Cambridge Assessment International Education

Cambridge Pre-U

BIOLOGY **9790/03**

Paper 3 Case Study and Synoptic Essay **October/November 2020**

MARK SCHEME

Maximum Mark: 60

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 syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

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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.

Notes:
The following abbreviations may be used in mark schemes:

;	separates marking points
/	alternative and acceptable answers for the same marking point
allow / accept / **A**	answers that can be accepted
not / reject / **R**	answers that are not worthy of credit
ignore / **I**	statements that are irrelevant – applies to neutral answers
AW / owtte	credit alternative wording / or words to that effect
ecf	error carried forward
(words)	bracketed words that are not essential to gain credit
words	underlined words must be present in answer to gain credit
max	indicates the maximum number of marks that can be given
ORA	or reverse argument
AVP	any valid point – marking points not listed on the mark scheme but which are worthy of credit

Question	Answer	Marks	Guidance
1(a)(i)	stimulated by increased blood glucose ; released from β-cells in pancreas ; reduces blood glucose ; increases glucose uptake into cells ; increases conversion glucose to glycogen ;	**4**	
1(a)(ii)	induces hypoglycaemia / sudden drop in blood glucose ; reduced glucose for respiration ; reduced energy / ATP for metabolic processes / brain activity / muscle contraction ;	**2**	
1(a)(iii)	(12 ÷ 20) × 100 = 60%;	**1**	
1(a)(iv)	forms disulphide bridges / stable bonds ; maintains tertiary structure ; (maintains 3D shape) for binding to receptors ;	**2**	

Question	Answer	Marks	Guidance
1(a)(v)	random mutation leads to variation in mollusc insulin ; versions closer to fish insulin had greatest effect ; (these) cone shells had more success hunting / more food ; increased chance of survival to breed ; alleles for fish-like insulin passed on ; idea of highly conserved sequence ; critical role in insulin in all animals ;	**4**	
1(b)(i)	blocks calcium ion / Ca^{2+} movement into presynaptic neurone ; prevents exocytosis ; of neurotransmitter into synaptic cleft ; reduced stimulation of post-synaptic neurone ;	**3**	
1(b)(ii)	(primary somatosensory cortex of) cerebrum ;	**1**	**A** thalamus
1(c)(i)	binding of inhibitor to alternative (active) site ; changes shape / conformation of the (active) site ; reducing activity (of receptor / enzyme) ;	**2**	

Question	Answer	Marks	Guidance
1(c)(ii)	oxygen, for aerobic respiration ; glucose, for respiration ; named ion, with function ; creatine phosphate ; water, solvent for metabolic processes ; ATP / releases myosin from actin filament / source of energy for cocking myosin's head ;	**3**	**Max one mark** for 3 correct substances but no/incorrect explanations **e.g.** phosphate ions, to make ATP/phospholipids/DNA nitrates, to make proteins/DNA Na^+ Mg^{2+} Ca^{2+} **A** buffer
1(c)(iii)	ρ-TIA decreases noradrenaline-stimulated calcium increase ; ρ-TIA increases the intracellular resting level of calcium ; manipulation of figures / percentage decrease ;	**2**	
1(c)(iv)	block α1-adrenergic stimulated calcium influx (from SR) ; reference to troponin (lack of Ca^{2+} binding / lack of shape change) ; reference to binding sites on actin (not exposed) ; detail of tropomyosin exposing myosin-binding sites ;	**3**	

Question	Answer	Marks	Guidance
1(d)	high habitat diversity / complex habitat ; reference to niches ; specialisation by different closely related species ; example of specialisation ; prey type, size, feeding methods reference to lack of / reduced interspecific competition / competitive exclusion principle ; changing conditions ;	**3**	

Section B – Synoptic Essay

Marking Strategy

Sequence of marker activities for each essay:

1 Familiarise yourself with the expected content.

2 Read through the essay.

3 Write marginal notes on script, highlight evidence of breadth, background reading, exemplification and argumentation as well as major and minor errors of fact and irrelevant material.

4 Apply the general descriptions for

- Breadth (B)
- Argumentation (A)
- Communication (C)
- Spelling, punctuation and grammar (S).

5 Match the content of the essay with the highest descriptor for Scientific Content (SC) that is fully satisfied. This represents the lowest mark that could be awarded. Then consider the next descriptor above this and, where appropriate, award intermediate marks in proportion to the degree to which this descriptor has been partially matched.

Marks should be written at the end of the essay as follows:

B = ……
A = ……
C = ……
S = ……
SC = ……
Total = ……

Breadth Maximum 3 marks

Mark	Descriptors
	Candidate has:
3	given a balanced account including most of the relevant topic areas and selected a wide range of facts, principles, concepts and/or examples pertinent to the title
2	given a fairly balanced account including some of the relevant topic areas and selected many of the appropriate facts, principles, concepts and/or examples pertinent to the title
1	given an account including a few of the relevant topic areas and selected some of the appropriate facts, principles, concepts and/or examples pertinent to the title
0	given an account that relies on one topic area alone and selected only a few of the appropriate facts, principles, concepts and/or examples pertinent to the title

Argumentation Maximum 3 marks

Mark	Descriptors
	Candidate has:
3	developed and sustained a coherent argument throughout the essay leading to an appropriate conclusion showing insight
2	introduced an argument and partially developed it, so that some coherence is shown in the essay
1	shown evidence of an argument, with little development
0	shown no evidence of argumentation

Communication Maximum 2 marks

Mark	Descriptors
	Candidate has:
2	organised and presented information clearly and used correct terminology in appropriate contexts
1	attempted to organise material and use some correct terminology, so that with re-reading the meaning becomes apparent
0	presented an unstructured answer with poor use of terminology

Spelling, punctuation and grammar Maximum 2 marks

Mark	Descriptors
	Candidate has:
2	used spelling, punctuation and grammar accurately, with no more than very few errors
1	generally used spelling, punctuation and grammar accurately, but has made a number of significant errors
0	not used spelling, punctuation and grammar accurately

Scientific Content Maximum 20 marks

Mark	Descriptors
	Candidate has:
20	• recalls and consistently uses all facts and principles (relevant to the essay); • shows sound understanding of all principles and concepts; • writes accurately with no major errors and very few minor errors; • gives comprehensive detail expected from the relevant learning outcomes, with evidence of relevant reading around the subject.
16	• recalls and consistently uses most facts and principles (relevant to the essay); • shows sound understanding of most principles and concepts; • writes accurately with no major errors and few minor errors; • gives full detail expected from the relevant learning outcomes.
12	• recalls and consistently uses some facts and principles (relevant to the essay); • shows sound understanding of some principles and concepts; • writes some material accurately with not more than one major error and some minor errors; • gives most detail expected from the relevant learning outcomes.
8	• recalls some facts and principles (relevant to the essay); • shows some understanding of some principles and concepts; • writes some material accurately with more than one major error or many minor errors; • gives some detail expected from the relevant learning outcomes.
4	• recalls a few facts and principles (relevant to the essay); • shows limited understanding of a few principles and concepts; • writes material that includes many errors, some of which may be major errors; • gives little detail expected from the relevant learning outcomes.
0	• recalls no relevant facts and principles; • shows no understanding of relevant principles and concepts; • writes irrelevant material or includes many major errors; • gives no detail expected from the relevant learning outcomes.

Expected content

For each of the questions, guidance is given as to the kind of content from the syllabus that may be appropriate to answering the question. Some candidates will include all of these areas and others may write in more detail about these or may include other relevant topics, in each case reflecting the candidate's reading-around the subject and personal research and other interests. Some topics, both in the candidates' answers and in the following expected content, may not be directly on the syllabus, but it is important to credit such responses where they are given and thus they are included here.

Question	Answer	Marks	Guidance
2	**Discuss the use of nitrogen in plants and animals.** Much of the content of this essay will come from Sections 1, 2, 3 and 4. • Cell structure • Enzymes • Genes and protein synthesis • Chemicals of life • Animal physiology • Plant physiology The following learning outcomes are directly relevant: • 1.1de • 1.4abc • 1.5a • 1.6bc • 2.2ghijklm • 3.2b • 4.2c • 4.4b ***Introduction:*** sources of nitrogen, nitrates overview of roles/uses		

Question	Answer	Marks	Guidance
2	***Sources of nitrates*** • Absorption by plant roots • Digestion of N-containing molecules ***Chemicals of life*** ***Proteins*** • Amino acid structure • Protein structure heirachy • Structure vs function/ active sites ***Nucleic acids*** • Nucleotide structure • DNA • RNA/types • Structure vs function NO –cell signalling ATP/ADP Chlorophyll Adrenaline/NA/ACh Chitin Auxin ***Cell structure/function*** ***Proteins in cells*** • Cell membranes • Role of proteins in membranes • Enzymes in cells		

Question	Answer	Marks	Guidance
2	***Nucleic acid in cells*** • Locations • Overview of roles • Genetic code • Translation • Transcription • tRNA • mRNA ***Cell respiration*** • ATP/ADP • NAD/FAD ***Animal physiology*** Absorption/digestion of nitrogenous compounds ***Proteins in animal body systems*** • homeostasis, hormone systems • immunity, cell recognition • synapses, action potential • reproduction, protein hormones • oxygen transport ***Excretion*** • role of liver • role of kidneys ***Plant physiology*** ***Photosynthesis*** • Role of protein carriers • Chlorophyll • NADP Plant growth Role of auxin/cytokinins		

Question	Answer	Marks	Guidance
3	**Experimental biology is essential for a full understanding of living systems.** **Discuss this statement with reference to examples.** Much of the content of this essay will come from Sections 1 to 5 • Cell biology • Molecules of life • Applications of molecular biology • Animal physiology • Plant physiology • Environmental studies The following learning outcomes are directly relevant: • 1.1 i, vi, ix, x • 1.2 i, ii • 1.3 ii, iii • 1.4 i, ii • 1.5 i, ii • 1.6 i, ii • 1.7 i-iii • 2.2 i-iii • 2.3 i • 3.1 i-iii • 3.3 ii, iii • 3.4 iii • 4.2 i-iii • 4.3 i-iv • 4.4 i-iii • 5.1 i • 5.2 i-iii		

Question	Answer	Marks	Guidance
3	***Introduction:*** What is experimental biology? Reference to observational biology. Comparison with theoretical biology Mathematical modelling ***Examples and contributions*** ***Molecular biology*** Enzyme action Properties of enzymes ***Cell biology*** Cell function Cell structure and microscopy ***Cell replication*** Stem cells Specialisation Cancers ***Diseases*** Viruses Bacteria Immunity / vaccination development ***Tissue / organ / system biology*** System function Drug action Animal experimentation Plant tissue culture		

Question	Answer	Marks	Guidance
3	***Ecology*** Animal and plant distribution Classification Effects of pollution Predicting climate change ***Counterargument*** examples of advances in which experimental biology was not a factor mathematical modelling meta-analysis ***Conclusions*** Summary of importance of experimental investigation Counter arguments Reference to hypothesis testing		

Question	Answer	Marks	Guidance
4	**It is possible to produce a vast number of polymers from only a small number of monomers.** **Discuss the importance of this for organisms.** Much of the content of this essay will come from Sections 1, 2 and 5. • Genes and protein synthesis • The origins of life • The chemicals of life • The evolution of life • Adaptation and biodiversity The following learning outcomes are directly relevant: • 1.2b • 1.6abcdekm • 2.2efghijklm • 2.3c • 3.4ch • 3.5b ***Introduction:*** What is a monomer/polymer Polymerisation reactions ***Monomers and polymers:*** ***Carbohydrates*** ***Glucose isomers*** Cellulose Starch, glycogen		

Question	Answer	Marks	Guidance
4	***Nucleic acids*** DNA/RNA ***Proteins*** Protein structure Variation in primary structure Links to secondary, tertiary and activity of proteins Link between few monomers giving rise to many polymers Combinations/permutations e.g. triplet code/redundancy idea Ref. to mutations Link between many types of the polymer and function e.g. proteins, with examples. proteomics ***Counterargument*** Idea of conservation of some molecules, e.g. starch, glycogen, cellulose ***Conclusion*** Importance of variation for survival and adaptation Evolutionary significance		