OCR
Oxford Cambridge and RSA

Monday 11 June 2018 – Afternoon

A Level Biology A

H420/02 Biological Diversity

MARK SCHEME

Duration: 2 hours 15 minutes

MAXIMUM MARK 100

Post Standardisation
21/06/2018

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris 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 scoris and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

   YOU MUST MARK 5 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 scoris 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 scoris 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.

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 scoris **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 scoris 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, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content 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 science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

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 science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **18** and **19(c)(i)**

11. **Annotations**

In mark scheme:

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	tatements which are irrelevant
ALLOW S	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

Annotation	Meaning
	Correct response
	Incorrect response
	Ignore
	Point already given (i.e. Given Mark)
	Underline (for ambiguous / contradictory wording)
	Omission
	Marking point partially met
	Benefit of doubt
	Benefit of doubt not given
	Contradiction
	Error carried forward

In RM Assessor:

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.

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
    - o 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
    - o 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
DO NOT CREDIT hybrid letters **DO NOT CREDIT** if more than one letter written inside the box **IGNORE** letters outside the box if there is a letter in the box **ALLOW** letters outside the box **only** if there is no letter in the box or the letter in the box has been crossed out.						
1			A ✓	**1**	AO1.1	
2			C ✓	**1**	AO2.4	
3			A ✓	**1**	AO2.4	
4			B ✓	**1**	AO1.2	
5			C ✓	**1**	AO2.1	
6			A ✓	**1**	AO1.1	
7			B ✓	**1**	AO1.2	
8			B ✓	**1**	AO1.1	
9			A ✓	**1**	AO1.1	
10			D ✓	**1**	AO1.1	
11			B ✓	**1**	AO1.2	
12			C ✓	**1**	AO1.1	
13			A ✓	**1**	AO1.1	
14			C ✓	**1**	AO1.1	
15			B ✓	**1**	AO1.1	
			Total	**15**		

Question				Answer	Marks	AO element	Guidance
16	(a)	(i)		<u>metaphase</u> ✓	1	AO1.2	**IGNORE** 1 / 2
		(ii)	1	single cell **and** ≥ 60 mm horizontal diameter **and** some attempt to draw chromosomes as in Fig. 16 ✓ **and** broadly circular	4 max/	AO1.1 AO2.3	**1** *Set measuring tool to 60 mm* **1 DO NOT CREDIT** if all chromosomes represented as a single line or shaded
			2	clear continuous lines (on chromosomes and membrane) ✓			**2 IGNORE** minor errors if it is clear candidate has attempted to draw continuous lines
			3	ruled label lines (touching correct feature) ✓			**3 DO NOT CREDIT** arrows
			4	chromosome(s) **and** cytoplasm labelled ✓			**4 ALLOW** chromatids **4 IGNORE** membrane / centromere / equator / pole / metaphase plate **4 DO NOT CREDIT** if any other structures are drawn or labelled **4 DO NOT CREDIT** if labels written on part of diagram
			5	colour of any of above mentioned (as annotation) ✓			**5 ALLOW** e.g. chromosomes are dark

Question			Answer	Marks	AO element	Guidance
(b)		(i)	*If cell B is measured and formula applied…* 1.7 (± 0.4) **or** *If working back from information given about cell A…* 2.2 (± 0.4) ✓✓ (number less than 10) x10^4 (μm^3) ✓	**3**	AO2.8	*Max 1 if given to 1 only or more than 3 sig. fig.* *Max 1 if no attempt at standard form* **ALLOW** any number that has 17 (± 4) as the first 2 significant figures **ALLOW** any number has 22 (± 4) as the first 2 significant figures If answer is incorrect, **ALLOW** 1 mark for evidence of r = 16 (± 1) mm
(b)		(ii)	*light (microscope) because* magnification , (only) 1000 / < 2000 / within LM range ✓ colour visible ✓ (other) subcellular structures / (named) organelles , not visible ✓ wide field of view ✓	**2**	AO3.1	*Electron microscope = 0 marks* **ALLOW** not black & white **IGNORE** stain / dye **ALLOW** whole cell visible **IGNORE** refs to resolution unqualified

Question			Answer	Marks	AO element	Guidance
		(iii)	*any **two** from* **1** asexual / vegetative , reproduction **2** (development of) body plan **3** proliferation of white blood cells **4** producing gametes from haploid cells **5** production of new stem cells ✓	**1**	AO1.2	**1 ALLOW** cloning **2 IGNORE** embryonic development **3 CREDIT** e.g. clonal expansion **4 IGNORE** gamete production unqualified
			Total	**11**		

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	**1** penguin species have overlapping / AW , niches ✓ **2** competitive exclusion ✓ **3** increase as , food / nesting sites / resources (available) ✓ **4** increase as , no / little , competition / limiting factors ✓ **5** plateau / drop, because of (increased) competition ✓ **6** drop / plateau , due to , arrival of / competition from , gentoo ✓	**3 max**	AO2.6	**ALLOW** 'fish' as AW for 'food' throughout **for this question only** **CREDIT** marking points 3-5 in the context of either intraspecific or interspecific competition **3 IGNORE** refs to predator **3 & 4 ALLOW** increase as no competition for food = 2 marks **3 & 4 ALLOW** increase as outcompetes Adélie for food = 2 marks **5 CREDIT** reached carrying capacity **5 & 6** 'plateaus because of competition from gentoo' = 2 marks
		(ii)	836 (± 40) / 8.36 (± 0.4) x 10^2 , (individuals) y^{-1} **or** 418 (± 20) / 4.18 (± 0.2) x 10^2 , per year / y^{-1} ✓✓	**2**	AO2.6	*Max 1 if answer not given to 3 SF* *Max 1 if no / incorrect units given* **ALLOW** per annum / a year , as units *If 'pairs' interpreted as individuals* *If answer incorrect allow 1 mark for* 83.6 (± 4) / 8.36 (± 0.4) x 10^1 **or** 41.8 (± 2) / 4.18 (± 0.2) x 10^1 , per year / y^{-1}

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	*supports because…* **1** Adélie / ice-reliant / AW , penguin (population) decreased **OR** gentoo / chinstrap / non-ice-reliant , penguin (population) increased ✓ **2** figs that support either point given above ✓ *does not support because…* **3** *idea that* changes could be explained by (chance) arrival of , gentoo / chinstrap (and subsequent competition) ✓ **4** change in another described factor could explain changes (in a single species) ✓ **5** correlation does not mean causation ✓	**3 max**	AO3.1 AO3.2	*Marks must reference support / AW* **2** Must quote 2 numbers and 2 years or a calculated , increase / reduction **2 IGNORE** units **4 ALLOW** *only* disease present in Adélie only **or** change in food availability that favours , gentoo / chinstrap **or** new predator that preys more on Adélie

Question				Answer	Marks	AO element	Guidance
(b)		(ii)	1	reduction in extent of ice ✓	2 max	AO3.2	**1 ALLOW** increased rate of ice melt **1 IGNORE** sea level changes
			2	change in ocean current ✓			
			3	change in (penguin) food (species or population) ✓			**3 IGNORE** fish or other named aquatic animal
			4	new , disease / parasite ✓			
			5	change in predator (species or population) ✓			**5 ALLOW** plausible examples, e.g. seals, orcas, sharks.
			6	new animal (species) present on land ✓			
			7	change in population of (aquatic) plants ✓			
				Total	**10**		

<table>
<tr><td>18</td><td></td><td></td><td colspan="4">Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.
In summary:
Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)
Using a ‘best-fit’ approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.
Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):
o award the higher mark where the Communication Statement has been met.
o award the lower mark where aspects of the Communication Statement have been missed.
• The science content determines the level.
• The Communication Statement determines the mark within a level.</td></tr>
<tr><td></td><td></td><td></td><td>Level 3 (5–6 marks)
Provides a detailed explanation of the benefits to selective breeding of maintaining a viable wild population.
The answer contains well-developed lines of reasoning which are clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is broadly relevant.

Level 2 (3–4 marks)
Provides an explanation of the benefits to selective breeding of maintaining a viable wild population.
The answer contains some reasoning, structure and use of appropriate scientific language. The information presented is mostly relevant.

Level 1 (1–2 marks)
Lists at least one benefit to selective breeding of maintaining a viable wild population.
The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms or substantial irrelevant material.

0 marks
No response or no response worthy of credit.</td><td>6</td><td>1.2</td><td>Indicative points
These could be described in terms of problems associated with selective breeding and solutions offered by maintaining a wild population

• genetic variation
• genetic resource / gene bank
• source of useful alleles
• can be cross bred with crop varieties
• allows introduction of different traits
• unknown future requirements
• potentially useful in changing climate
• prevention of inbreeding depression
• promotion of hybrid vigour
• prevent dwindling gene pool
• source of replacement if cultivated population is in danger
• plausible example(s) of any of the above</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
19	(a)		**1** volume of broth (in flask) ✓ **2** pH (of broth) ✓ **3** oxygen (concentration in flask) ✓ **4** number / concentration , of bacteria in , broth at beginning / AW ✓ **5** volume removed (from each flask) ✓ **6** (standard) stirring / mixing , before withdrawal of samples ✓	**1 max**	AO3.4	**IGNORE** 'amount' throughout **4 ALLOW** batch of broth / starting population of bacteria **4 IGNORE** volume / mass
	(b)	**(i)**	6.0 / 6 , x 10^7 ✓✓	**2**	AO2.8	*Max 1 if answer not given as standard form* **ALLOW** 1 mark for 6 x 10^6 / 6 x 10^8
		(ii)	**1** should have used E ✓ **2** (has) most / more , (countable) colonies ✓ **3** *idea that* anomalies will have smaller effect ✓ **4** more representative / larger , sample ✓ **5** (fewer serial dilutions) decreases chance of error ✓ **6** F (is appropriate) because , colonies / AW , are countable ✓	**3 max**	AO3.1 AO3.4	**1** Other points can be awarded in the context of plates other than E **2-5 ora** for F **4 ALLOW** estimate will be more accurate **4 IGNORE** valid / reliable / repeatable **6 ALLOW** bacteria as AW for colonies for this marking point only

<table>
<tr><td>(c)</td><td></td><td>(i)*</td><td colspan="4">Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.

In summary:
Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)
Using a ‘best-fit’ approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.
Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):
o award the higher mark where the Communication Statement has been met.
o award the lower mark where aspects of the Communication Statement have been missed.

• The science content determines the level.
• The Communication Statement determines the mark within a level.</td></tr>
<tr><td></td><td></td><td colspan="2">Level 3 (5–6 marks)
Describes the main differences between the two temperatures using key terms and explains in detail the difference between temperatures.
There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant.

Level 2 (3–4 marks)
Describes some differences between the two temperatures with some use of key terms and explains a difference between temperatures.
There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.

Level 1 (1–2 marks)
Describes some differences between the two temperatures or explains a difference between temperatures.
The information is communicated with only a little structure.
Communication is hampered by the inappropriate use of technical terms.

0 marks
No response or no response worthy of credit.</td><td>6</td><td>AO2.7
AO2.8</td><td>Indicative points may include

Comparison of curves
• similar lag phase
• quicker overall at 30°C
• exponential phase rises faster at 30°C
• shorter duration of stationary phase at 30°C
• faster death phase at 30°C
• lower population at 30°C after 72h
• figures used to support

Explanation for difference at higher temperature
• molecules have more kinetic energy
• bacterial enzymes closer to optimum temperature
• faster enzyme activity
• more competition for nutrients earlier
• resources, e.g. carbon source, used up more rapidly
• mineral availability becomes limiting factor more quickly
• toxic metabolites produced more quickly</td></tr>
</table>

		(ii)	control ✓ *idea of* checking for contamination ✓	**2**	AO3.3 AO3.4	**DO NOT CREDIT** control , group / variable / condition **ALLOW** shows growth due only to *B. subtilis* **ALLOW** e.g. to ensure conditions were aseptic / if the flask had bacterial growth the results would be invalid
		(iii)	*idea that* it could encourage the growth of human pathogens ✓	**1**	AO3.3	**ALLOW** harmful microbes could grow **DO NOT CREDIT** refs to denaturation **IGNORE** bacteria will grow rapidly which could be dangerous
		(iv)	reduce impact of , anomalous / AW , results ✓ measure / increase / show / ensure , repeatability ✓ allow , calculation of standard deviation / (named) statistical test ✓ (calculated) mean likely to be , more accurate / closer to true value (than individual value) ✓	**3 max**	AO3.3	**IGNORE** identify / ignore / exclude **ALLOW** reliability **IGNORE** valid / accurate **ALLOW** any named statistical test
			Total	**18**		

Question			Answer	Marks	AO element	Guidance
20	(a)	(i)	4.7 ✓✓	2	AO2.6	*Max 1 if answer not given to 2 s.f.* **IGNORE** sign If answer incorrect **ALLOW** 1 mark for 4.8 or 4.9
		(ii)	little / nothing (can be concluded) ✓ because no (named) statistical test done ✓	2 max	AO3.1	**IGNORE** 'not significant' *If no other marks awarded,* **ALLOW** *1 mark only for…* (probably) not significant because , error bars / standard deviations , overlap
		(iii)	*No, because…* *idea that* standard deviation is not the same as range ✓	1	AO3.2	**ALLOW** e.g. SD does not include all outliers / error bars don't show range
		(iv)	environment ✓ genes / genetic / alleles , and environment ✓ many genes / polygenic ✓ age ✓	2 max	AO2.1	**ALLOW** suitable example, e.g. diet **Note** 'genes and environment' = 2 marks **IGNORE** refs to mutation
(b)		(i)	genetic polymorphism / proportion of heterozygotes / proportion of gene variants ✓	1	AO1.1	**CREDIT** number of polymorphic genes
		(ii)	(many) alleles lost (when population dropped) ✓ **ora** (modern population) descended from few survivors / AW ✓	2	AO2.5	**ALLOW** few alleles were left after drop in population **ALLOW** cheetahs still alive descended from a small gene pool **IGNORE** founder effect unqualified

Question			Answer	Marks	AO element	Guidance
		(iii)	*idea that* one individual or allele has proportionally higher effect on small population ✓ (more likely that) <u>allele</u>s will be lost from population ✓ (population) more vulnerable / likely to become extinct due , to environmental change / AW ✓	**2 max**	AO1.2	**IGNORE** founder effect unqualified **ALLOW** example of environmental change E.g. might become extinct because of (new) disease **IGNORE** event
	(c)	**(i)**	*Fossa has …* longer , legs ✓ different (shaped / size) , ears ✓ (proportionally) bigger eyes ✓	**1 max**	AO2.3	*Mark the first response only* *Assume 'it' refers to mongoose* **IGNORE** references head / body / shape **ALLOW ora** for mongoose throughout **ALLOW** longer tail / larger jaw
		(ii)	**1** allopatric speciation ✓ **2** different , selection pressure / environmental conditions (from mainland) ✓ **3** (random) mutation ✓ **4** (fossa-like) individuals with , mutation / (new) feature , survive / reproduce ✓ **ora** **5** beneficial / AW , <u>alleles</u> passed on ✓ **6** <u>directional</u> selection ✓	**4 max**	AO2.5	**3 ALLOW** pre-existing genetic variation **4 IGNORE** best adapted / fittest

Question			Answer	Marks	AO element	Guidance
		(iii)	mutation / genetic diversity ✓ natural / directional , selection ✓ *idea that* environment / selection pressure , is different from the 'other' population ✓ time ✓	3 max	AO1.2	**IGNORE** refs to isolation **ALLOW** genetically different / large gene pool **ALLOW** e.g. different food source **ALLOW** many generations
			Total	21		

Question			Answer	Marks	AO element	Guidance
21	(a)		working out the sequence / AW , of nucleotides / bases ✓	1	AO1.2	**IGNORE** base pairs
	(b)		100 000 000 / 100 million / 1.0 x10^8 / 1 x10^8 ✓✓	2	AO2.6	**ALLOW** 1 mark for 100 000 / 1 x10^5 / 10^8
	(c)	(i)	high throughput sequencing ✓ shotgun sequencing ✓ whole genome sequencing / WGS ✓ next generation sequencing / NGS ✓ pyrosequencing / use of luciferase ✓ massive parallel sequencing ✓	1 max	AO1.2	 **ALLOW** swapping radioactive tags for fluorescent tags

<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>(ii)</td><td>
<table>
<tr><th>G</th><th>molecule of ATP</th><th></th></tr>
<tr><td>(contains) guanine / guanosine</td><td>(contains) adenine / adenosine</td><td>✓</td></tr>
<tr><td>(contains) deoxyribose</td><td>(contains) ribose</td><td>✓</td></tr>
<tr><td>1 phosphate</td><td>3 phosphates</td><td>✓</td></tr>
<tr><td>phosphate attached to C_3</td><td>no phosphate attached to C_3</td><td>✓</td></tr>
</table>
</td><td>2 max</td><td>AO1.1</td><td>Mark the first answer in each box.

IGNORE phosphorus / phosphate molecule

IGNORE phosphorus / phosphate molecule</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>sequence / order , of bases codes for , sequence / order , of amino acids ✓

(each) triplet / three bases / codon , (codes) for , one amino acid ✓</td><td>2</td><td>AO1.1</td><td>IGNORE base pairs

IGNORE base pairs</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
	(d)		*sequencing* **1** (high) mutation (rate) means many , strains / AW , of virus exist ✓ **2** can predict (viral) , strain / protein / antigen ✓ **3** (so) vaccine contains correct antigen ✓ *bioinformatics* **4** facilitates access to large amount of data ✓ **5** facilitates access to data on DNA **and** proteins ✓ **6** *idea that* format (of information) is universal ✓ **7** can identify source of outbreak ✓ **8** can identify vulnerable populations ✓ **9** vaccination program can target certain , area / individuals ✓	**4 max**	AO1.1 AO2.1	*Ignore prompts and mark as prose* **9 ALLOW** allows specific vaccines to be produced
			Total	**11**		

Question			Answer	Marks	AO element	Guidance
22	**(a)**		*saturated fatty acids have…* carboxyl(ic group) / COOH / OH / hydroxyl / oxygen atoms ✓	**1**	AO2.1	*Mark first response only* **IGNORE** hydroxide

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	**1** bacteria gain , nutrient / mineral / food , from , it / detergent ✓ **2** structures / AW (in fig. 21.1) contain only C **and** H ✓ **3** bacteria need (named) elements other than C and H ✓ **4** example of other element linked to use in bacterium ✓ **5** absence of other elements is a limiting factor (for bacterial growth) ✓	**3 max**	AO3.2	**3 ALLOW** e.g. bacteria need nitrogen **4 ALLOW** e.g. N for amino acids, P for ATP, O for aerobic respiration Note: bacteria need nitrogen for proteins = 2 marks (mp 3 and 4) **ALLOW** detergent facilitates uptake of hydrocarbons (across plasma membrane)
		(ii)	*idea of* data from investigation that controls surface area or elements available ✓ (information about) elements / AW , present in the detergent ✓	**1 max**	AO3.4	**ALLOW** e.g. grow bacteria on small droplets with and without detergent
(c)			adapted to occupy the (oil spill) , niche / environment ✓ outcompete other , bacteria / species ✓ oil is acting as selective agent / selection of bacteria that were able to digest oil ✓	**1 max**	AO2.5	

<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>(d)</td><td></td><td>
<table>
<tr><td></td><td>Is consistent with…</td><td></td></tr>
<tr><td>organisms are not removed from their natural habitat</td><td>B and C</td><td>✓</td></tr>
<tr><td>human intervention is happening</td><td>A and B</td><td>✓</td></tr>
</table>
</td><td>2</td><td>AO2.5</td><td>ALLOW in situ and preservation

ALLOW ex situ and in situ</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td><td></td></tr>
</table>