaction ;</p> <p>activation energy ;</p> | 2 |

| Question | Answer | Marks |
|----------|--|-------|
| 12(a)(i) | <p>highest percentage of electricity is generated by, coal (and natural gas) / fossil fuels / 61% of production from fossil fuels or coal and natural gas / 37% of production from coal / 24% of production from natural gas ;</p> <p>plus</p> <p>coal / natural gas / fossil fuels, release, carbon dioxide ;</p> <p>cause climate change / global warming / enhanced greenhouse effect ;</p> <p>OR</p> <p>coal / natural gas / fossil fuels, release sulfur dioxide ;</p> <p>causes acid rain ;</p> | 3 |

| Question | Answer | Marks |
|------------|---|----------|
| 12(a)(ii) | (advantage:) no nuclear, waste / accidents / suitable for small scale / no fuel is used / less set up time / AVP ; (disadvantage:) only works when wind speed is suitable / is less efficient / need lots of turbines (to generate large amounts of electricity) / noise pollution / AVP ; | 2 |
| 12(a)(iii) | (nuclear output E per kg =) $5.0 \times 10^5 \times 0.93 = 4.65 \times 10^5$ (MJ) ; (gas output E per kg =) $45 \times 0.49 = 22.05$ (MJ) ; $= 4.65 \times 10^5 / 22.05 = 21\,000$ (kg) ; | 3 |
| 12(b)(i) | (Ns =) $N_p \times V_s / V_p$ OR $3000 \times 132\,000 / 25\,000$; (Ns =) 16 000 ; | 2 |
| 12(b)(ii) | (increasing the voltage) reduces the current ; less, energy / power / heat, loss ; | 2 |