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Cambridge Assessment International Education

Cambridge IGCSE™

BIOLOGY **0610/41**

Paper 4 Theory (Extended) **October/November 2022**

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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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: 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.

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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)(i)	mechanical / physical, digestion **;**	**1**	
1(a)(ii)	<u>enamel</u> **;**	**1**	
1(a)(iii)	*any three from:* sugar / food / plaque, left on teeth **;** respiration (of sugar) by bacteria **;** produce (lactic) acid **;** dissolves, enamel / dentine / AW **;** AVP **;**	**3**	e.g. dentine is exposed / AW **or** dentine, is softer / dissolves more rapidly (than enamel) **or** ref. to, pulp / nerve endings, being exposed **or** (decay reaches nerve endings) leading to pain
1(b)(i)	*Orcinus orca* **E** *Myrmecophaga tridactyla* **F** *Cervus elephus* **G** Go to 5 *Macropus rufus* **B** *Equus ferus* **A** *Lemur catta* **C** *Pteropus niger* **D** **;;;;**	**4**	7 correct = 4 marks 5 or 6 correct = 3 marks 3 or 4 correct = 2 marks 1 or 2 correct = 1 mark

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Question	Answer	Marks	Guidance
1(b)(ii)	*any two from:* double circulation **;** four-chambered heart **;** lungs / any named part of lungs **;** diaphragm **;** red blood cells without nuclei **;** AVP **;**	**2**	
1(b)(iii)	vertebrates **;**	**1**	

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Question	Answer	Marks	Guidance
2(a)(i)	*any two from:* become soluble **;** for absorption **;** small enough, for diffusion / active transport **;**	**2**	
2(a)(ii)	water **;**	**1**	
2(b)	*any six from:* **1** protein → amino acids **;** **2** ref to specificity **;** **3** both enzymes are active between pH 3 and pH5 **;** **A** at pH4 **4** **A** is pepsin **;** **5** optimum pH at 2 **;** **6** enzyme shows, no activity / is denatured, from pH 5 **;** **7** (functions) in stomach **;** **8** where HCl is present / in acid conditions **;** **9** **B** is trypsin **;** **10** optimum pH at 10 **;** **11** enzyme shows, no activity / is denatured, from pH 3 **;** **12** (functions) in small intestine / secreted from pancreas **;** **13** bile neutralises (stomach) acid / in alkaline conditions **;**	**6**	MP1 **A** breaks down proteins (to, polypeptides / peptides) MP13 **A** pancreatic juice neutralises stomach acid
2(c)	(membrane of) epithelium **;**	**1**	

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Question	Answer	Marks	Guidance
3(a)(i)	transpiration **;**	**1**	
3(a)(ii)	ensure continuous column of water / prevents air bubbles / prevents airlock **;**	**1**	
3(a)(iii)	prevent, evaporation / condensation (from the top of the burette, affecting the volume of water in the burette) / AW **;**	**1**	
3(a)(iv)	measure the decrease in the volume of water (in burette over a period of time) / record the decrease in mass (over time) **;**	**1**	
3(b)(i)	12 096 g (per m^2) / 12.096 kg (per m^2) **;;;**	**3**	**A** 12 / 12.1 kg (per m^2) MP1 correct reading from graph 0.28 (g per m^2 per s) MP2 correct calculation $0.28 \times 60 \times 60 \times 12 = 12\,096$ g MP3 correct unit – g or kg **;** ecf for MP2 from incorrect MP1
3(b)(ii)	*any five from:* **1** as temperature increases, (rate of) water loss increases **;** **2** ref to steeper rate / greater loss of water, after 37 / 38 °C **;** **3** any correct comparative data quote (with units at least once) **;** **4** <u>water vapour</u> lost, through stomata / between guard cells **;** **5** evaporation from mesophyll into air spaces **;** **6** (diffusion) down a, water potential, gradient **;** **7** increasing temperature increases kinetic energy (of water molecule) **;** **8** faster (rate of) more, diffusion **;** **9** stomata open wider / more stomata open in high(er) temperatures **;** **10** AVP **;**	**5**	e.g. transpiration / evaporation, cools the plant

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Question	Answer	Marks	Guidance
3(c)(i)	no diffusion (of water vapour) **;** (because) no water potential gradient / described **;**	**2**	
3(c)(ii)	(it has a) continuous supply of water / AW **;**	**1**	
3(c)(iii)	line drawn below original line **;**	**1**	

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Question	Answer	Marks	Guidance
4(a)	*any four from:* two strands **;** formed into (double) helix **;** ref. to four bases / A and T and C and G **;** pairing of, A with T / C with G **;** cross links between bases **;**	**4**	**A** as an annotated drawing
4(b)(i)	*any three from:* **1** variation (in the bacteria) **;** **2** ref. to mutations / described **;** **3** mutations, give bacteria an advantage **;** **4** non-resistant bacteria, killed / inhibited / AW (by antibiotic) **;** **5** competition with non-resistant bacteria **;** **6** resistant bacteria reproduce **;** **7** pass on, gene / allele (for resistance) **;** **8** <u>natural selection</u> **;** **9** AVP **;**	**3**	e.g. horizontal gene transmission / described as gene(s) passed from one bacterium to another
4(b)(ii)	*any one from:* **1** no difference in appearance (of different strains of MRSA) / AW **;** **2** no need to culture the bacteria **;** **3** (gene sequencing is an) automated process / AW **;** / easy to do / AW **;** **4** only need small, number / quantity / amount (of bacteria) **;** **5** more, accurate / precise (than traditional methods) / AW **;** **6** explained in terms of comparing base sequences of different, strains / AW **;** **7** AVP **;**	**1**	e.g. (DNA sequences) within a species are very similar

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Question	Answer	Marks	Guidance
4(b)(iii)	*any two from:* (resistant) bacteria will not be killed by antibiotics / AW **;** *idea that* no antibiotic of last resort / AW **;** (bacterial diseases) cannot be treated / AW **;** infection / disease / (resistant) bacteria, will spread **;** AVP **;;**	**2**	e.g. new antibiotics need to be developed it takes time to make new antibiotics
4(c)(i)	*any two from:* antibiotics used only when essential **;** ensuring people, follow instructions / complete course of antibiotics **;** do not prescribe antibiotics for, viral / fungal, infections **;** AVP **;;**	**2**	*e.g.* develop new antibiotics
4(c)(ii)	placenta forms a barrier between mother and fetus / AW **;**	**1**	
4(d)	*any three from:* nitrogen fixation **;** decomposition / decay **;** nitrification **;** denitrification **;** deamination **;** fermentation **;** AVP **;;**	**3**	*e.g.* nitrogen cycle / carbon cycle / <u>aerobic</u> or <u>anaerobic</u> respiration

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Question	Answer	Marks	Guidance
5(a)(i)	*any one from:* respiration **;** decomposition **;** volcanic eruptions **;** release of carbon dioxide from oceans (ocean-atmosphere exchange) **;**	**1**	
5(a)(ii)	methane / AVP **;**	**1**	
5(b)(i)	*any three from:* **1** (total) number of fires in natural ecosystems is higher than (total) number of fires in managed land ***or*** *idea that* the savannah (alone) has more fires than the (total) fires in managed land **;** **2** fires on managed land, have a lower expansion rate / spread more slowly (than other fires) **;** **3** fires on managed land, have a shorter duration / last less time (than other fires) **;** **4** more fires on land being deforested than in natural forest **;** **5** comparative data quote (with units at least once) **;** **6** AVP **;**	**3**	MP5 e.g. approx. 20% of all fires occur on land managed by humans
5(b)(ii)	multiply **;** number of fires by expansion rate by duration (for each row) **;**	**2**	

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Question	Answer	Marks	Guidance
5(b)(iii)	*any three from:* **1** reduction in population sizes of organisms **;** **2** organisms / animals / plants, become endangered **;** **3** organisms / animals / plants, become extinct **;** **4** loss of biodiversity **;** **5** loss of genetic diversity **;** **6** ref. to negative effect on, food chains / food webs **;** **7** ref. to negative effect on, nutrient / water, cycling **;** **8** AVP **;**	**3**	*e.g.* migration of organisms / flooding / soil erosion / leaching / desertification

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>6(a)(i)</td><td>
<table>
<tr><th>function</th><th>name of the structure</th><th>letter on Fig. 6.1</th></tr>
<tr><td>traps particles (before they enter the airway) / mechanical barrier to pathogens / AW</td><td>hairs in the nose</td><td>A</td></tr>
<tr><td>prevents collapse of the airway</td><td>cartilage</td><td>J / B</td></tr>
<tr><td>contracts to decrease the pressure in the thorax</td><td><u>external</u> intercostal muscles</td><td>F</td></tr>
<tr><td>contracts to, reduce the pressure / increase the volume, in the thorax</td><td>diaphragm</td><td>C</td></tr>
<tr><td>protects the lungs from mechanical damage</td><td>rib(cage)</td><td>E</td></tr>
<tr><td>contain cilia to move mucus out of the airway</td><td>trachea / bronchi / bronchiole</td><td>J / B / G</td></tr>
<tr><td>site of gas exchange / AW</td><td>alveoli</td><td>H</td></tr>
</table>
;;;;;;;
</td><td>7</td><td>one mark for each correct row</td></tr>
</table>

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Question	Answer	Marks	Guidance
6(a)(ii)	*any three from:* thin / one cell thick **;** large surface area **;** (which) reduces diffusion distance / AW **;** good blood supply **;** AVP **;**	**3**	*e.g.* moist lining / presence of surfactant
6(b)(i)	*any three from:* less oxygen and more carbon dioxide in expired air (than inspired air) **;** (as) oxygen is required for <u>aerobic</u> respiration **;** carbon dioxide is released by respiration **;** water vapour increases (as it is released by respiration) **;** AVP **;**	**3**	
6(b)(ii)	*detected:* *either* (carbon dioxide is) in the blood *or* by the brain **;** *response:* *either* increases, rate / depth, of breathing *or* increases heart rate / AW **;**	**2**	
6(b)(iii)	limewater / hydrogencarbonate indicator (solution) / AVP **;**	**1**	

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