Cambridge Assessment International Education

# Cambridge IGCSE™

**BIOLOGY** **0610/43**

Paper 4 Theory (Extended) **October/November 2021**

MARK SCHEME

Maximum Mark: 80

**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.

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## 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.

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|---|
| GENERIC MARKING PRINCIPLE 5:<br><br>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:<br><br>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 | <u>'List rule' guidance</u><br><br>For questions that require ***n*** responses (e.g. State **two** reasons …):<br><br>• The response should be read as continuous prose, even when numbered answer spaces are provided.<br>• Any response marked *ignore* in the mark scheme should not count towards ***n***.<br>• Incorrect responses should not be awarded credit but will still count towards ***n***.<br>• 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.<br>• Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science. |

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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
- **/** alternative responses for the same marking point
- **R** reject the response
- **A** accept the response
- **I** ignore the response
- ecf error carried forward
- AVP any valid point
- ora or reverse argument
- AW alternative wording
- underline actual word given must be used by candidate (grammatical variants excepted)
- ( ) the word / phrase in brackets is not required but sets the context

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 1(a) | (made of) protein / biological ;<br>catalyst / described ; | **2** | |
| 1(b)(i) | CTTAAG ; | **1** | |
| 1(b)(ii) | restriction (enzyme) ; | **1** | |
| 1(b)(iii) | *any two from:*<br>cuts (DNA, molecule / strands) ;<br>to form sticky ends / AW ;<br>the sticky ends are complementary / described ; | **2** | |
| 1(b)(iv) | *any two from:*<br>DNA / bases sequence / substrate, and, enzyme / active site, are complementary ;<br>ref. to active site ;<br>AVP ; | **2** | |
| 1(c)(i) | bacteria ; | **1** | |
| 1(c)(ii) | (DNA) ligase ; | **1** | |
| 1(c)(iii) | recombinant (DNA / plasmid) ; | **1** | |
| 1(d) | temperature (on x axis) and enzyme activity or rate of enzyme reaction (on y axis) ;<br>plot showing one peak ;<br>gradient to the right of the peak is steeper than gradient to the left of the peak (only consider gradients in the top half of the 'peak') ; | **3** | |

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| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(a)(i) | *any five from:*<br>**1** (nitrate ion) uptake peaks / uptake increases and then decreases **;**<br>**2** maximum uptake / peak, is at 27 mm (from root tip) / of 28 pmol per $cm^2$ per s **;**<br>**3** no data before 2.75 mm / no (nitrate ion) uptake / uptake starts, at 2.75 mm (from tip) **;**<br>**4** (nitrate ion) uptake levels off at about, 5 / 10 mm to 15 mm (from tip) **;**<br>**5** comparative data quote **;**<br>**6** no root hair (cells), at tip / root cap / below 10 mm **;**<br>**7** between 25 ± 5 mm to 30 ± 5 mm (from root tip) is where many root hair (cells) are found **;** | **5** | |
| 2(a)(ii) | *any four from:*<br>**1** active transport **;**<br>**2** using energy (from respiration) **;**<br>**3** movement of (ions), across a cell membrane / into root hair (cells) **;**<br>**4** from low concentration to high concentration / against a concentration gradient (of nitrate ions) **;**<br>**5** through protein (molecules / pumps / carriers / channels) **;**<br>**6** nitrate ions are dissolved in water (before they move into root) **;** | **4** | |
| 2(a)(iii) | lowers the water potential (in roots) / maintains the water potential gradient (into the roots) **;** | **1** | |
| 2(a)(iv) | (nitrates) used to make, amino acids / proteins **;**<br>proteins are composed of amino acids **;**<br>named use of protein in plants (except water uptake or protein synthesis) **;** | **3** | MP1 **A** protein synthesis<br><br>MP3 any named cell component or cell structure that contains protein or process that uses proteins in plants, e.g. enzymes |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2(a)(v) | *any three from*<br>**1** proteins / amino acids / urea / organic material / AW, are decomposed **;**<br>**2** ammonium (ions) → (nitrite) → nitrate (by bacteria) **;**<br>**3** ref. to nitrification **;**<br>**4** nitrogen (gas) → ammonium (ions) / nitrate (by bacteria / lightning) **;**<br>**5** ref. to nitrogen fixation **;**<br>**6** any ref. to (nitrifying / nitrogen fixing) bacteria / lightning / root nodules / fungi / decomposers **;** | **3** | 'nitrifying bacteria' = **MP3** and **MP6**<br>'nitrogen fixing bacteria' = **MP5** and **MP6**<br>'decomposers breakdown dead organisms' = **MP1** and **MP6** |
| 2(b)(i) | **FDCEAB ;;** | **2** | MP1 for **F** at the beginning and **B** at the end of the sequence<br>MP2 remaining letters in the correct position |
| 2(b)(ii) | <u>eutrophication</u> **;** | **1** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3(a) | 3 black (bodies) : 1 yellow (bodies) **;** | **1** | |
| 3(b) | *parental phenotypes:* black x yellow<br>*parental genotypes:* Bb **;** x bb **;**<br>*gametes:* B b x b (b) **;**<br>*offspring genotype:* Bb and bb **;**<br>*offspring phenotype:* 1 black : 1 yellow **;** | **5** | |
| 3(c)(i) | exoskeleton / open circulatory system / compound eyes / segmented body **;** | **1** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 3(c)(ii) | *any one from:*<br>number of legs *or* 10 legs *or* 5 pairs of legs / limbs (in crab) *or* 8 legs *or* 4 pairs of legs (and 2 claws) **;**<br>number of antennae / two pairs of antennae **;**<br>gills **;**<br>AVP **;** | **1** | |
| 3(d)(i) | *any three from:*<br>natural selection **;**<br>albino crabs / crabs with no pigment, are (better) adapted / AW **;**<br>(albino crabs / AW) more likely to survive **;**<br><br>reproduction of albino crabs will pass on, mutation / allele (to offspring / next generation) **;**<br>change over time is evolution **;** | **3** | MP2 **A** no advantage of having pigment (in cave / dark) / favourable trait / **ora**<br>MP2 **A** no pigment, is an advantage / increases fitness<br>MP3 **A** struggle for survival in context<br><br>MP4 **A** albino crabs will pass on, mutation / allele, to offspring |
| 3(d)(ii) | *any two from:*<br>(ionising) radiation **;**<br>chemicals / mutagens / (named) carcinogens **;**<br>viruses **;** | **2** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4(a) | (exchange of) contaminated / infected (named) / AW, body fluids **;**<br>**AND**<br>*any two examples of mechanisms of transmission* **;;**<br>using (contaminated) needles (ignore ref to drugs unqualified)<br>sexual contact (with infected people)<br>(contaminated) blood transfusion<br>(tissue / organ) transplants<br>blood to blood contact<br>child birth<br>breast-feeding (if mother is infected) | **3** | |
| 4(b) | protein coat **;** | **1** | |
| 4(c)(i) | *any three from:*<br>produce antibodies **;**<br>named function of antibodies **;**<br>antibodies are specific to, antigen / pathogen **;**<br>ref to active immunity / described **;**<br>ref to memory cells **;** | **3** | **A** complementary to antigen |
| 4(c)(ii) | (HIV) destroys lymphocytes / decrease in lymphocyte count **;** | **1** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 4(d)(i) | *any four from:*<br><br>*vitamin C*<br>helps with, cell / tissue, repair / healing **;**<br>helps to reduce risk of (named) infection / AW **;**<br>AVP **;** e.g. formation of, collagen / hair / nails<br>anti-ageing of skin<br>improves (named) mineral ion absorption<br>required for protein synthesis<br>antioxidant<br><br>*iron:*<br>involved in the production of haemoglobin **;**<br>to transport oxygen (in red blood cells) **;**<br>to reduce fatigue **/** to prevent anaemia **;** | **4** | **A** prevents, scurvy / bleeding gums |
| 4(d)(ii) | 79(%) **;;** | **2** | MP1 selection of correct data (4291 and 897)<br>MP2 correct calculation<br>**A** answers to any number of correctly rounded decimal places, e.g. 79.1 (%) |
| 4(d)(iii) | *any two from:*<br>**1** increase (in average number of) lymphocytes in the treatment group (per μg blood after 3 months) **;**<br>**2** (but) no change (in lymphocytes) in control group **;**<br><br>**3** cannot come to a conclusion **;**<br>**4** (because) more, information / data, is required **;**<br>**5** (because) sample size is too small **;**<br>**6** (because) starting numbers of lymphocytes in the two groups is not similar **;** | **2** | MP1 **A** (supplements are associated with) increase in the number of lymphocytes<br>MP2 **A** no increase (in the number of lymphocytes) in the control group |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 5(a) | *any six from:*<br>**1** *idea that* a sustainable resource is one which is produced as rapidly as it is removed (from the environment) so that it does not run out / *idea that* sustainable development is providing for the needs of an increasing human population without harming the environment **;**<br>**2** *idea that* sustainable development requires management of conflicting demands **;**<br>**3** monitoring of, fish populations / factors affecting fish survival **;**<br>**4** education / awareness (of people who fish / people who eat fish) **;**<br>**5** (legal) quotas / licenses / restricted catch (of weight / length) **;**<br>**6** laws / guidelines / AW, on fishing equipment **;** e.g. mesh / net, size / bottom trawlers<br>**7** support, small scale / subsistence / AW, fishing **;**<br>**8** to ensure sustainability of fish stock / described **;**<br>**9** conservation / protected, areas / no-catch zones **;**<br>**10** limit the fishing season / nursery zones **;**<br>**11** fines / law enforcement (of illegal fishing) **;**<br>**12** to discourage poor practice **;**<br>**13** AVP **;** | **6** | MP1 **A** birth rate of fish must be as least as many fish as are being removed<br>MP4 **A** campaigns<br>MP5 **A** regulation of what can be done with by-catch / ban overfishing |
| 5(b) | (female contraceptive) hormones / oestrogen / progesterone **;**<br>lower percentage of male / presence of intersex fish (downstream / site 2) **; ora** | **2** | MP2 **A** male fish have become feminised (downstream) / AW |
| 5(c) | *ref. to* sex / X <u>and</u> Y, chromosomes **;** | **1** | |

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 6(a) | (group of) tissues working together, to pump blood around the body / AW / performing the (same) function **;** | **1** | |
| 6(b) | **1** circulatory **;**<br>**2** vena cava **;**<br>**3** thinner **;**<br>**4** diffusion **;**<br>**5** left atrium **;**<br>**6** septum **;**<br>**7** coronary, artery / arteries **;** | **7** | MP1 **A** cardiovascular / circulation<br>MP2 **A** veins<br>MP3 **A** less |
| 6(c) | ECG / electrocardiogram / listening to valves close / AVP **;** | **1** | |