GCE

Biology A

H420/02: Biological diversity

A Level

Mark Scheme for June 2025

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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 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, email or via the RM Assessor messaging system.

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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

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 is not 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.**

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 **19(c)**.

11. Annotations

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

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

12. **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.

REMEMBER EVERY MCQ MUST HAVE AN ANNOTATION

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

REMEMBER TO ANNOTATE SEEN/BP ON 3 PAGES PRIOR TO MARKING 16ai + MAKE LINKS TO EXTRA PAGES

Question			Answer	Mark	AO	Guidance
16	**(a)**	**(i)**	2D image / image **not** 3D ✓ (named) organelles / sub-cellular structures / ultrastructure , not (clearly) visible ✓ low(er) resolution ✓	**2 max**	**3.2**	*Mark as prose (ignore prompt lines)* **ALLOW** cannot see , ribosomes / mitochondria **IGNORE** magnification
16	**(a)**	**(ii)**	**FIRST CHECK ON ANSWER LINE** **If answer = 33.5 or 34 (µm) award 2 marks** diameter = 66 – 68 mm 68/2000 = 0.034 mm ✓	**2**	**2.4**	**ALLOW** between 33 and 34 for 2 marks **ALLOW** 1 mark for correct answer in incorrect unit to 2 s.f., e.g. between 0.033 and 0.034 **ALLOW ECF** if incorrect measurement of cell with units used but divided by 2000 for 1 mark
16	**(a)**	**(iii)**	improves <u>contrast</u> / AW ✓ spindle (fibres) / chromosomes / cell (surface) membrane, darkly stained / (made) visible ✓	**2 max**	**2.3**	**ALLOW** identifying / differentiating AW for visible **IGNORE** nucleus / centromeres / chromatids / mitochondria

Question			Answer	Mark	AO	Guidance
16	(b)	(i)	undifferentiated ✓ (named) potency ✓ capable of / AW , (continuous) mitosis ✓	2 max	1.1	*Mark as prose (ignore prompt lines)* **ALLOW** unspecialised / have the ability to differentiate **IGNORE** general descriptions of being unspecialised **ALLOW** idea of self-renewing / immortal
16	(b)	(ii)	**1** used for testing / researching , medicines ✓ **2** can study (named) disease , development / mechanisms ✓ **3** can study , development / AW, of embryo ✓ **4** (can be) used to produce , many cells / tissues / organs (for research) **5** avoids need for living organisms (during research) ✓ **6** genetically identical so a variable is controlled ✓	2 max	1.1	**ALLOW** measure efficacy of drug / finding drug dose / ref. to gene editing / find cures / find treatments **ALLOW** treat diseases / cure diseases named diseases could include Alzheimer's / Parkinson's **ALLOW** embryology **ALLOW** named tissues / organs **ALLOW** better ethically **ALLOW** avoids / identifies , side effects (as not using humans)

Question			Answer	Mark	AO	Guidance
16	(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)** Explains in detail the importance of mitosis **AND** apoptosis as mechanisms controlling the development of body form with examples. *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 the importance of mitosis **AND** apoptosis as mechanisms controlling the development of body form with at least one example. *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)** Explains the importance of mitosis **OR** apoptosis as mechanisms controlling the development. *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	1.2	**Indicative points may include** *Mitosis* • produces genetically identical cells • increases number of cells for growth **or** used to grow , tissues / organs / organisms • ref. Hayflick limit *Apoptosis* • programmed / controlled cell death • removes damaged / old / unnecessary cells • ref. to phagocytosis *Either mitosis or apoptosis* • stimulated by some genes and repressed by others • (genes / cells) respond to internal and external stimuli • under control of homeotic genes / regulatory genes / transcription factors • prevents, tumour formation / cancer • during development of embryo / fetus / child / organs • idea of rate of mitosis greater than rate of apoptosis during fetal development *Examples could include (from the animal kingdom)* • digit separation / removing webbing / preventing polydactyly / syndactyly • tadpoles losing tails / metamorphosis (tadpole to frog) • development of any named body part (not at cellular level) • development of neurones / synapses • removing immune system cells / preventing autoimmune diseases • **IGNORE** – examples of tissue repair **Aspects of the communication statement might typically not have been met when irrelevant / incorrect information (e.g. cell growth, detail of stages of mitosis) has been included.**

Question			Answer	Mark	AO	Guidance
17	(a)		(appearance affected by) environment ✓	1	2.1	**ALLOW** description of any environmental factors, e.g. different diet / sun exposure / epigenetics **IGNORE** mutations
17	(b)	(i)	(involves) meiosis ✓ (involves) fertilisation / described ✓ has no, alleles / genes, from W (chromosome) ✓	2 max	3.1	*Mark as prose (ignore prompt lines)* **ALLOW** independent assortment / crossing over **DO NOT ALLOW** if event in incorrect phase (e.g. crossing over in meiosis 1 and 2) **ALLOW only** has , alleles / genes , from Z chromosome **IGNORE** they are not genetically identical **IGNORE** genetic information
17	(b)	(ii)	female parent has no Y chromosome (to make a male) **or** (male mammals have) different / X and Y , chromosomes ✓	1	2.5	**ALLOW** there are ONLY X chromosomes in females / female mammals are homogametic / females are XX **ALLOW** males are heterogametic **IGNORE** heterozygous / homozygous

Question			Answer	Mark	AO	Guidance
17	(c)	(i)	(cells are) totipotent / able to differentiate into any cell type ✓	1	1.1	**IGNORE** cells are undifferentiated
17	(c)	(ii)	genetic resource / gene bank / preserves wanted genotypes ✓ *idea of* (freezing embryos), with good characteristics / for when environment is suitable / for when more (farm) animals needed ✓	1 max	2.1	**ALLOW** preserves wanted alleles **IGNORE** preserves wanted genes **ALLOW** extra (farm) animals needed
17	(d)	(i)	**1** number of polymorphic , genes / loci ✓ **2** total number of, genes / loci ✓ **3** proportion / percentage , of polymorphic, genes / loci ✓ **4** DNA profiling / comparing DNA base sequences (for percentage similarity) ✓	2 max	1.2	**IGNORE** proportion of heterozygous , genes / loci **ALLOW** 2 marks for correct equation, e.g. proportion of polymorphic , genes / loci = $\frac{\text{number of polymorphic , genes / loci}}{\text{total number of , genes / loci}}$ **ALLOW** DNA fingerprinting
17	(d)	(ii)	one , individual / organism ✓ predictable outcome / phenotype is known ✓	1 max	2.5	**ALLOW** need more than one individual for embryo splitting

Question			Answer	Mark	AO	Guidance
17	(d)	(iii)	*idea of* developments in , science / technology / understanding / knowledge ✓	1	2.5	**ALLOW** reference to possibility of DNA originating from younger cell, e.g. younger when nucleus taken **IGNORE** a better understanding of genetic engineering

Question			Answer	Mark	AO	Guidance
18	(a)	(i)	quicker ✓ easier than counting all organisms / AW ✓	1 max	1.1	**ALLOW** ora (too) time consuming / impossible / difficult , to count all organisms / to sample whole area **IGNORE** more efficient
18	(a)	(ii)	reduces / removes / avoids , <u>bias</u> ✓ makes sample (more) representative ✓ improves validity ✓	2 max	1.1	**ALLOW** ora, e.g. sample would be less representative if not random
18	(b)	(i)	six / 6 ✓	1	2.4	**DO NOT ALLOW** any other figures in addition to six / 6
18	(b)	(ii)	evenness is higher in B **and** (because) number of individuals (of each species) varies less ✓	1	2.4	**CREDIT** evenness is lower in A **ALLOW** fewer individuals of dominant species in B / no dominant species like in A / smaller range of abundances / smaller ratio between species **ALLOW** correct use of figures to support the statement, e.g. quadrat B has a ratio of 7:2:2:1:4:2 and A has a ratio of 13:2:2:1:4:1

Question			Answer	Mark	AO	Guidance
18	(c)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 0.79 award 3 marks** N = 100 ✓ $\Sigma(n/N)^2$ = 0.206(2) ✓	3	2.4	Correct answer to wrong number of s.f. = 2 marks, e.g. 0.8 / 0.794 / 0.7938 **IGNORE** significant figures for $\Sigma(n/N)^2$ **ALLOW** 1 mark for candidate's $\Sigma(n/N)^2$ value correctly subtracted from 1 to 2 s.f. (if working shown)
18	(c)	(ii)	high (species) (bio) diversity ✓ stable / resilient to change / AW ✓ no dominant species ✓	2 max	2.4	*If they do not answer with high (bio)diversity, look to credit ECF throughout answer* **ECF** if value calculated in (i) is: less than 0.4 = low diversity between 0.4 and 0.6 = medium diversity above 0.6 = high diversity **ALLOW** more likely to adapt to environmental changes
18	(c)	(iii)	set up grid / lay out two tape measures at right angles to each other / AW ✓ use random coordinates ✓	2	3.4	**DO NOT ALLOW** systematic sampling / transects / stratified sampling **ALLOW** lines / string as AW for tape measures **ALLOW** annotated diagram **IGNORE** throwing quadrats

Question			Answer	Mark	AO	Guidance
18	(c)	(iv)	***AWARD** marks for each improvement and its matching explanation* *Improvements* **A** control height (of sweep / net) ✓ **B** control / increase , breadth (of sweep) ✓ **C** control / increase , speed (of sweep) ✓ **D** more sweeps ✓ *Explanations (much match an intended limitation)* **A** different insects could be found at different heights (above ground / vegetation) / AW ✓ **B** wider / different (breadth), sweep likely to capture more / different , insects / ora ✓ **C** more / different, insects caught by, fast / different speed, sweep ✓ **D** some / more / different, insects caught ✓	**4 max**	**3.4**	*Mark as prose (ignore prompt lines)* If controlling height (**A**) / breadth (**B**) / speed (**C**) , **also** allow **1 mark max.** for explanation of a standardised approach, e.g. results , are comparable / representative / standardised / repeatable (between areas) **IGNORE** reproducible **ALLOW** intensity / power / AW **ALLOW** fast sweep *e.g.* *people that sweep nets should be of same height (NBOD for improvement A) ; but can still be awarded explanation A* **ALLOW** insects less likely to escape

Question			Answer	Mark	AO	Guidance
18	(c)	(v)	**1** time of day not specified ✓	2 max	3.3	**ALLOW** sampling might be in morning and / or evening **ALLOW** *idea of* no fixed range of times for each site **ALLOW** readings should be taken at the same time (of the day)
			2 (named) conditions vary at different times of the day ✓			**ALLOW** named factor, e.g. light intensity, wind speed, temperature, rainfall, weather, availability of nectar
			3 different insects are , more active / present , at certain times of the day / in different conditions ✓			**ALLOW** more / fewer AW for different
			4 sampling **only** carried out on one day (in a year) ✓			**ALLOW** should be carried out on different days
			5 different insects are , more active / present , at certain times of the year / AW ✓			**ALLOW** more / fewer AW for different
18	(c)	(vi)	different / more than 1 , species in one category ✓	1 max	3.3	**ALLOW** some (named) categories contain more than one species
			idea that they are not (all) identified at species (level) ✓			
			idea of use of 'other' categories increases value of $\Sigma(n/N)^2$ which reduces Simpson's index value ✓			

Question			Answer	Mark	AO	Guidance
19	(a)	(i)	*aesthetic* particularly popular with the public are puffins / AW ✓ *ecological* they are (considered by some to be) a keystone species ✓ *economic* (tour operators) reported a drop in income / AW ✓	3	3.2	**ALLOW** they have large colourful beaks **ALLOW** local tour operators transport large numbers of visitors **ALLOW** tour operators transport (large numbers of) visitors **ALLOW** money for tour operators **ALLOW** ecotourism for tour operators **IGNORE** general economic benefits of tourism
19	(a)	(ii)	repairing , boardwalks / fences ✓	1	2.1	**IGNORE** banning of visitors (as implies preservation)
19	(a)	(iii)	arrive on boats ✓	1	2.5	**IGNORE** pets
19	(a)	(iv)	*in situ* **AND** (conservation) in their (natural) habitat ✓	1	3.1	**ALLOW** (named) species , not removed / kept in their natural environment **IGNORE** on the islands
19	(b)	(i)	(puffin) footprints / feathers / eggshell / fish bones / droppings (near burrow entrance) / presence of predators ✓	1	2.1	**IGNORE** thermal imaging **IGNORE** eggs / nests

Question			Answer	Mark	AO	Guidance
19	(b)	(ii)	**1** decline in , predators / (large) gulls / species at higher trophic level / AW ✓ **2** (initial) decrease in , other prey species / species eaten by (large) gulls ✓ **3** increase in (small) fish ✓ **4** more competition between gulls / fish ✓ **5** increase in other (named) species , that eat (small) fish / that eat the same food (as puffins) / due to decreased competition ✓ **6** increase in other species that nest in burrows ✓ **7** decrease in species eaten by (small) fish / AW ✓ **8** reduced soil fertility affecting plant growth ✓	**4 max**	**2.6**	**IGNORE** interspecific / intraspecific **ALLOW** more burrows available (for other animals / species)
19	(b)	(iii)	predators are a <u>selection pressure</u> ✓ weaker individuals , removed from population / die ✓ (more) beneficial alleles , passed on / in next generation ✓	**2 max**	**2.5**	**ALLOW** selective pressure **ALLOW** better adapted individuals more likely to reproduce **IGNORE** selected against **ALLOW** alleles that are less useful are (gradually) removed from a population

Question			Answer	Mark	AO	Guidance
19	(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)** Uses data from the table to describe, in detail, continuous and discontinuous variation and their causes. **OR** Uses data from the table to describe continuous and discontinuous with a cause **AND** interspecific and intraspecific variation. *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)** Uses data from the table to describe: continuous and discontinuous variation with a cause **OR** interspecific and intraspecific variation. *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)** Uses data from the table to describe continuous **OR** discontinuous **OR** interspecific **OR** intraspecific variation. *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**	**2.5**	**Indicative points may include:** **Continuous (stated)** • range of values / intermediate values / no distinct categories • bell-shaped curve / normal distribution / histogram • quantitative *Data* • length or mass within either species *Cause* • both genetic and environmental • polygenic • additive effect of alleles **Discontinuous (stated)** • discrete / categoric / no intermediates / no range • bar chart • qualitative *Data* • the difference in length or mass of a male vs female grey seal *Cause* • **only** genetic • alleles have a large effect • controlled by one / small number of genes

Question			Answer	Mark	AO	Guidance
						Interspecific (stated) • differences between two species • grey seals longer or heavier than common seals **Intraspecific (stated)** • differences within species • length and mass variation in either species • sex differences in grey seals **Aspects of the communication statement might typically not have been met when irrelevant / incorrect information (e.g. adaptation as a cause of variation, ref. speciation, ref. genetic drift) has been included.**

Question			Answer	Mark	AO	Guidance
20	(a)	(i)	**1** autosomal linkage / (both) genes are on the same chromosome ✓ **2** no independent assortment ✓ **3** short / AW , distance between loci ✓ **4** no crossing over (so no recombinants) ✓ **5** alleles / BL and bl , are inherited together ✓	**3 max**	**1 x 3.1** **2 x 2.5**	**IGNORE** alleles on same chromosome / alleles linked **ALLOW** genes / loci , are linked **ALLOW** loci close together / genes located close to each other on chromosome **DO NOT ALLOW** crossing over rarely occurs **ALLOW** so, BL and bl, end up in the same gamete **IGNORE** genes inherited together
20	(a)	(ii)	gene interaction ✓ phenotype / AW , affected by , more than one gene ✓ (expression / allele of) one gene , affects / masks / prevents , expression of other gene ✓	**2 max**	**1.2**	**IGNORE** any reference to dominant and recessive **ALLOW** two genes affect the phenotype **IGNORE** references to genes being switched on or off **Note:** The product of one gene masks the expression of another, therefore changing the phenotype = MP2 and MP3

Question			Answer	Mark	AO	Guidance
20	**(b)**	**(i)**	**FIRST CHECK ON ANSWER LINE** **If answer = 222 or 221 or 220 award 3 marks** $q^2 = 0.06(0)$ ✓ q = 0.245 p = 0.755 2pq = 0.37(0) ✓ 600 x 0.37 = 222 ✓	**3**	**2.4**	**ALLOW** 1 mark for candidate's 2pq (stated) x 600 **ALLOW** 2 marks for whole number answers: (q = 0.06) answer = 67 or 68 ($p^2 = 0.94$) answer = 35 (q = 0.24) answer = 218 or 219
20	**(b)**	**(ii)**	no , migration / emigration / immigration / gene flow ✓ (600 is a) large population (size) ✓	**1**	**3.2**	**ACCEPT** descriptions of migration / gene flow **ALLOW** isolated from other populations / plants in closed environment **IGNORE** no mutations

Question			Answer	Mark	AO	Guidance
21	(a)		bacterial , diseases / infections , harder to treat **or** antibiotics cannot kill (resistant) bacteria ✓ **increased** deaths / AW ✓ need for new antibiotics ✓	**2 max**	**1.2**	**ALLOW** bacterial infections untreatable / fewer treatment options for bacterial infections / need larger dose **IGNORE** antibiotics , less effective / do not work **IGNORE** bacteria are immune **ALLOW** (more people affected so) reduced population **ALLOW** more serious illness **ALLOW** greater healthcare costs **ALLOW** *idea of* increased spread (of infection) **ALLOW** *idea of* limited / finite number of different antibiotics available
21	(b)		antibiotic is selection pressure ✓ evolution is observable ✓ in short period of time / AW ✓	**2 max**	**3.2**	 **ALLOW** it demonstrates how a population adapts or changes in response to a selection pressure **ALLOW** within a human lifetime **ALLOW** reproductive rate of bacteria is fast **ALLOW** figures that demonstrate fast reproductive rate
21	(c)	(i)	bases / nucleotides ✓ amino acids ✓ proteins ✓ compared ✓ recent(ly) ✓	**5**	**4 x 1.1** **3.1**	**IGNORE** pairs / bp **IGNORE** polypeptides **ALLOW** different / similar / conserved

Question			Answer	Mark	AO	Guidance
21	(c)	(ii)	**1** evidence of , extinction / AW ✓	3 max	1.1	
			2 *idea of* (fossils show) , development / evolution / changes (in anatomical features) , over time / over generations ✓			**ALLOW** general trend from , small / simple to , large / complex **ALLOW** descriptions of changes **ALLOW** fossils show missing links
			3 can be dated ✓			**ALLOW** carbon dating
			4 *idea of* age is based on depth (of fossil) ✓			
			5 DNA can be , sequenced / profiled ✓			**ALLOW** sequencing described **ALLOW** amino acid sequences

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