



# Cambridge IGCSE™

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**CO-ORDINATED SCIENCES****0654/43**

Paper 4 Theory (Extended)

**October/November 2020**

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.

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This document consists of **12** 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.

| Question | Answer  | Marks |
|----------|---|-------|
| 1(a)(i)  | as light intensity increases the rate of photosynthesis increases (initially) ;<br>then rate of photosynthesis stays constant ;                   | 2     |
| 1(a)(ii) | <b>X</b> light intensity / temperature / carbon dioxide concentration ;<br><b>Y</b> carbon dioxide concentration ;<br><b>Z</b> temperature ;      | 3     |
| 1(b)     | photosynthesis stops ;<br>high temperature denatures enzymes ;<br>shape of active site changes ;<br>substrate can no longer fit ;<br><b>max 3</b> | 3     |
| 1(c)     | $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$<br>LHS ;<br>RHS ;                                | 2     |
| 1(d)     | transfers light energy to chemical energy ;<br>to synthesise carbohydrates / glucose ;  | 2     |

| Question | Answer   | Marks |
|----------|--|-------|
| 2(a)     | 132 ;  | 1     |
| 2(b)     | $2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$<br>correct formulae ;<br>correctly balanced ;  | 2     |
| 2(c)(i)  | moles of KOH = mass $\div$ $M_r$ = $22.4 \div 56 = 0.40$<br>moles of $\text{H}_2\text{SO}_4$ mass $\div$ $M_r$ = $19.6 \div 98 = 0.20$<br><br>use of mass $\div$ $M_r$ or working ;<br>0.40 and 0.20 ; | 2     |

| Question | Answer  | Marks |
|----------|---|-------|
| 2(c)(ii) | simplest whole number ratio is 2:1 / (so) 2 mol of KOH react with 1 mol of H <sub>2</sub> SO <sub>4</sub> ;<br><br>2KOH + H <sub>2</sub> SO <sub>4</sub> → K <sub>2</sub> SO <sub>4</sub> + 2H <sub>2</sub> O<br>correct formulae ;<br>correctly balanced ; | 3     |
| 2(d)     | 450°C / higher temperature (rather than 200°C) increases rate of reaction ;<br>200 atmospheres / lower pressure (rather than 300 atmospheres) safer / less expensive ;<br>idea of compromise (e.g. between yield and rate) ;<br><b>max 3</b>                | 3     |

| Question  | Answer  | Marks |
|-----------|---|-------|
| 3(a)      | a <b>real image</b> is formed where light rays, converge / are focussed ;<br>a virtual image is formed from where light rays appear to have diverged from ;<br><br>a <b>real image</b> can be formed on a screen ;<br>a <b>virtual image</b> cannot be formed on a screen ;<br><b>max 1</b> | 1     |
| 3(b)(i)   | speed has magnitude only / velocity has magnitude and direction / velocity has direction / speed does not have direction ;  | 1     |
| 3(b)(ii)  | $\frac{\text{change in speed}}{\text{time taken}}$ or $\frac{v-u}{t}$ or $\frac{\Delta v}{t}$ or $\frac{1.2}{0.001}$ ;<br><br>1200 (m / s <sup>2</sup> ) ;  | 2     |
| 3(b)(iii) | conversion of grams to kilograms;<br>(force =) mass × acceleration or 0.0000005 × 1200 ;<br>= 0.0006 (N);   | 3     |

| Question  | Answer  | Marks |
|-----------|---|-------|
| 4(a)(i)   | carbon dioxide ;  | 1     |
| 4(a)(ii)  | (net movement of particles from their) higher concentration to their lower concentration / down a concentration gradient ;<br>ref to random movement of particles ;   | 2     |
| 4(a)(iii) | <i>any two from</i><br>thin membrane ;<br>large surface area ;<br>good blood supply ;<br>(semi) permeable membrane ;  | 2     |
| 4(a)(iv)  | uterus ;<br>oviduct ;<br>ovary ;  | 3     |
| 4(b)(i)   | <i>any two from</i><br>repair (of damaged tissue) ;<br>replacement of cells ;<br>asexual reproduction ;   | 2     |
| 4(b)(ii)  | chromosomes produced by <b>mitosis</b> have a diploid number / chromosomes produced by <b>meiosis</b> have a haploid number ;<br><br>cells produced by <b>mitosis</b> , contain two sets of chromosomes / are paired / cells produced by <b>meiosis</b> are unpaired ;<br>cells produced by <b>mitosis</b> are <u>genetically</u> identical (to parent cell / each other) / cells produced by <b>meiosis</b> are <u>genetically</u> different (to parent cell / each other) ;<br><b>max 2</b> | 2     |

| Question  | Answer                                  | Marks |
|-----------|---|-------|
| 5(a)(i)   | Ne ;                                    | 1     |
| 5(a)(ii)  | Mg ;                                    | 1     |
| 5(a)(iii) | <i>any two from</i><br>Cu, Zn, K, Mg ;; | 1     |

| Question  | Answer   | Marks |
|-----------|--|-------|
| 5(b)(i)   | proton ;   | 1     |
| 5(b)(ii)  | neutron ;  | 1     |
| 5(b)(iii) | diagram with 8 protons and any number of neutrons other than 10; | 1     |
| 5(c)      | <p>lithium ion ; chloride ion ;</p>                              | 2     |

| Question | Answer   | Marks |
|----------|--|-------|
| 6(a)(i)  | 0 (J);   | 1     |
| 6(a)(ii) | (ke =) $\frac{1}{2}mv^2$ or $\frac{1}{2} \times 2000 \times 11^2$ or $\frac{1}{2} \times 2000 \times 121$ ;<br>(ke =) 121 000 (J); | 2     |
| 6(b)     | <p>wavefronts curve as shown ;<br/>                     wavelength unchanged ;</p>   | 2     |




| Question | Answer  | Marks    |
|----------|---|----------|
| 6(c)     | (increase) temperature ;<br>(more) air flow ;<br>(increase) surface area of puddle ;<br>humidity ;<br>AVP ;<br><b>max 2</b> | <b>2</b> |
| 6(d)     | (W =) $\text{mg} / 1.2 \times 10 / 12$ ;<br>(p =) $F / A / 12 / 5.4$ ;<br>pressure = $2.2 \text{ (N / cm}^2\text{)}$ ;      | <b>3</b> |

| Question | Answer   | Marks    |
|----------|--|----------|
| 7(a)(i)  | fewer cases of kwashiorkor with age ;<br>fewer cases of marasmus with age ;<br>AVP ;                     | <b>2</b> |
| 7(a)(ii) | $(19 + 16 + 3 + 1 + 1) = 40$ ;<br>$(= 40 / 212)$<br>$= 19(\%)$ ;   | <b>2</b> |
| 7(b)     | protein ;  | <b>1</b> |
| 7(c)     | lack of vitamin D ;<br>leads to weak / bendy <u>bones</u> ;  | <b>2</b> |
| 7(d)     | prevents constipation ;  | <b>1</b> |
| 7(e)     | <i>any two from:</i><br>age ;<br>smoking ;<br>stress ;<br>genetic predisposition ;<br>gender ;<br>AVP ;; | <b>2</b> |

| Question | Answer   | Marks |
|----------|--|-------|
| 8(a)     | (ethene is unsaturated because) it contains a double bond between the carbon atoms ;<br>(ethene is a hydrocarbon because) it contains carbon and hydrogen (atoms) <b>only</b> / AW ;   | 2     |
| 8(b)     | poor electrical conductor / low boiling point / evaporates easily / volatile ;   | 1     |
| 8(c)(i)  | solvent / fuel ;   | 1     |
| 8(c)(ii) | fermentation requires water ;<br>fermentation requires sugar / named sugar ;<br>fermentation requires yeast / enzyme / zymase ;<br>fermentation requires suitable temperature ;<br>reference to anaerobic <u>respiration</u> ;<br><b>max 4</b> | 4     |

| Question  | Answer  | Marks |
|-----------|---|-------|
| 9(a)(i)   | use of $1/R = 1/R_1 + 1/R_2$ or $\frac{R_1 R_2}{R_1 + R_2}$ or substitution ;<br>4 ( $\Omega$ ) ;   | 2     |
| 9(a)(ii)  | (current =) voltage / resistance ;<br>9 / 6 = (1.5 A) ;   | 2     |
| 9(a)(iii) | (charge =) current $\times$ time / $I \times t$ / $1.5 \times 300$ ;<br>= 450 ;<br>C ;  | 3     |
| 9(a)(iv)  | in <b>direct current (DC)</b> , the electric charge / current only flows in one direction<br><b>or</b><br>in <b>alternating current (AC)</b> , the electric charge / current changes direction (periodically) ; | 1     |
| 9(a)(v)   | kinetic (energy) to electrical (energy) ;   | 1     |
| 9(a)(vi)  | electrical (energy) to light (energy) ;   | 1     |

| Question  | Answer   | Marks |
|-----------|--|-------|
| 9(b)(i)   | any named electromagnetic wave (apart from light) / water waves;   | 1     |
| 9(b)(ii)  |  <p>one wavelength correctly shown;</p> | 1     |
| 9(a)(iii) | (distance between compressions) decreases ;  | 1     |

| Question | Answer  | Marks |
|----------|---|-------|
| 10(a)    | fertiliser ;<br>sewage ;<br>AVP ;   | 2     |
| 10(b)    | producers / plants / algae ;<br>decomposers / bacteria / fungi ;<br>aerobic ;<br>oxygen ; | 4     |

| Question   | Answer   | Marks |
|------------|--|-------|
| 11(a)(i)   | B ;  | 1     |
| 11(a)(ii)  | A ;  | 1     |
| 11(a)(iii) | C ;  | 1     |
| 11(b)      | (substance which) gives oxygen to / removes / gains electrons (from another substance during a redox reaction) ; | 1     |
| 11(c)      | (molten) aluminium oxide ;<br><br>oxygen at the anode ;<br>aluminium at the cathode ;                            | 3     |

| Question  | Answer   | Marks |
|-----------|--|-------|
| 12(a)     | hot water is less dense / expands ;<br>less dense water rises ORA ;<br>cold water sinks ;  | 3     |
| 12(b)(i)  | alpha particles have low penetration;  | 1     |
| 12(b)(ii) | ${}_{95}^{241}\text{Au} \rightarrow {}_{93}^{237}\text{Np} + {}_2^4\text{He}$<br><br>mass numbers and proton numbers correct:<br>237 ;<br>93 ;<br>4 ;<br>${}_2\text{He}$ ; | 4     |
| 12(c)     | $(N_S =) N_P V_S / V_P$ or $5000 \times 2.4 / 220$ ;<br><br>54.5 / 54 / 55 turns;  | 2     |

| Question | Answer  | Marks |
|----------|---|-------|
| 13(a)    | weak forces between the layers ;<br>layers can slide over each other / AW ;   | 2     |
| 13(b)    | both macromolecular / both giant covalent (structures) ;  | 1     |
| 13(c)    | alloy ;   | 1     |
| 13(d)    | any two from:<br>zinc stops air / oxygen / water reaching the steel / iron ;<br>zinc acts as a sacrificial metal ;<br>zinc is more reactive than iron ; | 2     |