Cambridge Assessment International Education
Cambridge Pre-U Certificate

BIOLOGY **9790/03**

Paper 3 Case Study and Synoptic Essay **May/June 2019**

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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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.

Question	Answer	Marks	Guidance
1(a)	(short) RNA binds to mRNA (as complementary) / forms double-stranded RNA ; could prevent mRNA binding to ribosome ; stops / reduces, production of polypeptide / prevents translation ; could prevent tRNAs binding to mRNA / codon ; AVP ;	**3**	**A** prevents translation described
1(b)(i)	~95 °C, melt / denature DNA ; addition of, (DNA) primer sequence / primers ; free nucleotides ; *Taq* polymerase ; ~55 °C, binding / annealing (DNA) primer ; ~72 °C, polymerase activity ; repeat cycle ;	**4**	
1(b)(ii)	*promoter* to allow transcription of gene in host organism (idea that promotor may not occur naturally) ; *marker gene* *idea of,* to be able to select organisms with successful gene transferred ;	**2**	

Question	Answer	Marks	Guidance
1(b)(iii)	1. (T_i) plasmid extracted ; 2. (plasmid) cut with restriction enzyme ; 3. remove Ti genes ; 4. gene (of interest) added to plasmid **and** use of DNA ligase ; 5. (entry of plasmid into bacteria) by, electroporation / freeze-thaw / using Ca^{2+} ; 6. culturing of bacteria **and** selection by antibiotic resistance ; 7. transformed / selected, bacteria used to infect plant cells ; 8. extra detail of transfer mechanism (e.g. pili, T-DNA carries gene of interest) ; 9. *idea of,* integration of gene into host genome by Ti plasmid ;	**4**	
1(c)	unknown effect of GM food crop on humans / possible allergies ; cross-pollination / gene transfer with wild population ; *qualified* effect on farming practice ; concerns over transfer / spread of, antibiotic resistance gene (to bacteria) ; reduced genetic diversity ; AVP ;	**3**	e.g. cost of seed potatoes, sterility so cannot keep seed **A** reduce biodiversity e.g. risk of silencing non-target genes

Question	Answer	Marks	Guidance
2(a)	*Economic:* 1. less polyphenols produced (as less polyphenol oxidase) ; 2. less, spoilage / browning / bruising / less crop lost, so more can be sold ; 3. easier to, transport / store / longer shelf life, (so reduced, transportation / storage costs) ; 4. reduced health costs (associated with cancer treatment (in context of acrylamide production) ; *Nutritional:* 5. less asparagine produced ; 6. allows heating with less acrylamide produced ; 7. reduced, carcinogens / neurotoxin (in food) / chance of getting cancer / chance of nerve damage ;	**4**	**A** more glutamine present
2(b)	*Asparagine, max. 3 of:* 1. (large) decrease ; 2. SD / error bars, do not overlap with control ; 3. relevant data manipulation ; 4. SD / error bars, overlap in trials / not much variation between trials ; *Crop yield:* 5. no effect on yield ; 6. overlap of, SD / error bars, with control ; 7. results of control least variable, due to smallest SD ;	**4**	**A** *idea of*, effect is consistent across trials

Question	Answer	Marks	Guidance
2(c)	glutamine is a precursor of asparagine ; no / less, StAst1 enzyme / asparagine synthetase (results in build-up of glutamine) ;	**2**	**A** not being converted to asparagine **A** StAst1 enzyme is silenced
2(d)(i)	loading into, companion / transfer, cells (from source / leaves) ; moving into phloem sieve tubes / sieve tube elements ; mass flow (in phloem sieve tubes) ; *idea of,* driven by, water movement / osmosis, at source / sink ; description of unloading at, sink / tubers ; active process, in loading / unloading ;	**3**	if **no** other marks awarded, allow in the phloem, from source to sink
2(d)(ii)	no / wrong, transporter proteins ; produced in tubers already ; no excess to transport / it is all needed in the leaves ;	**1**	

Section B – Synoptic Essay

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	• recalled and consistently used all facts and principles (relevant to the essay); • shown sound understanding of all principles and concepts; • written accurately with no major errors and very few minor errors; • given comprehensive detail expected from the relevant learning outcomes, with evidence of relevant reading around the subject.
16	• recalled and consistently used most facts and principles (relevant to the essay); • shown sound understanding of most principles and concepts; • written accurately with no major errors and few minor errors; • given full detail expected from the relevant learning outcomes.
12	• recalled and consistently used some facts and principles (relevant to the essay); • shown sound understanding of some principles and concepts; • written some material accurately with not more than one major error and some minor errors; • given most detail expected from the relevant learning outcomes.
8	• recalled some facts and principles (relevant to the essay); • shown some understanding of some principles and concepts; • written some material accurately with more than one major error or many minor errors; • given some detail expected from the relevant learning outcomes.
4	• recalled a few facts and principles (relevant to the essay); • shown limited understanding of a few principles and concepts; • written material that includes many errors, some of which may be major errors; • given little detail expected from the relevant learning outcomes.
0	• recalled no relevant facts and principles; • shown no understanding of relevant principles and concepts; • written irrelevant material or includes many major errors; • given no detail expected from the relevant learning outcomes.

Question	Answer	Marks
3	***All living organisms rely on the Sun to survive.*** ***Discuss the extent to which this is true.*** Much of the content of this essay will come from Sections 4 and 5. • photosynthesis • biodiversity ***Introduction:*** Sun as energy source fixation of carbon ***Arguments for statement*** ***Environment:*** control of temperature / IR UV light / radiation mutation ice ages / sea level change weather systems water cycle and links with transpiration oxygen production (and carbon sequestration), plus links with aerobic respiration ***Impacts on biodiversity:*** effect on ecosystems diversity niches ***Photosynthesis:*** (*note a detailed description of this is NOT required by the question)* basic description brief outline of stages products of photosynthesis – *significance of these that is important* – i.e. carbohydrates and oxygen	

Question	Answer	Marks
3	***Food chains:*** plants as autotrophs carbon fixation into carbohydrates available to heterotrophs carbon cycling energy transfer ***Food chains / examples where sun seems less influential:*** *(good candidates would link to indirect reliance)* internal parasites cave life organisms in deep ocean / aphotic or twilight zones ***Impacts on behaviour:*** tropisms taxes sun basking circadian rhythm **Against** ***Alternatives:*** deep sea vents sulphur based food chains chemosynthesis and chemoautotrophs lack of life on other planets (despite the Sun being present)	

Question	Answer	Marks
4	***Describe applications of stem cell research and discuss the implications of this area of research.*** Much of the content of this essay will come from Section 1. • stem cells • cloning • reproduction • GM ***Introduction:*** definition of stem cells overview of their use ***Stem cells:*** definition and types • totipotent • pluripotent • multipotent • unipotent • iPSCs ref. to telomere shortening and telomerase no Hayflick limit where found how obtained uses – comparison of types protection during chemotherapy ***Drug testing:*** benefits vs animal / tissue testing	

Question	Answer	Marks
4	***Gene therapy:*** uses of gene therapy examples – modification of haematopoietic stem cells limitations ***Cloning and reproduction:*** stem cell cloning replacement tissues organ donation ***Moral / ethical implications of using stem cells:*** sourcing cost of treatment / equality of healthcare consent issues legal issues insurance storage	

Question	Answer	Marks
5	***'Biologically the species is the accumulation of the experiments of all its successful individuals since the beginning.' – HG Wells, A Modern Utopia, 1905.*** ***Discuss this statement.*** Much of the content of this essay will come from Section 2. • the species concept • evolution • adaptation • variation • selection • speciation ***Introduction:*** definition of species evolution speciation Good candidates may comment on fact that this is a forward thinking statement for its time. **What the statement means** ***Evolutionary change:*** variation meiosis and sexual reproduction leading to variation causes of mutation types of mutation selection pressures survival of the fittest adaptation survival	

Question	Answer	Marks
5	***Speciation:*** common ancestors isolation mechanisms allopatric sympatric ***Adaptation:*** gradual change and selection leading to adaptation niche concept ***Problems with statement:*** *(Note: candidates unlikely to include much from this **but** a good essay should have a small element from this list. Most likely the effect of random factors or mass extinction)* ref. to genetic drift, random events, random causes of extinction mass extinction events – highly successful species get wiped out due to random events relatively little of past species is known – idea of incompleteness of fossil record extinct lineages are species, but not successful under current / past conditions meaning of 'experiment' = learning / mutation ref. to Lamark meaning of 'accumulation' = gradual change vs. punctuated equilibrium examples of regressive evolution, loss of features bidirectional evolution ref. to embryological development of mammals showing prior stages *idea of,* 'fossil' genes (genes present but no longer expressed) not every feature adapted – simply function of other adaptive traits (could be linked to genes or body parts that are no longer expressed / required) *idea of*, recessive conditions being maintained in population that is now an evolutionary disadvantage in some environments – e.g. sickle cell	