GCE

Biology A

H420/02: Biological diversity

A Level

Mark Scheme for June 2023

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING
RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   Rubric Error Responses – Optional Questions
   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
   - there is nothing written in the answer space

   Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

The skills and science content determines the level.

The communication statement determines the mark within a level.

Level of response questions on this paper are **16(c)** and **18(c)(ii).**

11. **Annotations**

Annotation	Meaning
	Correct response
	Incorrect response
	Marking point partially met
	Omission mark
	Benefit of doubt given
	Contradiction
	Underline (to indicate errors / incorrect science terminology)
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3

Annotation	Meaning
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore
BP	Blank page

12. **Subject Specific Marking Instructions**

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
I	alternative and acceptable answers for the same marking point
✓	Separates marking points
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

13. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	AO element	Guidance
1			C ✓	1	1.1	
2			C ✓	1	1.2	
3			C ✓	1	2.5	
4			A ✓	1	2.7	
5			B ✓	1	1.2	
6			A ✓	1	1.1	
7			B ✓	1	2.1	
8			C ✓	1	1.1	
9			B ✓	1	2.4	
10			D ✓	1	1.1	
11			C ✓	1	1.2	
12			C ✓	1	1.2	
13			B ✓	1	1.2	
14			A ✓	1	2.1	
15			A ✓	1	2.1	
			Total	**15**		

Question			Answer	Marks	AO element	Guidance
16	(a)		growth (of organisms / tissues) **AND** repair (of organisms / tissues) ✓	**1**	1.1	Both answers required for 1 mark *If more than two responses are given,* **DO NOT AWARD** the mark if any of the responses is incorrect. **ALLOW** controlling body plan **ALLOW** clonal expansion / replacement of cells **IGNORE** stem cells
	(b)	(i)	produces genetically identical , cells / organisms ✓ maintains , chromosome / diploid , number (between generations) ✓	**2**	1.2	**ALLOW ora** for meiosis **ALLOW** offspring with identical genes **IGNORE** clones **IGNORE** produces diploid cells
		(ii)	mitosis is nuclear division ✓ bacteria have no nucleus ✓ AVP ✓	**2 max**	2.1	**ALLOW** e.g., mitosis involves disintegration of nuclear membrane **IGNORE** chromosomes / plasmids **CREDIT** further detail, e.g. ref to absence of spindle fibres

Question			Answer	Marks	AO element	Guidance
	(c)	*	***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.***			
			Level 3 (5–6 marks) Describes arguments for **AND** against artificial cloning in animals **AND** plants *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Describes arguments for **AND** against artificial cloning with some reference to animals or plants. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** States some reasons for **AND** against artificial cloning. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**	1.1	**Indicative points may include** *Generic advantages* • rapid production of large numbers of individuals • propagation of individuals with desirable traits • numbers of rare species can be increased • production of large numbers of selectively bred or genetically-modified individuals *Animal-specific advantages* • use of animal example • key individuals, e.g. beloved pets, can be cloned *Plant-specific advantages* • propagation of seedless plants • propagation of plants that are difficult to grow from seed • quicker than growing from seed • growth of pathogen-free individuals • use of plant example *Generic disadvantages of cloning* • lack of genetic variation • population at greater risk of environmental change *Animal-specific disadvantages* • process (SCNT) is inefficient / expensive • high incidence of health issues

Question			Answer	Marks	AO element	Guidance
						• use of animal example *Against cloning in plants* • if source material is infected with microorganisms offspring will be • complex aseptic procedures • use of plant example
16	**(d)**		**FIRST CHECK ON ANSWER LINE** **If answer = 1024 award 2 marks** number of combinations = 2^n ✓ 2^{10} = 1024 ✓	**2**	2.2	*If answer is incorrect* **ALLOW** 1 mark for 512 or 2048 or 1000

Question			Answer	Marks	AO element	Guidance
17	**(a)**	**(i)**	hydrogen peroxide <u>concentration</u> ✓	**1**	3.3	**IGNORE** conc.
		(ii)	(mix with) distilled water ✓ ratio of 3 (water) : 2 (stock solution) ✓	**2**	3.3	**ALLOW** deionized water **ALLOW** any suggested volumes if proportion (3:2) is correct **IGNORE** units **IGNORE** any procedure with more than one step

Question			Answer	Marks	AO element	Guidance
		(iii)	easier to control <u>surface area</u> ✓ less chance of ethical objection (to use of animal material) ✓ AVP ✓	2 max	3.4	**ALLOW** lower risk of infection **ALLOW** more acceptable to vegetarians **ALLOW** e.g., less chance of violent frothing reaching delivery tube / slower reaction so easier to record accurately **IGNORE** cheaper
		(iv)	ensure there is no skin on / consistent potato variety ✓	1	3.4	**ALLOW** use potatoes that are the same age **IGNORE** drying / use same (part of) potato / measure mass
17	(b)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 2.3 award 2 marks** mean = 76.7 $\Sigma(x-\overline{x})^2$ = 10.67 ✓ correct answer to 1 decimal place ✓	2	2.8	**ALLOW** 1 mark for 2.3 to >1 decimal place. Check table for correct answer.
		(ii)	standard deviations are low(er) at , low(er) concentration(s) / earlier times ✓ **ora** more repeatable at , (stated) low(er) concentration(s) / (stated) earlier times ✓ **ora**	2	3.4	**ALLOW** AW for 'concentrations', e.g., a.u. **IGNORE** quoted standard deviations **ALLOW** less repeatable as time goes on **IGNORE** it is repeatable / not repeatable (must be comparative) **CREDIT** 'higher precision' as AW for 'more repeatable'

Question			Answer	Marks	AO element	Guidance
		(iii)	**FIRST CHECK ON ANSWER LINE** **If answer = 0.2 or 0.18 cm^3 s^{-1} award 2 marks** 5.3/30 **or** 5.3/0.5 ✓ ≤ 3 s.f. and correct units ✓	**2**	2.8	*Max 1 if no or incorrect unit given* **ALLOW 2 marks** if answer is 11 or 10.6 or 10 (cm^3 min^{-1}) or 0.177 (cm^3 s^{-1}) **ALLOW** unit written as cm^3/min or cm^3/s
		(iv)	**1** bung not airtight / some (gas) escaped ✓ **2** some , oxygen / gas , dissolved (in solution) ✓ **3** difficult to judge (volume at a set time) / AW , if rate of gas production is high / AW ✓ **4** gas other than oxygen collected ✓	**2 max**	3.3	**1 IGNORE** gas entering **2 ALLOW** some oxygen used in respiration **3 ALLOW** e.g., measuring cylinder fills too quickly to measure accurately at 20 (a.u.) **4 IGNORE** non-standard atmospheric gases
	(c)		**1** more frequent collisions at the start ✓ **ora** **2** substrate / H_2O_2 (collides with) , active site (of catalase) ✓ **3** rate of , product / oxygen , formation decreases (with time or substrate concentration) ✓ **4** substrate / H_2O_2 , concentration decreases (with time) ✓	**3 max**	2.8	**1 ALLOW** (rate) depends on frequency of collisions / more collisions over first 30 s **2 ALLOW** formation of ESC **3 ALLOW** e.g., more oxygen produced per second at the beginning **4 ALLOW** substrate concentration initially higher **4 ALLOW** substrate concentration becomes limiting factor **4 DO NOT CREDIT** enzyme concentration **DO NOT AWARD 1**, **3** or **4** for answers that do not address changes over time

Question			Answer	Marks	AO element	Guidance
18	(a)		membrane separation / encapsulation / microcapsule ✓	1	1.2	**ALLOW** contained by a partially-permeable membrane
	(b)		covalent bonding / matrix / carrier , might affect shape of active site ✓ active site might be (partly) hidden (when bonded to the carrier) ✓ substrate must move through a matrix ✓	2	2.5	**ALLOW** carrier restricts induced fit **ALLOW** fewer active sites accessible **IGNORE** fewer active sites **ALLOW** enzymes and substrates can't freely mix **IGNORE** enzymes are unable to move **IGNORE** leakage
	(c)	(i)	*idea that* yeast needs resources to stay alive ✓	1	2.7	**ALLOW** waste products need to be removed

Question			Answer	Marks	AO element	Guidance
	(c)*	(ii)	***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.***			
			Level 3 (5–6 marks) Outlines a valid investigation that explains how the independent variable should be changed **AND** how the dependent variable should be measured **AND** mentions controlling other variables. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Outlines a valid investigation that mentions the independent variable **AND** the dependent variable **AND** control variables. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence* **Level 1 (1–2 marks)** Attempts to outline a valid investigation but does not discuss one of the variables. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant* **0 marks** *No response or no response worthy of credit.*	**6**	3.3	**Indicative points may include** *Independent variable* • set up two columns • one with invertase beads and one with yeast beads • use of control column *Dependent variable* • measure product for reducing sugar • using Benedict's test • quantity can be estimated by o colour chart or testing strips o colorimeter *Control variables* • number or volume of beads in each column • concentration of substrate solution added to columns • volume of substrate added to columns • substrate exposed to columns for same time • temperature • pH • identical procedure for measuring product • zero colorimeter

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>19</td><td>(a)</td><td></td><td><u>mucus</u> traps , pathogen / virus ✓

cilia , move / AW , mucus / pathogens (away from lungs) ✓</td><td>2</td><td>1.2</td><td>ALLOW pathogen / virus / microorganism , sticks to mucus
IGNORE germs / bacteria / microbes

ALLOW ciliated , cells / epithelium , waft mucus out of the body</td></tr>
<tr><td></td><td>(b)</td><td></td><td><table><tr><th>Event</th><th>Letter or letters</th></tr><tr><td>Antigen presentation</td><td>A</td></tr><tr><td>Clonal expansion</td><td>B and D</td></tr><tr><td>Clonal selection</td><td>A</td></tr><tr><td>High T-helper cell activity</td><td>B and D</td></tr><tr><td>Highest number of memory cells</td><td>E</td></tr></table>✓✓✓✓✓</td><td>5</td><td>2.2</td><td>DO NOT CREDIT if any incorrect or ambiguous letters appear in a box

IGNORE D

IGNORE A / E</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>artificial and passive ✓</td><td>1</td><td>2.1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>similarity (max 2)

two , <u>variable regions</u> / <u>binding sites</u> ✓
hinge region ✓
disulfide , bond(s) / bridge(s) ✓
four , polypeptides / chains ✓

difference
(F_{ab} has) <u>shorter</u> , constant region / heavy chain ✓</td><td>3 max</td><td>2.1</td><td>IGNORE prompt lines, mark first two responses

IGNORE constant regions (as a similarity)

ALLOW no F_c region
ALLOW ora for antibody</td></tr>
</table>

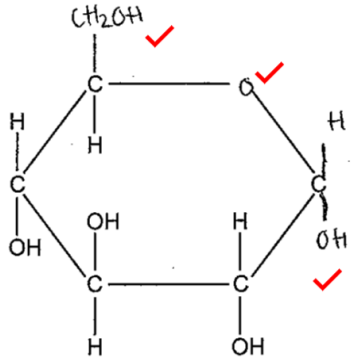
Question			Answer	Marks	AO element	Guidance
	(d)		widespread / AW , use ✓ at low dose / unfinished course ✓ natural selection / antibiotic is selective agent ✓ AVP ✓	**3**	1.1	**ALLOW** have been used a lot / overprescribing / use in agriculture / used to treat viral infections **CREDIT** description that includes genetic variation and differential survival and passing on traits **IGNORE** immune **CREDIT** sharing of , DNA / plasmids (containing resistance gene) , between bacteria **ALLOW** horizontal (gene) transmission
	(e)		genetic modification of (named) organisms ✓ to produce , (named) drug / (therapeutic) proteins / vaccine ✓	**2**	1.2	**IGNORE** humans Must be linked to (attempt at) first marking point **CREDIT** e.g. insulin / artemisinin **IGNORE** 'medicine'

Question			Answer	Marks	AO element	Guidance
20	(a)		**1** overall / AW , decrease ✓ **2** fluctuates (before 2006) ✓ **3** little / no , change after 2006 ✓ **4** figures that illustrate any of the above points ✓	**3 max**	2.6	**1 IGNORE '**decrease' unless the whole period (or until 2006) is implied **2 IGNORE** individual descriptions of short-term rises and falls **3 ALLOW** plateau after 2006 **4 ALLOW** e.g., fall of 39000 (67%) from 1993 to 2010 / around 20000 (after 2006) **4 AWARD** only if the m.p. that the figures illustrate has been awarded **3&4** varies by < 2000 after 2006 = **2 marks**
	(b)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 350 award 2 marks** 90−20 = 70 70/20 x 100 ✓ = 350 ✓	**2**	2.6	*Max 1* if answer given to > 3 s.f. *If answer is incorrect* **ALLOW 1 mark for** 90−20/20 **ALLOW** 350%
	(b)	(ii)	fall in deer (population) ✓ means less , food / prey (for wolves) ✓ *idea that* spike in wolf population in 2007 related to higher deer population in 2005 ✓	**2**	2.6	
	(c)	(i)	*idea that* living in water makes them hard to count ✓ easier to count (big) mounds (of wood) ✓	**1**	3.3	**ALLOW** living , in dams / underneath wood **IGNORE** nocturnal

Question			Answer	Marks	AO element	Guidance
		(ii)	*claim supported because…* **1** beaver and wolf population both increase ✓ **2** beaver (population) increases after wolf population increases ✓ **3** *idea that* lag in increase in beaver population is consistent with allowing sufficient time for wolf population to have affected ecosystem ✓ *claim not supported because…* **4** beaver and wolf population curves are different shapes ✓ **5** correlation does not imply causal link ✓ **6** plausible alternative reason for increase ✓ **7** figures that illustrate **1**, **2** or **4** ✓	**4 max**	3.2	*Assume points support the claim unless context states otherwise* **IGNORE** refs to deer **1 & 2** 'wolf population increases then beaver population does' **= 2 marks** **2 ALLOW** beaver population increases after wolf introduction (for mp 2 only) **2 & 7** Figures that illustrate must reference a time delay **4 ALLOW** example of where curves differ **4 IGNORE** wolf increase is bigger than beaver increase **5 IGNORE** (no) statistical tests **6 ALLOW** e.g. climate change / other management strategies / change in abiotic factor **7 IGNORE** time delay as figs to support m.p. **4**
		(iii)	population of trees near water ✓ proportion of damaged trees near water ✓ time spent by deer near water / AW ✓	**1**	3.2	**ALLOW** count the trees near the water

Question			Answer	Marks	AO element	Guidance
	(d)	(i)	*idea of* human intervention ✓ habitat / ecosystem / biodiversity , changed / restored , (when they were reintroduced) ✓	2	2.1	**ALLOW** e.g., population actively moved **IGNORE** maintain
		(ii)	*idea of* habitat being sensitive to damage ✓	1	1.1	**ALLOW** e.g., a rare / endangered / threatened , species lives there

Question			Answer	Marks	AO element	Guidance
21	(a)		ammonification ✓ nitrifying ✓ *Nitrosomonas* ✓ *Nitrobacter* ✓ amino acids ✓ nitrogen-fixing ✓	6	1.1 1.2	 **ALLOW** lower case letters for all generic names **ACCEPT** phonetic equivalent spelling **ACCEPT** phonetic equivalent spelling **ALLOW** protein **ALLOW** nucleic acids
	(b)		increased denitrification / decreased nitrification ✓ conditions favour (named) denitrifying bacteria ✓ (more) nitrate / NO_3^-, converted to nitrogen / N_2 , gas ✓	2	2.5	**ALLOW** descriptions of either **IGNORE** refs to nitrifying bacteria **ALLOW** reduces availability (to plants) of NO_3^-

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	*correct positions for* CH_2OH ✓ O ✓ H OH ✓	3	1.1	**ALLOW** bond line to any part of the group **ALLOW** correct displayed formula **IGNORE** bond angles 
	(c)	(ii)	small so it can cross membranes ✓ OH / H (groups) , allow , H bond formation / solubility / bonding with water molecules ✓	2	2.1	**ALLOW** small enough to fit through protein channels

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