GCE

Biology A

H420/02: Biological diversity

A Level

Mark Scheme for June 2022

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

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 50% 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, email or via the RM Assessor messaging system.

5. Work crossed out:

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. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space
   - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
   - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

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 email.

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(b)(iv)** and **18(a)(i)**.

11. Annotations available in RM Assessor

Marking Annotations

Annotation	Use
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
I	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
NBOD	Benefit of the doubt not given
	Tick
^	Omission Mark
BP	Blank Page
L1	Level 1 answer in Level of Response question
L2	Level 2 answer in Level of Response question
L3	Level 3 answer in Level of Response question

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

Annotation	Meaning
/	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.

Other subject-specific instructions

- Use **CON** when a correct response is associated with a piece of clearly incorrect science within the same statement and award no mark.
- For questions in which the command word is 'suggest', ignore incorrect responses and credit a correct response wherever it occurs
- Accept phonetic spellings unless otherwise indicated
- All marks are stand-alone unless otherwise stated in Guidance
- Bracketed words. The words in brackets are there to 'set the scene' and indicate the context in which the answer is expected. They do not need to appear. Award the mark as long as the statement in the brackets is not contradicted.
- Solidus (/): A solidus indicates alternative ways that a mark might be gained for a given Mark Point.
- Use of the comma in a mark point: This indicates that some information from either side of the comma or commas is needed. It is used in conjunction with the solidus.
- In some cases the Guidance column may indicate examples of wording or terms that are acceptable (ALLOW) or that should be ignored (IGNORE). In the case of IGNORE read on (or previously) to see if something creditworthy appears later in the response.
- Underlining
    - solid underline. The word or part of word underlined is required but minor mis-spellings are acceptable as long as the word is clearly the same
    - wavy underline. This indicates that, while the word underlined is not precisely needed, alternative responses need to be closely related in meaning or be a clear description.
- *idea of.* This is used as a prefix to marking points where there may be a fairly wide range of responses which cover the essence of the required response. This often requires examiner judgement. For '*idea of*' marking points, a wide range of wording is acceptable. The mark is to be awarded for the *idea*.

Question			Answer	Marks	AO element	Guidance
1			A ✓	1	2.5	
2			C ✓	1	1.2	
3			C ✓	1	1.2	
4			B ✓	1	2.5	
5			C ✓	1	1.1	
6			C ✓	1	1.2	
7			A ✓	1	2.3	
8			B ✓	1	1.1	
9			D ✓	1	1.1	
10			D ✓	1	1.1	
11			A ✓	1	1.2	
12			B ✓	1	2.7	
13			D ✓	1	1.1	
14			D ✓	1	1.1	
15			C ✓	1	1.2	
			Total	**15**		

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	peptide ✓	1	1.1	
		(ii)	haem ✓	1	1.1	**IGNORE** prosthetic group / iron / C atom
		(iii)	spherical (shape) / no fibres / (contains) prosthetic groups ✓	1	2.1	**ALLOW** round / ball-shaped **IGNORE** coiled / compact / tertiary structure
	(b)	(i)	1 = threonine ✓ 2 = proline ✓	2	2.1	
		(ii)	joins / adds , (RNA) nucleotides ✓ forms phosphodiester bonds (between nucleotides) ✓	2	1.2	**IGNORE** bases **ALLOW** forms sugar–phosphate backbone **IGNORE** covalent bonds
		(iii)	CAC ✓	1	2.1	**ALLOW** cytosine adenine cytosine **IGNORE** CAU

Question			Answer	Marks	AO element	Guidance
		(iv)*	***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) Explains in detail why mutations may leave the function of a protein unchanged using Fig 16.3 **and** referring to more than one level of protein structure. *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)** Explains why mutations may leave the function of a protein unchanged using Fig 16.3 **and** referring to protein structure. *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)** Suggests why mutations may leave the function of a protein unchanged using Fig 16.3 **or** referring to protein structure. *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**	2.1	**Indicative points may include** *Mutations* • genetic code is degenerate • point mutation might code for the same amino acid • use of example from Fig 16.3 to support *Protein structure and function* • haemoglobin function is dependent on tertiary structure • silent mutation would leave primary structure unchanged • unchanged primary structure would leave tertiary structure unchanged • substitution of amino acid with similar properties to the original amino acid might leave tertiary or secondary structure unchanged • mutation might change part of the tertiary structure away from the functional part of the protein, e.g. away from the active site of an enzyme

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	prevent contamination (by unwanted microorganisms) ✓ to prevent , entry / growth , of unwanted microorganisms ✓	**1 max**	1.2	 **IGNORE** kill
		(ii)	use , sterile / autoclaved , flask / pipette / equipment / broth ✓ stopper flask (to prevent contamination) ✓ disinfect / sterilise , surfaces ✓ (nearby) Bunsen flame (to create upward air flow) ✓	**2 max**	1.2 3.3	*Mark first two answers only or first answer on each prompt line, which ever gives the candidate most benefit.* **ALLOW** 'pasteurise' as AW for 'autoclave' **DO NOT CREDIT** if airtight seal is implied **ALLOW** flame neck (of flask) / remove stopper for minimal time / do not put stopper on bench **ALLOW** wash hands / wear gloves
	(b)	(i)	*idea of* so bacterial cells are evenly distributed ✓	**1**	3.4	
		(ii)	small(er size) ✓	**1**	3.4	**ALLOW** size similar to wavelength of (visible) light **IGNORE** reference to resolution of microscope

Question			Answer	Marks	AO element	Guidance
	(b)	(iii)	*Calculate the number in 10 cm^3* **1** multiply , 52 / number of bacteria in sample , by 1000 ✓ **2** *Correct treatment of serial dilutions* multiply by , 100^n (where n is the number of serial dilutions) ✓ **3** *Calculate the total in 50 cm^3* multiply (answer to **1**) by 5 ✓	**3**	2.8	*Credit steps in any order* **1 ALLOW** if 52 000 seen as part of a calculation **1 ALLOW** 52 x 100 if working out number in $1cm^3$ **3** 52 x 5 000 = 2 marks (**1** and **3**) *If mp1 has not been awarded* **ALLOW** 1 mark for 260 000 **ALLOW** answer written as single formula, e.g., • 52 x 1000 x 100^n x 5 = 3 marks • 52 000 x 100^n x 5 = 3 marks • 52 x 100 x 100^n x 50 = 3 marks (if working out no. in $1cm^3$ first) • 100^n x 260 000 = 2 marks (steps not clearly described)
	(c)	(i)	*idea that* differences in numbers would be too big to represent on paper ✓ two figures quoted in support ✓	**2**	2.8	**ALLOW** so the scale can fit on the paper **ALLOW** e.g. total count at 0 h is 10 but at 40 h is $1x10^{12}$

Question			Answer	Marks	AO element	Guidance
		(ii)	**FIRST CHECK ON ANSWER LINE** **If answer = 99.9 award 3 marks** *Reading from graph* log 9 = 1 x 10^9 and log 6 = 1 x 10^6 ✓ *Calculating percentage* $\frac{1 \times 10^9 - 1 \times 10^6}{1 \times 10^9}$ x 100 ✓ *Correct processing* correct answer to 3 s. f. ✓	**3**	2.8	*If the answer is not 99.9…* **ALLOW** −99.9 for 3 marks **ALLOW** numbers not in standard form / 10^9 / 10^6 **ALLOW** substitution of incorrect numbers into the formula $\frac{\text{difference}}{\text{original}}$ x 100 **and** answer given to 3 s. f. (with correct sign) for **1** mark **AWARD** 2 marks for 0.999
	(d)		**1** reproduction rate lower than death rate ✓ **2** total count / dead bacteria , much / AW , higher than viable bacteria ✓ **3** use of figures with units (to support **2**) ✓ **4** increased / high level of , (named) waste products ✓ **5** less oxygen / fewer (named) nutrients ✓ **6** increased (intraspecific) competition ✓ **7** dead cells / turbidity / lack of space , reduces surface area for access to nutrients / oxygen ✓	**4 max**	1.2 2.8	**1 ALLOW** death / decline , stage / phase **2 ALLOW** total count is *very* high **3 ALLOW** e.g log12 cells per cm^3 / difference at 48h is 999 999 000 000 cells **4 ALLOW** fall in pH **4 IGNORE** secondary metabolites **5 ALLOW** oxygen / nutrients , limiting / low **5 IGNORE** food

Question			Answer	Marks	AO element	Guidance

Question			Answer	Marks	AO element	Guidance
18	(a)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = −3400 award 2 marks** $\frac{110\,000}{32}$ ✓ (correct answer) as whole number with minus sign ✓	**2**	2.6	*Max 1 if no '−' sign.* **ALLOW** −3440 / −3438 / −3000 / −3437.5 **ALLOW** 1 mark for −3437

Question			Answer	Marks	AO element	Guidance
			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.			
		(ii)*	**Level 3 (5–6 marks)** Evaluates the support given by discussing aspects of the graph that support **and** do not support the claim **and** discusses the validity of the data. *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 evidence that supports the claim **and** either describes evidence that does not support the claim **or** questions the validity of the data. *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)** Describes evidence that supports the claim **or** describes evidence that does not support the claim **or** questions the validity of the data. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	**6**	3.2	**Indicative points may include** *Evidence in support* • decline in populations of wild species • domestic animals increase associated with decrease in wildebeest since 1995 • figures used to support *Evidence not in support* • number of species recorded on graph remains unchanged • before 1995 here was little change in domestic animals but concurrent decrease in wild animals • little or no change in gazelle and zebra since 1995 • figures used to support *Issues with validity* • graph does not show human population • only 3 species of wild animal shown • Simpson's Index not calculated • correlation does not mean causation • no statistical test to assess correlation between populations of domestic & wild species

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td>0 marks
No response or no response worthy of credit.</td><td></td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><th>Reason for maintaining biodiversity</th><th>Letter or letters</th></tr>
<tr><td>ecological</td><td>C ✓</td></tr>
<tr><td>economic</td><td>A and D and F ✓</td></tr>
<tr><td>aesthetic</td><td>A ✓</td></tr>
</table>
</td><td></td><td></td><td>DO NOT CREDIT if any incorrect letters are given

IGNORE B and E

IGNORE B and E

IGNORE F</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
19	(a)	(i)		5	3.3	*Points 1 and 2 can be awarded for a line graph.*
			1 horizontal axis labelled 'body length (mm)' **AND** vertical axis labelled , 'frequency' / 'frequency density' (/100 mm) ✓			**1 ALLOW** unit written as '/ mm' **1** Unit for frequency density can be omitted.
			2 linear scale on **both** axes **AND** at least 50% of grid covered by plotted area ✓			
			3 histogram plotted with ruled lines and touching bars ✓			
			4 first 5 bars plotted accurately ± 0.5 squares and equal width ✓			**4** Correct numbers: 10, 48, 121, 130, 119 (or 0.10, 0.48. 1.21, 1.30, 1.19 if frequency density used)
			5 6th bar twice the width and height 23 ✓			**5** Height 0.23 if axis labelled 'frequency density'
		(ii)	bell-shaped / normal distribution ✓ (data / variation) continuous ✓	2	2.2 3.2	**ALLOW** most frequent values in middle of range **ALLOW** e.g., most common length is between 400 and 500

Question			Answer	Marks	AO element	Guidance
	(b)	(i)		3 max	1.1	*Mark first three answers only or first answer on each prompt line, which ever gives the candidate most benefit.*
			1 quotas / limiting (mass of) fish caught ✓			**1 ALLOW** limit , number / amount , of fish caught **1 IGNORE** restrict fishing / limit boats
			2 use nets with larger mesh ✓			**2 ALLOW** different shaped mesh **2 IGNORE** different sized nets / different mesh size
			3 limit fishing to certain times (of year) ✓			**3 ALLOW** regulate fishing seasons
			4 areas where fishing is banned ✓			**4 ALLOW** regulate areas where you can catch fish
			5 allow catching of certain (non-endangered) species only ✓			**5 ALLOW** regulate which fish can be caught
			6 *idea of* strict enforcement of any one of the above ✓			**6 ALLOW** e.g., issuing licences
		(ii)	fish swim between countries ✓ much of ocean does not belong to any one country ✓ people catch fish in countries other than their own ✓	1 max	2.1	**ALLOW** fish are caught in countries far from where they are sold

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	(description of) systematic sampling / transect ✓	1	1.2	**IGNORE** stratified
		(ii)	(placement could be) not accurate / biased ✓ position of coordinates difficult to judge ✓ method does not specify top (left) or bottom (left) ✓	2 max	3.4	
	(b)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 0.6816 award 3 marks** $\Sigma(n/N)^2 = 0.3184$ ✓✓ 1 - calculated $\Sigma(n/N)^2$ ✓	3	2.4	**ALLOW** 0.68 / 0.682 **ALLOW** any correct rounding **ALLOW ecf** from calculated value of $\Sigma(n/N)^2$
		(ii)	*If treating grass as a single species…* D / calculated diversity / index , is lower ✓ **ora** $\Sigma(n/N)^2$ is higher ✓ **ora** *idea that* $(26/N)^2$ will be bigger than the sum of $(n/N)^2$ for individual grass species ✓	2 max	2.4	 **ALLOW** 'value' as AW for calculated diversity **ALLOW** 'a bigger number is subtracted from 1' **ALLOW** e.g. '0.270 is bigger than the equivalent number for individual grasses'
	(c)	(i)	quick(er) ✓ wide(r) area can be surveyed ✓	1 max	3.4	**IGNORE** easier **ALLOW** description of why it might be quicker
		(ii)	subjective / uses judgement ✓ misses , small(er) / non-flowering , plants ✓	1 max	3.4	**ALLOW** opinion **IGNORE** qualitative **/** (not) quantitative / inaccurate / imprecise / not random / biased **ALLOW** overestimates abundance of large plants

Question			Answer	Marks	AO element	Guidance
21	(a)		**1** no , welfare / ethical , issues ✓ **2** can be genetically modified (relatively easily) ✓ **3** rapid growth / production can be easily changed to meet demand ✓ **4** non-seasonal / year-round production ✓ **5** take up little space ✓ **6** low costs because work at low temperatures ✓	**2 max**	1.2	*Mark the first two answers.* **1 ALLOW** e.g., 'acceptable to vegetarians' **3 ALLOW** rapid reproduction **IGNORE** nutrient requirements
	(b)	**(i)**	pH below <u>optimum</u> ✓ (for) bacterial enzymes ✓	**2**	2.5	**ALLOW** low(er) pH denatures (enzymes) **ALLOW** enzymes in (named) microorganisms
		(ii)	*Product* amino acid(s) ✓ *Reaction* hydrolysis ✓	**2**	1.2	**ALLOW** water added
	(c)	**(i)**	continuous **AND** there is an outlet for (continuous) collection of product ✓	**1**	3.1	**ALLOW** (named) raw materials can be constantly added

Question			Answer	Marks	AO element	Guidance
		(ii)	temperature affects , rate of growth / enzyme activity ✓ (fungal) metabolic reactions generate heat ✓ to inhibit growth of pathogenic bacteria ✓	2 max	2.5	**ALLOW** proteins could denature (at higher temperatures) **ALLOW** respiration is exothermic
		(iii)	source of , nitrogen / N / amine / NH_2 ✓ for (producing) amino acids / polypeptides / proteins ✓	2	2.5	**IGNORE** nitrate / NH_3 **ALLOW** for (named) nucleic acids
	(d)	(i)	**1** zero the colorimeter ✓ **2** use known (concentration of protein) solutions ✓ **3** plot calibration curve / absorbance vs concentration ✓ **4** measure absorbance of (unknown) sample ✓ **5** compare (absorbance of) sample with (calibration) graph ✓ **6** use appropriate filter for , (shade of) purple / biuret ✓	4 max	1.2 2.5 3.3	**1 IGNORE** calibrate / blank / tare **1 ALLOW** reference to 100% only if explicitly measuring transmission **3, 4** and **5 ALLOW** 'transmission' as AW for 'absorbance' **6 ALLOW** use , green / yellow , filter
		(ii)	biosensor ✓	1	1.2	**ALLOW** compare with colour chart / chromatography / mass spectrometry / UV absorbance

Question			Answer	Marks	AO element	Guidance
22	(a)		environmental ✓ stimuli ✓ apoptosis ✓ enzymes ✓ phagocytes / phagocytosis ✓	5	1.2	 **ALLOW** stress / factors **ALLOW** proteases / caspases **IGNORE** lysosomes **ALLOW** macrophages / endocytosis
	(b)		Hox / homeotic / homeobox ✓	1	1.2	**IGNORE** regulatory

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